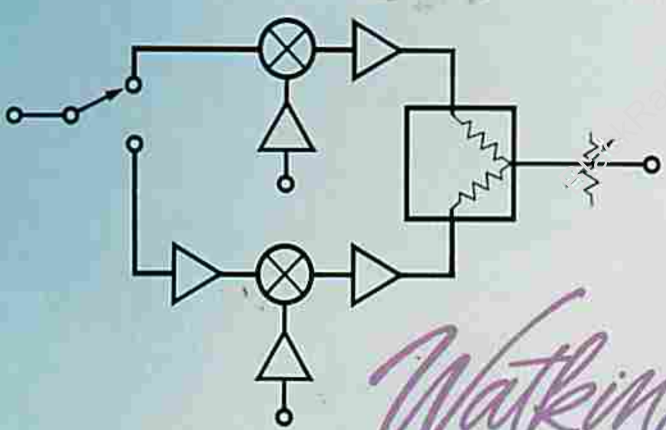
RF and Microwave Component Designers' Handbook



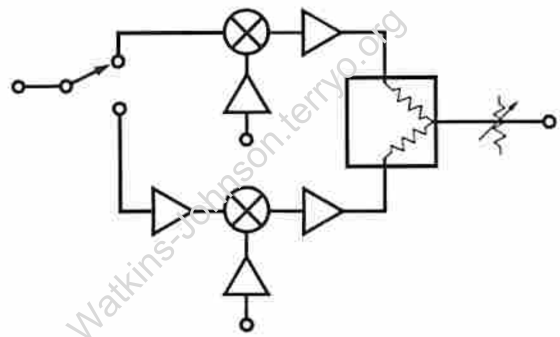
Watkins-Johnson Company

1988/89

Products Manufactured by Watkins-Johnson Company

- Amplifiers
  - Solid State & TWTA
  - TO-8
  - Cascaded
  - TWT (Space Qualified)
- Analysis Systems
- Antennas & Antenna Systems
- ATE, Test & Calibration Equipment
- Attenuators
- Converters
- Detectors
- Direction-Finding Systems
- Drivers
- ECM Subsystems
- Filters (YIG)
- Frequency Converters
- Frequency Generators
- Frequency Memory Loops
- Frequency Synchronizers & Synthesizers
- Frequency Translators
- Furnaces
- Hi-Reliability Components
- Integrated Front Ends
- Limiters
- Mixers
- Modulators/Demodulators
- Multipliers
- Oscillators
- Power Dividers
- Power Splitters
- Receiver Front Ends
- Receivers
- Sampling Mixers
- Simulation Systems
- Temperature Controllers
- Tuners
- YIG Devices

Sections



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Summary of Technical Articles

NOTE: Specifications subject to change without notice. All testing per applicable internal Watkins-Johnson test procedures which are available upon request (and also subject to change without notice).

Watkins-Johnson Company — An Overview —

Watkins-Johnson Company, now in its third decade of growth, is a diversified electronics firm engaged in the research, development and production of advanced electronic systems, electron devices and related equipment.

Today, more than 3,000 people are employed by the Company, whose corporate headquarters are located in Palo Alto, California. Additional manufacturing facilities are operated in Scotts Valley, Santa Barbara and San Jose, California; Gaithersburg and Columbia, Maryland; Wake County, North Carolina; and Windsor, England. Sales offices are located throughout the United States and in England, Italy and Germany. The Company also has distributors throughout the free world.

Watkins-Johnson Company's excellent technical staff and extensive production facilities enable the Company to respond quickly to customers' needs. Utilizing in-house capabilities to the fullest assures complete quality control of key components and expedites delivery on quantity production runs. Many of the thousands of superior catalog items are available from stock for early delivery. In addition, Watkins-Johnson Company will either modify an existing product or design and fabricate new units to meet unusual applications. Important to many such projects is the Company's provision for secure areas which allow the undertaking of rigidly classified assignments of wide scope and complexity.

The Company is composed of two groups — Devices and Systems. The products of the Devices Group serve the communication, radar, electronic countermeasures, test equipment and production equipment markets.

Voltage-controlled and backward-wave oscillators are produced for a wide range of military and commercial applications. In addition, the Devices Group manufactures heat-processing and parts-handling equipment for the semiconductor and solar-cell production industries.

Three divisions develop and manufacture microwave semiconductor devices, integrated circuits, solid-state signal-processing components and integrated subsystems.

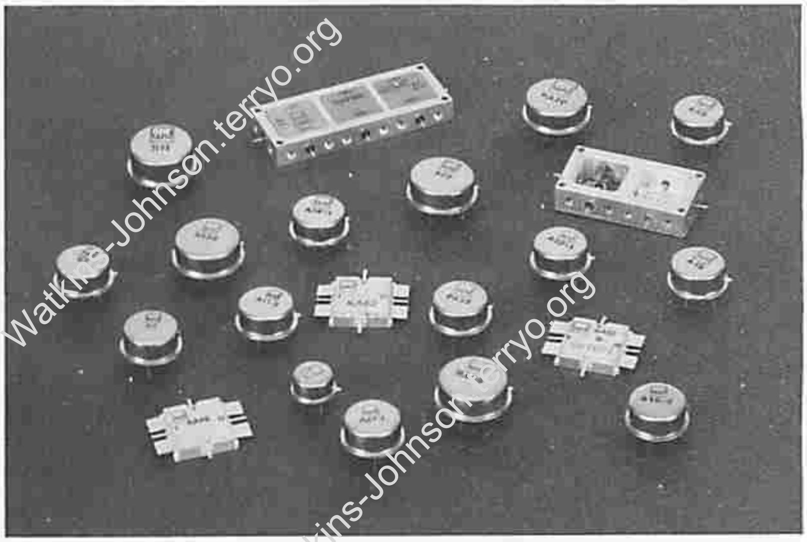
An additional manufacturing facility, located in Windsor, England, produces radio-frequency simulation equipment and provides support for all Watkins-Johnson products in the British Isles.

The Systems Group is an engineering and production entity devoted to the design, development and production of special-purpose receivers, antennas, test equipment, and space communication amplifiers.

At San Jose, the group produces reconnaissance and surveillance systems, antennas and antenna systems, electronic countermeasures (ECM) equipment, high-reliability amplifiers for space communication and automatic test equipment.

In Maryland and North Carolina, two other divisions offer products for communications, direction finding, surveillance, electromagnetic interference (EMI) and electromagnetic compatibility (EMC) investigations, and signal processing.

Cascadable Amplifiers



CASCADABLE AMPLIFIERS

The RF and Microwave Frequency Range is well covered from 2 MHz through 8000 MHz by Watkins-Johnson's extensive line of cascadable amplifiers. These amplifiers have been designed to offer the system or subsystem designer maximum flexibility in performance options.

A predominantly hybrid approach using thin-film technology is used throughout the product line to obtain the highest levels of electrical performance, repeatability, stability, quality and reliability. Most recently, the product line has been emphasizing the utilization of the most recentl advances in bi-polar and GaAs FET technology to obtain the highest gain per stage, the lowest noise figures, the highest output power and the widest bandwidths. In addition, much emphasis has been placed on improving the efficiency for power consumption limited applications. Using thin-film hybrid construction techniques coupled with ferrite core material and optimizing the electrical circuits, the maximum in efficiency is obtained.

The units are designed for maximum ease of cascading in a 50-ohm system. The designer may select an appropriate low-noise module for his first stage followed by as many gain blocks as required for his design. Cascaded power output will be determined by the final stage, where the output level will be unchanged, provided sufficient drive from the preceeding amplifiers is available.

Each of these thin-film cascadable amplifiers is a complete amplifier in itself, including stable DC biasing circuitry and internal power supply decoupling. In addition to a good ground plane connection, the use of a external decoupling capacitor of at least 0.1 μf should be added.

Intended to cover a maximum number of applications, these amplifiers offer noise figures as low as 1.5 dB for narrow band applications, frequency coverage from 2 MHz to 8000 MHz, and power output in excess of +27 dBm. Most of these units are designed for a positive 15 volt supply voltage, while some may accept 12 volts or 5 volts. Overall, these universal modules can be characterized by stable and repeatable performance over a very broad range of frequencies, temperature and supply voltages.

The construction of the Watkins-Johnson amplifier series involves the highest levels of thin-film technology. The thin-film metalization is performed by using a high-vacuum RF sputtering system for both resistor and conductor metalizations. All conductor traces are gold metalization. The thin-film resistors are formed from tantalum nitride and are passivated at high temperature to yield excellent long-term stability. The resistor composition is such that there is less than 150 ppm/°C of change in resistor value over the full operating temperature range.

Thin-film circuitry offers very precise control of resistor and circuit patterns. Thin-film inductors, etched on the substrate, yield a high degree of repeatability from unit to unit. This is particularly important when repeatable gain, VSWR and phase characteristics are required.

All RF transistors are bonded to the substrate using a gold-silicon eutectic-die-attach process. This eliminates the need for scrubbing the thin-film gold and results in superior adhesion and more uniform contact which, in turn, gives better reliability and heat transfer.

The Watkins-Johnson cascadable amplifier provides the system designer with a reliable, low-cost, ultraminiature approach to his circuit design and allows him to concentrate on the complexities of the system without worrying about the intricacies of the RF transistor amplifier design.

A plot of the highest gain in a single TO-8 as a function of frequency is given in Figure 1. Over 40 dB is currently available up to 500 MHz, in excess of 24 dB up to 2000 MHz, and 20 dB up to 6000 MHz.

The lowest typical noise figure available versus frequency is shown in Figure 2, with 2.5 dB up to 1000 MHz, 3.5 dB up to 2000 MHz, and 3.5 dB up to 6000 MHz.

The highest output power available versus frequency is shown in Figure 3, with typically greater than +26 dBm up to 500 MHz, greater than +24 dBm to 2000 MHz, and greater than +25 dBm to 4000 MHz.

Several accessory components which further enhance the versatility of this approach are the TO-8 packaged passive limiters and gain control modules. A combination of up to eight TO-8 modules may be integrated in a W-J metal housing with SMA connectors. Other complementary signal processing components available from Watkins-Johnson include high quality mixers, detectors, switches, hybrids and transformers which may be integrated with the amplifier series into a number of useful subassemblies (see Index).

Note: Application information on using TO-8 amplifiers and further technical discussion on the circuit description of these amplifiers follows the technical data sheet pages.

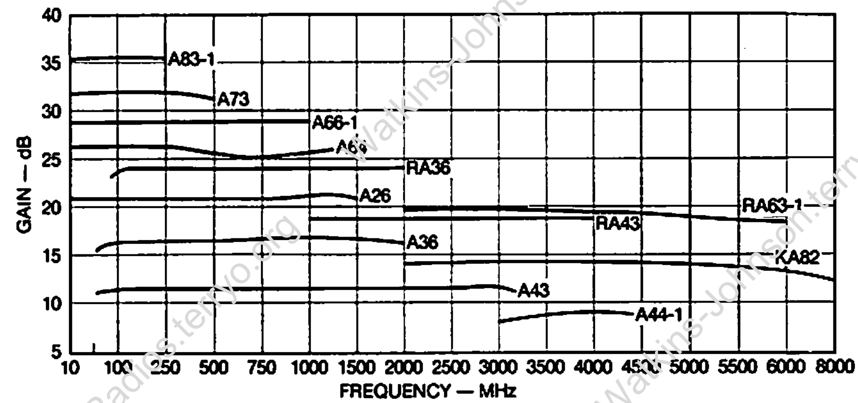


FIGURE 1. GAIN PERFORMANCE VS. FREQUENCY.

1

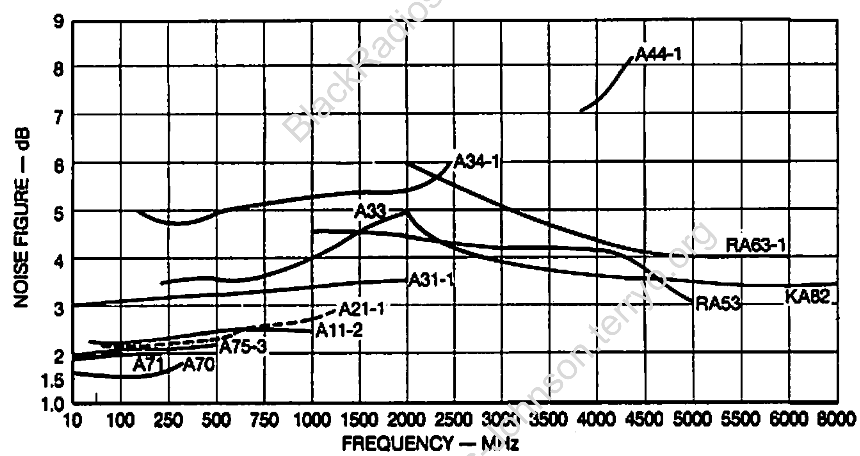


FIGURE 2. NOISE PERFORMANCE VS. FREQUENCY OUTPUT.

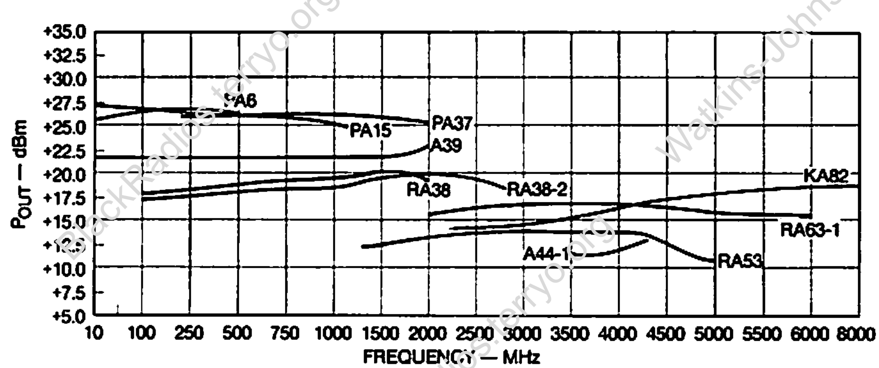


FIGURE 3. OUTPUT POWER PERFORMANCE VS. FREQUENCY.

SELECTION TIPS

The following groupings of Watkins-Johnson Cascadable Amplifiers have been provided for the purpose of increasing the awareness for the design engineer regarding differences between the amplifier families. With the gargantuan list of amplifiers that follows in the Selection Chart, the task of choosing the optimum amplifier for the given application has become increasingly difficult. It is intended that this additional information will help ease the task.

Full Performance • Passive Bias

A3/A5/A7/A9/A19 Series

These are full performance, no compromise amplifiers all designed using passive bias, and, except for the A32, all use choke decoupling. The A5 offers extremely low gain variation over temperature with a typical performance of less than ±2 dB from -54°C to +100°C. In addition, these models that use choke decoupling provide very wide power supply ranges with the minimum effect on gain variation.

Full Performance • Single-Stage Gain Blocks

A5-5/A5-6/A12/A15/A25-1/A35/A75 Series

This group of amplifiers all provide medium output level of +7 dBm minimum using active bias circuits with resistive decoupling from the power supply. They will all operate effectively at lower than their rated 15 volt power supply with virtually no change in gain, NF or VSWR characteristics on 12 volt supplies. At 5 volts V_{CC}, this series of amplifiers will draw typically about 9 mA of current and provide approximately 0 dBm of output power with an attendent gain drop of only about 1 dB. From 15V down to +10V V_{CC}, the drop in output power is about 0.67 dB/volt. Below 10 volts, the output power drop is closer to 0.8 dB per volt. The low frequency range of this group is typically flat down to 1 MHz.

High Gain • Two Stages • Full Performance

A73/A74/A74-1/A76/A64/A66/A66-1/A24 Series

These are full performance amplifiers that offer 20 to 30 dB of gain using two common emitter rf stages complete with active bias housed in a single TO-8 package. These amplifiers have their rated specifications at 15 volts V_{CC}, but, with the exception of the A73, will all operate with typically less than 10% loss of gain on power supply voltages as low as 5 volts. By combining two RF stages into a single package, the performance of two separate TO-8 single-stage amplifiers is very nearly achieved. Reliability is improved since the total parts count is reduced.

The WJ-A66-1 is a new 10 to 1000 MHz amplifier that provides 27.5 dB of gain, less than 3 dB noise figure, and greater than +15 dBm of output power for a new level of high performance in a single TO-8 package.

Performance Cost Leaders

A51/A53/A54/A55/A56/A57 Series

This group of amplifiers has been designed using totally passive bias and without the use of ferrites for the purpose of minimizing cost and, at the same time, maximizing performance within these constraints. Noise figures, for example, are typically only about 0.5 dB higher than a conventional full performance, active bias design. The A54 and the A56 are two-stage common emitter designs which offer a higher dB of gain per dollar ratio than is typically available using other design approaches. One trade off that accompanies the approach used in this series is that because of the relatively low V_{CE} used, it is generally not recommended that they be operated on V_{CC} supplies of less than 12 volts.

High Output Level • Full Performance • Choke Decoupling

A77/A77-1/A18/A18-1/A17/A27/A28/A37 Series

The use of ferrite decoupling in this series allows for maximum bandwidth, gain, and output signal level for the collector current used. The active bias used controls the collector current to within ±3% of the nominal value over the full MIL-STD temperature range of -54°C to +85°C. This series provides typically +14 to +15 dBm of output power at 15 volts V_{CC} and will work well on power supplies as low as 5 volts with an attendent output power near +2 dBm while drawing only 9 to 13 mA of DC current.

High Output Level • Low Intermod Series

A78/A79/A58/A59/A59-1/A19-1/A29-1/A38/A38-1/A39

This group represents single-stage, bipolar designs that all have +22 dBm or +19 dBm typical output power at 15V V_{CC} and have been designed to offer the minimum noise figure generally obtainable using conventional feedback for this output level. They all incorporate a single RF choke using a toroidal ferrite for excellence in design simplicity while maintaining high performance. The bias points on the transistors have been chosen for optimum third-order, two-tone suppression within the constraint of providing better than +20 dBm of output power on the models that have a "9" as the second digit. The single toroid/single substrate approach used in these designs also has improved reliability compared to multi-transformer or lossless feedback approaches. This group of amplifiers will operate effectively on 5 volts with typically less than 1 dB reduction in gain and will provide typically between 8 and 12 dBm of output power.

High Gain • Two RF Stages • 100 Milliwatt Output Power

RA69/RA89/RA89-1 Series

The WJ-RA38 through RA89-1 is a high gain series of amplifiers that typically offers in excess of +20 dBm output power in a 6-inch diameter TO-8 package. Most amplifiers that offer +20 dBm of output power are limited to less than 15 dB of gain while the RA89-1 typically provides 30.5 dB of gain. This group of amplifiers are designed using the traditional full performance active bias approach used in the W-J lower output power amplifiers, such as the A76, A66 and A26 amplifiers.

High Gain • Three RF Stages • 25 Milliwatt Output Power

RA76/RA66/RA26/RA36/RA43/RA53

The WJ-RA76 through RA43 are the highest gain series of amplifiers that typically offers +15 dBm output power in a 0.5 inch diameter TO-8 package. The RA76 typically provides 40.5 dB of gain up to 500 MHz while the RA53 provides 21 dB of gain to 5000 MHz. This group of amplifiers are designed using the traditional full performance active bias approach used in many lower gain amplifiers.

Medium Power Class A • > 200 Milliwatts

PA2/PA3/PA3-1/PA5/PA6/PA10/PA10-1/PA15/PA37/ PA38-2 Series

Each of the WJ-PA series of amplifiers offers over 200 milliwatts of output power, covering 5 MHz to 4000 MHz, with the PA48 providing over 25 dBm of output power. The PA38-2 amplifier is the leader in dynamic range within this series by providing typically +24 dBm output, 9 dB of gain with a noise figure of less than 5 dB. Its dynamic range calculates to +122 dBm for a 1 MHz bandwidth. The PA15 provides typically 0.5 watt to 500 MHz and 0.35 watt to 1000 MHz with 13.5 dB of gain.

Low Noise • Low Level • Active Bias

A1/A11/A11-2/A21-1/A31-1/A71 Series

This series of amplifiers is designed for minimum broadband noise figures, biased typically with 5 mA of collector current, and uses little or no emitter feedback resistance. Because of the low collector bias current, these amplifiers operate best at their design V_{CC} of 15 volts and are not recommended for operation on supplies of less than 12 volts. At 12 volts V_{CC}, this series will typically lose about 1.5 dB of gain compared to less than 0.2 dB loss for other W-J full performance amplifiers that provide 7.0 dBm or greater output power at 15 volts V_{CC}. The low frequency range of this group is typically flat down to 1 MHz.

Low Noise • High Dynamic Range • High Efficiency

A70/A70-1/A70-2/A70-3 Series

The WJ-A70 through A70-3 series offers noise figures from as low as 1.5 dB with an attendent output power of +9.0 dBm to an output power of as high as +23 dBm (+33 dBm Third Order IM Point) with an attendent noise figure of only 2.8 dB. This series is designed for the lowest possible noise figure consistent with the highest possible dynamic range. For example, the WJ-A70-3 has a dynamic range of +123.7 dBm in a 1 MHz bandwidth.

Low Noise • High Efficiency • High Reverse Isolation

A81/A81-1/A81-2/A81-3/A82/A82-1 Series

The WJ-A81 through A82-1 series is designed for the ultimate in efficiency and very high reverse isolation (> 35 dB). They are also designed for low noise figures (less than 3 dB) and output levels (> 15 dBm). This series has the highest efficiency index of the cascadable amplifiers which is attributable to the unique cascade circuit configuration used. The cascode design consists of driving a common emitter stage into a common base stage where the common base acts as a non-phase inverting impedance transformer which allows a much smaller amount of resistive feedback to be used which in turn improves the reverse isolation and decreases the degradation in noise figure.

High Efficiency • Transformer Coupled

A87/A87-1/A87-2/A67/A67-1/A86 Series

This series of amplifiers used transformer coupled collector circuits for the purpose of minimizing the shunt loading on the output. This increases the effective output power obtainable from a given collector current thereby increasing the DC to RF conversion efficiency. For example, the A87-1 yields +17 dBm of output power drawing 33 mA of current compared with +16.5 of output power for the A77, which draws 50 mA of current. For the ultimate in efficiency improvement, the A86 provides 9 dBm of output power using a 5 volt V_{CC} and draws 21 mA of current. Compared to the A74 amplifier, this represents about a 700% savings in total DC power consumption. The compromise that accompanies this approach is some loss of gain and bandwidth over straight choke decoupling.

GaAs FET Amplifiers

This series of GaAs FET amplifiers is designed for maximum bandwidth such as 1 to 4 GHz and 2 to 8 GHz using resistive feedback. The amplifiers are available with one, two, or three stages of amplification depending on the model. These devices have an average of 7 dB per stage and noise figures of 4 to 6 dB. These amplifiers operate off either a 12 or 5 volt supply.

AMPLIFIER SELECTION CHART

Typical and Guaranteed Specifications

Model	Frequency Range MHz	Small Signal Gain dB Typ.	Small Signal Gain dB Min. 0/50C	Small Signal Gain dB Min. -54/85C	Gain Flatness ±dB Max. 0/50C	Gain Flatness ±dB Max. -54/85C	Noise Figure dB Typ.	Noise Figure dB Max. 0/50C	Noise Figure dB Max. -54/85C	Power Output At 1 dB Compression dBm Typ.	Power Output Min. 0/50C	Power Output Min. -54/85C	Intercept Point dBm Typ.	VSWR In/Out Max. 0/50C	VSWR In/Out Max. -54/85C	DC Volts Nom.	DC mA Typ.	Package Type*
10 TO 250 MHz • LOW NOISE • HIGH DYNAMIC RANGE • HIGH EFFICIENCY																		
A70	10-250	8.0	7.5	7.0	0.5	0.7	1.8	2.3	2.8	8.5	7.5	7.0	21	2.1	2.3	15	10	TO-8
A70-1	10-250	8.0	7.5	7.0	0.5	0.7	1.8	2.3	2.8	14.0	13.0	12.5	28	2.1	2.3	15	15	TO-8
A70-2	10-250	7.0	6.5	6.0	0.8	1.0	2.2	2.7	3.2	19.0	18.0	17.5	35	2.1	2.3	15	25	TO-8
A70-3	20-250	7.0	6.5	5.5	0.5	1.0	2.5	3.0	3.5	21.0	20.5	20.0	34	2.1	2.3	15	37	TO-8
20 TO 500 MHz • LOW NOISE • HIGH EFFICIENCY • HIGH REVERSE ISOLATION																		
A81	20-250	25.0	23.5	23.0	0.5	0.7	3.0	3.5	4.0	17.0	16.0	15.5	28	1.9	2.0	15	35	TO-8
A81-1	20-250	24.5	23.5	23.0	0.5	0.7	2.5	3.2	3.7	12.5	11.5	11.0	23	1.9	2.0	15	25	TO-8
A82	20-250	22.5	21.5	21.0	0.7	1.0	4.0	4.5	5.0	20.0	19.0	18.0	30	2.0	2.0	15	50	TO-8
A82-1	20-250	18.0	16.5	16.0	0.7	1.0	4.0	4.5	5.0	15.5	14.0	13.5	28	2.0	2.0	15	50	TO-8
A81-2	20-300	22.0	21.5	21.0	0.5	0.7	3.5	4.0	4.5	15.5	14.0	13.5	28	1.8	2.0	15	29	TO-8
	20-500	22.0	21.5	21.0	0.5	0.7	4.0	4.5	5.0	15.0	14.0	13.5	28	1.8	2.0	15	29	
A81-3	20-300	17.0	16.0	15.5	0.5	0.7	3.5	4.0	4.5	8.0	7.5	7.0	20	1.8	2.0	15	29	TO-8
	20-500	17.0	16.0	15.5	0.5	0.7	4.0	4.5	5.0	8.0	7.5	7.0	20	1.8	2.0	15	29	
5 TO 700 MHz • HIGH EFFICIENCY • 15 VDC BIAS																		
A87	10-400	12.5	12.0	11.5	0.5	0.7	4.7	5.5	6.0	17.0	16.0	16.0	32	2.0	2.0	15	31	TO-8
A87-1	10-400	15.5	14.5	14.0	0.7	1.0	3.6	4.5	5.0	17.0	15.5	15.0	31	2.0	2.0	15	33	TO-8
A67	10-500	12.5	11.5	11.0	0.5	0.7	4.0	4.5	5.0	15.5	14.5	14.0	28	2.0	2.2	15	32	TO-8
	10-800	12.5	11.5	11.0	0.5	0.7	4.3	5.0	5.5	15.5	15.0	14.0	28	2.0	2.2	15	32	
A67-1	10-600	14.0	13.0	12.5	0.5	0.7	4.0	4.5	5.0	16.0	15.0	14.0	28	2.0	2.0	15	32	TO-8
PA2[1]	10-300	12.5	11.5	11.0	0.8	1.0	8.0	9.5	10.0	25.0	24.0	23.5	38	2.0	2.2	24	95	TO-8
5 TO 1000 MHz • HIGH EFFICIENCY • ULTRA LOW POWER CONSUMPTION • 5 VDC BIAS																		
A86	10-200	28.0	27.0	26.0	0.8	1.0	3.8	4.5	5.0	9.0	7.5	7.0	20	1.9	2.0	5	21	TO-8
A83-1	10-250	35.5	34.0	33.0	0.5	0.8	2.5	3.0	3.5	-1.5	-2.5	-3.5	9	1.8	2.0	5	13	TO-8
A87-2	10-300	15.5	15.0	14.5	0.5	0.8	3.0	3.5	4.0	9.5	9.0	8.5	23	1.8	2.0	5	14.5	TO-8
A83	10-500	30.0	29.0	28.0	0.5	0.8	3.0	3.5	4.0	-1.0	-2.0	-4.0	10	1.8	2.0	5	13	TO-8
A74-2	5-500	26.0	25.0	24.0	1.0	1.2	3.8	4.3	4.8	-1.0	-2.0	-2.0	10	2.0	2.0	5	13	TO-8
A72	5-500	14.7	14.0	13.5	0.7	1.0	4.0	5.0	5.5	12.5	11.5	11.0	27	1.7	1.8	5	30	TO-8
A66-3	10-1000	26.0	24.5	24.0	0.8	1.1	3.0	3.5	4.0	3.0	1.5	1.0	13	1.8	2.0	5	16	TO-8
10 TO 1500 MHz • HIGH EFFICIENCY • ULTRA LOW POWER CONSUMPTION • 5 VDC BIAS																		
A16-2	10-1200	13.0	12.0	11.5	0.5	0.7	3.5	4.0	4.5	6.0	5.0	4.5	18	1.9	2.0	5	15	TO-8
A28-2	10-1000	14.0	13.0	12.5	0.5	1.0	3.5	4.5	5.0	10.5	9.5	8.5	24	1.9	2.0	5	27	TO-8
	10-1500	14.0	13.0	12.5	0.5	1.0	3.5	4.5	5.0	10.0	7.5	7.0	24	1.9	2.0	5	27	
5 TO 300 MHz																		
A71	5-200	18.0	16.5	16.0	0.8	1.0	2.1	2.5	2.8	-2.5	-3.0	-3.5	10	1.9	2.0	15	9	TO-8
A75-2	5-250	21.0	20.0	19.0	0.7	1.0	4.2	4.5	5.0	8.0	7.0	7.0	19	1.7	2.0	15	24	TO-8
A74-1	5-250	31.0	30.0	29.0	0.7	1.0	4.5	5.0	5.5	8.5	7.0	7.0	21	1.7	2.0	15	40	TO-8
A78	5-300	14.0	13.0	12.5	0.7	1.0	4.5	5.5	6.0	19.5	18.0	17.5	33	1.9	2.0	15	65	TO-8
A79	5-250	14.0	13.0	12.5	0.7	1.0	5.2	6.5	7.0	22.0	20.0	19.5	36	1.8	2.0	15	88	TO-8
5 TO 400 MHz																		
A51	10-400	15.0	14.0	13.0	0.7	1.0	2.7	3.0	3.5	-3.0	-3.5	-3.5	10	1.7	2.0	15	7	TO-8
A54	5-400	27.5	26.0	24.0	0.8	1.0	4.5	5.5	6.0	8.0	6.5	5.5	19	2.0	2.0	15	34	TO-8
A56	5-400	26.0	24.0	23.0	1.0	1.0	5.5	7.0	7.5	13.5	12.5	12.0	27	2.0	2.0	15	69	TO-8
5 TO 700 MHz																		
A1	5-500	16.0	15.0	14.5	0.7	1.0	2.4	3.0	3.5	-1.0	-2.0	-3.0	11	1.8	2.0	15	9	TO-8
A3	5-500	15.5	14.0	13.5	0.7	1.0	3.3	4.0	4.5	-1.0	-2.0	-3.0	11	1.7	2.0	15	9	TO-8
A5	5-500	14.8	14.0	13.5	0.7	0.7	4.5	5.5	6.0	8.5	7.0	7.0	22	1.8	2.0	15	25	TO-8
A5-5	5-500	15.5	14.0	13.5	0.5	0.7	4.0	5.0	5.5	9.0	7.0	7.0	21	1.5	1.6	15	24	TO-8
A5-6	5-600	16.0	15.0	14.5	0.7	0.7	4.5	5.5	6.0	8.5	7.0	6.5	21	1.8	2.0	15	24	TO-8
A7[1]	5-500	14.9	14.0	13.5	0.7	1.0	5.5	6.5	6.5	14.0	13.0	12.5	26	1.8	2.0	24	43	TO-8

NOTES:
1. Specifications guaranteed to +71°C.
*Outline drawings for these packages are on page 18.

Typical and Guaranteed Specifications

Model	Frequency Range MHz	Small Signal Gain dB Typ.	Small Signal Gain dB Min. 0/50C	Small Signal Gain dB Min. -54/85C	Gain Flatness ±dB Max. 0/50C	Gain Flatness ±dB Max. -54/85C	Noise Figure dB Typ.	Noise Figure dB Max. 0/50C	Noise Figure dB Max. -54/85C	Power Output At 1 dB Compression dBm Typ.	Power Output At 1 dB Compression dBm Min. 0/50C	Power Output At 1 dB Compression dBm Min. -54/85C	Intercept Point dBm Typ.	VSWR In/Out Max. 0/50C	VSWR In/Out Max. -54/85C	DC Volts Nom.	DC mA Typ.	Package Type*
5 TO 700 MHz Continued																		
A9[1]	5-500	11.0	10.0	9.5	1.0	1.0	8.0	10.0	10.5	22.0	20.0	20.0	35	2.0	2.0	24	110	TO-8
A75-3	10-500	20.5	19.5	18.5	0.7	1.0	2.3	2.5	3.0	3.5	2.0	1.5	15	1.8	2.0	15	14	TO-8
A75	5-500	21.0	20.0	19.0	0.7	1.0	2.6	3.0	3.5	9.0	7.0	7.0	21	1.8	2.0	15	24	TO-8
A53	10-500	15.0	14.0	13.5	0.8	1.0	3.0	3.5	4.0	3.5	2.0	1.5	16	2.0	2.0	15	12	TO-8
A55	10-500	14.7	14.0	13.5	0.8	1.0	5.0	6.0	6.5	11.0	9.0	8.0	24	2.0	2.0	15	30	TO-8
A57	10-500	14.7	14.0	13.0	0.8	1.0	4.8	6.0	6.5	14.0	13.0	12.5	28	2.0	2.0	15	44	TO-8
A77	5-500	16.5	16.0	15.0	0.7	1.0	5.0	6.0	6.5	16.5	15.0	14.5	30	1.7	2.0	15	50	TO-8
A77-1	5-600	16.0	15.0	14.5	0.7	1.0	5.0	6.5	7.0	16.5	15.0	14.5	30	1.8	2.0	15	50	TO-8
A58	5-500	11.5	10.0	9.5	0.7	1.0	4.8	6.0	6.5	19.0	18.0	17.5	35	1.9	2.0	15	65	TO-8
A59	5-500	11.5	10.0	9.5	0.7	1.0	5.5	6.5	7.0	22.0	20.0	20.0	38	1.9	2.0	15	88	TO-8
A59-1	10-700	10.5	9.5	9.0	0.8	1.0	6.0	7.5	8.0	22.0	20.0	20.0	36	1.9	2.0	15	88	TO-8
A88	5-500	18.7	18.0	17.5	0.5	0.7	6.5	7.5	8.0	20.5	19.5	19.0	30	1.8	2.0	15	79	TO-8
5 TO 500 MHz • HIGH GAIN • MULTI-STAGE																		
A73	5-500	32.0	30.0	29.0	0.7	1.0	3.5	4.0	4.5	1.5	1.0	0.5	15	1.8	2.0	15	20	TO-8
A74	5-500	30.0	28.0	27.0	0.7	1.0	4.7	5.5	6.0	8.5	7.0	7.0	20	1.8	2.0	15	40	TO-8
A76	5-500	28.0	27.0	26.0	1.0	1.0	4.7	5.5	6.0	15.0	14.0	13.5	28	1.9	2.0	15	62	TO-8
RA89	5-500	26.5	25.5	25.0	0.7	1.0	3.7	4.5	5.0	21.5	20.5	20.0	35	1.8	2.0	15	130	TO-8B
RA89-1	10-500	30.0	29.0	28.0	0.7	1.0	3.2	4.5	5.0	21.5	20.0	20.0	36	1.8	2.0	15	130	TO-8B
RA76	10-500	40.5	38.5	37.5	0.9	1.2	3.0	3.8	4.3	15.0	13.3	12.3	26	1.8	2.0	15	81	TO-8B
5 TO 1000 MHz																		
A18	10-800	14.7	14.0	13.5	0.7	1.0	4.5	5.5	6.0	15.0	14.0	13.5	29	1.9	2.0	15	43	TO-8
A11-2	5-1000	16.0	15.0	14.0	0.9	1.0	2.5	3.0	3.5	-1.0	-3.0	-3.5	10	1.9	2.0	15	9	TO-8
A11	5-1000	14.7	14.0	13.5	1.0	1.2	3.1	3.5	4.0	-2.0	-3.0	-4.0	10	1.8	2.0	15	9	TO-8
A12	10-1000	16.0	15.0	14.5	0.7	1.0	2.8	3.5	3.9	8.0	7.0	6.5	22	1.9	2.0	15	22	TO-8
A63	5-1000	16.0	15.0	14.5	1.0	1.0	3.0	4.0	4.5	4.0	2.0	2.0	15	1.9	2.0	15	14	TO-8
A18-1	10-1000	14.7	14.0	13.5	0.5	1.0	3.8	5.0	5.5	16.0	15.0	14.5	30	1.8	2.0	15	44	TO-8
A15	5-1000	14.5	14.0	13.0	1.0	1.2	5.4	6.5	7.0	8.5	7.0	6.5	21	1.9	2.0'	15	24	TO-8
A65	10-1000	10.5	9.5	9.0	0.7	0.8	6.0	7.5	8.0	10.0	8.0	8.0	24	1.9	2.0	15	30	TO-8
A17	10-1000	12.0	10.5	10.0	0.7	1.0	6.0	7.5	8.0	15.3	14.0	13.5	27	1.8	2.0	15	44	TO-8
A19-1	30-600	11.5	10.5	10.0	0.6	0.8	6.0	7.0	7.5	22.5	20.5	20.0	35	1.7	2.0	15	90	TO-8
	10-1000	11.5	10.5	10.0	0.6	0.8	6.5	8.0	8.5	22.5	20.5	20.0	35	1.7	2.0	15	90	
A19	10-1000	7.5	6.0	5.5	1.0	1.3	9.0	10.5	11.0	21.0	20.0	19.0	34	2.2	2.2	15	100	TO-8
10 TO 1200 MHz • HIGH GAIN • MULTI-STAGE																		
A66-1	10-500	27.5	26.0	25.5	0.7	1.0	2.7	3.5	4.0	15.0	14.5	14.0	27	1.8	2.0	15	65	TO-8
	10-1000	27.5	26.0	25.5	0.7	1.0	3.0	4.0	4.5	15.0	14.5	14.0	27	1.8	2.0	15	65	
RA69	10-1000	25.0	24.0	23.0	0.7	1.0	4.5	5.0	5.5	23.0	20.0	20.0	34	2.0	2.0	15	130	TO-8B
A64	10-1000	26.0	24.0	23.0	0.8	1.0	3.0	3.8	4.3	8.0	7.0	6.5	20	1.7	1.8	15	35	TO-8
	10-1200	26.0	24.0	23.0	0.8	1.0	3.4	4.3	4.8	8.0	7.0	6.5	20	1.9	2.0	15	35	
A66	10-1200	23.5	22.0	21.0	0.7	1.0	4.0	5.0	5.5	15.0	14.0	13.5	28	1.6	1.8	15	64	TO-8
RA66	10-1000	37.0	35.0	34.0	1.0	1.3	3.5	4.5	5.0	15.5	14.0	13.0	30	1.8	2.0	15	81	TO-8B
2 TO 1500 MHz																		
A21-1	5-1200	15.0	14.0	13.5	0.5	1.0	2.8	3.5	3.9	-1.0	-2.0	-3.0	10	1.9	2.0	15	10	TO-8
A24	5-1500	20.0	19.0	18.0	0.8	1.0	4.2	5.3	5.8	8.0	7.0	6.5	20.5	2.0	2.0	15	34	TO-8
A25-1	10-600	13.5	13.0	12.5	0.5	0.7	3.0	3.5	4.0	9.0	8.0	7.5	22	2.0	2.0	15	24	TO-8
	2-1500	13.5	13.0	12.5	0.5	0.7	3.8	4.5	5.0	9.0	8.0	7.5	22	2.0	2.0	15	24	
A25	5-1500	10.0	9.0	8.0	0.6	1.0	6.0	7.5	8.0	9.0	7.0	6.5	21	2.0	2.0	15	24	TO-8
A26	10-1500	20.5	19.0	18.5	0.6	0.8	5.0	5.5	6.0	14.0	13.0	12.5	27	1.7	2.0	15	64	TO-8
A27	10-1500	8.5	7.5	7.0	0.6	1.0	7.5	9.0	9.5	15.5	14.0	13.5	28	1.9	2.0	15	50	TO-8
A28	10-1500	11.0	10.0	9.5	0.6	1.0	6.0	7.0	7.5	15.0	14.0	13.5	29	2.0	2.0	15	45	TO-8
A29-1	30-1000	9.0	8.5	7.5	0.5	1.0	7.0	8.5	9.0	22.0	20.0	19.0	32	2.0	2.0	15	90	TO-8
	10-1500	9.0	8.5	7.5	0.5	1.0	8.0	9.0	9.5	22.0	20.0	19.0	32	2.0	2.0	15	90	
A29	10-1500	6.5	5.5	5.0	0.5	0.7	9.0	10.0	10.5	22.0	20.0	19.5	34	2.0	2.0	15	105	TO-8
RA26	10-1500	27.5	26.0	25.0	0.8	1.2	5.5	6.0	6.5	14.5	13.5	12.5	27	2.0	2.0	15	82	TO-8B

NOTES: 1. Specifications guaranteed to 71°C. *Outline drawings for these packages are on page 18.

(Continued)

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Typical and Guaranteed Specifications (Continued)

Model	Frequency Range MHz	Small Signal Gain dB Typ.	Small Signal Gain dB Min. 0/50C	Small Signal Gain dB Min. -54/85C	Gain Flatness ±dB Max. 0/50C	Gain Flatness ±dB Max. -54/85C	Noise Figure dB Typ.	Noise Figure dB Max. 0/50C	Noise Figure dB Max. -54/85C	Power Output At 1 dB Compression dBm Typ.	Power Output At 1 dB Compression dBm Min. 0/50C	Power Output At 1 dB Compression dBm Min. -54/85C	Intercept Point dBm Typ.	VSWR In/Out Max. 0/50C	VSWR In/Out Max. -54/85C	DC Volts Nom.	DC mA Typ.	Package Type*
10 TO 2000 MHz																		
A31-1	10-2000	11.5	11.0	10.5	0.7	1.0	3.5	4.0	4.5	-2.0	-4.0	-4.5	9	2.0	2.0	15	9	TO-8
A33	500-2000	9.5	8.5	8.0	0.6	0.8	4.5	5.5	6.0	3.0	2.0	2.0	15	2.0	2.0	15	14	TO-8
	10-2000	9.5	8.5	8.0	0.8	1.0	4.5	5.5	6.0	3.0	2.0	2.0	15	2.0	2.0	15	14	
A34	100-2000	16.0	15.0	14.0	0.7	1.0	5.5	6.5	7.0	7.0	6.0	5.0	18	1.9	2.0	15	35	TO-8
A35	500-2000	10.0	9.0	8.5	0.6	0.8	5.0	6.5	7.0	9.0	7.0	6.5	21	2.2	2.2	15	24	TO-8
	10-2000	10.0	9.0	8.5	0.8	1.0	5.0	6.5	7.0	9.0	7.0	6.5	21	2.2	2.2	15	24	
RA36	100-2000	24.0	23.0	22.0	0.9	1.0	5.5	6.5	7.0	13.0	12.0	11.5	22	1.8	2.0	15	76	TO-8B
A36	100-2000	16.5	15.5	14.5	0.8	1.0	5.5	7.0	7.5	12.0	11.0	11.0	23	2.0	2.0	15	63	TO-8
RA38	200-1800	16.0	14.5	13.5	1.0	1.2	6.0	6.7	7.0	18.5	17.5	16.5	25	2.3	2.3	15	127	TO-8B
	200-2000	16.0	14.5	13.5	1.0	1.2	6.8	7.5	8.0	17.0	16.0	15.5	25	2.3	2.3	15	127	
A37	500-2000	9.3	8.0	7.0	0.6	0.8	6.5	8.0	8.5	15.5	14.0	13.5	26	2.2	2.2	15	45	TO-8
	10-2000	9.3	8.0	7.0	0.8	1.0	6.5	8.0	8.5	15.5	14.0	13.5	26	2.2	2.2	15	45	
A38[1]	10-1500	7.5	6.5	6.0	0.7	1.0	6.5	7.7	8.2	19.0	18.0[1]	17.5[1]	30	2.2	2.2	15	65	TO-8
	10-2000	7.5	6.5	6.0	0.7	1.0	7.5	9.0	9.5	19.0	18.0[1]	17.5	30	2.2	2.2	15	65	
A38-1	10-2000	9.5	8.5	7.5	0.7	1.0	6.5	7.5	8.0	18.0	17.0	16.5	30	2.1	2.2	15	65	TO-8
A39	10-1500	7.5	6.5	6.0	0.7	1.0	8.0	9.0	9.5	22.0	20.0	19.5	34	2.2	2.2	15	90	TO-8
	1500-2000	7.5	6.5	6.0	0.7	1.0	8.5	9.5	10.0	22.0	20.0	19.5	34	2.2	2.2	15	90	
2 TO 3200 MHz																		
A33-1	2-2400	9.0	8.2	7.8	0.6	0.8	4.5	5.8	5.3	6.0	4.5	4.0	19	1.9	2.0	15	19	TO-8
A35-1	2-2400	9.0	8.5	8.0	0.6	0.8	5.0	5.8	6.3	9.5	8.5	8.0	23	1.9	2.0	15	28	TO-8
A34-1	1500-2300	14.5	13.7	12.5	0.6	0.8	5.7	6.8	7.3	8.0	6.5	6.0	20	2.0	2.0	15	34	TO-8
A36-1	100-2300	16.2	15.0	14.0	0.7	1.0	6.0	7.0	7.5	12.0	11.0	11.0	23	2.0	2.0	15	63	TO-8
A36-2	100-2000	15.0	14.0	13.0	0.7	1.0	6.0	7.0	7.5	12.0	11.0	11.0	23	2.2	2.2	15	63	TO-8
	2000-2600	15.0	14.0	13.0	0.7	1.0	6.0	7.0	7.5	14.0	12.5	12.0	23	2.2	2.2	15	63	
A43	100-3200	11.5	10.5	9.8	0.7	1.0	6.7	7.2	7.7	8.5	7.0	6.5	21	2.3	2.4	15	45	TO-8
5 TO 500 MHz MEDIUM POWER CLASS A AMPLIFIERS																		
PA2[2]	10-300	12.5	11.5	11.0	0.8	1.0	8.0	9.5	10.0	25.0	24.0	23.5	38	2.0	2.2	24	95	TO-8
PA3-1	5-500	14.5	13.5	13.0	0.5	0.7	7.0	8.5	9.0	22.5	20.0	20.0	38	2.0	2.0	15	91	TO-8
PA3	5-400	14.5	13.5	13.0	0.7	1.0	7.5	9.0	9.5	24.5	23.0	22.5	34	2.0	2.0	15	130	TO-8
	400-500	14.5	13.5	13.0	0.7	1.0	7.5	9.0	9.5	24.5	22.5	22.0	34	2.0	2.0	15	130	
PA5	10-500	9.4	8.5	8.0	0.7	1.0	8.5	9.5	10.0	25.0	23.5	23.5	35	1.7	2.0	15	130	TO-8
	70-500	9.4	8.5	8.0	0.7	1.0	7.8	8.8	9.3	25.0	23.5	23.5	35	1.7	2.0	15	130	
PA6	10-100	9.5	8.5	8.0	0.5	1.0	8.5	9.5	10.0	26.5	25.0	25.0	35	1.7	2.0	20	150	TO-8
	100-500	9.5	8.5	8.0	0.5	1.0	7.8	8.8	9.3	26.5	25.0	25.0	35	1.7	2.0	20	150	
10 TO 4000 MHz MEDIUM POWER CLASS A AMPLIFIERS																		
PA15	10-500	13.5	12.5	12.0	0.5	0.7	7.0	8.5	9.0	27.0	26.0	25.5	38	2.3	2.3	15	216	TO-8
	500-1000	13.5	12.5	12.0	0.5	0.7	7.0	8.5	9.0	25.5	23.5	23.0	38	2.3	2.3	15	216	
PA10	10-1000	10.0	9.5	9.0	0.5	0.7	8.5	9.5	10.0	22.5	20.0	20.0	36	2.0	2.0	15	95	TO-8
PA10-1	10-1000	10.0	9.5	9.0	0.5	0.7	8.5	9.5	10.0	22.0	21.0	20.0	35	2.0	2.0	12	98	TO-8
PA12	10-1200	9.5	9.0	8.5	0.5	0.7	8.5	9.5	10.0	22.5	20.0	19.5	35	2.0	2.0	15	95	TO-8
PA38	200-2000	10.0	8.5	8.0	0.7	1.0	4.0	4.7	5.2	24.0	22.5	22.0	39	1.9	2.0	15	150	TO-8
PA38-2	200-2600	8.5	7.5	7.0	0.7	1.0	4.5	5.5	6.0	23.5	22.0	21.4	32	1.9	2.0	15	150	TO-8
★ **PA48**	**1000-4000**	**16.0**	**14.0**	**13.5**	**0.7**	**0.8**	**5.5**	**7.0**	**7.5**	**24.0**	**22.5**	**21.5**	**33**	**2.0**	**2.2**	**15**	**225**	**TO-8B**
ECONOMY AMPLIFIERS																		
EA1	5-400	15.0	14.0	13.0	< 0.5 (Typ.)			4.3 (Typ.)		-0.5	-2.5	-3.0	13	< 1.9 (Typ.)		15	10	TO-5
EA2	5-400	14.0	13.0	12.5	< 0.3 (Typ.)			5.7 (Typ.)		9.0	6.5	6.0	21	< 1.8 (Typ.)		15	27	TO-5
EA5[3]	200 kHz-500 MHz																	
EA7	5-250	9.5	8.5	8.0	0.8	1.0	6.0	6.5	7.0	16.0	15.0	14.0	28	2.0	2.1	15	60	TO-5
EA53-2	5-500	19.0	18.5	17.5	0.5	1.0	3.6	4.0	4.5	11.0	10.0	9.0	24	2.0	2.0	15	33	TO-5
EA54-2	5-500	29.5	28.5	27.5	0.8	1.0	4.5	5.0	5.5	9.5	8.0	6.0	20	2.0	2.1	15	55	TO-5
EA17	5-1000	11.5	10.5	10.0	0.7	1.0	4.8	5.5	6.0	13.5	11.0	10.5	20	1.9	2.0	15	43	TO-5
EA15	5-1000	14.0	13.0	12.5	0.5	0.7	3.6	4.5	5.0	8.5	7.0	6.0	20	2.1	2.2	15	24	TO-5

★ **NEW PRODUCT**

NOTES:
1. Power output below 500 MHz is 17.0 dBm at 0° to +50°C and 16.5 dBm at -54° to +85°C.
2. Specifications guaranteed to +71°C.
3. Same as EA2 except three external capacitors are required for 200 kHz to 500 MHz frequency response.

*Outline drawings for these packages are on page 18.

Typical and Guaranteed Specifications (Continued)

Model	Frequency Range MHz	Small Signal Gain dB Typ.	Small Signal Gain dB Min. 0/50C	Small Signal Gain dB Min. -54/85C	Gain Flatness ±dB Max. 0/50C	Gain Flatness ±dB Max. -54/85C	Noise Figure dB Typ.	Noise Figure dB Max. 0/50C	Noise Figure dB Max. -54/85C	Power Output At 1 dB Compression dBm Typ.	Power Output At 1 dB Compression dBm Min. 0/50C	Power Output At 1 dB Compression dBm Min. -54/85C	Intercept Point dBm Typ.	VSWR In/Out Max. 0/50C	VSWR In/Out Max. -54/85C	DC Volts Nom.	DC mA Typ.	Package Type*
ECONOMY AMPLIFIERS • 5 VDC BIAS																		
EA51	5-250	17.0	16.0	15.5	0.7	1.0	3.0	3.5	4.0	1.8	1.0	-1.0	13	2.0	2.2	5	13	TO-5
EA53	5-250	22.0	20.5	19.5	0.9	1.0	2.0	2.8	3.2	4.5	2.5	2.0	16	1.8	2.0	5	15	TO-5
EA54	10-250	27.0	25.0	24.0	1.0	1.2	3.8	4.5	5.0	5.0	4.0	2.0	16	1.7	1.8	5	30	TO-5

*Outline drawings for these packages are on page 18.

Mounting Instructions

Along with good RF grounding, good thermal conduction must exist between the TO-8 amplifier and the microstrip board on which it is mounted.

Thermal conduction is most efficient when the TO-8 is mounted onto a printed wiring board having a ground plane that is heat sunk to the enclosure. TO-8 amplifiers that draw high levels of current such as W-J power amplifiers, which dissipate higher levels of heat, must be heat sunk in this manner.

Watkins-Johnson Company employs two methods of mounting TO-8 packaged devices. These methods are mounting brackets or epoxy preforms. Mounting bracket kits are supplied at no charge with all TO-8, TO-8B and TO-5 amplifiers, attenuators, limiters, and similar components. (See Figure 1.)

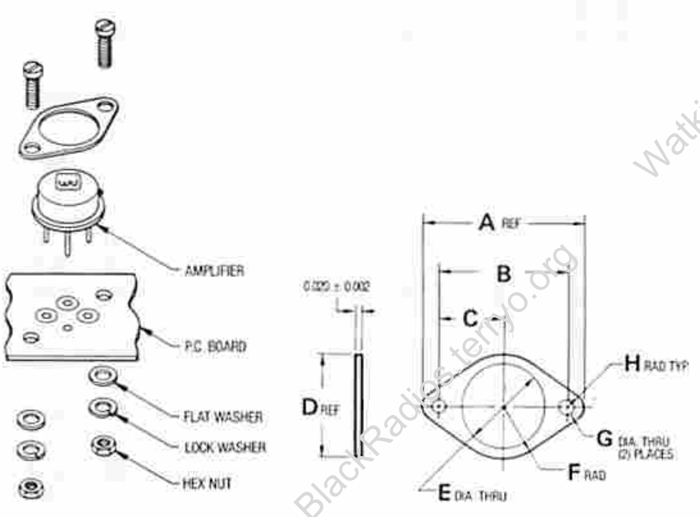
An alternative method for mounting our products is the use of a conductive epoxy preform that is currently used in our cascaded amplifier products (see Figure 2). The preform is made of a conductive material and must be ordered directly from Ablestik Laboratories, 833 West 182nd Street, Gardena, California 90248. Telephone: (213) 532-9341.

Preform Part Numbers:

TO-8 P/N 209851-002	TO-5 Preforms — Not Available
TO-8B P/N 209851-005	KA P/N 410407-002

Epoxy preforms have the advantage over mounting brackets of being more space efficient and are able to conform to the TO-8 to PWB interface, offering the best possible grounding connection.

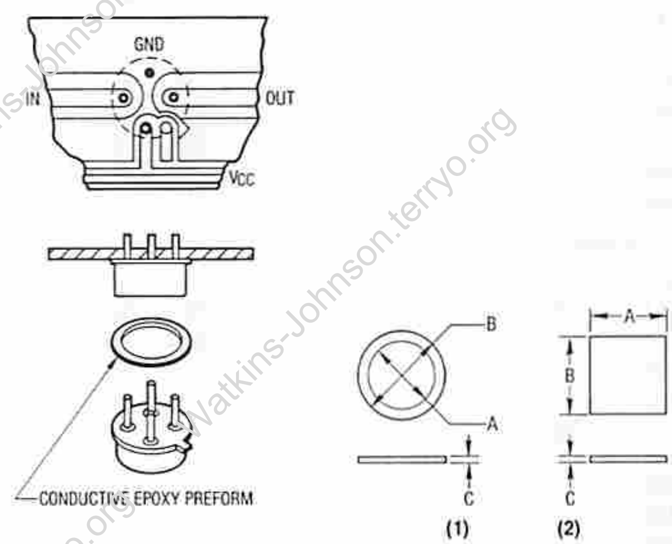
Figure 1. TO-8 Mounting kit for standard TO-8 packaged devices. Similar mounting kits supplied with TO-5 and TO-8B type products.



Dimensions are in inches (millimeters)

Package Type	A	B	C	D	E	F	G	H
TO-8	**0.859**	**0.687**	**0.343**	**0.520**	**0.455**	**0.260**	**0.078**	**0.086**
TO-8B	1.095	0.875	0.437	0.660	0.557	3.330	0.078	0.110
TO-5	0.750	0.580	0.290	0.390	0.330	0.195	0.078	0.085

Figure 2. Epoxy preform mounting procedure for TO-8 and TO-8B type amplifiers.

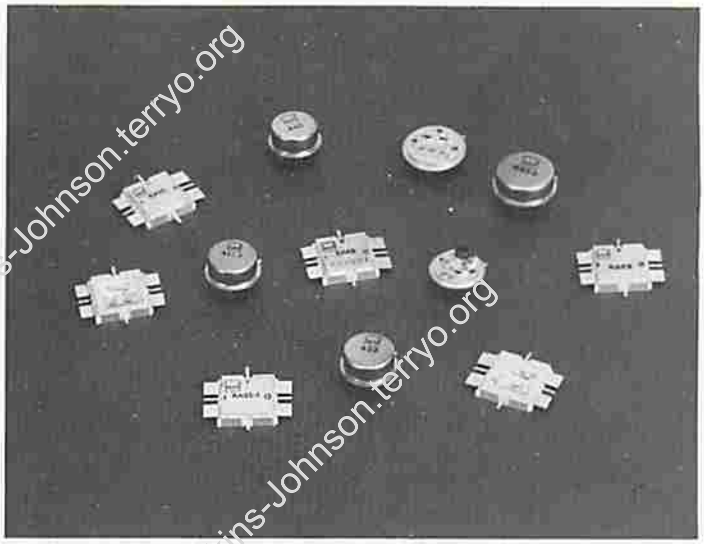


Clamp amplifiers to board with a minimum force of 20 to 30 lbs. while curing the preform at 125°C for two hours. Do not solder leads until after the epoxy is cured.

Package Type	A	B	C	Drawing
TO-8	0.43"	0.53"	.006	(1)
TO-8B	0.53"	0.63"	.006	(1)
KA	0.50"	0.50"	.006	(2)

1

Wideband GaAs FET Feedback Technology



This series of GaAs FET amplifiers is designed for maximum bandwidth such as 1 to 4 GHz and 2 to 8 GHz using resistive feedback. The amplifiers are available with one, two, or three stages of amplification depending on the model. These devices have an average of 7 dB per stage and noise figures of 4 to 6 dB. These amplifiers operate off either a 5, 12 or 15 volt supply.

Typical and Guaranteed Specifications

		Small Signal Gain dB			Gain Flatness ±dB		Noise Figure dB			Power Output At 1 dB Compression dBm			Intercept Point dBm	VSWR In/Out		DC		
Model	Frequency Range MHz	Typ.	Min. 0/50C	Min. -54/85C	Max. 0/50C	Max. -54/85C	Typ.	Max. 0/50C	Max. -54/85C	Typ.	Min. 0/50C	Min. -54/85C	Typ.	Max. 0/50C	Max. -54/85C	Volts Nom.	mA Typ.	Package Type*
A32	0.1-2	10.0	9.0	8.5	0.7	1.0	3.5	4.0	4.5	15.0	13.5	13.0	32	1.8	2.0	15	94	TO-8
A41	1-4	8.0	7.0	6.5	0.7	0.9	4.0	5.0	5.5	12.0	11.0	10.5	25	2.1	2.2	5	35	TO-8
A41-1	1-4	9.0	8.0	7.5	0.7	1.0	3.5	4.7	5.2	19.0	17.0	16.5	30	2.0	2.1	12	70	TO-8
EA41	1-4	8.0	7.0	6.5	0.7	0.9	3.5	5.0	5.5	12.0	11.0	10.5	23	2.1	2.2	5	35	TO-5
EA41-1	1-4	8.0	8.0	7.5	0.7	0.9	3.5	5.0	5.5	19.0	17.5	17.0	30	2.0	2.1	8	68	TO-5
KA41	1-4	8.5	7.0	6.5	0.7	0.9	4.0	5.0	5.5	12.0	11.0	10.5	25	2.1	2.2	5	35	KA
KA41-1	1-4	8.5	7.5	7.0	0.7	1.0	4.0	4.8	5.3	19.0	17.0	16.5	30	2.0	2.1	12	70	KA
KA43	1-4	21.0	19.5	18.0	0.9	1.2	4.5	5.3	5.8	11.5	10.5	9.5	22	2.1	2.3	5	115	KA
RA43	1-4	21.0	19.5	18.0	0.9	1.2	4.5	5.3	5.8	12.0	10.5	9.5	22	2.0	2.0	5	115	TO-8B
RA44[1]	0.5	15.0	14.0	13.5	1.1	1.2	6.0	7.0	7.5	19.0	18.0	17.0	28	2.1	2.2	15	120	TO-8B
A45	1-4	17.5	16.5	15.5	0.8	1.0	4.5	5.5	6.0	19.5	18.0	17.0	29	2.1	2.2	15	120	TO-8
A45-1	1-4	17.5	16.5	15.5	0.8	1.0	4.1	5.0	5.5	13.0	12.5	12.0	26	1.9	2.0	5	65	TO-8
KA45	1-4	17.5	16.5	15.5	0.8	1.0	4.5	5.5	6.0	19.0	18.0	17.0	30	2.1	2.2	15	120	KA
RA46	1-4	25.5	24.0	23.5	0.8	1.0	4.5	5.2	5.7	19.0	17.0	16.5	30	2.0	2.1	12	175	TO-8B
KA48	1-4	16.0	14.5	14.0	0.7	0.8	5.5	7.0	7.5	24.0	22.5	21.5	33	2.0	2.2	15	225	KA
KA53	1-5	21.0	19.5	18.0	0.9	1.2	4.5	5.3	5.8	11.5	10.5	9.5	22	2.1	2.3	5	115	KA
RA53	1-5	21.0	19.5	18.0	0.9	1.2	4.5	5.3	5.8	11.5	10.5	9.5	22	2.1	2.3	5	115	TO-8B
2 TO 6 GHz																		
A61	2-6	7.5	6.5	6.0	0.7	0.9	3.2	4.3	4.8	12.5	11.0	10.5	25	2.0	2.1	5	35	TO-8
A61-1	2-6	8.0	7.0	6.5	0.7	0.8	3.4	4.2	4.7	20.0	18.5	18.0	30	2.0	2.1	8	70	TO-8
KA61	2-6	7.5	6.5	6.0	0.7	0.9	3.5	4.5	5.0	12.0	10.5	10.0	26	2.1	2.2	5	35	KA
KA62	2-6	15.0	13.0	12.5	0.8	1.1	4.0	5.0	5.5	12.5	10.5	10.0	25	2.1	2.2	5	65	KA
RA62	2-6	16.0	14.0	13.5	0.7	1.0	4.0	5.0	5.5	13.0	12.0	11.5	28	2.0	2.0	5	65	TO-8B
KA63	2-6	18.5	16.5	15.5	1.0	1.2	5.5	7.0	7.5	13.0	11.0	10.5	25	2.2	2.3	5	120	KA
KA63-1	2-6	20.0	17.0	16.0	1.0	1.2	5.5	7.0	7.5	16.0	13.0	12.5	32	2.2	2.3	5	120	KA
RA63	2-6	18.5	16.5	15.5	1.0	1.2	5.5	7.0	7.5	13.0	10.0	9.5	25	2.2	2.3	5	120	TO-8B
RA63-1	2-6	19.0	16.5	15.5	1.0	1.2	5.5	7.0	7.5	16.0	13.0	12.5	32	2.2	2.3	5	120	TO-8B
KA65	2-6	14.5	12.5	12.0	1.0	1.2	4.5	6.0	6.5	19.0	17.0	16.5	26	2.1	2.2	12	115	KA
KA66	2-6	20.0	17.0	16.0	1.1	1.3	5.0	6.5	7.0	20.0	17.0	16.5	30	2.2	2.3	12	200	KA
KA68	2-6	13.0	11.5	11.0	0.8	1.0	6.0	7.5	8.0	22.5	20.5	19.5	32	2.0	2.2	12	225	KA
KA82[1]	2-8	13.5	12.0	11.5	0.8	1.0	4.5	5.5	6.0	13.0	11.5	11.0	25	2.1	2.2	5	55	KA

NOTE:
1. Preliminary specifications.
*Outline drawings for these packages are on page 18.

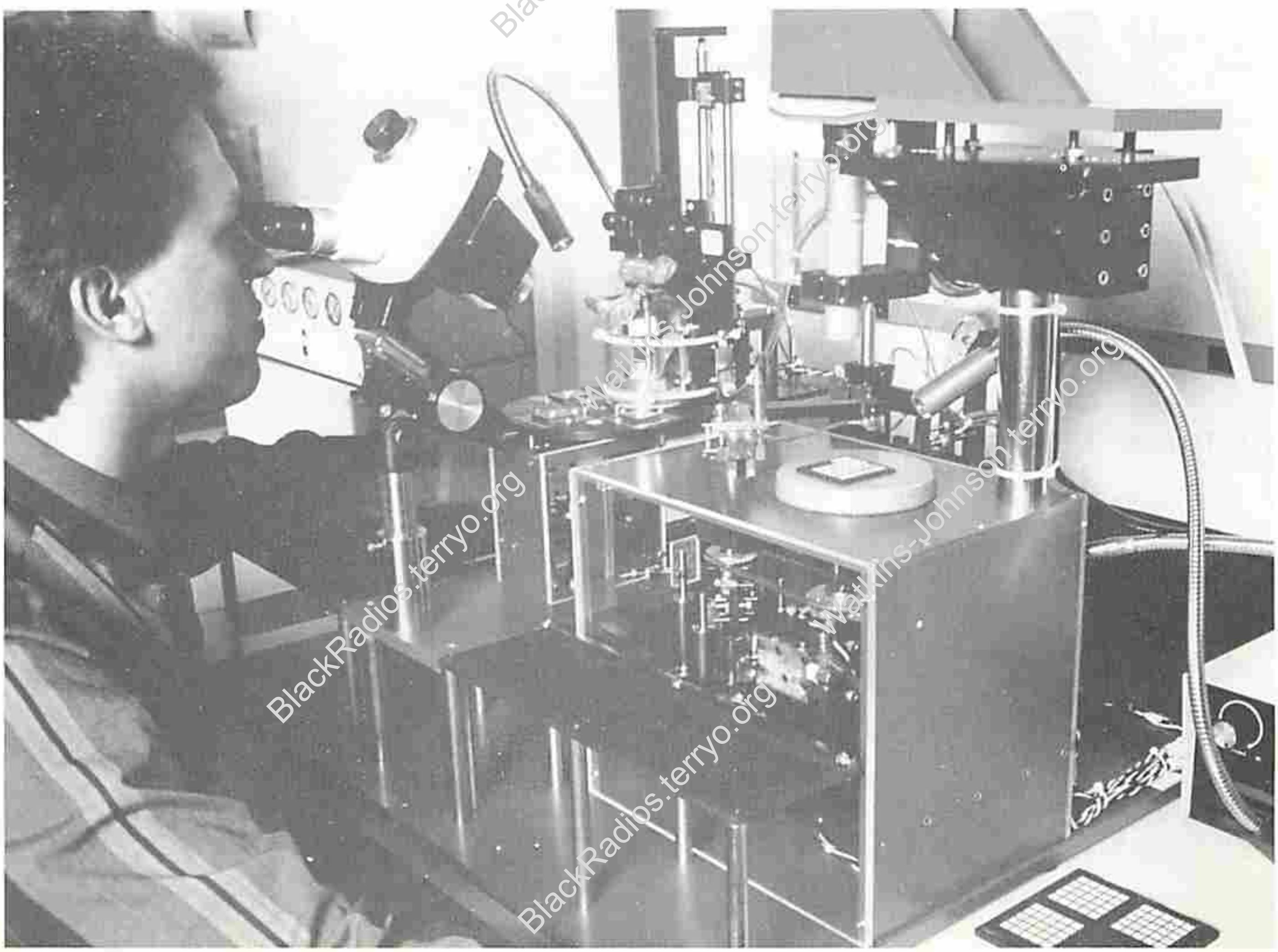
Miniature Flatpack Amplifiers

For stripline or microstrip designs, W-J offers the performance of most of its TO-8 amplifiers in an optional hermetically sealed MIC flatpack. For ordering purposes these modules use an "F" prefix to denote this package style. For example, an A5 becomes an FA5, and L1 becomes an FL1, etc. The following is a list of models currently available in the flatpack package. For any model not listed, please consult Watkins-Johnson Company directly.

Flatpack Cascadable Amplifier Devices

Model	Model	Model	Model	Model	Model	Model
A1	A18	A32	A54	A70-2	A83	G34
A3	A18-1	A33	A55	A71	A83-1	L1
A5	A21-1	A33-1	A56	A72	A86	L2
A5-5	A24	A34	A57	A73	A87	L34
A5-6	A25	A34-1	A63	A74	A87-1	LA7
A11	A25-1	A35	A64	A74-1	A87-2	LA17
A11-2	A27	A35-1	A65	A74-2	AL7	LG1
A12	A28	A37	A66-3	A75	G1	LG30
A15	A28-2	A51	A70	A75-2	G2	PL30
A16-2	A31-2	A53	A70-1	A75-3	G30	RA36
A17						A77

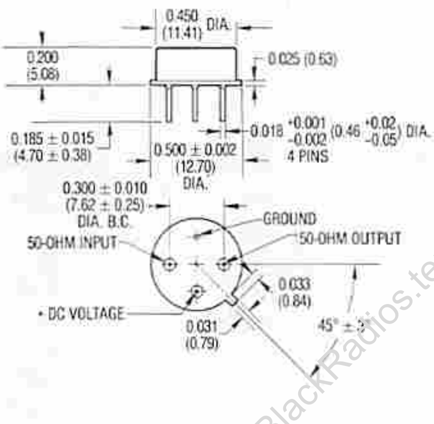
1



Amplifier Outline Drawings

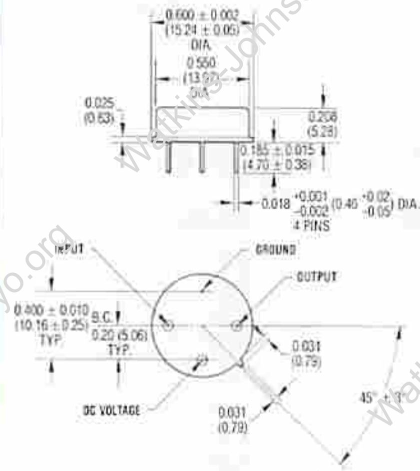
DIMENSIONS ARE IN INCHES (MILLIMETERS).
ALL DIMENSIONS ARE .XXX ± .005 UNLESS OTHERWISE STATED.

Standard TO-8 Amplifier



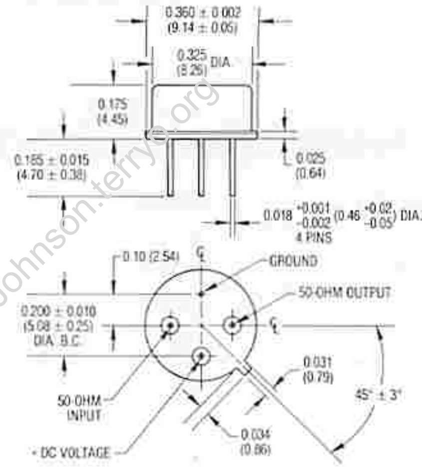
WEIGHT: APPROXIMATELY 2.0 GRAMS

TO-8B Amplifier



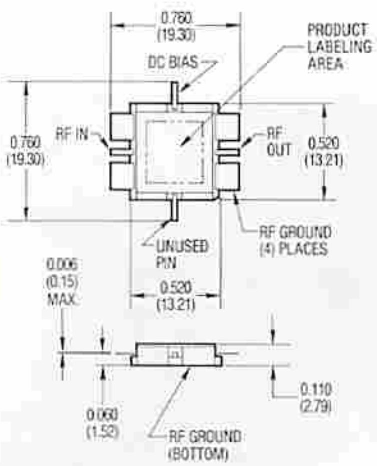
WEIGHT: APPROXIMATELY 3.0 GRAMS

Standard TO-5 Amplifier



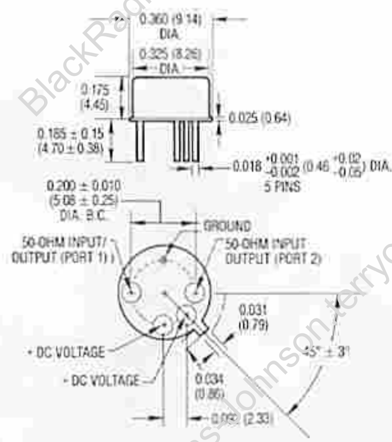
WEIGHT: APPROXIMATELY 1.0 GRAMS

KA Amplifier



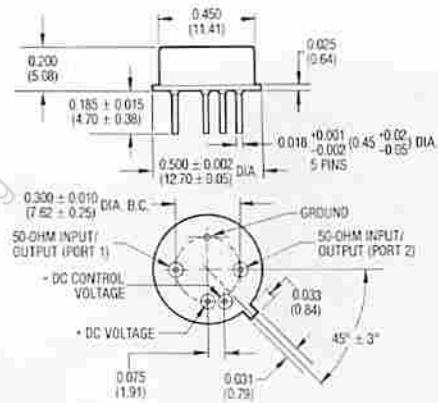
WEIGHT: APPROXIMATELY 1.7 GRAMS

EG1



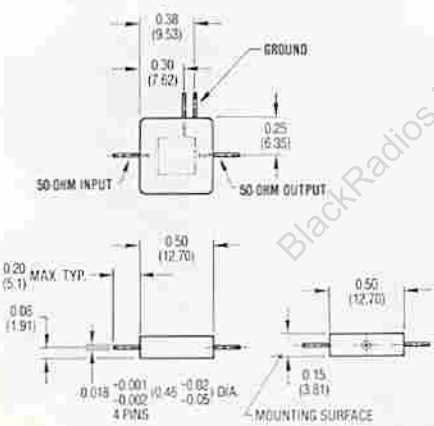
WEIGHT: APPROXIMATELY 1.0 GRAMS

TO-8 Attenuator



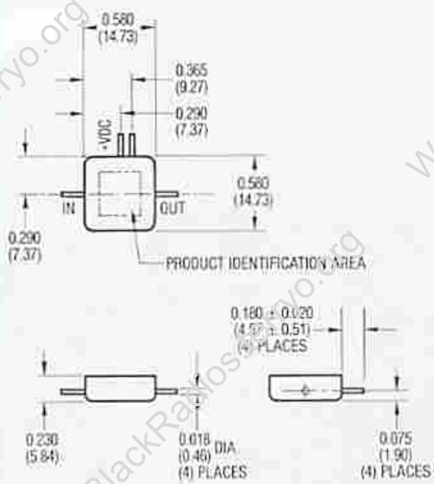
WEIGHT: APPROXIMATELY 2.0 GRAMS

TO-8 Flatpack



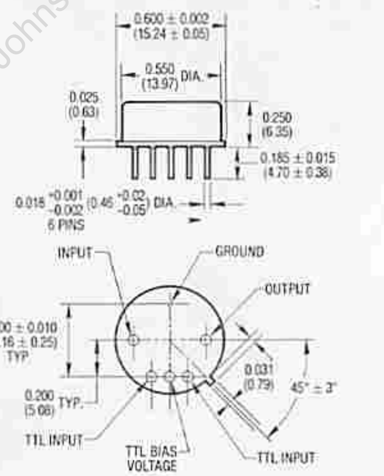
WEIGHT: APPROXIMATELY 2.5 GRAMS

TO-8B Flatpack



WEIGHT: APPROXIMATELY 3.5 GRAMS

S11/RG45



WEIGHT: APPROXIMATELY 3.0 GRAMS

RELIABILITY AND SCREENING

Watkins-Johnson Company's proven product line and experienced high reliability team can give maximum quality per dollar, reduce risks, and minimize the required amount of interface effort to get an order placed and shipped.

Our technical and management personnel have a thorough understanding of the importance and complexities of quality and high reliability requirements. To make it easy to meet reliability, cost, and schedule needs we offer several approaches to select from to satisfy any particular application:

1. **Standard Product Line**
2. **"S Series" Standard W-J Screening**
3. **Standard Hi-Rel Options**
4. **Custom Developed Programs**

1

HIGH QUALITY STANDARD PRODUCT LINE

THE NUMBER ONE PRIORITY IN WATKINS-JOHNSON'S CASCADABLE AMPLIFIER PRODUCT LINE IS SUPERIOR PERFORMANCE AND QUALITY. Quality and reliability are designed and built in, not added on. Industry budget objectives are met through standardization, automation, and efficiency of operations, not by taking compromising short cuts in the design or manufacture of the product.

Our standard line of thin-film cascadable amplifiers is designed and manufactured to meet the reliability and screening requirements of MIL-M-38510 and MIL-STD-883 (Class B of test method 5008) for RF hybrid microcircuits. Standardization of product flows and high levels of quality monitoring allow the amplifiers to be manufactured with all the considerations desired for high-reliability applications.

The construction of the Watkins-Johnson Company amplifier series involves the highest levels of thin-film and hybrid microcircuit design and construction technology. The thin-film metalization is produced by using a computer-controlled, high-vacuum, multi-target RF sputtering system for both resistor and conductor metalizations. A residual gas analyzer is utilized for added process control on every run.

All conductor traces are gold metalization. The thin-film resistors are formed from tantalum nitride and are passivated at high temperatures to yield excellent long-term stability. The resistor composition is such that there is less than 150 ppm/°C of change in resistor value over the full operating temperature range.

Thin-film circuitry offers very precise control of resistor and circuit patterns. Thin-film inductors, etched on the substrate, yield a high degree of repeatability from unit to unit.

All RF transistors are bonded to the substrate using a specially developed gold/silicon eutectic die attach process. This process eliminates the need for scrubbing the thin-film gold and results in superior adhesion and more uniform contact which, in turn, gives better reliability and heat transfer.

The wire interconnects are made utilizing thermocompression and thermosonic gold-ball wire bonding processes. The RF die wire bonding equipment is custom designed by W-J to obtain superior quality over that produced by standard commercial bonders.

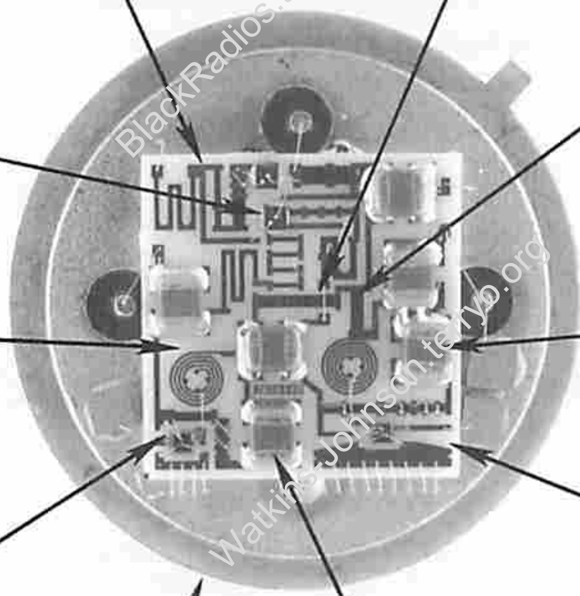
QUALITY AND RELIABILITY IS DESIGNED AND BUILT IN

Sputtered Gold Metalization
RF sputtered thin-film gold for optimum adhesion, repeatability, and conductivity.

Wire Bonds
All wire bonds are gold ball thermocompression or thermosonic to eliminate intermetallic failure modes.

Transistor Bonds
Gold transistor pads are not subject to corrosion and provide maximum reliability with gold wire interconnections by eliminating bimetallic interfaces.

Thin-Film Resistors
Stabilized and passivated tantalum nitride resistors giving high accuracy.



Thin-Film Inductors
Line resolutions typically within 0.2 mils for high circuit-to-circuit repeatability.

Capacitor Attach
Capacitors are attached using a reflow solder process under forming gas.

Substrate Attach
Polished alumina substrate is eutectically attached in a forming gas environment utilizing a gold/tin preform to provide excellent adhesion and ground plane contact.

Transistor Attach
All RF die are Au/Si eutectically attached with a specially developed process and equipment that results in superior adhesion and uniform electrical contact.

Package
High quality gold-plated kovar header with a hermetically welded solid nickle can.

Chip Capacitors
Ceramic chip capacitors provide minimum thermal expansion mismatch with the alumina substrate, preventing solder joint fatigue during power and thermal cycling.

PROGRAM MANAGEMENT AND ENGINEERING TEAM

DEDICATED PROGRAM SUPPORT IS THE RULE, NOT THE EXCEPTION

Watkins-Johnson's Cascadable Amplifier Product Line has a full-time staff of program managers and technical and administrative support personnel. This dedicated group has the experience and capabilities for supporting your program and high reliability needs. Every program and customer has an assigned program manager and engineer who is responsible for the proposal and for managing and carrying out all of the contract commitments. This continuity greatly minimizes risks, miscommunications, and customer costs. The specific responsibilities of the program management group include: customer support for program and technical needs; technical quality and engineering feedback to the standard product line; contract administration; program management; and customer interface during the contract.

1

PRODUCT LINE QUALIFICATION PROGRAM

In addition to quality conformance inspections performed for many of Watkins-Johnson's specific customer contracts, Group B, C and D inspections per Method 5008 (modified) of MIL-STD-883 are performed as an ongoing part of the product line's qualification program. These QCI inspections are an integral part of the MIL-STD-883 and MIL-M-38510 product line qualification requirements and provide generic data to satisfy many customer's program qualification needs without the normal expense. This data also provides an important source of technical feedback to the design and production departments where it is utilized to continually upgrade the quality of the product.

RELIABILITY OPTIONS

S Series

Watkins-Johnson Company's standard screened line of thin-film TO-8 amplifiers ("S Series") provides a cost and time effective approach to meeting the requirements commonly found on airborne applications and high MTBF ground equipment. The screening is per MIL-STD-883, Method 5008, as detailed on the following page. All standard TO-8 and TO-5 models are also available in the "S Series" version. These units also serve well in developmental phases of higher scope programs.

Custom Hi-Rel Programs

In applications involving more difficult software/system requirements and critical schedules, the Hi-Rel Engineering Group is available to establish and carry out all program requirements. As described above, they have extensive experience in supporting specialized and high-scope needs. This expertise can also supply screened cascaded amps with SMA connectors for high-reliability programs. Our experience includes extensive programs for full space requirements.

Standard Hi-Rel Options

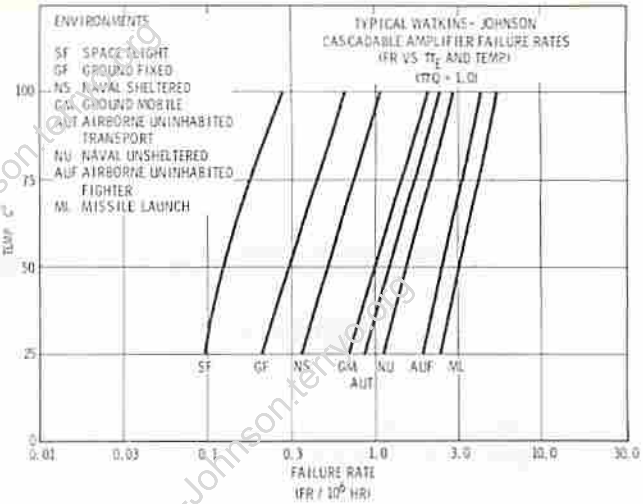
When requirements call for more than "S Series", cost and schedule can still be improved by taking advantage of our standard Hi-Rel options. Some of the many options that are available include: transistor SEM; screened piece parts; 100% nondestruct bond pull; preburn-in electricals; mechanical shock; X-ray; PIND; extended burn-in; delta calculations; and lot quality conformance testing (Groups A, B, C, and D).

Screened Piece Parts Program

Watkins-Johnson Company maintains a large standarized inventory of Hi-Rel screened piece parts because of our leadership in space programs and consequent large volume of Hi-Rel business. Three to five months of leadtime can be saved by utilizing this inventory. There is also the advantage of piece parts with a large extensive test data base and a proven record of reliability. The screening performed meets or exceeds the device evaluation requirements of S level screening of Method 5008. Amortization of the sample testing across the large quantities that are regularly processed maximizes cost effectiveness for high-level programs.

Typical Amplifier MTBF

Reliability is built into every Watkins-Johnson amplifier. The table to the right presents sample calculated MTBF predictions for a representative W-J TO-8 amplifier. The calculations are based on an S Series level of screening. Other amplifiers in the product line do not typically vary by more than a factor of 2. There are several variables in the MIL-HDBK-217 formula that are open to manufacturer's assumptions and interpretations. W-J's predictions are conservatively safe, and you can be assured that our design and manufacturing technology provide the best reliability available.



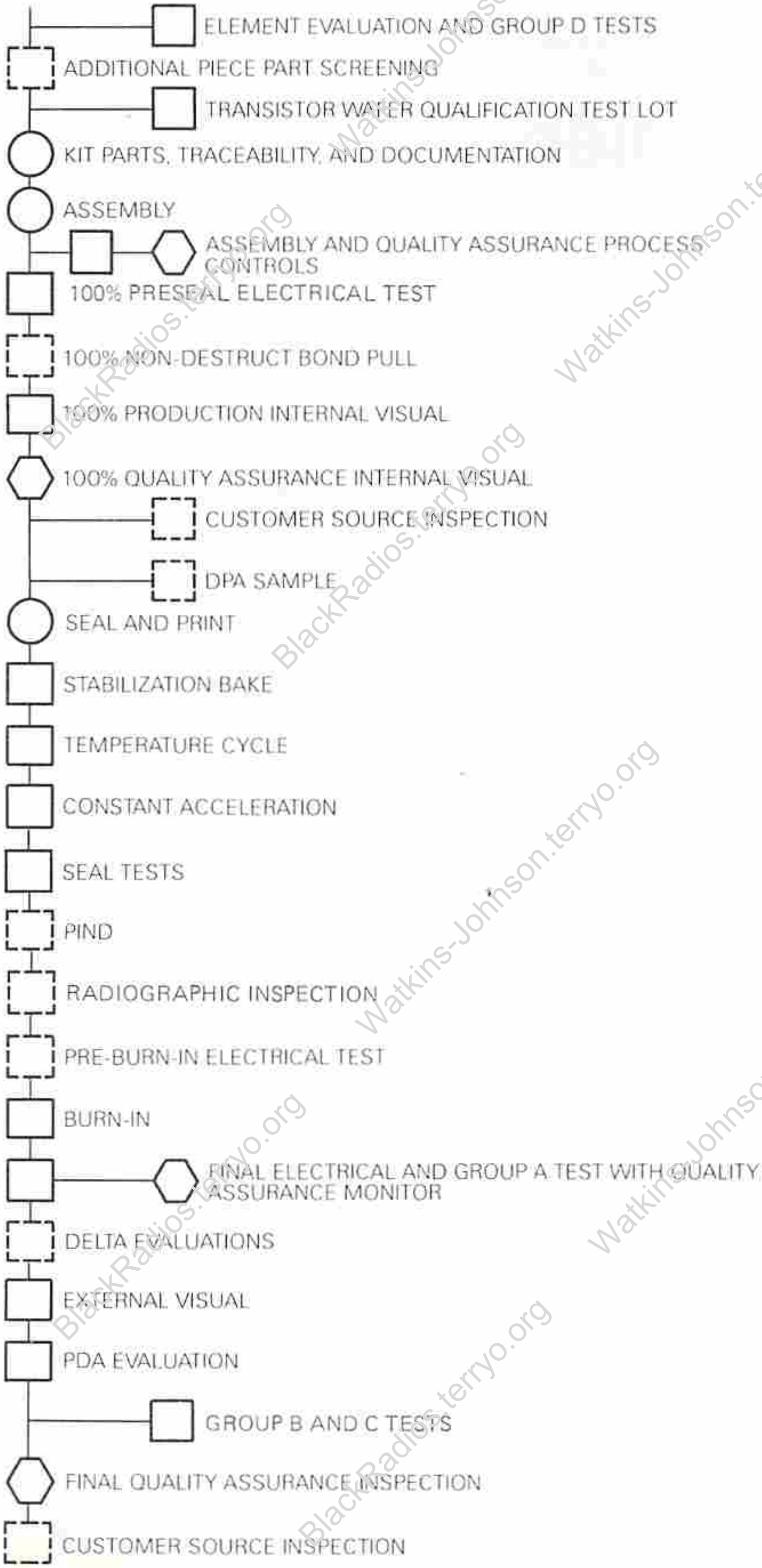
W-J "S Series" Screening (Methods refer to MIL-STD-883)[2]

Test	Method	Condition
Element Evaluation & Group D Test	5008	Sample[1]
Transistor Wafer Qualification Test Lot		Sample[1]
Process Control and Monitors	5008; 2011; 2019	Sample[1]
Preseal Electrical Test	Per Applicable Document	
Production Internal Visual	WJ-146505	100% B[1]
Quality Assurance Internal Visual	WJ-146505	100% B[1]
Stabilization Bake	1008	B; 24 hrs., +125°C
Temperature Cycle	1010	B; -55°C to +125°C
Constant Acceleration	2001	B; 10,000 g's, Y_1 axis
Seal Tests	1014	100%
Burn-In	1015	B; 160 hrs., T_C = +71°C to +125°C
Final Electrical and Group A Test	Per Applicable Document	
External Visual	2009	100%
PDC Evaluation	WJ-136948	
QCI-Group B and C Tests	5008	Sample[1]

NOTES:
1. As defined or modified by W-J standard procedures for microwave hybrid microcircuits.
2. The S Series screening process differs from MIL-STD-883, Class B as follows: 1) Internal visual inspection is performed in accordance with W-J 146505 instead of Method 2017; 2) Stabilization bake and temperature cycling are conducted per Condition B instead of Condition C of the respective methods; 3) Constant acceleration is conducted per Condition B instead of Condition E of Method 2001; and 4) The 96 hour time constraint between burn-in and final electrical testing per Method 1015 is not guaranteed.

MANUFACTURING AND SCREENING FLOW CHART FOR HIGH RELIABILITY PROGRAMS

OPTIONAL SCREENING BEYOND "S SERIES" ARE REPRESENTED BY DOTTED ENTRIES



Specifying High-rel Mixers and Amplifiers

While the subject of this article is a slight departure from that of the usual *Tech-notes* topic, it is, nevertheless, important to acquaint the reader with high reliability — a subject that is very much a part of the microwave industry. The specifying of high-reliability (hi-rel) items may sometimes be a mystifying process to vendor and equipment user alike, but it is important that designers, manufacturers, buyers and end users of microwave electronic equipment be aware of the various methods used to specify hi-rel products, what documented specifications entail in the way of testing, and the risks, in time and cost, of over- or under-specification. This article deals mainly with the specifying of mixers and RF hybrid amplifiers.

A hi-rel part is generally specified to ensure that its failure rate satisfies its intended use. The 1979 Environmental Stress Screening of Electronic Hardware Conference (ESSEH) concluded that failures could be mainly attributed to improperly constructed hardware and misapplication of the product. The goal of stress screening is to find flaws before a part is included in a sophisticated spacecraft, weapons system, or other high-performance electronic hardware. Since there is presently no universal standard for testing every type of microwave component and subsystem, and since there is no authoritative data base with which to compare test results, designers have developed their own set of rules and procedures from which are selected those that best describe the desired screening tests. These rules and procedures are often dictated by the designer's client and/or mandated by various military standards (MIL-STDs).

MIL-STDs have been established to standardize test methods and screening levels for general types of hardware (see Table 1). Unfortunately, they frequently become outdated or fail to cover a specific hardware type. Military standards are not "hard and fast" rules for testing, but, instead, are written to allow some latitude in the methods and levels of testing. For example, MIL-STD-883B, Method 5004.4 states: "This method establishes screening of microelectronics to assist in achieving levels of quality and reliability commensurate with the intended application."

There are three distinct levels of screening tests: Class S, Class B, and Class C. Class S represents the most stringent testing and Class C the least stringent. MIL-STD-883B, Method 5004.4, also states: "Since it is not possible to prescribe an absolute level of quality or reliability which would result from a particular screening level or to make a precise value judgment on the cost of a failure in an anticipated application. . .the method provides flexibility in the choice of conditions and stress levels to allow the screens to be further tailored to a particular source, product or application based on user experience."

MIL Specifications	Purpose and Application
MIL-STD-883 Test Methods and Procedures for Microelectronics	Standardizes environmental screens for IC's and hybrids and suggests series of tests for 100-percent screening and sample testing for qualification and production lot acceptance testing (QCI)
MIL-STD-202 Test Methods for Electronic and Electrical Parts	Standardizes environmental screens for general electronic components
MIL-M-38510 General Specification for Microcircuits	Establishes guidelines for hybrid physical design and the environment within which the hybrid is manufactured, including documentation
MIL-M-28837 General Specification for RF Mixers	Standardizes general requirements for RF mixers including manufacturing and qualification requirements
MIL-S-19500 General Specification for Semiconductor Devices	Defines product assurance levels for JAN, JANTX, JANTXV, and JANS semiconductor devices
MIL-HDBK-217C Reliability Prediction of Electronic Equipment	Provides formulas and data for calculating the failure rate/MTBF of electronic components and systems

Table 1. Primary mixer and hybrid amplifier military specifications.

Users Must Request Proper Screens

Users of hi-rel parts must provide the proper tailoring of screening methods and levels when making a hi-rel request. Often, a hi-rel request specifies more than is needed for the intended application, resulting in high costs for unnecessary screening. It was pointed out in the 1979 ESSEH that the manufacturer is in the best position to determine what screens will be most effective for his type of hardware. It is risky for a vendor to change his fabrication process simply to meet customer specifications. Such a change means a departure from familiar construction techniques to procedures whose results are not yet proven.

The customer should be flexible in his hi-rel requests. Also, a design engineer knowledgeable in hi-rel can be influential in determining realistic needs, and in making recommendations to both customer and manufacturer.

Screening and Reliability Relationships

A screening test causes a flaw to become a failure, but quality assurance and process control should be aimed toward preventing and finding potential failures before they enter the screening process. Screening increases the expected *mean time between failure (MTBF)* of the final product (see Figure 1), but at some level (point B), the return on investment begins to decline. The specifier must decide when the increased reliability warrants the added expense. Screening the completed items yields a higher return than testing piece parts (individual components) or subassemblies.

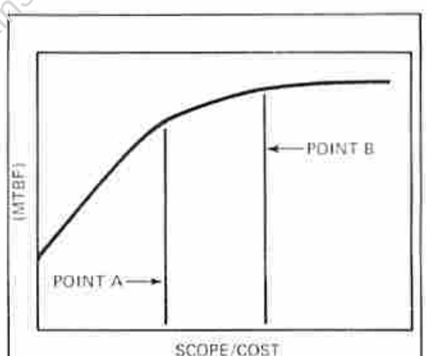


Figure 1. Screening increases the expected MTBF of the final product.

Overstressing a part can reduce its MTBF (see Figure 2). Screening tests which exceed the design limits of a piece of hardware may weaken some part of the assembly. The resulting MTBF figures fail to indicate the component's reliability in the intended environment, thus needlessly adding cost and time.

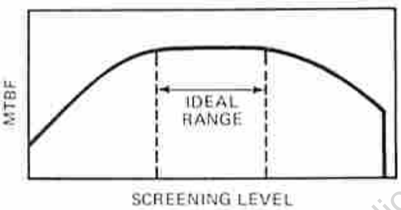


Figure 2. Overstressing a part can reduce its MTBF.

An optimum screening level exists for each hi-rel item, which will minimize total system cost (see Figure 3). A typical $100 part may require $50 in testing to reach point A, but an additional $250 to reach point B. The relationship shown in Figure 3 is similar to that shown in Figure 1, but determining the screening level also depends on the expense of locating and repairing a system failure, which includes lost business, reduced mission effectiveness and fixed overhead costs.

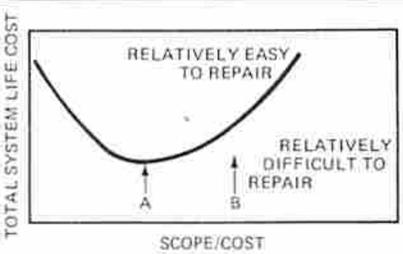


Figure 3. An optimum screening level exists for each hi-rel item, which will minimize total system cost.

Screening must maximize potential failures to control the cost of a hi-rel part. The proper sequence must be determined through empirical data developed by the vendor (see Figure 4). Also, costs can be minimized by using the vendor's in-house standards rather than implementing new and untried fabrication methods and test procedures.

Specifying Hi-rel Hybrid Microcircuits

The trend in the design of RF components and thin-film RF and microwave mixers is to use hybrid microcircuit construction and manufacturing techniques. These circuits, which are called MICs (microwave integrated circuits) by many manufacturers, are being procured with an increased interest in reliability. In spite of the well-established use of the hybrids, the best way to maximize cost/quality value while minimizing manufacturing and procurement cycles is still unknown.

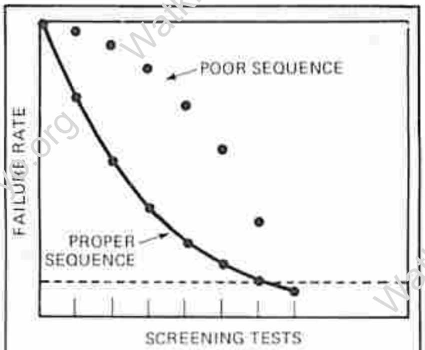


Figure 4. Screening must maximize potential failures to control the cost of a hi-rel part.

A hybrid microcircuit consists of a single-package electronic subsystem utilizing a substrate, with film interconnects and some film passive components, onto which unpackaged discrete active and passive components are attached. Low-frequency linear and digital hybrids have been popular since the late 1960's, even for nonmilitary applications.

Because of the microwave industry's specialized nature, it has been isolated from the general semiconductor component developments from which the hybrid has evolved. As a result, it has taken more time to adapt the new manufacturing technology. In addition, the design of hybrids for microwave applications are difficult to modify for optimum manufacturing. Unlike low-frequency components in which parasitic effects can be neglected, the performance of an MIC depends more on its physical configuration.

Today, most of the hurdles have been overcome and an increased number of new designs are using microcircuit techniques with increasing advantage and confidence.

Figure 5 shows a typical cascadable amplifier arrangement. Hybrids of this type are inherently more compatible with high-reliability applications than their printed-circuit counterparts. Most significantly, the number of interconnects (potential weak links in the reliability chain) is reduced by a factor of two to four. Furthermore, all of the components in a hybrid are in a small, common, hermetic package. The same production facilities used for a standard product line can also produce high-reliability units. The best manufacturing philosophy establishes a high-quality base on the standard line. Most high-reliability requirements should be able to be met through additional processing or testing rather than changes in the manufacturing procedures.

1

Hybrid Screening

Since the hybrid microcircuit extends from the semiconductor industry, two previous MIL-STD documents are used by all experienced hybrid customers and manufacturers: MIL-STD-883, "Test Method and Procedures for Microcircuits," and MIL-M-38510, "General Specifications for Microcircuits." Since "883" and "38510" provide such appropriate industry standards, less applicable documents (such as MIL-STD-202 and MIL-STD-

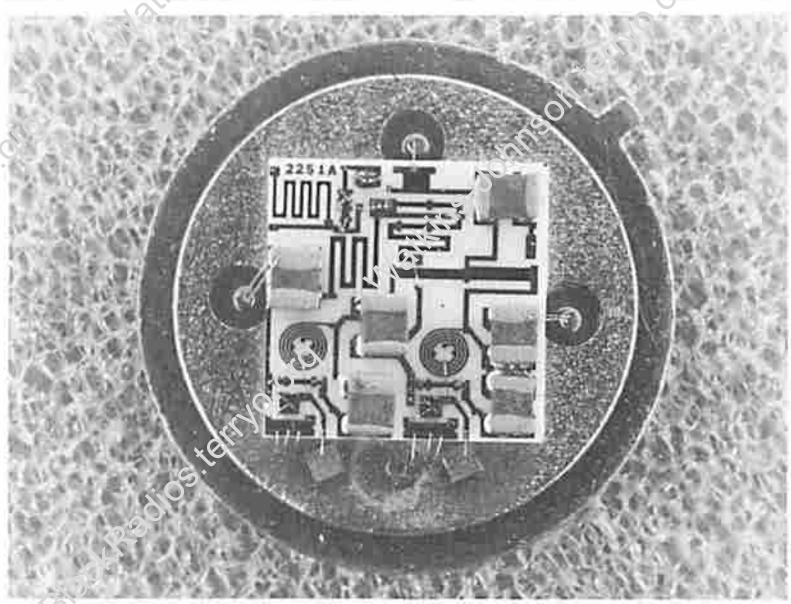


Figure 5. Typical cascadable amplifier arrangement.

750) merely add time and cost to the specifying/manufacturing cycle.

MIL-STD-883 compiles the many environmental tests, electrical tests, and process controls to which any semiconductor-based electronic component may be subjected to detect quality and reliability problems. Methods 5004 and 5008 of this standard suggest tests to be performed on a 100-percent basis (testing of each and every part) to screen potential failures. In particular, Method 5008, the more current section, is being adopted by the hybrid industry.

Ninety percent of all hi-rel hybrid microcircuits are currently screened to the Class B level of Method 5004 or 5008, with minor variations according to the specified product and application. Because of the widespread use of the hybrids and the resultant standardization of screening, both customer and manufacturer benefit with lower costs and better test correlation. For these reasons, the continued use of MIL-STD-883 is very important.

Screening, and monitoring of fabrication processes can be applied during three stages of production: on the individual parts (piece parts) that go into the assembly, during manufacture, and after a unit is sealed and functionally complete. The relative costs usually decrease for these successive stages, unless a well-identified yield or reliability problem exists that can be best addressed at a lower level.

Because the extremely small hybrid piece parts, such as silicon chip bipolar transistors (see Figure 6) and multilayer chip capacitors, have no attached leads or packages, screening at this level is very expensive. Due to the uniqueness of small, unpackaged and leadless devices, the customer needs to be especially well informed about the necessity of screen requirements at this level of manufacture.

Chip transistors can be tested by scanning electron microscope inspection, 100-percent visual inspection, 100-percent DC probing, visual and sheer-strength testing of die attachability, wire bonding test, and burn-in or life tests. The sample testing is performed on a wafer or on a wafer diffusion lot for qualification.

Chip capacitors can be screened by 100-percent electrical testing (dielectric withstanding voltage, insulation resistance, and dissipation factor), 100-percent visual inspection, and sample bondability testing. Life and burn-in tests can be performed, but these are expensive and time-consuming. Delamination and voiding problems can be detected through destructive physical analysis.

Piece-part screening usually extends schedules by three to five months. Since many programs cannot tolerate this type of delay, hybrid manufacturers should establish standard in-house specifications, for additional screening on their standard parts inventory, based on their customers' most common needs. They should also maintain an in-house stock of screened piece parts. Customers must assist by forecasting upcoming needs as early as possible.

Screening can also be applied during manufacture. This type of screening includes pre- and post-process destruct sample monitoring, and post-process, 100-percent nondestruct screening of component attachment and wire bonding. Hybrid manufacturers have a responsibility to provide their customers with an established level of process quality control based on the best known common denominator of customer needs. Screens which are more stringent than those established by the manufacturer will, therefore, be expensive.

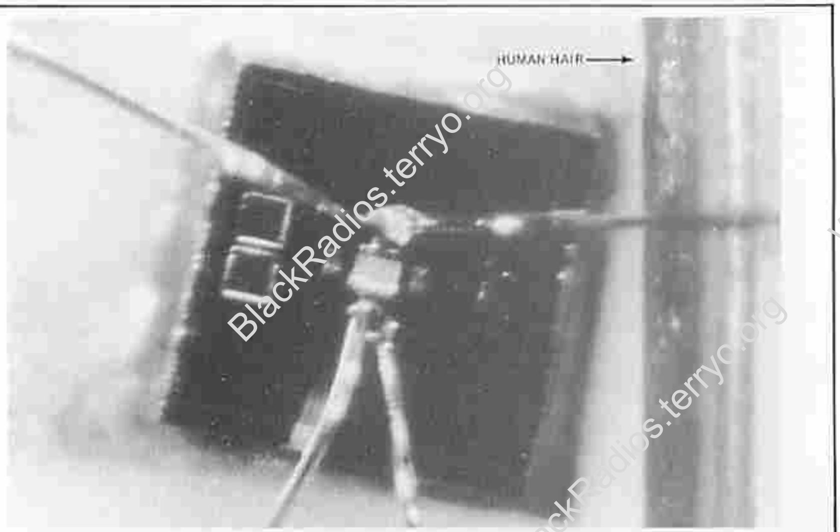


Figure 6. Because hybrid piece parts, such as silicon chip transistors, have no attached leads or packages and are extremely small, screening at this level is very expensive.

The third and best stage to screen a hybrid is after it has been sealed. Screening at this point produces the highest mean time before failure per dollar ratio. The most cost-effective screens are a manufacturer's own adaptation of Method 5004 or 5008 of MIL-STD-883 (as shown in Table 2).

Test	Method	Condition
Internal visual	2017	B modified
Stabilization bake	1008	B; 24 hrs. 125°C
Temperature cycle	1010	B; −55°C to +125°C
Acceleration	2001	B; 10,000 Gs, Y1
Seal, fine and gross	1014	A, C; 5×10^{-8} at mcc/sec
Burn-in	1015	B; 160 hrs. T_c = 85 to 125°C
Final electrical	App. Doc.	Per applicable document
External visual	2009	

Table 2. Typical RF hybrid basic screening per method 5008 of MIL-STD-883.

MIL-STD-883 leads to several standardized screens including: internal visual inspection, bake tests, temperature cycle tests, centrifuge tests, fine and gross leak tests, burn-in, and external visual inspection. Method 5004 states: "The user is cautioned to collect experience data so that a legitimate value judgment can be made with regard to the specification of screening level." Again, the manufacturer usually has the best experience data.

Although internal visual inspection is the only screen in this sequence prior to seal, it is performed after completion of an otherwise functional unit. Method 2017, the only appropriate MIL-STD internal visual specification for hybrid microcircuits, is comprehensively written for a "typical" unit. It must be modified and amended for unique piece parts and other aspects of specific applications. The detail specifications should call for internal visual inspection according to the manufacturer's approved standards in compliance with the intent of 2017.

Stabilization bake and temperature cycle tests are listed in Methods 5004 and 5008 with test condition level C (150°C and −65° to +150°C, respectively). Level A (75°C and −55°C to +85°C) or level B (+125°C and −55°C to +125°C) should be specified for most hybrids with multilayer chip capacitors or other large components, substrates and packages, and relatively hard attachment alloys.

The general screening levels, which were somewhat arbitrarily chosen for

MIL-STD-883, originally addressed only monolithic circuits which do not possess the special conditions of hybrids. Similarly, a suggested constant acceleration level of 30,000 G (Condition E) was originally selected only for stressing wire bonds on monolithics without large mass components. Hybrids should only be stressed at 5,000 or 10,000 G (Condition A and B, respectively). Excessive stress testing can actually reduce the MTBF of the components.

For cost considerations, pre-burn-in electrical tests should only be specified if a critical parameter drift is of concern. Burn-in temperature commensurate with a maximum operating junction temperature of the highest stressed active device must be selected. A typical burn-in time for hybrids is 160 hours (one week) the less common Class S level testing requires 240 hours!

Differences Between RF Hybrids and Non-RF IC's

It is vital to understand the electrical and manufacturing construction differences between non-RF integrated circuits and RF hybrids relative to cost and type of testing. For example, a lot of non-RF integrated circuits may only require 30 minutes for complete testing. One lot of 100 RF hybrids with a similar number of tested parameters and with customer-specified (rather than manufacturer standard) electrical testing takes two days of senior technician time plus supervision and engineering consultation. To maximize product value, customers should utilize the manufacturer's standard testing or, at least, carefully select the number and type of test points.

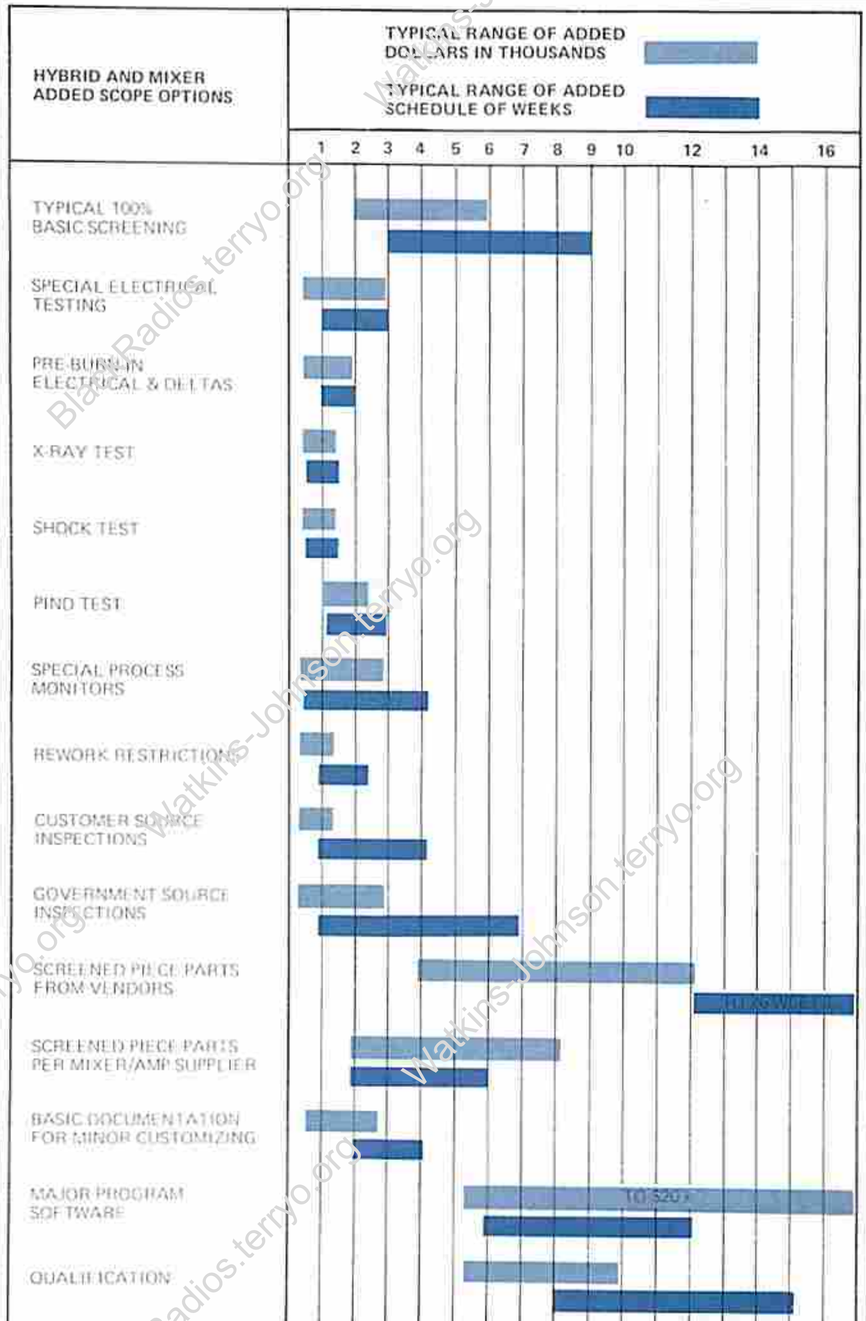
Radiographic (X-ray) inspection, which is specified by approximately 15 percent of RF hybrid users, is relatively inexpensive to perform but can produce very expensive yield losses, since radiographic detail may vaguely show possible flaws that will not affect the operation of the part under test. Strict adherence to X-ray inspection rejection standards will often cause many good parts to be scrapped. Since it can very effectively determine catastrophic damage occurring after internal visual inspection, X-ray testing is generally performed near the end of the screening sequence. Because of the ambiguous nature of X-ray images, the inspection parameters and accept/reject levels should be sparingly and carefully chosen. This exemplifies the need to prevent misapplication of standards which could result in a very poor MTBF return per invested dollar.

Particle impact noise detection (PIND) testing, one of the newest screens, is now being specified more often. PIND detects loose particles within sealed units by electronic monitoring through an acoustic coupler while the device is vibrated and mechanically shocked.

The buyer (customer) of electronics parts will sometimes request a *customer source inspection*, in which the buyer sends his own inspector to observe certain phases of the fabrication process and to inspect test data and observe the taking of test data.

Customer source inspection is recommended only when the buyer has no experience with a particular manufacturer's product or knows of recent problems that warrant monitoring. Government source inspection (similar to customer source inspection, but with government inspectors) seldom contributes to the quality of the product if customer source inspection has already been performed, and can significantly contribute to schedule delay and costs.

Table 3 summarizes the costs and schedule impact of most of the standard screens for both mixers and RF hybrid microcircuits. A detailed description of the screens and their purposes is shown in Table 4.



*Based on a typical lot of up to 75 shippable devices.

Table 3. Cost and schedule impact of standard screens (based on a typical lot of up to 75 shippable devices).

Stabilization bake
- A redistribution process for impurity atoms, following assembly and seal.
- Believed to be most effective when followed by thermal shock and burn-in.
- A low-cost screen.

Temperature cycle/thermal shock
- Temperature cycling allows for an ambient dwell period between extremes; thermal shock has no dwell period and induces higher stress.
- Intended to produce stress due to differences in thermal expansion of the materials in the assembly.
- Exercise solder joints, welds, bonds and package seals. Also test adhesive quality of interface between trace and dielectric material on microstrip/stripline designs.
- A low-cost screen.

Constant acceleration
- Hybrid screen to detect weak bonds, poor component mountings, and poor substrate attach.
- A moderate-cost screen.

Hermeticity
- For gross leak, a fluorocarbon immersion technique is used (1×10^{-5} atm cc/sec). For a fine leak, a helium tracer gas is detected with a mass spectrometer (1×10^{-8} atm cc/sec, typical).
- Both tests performed on hermetic designs to screen hardware which could have moisture or other package contaminants.
- A moderate-cost screen.

PIND testing (particle impact noise detection)
- Vibration of the packaging while monitoring both visually (oscilloscope) and audibly for loose particles inside the package.
- Sensitivity standards for particle size yet undefined in the industry and test results are frequently nonrepeatable and ambiguous.
- Detection of both conductive and nonconductive particles causes many reliable devices to be rejected.
- Discussion with the vendor recommended to determine program impact.
- A very expensive screen.

Mechanical shock
- Performed to demonstrate mechanical integrity and to verify design in worst-case handling conditions.
- Typically specified as a qualification test or sample test; may be considered a destructive test.
- An expensive screen.

High frequency vibration
- Demonstrates mechanical integrity; verifies ability of a design to withstand vibration levels encountered in aircraft, missiles, and tanks.
- Typically specified as a qualification test or sample test; may be considered a destructive test.
- A very expensive screen.

Random vibration (unmonitored)
- For lumped element and microstrip/stripline designs; very effective in locating weak solder joints and poor epoxy bonds.
- Specified in lieu of acceleration for lumped element and microstrip/stripline designs.
- A moderate-cost screen.

Burn-in
- Stresses the semiconductors, indicates parameter stabilization, and identifies marginal metallization defects and potential oxide shorts.
- Marginal units and infant mortalities detected in the electrical test following burn-in.
- A moderate-cost screen.

Radiographic inspection (X-ray)
- One radiograph taken and inspected for particles or contaminants (greater than a predefined diameter) and for cracked or broken connections and components.
- Radiographs verify adequate coverage of solder for chip and substrate attach.
- Either the vendor's certified inspector should perform the review or assist an inspector certified by the procuring agency.
- Value of test depends upon design, package, and seal techniques. (X-ray is often a cost driver due to subjectivity of the inspection, reduction in manufacturing yields and, therefore, higher unit costs.)
- Program impact and details of accept/reject criteria should be discussed with vendor.
- An expensive screen.

Table 4. Standard screening tests and their purposes.

Specifying Hybrid Microcircuits

The other appropriate document that should be applied in specifying hybrid microcircuits is MIL-M-38510. It establishes guidelines for the design and manufacturing environments. This specification is intended to be broad and comprehensive in its interpretation. The scope paragraph states: "Detail requirements, specific characteristics of microcircuits, and other provisions which are sensitive to the particular use intended shall be specified in the applicable device specification." Because of its general nature, MIL-M-38510 should never be specified without supplemental detail.

Interpretation of MIL-M-38510

Some areas of MIL-M-38510 frequently need further definition. Design is the first of these. Most hybrid manufacturers use epoxy in some stage of construction. MIL-M-38510 states: "No organic or polymeric materials shall be used inside the microcircuit package. . .unless otherwise specified." The supplier should not assume that his epoxy will be approved. The customer should state in his detail specification which epoxies can be accepted, and the supplier must state in his quotation what epoxy he proposes to use.

Paragraph 3.7.1 (Rework Restrictions) of MIL-M-38510 is frequently overlooked. A manufacturer rarely imposes MIL-M-38510 rework restrictions on his standard product line. Although most manufacturers will not experience a serious cost impact from the minor yield loss caused by such restrictions, the labor required to keep track of all the rework on unserialized and unsealed circuits can be substantial. This area should be addressed in some detail with the manufacturer before the specification is written.

Documentation helps maintain and insure reliability, but it can also create unnecessary additional costs if it isn't properly utilized and interpreted. More than $100,000 can be added to the average hybrid manufacturer's documentation system if MIL-M-38510 is directly and literally applied, because it is of such a general nature. Nevertheless, some hybrid customers consistently attempt to apply the full interpretation of MIL-M-38510 to contracts. In many cases, a customer only intends to use Appendix A (defines documentation requirements), which is a good general guideline. In such cases, the specificiation should state that the supplier's documentation should meet the general intent of Appendix A and "shall be subject to review and approval." That simple statement can save money, problems, and rebid cycles.

Qualification

Qualification (also called "first-article testing") requires a set of sample environmental tests, many of which are destructive, that establish the reliability of a design. Qualification of a product type can be accomplished in any of the following ways:

- A vendor can perform qualification testing before or during the delivery of the first product hardware.
- The procuring organization can perform qualification of the first production hardware before and/or after it is in the system.
- If qualification testing has been previously performed on the same or a similar design, the vendor can provide the procuring activity with a duplicate of or access to the data and history (qualification by similarity).

Qualification by similarity (which is specifically allowed by MIL-STD-883) represents the most cost- and schedule-effective approach to verifying mechanical and electrical integrity.

If new testing is definitely needed, sample sizes should be carefully discussed with the vendor, since hybrids can be two orders of magnitude more expensive than the monolithic ICs for which most of the traditional sample sizes have been established.

Nondestructive testing levels should be selected carefully and modified to be consistent with, and not to exceed, those chosen for 100-percent production acceptance screening. The specific tests performed in sample lot acceptance testing or quality conformance inspection can be similar, or even identical, to those performed in qualification. However, qualification is intended to verify a design, whereas sample lot acceptance testing identifies lot-oriented flaws resulting from production processes and materials.

Because of normal schedule constraints, hybrid production quality conformance inspection almost always serves to satisfy qualification requirements if qualification by similarity is unacceptable. Qualification and/or quality conformance inspection for amplifiers and mixer hybrids is performed according to MIL-STD-883, Method 5008, Groups A through D.

Group A, electrical testing, which frequently duplicates and occurs concurrently with final production electrical testing, is customized for the particular device and application. Groups B, C, and D are generally performed without major modification to the MIL-STD. Frequently, tests can be omitted to reduce costs; these should be discussed with the manufacturer before specifying. Included in the tests that may be omitted are PIND testing (Method 2020), internal water-vapor content (Method 1018), and salt atmosphere testing (Method 1009).

Specifying Hi-rel Mixers

Because of the variety of military/OEM (original equipment manufacturer) systems applications which employ RF and microwave mixers, a great demand has developed for high-reliability programs of vastly varying scope. Several approaches may be selected for hi-rel RF and microwave mixer programs for the military/OEM market:

- "Off-the-shelf" catalog products can be screened to customer requirements ("screened standard").
- A catalog design can be specified with hi-rel manufacturing controls (including assembly by certified personnel) and screening.
- A custom design can be specified with hi-rel manufacturing controls and screening.
- Mixers can be specified according to MIL-M-28837.

The first, screened-standard option offers quickest delivery at the lowest cost. In many cases, the catalog model may be a stock item and only lead time (generally, the length of time from when an item is ordered to the time that it is shipped) for the specified environmental screening and/or selected electrical testing will be required. Costs of the screened-standard option consist of the catalog model unit price, plus the yield factor (associated with the screening or the electrical selection) and a lot charge determined by the magnitude of the screening program. Lot charges can range from $2,000 to $5,000 and are often amortized over the quantity of units in a screening lot. Deliveries of screened catalog items can range from four weeks (if the item is in stock) to nine weeks.

A hi-rel program utilizing a catalog design, the second program option, offers the customer a wide range of flexibility. If a reliability-proven catalog design can be used, all other aspects of the program can be tailored to the needs of the customer. A hi-rel specialist can recommend the most effective screening options, and a program can be proposed to meet the cost, delivery, and performance guidelines specified. In some cases, trade-offs on specified performance versus cost and delivery are considered, and a unique program is defined to meet critical requirements.

The magnitude of the hi-rel program, including cost and delivery, is determined by any or all of the following factors:

- Utilization of screened internal components.
- Hi-rel assembly by certified assemblers at laminar flow benches (work benches with a filtered air system) in a controlled area.
- Hi-rel documentation (i.e., acceptance and qualification test documents, assembly procedure, electrical test procedure, screened internal component, etc.).
- Design reviews.
- Customer and government source inspections.
- Acceptance testing.
- Qualification testing.

Specifying screened internal components has a major impact on cost and delivery. For example, hi-rel diode quads which are used in many mixers, can range from $75 to $175 in small quantities, and require lead times from 12 to 20 weeks. Recently, lead times on "special" order or hi-rel SMA connectors have become extremely high, requiring up to 30 weeks. If screened internal components are required, delivery of the mixers can range from 24 to 30 weeks after completion of acceptance testing (excluding "special" connector procurements).

If a customer requires mechanical and/or electrical characteristics which cannot be satisfied by a catalog design, a custom design (the third program option) can be proposed. This option is constrained by the high cost and long lead time associated with new designs and prototype tooling and machining. A risk factor is also involved with qualifying a new design. A custom design can require 6 to 12 months for first-article delivery, and nonrecurring engineering (NRE — a one-time design cost) charges can run $15,000 to $30,000 or more. Any or all hi-rel options of a preestablished design are also available with a custom design.

The MIL-M-28837 mixer specification has fostered the fourth program option. Since the military system designer must use MIL standard parts when available, a military specification to govern the design and performance characteristics of RF and microwave mixers has been needed. With the availability of MIL-M-28837 (which includes addendums or "slash sheets" to detail the mechanical and electrical characteristics for each previously-provided mixer), the system designer can specify any existing component and be assured that a nonstandard parts request will not be required. Unfortunately, MIL-M-28837 is very new and the Defense Electronics Supply Center (DESC), which governs vendor qualifications, has only recently authorized manufacturers to begin qualification of various slash-sheet products. Therefore, *no vendor* currently has mixers qualified under MIL-M-28837.

Although qualified "off-the-shelf" devices are not yet available, a customer can specify: "The subject mixer shall be capable of meeting the requirements of MIL-M-28837." A nonstandard parts request must continue to be submitted to the military for any mixer not qualified to an existing slash sheet or having its own slash sheet.

In summary, MIL-M-28837 will provide end users and manufacturers with the following advantages:

- An option to procure qualified parts without nonstandard parts request — saving time, dollars and effort.
- Eventual "off-the-shelf" availability of MIL-M-28837 qualified screened or unscreened mixers.
- An industry standard for mixers allowing specification uniformity.
- Lower costs due to higher volume of standard units and deletion of qualification testing.
- "Plug-in" replacement availability from all qualified vendors.
- Elimination of "special" procurement documentation and associated cost.

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Mixer Design Technologies

The three mixer design technologies now available in industry vary in frequency capabilities. In some cases the technologies can be interchanged to produce performance as well as reliability advantages, but the recommended screening for each will remain quite different. The most effective screening program is not only determined by the system environment, but also by the design technology used.

Lumped element mixers with toroidal transformers are applied at frequencies below 3 GHz (see Figure 7). One or two monolithic diode ring quads (hermetic or epoxy encapsulated) are combined with discrete resistors, capacitors, and diodes. This type of mixer is constructed in a variety of packages with highly adhesive, low-outgassing epoxies, and has bi-, tri-, or quadfilar wired assemblies. MIL-STD-202 screening is most applicable to this technology.

Microstrip and stripline mixers find application between 3 and 18.5 GHz (see Figure 8). The low-loss, printed

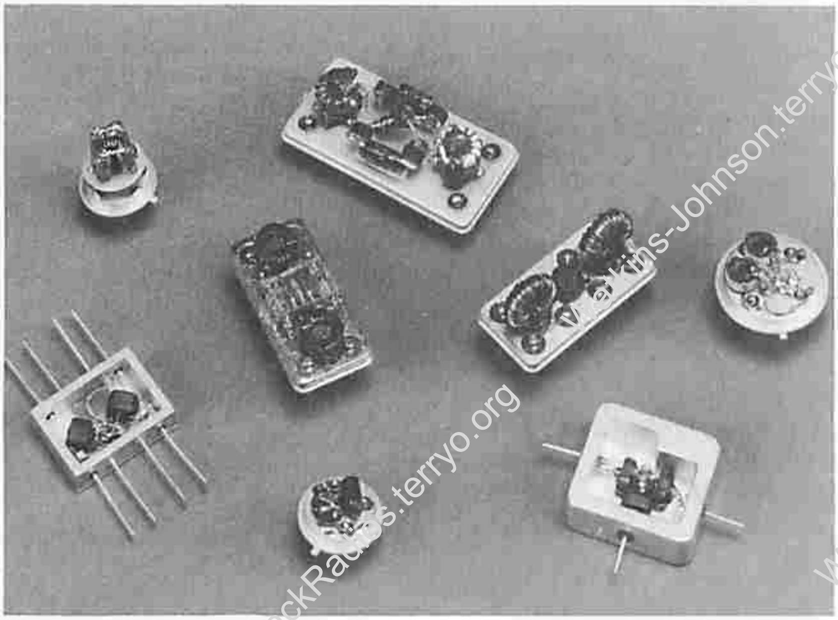


Figure 7. Lumped element mixers with toroidal transformers are applied at frequencies below 3 GHz.

transmission lines offer consistent circuit repeatability. One or two monolithic diode quads are used, each in epoxy-encapsulated or hermetically sealed ceramic packages. Since this construction uses fewer components and solder connections, it produces higher MTBF than lumped element designs. Highly adhesive, low outgassing epoxies are used in the microstrip/stripline as well as the coaxial packages. MIL-STD-202 is also appropriate for screening these mixers.

Thin-film technology produces mixers for use between 10 MHz and 18.5 GHz with the lowest loss characteristics and the highest circuit repeatability (see Figure 9). Below 3 GHz, designs usually include a ceramic (alumina) substrate with printed tantalum nitride resistors, chip capacitors and diodes, and toroidal coupling. Such mixers use solder reflow or gold epoxy for component attachment, and TO-8 or flatpack hermetic packaging.

At higher frequencies, alumina (3 to 18.5 GHz) and quartz (above 8 GHz) substrates are used and are brazed to a gold-plated carrier assembly. Beam lead diodes and capacitors predominate and are attached through thermocompression. The carrier assembly is normally housed in a nonhermetic coaxial housing with SMA connectors. Of the three technologies, thin film requires the highest investment and the longest lead times. It is covered by MIL-STD-833.

Because of the significant differences in mixer design technologies, one screening program can't suffice for all devices. With the exception of thin-film mixers, all other designs adapt directly to MIL-STD-202 ("Test methods and procedures for microelectronics"). The earlier screening discussion for thin-film hybrid products applies to thin-film mixers as well.

In addition to improperly specifying MIL-STD-883 for lumped element and microstrip/stripline mixers, there are several other misconceptions concerning high reliability screening for mixers.

Time and money can be saved by adhering to the following suggestions:

- Don't specify hermeticity, humidity, and salt spray tests on nonhermetic packages.
- Don't specify fine-leak hermeticity testing on packages with coaxial (SMA) connectors. (There are solutions to this problem; discuss this with the vendor before specifying.)
- Recognize that utilization of connectors greatly reduces MTBF.
- Realize that most mixer designs are not repairable. (Discuss this matter with the vendor before specifying repair clauses.)
- Don't specify burn-in with an RF source due to the cost impact of commiting expensive test equipment. (A burn-in requirement can be easily satisfied by injecting a 60-Hz signal into the I port of the mixer. While the diodes are repeatedly switched on and off, the junction is heated to the maximum recommended temperature.)
- Don't specify large samples for "destructive" testing. A typical sample of two units serves to verify design integrity while minimizing costs.
- Don't specify operating temperatures above 100°C. (Most mixer designs carry a 100°C maximum operating temperature with maximum storage temperatures to 125°C. However, for ease of specification, a 100°C maximum for storage and operating is common.)

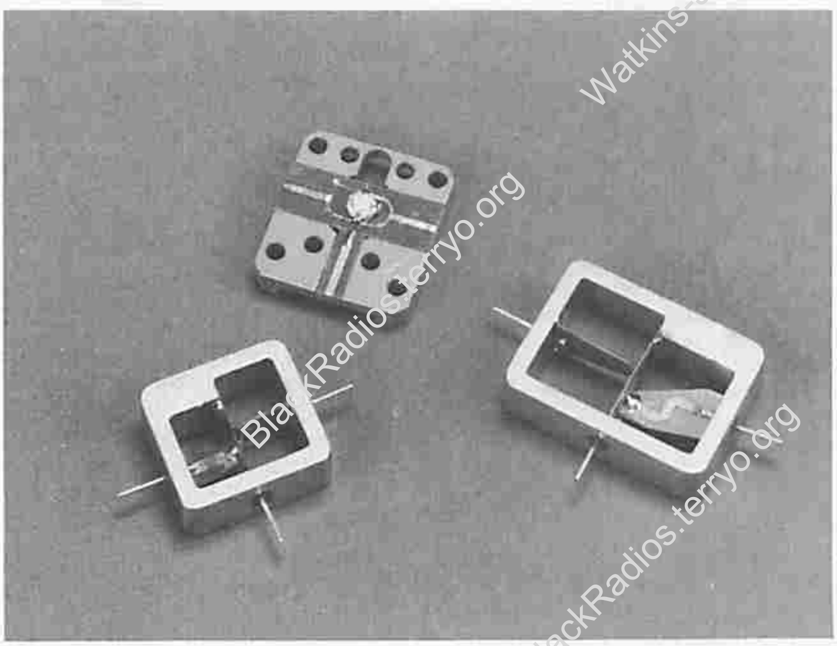


Figure 8. Microstrip and stripline mixers find application between 3 and 18.5 GHz.

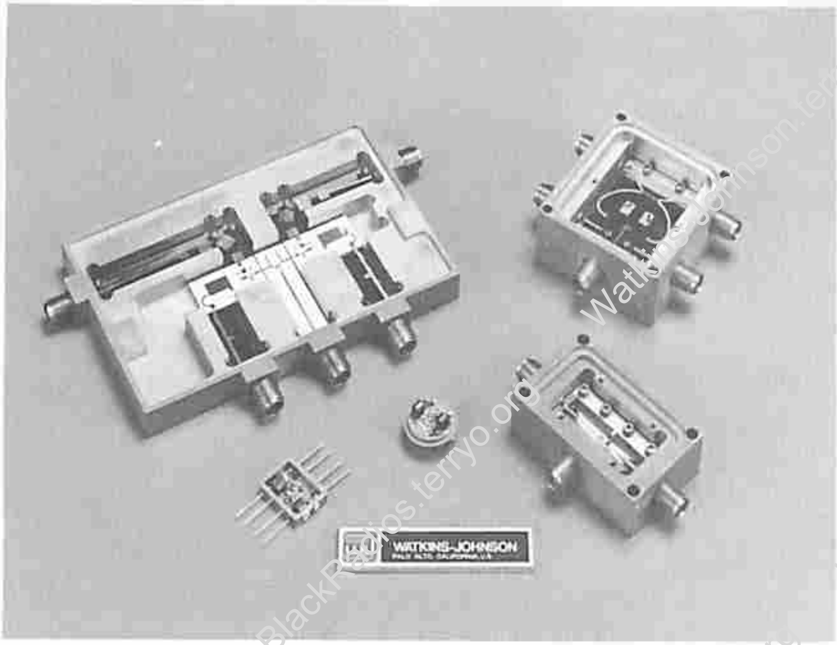


Figure 9. Thin-film technology produces mixers for use between 10 MHz and 18.5 GHz.

1

- Don't specify acceleration tests for the lumped element or microstrip/stripline technologies unless truly applicable. (In most cases, vibration is a much more effective and applicable screen.)

Mixer Tests Undefined

No military test specification exists which clearly defines qualification and acceptance tests for lumped element and microstrip/stripline mixers. Although MIL-STD-202 delineates many screening tests applicable to mixers, this specification was not prepared specifically with mixers in mind. Consequently, numerous discrepancies are created when only test conditions guide general specifications, they must be modified for different designs and environments.

As stated earlier, qualification testing is performed specifically to demonstrate design integrity, while acceptance testing (Group A) demonstrates lot integrity. If specified, temperature (Group B) and mechanical (Group C) tests are performed for proving lot acceptability.

Qualification tests can cost from $5,000 to $10,000 and involve lead times from 10 to 15 weeks. The costs of acceptance testing (through Group A) typically ranges from $3,000 to $6,000, with the magnitude of the electrical test program determining the higher cost. Delivery upon completion of Group A testing requires five to seven weeks after completion of assembly, pre-seal visual inspection, electrical testing, and seal. Group B and Group C testing can add $4,000 to $6,000 to the cost, depending on the extent of the electrical and mechanical screening, and requires another five weeks following completion of Group A.

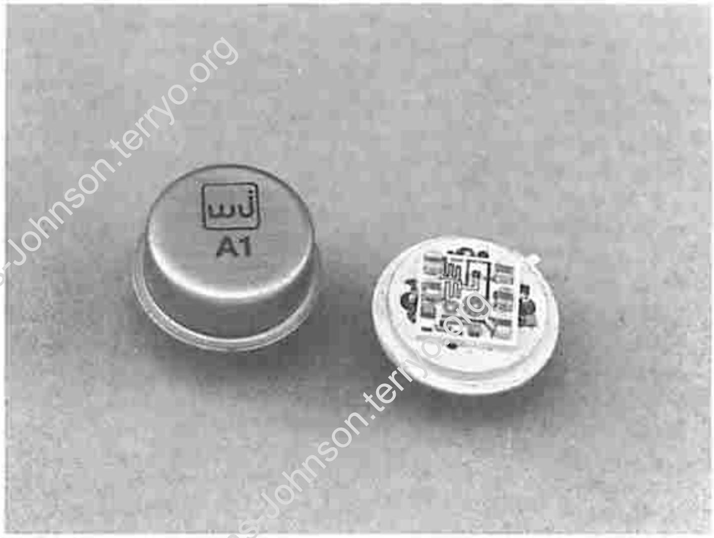
Cascadable Amplifier Technical Data Sheets

1

WJ-A1

5 TO 500 MHz
TO-8 CASCADABLE AMPLIFIER

- LOW NOISE: 2.4 dB (TYP.)
- LOW VSWR: 1.3:1 (TYP.)
- HIGH GAIN: 16 dB (TYP.)



Specifications *

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	1-600 MHz	5-500 MHz	5-500 MHz
Small Signal Gain (Min.)	16 dB	15 dB	14.5 dB
Gain Flatness (Max.)	±0.2 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	2.4 dB	3.0 dB	3.5 dB
Power Output at 1 dB Compression (Min.)	-1.0 dBm	-2.0 dBm	-3.0 dBm
VSWR (Max.) Input/Output	1.3:1	1.8:1	2.0:1
DC Current (Max.) at 15 Volts	9 mA	11 mA	12 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +15 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +10 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +11 dBm (Typ.)

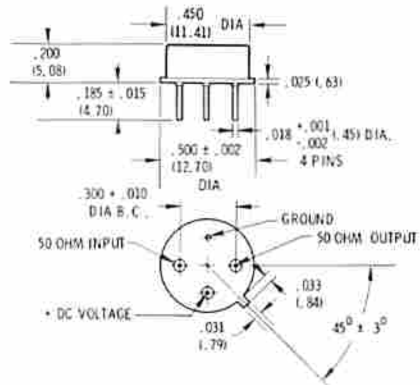
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +18 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . 50 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

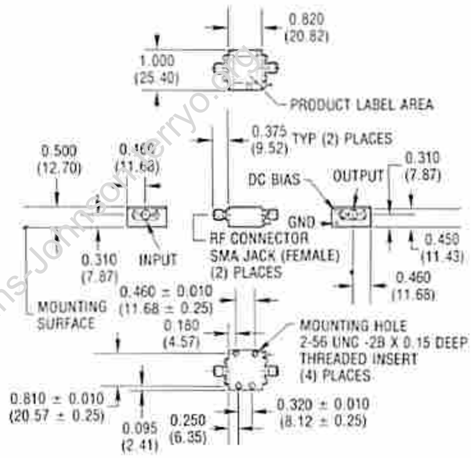
Outline Drawings

A1



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA1

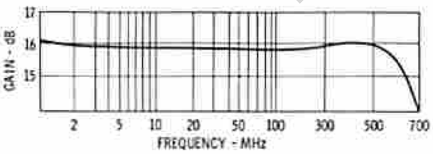


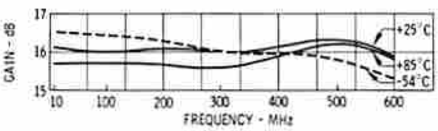
DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

*WJ CA1 is standard WJ A1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

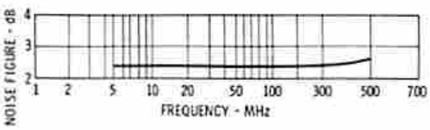
Typical Performance at 25°C

Gain

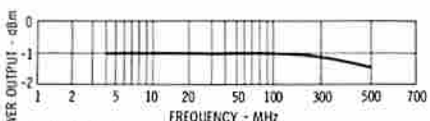




Noise Figure

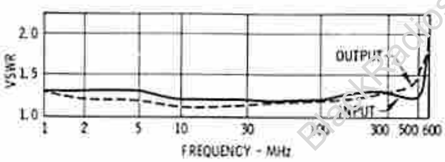


Power Output*



*at 1 dB Gain Compression.

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.2	16.0
200.	1.3	1.2	16.1
300.	1.3	[illegible]	16.0
400.	1.2	[illegible]	16.1
500.	1.1	1.3	16.3
600.	2.1	1.9	15.9

Linear S-Parameters

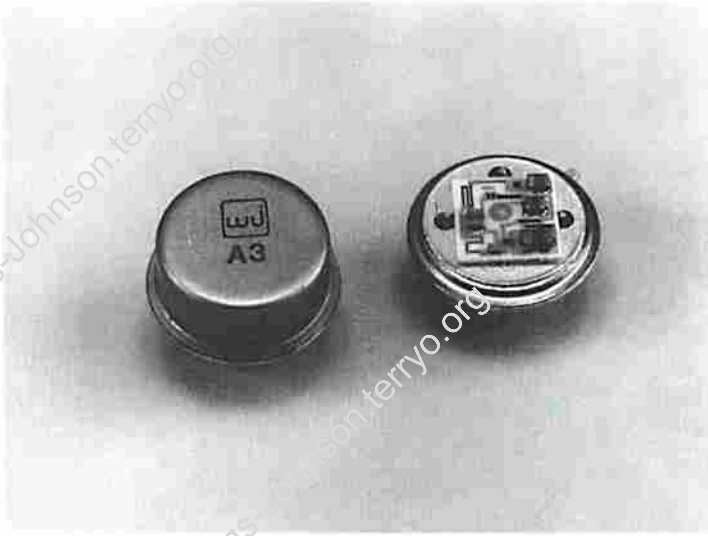
FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.06	94.1	6.33	146.7	.10	-13.1	.08	-151.5
200.	.11	51.8	6.38	118.2	.10	-19.6	.10	-146.9
300.	.14	21.9	6.31	90.6	.10	-30.4	.12	-165.3
400.	.09	-18.1	6.38	61.0	.10	-42.8	.15	161.1
500.	.06	166.8	6.57	24.7	.12	-58.8	.20	109.3
600.	.36	100.7	6.23	-21.4	[illegible]	-81.2	.31	49.1
700.	.67	50.6	4.34	-69.2	.11	-108.3	.40	-8.2
800.	.79	14.9	2.45	-102.5	.08	-125.7	.41	-50.9

1

WJ-A3

5 TO 500 MHz TO-8 CASCADABLE AMPLIFIER

- LOW NOISE: 3.3 dB (TYP.)
- LOW VSWR: 1.3:1 (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C – +85°C
Frequency (Min.)	4-550 MHz	5-500 MHz	5-500 MHz
Small Signal Gain (Min.)	15.5 dB	14 dB	13.5 dB
Gain Flatness (Max.)	±0.2 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	3.3 dB	4.0 dB	4.5 dB
Power Output at 1 dB Compression (Min.)	-1.0 dBm	-2.0 dBm	-3.0 dBm
VSWR (Max.) Input/Output	1.3:1	1.7:1	2.0:1
DC Current (Max.) at 15 Volts	9 mA	11 mA	12 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +17 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +12 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +11 dBm (Typ.)

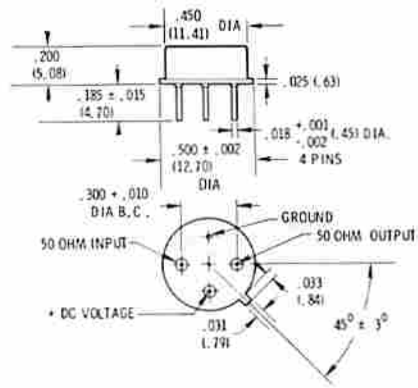
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +18 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . 50 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

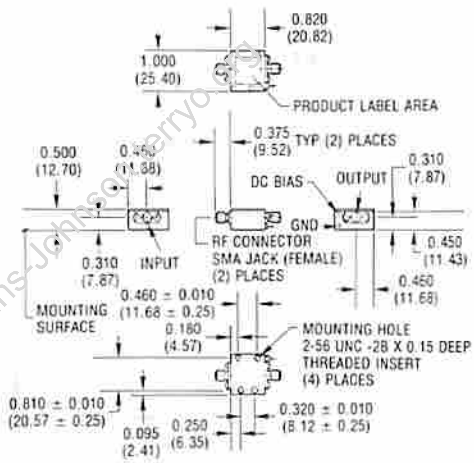
Outline Drawings

A3



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

CA3

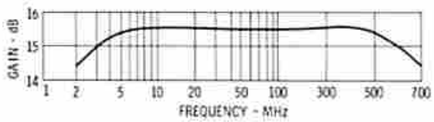


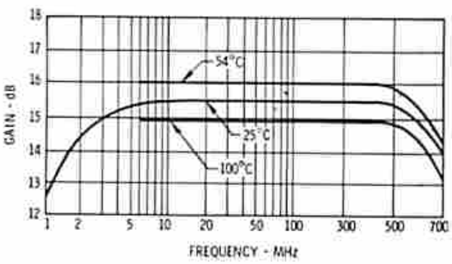
DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

*WJ CA3 is standard WJ A3 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

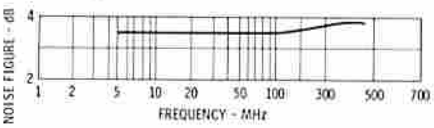
Typical Performance at 25°C

Gain

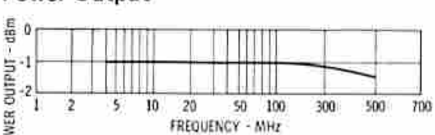




Noise Figure

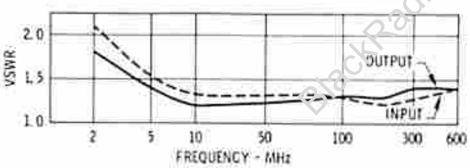


Power Output*



*at 1 dB Gain Compression.

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.3	1.3	15.2
200.	1.2	1.3	15.2
300.	1.3	[illegible]	15.2
400.	1.3	[illegible]	15.1
500.	1.4	1.4	15.0
600.	1.4	1.4	14.7

Linear S-Parameters

FREQ MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.11	152.5	5.78	154.4	.10	-4.3	.12	128.7
200.	.11	102.6	5.76	132.2	.10	3.5	.15	88.7
300.	.12	69.6	5.73	111.1	.11	.1	.18	65.0
400.	.13	42.9	5.71	88.5	.11	-3.6	.18	48.6
500.	.15	12.3	5.64	62.9	.12	-7.3	.17	45.9
600.	.16	-15.8	5.46	33.3	.13	-11.0	.18	63.0
700.	.15	-35.6	4.87	2.2	.13	-16.7	.32	65.8
800.	.14	-54.1	3.84	-28.2	.14	-23.5	.47	51.5

1

WJ-A5

5 TO 500 MHz
TO-8 CASCADABLE AMPLIFIER

- FLAT BANDWIDTH: < ±.3 dB (TYP.)
- LOW VSWR: < 1.2 INPUT, < 1.5 OUTPUT (TYP.)
- WIDE POWER SUPPLY RANGE: +8 TO +20 VOLTS
- WIDE TEMPERATURE RANGE: -54°C TO +100°C

Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +100°C
Frequency (Min.)	3-550 MHz	5-500 MHz	5-500 MHz
Small Signal Gain (Min.)	14.8 dB	14 dB	13.5 dB
Gain Flatness (Max.)	±0.2 dB	±0.7 dB	±0.7 dB
Noise Figure (Max.)	4.5 dB	5.5 dB	6.0 dB
Power Output at 1 dB Compression (Min.)	+8.5 dBm	+7 dBm	+7 dBm
VSWR (Max.) Input/Output	1.3:1	1.8:1	2.0:1
DC Current (Max.) at 15 Volts	25 mA	28 mA	30 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

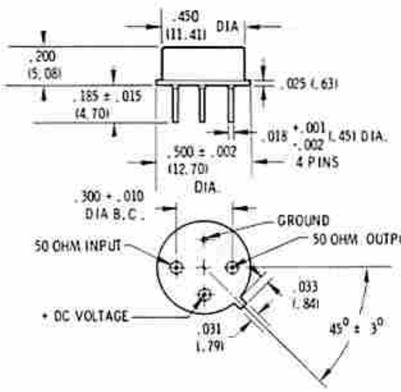
Second Order Harmonic Intercept Point . . . . +41 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +36 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +22 dBm (Typ.)

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +21 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . 50 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-in Temperature (Case) . . . . 125°C

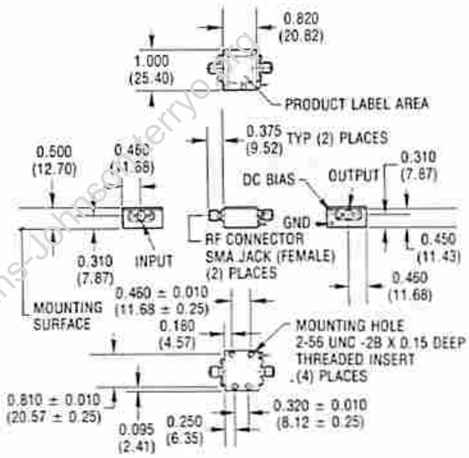
Outline Drawings

A5



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA5



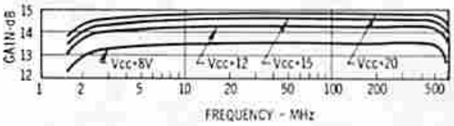
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

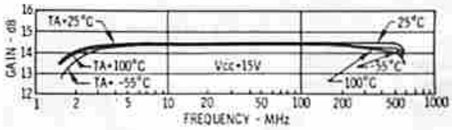
*WJ CA5 is standard WJ-A5 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Weight approximately 2.0 grams (0.07 oz.)

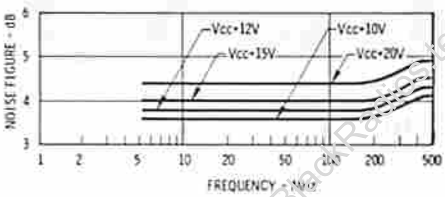
Typical Performance at 25°C

Gain

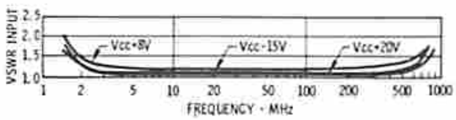




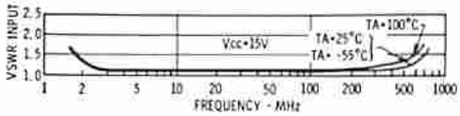
Noise Figure



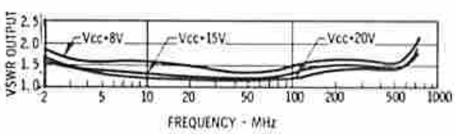
Input VSWR



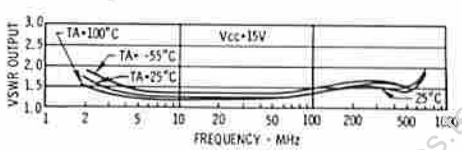
Input VSWR Over Temperature



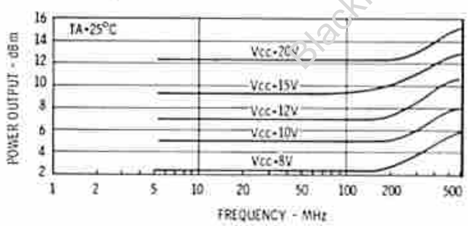
Output VSWR



Output VSWR Over Temperature

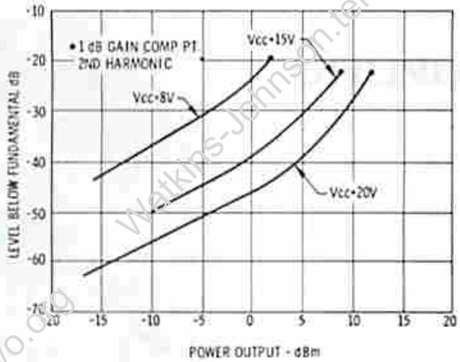


Power Output*

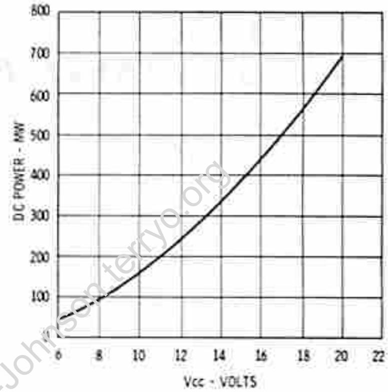


*at 1 dB Gain Compression

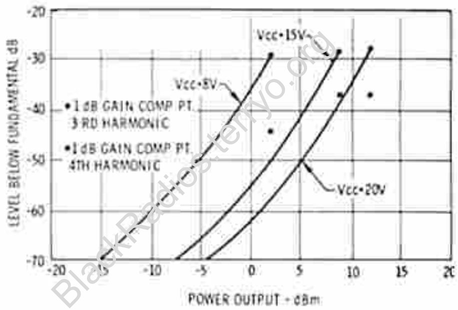
Second Harmonic Suppression vs. Power Out



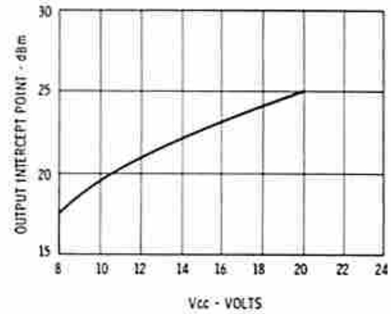
DC Power Drain vs. Supply Voltage



Third Harmonic Suppression vs. Power Out



Two-Tone Third Order Output Intercept Point vs. Supply Voltage



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Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.2	14.7
200.	1.1	1.4	14.9
300.	1.1	1.5	14.8
400.	1.3	1.4	14.8
500.	1.4	[illegible]	14.7
600.	1.4	1.3	14.3

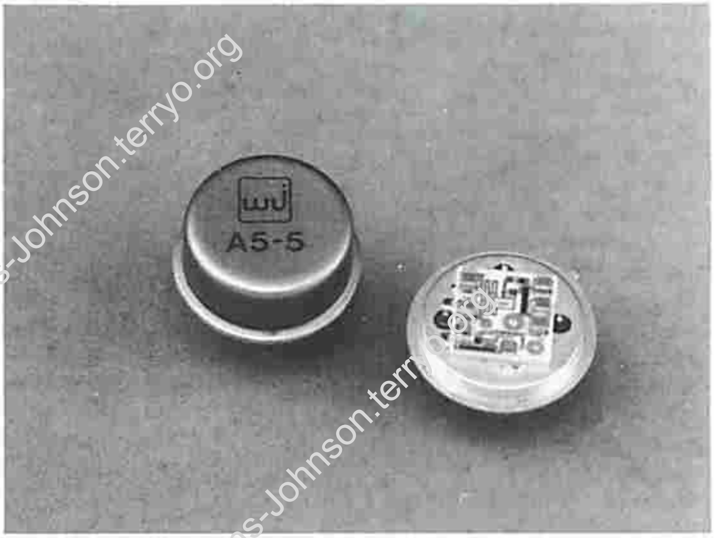
Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.03	-153.2	5.44	153.1	.10	-1.5	.11	11.5
200.	.03	-111.3	5.54	128.7	.11	-2.6	.15	.1
300.	.07	-72.4	5.52	105.1	.11	[illegible]	.18	-18.4
400.	.12	-76.7	5.48	80.3	.12	-7.9	.17	-44.4
500.	.17	-90.3	5.41	52.3	.13	-15.0	.13	-89.6
600.	.18	-99.6	5.17	19.3	.14	-22.2	.14	170.8
700.	.17	-96.4	4.44	-15.4	[illegible]	-30.5	.31	104.5
800.	.21	-83.5	3.33	-49.7	.14	-38.8	.47	61.0

WJ-A5-5

5 TO 500 MHz
TO-8 CASCADABLE AMPLIFIER

- FLAT BANDWIDTH: ±.1 dB (TYP.)
- LOW VSWR: 1.2:1 (TYP.)
- WIDE POWER SUPPLY RANGE: +8 TO +15 VOLTS
- EXCELLENT PHASE LINEARITY: < ±.8° (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	1-650 MHz	5-500 MHz	5-500 MHz
Small Signal Gain (Min.)	15.5 dB	14 dB	13.5 dB
Gain Flatness (Max.)	±0.1 dB	±0.5 dB	±0.7 dB
Noise Figure (Max.)	4 dB	5 dB	5.5 dB
Power Output at 1 dB Compression (Min.)	+9 dBm	+7 dBm	+7 dBm
VSWR (Max.) Input/Output	1.2:1	1.5:1	1.6:1
DC Current (Max.) at 15 Volts	24 mA	27 mA	29 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +42 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +38 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +21 dBm (Typ.)

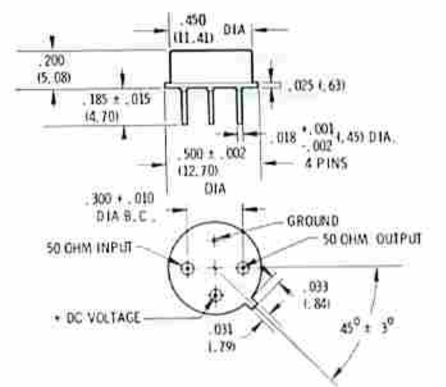
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . 50 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

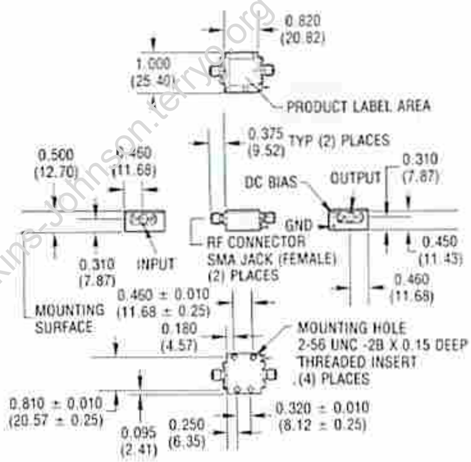
Outline Drawings

A5-5



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .005 (.13) UNLESS OTHERWISE SPECIFIED

CA5-5

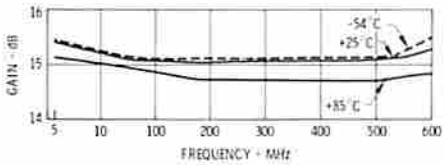


DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

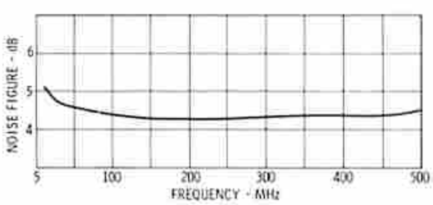
*WJ CA5-5 is standard WJ A5-5 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

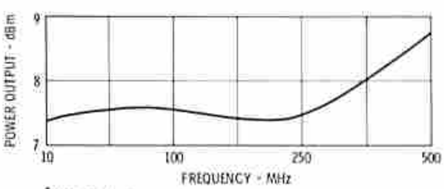
Gain



Noise Figure

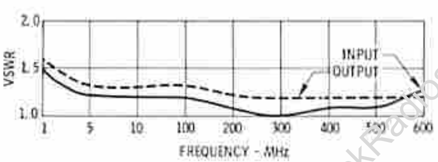


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.3	15.2
200.	1.1	1.2	15.2
300.	1.0	1.2	15.3
400.	1.1	1.0	15.3
500.	1.1	1.2	15.4
600.	1.3	1.2	15.4

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.08	166.4	5.75	157.3	.10	-8.2	.13	158.1
200.	.06	140.8	5.77	137.0	.09	-11.7	.11	138.3
300.	.02	111.3	5.82	118.6	.09	-17.9	.09	114.9
400.	.03	-44.3	5.82	99.7	.09	-25.0	.09	92.6
500.	.07	-80.8	5.86	80.2	.09	-32.1	.09	74.0
600.	.12	-104.4	5.91	57.9	.09	-38.6	.08	64.1
700.	.17	-131.8	6.08	34.5	.09	-45.6	.08	69.3
800.	.22	-161.7	6.11	8.6	.09	-53.2	.10	74.8

1

WJ-A5-6

5 TO 600 MHz
TO-8 CASCADABLE AMPLIFIER

- FLAT BANDWIDTH: ±.2 dB (TYP.)
- LOW VSWR: 1.3:1 (TYP.)
- WIDE POWER SUPPLY RANGE: +8 TO +15 VOLTS

Specifications*

Characteristics	Typical	Guaranteed 0° -50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	1-700 MHz	5-600 MHz	5-600 MHz
Small Signal Gain (Min.)	16.0 dB	15.0 dB	14.5 dB
Gain Flatness (Max.)	±0.2 dB	±0.7 dB	±0.7 dB
Noise Figure (Max.)	4.5 dB	5.5 dB	6.0 dB
Power Output at 1 dB Compression (Min.)	+8.5 dBm	+7 dBm	+6.5 dBm
VSWR (Max.) Input/Output	1.3:1	1.8:1	2.0:1
DC Current (Max.) at 15 Volts	24 mA	27 mA	29 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +42 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +38 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +21 dBm (Typ.)

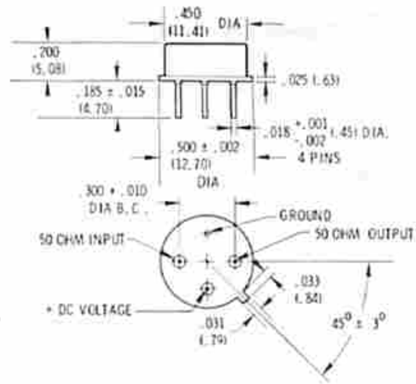
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . 50 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 µsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

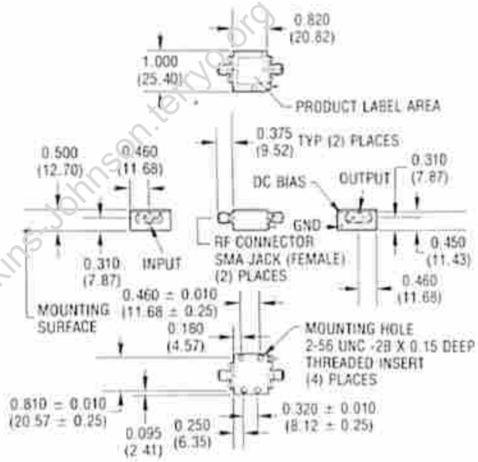
Outline Drawings

A5-6



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .005 (.13) UNLESS OTHERWISE SPECIFIED

CA5-6

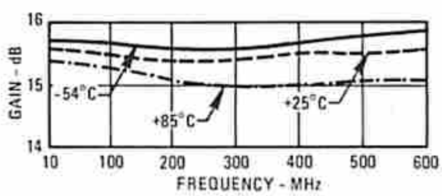


DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

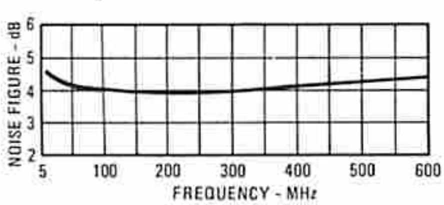
*WJ CA5-6 is standard WJ A5-6 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers

Typical Performance at 25°C

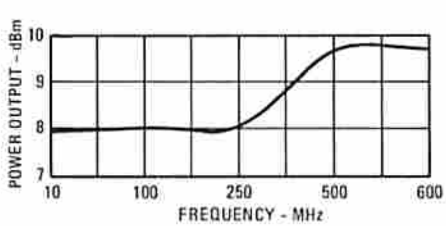
Gain



Noise Figure

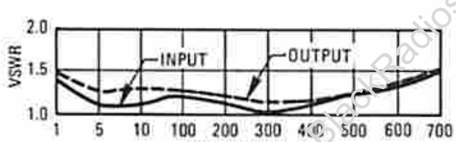


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.2	15.8
200.	1.1	1.2	15.9
300.	1.0	1.1	16.0
400.	1.1	1.1	16.0
500.	1.2	1.2	16.2
600.	1.3	1.3	16.3
700.	1.5	1.5	16.4

Linear S-Parameters

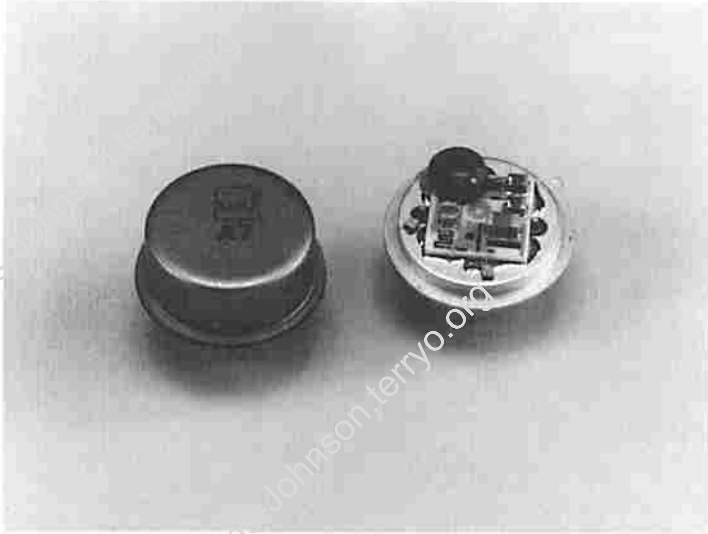
FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.07	161.8	6.16	155.1	.09	-8.6	.10	165.6
200.	.05	134.9	6.25	133.3	.08	-14.4	.08	149.5
300.	.02	76.4	6.31	112.4	.08	-17.0	.06	136.7
400.	.04	-41.1	6.34	91.1	.08	-20.9	.06	132.2
500.	.08	-81.8	6.43	68.4	.08	-26.6	.08	129.5
600.	.14	-110.9	6.55	41.6	.09	-32.4	.13	127.4
700.	.20	-146.4	6.63	12.8	.09	-38.0	.21	112.6
800.	.25	176.0	6.24	-19.9	.10	-47.5	.30	88.5

1

WJ-A7

5 TO 500 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT POWER: +14 dBm (TYP.)
- INTERCEPT POINT: +26 dBm (TYP.)
- LOW VSWR: < 1.2:1 INPUT; < 1.5:1 OUTPUT
- FLAT BANDWIDTH: < ±.3 dB (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +71°C
Frequency (Min.)	3-550 MHz	5-500 MHz	5-500 MHz
Small Signal Gain (Min.)	14.9 dB	14 dB	13.5 dB
Gain Flatness (Max.)	±0.2 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	5.5 dB	6.5 dB	6.5 dB
Power Output at 1 dB Compression (Min.)	+14 dBm	+13 dBm	+12.5 dBm
VSWR (Max.) Input/Output	1.3:1	1.8:1	2.0:1
DC Current (Max.) at 24 Volts	43 mA	45 mA	47 mA

*Measured in a 50-ohm system at +24 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +47 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +45 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +26 dBm (Typ.)

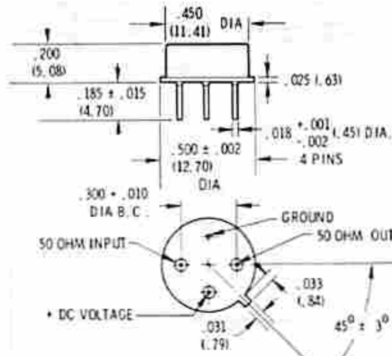
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +25 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . 50 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 1 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

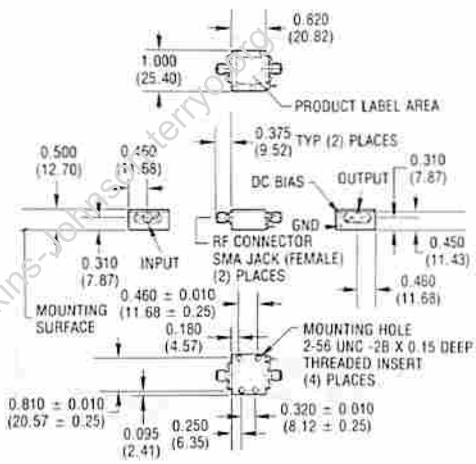
Outline Drawings

A7



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA7

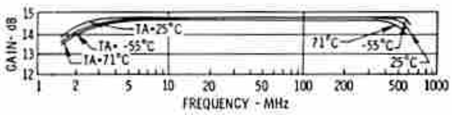


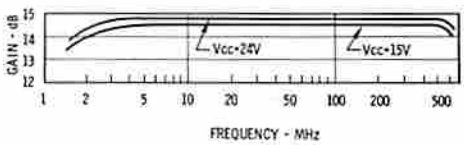
DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

*WJ CA7 is standard WJ A7 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

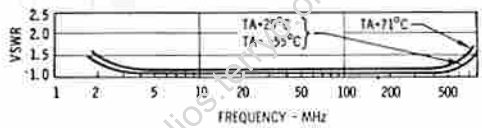
Typical Performance at 25°C

Gain

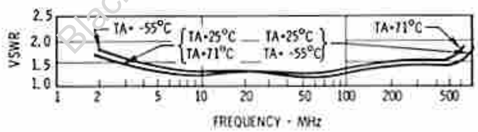




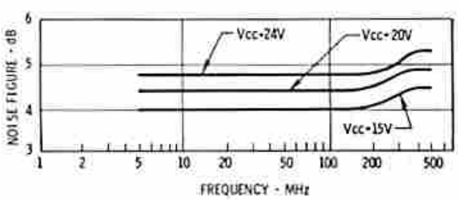
Input VSWR



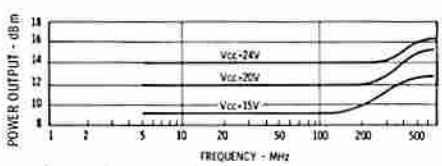
Output VSWR



Noise Figure

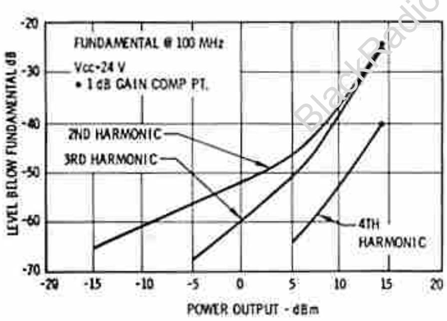


Power Output*



*at 1 dB Gain Compression

Harmonic Suppression vs. Power Out



Typical Automatic Test Data

V_{CC} = 24 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.1	15.2
200.	1.1	1.3	15.3
300.	1.1	1.4	15.4
400.	1.2	1.5	15.3
500.	1.3	[illegible]	15.3
600.	1.4	[illegible]	15.3

Linear S-Parameters

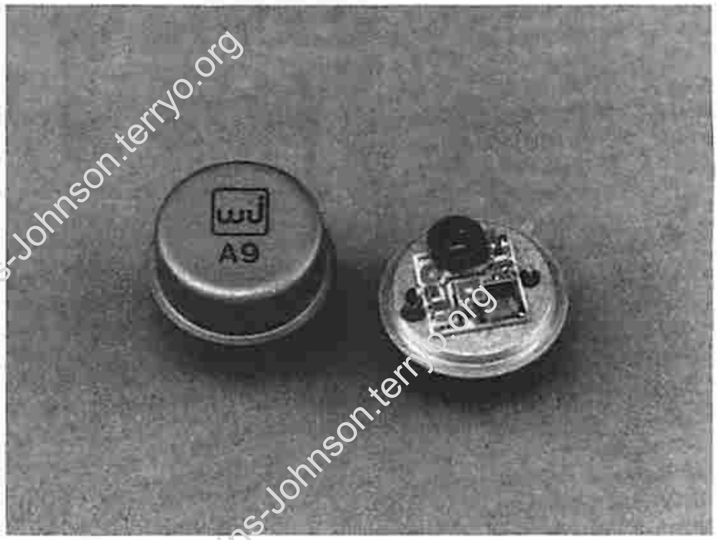
FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.06	-172.3	5.76	154.5	.10	-3.6	.07	45.8
200.	.04	-164.1	5.81	130.7	.11	[illegible]	.13	25.3
300.	.04	-108.1	5.89	106.9	.11	-7.4	.18	7.5
400.	.09	-87.8	5.85	86.2	.12	[illegible]	.19	-16.8
500.	.14	-96.5	5.83	59.9	.12	-16.7	.15	-44.4
600.	.17	-106.0	5.82	30.4	.13	-22.6	.07	-113.3
700.	.16	-111.1	5.42	-2.4	.14	-30.3	.17	124.5
800.	.17	-98.2	4.44	-37.3	[illegible]	-38.5	.37	75.7

1

WJ-A9

5 TO 500 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT POWER: +22 dBm (TYP.)
- HIGH THIRD ORDER I.P.: +35 dBm (TYP.)
- WIDE POWER SUPPLY RANGE: +15 TO +24 VOLTS



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +71°C
Frequency (Min.)	3-550 MHz	5-500 MHz	5-500 MHz
Small Signal Gain (Min.)	11 dB	10 dB	9.5 dB
Gain Flatness (Max.)	±0.3 dB	±1.0 dB	±1.0 dB
Noise Figure (Max.)	8 dB	10 dB	10.5 dB
Power Output at 1 dB Compression (Min.)	+22 dBm	+20 dBm	+20 dBm
VSWR (Max.) Input/Output	1.4:1	2.0:1	2.0:1
DC Current (Max.) at 24 Volts	110 mA	121 mA	127 mA

*Measured in a 50-ohm system at +24 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +55 dBm (Typ.)
Second Order Two Tone Intercept . . . . +53 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +35 dBm (Typ.)

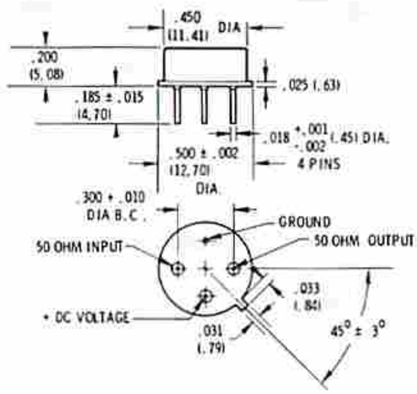
Absolute Maximum Ratings

Storage Temperature . . . . -65°C to +125°C
Maximum Case Temperature . . . . 71°C
Maximum DC Voltage . . . . +25 Volts
Maximum Continuous RF Input Power . . . . +15 dBm
Maximum Short Term RF Input Power . . . . +20 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 1 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 71°C
Proper heat sinking required to insure reliable performance.

Weight approximately 2.0 grams (0.07 oz.)

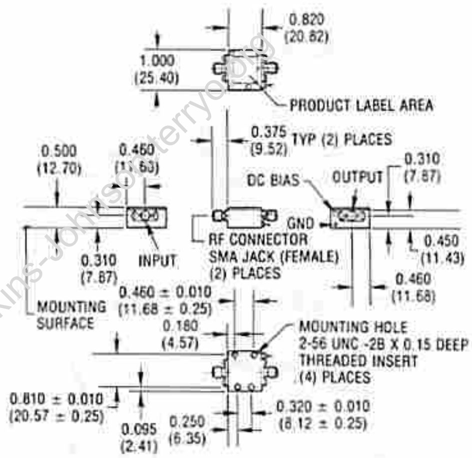
Outline Drawings

A9



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .005 (.13) UNLESS OTHERWISE SPECIFIED

CA9

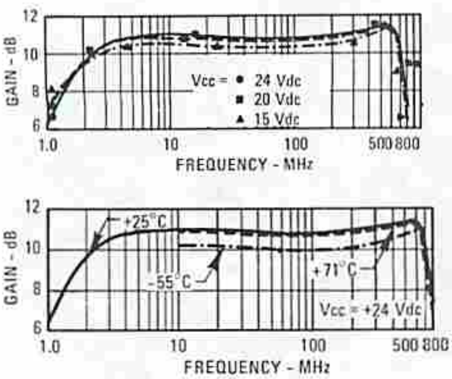


DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

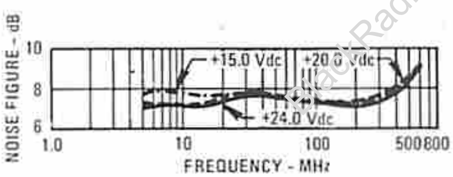
*WJ CA9 is standard WJ A9 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

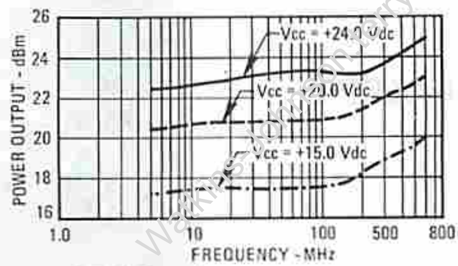
Gain



Noise Figure

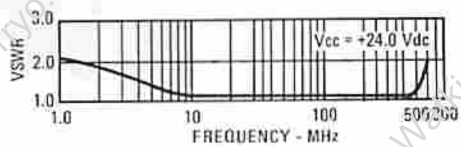


Power Output*

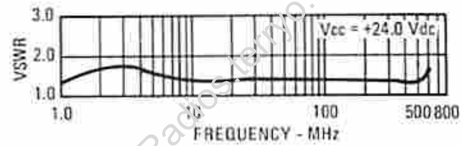


*at 1 dB Gain Compression

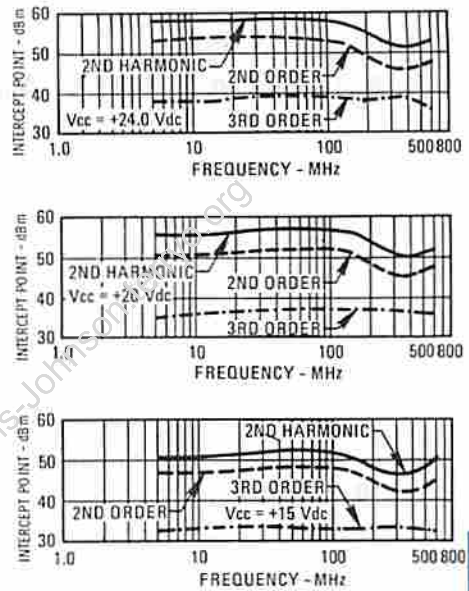
Input VSWR



Output VSWR



Intercept Point



1

Typical Automatic Test Data

Vcc = +24 Vdc

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.5	10.8
200.	1.2	1.5	10.9
300.	1.2	1.5	11.2
400.	1.1	1.4	11.2
500.	1.2	1.4	11.5
600.	1.8	1.6	11.5

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.06	-51.6	3.46	153.0	.13	-8.1	.20	-8.3
200.	.08	-78.8	3.50	126.2	.13	-16.2	.20	-23.0
300.	.09	-96.5	3.65	101.2	.14	-29.3	.19	-42.8
400.	.06	-97.8	3.63	73.3	.15	-41.4	.17	-74.2
500.	.08	-14.5	3.74	40.8	.17	-55.0	.16	-127.3
600.	.29	-19.2	3.75	2.6	.18	-76.1	.24	154.2
700.	.56	-45.8	3.24	-37.1	.16	-102.8	.43	94.9
800.	.77	-75.7	2.35	-75.4	.13	-126.5	.56	52.2

Vcc = +20 Vdc

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.5	10.6
200.	1.2	1.5	10.7
300.	1.2	1.5	11.1
400.	1.1	1.5	11.1
500.	1.2	1.4	11.4
600.	1.3	1.7	11.4

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.05	-53.3	3.40	153.0	.13	-7.7	.21	-10.1
200.	.08	-81.2	3.45	126.2	.13	-15.6	.21	-25.5
300.	.08	-97.7	3.61	101.2	.14	-28.5	.20	-46.2
400.	.05	-99.0	3.60	73.1	.16	-40.7	.18	-78.5
500.	.08	-9.1	3.72	40.3	.17	-54.5	.18	-131.3
600.	.30	-17.9	3.72	1.8	.18	-76.2	.27	154.2
700.	.57	-45.9	3.19	-33.5	.16	-103.4	.46	95.0
800.	.78	-76.0	2.28	-76.9	.13	-127.3	.58	52.3

V_{CC} = +15 Vdc

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.6	10.3
200.	1.1	1.6	10.5
300.	1.2	1.5	10.9
400.	1.1	1.5	10.9
500.	1.2	1.5	11.2
600.	2.0	1.9	11.2

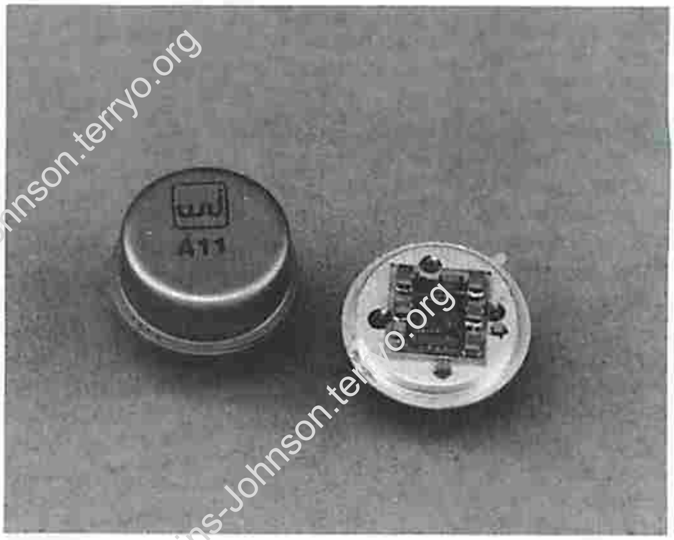
Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.04	-61.0	3.29	152.8	.13	-7.0	.23	-12.3
200.	.07	-87.9	3.35	125.8	.13	-14.5	.22	-29.1
300.	.07	-105.5	3.51	100.4	.14	-27.2	.21	-51.5
400.	.03	-111.6	3.51	71.7	.16	-39.5	.20	-84.9
500.	.09	8.0	3.63	37.9	.18	-54.3	.20	-138.0
600.	.33	-14.8	3.62	-1.9	.19	-77.1	.30	150.7
700.	.60	-46.3	3.02	-42.3	.16	-105.3	.49	93.1
800.	.79	-76.9	2.10	-80.6	.13	-128.7	.59	50.5

WJ-A11

5 TO 1000 MHz
TO-8 CASCADABLE AMPLIFIER

- LOW NOISE: 3.0 dB (TYP.)
- LOW VSWR: 1.3:1 (TYP.)
- FLAT BANDWIDTH: < ±0.25 dB



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	1-1100 MHz	5-1000 MHz	5-1000 MHz
Small Signal Gain (Min.)	14.7 dB	14 dB	13.5 dB
Gain Flatness (Max.)	±0.25 dB	±1.0 dB	±1.2 dB
Noise Figure (Max.)	3.1 dB	3.5 dB	4 dB
Power Output at 1 dB Compression (Min.)	-2.0 dBm	-3.0 dBm	-4.0 dBm
VSWR (Max.) Input/Output	1.3:1	1.8:1	2.0:1
DC Current (Max.) at 15 Volts	9 mA	11 mA	12 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

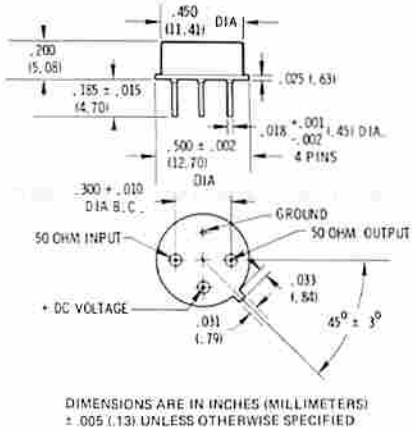
Second Order Harmonic Intercept Point . . . . +15 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +10 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +10 dBm (Typ.)

Absolute Maximum Ratings

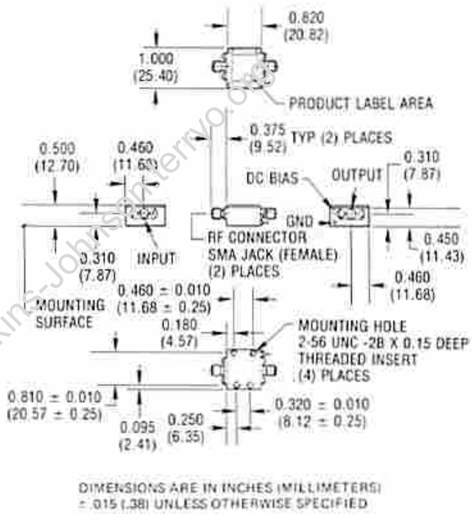
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +20 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . 50 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Outline Drawings

A11



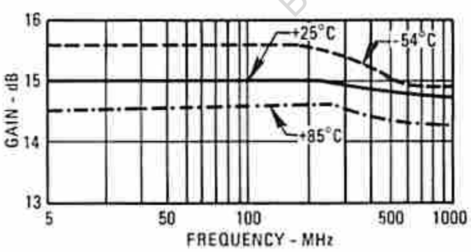
CA11



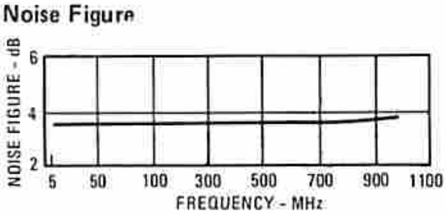
Weight approximately 2.0 grams (0.07 oz.)

Typical Performance at 25°C

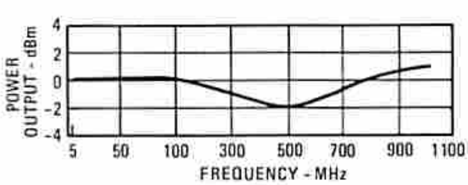
Gain



Noise Figure

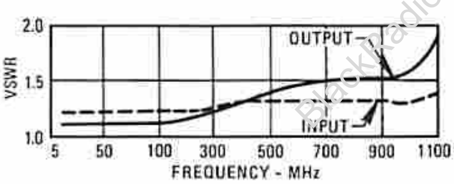


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.1	15.2
200.	1.2	1.1	15.2
300.	1.1	1.1	15.1
400.	1.0	1.1	15.0
500.	1.1	1.2	14.9
600.	1.1	1.2	14.8
700.	1.2	1.1	14.9
800.	1.3	1.1	14.9
900.	1.4	1.0	15.2
1000.	1.4	1.2	15.3
1100.	1.6	1.4	14.9

Linear S-Parameters

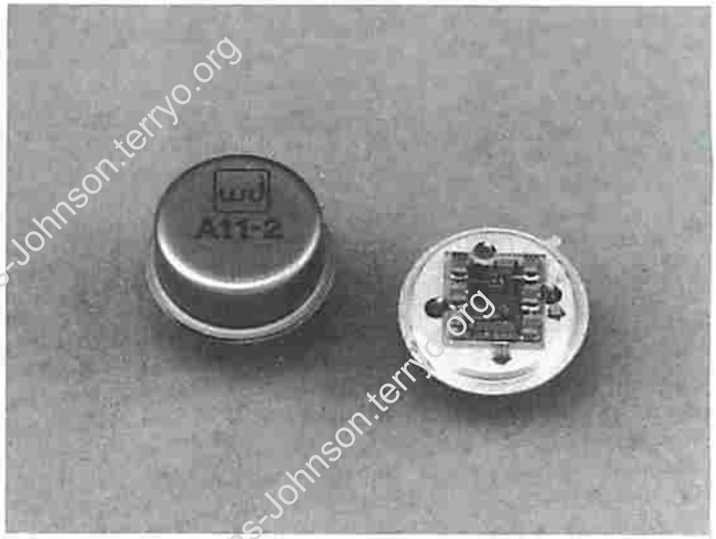
FREQ MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.11	166.1	5.76	156.7	.10	-6.0	.06	160.1
200.	.08	146.5	5.75	136.4	.09	-14.8	.05	113.9
300.	.05	121.8	5.69	118.4	.09	-23.4	.05	62.8
400.	.01	55.0	5.62	99.4	.10	-30.0	.06	28.8
500.	.03	-52.8	5.55	86.9	.09	-37.8	.08	9.8
600.	.07	-75.7	5.48	60.0	.09	-43.8	.08	-12.0
700.	.10	-97.7	5.55	39.5	.09	-50.7	.06	-35.7
800.	.13	-120.7	5.59	18.1	.09	-57.1	.04	-71.7
900.	.15	-153.1	5.69	-5.6	.09	-63.5	.02	-172.1
1000.	.17	163.9	5.79	-30.4	.10	-72.6	.07	103.6
1100.	.23	111.6	5.56	-57.9	.11	-83.0	.17	65.6
1200.	.31	63.5	4.98	-88.6	.11	-100.3	.27	30.4

1

WJ-A11-2

5 TO 1000 MHz
TO-8 CASCADABLE AMPLIFIER

- LOW NOISE: 2.5 dB (TYP.)
- HIGH GAIN: 16 dB (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C-+85°C
Frequency (Min.)	1-1100 MHz	5-1000 MHz	5-1000 MHz
Small Signal Gain (Min.)	16 dB	15 dB	14 dB
Gain Flatness (Max.)	±0.3 dB	±0.9 dB	±1.0 dB
Noise Figure (Max.)	2.5 dB	3.0 dB	3.5 dB
Power Output at 1 dB Compression (Min.)	-1.0 dB	-3.0 dB	-3.5 dB
VSWR (Max.) Input/Output	$<$1.4:1	1.9:1	2.0:1
DC Current (Max.) at 15 Volts	9 mA	11 mA	12 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +15 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +10 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +10 dBm (Typ.)

Absolute Maximum Ratings

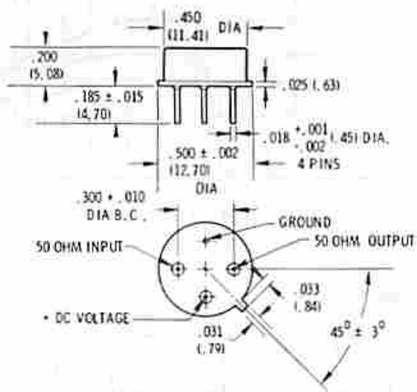
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +20 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . 50 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)

"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

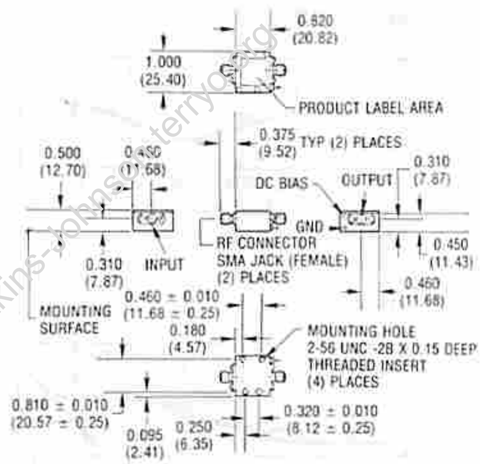
Outline Drawings

A11-2



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

CA11-2

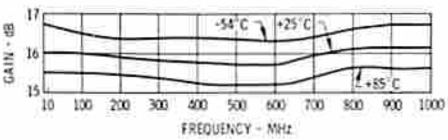


DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

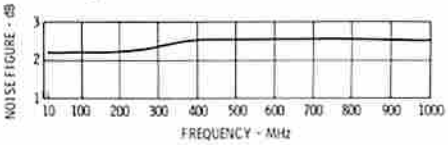
*WJ CA11-2 is standard WJ A11-2 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

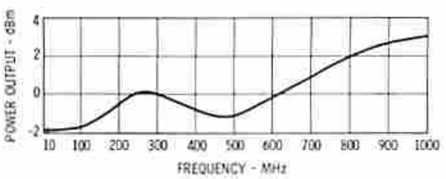
Gain



Noise Figure

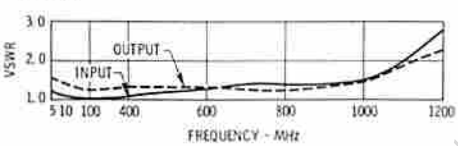


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ.	VSWR IN	VSWR OUT	GAIN DB
100.	1.0	1.2	15.8
200.	1.0	1.2	15.8
300.	1.1	1.2	15.8
400.	1.1	1.3	15.6
500.	1.2	1.3	15.5
600.	1.3	1.3	15.6
700.	1.4	1.2	15.8
800.	1.4	1.1	15.9
900.	1.4	1.2	16.3
1000.	1.5	1.5	16.0
1100.	1.9	1.9	14.7
1200.	2.8	2.2	12.3

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.02	160.0	6.17	154.5	.10	-10.3	.10	131.6
200.	.00	48.3	6.17	135.7	.10	-16.1	.11	94.7
300.	.03	-39.0	6.14	118.1	.10	-23.3	.12	64.4
400.	.07	-50.5	6.05	100.2	.10	-30.0	.13	39.1
500.	.11	-69.4	5.98	81.8	.09	-37.0	.14	17.1
600.	.14	-86.3	5.99	61.4	.09	-42.9	.13	.5
700.	.16	-106.2	6.14	40.8	.09	-48.8	.10	-8.9
800.	.17	-133.0	6.27	18.1	.09	-55.2	.06	2.1
900.	.15	177.0	6.50	-8.1	.09	-60.9	.08	64.2
1000.	.18	103.4	6.30	-37.8	.09	-70.4	.19	61.0
1100.	.31	37.8	5.41	-70.6	.10	-84.9	.31	39.8
1200.	.47	-6.4	4.11	-102.7	.09	-102.7	.37	17.7

WJ-A12

10 TO 1000 MHz
TO-8 CASCADABLE AMPLIFIER

- LOW NOISE: 2.8 dB (TYP.)
- HIGH GAIN: 16 dB (TYP.)
- MEDIUM LEVEL OUTPUT: 8.0 dBm (TYP.)
- LOW VSWR: <1.5:1 (TYP.)

Specifications*

Characteristic	Typical	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	5-1000 MHz	10-1000 MHz	10-1000 MHz
Small Signal Gain (Min.)	16.0 dB	15.0 dB	14.5 dB
Gain Flatness (Max.)	±0.3 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	2.8 dB	3.5 dB	3.9 dB
Power Output at 1 dB Compression (Min.)	>8.0 dBm	+7.0 dBm	+6.5 dBm
VSWR (Max.) Input/Output	1.6:1	1.9:1	2.0:1
DC Current (Max.) at 15 Volts	22 mA	25 mA	27 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +32 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +25 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +22 dBm (Typ.)

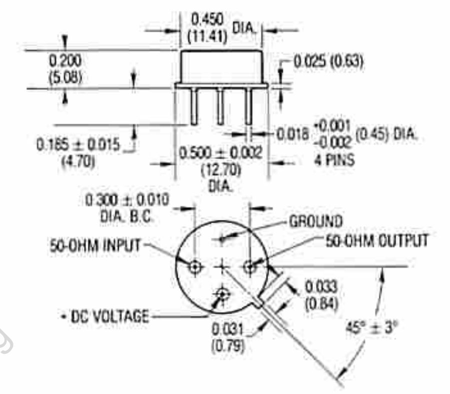
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

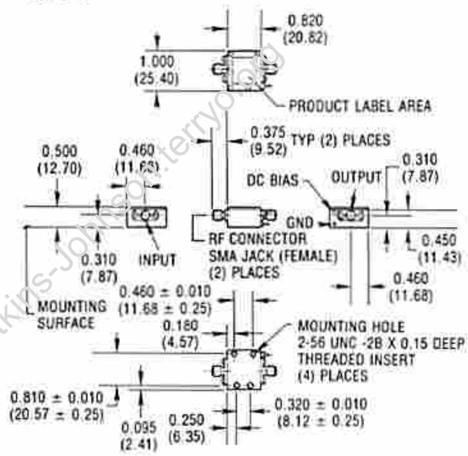
Outline Drawings

A12



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA12

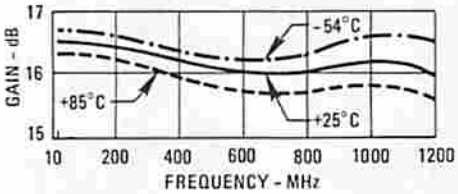


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

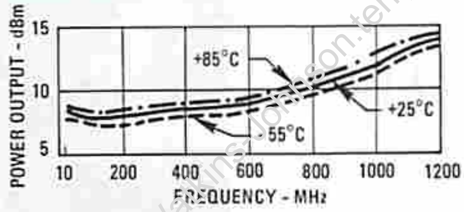
*WJ-CA12 is standard WJ-A12 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

Gain

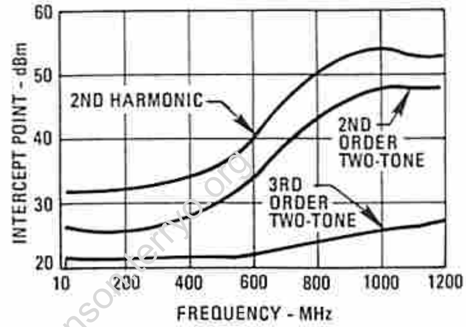


Power Output*

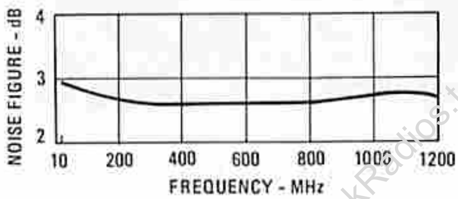


*at 1 dB Gain Compression

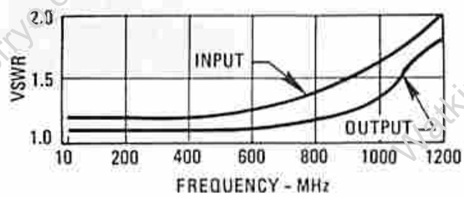
Intercept Point



Noise Figure



VSWR



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Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
1.0	1.1	1.3	16.3
2.0	[illegible]	1.2	16.5
5.0	[illegible]	1.1	16.6
10.0	[illegible]	1.1	16.5
50.0	[illegible]	1.1	16.5
100.0	[illegible]	1.1	16.5
200.0	[illegible]	1.1	16.4
300.0	[illegible]	1.1	16.3
400.0	[illegible]	1.1	16.2
500.0	[illegible]	1.1	16.1
600.0	1.3	1.1	16.0
700.0	[illegible]	1.1	16.1
800.0	1.4	1.2	16.0
900.0	1.5	1.3	16.1
1000.0	1.6	[illegible]	16.2
1100.0	1.8	1.6	16.2
1200.0	2.0	1.8	16.0

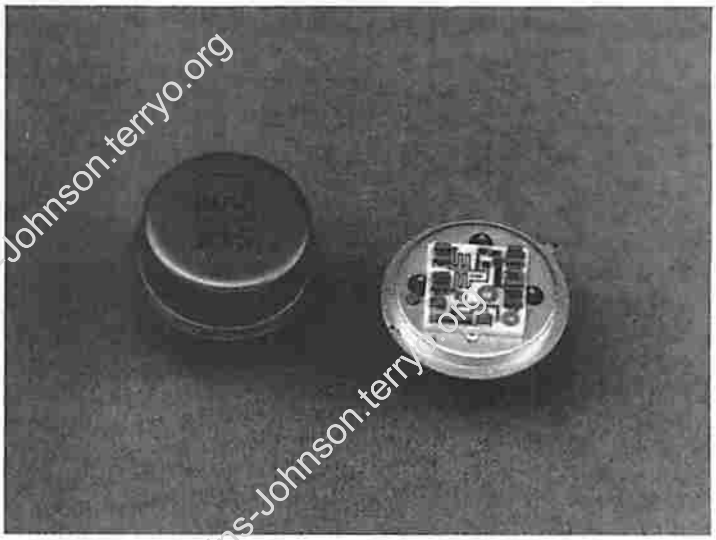
Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.034	-57	6.54	-158	0.09	21	0.137	-140
2.0	0.074	2	6.70	-170	0.09	7	0.074	-151
5.0	0.089	-1	6.75	-175	0.09	1	0.054	-167
10.0	0.089	-9	[illegible]	-179	0.09	-1	0.055	174
50.0	0.087	-12	6.66	172	0.08	-6	0.053	173
100.0	0.086	-8	6.65	160	0.09	[illegible]	0.056	164
200.0	0.089	-27	6.60	142	0.08	[illegible]	0.052	137
300.0	0.097	-35	6.50	122	0.09	-24	0.053	127
400.0	0.099	-50	6.48	106	0.09	-31	0.051	118
500.0	0.103	-64	6.36	85	[illegible]	-39	[illegible]	115
600.0	0.126	-84	6.34	69	0.09	-48	0.029	86
700.0	0.138	-114	6.37	50	0.09	-56	0.062	103
800.0	0.164	-144	6.32	30	0.09	-66	0.091	109
900.0	0.186	-172	6.40	10	0.10	-75	0.122	103
1000.0	0.233	160	6.45	-12	0.10	-83	0.122	91
1100.0	0.292	119	6.43	[illegible]	0.10	-98	0.230	67
1200.0	0.329	71	6.28	[illegible]	0.10	-112	0.238	43

WJ-A15

5 TO 1000 MHz
TO-8 CASCADABLE AMPLIFIER

- MEDIUM LEVEL: +8.5 dBm OUTPUT (TYP.)
- WIDE POWER SUPPLY RANGE: +8 TO +15 VOLTS



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	1-1100 MHz	5-1000 MHz	5-1000 MHz
Small Signal Gain (Min.)	14.5 dB	14 dB	13 dB
Gain Flatness (Max.)	±0.3 dB	±1.0 dB	±1.2 dB
Noise Figure (Max.)	5.4 dB	6.5 dB	7 dB
Power Output at 1 dB Compression (Min.)	+8.5 dBm	+7 dBm	+6.5 dBm
VSWR (Max.) Input/Output	<1.4:1	1.9:1	2.0:1
DC Current (Max.) at 15 Volts	24 mA	27 mA	29 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +38 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +33 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +21 dBm (Typ.)

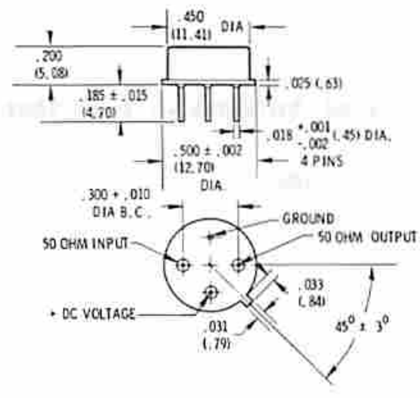
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . 50 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 µsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

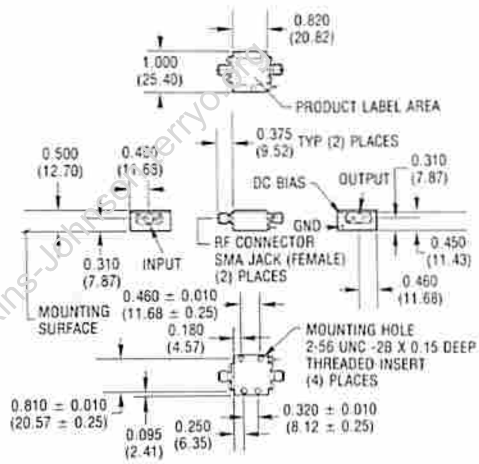
Outline Drawings

A15



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

CA15

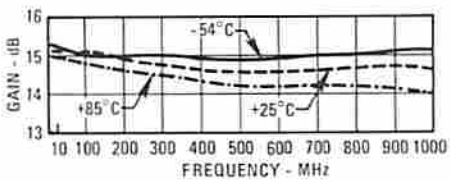


DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

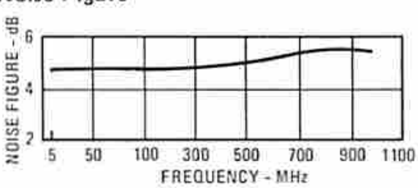
*WJ-CA15 is standard WJ-A15 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

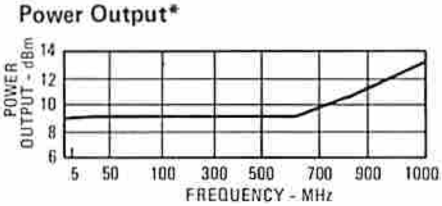
Gain



Noise Figure

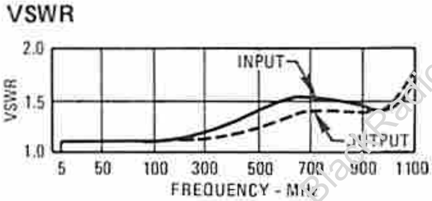


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.2	14.9
200.	1.2	1.2	14.9
300.	1.1	1.1	14.9
400.	1.0	[illegible]	14.7
500.	1.1	1.1	14.6
600.	1.2	1.1	14.5
700.	1.2	1.1	14.5
800.	1.2	1.2	14.6
900.	[illegible]	1.2	14.7
1000.	1.3	1.4	14.6
1100.	1.6	1.7	14.1

Linear S-Parameters

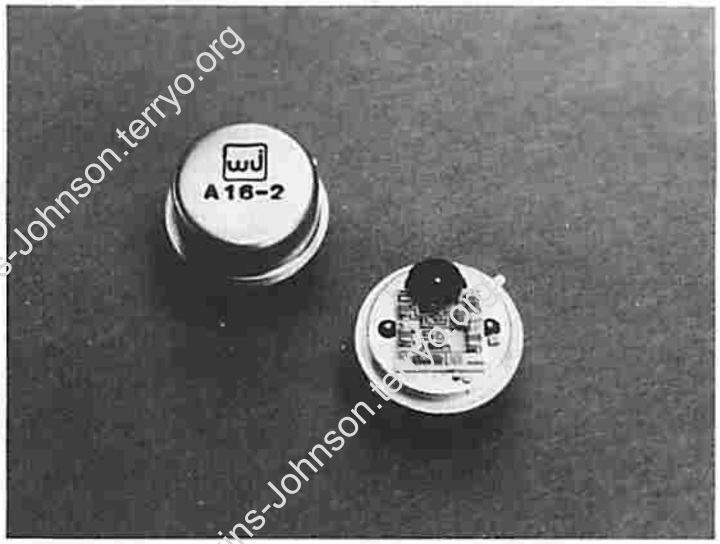
FREQ MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.10	164.7	5.53	157.2	.09	-5.1	.11	163.0
200.	.07	140.5	5.54	137.8	.09	-11.1	.08	144.4
300.	.04	109.6	5.56	119.1	.09	-15.0	.07	126.2
400.	.02	-8.9	5.44	102.3	.09	-21.7	.06	98.3
500.	.05	-56.9	5.38	[illegible]	.09	-27.9	.07	77.6
600.	.08	-84.2	5.30	64.1	.10	-35.3	.06	75.9
700.	.10	-108.1	5.33	43.8	.10	-41.6	.06	81.9
800.	.11	-138.1	5.38	22.8	.10	-50.1	.07	93.5
900.	.11	179.1	5.41	-.4	.11	-60.1	.10	98.7
1000.	.15	119.9	[illegible]	-24.8	.11	-71.6	.17	83.1
1100.	.24	66.8	5.04	-51.1	.12	-87.0	.25	61.0
1200.	.35	24.6	4.39	-79.4	.12	-102.8	.31	33.9

1

WJ-A16-2

10 TO 1200 MHz
TO-8 CASCADABLE AMPLIFIER

- LOW NOISE: 3.5 dB (TYP)
- HIGH EFFICIENCY: 15 mA (TYP) AT 5 VOLTS
- GOOD DYNAMIC RANGE: 102.5 dB (TYP) IN 1 MHz BW
- LOW VSWR: <1.5:1 (TYP)



Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54° - +85°C
Frequency (Min.)	5 - 1300 MHz	10 - 1200 MHz	10 - 1200 MHz
Small Signal Gain (Min.)	13.0 dB	12.0 dB	11.5 dB
Gain Flatness (Max.)	±.2 dB	±.5 dB	±.7 dB
Noise Figure (Max.)	3.5 dB	4.0 dB	4.5 dB
Power Output at 1 dB Compression (Min.)	6.0 dBm	5.0 dBm	4.5 dBm
VSWR (Max.) Input/Output	<1.5:1	1.9:1	2.0:1
DC Current (Max.) at +5 Volts	15 mA	17 mA	18 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point .... +34 dBm (Typ.)
Second Order Two-Tone Intercept Point .... +28 dBm (Typ.)
Third Order Two-Tone Intercept Point .... +18 dBm (Typ.)

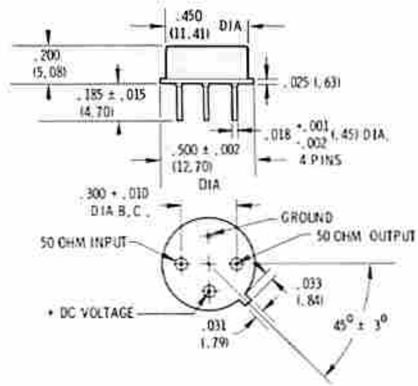
Absolute Maximum Ratings

Storage Temperature .... -62°C to +125°C
Maximum Case Temperature .... +125°C
Maximum DC Voltage .... +8 Volts
Maximum Continuous RF Input Power .... +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) .... 50 Milliwatts
Maximum Peak Power .... .5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) .... 125°C

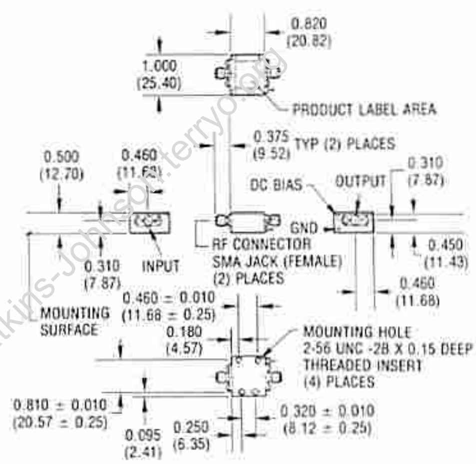
Weight approximately 2.0 grams (0.07 oz.)

Outline Drawings

A16 - 2



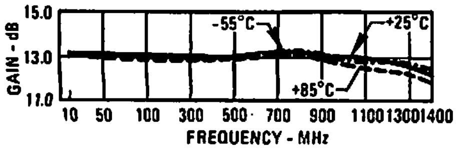
CA16 - 2



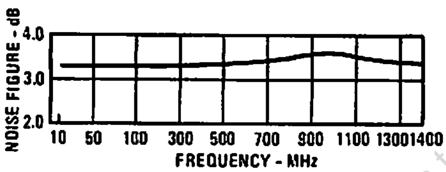
WJ-CA16-2 is standard WJ-A16-2 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

Typical Performance at 25°C

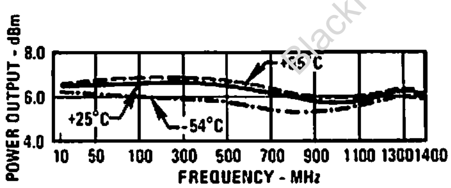
Gain



Noise Figure

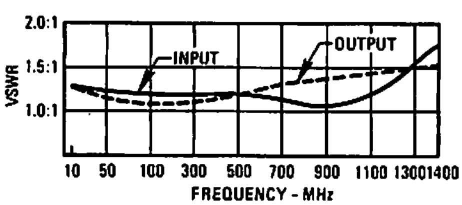


Power Output*

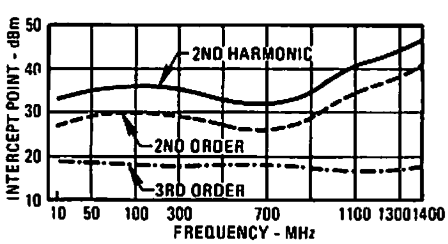


* at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{CC} = +5 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
100.0	1.3	1.2	12.7
200.0	1.0	1.1	12.5
300.0	1.1	1.2	12.6
400.0	1.0	1.3	12.5
500.0	1.0	1.3	12.5
600.0	1.0	1.3	12.5
700.0	1.1	1.4	12.6
800.0	1.1	1.4	12.4
900.0	[illegible]	1.4	12.5
1000.0	1.3	1.5	12.4
1100.0	1.3	1.6	12.4
1200.0	1.4	1.5	12.4
1300.0	1.6	1.5	12.3
1400.0	1.7	1.5	11.8

Linear S-Parameters

FREQUENCY MHz	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.0	0.112	149	4.32	166	0.12	-2	0.101	155
200.0	0.087	87	4.22	149	0.13	-13	0.051	-120
300.0	0.037	141	4.27	134	0.13	-23	0.097	-159
400.0	0.013	38	4.22	118	0.13	-28	0.114	-149
500.0	0.010	49	4.22	106	0.13	-38	0.139	-154
600.0	0.017	-3	4.22	90	0.13	-44	0.142	-170
700.0	0.026	-93	4.27	73	0.13	-51	0.167	-174
800.0	0.056	-114	4.17	55	0.13	-58	0.174	-179
900.0	0.067	-137	4.22	39	0.13	-69	0.163	157
1000.0	0.130	-141	4.17	24	0.13	-75	0.210	152
1100.0	0.141	-158	4.17	6	0.14	-82	0.217	128
1200.0	0.167	-176	[illegible]	-13	0.14	-90	0.199	101
1300.0	0.241	168	4.12	-31	0.14	-100	0.200	77
1400.0	0.268	152	3.80	-49	0.14	-112	0.205	47

Vcc = +8 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
100.0	1.4	1.3	13.5
200.0	1.2	1.1	13.7
300.0	1.3	1.2	13.6
400.0	1.2	1.2	13.7
500.0	1.2	1.2	13.5
600.0	1.2	1.2	13.7
700.0	1.1	1.3	13.7
800.0	1.1	1.3	13.7
900.0	1.0	1.3	13.6
1000.0	1.1	1.4	13.6
1100.0	1.2	1.4	13.6
1200.0	1.2	1.4	13.5
1300.0	1.5	1.4	13.3
1400.0	1.6	1.4	12.9

Linear S-Parameters

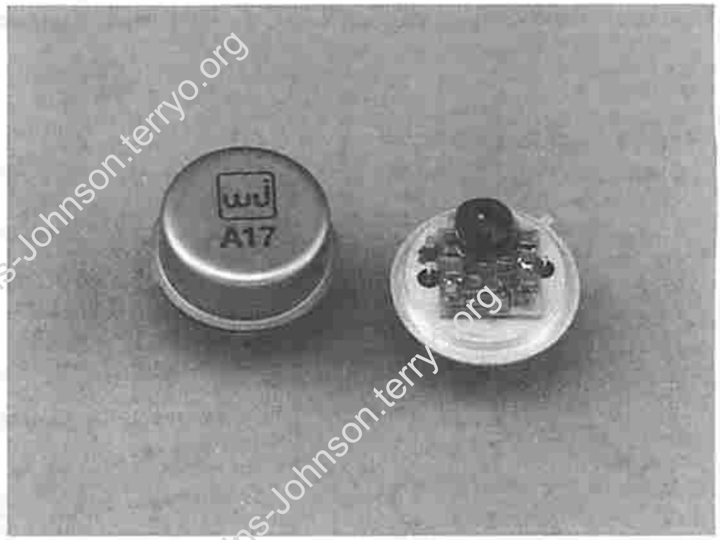
FREQUENCY MHz	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.0	0.103	158	[illegible]	166	0.11	-4	0.139	159
200.0	0.090	143	4.84	149	0.12	-14	0.052	-168
300.0	0.123	138	4.79	134	0.12	-22	0.105	179
400.0	0.094	111	4.84	118	0.12	-29	0.094	-169
500.0	0.091	102	4.73	106	0.12	-38	0.107	-167
600.0	0.087	82	4.84	93	0.12	-44	0.107	-179
700.0	0.057	77	4.84	75	0.12	-51	0.125	-176
800.0	0.030	[illegible]	4.84	57	0.12	-60	[illegible]	-176
900.0	0.015	[illegible]	4.79	40	0.13	-69	0.119	159
1000.0	0.061	-139	4.79	25	0.12	-76	0.174	162
1100.0	0.073	-156	4.79	8	0.12	-83	0.183	136
1200.0	[illegible]	-174	4.73	-11	0.13	-91	[illegible]	108
1300.0	[illegible]	169	4.62	-29	0.13	-101	[illegible]	86
1400.0	0.220	154	4.42	-48	0.13	-111	0.166	57

1

WJ-A17

10 TO 1000 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT LEVEL: +15.3 dB (TYP.)
- HIGH THIRD ORDER I.P. +27 dBm (TYP.)
- LOW VSWR: < 1.3:1 (TYP.)
- WIDE POWER SUPPLY RANGE: +5 TO +15 VOLTS



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	2-1100 MHz	10-1000 MHz	10-1000 MHz
Small Signal Gain (Min.)	12 dB	10.5 dB	10 dB
Gain Flatness (Max.)	±0.2 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	6.0 dB	7.5 dB	8.0 dB
Power Output at 1 dB Compression (Min.)	+15.3 dBm	+14 dBm	+13.5 dBm
VSWR (Max.) Input/Output	< 1.3:1	1.8:1	2.0:1
DC Current (Max.) at 15 Volts	44 mA	47 mA	49 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +48 dBm (Typ.)
Second Order Two-Tone Intercept Point . . . . +49 dBm (Typ.)
Third Order Two-Tone Intercept Point . . . . +27 dBm (Typ.)

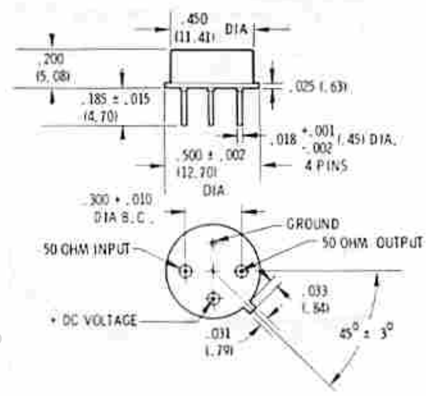
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . +17 dBm (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

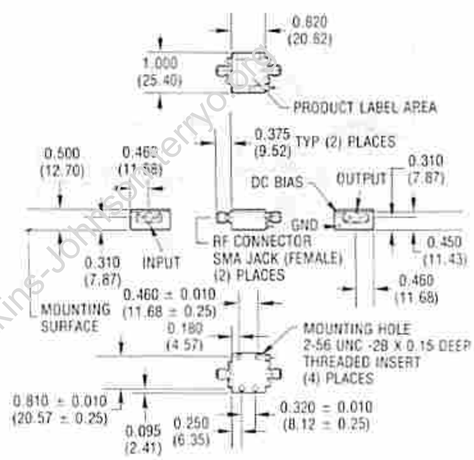
Outline Drawings

A17



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

CA17

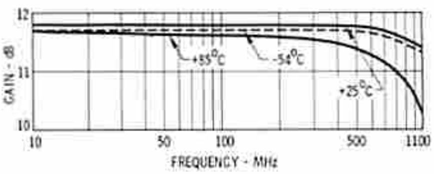


DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

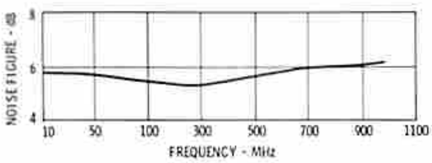
*WJ CA17 is standard WJ A17 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

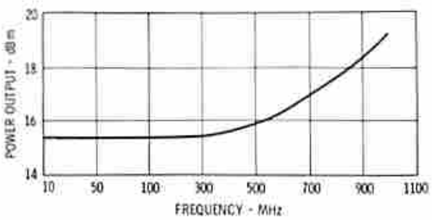
Gain



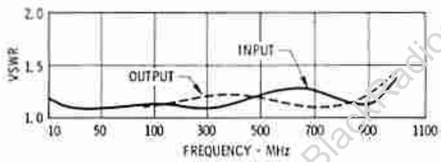
Noise Figure



Power Output*



VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ.	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.1	12.1
200.	1.2	1.1	12.2
300.	1.1	1.1	12.3
400.	1.1	1.1	12.1
500.	1.1	1.1	12.1
600.	1.2	1.1	12.0
700.	1.2	1.1	12.0
800.	1.2	1.2	12.0
900.	1.2	1.3	12.1
1000.	1.4	1.4	12.2
1100.	1.9	1.6	11.9

Linear S-Parameters

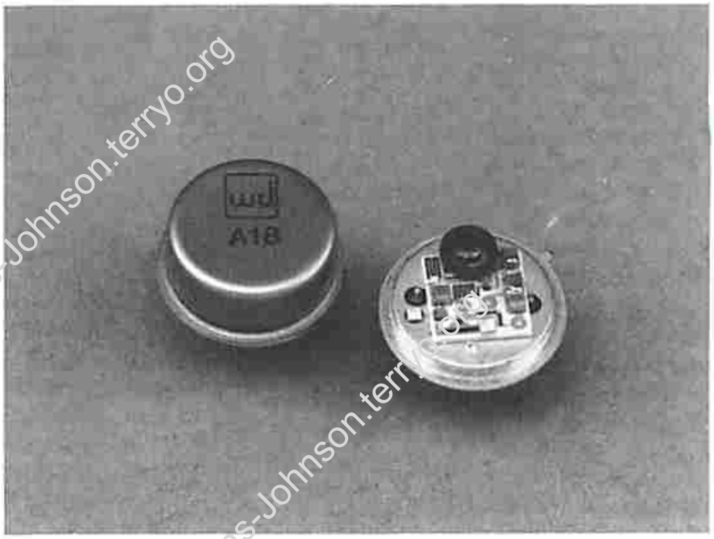
FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.07	-161.9	4.02	158.5	.13	-6.7	.06	147.3
200.	.07	-167.4	4.05	139.0	.13	-13.1	.05	109.1
300.	.07	-175.2	4.11	121.2	.13	-19.4	.04	56.6
400.	.06	-158.1	4.03	102.1	.13	-28.0	.05	22.1
500.	.07	-156.7	4.01	83.7	.13	-36.6	.07	-2.0
600.	.08	-161.1	3.96	62.9	.13	-44.2	.07	-35.4
700.	.08	-179.1	3.99	42.4	.14	-52.8	.07	-77.5
800.	.08	147.0	3.99	21.2	.14	-62.9	.08	-122.4
900.	.10	95.5	4.05	-2.1	.14	-74.0	.12	-164.6
1000.	.17	46.5	4.08	-26.8	.15	-89.2	.17	153.8
1100.	.31	6.1	[illegible]	-54.4	.15	-107.3	.24	112.7
1200.	.45	-31.3	3.45	-85.8	.14	-133.1	.30	70.7

1

WJ-A18

10 TO 800 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH DYNAMIC RANGE:
  +15 dBm OUTPUT LEVEL;
  4.5 dB N.F.
- HIGH THIRD ORDER I.P.
  +29 dBm



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	2-850 MHz	10-800 MHz	10-800 MHz
Small Signal Gain (Min.)	14.7 dB	14 dB	13.5 dB
Gain Flatness (Max.)	< ±0.3 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	4.5 dB	5.5 dB	6.0 dB
Power Output at 1 dB Compression (Min.)	+15 dBm	+14 dBm	+13.5 dBm
VSWR (Max.) Input/Output	< 1.4:1	1.9:1	2.0:1
DC Current (Max.) at 15 Volts	43 mA	45 mA	47 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +52 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +51 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +29 dBm (Typ.)

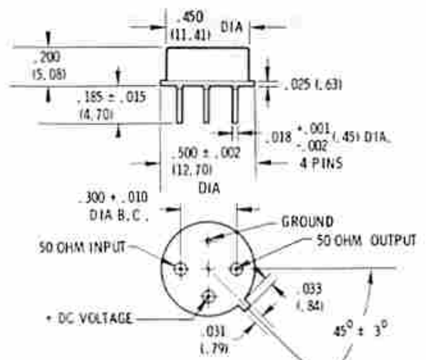
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . +17 dBm (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

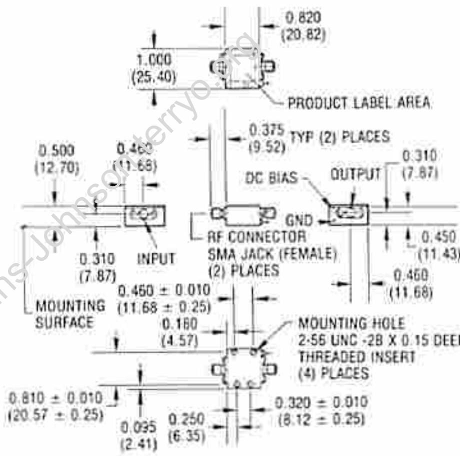
Outline Drawings

A18



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

CA18

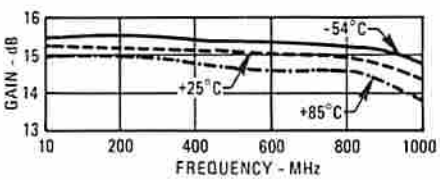


DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

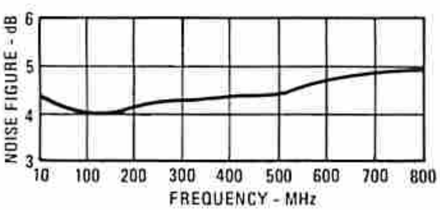
*WJ CA18 is standard WJ A18 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers

Typical Performance at 25°C

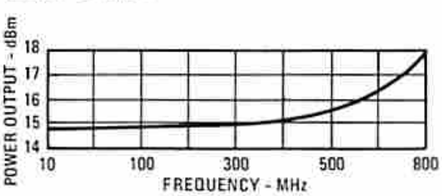
Gain



Noise Figure

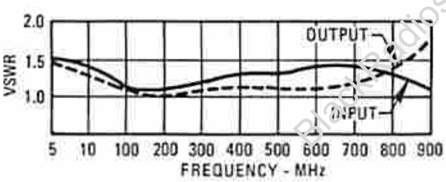


Power Output*



*@ 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.0	1.0	14.6
200.	1.1	1.0	14.8
300.	1.2	1.1	14.8
400.	1.3	1.1	14.7
500.	1.3	1.1	14.6
600.	1.4	1.1	14.5
700.	1.4	1.2	14.6
800.	1.3	1.4	14.6
900.	1.1	1.8	14.0

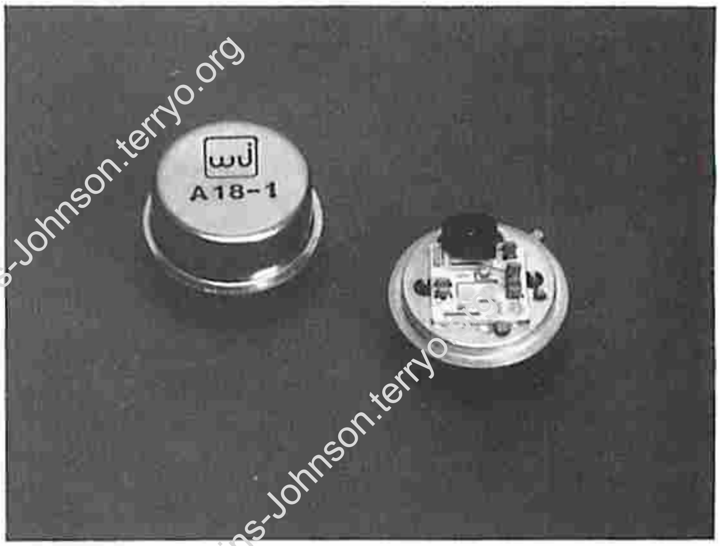
Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.02	-22.5	5.39	157.2	.11	-7.9	.01	122.4
200.	.03	7.5	5.49	136.5	.11	-14.3	.02	-29.2
300.	.07	1.0	5.47	117.4	.11	-20.2	.04	-36.1
400.	.11	-19.1	5.44	97.4	.11	-27.1	.04	-66.0
500.	.14	-37.2	5.39	77.[illegible]	.11	-36.7	.04	-99.9
600.	.16	-51.7	5.33	55.0	.12	-43.4	.05	-161.2
700.	.16	-66.7	5.38	32.8	.12	-50.9	.10	161.2
800.	.13	-79.4	5.39	9.0	.13	-60.4	.17	133.0
900.	.04	-76.1	5.48	-17.7	.14	-72.9	.27	104.1
1000.	.12	35.6	5.2[illegible]	-46.6	.15	-88.2	.40	71.9
1100.	.33	13.5	4.[illegible]	-77.9	.15	-106.8	.52	36.8
1200.	.52	-11.5	3.[illegible]3	-109.5	.14	-128.3	.57	4.0

WJ-A18-1

10 TO 1000 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT LEVEL:
  +16 dBm (TYP.)
- HIGH THIRD ORDER I. P.
  +30 dBm (TYP.)
- LOW VSWR: 1.5:1 (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	5-1100 MHz	10-1000 MHz	10-1000 MHz
Small Signal Gain (Min.)	14.7 dB	14.0 dB	13.5 dB
Gain Flatness (Max.)	<±0.3 dB	±0.5 dB	±1.0 dB
Noise Figure (Max.)	3.8 dB	5.0 dB	5.5 dB
Power Output at 1 dB Compression (Min.)	+16.0 dBm	+15.0 dBm	+14.5 dBm
VSWR (Max.) Input/Output	1.5:1	1.8:1	2.0:1
DC Current (Max.) at 15 Volts	44 mA	46 mA	48 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +45 dBm (Typ.)
Second Order Two-Tone Intercept Point . . . . +42 dBm (Typ.)
Third Order Two-Tone Intercept Point . . . . +30 dBm (Typ.)

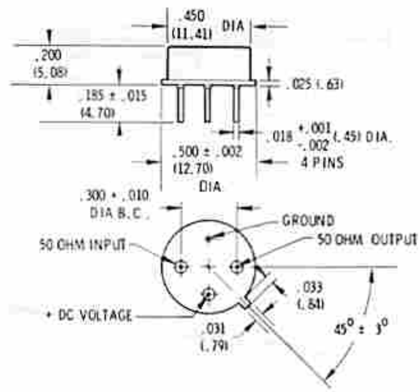
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . 50 Milliwatts
(1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt
(3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

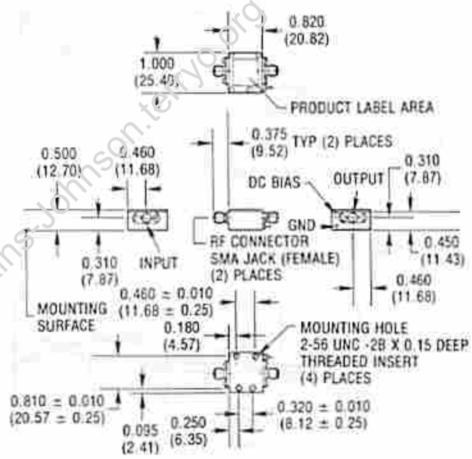
Outline Drawings

A18-1



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .005 (.13) UNLESS OTHERWISE SPECIFIED

CA18-1

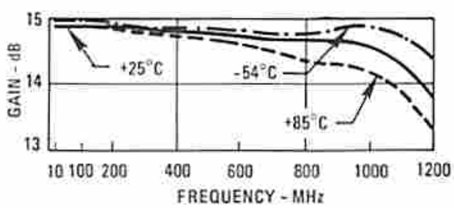


DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

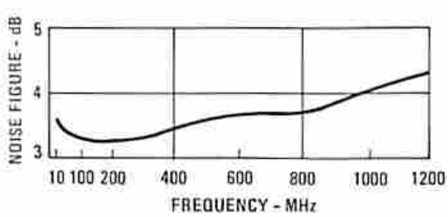
*WJ-CA18-1 is standard WJ-A18-1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

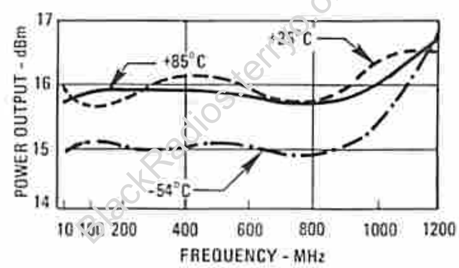
Gain



Noise Figure

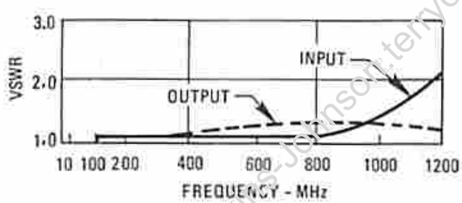


Power Output*

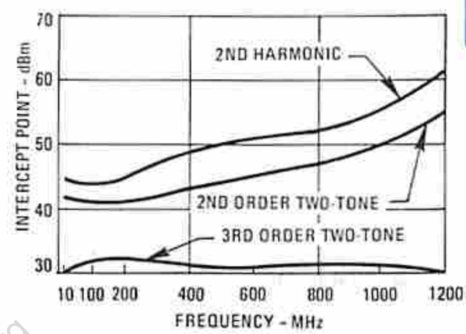


* at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.0	1.1	14.9
200.	1.0	1.1	14.8
300.	1.0	1.2	14.6
400.	1.0	1.2	14.6
500.	1.0	1.2	14.6
600.	1.0	1.3	14.6
700.	1.1	1.3	14.6
800.	1.2	1.3	14.6
900.	1.3	1.3	14.5
1000.	1.5	1.2	14.5
1100.	1.8	1.2	14.3
1200.	2.2	1.2	13.9

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.01	-150.7	5.59	165.4	.11	-3.4	.03	-140.0
200.	.01	142.3	5.47	150.5	.11	-8.5	.05	-130.7
300.	.02	120.9	5.38	134.8	.11	-11.8	.07	-132.1
400.	.02	110.9	5.35	119.1	.11	-16.4	.09	-139.6
500.	.01	70.3	5.36	104.4	.12	-22.5	.11	-144.7
600.	.01	-88.1	5.38	88.6	.12	-28.6	.13	-155.8
700.	.03	-119.6	5.39	73.9	.12	-34.5	.13	-169.6
800.	.07	-144.0	5.35	57.9	.13	-40.0	.13	178.8
900.	.14	-166.4	5.29	41.0	.13	-46.0	.13	162.2
1000.	.19	175.6	5.28	22.9	.14	-52.5	.10	134.2
1100.	.28	153.8	5.20	4.0	.14	-59.0	.08	93.8
1200.	.37	134.1	4.94	-15.0	.15	-69.4	.08	31.2

V_{CC} = +12 Vdc

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.0	1.1	14.8
200.	1.0	1.1	14.7
300.	1.0	1.2	14.5
400.	1.0	1.3	14.5
500.	1.0	1.3	14.5
600.	1.0	1.4	14.5
700.	1.1	1.4	14.5
800.	1.2	1.4	14.5
900.	1.4	1.4	14.4
1000.	1.5	1.3	14.3
1100.	1.8	1.3	14.2
1200.	2.3	1.3	13.7

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.01	[illegible]	5.52	165.3	.12	-3.2	.03	-119.9
200.	.00	[illegible]	5.40	150.4	.11	-8.3	.06	-119.7
300.	.01	138.8	5.32	134.7	.11	-11.4	.08	-127.0
400.	.01	132.8	5.29	119.0	.11	-15.9	.11	-137.4
500.	.00	141.2	5.31	104.3	.12	-21.9	.13	-146.0
600.	.02	-103.3	5.32	88.6	.12	-27.9	.15	-158.4
700.	.04	-125.6	5.34	73.9	.13	-33.7	.16	-174.9
800.	.08	-147.8	5.29	57.9	.13	-39.2	.16	170.5
900.	.15	-168.3	5.23	40.7	.14	-45.3	.15	151.2
1000.	.21	174.2	5.22	22.6	.14	-52.0	.14	122.0
1100.	.29	152.2	5.13	3.5	.15	-58.7	.12	83.2
1200.	.38	132.4	4.84	-15.7	.15	-69.4	.12	33.1

V_{CC} = +5 Vdc

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.2	13.4
200.	1.2	1.3	13.1
300.	1.2	1.3	13.0
400.	1.2	1.4	12.9
500.	1.3	1.5	12.9
600.	1.3	1.6	12.8
700.	1.4	1.6	12.7
800.	1.5	1.6	12.5
900.	1.8	1.5	12.2
1000.	2.0	1.4	12.0
1100.	2.3	1.3	11.7
1200.	2.7	1.2	11.1

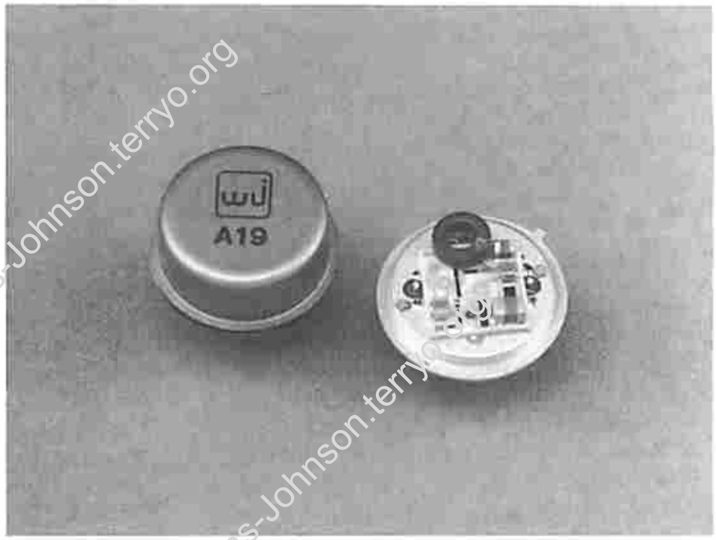
Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.10	-25.2	4.66	164.6	.13	-3.7	.10	-34.1
200.	.10	-43.8	4.53	148.6	.13	-8.6	.12	-62.0
300.	.10	-68.2	4.46	131.9	.13	-12.4	.15	-86.9
400.	.11	-94.2	4.41	115.3	.13	-17.3	.18	-107.8
500.	.12	-113.4	4.39	99.7	.13	-23.6	.20	[illegible]
600.	.14	-131.9	4.35	83.2	.14	-29.9	.22	[illegible]
700.	.17	-151.0	4.30	68.0	.14	-36.3	.22	[illegible]
800.	.21	-169.1	4.19	51.3	.15	-42.3	.22	-173.4
900.	.28	173.6	4.07	34.0	.15	-48.9	.21	168.0
1000.	.32	156.7	3.99	16.0	.16	-56.1	.18	145.8
1100.	.40	138.1	3.85	-3.3	.16	-63.6	[illegible]	120.0
1200.	.46	119.3	3.58	-21.6	.17	-73.8	[illegible]	75.2

WJ-A19

10 TO 1000 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT POWER: +21 dBm (TYP.)
- HIGH THIRD ORDER I.P.: +34 dBm (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C – +85°C
Frequency (Min.)	5-1050 MHz	10-1000 MHz	10-1000 MHz
Small Signal Gain (Min.)	7.5 dB	6 dB	5.5 dB
Gain Flatness (Max.)	< ±0.3 dB	±1.0 dB	±1.3 dB
Noise Figure (Max.)	9 dB	10.5 dB	11.0 dB
Power Output at 1 dB Compression (Min.)	+21 dBm	+20 dBm	+19 dBm
VSWR (Max.) Input/Output	< 1.8:1	2.2:1	2.2:1
DC Current (Max.) at 15 Volts	100 mA	109 mA	114 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +45 dBm (Typ.)
Second Order Two-Tone Intercept Point . . . . +40 dBm (Typ.)
Third Order Two-Tone Intercept Point . . . . +34 dBm (Typ.)

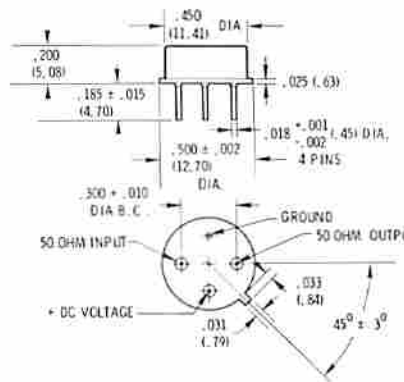
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 85°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +17 dBm
Maximum Short Term RF Input Power . . . . +20 dBm (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 85°C

Weight approximately 2.0 grams (0.07 oz.)

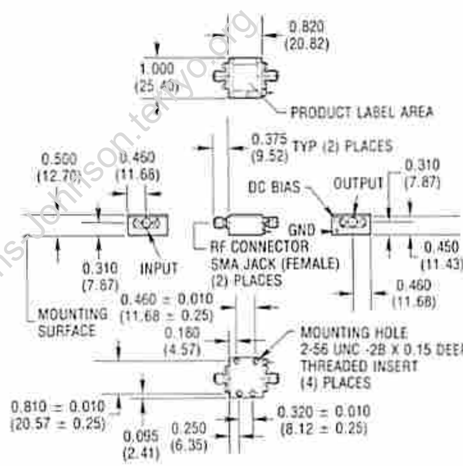
Outline Drawings

A19



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

CA19

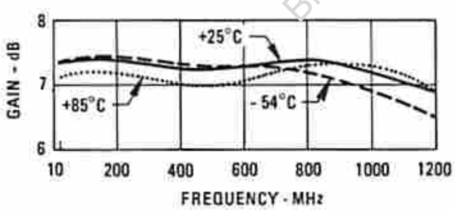


DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

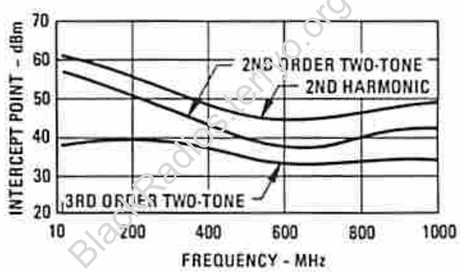
*WJ CA19 is standard WJ A19 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

Typical Performance at 25°C

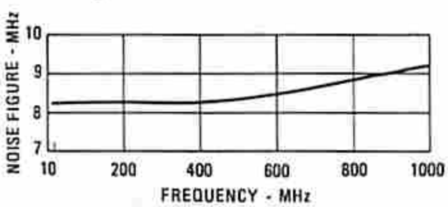
Gain



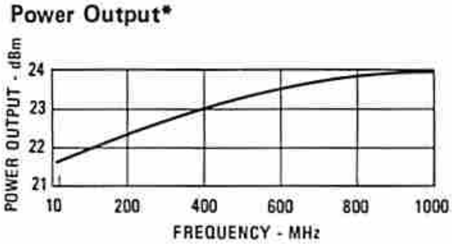
Intercept Point



Noise Figure

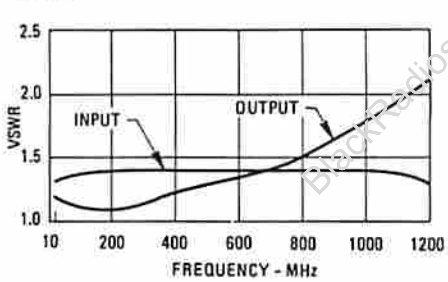


Power Output*



* at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.0	1.4	7.4
200.	1.1	1.4	7.5
300.	1.2	1.4	7.4
400.	1.2	1.4	7.1
500.	1.3	1.4	[illegible]
600.	1.4	1.4	7.7
700.	1.5	1.5	7.5
800.	1.5	1.4	7.5
900.	1.6	1.4	7.5
1000.	1.8	1.4	7.3
1100.	1.9	1.4	7.3
1200.	2.0	1.3	7.2

Linear S Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.02	-135.1	2.35	164.2	.16	[illegible]	.18	-.5
200.	.05	-114.7	2.37	147.7	.16	-5.5	.17	-11.3
300.	.08	-122.9	2.34	134.8	.17	-8.2	.18	-19.2
400.	.11	-136.6	2.25	119.1	.17	-10.5	.18	-26.1
500.	.14	-149.9	2.32	101.5	.18	-16.3	.18	-37.7
600.	.16	-165.0	2.42	85.7	.19	-20.3	.18	-52.1
700.	.19	179.6	2.36	70.5	.20	-23.7	.19	-66.8
800.	.21	163.1	2.37	53.5	.21	-29.0	.18	-82.2
900.	.24	142.4	2.37	36.9	.22	-35.5	.17	-102.2
1000.	.28	123.8	2.33	19.4	.23	-44.1	.16	-124.1
1100.	.30	103.0	2.33	[illegible]	.26	-50.9	.15	-148.6
1200.	.34	78.9	2.28	-15.6	.27	-57.4	.14	-177.0

1

WJ-A19-1

10 TO 1000 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT POWER: +22.5 dBm (TYP.)
- HIGH THIRD ORDER I.P.: +35 dBm (TYP.)
- MEDIUM NOISE FIGURE: 6.0 dB (TYP.)

Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	10-1100 MHz	10-1000 MHz	10-1000 MHz
Small Signal Gain (Min.)	11.5 dB	10.5 dB	10.0 dB
Gain Flatness (Max.)	±0.2 dB	±0.6 dB	±0.8 dB
Noise Figure (Max.)			
30-600 MHz	6.0 dB	7.0 dB	7.5 dB
10-1000 MHz	6.5 dB	8.0 dB	8.5 dB
Power Output at 1 dB Compression (Min.)	+22.5 dBm	+20.5 dBm	+20.0 dBm
VSWR (Max.) Input/Output	1.5:1	1.7:1	2.0:1
DC Current (Max.) at 15 Volts	90 mA	94 mA	99 mA

* Measured in a 50-ohm system at 15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +58 dBm (Typ.)
Second Order Two-Tone Intercept Point . . . . +51 dBm (Typ.)
Third Order Two-Tone Intercept Point . . . . +35 dBm (Typ.)

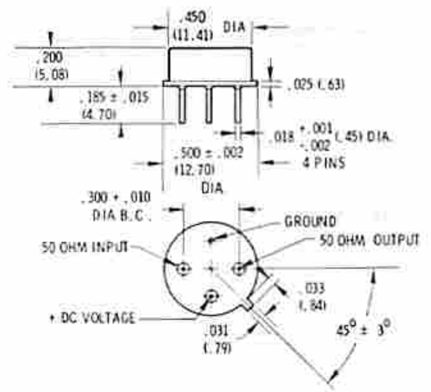
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 100°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 minute max.) . . . . 100 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 100°C

Weight approximately 2.0 grams (0.07 oz.)

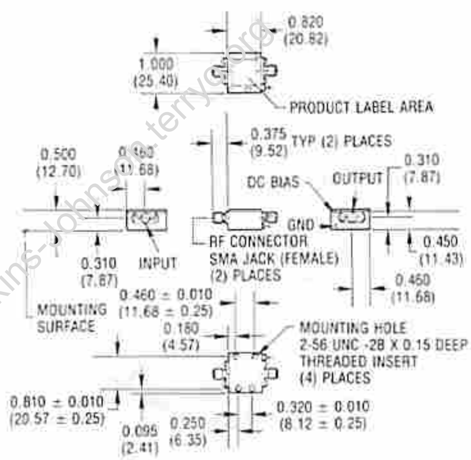
Outline Drawings

A19-1



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA19-1

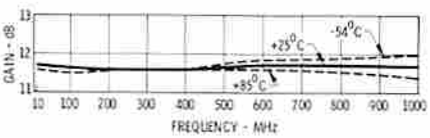


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

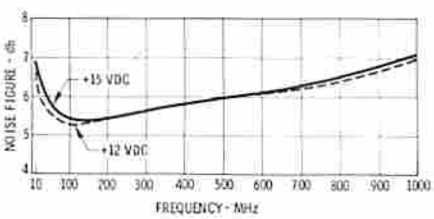
*WJ CA19-1 is standard WJ A19-1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

Typical Performance at 25°C

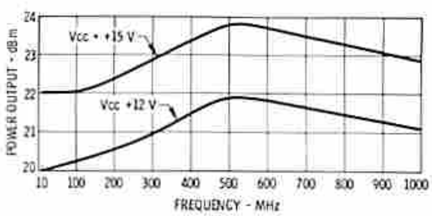
Gain



Noise Figure

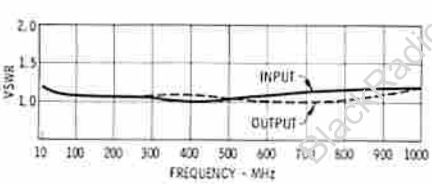


Power Output*

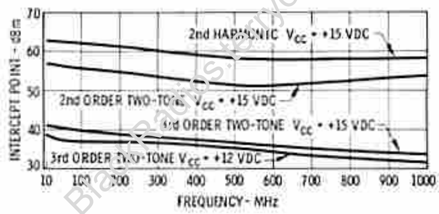


* at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.0	1.1	11.7
200.	1.0	1.0	11.7
300.	1.1	1.0	11.7
400.	1.1	1.0	11.6
500.	1.1	1.0	11.7
600.	1.2	1.0	11.7
700.	1.2	1.0	11.7
800.	1.2	1.1	11.7
900.	1.2	1.1	11.6
1000.	1.3	1.2	11.6
1100.	1.4	1.2	11.5
1200.	1.6	[illegible]	11.2

V_{CC} = 12V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.0	1.1	11.6
200.	1.0	1.0	11.6
300.	1.1	1.0	11.6
400.	1.1	1.0	11.7
500.	1.1	1.0	11.7
600.	1.1	1.0	11.7
700.	1.2	1.0	11.7
800.	1.2	1.1	11.7
900.	1.2	1.1	11.6
1000.	1.3	1.2	11.5
1100.	1.4	1.2	11.4
1200.	1.6	1.3	[illegible]

Linear S-Parameters

FREQ MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.02	-105.9	3.84	175.5	.15	6.8	.03	138.1
200.	.02	-105.7	3.83	169.4	.15	10.5	.02	124.6
300.	.03	-106.4	3.85	162.2	.15	[illegible]	.02	113.6
400.	.04	-105.7	3.87	157.5	.15	19.4	.01	108.0
500.	.05	-108.4	3.85	150.5	.16	22.4	.00	-115.0
600.	.07	-116.5	3.85	144.4	.16	26.7	.01	-116.2
700.	.08	-120.4	3.85	137.4	.17	29.7	.02	-147.1
800.	.10	-149.0	3.83	130.3	.17	32.0	.04	-166.0
900.	.10	-174.3	3.82	122.6	.18	33.8	.05	164.0
1000.	.12	140.0	3.80	113.9	.19	34.9	.07	133.1
1100.	.16	107.6	3.74	104.4	.20	35.4	.11	102.5
1200.	.22	70.5	3.62	94.1	.21	34.0	.15	69.9

1

WJ-A21-1

10 TO 1200 MHz
TO-8 CASCADABLE AMPLIFIER

- LOW NOISE: <2.8 dB (TYP.)
- LOW VSWR: 1.5:1 (TYP.)
- HIGH SINGLE STAGE GAIN: 15 dB (TYP.)

Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	1-1300 MHz	5-1200 MHz	5-1200 MHz
Small Signal Gain (Min.)	15.0 dB	14.0 dB	13.5 dB
Gain Flatness (Max.)	±0.3 dB	±0.5 dB	±1.0 dB
Noise Figure (Max.)	<2.8 dB	3.5 dB	3.9 dB
Power Output at 1 dB Compression (Min.)	-1.0 dBm	-2.0 dBm	-3.0 dBm
VSWR (Max.) Input/Output	1.5:1	1.9:1	2.0:1
DC Current (Max.) at 15 Volts	10 mA	11 mA	12 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . >16 dBm (TYP)
Second Order Two Tone Intercept Point . . . . >11 dBm (TYP)
Third Order Two Tone Intercept Point . . . . 10 dBm (Typ.)

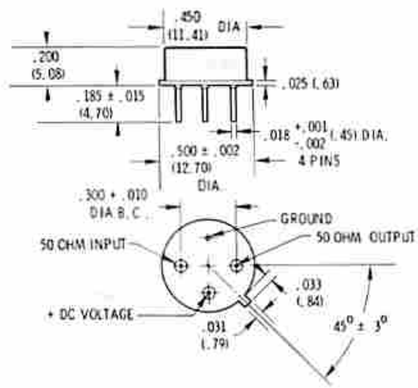
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . 50 Milliwatts
(1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt
(3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

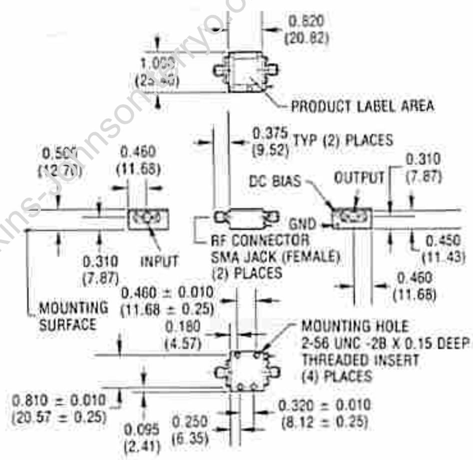
Outline Drawings

A21-1



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .005 (.13) UNLESS OTHERWISE SPECIFIED

CA21-1

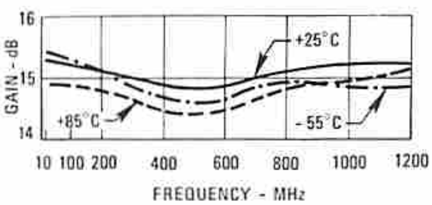


DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

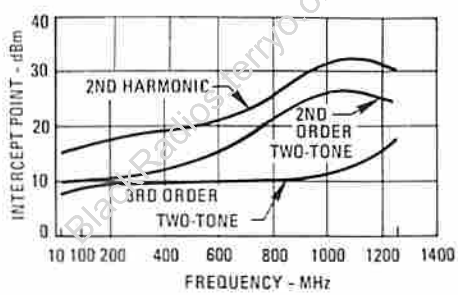
*WJ-CA21-1 is standard and WJ-A21-1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

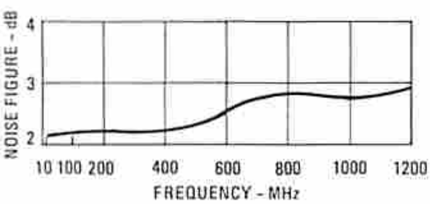
Gain



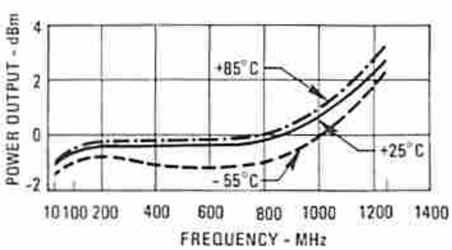
Intercept Point



Noise Figure

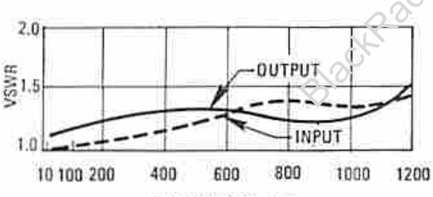


Power Output*



* at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.0	1.1	1.0	15.3
10.0	1.1	1.0	15.3
50.0	1.1	1.0	15.2
100.0	1.1	1.0	15.2
200.0	1.1	1.1	15.2
300.0	1.1	1.1	15.0
400.0	1.1	1.1	15.0
500.0	1.1	1.1	14.9
600.0	1.2	1.2	14.9
700.0	1.2	1.2	15.0
800.0	1.4	1.2	15.2
900.0	1.3	1.2	15.2
1000.0	1.3	1.3	15.2
1100.0	1.4	1.4	15.2
1200.0	1.5	1.6	15.1
1300.0	2.0	1.8	14.5

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
5.0	0.038	-37	5.84	-176	0.10	5	0.021	-74
10.0	0.034	-25	5.83	-179	0.10	2	0.013	-58
50.0	0.035	-32	5.78	172	0.10	-4	0.012	24
100.0	0.031	-22	5.76	[illegible]	0.10	-9	0.017	47
200.0	0.038	-64	5.73	[illegible]	0.10	-19	0.051	41
300.0	0.042	-83	5.64	122	0.10	-28	0.053	33
400.0	0.050	-76	5.61	107	0.10	-37	0.058	16
500.0	0.052	-85	[illegible]	86	0.10	-46	0.069	-9
600.0	0.072	-89	[illegible]	70	0.10	-56	0.106	-21
700.0	0.101	-109	5.62	51	0.09	-64	0.107	-38
800.0	0.149	-136	5.73	32	0.09	-71	0.093	-82
900.0	0.149	-165	5.77	10	0.10	-81	0.099	-145
1000.0	0.140	169	5.79	-11	0.10	-89	0.130	177
1100.0	0.158	116	5.78	-35	0.10	-103	0.179	111
1200.0	0.203	[illegible]	5.72	-62	0.11	-114	0.238	72
1300.0	0.344	16	5.30	-91	0.11	-133	0.281	40

WJ-A24

5 TO 1500 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH GAIN – TWO STAGES: 20.0 dB (TYP.)
- ULTRA LOW PHASE DEVIATION FROM LINEARITY: <±2.5°, 100–1500 MHz
- LOW VSWR: <1.3:1 (TYP.)
- MEDIUM LEVEL OUTPUT: +8 dBm (TYP.)

Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	2-1700 MHz	5-1500 MHz	5-1500 MHz
Small Signal Gain (Min.)	20.0 dB	19.0 dB	18.0 dB
Gain Flatness (Max.)	<±0.4 dB	±0.8 dB	1.0 dB
Noise Figure (Max.)	4.2 dB	5.3 dB	5.8 dB
Power Output at 1 dB Compression (Min.)	+8.0 dBm	+7.0 dBm	+6.5 dBm
VSWR (Max.) Input/Output	<1.4:1	2.0:1	2.0:1
DC Current (Max.) at +15 Volts	34 mA	38 mA	40 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Secord Order Harmonic Intercept Point . . . . +47 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +42 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +20.5 dBm (Typ.)

Absolute Maximum Ratings

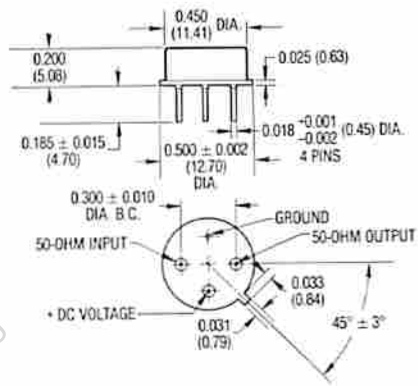
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +20 Volts
Maximum Continuous RF Input Power . . . . +7 dBm
Maximum Short Term RF Input Power . . . . +15 dBm (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight

2.27 grams (0.08 oz.) max.

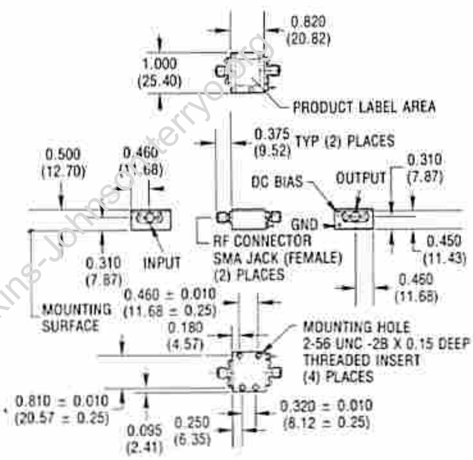
Outline Drawings

A24



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA24

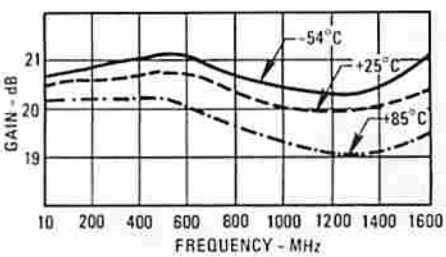


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

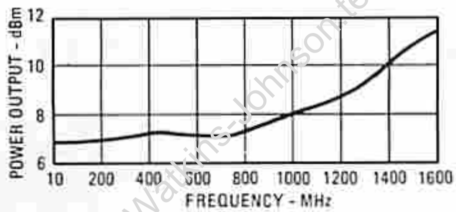
*WJ CA24 is standard WJ A24 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

Gain

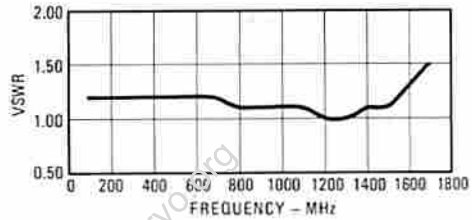


Power Output*

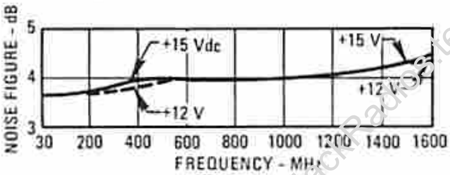


*at 1 dB Gain Compression

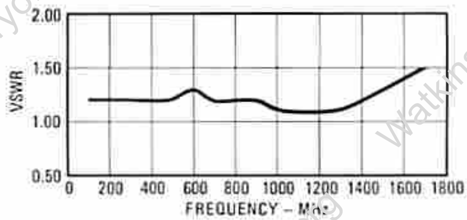
VSWR



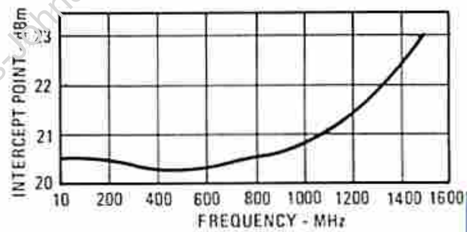
Noise Figure



VSWR



Intercept Point



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Typical Automatic Test Data

V_{CC} = 15 V

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN dB
100.0	1.2	1.2	20.6
200.0	1.2	1.2	20.7
300.0	1.2	1.2	20.7
400.0	1.2	1.2	20.7
500.0	1.2	1.2	20.8
600.0	1.2	1.3	20.8
700.0	1.2	1.2	20.7
800.0	1.1	1.2	20.7
900.0	1.1	1.2	20.6
1000.0	1.1	1.1	20.5
1100.0	1.1	1.1	20.3
1200.0	1.0	1.1	20.3
1300.0	1.0	1.1	20.2
1400.0	1.1	1.2	20.1
1500.0	1.1	1.3	20.1
1600.0	1.3	1.4	20.3
1700.0	1.5	1.5	20.5

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.0	.081	170	10.756	-15	.024	2	.074	-179
200.0	.077	169	10.884	-30	.024	1	.082	177
300.0	.079	160	10.872	-45	.024	2	.092	168
400.0	.083	154	10.891	-60	.024	5	.102	159
500.0	.071	140	11.004	-75	.024	3	.109	146
600.0	.085	130	10.992	-91	.024	3	.112	132
700.0	.079	114	10.892	-107	.024	6	.110	116
800.0	.066	108	10.850	-123	.025	5	.101	98
900.0	.055	84	10.687	-138	.023	5	.087	79
1000.0	.046	92	10.566	-155	.023	3	.065	53
1100.0	.027	54	10.384	-170	.023	6	.044	14
1200.0	.016	47	10.312	175	.023	3	.042	-50
1300.0	.009	125	10.273	158	.022	1	.065	-98
1400.0	.031	99	10.145	143	.022	2	.098	-127
1500.0	.068	103	10.088	126	.022	-1	.135	-146
1600.0	.113	82	10.403	109	.023	-5	.172	-165
1700.0	.192	56	10.538	89	.024	-3	.198	177

V_{CC} = 12 V

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN dB
100.0	1.1	1.2	20.2
200.0	1.1	1.2	20.2
300.0	1.1	1.2	20.2
400.0	1.1	1.2	20.2
500.0	1.1	1.2	20.3
600.0	1.2	1.2	20.4
700.0	1.1	1.2	20.3
800.0	1.1	1.2	20.2
900.0	1.1	1.2	20.1
1000.0	1.1	1.1	20.0
1100.0	1.1	1.0	19.9
1200.0	1.1	1.1	19.8
1300.0	1.1	1.2	19.8
1400.0	1.1	1.2	19.7
1500.0	1.2	1.3	19.6
1600.0	1.4	1.4	19.8
1700.0	1.6	1.5	19.8

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.0	.059	175	10.202	-15	.025	2	.075	-180
200.0	.062	175	10.286	-30	.025	2	.081	175
300.0	.057	171	10.271	-45	.025	2	.089	167
400.0	.063	156	10.288	-61	.025	4	.097	158
500.0	.061	157	10.403	-76	.025	3	.103	145
600.0	.071	147	10.423	-92	.025	4	.104	132
700.0	.063	136	10.320	-108	.024	5	.098	117
800.0	.060	132	10.278	-124	.025	5	.087	100
900.0	.043	126	10.119	-140	.024	4	.071	82
1000.0	.040	130	10.054	-156	.023	3	.045	55
1100.0	.032	135	9.898	-172	.023	6	.024	3
1200.0	.030	120	9.815	173	.023	4	.036	-84
1300.0	.045	135	9.743	156	.022	2	.070	-120
1400.0	.070	114	9.642	140	.024	3	.107	-141
1500.0	.104	95	9.532	123	.024	1	.145	-158
1600.0	.162	75	9.812	106	.025	-3	.180	-176
1700.0	.242	52	9.823	85	.026	-3	.204	167

WJ-A25

5 TO 1500 MHz
TO-8 CASCADABLE AMPLIFIER

- MEDIUM OUTPUT LEVEL: +8 dBm (TYP.)
- WIDE POWER SUPPLY RANGE: +8 TO +15 VOLTS

Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	1-1600 MHz	5-1500 MHz	5-1500 MHz
Small Signal Gain (Min.)	10 dB	9 dB	8 dB
Gain Flatness (Max.)	<±0.3 dB	±0.6 dB	±1.0 dB
Noise Figure (Max.)	6.0 dB	7.5 dB	8.0 dB
Power Output at 1 dB Compression (Min.)	+9 dBm	+7 dBm	+6.5 dBm
VSWR (Max.) Input/Output	<1.5:1	2.0:1	2.0:1
DC Current (Max.) at 15 Volts	24 mA	27 mA	29 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +38 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +33 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +21 dBm (Typ.)

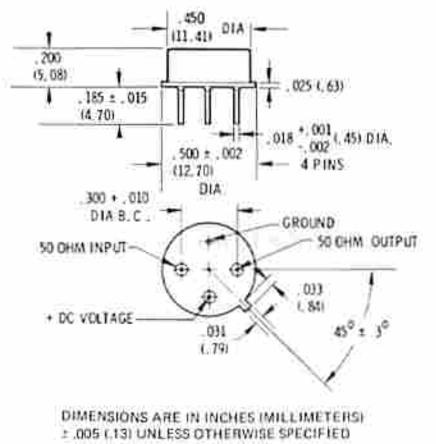
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . +17 dBm (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

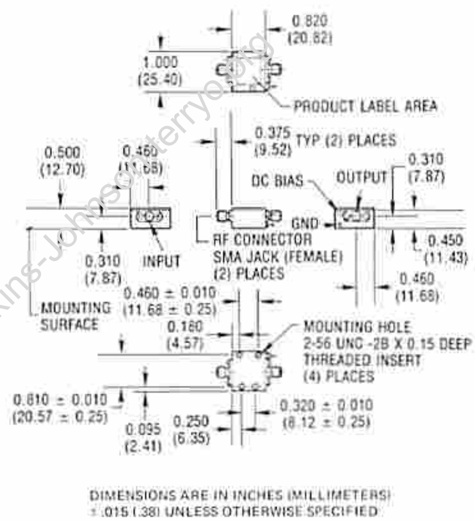
Weight approximately 2.0 grams (0.07 oz.)

Outline Drawings

A25



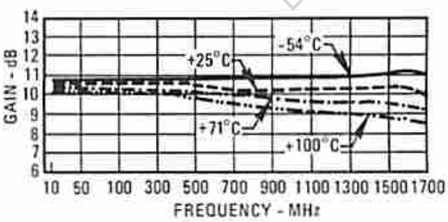
CA25



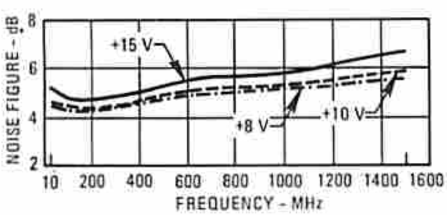
*WJ CA25 is standard WJ A25 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

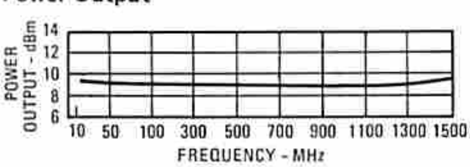
Gain



Noise Figure

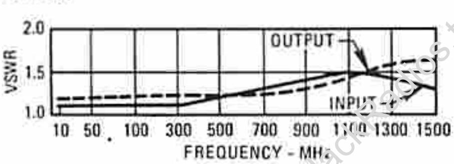


Power Output*



* at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.0	1.2	10.6
200.	1.0	1.1	10.6
300.	1.1	1.1	10.6
400.	1.1	1.1	10.5
500.	1.1	1.0	10.5
600.	1.2	1.1	10.4
700.	1.2	1.1	10.3
800.	1.3	1.2	10.2
900.	1.3	1.2	10.3
1000.	1.4	1.2	10.3
1100.	1.4	1.3	10.3
1200.	1.5	1.3	10.3
1300.	1.5	1.4	10.3
1400.	1.4	1.4	10.4
1500.	1.4	1.5	10.4
1600.	1.4	1.5	10.3

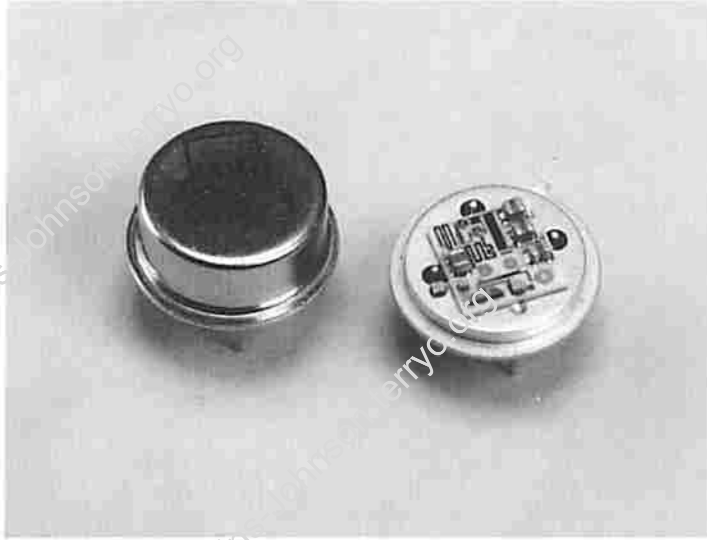
Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.02	-97.9	3.40	163.0	.14	-6.9	.08	175.1
200.	.02	-47.3	3.40	149.2	.13	-11.5	.07	163.9
300.	.03	-61.4	[illegible]	136.2	.14	-16.6	.05	150.8
400.	.04	-66.8	[illegible]	121.9	.14	-22.6	.03	140.3
500.	.06	-74.2	3.34	108.6	.14	-28.9	.01	52.9
600.	.08	-86.6	3.30	94.2	.14	-35.8	.03	-37.1
700.	.10	[illegible]	3.28	79.0	.14	-41.4	.05	-48.8
800.	.12	[illegible]	3.25	64.7	.13	-48.3	.07	-68.3
900.	.14	-119.1	3.27	49.2	.14	-54.8	.09	-82.0
1000.	.16	-132.9	3.28	33.6	.14	-60.7	.10	[illegible]
1100.	.18	-148.0	3.26	19.1	.14	-67.5	.12	-111.8
1200.	.19	-166.6	3.27	4.2	.14	-74.4	.14	-129.1
1300.	.19	175.7	3.27	-11.9	.14	-82.2	.15	-146.4
1400.	.18	150.8	3.30	-29.8	.15	-91.7	.17	-162.7
1500.	.17	120.5	3.31	-48.7	.15	-100.3	.19	177.4
1600.	.17	78.4	3.26	-68.7	.16	-111.6	.20	159.8
1700.	.21	27.7	3.13	-89.8	.17	-124.4	.19	138.6

WJ-A25-1

2 TO 1500 MHz TO-8 CASCADABLE AMPLIFIER

- LOW NOISE: <3.5 dB (TYP.)
- MEDIUM POWER OUT: 9.0 dBm (TYP.)
- LOW VSWR: <1.7:1 VSWR (TYP.)
- WIDE POWER SUPPLY RANGE: +5 to +15 VOLTS



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	1-1600 MHz	2-1500 MHz	2-1500 MHz
Small Signal Gain (Min.)	13.5 dB	13.0 dB	12.5 dB
Gain Flatness (Max.)	±0.4 dB	±0.5 dB	±0.7 dB
Noise Figure (Max.)			
10-600	⩽3.0 dB	3.5 dB	4.0 dB
2-1500	⩽3.8 dB	4.5 dB	5.0 dB
Power Output at 1 dB	9.0 dBm	8.0 dBm	7.5 dBm
VSWR (Max.) Input/Output	⩽1.7:1/1.2:1	2.0:1	2.0:1
DC Current (Max.) at 15 Volts	24 mA	27 mA	28 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . ⩾36 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . ⩾30 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . ⩾22 dBm (Typ.)

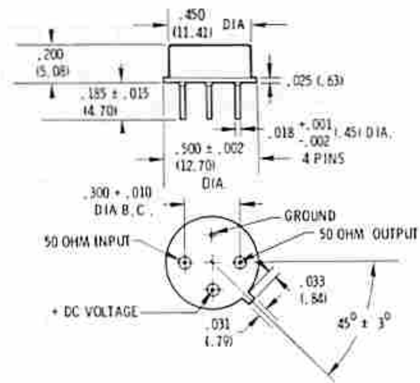
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +18 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . 50 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

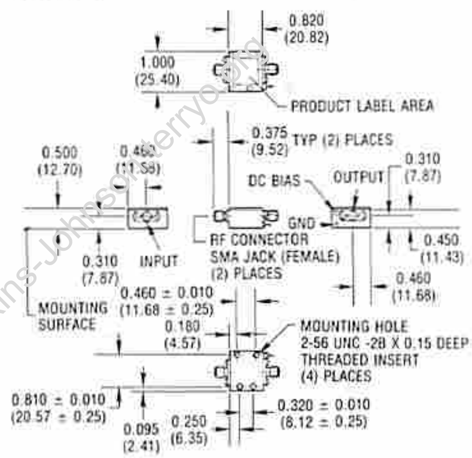
Outline Drawings

A25-1



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

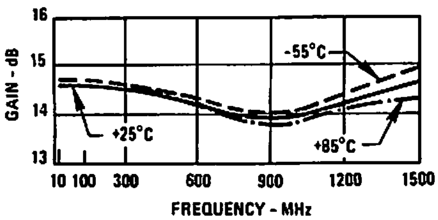
CA25-1



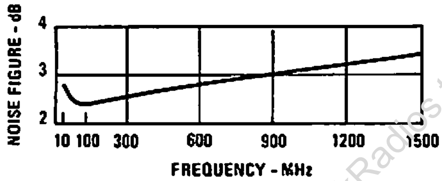
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C

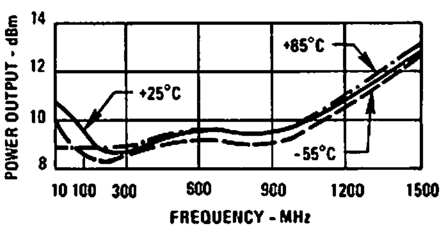
Gain



Noise Figure

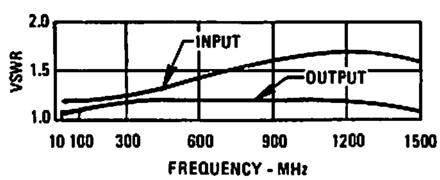


Power Output*

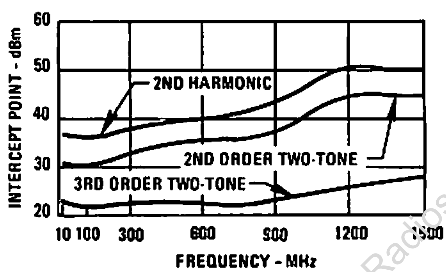


* at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.0	14.4
200.	1.3	1.0	14.2
300.	1.3	1.0	14.0
400.	1.4	1.1	13.9
500.	1.5	1.1	13.8
600.	1.5	1.2	13.8
700.	1.6	1.2	13.7
800.	1.7	1.3	13.5
900.	1.7	1.3	13.4
1000.	1.7	1.3	13.4
1100.	1.7	1.3	13.5
1200.	1.7	1.3	13.7
1300.	1.6	1.3	13.8
1400.	1.6	1.2	13.7
1500.	1.7	1.2	13.4
1600.	2.1	1.3	12.7

Linear S-Parameters

FREQ MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.11	-30.6	5.26	164.9	.10	-5.0	.01	155.4
200.	.12	-53.8	5.13	150.6	.10	-10.4	.02	76.6
300.	.14	-74.7	5.02	135.3	.10	-14.3	.02	29.1
400.	.16	-93.4	4.94	120.3	.10	-19.3	.04	-1.4
500.	.19	-104.1	4.89	105.8	.10	-25.8	.05	-25.1
600.	.22	-114.7	4.88	91.8	.10	-32.2	.07	-50.5
700.	.23	-123.9	4.83	78.6	.10	-38.1	.09	-67.1
800.	.25	-135.7	4.75	64.8	.11	-43.3	.11	-82.2
900.	.27	-147.7	4.68	50.7	.11	-48.9	.13	-99.3
1000.	.27	-158.4	4.68	36.5	.11	-54.6	.13	-115.4
1100.	.26	-173.8	4.75	21.3	.11	-58.5	.14	-132.8
1200.	.25	166.2	4.82	6.2	.12	-66.7	.14	-154.2
1300.	.24	141.0	4.88	-10.1	.12	-74.9	.12	-178.9
1400.	.23	103.1	4.84	-29.4	.13	-84.6	.09	145.9
1500.	.27	57.5	4.69	-50.8	.14	-96.0	.08	72.9
1600.	.36	17.5	4.34	-74.0	.14	-109.9	.13	10.1
1700.	.47	-16.3	3.78	-96.0	.13	-122.2	.21	-31.4

V_{CC} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
1.0	1.2	1.2	14.2
5.0	1.3	1.0	14.2
10.0	1.3	1.0	14.2
50.0	1.3	1.0	14.2
100.0	1.3	1.0	14.2

Linear S-Parameters

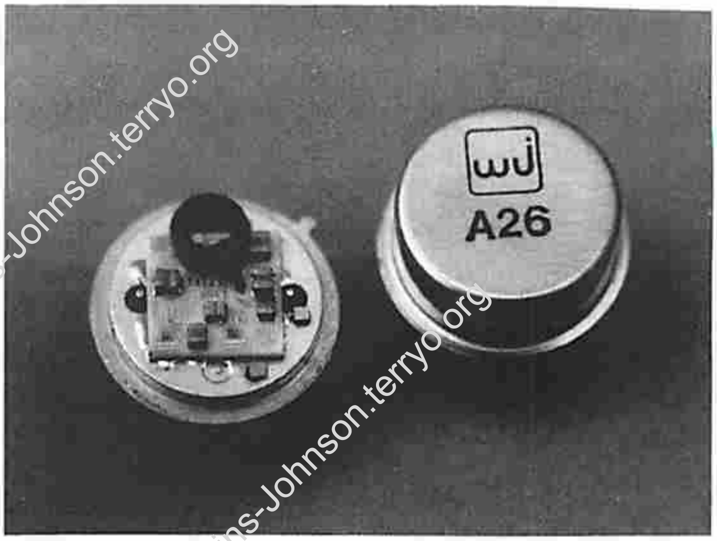
FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.1	-21	5.1	-166	0.1	16	0.1	-117
5.0	0.1	-10	5.1	-178	0.1	3	0.0	-96
10.0	0.1	-10	5.1	179	0.1	1	0.0	-107
50.0	0.1	-19	5.1	173	0.1	-4	0.0	-128
100.0	0.1	-25	5.1	164	0.1	-7	0.0	-162

1

WJ-A26

10 TO 1500 MHz TO-8 CASCADABLE AMPLIFIER

- HIGH GAIN – TWO STAGES: 20.5 dB (TYP)
- HIGH OUTPUT LEVEL +15 dBm (TYP)
- LOW VSWR <1.4:1 (TYP)



Specifications*

Characteristics	Typical	Guaranteed 0° – 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	10-1600 MHz	10-1500 MHz	10-1500 MHz
Small Signal Gain (Min.)	20.5 dB	19.0 dB	18.5 dB
Gain Flatness (Max.)	±0.4 dB	±0.6 dB	±0.8 dB
Noise Figure (Max.)	5.0 dB	5.5 dB	6.0 dB
Power Output at 1 dB Compression (Min.)			
10–1000 MHz	+14.0 dBm	+13.0 dBm	+12.5 dBm
1000–1500 MHz	+16.0 dBm	+15.0 dBm	+14.5 dBm
VSWR (Max.) Input/Output	<1.4:1	1.7:1	2.0:1
DC Current (Max.) at 15 Volts	64 mA	67 mA	70 mA

* Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

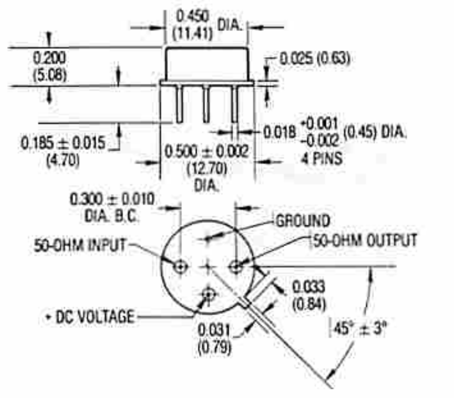
Second Order Harmonic Intercept Point .... +51 dBm (Typ.)
Second Order Two Tone Intercept Point .... +45 dBm (Typ.)
Third Order Two Tone Intercept Point .... +27 dBm (Typ.)

Absolute Maximum Ratings

Storage Temperature .... -62°C to +125°C
Maximum Case Temperature .... 125°C
Maximum DC Voltage .... +17 Volts
Maximum Continuous RF Input Power .... +10 dBm
Maximum Short Term RF Input Power .... +100 Milliwatts (1 Minute Max.)
Maximum Peak Power .... 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) .... 125°C

Outline Drawings

A26

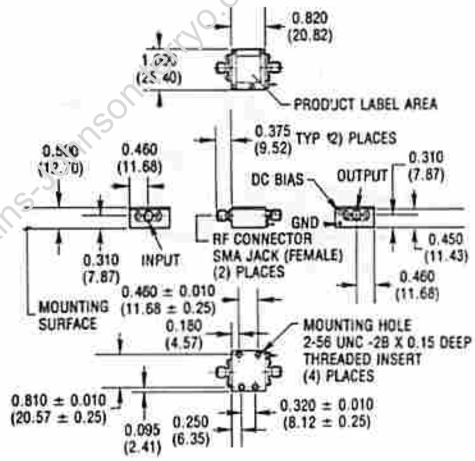


DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

Weight

approximately 2.0 grams (0.07 oz.)

CA26

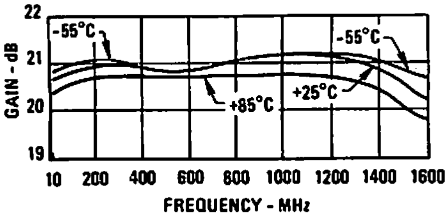


DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

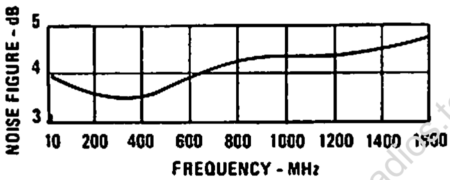
*WJ-CA26 is standard WJ-A26 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

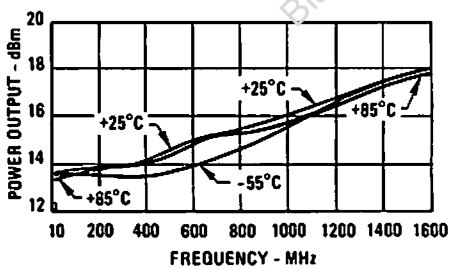
Gain



Noise Figure

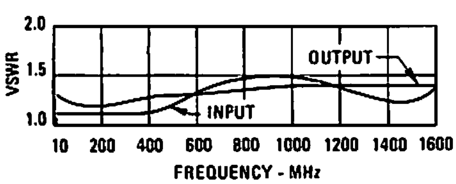


Power Output*

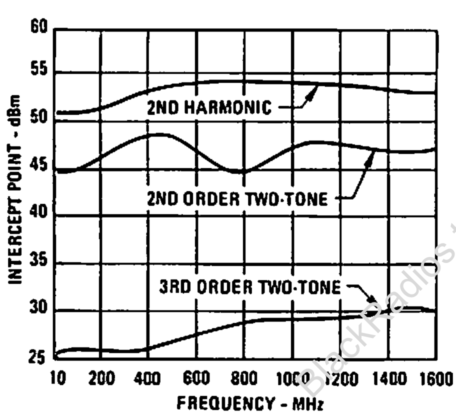


*@ 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{cc} = 12 V

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
100.0	1.0	1.1	20.7
200.0	1.1	1.2	21.1
300.0	1.2	1.2	20.9
400.0	1.3	1.1	20.6
500.0	1.3	1.1	20.6
600.0	1.3	1.1	20.6
700.0	1.3	1.2	20.7
800.0	1.4	1.2	20.8
900.0	1.3	1.3	20.9
1000.0	1.4	1.3	21.1
1100.0	1.3	1.4	21.1
1200.0	1.2	1.5	21.0
1300.0	1.2	1.5	21.1
1400.0	1.1	1.5	20.8
1500.0	1.3	1.5	20.4

GMAX = 21.1 GMIN = 20.4 FLAT +/- 0.35

V_{cc} = 15 V

FREQ MHz	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.2	21.1
200.	1.1	1.2	21.1
300.	1.1	1.2	21.2
400.	1.1	1.3	21.2
500.	1.2	1.3	21.2
600.	1.2	1.3	21.2
700.	1.3	1.3	21.3
800.	1.3	1.3	21.3
900.	1.4	1.4	21.3
1000.	1.4	1.4	21.2
1100.	1.5	1.3	21.2
1200.	1.4	1.3	21.3
1300.	1.4	1.3	21.2
1400.	1.2	1.3	21.0
1500.	1.1	1.3	20.6
1600.	1.2	1.3	20.0

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.02	55.2	11.37	-19.3	.03	-2.0	.10	165.0
200.	.04	50.4	11.40	-39.5	.03	-2.9	.10	156.0
300.	.05	44.6	11.46	-59.9	.03	-4.7	.10	147.6
400.	.05	37.9	11.52	-79.5	.03	-7.0	.11	134.1
500.	.07	25.6	11.49	-100.9	.03	-9.3	.12	117.6
600.	.09	5.5	11.52	-121.1	.03	-14.0	.13	105.1
700.	.12	1.3	11.63	-141.4	.03	-18.6	.14	93.3
800.	.13	-13.7	11.58	-162.0	.03	-22.3	.15	64.9
900.	.15	-33.6	11.67	177.9	.03	-27.5	.15	42.3
1000.	.18	-53.1	11.52	158.4	.03	-31.7	.15	15.9
1100.	.19	-72.0	11.51	137.2	.03	-37.2	.15	-5.2
1200.	.18	-94.1	11.59	116.2	.03	-44.1	.14	-33.2
1300.	.16	-120.6	11.54	93.1	.04	-51.5	.14	-66.0
1400.	.11	-143.5	11.16	68.1	.04	-60.6	.14	-101.2
1500.	.02	-125.5	10.76	42.8	.04	-71.0	.14	-138.3
1600.	.11	-33.9	9.96	18.1	.04	-81.3	.15	-177.8
1700.	.25	-58.6	8.89	-7.6	.04	-91.4	.15	144.2
1800.	.29	-87.3	7.54	-32.1	.03	-101.6	.15	102.0

WJ-A27

10 TO 1500 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT LEVEL: +15.5dBm (TYP.)
- HIGH THIRD ORDER I.P.: +28 dBm (TYP.)
- WIDE POWER SUPPLY RANGE: +5 TO +15 VOLTS

Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	5-1600 MHz	10-1500 MHz	10-1500 MHz
Small Signal Gain (Min.)	8.5 dB	7.5 dB	7.0 dB
Gain Flatness (Max.)	±0.2 dB	±0.6 dB	±1.0 dB
Noise Figure (Max.)	7.5 dB	9.0 dB	9.5 dB
Power Output at 1 dB Compression (Min.)	+15.5 dBm	+14 dBm	+13.5 dBm
VSWR (Max.) Input/Output	<1.5:1	1.9:1	2.0:1
DC Current (Max.) at 15 Volts	50 mA	54 mA	57 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . . . +50 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . . . +46 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . . . +28 dBm (Typ.)

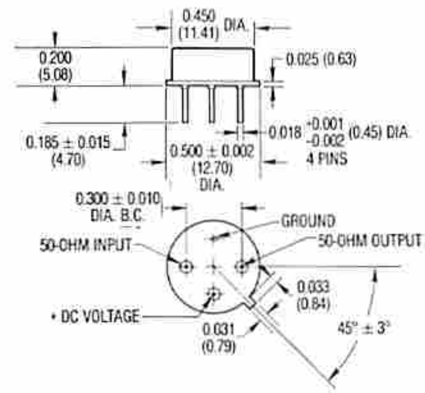
Absolute Maximum Ratings

Storage Temperature . . . . . . -62°C to +125°C
Maximum Case Temperature . . . . . . 125°C
Maximum DC Voltage . . . . . . +17 Volts
Maximum Continuous RF Input Power . . . . . . +13 dBm
Maximum Short Term RF Input Power . . . . . . +17 dBm (1 Minute Max.)
Maximum Peak Power . . . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

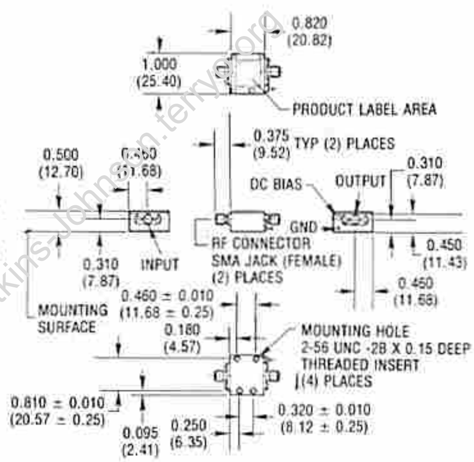
Outline Drawings

A27



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA27

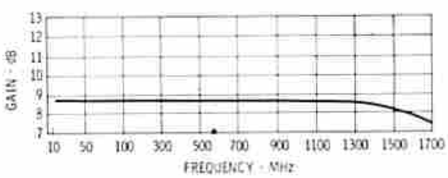


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

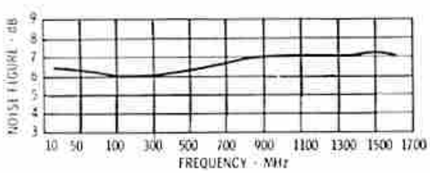
*WJ CA27 is standard WJ A27 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

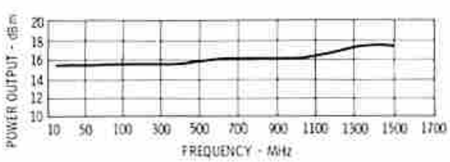
Gain



Noise Figure

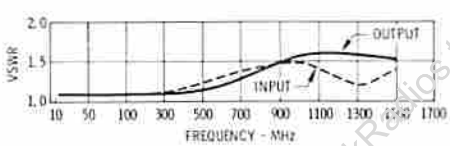


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.1	8.2
200.	1.1	1.1	8.4
300.	1.2	1.1	8.5
400.	1.2	1.2	8.5
500.	1.3	1.3	8.4
600.	1.3	1.3	8.4
700.	1.4	1.4	8.3
800.	1.4	1.4	8.2
900.	1.5	1.5	8.3
1000.	1.5	1.5	8.3
1100.	1.5	1.5	8.3
1200.	1.4	1.5	8.3
1300.	1.4	1.5	8.3
1400.	1.3	1.5	8.3
1500.	1.4	1.5	8.2
1600.	1.7	1.5	7.8

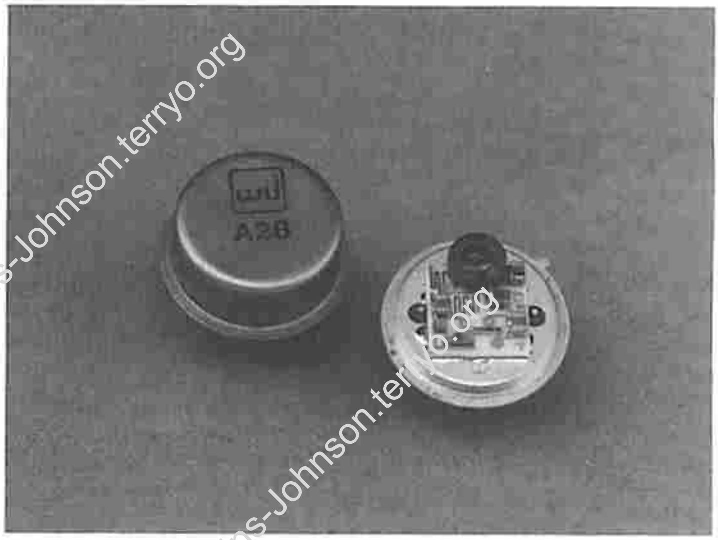
Linear S-Parameters

FREQ MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.05	-95.6	2.58	163.5	.18	-6.8	.03	.142.4
200.	.07	-99.0	2.62	149.1	.18	-12.0	.04	65.4
300.	.08	-109.0	2.65	134.2	.17	-17.9	.06	26.1
400.	.11	-119.4	[illegible]	119.0	.17	-27.5	.08	.3
500.	.12	-126.4	2.64	104.4	.18	-33.7	.11	-13.2
600.	.15	-133.9	2.62	88.5	.17	-41.7	.14	-32.1
700.	.16	-141.4	2.61	72.0	.17	-48.8	.16	-43.2
800.	.17	-148.5	2.58	56.7	.17	-56.0	.18	-59.9
900.	.19	[illegible]	2.59	39.8	.17	-62.7	.20	[illegible]
1000.	.19	[illegible]	2.61	23.5	.17	-69.5	.20	[illegible]
1100.	.19	174.5	2.61	7.5	.17	-76.7	.21	-103.7
1200.	.18	154.9	2.60	-0.7	.17	-85.4	.21	-123.9
1300.	.16	130.2	2.60	-26.9	.18	-96.1	.21	-141.9
1400.	.15	88.8	2.60	-46.5	.19	-106.3	.21	-161.4
1500.	.17	42.4	2.56	-66.6	.19	-118.8	.21	177.1
1600.	.26	-.0	2.45	-87.8	.20	-132.7	.19	155.4
1700.	.38	-30.1	2.31	-109.8	.20	-148.0	.14	132.0

WJ-A28

10 TO 1500 MHz TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT LEVEL: +15 dBm (TYP.)
- HIGH THIRD ORDER I.P.: +29 dBm (TYP.)
- HIGH GAIN: 11 dB (TYP.)
- WIDE POWER SUPPLY RANGE: +5 TO +15 VOLTS



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	5-1600 MHz	10-1500 MHz	10-1500 MHz
Small Signal Gain (Min.)	11 dB	10 dB	9.5 dB
Gain Flatness (Max.)	±0.2 dB	±0.6 dB	±1.0 dB
Noise Figure (Max.)	6.0 dB	7.0 dB	7.5 dB
Power Output at 1 dB Compression (Min.)	+15 dBm	+14 dBm	+13.5 dBm
VSWR (Max.) Input/Output	<1.5:1	2.0:1	2.0:1
DC Current (Max.) at 15 Volts	45 mA	50 mA	53 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +49 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +44 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +29 dBm (Typ.)

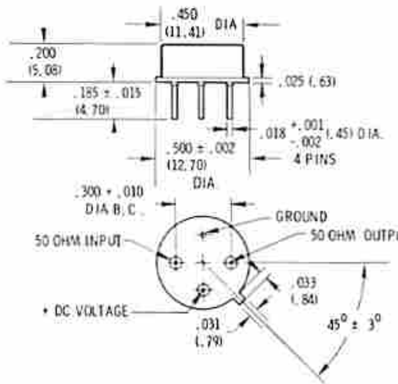
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . +17 dBm (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 µsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

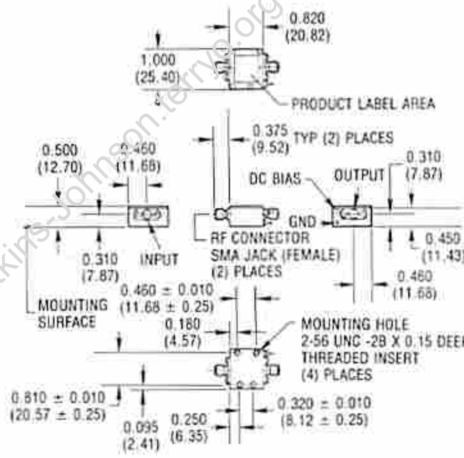
Outline Drawings

A28



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA28



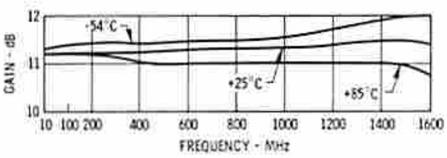
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

*WJ CA28 is standard WJ A28 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

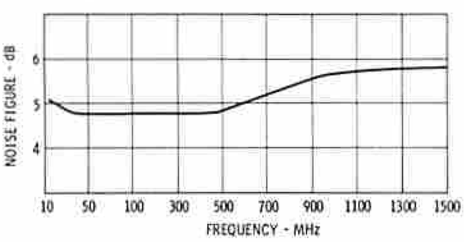
1

Typical Performance at 25°C

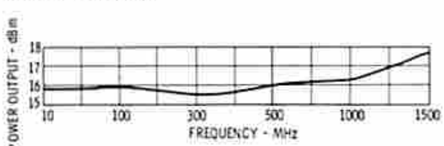
Gain



Noise Figure

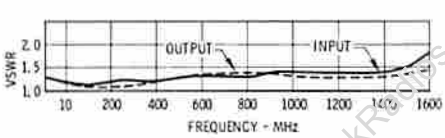


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.0	11.4
200.	1.2	1.1	11.5
300.	1.2	1.1	11.4
400.	1.2	1.2	11.5
500.	1.3	1.3	11.4
600.	1.3	1.3	11.3
700.	1.3	1.3	11.2
800.	1.4	1.4	11.0
900.	1.4	1.4	11.0
1000.	1.4	1.3	11.0
1100.	1.4	1.3	11.0
1200.	1.4	1.3	11.1
1300.	1.4	1.3	11.1
1400.	1.4	1.3	11.2
1500.	1.5	1.4	11.2
1600.	1.9	1.5	11.0

Linear S-Parameters

FREQ MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.10	-34.3	3.71	164.7	.15	-3.9	.02	76.1
200.	.10	-43.1	3.75	149.8	.14	-8.6	.05	22.3
300.	.10	-61.5	3.73	135.1	.15	-13.8	.07	3.3
400.	.11	-74.9	3.75	120.0	.15	-20.5	.09	-11.9
500.	.12	-86.5	3.70	105.1	.15	-27.2	.11	-25.3
600.	.13	-100.6	3.65	90.0	.15	-33.5	.13	-40.4
700.	.13	-110.9	3.61	73.8	.15	-39.0	.14	-50.7
800.	.15	-122.7	3.56	58.4	.15	-46.8	.15	-66.1
900.	.16	-135.6	3.54	42.0	.16	-53.5	.15	-80.4
1000.	.16	-152.5	3.56	26.2	.16	-61.3	.15	-96.0
1100.	.17	-169.2	3.56	10.7	.16	-68.2	.15	-116.2
1200.	.16	166.5	3.57	-5.5	.17	-78.2	.14	-141.2
1300.	.15	138.8	3.58	-23.1	.18	-89.2	.14	-170.1
1400.	.16	95.0	3.63	-42.9	.18	-101.8	.15	157.6
1500.	.20	50.2	3.63	-63.9	.18	-115.9	.17	124.5
1600.	.31	6.7	3.54	-86.8	.19	-133.1	.20	86.5
1700.	.46	-27.7	3.31	-111.6	.18	-150.8	.24	46.3

WJ-A28-2

10 TO 1500 MHz
TO-8 CASCADABLE AMPLIFIER

- LOW NOISE: 3.5 dB (TYP)
- HIGH EFFICIENCY: 27 mA (TYP) AT 5 VOLTS
- GOOD DYNAMIC RANGE: 105 dB (TYP) IN 1 MHz BW
- LOW VSWR: <1.5:1 (TYP)

Specifications *

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed 54°C - +85°C
Frequency (Min.)	5 - 1600 MHz	10 - 1500 MHz	10-1500 MHz
Small Signal Gain (Min.)	14.0 dB	13.0 dB	12.5 dB
Gain Flatness (Max.)	±.3 dB	±.5 dB	±1.0 dB
Noise Figure (Max.)	3.5 dB	4.5 dB	5.0 dB
Power Output at 1 dB Compression (Min.)			
10 - 1500 MHz	10.0 dBm	7.5 dBm	7.0 dBm
10 - 1000 MHz	10.5 dBm	9.5 dBm	8.5 dBm
VSWR (Max.)			
Input	<1.3:1	1.8:1	1.9:1
Output	<1.5:1	1.9:1	2.0:1
DC Current (Max.) at +5 Volts	27 mA	30 mA	32 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point	+40 dBm (Typ.)
Second Order Two Tone Intercept Point	+34 dBm (Typ.)
Third Order Two Tone Intercept Point	+24 dBm (Typ.)

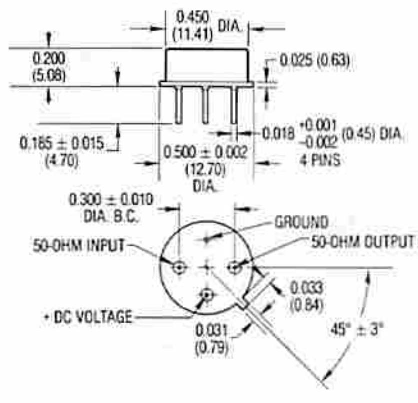
Absolute Maximum Ratings

Storage Temperature	-62°C to +125°C
Maximum Case Temperature	+125°C
Maximum DC Voltage	+8 Volts
Maximum Continuous RF Input Power	+13 dBm
Maximum Short Term RF Input Power (1 Minute Max.)	50 Milliwatts
Maximum Peak Power	.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case)	125°C

Weight approximately 2.0 grams (0.07 oz.)

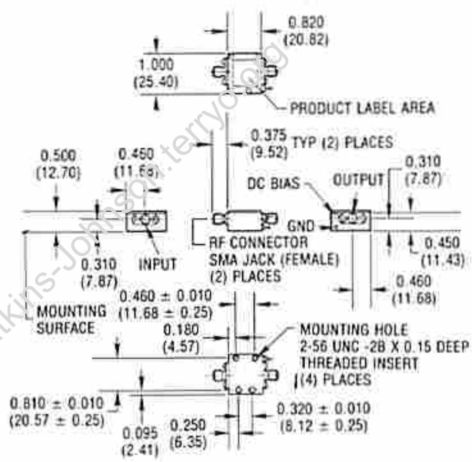
Outline Drawings

A28 -2



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

CA28 - 2

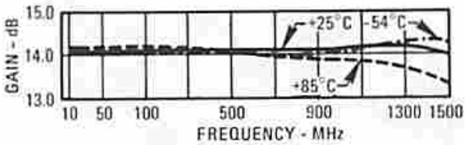


DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

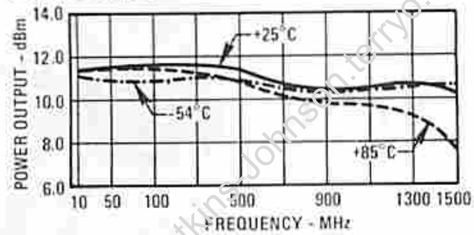
*WJ-CA28-2 is standard and WJ-A28-2 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

Gain

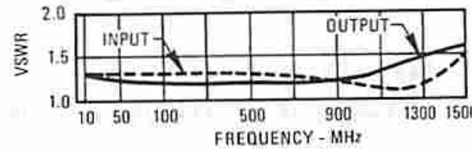


Power Output*

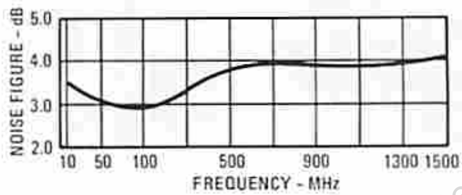


*@ 1 dB Gain Compression

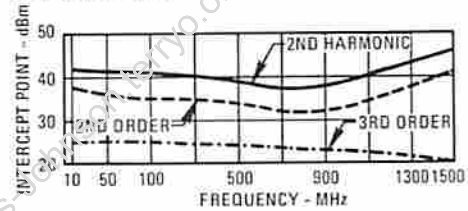
VSWR



Noise Figure



Intercept Point



Typical Automatic Test Data

V_{CC} = +8 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
100.0	1.6	1.6	14.1
200.0	1.3	1.3	14.5
300.0	1.4	1.4	14.2
400.0	1.4	1.3	14.2
500.0	1.3	1.2	14.0
600.0	1.3	1.3	14.0
700.0	1.3	1.2	14.0
800.0	1.3	1.1	14.0
900.0	1.3	1.2	13.8
1000.0	1.2	1.1	13.8
1100.0	1.3	1.1	13.7
1200.0	1.3	1.1	13.5
1300.0	1.3	1.1	13.4
1400.0	1.5	1.2	13.1
1500.0	1.6	1.2	12.8
1600.0	1.8	1.3	12.6
1700.0	2.2	1.4	11.9

Linear S-Parameters

FREQUENCY MHz	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.0	0.234	160	5.07	160	0.11	-5	0.217	157
200.0	0.144	155	5.31	149	0.12	-14	0.116	149
300.0	0.182	150	5.13	136	0.11	-21	0.152	141
400.0	0.149	130	5.13	120	0.12	-27	0.119	128
500.0	0.144	129	5.01	109	0.12	-35	0.108	118
600.0	0.142	112	5.01	96	0.12	-42	0.114	99
700.0	0.130	107	5.01	80	0.12	-48	0.098	89
800.0	0.120	93	5.01	63	0.12	-57	0.064	64
900.0	0.126	82	4.90	48	0.12	-66	0.097	48
1000.0	0.086	70	4.90	33	0.12	-76	0.029	56
1100.0	0.114	53	4.84	19	0.12	-83	0.046	72
1200.0	0.142	38	4.73	3	0.13	-91	0.069	29
1300.0	0.143	40	4.68	-14	0.13	-102	0.068	14
1400.0	0.208	28	4.52	-29	0.13	-113	0.086	-8
1500.0	0.230	21	4.37	-49	0.13	-124	0.103	-30
1600.0	0.207	9	4.27	-67	0.13	-136	0.131	[illegible]
1700.0	0.384	-9	3.94	-85	0.13	-146	0.179	-54

V_{CC} = +5 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
100.0	1.5	1.4	13.8
200.0	1.3	1.2	14.2
300.0	1.3	1.3	14.0
400.0	1.2	1.2	14.1
500.0	1.2	1.3	14.0
600.0	1.2	1.3	14.1
700.0	1.2	1.3	14.1
800.0	1.2	1.2	14.1
900.0	1.2	1.3	14.0
1000.0	1.1	1.3	14.1
1100.0	1.1	1.4	14.1
1200.0	1.2	1.4	14.0
1300.0	1.2	1.4	14.0
1400.0	1.4	1.5	13.8
1500.0	1.5	1.5	13.6
1600.0	1.8	1.6	13.4
1700.0	2.2	1.8	12.8

Linear S-Parameters

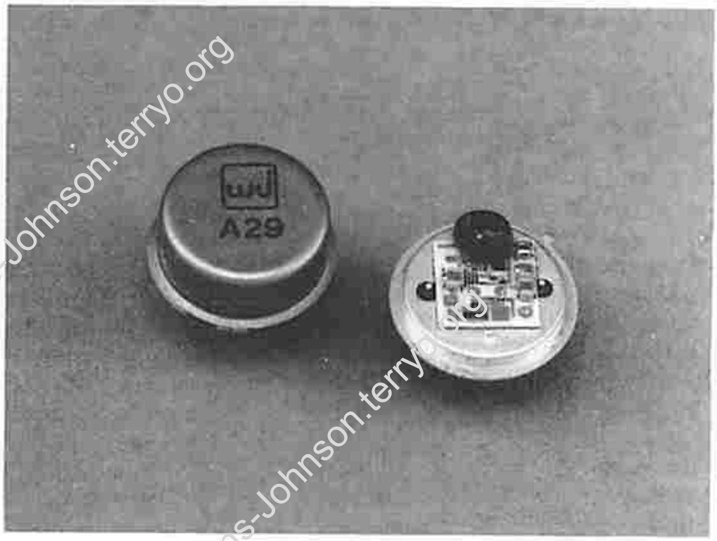
FREQUENCY MHz	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.0	0.197	163	4.90	160	0.11	-6	0.183	158
200.0	[illegible]	153	5.13	151	0.11	-15	0.089	167
300.0	0.148	150	5.01	137	0.12	-20	0.140	157
400.0	0.108	136	5.07	123	0.12	-26	0.111	152
500.0	0.107	126	5.01	111	0.12	-33	0.113	151
600.0	0.106	109	5.07	99	0.12	-38	0.124	136
700.0	0.085	104	5.07	82	0.13	-45	0.118	138
800.0	0.076	90	5.07	66	0.13	-54	0.101	134
900.0	0.084	84	5.01	51	0.13	-64	0.127	106
1000.0	0.035	76	5.07	37	0.14	-72	0.124	129
1100.0	0.063	60	5.07	22	0.14	-79	0.165	114
1200.0	0.090	47	5.01	5	0.14	-88	0.172	86
1300.0	0.095	63	5.01	-12	0.15	[illegible]	0.182	72
1400.0	0.169	45	4.90	-27	0.15	-112	0.193	51
1500.0	0.211	40	4.79	-40	0.16	-124	0.202	29
1600.0	0.280	24	4.68	-67	0.16	-135	0.242	0
1700.0	0.380	2	4.37	-85	0.16	-149	0.298	-16

1

WJ-A29

10 TO 1500 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT POWER: +22 dBm (TYP.)
- HIGH THIRD ORDER I.P.: +34 dBm (TYP.)
- WIDE POWER SUPPLY RANGE: +10 TO +18 VOLTS
- NEW HIGHER GAIN: 6.5 dB (TYP.)
- IMPROVED FLATNESS: ±0.2 dB (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	5-1700 MHz	10-1500 MHz	10-1500 MHz
Small Signal Gain (Min.)	6.5 dB	5.5 dB	5.0 dB
Gain Flatness (Max.)	±0.2 dB	±0.5 dB	±0.7 dB
Noise Figure (Max.)	9.0 dB	10.0 dB	10.5 dB
Power Output at 1 dB Compression (Min.)	+22.0 dBm	+20.0 dBm	+19.5 dBm
VSWR (Max.) Input/Output	<1.7:1	2.0:1	2.0:1
DC Current (Max.) at 15 Volts	105 mA	107 mA	109 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Third Order Two Tone Intercept Point . . . . +34 dBm

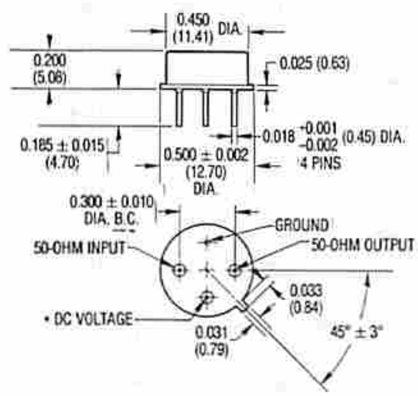
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 85°C
Maximum DC Voltage . . . . +18 Volts
Maximum Continuous RF Input Power . . . . +19 dBm
Maximum Short Term RF Input Power . . . . +21 dBm (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 85°C

Weight approximately 2.0 grams (0.07 oz.)

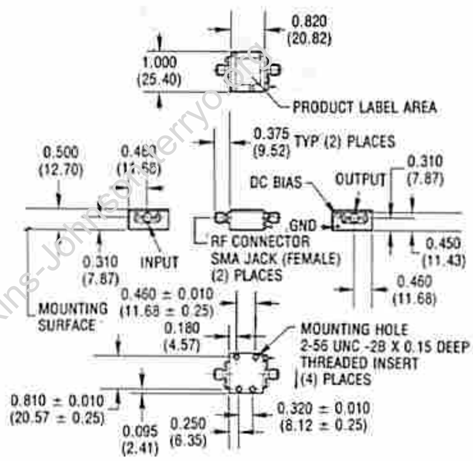
Outline Drawings

A29



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA29

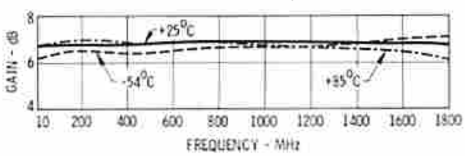


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

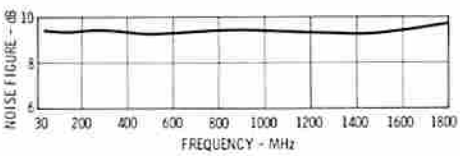
*WJ CA29 is standard WJ A29 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

Typical Performance at 25°C

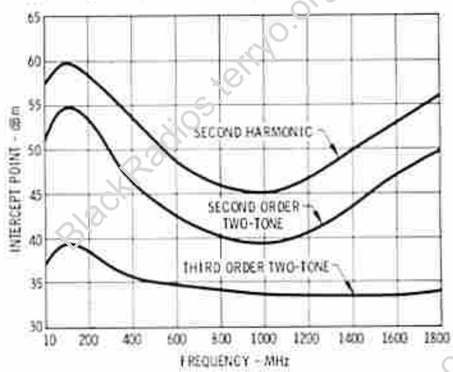
Gain



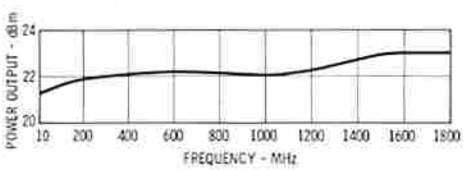
Noise Figure

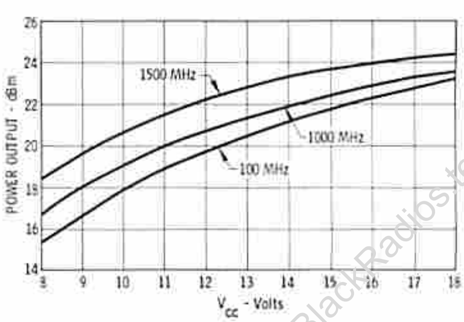


Intercept Point



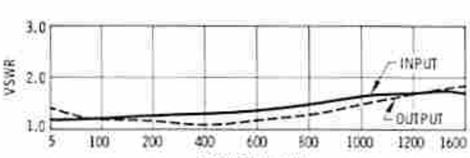
Power Output *





*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 12 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.3	1.3	6.3
200.	1.3	1.2	6.3
300.	1.4	1.2	6.3
400.	1.3	1.2	6.4
500.	1.4	1.1	6.5
600.	1.4	1.1	6.5
700.	1.4	1.2	6.5
800.	1.5	1.3	6.4
900.	1.5	1.3	6.4
1000.	1.6	1.4	6.4
1100.	1.6	1.5	6.4
1200.	1.6	1.6	6.5
1300.	1.7	1.7	6.5
1400.	1.7	1.7	6.4
1500.	1.6	1.8	6.5
1600.	1.6	1.7	6.5
1700.	1.5	1.8	6.5

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.3	1.3	6.4
200.	1.3	1.3	6.5
300.	1.3	1.2	6.5
400.	1.3	1.2	6.6
500.	1.3	1.1	6.7
600.	1.4	1.1	6.7
700.	1.4	1.1	6.7
800.	1.5	1.2	6.6
900.	1.5	1.3	6.6
1000.	1.6	1.4	6.6
1100.	1.6	1.5	6.6
1200.	1.6	1.6	6.7
1300.	1.7	1.6	6.6
1400.	1.7	1.7	6.6
1500.	1.7	1.7	6.6
1600.	1.6	1.7	6.6
1700.	1.6	1.7	6.6

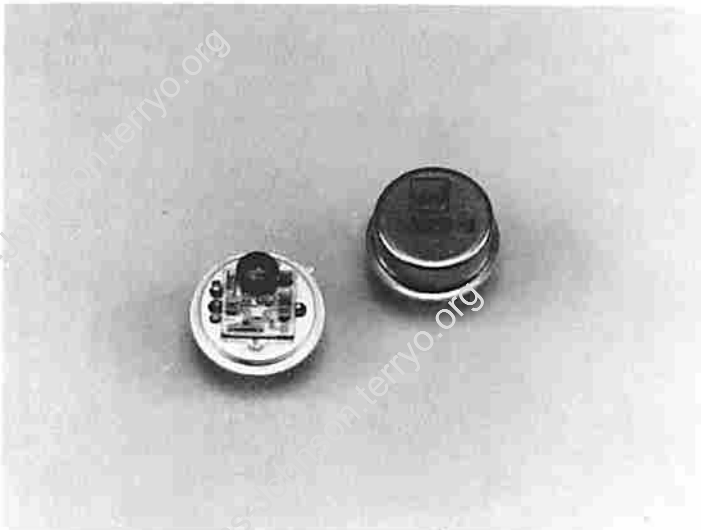
Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.14	-176.6	2.10	169.3	.20	-3.4	.12	169.4
200.	.14	-169.6	2.11	156.4	.20	-6.8	.11	164.8
300.	.14	-168.4	2.10	144.2	.20	-10.1	.09	168.6
400.	.14	-165.1	2.14	131.9	.20	-13.6	.07	168.1
500.	.15	-161.0	2.16	119.9	.20	-17.2	.05	172.6
600.	.16	-160.5	2.16	107.6	.20	-22.0	.04	-153.9
700.	.16	-155.5	2.15	95.7	.20	-26.1	.05	-117.7
800.	.19	-158.1	2.13	83.9	.21	-30.8	.09	-113.7
900.	.20	-158.0	2.14	70.8	.20	-34.4	.12	-116.1
1000.	.22	-160.5	2.13	58.3	.20	-39.2	.15	-124.6
1100.	.23	-166.1	2.13	45.5	.21	-43.3	.19	-132.9
1200.	.24	-172.2	2.15	32.4	.21	-47.5	.22	-143.9
1300.	.25	170.6	2.15	19.9	.21	-52.6	.24	-154.2
1400.	.25	167.8	2.14	6.2	.22	-58.1	.25	-166.9
1500.	.25	154.2	2.14	-7.0	.23	-63.6	.26	170.0
1600.	.24	137.6	2.14	-20.9	.24	-70.4	.26	161.1
1700.	.22	111.5	2.14	-36.1	.26	-78.4	.27	141.1
1800.	.22	88.8	2.11	-51.0	.27	-87.7	.26	117.9

WJ-A29-1

10 TO 1500 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT POWER: +22 dBm (TYP.)
- HIGH THIRD ORDER I.P.: > 33 dBm (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	-54°C - +85°C
Frequency (Min.)	10-1600 MHz	10-1500 MHz	10-1500 MHz
Small Signal Gain (Min.)	9.0 dB	8.5 dB	7.5 dB
Gain Flatness (Max.)	±0.2 dB	±0.5 dB	±1.0 dB
Noise Figure (Max.)			
30-1000 MHz	7.0 dB	8.5 dB	9.0 dB
10-1500 MHz	8.0 dB	9.0 dB	9.5 dB
Power Output at 1 dB Compression (Min.)	+22.0 dBm	+20.0 dBm	+19.0 dBm
VSWR (Max.) Input/Output	1.6:1	2.0:1	2.0:1
DC Current (Max.) at 15 Volts	90 mA	94 mA	99 mA

* Measured in a 50-ohm system at 15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . . +57 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . . +49 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . . +32 dBm (Typ.)

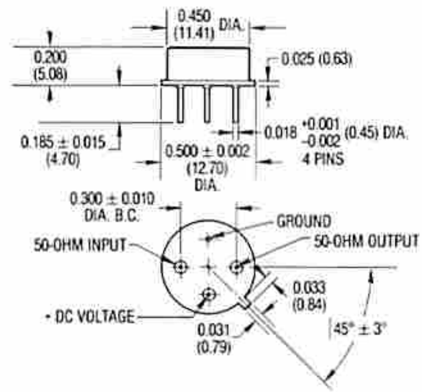
Absolute Maximum Ratings

Storage Temperature . . . . . -62°C to +125°C
Maximum Case Temperature . . . . . 100°C
Maximum DC Voltage . . . . . +17 Volts
Maximum Continuous RF Input Power . . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . . 100 Milliwatts
Maximum Peak Power . . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-in Temperature (Case) . . . . . +100°C

Weight approximately 2.0 grams (0.07 oz.)

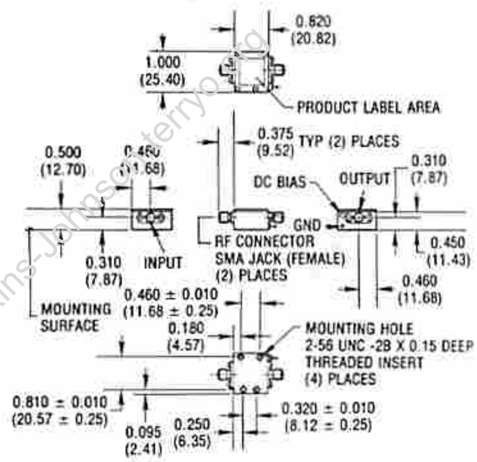
Outline Drawings

A29-1



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA29-1

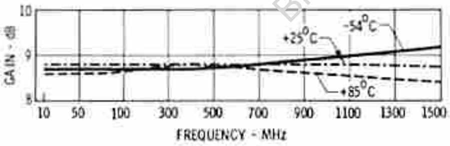


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

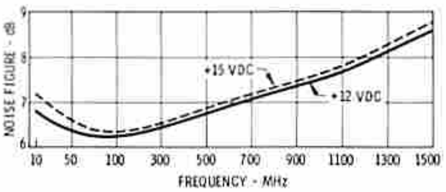
*WJ CA29-1 is standard WJ A29-1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

Typical Performance at 25°C

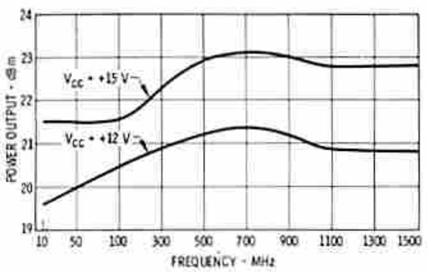
Gain



Noise Figure

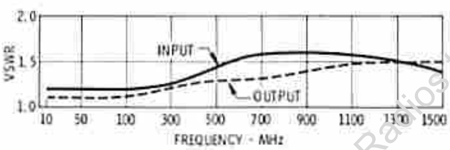


Power Output*

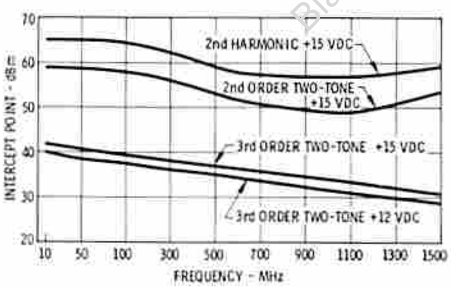


* at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.1	8.8
200.	1.2	1.1	8.8
300.	1.3	1.2	8.8
400.	1.3	1.2	8.8
500.	1.4	1.3	8.8
600.	1.4	1.3	8.8
700.	1.5	1.3	8.9
800.	1.5	1.4	8.7
900.	1.6	1.4	8.8
1000.	1.6	1.5	8.8
1100.	1.6	1.5	8.7
1200.	1.5	1.5	8.8
1300.	1.4	1.5	8.8
1400.	1.4	1.5	8.9
1500.	1.4	1.5	8.8
1600.	1.6	1.5	8.5

V_{CC} = 12V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.1	8.7
200.	1.2	1.2	8.7
300.	1.3	1.2	8.8
400.	1.3	1.2	8.8
500.	1.4	1.3	8.7
600.	1.4	1.3	8.7
700.	1.5	1.3	8.9
800.	1.5	1.4	8.6
900.	1.6	1.4	8.8
1000.	1.6	1.5	8.8
1100.	1.6	1.5	8.7
1200.	1.5	1.5	8.7
1300.	1.4	1.5	8.8
1400.	1.4	1.5	8.8
1500.	1.4	1.5	8.7
1600.	1.6	1.5	8.5

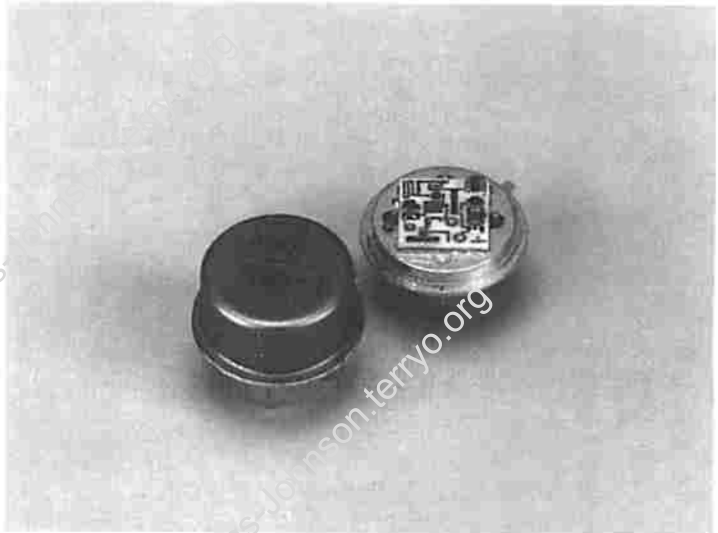
Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.10	-21.8	2.75	177.2	.18	6.7	.06	-1.7
200.	.11	-50.4	2.75	173.2	.18	11.6	.07	-18.5
300.	.12	-70.4	2.77	169.2	.18	16.4	.08	-35.4
400.	.14	-85.9	2.76	165.1	.19	21.1	.09	-51.1
500.	.17	-97.2	2.76	160.8	.19	25.4	.11	-66.0
600.	.18	-106.7	2.78	156.5	.19	29.5	.12	-80.3
700.	.20	-116.8	2.80	152.2	.20	33.7	.14	-92.2
800.	.21	-127.6	2.81	147.6	.20	36.9	.16	-107.0
900.	.22	-138.5	2.76	142.9	.21	40.3	.17	-120.6
1000.	.22	-150.5	2.76	138.7	.21	43.5	.19	-134.2
1100.	.22	-164.3	2.74	134.1	.22	47.3	.20	-150.8
1200.	.20	[illegible]	2.74	128.2	.23	49.7	.21	-166.8
1300.	.18	[illegible]	2.77	122.8	.24	51.6	.21	[illegible]
1400.	.15	123.0	2.77	116.3	.25	52.7	.21	[illegible]
1500.	.16	74.0	2.74	108.0	.27	51.9	.20	[illegible]
1600.	.22	20.0	2.66	98.5	.28	49.3	.18	[illegible]
1700.	.23	-4.3	2.49	88.3	.28	45.3	.18	52.0

WJ-A31-1

10 TO 2000 MHz
TO-8 CASCADABLE AMPLIFIER

- LOW NOISE: < 3.5 dB (TYP.)
- LOW VSWR: 1.5:1 (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	1-2050 MHz	10-2000 MHz	10-2000 MHz
Small Signal Gain (Min.)	11.5 dB	11.0 dB	10.5 dB
Gain Flatness (Max.)	<±0.4 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	≤3.5 dB	4.0 dB	4.5 dB
Power Output at 1 dB Compression (Min.)	-2.0 dBm	-4.0 dBm	-4.5 dBm
VSWR (Max.)			
Input	1.5:1	2.0:1	2.0:1
Output	1.3:1	2.0:1	2.0:1
DC Current (Max.) at 15 Volts	9 mA	11 mA	12 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point	+15 dBm (Typ.)
Second Order Two Tone Intercept Point	+10 dBm (Typ.)
Third Order Two Tone Intercept Point	+9 dBm (Typ.)

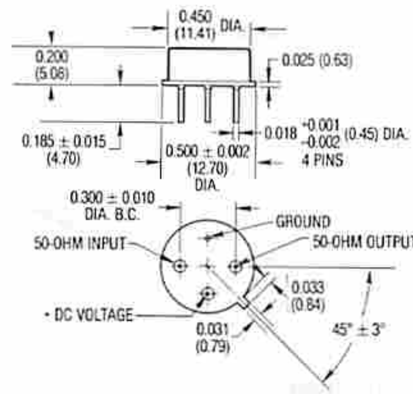
Absolute Maximum Ratings

Storage Temperature	-62°C to +125°C
Maximum Case Temperature	125°C
Maximum DC Voltage	+18 Volts
Maximum Continuous RF Input Power	+13 dBm
Maximum Short Term RF Input Power	+50 Milliwatts (1 Minute Max.)
Maximum Peak Power	0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case)	125°C

Weight approximately 2.0 grams (0.07 oz.)

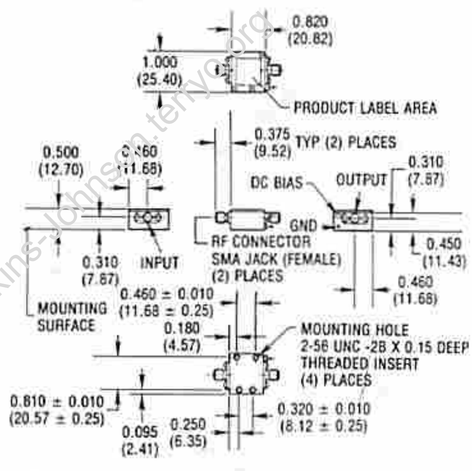
Outline Drawings

A31-1



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

CA31-1

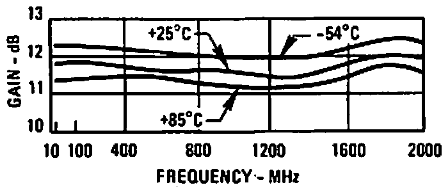


DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

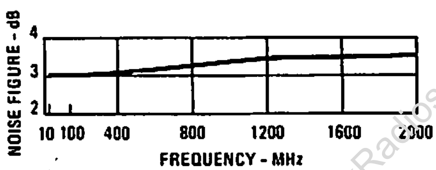
*WJ-CA31-1 is standard WJ-A31-1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

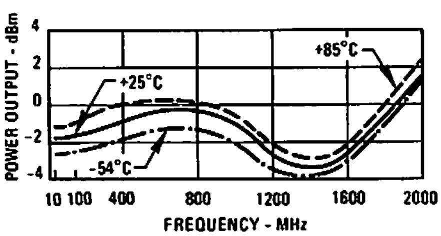
Gain



Noise Figure

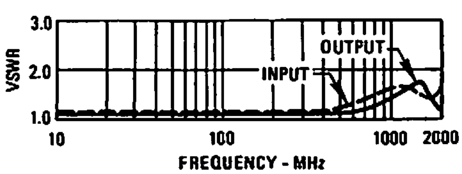


Power Output*

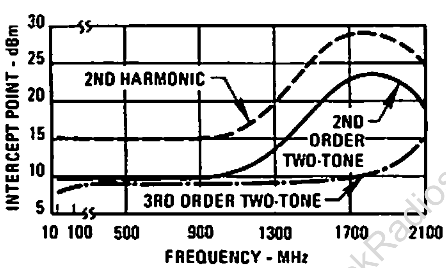


* at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{CC} = +15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.1	[illegible]
200.	1.2	1.1	10.9
300.	1.2	1.1	10.9
400.	1.2	1.0	10.9
500.	1.3	[illegible]	10.9
600.	1.3	[illegible]	10.9
700.	1.4	1.1	11.0
800.	1.4	1.2	11.0
900.	1.5	1.3	11.1
1000.	1.6	1.4	11.0
1100.	1.6	1.4	11.1
1200.	1.6	1.5	11.1
1300.	1.7	1.6	11.1
1400.	1.7	1.7	11.2
1500.	1.6	1.7	11.4
1600.	1.6	1.7	11.5
1700.	1.4	1.6	11.8
1800.	1.4	1.5	12.0
1900.	1.4	1.3	12.3
2000.	1.6	1.3	12.2
2100.	2.1	1.4	11.6
2200.	2.9	1.7	10.7

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.06	-18.2	3.44	170.8	.14	-2.4	.06	150.6
200.	.07	-62.1	3.49	162.4	.14	-4.0	.05	135.2
300.	.08	-91.0	3.49	154.1	.14	-6.6	.04	117.4
400.	.10	-100.4	3.51	145.5	.14	-9.3	.02	60.0
500.	.13	[illegible]	3.52	137.0	.14	-11.7	.02	-8.0
600.	.13	[illegible]	3.53	128.4	.14	-14.6	.04	-53.1
700.	.16	-143.0	3.54	119.6	.14	-17.5	.07	-84.0
800.	[illegible]	-161.3	3.56	111.2	.14	-21.2	.09	-103.5
900.	[illegible]	-171.3	3.60	102.2	.14	-24.1	.12	-120.3
1000.	[illegible]	175.4	3.56	93.2	.14	-26.7	.16	-138.9
1100.	.23	161.2	3.57	83.5	.14	-30.2	.18	153.5
1200.	.24	148.6	3.61	75.1	.14	-32.9	.21	-160.9
1300.	.25	132.3	3.58	66.7	.13	-35.1	.23	175.6
1400.	.25	115.4	3.61	56.6	.13	-37.8	.25	160.0
1500.	.24	98.3	3.70	46.9	.13	-40.5	.26	144.9
1600.	.22	76.3	3.74	36.8	.13	-41.8	.25	120.4
1700.	.18	49.3	3.87	25.4	.14	-44.9	.22	113.8
1800.	.16	15.1	4.00	12.9	.14	-49.9	.19	105.4
1900.	.16	-37.5	4.12	-2.0	.15	-56.4	.15	101.3
2000.	.24	-92.6	4.07	-18.5	.15	-64.4	.12	121.3
2100.	.36	-131.1	3.82	-37.6	.15	-73.6	.17	132.8
2200.	.48	-164.1	3.42	-54.9	.14	-82.1	.26	127.0

WJ-A32

100 TO 2000 MHz
TO-8 CASCADABLE AMPLIFIER

- LOW NOISE FIGURE: 3.5 dB (TYP)
- HIGH THIRD ORDER IM: +32 dBm (TYP)
- HIGH OUTPUT LEVEL: 15.0 dBm (TYP)
- LOW VSWR: 1.5:1 (TYP.)
- GaAs FET DESIGN

Specifications *

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54° - +85°C
Frequency (Min.)	10 - 2000 MHz	100 - 2000 MHz	100 - 2000 MHz
Small Signal Gain (Min.)	10.0 dB	9.0 dB	8.5 dB
Gain Flatness (Max.)	±.3 dB	±.7 dB	±1.0 dB
Noise Figure (Max.)	3.5 dB	4.0 dB	4.5 dB
Power Output at 1 dB Compression (Min.)	15.0 dBm	13.5 dBm	13.0 dBm
VSWR (Max.) Input/Output	1.5:1	1.8:1	2.0:1
DC Current (Max.) at 15 Volts	94 mA	98 mA	100 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +40 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +38 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +32 dBm (Typ.)

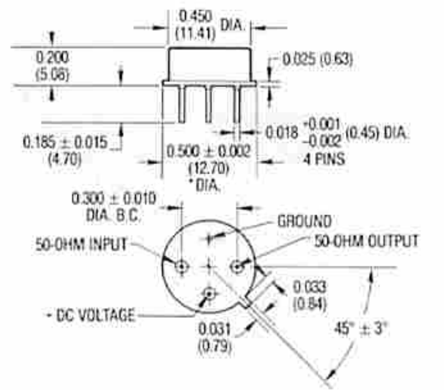
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to 125°C
Maximum Case Temperature . . . . 100°C
Maximum DC Voltage . . . . 17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt
(3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 100°C

Weight approximately 2.0 grams (0.07 oz.)

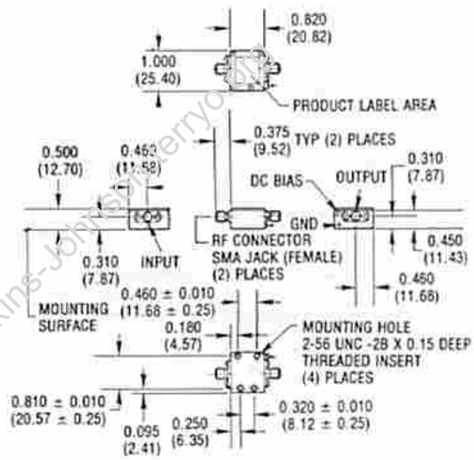
Outline Drawings

A32



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA32

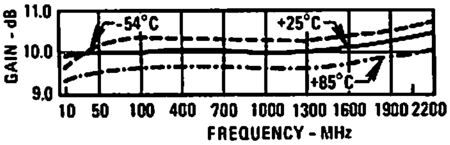


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

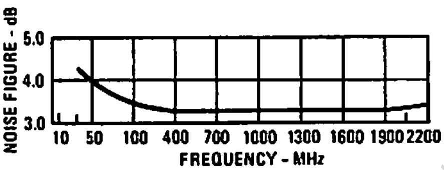
*WJ-CA32 is standard WJ-A32 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

Typical Performance at 25°C

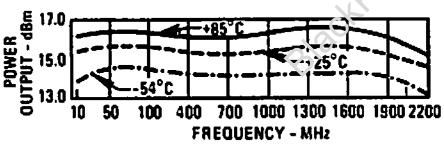
Gain



Noise Figure

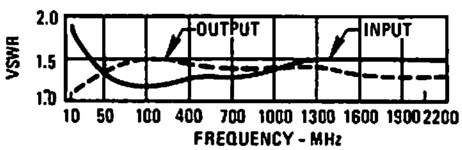


Power Output*

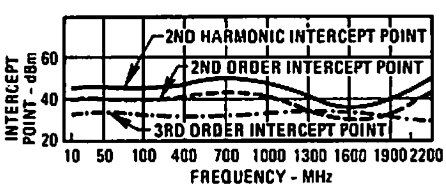


* at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
100.0	1.1	1.5	9.9
200.0	1.3	1.4	10.2
300.0	1.2	1.4	10.2
400.0	1.2	1.4	10.1
500.0	1.3	1.5	10.1
600.0	1.3	1.4	10.0
700.0	1.3	1.3	10.0
800.0	1.4	1.4	10.1
900.0	1.3	1.5	10.0
1000.0	1.4	1.3	10.0
1100.0	1.4	1.4	10.0
1200.0	1.4	1.4	10.0
1300.0	1.5	1.4	10.1
1400.0	1.4	1.5	10.0
1500.0	1.4	1.5	10.0
1600.0	1.5	1.4	10.2
1700.0	1.5	1.3	10.2
1800.0	1.5	1.4	10.4
1900.0	1.5	1.2	10.6
2000.0	1.5	1.2	10.5
2100.0	1.4	1.3	10.5
2200.0	1.4	1.4	10.5

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.0	0.055	1	3.13	175	0.08	-15	0.205	167
200.0	0.110	-6	3.24	162	0.11	-13	0.167	157
300.0	0.083	-2	3.21	152	0.10	-20	0.165	157
400.0	0.111	3	3.20	144	0.11	-40	0.158	139
500.0	0.113	4	3.20	133	0.11	-27	0.190	138
600.0	0.127	8	3.16	126	0.12	-33	0.182	129
700.0	0.141	2	3.16	116	0.12	-38	0.146	124
800.0	0.152	2	3.20	105	0.12	-55	0.159	102
900.0	0.146	-3	3.16	95	0.12	-52	0.109	98
1000.0	0.170	-16	3.16	84	0.12	-55	0.144	84
1100.0	0.173	-21	3.16	77	0.12	-72	0.160	81
1200.0	0.177	-22	3.16	68	0.12	-67	0.181	78
1300.0	0.194	-27	3.20	[illegible]	0.12	-77	0.177	66
1400.0	0.170	-28	3.16	[illegible]	0.11	-87	0.193	64
1500.0	0.182	-40	3.16	38	0.12	-95	0.185	61
1600.0	0.195	-52	3.24	32	0.13	-98	0.152	53
1700.0	0.210	-60	3.24	22	0.13	-107	0.140	42
1800.0	0.210	-81	3.31	10	0.13	-110	0.153	39
1900.0	0.208	-93	3.39	0	0.14	-117	0.104	22
2000.0	0.185	-117	3.35	-10	0.13	-132	0.072	-22
2100.0	0.177	-148	3.35	-22	0.13	-138	0.130	-39
2200.0	0.183	-165	3.35	-33	0.14	-148	0.165	-31

1

WJ-A33

10 TO 2000 MHz
TO-8 CASCADABLE AMPLIFIER

- NEW LOWER NOISE: 4.5 dB (TYP.)
- +3 dBm OUTPUT LEVEL (TYP.)
- WIDE POWER SUPPLY RANGE: +8 TO +15 VOLTS

Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	1-2050 MHz	10-2000 MHz	10-2000 MHz
Small Signal Gain (Min.)	9.5 dB	8.5 dB	8.0 dB
Gain Flatness (Max.)			
500-2000 MHz	< ±0.3 dB	±0.6 dB	±0.8 dB
10-2000 MHz	< ±0.5 dB	±0.8 dB	±1.0 dB
Noise Figure (Max.)	4.5 dB	5.5 dB	6.0 dB
Power Output at 1 dB Compression (Min.)	+3.0 dBm	+2.0 dBm	+2.0 dBm
VSWR (Max.) Input/Output	< 1.7:1	2.0:1	2.2:1
DC Current (Max.) at 15 Volts	14 mA	16 mA	17 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +28 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +22 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +15 dBm (Typ.)

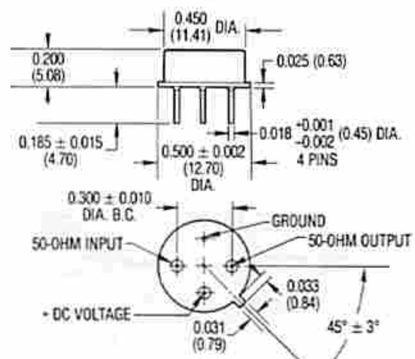
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +20 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . +50 Milliwatt (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

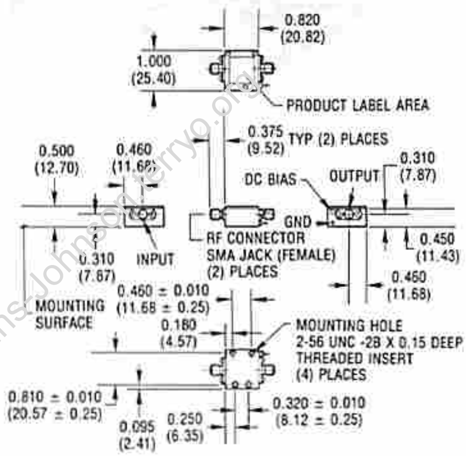
Outline Drawings

A33



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA33

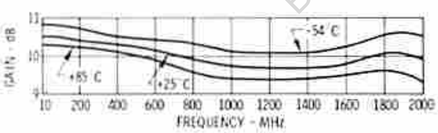


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

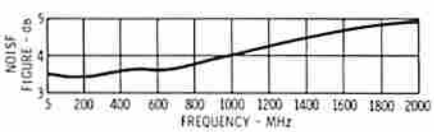
*WJ CA33 is standard WJ-A33 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

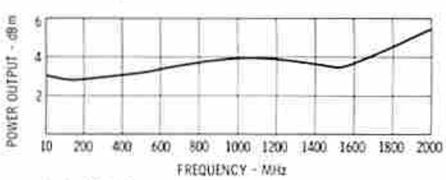
Gain



Noise Figure

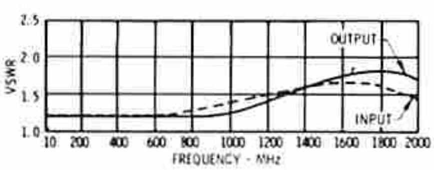


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.0	1.1	10.5
200.	1.1	1.0	10.5
300.	1.1	[illegible]	10.4
400.	1.1	[illegible]	10.4
500.	1.1	1.2	10.4
600.	1.2	1.3	10.1
700.	1.2	1.4	10.0
800.	[illegible]	1.4	10.0
900.	1.2	1.4	9.9
1000.	1.3	1.5	9.8
1100.	1.3	1.5	9.8
1200.	1.3	1.5	9.7
1300.	1.3	1.6	9.7
1400.	1.3	1.6	9.7
1500.	1.3	1.6	9.8
1600.	1.2	1.7	9.9
1700.	1.2	1.8	9.9
1800.	1.1	1.7	9.9
1900.	1.2	1.7	9.8
2000.	1.5	1.6	9.6
2100.	2.1	1.4	8.8

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.01	106.8	3.35	169.6	.14	-2.8	.03	144.2
200.	.05	-69.0	3.34	156.0	.14	-8.2	.02	69.1
300.	.04	-78.6	3.33	143.4	.14	-14.4	.05	54.8
400.	.05	[illegible]	3.31	130.6	.14	-21.0	.07	30.8
500.	.07	[illegible]	3.30	118.4	.14	-28.0	.10	16.7
600.	.08	[illegible]	3.21	105.3	.13	-34.9	.12	1.4
700.	.08	-100.9	3.17	91.8	.13	-40.4	.15	-5.8
800.	.11	-117.0	3.18	78.2	.13	-47.8	.17	-20.7
900.	.10	-130.9	3.13	64.7	.13	-54.6	.18	-31.4
1000.	.12	-129.0	3.10	51.2	.13	-59.8	.19	-40.9
1100.	.13	-140.9	3.08	37.8	.12	-66.9	.21	-52.9
1200.	.13	-154.1	3.06	24.5	.12	-73.4	.21	-66.1
1300.	.14	-160.1	3.06	12.2	.12	-81.6	.22	-77.5
1400.	.13	-169.9	3.05	-2.0	.12	-87.9	.23	-89.9
1500.	.12	175.4	3.07	-17.3	.12	-95.1	.24	-107.4
1600.	.09	158.8	3.12	-32.8	.12	-102.2	.25	-118.7
1700.	.08	139.8	3.12	-48.3	.12	[illegible]	.28	-133.3
1800.	.06	66.2	3.13	-65.1	.12	-118.3	.27	-149.1
1900.	.10	8.9	3.10	-82.4	.12	-128.2	.26	-161.2
2000.	.19	-19.3	3.02	-100.6	.12	-140.0	.24	-171.1
2100.	.35	-49.7	2.76	-129.4	.12	-156.2	.16	167.2
2200.	.48	-67.8	2.45	-150.2	.12	-170.7	.09	175.3

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WJ-A33-1

2 TO 2400 MHz
TO-8 CASCADABLE AMPLIFIER

- ULTRA WIDE BANDWIDTH: 1 - 2600 MHz (TYP.)
- MEDIUM OUTPUT LEVEL: +6 dBm (TYP.)

Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54° - +85°C
Frequency (Min.)	1 - 2600 MHz	2 - 2400 MHz	2 - 2400 MHz
Small Signal Gain (Min.)	9.0 dB	8.2 dB	7.8 dB
Gain Flatness (Max.)	±.4 dB	±.6 dB	±.8 dB
Noise Figure (Max.)			
10 - 1500 MHz	4.0 dB	5.0 dB	5.5 dB
10 - 2400 MHz	4.5 dB	5.8 dB	6.3 dB
Power Output at 1 dB Compression (Min.)	6.0 dBm	4.5 dBm	4.0 dBm
VSWR (Max.)			
Input	<1.6:1	1.9:1	2.0:1
Output	<1.4:1	1.8:1	2.0:1
DC Current (Max.) at +15 Volts	19 mA	21 mA	23 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +35 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +29 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +19 dBm (Typ.)

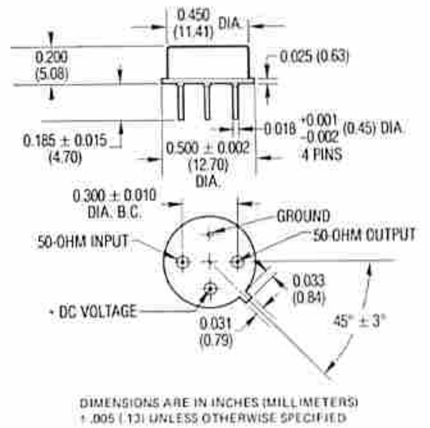
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to 125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +20 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . +50 Milliwatts
Maximum Peak Power . . . . .5 Watt (3 µsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

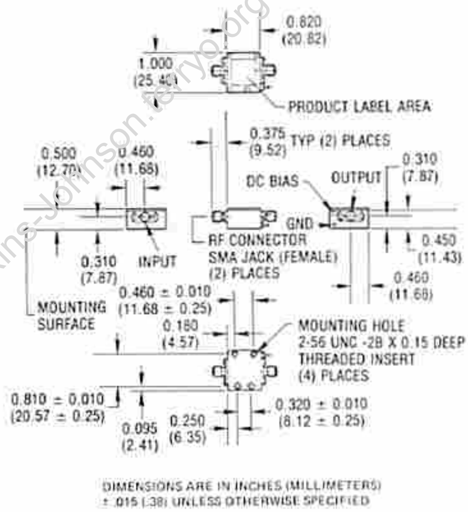
Weight approximately 2.0 grams (0.07 oz.)

Outline Drawings

A33-1

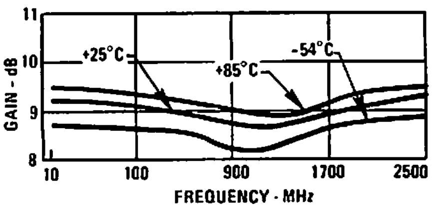


CA33-1

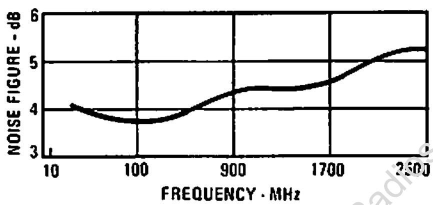


Typical Performance at 25°C

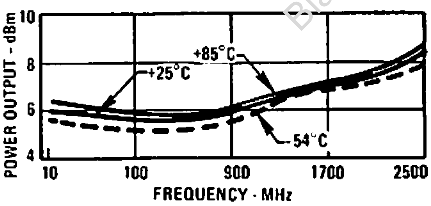
Gain



Noise Figure

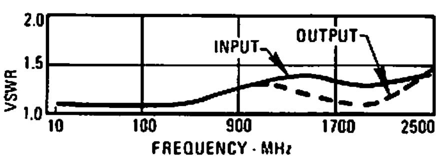


Power Output*

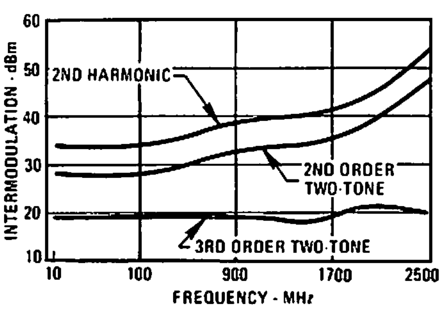


* at 1 dB Gain Compression

VSWR



Intermodulation



Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
100.0	1.1	1.1	8.9
200.0	1.3	1.2	8.7
300.0	1.2	1.1	8.8
400.0	1.3	1.2	8.7
500.0	1.3	1.2	8.6
600.0	1.3	1.2	8.6
700.0	1.4	1.2	8.6
800.0	1.4	1.3	8.5
900.0	1.4	1.3	8.5
1000.0	1.5	1.4	8.3
1100.0	1.5	1.4	8.5
1200.0	1.5	1.4	8.5
1300.0	1.5	1.4	8.4
1400.0	1.5	1.4	8.4
1500.0	1.6	1.5	8.3
1600.0	1.6	1.5	8.4
1700.0	1.6	1.4	8.4
1800.0	1.5	1.4	8.5
1900.0	1.5	1.3	8.5
2000.0	1.4	1.2	8.8
2100.0	1.3	1.1	9.1
2200.0	1.2	1.1	9.1
2300.0	1.1	1.3	9.3
2400.0	1.2	1.5	9.1
2500.0	1.4	1.6	8.9
2600.0	1.4	1.8	8.7

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.0	0.043	16	2.79	158	0.17	-6	0.030	69
200.0	0.112	-31	2.72	152	0.17	-15	0.074	-19
300.0	0.101	-58	2.75	141	0.17	-26	0.040	-30
400.0	0.123	-64	2.72	127	0.17	-32	0.071	-44
500.0	0.130	-78	2.69	117	0.17	-40	0.079	-54
600.0	0.132	-86	2.69	106	0.17	-46	0.081	-53
700.0	0.153	-99	2.69	92	0.17	-51	0.104	-66
800.0	0.168	-110	2.66	76	0.17	-60	0.132	-73
900.0	0.175	-124	2.66	64	0.17	-71	0.125	-75
1000.0	0.210	-129	2.60	51	0.16	-75	0.171	-99
1100.0	0.209	-137	2.66	42	0.17	-83	0.166	-110
1200.0	0.208	-147	2.66	27	0.17	-92	0.163	-114
1300.0	0.229	-157	2.63	14	0.17	-102	0.173	-124
1400.0	0.231	-169	2.63	3	0.17	-111	0.181	-129
1500.0	0.239	-177	2.60	-12	0.17	-119	0.193	-137
1600.0	0.243	179	2.63	-24	0.17	-128	0.192	-146
1700.0	0.227	168	2.63	-37	0.17	-132	0.183	-161
1800.0	0.213	153	2.66	-50	0.17	-143	0.154	-172
1900.0	0.198	138	2.66	-63	0.17	-154	0.137	176
2000.0	0.177	117	2.75	-77	0.18	-164	0.102	157
2100.0	0.149	93	2.85	-94	0.19	-174	0.067	104
2200.0	0.106	79	2.85	-109	0.19	177	0.052	43
2300.0	0.067	26	2.92	-125	0.19	162	0.129	-11
2400.0	0.110	-31	2.85	-143	0.19	149	0.210	-31
2500.0	0.150	-48	2.79	-161	0.19	138	0.244	-55
2600.0	0.176	-64	2.72	-179	0.18	[illegible]	0.283	-66

V_{CC} = +12 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
100.0	1.2	1.1	8.2
200.0	1.4	1.2	7.9
300.0	1.3	1.1	8.0
400.0	1.4	1.2	7.9
500.0	1.4	1.2	7.9
600.0	1.4	1.2	8.0
700.0	1.5	1.3	7.9
800.0	1.5	1.3	7.8
900.0	1.5	1.3	7.9
1000.0	1.7	1.4	7.7
1100.0	1.6	1.4	7.8
1200.0	1.6	1.4	8.0
1300.0	1.7	1.4	7.8
1400.0	1.6	1.4	7.9
1500.0	1.7	1.4	7.8
1600.0	1.7	1.4	7.9
1700.0	1.7	1.4	7.9
1800.0	1.6	1.3	8.0
1900.0	1.6	1.3	8.1
2000.0	1.5	1.2	8.5
2100.0	1.4	1.2	8.8
2200.0	1.3	1.2	8.7
2300.0	1.3	1.4	8.8
2400.0	1.4	1.7	8.5
2500.0	1.5	1.8	8.2
2600.0	1.6	1.9	8.8

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.0	0.080	-1	2.57	166	0.17	-5	0.034	47
200.0	0.157	-29	2.48	152	0.17	-16	0.091	-26
300.0	0.147	-57	2.51	140	0.17	-26	0.058	-39
400.0	0.169	-66	2.48	125	0.18	-32	0.085	-50
500.0	0.169	-79	2.48	116	0.17	-42	0.094	-63
600.0	0.172	-88	2.51	104	0.17	-45	0.092	-63
700.0	0.189	-103	2.49	89	0.17	-51	0.114	-75
800.0	0.205	-114	2.45	75	0.17	-60	0.140	-81
900.0	0.208	-128	2.48	61	0.17	-70	0.126	-87
1000.0	0.254	-132	2.43	51	0.17	-77	0.173	-107
1100.0	0.236	-143	2.45	38	0.18	-83	0.170	-121
1200.0	0.233	-154	2.51	24	0.18	-89	0.160	-126
1300.0	0.255	-165	2.45	11	0.17	-99	0.167	-135
1400.0	0.241	-177	2.48	0	0.18	-110	0.173	-140
1500.0	0.265	176	2.45	-16	0.17	-120	0.179	-148
1600.0	0.266	170	2.48	-28	0.17	-126	0.175	-159
1700.0	0.252	158	2.48	-41	0.19	-132	0.160	-177
1800.0	0.240	143	2.51	-54	0.19	-142	0.136	171
1900.0	0.226	127	2.54	-66	0.19	-154	0.112	159
2000.0	0.211	104	2.66	-82	0.20	-160	0.089	127
2100.0	0.182	77	2.75	-99	0.20	-173	0.090	67
2200.0	0.146	60	2.72	-114	0.20	176	0.099	21
2300.0	0.119	15	2.75	-130	0.20	162	0.176	-17
2400.0	0.164	-26	2.66	-150	0.20	148	0.249	-39
2500.0	0.205	-44	2.57	-169	0.20	135	0.275	-57
2600.0	0.231	-63	2.51	173	0.19	125	0.312	-70

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WJ-A34

100 TO 2000 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH GAIN – TWO STAGES: 16 dB (TYP.)
- ULTRA LOW PHASE DEVIATION FROM LINEARITY: < ±3°; 500-2000 MHz
- LOW VSWR: < 1.5:1 (TYP.)
- MEDIUM LEVEL OUTPUT: +7 dBm (TYP.)
- EXCELLENT GAIN BLOCK

Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C – +85°C
Frequency (Min.)	30-2100 MHz	100-2000 MHz	100-2000 MHz
Small Signal Gain (Min.)	16.0 dB	15.0 dB	14.0 dB
Gain Flatness (Max.)	<±0.5 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	5.5 dB	6.5 dB	7.0 dB
Power Output at 1 dB Compression (Min.)	+7 dBm	+6 dBm	+5 dBm
VSWR (Max.) Input/Output	<1.5:1	1.9:1	2.0:1
DC Current (Max.) at 15 Volts	35 mA	39 mA	41 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

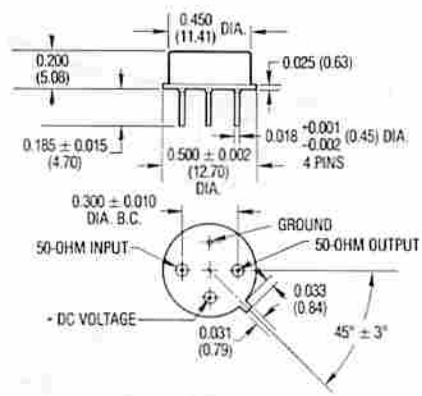
Second Order Harmonic Intercept Point . . . .+46 dBm (Typ.)
Second Order Two Tone Intercept Point . . . .+42 dBm (Typ.)
Third Order Two Tone Intercept Point . . . .+18 dBm (Typ.)

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +20 Volts
Maximum Continuous RF Input Power . . . . +10 dBm
Maximum Short Term Input Power. . . . . 50 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

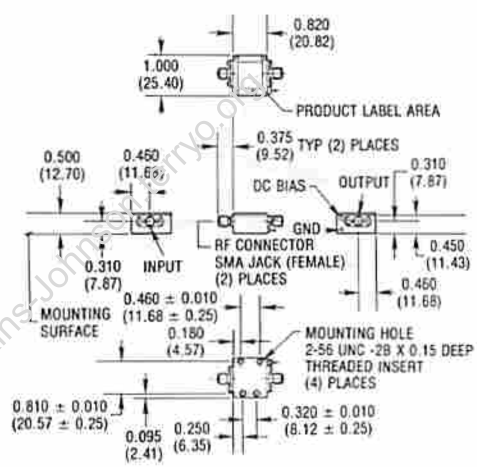
Outline Drawings

A34



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA34



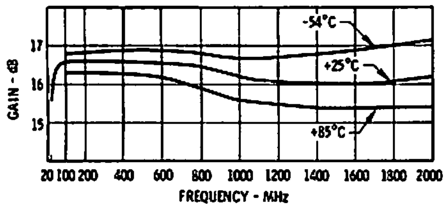
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

*WJ CA34 is standard WJ A34 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

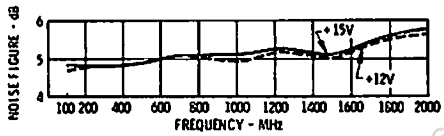
Weight approximately 2.0 grams (0.07 oz.)

Typical Performance at 25°C

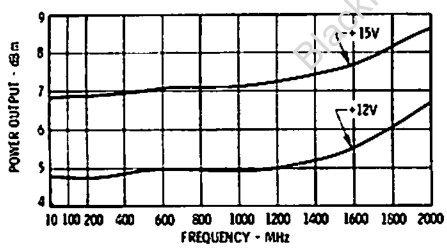
Gain



Noise Figure

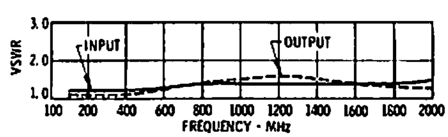


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 12 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.1	16.2
200.	1.2	1.1	16.1
300.	1.2	1.1	16.1
400.	1.2	1.1	16.1
500.	1.3	1.2	16.1
600.	1.3	1.2	16.2
700.	1.3	1.3	16.2
800.	1.4	1.4	16.1
900.	1.4	1.4	15.9
1000.	1.4	1.5	15.8
1100.	1.5	1.5	15.8
1200.	1.5	1.5	15.6
1300.	1.5	1.5	15.7
1400.	1.5	1.5	15.7
1500.	1.5	1.4	15.7
1600.	1.5	1.4	15.7
1700.	1.5	1.3	15.7
1800.	1.5	1.2	15.8
1900.	1.5	1.2	15.7
2000.	1.6	1.2	15.9
2100.	1.9	1.3	16.1

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.1	16.6
200.	1.2	1.1	16.5
300.	1.2	1.1	16.5
400.	1.2	1.1	16.6
500.	1.2	1.2	16.5
600.	1.3	1.3	16.6
700.	1.3	1.3	16.6
800.	1.4	1.4	16.5
900.	1.4	1.5	16.3
1000.	1.4	1.5	16.2
1100.	1.4	1.6	16.1
1200.	1.4	1.6	16.0
1300.	1.5	1.6	16.0
1400.	1.4	1.5	16.0
1500.	1.4	1.5	16.0
1600.	1.4	1.4	16.0
1700.	1.4	1.4	16.0
1800.	1.4	1.3	16.1
1900.	1.4	1.3	16.1
2000.	1.5	1.3	16.2
2100.	1.7	1.4	16.5

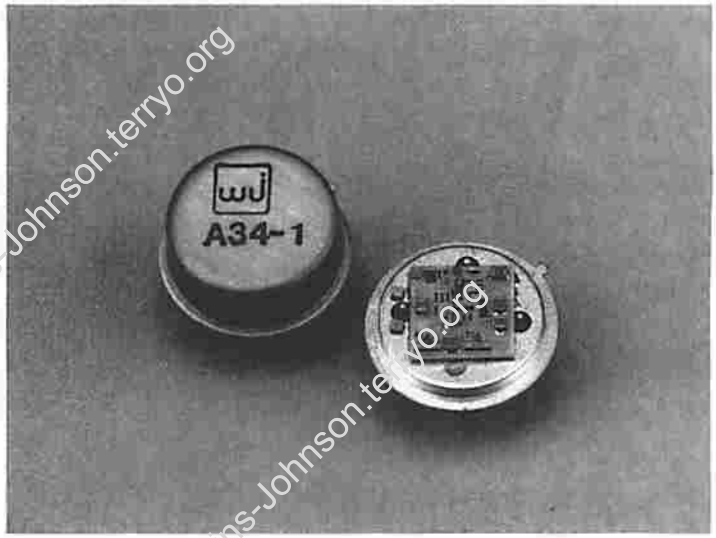
Linear S-Parameters, V_{CC} = 15 V

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.08	-57.0	6.75	-9.4	.03	2.1	.06	-135.1
200.	.07	-46.8	6.68	-31.3	.03	-6.0	.04	173.0
300.	.07	-56.0	6.67	-50.9	.03	-15.1	.05	135.5
400.	.08	-53.6	6.72	-70.2	.03	-22.2	.07	100.4
500.	.11	-63.4	6.70	-88.4	.03	-28.9	.09	91.5
600.	.12	-72.9	6.75	-107.1	.03	-37.2	.11	77.3
700.	.13	-74.3	6.77	-125.4	.03	-43.7	.15	63.6
800.	.16	-86.8	6.69	-143.0	.03	-52.1	.17	51.9
900.	.16	-97.1	6.53	-162.9	.03	-60.2	.19	42.7
1000.	.17	-104.5	6.42	177.0	.03	-68.0	.21	31.7
1100.	.18	-117.7	6.39	158.4	.03	-77.0	.23	22.1
1200.	.18	-132.8	6.31	139.5	.03	-85.2	.22	13.9
1300.	.19	-144.6	6.31	120.5	.02	-93.5	.22	4.3
1400.	.19	-159.8	6.36	102.6	.02	-102.5	.21	-7.2
1500.	.18	-175.6	6.32	84.9	.02	-110.3	.19	-18.3
1600.	.17	170.1	6.29	65.2	.02	-119.7	.18	-31.6
1700.	.18	153.6	6.33	45.3	.02	-129.1	.16	-50.5
1800.	.17	131.7	6.41	25.5	.02	-138.6	.14	-68.1
1900.	.17	105.5	6.37	5.4	.02	-148.0	.13	-91.2
2000.	.19	76.5	6.49	-16.2	.03	-157.8	.14	-114.7
2100.	.26	33.5	6.70	-41.9	.02	-169.3	.15	-141.0
2200.	.37	4.8	6.36	-66.0	.02	-178.7	.16	-166.7

WJ-A34-1

1.5 TO 2.3 GHz
TO-8 CASCADABLE AMPLIFIER

- HIGH GAIN — TWO STAGES: 14.5 dB (TYP.)
- LOW PHASE DEVIATION FROM LINEARITY: < ±3.0°, 1500-2300 MHz;
- MEDIUM LEVEL OUTPUT: +8 dBm (TYP.)
- ULTRA WIDE TYPICAL BANDWIDTH: 0.1 TO 2.4 GHz



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C – +85°C
Frequency (Min.)	0.1-2.4 GHz	1.5-2.3 GHz	1.5-2.3 GHz
Small Signal Gain (Min.)	14.5 dB	13.7 dB	12.5 dB
Gain Flatness (Max.)	±0.3 dB	±0.6 dB	±0.8 dB
Noise Figure (Max.)	5.7 dB	6.8 dB	7.3 dB
Power Output at 1 dB Compression (Min.)	+8.0 dBm	+6.5 dBm	+6.0 dBm
VSWR (Max.) Input/Output	1.6:1	2.0:1	2.0:1
DC Current (Max.) at 15 Volts	34 mA	38 mA	40 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +45 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +41 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +20 dBm (Typ.)

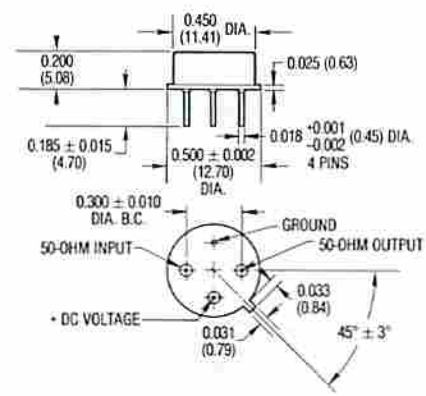
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +20 Volts
Maximum Continuous RF Input Power . . . . +10 dBm
Maximum Short Term RF Input Power . . . . +50 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

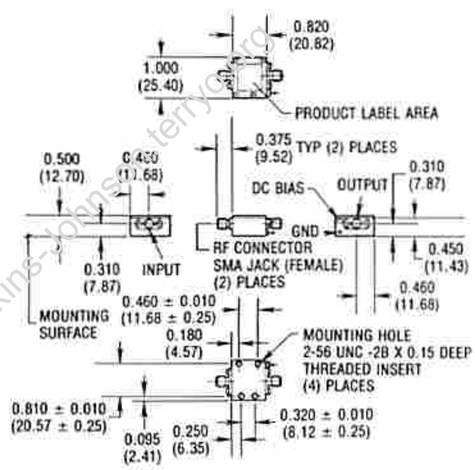
Outline Drawings

A34-1



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA34-1

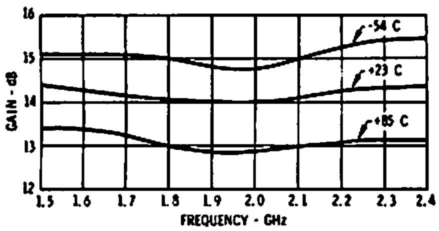


DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

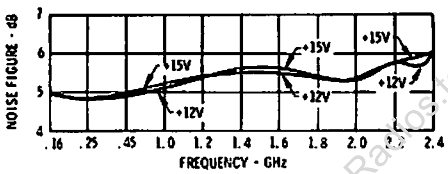
*WJ CA34-1 is standard WJ-A34-1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers

Typical Performance at 25°C

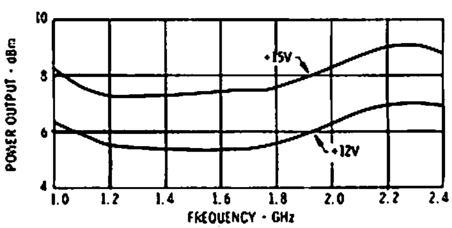
Gain



Noise Figure

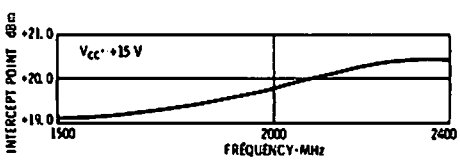


Power Output*



*at 1 dB Gain Compression

Third Order Two Tone Intercept Point



Typical Automatic Test Data

V_{CC} = 12 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.2	16.5
200.	1.1	1.1	16.4
300.	1.1	1.1	16.5
400.	1.2	1.0	16.5
500.	1.2	1.1	16.4
600.	1.3	1.1	16.4
700.	1.3	1.2	16.2
800.	1.3	1.2	16.1
900.	1.4	1.3	15.8
1000.	1.3	1.3	15.5
1100.	1.4	1.4	15.4
1200.	1.3	1.4	15.2
1300.	1.4	1.3	15.1
1400.	1.4	1.3	15.0
1500.	1.4	1.2	14.9
1600.	1.4	1.2	14.7
1700.	1.5	1.2	14.5
1800.	1.5	1.2	14.5
1900.	1.5	1.3	14.5
2000.	1.5	1.4	14.2
2100.	1.5	1.5	14.3
2200.	1.6	1.6	14.2
2300.	1.7	1.6	14.2
2400.	1.9	1.6	14.4
2500.	2.3	1.6	14.9

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.2	16.8
200.	1.1	1.1	16.7
300.	1.1	1.1	16.8
400.	1.2	1.0	16.8
500.	1.2	1.1	16.7
600.	1.2	1.1	16.7
700.	1.3	1.2	16.6
800.	1.3	1.3	16.5
900.	1.3	1.3	16.2
1000.	1.3	1.4	15.9
1100.	1.3	1.4	15.7
1200.	1.3	1.4	15.5
1300.	1.3	1.4	15.4
1400.	1.3	1.3	15.3
1500.	1.3	1.3	15.2
1600.	1.4	1.2	15.0
1700.	1.4	1.2	14.8
1800.	1.4	1.3	14.8
1900.	1.5	1.3	14.8
2000.	1.4	1.5	14.5
2100.	1.4	1.6	14.5
2200.	1.5	1.6	14.5
2300.	1.5	1.7	14.5
2400.	1.7	1.7	14.7
2500.	2.0	1.7	14.7

Linear S-Parameters, V_{CC} = 15 V

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.08	-82.4	6.92	5.2	.03	14.6	.09	-144.4
200.	.06	-73.0	6.87	-2.8	.03	20.4	.06	-158.5
300.	.06	-69.3	6.92	-6.9	.03	29.0	.03	-174.6
400.	.07	-65.5	6.93	-10.6	.03	36.2	.01	108.7
500.	.09	-68.8	6.83	-14.5	.03	43.3	.04	62.6
600.	.11	-74.0	6.86	-18.3	.03	51.6	.06	53.3
700.	.12	-79.8	6.74	-21.7	.03	59.6	.09	49.5
800.	.14	-87.3	6.67	-24.9	.03	66.4	.12	44.9
900.	.14	-97.5	6.45	-28.0	.03	72.9	.14	38.9
1000.	.13	-106.2	6.21	-31.8	.03	79.8	.16	31.8
1100.	.14	-117.4	6.11	-34.8	.03	87.5	.17	23.1
1200.	.13	-135.4	5.99	-38.0	.02	93.9	.17	16.6
1300.	.13	-150.6	5.86	-41.8	.02	100.3	.16	8.8
1400.	.14	-169.1	5.83	-44.3	.02	106.1	.15	-1.7
1500.	.14	174.7	5.76	-46.3	.02	111.5	.12	-15.5
1600.	.16	160.5	5.60	-47.1	.02	118.1	.11	-34.9
1700.	.17	148.2	5.52	-50.0	.02	124.2	.10	-61.8
1800.	.18	135.3	5.52	-53.2	.02	129.7	.12	-86.3
1900.	.19	122.1	5.49	-57.1	.02	137.7	[illegible]	-103.5
2000.	.18	109.4	5.30	-60.1	.02	140.9	.19	-116.9
2100.	.17	83.8	5.33	-65.3	.02	145.0	.23	-132.9
2200.	.19	63.7	5.30	-67.5	.02	157.2	.24	-146.5
2300.	.21	37.3	5.30	-69.8	.02	160.3	.25	-151.9
2400.	.26	10.4	5.42	-75.5	.02	166.5	.27	-160.0
2500.	.33	-13.3	5.45	-83.6	.03	175.8	.26	-175.8
2600.	.41	-32.3	5.25	-95.3	.03	-179.7	.24	157.8

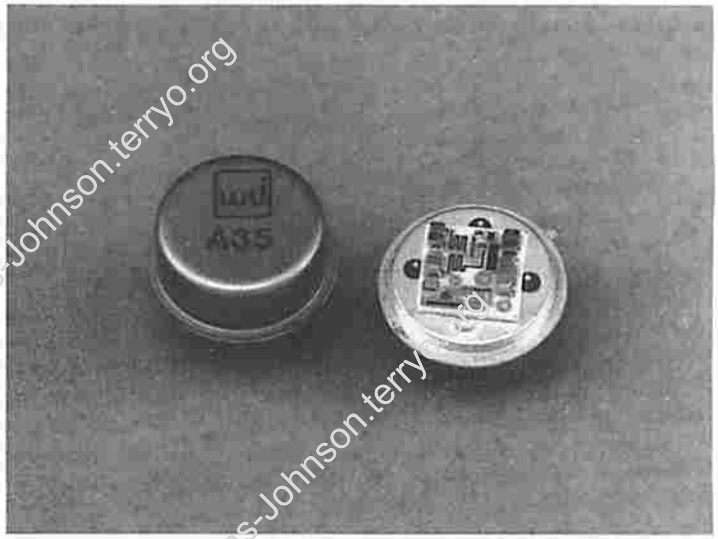
Deviation from Linear Phase, Gain and Group Delay, V_{CC} = 15 V

FREQ MHZ	DEV LIN 0 DEG	REL 0 DEG	GAIN DEV DB	ABS GAIN DB	GROUP DELAY N-SEC
1500.	-1.60	.00	.35	15.19	.02
1600.	.61	-.81	.14	14.98	.05
1700.	.95	-3.49	.02	14.86	.08
1800.	.80	-6.66	.02	14.96	.09
1900.	.16	-10.32	-.03	14.81	.09
2000.	.44	-13.07	-.35	14.49	.10
2100.	-1.28	-17.81	-.30	14.54	.10
2200.	-.61	-20.16	-.34	14.50	.06
2300.	.52	-22.05	-.35	14.49	.05

WJ-A35

10 TO 2000 MHz TO-8 CASCADABLE AMPLIFIER

- MEDIUM OUTPUT LEVEL: +9 dBm (TYP.)
- WIDE POWER SUPPLY RANGE: +8 TO + 20 VOLTS



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	1-2050 MHz	10-2000 MHz	10-2000 MHz
Small Signal Gain (Min.)	10.0 dB	9.0 dB	8.5 dB
Gain Flatness (Max.)			
500-2000 MHz	< ±0.3 dB	±0.6 dB	±0.8 dB
10-2000 MHz	< ±0.5 dB	±0.8 dB	±1.0 dB
Noise Figure (Max.)	5.0 dB	6.5 dB	7.0 dB
Power Output at 1 dB Compression (Min.)	+9 dBm	+7 dBm	+6.5 dBm
VSWR (Max.)			
Input	< 1.5:1	2.0:1	2.2:1
Output	< 1.5:1	2.2:1	2.2:1
DC Current (Max.) at 15 Volts	24 mA	27 mA	29 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

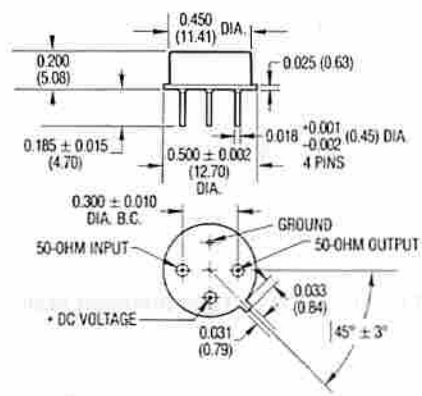
Second Order Harmonic Intercept Point . . . . . +38 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . . +33 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . . +21 dBm (Typ.)

Absolute Maximum Ratings

Storage Temperature . . . . . -62°C to +125°C
Maximum Case Temperature . . . . . 125°C
Maximum DC Voltage . . . . . +21 Volts
Maximum Continuous RF Input Power . . . . . +13 dBm
Maximum Short Term RF Input Power . . . . . +17 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . . 125°C

Outline Drawings

A35

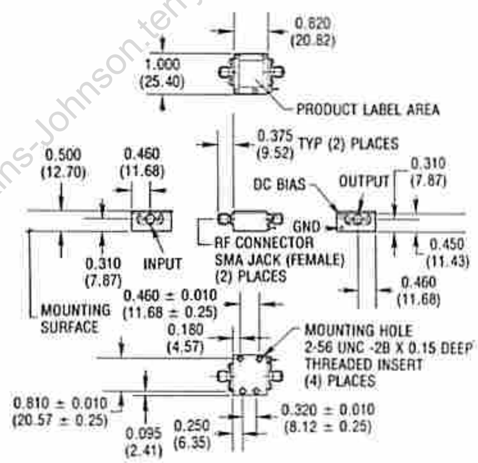


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

Weight

approximately 2.0 grams (0.07 oz.)

CA35

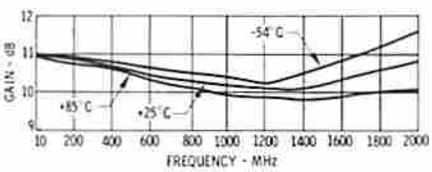


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

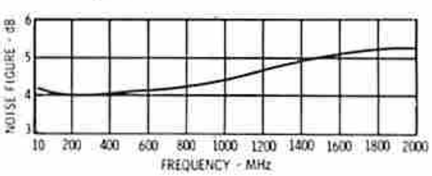
*WJ CA35 is standard WJ A35 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers

Typical Performance at 25°C

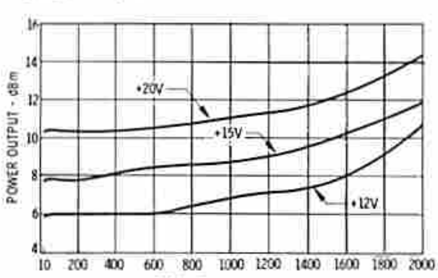
Gain



Noise Figure

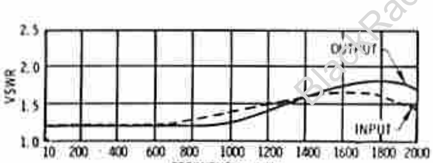


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.5	10.6
200.	1.1	1.4	10.5
300.	1.1	1.3	10.5
400.	1.1	1.3	10.5
500.	1.1	1.2	10.5
600.	1.1	1.2	10.3
700.	1.1	1.2	10.3
800.	1.1	1.2	10.3
900.	1.2	1.2	10.3
1000.	1.2	1.2	10.2
1100.	1.3	1.2	10.2
1200.	1.3	1.2	10.2
1300.	1.4	1.2	10.3
1400.	1.4	1.3	10.3
1500.	1.4	1.3	10.5
1600.	1.4	1.3	10.7
1700.	1.4	1.4	10.9
1800.	1.2	1.4	11.1
1900.	1.2	1.3	11.2
2000.	1.5	1.2	11.1
2100.	2.4	1.2	10.2

Linear S-Parameters

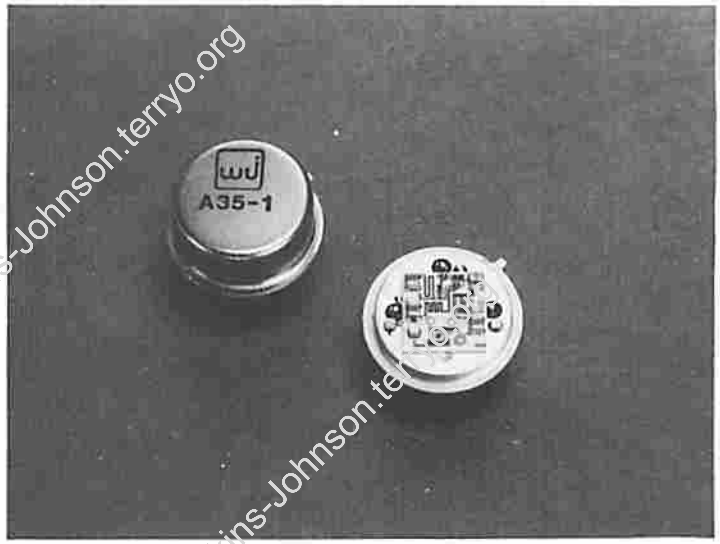
FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.09	160.6	3.38	171.0	.15	-1.8	.19	168.2
200.	.05	-166.8	3.35	156.7	.14	-7.0	.16	164.0
300.	.06	179.3	3.37	144.3	.14	-12.3	.15	149.8
400.	.04	166.2	3.36	131.7	.14	-18.3	.12	134.8
500.	.03	-167.2	3.35	119.8	.14	-24.3	.10	114.6
600.	.04	-164.7	3.29	106.9	.14	-31.1	.08	100.7
700.	.03	-124.2	3.26	93.5	.14	-36.4	.08	58.2
800.	.07	-126.9	3.29	79.9	.14	-43.4	.07	40.9
900.	.07	-136.1	3.26	66.4	.14	-50.2	.07	17.7
1000.	.10	-127.4	3.25	52.4	.14	-55.7	.09	-3.9
1100.	.13	-139.3	3.25	39.2	.13	-62.9	.10	-28.1
1200.	.14	-151.6	3.25	25.7	.13	-69.0	.09	-44.5
1300.	.18	-158.8	3.26	13.4	.13	-76.7	.10	-63.5
1400.	.17	-169.6	3.28	-.8	.13	-84.5	.12	-81.8
1500.	.18	176.6	3.33	-16.2	.13	-91.5	.13	-107.2
1600.	.16	160.5	3.43	-32.1	.13	-99.3	.14	-120.6
1700.	.15	143.9	3.51	-48.3	.14	-108.3	.17	-140.3
1800.	.10	101.1	3.59	-66.4	.14	-118.2	.16	-163.5
1900.	.10	31.0	3.65	-85.8	.14	-129.5	.14	174.2
2000.	.21	-22.3	3.61	-107.2	.14	-144.1	.09	145.5
2100.	.42	-67.3	3.23	-141.9	.13	-168.6	.08	20.9
2200.	.57	-93.8	2.71	-167.0	.12	173.6	.17	-33.5

1

WJ-A35-1

2 TO 2400 MHz
TO-8 CASCADABLE AMPLIFIER

- ULTRA WIDE BANDWIDTH: 1 - 2600 (TYP.)
- MEDIUM OUTPUT LEVEL: +9.5 dBm (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	-54° - +85°C
Frequency (Min.)	1 - 2600 MHz	2 - 2400 MHz	2 - 2400 MHz
Small Signal Gain (Min.)	9.0 dB	8.5 dB	8.0 dB
Gain Flatness (Max.)	±.4 dB	±.6 dB	±.8 dB
Noise Figure (Max.)			
2 - 1500	4.2 dB	5.0 dB	5.5 dB
2 - 2400	<5.0 dB	5.8 dB	6.3 dB
Power Output at 1 dB Compression (Min.)	9.5 dBm	8.5 dBm	8.0 dBm
VSWR (Max.) Input/Output	<1.4:1	1.9:1	2.0:1
DC Current (Max.) at +15 Volts	28 mA	31 mA	33 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +40 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +34 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +23 dBm (Typ.)

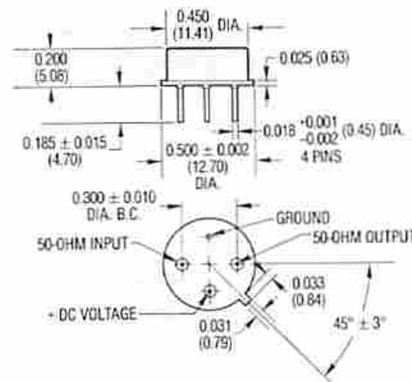
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to 125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +21 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . +50 Milliwatts
Maximum Peak Power . . . . .5 Watt (3 µsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

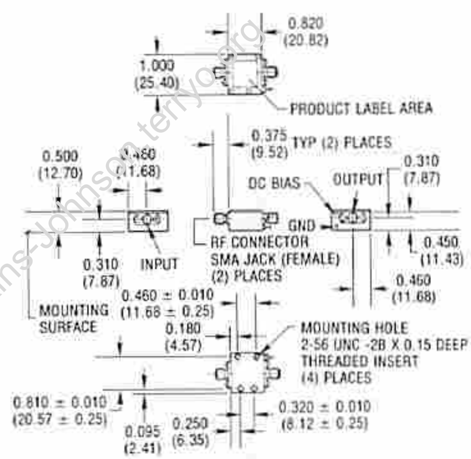
Outline Drawings

A35-1



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

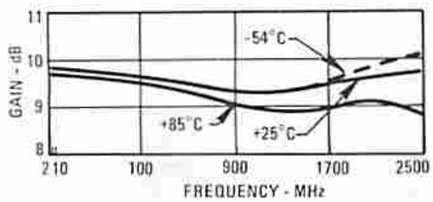
CA35-1

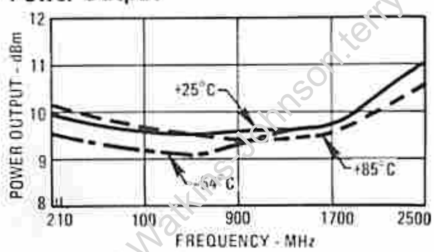


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

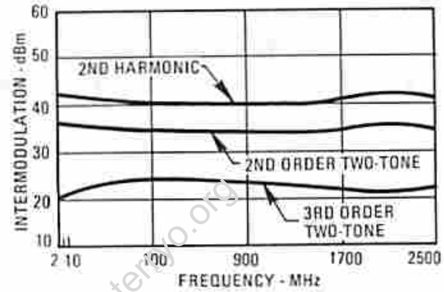
*WJ-CA35-1 is standard WJ-A35-1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

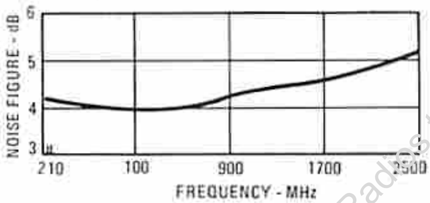
Typical Performance at 25°C

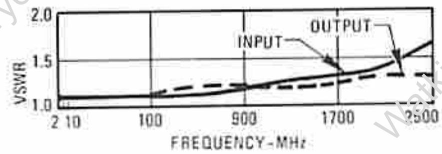
Gain


Power Output*


* at 1 dB Gain Compression

Intermodulation


Noise Figure


VSWR


1

Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
100.0	1.1	1.1	9.8
200.0	1.2	1.0	9.8
300.0	1.1	1.1	9.8
400.0	1.2	1.1	9.7
500.0	1.2	1.1	9.5
600.0	1.2	1.1	9.6
700.0	1.2	1.1	9.5
800.0	1.2	1.1	9.4
900.0	1.2	1.2	9.4
1000.0	1.3	1.2	9.3
1100.0	1.3	1.2	9.3
1200.0	1.3	1.2	9.3
1300.0	1.4	1.2	9.3
1400.0	1.3	1.3	9.2
1500.0	1.4	1.3	9.1
1600.0	1.5	1.4	9.1
1700.0	1.5	1.4	9.1
1800.0	1.5	1.4	9.1
1900.0	1.5	1.5	9.1
2000.0	1.5	1.5	9.2
2100.0	1.5	1.5	9.4
2200.0	1.5	1.5	9.4
2300.0	1.4	1.4	9.6
2400.0	1.4	1.4	9.6
2500.0	1.6	1.4	9.3
2600.0	1.8	1.5	8.9

V_{CC} = +12 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
100.0	1.1	1.1	9.5
200.0	1.2	1.1	9.4
300.0	1.2	1.0	9.4
400.0	1.2	1.0	9.4
500.0	1.3	1.0	9.2
600.0	1.2	1.0	9.3
700.0	1.3	1.1	9.2
800.0	1.3	1.1	9.1
900.0	1.3	1.1	9.1
1000.0	1.4	1.2	9.0
1100.0	1.4	1.2	9.1
1200.0	1.3	1.1	9.2
1300.0	1.4	1.2	9.0
1400.0	1.4	1.2	9.1
1500.0	1.5	1.3	8.9
1600.0	1.5	1.3	8.9
1700.0	1.5	1.3	8.9
1800.0	1.5	1.3	8.9
1900.0	1.5	1.4	8.9
2000.0	1.5	1.4	9.1
2100.0	1.6	1.4	9.3
2200.0	1.6	1.4	9.3
2300.0	1.5	1.4	9.4
2400.0	1.6	1.3	9.4
2500.0	1.8	1.3	8.9
2600.0	2.0	1.3	8.5

Linear S-Parameters

FREQUENCY MHz	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.0	0.033	51	3.09	167	0.15	3	0.066	136
200.0	0.091	-22	3.09	155	0.16	-12	0.024	20
300.0	0.068	-54	3.09	143	0.16	-22	0.030	106
400.0	0.088	-55	3.05	130	0.16	-29	0.027	44
500.0	0.085	-69	2.99	120	0.15	-36	0.029	22
600.0	0.083	-74	3.02	110	0.15	-42	0.043	26
700.0	0.097	-88	2.99	97	0.15	-49	0.047	-3
800.0	0.105	-97	2.95	83	0.16	-57	0.069	-24
900.0	0.105	-113	2.95	71	0.16	-66	0.072	-14
1000.0	0.144	-111	2.92	59	0.15	-70	0.089	-66
1100.0	0.132	-120	2.92	50	0.15	-75	0.084	-83
1200.0	0.125	-127	2.92	36	0.15	-84	0.085	-81
1300.0	0.153	-137	2.92	22	0.15	-91	0.100	-95
1400.0	0.142	-150	2.88	13	0.15	-103	0.114	-105
1500.0	0.175	-157	2.85	-1	0.15	-111	0.140	-116
1600.0	0.195	-160	2.85	-12	0.15	-115	0.155	-128
1700.0	0.193	-168	2.85	-24	0.15	-123	0.162	-144
1800.0	0.199	179	2.85	-36	0.15	-130	0.171	-156
1900.0	0.197	160	2.85	-47	0.15	-143	0.185	-165
2000.0	0.196	149	2.88	-61	0.15	-150	0.196	-176
2100.0	0.196	129	2.95	-75	0.15	-156	0.201	167
2200.0	0.192	119	2.95	-89	0.15	-169	0.198	157
2300.0	0.169	97	3.02	-102	0.15	-179	0.183	145
2400.0	0.172	60	3.02	-118	0.15	172	0.176	130
2500.0	0.222	30	2.92	-130	0.15	168	0.170	129
2600.0	0.286	4	2.79	-155	0.14	153	0.198	119

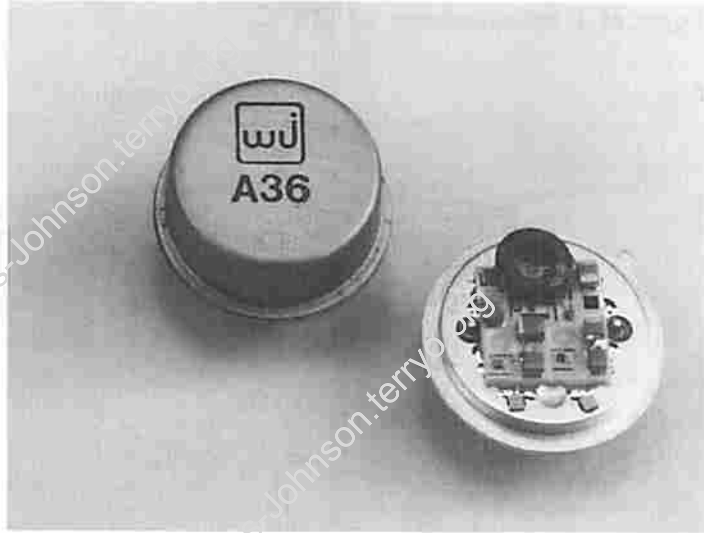
Linear S-Parameters

FREQUENCY MHz	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.0	0.043	19	2.99	168	0.15	-2	0.058	131
200.0	0.110	-26	2.95	154	0.15	-14	0.027	-3
300.0	0.091	-54	2.95	143	0.15	-22	0.011	92
400.0	0.109	-57	2.95	129	0.16	-29	0.020	-3
500.0	0.111	-71	2.88	121	0.16	-35	0.019	-16
600.0	0.104	-78	2.92	110	0.16	-41	0.024	4
700.0	0.117	-91	2.88	95	0.15	-46	0.073	-31
800.0	0.130	-103	2.85	82	0.16	-52	0.055	-45
900.0	0.129	-117	2.85	70	0.16	-60	0.045	-33
1000.0	0.166	-117	2.82	59	0.15	-68	0.060	-85
1100.0	0.155	-127	2.85	48	0.16	-75	0.077	-107
1200.0	0.147	-135	2.88	34	0.16	-83	0.067	-107
1300.0	0.173	-144	2.82	22	0.16	-91	0.054	-119
1400.0	0.162	-160	2.85	11	0.16	-100	0.094	-125
1500.0	0.195	-165	2.79	-2	0.16	-107	0.116	-132
1600.0	0.212	-160	2.79	-14	0.16	-115	0.131	-143
1700.0	0.207	-180	2.79	-25	0.16	-121	0.142	-161
1800.0	0.213	166	2.79	-39	0.16	-129	0.147	-171
1900.0	0.210	156	2.79	-50	0.16	-140	0.155	-178
2000.0	0.214	133	2.85	-64	0.17	-144	0.170	163
2100.0	0.227	112	2.92	-79	0.17	-158	0.172	149
2200.0	0.217	101	2.92	-93	0.17	-163	0.164	141
2300.0	0.205	79	2.95	-106	0.17	-177	0.152	123
2400.0	0.226	44	2.95	-124	0.17	172	0.132	108
2500.0	0.282	16	2.79	-143	0.16	159	0.122	117
2600.0	0.338	-7	2.66	-161	0.16	157	0.139	107

WJ-A36

100 TO 2000 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH GAIN – TWO STAGES: 16.5 dB (TYP.)
- LOW VSWR: < 1.5:1 (TYP.)
- HIGH OUTPUT LEVEL: +12.0 dBm (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C – +85°C
Frequency (Min.)	80-2000 MHz	100-2000 MHz	100-2000 MHz
Small Signal Gain (Min.)	16.5 dB	15.5 dB	14.5 dB
Gain Flatness (Max.)	±0.3 dB	±0.8 dB	±1.0 dB
Noise Figure (Max.)	5.5 dB	7.0 dB	7.5 dB
Power Output at 1 dB Compression (Min.)	+12.0 dBm	+11.0 dBm	+11.0 dBm
VSWR (Max.) Input/Output	<1.5:1	2.0:1	2.0:1
DC Current (Max.) at 15 Volts	63 mA	64 mA	67 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +35 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +30 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +23 dBm (Typ.)

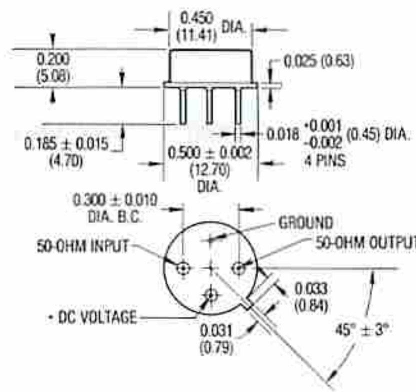
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +10 dBm
Maximum Short Term RF Input Power . . . . +50 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

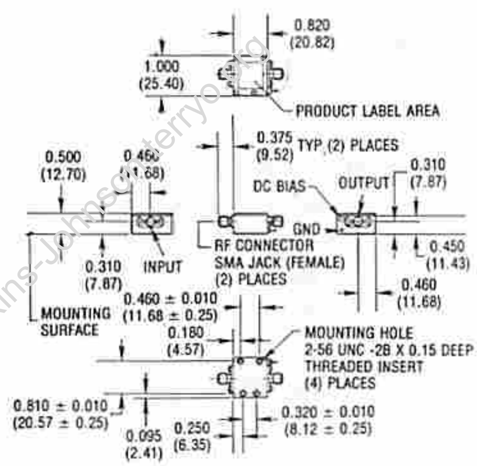
Outline Drawings

A36



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA36

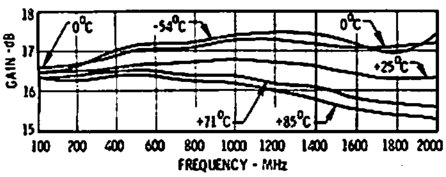


DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

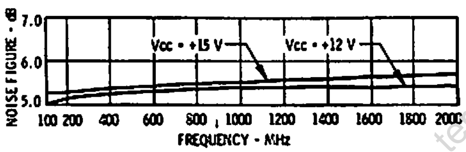
*WJ CA36 is standard WJ-A36 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers

Typical Performance at 25°C

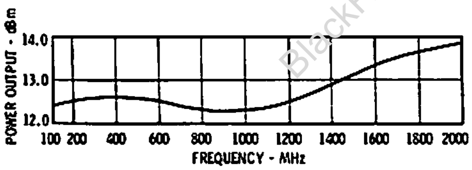
Gain



Noise Figure

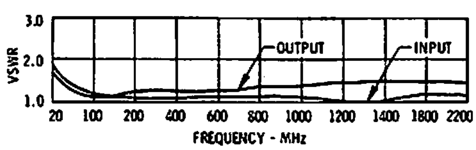


Power Output*

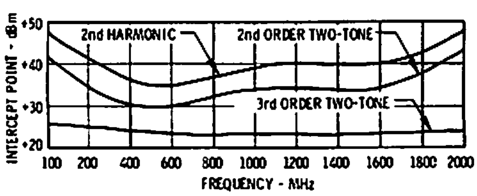


*@ 1 dB GAIN COMPRESSION

VSWR



Intercept Point



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.2	16.6
200.	1.1	1.2	16.6
300.	1.1	1.2	16.6
400.	1.1	1.2	16.6
500.	1.1	1.2	16.7
600.	1.1	1.2	16.8
700.	1.1	1.2	16.8
800.	1.1	1.3	16.8
900.	1.1	1.3	16.8
1000.	1.1	1.3	16.8
1100.	1.1	1.3	16.7
1200.	1.0	1.4	16.7
1300.	1.0	1.4	16.6
1400.	1.0	1.4	16.5
1500.	1.0	1.4	16.4
1600.	1.0	1.4	16.3
1700.	1.1	1.4	16.3
1800.	1.1	1.4	16.2
1900.	1.1	1.3	16.2
2000.	1.1	1.3	16.2
2100.	1.1	1.3	16.2

Linear S-Parameters

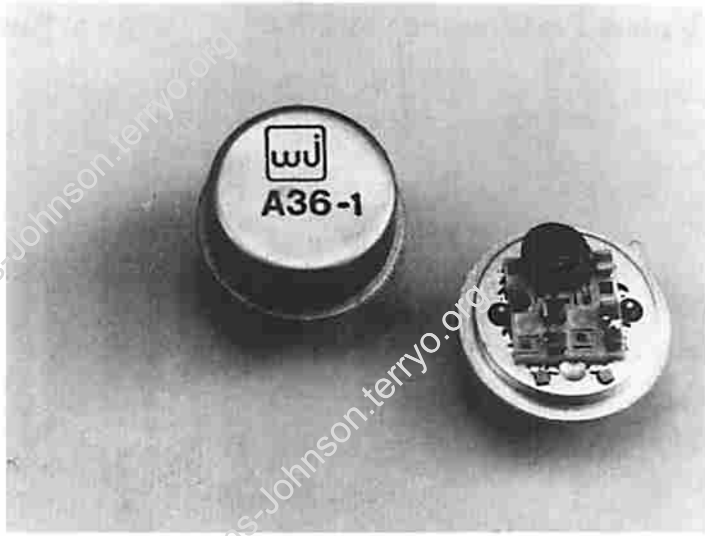
FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.05	[illegible]	6.73	-10.6	.03	7.1	.09	164.9
200.	.04	[illegible]	6.73	-35.7	.03	-9.3	.08	141.5
300.	.04	[illegible]	6.74	-56.9	.03	-20.3	.08	122.4
400.	.04	-113.2	6.78	-77.8	.03	-31.1	.08	94.9
500.	.05	-135.8	6.88	-98.0	.03	-41.9	.09	74.8
600.	.05	-163.3	6.90	-120.4	.03	-53.3	.10	59.8
700.	.05	-163.5	6.90	-141.8	.03	-63.8	.11	41.2
800.	.05	166.4	6.91	-163.1	.03	-74.7	.12	29.0
900.	.04	153.1	6.90	175.3	.03	-84.8	.13	9.9
1000.	.04	139.4	6.89	153.9	.03	-95.6	.14	-6.9
1100.	.03	111.9	6.86	132.7	.03	-106.9	.15	-23.5
1200.	.01	90.8	6.82	110.9	.03	-119.9	.15	-41.6
1300.	.01	117.6	6.74	89.6	.03	-133.7	.16	-59.4
1400.	.00	-103.5	6.67	68.6	.03	-147.3	.16	-78.7
1500.	.02	-117.8	6.61	47.5	.03	-161.4	.16	-96.4
1600.	.02	-151.2	6.57	26.5	.03	-174.7	.15	-118.0
1700.	.03	-131.3	6.51	6.3	.03	172.4	.15	-135.0
1800.	.04	-160.5	6.48	-14.4	.03	159.5	.15	-158.1
1900.	.02	-146.1	6.44	-35.1	.03	146.0	.15	180.0
2000.	.04	-148.1	6.46	-55.8	.03	132.6	.15	160.3
2100.	.04	-126.0	6.48	-76.2	.03	119.6	.15	131.1
2200.	.06	-120.0	6.54	-99.6	.03	107.0	.15	106.0

1

WJ-A36-1

100 TO 2300 MHz TO-8 CASCADABLE AMPLIFIER

- HIGH GAIN – TWO STAGES: 16.2 dB (TYP.)
- LOW VSWR: < 1.6:1 (TYP.)
- HIGH OUTPUT LEVELS: > +13.5 dBm, 1700-2300 MHz (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	80-2400 MHz	100-2300 MHz	100-2300 MHz
Small Signal Gain (Min.)	16.2 dB	15.0 dB	14.0 dB
Gain Flatness (Max.)	±0.2 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	6.0 dB	7.0 dB	7.5 dB
Power Output at 1 dB Compression (Min.)	+12.0 dBm	+11.0 dBm	+11.0 dBm
VSWR (Max.) Input/Output	< 1.6:1	2.0:1	2.0:1
DC Current (Max.) at 15 Volts	63 mA	64 mA	67 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . . . +38 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . . . +33 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . . . +23 dBm (Typ.)

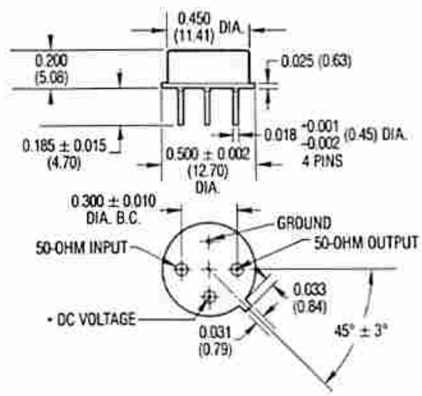
Absolute Maximum Ratings

Storage Temperature . . . . . . -62°C to +125°C
Maximum Case Temperature . . . . . . 125°C
Maximum DC Voltage . . . . . . +17 Volts
Maximum Continuous RF Input Power . . . . . . +10 dBm
Maximum Short Term RF Input Power . . . . . . +50 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

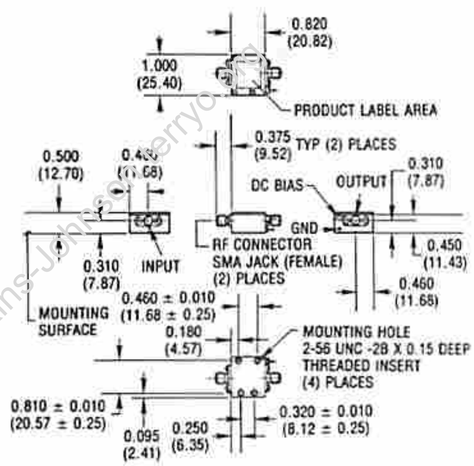
Outline Drawings

A36-1



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA36-1

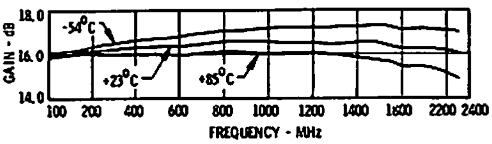


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

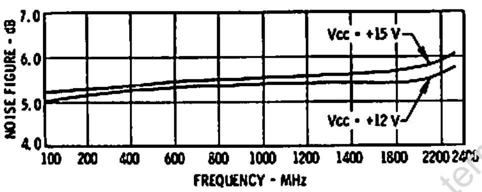
*WJ CA36-1 is standard WJ A36-1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers

Typical Performance at 25°C

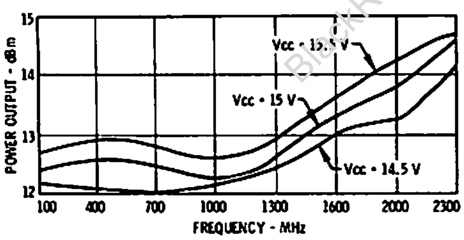
Gain



Noise Figure

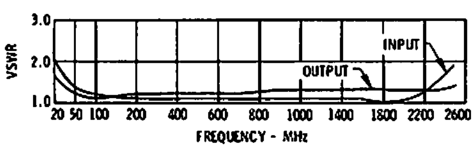


Power Output*

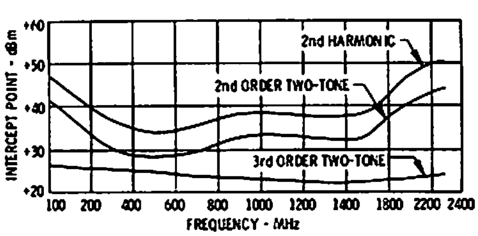


* @1 dB GAIN COMPRESSION

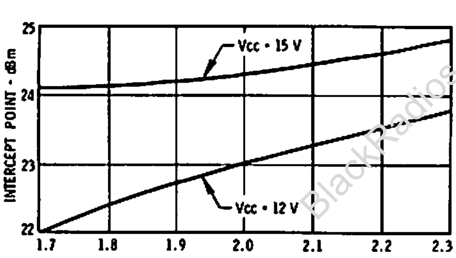
VSWR



Intercept Point



Two Tone Third Order Intercept Point



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.2	16.1
200.	1.1	1.2	16.1
300.	1.1	1.2	16.1
400.	1.1	1.2	16.2
500.	1.1	1.2	16.3
600.	1.1	1.2	16.3
700.	1.1	1.2	16.3
800.	1.1	1.2	16.4
900.	1.1	1.3	16.4
1000.	1.1	1.3	16.4
1100.	1.1	1.3	16.4
1200.	1.1	1.3	16.4
1300.	1.1	1.3	16.4
1400.	1.1	1.3	16.3
1500.	1.1	1.3	16.3
1600.	1.1	1.3	16.2
1700.	1.1	1.3	16.2
1800.	1.1	1.3	16.2
1900.	1.2	1.2	16.1
2000.	1.2	1.2	16.1
2100.	1.3	1.2	16.0
2200.	1.4	1.2	15.9
2300.	1.6	1.2	15.8
2400.	1.8	1.2	15.6

Linear S-Parameters

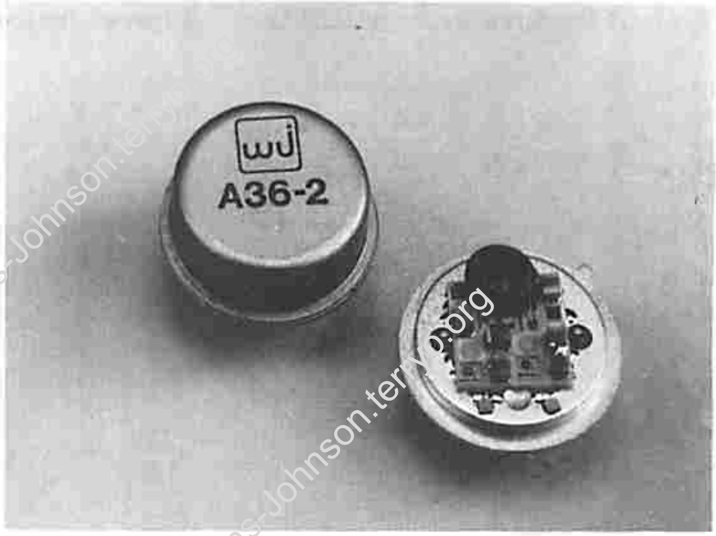
FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.04	-101.4	6.36	-9.2	.03	8.3	.10	167.2
200.	.04	-91.7	6.40	-34.5	.03	-8.1	.08	143.3
300.	.04	-110.9	6.42	-56.2	.03	-20.1	.08	124.7
400.	.04	-116.2	6.47	-77.4	.03	-31.3	.07	94.5
500.	.05	-136.8	6.52	-97.9	.03	-42.5	.08	71.8
600.	.05	-162.8	6.56	-119.8	.03	-53.9	.09	55.7
700.	.05	-160.1	6.57	-141.1	.03	-64.1	.10	37.7
800.	.06	172.5	6.59	-162.2	.03	-74.9	.11	20.7
900.	.05	161.7	6.59	176.3	.03	-85.0	.12	11.4
1000.	.06	147.4	6.61	155.0	.03	-95.8	.12	-3.8
1100.	.05	125.7	6.61	133.7	.03	-107.0	.13	-19.5
1200.	.05	110.9	6.62	111.8	.03	-119.8	.13	-37.4
1300.	.05	104.0	6.59	90.3	.03	-133.2	.13	-55.1
1400.	.05	80.4	6.54	69.2	.03	-146.9	.13	-73.8
1500.	.03	60.0	6.51	47.7	.03	-159.9	.14	-90.2
1600.	.04	47.6	6.49	26.1	.03	-173.3	.12	-110.1
1700.	.05	7.4	6.45	5.5	.03	174.7	.12	-124.3
1800.	.04	-8.7	6.44	-15.9	.03	162.2	.11	-147.6
1900.	.08	-28.7	6.40	-37.5	.03	149.2	.10	-169.2
2000.	.09	-57.3	6.39	-59.2	.03	135.7	.10	171.8
2100.	.13	-73.9	6.32	-82.5	.03	123.4	.09	140.5
2200.	.17	-92.2	6.27	-104.8	.03	109.9	.09	113.6
2300.	.22	-110.0	6.14	-128.3	.03	96.5	.09	90.9
2400.	.28	-127.2	6.00	-152.3	.03	83.1	.09	65.5
2500.	.35	-143.9	5.76	-176.2	.03	69.9	.09	40.7

1

WJ-A36-2

100 TO 2600 MHz
TO-8 CASCADABLE AMPLIFIER

- ULTRA-WIDE BANDWIDTH: 100-2600 MHz
- HIGH GAIN — TWO STAGES: 15.0 dB (TYP.)
- HIGH OUTPUT LEVEL: > +14 dBm, 2000-2600 MHz (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	80-2700 MHz	100-2600 MHz	100-2600 MHz
Small Signal Gain (Min.)	15.0 dB	14.0 dB	13.0 dB
Gain Flatness (Max.)	±0.3 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	6.0 dB	7.0 dB	7.5 dB
Power Output at 1 dB Compression (Min.)			
100-2000 MHz	+12.0 dBm	+11.0 dBm	+11.0 dBm
2000-2600 MHz	+14.0 dBm	+12.5 dBm	+12.0 dBm
VSWR (Max.)			
Input	1.7:1	2.0:1	2.0:1
Output	1.7:1	2.2:1	2.2:1
DC Current (Max.) at 15 Volts	63 mA	64 mA	67 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +10 dBm
Maximum Short Term RF Input Power . . . . . . +50 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3μsec Max.)
"S" Series Burn-In Temperature . . . . 125°C

Typical Intermodulation Performance at 25°C

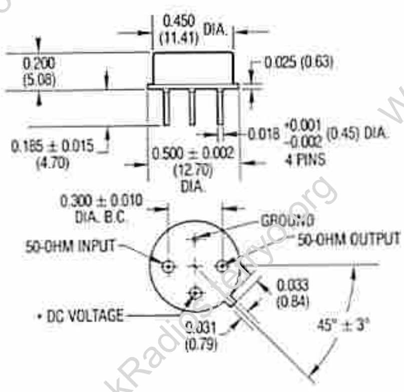
Second Order Harmonic Intercept Point. . . . . 37 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . ≥ +32 dBm (Typ.)
Third Order Two Tone Intercept Point. . . . . 30 dBm (Typ.)

Weight

approximately 2.0 grams (0.07 oz.)

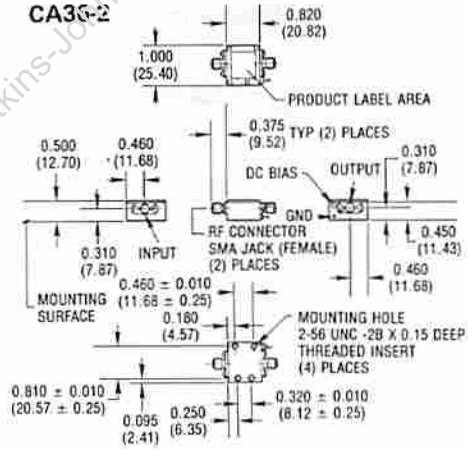
Outline Drawings

A36-2



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

CA36-2*

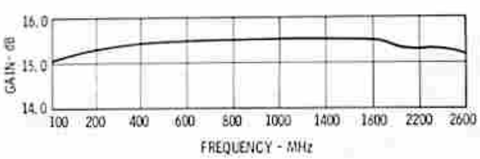


DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

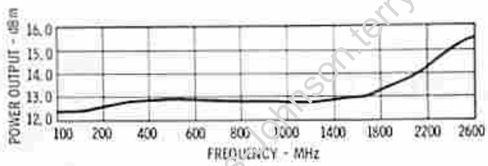
*WJ CA36-2 is standard WJ A36-2 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

Gain

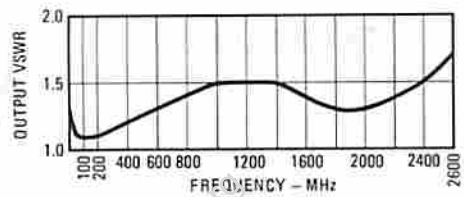


Power Output*

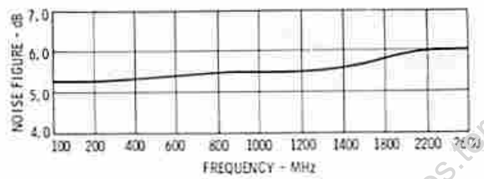


*at 1 dB Gain Compression

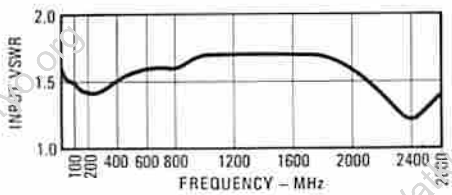
VSWR



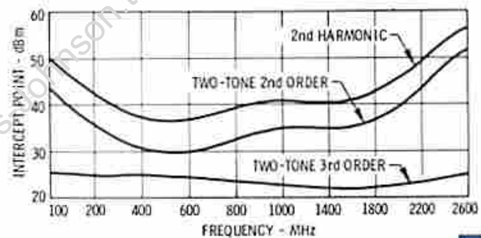
Noise Figure



VSWR



Intercept Point



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Typical Automatic Test Data

V_{CC} = 15 V

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN dB
100.0	1.2	1.1	15.0
200.0	1.2	1.1	15.1
300.0	1.2	1.1	15.3
400.0	1.2	1.2	15.3
500.0	1.2	1.2	15.4
600.0	1.2	1.2	15.4
700.0	1.3	1.3	15.5
800.0	1.3	1.3	15.5
900.0	1.3	1.3	15.7
1000.0	1.4	1.4	15.6
1100.0	1.4	1.4	15.6
1200.0	1.4	1.4	15.6
1300.0	1.5	1.4	15.9
1400.0	1.5	1.4	15.7
1500.0	1.6	1.5	15.8
1600.0	1.6	1.5	15.4
1700.0	1.7	1.5	15.6
1800.0	1.6	1.5	15.6
1900.0	1.7	1.5	15.9
2000.0	1.7	1.6	15.4
2100.0	1.6	1.6	15.5
2200.0	1.5	1.7	15.4
2300.0	1.4	1.7	15.5
2400.0	1.2	1.8	15.2
2500.0	1.1	1.9	15.3
2600.0	1.2	1.9	15.1

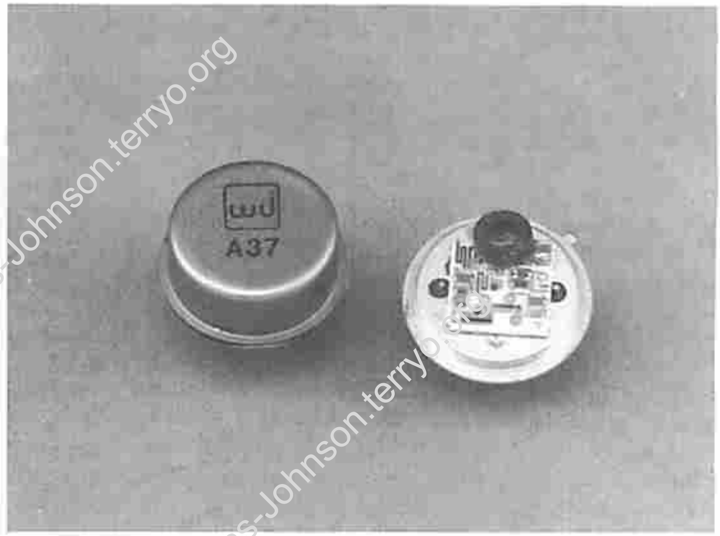
Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.0	.082	-47	5.646	-4.76	.031	7.47	.038	7
200.0	.080	-48	5.716	-23.96	.032	-4.45	.054	16
300.0	.075	-57	5.816	-40.47	.032	-11.26	.066	14
400.0	.086	-68	5.795	-56.44	.032	-18.54	.077	9
500.0	.089	-81	5.869	-71.35	.032	-24.70	.089	3
600.0	.096	-96	5.869	-86.95	.032	-32.11	.104	-5
700.0	.112	-107	5.970	-102.38	.031	-37.64	.118	-15
800.0	.126	-120	5.974	-117.39	.031	-43.47	.130	-26
900.0	.138	-134	6.092	-132.96	.030	-52.19	.142	-40
1000.0	.149	-147	6.090	-148.63	.030	-58.38	.153	-54
1100.0	.156	-156	6.019	-164.01	.030	-64.43	.162	-70
1200.0	.180	-173	6.034	-178.94	.030	-70.56	.172	-86
1300.0	.195	173	6.229	164.96	.029	-76.86	.178	-104
1400.0	.211	165	6.095	149.26	.027	-86.29	.183	-124
1500.0	.219	150	6.139	132.28	.027	-93.94	.187	-144
1600.0	.229	138	5.904	117.67	.027	-100.18	.189	-165
1700.0	.246	123	6.038	103.52	.027	-106.13	.194	172
1800.0	.240	112	6.052	87.63	.026	-114.35	.199	149
1900.0	.258	96	6.203	70.23	.027	-118.92	.209	126
2000.0	.250	84	5.871	53.98	.027	-126.12	.220	103
2100.0	.217	68	5.963	37.80	.027	-131.77	.236	80
2200.0	.187	51	5.911	22.26	.028	-136.33	.254	57
2300.0	.158	37	5.934	4.19	.030	-142.69	.271	34
2400.0	.108	11	5.786	-12.72	.031	-149.31	.289	12
2500.0	.037	-22	5.821	-31.14	.033	-157.59	.308	-9
2600.0	.076	-157.	5.675	-48.52	.036	-164.42	.317	-30

WJ-A37

10 TO 2000 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT LEVEL: +15.5 dBm (TYP.)
- HIGH THIRD ORDER I.P.: +26 dBm (TYP.)
- WIDE POWER SUPPLY RANGE: +5 TO +15 VOLTS



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	5-2050 MHz	10-2000 MHz	10-2000 MHz
Small Signal Gain (Min.)	9.3 dB	8.0 dB	7.0 dB
Gain Flatness (Max.)			
500-2000 MHz	< ±0.4 dB	±0.6 dB	±0.8 dB
10-2000 MHz	< ±0.5 dB	±0.8 dB	±1.0 dB
Noise Figure (Max.)	6.5 dB	8.0 dB	8.5 dB
Power Output at 1 dB Compression (Min.)	+15.5 dBm	+14 dBm	+13.5 dBm
VSWR (Max.) Input/Output	< 1.7:1	2.2:1	2.2:1
DC Current (Max.) at 15 Volts	45 mA	50 mA	53 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

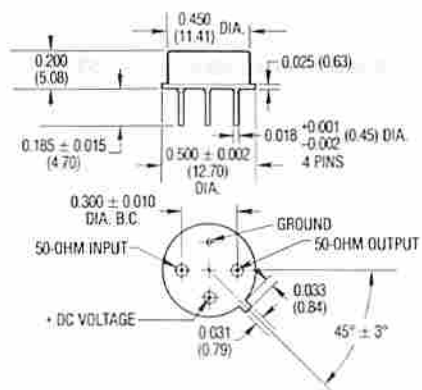
Second Order Harmonic Intercept Point . . . . +52 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +49 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +26 dBm (Typ.)

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . +50 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

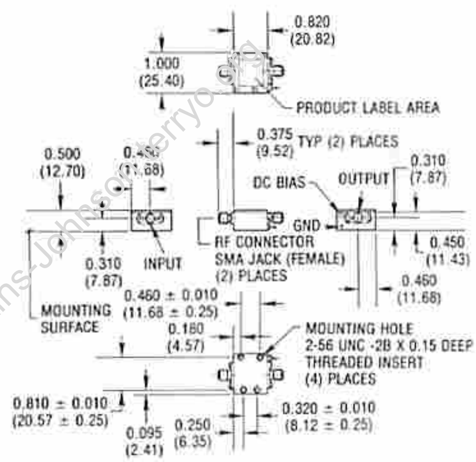
Outline Drawings

A37



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA37



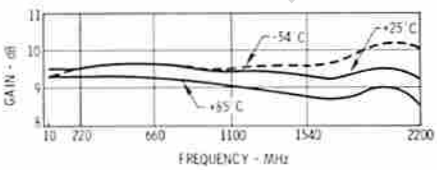
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

*WJ CA37 is standard WJ A37 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

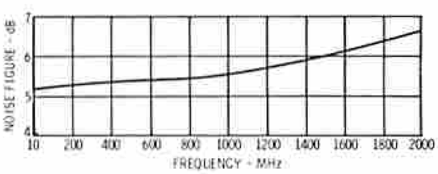
Weight approximately 2.0 grams (0.07 oz.)

Typical Performance at 25°C

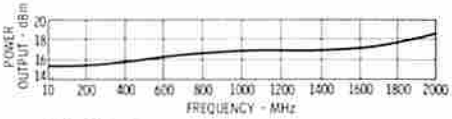
Gain



Noise Figure

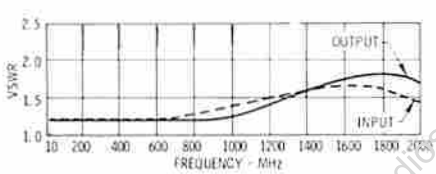


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.4	9.2
200.	1.2	1.3	9.2
300.	1.2	1.2	9.3
400.	1.2	1.2	9.4
500.	1.2	1.2	9.3
600.	1.2	1.1	9.2
700.	1.2	1.2	9.2
800.	1.2	1.2	9.2
900.	1.2	1.2	9.1
1000.	1.3	1.2	9.1
1100.	1.4	1.3	9.1
1200.	1.4	1.3	9.1
1300.	1.6	1.4	9.0
1400.	1.6	1.4	9.0
1500.	1.7	1.5	8.9
1600.	1.7	1.6	9.0
1700.	1.8	1.7	9.0
1800.	1.7	1.7	9.1
1900.	1.6	1.7	9.1
2000.	1.5	1.5	9.2
2100.	1.9	1.8	9.2

Linear S-Parameters

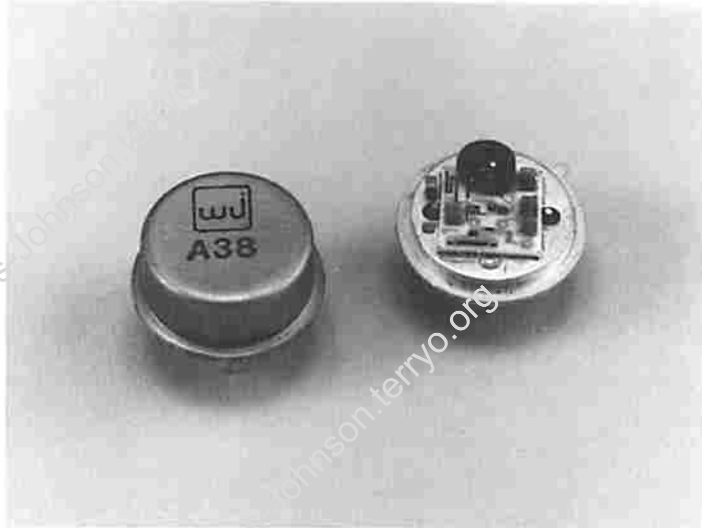
FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.10	174.3	2.87	172.4	.17	-.7	.16	156.5
200.	.08	-153.4	2.90	157.1	.17	-6.6	.12	153.2
300.	.10	-167.0	2.92	144.0	.17	-13.0	.11	135.2
400.	.08	[illegible]	2.94	130.6	.17	-19.5	.09	108.0
500.	.08	[illegible]	2.93	117.7	.18	-25.6	.08	79.4
600.	.10	[illegible]	2.90	103.8	.17	-32.4	.07	53.5
700.	.07	-155.8	2.87	89.8	.17	-38.7	.09	24.3
800.	.10	-148.4	2.89	75.0	.18	-47.1	.09	-3.2
900.	.11	-154.0	2.87	60.8	.18	-53.3	.09	-27.6
1000.	.13	-140.1	2.87	46.1	.17	-60.3	.11	-46.2
1100.	.17	-149.9	2.85	31.7	.17	-67.2	[illegible]	-68.3
1200.	.18	-159.3	2.84	17.4	.17	-74.9	.13	-91.6
1300.	.22	-168.7	2.82	4.2	.17	-83.9	.15	-109.8
1400.	.23	-171.5	2.80	-11.3	.17	-91.7	.18	-127.2
1500.	.26	170.2	2.80	-27.1	.17	-101.3	.21	-149.5
1600.	.26	166.5	2.01	-42.8	.18	-109.8	.23	-163.9
1700.	.27	154.2	2.00	-58.5	.18	-118.9	.26	-177.4
1800.	.25	133.6	2.04	-74.9	.18	-127.0	.27	163.9
1900.	.23	106.7	2.06	-91.9	.19	-137.6	.26	146.0
2000.	.21	67.3	2.09	-110.3	.19	-150.2	.21	129.9
2100.	.30	-7.3	2.07	-142.2	.20	-173.7	.14	75.8
2200.	.43	-51.1	2.64	-168.1	.19	166.1	.10	-2.7

1

WJ-A38

10 TO 2000 MHz TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT POWER: +19 dBm (TYP.)
- HIGH THIRD ORDER I.P.: +30 dBm
- WIDE BANDWIDTH: 10-2000 MHz



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	5-2050 MHz	10-2000 MHz	10-2000 MHz
Small Signal Gain (Min.)	7.5 dB	6.5 dB	6.0 dB
Gain Flatness (Max.)	±0.3 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)			
10-1500 MHz	6.5 dB	7.7 dB	8.2 dB
500-2000 MHz	7.5 dB	9.0 dB	9.5 dB
Power Output at 1 dB Compression (Min.)			
10-1500 MHz	+18.0 dBm	+17.0 dBm	+16.5 dBm
500-2000 MHz	+19.0 dBm	+18.0 dBm	+17.5 dBm
VSWR (Max.) Input/Output	1.8:1	2.2:1	2.2:1
DC Current (Max.) at 15 Volts	65 mA	69 mA	72 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

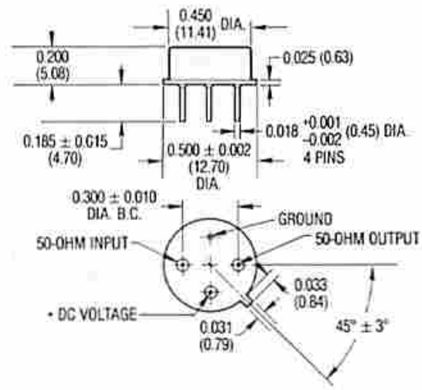
Second Order Harmonic Intercept Point . . . . +52 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +45 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +30 dBm (Typ.)

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 100°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +50 Milliwatts
Maximum Short Term CW Input . . . . +100 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 100°C

Outline Drawings

A38

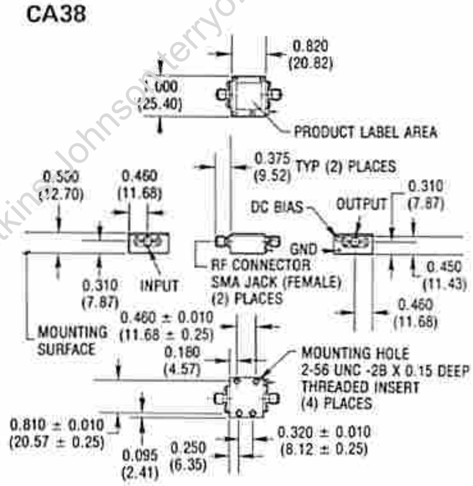


DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.005 (.13) UNLESS OTHERWISE SPECIFIED

Weight

approximately 2.0 grams (0.07 oz.)

CA38

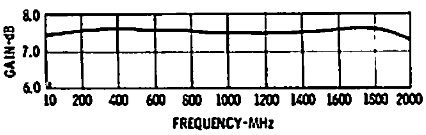


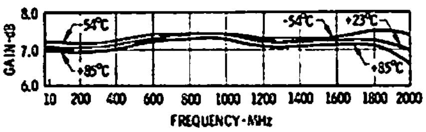
DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

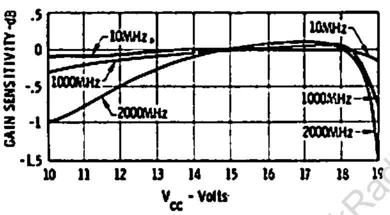
*WJ CA38 is standard WJ A38 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers

Typical Performance at 25°C

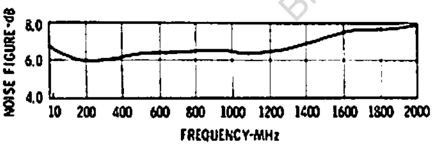
Gain



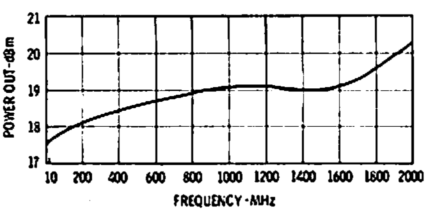


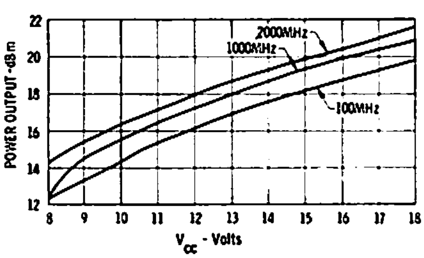


Noise Figure



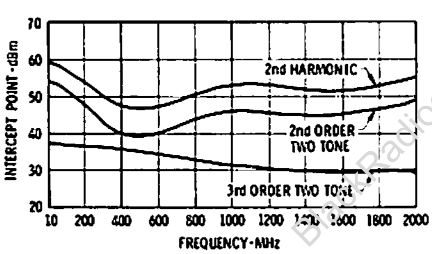
Power Output *



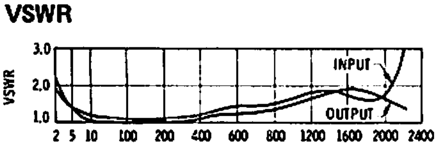


*at 1 dB Gain Compression

Intercept Point



VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.0	7.5
200.	1.1	1.0	7.4
300.	1.2	1.1	7.4
400.	1.2	1.1	7.4
500.	1.3	1.2	7.4
600.	1.3	1.2	7.4
700.	1.4	1.3	7.4
800.	1.5	1.4	7.4
900.	1.5	1.4	7.4
1000.	1.6	1.5	7.3
1100.	1.6	1.6	7.3
1200.	1.7	1.7	7.3
1300.	1.7	1.8	7.2
1400.	1.7	1.8	7.2
1500.	1.7	1.9	7.2
1600.	1.7	1.9	7.2
1700.	1.6	1.9	7.2
1800.	1.6	1.8	7.1
1900.	1.5	1.8	7.2
2000.	1.7	1.7	7.0
2100.	1.9	1.5	6.6

Linear S-Parameters

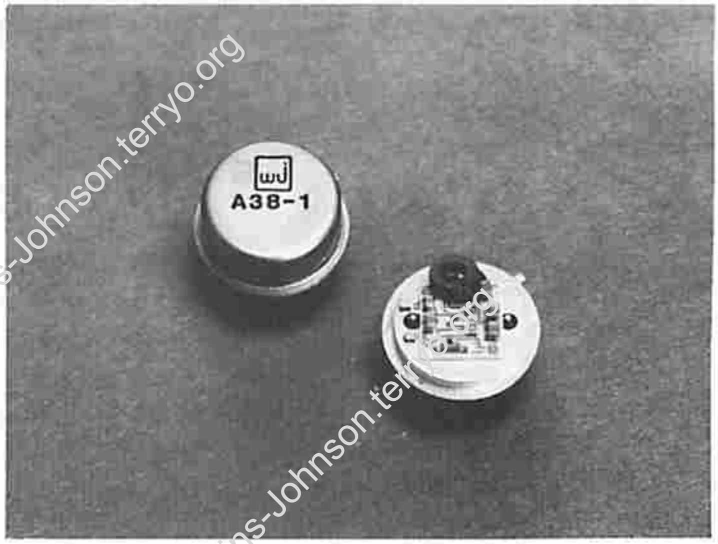
FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.03	-94.0	2.37	163.9	.20	-8.6	.00	-170.6
200.	.06	-105.0	2.35	146.9	.20	-18.0	.01	-104.0
300.	.08	-117.8	2.36	130.0	.20	-27.4	.03	-98.0
400.	.10	-129.2	2.35	113.2	.20	-37.1	.05	-103.3
500.	.12	-139.1	2.34	94.6	.21	-47.0	.07	-115.0
600.	.14	-149.1	2.34	77.1	.21	-56.8	.10	-128.4
700.	.16	-158.4	2.34	59.9	.21	-66.7	.12	-140.2
800.	.19	-168.[illegible]	2.35	43.1	.21	-76.1	.15	-154.2
900.	.21	-179.8	2.35	26.4	.21	-85.8	.18	-167.5
1000.	.23	169.5	2.33	9.8	.21	-95.5	.21	178.4
1100.	.24	155.9	2.32	-6.9	.22	-105.8	.23	163.3
1200.	.26	143.0	2.31	-23.3	.22	-116.1	.26	148.8
1300.	[illegible]	129.2	2.29	-40.6	.22	-126.3	.27	132.9
1400.	[illegible]	113.4	2.28	-57.8	.23	-137.2	.29	118.1
1500.	.27	96.4	2.28	-74.8	.24	-147.6	.30	101.8
1600.	.26	76.2	2.28	-92.6	.24	-159.0	.31	84.5
1700.	.24	50.4	2.28	-110.3	.26	-170.4	.31	66.5
1800.	.22	18.5	2.27	-129.0	.27	176.8	.30	47.0
1900.	.21	-23.6	2.29	-148.8	.28	162.9	.28	23.9
2000.	.25	-69.6	2.23	-169.9	.30	147.5	.25	-3.3
2100.	.31	-109.6	2.13	169.0	.30	130.4	.20	-40.4
2200.	.41	-143.3	2.00	146.6	.30	113.8	.16	-83.9

1

WJ-A38-1

10 TO 2000 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT POWER: +18 dBm (TYP.)
- HIGH THIRD ORDER I.P.: +30 dBm (TYP.)
- WIDE BANDWIDTH: 10 - 2000 MHz



Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54° - +85°C
Frequency (Min.)	5 - 2050 MHz	10 - 2000 MHz	10 - 2000 MHz
Small Signal Gain (Min.)	9.5 dB	8.5 dB	7.5 dB
Gain Flatness (Max.)	±.4 dB	±.7 dB	±1.0 dB
Noise Figure (Max.)			
10 - 1500	5.5 dB	6.0 dB	6.5 dB
10 - 2000	6.5 dB	7.5 dB	8.0 dB
Power Output at 1 dB Compression (Min.)			
10 - 2000	18.0 dBm	17.0 dBm	16.5 dBm
VSWR (Max.)			
Input/Output	1.6:1	2.1:1	2.2:1
DC Current (Max.) at 15 Volts	65 mA	70 mA	74 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

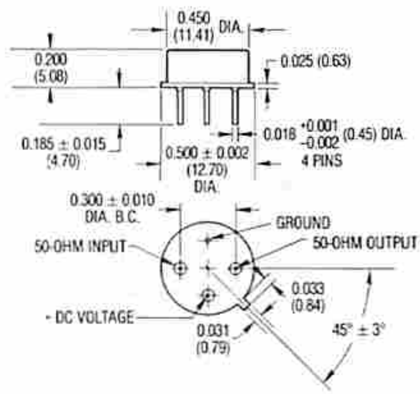
Second Order Harmonic Intercept Point .... 52 dBm (Typ.)
Second Order Two Tone Intercept Point .... 45 dBm (Typ.)
Third Order Two Tone Intercept Point .... 30 dBm (Typ.)

Absolute Maximum Ratings

Storage Temperature .... -62°C to 125°C
Maximum Case Temperature .... 100°C
Maximum DC Voltage .... +17 Volts
Maximum Continuous RF Input Power .... +17 dBm
Maximum Short Term RF Input Power (1 Minute Max.) .... +100 Milliwatts
Maximum Peak Power .... .5 Watt
(3 μsec Max.)
"S" Series Burn-In Temperature (Case) .... 100°C

Outline Drawings

A38-1

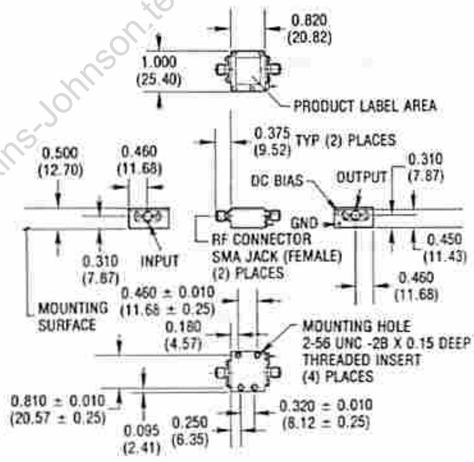


DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .005 (.13) UNLESS OTHERWISE SPECIFIED

Weight

approximately 2.0 grams (0.07 oz.)

CA38-1

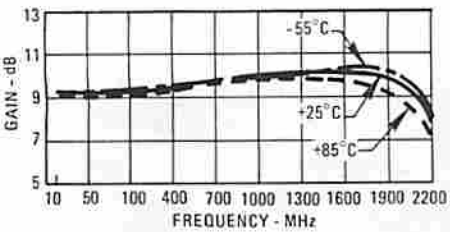


DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

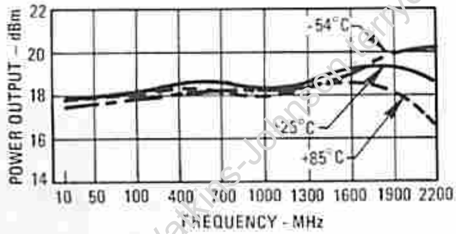
WJ-CA38-1 is standard and WJ-A38-1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

Gain

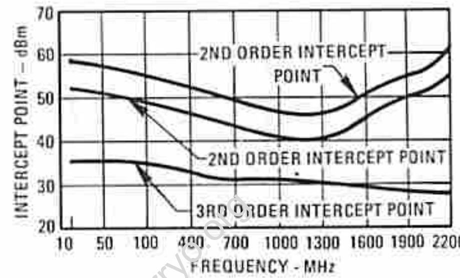


Power Output*

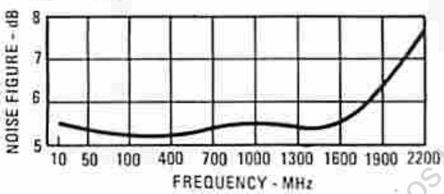


* at 1 dB Gain Compression

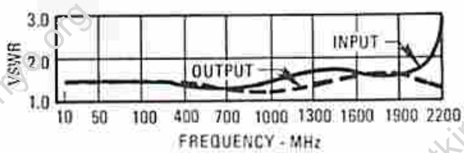
Intermodulation



Noise Figure



VSWR



Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
100.0	1.6	1.5	9.1
200.0	1.3	1.3	9.6
300.0	1.4	1.4	9.5
400.0	1.3	1.3	9.6
500.0	1.3	1.2	9.6
600.0	1.3	1.2	9.7
700.0	1.3	1.1	9.8
800.0	1.3	1.1	9.8
900.0	1.4	1.1	9.8
1000.0	1.5	1.2	9.9
1100.0	1.5	1.2	10.0
1200.0	1.6	1.2	10.1
1300.0	1.8	1.3	10.0
1400.0	1.7	1.4	10.0
1500.0	1.9	1.5	9.9
1600.0	1.9	1.6	9.9
1700.0	1.8	1.7	9.9
1800.0	1.5	1.6	9.9
1900.0	1.3	1.5	9.7
2000.0	1.4	1.5	9.4
2100.0	2.1	1.3	8.4
2200.0	2.0	1.3	7.3

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.0	0.216	169	2.85	171	0.18	-2	0.210	154
200.0	0.143	176	3.02	155	0.17	-13	0.114	145
300.0	0.171	179	2.99	142	0.17	-18	0.151	141
400.0	0.129	178	3.02	129	0.18	-25	0.113	125
500.0	0.129	-177	3.02	117	0.18	-31	0.097	115
600.0	0.116	-176	3.05	106	0.18	-39	0.099	96
700.0	0.121	-162	3.09	91	0.18	-43	0.062	75
800.0	0.131	-152	3.09	76	0.18	-50	0.047	19
900.0	0.151	-152	3.09	61	0.18	-61	0.062	7
1000.0	0.195	-137	3.13	48	0.18	-67	0.077	-83
1100.0	0.204	-143	3.16	37	0.19	-72	0.092	-111
1200.0	0.218	-147	3.20	28	0.19	-81	0.105	-114
1300.0	0.276	-151	3.16	5	0.19	-90	0.142	-132
1400.0	0.264	-162	3.16	-8	0.19	-100	0.172	-144
1500.0	0.301	-168	3.13	-24	0.19	-109	0.208	-157
1600.0	0.311	-174	3.13	-39	0.20	-116	0.232	-172
1700.0	0.273	172	3.13	-54	0.20	-123	0.246	163
1800.0	0.206	144	3.13	-70	0.21	-133	0.229	148
1900.0	0.115	98	3.05	-89	0.21	-147	0.211	130
2000.0	0.163	-6	2.95	-110	0.22	-160	0.187	108
2100.0	0.346	-55	2.63	-131	0.20	-175	0.144	66
2200.0	0.474	-86	2.32	-149	0.13	172	0.117	27

V_{CC} = +12 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
100.0	1.6	1.5	9.0
200.0	1.3	1.3	9.5
300.0	1.4	1.3	9.4
400.0	1.3	1.2	9.6
500.0	1.3	1.2	9.5
600.0	1.3	1.2	9.6
700.0	1.3	1.1	9.7
800.0	1.3	1.0	9.8
900.0	1.4	1.1	9.7
1000.0	1.5	1.1	9.9
1100.0	1.5	1.2	10.0
1200.0	1.6	1.2	10.1
1300.0	1.8	1.3	10.1
1400.0	1.7	1.4	10.0
1500.0	1.9	1.4	9.9
1600.0	1.9	1.5	9.9
1700.0	1.7	1.6	10.0
1800.0	1.6	1.5	10.0
1900.0	1.3	1.5	9.7
2000.0	1.6	1.4	9.2
2100.0	2.3	1.4	8.0
2200.0	3.0	1.4	6.7

Linear S-Parameters

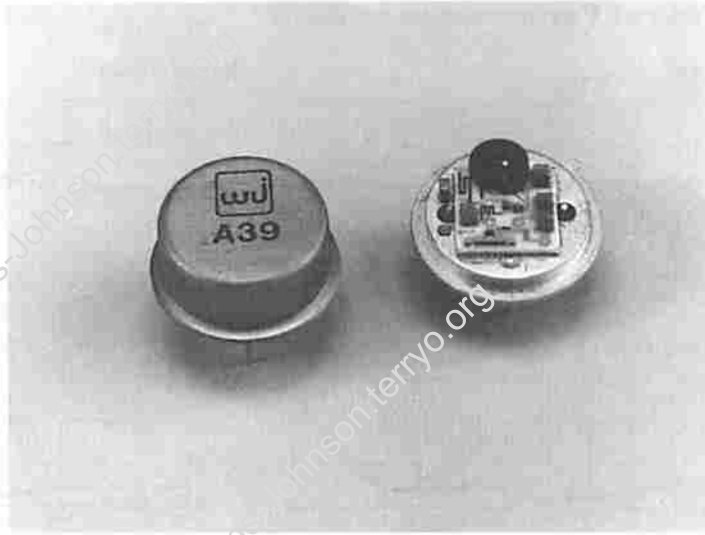
FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.0	0.220	170	2.82	170	0.17	-1	0.203	156
200.0	0.143	175	2.99	154	0.17	-12	0.118	152
300.0	0.164	177	2.95	142	0.17	-20	0.148	147
400.0	0.126	-178	3.02	127	0.18	-26	0.109	135
500.0	0.131	-177	2.99	118	0.18	-32	0.093	128
600.0	0.118	-174	3.02	106	0.18	-38	0.091	111
700.0	0.128	-163	3.05	90	0.19	-43	0.059	106
800.0	0.139	-155	3.09	75	0.19	-50	0.022	64
900.0	0.161	-156	3.05	60	0.19	-61	0.033	51
1000.0	0.203	-142	3.09	48	0.19	-67	0.058	-117
1100.0	0.218	-149	3.16	35	0.20	-70	0.083	-144
1200.0	0.219	-154	3.20	28	0.20	-80	0.086	-145
1300.0	0.279	-159	3.20	4	0.20	-89	0.122	-155
1400.0	0.270	-168	3.16	-10	0.21	-98	0.151	-162
1500.0	0.311	-176	3.13	-26	0.21	-108	0.183	-173
1600.0	0.316	176	3.13	-43	0.21	-117	0.210	170
1700.0	0.267	162	3.16	-58	0.22	-125	0.225	148
1800.0	0.219	128	3.16	-75	0.23	-134	0.215	127
1900.0	0.148	71	3.05	[illegible]	0.23	-150	0.199	109
2000.0	0.228	-11	2.82	[illegible]	0.23	-164	0.179	75
2100.0	0.390	-58	2.51	[illegible]	0.21	-179	0.160	40
2200.0	0.502	-88	[illegible]	-157	0.19	169	0.152	5

1

WJ-A39

10 TO 2000 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT POWER: +22 dBm (TYP.)
- HIGH THIRD ORDER I.P.: +34 dBm (TYP.)
- WIDE BANDWIDTH: 10-2000 MHz



Specifications*

Characteristics		Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)		5-2050 MHz	10-2000 MHz	10-2000 MHz
Small Signal Gain (Min.)		7.5 dB	6.5 dB	6.0 dB
Gain Flatness (Max.)		±0.3 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	10-1500 MHz	<8.0 dB	9.0 dB	9.5 dB
	1500-2000 MHz	8.5 dB	9.5 dB	10.0 dB
Power Output at 1 dB Compression (Min.)		+22 dBm	+20 dBm	+19.5 dBm
VSWR (Max.) Input/Output		1.6:1	2.2:1	2.2:1
DC Current (Max.) at 15 Volts		90 mA	94 mA	98 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +55 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +50 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +34 dBm (Typ.)

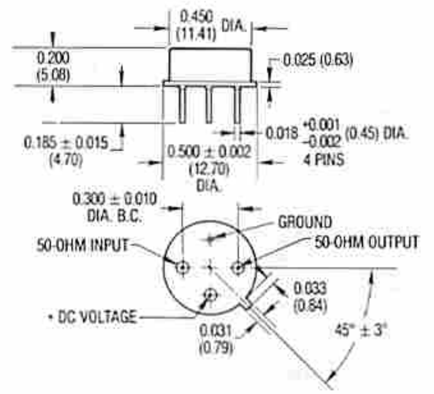
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 100°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +50 Milliwatts
Maximum Short Term CW Input . . . . +100 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 100°C

Weight approximately 2.0 grams (0.07 oz.)

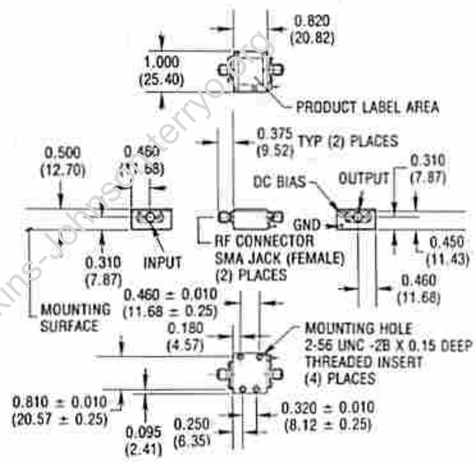
Outline Drawings

A39



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

CA39

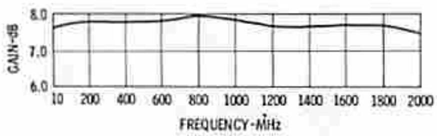


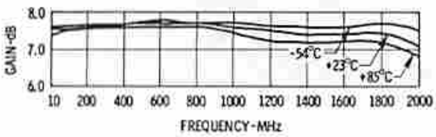
DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

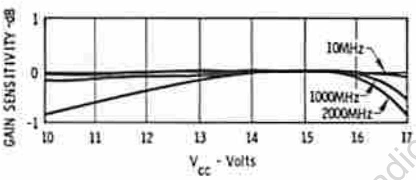
*WJ CA39 is standard WJ A39 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

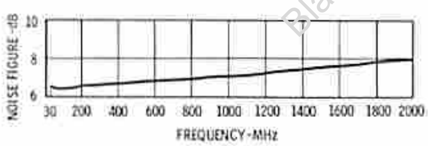
Gain



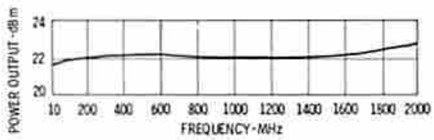


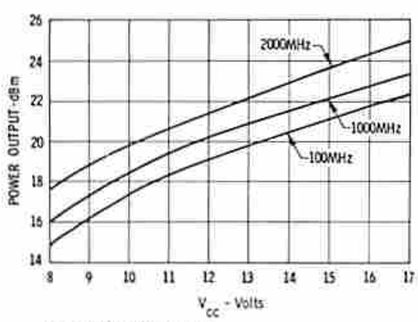


Noise Figure



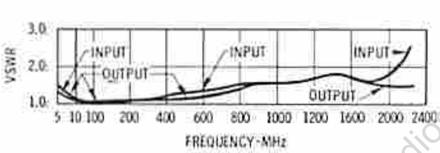
Power Output *



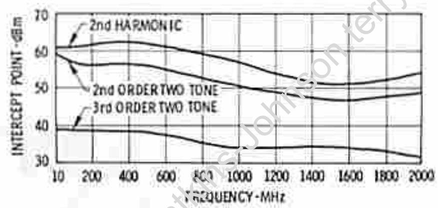


*at 1 dB Gain Compression

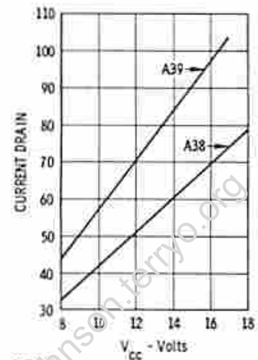
VSWR



Intercept Point



Current Drain vs. V_{CC}



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.1	7.9
200.	1.1	1.1	7.9
300.	1.2	1.0	7.9
400.	1.2	1.0	7.9
500.	1.3	1.1	7.9
600.	1.3	1.1	7.9
700.	1.4	1.2	7.9
800.	1.4	1.2	7.9
900.	1.5	1.3	7.9
1000.	1.5	1.4	7.8
1100.	1.6	1.4	7.8
1200.	1.6	1.5	7.8
1300.	1.6	1.6	7.7
1400.	1.6	1.7	7.7
1500.	1.6	1.8	7.7
1600.	1.5	1.8	7.7
1700.	1.4	1.8	7.7
1800.	1.4	1.7	7.6
1900.	1.5	1.7	7.6
2000.	[illegible]	1.6	7.2
2100.	2.1	1.5	6.6

V_{CC} = 12V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.1	7.9
200.	1.1	1.1	7.9
300.	1.2	1.1	7.9
400.	1.2	1.1	7.9
500.	1.3	1.1	7.9
600.	1.3	1.2	7.9
700.	1.4	1.2	7.9
800.	1.5	1.3	7.9
900.	1.5	1.3	7.8
1000.	1.6	1.4	7.8
1100.	1.6	1.5	7.7
1200.	1.6	1.6	7.7
1300.	1.6	1.6	7.6
1400.	1.6	1.7	7.6
1500.	1.6	1.7	7.6
1600.	1.5	1.8	7.6
1700.	1.5	1.7	7.5
1800.	1.5	1.7	7.4
1900.	1.6	1.7	7.3
2000.	1.8	1.6	6.9
2100.	2.2	1.5	6.3

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.04	-125.4	2.49	164.1	.20	-8.1	.04	155.8
200.	.06	-127.9	2.49	146.7	.20	-17.8	.03	158.0
300.	.08	-135.9	2.50	129.5	.20	-27.6	.02	173.6
400.	.10	-144.9	2.49	112.3	.20	-37.5	.02	-154.3
500.	.12	-152.3	2.49	94.8	.20	-47.5	.04	-140.2
600.	.14	-160.9	2.49	77.1	.20	-57.5	.06	-144.8
700.	.16	-169.9	2.50	59.8	.20	-67.7	.08	-152.0
800.	.18	-179.5	2.50	42.6	.21	-77.3	.11	-164.0
900.	.19	170.1	2.49	25.5	.21	-87.3	.13	-176.9
1000.	.21	158.6	2.47	8.4	.21	-97.3	.16	168.9
1100.	.22	146.1	2.46	-9.5	.21	-108.0	.18	154.0
1200.	.23	133.4	2.46	-26.4	.22	-118.6	.21	139.4
1300.	.23	119.5	2.44	-44.0	.22	-129.4	.23	122.2
1400.	.23	103.1	2.44	-61.7	.23	-140.7	.25	106.7
1500.	.22	85.2	2.44	-79.4	.24	-151.8	.26	89.3
1600.	.20	[illegible]	2.43	-97.8	.24	-164.0	.28	70.8
1700.	.18	33.2	2.42	-116.5	.25	-176.4	.27	50.8
1800.	.16	-7.6	2.40	-136.1	.27	169.8	.27	29.4
1900.	.19	-55.5	2.39	-157.1	.28	154.8	.25	4.2
2000.	.26	-98.8	2.28	-178.9	.29	138.1	.23	-24.9
2100.	.35	-133.4	2.14	159.9	.29	120.1	.26	-61.7
2200.	.46	-162.5	1.96	137.7	.28	102.8	[illegible]	-104.4

1

WJ-A41

1000 TO 4000 MHz TO-8 CASCADABLE AMPLIFIER

- WIDE BANDWIDTH: 1-4 GHz
- MEDIUM OUTPUT LEVEL: +12 dBm (TYP.)
- LOW NOISE: 3.5 dB (TYP.)
- EXCELLENT GAIN BLOCK
- GaAs FET DESIGN

Specifications*

Characteristics	Typ.	Guaranteed 0° – +50°C	Guaranteed -54° – +85°C
Frequency (Min.)	.9-4.2 GHz	1-4 GHz	1-4 GHz
Small Signal Gain (Min.)	8.5 dB	7.0 dB	6.5 dB
Gain Flatness (Max.)	±.4 dB	±.7 dB	±.9 dB
Noise Figure (Max.)	4.0 dB	5.0 dB	5.5 dB
Power Output at 1 dB Compression (Min.)	12.0 dBm	11.0 dBm	10.5 dBm
VSWR (Max.)			
Input	1.6:1	2.1:1	2.2:1
Output	1.4:1	2.1:1	2.2:1
DC Current (Max.) at +5 Volts	35 mA	40 mA	42 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point .... 45 dBm (Typ.)
Second Order Two Tone Intercept Point .... 35 dBm (Typ.)
Third Order Two Tone Intercept Point .... 25 dBm (Typ.)

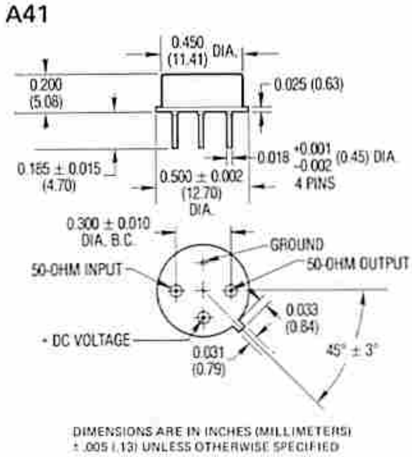
Absolute Maximum Ratings

Storage Temperature .... -62°C to +125°C
Maximum Case Temperature .... +125°C
Maximum DC Voltage .... + 6 Volts
Maximum Continuous RF Input Power .... +12 dBm
Maximum Short Term RF Input Power (1 Minute Max.) .... 50 Milliwatts
Maximum Peak Power .... 0.25 Watts
.... (3μsec Max.)
"S" Series Burn-In Temperature .... 125°C

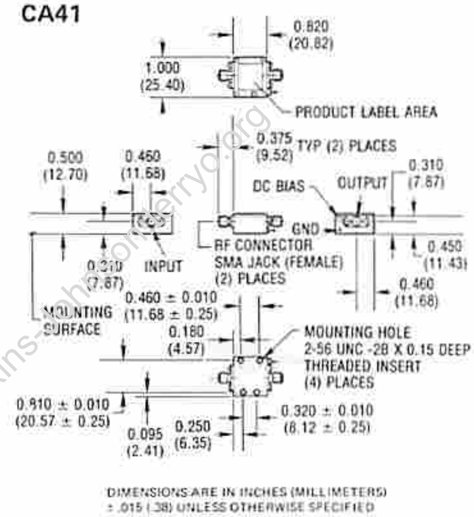
Weight approximately 2.0 grams (0.07 oz.)

Outline Drawings

A41



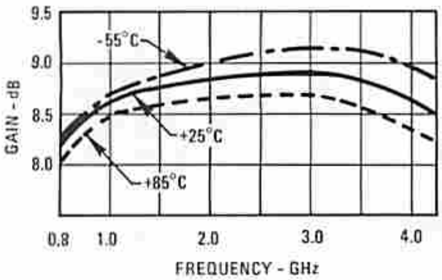
CA41



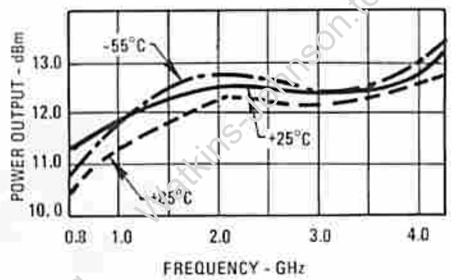
*WJ-CA41 is standard WJ-A41 installed in a miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See cascaded Thin-Film amplifiers.

Typical Performance at 25°C

Gain

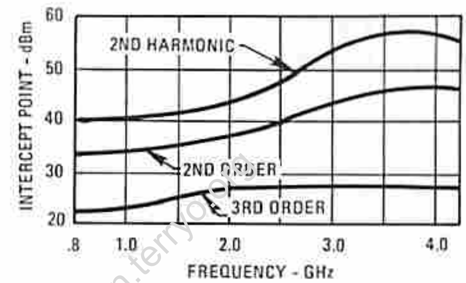


Power Output*

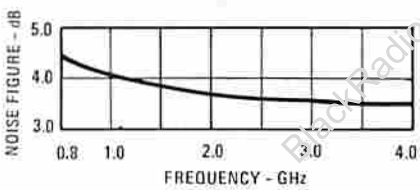


*at 1 dB Gain Compression

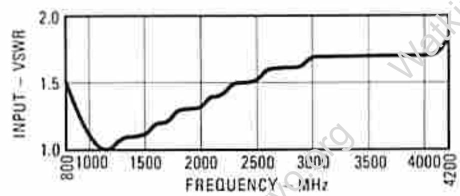
Intercept Point

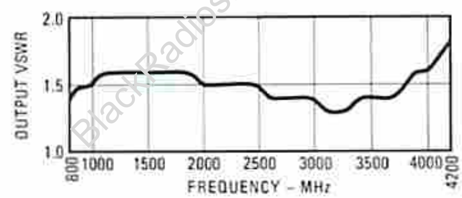


Noise Figure



VSWR





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Typical Automatic Test Data

V_{cc} = +5 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
800.0	1.5	1.4	8.19
900.0	1.3	1.5	8.53
1000.0	1.1	1.5	8.70
1100.0	1.0	1.6	8.76
1200.0	1.0	1.6	8.80
1300.0	1.1	1.6	8.83
1400.0	1.1	1.6	8.85
1500.0	1.1	1.6	8.84
1600.0	1.2	1.6	8.83
1700.0	1.2	1.6	8.84
1800.0	1.3	1.6	8.86
1900.0	1.3	1.6	8.83
2000.0	1.3	1.5	8.82
2100.0	1.4	1.5	8.84
2200.0	1.4	1.5	8.83
2300.0	1.5	1.5	8.84
2400.0	1.5	1.5	8.86
2500.0	1.5	1.5	8.90
2600.0	1.6	1.4	8.89
2700.0	1.6	1.4	8.90
2800.0	1.6	1.4	8.93
2900.0	1.6	1.4	8.95
3000.0	1.7	1.4	8.97
3100.0	1.7	1.3	8.99
3200.0	1.7	1.3	9.00
3300.0	1.7	1.3	8.99
3400.0	1.7	1.4	8.99
3500.0	1.7	1.4	8.97
3600.0	1.7	1.4	8.94
3700.0	1.7	1.4	8.90
3800.0	1.7	1.5	8.83
3900.0	1.7	1.6	8.79
4000.0	1.7	1.6	8.70
4100.0	1.7	1.7	8.59
4200.0	1.8	1.8	8.45

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
800.0	.213	-174	2.569	-134	.151	56	.182	-122
900.0	.114	165	2.669	-155	.152	37	.199	-151
1000.0	.057	140	2.722	-172	.151	23	.209	-169
1100.0	.023	93	2.742	174	.149	12	.219	178
1200.0	.023	14	2.754	160	.148	0	.226	167
1300.0	.030	-22	2.763	148	.144	-10	.231	159
1400.0	.052	-40	2.770	137	.142	-19	.233	151
1500.0	.067	-59	2.766	126	.141	-26	.234	145
1600.0	.083	-72	2.762	116	.139	-34	.235	138
1700.0	.097	-80	2.766	106	.136	-41	.229	133
1800.0	.112	-88	2.772	97	.133	-49	.227	127
1900.0	.127	-96	2.765	88	.131	-56	.222	123
2000.0	.144	-101	2.761	79	.129	-62	.211	118
2100.0	.159	-107	2.768	70	.127	-68	.207	113
2200.0	.172	-113	2.765	62	.125	-76	.202	109
2300.0	.186	-120	2.768	53	.123	-82	.197	104
2400.0	.200	-126	2.772	45	.122	-89	.190	100
2500.0	.211	-134	2.785	36	.121	-95	.185	96
2600.0	.221	-140	2.782	28	.118	-102	.178	90
2700.0	.226	-148	2.786	19	.116	-108	.169	85
2800.0	.237	-154	2.795	11	.115	-114	.163	79
2900.0	.242	-163	2.801	3	.117	-120	.158	73
3000.0	.247	-170	2.809	-5	.115	-125	.151	67
3100.0	.250	-177	2.814	-14	.115	-131	.148	59
3200.0	.256	174	2.820	-22	.113	-137	.145	51
3300.0	.262	166	2.814	-31	.113	-142	.146	42
3400.0	.261	157	2.815	-39	.114	-148	.150	31
3500.0	.266	149	2.808	-48	.114	-153	.155	20
3600.0	.267	140	2.801	-56	.113	-159	.166	9
3700.0	.269	131	2.787	-65	.114	-166	.179	-1
3800.0	.269	122	2.764	-74	.115	-171	.196	-12
3900.0	.272	114	2.750	-82	.116	-177	.217	-22
4000.0	.272	105	2.724	-91	.114	176	.240	-31
4100.0	.271	95	2.690	-100	.115	172	.262	-40
4200.0	.274	86	2.646	-109	.116	167	.287	-48

WJ-A41-1

1 TO 4 GHz
TO-8 CASCADABLE AMPLIFIER

- WIDE BANDWIDTH
- HIGH OUTPUT LEVEL: +19.0 dBm (TYP.)
- LOW NOISE: 3.5 dBm (TYP.)

Specifications*

Characteristics	Typ.	Guaranteed 0° – 50°C	Guaranteed -54° – +85°C
Frequency (Min.)	0.9-4.2 GHz	1-4 GHz	1-4 GHz
Small Signal Gain (Min.)	9.0 dB	8.0 dB	7.5 dB
Gain Flatness (Max.)	±.4 dB	±.7 dB	±1.0 dB
Noise Figure (Max.)	3.5 dB	4.7 dB	5.2 dB
Power Output at 1 dB Compression (Min.)	19.0 dBm	17.0 dBm	16.5 dBm
VSWR (Max.)			
Input	1.7:1	2.0:1	2.1:1
Output	1.4:1	2.0:1	2.1:1
DC Current (Max.) at 12 Volts	70 mA	75 mA	77 mA

*Measured in a 50-ohm system at +12 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . .50 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . .44 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . .30 dBm (Typ.)

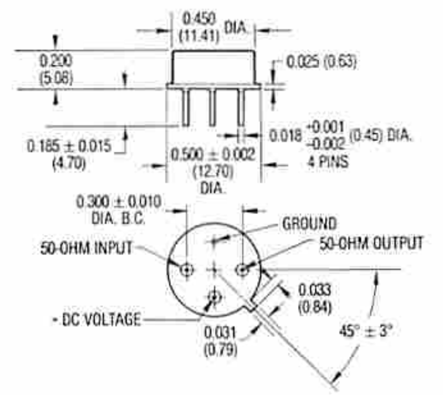
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 100°C
Maximum DC Voltage . . . . +13 Volts
Maximum Continuous RF Input Power . . . . +14 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 50 Milliwatts
Maximum Peak Power . . . . 0.25 Watt
. . . . (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 100°C

Weight approximately 2.0 grams (0.07 oz.)

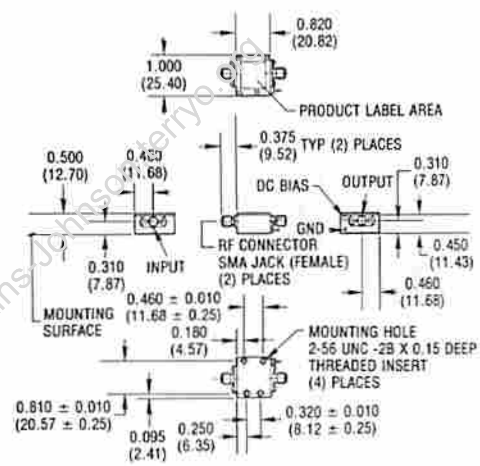
Outline Drawings

A41-1



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA41-1

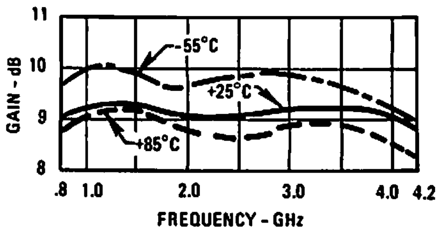


DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

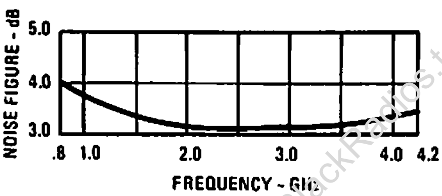
*WJ-CA41-1 is standard. WJ-A41-1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin-Film Amplifiers.

Typical Performance at 25°C

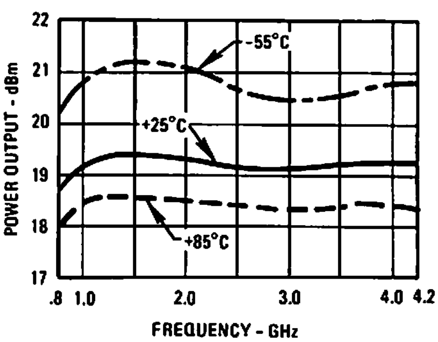
Gain



Noise Figure

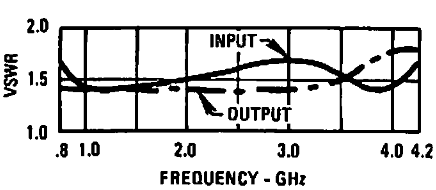


Power Output*

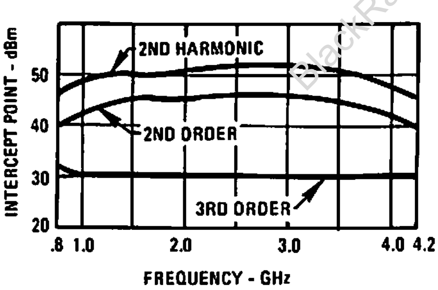


* at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{cc} = +12 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB	FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
800.0	1.9	1.4	8.72	2700.0	1.5	1.3	8.86
900.0	1.6	1.4	8.96	2800.0	1.5	1.3	8.87
1000.0	1.4	1.4	9.08	2900.0	1.5	1.3	8.89
1100.0	1.3	1.4	9.17	3000.0	1.5	1.3	8.89
1200.0	1.2	1.4	9.18	3100.0	1.5	1.3	8.91
1300.0	1.1	1.4	9.20	3200.0	1.5	1.3	8.94
1400.0	1.0	1.4	9.19	3300.0	1.5	1.3	8.95
1500.0	1.0	1.4	9.14	3400.0	1.5	1.3	8.94
1600.0	1.1	1.4	9.12	3500.0	1.4	1.4	8.96
1700.0	1.1	1.4	9.10	3600.0	1.4	1.4	8.95
1800.0	1.2	1.4	9.06	3700.0	1.4	1.4	8.94
1900.0	1.2	1.3	9.03	3800.0	1.4	1.5	8.89
2000.0	1.3	1.3	9.00	3900.0	1.4	1.5	8.83
2100.0	1.3	1.3	8.97	4000.0	1.4	1.5	8.72
2200.0	1.4	1.3	8.94	4100.0	1.4	1.6	8.60
2300.0	1.4	1.3	8.89	4200.0	1.4	1.6	8.43
2400.0	1.4	1.3	8.89				
2500.0	1.5	1.2	8.87				
2600.0	1.5	1.2	8.85				

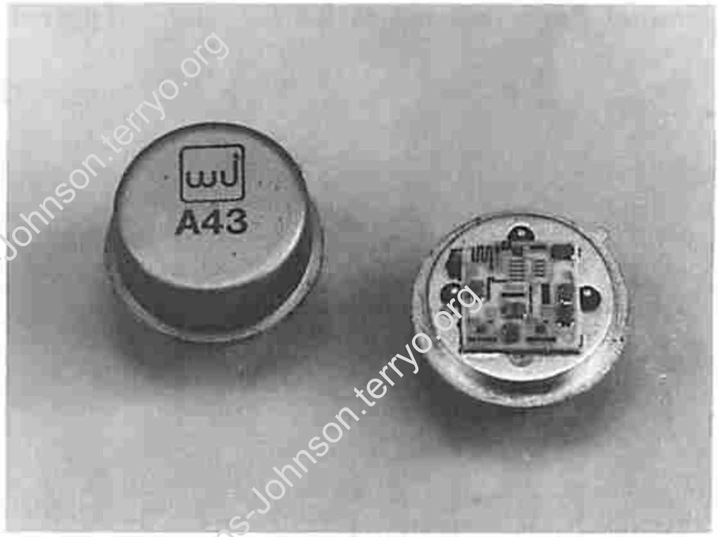
Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
800.0	.318	72	2.729	-170	.145	34	.170	-63
900.0	.243	62	2.805	174	.149	19	.152	-100
1000.0	.186	55	2.845	160	.149	6	.150	-130
1100.0	.134	49	2.873	148	.148	-4	.154	-154
1200.0	.089	43	2.877	137	.149	-15	.162	-173
1300.0	.052	38	2.884	126	.148	-24	.166	171
1400.0	.019	28	2.880	116	.145	-33	.169	158
1500.0	.009	-124	2.865	106	.145	-41	.169	147
1600.0	.036	-144	2.857	97	.142	-50	.166	137
1700.0	.061	-147	2.851	88	.139	-58	.160	130
1800.0	.083	-148	2.838	79	.139	-65	.153	123
1900.0	.104	-153	2.827	70	.136	-72	.143	118
2000.0	.120	-154	2.819	62	.135	-79	.134	114
2100.0	.138	-155	2.808	54	.133	-85	.127	109
2200.0	.150	-159	2.798	46	.131	-92	.120	107
2300.0	.162	-162	2.782	37	.129	-100	.115	106
2400.0	.175	-166	2.784	29	.128	-107	.112	104
2500.0	.187	-172	2.778	20	.128	-114	.109	103
2600.0	.193	-176	2.770	12	.126	-121	.111	101
2700.0	.198	179	2.773	4	.124	-128	.112	100
2800.0	.201	173	2.777	-4	.122	-135	.113	98
2900.0	.204	166	2.783	-12	.123	-141	.116	94
3000.0	.201	159	2.782	-20	.122	-147	.120	90
3100.0	.200	152	2.788	-29	.120	-154	.128	84
3200.0	.197	145	2.799	-37	.121	-160	.131	77
3300.0	.193	136	2.802	-46	.120	-167	.138	70
3400.0	.187	126	2.800	-55	.120	-173	.147	61
3500.0	.180	117	2.805	-64	.120	-180	.156	51
3600.0	.171	105	2.803	-73	.119	174	.164	42
3700.0	.163	93	2.800	-82	.119	168	.174	32
3800.0	.156	79	2.784	-91	.118	161	.184	23
3900.0	.151	63	2.764	-101	.117	155	.197	14
4000.0	.153	48	2.728	-110	.118	148	.211	5
4100.0	.158	32	2.692	-120	.115	142	.223	-2
4200.0	.152	16	2.640	-130	.115	136	.240	-10

WJ-A43

100 TO 3200 MHz
TO-8 CASCADABLE AMPLIFIER

- ULTRA-WIDE BANDWIDTH: 100-3200 MHz
- EXCELLENT GAIN BLOCK: 11.5 dB (TYP.)
- MEDIUM OUTPUT LEVEL: +8.5 dBm (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	80-3200 MHz	100-3200 MHz	100-3200 MHz
Small Signal Gain (Min.)	11.5 dB	10.5 dB	9.8 dB
Gain Flatness (Max.)	±0.3 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	6.7 dB	7.2 dB	7.7 dB
Power Output at 1 dB Compression (Min.)	+8.5 dBm	+7.0 dBm	+6.5 dBm
VSWR (Max.) Input	1.6:1	2.0:1	2.2:1
VSWR (Max.) Output	1.8:1	2.3:1	2.4:1
DC Current (Max.) at 15 Volts	45 mA	48 mA	50 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

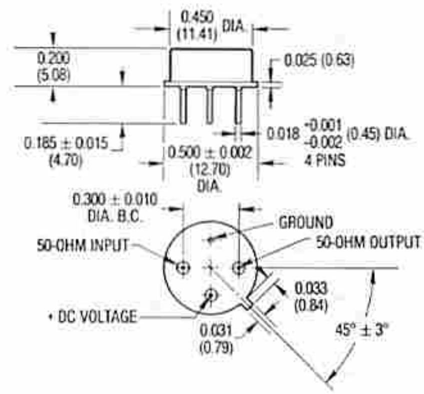
Second Order Harmonic Intercept Point . . . . . +45 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . . +40 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . . +21 dBm (Typ.)

Absolute Maximum Ratings

Storage Temperature . . . . . -62°C to +125°C
Maximum Case Temperature . . . . . 125°C
Maximum DC Voltage . . . . . +17 Volts
Maximum Continuous RF Input Power . . . . . +10 dBm
Maximum Short Term RF Input Power . . . . . +50 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . . 125°C

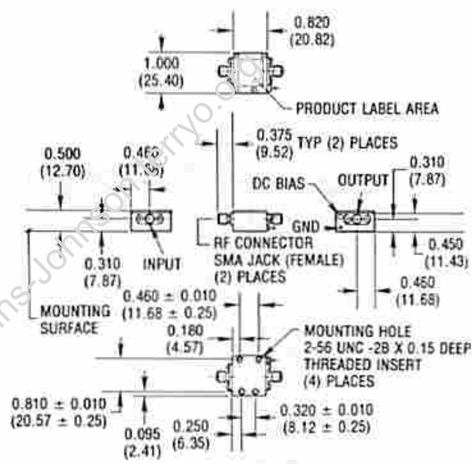
Outline Drawings

A43



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA43



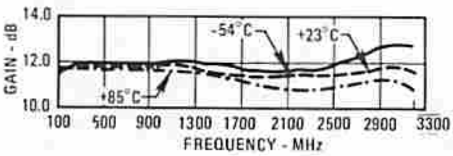
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

*WJ CA43 is standard WJ A43 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

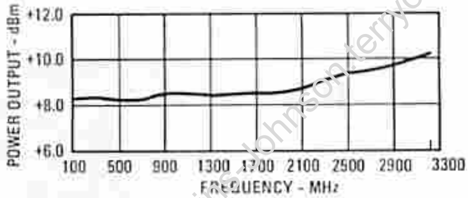
Weight approximately 2.0 grams (0.07 oz.)

Typical Performance at 25°C

Gain

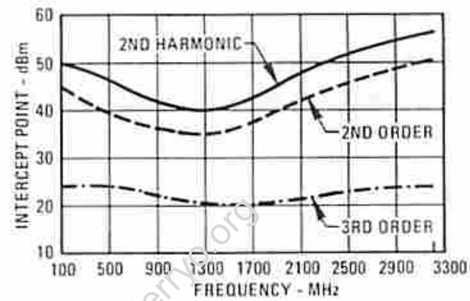


Power Output*

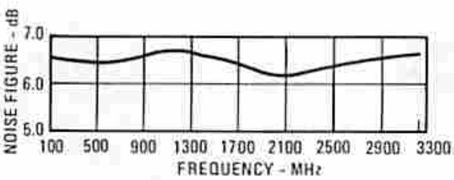


* at 1 dB Gain Compression

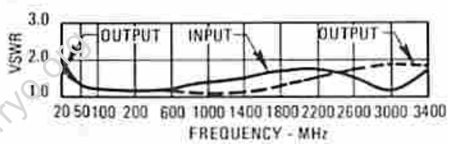
Intercept Point



Noise Figure



VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.2	11.6
200.	1.2	1.1	11.7
300.	1.2	1.1	11.7
400.	1.2	1.1	11.8
500.	1.2	1.1	11.8
600.	1.2	1.1	11.8
700.	1.3	1.1	11.8
800.	1.3	1.1	11.8
900.	1.3	1.1	11.8
1000.	1.4	1.1	11.8
1100.	1.4	1.1	11.8
1200.	1.4	1.1	11.8
1300.	1.5	1.1	11.8
1400.	1.5	1.1	11.7
1500.	1.5	1.2	11.5
1600.	1.6	1.2	11.5
1700.	1.6	1.3	11.4
1800.	1.7	1.3	11.4
1900.	1.7	1.3	11.4
2000.	1.7	1.4	11.3
2100.	1.6	1.4	11.3
2200.	1.6	1.5	11.3
2300.	1.6	1.5	11.3
2400.	1.5	1.6	11.3
2500.	1.5	1.7	11.3
2600.	1.4	1.7	11.3
2700.	1.4	1.8	11.5
2800.	1.3	1.8	11.4
2900.	1.2	1.8	11.5
3000.	1.1	1.8	11.6
3100.	1.1	1.8	11.5
3200.	1.2	1.8	11.4
3300.	1.3	1.8	11.2
3400.	1.5	1.8	10.9

Linear S-Parameters V_{CC} = 15 V

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.09	-61.8	3.82	-9.3	.04	5.0	.09	-129.0
200.	.08	-64.2	3.86	-30.5	.04	-9.6	.06	-156.5
300.	.08	-79.6	3.86	-49.3	.04	-21.1	.06	179.0
400.	.08	-85.1	3.88	-67.9	.04	-31.4	.05	159.0
500.	.10	-101.6	3.90	-86.0	.04	-41.8	.05	144.6
600.	.10	-113.8	3.89	-104.8	.04	-51.7	.05	123.1
700.	.12	-120.9	3.90	-123.3	.04	-61.6	.05	105.3
800.	.13	-136.8	3.88	-141.4	.04	-71.3	.05	80.9
900.	.14	-143.0	3.89	-159.9	.04	-80.7	.05	62.4
1000.	.16	-156.9	3.89	-178.3	.04	-90.8	.04	41.4
1100.	.17	-168.0	3.88	163.3	.04	-100.8	.05	11.7
1200.	.18	-177.0	3.91	144.2	.04	-111.4	.05	-16.2
1300.	.19	170.6	3.88	125.6	.04	-121.7	.05	-47.8
1400.	.20	159.5	3.83	107.4	.04	-131.3	.06	-73.0
1500.	.20	152.9	3.76	89.0	.04	-139.4	.08	-98.8
1600.	.22	142.4	3.74	71.7	.04	-148.3	.10	-124.7
1700.	.23	134.0	3.73	54.2	.04	-159.3	.11	-143.6
1800.	.25	121.3	3.71	36.6	.04	-171.1	.13	-162.6
1900.	.25	109.0	3.71	19.1	.04	178.8	.14	-178.2
2000.	.25	101.1	3.67	1.4	.04	167.9	.17	167.3
2100.	.24	84.4	3.67	-17.4	.04	157.8	.17	145.0
2200.	.24	74.0	3.68	-34.3	.04	147.5	.19	129.8
2300.	.23	63.3	3.67	-52.1	.04	136.3	.21	115.2
2400.	.22	53.3	3.68	-69.7	.04	125.0	.23	101.3
2500.	.20	43.3	3.68	-86.6	.04	114.0	.25	87.1
2600.	.18	33.4	3.66	-105.4	.04	103.0	.26	73.7
2700.	.16	23.9	3.74	-122.8	.04	91.3	.28	60.0
2800.	.13	15.7	3.72	-139.8	.04	81.3	.29	46.4
2900.	.09	9.2	3.74	-159.1	.04	70.1	.29	32.3
3000.	.05	14.8	3.80	-179.5	.04	58.7	.30	18.2
3100.	.03	84.9	3.77	162.4	.04	47.9	.30	4.1
3200.	.08	111.4	3.70	141.8	.05	37.4	.29	-9.8
3300.	.15	106.2	3.68	121.1	.05	26.3	.29	-24.4
3400.	.21	95.9	3.49	101.2	.05	16.9	.27	-38.3

V_{CC} = 12 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.2	11.3
200.	1.2	1.1	11.4
300.	1.2	1.1	11.4
400.	1.2	1.1	11.5
500.	1.2	1.1	11.5
600.	1.2	1.1	11.5
700.	1.3	1.1	11.5
800.	1.3	1.1	11.5
900.	1.3	1.1	11.5
1000.	1.4	1.1	11.5
1100.	1.4	1.1	11.5
1200.	1.5	1.1	11.6
1300.	1.5	1.1	11.5
1400.	1.5	1.1	11.4
1500.	1.5	1.2	11.3
1600.	1.6	1.2	11.2
1700.	1.6	1.2	11.2
1800.	1.7	1.3	11.2
1900.	1.7	1.3	11.2
2000.	1.7	1.4	11.1
2100.	1.6	1.4	11.1
2200.	1.6	1.4	11.2
2300.	1.6	1.5	11.1
2400.	1.5	1.5	11.1
2500.	1.5	1.6	11.2
2600.	1.4	1.6	11.1
2700.	1.3	1.7	11.3
2800.	1.2	1.7	11.3
2900.	1.1	1.7	11.4
3000.	1.0	1.7	11.5
3100.	1.1	1.7	11.4
3200.	1.3	1.7	11.2
3300.	1.4	1.7	11.0
3400.	1.7	1.6	10.6

Linear S-Parameters V_{CC} = 12 V

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.09	-50.9	3.69	-9.5	.04	4.9	.09	-127.8
200.	.09	-61.4	3.73	-30.9	.04	-9.0	.06	-153.7
300.	.08	-77.8	3.74	-49.7	.04	-21.2	.06	-178.2
400.	.09	-84.6	3.76	-68.4	.04	-30.9	.05	162.9
500.	.10	-100.4	3.77	-86.5	.04	-41.3	.05	148.9
600.	.10	-113.4	3.77	-105.4	.04	-51.3	.05	128.3
700.	.12	-121.6	3.77	-123.9	.04	-61.1	.04	113.1
800.	.13	-137.4	3.75	-142.2	.04	-70.3	.05	95.7
900.	.14	-144.3	3.77	-160.8	.04	-79.9	.04	71.0
1000.	.17	-157.9	3.77	-179.2	.04	-89.7	.03	49.7
1100.	.17	-170.0	3.77	162.3	.04	-99.9	.05	18.9
1200.	.19	-179.1	3.79	143.3	.04	-110.1	.03	-16.9
1300.	.20	168.3	3.77	124.6	.04	-120.4	.04	-49.7
1400.	.20	156.8	3.72	106.2	.04	-130.0	.05	-80.0
1500.	.21	150.2	3.66	87.9	.04	-138.0	.07	-105.7
1600.	.23	139.1	3.64	70.5	.04	-146.3	.09	-133.1
1700.	.24	130.0	3.63	52.9	.04	-156.6	.10	-151.8
1800.	.26	117.8	3.63	35.3	.04	-168.3	.12	-170.9
1900.	.26	105.1	3.63	17.6	.04	-178.5	.13	173.0
2000.	.25	96.6	3.59	-.1	.04	171.1	.15	160.2
2100.	.24	78.9	3.59	-19.0	.04	160.1	.16	137.5
2200.	.24	68.3	3.61	-36.2	.04	150.4	.18	122.9
2300.	.22	56.0	3.60	-53.9	.04	139.2	.19	108.7
2400.	.21	46.3	3.61	-71.5	.04	128.0	.21	95.7
2500.	.19	35.2	3.62	-88.6	.04	116.9	.23	81.8
2600.	.17	23.8	3.61	-107.4	.04	106.1	.24	68.6
2700.	.14	12.9	3.69	-125.2	.04	94.7	.25	54.9
2800.	.11	4.3	3.68	-142.4	.04	84.8	.26	41.4
2900.	.06	-13.7	3.70	-161.9	.04	72.8	.27	27.4
3000.	.01	-39.2	3.75	177.3	.05	61.9	.27	13.3
3100.	.05	147.8	3.72	158.0	.05	50.3	.27	-.8
3200.	.11	130.3	3.65	137.9	.05	39.2	.26	-14.4
3300.	.18	115.1	3.54	116.9	.05	27.7	.25	-29.1
3400.	.25	100.2	3.39	96.8	.05	17.9	.24	-42.9

WJ-A45

1 TO 4 GHz
TO-8 CASCADABLE AMPLIFIER

- ULTRA-WIDE BANDWIDTH 1-4 GHz
- HIGH GAIN 17.5 dB (TYP.)
- LOW NOISE 4.5 dB (TYP.)
- HIGH OUTPUT POWER: +19.5 dBm (TYP.)
- GaAs FET DESIGN

Specifications*

Characteristic	Typical	Guaranteed 0° - 50°C	Guaranteed -55° - +85°C
Frequency (Min.)	1-4 GHz	1-4 GHz	1-4 GHz
Small Signal Gain (Min.)	17.5 dB	16.5 dB	15.5 dB
Gain Flatness (Max.)	± 0.6 dB	± 0.8 dB	± 1.0 dB
Noise Figure (Max.)			
1-4 GHz	4.5 dB	5.5 dB	6.0 dB
2-4 GHz	4.0 dB	5.0 dB	5.5 dB
Power Output at 1 dB Compression (Min.)	19.5 dBm	18 dBm	17 dBm
VSWR (Max.) Input	1.8:1	2.1:1	2.2:1
VSWR (Max.) Output	1.7:1	2.1:1	2.2:1
DC Current (Max.) at +15 Volts	120 mA	125 mA	130 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . .44 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . .39 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . .29 dBm (Typ.)

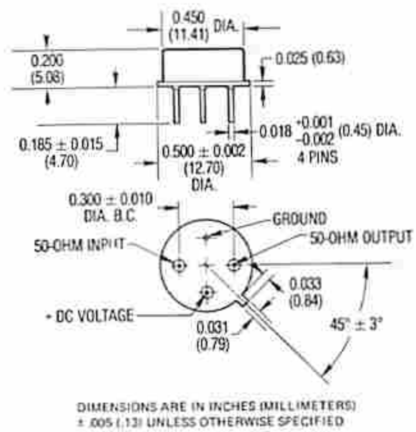
Absolute Maximum Ratings

Storage Temperature . . . . -65°C to +125°C
Maximum Case Temperature . . . . +100°C
Maximum DC Voltage . . . . +16 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
Maximum Peak Power . . . . 0.25 Watts
(3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . +100°C

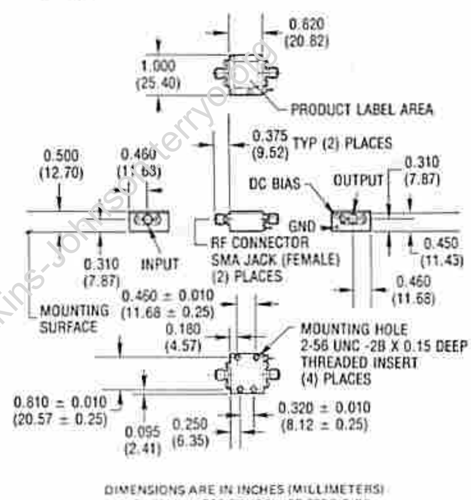
Weight approximately 2.0 grams (0.07 oz.)

Outline Drawings

A45

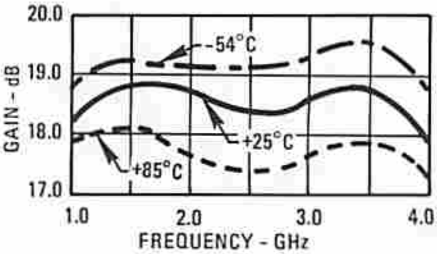


CA45

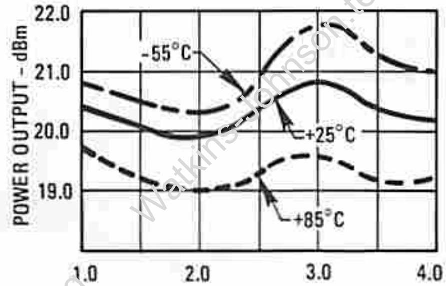


Typical Performance at 25°C

Gain

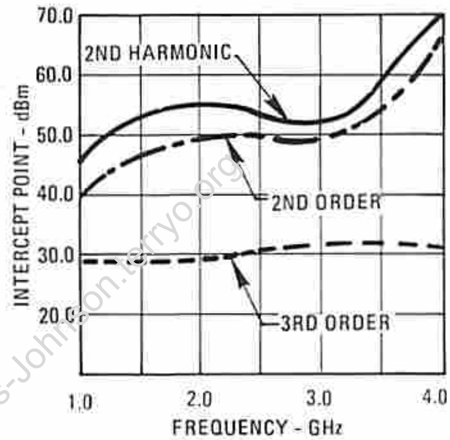


Power Output*

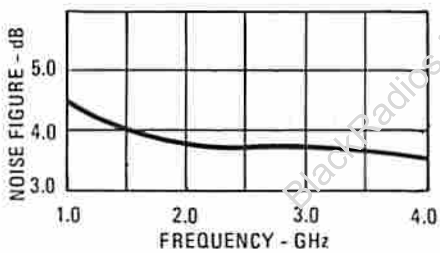


*at 1 dB Gain Compression

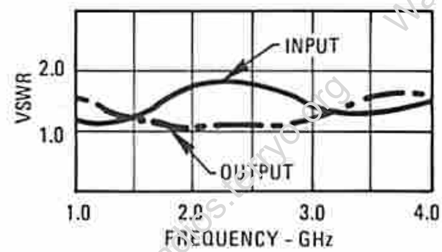
Intercept Point



Noise Figure



VSWR



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Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
800	1.7	1.8	17.24
1000	1.3	1.5	18.16
1200	1.1	1.4	18.51
1400	1.2	1.2	18.77
1600	1.3	1.2	18.84
1800	1.5	1.1	18.83
2000	1.7	1.1	18.69
2200	1.8	1.1	18.51
2400	1.8	1.1	18.37
2600	1.7	1.1	18.34
2800	1.6	1.1	18.39
3000	1.5	1.2	18.54
3200	1.3	1.3	18.69
3400	1.4	1.5	18.78
3600	1.4	1.6	18.63
3800	1.5	1.6	18.25
4000	1.6	1.6	17.72
4200	1.8	1.6	16.85

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
800.0	.270	54	7.281	127	.017	173	.292	51
1000.0	.149	-38	8.092	67	.018	133	.204	33
1200.0	.053	-58	8.419	29	.019	105	.153	11
1400.0	.073	-23	8.679	-1	.016	81	.106	-15
1600.0	.146	-36	8.754	-27	.016	72	.070	-43
1800.0	.211	-56	8.744	-50	.013	54	.045	-77
2000.0	.252	-76	8.603	-71	.011	35	.036	-101
2200.0	.275	-107	8.423	-91	.010	16	.029	-108
2400.0	.276	-125	8.289	-109	.009	-8	.027	[illegible]
2600.0	.263	-146	8.261	-126	.011	-26	.037	-73
2800.0	.233	-162	8.312	-143	.010	-41	.062	-65
3000.0	.194	172	8.453	-160	.014	-47	.095	-64
3200.0	.144	134	8.596	-178	.013	-57	.138	-68
3400.0	.150	87	8.691	162	.016	-60	.187	-75
3600.0	.168	55	8.539	141	.016	-55	.223	-84
3800.0	.193	32	8.174	120	.017	-61	.238	-91
4000.0	.237	11	7.689	98	.015	-56	.243	-96
4200.0	.273	6	6.962	77	.015	-45	.234	-97

WJ-A45-1

1 TO 4 GHz
TO-8 CASCADABLE AMPLIFIER

- WIDE BANDWIDTH
- HIGH GAIN 17.5 dB (TYP.)
- LOW NOISE: 4.1 dB (TYP.)
- LOW POWER CONSUMPTION: 325 mW (TYP.)
- GaAs FET DESIGN

Specifications*

Characteristics	Typical	Guaranteed 0° - -50°C	Guaranteed -55° - +85°C
Frequency (Min.)	.8-4.2 GHz	1-4 GHz	1-4 GHz
Small Signal Gain (Min.)	17.5 dB	16.5 dB	15.5 dB
Gain Flatness (Max.)	0.6 dB	0.8 dB	1.0 dB
Noise Figure (Max.)	4.1 dB	5.0 dB	5.5 dB
Power Output at 1 dB Compression (Min.)	13.0 dBm	12.5 dBm	12.0 dBm
VSWR (Max.)			
Input	1.8:1	1.9:0	2.0:1
Output	1.8:1	1.9:0	2.0:1
DC Current (Max.) at -5.0 Volts	65 mA	75 mA	80 mA

*Measured in a 50-ohm system at +5.0 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 40 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 33 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 26 dBm (Typ.)

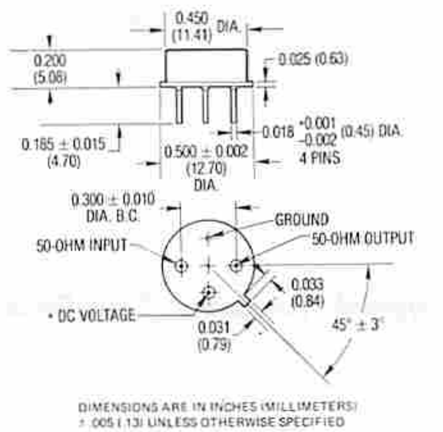
Absolute Maximum Ratings

Storage Temperature . . . . -65°C to +125°C
Maximum Case Temperature . . . . +125°C
Maximum DC Voltage . . . . 6.0 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
Maximum Peak Power . . . . 0.25 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . +125°C

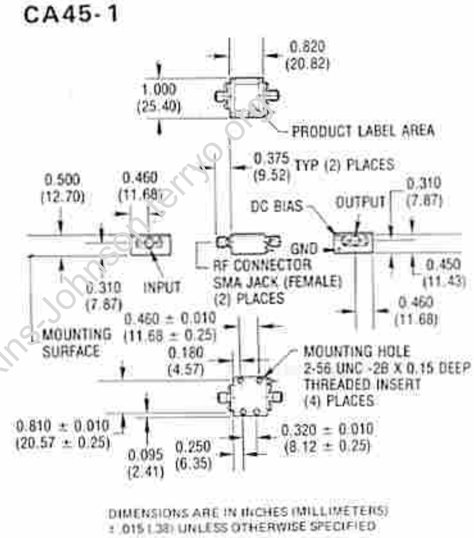
Weight approximately 2.0 grams (0.07 oz.)

Outline Drawings

A45-1



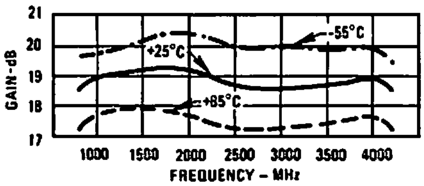
CA45-1



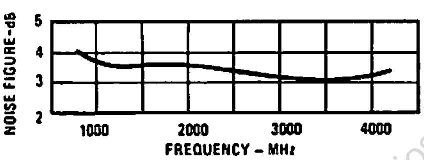
*WJ-CA 45-1 is standard WJ-45-1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

Typical Performance at 25°C

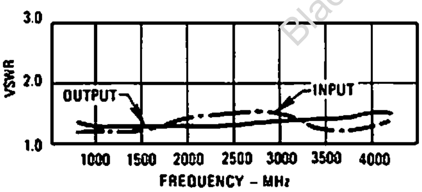
Gain



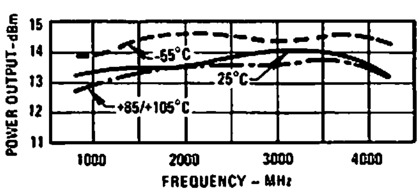
Noise Figure



VSWR

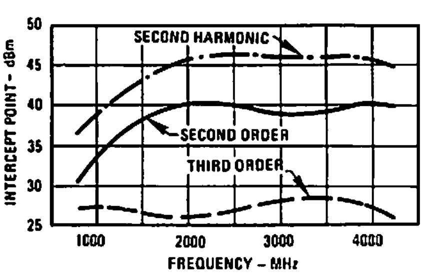


Power Output*



*at 1 dB Gain Compression

Intercept Point



Typical Automatic Test Data

V_{cc} = +5 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB	FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
500.0	10.6	5.5	11.6	2500.0	1.5	1.3	18.7
600.0	2.2	1.5	18.6	2600.0	1.5	1.3	18.6
700.0	1.5	1.4	17.2	2700.0	1.5	1.3	18.5
800.0	1.2	1.4	18.5	2800.0	1.4	1.3	18.4
900.0	1.2	1.3	18.7	2900.0	1.4	1.4	18.4
1000.0	1.2	1.3	18.9	3000.0	1.5	1.4	18.6
1100.0	1.1	1.3	19.0	3100.0	1.4	1.4	18.6
1200.0	1.1	1.3	19.1	3200.0	1.3	1.4	18.6
1300.0	1.1	1.3	19.1	3300.0	1.3	1.4	18.6
1400.0	1.2	1.3	19.2	3400.0	1.2	1.4	18.7
1500.0	1.2	1.3	19.2	3500.0	1.2	1.4	18.7
1600.0	1.3	1.3	19.3	3600.0	1.2	1.4	18.8
1700.0	1.3	1.3	19.3	3700.0	1.2	1.5	18.9
1800.0	1.4	1.3	19.3	3800.0	1.2	1.5	18.9
1900.0	1.4	1.3	19.2	3900.0	1.2	1.5	18.9
2000.0	1.4	1.3	19.2	4000.0	1.3	1.5	18.9
2100.0	1.5	1.3	19.1	4100.0	1.3	1.5	18.7
2200.0	1.5	1.3	19.0	4200.0	1.4	1.5	18.5
2300.0	1.5	1.3	18.9	4300.0	1.5	1.5	18.1
2400.0	1.5	1.3	18.7	4400.0	1.5	1.5	17.6
				4500.0	1.6	1.5	17.1

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22		K
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG	
500.0	.827	-129	3.816	-114	.016	42	.691	168	1.546
600.0	.384	171	8.559	152	.024	-107	.215	29	2.184
700.0	.108	137	7.204	103	.023	157	.154	-139	2.957
800.0	.100	42	9.434	69	.020	109	.154	153	2.984
900.0	.093	-24	9.629	35	.019	81	.140	109	3.288
1000.0	.030	-48	9.822	9	.018	61	.134	77	3.156
1100.0	.060	-53	8.911	-13	.017	45	.132	51	3.344
1200.0	.047	-57	8.980	-33	.016	31	.134	30	3.483
1300.0	.052	[illegible]	9.065	-52	.015	19	.132	13	3.606
1400.0	.072	-4	9.129	-70	.014	8	.132	-3	3.929
1500.0	.095	-6	9.157	-87	.013	-3	.131	-16	4.083
1600.0	.117	-12	9.192	-104	.012	-12	.130	-31	4.318
1700.0	.137	-21	9.213	-120	.011	-24	.131	-42	4.674
1800.0	.154	-30	9.183	-135	.010	-34	.130	-52	5.146
1900.0	.166	-40	9.144	-150	.009	-45	.132	-61	5.619
2000.0	.182	-50	9.071	-165	.009	-56	.136	-66	6.192
2100.0	.191	-60	8.992	-180	.007	-70	.136	-71	7.126
2200.0	.195	-70	8.878	166	.007	-85	.136	-75	8.038
2300.0	.200	-79	8.762	153	.005	-102	.137	-78	8.506
2400.0	.198	-88	8.601	139	.006	-118	.137	-80	9.749
2500.0	.196	-97	8.566	126	.005	-138	.135	-82	9.249
2600.0	.190	-106	8.464	114	.006	-157	.140	-82	8.972
2700.0	.184	-114	8.425	102	.007	-174	.141	-82	8.677
2800.0	.176	-122	8.356	89	.009	165	.145	-81	7.469
2900.0	.175	-129	8.319	77	.006	147	.156	-78	7.273
3000.0	.166	-143	8.450	65	.006	148	.173	-85	9.939
3100.0	.159	-159	8.473	52	.007	153	.167	-88	7.514
3200.0	.138	-170	8.487	39	.009	145	.166	-89	6.183
3300.0	.123	177	8.516	27	.010	137	.165	-89	5.501
3400.0	.109	165	8.576	15	.011	132	.172	-91	5.030
3500.0	.098	147	8.639	2	.012	125	.176	-92	4.601
3600.0	.069	128	8.734	-12	.013	120	.180	-94	4.231
3700.0	.059	105	8.610	-26	.014	114	.186	-95	3.966
3800.0	.085	85	8.657	-40	.014	110	.189	-98	3.874
3900.0	.107	67	8.843	-55	.015	106	.196	-100	3.590
4000.0	.126	54	8.767	-70	.016	101	.197	-103	3.488
4100.0	.142	42	8.612	-86	.016	97	.203	-106	3.394
4200.0	.166	35	8.367	-101	.017	94	.208	-129	3.397
4300.0	.188	[illegible]	8.030	[illegible]	.017	91	.203	-112	3.422
4400.0	.215	[illegible]	7.525	[illegible]	.017	87	.197	-115	3.557
4500.0	.242	[illegible]	7.146	45	.017	84	.188	-117	3.743

1

WJ-A51

10 TO 400 MHz
TO-8 CASCADABLE AMPLIFIER

- LOW NOISE: 2.7 dB (TYP.)
- FULL PERFORMANCE WITH LOW COST
- LOW VSWR: 1.2:1 (TYP.)
- FLAT BANDWIDTH: ±.2 dB

Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	5-500 MHz	10-400 MHz	10-400 MHz
Small Signal Gain (Min.)	15.0 dB	14.0 dB	13.0 dB
Gain Flatness (Max.)	< ±0.2 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	2.7 dB	3.0 dB	3.5 dB
Power Output at 1 dB Compression (Min.)	-3.0 dBm	-3.5 dBm	-3.5 dBm
VSWR (Max.) Input/Output	< 1.3:1	1.7:1	2.0:1
DC Current (Max.) at 15 Volts	7 mA	9 mA	11 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

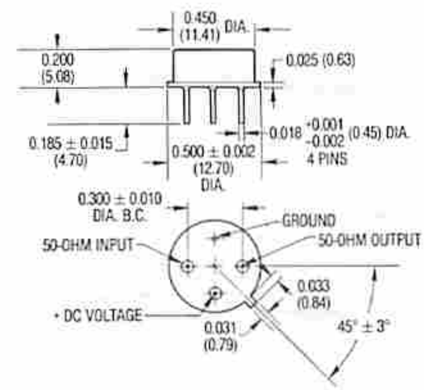
Second Order Harmonic Intercept Point . . . . +15 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +9 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +10 dBm (Typ.)

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . +50 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

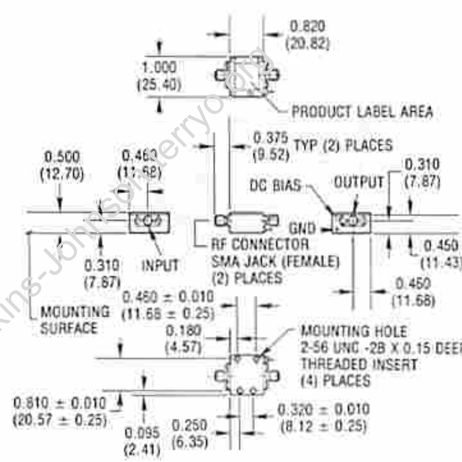
Outline Drawings

A51



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA51



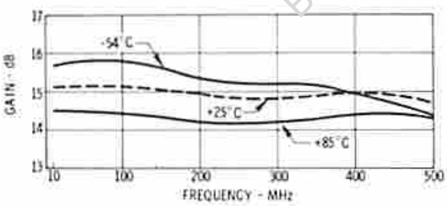
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

*WJ CA51 is standard WJ A51 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

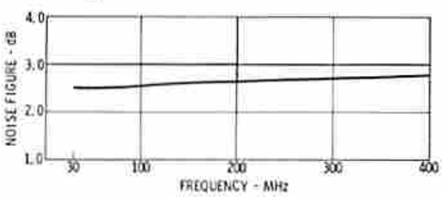
Weight approximately 2.0 grams (0.07 oz.)

Typical Performance at 25°C

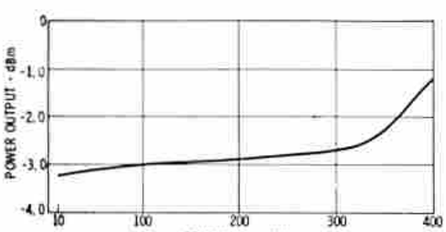
Gain



Noise Figure

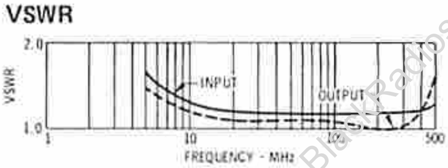


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.1	14.9
200.	1.2	1.0	14.9
300.	1.2	1.0	14.8
400.	1.2	[illegible]	14.8
500.	1.3	[illegible]	14.8

Linear S-Parameters

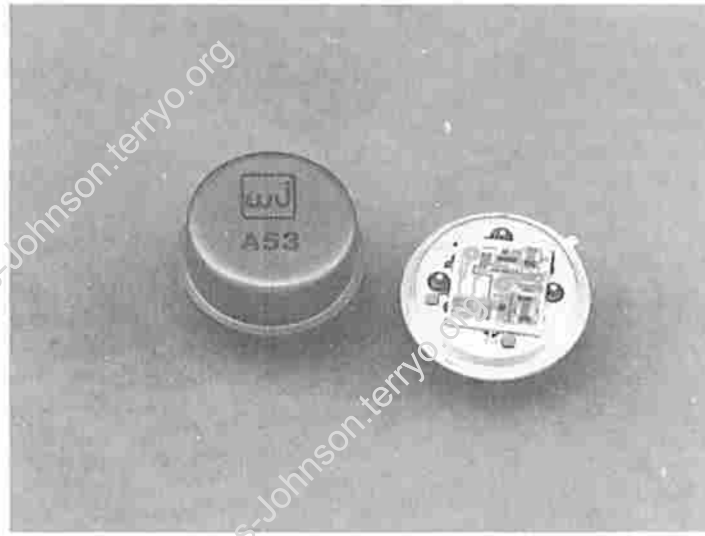
FREQ MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.09	-102.2	5.59	142.3	.10	-15.2	.04	149.6
200.	.11	-124.2	5.56	109.9	.09	-23.9	.02	92.3
300.	.11	-145.2	5.49	78.9	.09	-34.4	.01	-117.2
400.	.07	170.2	5.50	44.3	.10	-47.0	.09	-174.0
500.	.13	49.5	5.49	2.9	.10	-64.5	.23	147.2
600.	.37	-6.0	4.78	-44.5	.10	-87.0	.41	109.0
700.	.59	-42.3	3.40	-90.5	.09	-108.1	.53	72.1
800.	.73	-68.7	2.10	-128.2	.07	-125.6	.55	43.4

1

WJ-A53

10 TO 500 MHz
TO-8 CASCADABLE AMPLIFIER

- LOW NOISE: 3.0 dB (TYP.)
- MEDIUM THIRD ORDER I.P.: +16 dBm (TYP.)
- FULL PERFORMANCE WITH LOW COST



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	5-600 MHz	10-500 MHz	10-500 MHz
Small Signal Gain (Min.)	15.0 dB	14.0 dB	13.5 dB
Gain Flatness (Max.)	<±0.5 dB	±0.8 dB	±1.0 dB
Noise Figure (Max.)	3.0 dB	3.5 dB[1]	4.0 dB
Power Output at 1 dB Compression (Min.)	+3.5 dBm	+2.0 dBm	+1.5 dBm
VSWR (Max.) Input/Output	<1.5:1	2.0:1	2.0:1
DC Current (Max.) at 15 Volts	12 mA	15 mA	17 mA

Notes:
* Measured in a 50-ohm system at +15 Vdc Nominal.
1. Specification guaranteed at 25°C.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +28 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +22 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +16 dBm (Typ.)

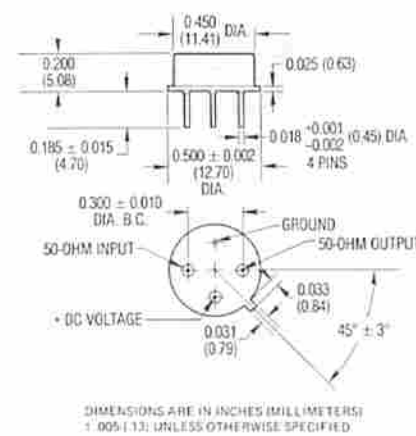
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . +50 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

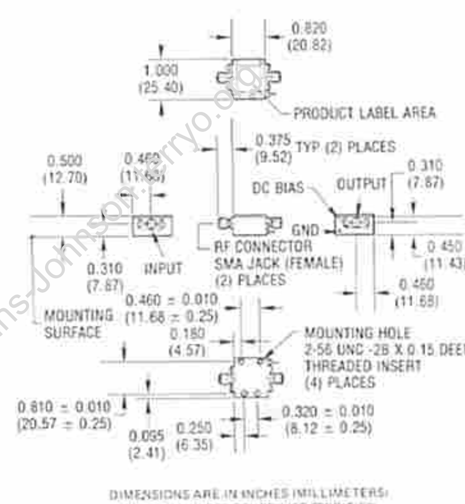
Weight approximately 2.0 grams (0.07 oz.)

Outline Drawings

A53



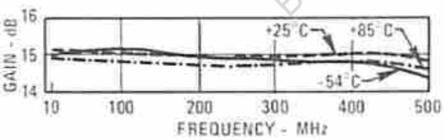
CA53



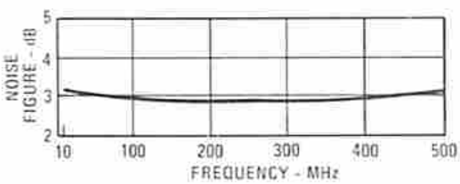
*WJ CA53 is standard WJ A53 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

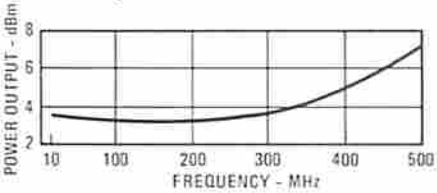
Gain



Noise Figure

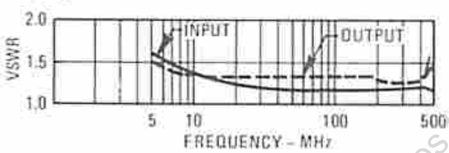


Power Output*

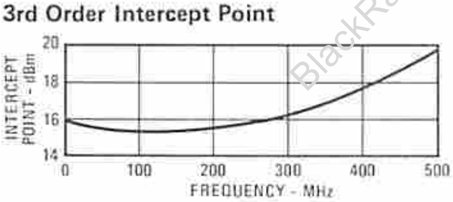


*at 1 dB Gain Compression

VSWR



3rd Order Intercept Point



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.4	15.0
200.	1.2	1.3	15.0
300.	1.1	1.3	14.9
400.	1.1	1.2	14.8
500.	1.3	1.5	14.6
600.	1.7	1.9	14.1

Linear S Parameters

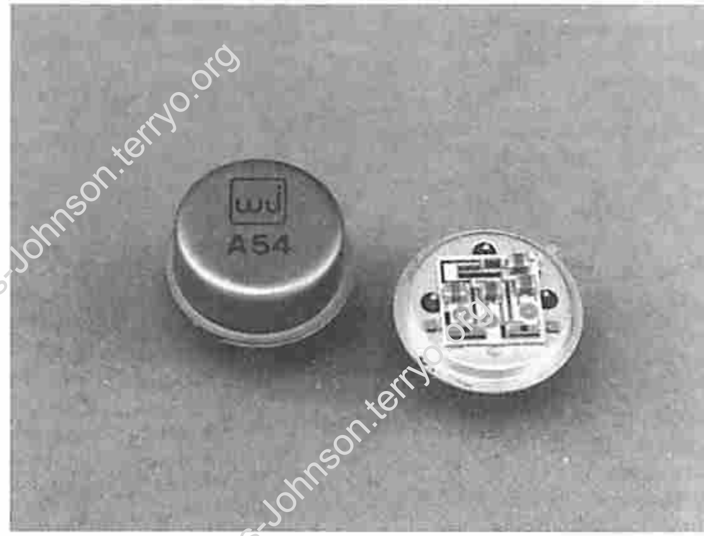
FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.10	157.2	5.61	146.8	.09	-7.0	.16	157.3
200.	.08	127.5	5.63	117.8	.10	-11.8	.13	132.0
300.	.06	103.3	5.56	90.0	.10	-16.7	.12	119.0
400.	.07	102.9	5.51	60.0	.11	-23.8	.13	115.8
500.	.13	94.3	5.37	25.9	.10	-34.8	.20	113.5
600.	.25	64.2	5.06	-10.8	.12	-46.3	.31	100.9
700.	.38	30.8	4.13	-49.4	.12	-60.3	.43	77.6
800.	.47	.8	3.05	-83.8	.11	-73.3	.50	53.3

1

WJ-A54

5 TO 400 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH GAIN – TWO STAGES: 27.5 dB (TYP.)
- MEDIUM OUTPUT LEVEL: +8 dBm (TYP.)
- LOW VSWR: < 1.4:1 (TYP.)
- FULL PERFORMANCE WITH LOW COST



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	3-500 MHz	5-400 MHz	5-400 MHz
Small Signal Gain (Min.)	27.5 dB	26.0 dB	24.0 dB
Gain Flatness (Max.)	< ±0.3 dB	±0.8 dB	±1.0 dB
Noise Figure (Max.)	4.5 dB	5.5 dB	6.0 dB
Power Output at 1 dB Compression (Min.)	+8.0 dBm	+6.5 dBm	+5.5 dBm
VSWR (Max.) Input/Output	< 1.4:1	2.0:1	2.0:1
DC Current (Max.) at 15 Volts	34 mA	37 mA	39 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +39.5 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +32.5 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +19 dBm (Typ.)

Absolute Maximum Ratings

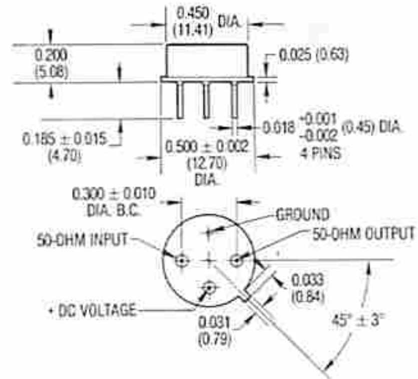
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +12 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . +50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)

"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

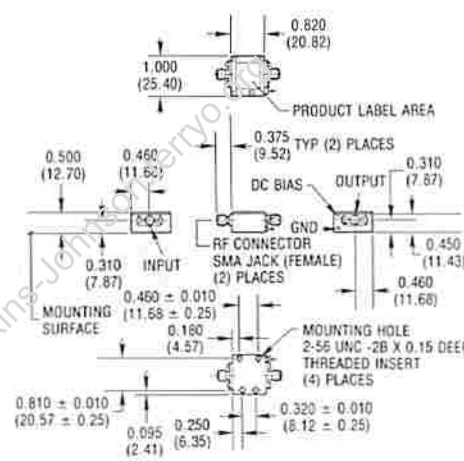
Outline Drawings

A54



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA54

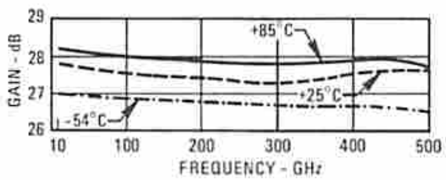


DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

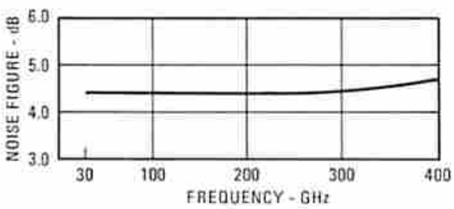
*WJ CA54 is standard WJ A54 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

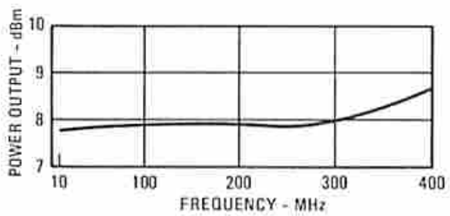
Gain



Noise Figure

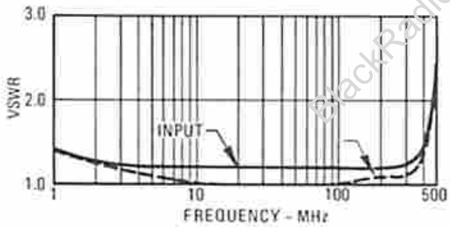


Power Output*



* at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.0	27.5
200.	1.2	1.1	27.4
300.	1.2	1.1	27.3
400.	1.4	1.3	27.5
500.	2.3	2.2	27.6

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.09	-35.7	23.73	-51.6	.01	-4.4	.02	-63.0
200.	.07	-67.3	23.44	-97.2	.01	21.5	.03	-67.1
300.	.10	-111.6	23.28	-142.4	.01	12.2	.07	-92.3
400.	.18	-160.2	23.64	168.3	.01	-3.4	.15	-140.7
500.	.40	162.0	23.89	112.7	.01	-30.5	.37	172.2
600.	.70	119.0	19.91	44.3	.01	-73.2	.67	121.7
700.	.79	77.7	11.10	-20.1	.01	-118.6	.77	75.5
800.	.77	54.3	5.46	-68.0	.01	-153.5	.73	45.7

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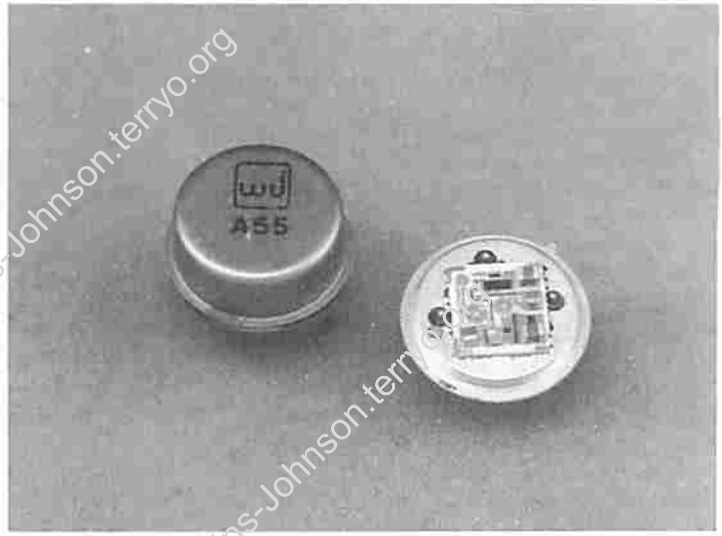
WJ-A55

10 TO 500 MHz TO-8 CASCADABLE AMPLIFIER

- MEDIUM OUTPUT LEVEL: +11 dBm (TYP.)
- +24 dBm THIRD ORDER I.P.
- FULL PERFORMANCE WITH LOW COST



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C – +85°C
Frequency (Min.)	5-600 MHz	10-500 MHz	10-500 MHz
Small Signal Gain (Min.)	14.7 dB	14.0 dB	13.5 dB
Gain Flatness (Max.)	<±0.5 dB	±0.8 dB	±1.0 dB
Noise Figure (Max.)	5.0 dB	6.0 dB	6.5 dB
Power Output at 1 dB Compression (Min.)	+11.0 dBm	+9.0 dBm	+8.0 dBm
VSWR (Max.) Input/Output	<1.5:1	2.0:1	2.0:1
DC Current (Max.) at 15 Volts	30 mA	35 mA	37 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +42 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +37 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +24 dBm (Typ.)

Absolute Maximum Ratings

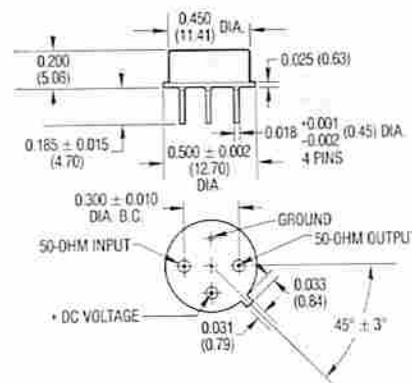
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +18 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . +50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)

"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

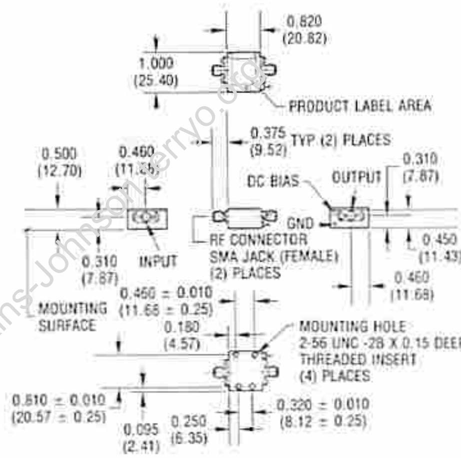
Outline Drawings

A55



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA55

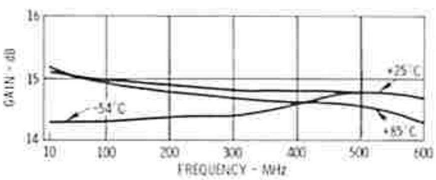


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

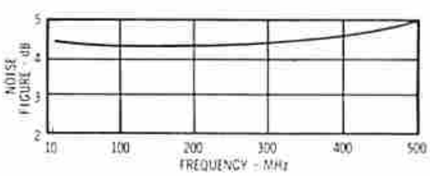
*WJ CA55 is standard WJ A55 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

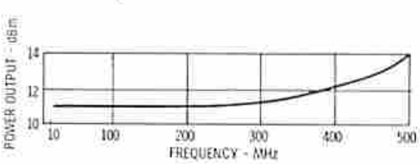
Gain



Noise Figure

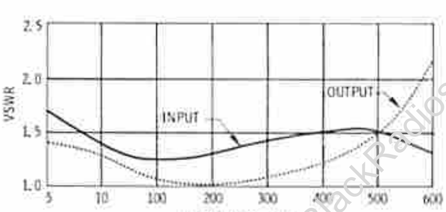


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.3	1.0	15.3
200.	1.3	1.0	15.2
300.	1.4	1.1	15.0
400.	1.5	[illegible]	14.8
500.	1.5	1.5	14.8
600.	1.3	2.2	14.4

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.12	-49.8	5.81	147.0	.08	-5.3	.01	-70.7
200.	.15	-75.6	5.75	118.4	.08	-6.2	.02	-72.3
300.	.18	-100.4	5.60	92.0	.08	-9.9	.04	-112.3
400.	.20	-127.0	5.49	64.4	.09	-19.0	.09	-163.0
500.	.19	-163.5	5.47	32.5	.10	-31.5	.21	160.0
600.	.14	135.9	5.22	-4.8	.11	-46.2	.37	127.3
700.	.16	44.3	4.29	-44.3	.10	-64.0	.52	92.6
800.	.25	-14.1	3.10	-79.4	.09	-77.6	.59	62.1

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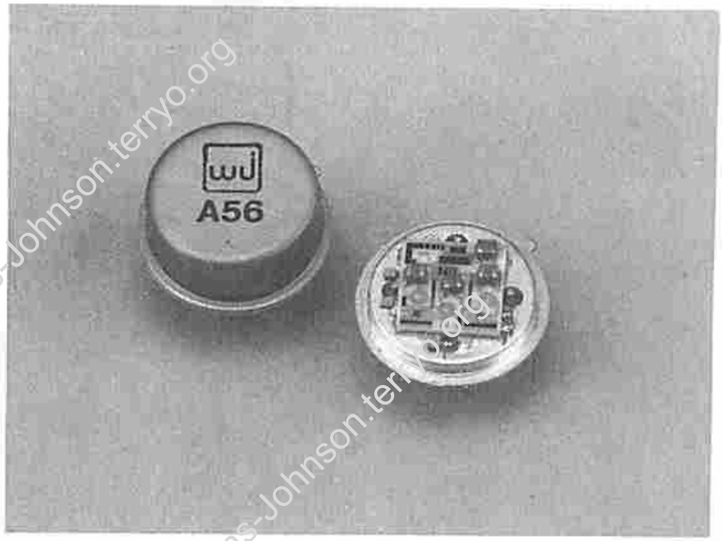
WJ-A56

5 TO 400 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH GAIN – TWO STAGES: 26 dB (TYP.)
- HIGH OUTPUT LEVEL: +13.5 dBm (TYP.)
- HIGH THIRD ORDER I.P.: +27 dBm
- FULL PERFORMANCE WITH LOW COST



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	-54°C - +85°C
Frequency (Min.)	3-500 MHz	5-400 MHz	5-400 MHz
Small Signal Gain (Min.)	26.0 dB	24.0 dB	23.0 dB
Gain Flatness (Max.)	±0.3 dB	±1.0 dB	±1.0 dB
Noise Figure (Max.)	5.5 dB	7.0 dB	7.5 dB
Power Output at 1 dB Compression (Min.)	+13.5 dBm	+12.5 dBm	+12.0 dBm
VSWR (Max.) Input/Output	<1.4:1	2.0:1	2.0:1
DC Current (Max.) at 15 Volts	69 mA	75 mA	79 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +54 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +48 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +27 dBm (Typ.)

Absolute Maximum Ratings

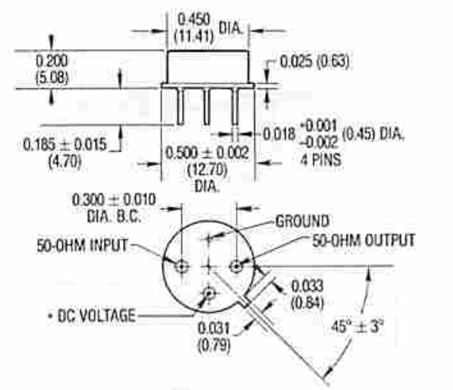
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +12 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . +50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)

"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

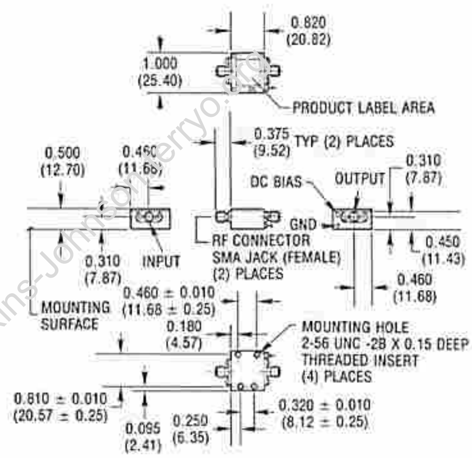
Outline Drawings

A56



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA56

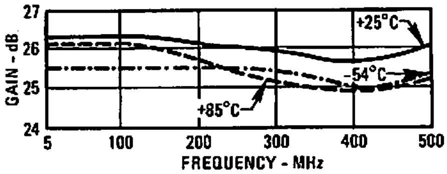


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

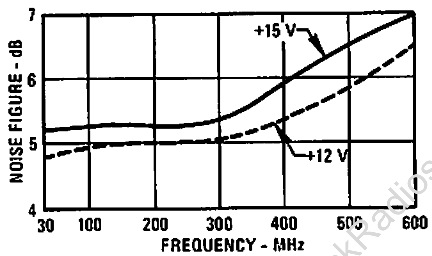
*WJ CA56 is standard WJ-A56 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

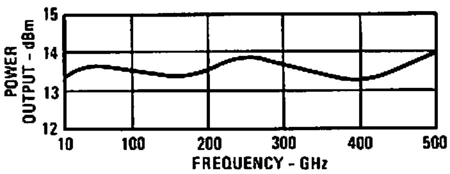
Gain



Noise Figure

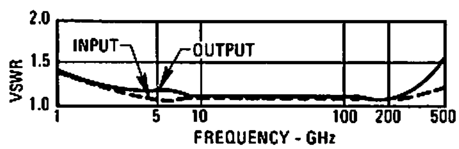


Power Output*

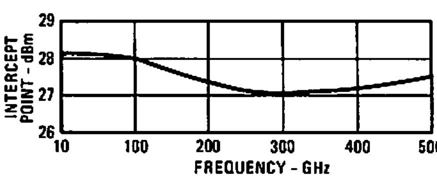


* at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.1	26.6
200.	1.1	1.1	26.5
300.	1.1	1.2	26.2
400.	1.2	1.3	26.0
500.	1.3	1.6	25.8
600.	1.6	2.3	26.0
700.	5.6	5.1	25.6
800.	28.[illegible]	5.7	19.8

V_{CC} = 15 V

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.03	168.7	21.49	-49.3	.01	1.9	.05	-46.8
200.	.04	127.2	21.10	-92.4	.01	6.8	.06	-60.2
300.	.05	64.5	20.42	-133.9	.01	.6	.10	-68.1
400.	.08	32.0	19.94	-178.0	.01	-9.2	.14	-80.6
500.	.12	23.0	19.42	[illegible]	.01	-26.0	.23	-103.4
600.	.24	36.1	20.00	87.5	.02	-55.5	.40	-142.8
700.	.70	10.0	19.02	16.3	.02	-111.5	.67	153.2
800.	.93	-36.2	9.82	-54.4	.01	-178.9	.70	85.4

V_{CC} = 12 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.0	1.1	25.9
200.	1.0	1.1	25.7
300.	1.1	1.2	25.5
400.	1.1	1.3	25.3
500.	1.2	1.6	25.1
600.	1.6	2.3	25.5
700.	5.3	5.3	25.4
800.	30.1	6.3	19.8

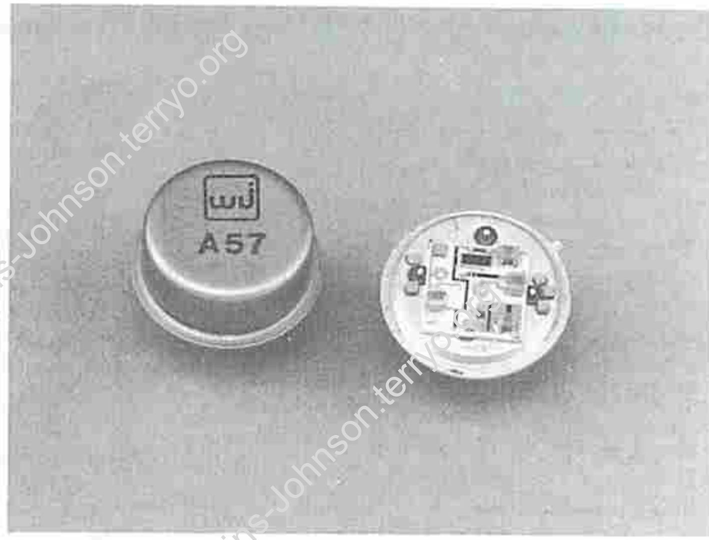
Linear S-Parameters V_{CC} = 12 V

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.02	-154.4	19.78	-48.6	.01	1.1	.04	-48.1
200.	.02	141.4	19.35	-91.3	.01	2.2	.06	-61.2
300.	.04	58.0	18.80	-133.0	.01	1.1	.09	-68.7
400.	.07	30.1	[illegible]	-176.6	.01	-8.8	.14	-78.6
500.	.11	23.1	18.07	140.2	.01	-26.2	.22	-100.3
600.	.23	36.5	18.84	90.5	.02	-55.4	.39	-138.7
700.	.68	11.9	18.58	19.7	.02	-110.1	.68	157.9
800.	.94	-35.5	9.82	-53.5	.01	-178.0	.72	87.8

WJ-A57

10 TO 500 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT LEVEL: +15 dBm (TYP.)
- HIGH THIRD ORDER I.P.: +28.0 dBm (TYP.)
- FULL PERFORMANCE WITH LOW COST



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	5-600 MHz	10-500 MHz	10-500 MHz
Small Signal Gain (Min.)	14.7 dB	14.0 dB	13.0 dB
Gain Flatness (Max.)	< ±0.25 dB	±0.8 dB	±1.0 dB
Noise Figure (Max.)	4.8 dB	6.0 dB	6.5 dB
Power Output at 1 dB Compression (Min.)	+14 dBm	+13 dBm	+12.5 dBm
VSWR (Max.) Input/Output	< 1.5:1	2.0:1	2.0:1
DC Current (Max.) at 15 Volts	44 mA	49 mA	51 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +46 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +41 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +28 dBm (Typ.)

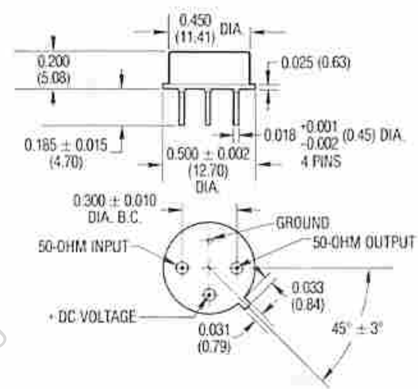
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . +50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 µsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

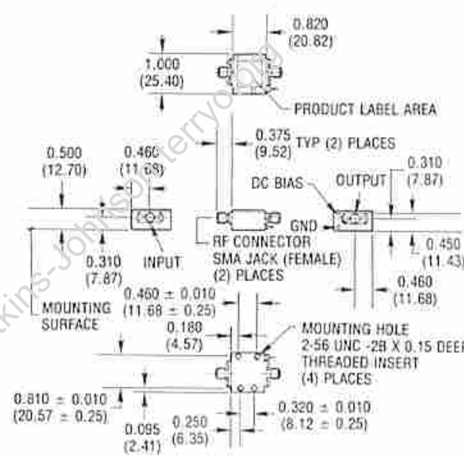
Outline Drawings

A57



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

CA57

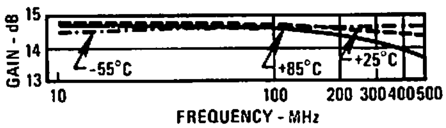


DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

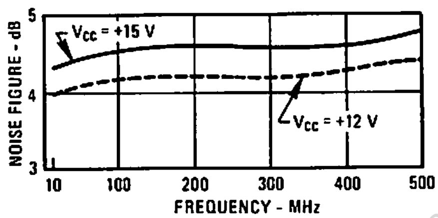
*WJ CA57 is standard WJ A57 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

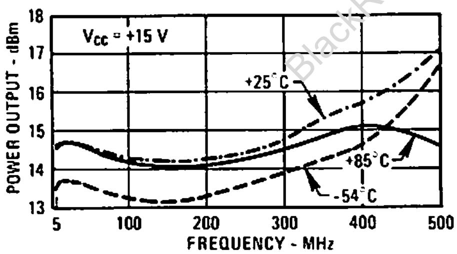
Gain

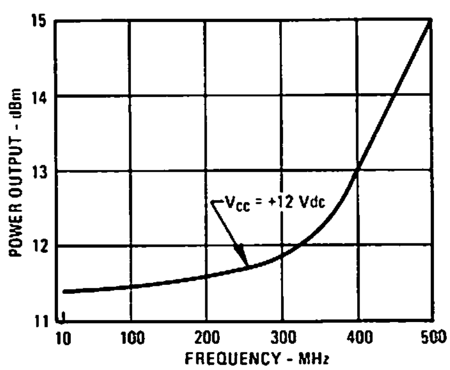


Noise Figure



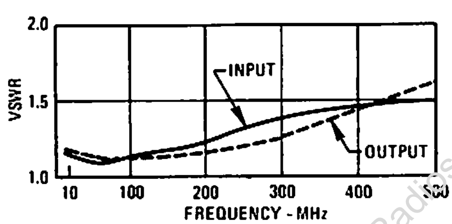
Power Output*



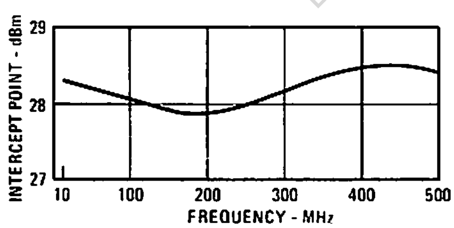


* at 1 dB Gain Compression

VSWR



3rd Order Intercept Point



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.1	14.6
200.	1.2	1.1	14.7
300.	1.4	1.2	14.6
400.	1.5	1.4	14.4
500.	1.5	1.6	14.4
600.	1.5	1.9	13.7

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.06	-93.4	5.40	141.4	.08	-10.5	.05	-142.6
200.	.10	-105.0	5.42	110.3	.09	-15.0	.07	-125.0
300.	.16	-126.3	5.35	79.6	.09	-23.7	.11	-132.4
400.	.19	-158.4	5.28	45.2	.11	-35.6	.17	-157.9
500.	.19	156.3	5.23	6.3	.12	-50.9	.23	164.7
600.	.19	69.5	4.04	-38.0	.13	-73.9	.31	111.7
700.	.34	-12.4	3.73	-85.2	.13	-100.7	.42	54.3
800.	.50	-61.3	2.36	-124.7	.10	-123.7	.49	9.1

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WJ-A58

5 TO 500 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH DYNAMIC RANGE: +114 dBm (1 MHz BAND)
- HIGH OUTPUT POWER: +19 dBm (TYP.)
- HIGH THIRD ORDER I.P.: +35 dBm (TYP.)
- LOW NOISE: 4.8 dB (TYP.)

Specifications*

Characteristics	Typical	Guaranteed 0° -50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	2-700 MHz	5-500 MHz	5-500 MHz
Small Signal Gain (Min.)	11.5 dB	10.0 dB	9.5 dB
Gain Flatness (Max.)	<±0.3 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	4.8 dB	6.0 dB	6.5 dB
Power Output at 1 dB Compression (Min.)	+19.0 dBm	+18.0 dBm	+17.5 dBm
VSWR (Max.) Input/Output	<1.5:1	1.9:1	2.0:1
DC Current (Max.) at 15 Volts	65 mA	69 mA	72 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . . +57 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . . +55 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . . +35 dBm (Typ.)

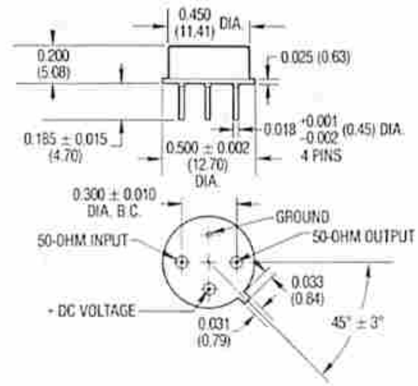
Absolute Maximum Ratings

Storage Temperature . . . . . -62°C to +125°C
Maximum Case Temperature . . . . . 100°C
Maximum DC Voltage . . . . . +17 Volts
Maximum Continuous RF Input Power . . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . . +100 Milliwatts
Maximum Peak Power . . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . . 100°C

Weight approximately 2.0 grams (0.07 oz.)

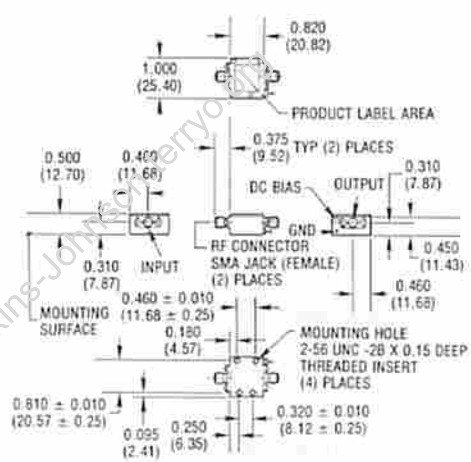
Outline Drawings

A58



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA58

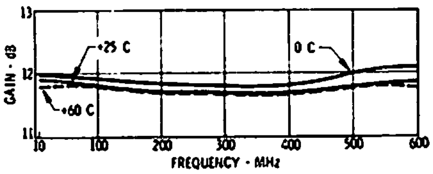


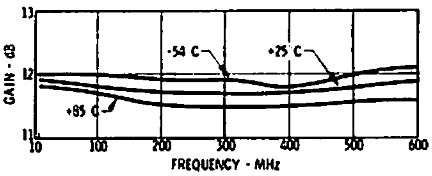
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

*WJ CA58 is standard WJ A58 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

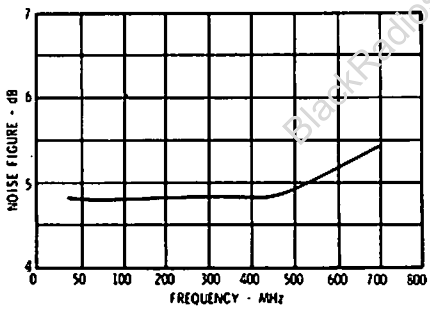
Typical Performance at 25°C

Gain

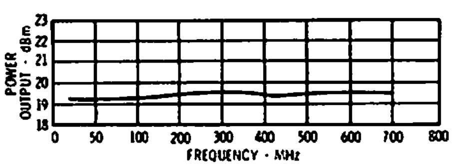




Noise Figure

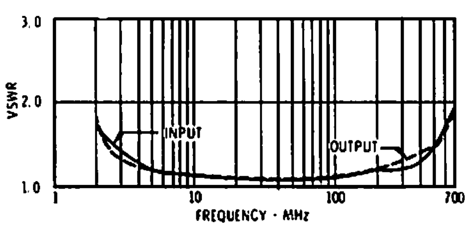


Power Output*

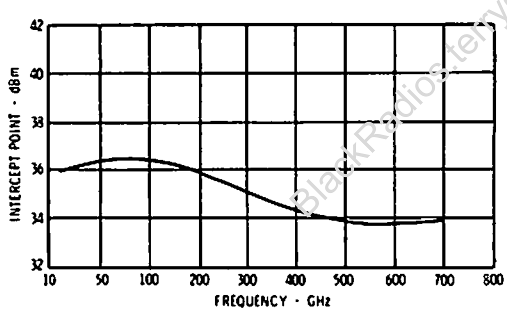


*at 1 dB Gain Compression

VSWR



Third-Order Intercept Point



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.1	11.6
200.	1.2	1.2	11.6
300.	1.2	1.3	11.6
400.	1.3	1.4	11.6
500.	1.5	1.5	11.6
600.	1.7	1.7	11.7

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.05	-124.1	3.81	154.2	.16	-6.7	.05	-138.4
200.	.09	-130.4	3.82	132.1	.15	-11.5	.10	-128.3
300.	.11	-138.0	3.80	110.8	.16	-18.8	.14	-137.9
400.	.15	-148.6	3.79	89.8	.17	-28.5	.17	-154.5
500.	.19	-167.5	3.81	67.1	.19	-40.6	.21	-173.6
600.	.25	166.4	3.86	41.1	.20	-55.2	.26	167.7
700.	.34	129.4	3.91	12.6	.21	-70.1	.31	144.3
800.	.48	81.5	3.73	-21.5	.22	-91.2	.34	115.5

1

WJ-A59

5 TO 500 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH DYNAMIC RANGE: +117 dBm (1 MHz BAND)
- HIGH OUTPUT POWER: +22 dBm (TYP.)
- HIGH THIRD ORDER I.P.: +38 dBm (TYP.)
- LOW NOISE: 5.5 dB (TYP.)
- WIDE POWER SUPPLY RANGE: +5 TO +15 VOLTS

Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C – +85°C
Frequency (Min.)	2-700 MHz	5-500 MHz	5-500 MHz
Small Signal Gain (Min.)	11.5 dB	10.0 dB	9.5 dB
Gain Flatness (Max.)	< ±0.3 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	5.5 dB	6.5 dB	7.0 dB
Power Output at 1 dB Compression (Min.)	+22 dBm	+20 dBm	+20 dBm
VSWR (Max.) Input/Output	< 1.5:1	1.9:1	2.0:1
DC Current (Max.) at 15 Volts	88 mA	93 mA	98 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . . +47 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . . +43 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . . +38 dBm (Typ.)

Absolute Maximum Ratings

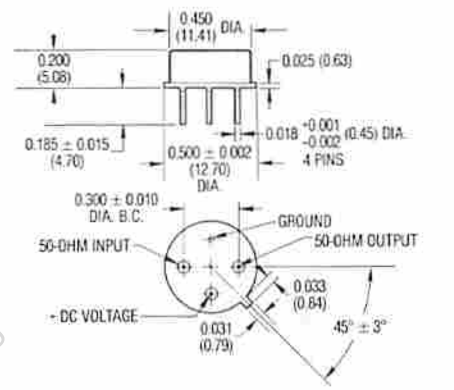
Storage Temperature . . . . . -62°C to +125°C
Maximum Case Temperature . . . . . 100°C
Maximum DC Voltage . . . . . +17 Volts
Maximum Continuous RF Input Power . . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . . +100 Milliwatts
Maximum Peak Power . . . . . 0.5 Watt (3 μsec Max.)

"S" Series Burn-In Temperature (Case) . . . . . 100°C

Weight approximately 2.0 grams (0.07 oz.)

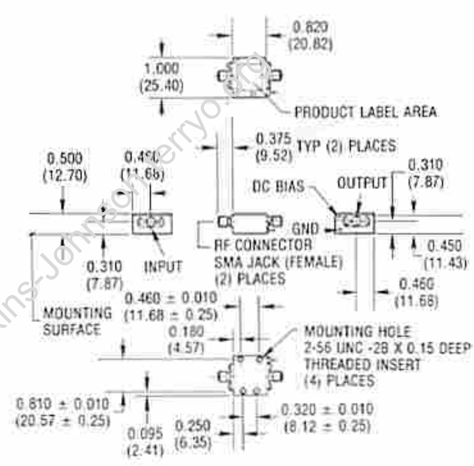
Outline Drawings

A59



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA59

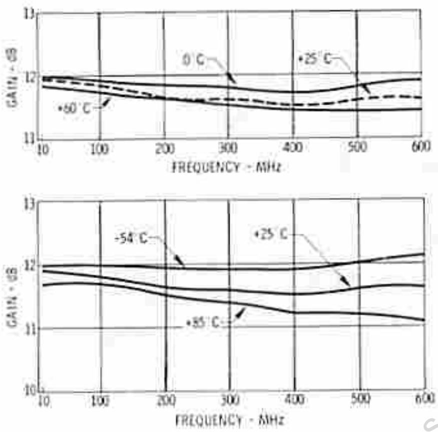


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

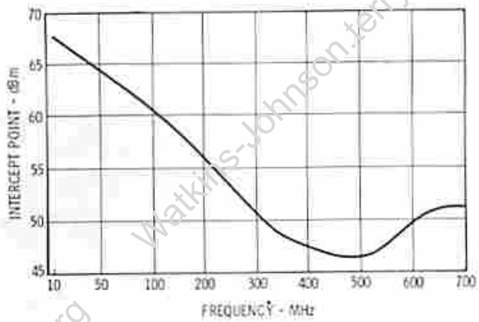
*WJ CA59 is standard WJ A59 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

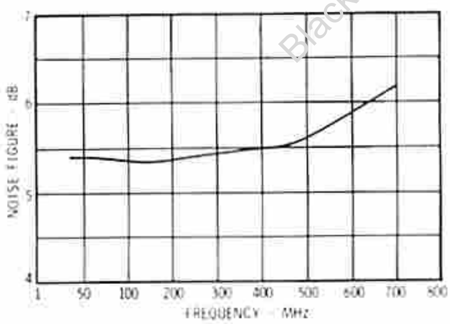
Gain



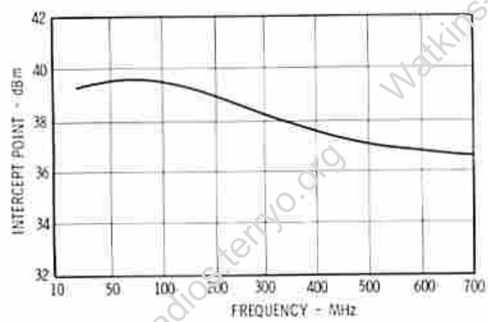
Second Harmonic Intercept Point



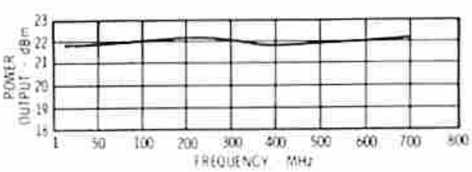
Noise Figure



Third-Order Intercept Point

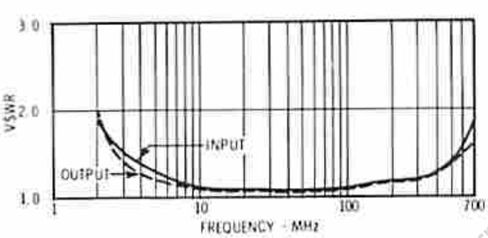


Power Output*

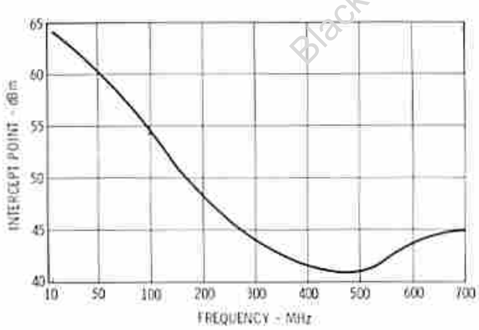


*at 1 dB Gain Compression

VSWR



Second-Order Two-Tone Intercept Point



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.1	11.7
200.	1.2	1.2	11.6
300.	1.2	1.2	11.6
400.	1.3	1.3	11.5
500.	1.4	1.4	11.4
600.	1.6	1.5	11.6

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.06	-128.5	3.83	153.9	.15	-6.2	.05	-150.0
200.	.08	-139.2	3.79	131.5	.15	-14.0	.07	[illegible]
300.	.10	-147.9	3.81	109.9	.15	-20.8	.10	-141.0
400.	.13	-153.7	3.75	88.8	.17	-31.1	[illegible]	-155.2
500.	.17	-172.7	3.73	64.9	.18	-42.9	[illegible]	-175.1
600.	.22	160.0	3.79	39.9	.19	-55.4	[illegible]	166.1
700.	.32	121.8	3.85	11.2	.20	-72.7	.24	141.0
800.	.49	74.3	3.66	-23.6	.20	-93.8	.26	109.4

1

WJ-A59-1

10 TO 700 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH DYNAMIC RANGE: +117 dBm (1 MHz BAND)
- HIGH OUTPUT POWER: +22 dBm (TYP.)
- HIGH THIRD ORDER I.P.: +36 dBm (TYP.)
- EXTENDED BANDWIDTH: 10-700 MHz
- WIDE POWER SUPPLY RANGE: +5 TO +15 VOLTS

Specifications*

Characteristics	Typical	Guaranteed 0° -50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	2-800 MHz	10-700 MHz	10-700 MHz
Small Signal Gain (Min.)	10.5 dB	9.5 dB	9.0 dB
Gain Flatness (Max.)	< ±0.4 dB	±0.8 dB	±1.0 dB
Noise Figure (Max.)	6.0 dB	7.5 dB	8.0 dB
Power Output at 1 dB Compression (Min.)	+22 dBm	+20 dBm	+20 dBm
VSWR (Max.) Input/Output	< 1.5:1	1.9:1	2.0:1
DC Current (Max.) at 15 Volts	88 mA	98 mA	98 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

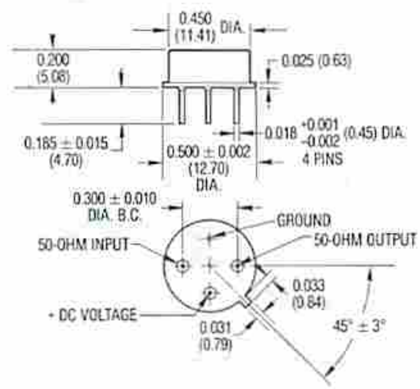
Second Order Harmonic Intercept Point . . . . +64 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +62 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +36 dBm (Typ.)

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 100°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +17 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . +100 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 100°C

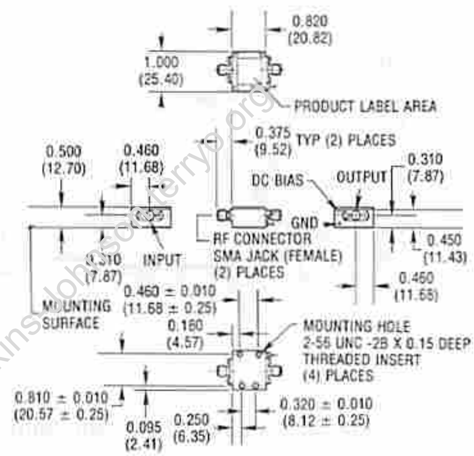
Outline Drawings

A59-1



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA59-1



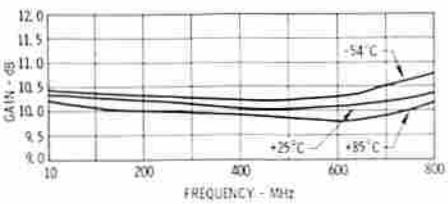
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

*WJ CA59-1 is standard WJ A59-1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

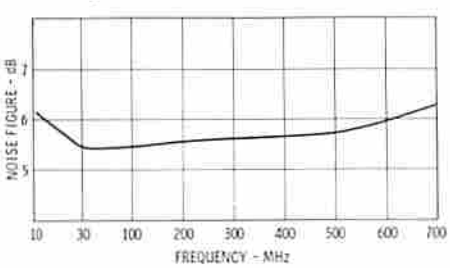
Weight approximately 2.0 grams (0.07 oz.)

Typical Performance at 25°C

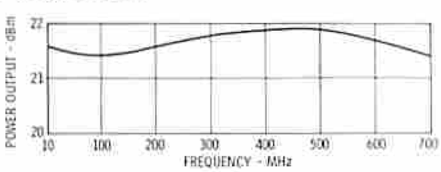
Gain



Noise Figure

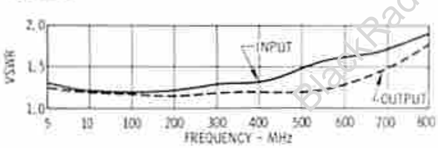


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.1	10.0
200.	1.2	[illegible]	10.0
300.	1.3	[illegible]	10.0
400.	1.3	1.2	10.0
500.	1.5	1.2	9.9
600.	1.6	1.3	10.0
700.	[illegible]	1.5	10.3
800.	[illegible]	1.8	10.0

Linear S-Parameters

FREQ MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.07	-152.7	3.18	150.7	.17	-8.2	.06	-173.0
200.	.09	-143.9	3.16	137.4	[illegible]	-14.4	.06	-168.0
300.	.11	-139.9	3.16	118.3	[illegible]	-22.4	.07	-160.5
400.	.15	-143.2	3.16	99.8	.18	-30.6	.09	-154.9
500.	.19	-150.2	3.13	79.8	.18	-39.4	.11	-153.1
600.	.23	-163.1	3.17	58.8	.19	-50.1	.15	-150.2
700.	.27	174.2	3.29	[illegible]	.20	-62.4	.21	-171.8
800.	.30	136.2	3.47	[illegible]	.21	-76.6	.30	169.0

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WJ-A61

2 TO 6 GHz
TO-8 CASCADABLE AMPLIFIER

- WIDE BANDWIDTH: 2-6 GHz
- MEDIUM OUTPUT LEVEL: +12.5 dBm (TYP.)
- LOW NOISE: 3.2 dB (TYP.)
- EXCELLENT GAIN BLOCK
- TO-8 PACKAGE

Specifications*

Characteristics	Typical	Guaranteed 0° -50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	1.8-6.2 GHz	2-6 GHz	2-6 GHz
Small Signal Gain (Min.)	7.5 dB	6.5 dB	6.0 dB
Gain Flatness (Max.)	±0.4 dB	±0.7 dB	±0.9 dB
Noise Figure (Max.)	3.2 dB	4.3 dB	4.8 dB
Power Output at 1 dB Compression (Min.)	12.5 dBm	11.0 dBm	10.5 dBm
VSWR (Max.)			
Input	1.5:1	2.0:1	2.1:1
Output	1.5:1	2.0:1	2.1:1
DC Current (Max.) at +5 Volts	35 mA	40 mA	42 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 42 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 37 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 25 dBm (Typ.)

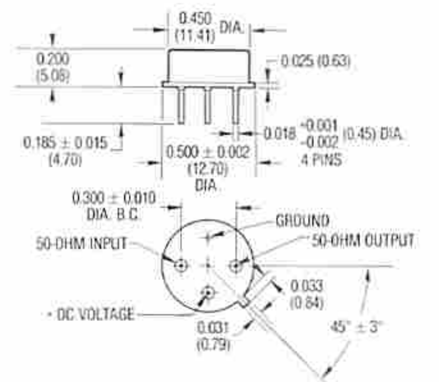
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . 6 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 50 Milliwatts
Maximum Peak Power . . . . 0.25 Watt
. . . . (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

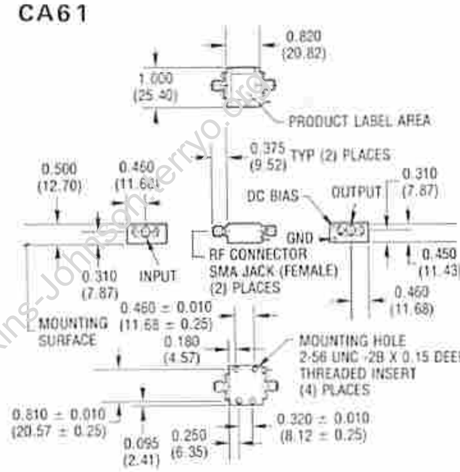
Weight approximately 2.0 grams (0.07 oz.)

Outline Drawings

A61



CA61

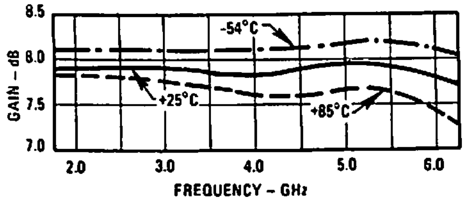


WJ-CA 61 is standard.

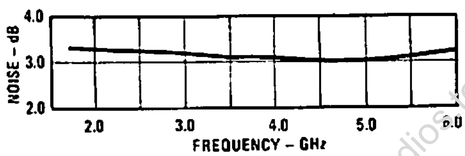
WJ-A61 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

Typical Performance at 25°C

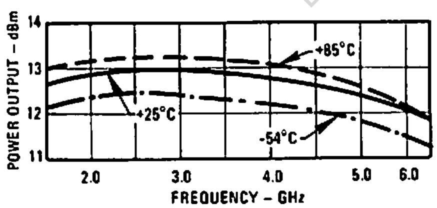
Gain



Noise Figure

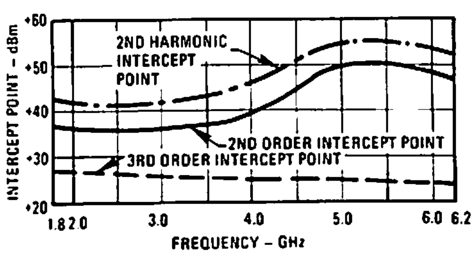


Power Output*

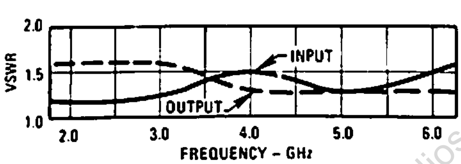


* at 1 dB Gain Compression

Intercept Point



VSWR



Typical Automatic Test Data

V_{CC} = +5 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
1800.0	1.2	1.4	7.6
2000.0	1.2	1.4	7.6
2200.0	1.2	1.4	7.6
2400.0	1.2	1.4	7.6
2600.0	1.2	1.4	7.6
2800.0	1.2	1.5	7.6
3000.0	1.2	1.5	7.7
3200.0	1.2	1.5	7.8
3400.0	1.2	1.4	7.8
3600.0	1.3	1.4	7.7
3800.0	1.3	1.3	7.7
4000.0	1.4	1.2	7.7
4200.0	1.4	1.2	7.7
4400.0	1.4	1.2	7.8
4600.0	1.3	1.3	7.8
4800.0	1.2	1.4	7.9
5000.0	1.1	1.5	8.0
5200.0	1.1	1.5	8.1
5400.0	1.1	1.5	8.0
5600.0	1.2	1.4	8.0
5800.0	1.3	1.3	8.0
6000.0	1.5	1.2	7.9
6200.0	1.5	1.1	7.9

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
1800.0	.088	-34	2.411	86	.158	-55	.183	113
2000.0	.085	-64	2.408	69	.156	-67	.180	93
2200.0	.094	-89	2.395	51	.153	-80	.180	74
2400.0	.097	-106	2.406	35	.151	-91	.177	55
2600.0	.102	-120	2.404	19	.149	-102	.183	39
2800.0	.100	-135	2.401	4	.148	-112	.189	28
3000.0	.054	-150	2.424	-11	.145	-122	.193	18
3200.0	.059	-164	2.441	-27	.143	-132	.188	11
3400.0	.106	-175	2.448	-43	.141	-142	.175	4
3600.0	.126	175	2.440	-58	.140	-151	.150	-4
3800.0	.145	167	2.439	-73	.139	-160	.123	-14
4000.0	.162	160	2.428	-88	.141	-169	.096	-28
4200.0	.169	152	2.435	-103	.142	-179	.087	-46
4400.0	.160	146	2.445	-118	.141	171	.098	-60
4600.0	.133	138	2.465	-134	.141	161	.125	-65
4900.0	.091	130	2.484	-150	.141	151	.159	-68
5000.0	.053	112	2.501	-164	.141	142	.192	-69
5200.0	.031	63	2.529	180	.142	132	.211	-72
5400.0	.055	23	2.509	163	.144	122	.208	-75
5600.0	.097	19	2.517	146	.148	112	.177	-80
5800.0	.144	15	2.502	129	.151	101	.129	-88
6000.0	.106	9	2.489	112	.155	90	.077	-107
6200.0	.215	-5	2.481	94	.150	77	.061	-167

1

WJ-A61-1

2 TO 6 GHz
TO-8 CASCADABLE AMPLIFIER

- WIDE BANDWIDTH: 1-6 GHz (TYP.)
- MEDIUM POWER: +20 dBm (TYP.)
- LOW NOISE: 3.4 dB (TYP.)
- TO-8 PACKAGE

Specifications*

Characteristics	Typical	Guaranteed 0° -50°C	-54°C - +85°C
Frequency (Min.)	1-6 GHz	2-6 GHz	2-6 GHz
Small Signal Gain (Min.)	8.0 dB	7.0 dB	6.5 dB
Gain Flatness (Max.)	±0.4 dB	±0.7 dB	±0.8 dB
Noise Figure (Max.)	3.4 dB	4.2 dB	4.7 dB
Power Output at 1 dB Compression (Min.)	+20.0 dBm	18.5 dBm	18.0 dBm
VSWR (Max.)			
Input	1.6:1	2.0:1	2.1:1
Output	1.5:1	2.0:1	2.1:1
DC Current (Max.) at +8 Volts	70 mA	77 mA	79 mA

*Measured in a 50-ohm system at +8 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 50 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 45 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 30 dBm (Typ.)

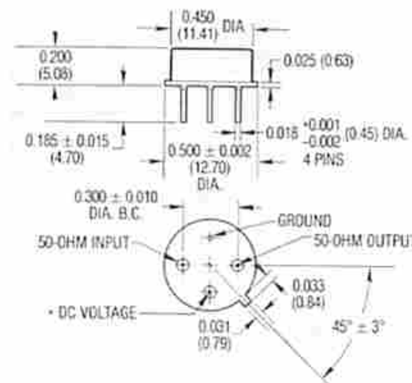
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to 125°C
Maximum Case Temperature . . . . +100°C
Maximum DC Voltage . . . . +9 Volts
Maximum Continuous RF Input Power . . . . +17 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
Maximum Peak Power . . . . 0.25 Watt
. . . . (3 µsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 100°C

Weight approximately 2.0 grams (0.07 oz.)

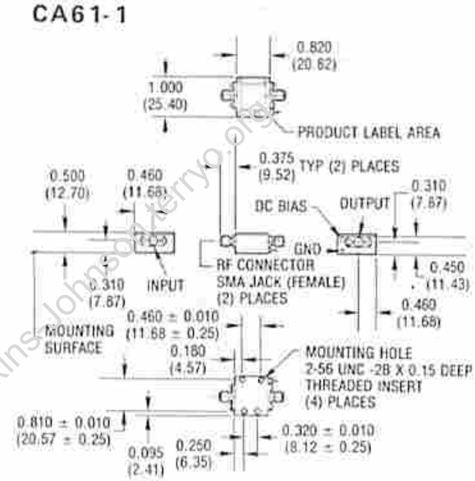
Outline Drawings

A61-1



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA61-1

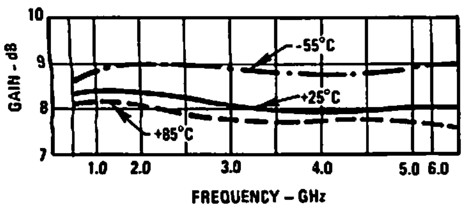


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

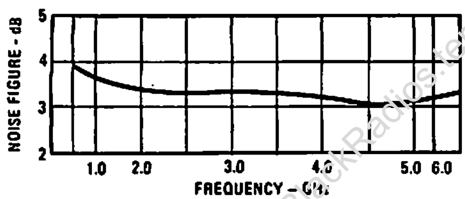
WJ-A61-1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

Typical Performance at 25°C

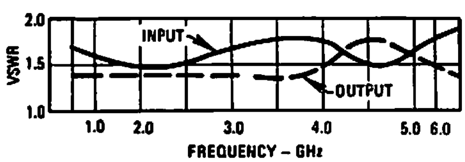
Gain



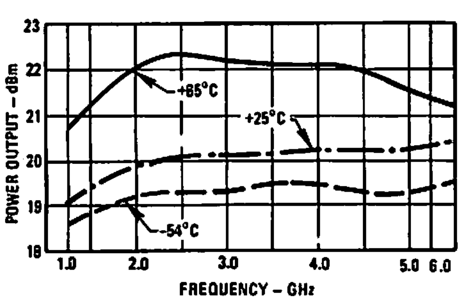
Noise Figure



VSWR

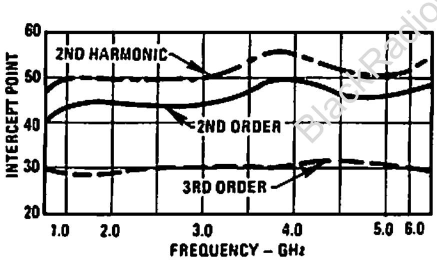


Power Output*



* at 1 dB Gain Compression

Intercept Point



Typical Automatic Test Data

V_{CC} = +8 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
600.0	2.4*	1.7	7.7
800.0	1.5	1.3	8.5
1000.0	1.2	1.3	8.7
1200.0	1.2	1.3	8.6
1400.0	1.2	1.4	8.6
1600.0	1.3	1.3	8.5
1800.0	1.4	1.3	8.4
2000.0	1.5	1.4	8.4
2200.0	1.5	1.4	8.3
2400.0	1.5	1.4	8.2
2600.0	1.5	1.4	8.2
2800.0	1.6	1.4	8.1
3000.0	1.6	1.3	8.1
3200.0	1.6	1.3	8.0
3400.0	1.7	1.2	8.0
3600.0	1.7	1.2	8.0
3800.0	1.7	1.2	8.0
4000.0	1.7	1.3	8.0
4200.0	1.6	1.4	8.0
4400.0	1.5	1.5	8.0
4600.0	1.4	1.6	8.0
4800.0	1.3	1.7	8.0
5000.0	1.3	1.8	8.0
5200.0	1.3	1.8	8.0
5400.0	1.4	1.8	8.1
5600.0	1.5	1.7	8.1
5800.0	1.6	1.6	8.2
6000.0	1.7	1.6	8.2
6200.0	1.9	1.5	8.2
6400.0	2.0*	1.4	8.2

Linear S-Parameters

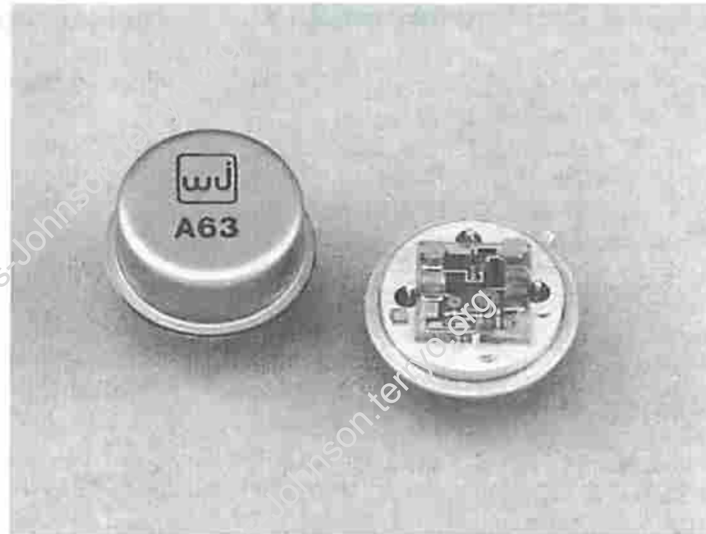
FREQUENCY MHZ	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.0	.420	88	2.431	-134	.153	73	.270	-1
800.0	.214	53	2.667	-172	.167	34	.144	-84
1000.0	.102	13	2.708	161	.167	8	.136	-154
1200.0	.074	-48	2.695	139	.163	-11	.147	163
1400.0	.095	-87	2.679	121	.160	-27	.150	135
1600.0	.130	-109	2.660	104	.156	-41	.147	108
1800.0	.160	-124	2.633	88	.151	-53	.149	83
2000.0	.178	-135	2.620	72	.147	-65	.158	63
2200.0	.192	-145	2.596	57	.144	-76	.162	48
2400.0	.199	-154	2.579	44	.140	-86	.164	38
2600.0	.208	-162	2.566	30	.137	-95	.160	30
2800.0	.218	-171	2.552	16	.133	-105	.150	23
3000.0	.230	-178	2.538	2	.130	-115	.135	17
3200.0	.245	176	2.521	-12	.126	-124	.118	10
3400.0	.258	170	2.517	-25	[illegible]	-132	.107	5
3600.0	.266	164	2.510	-39	.120	-141	.103	-0
3800.0	.265	158	2.511	-53	.117	-150	.110	-5
4000.0	.253	152	2.514	-67	.114	-159	.131	-10
4200.0	.231	146	2.516	-81	.112	-166	.161	-15
4400.0	.206	140	2.520	-94	.110	-174	.192	-21
4600.0	.174	131	2.515	-108	.108	178	.226	-27
4800.0	.147	117	2.508	-122	.106	170	.255	-33
5000.0	.131	97	[illegible]	-137	.104	163	.274	-40
5200.0	.134	73	2.526	-150	.104	156	.282	-47
5400.0	.159	50	2.538	-165	.104	148	.275	-55
5600.0	.197	32	2.547	180	.105	140	.262	-64
5800.0	.238	18	2.563	164	.106	132	.241	-76
6000.0	.272	5	2.575	148	.110	123	.217	-90
6200.0	.301	-9	2.580	132	.112	114	.193	-106
6400.0	.320	-25	2.583	114	.116	103	.172	-130

1

WJ-A63

5 TO 1000 MHz
TO-8 CASCADABLE AMPLIFIER

- LOW NOISE: 3.0 dB (TYP.)
- +15 dBm THIRD ORDER I.P. (TYP.)
- HIGH GAIN: 16 dB (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	1-1100 MHz	5-1000 MHz	5-1000 MHz
Small Signal Gain (Min.)	16.0 dB	15.0 dB	14.5 dB
Gain Flatness (Max.)	< ±0.3 dB	±1.0 dB	±1.0 dB
Noise Figure (Max.)	3.0 dB	4.0 dB	4.5 dB
Power Output at 1 dB Compression (Min.)	+4.0 dBm	+2.0 dBm	+2.0 dBm
VSWR (Max.) Input/Output	< 1.4:1	1.9:1	2.0:1
DC Current (Max.) at 15 Volts	14 mA	16 mA	18 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +25 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +20 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +15 dBm (Typ.)

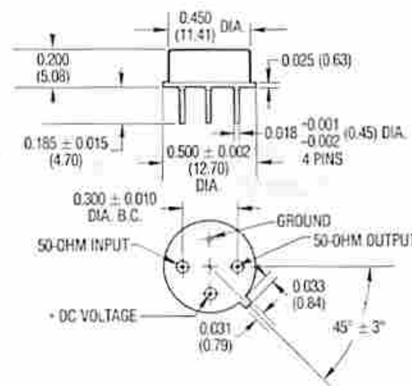
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +18 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . +50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

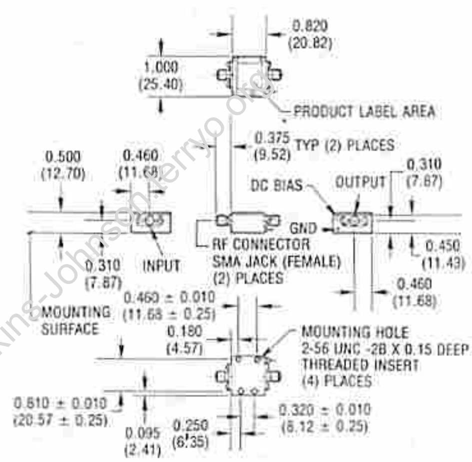
Outline Drawings

A63



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

CA63

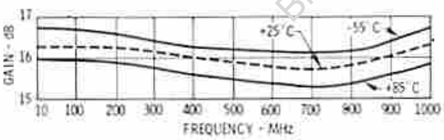


DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

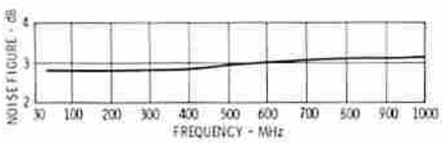
*WJ CA63 is standard WJ-A63 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers

Typical Performance at 25°C

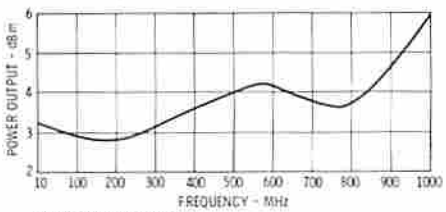
Gain



Noise Figure

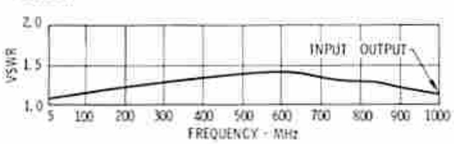


Power Output*

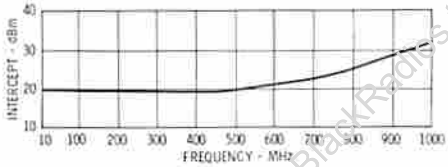


*at 1 dB Gain Compression

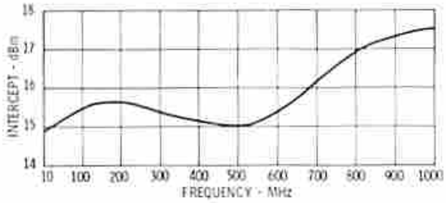
VSWR



Second Order Two Tone Intercept Point



Third Order Two Tone Intercept Point



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.0	1.0	16.2
200.	1.1	1.0	16.0
300.	1.2	1.1	15.8
400.	1.3	1.2	15.5
500.	1.3	1.3	15.4
600.	1.3	1.3	15.3
700.	1.3	1.2	15.4
800.	1.3	1.2	15.4
900.	1.1	1.1	15.6
1000.	1.1	1.2	16.1
1100.	1.4	1.5	16.1
1200.	2.2	1.9	15.4

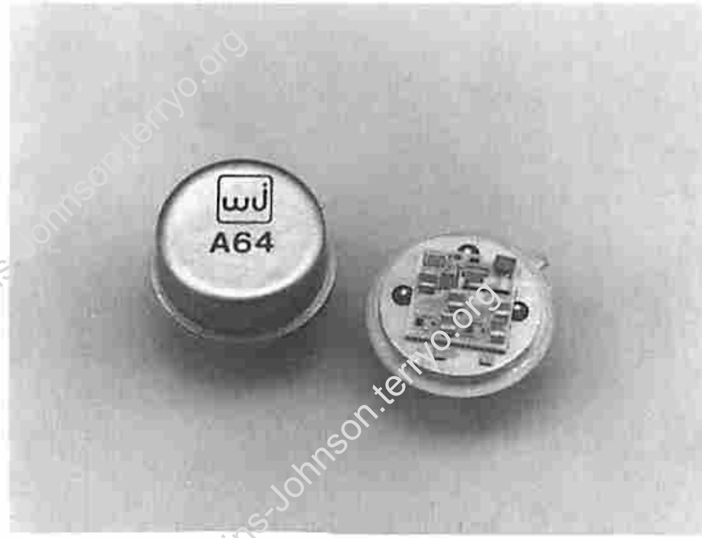
Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.01	-34.2	6.42	153.0	.09	-15.1	.05	170.1
200.	.06	-10.1	6.40	133.9	.09	-22.1	.02	[illegible]
300.	.10	-38.3	6.17	115.2	.09	-31.4	.06	[illegible]
400.	.12	-61.2	5.98	95.0	.09	-40.4	.10	[illegible]
500.	.14	-76.5	5.92	77.3	.09	-50.5	.11	[illegible]
600.	.15	[illegible]	5.92	56.9	.09	-60.0	.12	[illegible]
700.	.14	-108.1	5.86	36.1	.09	-70.9	[illegible]	[illegible]
800.	.12	-131.6	5.92	14.7	.09	[illegible]	[illegible]	[illegible]
900.	.07	156.4	6.14	-9.2	.09	[illegible]	.05	[illegible]
1000.	.05	92.9	6.35	-34.7	.09	-106.1	.10	107.0
1100.	.13	20.3	6.39	-64.0	.09	[illegible]	.20	30.9
1200.	.37	-14.7	5.87	-100.9	.09	[illegible]	.30	22.0

WJ-A64

10 TO 1200 MHz TO-8 CASCADABLE AMPLIFIER

- LOW NOISE: 3.2 dB (TYP.)
- HIGH GAIN – TWO STAGES
- ULTRA LOW PHASE DEVIATION FROM LINEARITY: < ±2°, 100-1000 MHz
- LOW VSWR: 1.2:1 (TYP.)
- MEDIUM LEVEL OUTPUT: +8 dBm (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	2-1250 MHz	10-1200 MHz	10-1200 MHz
Small Signal Gain (Min.)	26.0 dB	24.0 dB	23.0 dB
Gain Flatness (Max.)	< ±0.5 dB	±0.8 dB	±1.0 dB
Noise Figure (Max.)			
10-1000 MHz	3.0 dB	3.8 dB	4.3 dB
10-1200 MHz	3.4 dB	4.3 dB	4.8 dB
Power Output at 1 dB Compression (Min.)	+8.0 dBm	+7.0 dBm	+6.5 dBm
VSWR (Max.) Input/Output			
10-1000	1.2:1	1.7:1	1.8:1
10-1200	1.5:1	1.9:1	2.0:1
DC Current (Max.) at 15 Volts	35 mA	38 mA	40 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . . +47 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . . +41 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . . +20 dBm (Typ.)

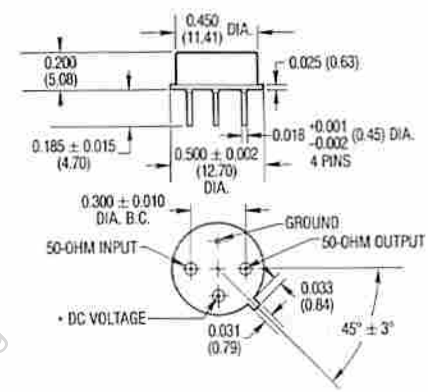
Absolute Maximum Ratings

Storage Temperature . . . . . -62°C to +125°C
Maximum Case Temperature . . . . . 125°C
Maximum DC Voltage . . . . . +20 Volts
Maximum Continuous RF Input Power . . . . . +6 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . . +50 Milliwatts
Maximum Peak Power . . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

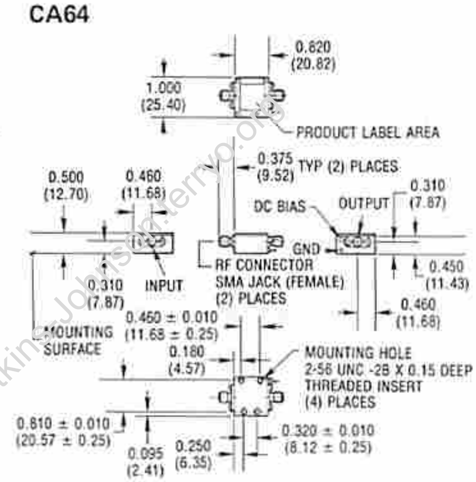
Outline Drawings

A64



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .005 (.13) UNLESS OTHERWISE SPECIFIED

CA64

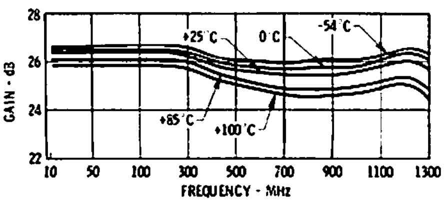


DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

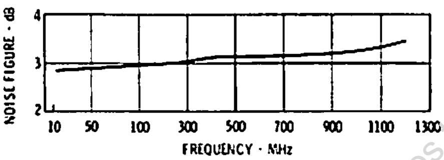
*WJ CA64 is standard WJ A64 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers

Typical Performance at 25°C

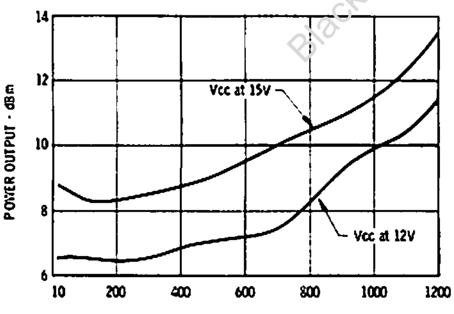
Gain



Noise Figure

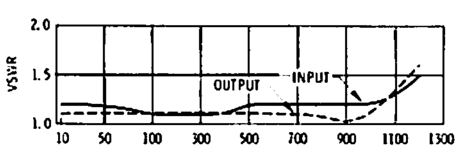


Power Output*

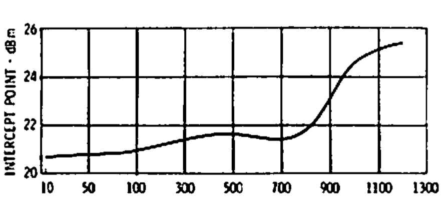


*at 1 dB Gain Compression

VSWR



3rd Order Intercept Point



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.0	1.1	26.0
200.	1.1	1.1	25.9
300.	1.1	1.2	25.9
400.	1.1	1.2	25.9
500.	1.1	1.2	25.9
600.	1.2	1.2	25.8
700.	1.2	1.1	25.4
800.	1.2	1.1	25.1
900.	1.2	1.0	24.9
1000.	1.2	1.1	24.8

V_{CC} = 12 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.2	25.4
200.	1.1	1.1	25.3
300.	1.1	1.2	25.3
400.	1.1	1.2	25.3
500.	1.2	1.2	25.4
600.	1.2	1.1	25.2
700.	1.2	1.1	24.9
800.	1.2	1.1	24.6
900.	1.2	1.1	24.5
1000.	1.3	1.2	24.4
1100.	1.3	1.4	24.6
1200.	1.6	1.7	24.9

Linear S-Parameters,

V_{CC} = 15 V

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.02	39.5	20.06	-31.2	.01	-4.7	.07	170.8
200.	.03	6.5	19.75	-57.8	.01	-10.1	.07	162.7
300.	.03	-4.8	19.77	-84.9	.01	-14.0	.07	147.0
400.	.04	-9.5	19.74	-111.7	.01	-18.0	.08	129.0
500.	.06	-23.2	19.78	-140.3	.01	-22.5	.08	106.6
600.	.07	-36.5	19.41	-167.4	.01	-27.5	.08	87.3
700.	.08	-50.8	18.72	165.4	.01	-32.2	.06	63.5
800.	.10	-70.4	17.96	136.3	.01	-37.9	.04	31.3
900.	.10	-93.6	17.60	107.1	.01	-42.3	.02	-65.3
1000.	.10	-124.8	17.36	78.5	.01	-47.4	.06	-146.4

V_{CC} = 12 V

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.04	2.2	18.70	-31.3	.01	-6.9	.07	168.5
200.	.05	-17.9	18.41	-57.8	.01	-11.2	.07	156.9
300.	.05	-34.1	18.46	-84.9	.01	-14.4	.07	142.5
400.	.06	-41.3	19.47	-112.0	.01	-19.1	.07	124.0
500.	.07	-51.8	18.54	-140.4	.01	-23.9	.07	102.3
600.	.08	-62.7	18.22	-167.6	.01	-29.0	.07	82.6
700.	.09	-75.9	17.61	165.0	.01	-32.6	.05	57.8
800.	.10	-89.9	16.99	135.7	.01	-38.7	.03	19.2
900.	.10	-112.5	16.70	106.3	.01	-43.5	.03	-104.2
1000.	.11	-141.1	16.53	77.3	.01	-47.7	.08	-153.5
1100.	.15	-169.9	17.06	47.1	.02	-52.0	.16	-175.0
1200.	.23	134.8	17.49	11.0	.02	-68.7	.26	146.1

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WJ-A65

10 TO 1000 MHz TO-8 CASCADABLE AMPLIFIER

- MEDIUM OUTPUT LEVEL: +10 dBm (TYP.)
- +24 dBm THIRD ORDER I.P. (TYP.)
- FULL PERFORMANCE WITH LOW COST

Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	-54°C - +85°C
Frequency (Min.)	5-1100 MHz	10-1000 MHz	10-1000 MHz
Small Signal Gain (Min.)	10.5 dB	9.5 dB	9.0 dB
Gain Flatness (Max.)	< ±0.3 dB	±0.7 dB	±0.8 dB
Noise Figure (Max.)	6.0 dB	7.5 dB	8.0 dB
Power Output at 1 dB Compression (Min.)	+10.0 dBm	+8.0 dBm	+8.0 dBm
VSWR (Max.) Input/Output	< 1.5:1	1.9:1	2.0:1
DC Current (Max.) at 15 Volts	30 mA	35 mA	37 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +44 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +39 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +24 dBm (Typ.)

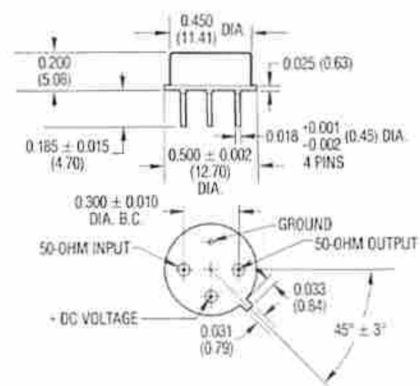
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +20 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . +50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 µsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

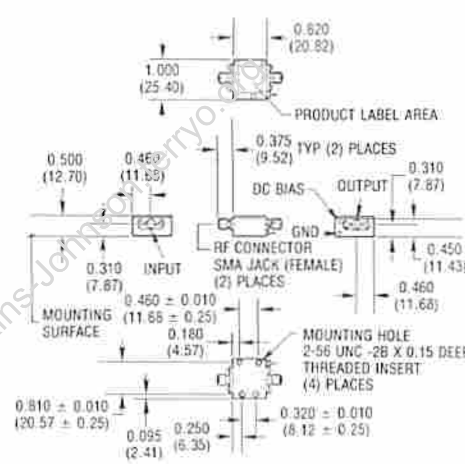
Outline Drawings

A65



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA65

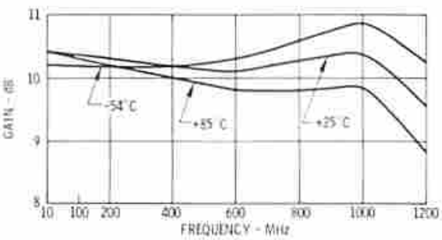


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

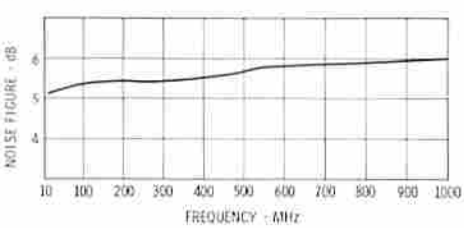
*WJ CA65 is standard WJ A65 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

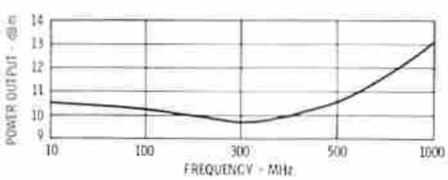
Gain



Noise Figure

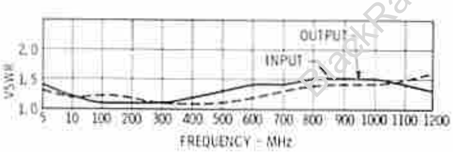


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.2	10.3
200.	1.1	1.2	10.3
300.	1.1	[illegible]	10.3
400.	1.2	1.1	10.2
500.	1.3	1.1	10.0
600.	1.4	1.2	10.0
700.	1.5	1.3	10.1
800.	1.5	1.4	10.2
900.	1.5	1.4	10.4
1000.	1.5	1.4	10.5
1100.	1.4	1.5	10.3
1200.	1.3	1.6	9.4

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.04	-161.4	3.27	156.5	.13	-7.6	.11	172.2
200.	.04	-141.0	3.26	137.7	.13	-10.1	.08	165.3
300.	.05	-113.9	3.26	120.1	.13	-14.6	.06	175.6
400.	.08	-109.3	3.22	102.0	.13	-20.0	.05	-140.4
500.	.11	-110.7	3.17	84.0	.14	-25.2	.07	-119.5
600.	.15	-120.6	3.16	64.5	.14	-30.7	.11	-118.2
700.	.17	-131.3	3.19	44.9	.14	-36.6	.14	-126.9
800.	.20	-145.2	3.22	25.9	.15	-42.8	.17	-141.0
900.	.20	-164.5	3.30	3.2	.16	-50.5	.18	-163.5
1000.	.19	168.3	3.36	-20.2	.17	-59.1	.18	162.8
1100.	.16	120.7	3.26	-45.8	.18	-70.8	.19	117.6
1200.	.13	74.6	2.96	-73.9	.18	-85.4	.20	67.5

1

WJ-A66

10 TO 1200 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH GAIN - TWO STAGES 23.5 dB (TYP.)
- LOW NOISE: 4.0 dB (TYP.)
- HIGH OUTPUT LEVEL: +15 dBm (TYP.)
- ULTRA LOW PHASE DEVIATION FROM LINEARITY: <±2°, 100 - 1000 MHz

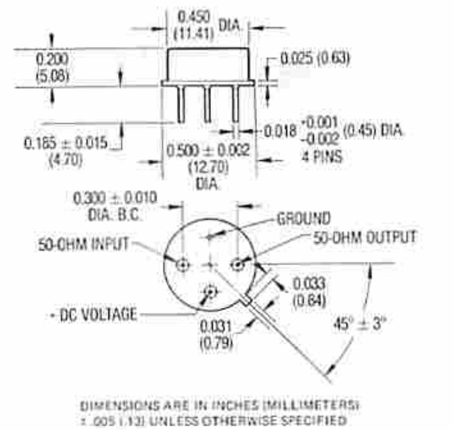
Specifications*

Characteristics	Typical	Guaranteed 0° -50°C	-54°C - +85°C
Frequency (Min.)	5-1250 MHz	10-1200 MHz	10-1200 MHz
Small Signal Gain (Min.)	23.5 dB	22.0 dB	21.0 dB
Gain Flatness (Max.)	±0.4 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	4.0 dB	5.0 dB	5.5 dB
Power Output at 1 dB Compression (Min.)	+15.0 dBm	+14.0 dBm	+13.5 dBm
VSWR (Max.) Input/Output	1.3:1	1.6:1	1.8:1
DC Current at 15 Volts	64 mA	67 mA	70 mA

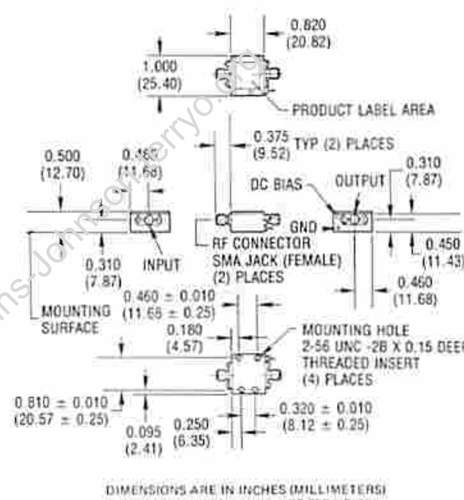
* Measured in a 50-ohm system at 15 Vdc Nominal.

Outline Drawings

A66



CA66



Typical Intermodulation Performance at 25°C

Second Order Harmonic IP	+53 dBm (Typ.)
Second Order Two-Tone IP	+47 dBm (Typ.)
Third Order Two-Tone IP	+28 dBm (Typ.)

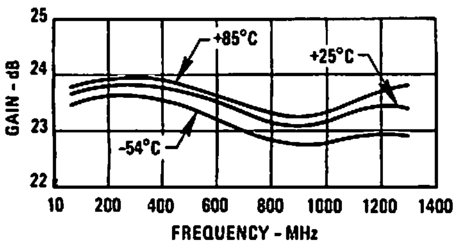
Absolute Maximum Ratings

Storage Temperature	-62°C to +125°C
Maximum Case Temperature	125°C
Maximum DC Voltage	+17 Volts
Maximum Continuous RF Input Power	+10 dBm
Maximum Short-Term RF Input Power (1 Minute Max.)	+100 Milliwatts
Maximum Peak Power	0.5 Watt (3 μsec. Max.)
"S" Series Burn-In Temperature (Case)	125°C

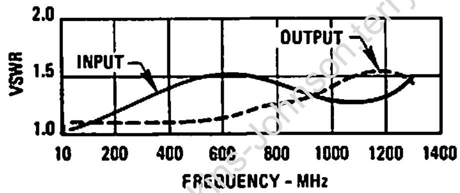
Weight approximately 2.0 grams (0.07 oz.)

Typical Performance at 25°C

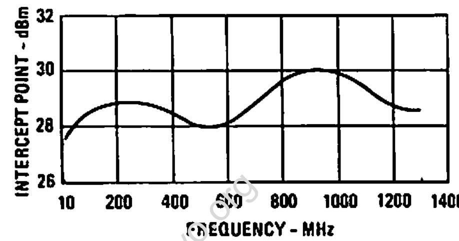
Gain



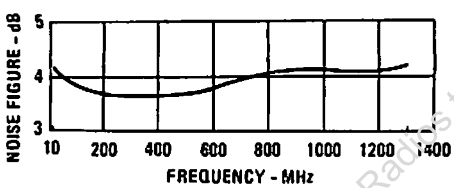
VSWR



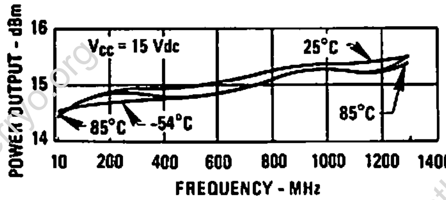
3rd Order Intercept Point

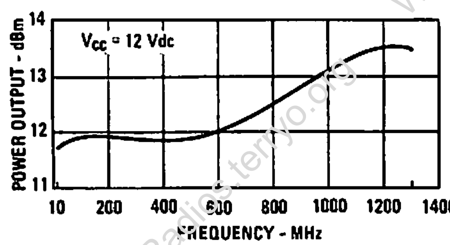


Noise Figure



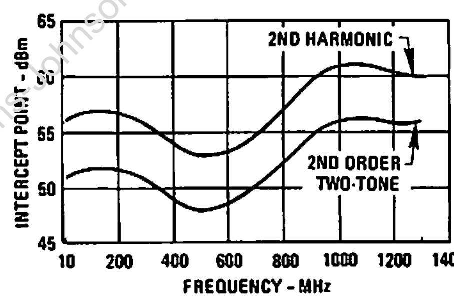
Power Output*





* at 1 dB Gain Compression

Intercept Point



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.0	23.5
200.	1.1	1.0	23.4
300.	1.2	1.1	23.5
400.	1.2	1.1	23.8
500.	1.3	1.2	23.5
600.	1.4	1.3	23.5
700.	1.4	1.4	23.3
800.	1.5	1.5	23.2
900.	1.4	1.5	23.0
1000.	1.4	1.6	22.9
1100.	1.2	1.6	22.9
1200.	1.1	1.5	22.8
1300.	1.5	1.4	22.5
1400.	2.5	1.2	21.4
1500.	4.5	1.2	19.3

Linear S-Parameters

FREQ MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.04	114.7	14.75	-19.9	.02	2.3	.01	147.9
200.	.06	103.2	14.54	-40.6	.02	[illegible]	.02	-119.5
300.	.07	91.2	14.74	-64.7	.02	[illegible]	.03	-97.1
400.	.09	83.7	15.27	-89.3	.02	[illegible]	.06	-99.8
500.	.13	72.4	14.24	-111.9	.02	-8.3	.08	-109.9
600.	.14	60.9	14.21	-133.9	.02	-14.0	.13	-116.5
700.	.17	56.3	14.62	-156.5	.02	-18.8	.17	-131.3
800.	.17	47.6	14.41	-179.2	.02	-23.2	.20	-145.5
900.	.16	35.3	14.09	156.3	.02	-29.0	.22	-162.0
1000.	.13	24.0	13.96	131.7	.02	-37.0	.24	-176.0
1100.	.07	23.0	13.90	106.5	.03	-45.9	.25	162.1
1200.	.07	133.7	13.66	79.3	.03	-57.4	.23	150.3
1300.	.23	122.7	12.97	[illegible]	.03	-69.9	.18	134.1
1400.	.42	105.7	11.25	[illegible]	.02	-83.3	.11	128.7
1500.	.67	81.4	8.87	-12.7	.02	-97.0	.09	172.2

V_{CC} = 12 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.0	23.4
200.	1.1	1.0	23.3
300.	1.2	1.1	23.4
400.	1.2	1.1	22.7
500.	1.3	1.2	23.4
600.	1.3	1.2	23.4
700.	1.4	1.4	23.3
800.	1.4	1.5	23.2
900.	1.4	1.6	23.0
1000.	1.3	1.6	22.9
1100.	1.1	1.7	22.9
1200.	1.2	1.6	22.7
1300.	1.7	1.4	22.3
1400.	2.8	1.2	21.0
1500.	5.1	1.2	19.0

Linear S-Parameters

FREQ MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.04	121.9	15.03	-20.0	.02	-1.4	.01	137.4
200.	.06	106.6	14.83	-40.6	.02	-1.7	.01	-123.9
300.	.08	94.5	15.00	-64.7	.02	-3.7	.03	-105.2
400.	.10	88.1	15.48	-89.6	.02	-7.3	.05	-104.7
500.	.14	74.4	14.98	-111.8	.02	-8.3	.07	-112.0
600.	.15	[illegible]	14.93	-133.6	.02	-14.8	.12	-118.4
700.	.18	[illegible]	14.69	-156.0	.02	-19.1	.15	-131.9
800.	.19	48.1	14.46	-178.3	.02	-23.5	.19	-145.0
900.	.18	33.6	14.11	158.3	.02	-29.9	.21	-159.0
1000.	.16	22.6	13.97	133.4	.02	-37.4	.22	-173.9
1100.	.12	12.1	13.95	108.7	.02	-45.2	.23	171.1
1200.	.03	117.3	13.81	82.3	.03	-56.7	.21	154.8
1300.	.20	134.4	13.30	52.9	.03	-69.5	.17	140.2
1400.	.43	110.7	11.77	21.7	.02	-84.3	.10	139.7
1500.	.64	85.6	9.42	-10.4	.02	-97.0	.12	-179.5

WJ-A66-1

10 TO 1000 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH GAIN – TWO STAGES: 27.5 dB (TYP.)
- LOW NOISE: <3.0 dB (TYP.)
- MEDIUM POWER OUTPUT: 15.0 dBm (TYP.)
- WIDE POWER SUPPLY RANGE: 5 VOLTS TO 15 VOLTS

Specifications*

Characteristics	Typ.	Guaranteed 0° - 50°C	Guaranteed -54° - +85°C
Frequency (Min.)	5-1200 MHz	10-1000 MHz	10-1000 MHz
Small Signal Gain (Min.)	27.5 dB	26.0 dB	25.5 dB
Gain Flatness (Max.)	±0.4 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)			
10-500	2.7 dB	3.5 dB	4.0 dB
10-1000	3.0 dB	4.0 dB	4.5 dB
Power Output at 1 dB Compression (Min.)	15.0 dBm	14.5 dBm	14.0 dBm
VSWR (Max.)			
Input	<1.5:1	1.8:1	2.0:1
Output	<1.5:1	1.8:1	2.0:1
DC Current (Max.) at 15 Volts	65 mA	69 mA	72 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

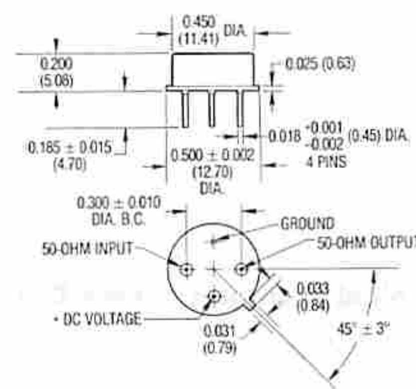
Second Order Harmonic Intercept Point . . . . 45 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 40 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 27 dBm (Typ.)

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . 17 Volts
Maximum Continuous RF Input Power . . . . +6 dBm
Maximum Short Term RF Input . . . . 50 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt ($3\ \mu sec$ Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Outline Drawings

A66-1

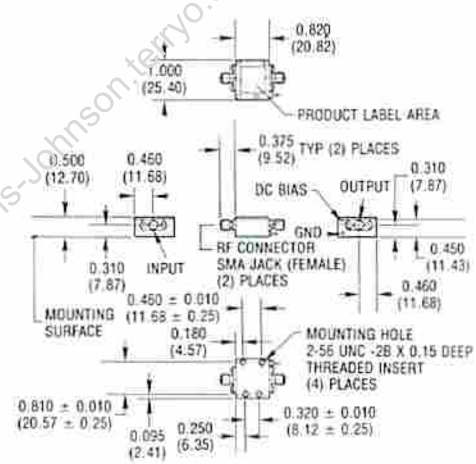


DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

Weight

approximately 2.0 grams (0.07 oz.)

CA66-1

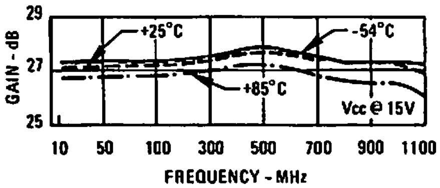


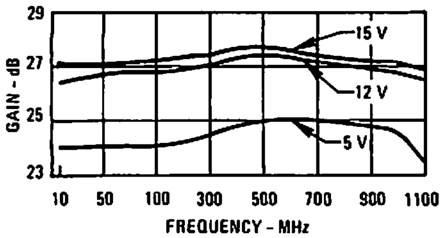
DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

*WJ C66-1 is standard WJ A66-1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

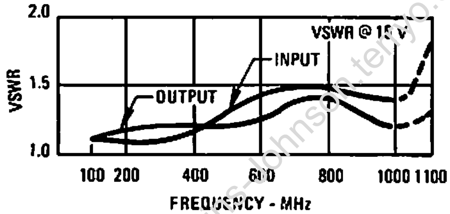
Typical Performance at 25°C

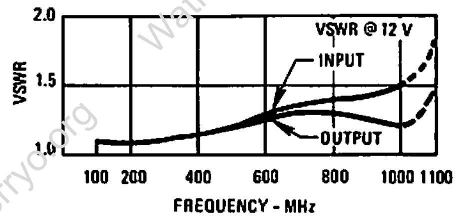
Gain

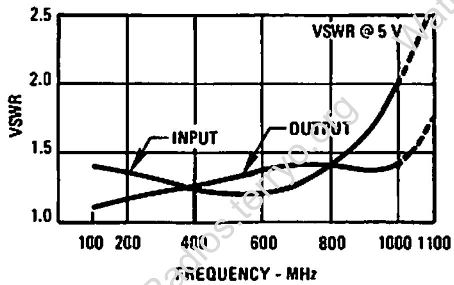




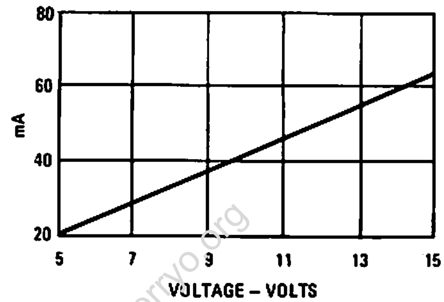
VSWR



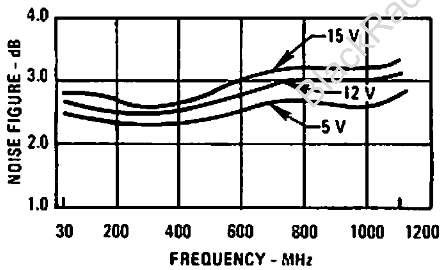




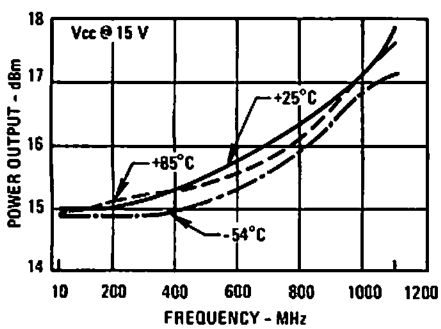
Current Drain

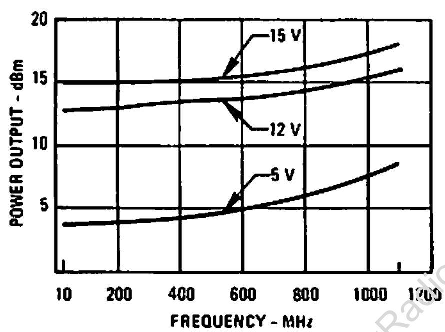


Noise Figure



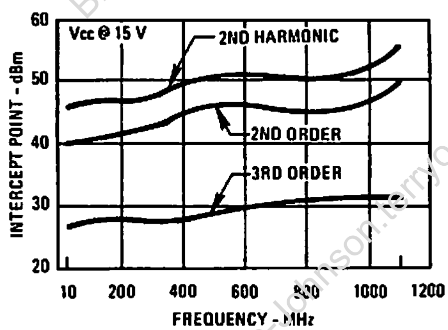
Power Output*

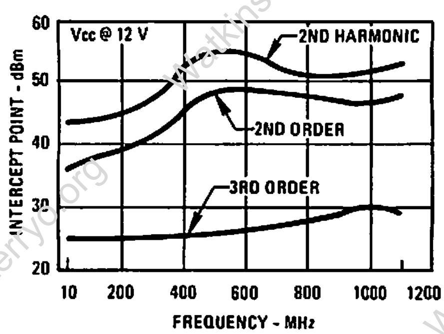


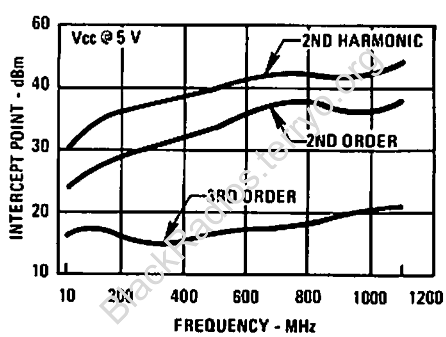


* at 1 dB Gain Compression

Intercept Point







Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.0	1.2	1.2	26.7
10.0	1.1	1.1	27.0
50.0	1.1	1.1	27.1
100.0	1.0	1.1	27.1
200.0	1.0	1.1	27.2
300.0	1.1	1.1	27.5
400.0	1.2	1.2	27.5
500.0	1.3	1.2	27.6
600.0	1.4	1.2	27.6
700.0	1.5	1.3	27.3
800.0	1.5	1.3	27.2
900.0	1.4	1.3	27.0
1000.0	1.4	1.2	27.0
1100.0	1.8	1.2	26.9

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.519	-54	13.91	26	0.03	-2	0.367	-124
2.0	0.366	-128	17.35	35	0.01	-39	0.313	157
5.0	0.103	179	21.54	12	0.01	6	0.102	100
10.0	0.064	148	22.45	5	0.01	1	0.058	77
50.0	0.032	65	22.55	-12	0.01	-6	0.032	26
100.0	0.016	37	22.75	-27	0.01	-8	0.034	15
200.0	0.023	91	22.88	-54	0.01	-11	0.036	9
300.0	0.056	118	23.60	-83	0.01	-15	0.063	-1
400.0	0.100	96	23.72	-112	0.01	-20	0.086	-14
500.0	0.137	81	24.07	-142	0.01	-24	0.108	-26
600.0	0.176	65	23.89	-170	0.01	-29	0.108	-48
700.0	0.193	40	23.38	156	0.02	-35	0.129	-60
800.0	0.196	10	22.83	127	0.02	-41	0.147	-72
900.0	0.174	-27	22.45	93	0.02	-48	0.145	-85
1000.0	0.162	-87	22.42	60	0.02	-54	0.093	-96
1100.0	0.208	-164	22.04	19	0.02	-73	0.075	33

V_{CC} = +12 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.0	1.2	1.2	26.3
10.0	1.2	1.1	26.6
50.0	1.1	1.1	26.7
100.0	1.0	1.1	26.7
200.0	1.1	1.1	26.9
300.0	1.1	1.2	27.2
400.0	1.2	1.2	27.3
500.0	1.3	1.2	27.3
600.0	1.4	1.2	27.4
700.0	1.4	1.2	27.2
800.0	1.4	1.2	27.1
900.0	1.4	1.1	26.9
1000.0	1.4	1.1	26.8
1100.0	1.7	1.5	26.3

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.469	-57	12.99	28	0.03	-3	0.366	-127
2.0	0.315	-120	16.77	34	0.01	-38	0.292	154
5.0	0.183	178	20.57	13	0.01	7	0.107	99
10.0	0.102	143	21.43	5	0.01	2	0.068	72
50.0	0.036	68	21.54	-12	0.01	-6	0.041	22
100.0	0.023	43	21.73	-26	0.01	-7	0.041	23
200.0	0.035	69	22.10	-52	0.01	-9	0.051	27
300.0	0.057	82	22.82	-81	0.01	-14	0.073	18
400.0	0.092	77	23.21	-109	0.01	-17	0.083	10
500.0	0.121	64	23.30	-139	0.02	-20	0.100	4
600.0	0.149	52	23.37	-167	0,02	-24	0.089	-4
700.0	0.167	27	23.01	159	0.02	-30	0.086	-24
800.0	0.174	-2	22.75	130	0.02	-34	0.080	-42
900.0	0.155	-40	22.16	95	0.02	-40	0.059	-62
1000.0	0.151	-101	21.86	62	0.02	-50	0.024	107
1100.0	0.261	-172	20.63	21	0.02	-64	0.204	76

V_{CC} = +5 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.0	1.2	1.2	23.8
10.0	1.3	1.1	24.0
50.0	1.4	1.1	24.0
100.0	1.4	1.1	24.1
200.0	1.4	1.1	24.2
300.0	1.3	1.2	24.5
400.0	1.3	1.2	24.7
500.0	1.2	1.3	24.9
600.0	1.2	1.3	24.9
700.0	1.2	1.4	24.8
800.0	1.3	1.4	24.7
900.0	1.5	1.4	24.6
1000.0	1.9	1.2	24.7
1100.0	2.8	1.4	24.2

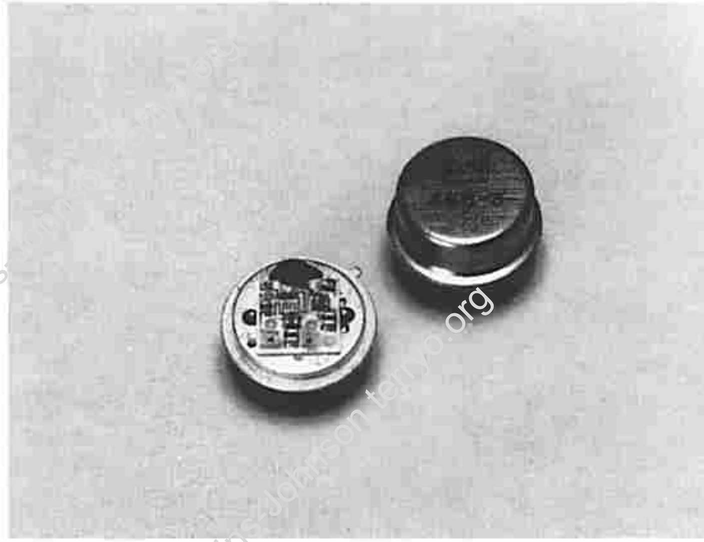
Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.369	-46	[illegible]	32	0.02	1	0.431	-134
2.0	0.122	-83	13.36	36	0.01	-3	0.312	152
5.0	0.109	4	15.44	11	0.02	7	0.101	125
10.0	0.140	8	15.93	4	0.02	1	0.056	125
50.0	0.177	-2	15.77	-12	0.02	-6	0.028	117
100.0	0.176	-12	16.01	-27	0.02	-8	0.031	103
200.0	0.162	-22	16.22	-54	0.02	-11	0.045	72
300.0	0.137	-37	16.78	-83	0.02	-16	0.073	32
400.0	0.111	-42	17.25	-112	0.02	-23	0.102	4
500.0	0.094	-53	17.49	-143	0.02	-27	0.134	[illegible]
600.0	0.073	-60	17.50	-173	0.02	-33	0.142	[illegible]
700.0	0.091	-68	17.44	153	0.02	-38	0.160	-67
800.0	0.128	-88	17.18	123	0.02	-45	[illegible]	-89
900.0	0.191	-119	17.01	87	0.02	-51	0.152	-114
1000.0	0.303	-154	17.09	52	0.02	-63	[illegible]	-166
1100.0	0.475	167	16.22	7	0.03	-85	0.174	58

WJ-A66-3

10 TO 1000 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH GAIN – TWO STAGES: 26.0 dB (TYP.)
- LOW NOISE: <3.0 dB (TYP.)
- HIGH EFFICIENCY: 18 mA (TYP.) AT 5 VOLTS



Specifications*

Characteristics	Typ.	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	5-1100 MHz	10-1000 MHz	10-1000 MHz
Small Signal Gain (Min.)	26.0 dB	24.5 dB	24.0 dB
Gain Flatness (Max.)	±0.5 dB	±0.8 dB	±1.1 dB
Noise Figure (Max.)	<3.0 dB	3.5 dB	4.0 dB
Power Output at 1 dB Compression (Min.)	3.0 dBm	1.5 dBm	1.0 dBm
VSWR (Max.)			
Input	1.3:1	1.8:1	2.0:1
Output	1.3:1	1.8:1	2.0:1
DC Current (Max.) at 5 Volts	16 mA	18 mA	19 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . > 30 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . > 25 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 13 dBm (Typ.)

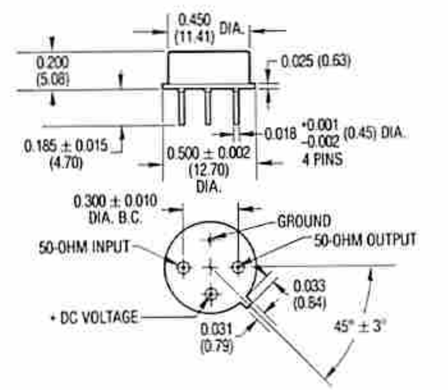
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +10 Volts
Maximum Continuous RF Input Power . . . . +6 dBm
Maximum Short Term RF Input Power . . . . 50 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

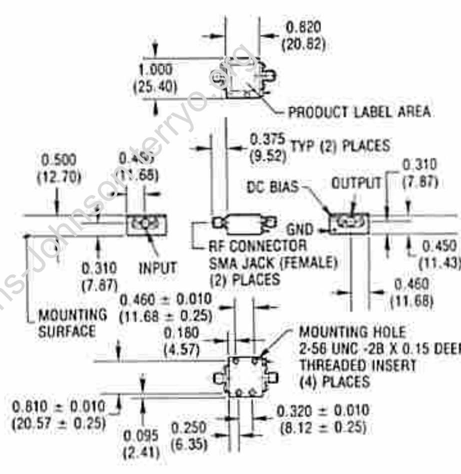
Outline Drawings

A66-3



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .005 (.13) UNLESS OTHERWISE SPECIFIED

CA66-3

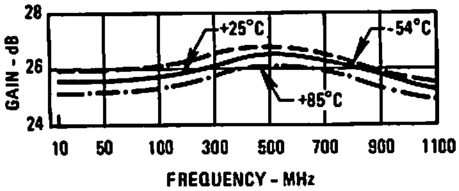


DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

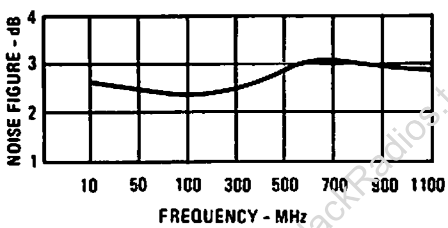
*WJ-CA66-3 is standard WJ-A66-3 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers

Typical Performance at 25°C

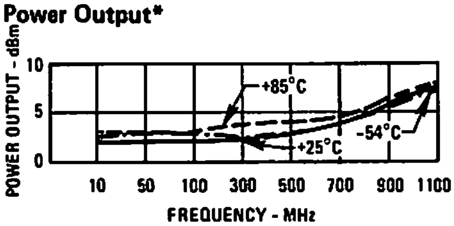
Gain



Noise Figure

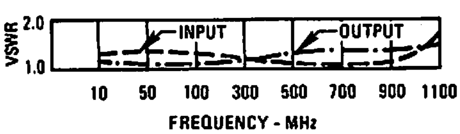


Power Output*

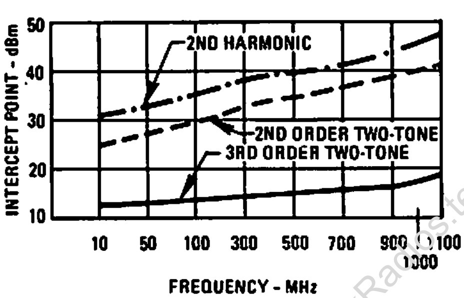


* at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{CC} = +5 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.0	1.5	1.1	25.2
10.0	1.4	1.1	25.6
50.0	1.4	1.1	25.5
100.0	1.4	1.1	25.6
200.0	1.4	1.2	25.7
300.0	1.3	1.2	26.0
400.0	1.2	1.3	26.2
500.0	1.2	1.3	26.4
600.0	1.2	1.3	26.4
700.0	1.2	1.3	26.3
800.0	1.2	1.4	26.0
900.0	1.1	1.4	25.7
1000.0	1.1	1.5	25.6
1100.0	1.5	1.4	25.3

Linear S-Parameters

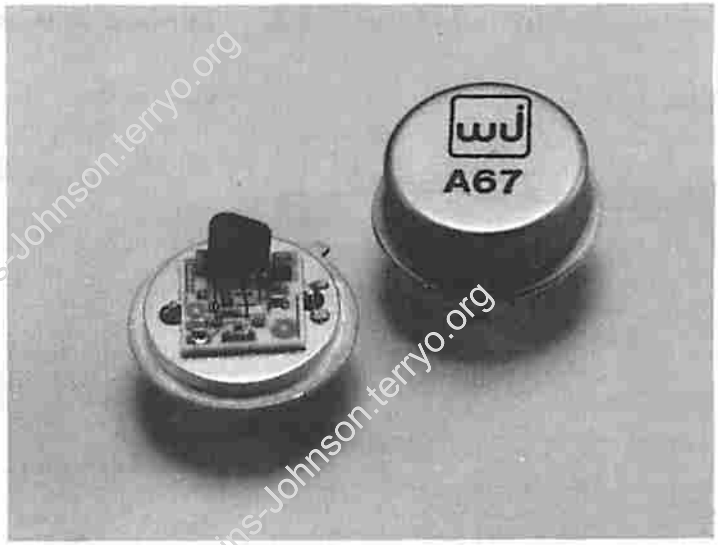
FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
1.0	0.660	-40	12.22	62	0.01	29	0.182	-99
2.0	0.403	-55	15.62	38	0.01	12	0.113	-139
5.0	0.184	-38	18.14	16	0.01	9	0.065	-167
10.0	0.163	-20	19.16	6	0.01	3	0.060	-177
50.0	0.160	-10	18.73	-10	0.02	-4	0.063	159
100.0	0.160	-18	19.03	-24	0.02	-6	0.068	140
200.0	0.151	-32	19.28	-49	0.01	-9	0.083	114
300.0	0.126	-59	19.97	-75	0.02	-14	0.100	86
400.0	0.096	-87	20.56	-102	0.02	-17	0.122	61
500.0	0.077	-131	20.79	-130	0.02	-24	0.144	44
600.0	0.086	170	20.95	-157	0.02	-29	0.138	34
700.0	0.086	126	20.59	171	0.02	-36	0.139	19
800.0	0.083	87	20.04	145	0.02	-42	0.151	5
900.0	0.054	40	19.37	113	0.02	-51	0.176	-6
1000.0	0.034	-167	19.09	85	0.02	-59	0.193	-17
1100.0	0.195	-159	18.46	52	0.02	-75	0.178	-23

1

WJ-A67

10 TO 800 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH EFFICIENCY — 15.5 dBm (TYP.) OUTPUT POWER @ 32 mA (TYP.)
- LOW NOISE FIGURE: <4.3 dB (TYP.)
- WIDE POWER SUPPLY RANGE: 5 VOLTS TO 15 VOLTS



Specifications*

Characteristics	Typ.	Guaranteed 0° - 50°C	Guaranteed -54° - +85°C
Frequency (Min.)	10-900 MHz	10-800 MHz	10-800 MHz
Small Signal Gain (Min.)	12.5 dB	11.5 dB	11.0 dB
Gain Flatness (Max.)	±0.3 dB	±0.5 dB	±0.7 dB
Noise Figure (Max.)			
10-500	4.0 dB	4.5 dB	5.0 dB
500-800	4.3 dB	5.0 dB	5.5 dB
Power Output at 1 dB Compression (Min.)			
15 Vdc	>15.5 dBm	15.0 dBm	14.0 dBm
12 Vdc	14.0 dBm	13.0 dBm	12.5 dBm
VSWR (Max.)			
Input	1.8:1	1.9:1	2.0:1
Output	2.0:1	2.0:1[1]	2.2:1[2]
DC Current (Max.) at 15 Volts	32 mA	34 mA	35 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Notes:
1. Output VSWR above 350 MHz is 2.2:1.
2. Output VSWR above 350 MHz is 2.4:1.

Typical Intermodulation Performance at 25°C

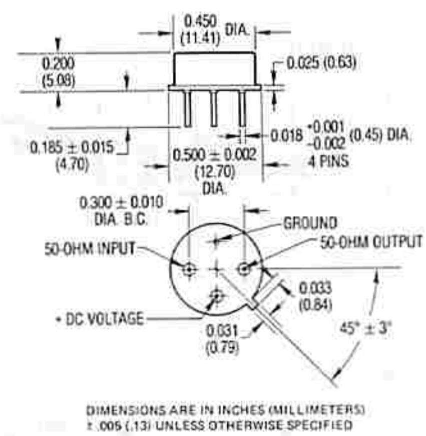
Second Order Harmonic Intercept Point . . . . 50 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 45 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 28 dBm (Typ.)

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . 17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input . . . . 50 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 µsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Outline Drawings

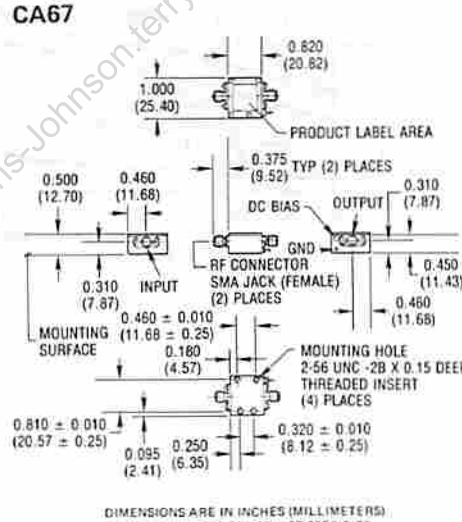
A67



Weight

approximately 2.0 grams (0.07 oz.)

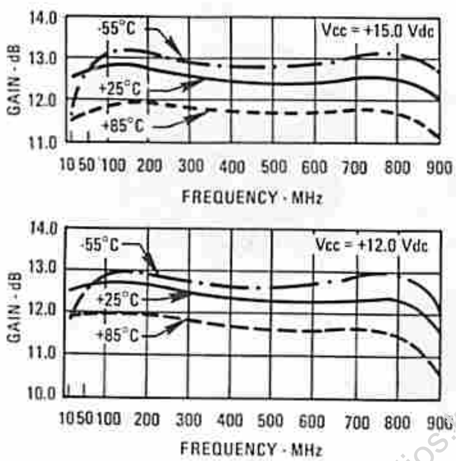
CA67



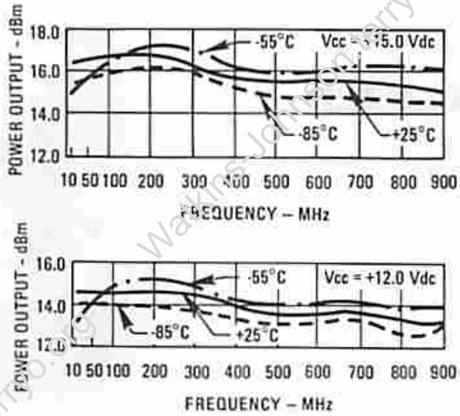
*WJ-CA67 is standard WJ-A67 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

Gain

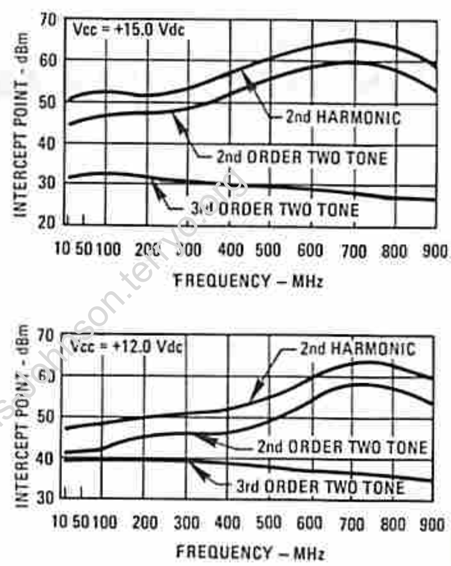


Power Output*

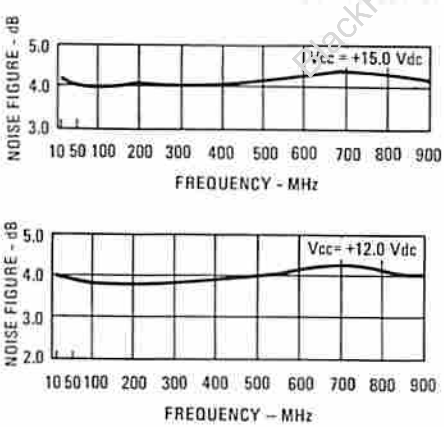


* at 1 dB Gain Compression

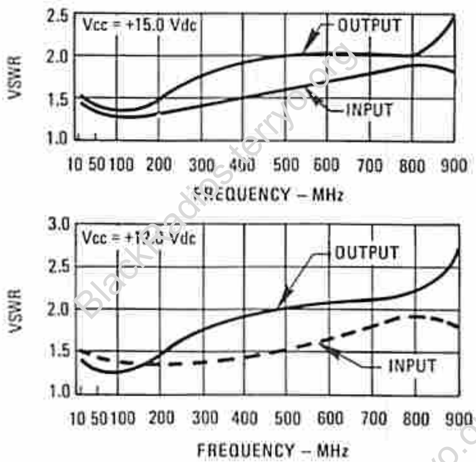
Intercept Point



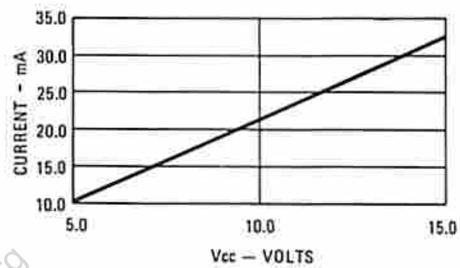
Noise Figure



VSWR



Current Drain



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Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.0	1.7	1.8	12.2
10.0	1.5	1.5	12.7
50.0	1.3	1.3	12.8
100.0	1.3	1.4	12.9
200.0	1.3	1.5	12.8
300.0	1.3	1.7	12.7
400.0	1.4	1.9	12.6
500.0	1.4	2.0	12.6
600.0	1.5	1.9	12.6
700.0	1.6	1.9	12.6
800.0	1.9	2.0	12.4
900.0	1.9	2.6	11.9

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.848	-12	2.68	-114	0.13	-85	0.728	-168
2.0	0.474	-39	3.52	-143	0.04	14	0.496	159
5.0	0.258	-42	4.09	-162	0.10	2	0.292	142
10.0	0.187	-36	4.32	-171	0.10	6	0.202	142
50.0	0.127	-24	4.38	175	0.10	-7	0.134	173
100.0	0.122	-18	4.48	164	0.12	-16	0.150	-176
200.0	0.119	-30	4.36	143	0.10	-25	0.192	-170
300.0	0.143	-40	4.31	124	0.12	-35	0.270	-175
400.0	0.161	-50	4.26	105	0.11	-45	0.302	174
500.0	0.172	-64	4.29	82	0.11	-54	0.325	162
600.0	0.196	-86	4.24	64	0.11	-62	0.308	135
700.0	0.231	-104	4.28	39	0.13	-71	0.316	98
800.0	0.312	-125	4.17	16	0.14	-22	0.343	64
900.0	0.383	-153	3.92	-11	0.13	-98	0.445	11

V_{CC} = +12 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.0	1.7	1.8	12.2
10.0	1.4	1.4	12.6
50.0	1.3	1.3	12.9
100.0	1.3	1.3	12.8
200.0	1.3	1.5	12.9
300.0	1.3	1.7	12.7
400.0	1.3	1.9	12.4
500.0	1.4	2.1	12.4
600.0	1.5	2.0	12.5
700.0	1.7	2.0	12.4
800.0	1.8	2.1	12.4
900.0	1.9	2.6	11.8

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.802	-19	2.87	-118	0.10	-86	0.693	-171
2.0	0.440	-40	3.57	-146	0.05	-6	0.476	157
5.0	0.252	-40	4.09	-162	0.10	-0	0.281	140
10.0	0.172	-36	4.27	-171	0.10	-0	0.183	139
50.0	0.121	-24	4.43	175	0.11	-8	0.122	176
100.0	0.114	-21	4.35	164	0.11	-11	0.138	-174
200.0	0.121	-30	4.41	144	0.11	-23	0.196	-166
300.0	0.135	-41	4.31	123	0.11	-34	0.268	-175
400.0	0.148	-46	4.16	105	0.11	-41	0.319	-180
500.0	0.175	-61	4.15	81	0.12	-41	0.351	153
600.0	0.212	-84	4.28	62	0.12	-45	0.326	131
700.0	0.258	-105	4.19	37	0.14	-61	0.343	95
800.0	0.292	-130	4.17	15	0.13	-81	0.362	53
900.0	0.305	-155	3.87	-13	0.12	-88	0.449	13

WJ-A67-1

10 TO 600 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH EFFICIENCY – 16.0 dBm (TYP.) POWER OUTPUT @ 15 Vdc WITH 32 mA (TYP.)
- LOW NOISE FIGURE: <4.0 dB (TYP.)
- WIDE POWER SUPPLY RANGE: +5 Vdc to +15 Vdc

Specifications*

Characteristics	Typ.	Guaranteed 0°-50°C	Guaranteed -54°C-+85°C
Frequency (Min.)	5-700 MHz	10-600 MHz	10-600 MHz
Small Signal Gain (Min.)	14.0 dB	13.0 dB	12.5 dB
Gain Flatness (Max.)	±0.3 dB	±0.5 dB	±0.7 dB
Noise Figure (Max.)	<4.0 dB	4.5 dB	5.0 dB
Power Output at 1 dB Compression (Min.)	>16.0 dBm	15.0 dBm	14.0 dBm
VSWR (Max.)			
Input	<1.7:1	2.0:1	2.0:1
Output	<1.7:1	2.0:1	2.0:1
DC Current (Max.) at 15 Volts	32 mA	34 mA	35 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

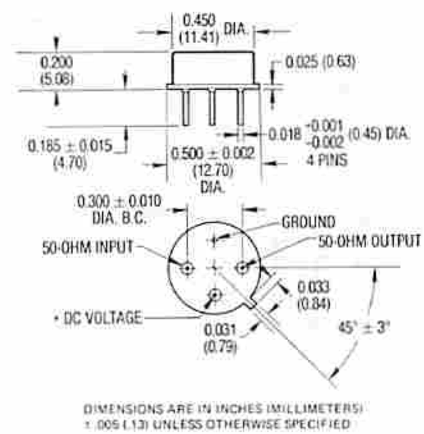
Second Order Harmonic Intercept Point . . . . 52 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 45 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 28 dBm (Typ.)

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to 125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Temperature . . . . 17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . 50 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Outline Drawings

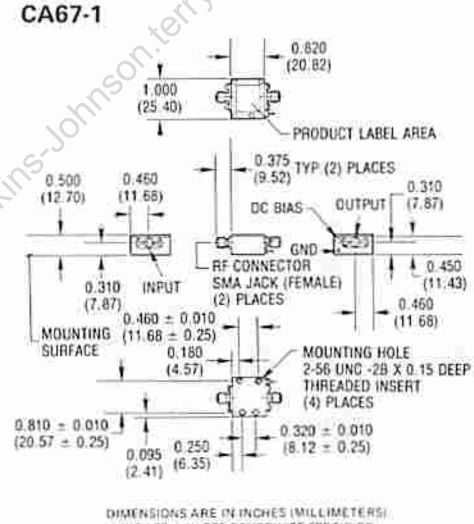
A67-1



Weight

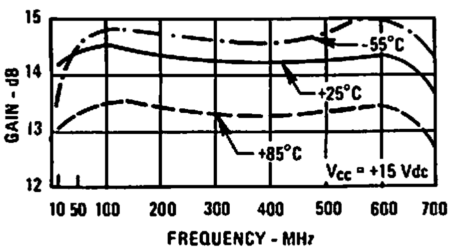
approximately 2.0 grams (0.07 oz.)

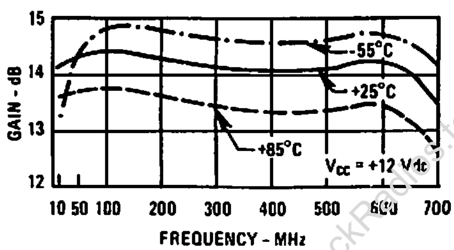
CA67-1

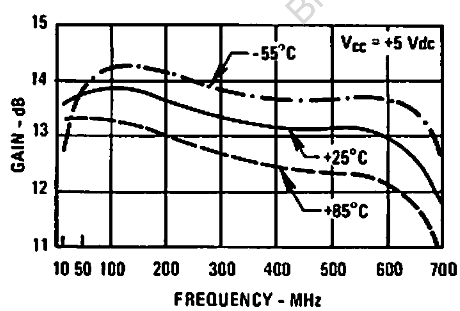


Typical Performance at 25°C

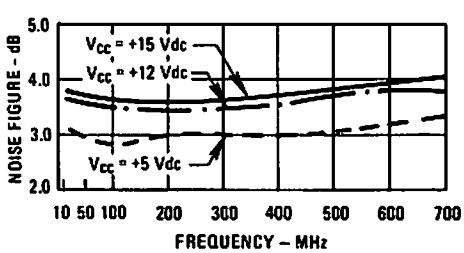
Gain



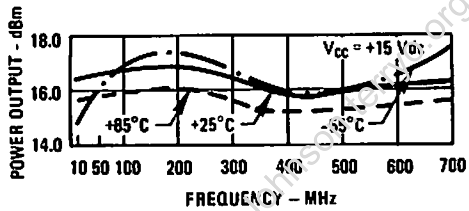


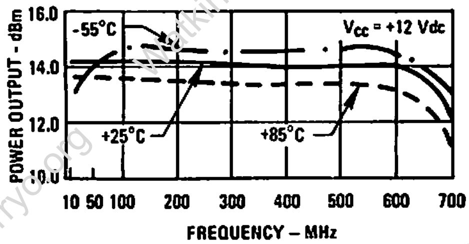


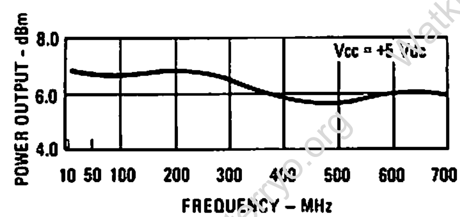
Noise Figure



Power Output*

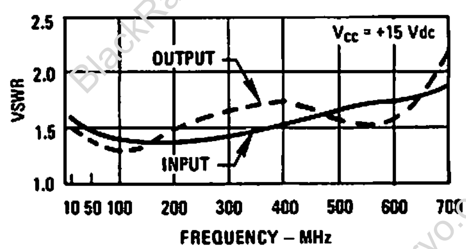


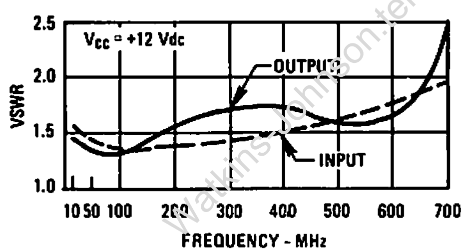


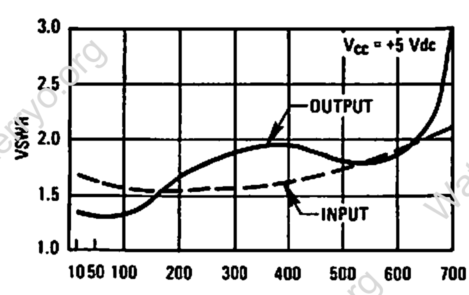


*at 1 dB Gain Compression

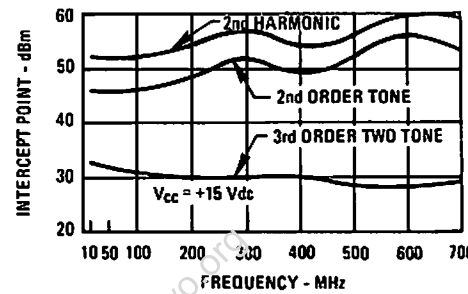
VSWR

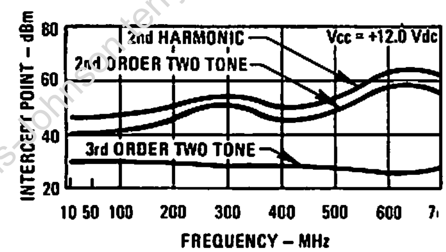


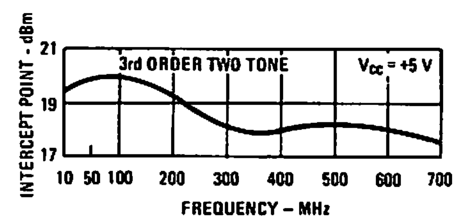




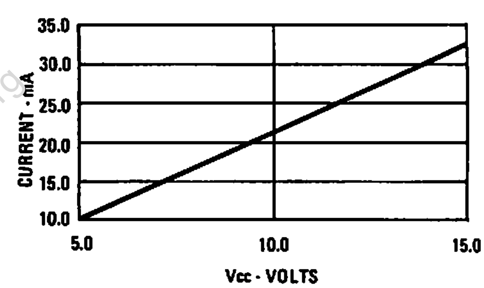
Intercept Point







Current Drain



1

Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.0	2.0	1.9	13.1
10.0	1.7	1.9	13.9
50.0	1.4	1.2	14.4
100.0	1.4	1.3	14.5
200.0	1.3	1.4	14.3
300.0	1.4	1.7	14.3
400.0	1.4	1.7	14.3
500.0	1.4	1.7	14.2
600.0	1.5	1.5	14.1
700.0	1.8	2.1	13.8

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG.	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.951	-6	2.62	-108	0.12	-102	0.730	-163
2.0	0.547	-33	3.77	-139	0.03	-25	0.516	163
5.0	0.333	-35	4.54	-159	0.07	8	0.322	139
10.0	0.240	-36	4.96	-160	0.09	9	0.204	134
50.0	0.165	-25	5.27	175	0.09	-14	0.085	174
100.0	0.151	-16	5.29	161	0.10	-15	0.114	-158
200.0	0.146	-29	5.19	137	0.09	-28	0.181	-160
300.0	0.161	-46	5.18	113	0.10	-35	0.249	-172
400.0	0.162	-58	5.17	89	0.10	-40	0.270	164
500.0	0.169	-88	5.14	60	0.11	-62	0.247	125
600.0	0.214	-134	5.07	34	0.12	-93	0.286	60
700.0	0.277	-180	4.91	-8	0.10	-110	0.346	-3

V_{CC} = +12 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.0	1.9	1.9	13.2
10.0	1.6	1.5	13.9
50.0	1.4	1.2	14.5
100.0	1.4	1.3	14.5
200.0	1.4	1.5	14.4
300.0	1.4	1.7	14.3
400.0	1.4	1.8	14.3
500.0	1.4	1.7	14.3
600.0	1.5	1.7	14.2
700.0	1.8	2.3	13.5

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.863	-17	3.03	-114	0.11	-61	0.694	-167
2.0	0.510	-35	3.88	-144	0.04	-8	0.475	161
5.0	0.319	-35	4.59	-161	0.07	5	0.300	141
10.0	0.242	-31	4.96	-169	0.08	4	0.187	131
50.0	0.166	-24	5.33	174	0.10	-9	0.079	175
100.0	0.157	-20	5.29	160	0.09	-19	0.112	-163
200.0	0.153	-25	5.25	136	0.10	-26	0.187	-158
300.0	0.151	-46	5.18	112	0.10	-35	0.247	-176
400.0	0.160	-60	5.17	87	0.10	-49	0.276	160
500.0	0.172	-93	5.20	59	0.10	-75	0.266	127
600.0	0.215	-140	5.13	32	0.12	-87	0.259	60
700.0	0.209	176	4.74	-2	0.12	-100	0.399	-5

V_{CC} = +5 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.0	1.9	1.6	12.6
10.0	1.7	1.3	13.3
50.0	1.5	1.1	13.9
100.0	1.5	1.3	13.9
200.0	1.5	1.6	13.7
300.0	1.5	2.0	13.4
400.0	1.5	2.0	13.2
500.0	1.5	1.9	12.9
600.0	1.8	2.0	12.8
700.0	2.1	2.6	11.8

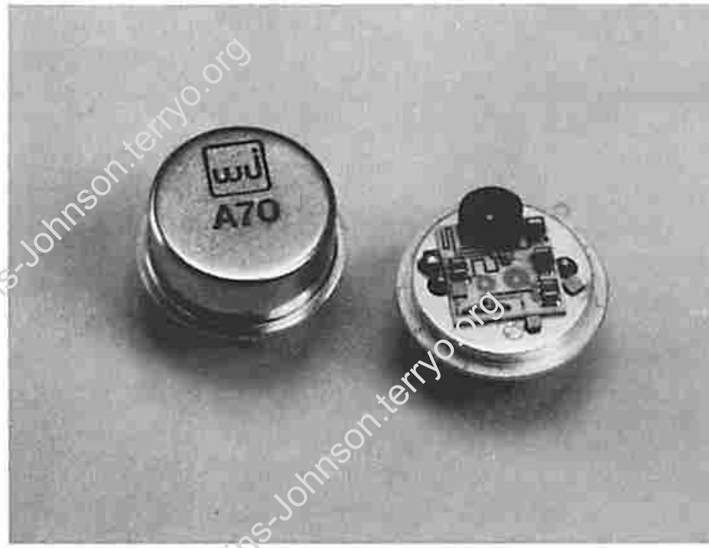
Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.658	-24	3.26	-127	0.07	-74	0.575	-174
2.0	0.441	-30	3.84	-152	0.05	13	0.362	158
5.0	0.318	-26	4.28	-164	0.08	7	0.233	137
10.0	0.270	-23	4.64	-170	0.09	-3	0.142	127
50.0	0.207	-17	4.98	173	0.10	-13	0.055	-155
100.0	0.196	-22	4.93	159	0.11	-12	0.115	-139
200.0	0.187	-36	4.84	133	0.11	-27	0.244	-149
300.0	0.185	-56	4.67	107	0.10	-37	0.323	-172
400.0	0.198	-78	4.56	82	0.12	-48	0.332	161
500.0	0.205	-110	4.42	52	0.12	-68	0.309	137
600.0	0.274	-150	4.38	23	0.14	-86	0.337	59
700.0	0.364	170	3.90	-11	0.14	-106	0.439	-3

WJ-A70

10 TO 250 MHz
TO-8 CASCADABLE AMPLIFIER

- VERY LOW NOISE: 1.8 dB (TYP.) 10-250 MHz
- HIGH EFFICIENCY 8.5 dBm O.P. (TYP.) AT 10 mA CURRENT



Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	10-300 MHz	10-250 MHz	10-250 MHz
Small Signal Gain (Min.)	8.0 dB	7.5 dB	7.0 dB
Gain Flatness (Max.)	±0.3 dB	±0.5 dB	±0.7 dB
Noise Figure (Max.)	1.8 dB	2.3 dB	2.8 dB
Power Output at 1 dB Compression (Min.)	8.5 dBm	7.5 dBm	7.0 dBm
VSWR (Max.) Input/Output	1.9:1	2.1:1	2.3:1
DC Current (Max.) at 15 Volts	10.0 mA	11.0 mA	13.0 mA

* Measured in a 50-ohm system at +15 Vdc nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 35 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 30 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 21 dBm (Typ.)

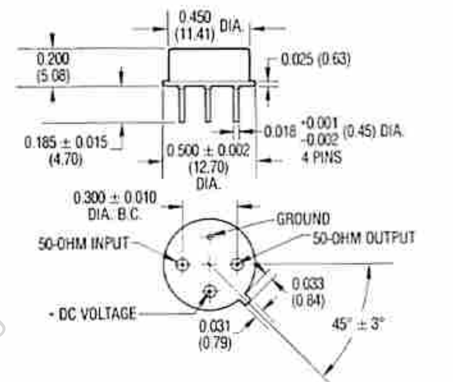
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +18 Volts
Maximum Continuous RF Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

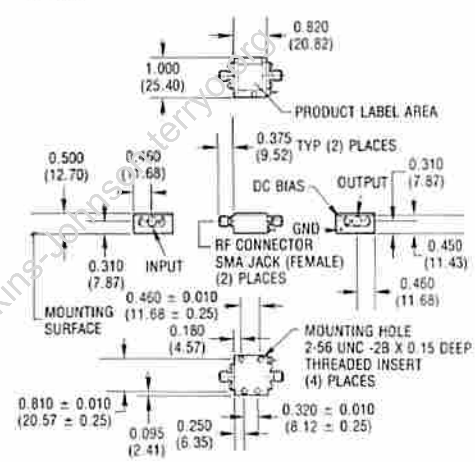
Outline Drawings

A70



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA70

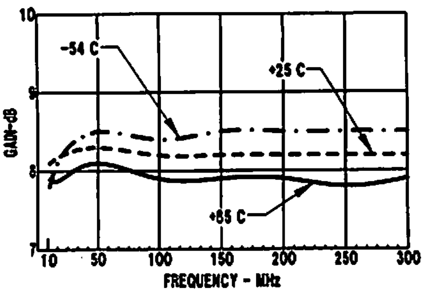


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

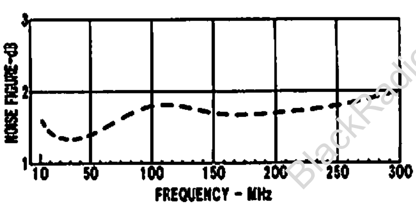
1

Typical Performance at 25°C

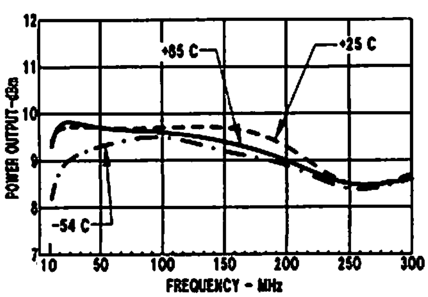
Gain vs. Frequency vs. Temperature



Noise Figure

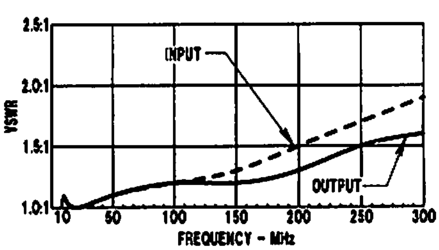


Power Output *

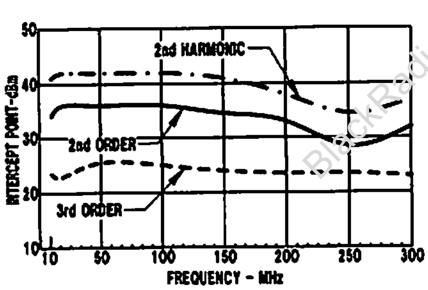


*at 1 dB Gain Compression

Input/Output VSWR



Intercept Points



Typical Automatic Test Data

V_{cc} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.00	1.1	1.1	7.9
10.00	1.1	1.1	8.1
20.00	1.0	1.0	8.2
50.00	1.1	[illegible]	8.3
100.00	1.2	[illegible]	8.2
150.00	1.3	1.2	9.2
200.00	1.5	1.3	8.2
250.00	1.7	1.5	8.2
300.00	1.9	1.6	8.2
350.00	2.1	1.8	8.1

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
5.0	0.044	-167	2.47	10	0.28	10	0.069	-164
10.0	0.027	-177	2.55	4	0.29	4	0.039	173
20.0	0.020	-155	2.58	-1	0.29	-2	0.022	-176
50.0	0.046	-119	2.59	-10	0.29	-10	0.038	-133
100.0	0.084	-111	2.58	-22	0.29	-21	0.064	-139
150.0	0.130	-110	2.58	-34	0.28	-32	0.106	-150
200.0	0.184	-110	2.58	-46	0.27	-43	0.148	-168
250.0	0.246	-116	2.58	-58	0.26	-54	0.202	177
300.0	0.306	-125	2.56	-70	0.25	-66	0.245	164
350.0	0.355	-132	2.55	-82	0.23	-76	0.284	154

V_{cc} = +12 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.00	1.1	1.1	7.7
10.00	1.0	1.1	8.0
20.00	1.0	1.0	8.1
50.00	1.1	1.1	8.1
100.00	1.2	1.1	8.1
150.00	1.3	1.2	8.1
200.00	1.5	1.4	8.1
250.00	1.7	1.5	8.1
300.00	1.9	1.7	8.0
350.00	2.1	1.8	8.0

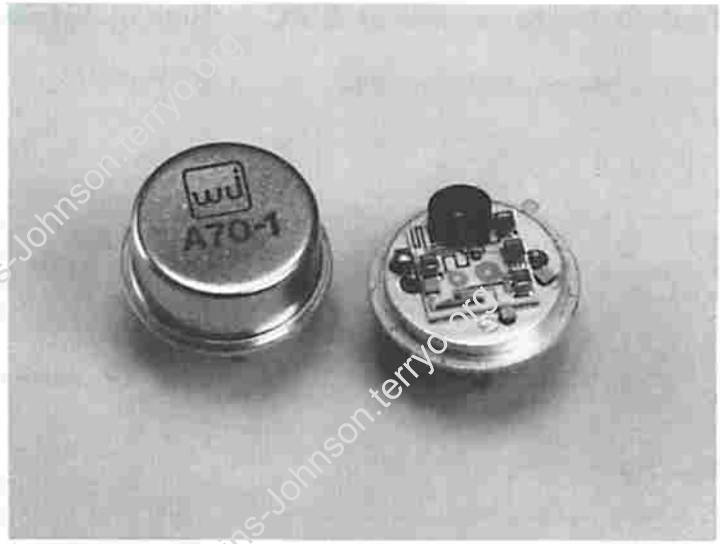
Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
5.0	0.031	-166	2.43	11	0.27	10	0.059	-169
10.0	0.014	175	2.51	[illegible]	0.28	4	0.031	163
20.0	0.010	-120	2.55	[illegible]	0.28	-2	0.011	-173
50.0	0.045	-103	2.55	-10	0.29	-10	0.035	-117
100.0	0.087	-103	2.55	-22	0.28	-21	0.065	-129
150.0	0.134	-105	2.55	-35	0.27	-32	0.109	-142
200.0	0.191	-107	2.54	-47	0.27	-43	0.150	-162
250.0	0.252	-114	2.53	-59	0.25	-54	0.206	-178
300.0	0.313	-124	2.52	-71	0.24	-65	0.247	168
350.0	0.360	-131	2.51	-84	0.23	-77	0.209	158

WJ-A70-1

10 TO 250 MHz
TO-8 CASCADABLE AMPLIFIER

- LOW NOISE 1.8 dB (TYP.)
- HIGH EFFICIENCY: 14 dBm P.O. (TYP.) AT 15 mA CURRENT



Specifications*

Characteristics	Typical	Guaranteed 0° – 50°C	Guaranteed -54°C – +85°C
Frequency (Min.)	5-300 MHz	10-250 MHz	10-250 MHz
Small Signal Gain (Min.)	8.0 dB	7.5 dB	7.0 dB
Gain Flatness (Max.)	±0.3 dB	±0.5 dB	±0.7 dB
Noise Figure (Max.)	1.8 dB	2.3 dB	2.8 dB
Power Output at 1 dB Compression (Min.)	14.0 dBm	13.0 dBm	12.5 dBm
VSWR (Max.) Input/Output	1.9:1	2.1:1	2.3:1
DC Current (Max.) at 15 Volts	15 mA	17 mA	19 mA

* Measured in a 50 – ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 44 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 38 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 28 dBm (Typ.)

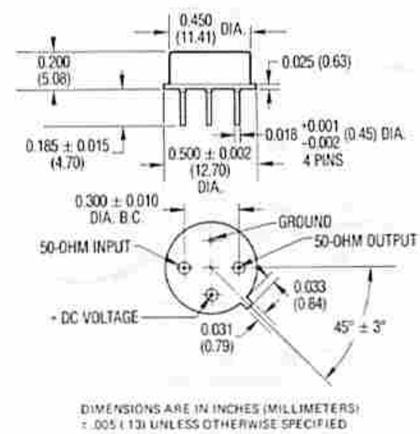
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +18 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . +50 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 µsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

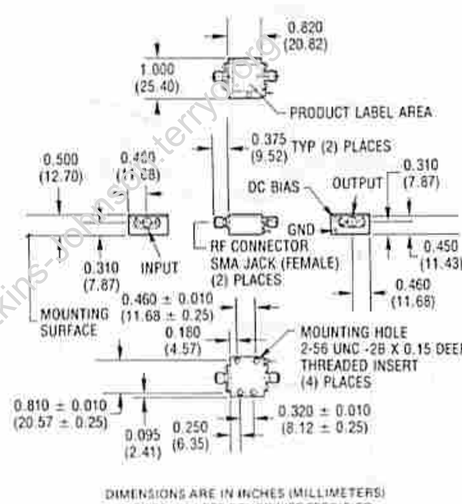
Weight approximately 2.0 grams (0.07 oz.)

Outline Drawings

A70-1

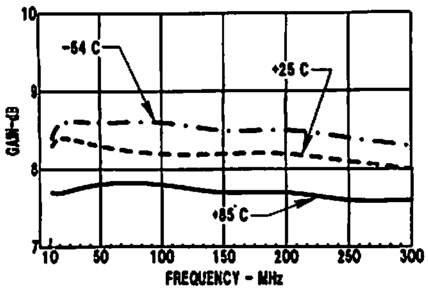


CA70-1

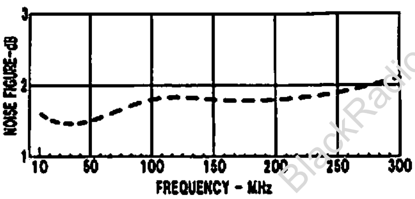


Typical Performance at 25°C

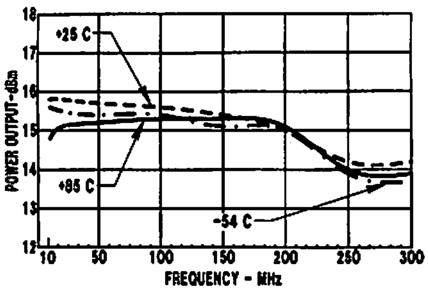
Gain vs. Frequency vs. Temperature



Noise Figure

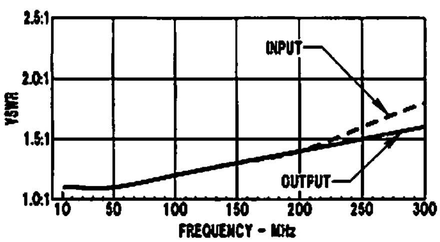


Power Output *

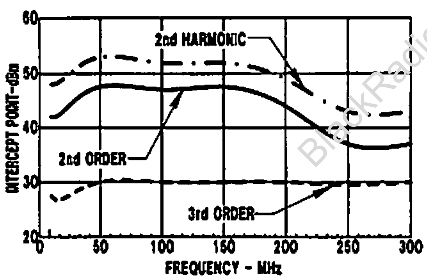


*at 1 dB Gain Compression

Input/Output VSWR



Intercept Points



Typical Automatic Test Data

V_{cc} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.00	1.1	1.2	8.2
10.00	1.1	1.1	8.3
20.00	1.1	1.1	8.4
50.00	1.1	1.1	8.3
100.00	1.2	1.2	8.2
150.00	1.3	1.3	8.2
200.00	1.4	1.4	8.2
250.00	1.6	1.5	8.1
300.00	1.6	1.6	8.0
350.00	1.9	1.7	7.9

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
5.0	0.058	-169	2.56	10	0.28	9	0.075	-165
10.0	0.051	-172	2.61	3	0.29	3	0.057	-174
20.0	0.050	-166	2.62	-2	0.29	-3	0.049	-171
50.0	0.068	-147	2.61	-11	0.29	-12	0.060	-155
100.0	0.093	-136	2.59	-24	0.29	-24	0.080	-157
150.0	0.128	-130	2.57	-36	0.28	-36	0.115	-162
200.0	0.175	-126	2.56	-48	0.27	-48	0.152	-175
250.0	0.228	-132	2.54	-61	0.27	-60	0.196	173
300.0	0.281	-141	2.52	-73	0.26	-72	0.223	162
350.0	0.313	-148	2.50	-86	0.25	-85	0.249	155

V_{cc} = +12 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.00	1.1	1.1	8.2
10.00	1.1	1.1	8.4
20.00	1.1	1.1	8.4
50.00	1.1	1.1	8.3
100.00	1.2	1.2	8.2
150.00	1.3	1.3	8.2
200.00	1.4	1.4	8.1
250.00	1.6	1.5	8.0
300.00	1.8	1.6	8.0
350.00	1.9	1.7	7.9

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
5.0	0.047	-154	2.57	9	0.29	9	0.061	-153
10.0	0.041	-160	2.62	3	0.29	2	0.046	-166
20.0	0.040	-155	2.62	-2	0.29	-3	0.040	-161
50.0	0.064	-135	2.60	-12	0.29	-12	0.057	-144
100.0	0.094	-128	2.58	-24	0.29	-24	0.080	-148
150.0	0.132	-125	2.56	-37	0.28	-36	0.119	-156
200.0	0.181	-124	2.55	-49	0.27	-48	0.159	-170
250.0	0.234	-130	2.53	-62	0.27	-60	0.205	177
300.0	0.288	-140	2.50	-74	0.26	-73	0.234	166
350.0	0.320	-148	2.47	-87	0.25	-85	0.259	159

WJ-A70-2

10 TO 250 MHz
TO-8 CASCADABLE AMPLIFIER

- LOW NOISE: 2.2 dB (TYP.)
- HIGH OUTPUT POWER: +19 dBm (TYP.)
- HIGH THIRD ORDER IP: +35 dBm (TYP.)
- LOW POWER SUPPLY DRAIN: 25 mA AT +15 Vdc (TYP.)

Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	10-300 MHz	10-250 MHz	10-250 MHz
Small Signal Gain (Min.)			
10-50	7.0 dB	6.5 dB	6.0 dB
50-250	7.5 dB	7.0 dB	6.5 dB
Gain Flatness (Max.)	±0.4 dB	±0.8 dB	±1.0 dB
Noise Figure (Max.)	2.2 dB	2.7 dB	3.2 dB
Power Output at 1 dB Compression (Min.)	+19.0 dBm	+18.0 dBm	17.5 dBm
VSWR (Max.) Input/Output	1.9:1	2.1:1	2.3:1
DC Current (Max.) at 15 Volts	25 mA	27 mA	29 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 45 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 40 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 35 dBm (Typ.)

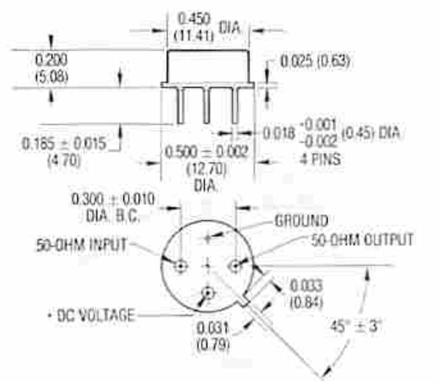
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . +17 dBm
(1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt
(3 μsec Max.)
"S" Series Burn-In Temperature . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

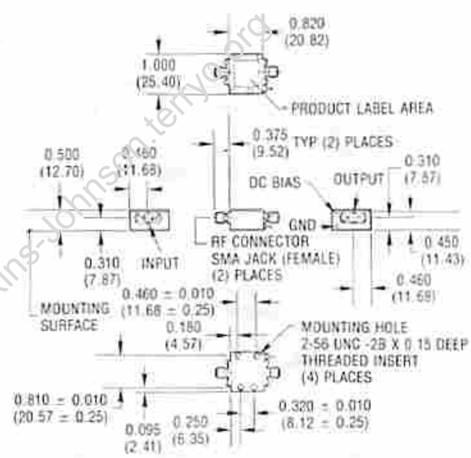
Outline Drawings

A70-2



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.005 (.13) UNLESS OTHERWISE SPECIFIED

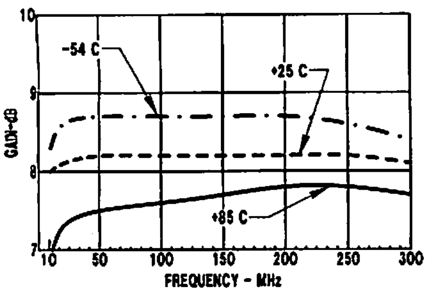
CA70-2



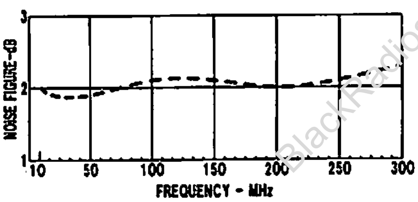
DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C

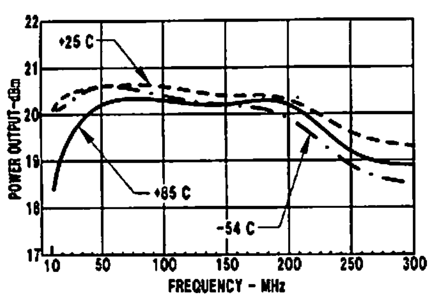
Gain vs. Frequency vs. Temperature



Noise Figure

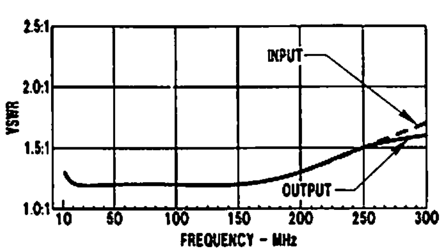


Power Output *

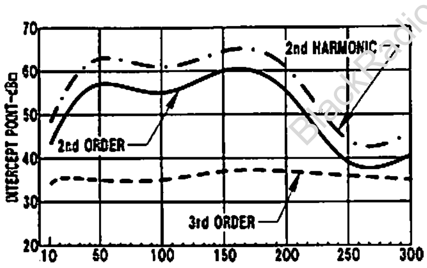


*at 1 dB Gain Compression

Input/Output VSWR



Intercept Points



Typical Automatic Test Data

V_{cc} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.00	1.5	1.6	7.6
10.00	1.3	1.3	8.0
20.00	1.2	1.2	8.1
50.00	1.2	1.2	8.2
100.00	1.2	1.2	8.2
150.00	1.2	1.2	8.2
200.00	1.3	1.3	8.2
250.00	1.5	1.5	8.2
300.00	1.7	1.6	8.1
350.00	[illegible]	1.7	8.1

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
5.0	0.208	137	2.40	21	0.27	21	0.227	146
10.0	0.133	143	2.50	10	0.28	9	0.146	143
20.0	0.101	154	2.54	2	0.29	2	0.105	149
50.0	0.082	-179	2.57	-9	0.29	-9	0.078	167
100.0	0.088	-158	2.57	-21	0.28	-21	0.085	172
150.0	0.109	-142	2.57	-33	0.28	-33	0.109	174
200.0	0.145	-130	2.57	-44	0.27	-44	0.144	166
250.0	0.197	-129	2.56	-56	0.27	-55	0.192	156
300.0	0.251	-134	2.55	-68	0.26	-67	0.226	145
350.0	0.292	-138	2.55	-80	0.25	-78	0.246	135

V_{cc} = +12 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.00	1.2	1.2	8.0
10.00	1.2	1.2	8.2
20.00	[illegible]	1.1	8.3
50.00	1.2	1.1	8.3
100.00	1.2	1.2	8.2
150.00	1.3	1.3	8.2
200.00	1.4	1.4	8.2
250.00	1.5	1.5	8.2
300.00	1.7	1.6	8.1
350.00	1.9	1.7	8.1

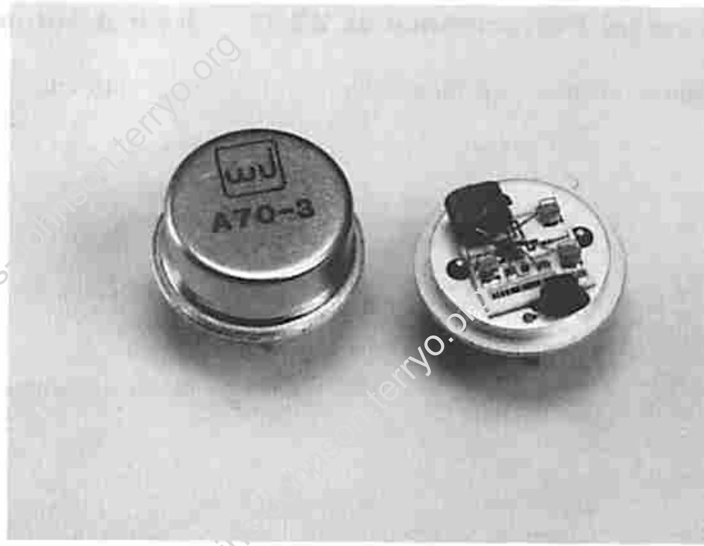
Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
5.0	0.086	163	2.52	12	0.29	12	0.101	172
10.0	0.074	169	2.58	5	0.29	4	0.080	168
20.0	0.067	178	2.60	-1	0.29	-2	0.067	173
50.0	0.075	-160	2.60	-10	0.29	-10	0.067	-171
100.0	0.091	-145	2.58	-22	0.28	-22	[illegible]	-172
150.0	0.119	-133	2.58	-34	0.28	-34	0.112	-175
200.0	0.162	-126	2.58	-46	0.27	-45	0.151	174
250.0	0.216	-127	2.57	-57	0.27	-57	0.200	162
300.0	0.270	-134	2.55	-69	0.26	-68	0.229	150
350.0	0.309	-138	2.54	-81	0.25	-80	0.253	140

WJ-A70-3

20 TO 250 MHz TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT POWER: +21 dBm (TYP.)
- LOW NOISE: 2.5 dB (TYP.)
- HIGH THIRD ORDER IP: +34 dBm (TYP.)
- LOW POWER SUPPLY DRAIN: 37 mA AT 15 Vdc



Specifications*

Characteristics	Typical	Guaranteed 0° – 50°C	Guaranteed -54°C – +85°C
Frequency (Min.)	15-300 MHz	20-250 MHz	20-250 MHz
Small Signal Gain (Min.)			
20-50	7.0 dB	6.5 dB	5.5 dB
50-250	7.5 dB	7.0 dB	6.5 dB
Gain Flatness (Max.)	±0.3 dB	±0.5 dB	±1.0 dB
Noise Figure (Max.)	2.5 dB	3.0 dB	3.5 dB
Power Output at 1 dB Compression (Min.)	21.0 dBm	20.5 dBm	20.0 dBm
VSWR (Max.) Input/Output	1.9:1	2.1:1	2.3:1
DC Current (Max.) at 15 Volts	37 mA	40 mA	42 mA

* Measured in a 50 - ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 50 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 45 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 34 dBm (Typ.)

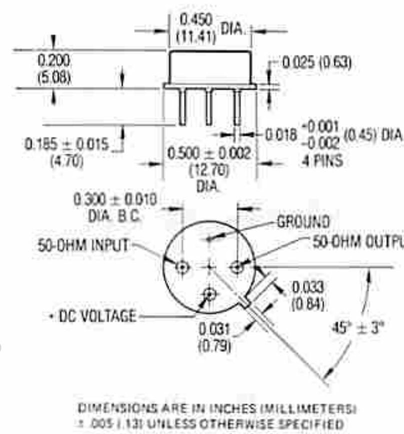
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +15 dBm
Maximum Short Term RF Input Power . . . . 100 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 µsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

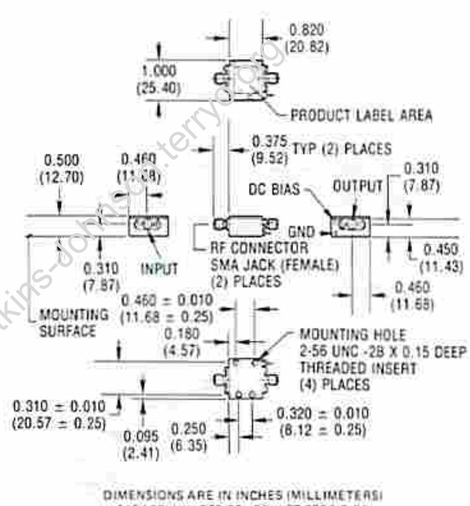
Weight approximately 2.0 grams (0.07 oz.)

Outline Drawings

A70-3

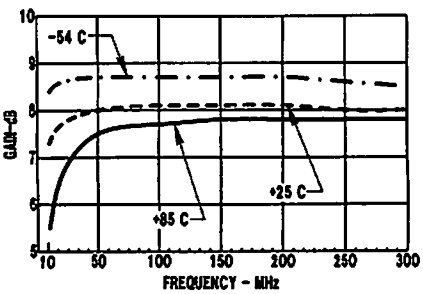


CA70-3

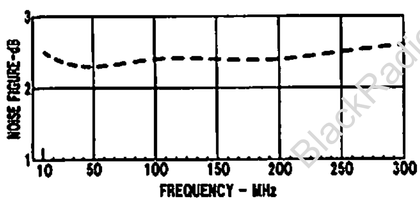


Typical Performance at 25°C

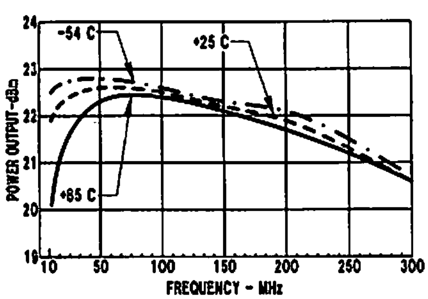
Gain vs. Frequency vs. Temperature



Noise Figure

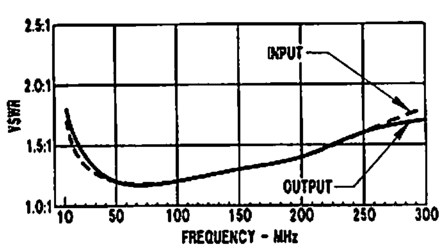


Power Output *

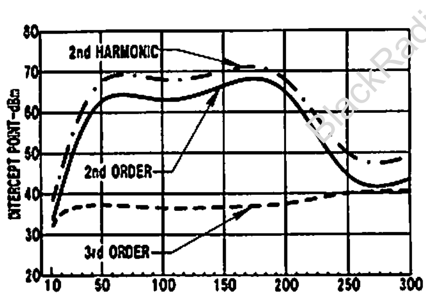


*at 1 dB Gain Compression

Input/Output VSWR



Intercept Points



Typical Automatic Test Data

V_{cc} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.00	2.6	2.8	6.1
10.00	1.7	1.8	7.3
20.00	1.4	1.5	7.7
50.00	1.2	1.2	8.0
100.00	1.2	1.2	8.1
150.00	1.3	1.3	8.1
200.00	1.4	1.4	8.1
250.00	1.6	1.6	8.0
300.00	1.8	1.7	8.0
350.00	2.0	1.8	7.9

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
5.0	0.448	142	2.03	38	0.23	37	0.468	149
10.0	0.270	135	2.33	19	0.26	18	0.287	136
20.0	0.176	140	2.44	7	0.27	6	0.187	135
50.0	0.110	161	2.51	-7	0.28	-7	0.109	144
100.0	0.095	-173	2.53	-21	0.28	-22	0.099	153
150.0	0.112	-149	2.54	-34	0.28	-35	0.121	158
200.0	0.153	-134	2.53	-47	0.27	-48	0.164	151
250.0	0.217	-133	2.52	-60	0.26	-60	0.222	144
300.0	0.284	-138	2.51	-73	0.25	-73	0.258	133
350.0	0.335	-145	2.48	-87	0.24	-87	0.294	123

V_{cc} = +12 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.00	1.3	1.3	7.8
10.00	1.2	1.2	8.1
20.00	1.3	1.2	8.2
50.00	1.2	1.2	8.2
100.00	1.2	1.2	8.2
150.00	1.3	1.3	8.2
200.00	1.4	1.4	8.1
250.00	1.7	1.6	8.1
300.00	1.9	1.7	8.0
350.00	2.1	1.9	7.9

Linear S-Parameters

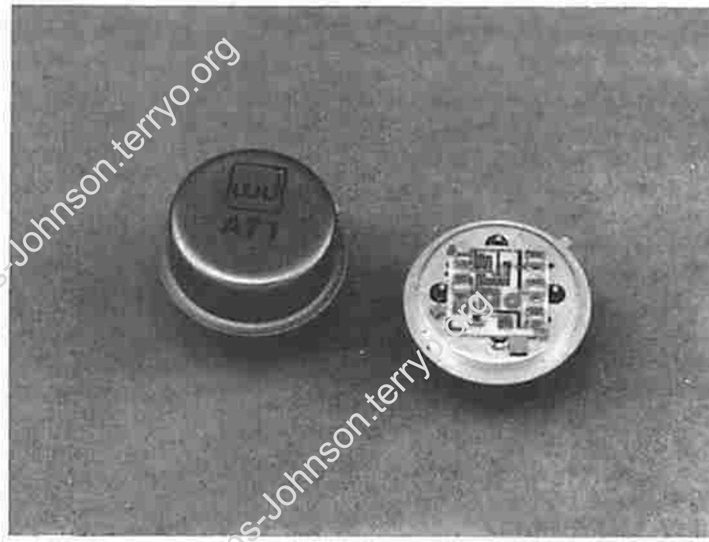
FREQUENCY MHZ	DEV LIN Φ DEG	REL Φ DEG	GAIN DEV DB	ABS GAIN DB	GROUP DELAY NSEC
5.0	9.50	0.00	-0.05	7.76	5.331
10.0	1.33	-9.60	0.24	8.05	1.919
20.0	-2.74	-16.51	0.35	8.16	0.965
50.0	-4.64	-26.92	0.40	8.21	0.734
100.0	-3.64	-40.13	0.38	8.19	0.717
150.0	-2.26	-52.95	0.36	8.17	0.719
200.0	-1.06	-65.95	0.33	8.14	0.724
250.0	0.27	-78.32	0.27	8.08	0.742
300.0	1.27	-92.03	0.18	7.99	0.619
350.0	1.98	-105.52	0.05	7.87	0.784

1

WJ-A71

5 TO 200 MHz
TO-8 CASCADABLE AMPLIFIER

- LOW NOISE: 2.1 dB (TYP.)
- HIGH GAIN: 18 dB (TYP.)
- LOW VSWR: < 1.4:1 (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0° -50°C	-54°C - +85°C
Frequency (Min.)	1-300 MHz	5-200 MHz	5-200 MHz
Small Signal Gain (Min.)	18.0 dB	16.5 dB	16.0 dB
Gain Flatness (Max.)	< ±0.5 dB	±0.8 dB	±1.0 dB
Noise Figure (Max.)	2.1 dB	2.5 dB	2.8 dB
Power Output at 1 dB Compression (Min.)	-2.5 dBm	-3.0 dBm	-3.5 dBm
VSWR (Max.) Input/Output	< 1.4:1	1.9:1	2.0:1
DC Current (Max.) at 15 Volts	9 mA	11 mA	13 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +18.5 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +11.5 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +10 dBm (Typ.)

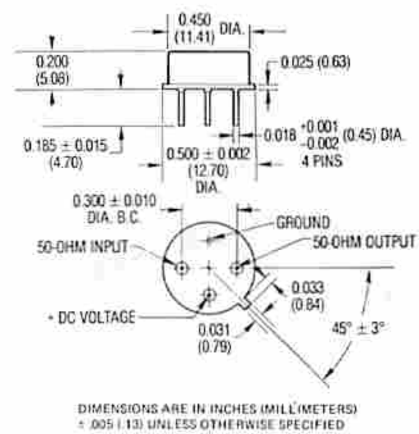
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +18 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . +50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

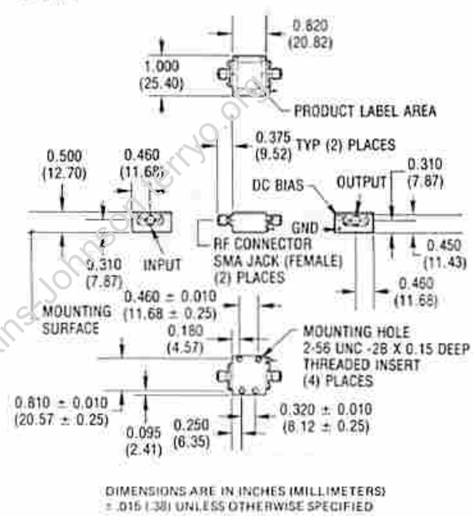
Weight approximately 2.0 grams (0.07 oz.)

Outline Drawings

A71



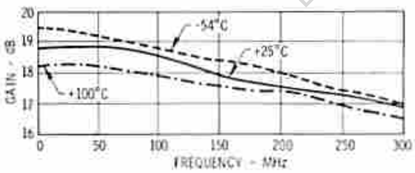
CA71



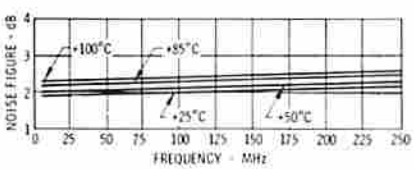
*WJ CA71 is standard WJ A71 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

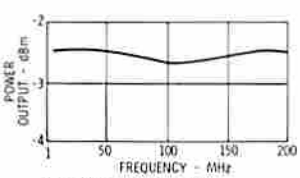
Gain



Noise Figure

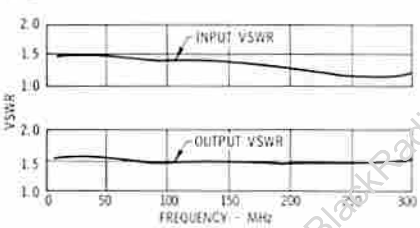


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ (MHZ)	VSWR (IN)	VSWR (OUT)	GAIN (DB)
100.	1.43	1.45	18.39
150.	1.34	1.43	18.22
200.	1.23	1.42	17.51
250.	1.17	1.46	17.45
300.	1.27	1.58	16.91

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.178	-12.98	8.308	130.14	.063	-7.58	.185	-57.21
150.	.147	-14.37	8.144	111.41	.067	-8.22	.177	-83.84
200.	.102	-5.24	7.866	93.46	.071	-10.39	.172	-115.68
250.	.077	28.49	7.454	74.87	.072	-13.08	.188	-151.21
300.	.121	64.54	7.006	55.44	.076	-19.97	.223	177.13

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WJ-A72

5 TO 500 MHz
TO-8 CASCADABLE AMPLIFIER

- LOW POWER DRAIN: 150 mW, V_{CC} = 5 VOLTS
- HIGH OUTPUT LEVEL WITH LOW V_{CC}: +12 dBm, 5 VOLTS (TYP.)
- LOW NOISE: 4.0 dB, V_{CC} = 5 VOLTS
- HIGH THIRD ORDER I.P.: +31 dBm, V_{CC} = 8 VOLTS

Specifications*

Characteristics	Typical	Guaranteed 0°–50°C	Guaranteed -54°C – +85°C
Frequency (Min.)	2-650 MHz	5-500 MHz	5-500 MHz
Small Signal Gain (Min.)	14.7 dB	14.0 dB	13.5 dB
Gain Flatness (Max.)	< ±0.2 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	4.0 dB	5.0 dB	5.5 dB
Power Output at 1 dB Compression (Min.)			
V_{CC} = 5 V	+12.5 dBm	+11.5 dBm	+11.0 dBm
V_{CC} = 8 V	+16.5 dBm	+15.0 dBm	+14.5 dBm
VSWR (Max.) Input/Output	< 1.3:1	1.7:1	1.8:1
DC Current (Max.) at 5 Volts	30 mA	33 mA	35 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +9 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . . . +50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point. . . . . . . +46 dBm (Typ.), 5 V
+48 dBm (Typ.), 6 V
+50 dBm (Typ.), 8 V

Second Order Two Tone Intercept Point. . . . . . . +40 dBm (Typ.), 5 V
+42 dBm (Typ.), 6 V
+44 dBm (Typ.), 8 V

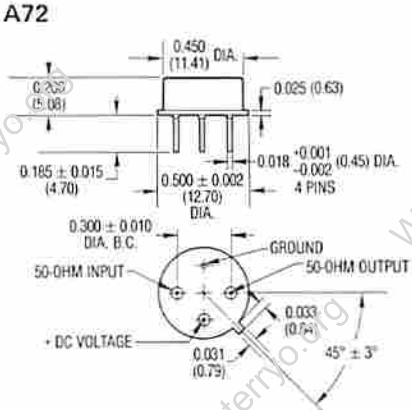
Third Order Two Tone Intercept Point. . . . . . . +27 dBm (Typ.), 5 V
+31 dBm (Typ.), 8 V

Weight

approximately 2.0 grams (0.07 oz.)

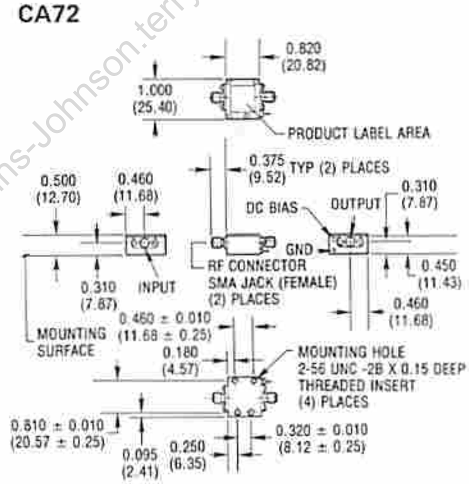
Outline Drawings

A72



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA72

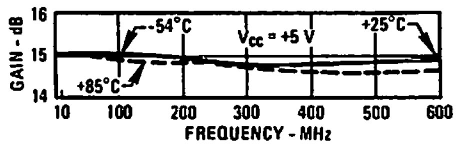


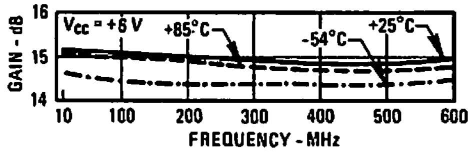
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

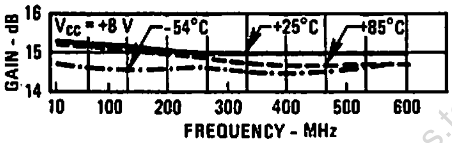
*WJ CA72 is standard WJ A72 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

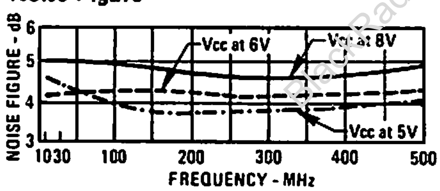
Gain



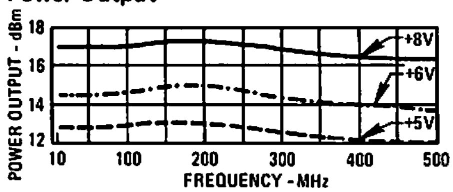




Noise Figure

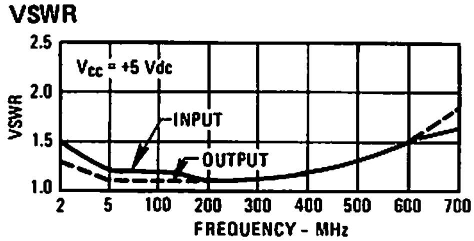


Power Output*

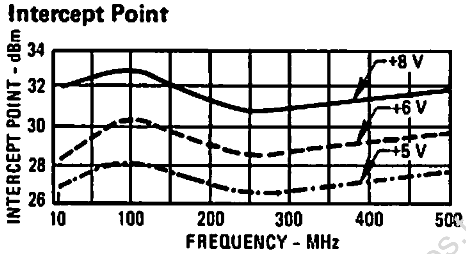


* at 1 dB Gain Compression

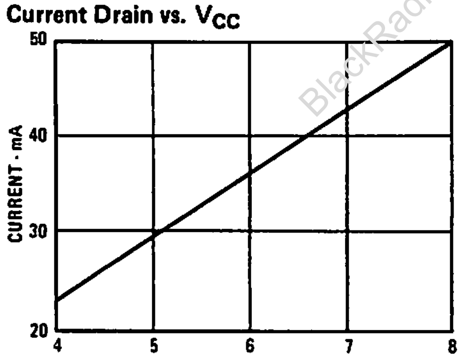
VSWR



Intercept Point



Current Drain vs. V_{CC}



Typical Automatic Test Data

V_{CC} = 5 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.0	14.7
200.	1.1	1.1	14.8
300.	1.1	1.1	[illegible]
400.	1.2	1.2	14.6
500.	1.3	1.3	14.6
600.	1.5	1.5	14.9

Linear S-Parameters

V_{CC} = 5 V

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.06	-173.3	5.42	152.3	.11	-8.9	.02	-172.2
200.	.04	-157.8	5.48	130.5	.11	[illegible]	.03	-156.7
300.	.05	-114.5	5.45	109.9	.12	-21.3	.04	-156.8
400.	.09	-109.8	5.39	87.6	.13	-30.7	.07	-160.2
500.	.15	-122.8	5.39	64.0	.14	-41.9	.12	173.6
600.	.19	-152.9	5.55	37.3	.16	-55.8	.19	147.7
700.	.22	152.5	5.82	6.4	.18	-75.6	.32	111.4
800.	.42	69.8	5.76	-35.9	.20	-104.8	.52	62.5

V_{CC} = 8 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.1	14.9
200.	1.1	1.1	15.0
300.	1.0	1.1	15.0
400.	1.2	1.1	14.8
500.	1.3	1.1	14.8
600.	1.5	1.3	15.1

V_{CC} = 8 V

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.07	172.2	5.58	152.8	.11	-9.6	.04	157.8
200.	.04	161.8	5.62	131.3	.11	-15.0	.03	140.6
300.	.02	-89.1	5.60	111.7	.12	-22.6	.03	138.2
400.	.07	-79.0	5.53	90.1	.12	-32.1	.03	157.1
500.	.14	-94.5	5.51	67.6	.13	-43.4	.05	158.9
600.	.19	-123.4	5.66	42.6	.15	-56.1	.12	141.5
700.	.20	-168.9	6.02	14.4	.17	-74.1	.24	110.7
800.	.31	99.8	6.41	-24.2	.19	-100.4	.46	68.1

1

WJ-A73

5 TO 500 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH GAIN – TWO STAGES: 32 dB (TYP.)
- LOW NOISE: 3.5 dB (TYP.)
- +15 dBm THIRD ORDER I.P.
- LOW VSWR: < 1.4:1 (TYP.)

Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C – +85°C
Frequency (Min.)	1-600 MHz	5-500 MHz	5-500 MHz
Small Signal Gain (Min.)	32.0 dB	30.0 dB	29.0 dB
Gain Flatness (Max.)	< ±0.25 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	3.5 dB	4.0 dB	4.5 dB
Power Output at 1 dB Compression (Min.)	+1.5 dBm	+1.0 dBm	+0.5 dBm
VSWR (Max.) Input/Output	< 1.4:1	1.8:1	2.0:1
DC Current (Max.) at 15 Volts	20 mA	23 mA	25 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . . +26 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . . +19.5 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . . +15 dBm (Typ.)

Absolute Maximum Ratings

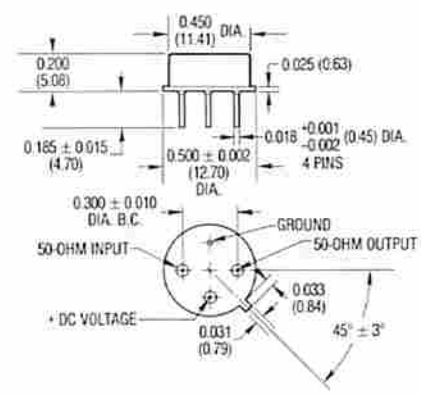
Storage Temperature . . . . . -62°C to +125°C
Maximum Case Temperature . . . . . 125°C
Maximum DC Voltage . . . . . +17 Volts
Maximum Continuous RF Input Power . . . . . +6 dBm
Maximum Short Term RF Input Power (1 Minute Maximum) . . . . . +50 Milliwatts
Maximum Peak Power . . . . . 0.5 Watt (3 μsec Max.)

"S" Series Burn-In Temperature (Case) . . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

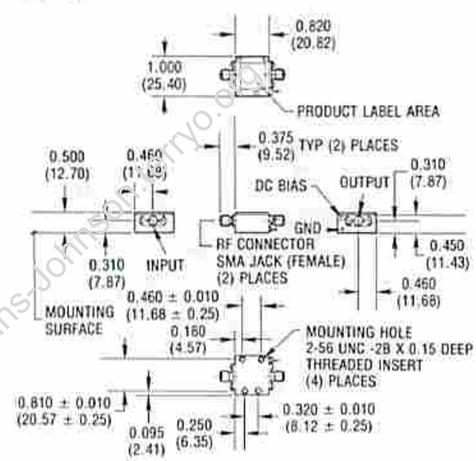
Outline Drawings

A73



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

CA73

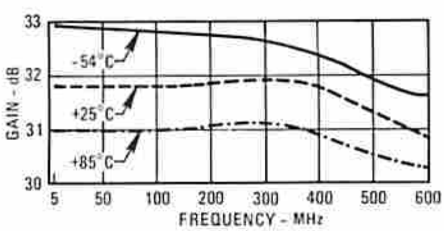


DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

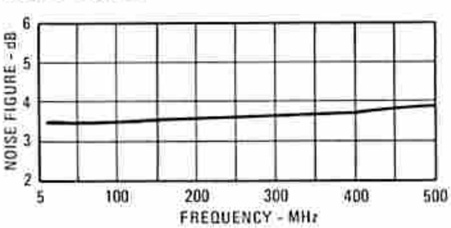
*WJ CA73 is standard WJ A73 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

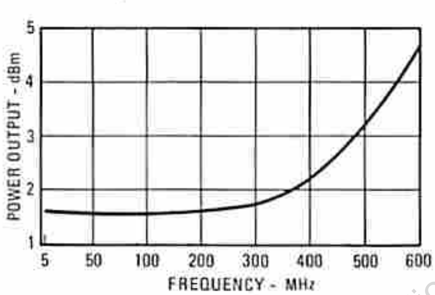
Gain



Noise Figure

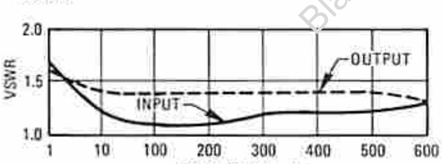


Power Output*



* at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHz	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.5	31.9
200.	1.3	1.5	31.9
300.	1.3	1.4	31.9
400.	1.2	1.2	31.8
500.	1.1	1.1	31.3
600.	1.5	1.1	30.9

Linear S-Parameters

FREQ MHz	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.06	-93.1	39.20	-29.4	.01	26.2	.21	169.9
200.	.12	-130.2	39.24	-59.6	.01	24.4	.20	161.7
300.	.13	-162.2	38.97	-90.1	.01	34.9	.17	143.1
400.	.09	156.9	38.79	-122.5	.01	51.8	.11	119.3
500.	.05	25.1	36.91	-157.2	.01	49.7	.04	77.3
600.	.19	-44.0	34.90	169.2	.01	62.5	.04	-80.0

1

WJ-A74

5 TO 500 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH GAIN – TWO STAGES: 30.0 dB (TYP.)
- MEDIUM OUTPUT LEVEL: +8.5 dBm (TYP.)
- WIDE POWER SUPPLY RANGE: +8 TO +15 VOLTS
- LOW VSWR: < 1.3:1 (TYP.)

Specifications*

Characteristics	Typical	Guaranteed 0° -50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	1-600 MHz	5-500 MHz	5-500 MHz
Small Signal Gain (Min.)	30.0 dB	28.0 dB	27.0 dB
Gain Flatness (Max.)	< ±0.25 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	4.7 dB	5.5 dB	6.0 dB
Power Output at 1 dB Compression (Min.)	+8.5 dBm	+7.0 dBm	+7.0 dBm
VSWR (Max.) Input/Output	< 1.3:1	1.8:1	2.0:1
DC Current (Max.) at 15 Volts	40 mA	42 mA	44 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +36 dBm (Typ.)
Second Order Two-Tone Intercept Point . . . . +33 dBm (Typ.)
Third Order Two-Tone Intercept Point . . . . +20 dBm (Typ.)

Absolute Maximum Ratings

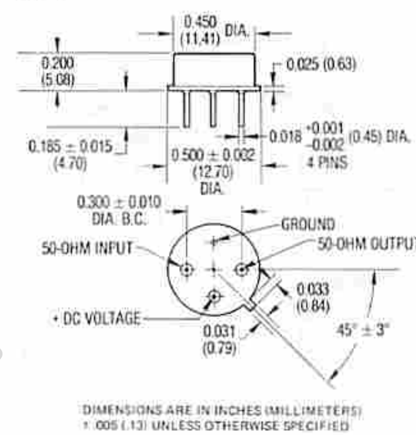
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +6 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . +50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 µsec Max.)

"S" Series Burn-In Temperature (Case) . . . . 125°C

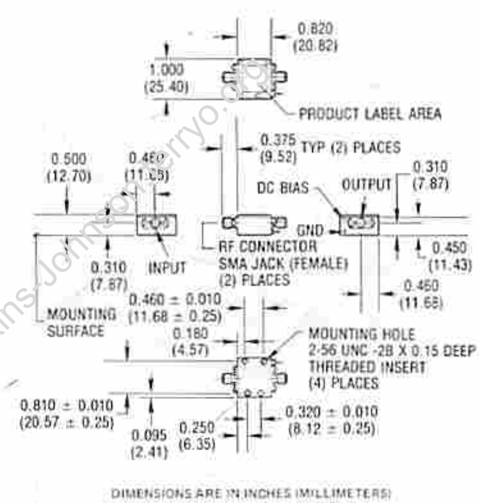
Weight approximately 2.0 grams (0.07 oz.)

Outline Drawings

A74



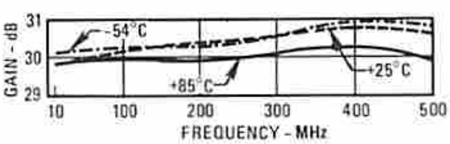
CA74



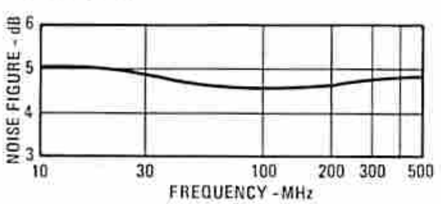
*WJ-CA74 is standard WJ-A74 installed in miniature SMA connector housing and guaranteed over 0° C to 50° C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

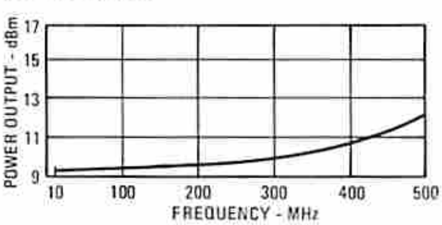
Gain



Noise Figure

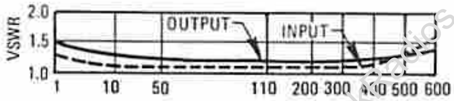


Power Output*



* at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.2	30.2
200.	1.1	1.2	30.3
300.	1.1	1.2	30.6
400.	1.2	1.2	30.7
500.	1.4	1.2	30.6
600.	1.6	1.5	30.0

Linear S-Parameters

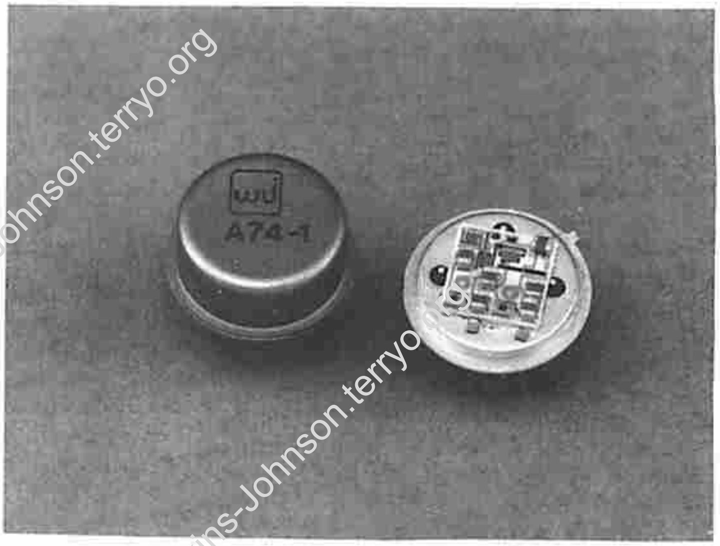
FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.05	-2.9	32.31	-39.3	.01	15.8	.10	172.4
200.	.05	-26.0	32.88	-74.7	.01	1.2	.09	159.2
300.	.07	-33.3	34.03	-111.5	.01	11.0	.08	140.4
400.	.10	-35.2	34.46	-150.5	.01	8.6	.08	127.3
500.	.15	-47.8	33.81	168.2	.01	5.5	.10	133.3
600.	.22	-65.6	31.72	127.6	.01	0.7	.18	136.1
700.	.31	-90.1	29.18	82.2	.01	3.1	.34	120.6
800.	.39	-119.3	25.79	31.6	.02	-4.0	.55	91.8

1

WJ-A74-1

5 TO 250 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH GAIN – TWO STAGES: 31.0 dB (TYP.)
- MEDIUM OUTPUT LEVEL: +8.5 dBm (TYP.)
- WIDE POWER SUPPLY RANGE: +8 TO +15 VOLTS
- LOW VSWR: < 1.2:1 (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0° -50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	1-300 MHz	5-250 MHz	5-250 MHz
Small Signal Gain (Min.)	31.0 dB	30.0 dB[1]	29.0 dB
Gain Flatness (Max.)	< ±0.2 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	4.5 dB	5.0 dB	5.5 dB
Power Output at 1 dB Compression (Min.)	+8.5 dBm	+7.0 dBm	+7.0 dBm
VSWR (Max.) Input/Output	< 1.3:1	1.7:1	2.0:1
DC Current (Max.) at 15 Volts	40 mA	42 mA	44 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Notes:

1. Specification guaranteed at 25°C.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point .... +42 dBm (Typ.)
Second Order Two Tone Intercept Point .... +34 dBm (Typ.)
Third Order Two Tone Intercept Point .... +21 dBm (Typ.)

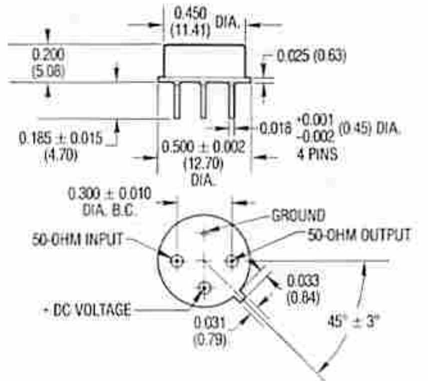
Absolute Maximum Ratings

Storage Temperature .... -62°C to +125°C
Maximum Case Temperature .... 125°C
Maximum DC Voltage .... +17 Volts
Maximum Continuous RF Input Power .... +6 dBm
Maximum Short Term RF Input Power (1 Minute Max.) .... +50 Milliwatts
Maximum Peak Power .... 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) .... 125°C

Weight approximately 2.0 grams (0.07 oz.)

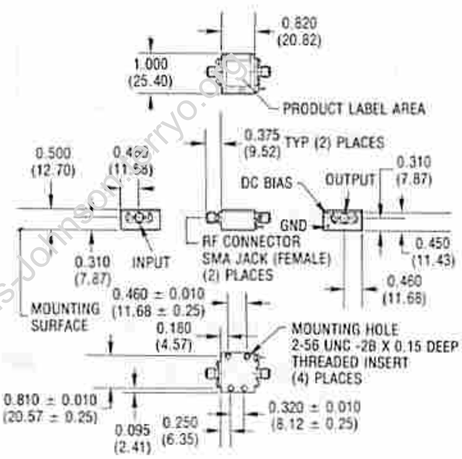
Outline Drawings

A74-1



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA74-1

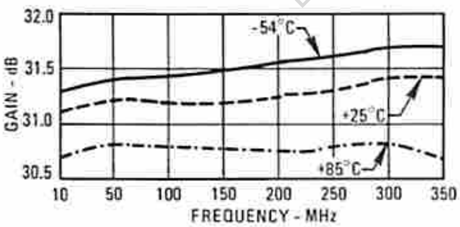


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

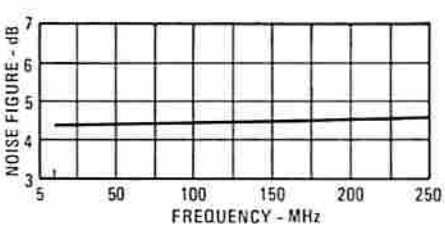
*WJ CA74-1 is standard WJ A74-1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

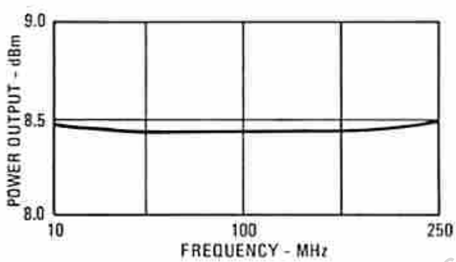
Gain



Noise Figure

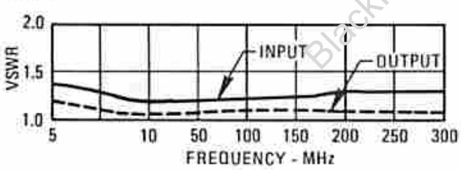


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.1	31.0
150.	1.2	1.1	31.0
200.	1.3	1.1	31.0
250.	1.3	1.0	31.1
300.	1.3	1.1	31.1

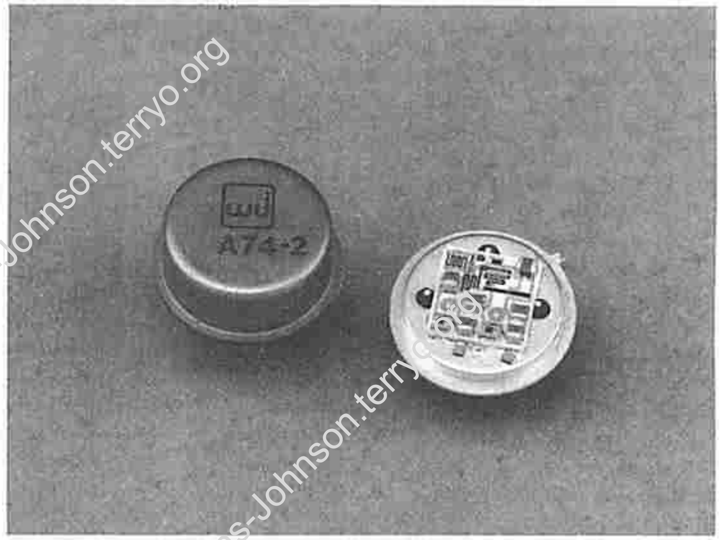
Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.10	141.1	35.32	-33.5	.01	-3.4	.05	-56.0
150.	.10	120.5	35.42	-55.5	.01	4.5	.05	-66.2
200.	.11	104.9	35.47	-73.0	.01	6.2	.05	-81.0
250.	.12	88.3	35.97	-90.4	.01	7.6	.05	-91.1
300.	.14	72.1	36.09	-108.1	.01	4.1	.05	-103.6

WJ-A74-2

5 TO 500 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH GAIN — TWO STAGES: 26 dB (TYP.)
- LOW POWER DRAIN: 65 mW @ 5 VOLTS



Specifications *

Characteristics	Typical	Guaranteed 0° – 50°C	Guaranteed -54°C – +85°C
Frequency (Min.)	1-550 MHz	5-500 MHz	5-500 MHz
Small Signal Gain (Min.)	26.0 dB	25.0 dB	24.0 dB
Gain Flatness (Max.)	±0.8 dB	±1.0 dB	±1.2 dB
Noise Figure (Max.)	3.8 dB	4.3 dB	4.8 dB
Power Output at 1 dB Compression (Min.)	-1.0 dBm	-2.0 dBm	-2.0 dBm
VSWR (Max.) Input/Output	1.5:1	2.0:1	2.0:1
DC Current (Max.) at 5 Volts	13 mA	16 mA	18 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . . +20 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . . +16 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . . +10 dBm (Typ.)

Absolute Maximum Ratings

Storage Temperature . . . . . -62°C to +125°C
Maximum Case Temperature . . . . . 125°C
Maximum DC Voltage . . . . . +17 Volts
Maximum Continuous RF Input Power . . . . . +6 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . . +50 Milliwatts
Maximum Peak Power . . . . . 0.5 Watt (3 μsec Max.)

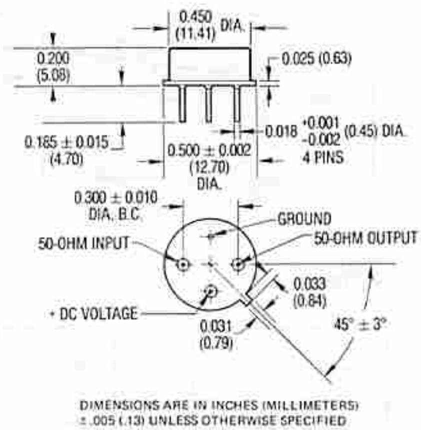
"S" Series Burn-In Temperature (Case) . . . . . 125°C

Weight

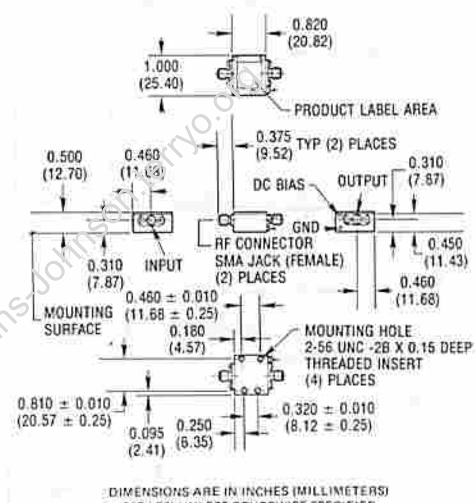
2.26 grams (0.08 oz.) max.

Outline Drawings

A74-2



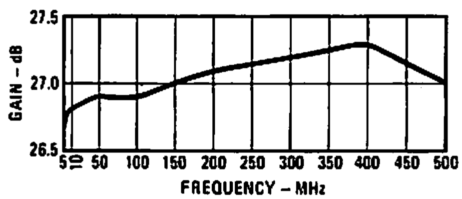
CA74-2



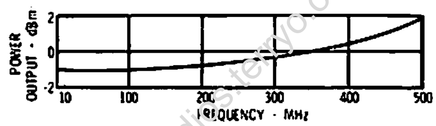
*WJ CA74-2 is standard WJ A74-2 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

Gain

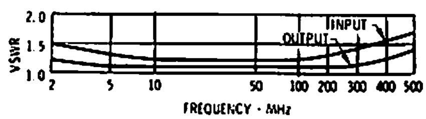


Power Output*

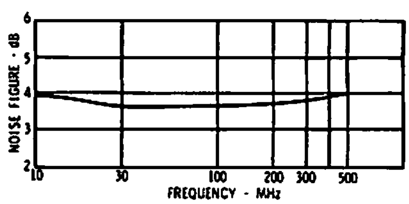


*at 1 dB Gain Compression

VSWR



Noise Figure



Typical Automatic Test Data

$V_{CC} = 5$ V

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.00	1.1	1.1	26.7
10.00	1.1	1.0	26.8
50.00	1.1	1.0	26.9
100.00	1.1	1.0	26.9
200.00	1.2	1.1	27.1
300.00	1.3	1.1	27.2
400.00	1.4	1.2	27.3
500.00	1.6	1.4	27.0

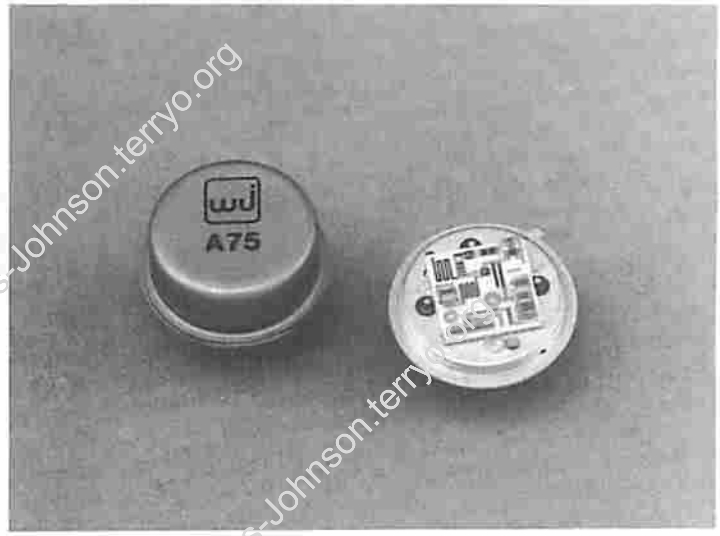
Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
5.0	0.049	-67	21.63	4	0.01	-5	0.041	-100
10.0	0.030	-31	21.88	-0	0.01	-10	0.022	-111
50.0	0.045	15	22.03	-17	0.01	-12	0.012	-119
100.0	0.061	21	22.20	-35	0.01	-8	0.017	-133
200.0	0.092	12	22.60	-71	0.01	-9	0.032	-134
300.0	0.133	-3	23.04	-108	0.01	-15	0.061	-161
400.0	0.183	-20	23.19	-147	0.01	-17	0.109	-174
500.0	0.245	-43	22.46	172	0.01	-15	0.170	165

WJ-A75

5 TO 500 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH GAIN: 21 dB (TYP.)
- LOW NOISE: 2.6 dB (TYP.)
- MEDIUM OUTPUT LEVEL: +9 dBm (TYP.)
- WIDE POWER SUPPLY RANGE: +5 TO +20 VOLTS



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	1-600 MHz	5-500 MHz	5-500 MHz
Small Signal Gain (Min.)	21.0 dB	20.0 dB	19.0 dB
Gain Flatness (Max.)	±0.2 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	2.6 dB	3.0 dB	3.5 dB
Power Output at 1 dB Compression (Min.)	+9 dBm	+7 dBm	+7 dBm
VSWR (Max.) Input/Output	< 1.4:1	1.8:1	2.0:1
DC Current (Max.) at 15 Volts	24 mA	27 mA	29 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +35 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +30 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +21 dBm (Typ.)

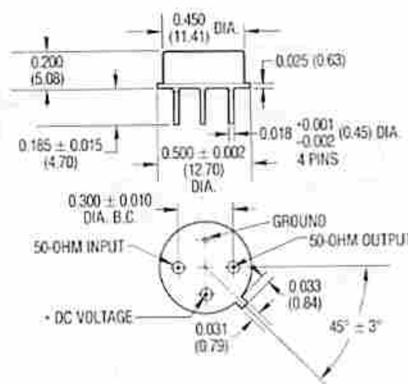
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +21 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . +50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 µsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

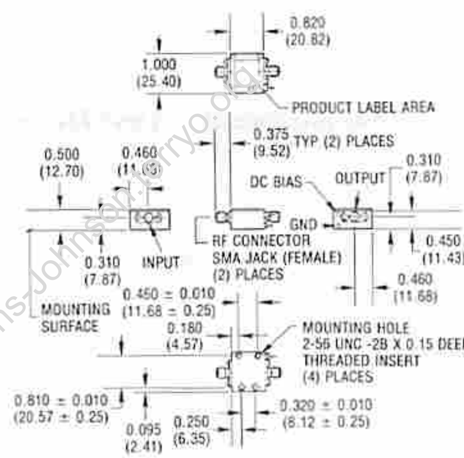
Outline Drawings

A75



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .005 (.13) UNLESS OTHERWISE SPECIFIED

CA75

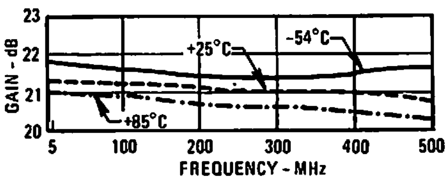


DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

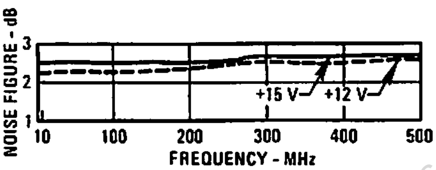
*WJ-CA75 is standard WJ-A75 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers

Typical Performance at 25°C

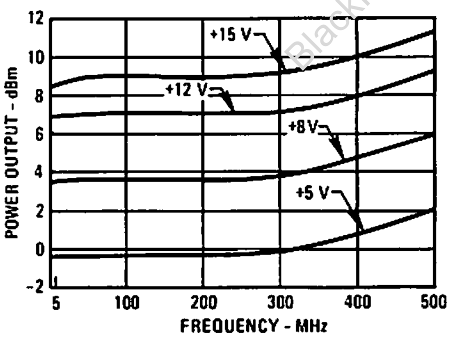
Gain



Noise Figure

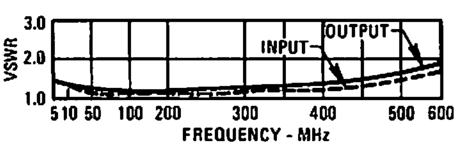


Power Output*



* at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 12 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.0	1.2	20.3
200.	1.1	1.2	20.3
300.	1.1	1.3	20.3
400.	1.2	1.4	20.2
500.	1.4	1.6	20.0
600.	1.8	2.0	19.7
700.	2.3	2.5	18.6
800.	3.1	3.1	16.9

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.2	20.5
200.	1.1	1.2	20.6
300.	1.2	1.3	20.5
400.	1.2	1.4	20.4
500.	1.4	1.6	20.2
600.	1.7	1.9	20.0
700.	2.2	2.4	19.0
800.	3.0	3.1	17.3

Linear S-Parameters
V_{CC} = 15 V

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.05	159.7	10.56	149.4	.05	-11.2	.11	171.3
200.	.05	139.3	10.67	126.7	.05	-14.3	.11	170.8
300.	.07	131.5	10.55	105.5	.05	-21.6	.13	168.9
400.	.11	131.0	10.46	83.3	.05	-28.1	.16	162.9
500.	.17	128.4	10.25	57.4	.05	-33.3	.22	147.3
600.	.27	119.2	9.99	29.2	.06	-41.3	.30	123.6
700.	.38	102.4	8.90	-2.5	.06	-52.3	.42	92.9
800.	.50	83.6	7.31	-34.8	.06	-64.8	.51	63.8

V_{CC} = 5 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.4	1.2	18.2
200.	1.4	1.3	18.3
300.	1.4	1.5	18.4
400.	1.4	1.7	18.4
500.	1.7	2.0	18.2
600.	2.1	2.3	17.6
700.	2.7	2.8	16.1
800.	3.3	3.2	14.1

V_{CC} = 8 V

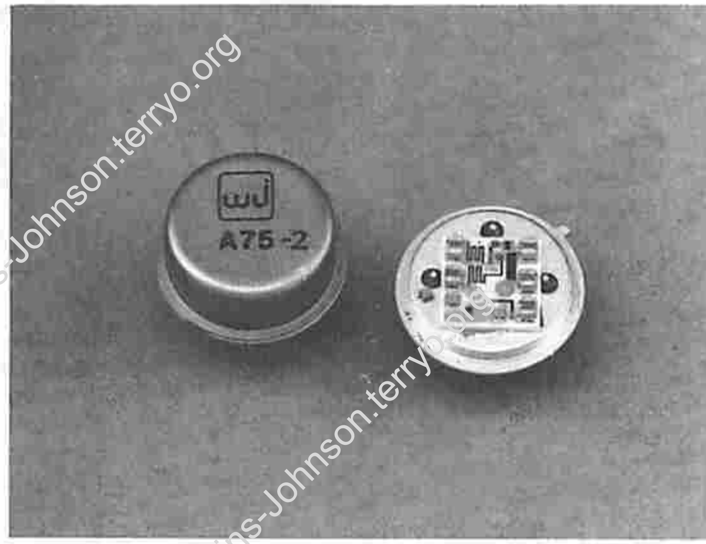
FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.1	19.4
200.	1.1	1.2	19.5
300.	1.1	1.3	19.6
400.	1.2	1.5	19.6
500.	1.5	1.8	19.3
600.	1.9	2.2	18.9
700.	2.4	2.7	17.7
800.	3.2	3.3	15.8

1

WJ-A75-2

5 TO 250 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH GAIN: 21.0 dB (TYP.)
- MEDIUM OUTPUT LEVEL: +8.0 dBm (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	1-300 MHz	5-250 MHz	5-250 MHz
Small Signal Gain (Min.)	21.0 dB	20.0 dB[1]	19.0 dB
Gain Flatness (Max.)	< ±0.3 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	4.2 dB	4.5 dB	5.0 dB
Power Output at 1 dB Compression (Min.)	+8.0 dBm	+7.0 dBm	+7.0 dBm
VSWR (Max.) Input/Output	1.4:1	1.7:1	2.0:1
DC Current (Max.) at 15 Volts	24 mA	26 mA	28 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.
Note: 1. Specification guaranteed at 25°C.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . . +30 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . . +26 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . . +19 dBm (Typ.)

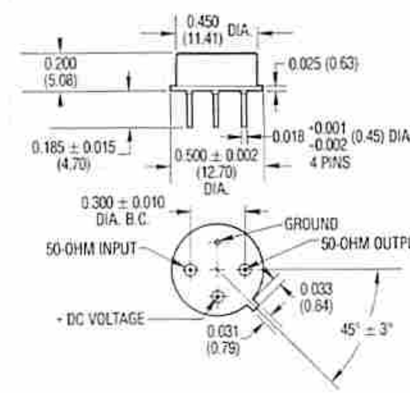
Absolute Maximum Ratings

Storage Temperature . . . . . -62°C to +125°C
Maximum Case Temperature . . . . . 125°C
Maximum DC Voltage . . . . . +17 Volts
Maximum Continuous RF Input Power . . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . . +50 Milliwatts
Maximum Peak Power . . . . . 0.5 Watt (3 µsec Max.)
"S" Series Burn-In Temperature (Case) . . . . . 125°C

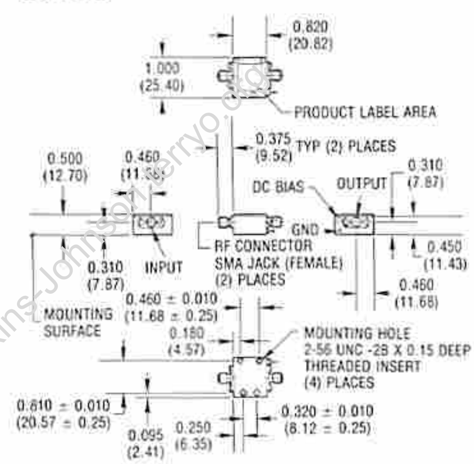
Weight approximately 2.0 grams (0.07 oz.)

Outline Drawings

A75-2



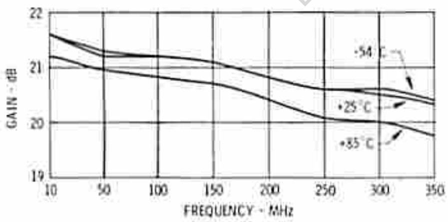
CA75-2



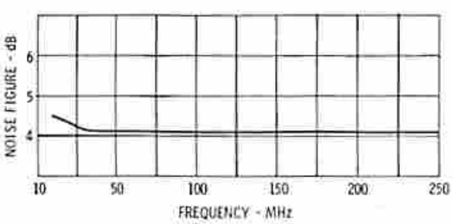
*WJ CA75-2 is standard WJ A75-2 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

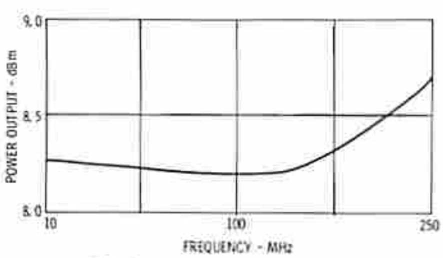
Gain



Noise Figure

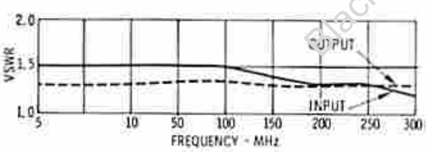


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.4	1.3	21.3
150.	1.4	1.3	21.2
200.	1.3	1.3	21.1
250.	1.3	[illegible]	20.9
300.	1.2	[illegible]	20.7

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.17	128.9	11.68	138.6	.04	-3.3	.14	144.9
150.	.16	107.0	11.53	121.3	.05	-5.1	.13	134.2
200.	.14	83.5	11.36	104.4	.05	-7.9	.13	124.0
250.	.12	61.0	11.09	87.6	.05	-11.6	.13	119.5
300.	.10	40.4	10.86	70.6	.05	-17.1	.15	118.0

1

WJ-A75-3

10 TO 500 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH GAIN: 20.5 dB (TYP.)
- LOW NOISE: 2.3 dB (TYP.)

Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	1-600 MHz	10-500 MHz	10-500 MHz
Small Signal Gain (Min.)	20.5 dB	19.5 dB	18.5 dB
Gain Flatness (Max.)	±0.2 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	2.3 dB	2.5 dB	3.0 dB
Power Output at 1 dB Compression (Min.)	+3.5 dBm	+2.0 dBm	+1.5 dBm
VSWR (Max.) Input/Output	<1.5:1	1.8:1	2.0:1
DC Current (Max.) at 15 Volts	14 mA	16 mA	18 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +30 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +25 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +15 dBm (Typ.)

Absolute Maximum Ratings

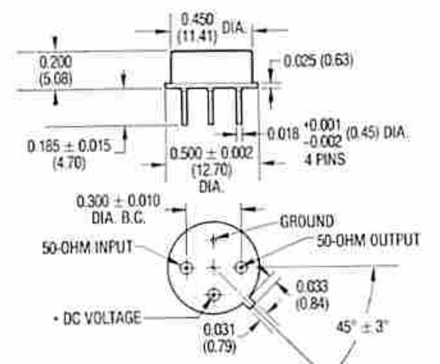
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +21 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . +50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 µsec Max.)

"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

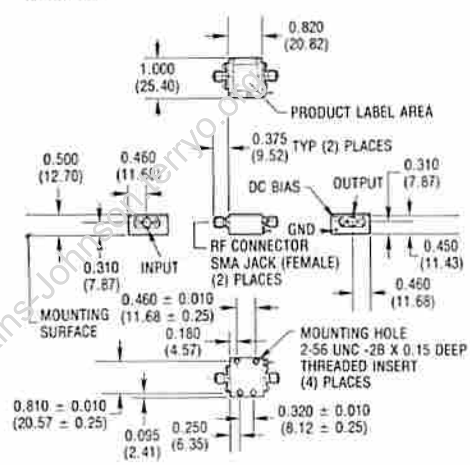
Outline Drawings

A75-3



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA75-3

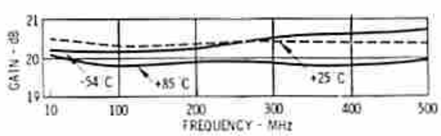


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

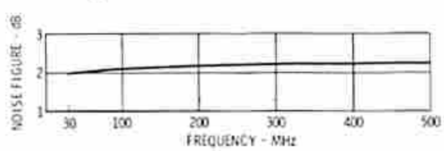
*WJ CA75-3 is standard WJ A75-3 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

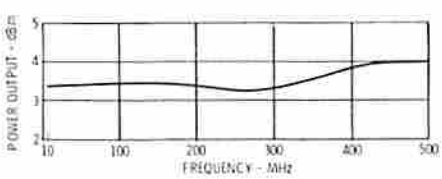
Gain



Noise Figure

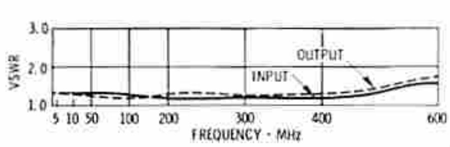


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.3	1.2	19.9
200.	1.2	1.3	19.9
300.	1.2	1.3	19.9
400.	1.2	[illegible]	19.9
500.	1.3	1.4	19.7
600.	1.6	1.7	19.5
700.	2.0	2.2	18.5
800.	2.6	3.0	16.8

Linear S-Parameters

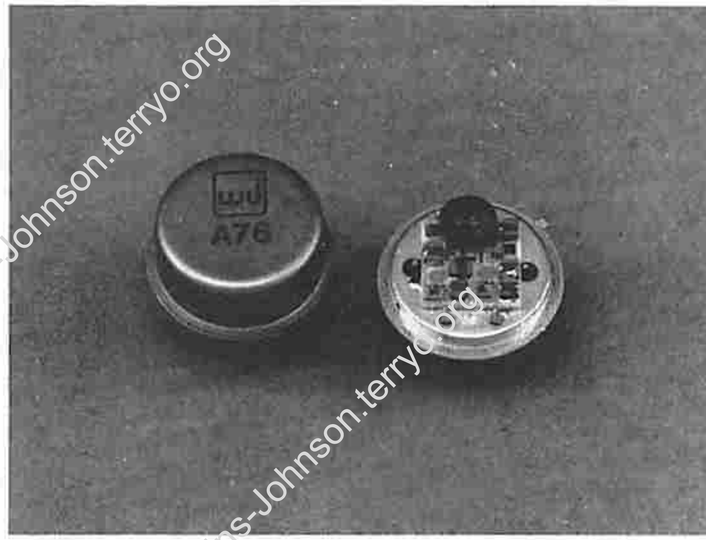
FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.10	-31.0	9.89	150.5	.06	-12.0	.10	-36.3
200.	.11	-51.8	9.93	127.6	.06	-19.7	.11	-61.8
300.	.08	-82.9	9.92	106.2	.06	-26.2	.12	-91.7
400.	.08	-140.9	9.84	83.6	.06	-33.2	.14	-128.1
500.	.13	169.7	9.68	57.3	.06	-39.4	.18	-169.7
600.	.22	139.0	9.41	28.5	.06	-47.8	.26	149.8
700.	.33	113.8	8.39	-3.0	.06	-58.8	.38	107.9
800.	.44	90.5	6.94	-35.2	.06	-71.3	.50	73.7

1

WJ-A76

5 TO 500 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH GAIN – TWO STAGES: 28 dB (TYP.)
- HIGH OUTPUT LEVEL: +15 dBm (TYP.)
- HIGH THIRD ORDER I.P.: +28 dBm (TYP.)
- WIDE POWER SUPPLY RANGE: +8 TO +15 VOLTS



Specifications*

Characteristics	Typical	Guaranteed 0° -50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	3-600 MHz	5-500 MHz	5-500 MHz
Small Signal Gain (Min.)	28.0 dB	27.0 dB	26.0 dB
Gain Flatness (Max.)	±0.3 dB	±1.0 dB	±1.0 dB
Noise Figure (Max.)	4.7 dB	5.5 dB	6.0 dB
Power Output at 1 dB Compression (Min.)	+15.0 dBm	+14.0 dBm	+13.5 dBm
VSWR (Max.) Input/Output	<1.5:1	1.9:1	2.0:1
DC Current (Max.) at 15 Volts	62 mA	65 mA	68 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +49 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +44 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +28 dBm (Typ.)

Absolute Maximum Ratings

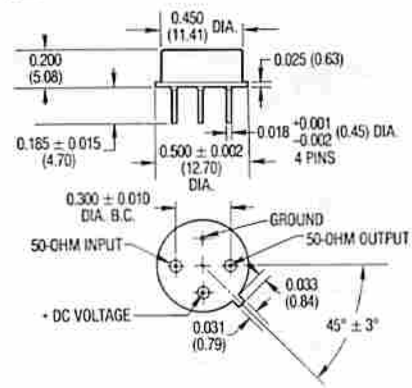
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +6 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . +100 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)

"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

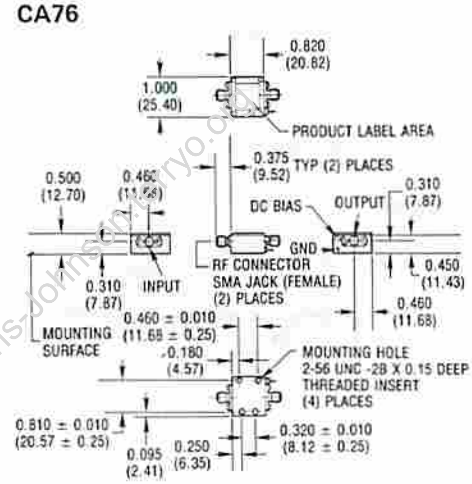
Outline Drawings

A76



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA76

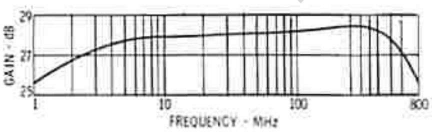


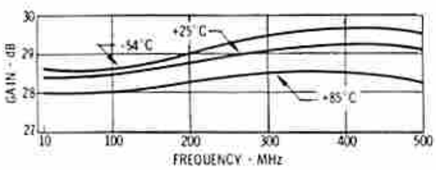
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

*WJ CA76 is standard WJ A76 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

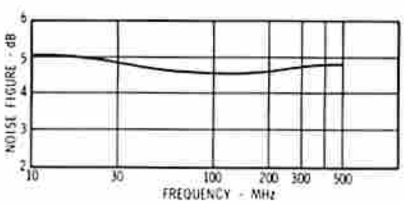
Typical Performance at 25°C

Gain

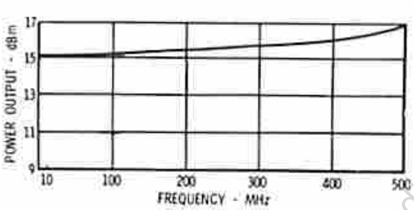




Noise Figure

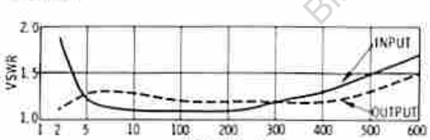


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.1	28.5
200.	1.1	1.2	28.0
300.	1.2	1.2	29.1
400.	1.3	1.2	29.2
500.	1.5	1.3	29.1
600.	1.7	1.5	28.5

Linear S-Parameters

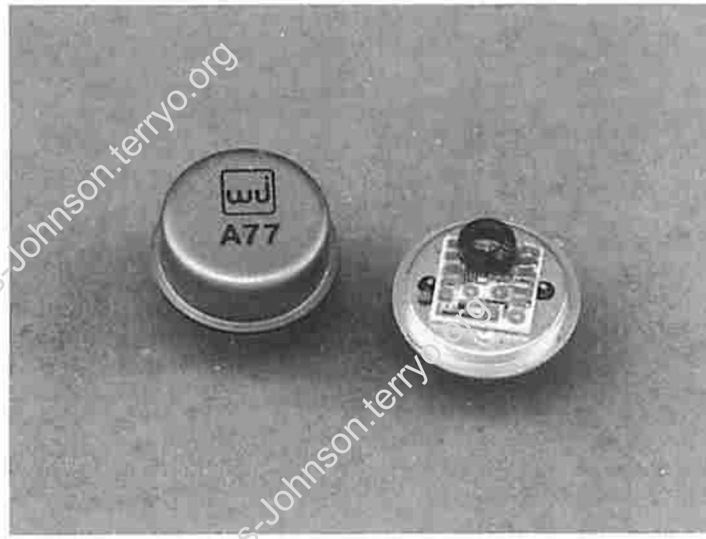
FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.04	88.4	26.71	-36.8	.01	3.8	.05	-53.2
200.	.06	34.0	27.46	-71.7	.01	3.4	.08	-78.7
300.	.10	1.4	28.39	-107.1	.01	.2	.09	-99.4
400.	.14	-21.1	28.73	-145.8	.01	12.1	.10	-130.1
500.	.20	-41.1	28.50	175.2	.01	4.8	.13	-167.4
600.	.26	-60.5	26.76	136.4	.01	1.3	.19	162.7
700.	.33	-81.9	24.67	93.9	.02	3.5	.29	136.6
800.	.42	-104.8	22.73	48.4	.02	-2.4	.45	105.8

1

WJ-A77

5 TO 500 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH GAIN: 16.0 dB (MIN.)
- HIGH OUTPUT LEVEL: +15 dBm (MIN.)
- HIGH THIRD ORDER I.P.: +30 dBm (TYP.)
- LOW VSWR: 1.3:1 (TYP.)
- WIDE POWER SUPPLY RANGE: +8 TO +15 VOLTS



Specifications*

Characteristics	Typical	Guaranteed 0° -50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	2-600 MHz	5-500 MHz	5-500 MHz
Small Signal Gain (Min.)	16.5 dB	15.0 dB[1]	15.0 dB
Gain Flatness (Max.)	< ±0.3 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	5.0 dB	6.0 dB	6.5 dB
Power Output at 1 dB Compression (Min.)	+16.5 dBm	+15.0 dBm	+14.5 dBm
VSWR (Max.) Input/Output	1.3:1	1.7:1	2.0:1
DC Current (Max.) at 15 Volts	50 mA	53 mA	56 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.
Note: 1. Specification guaranteed at 25°C.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +49 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +43 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +30 dBm (Typ.)

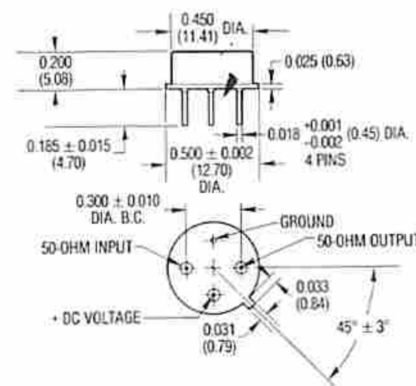
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . +100 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

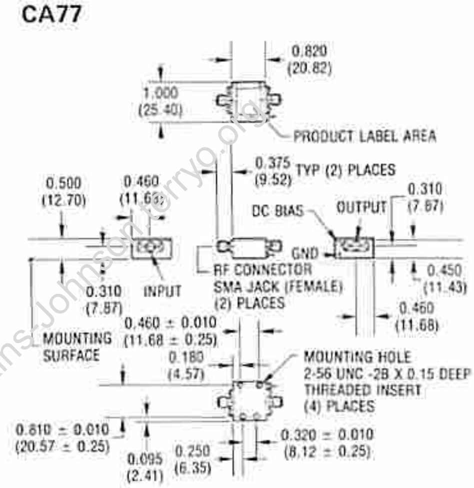
Outline Drawings

A77



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .005 (.13) UNLESS OTHERWISE SPECIFIED

CA77

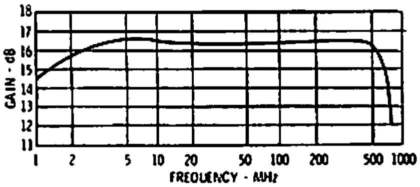


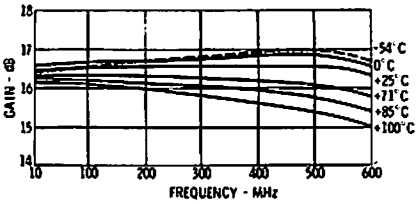
DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

*WJ-CA77 is standard WJ-A77 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

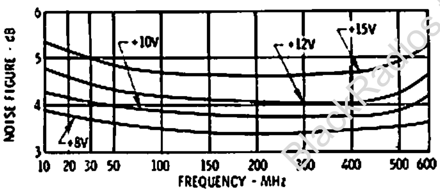
Typical Performance at 25°C

Gain

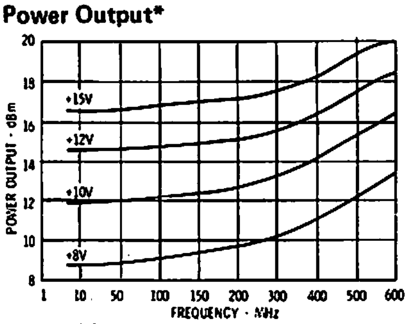




Noise Figure

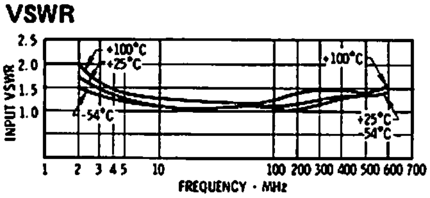


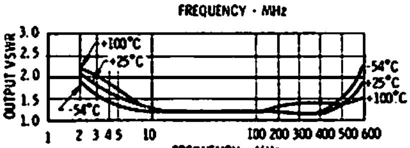
Power Output*



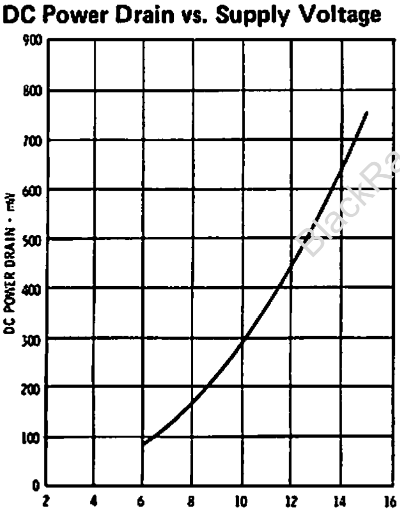
*at 1 dB Gain Compression

VSWR





DC Power Drain vs. Supply Voltage



Typical Automatic Test Data

V_{CC} = 15 V

FREQ (MHZ)	VSWR (IN)	VSWR (OUT)	GAIN (DB)
100.	1.17	1.16	16.48
200.	1.14	1.12	16.56
300.	1.22	1.05	16.56
400.	1.23	1.08	16.48
500.	1.31	1.38	16.41

V_{CC} = 15 V

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.048	-60.93	6.663	146.60	.085	-7.04	.068	3.44
200.	.069	-83.12	6.777	119.70	.087	-13.38	.056	-7.95
300.	.100	-101.11	6.774	92.13	.092	-22.99	.026	-25.57
400.	.122	-125.81	6.731	63.72	.095	-32.01	.040	152.41
500.	.124	-163.65	6.683	30.64	.103	-42.62	.157	125.44
600.	.126	126.86	6.494	-5.02	.111	-56.81	.321	98.24
700.	.242	41.24	5.720	-46.20	.116	-79.18	.514	63.15
800.	.446	-13.46	4.248	-87.05	.106	-103.36	.653	27.20

V_{CC} = 8 V

FREQ (MHZ)	VSWR (IN)	VSWR (OUT)	GAIN (DB)
100.	1.28	1.25	15.94
200.	1.25	1.16	16.08
300.	1.35	1.16	16.21
400.	1.41	1.32	16.14
500.	1.44	1.78	16.11

Linear S-Parameters

V_{CC} = 8 V

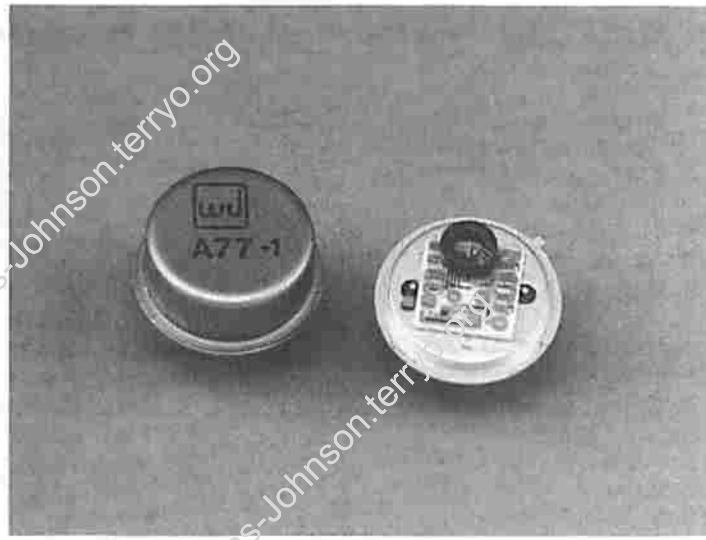
FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	[illegible]	-47.56	6.265	147.32	.094	-9.34	.100	-23.37
200.	.119	-79.24	6.394	120.55	.097	-12.80	.081	-58.21
300.	.154	-104.87	6.457	92.46	.103	-20.68	.071	-123.28
400.	.169	-133.94	6.445	63.26	.111	-30.86	.140	168.98
500.	.173	-177.72	6.354	28.87	.121	-44.29	.278	128.59
600.	.166	113.99	5.980	-7.60	.129	-61.11	.452	93.94
700.	.274	23.98	4.999	-47.33	.131	-84.96	.615	58.12
800.	.454	-18.12	[illegible]	86.16	.115	-108.57	.710	23.71

1

WJ-A77-1

5 TO 600 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT LEVEL: +15 dBm (MIN.)
- HIGH THIRD ORDER I.P.: +30 dBm (TYP.)
- EXTENDED BANDWIDTH: 5-600 MHz
- WIDE POWER SUPPLY RANGE: +8 TO +15 VOLTS



Specifications*

Characteristics	Typical	Guaranteed 0° -50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	2-700 MHz	5-600 MHz	5-600 MHz
Small Signal Gain (Min.)	16.0 dB	15.0 dB	14.5 dB
Gain Flatness (Max.)	±0.3 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	5.0 dB	6.5 dB	7.0 dB
Power Output at 1 dB Compression (Min.)	+16.5 dBm	+15.0 dBm	+14.5 dBm
VSWR (Max.) Input/Output	<1.5:1	1.8:1	2.0:1
DC Current (Max.) at 15 Volts	50 mA	53 mA	56 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +49 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +43 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +30 dBm (Typ.)

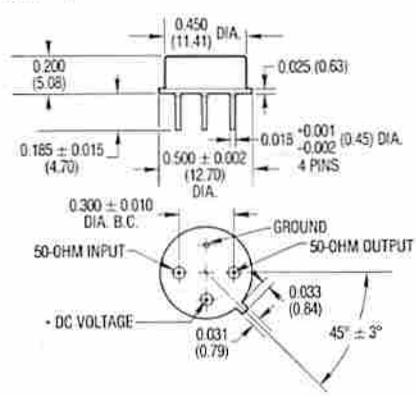
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . +100 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 µsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

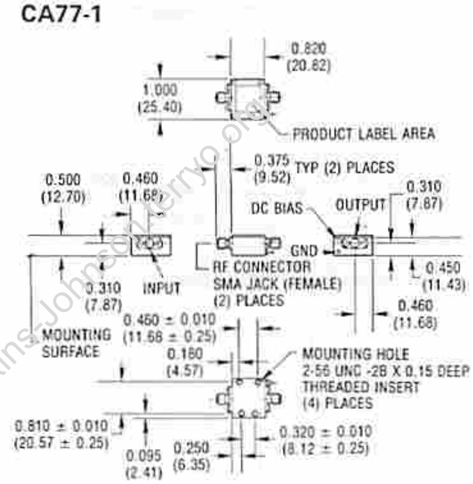
Outline Drawings

A77-1



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA77-1

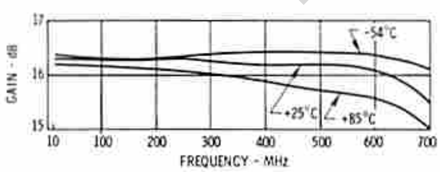


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

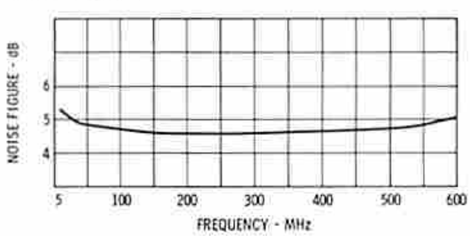
*WJ CA77-1 is standard WJ-A77-1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

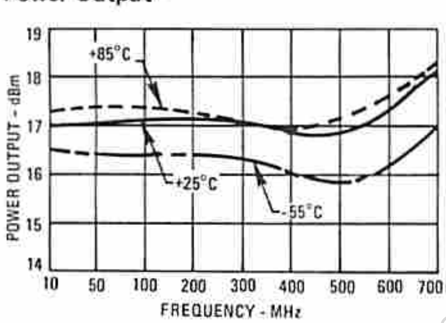
Gain



Noise Figure

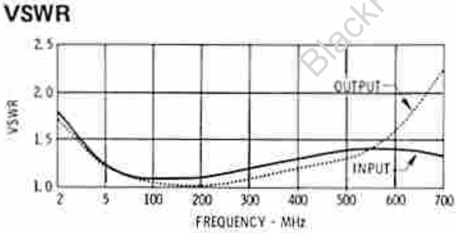


Power Output*



* at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.0	16.1
200.	1.1	1.0	16.1
300.	1.2	1.1	16.2
400.	1.3	1.2	16.2
500.	1.4	1.3	16.0
600.	1.4	1.6	16.0
700.	1.3	2.3	15.5

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.05	-149.7	6.39	150.7	.09	-10.0	.01	-24.3
200.	.06	-125.8	6.41	125.2	.09	-17.2	.02	-72.4
300.	.09	-119.2	6.44	100.3	.10	-25.3	.04	-112.8
400.	.13	-127.8	6.43	74.8	.10	-34.0	.07	-150.1
500.	.16	-146.2	6.32	45.6	.11	-43.3	.13	174.0
600.	.16	-178.6	6.20	13.8	.11	-55.4	.23	138.9
700.	.14	116.0	5.94	-20.6	.12	-72.1	.39	102.8
800.	.23	33.3	5.22	-58.5	.13	-93.7	.56	67.3

WJ-A78

5 TO 300 MHz TO-8 CASCADABLE AMPLIFIER

- HIGH DYNAMIC RANGE: +114 dBm (1 MHz BAND)
- HIGH OUTPUT: 19.5 dBm (TYP.)
- LOW NOISE: 4.5 dB (TYP.)
- HIGH THIRD ORDER IP: +33 dBm (TYP.)

Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	2-350 MHz	5-300 MHz	5-300 MHz
Small Signal Gain (Min.)	14.0 dB	13.0 dB	12.5 dB
Gain Flatness (Max.)	±0.3 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	4.5 dB	5.5 dB	6.0 dB
Power Output at 1 dB Compression (Min.)	19.5 dBm	18.0 dBm	17.5 dBm
VSWR (Max.) Input/Output	<1.7:1	1.9:1	2.0:1
DC Current (Max.) at 15 Volts	65 mA	69 mA	72 mA

* Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +50 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +45 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +33 dBm (Typ.)

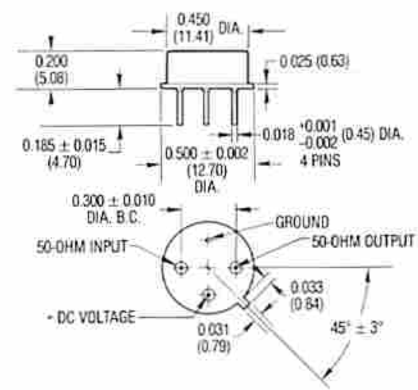
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 105°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power . . . . +100 Milliwatts (1 Minute Max.)
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 100°C

Weight approximately 2.0 grams (0.07 oz.)

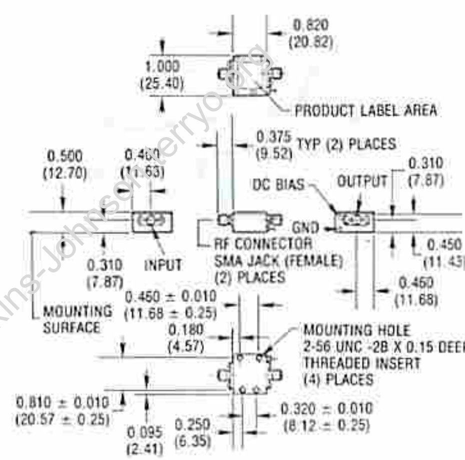
Outline Drawings

A78



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA78

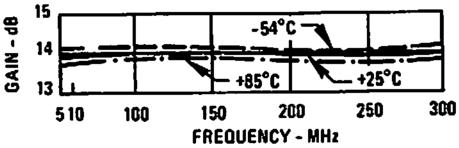


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

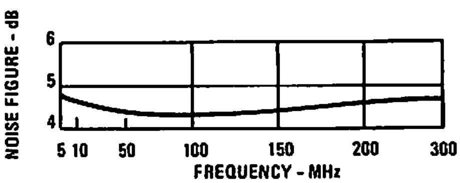
*WJ-CA78 is standard and WJ-A78 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers

Typical Performance at 25°C

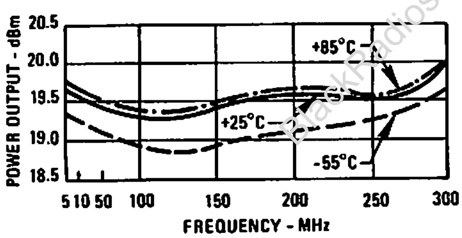
Gain



Noise Figure

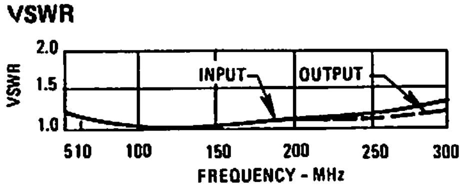


Power Output*

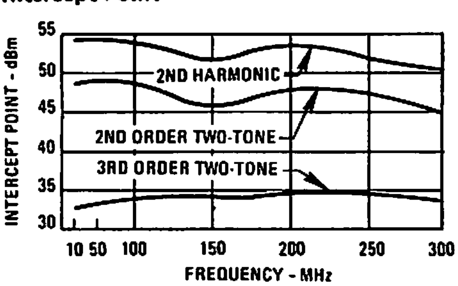


* at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
2.0	1.6	1.6	14.1
10.0	1.2	1.2	13.9
50.0	1.2	1.2	14.0
100.0	1.2	1.2	13.9
150.0	1.2	1.2	13.9
200.0	1.2	1.2	13.9
250.0	1.3	1.2	13.8
300.0	1.3	1.3	13.8
350.0	1.5	1.3	13.7
400.0	1.6	1.4	13.6

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.509	-54	4.77	-138	0.07	36	0.536	139
2.0	0.243	-63	5.06	-164	0.11	17	0.238	85
10.0	0.098	-35	4.97	-180	0.12	3	0.098	19
50.0	0.084	-35	5.00	170	0.12	-2	0.100	-22
100.0	0.074	-42	4.96	157	0.12	-5	0.096	-47
150.0	0.093	-80	4.93	143	0.13	-7	0.087	-61
200.0	0.095	-101	4.94	133	0.13	-10	0.091	-86
250.0	0.116	-123	4.92	120	0.13	-14	0.091	-118
300.0	0.149	-148	4.92	107	0.14	-18	0.112	-149
350.0	0.204	-165	4.86	91	0.14	-23	0.131	-170
400.0	0.229	179	4.76	[illegible]	0.15	-28	0.161	161

V_{CC} = +12 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
2.0	1.6	1.6	14.0
10.0	1.2	1.2	13.8
50.0	1.2	1.2	13.9
100.0	1.2	1.2	13.9
150.0	1.2	1.2	13.9
200.0	[illegible]	1.2	13.8
250.0	[illegible]	1.2	13.7
300.0	1.4	1.3	13.6
350.0	1.6	1.4	13.5
400.0	1.7	1.4	13.3

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.486	-56	4.88	-141	0.07	35	0.501	133
2.0	0.234	-62	5.00	-165	0.11	16	0.224	80
10.0	0.102	-34	4.91	180	0.12	3	0.105	16
50.0	0.090	-37	4.94	169	0.12	-2	0.108	-23
100.0	0.081	-49	4.95	156	0.12	-4	0.106	-49
150.0	0.107	-85	4.93	141	0.13	-7	0.097	-65
200.0	0.114	-107	4.88	131	0.13	-10	0.103	-91
250.0	0.141	-128	4.86	[illegible]	0.14	-13	0.107	-121
300.0	0.179	-152	4.80	104	0.14	-18	0.130	-151
350.0	0.240	-168	4.75	88	0.15	-23	0.152	-172
400.0	0.268	175	4.65	77	0.15	-28	0.181	160

V_{CC} = +5 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
2.0	1.6	1.6	13.5
10.0	1.3	1.3	13.3
50.0	[illegible]	1.3	13.3
100.0	1.3	1.3	13.2
150.0	1.5	1.3	13.1
200.0	1.6	1.3	13.0
250.0	1.7	1.4	12.6
300.0	2.0	1.4	12.3
350.0	2.3	1.5	11.9
400.0	2.5	1.6	11.3

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.453	-54	4.67	-145	0.08	34	0.450	123
2.0	0.234	-53	4.72	-167	0.12	15	0.221	68
10.0	0.132	-28	4.64	179	0.12	3	0.138	9
50.0	0.130	-45	4.62	167	0.13	-0	0.145	-27
100.0	0.135	-69	4.57	151	0.13	-2	0.144	-54
150.0	0.186	-102	4.49	134	0.14	-4	0.137	-75
200.0	0.220	-126	4.45	122	0.14	-8	0.144	-101
250.0	0.269	-146	[illegible]	106	0.15	-12	0.151	-132
300.0	0.327	-167	[illegible]	90	0.16	-18	0.173	-161
350.0	0.398	176	3.93	76	0.17	-25	0.194	178
400.0	0.430	160	[illegible]	61	0.17	-31	0.217	150

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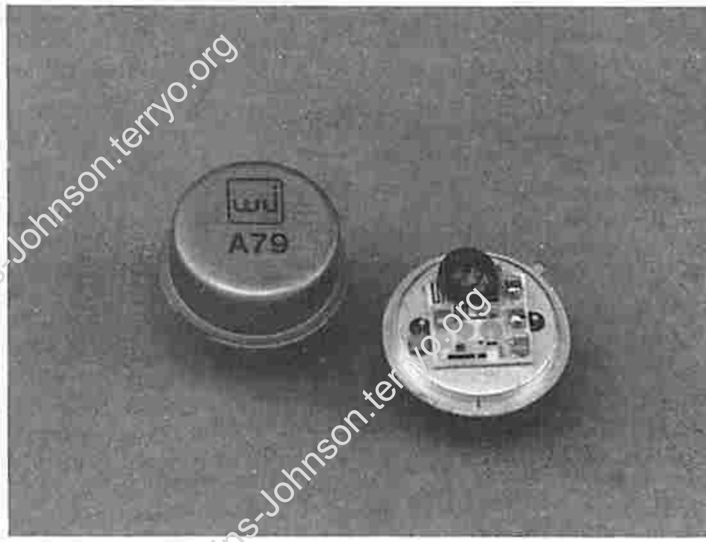
WJ-A79

5 TO 250 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH DYNAMIC RANGE: +114 dBm (1 MHz BAND)
- HIGH OUTPUT POWER: +22 dBm (TYP.)
- HIGH THIRD ORDER I.P.: +36 dBm (TYP.)
- LOW NOISE: 5.2 dB (TYP.)
- WIDE POWER SUPPLY RANGE: +5 TO +15 VOLTS



Specifications*

Characteristics	Typical	Guaranteed 0° -50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	2-300 MHz	5-250 MHz	5-250 MHz
Small Signal Gain (Min.)	14 dB	13.0 dB	12.5 dB
Gain Flatness (Max.)	<±0.2 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	5.2 dB	6.5 dB	7.0 dB
Power Output at 1 dB Compression (Min.)	+22.0 dBm	+20.0 dBm	+19.5 dBm
VSWR (Max.) Input/Output	<1.5:1	1.8:1	2.0:1
DC Current (Max.) at 15 Volts	88 mA	93 mA	98 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . . +56 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . . +52 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . . +36 dBm (Typ.)

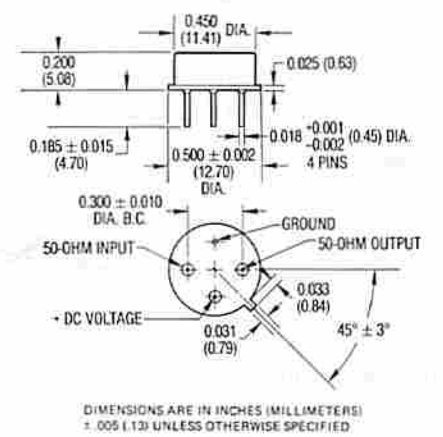
Absolute Maximum Ratings

Storage Temperature . . . . . -62°C to +125°C
Maximum Case Temperature . . . . . 105°C
Maximum DC Voltage . . . . . +17 Volts
Maximum Continuous RF Input Power . . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . . +100 Milliwatts
Maximum Peak Power . . . . . 0.5 Watt (3 µsec Max.)
"S" Series Burn-In Temperature (Case) . . . . . 100°C

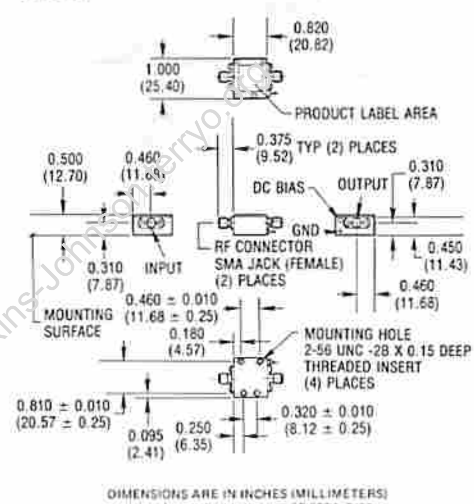
Weight approximately 2.0 grams (0.07 oz.)

Outline Drawings

A79



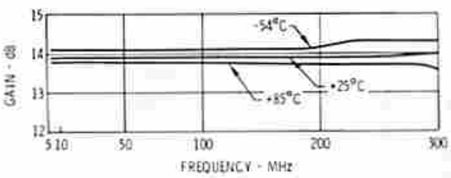
CA79



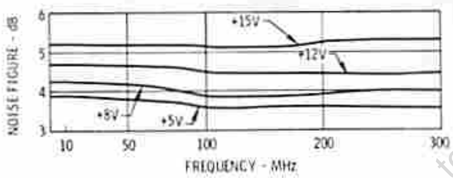
*WJ CA79 is standard WJ A79 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

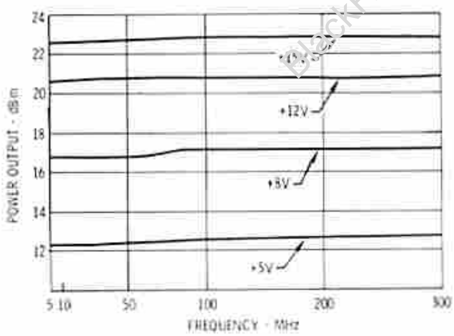
Gain



Noise Figure

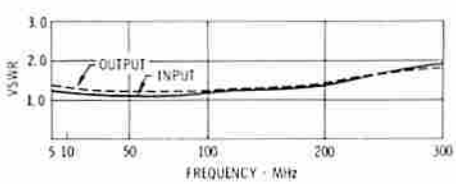


Power Output*

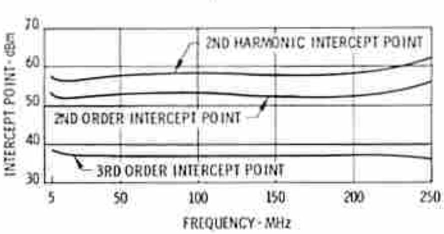


*at 1 dB Gain Compression

VSWR



Third-Order Intercept Point



Typical Automatic Test Data

V_{CC} = 12 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.2	13.9
150.	1.3	1.4	14.0
200.	1.4	1.5	[illegible]
250.	1.6	1.7	14.2
300.	1.8	1.9	14.2
350.	2.1	2.1	14.1

V_{CC} = 8 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.3	1.3	13.7
150.	1.4	1.4	13.8
200.	1.6	1.6	13.9
250.	1.8	1.8	13.8
300.	2.1	2.0	13.0
350.	2.4	2.3	13.6

V_{CC} = 5 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.4	1.3	13.4
150.	1.6	1.5	13.5
200.	1.8	1.7	13.4
250.	2.1	1.9	13.2
300.	2.4	2.2	13.0
350.	2.9	2.4	12.6

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.2	13.8
150.	1.3	1.3	14.0
200.	1.4	[illegible]	14.1
250.	1.5	[illegible]	14.1
300.	1.7	1.7	14.1
350.	2.0	1.9	14.1

Linear S-Parameters

V_{CC} = 15 V

FREQ MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.09	-128.1	4.92	147.6	.13	-4.9	.09	-151.9
150.	.13	-131.7	5.00	134.8	.13	-6.7	.13	-156.0
200.	.17	-137.8	5.05	121.7	.14	-9.4	.17	-166.4
250.	.21	-145.8	5.10	109.1	.15	-13.2	.21	-177.8
300.	.26	-154.5	5.08	95.9	.16	-18.2	.26	169.2
350.	.32	-166.4	5.06	81.8	.17	-24.4	.31	154.9

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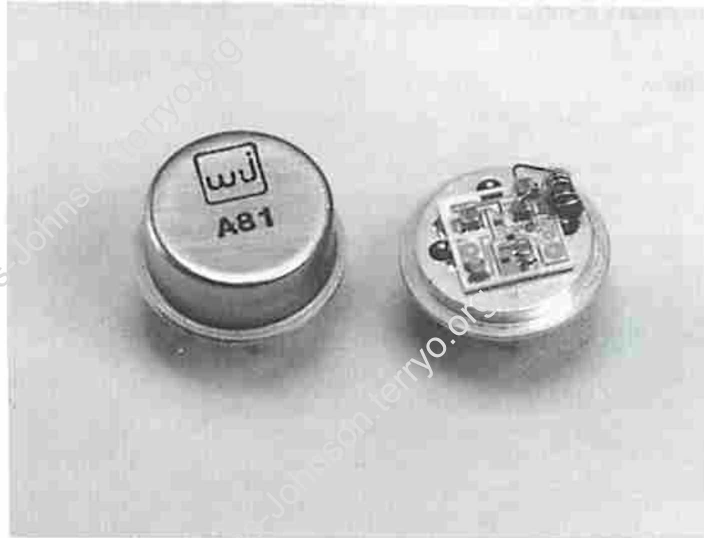
WJ-A81

20 TO 250 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH REVERSE ISOLATION: ≥29 dB (TYP.)
- HIGH GAIN: 25 dB (TYP.)
- HIGH EFFICIENCY: 35 mA CURRENT DRAIN
- HIGH LEVEL OUTPUT: 17 dBm (TYP.)
- LOW NOISE: 3.0 dB (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	10-300 MHz	20-250 MHz	20-250 MHz
Small Signal Gain (Min.)	25.0 dB	23.5 dB	23.0 dB
Gain Flatness (Max.)	±0.3 dB	±0.5 dB	±0.7 dB
Noise Figure (Max.)	3.0 dB	3.5 dB	4.0 dB
Power Output at 1 dB Compression (Min.)	17.0 dBm	16.0 dBm	15.5 dBm
VSWR (Max.)			
Input	<1.4:1	1.9:1	2.0:1
Output	<1.4:1	1.9:1	2.0:1
DC Current (Max.) at +15 Volts	35 mA	37 mA	39 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . >40 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . >35 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 28 dBm (Typ.)

Absolute Maximum Ratings

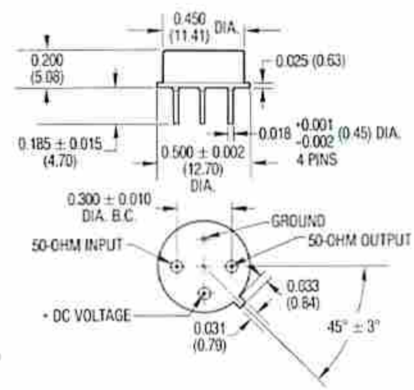
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +10 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . +125°C

Weight

approximately 2.0 grams (0.07 oz.)

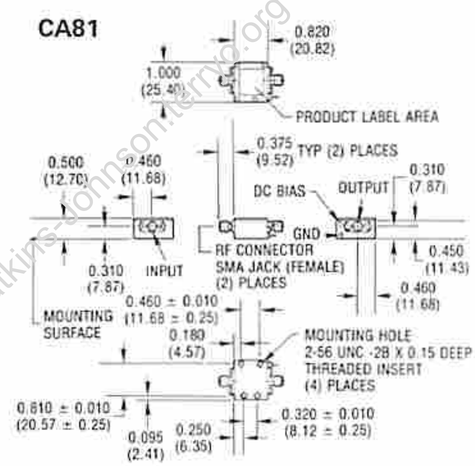
Outline Drawings

A81



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA81

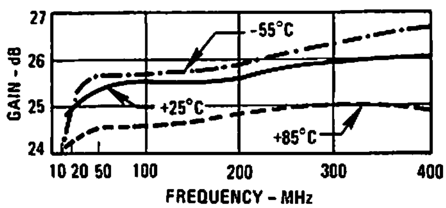


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

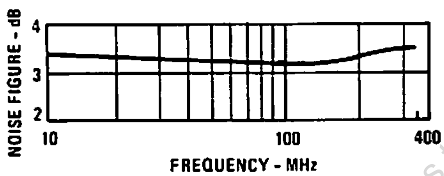
*WJ-CA81 is standard and WJ-A81 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

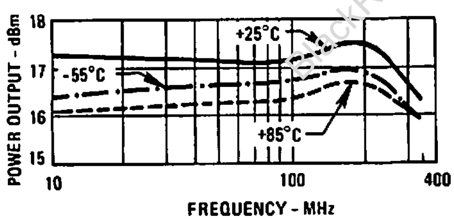
Gain



Noise Figure

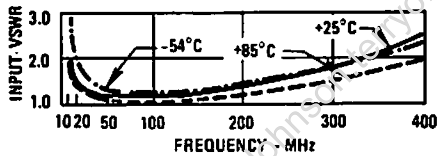


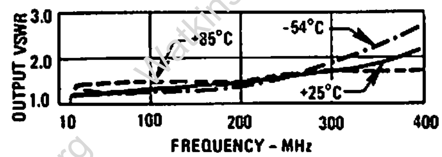
Power Output*



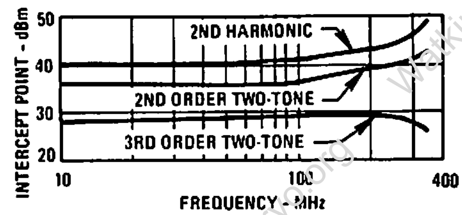
* at 1 dB Gain Compression

VSWR

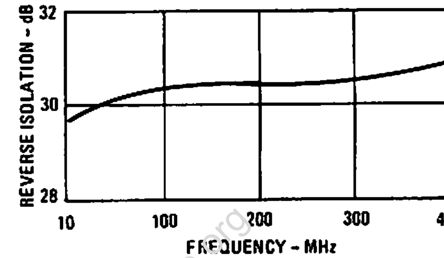




Intercept Point



Reverse Isolation



Typical Automatic Test Data

V_{CC} = +15 Vdc

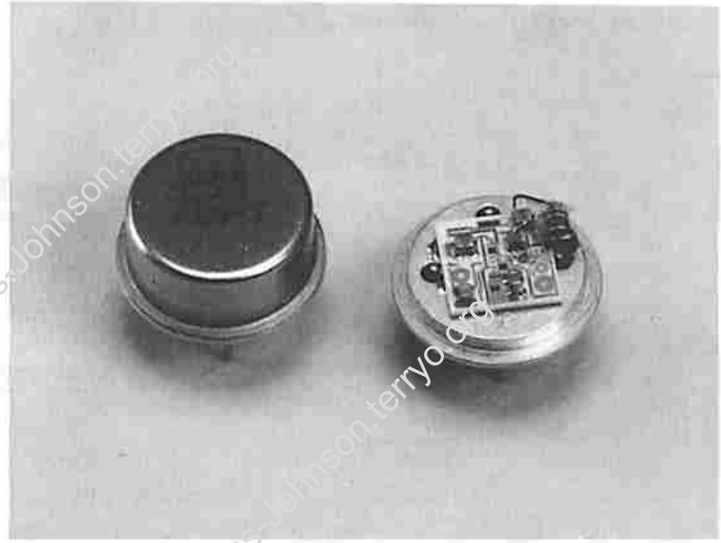
FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB	REV-ISO dB
10.0	1.9	1.2	24.6	27.9
20.0	1.4	1.2	25.0	29.0
50.0	1.2	1.2	25.1	29.9
100.0	1.2	1.3	25.2	30.2
150.0	1.3	1.3	25.2	30.1
200.0	1.5	1.4	25.4	30.4
250.0	1.6	1.6	25.6	30.4
300.0	1.9	1.8	25.8	28.0

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
5.0	0.558	-65	15.39	-139	0.04	-9	0.087	-43
10.0	0.312	-86	16.98	-161	0.03	-12	0.093	-122
20.0	0.171	-109	17.76	-176	0.03	-11	0.101	-162
50.0	0.081	-161	17.98	169	0.03	-12	0.105	153
100.0	0.094	125	18.19	149	0.03	-16	0.111	102
150.0	0.129	100	18.26	128	0.03	-26	0.143	52
200.0	0.186	74	18.71	112	0.03	-36	0.175	10
250.0	0.239	53	18.98	93	0.03	-47	0.228	-26
300.0	0.318	36	19.60	73	0.04	-61	0.278	-62
350.0	0.410	20	20.10	52	0.04	-77	0.360	-97

WJ-A81-1

20 TO 250 MHz
TO-8 CASCADABLE AMPLIFIER



- HIGH REVERSE ISOLATION: ⩾20.0 dB (TYP.)
- VERY LOW NOISE: <2.5 dB (TYP.)
- HIGH GAIN: 24.5 dB (TYP.)
- HIGH EFFICIENCY: 25 mA CURRENT DRAIN
- MEDIUM LEVEL OUTPUT: 12.5 dBm (TYP.)

Specifications*

Characteristics	Typical	Guaranteed 0° – 50°C	Guaranteed -54°C – +85°C
Frequency (Min.)	10–300 MHz	20–250 MHz	20–250 MHz
Small Signal Gain (Min.)	24.5 dB	23.5 dB	23.0 dB
Gain Flatness (Max.)	±0.3 dB	±0.5 dB	±0.7 dB
Noise Figure (Max.)	⩽2.5 dB	3.2 dB	3.7 dB
Power Output at 1 dB Compression (Min.)	12.5 dBm	11.5 dBm	11.0 dBm
VSWR (Max.)			
Input	1.5:1	1.9:1	2.0:1
Output	1.6:1	1.9:1	2.0:1
DC Current (Max.) at +15 Volts	25 mA	27 mA	29 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

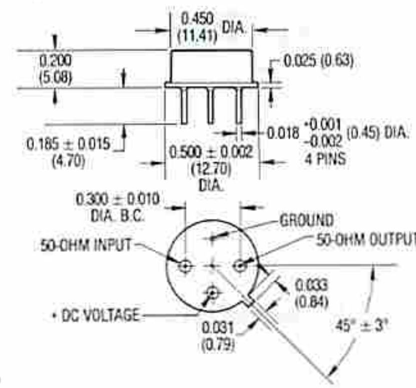
Second Order Harmonic Intercept Point . . . . >33 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . >27 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . >23 dBm (Typ.)

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . 17 Volts
Maximum Continuous RF Input Power . . . . +10 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . +125°C

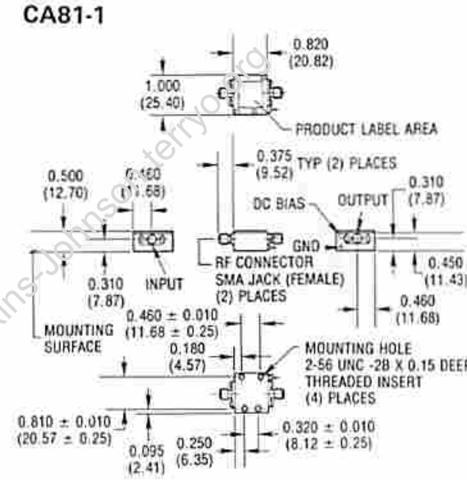
Outline Drawings

A81-1



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA81-1



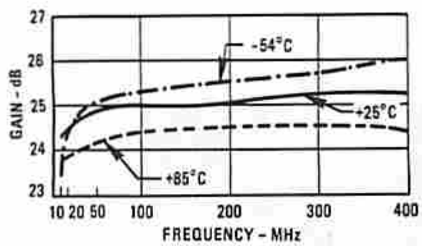
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

*WJ-CA81-1 is standard and WJ-A81-1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

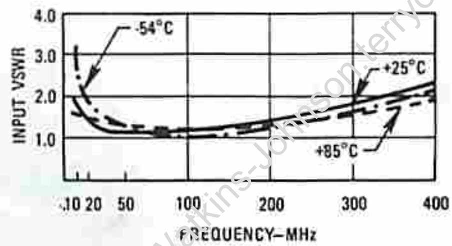
Weight approximately 2.0 grams (0.07 oz.)

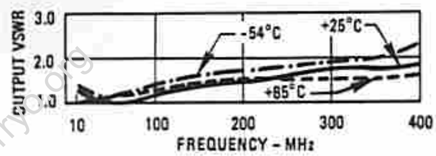
Typical Performance at 25°C

Gain

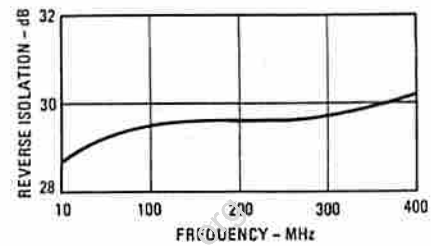


VSWR

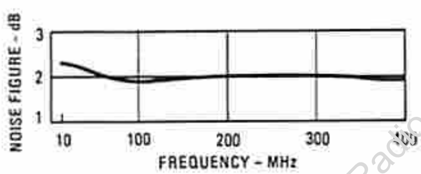




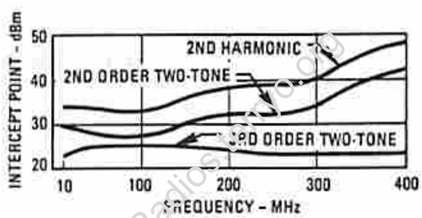
Reverse Isolation



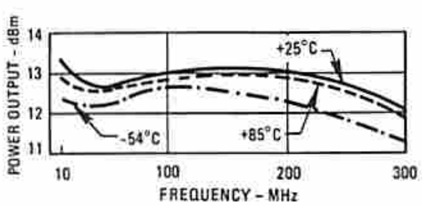
Noise Figure



Intercept Point



Power Output*



*at 1 dB Gain Compression

Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB	REV-ISO dB
10.0	1.8	1.2	24.2	29.3
20.0	1.4	1.1	24.5	29.7
50.0	1.1	1.1	24.6	29.9
100.0	1.1	1.2	24.7	29.9
150.0	1.2	1.3	24.6	29.9
200.0	1.3	1.5	24.8	29.9
250.0	1.5	1.6	24.9	29.9
300.0	1.7	1.6	25.2	29.9

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
5.0	0.500	-56	14.53	-143	0.04	-8	0.146	-19
10.0	0.282	-66	16.24	-164	0.03	-9	0.086	-47
20.0	0.149	-69	16.78	-177	0.03	-10	0.040	-52
50.0	0.054	-51	17.03	167	0.03	-14	0.029	30
100.0	0.055	30	17.17	147	0.03	-24	0.081	29
150.0	0.078	45	17.07	125	0.03	-34	0.146	7
200.0	0.138	42	17.46	106	0.03	-45	0.186	-22
250.0	0.191	33	17.49	89	0.03	-58	0.224	-58
300.0	0.270	24	18.10	68	0.03	-74	0.242	-86
350.0	0.368	14	18.56	45	0.03	-92	0.286	-127

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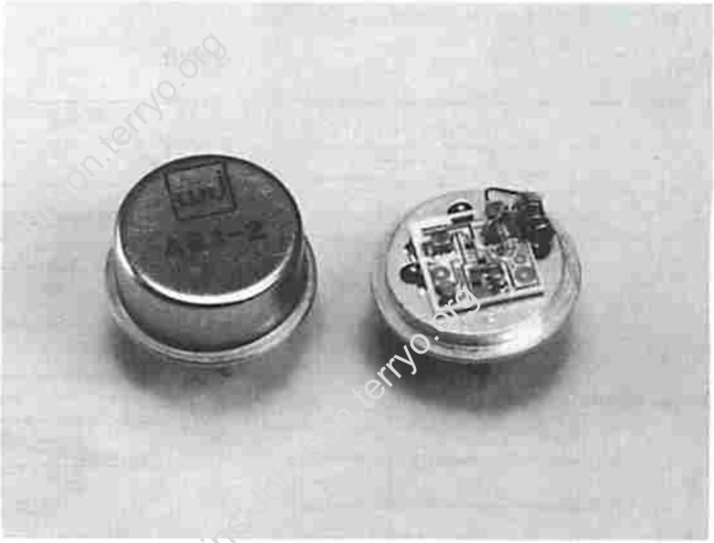
WJ-A81-2

20 TO 500 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH REVERSE ISOLATION: >29 dB (TYP.)
- HIGH EFFICIENCY: 29 mA CURRENT DRAIN
- HIGH LEVEL OUTPUT: 15.0 dBm (TYP.)
- LOW NOISE ≤3.5 dB (TYP.)
- HIGH GAIN: >22.0 dB (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	10-500 MHz	20-500 MHz	20-500 MHz
Small Signal Gain (Min.)	>22.0 dB	21.5 dB	21.0 dB
Gain Flatness (Max.)	±0.2	±0.5	±0.7
Noise Figure (Max.)			
20-300	3.5 dB	4.0 dB	4.5 dB
300-500	4.0 dB	4.5 dB	5.0 dB
Power Output at 1 dB Compression (Min.)	15.0 dBm	14.0 dBm	13.5 dBm
VSWR (Max.) Input/Output	1.5:1	1.8:1	2.0:1
DC Current (Max.) at 15 Volts	29 mA	31 mA	33 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point .... 40 dBm (Typ.)
Second Order Two Tone Intercept Point .... 35 dBm (Typ.)
Third Order Two Tone Intercept Point .... 28 dBm (Typ.)

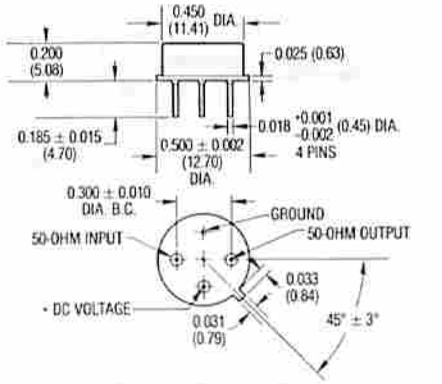
Absolute Maximum Ratings

Storage Temperature .... -62°C to +125°C
Maximum Case Temperature .... 125°C
Maximum DC Voltage .... +17 Volts
Maximum Continuous RF Input Power .... +10 dBm
Maximum Short Term RF Input Power (1 Minute Max.) .... 50 Milliwatts
Maximum Peak Power .... 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) .... +125°C

Weight approximately 2.0 grams (0.07 oz.)

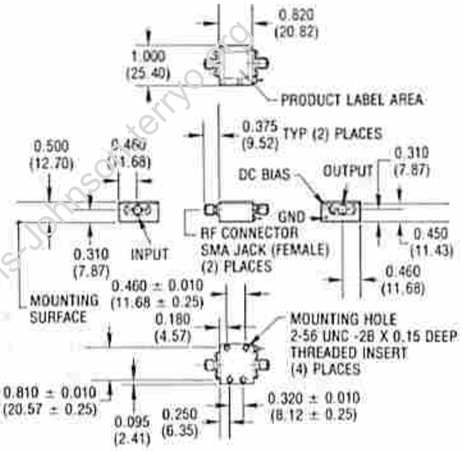
Outline Drawings

A81-2



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA81-2

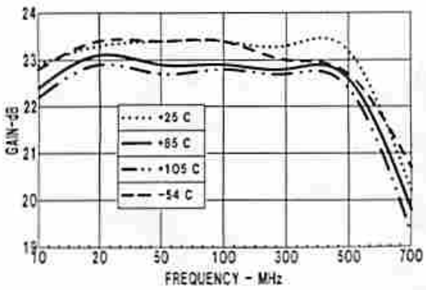


DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

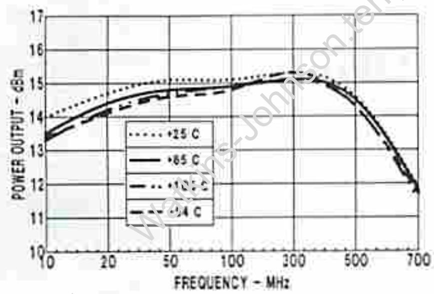
*WJ CA81-2 is standard WJ A81-2 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

Gain

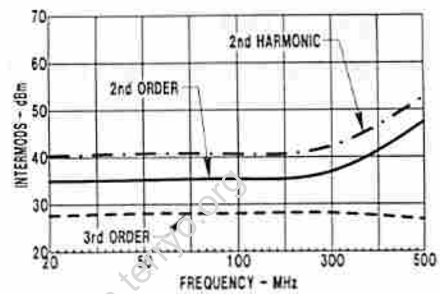


Power Output*

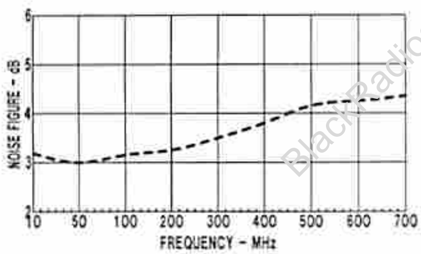


*at 1 dB Gain Compression

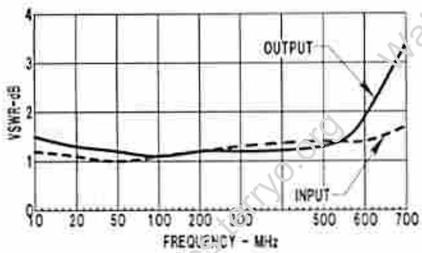
Intermodulation



Noise Figure



VSWR



1

Typical Automatic Test Data

V_{cc} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN dB
10.0	1.2	1.5	22.9
20.0	1.1	1.3	23.3
50.0	1.0	1.2	23.5
100.0	1.1	1.1	23.4
150.0	1.2	1.2	23.3
200.0	1.2	1.2	23.3
250.0	1.3	1.2	23.2
300.0	1.3	1.2	23.3
350.0	1.4	1.2	23.3
400.0	1.4	1.1	23.4
450.0	1.4	1.1	23.4
500.0	1.4	1.3	23.2
550.0	1.4	1.5	22.9
600.0	1.4	1.9	22.5
650.0	1.5	2.5	21.6
700.0	1.7	3.4	20.2

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
10.0	.108	-64	14.008	-169	.029	11	.194	131
20.0	.048	-68	14.631	-178	.029	6	.128	123
50.0	.017	10	14.882	169	.030	-5	.072	117
100.0	.058	54	14.867	153	.029	-16	.065	109
150.0	.076	52	14.706	139	.028	-24	.076	103
200.0	.110	47	14.573	125	.028	-31	.085	88
250.0	.126	47	14.474	[illegible]	.026	-40	.095	76
300.0	.141	41	14.629	97	.027	-48	.094	65
350.0	.167	34	14.619	83	.026	-55	.083	61
400.0	.179	30	14.816	67	.025	-65	.064	67
450.0	.182	23	14.75[illegible]	51	.024	-73	.069	99
500.0	.173	17	14.[illegible]90	33	.023	-85	.122	117
550.0	.160	23	14.016	15	.022	-97	.213	115
600.0	.160	32	13.372	-4	.020	-105	.315	103
650.0	.197	41	11.976	-23	.017	-113	.431	88
700.0	.266	43	10.202	-42	.015	-121	.543	73

WJ-A81-3

20 TO 500 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH REVERSE ISOLATION: >35 dBm (TYP.)
- EXCEPTIONAL OUTPUT VSWR: 1.1:1 (TYP.)
- LOW NOISE: 3.5 dB (TYP.)
- MEDIUM LEVEL OUTPUT: 8.0 dBm (TYP.)

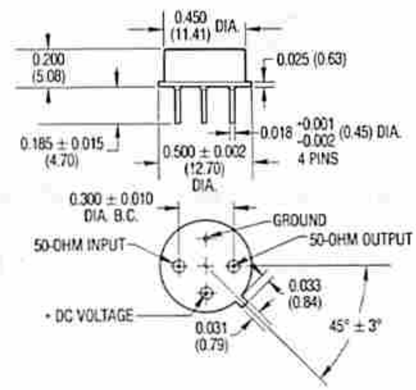
Specifications *

Characteristics	Typical	Guaranteed 0° – 50°C	Guaranteed -54°C – +85°C
Frequency (Min.)	10–500 MHz	20–500 MHz	20–500 MHz
Small Signal Gain (Min.)	17.0 dB	16.0 dB	15.5 dB
Gain Flatness (Max.)	±0.2 dB	±0.5 dB	±0.7 dB
Noise Figure (Max.)			
20–300	3.5 dB	4.0 dB	4.5 dB
300–500	4.0 dB	4.5 dB	5.0 dB
Power Output at 1 dB Compression (Min.)			
20–500	8.0 dBm	7.5 dBm	7.0 dBm
VSWR (Max.)			
Input	1.5:1	1.8:1	2.0:1
Output	1.1:1	1.3:1	1.3:1
DC Current (Max.) at 15 Volts	29.0 mA	31.0 mA	33.0 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

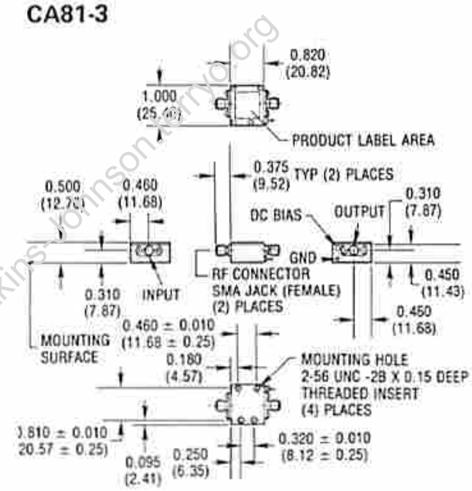
Outline Drawings

A81-3



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA81-3



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

*WJ-CA81-3 is standard and WJ-A81-3 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range See Cascaded Thin Film Amplifiers.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point	32 dBm (Typ.)
Second Order Two Tone Intercept Point	28 dBm (Typ.)
Third Order Two Tone Intercept Point	20 dBm (Typ.)

Absolute Maximum Ratings

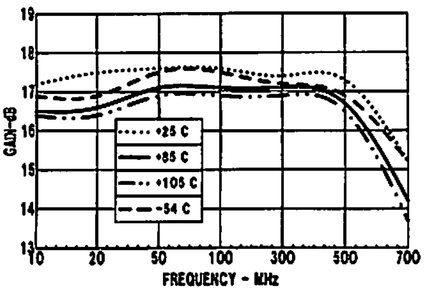
Storage Temperature	-62°C to +125°C
Maximum Case Temperature	125°C
Maximum DC Voltage	+17 Volts
Maximum Continuous RF Power	+10 dBm
Maximum Short Term RF Input Power (1 Minute Max.)	50 Milliwatts
Maximum Peak Power	0.5 Watt (3 µsec Max.)
"S" Series Burn-In Temperature (Case)	+125°C

Weight

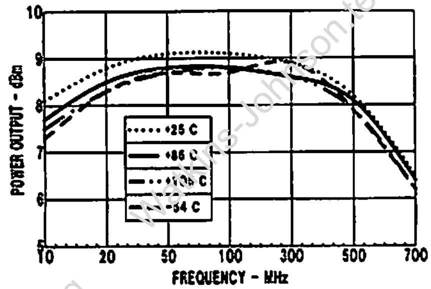
approximately 2.0 grams (0.07 oz.)

Typical Performance at 25°C

Gain

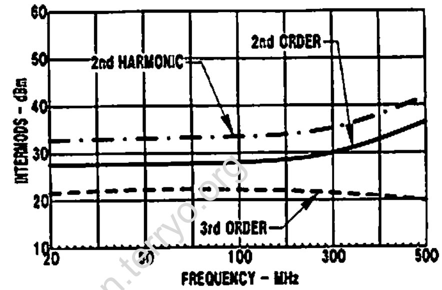


Power Output*

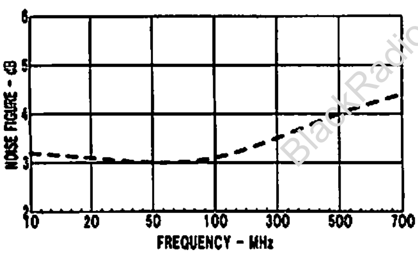


*at 1 dB Gain Compression

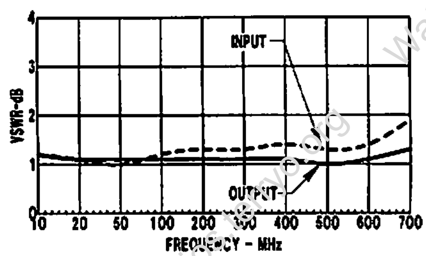
Intercept Point



Noise Figure



VSWR



1

Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN dB
10.0	1.2	1.2	17.2
20.0	1.1	1.1	17.5
50.0	1.0	1.1	17.6
100.0	1.2	1.1	17.6
150.0	1.2	1.1	17.4
200.0	1.3	1.1	17.4
250.0	1.3	1.1	17.3
300.0	1.3	1.1	17.4
350.0	1.4	1.1	17.4
400.0	1.4	1.1	17.5
450.0	1.3	1.1	17.4
500.0	1.3	1.0	17.3
550.0	1.3	1.1	17.0
600.0	1.4	1.1	16.7
650.0	1.6	1.2	16.0
700.0	1.9	1.3	15.2

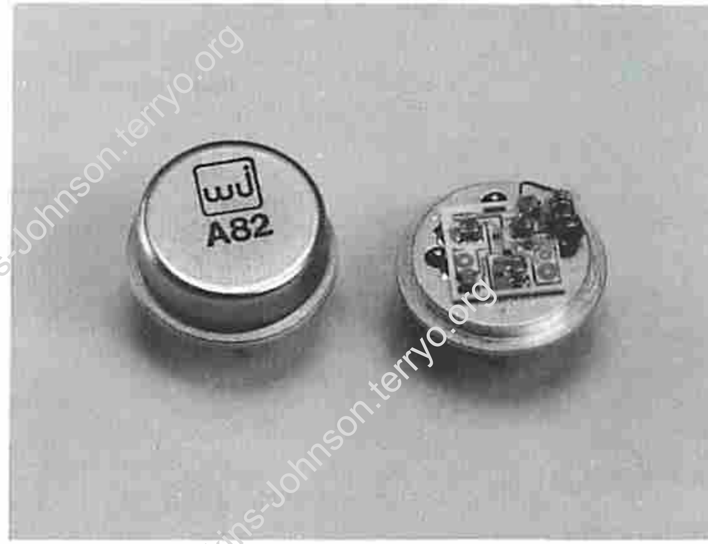
Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
10.0	.107	-80	7.204	-168	.014	13	.070	141
20.0	.044	-111	7.505	-177	.015	6	.051	139
50.0	.018	126	7.582	170	.016	-3	.036	141
100.0	.073	78	7.543	155	.015	-11	.035	124
150.0	.098	55	7.451	143	.015	-18	.040	116
200.0	.123	52	7.398	130	.014	-24	.041	96
250.0	.137	44	7.362	117	.014	-28	.046	82
300.0	.147	36	7.427	104	.014	-36	.046	66
350.0	.157	30	7.389	91	.012	-42	.043	59
400.0	.155	24	7.465	77	.012	-48	.035	44
450.0	.144	23	7.442	62	.011	-53	.027	48
500.0	.135	27	7.305	46	.010	-64	.026	78
550.0	.147	38	7.075	31	.009	-77	.033	127
600.0	.172	49	6.828	15	.008	-84	.056	129
650.0	.229	50	6.335	-2	.007	-95	.090	116
700.0	.312	45	5.774	-19	.005	-90	.130	105

WJ-A82

20 TO 250 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH REVERSE ISOLATION: ≥28.5 dB (TYP.)
- HIGH LEVEL OUTPUT: >20 dBm (TYP.)
- HIGH GAIN: 22.5 dB (TYP.)
- LOW NOISE: 4.0 dB (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	20-300 MHz	20-250 MHz	20-250 MHz
Small Signal Gain (Min.)	22.5 dB	21.5 dB	21.0 dB
Gain Flatness (Max.)	±0.4 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	4.0 dB	4.5 dB	5.0 dB
Power Output at 1 dB Compression (Min.)	20.0 dBm	19.0 dBm	18.0 dBm
VSWR (Max.)			
Input	1.6:1	2.0:1	2.0:1
Output	1.5:1	2.0:1	2.0:1
DC Current (Max.) at +15 Volts	50 mA	52 mA	54 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 40 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 35 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 30 dBm (Typ.)

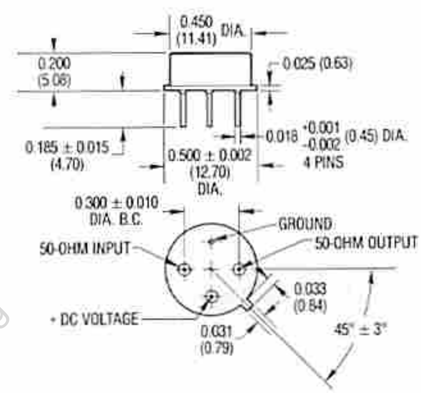
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +10 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

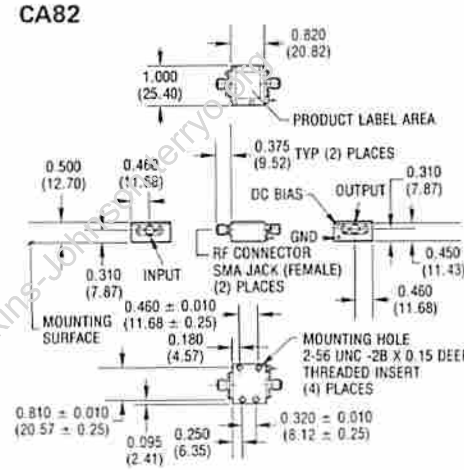
Outline Drawings

A82



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

CA82

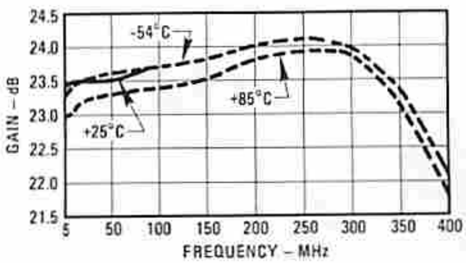


DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

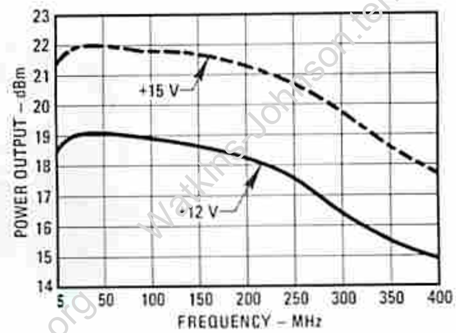
*WJ-CA82 is standard and WJ-A82 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range see Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

Gain

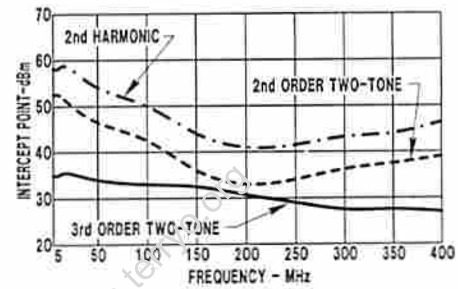


Power Output*

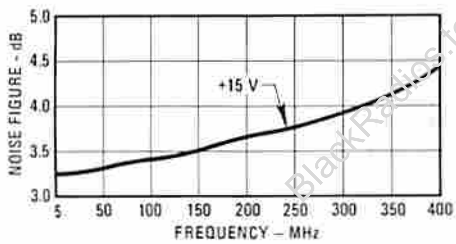


*at 1 dB Gain Compression

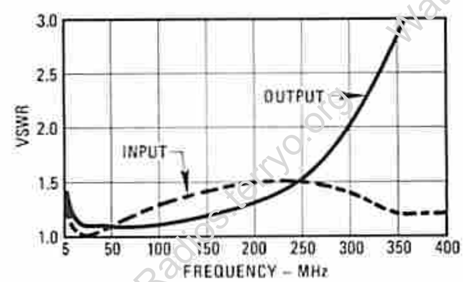
Intercept Point



Noise Figure



VSWR



1

Typical Automatic Test Data

V_{cc} = 15 Vdc

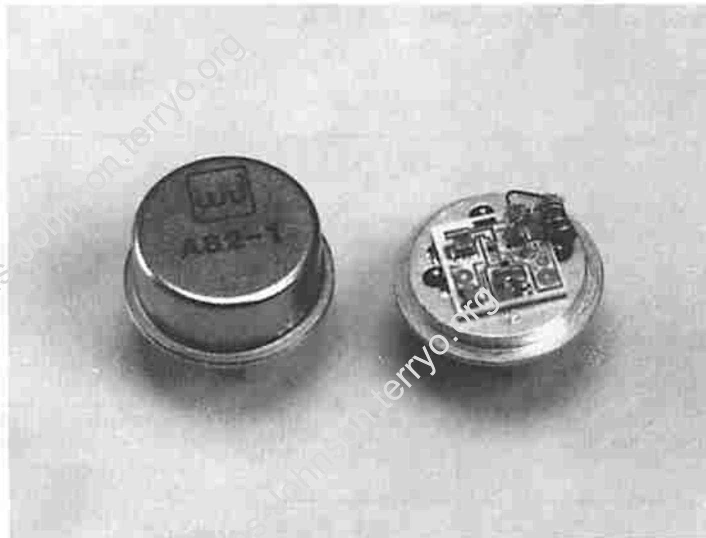
FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.00	1.3	1.4	23.4
10.00	1.1	1.2	23.4
20.00	1.0	1.1	23.5
50.00	1.1	1.1	23.5
100.00	1.3	1.1	23.7
150.00	1.4	1.2	23.8
200.00	1.5	1.3	24.0
250.00	1.5	1.5	24.1
300.00	1.4	2.0	24.0
350.00	1.2	2.8*	23.4
400.00	1.2	3.7*	22.1

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
5.0	0.133	-85	14.71	-166	0.04	10	0.164	100
10.0	0.063	-92	14.83	-175	0.04	3	0.092	77
20.0	0.022	-121	14.92	178	0.04	-5	0.065	50
50.0	0.040	93	14.96	165	0.04	-13	0.047	2
100.0	0.112	71	15.24	146	0.04	-24	0.053	-52
150.0	0.163	56	15.50	128	0.03	-32	0.074	-97
200.0	0.190	41	15.86	108	0.03	-41	0.122	-127
250.0	0.203	26	16.10	86	0.03	-48	0.212	-151
300.0	0.159	12	15.84	62	0.03	-52	0.339	-174
350.0	0.091	21	14.76	36	0.03	-49	0.471	163
400.0	0.098	79	12.73	12	0.03	-55	0.573	144

WJ-A82-1

20 TO 250 MHz
TO-8 CASCADABLE AMPLIFIER



- EXTREMELY HIGH REVERSE ISOLATION >34 dB (TYP.)
- HIGH LEVEL OUTPUT
- HIGH GAIN: >17 dB (TYP)
- LOW NOISE: 4.0 dB (TYP.)
- LOW OUTPUT VSWR: 1.1:1 (TYP.)

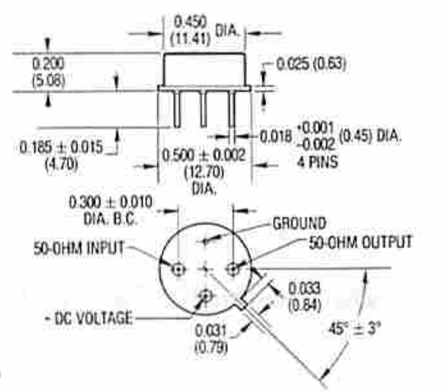
Specifications*

Characteristics	Typical	Guaranteed 0° – 50°C	Guaranteed -54°C – +85°C
Frequency (Min.)	20-300 MHz	20-250 MHz	20-250 MHz
Small Signal Gain (Min.)	18 dB	16.5 dB	16.0 dB
Gain Flatness (Max.)	±0.5 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	4.0 dB	4.5 dB	5.0 dB
Power Output at 1 dB Compression (Min.)	15.5 dBm	14.0 dBm	13.5 dBm
VSWR (Max.)			
Input	1.6:1	2.0:1	2.0:1
Output	1.1:1	1.3:1	1.3:1
DC Current (Max.) at +15 Volts	50 mA	52 mA	54 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

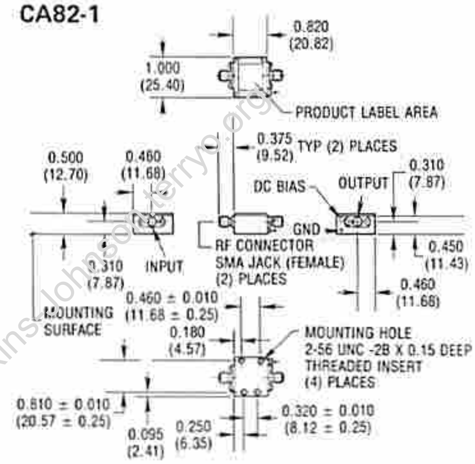
Outline Drawings

A82-1



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA82-1



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

*WJ-CA82-1 is standard and WJ-A82-1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range see Cascaded Thin Film Amplifiers.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 35 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 30 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 28 dBm (Typ.)

Absolute Maximum Ratings

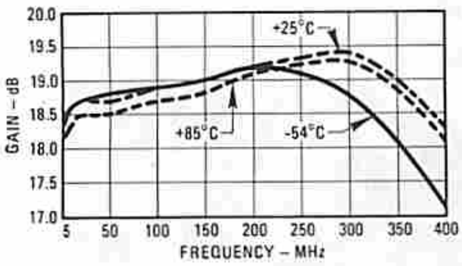
Storage Temperature . . . . -62°C to 125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +10 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 µsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight

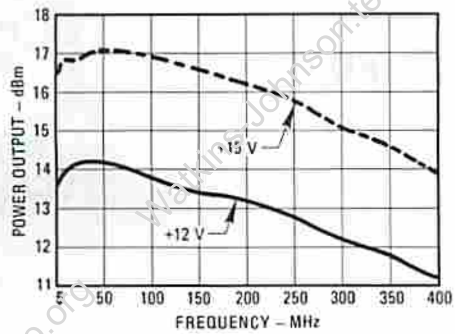
approximately 2.0 grams (0.07 oz.)

Typical Performance at 25°C

Gain

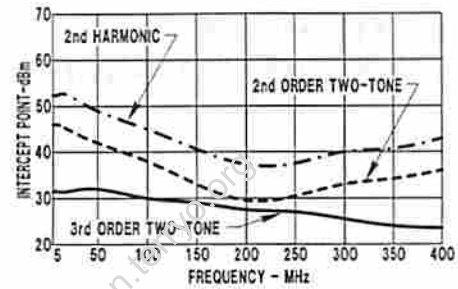


Power Output*

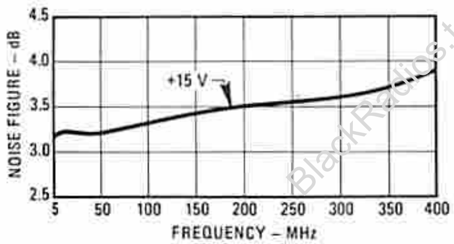


*at 1 dB Gain Compression

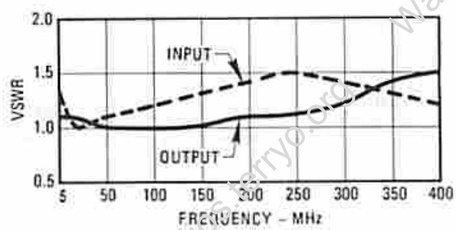
Intercept Point



Noise Figure



VSWR



Typical Automatic Test Data

V_{CC} = 15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.00	1.3	1.1	18.5*
10.00	1.1	1.1	18.6*
20.00	1.0	1.1	18.7*
50.00	1.1	1.0	18.7*
100.00	1.2	1.0	18.9*
150.00	1.3	1.0	19.0*
200.00	1.4	1.1	19.2*
250.00	1.5	1.1	19.3*
300.00	1.4	1.2	19.4*
350.00	1.3	1.4	19.0*
400.00	1.2	1.5	18.3*

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
5.0	0.122	-89	8.46	-166	0.02	10	0.064	126
10.0	0.057	-100	8.53	-175	0.02	-3	0.037	128
20.0	0.021	-136	8.58	179	0.02	-1	0.027	135
50.0	0.039	94	8.62	168	0.02	-11	0.020	152
100.0	0.101	67	8.78	152	0.02	-20	0.013	-180
150.0	0.145	50	8.92	137	0.02	-29	0.020	-158
200.0	0.174	30	9.11	121	0.02	-32	0.036	-150
250.0	0.188	10	9.26	103	0.02	-43	0.064	-149
300.0	0.175	-16	9.31	84	0.02	-37	0.102	-160
350.0	0.137	-51	8.93	63	0.02	-36	0.150	-173
400.0	0.107	-104	8.24	42	0.02	-31	0.192	175

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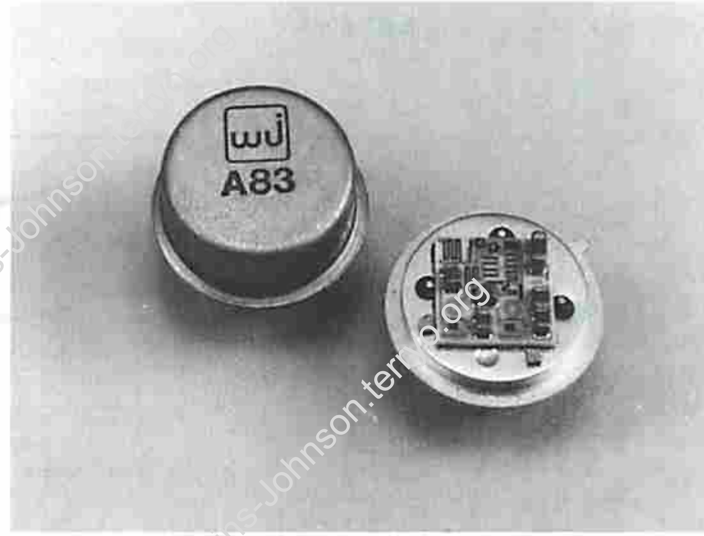
WJ-A83

10 TO 500 MHz TO-8 CASCADABLE AMPLIFIER

- HIGH GAIN – TWO STAGES: 30 dB (TYP.)
- LOW POWER DRAIN: 65 mW @ 5 VOLTS
- VOLTAGE CONTROLLED GAIN: 27 dB TO 34 dB @ V_{CC} = 3 TO 12 VOLTS
- LOW VSWR OVER FULL CONTROL RANGE: < 1.5:1 (TYP.)



Specifications*

Characteristic	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	10-600 MHz	10-500 MHz	10-500 MHz
Small Signal Gain (Min.)	30.0 dB	29.0 dB	28.0 dB
Gain Flatness (Max.)	±0.3 dB	±0.5 dB	±0.8 dB
Noise Figure (Max.)	3.0 dB	3.5 dB	4.0 dB
Power Output at 1 dB Compression (Min.)	-1.0 dBm	-2.0 dBm	-4.0 dBm
VSWR (Max.) Input/Output	1.3:1	1.8:1	2.0:1
DC Current (Max.) at 5 Volts	13.0 mA	15.0 mA	16.0 mA

* Measured in a 50-ohm system at +5 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point .... +20 dBm (Typ.)
Second Order Two Tone Intercept Point .... +14 dBm (Typ.)
Third Order Two Tone Intercept Point .... +10 dBm (Typ.)

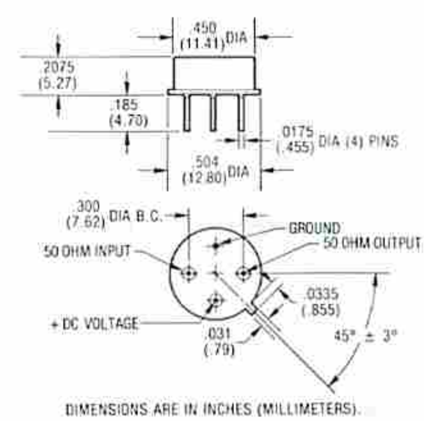
Absolute Maximum Ratings

Storage Temperature .... -62°C to +125°C
Maximum Case Temperature .... +125°C
Maximum DC Voltage .... +13 Volts
Maximum Continuous RF Input Power .... +6 dBm
Maximum Short Term RF Input Power (1 Minute Max.) .... 50 Milliwatts
Maximum Peak Power .... 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) .... +125°C

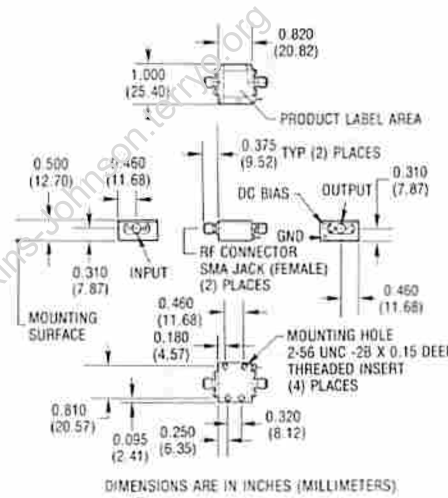
Weight approximately 2.0 grams (0.07 oz.)

Outline Drawings

A83



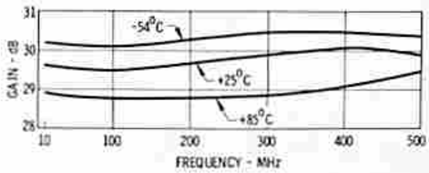
CA83

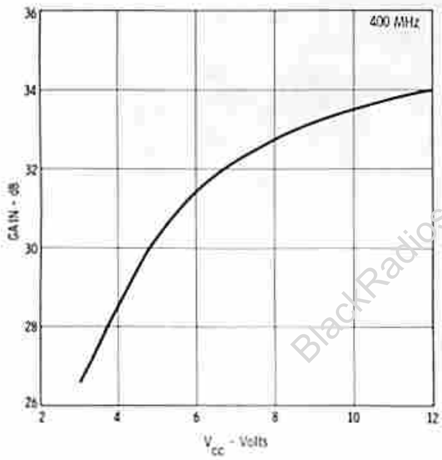


*WJ CA83 is standard WJ-A83 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range

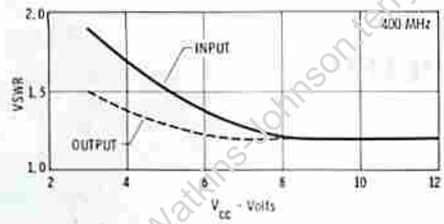
Typical Performance at 25°C

Gain

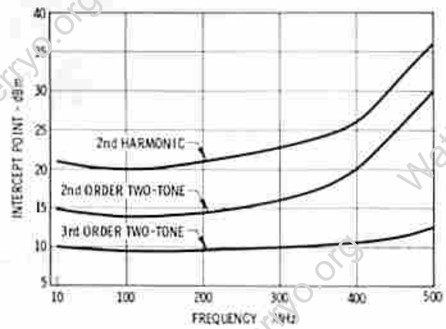




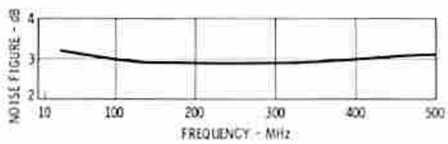
VSWR



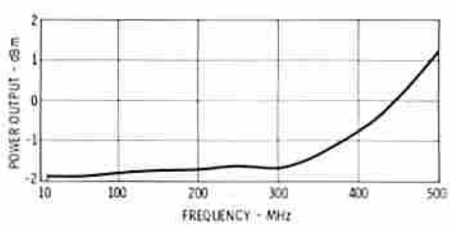
Intercept Point

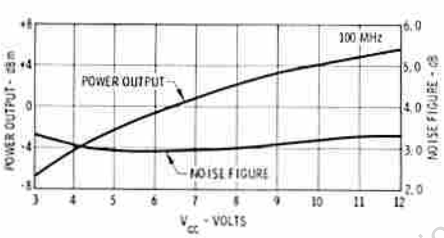


Noise Figure



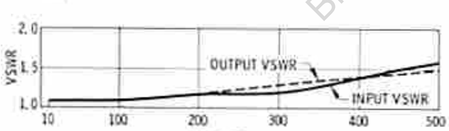
Power Output *





* at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

$V_{CC} = 5V$

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.1	29.9
200.	1.2	1.1	30.2
300.	1.3	1.2	30.3
400.	1.4	1.4	30.3
500.	1.6	1.5	30.0
600.	2.1	1.7	29.5
700.	2.0	2.3	28.5
800.	3.2	3.0	25.5

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.07	-13.3	31.38	-43.7	.01	-21.4	.05	-139.2
200.	.09	-20.7	32.27	-89.3	.01	-11.0	.07	-140.2
300.	.12	-37.4	32.69	-136.9	.01	-14.0	.11	-149.4
400.	.17	-57.6	32.79	174.0	.01	-17.1	.15	-171.7
500.	.24	[illegible]	31.51	123.3	.01	-25.0	.20	[illegible]
600.	.35	-119.2	29.94	70.6	.01	-37.3	.26	102.5
700.	.48	-160.7	26.74	12.6	.02	-56.7	.40	[illegible]
800.	.52	150.1	18.79	-51.6	.02	-90.2	.59	-30.7

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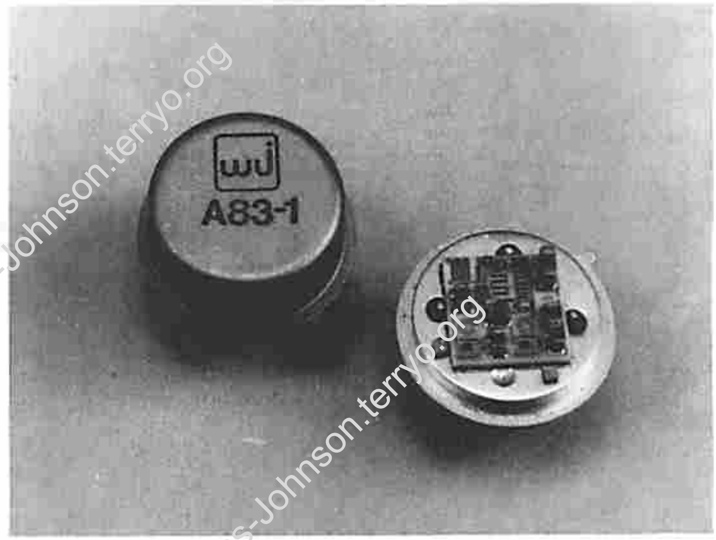
WJ-A83-1

10 TO 250 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH GAIN – TWO STAGES: 34 dB (MIN.)
- LOW POWER DRAIN: 65 mW @ 5 VOLTS
- VOLTAGE CONTROLLED GAIN: 28 dB TO 39 dB @ V_{CC} = 3 TO 12 VOLTS
- LOW VSWR OVER FULL CONTROL RANGE: < 1.5:1 (TYP.)



Specifications*

Characteristic	Typical	Guaranteed 0°-50°C	-54°C – +85°C
Frequency (Min.)	10-300 MHz	10-250 MHz	10-250 MHz
Small Signal Gain (Min.)	35.5 dB	34.0 dB	33.0 dB
Gain Flatness (Max.)	±0.3 dB	±0.5 dB	±0.8 dB
Noise Figure (Max.)	2.5 dB	3.0 dB	3.5 dB
Power Output at 1 dB Compression (Min.)	-1.5 dBm	-2.5 dBm	-3.5 dBm
VSWR (Max.) Input/Output	1.3:1	1.8:1	2.0:1
DC Current (Max.) at 5 Volts	13.0 mA	15.0 mA	16.0 mA

* Measured in a 50-ohm system at +5 Vdc Nominal.

Typical Intermodulation Performance at 25°C

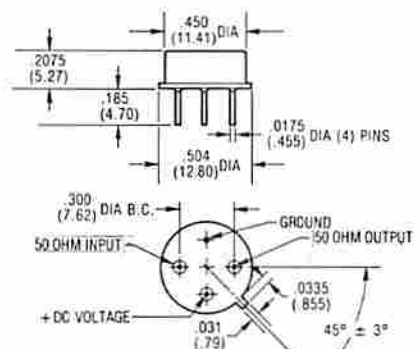
Second Order Harmonic Intercept Point . . . . +18 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +12 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +9 dBm (Typ.)

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . +125°C
Maximum DC Voltage . . . . +13 Volts
Maximum Continuous RF Input Power . . . . +6 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . +125°C

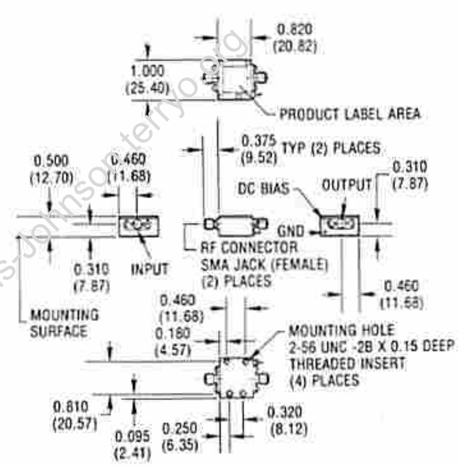
Outline Drawings

A83-1



DIMENSIONS ARE IN INCHES (MILLIMETERS).

CA83-1



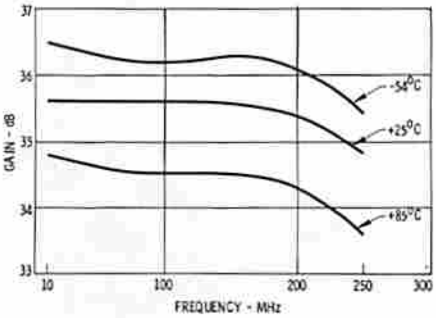
DIMENSIONS ARE IN INCHES (MILLIMETERS)

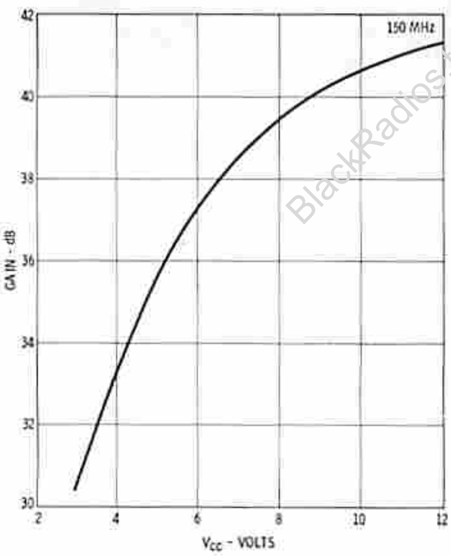
*WJ CA83-1 is standard WJ-A83-1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

Weight approximately 2.0 grams (0.07 oz.)

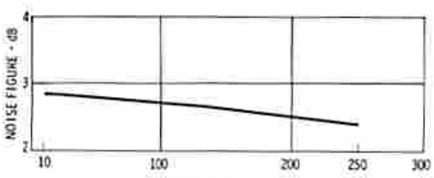
Typical Performance at 25°C

Gain

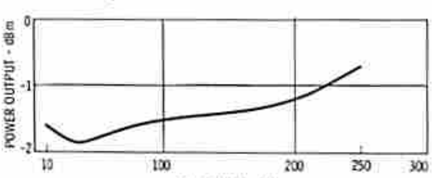


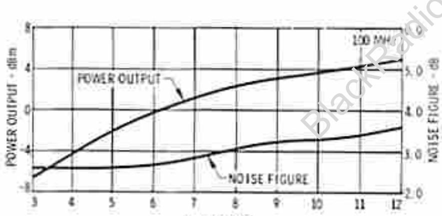


Noise Figure



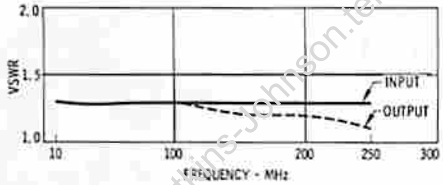
Power Output *

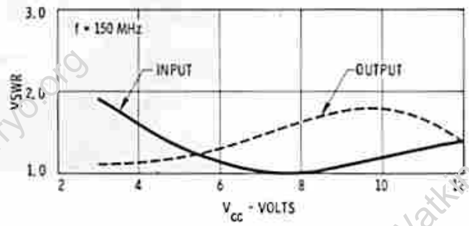




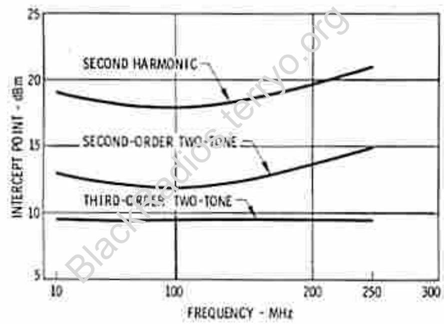
* at 1 dB Gain Compression

VSWR





Intercept Point



Typical Automatic Test Data

V_{CC} = 5V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.2	36.0
150.	1.1	1.1	36.0
200.	1.1	1.2	35.8
250.	1.1	1.2	35.3
300.	1.2	1.1	34.4

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.05	-26.3	62.86	-29.0	.01	-10.5	.09	-90.6
150.	.06	-3.7	63.07	-59.1	.00	98.4	.07	-158.9
200.	.03	-6.0	62.00	-81.4	.01	58.0	.08	-176.5
250.	.05	-.4	57.95	-104.4	.01	50.4	.07	-179.2
300.	.08	-5.5	52.78	-125.7	.01	40.0	.07	178.2
350.	.11	-17.4	46.85	-145.9	.01	45.1	.07	-179.2
400.	.15	-22.7	41.55	-165.0	.01	65.9	.08	-172.4
450.	.19	-40.9	37.17	178.2	.01	72.3	.11	-177.2
500.	.24	-44.6	33.80	161.5	.01	92.3	.16	172.5

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WJ-A86

10 TO 200 MHz TO-8 CASCADABLE AMPLIFIER

- HIGH GAIN - TWO STAGES: 28 dB (TYP.)
- HIGH EFFICIENCY: 21 mA @ 5 VDC (85 mW)
- LOW NOISE: 3.8 dB (TYP.)
- MEDIUM OUTPUT LEVEL: +9.0 dBm (TYP.)
- MEDIUM THIRD ORDER I.P.: 20 dBm (TYP.)

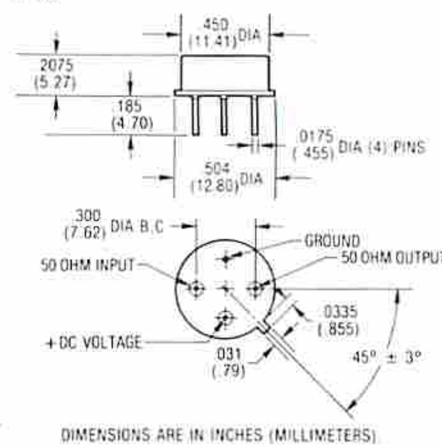
Specifications *

Characteristic	Typical	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	3-250 MHz	10-200 MHz	10-200 MHz
Small Signal Gain (Min.)	28 dB	27 dB	26 dB
Gain Flatness (Max.)	±.3 dB	±.8 dB	±1.0 dB
Noise Figure (Max.)	3.8 dB	4.5 dB	5.0 dB
Power Output at 1 dB Compression (Min.)	9.0 dBm	7.5 dBm	7.0 dBm
VSWR (Max.) Input/Output	<1.5:1	1.9:1	2.0:1
DC Current at 5 Volts	21 mA	23 mA	25 mA

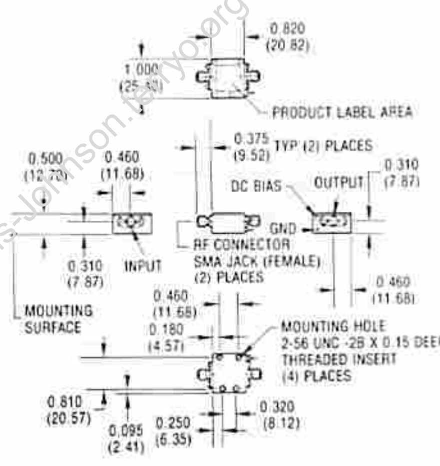
*Measured in a 50 ohm system at +5 Vdc.

Outline Drawings

A86



CA86



*WJ CA86 is standard WJ A86 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 36 dBm (Typ.)
Second Order Two-Tone Intercept Point . . . . 32 dBm (Typ.)
Third-Order Two-Tone Intercept Point . . . . 20 dBm (Typ.)

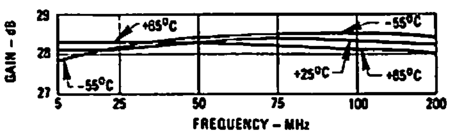
Absolute Maximum Ratings

Storage Temperature	-62°C to +125°C
Maximum Case Temperature	125°C
Maximum DC Voltage	8 Volts
Maximum Continuous RF Input Power	+6 dBm
Maximum Short Term RF Input Power (1 Minute Max.)	50 mW
Maximum Peak Power	0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case)	+125°C

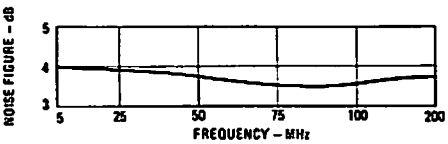
Weight approximately 2.0 grams (0.07 oz.)

Typical Performance at 25°C

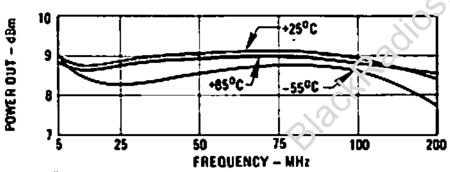
Gain



Noise Figure

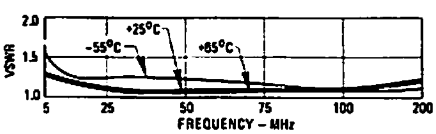


Power Output*

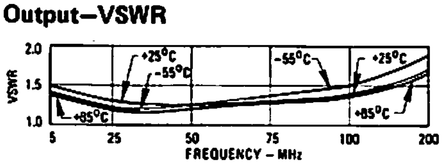


*at 1 dB Gain Compression

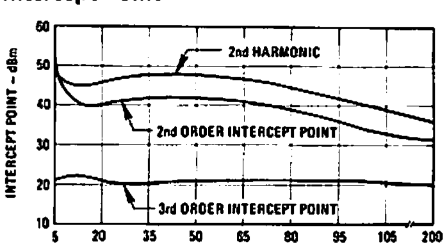
Input–VSWR



Output–VSWR



Intercept Point



Typical Automatic Test Data

$V_{CC} = 5$ V

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.0	1.30	1.50	27.6
10.0	1.25	1.30	27.8
50.0	1.10	1.26	28.4
100.0	1.09	[illegible]	28.5
150.0	1.08	[illegible]	28.4
200.0	1.10	1.69	28.2
250.0	1.11	2.00	28.0

Linear S Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
5.0	0.131	159	23.99	17	0.01	7	0.200	77
10.0	0.110	151	[illegible]	8	0.01	[illegible]	0.132	42
50.0	0.049	127	26.21	-12	0.01	-6	0.113	-41
100.0	0.041	117	26.47	-30	0.01	-4	0.143	-87
150.0	0.037	90	26.17	-47	0.01	-2	0.183	-128
200.0	0.049	46	25.84	-66	0.01	0	0.256	-158
250.0	0.050	13	25.23	-84	0.01	2	0.333	174
300.0	0.057	-21	23.92	-99	0.01	3	0.420	148

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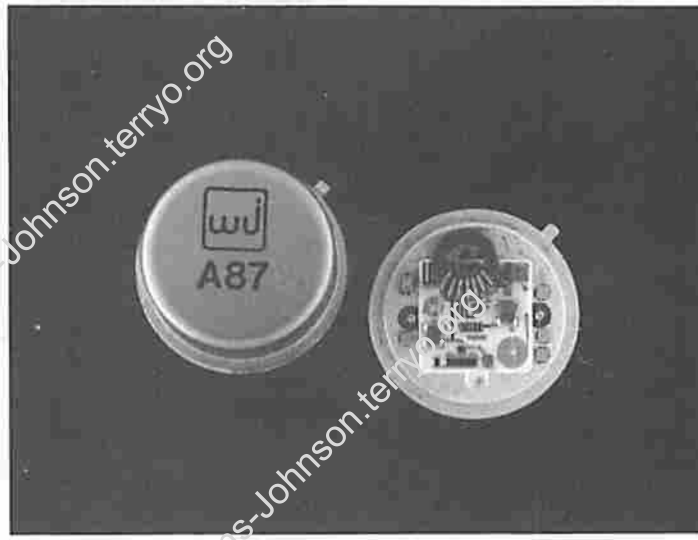
WJ-A87

10 TO 400 MHz TO-8 CASCADABLE AMPLIFIER



- HIGH OUTPUT LEVEL: +17 dBm (TYP.)
- HIGH EFFICIENCY: 31 mA CURRENT DRAIN
- HIGH THIRD ORDER I.P.: +32 dBm (TYP.)
- WIDE POWER SUPPLY RANGE: +5 TO +15 VOLTS

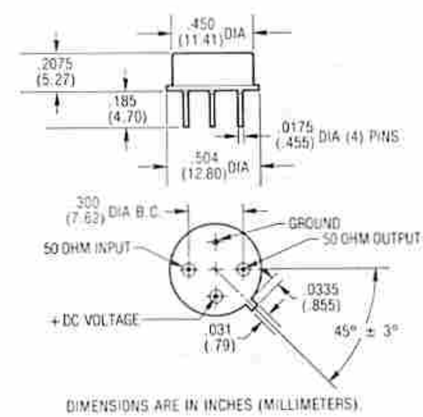
Specifications*

Characteristic	Typical	Guaranteed 0° -50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	5-450 MHz	10-400 MHz	10-400 MHz
Small Signal Gain (Min.)	12.5 dB	12.0 dB	11.5 dB
Gain Flatness (Max.)	±0.3 dB	±0.5 dB	±0.7 dB
Noise Figure (Max.)	4.7 dB	5.5 dB	6.0 dB
Power Output at 1 dB Compression (Min.)	> +17.0 dBm	+16.0 dBm	+16.0 dBm
VSWR (Max.)			
Input	< 1.3:1	1.7:1	2.0:1
Output	< 1.6:1	2.0:1[1]	2.0:1[1]
DC Current (Max.) at 15 Volts	31 mA	35 mA	37 mA

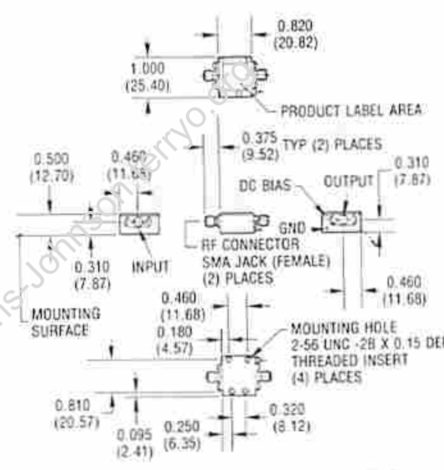
*Meausured in a 50-ohm system at +15 Vdc Nominal.
Note: 1. Up to 350 MHz; 2.2:1 Max. from 350 to 400 MHz.

Outline Drawings

A87



CA87



*WJ-CA87 is standard WJ-A87 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . > +50 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . > +46 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +32 dBm (Typ.)

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +17 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

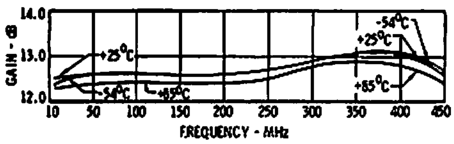
Weight

approximately 2.0 grams (0.07 oz.)

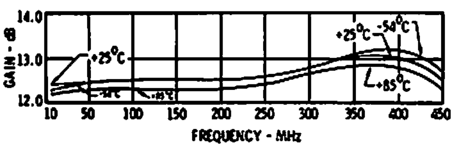
Typical Performance at 25°C

Gain

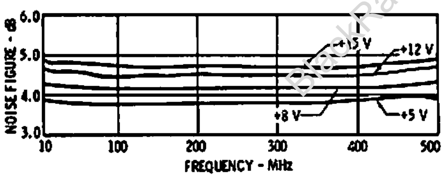
V_{CC} = 15 V



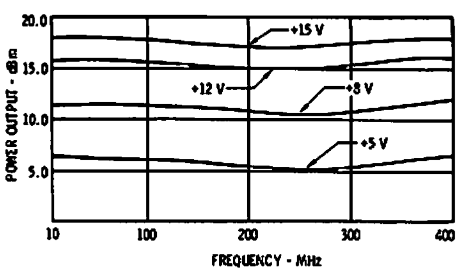
V_{CC} = 12 V



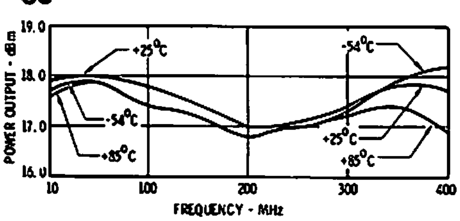
Noise Figure



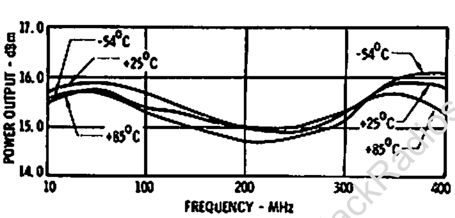
Power Output *



V_{CC} = 15 V

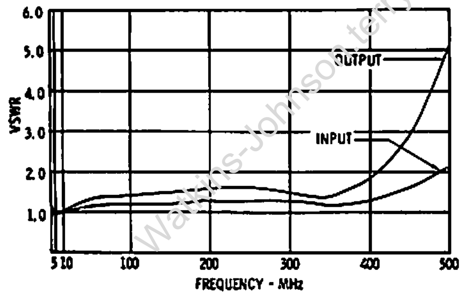


V_{CC} = 12 V

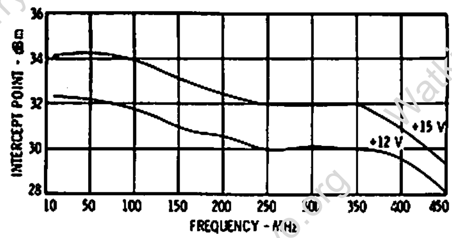


*at 1 dB Gain Compression

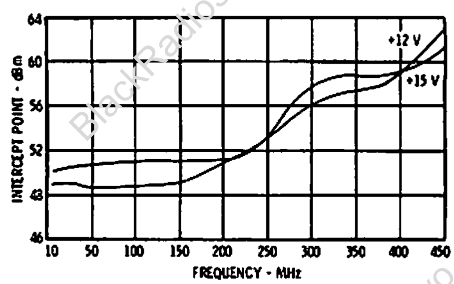
VSWR



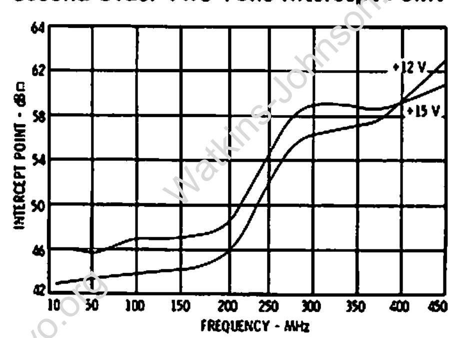
Third Order Two Tone Intercept Point



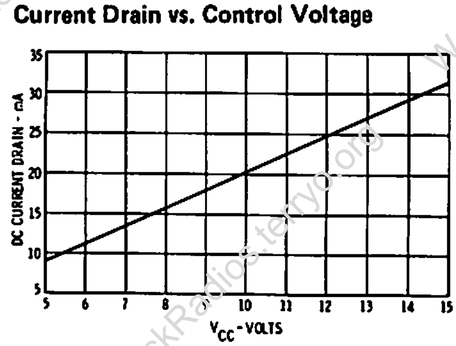
Second Order Harmonic Intercept Point



Second Order Two Tone Intercept Point



Current Drain vs. Control Voltage



1

Typical Automatic Test Data

V_{CC} = 5 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.4	11.3
150.	1.2	1.6	11.4
200.	1.3	1.7	11.3
250.	1.2	1.7	11.4
300.	1.2	1.6	11.6
350.	1.1	1.7	12.0
400.	1.2	2.1	11.8
450.	1.5	3.4	11.0
500.	1.8	6.1	8.8

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.08	26.4	3.60	152.1	.14	-13.6	.10	-133.1
150.	.10	22.0	3.70	140.7	.13	-17.9	.24	-149.8
200.	.12	12.3	3.66	129.3	.13	-22.9	.26	-169.1
250.	.11	4.0	3.73	118.6	.13	-28.1	.27	167.6
300.	.09	-1.6	3.82	105.9	.13	-35.1	.31	133.2
350.	.05	20.6	3.96	90.3	.14	-44.4	.35	81.0
400.	.09	73.1	3.88	71.0	.13	-56.8	.36	23.3
450.	.19	71.3	3.56	47.1	.12	-70.7	.55	-19.7
500.	.20	54.0	2.74	25.6	.10	-85.0	.72	-53.0

V_{CC} = 8 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.4	12.2
150.	1.2	1.6	12.1
200.	1.3	1.7	12.0
250.	1.3	1.7	12.2
300.	1.2	1.6	12.5
350.	1.2	1.6	12.7
400.	1.3	2.1	12.5
450.	1.6	3.3	11.8
500.	2.0	5.9	9.7

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.07	70.2	4.07	153.2	.13	-13.7	.17	-142.5
150.	.10	53.5	4.04	142.4	.13	-17.8	.22	-155.7
200.	.11	40.6	4.00	131.6	.13	-22.9	.25	-173.4
250.	.11	32.1	4.08	121.3	.13	-28.9	.25	163.9
300.	.10	30.7	4.19	108.0	.13	-35.6	.22	129.6
350.	.09	46.4	4.32	93.9	.13	-44.8	.23	77.3
400.	.13	70.0	4.23	75.5	.13	-57.0	.35	21.7
450.	.23	69.0	3.91	52.4	.12	-70.6	.54	-19.9
500.	.33	53.4	3.05	30.7	.10	-85.7	.71	-52.9

V_{CC} = 12 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.4	12.5
150.	1.2	1.5	12.5
200.	1.3	1.6	12.5
250.	1.3	1.6	12.6
300.	1.2	1.5	12.8
350.	1.2	1.5	13.1
400.	1.3	1.8	13.0
450.	1.6	2.9	12.5
500.	2.1	5.4	10.5

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.08	87.4	4.21	156.2	.13	-10.9	.16	-147.2
150.	.10	67.8	4.22	145.8	.13	-15.8	.21	-156.3
200.	.12	52.5	4.20	135.0	.13	-20.7	.23	-171.0
250.	.12	44.9	4.20	126.2	.13	-26.5	.23	167.6
300.	.11	41.5	4.37	114.9	.13	-33.3	.20	136.5
350.	.10	52.6	4.51	101.4	.13	-41.6	.20	84.8
400.	.14	73.0	4.45	83.8	.13	-52.3	.30	26.7
450.	.23	73.6	4.30	62.1	.12	-65.3	.49	-16.0
500.	.35	59.5	3.35	40.8	.10	-80.5	.69	-48.5

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.4	12.6
150.	1.2	1.5	12.6
200.	1.3	1.6	12.6
250.	1.3	1.6	12.7
300.	1.3	1.5	12.9
350.	1.2	1.4	13.1
400.	1.3	1.8	13.0
450.	1.6	2.9	12.6
500.	2.1	5.1	10.6

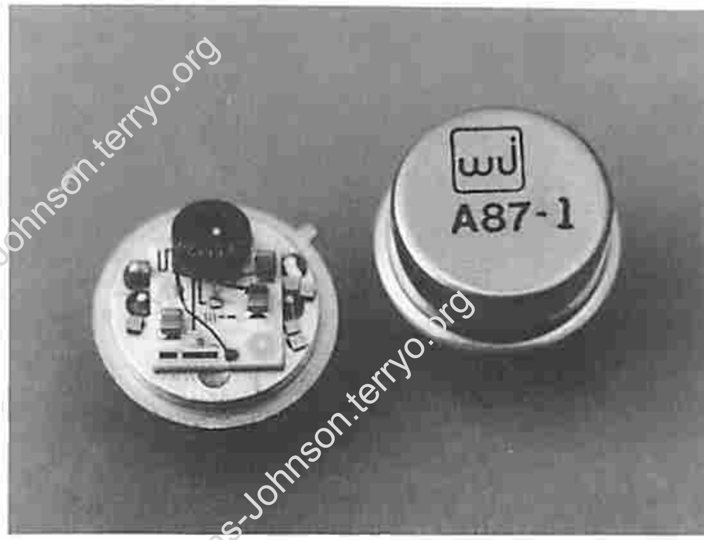
Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.08	89.8	4.25	156.3	.13	-11.2	.15	-149.9
150.	.10	69.9	4.27	145.9	.13	-15.8	.20	-157.7
200.	.12	55.4	4.24	136.0	.13	-21.2	.22	-172.9
250.	.12	47.0	4.32	126.4	.12	-27.0	.22	167.4
300.	.11	43.2	4.41	115.2	.13	-33.8	.19	136.2
350.	.11	53.9	4.54	101.9	.13	-42.2	.18	82.8
400.	.15	72.3	4.48	84.5	.12	-52.9	.28	24.4
450.	.24	73.0	4.24	63.1	.12	-65.7	.48	-17.3
500.	.35	58.8	3.41	41.5	.10	-81.2	.67	-48.9

WJ-A87-1

5 TO 400 MHz TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT LEVEL: +17 dBm (TYP.)
- HIGH EFFICIENCY: 33 mA AT 15 VOLTS
- HIGH THIRD ORDER I.P.: +32 dBm (TYP.)
- WIDE POWER SUPPLY RANGE: +5 TO +15 VOLTS



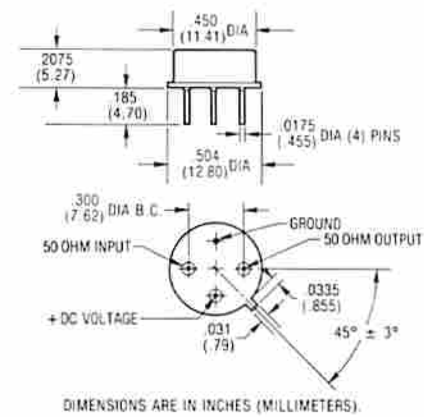
Specifications*

Characteristic	Typical	Guaranteed 0° - 50°C	-54°C - +85°C
Frequency (Min.)	5-450 MHz	10-400 MHz	10-400 MHz
Small Signal Gain (Min.)	15.5 dB	14.5 dB	14.0 dB
Gain Flatness (Max.)	±.5 dB	±.7 dB	±1.0 dB
Noise Figure (Max.)	3.6 dB	4.5 dB	5.0 dB
Power Output at 1 dB Compression (Min.)			
V_{CC} = +15 Volts	+17.0 dBm	+15.5 dBm	+15.0 dBm
V_{CC} = +12 Volts	+15.0 dBm	+13.7 dBm	+13.0 dBm
VSWR (Max.) Input/Output	1.5:1	2.0:1	2.0:1
DC Volts (nominal) 15;			
DC Current at 15 Volts	33 mA	35 mA	37 mA

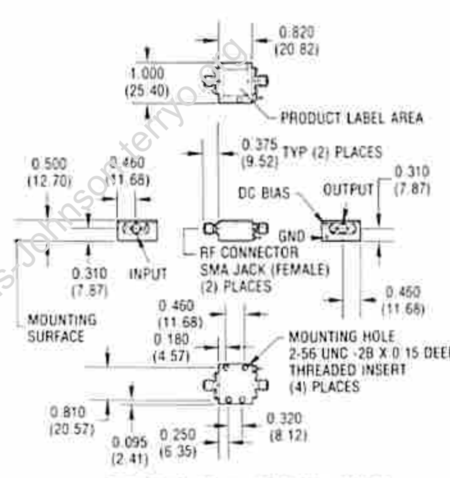
*Measured in a 50 ohm system at +15 Vdc.

Outline Drawings

A87 - 1



CA87 - 1



*WJ CA87-1 is standard WJ A87-1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point	>+47 dBm (Typ.)
Second Order Two-Tone Intercept Point	>+42 dBm (Typ.)
Third-Order Two-Tone Intercept Point	>+31 dBm (Typ.)

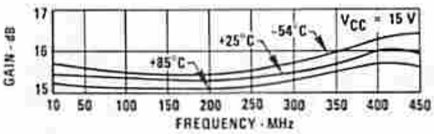
Absolute Maximum Ratings

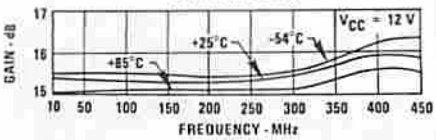
Storage Temperature	-62°C to +125°C
Maximum Case Temperature	125°C
Maximum DC Voltage	+17 Vdc
Maximum Continuous RF Input Power	+13 dBm
Maximum Short Term RF Input Power (1 Minute Max.)	50 milliwatts
Maximum Peak Power	0.5 Watt (3 µsec Max.)
"S" Series Burn-In Temperature (Case)	125°C

Weight approximately 2.0 grams (0.07 oz.)

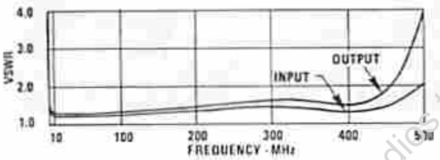
Typical Performance at 25°C

Gain

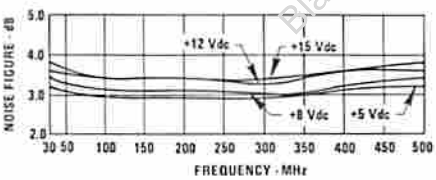




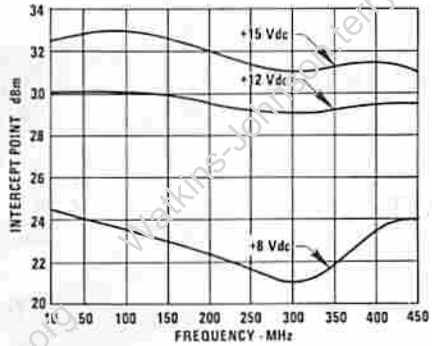
VSWR



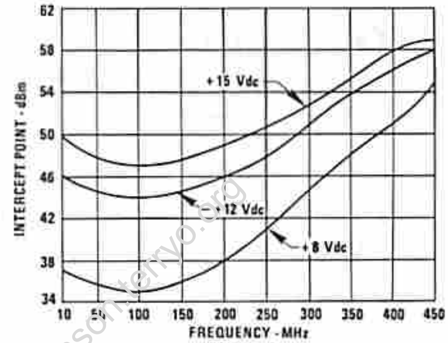
Noise Figure



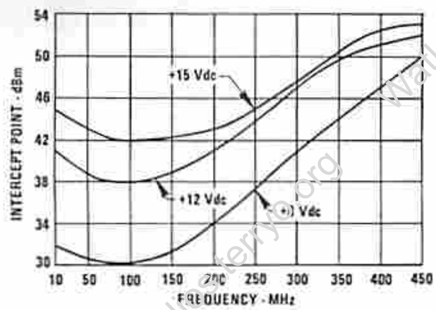
Third Order Two-Tone Intercept Point



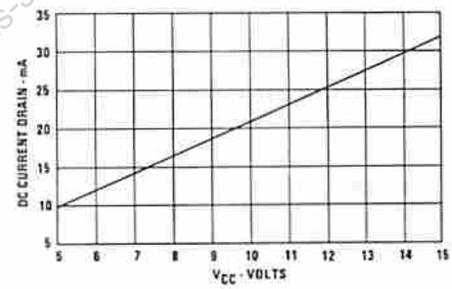
Second Order Harmonic Intercept Point



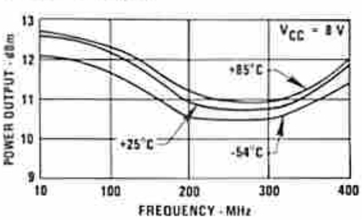
Second Order Two-Tone Intercept Point

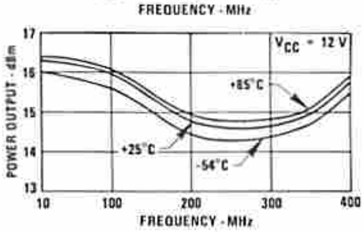


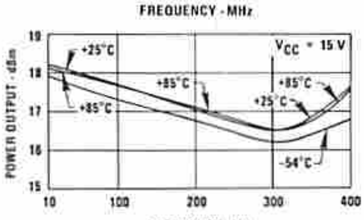
Current Drain

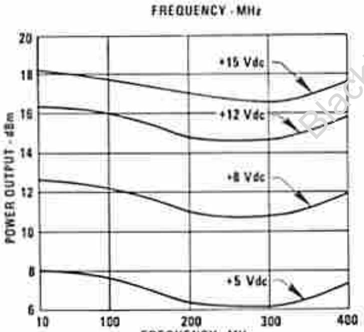


Power Output*









*at 1 dB Gain Compression

Typical Automatic Test Data

V_{CC} = 5 V

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.0	1.29	1.35	14.4
10.0	1.14	1.13	14.5
50.0	1.14	1.17	14.6
100.0	1.30	1.45	14.4
150.0	1.45	1.74	14.2
200.0	1.52	1.97	14.1
250.0	1.58	2.09	14.1
300.0	1.57	2.00	14.2
350.0	1.47	1.80	14.6
400.0	1.25	1.65	14.8

V_{CC} = 8 V

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.0	1.23	1.39	14.9
10.0	1.11	1.19	15.0
50.0	1.12	1.19	15.0
100.0	1.28	1.41	14.9
150.0	1.43	1.65	14.7
200.0	1.51	1.85	14.7
250.0	1.59	1.95	14.7
300.0	1.53	1.87	14.8
350.0	1.48	1.69	15.1
400.0	1.30	1.53	15.4

V_{CC} = 12 V

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.0	1.31	1.44	15.2
10.0	1.12	[illegible]	15.2
50.0	1.13	1.18	15.2
100.0	1.30	1.37	15.1
150.0	1.45	1.57	14.9
200.0	1.54	1.76	14.9
250.0	1.60	1.84	15.0
300.0	1.59	1.76	15.1
350.0	1.50	1.57	15.4
400.0	1.32	1.41	15.7

V_{CC} = 15 V

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.0	1.34	1.47	15.4
10.0	1.15	1.27	15.3
50.0	1.13	1.23	15.4
100.0	1.26	1.42	15.4
150.0	1.38	1.63	15.2
200.0	1.47	1.70	15.1
250.0	1.54	1.84	15.2
300.0	1.54	1.72	15.3
350.0	1.47	1.56	15.5
400.0	1.32	1.36	15.8
450.0	1.36	1.69	15.8

Linear S Parameters at +15 Vdc

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
5.0	0.144	-93	5.86	-174	0.09	5	0.190	131
10.0	0.070	-123	5.82	-180	0.09	1	0.110	145
50.0	0.061	109	5.90	161	0.09	-14	0.101	-160
100.0	0.116	61	5.86	140	0.09	-29	0.173	-152
150.0	0.159	30	5.74	120	0.09	-44	0.241	-163
200.0	0.192	5	5.70	100	0.09	-58	0.281	-178
250.0	0.213	-20	5.72	80	0.09	-72	0.295	164
300.0	0.212	-41	5.61	61	0.09	-85	0.266	143
350.0	0.198	-61	5.43	39	0.09	-101	0.216	114
400.0	0.139	-64	6.14	18	0.09	-121	0.151	49
450.0	0.151	-39	6.14	[illegible]	0.09	-143	0.256	-35

1

WJ-A87-2

5 TO 300 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH EFFICIENCY: 13 mA AT 5 VOLTS WITH ≥ 9.5 dBm OUTPUT POWER (TYP.)
- LOW NOISE FIGURE: 3.0 dB (TYP.)
- LOW VSWR: <1.5:1 (TYP.)

Specifications*

Characteristics	Typical	Guaranteed 0° – 50°C	Guaranteed -54°C – +85°C
Frequency (Min.)	5–350 MHz	10–300 MHz	10–300 MHz
Small Signal Gain (Min.)	15.5 dB	15.0 dB	14.5 dB
Gain Flatness (Max.)	±0.2 dB	±0.5 dB	±0.8 dB
Noise Figure (Max.)	3.0 dB	3.5 dB	4.0 dB
Power Output at 1 dB Compression (Min.)	+9.5 dBm	+9.0 dBm	+8.5 dBm
VSWR (Max.) Input/Output	<1.5:1	1.8:1	2.0:1
DC Current (Max.) at +5 Volts	14.5 mA	17 mA	18 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point .... >+37 dBm (Typ.)
Second Order Two Tone Intercept Point .... >+31 dBm (Typ.)
Third Order Two Tone Intercept Point .... >+23 dBm (Typ.)

Absolute Maximum Ratings

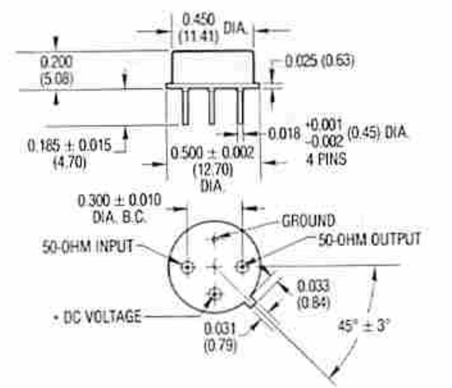
Storage Temperature .... -62°C to +125°C
Maximum Case Temperature .... 125°C
Maximum DC Voltage .... +10 Volts
Maximum Continuous RF Input Power .... +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) .... 50 Milliwatts
Maximum Peak Power .... 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) .... 125°C

Weight

approximately 2.0 grams (0.07 oz.)

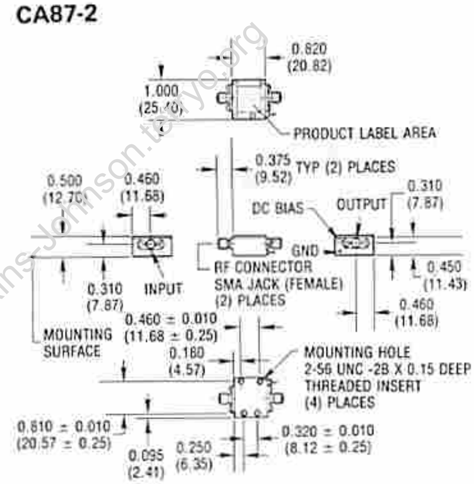
Outline Drawings

A87-2



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA87-2

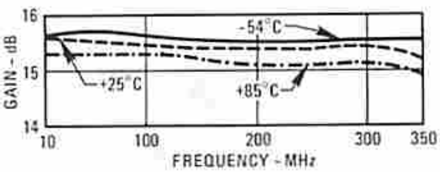


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

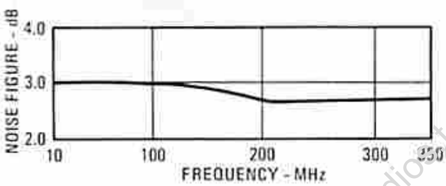
*WJ CA87-2 is standard WJ-A87-2 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

Typical Performance at 25°C

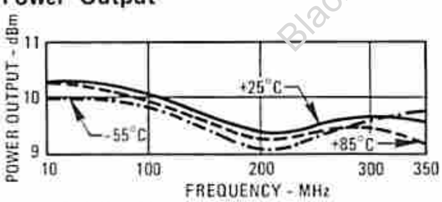
Gain



Noise Figure

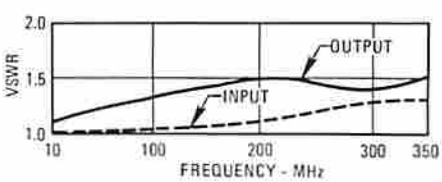


Power Output*

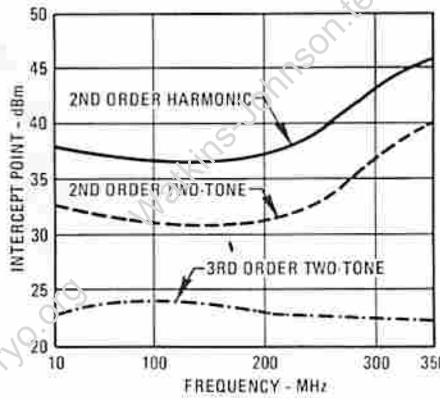


*at 1 dB Gain Compression

VSWR



Second Order Two-Tone Intercept Point



Typical Automatic Test Data

V_{CC} = 5V

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.0	1.20	1.29	15.4
10.0	[illegible]	1.12	15.4
50.0	1.01	1.13	15.5
100.0	1.04	1.32	15.4
150.0	1.07	1.49	15.2
200.0	1.11	1.55	15.2
250.0	1.17	1.52	15.1
300.0	1.24	1.41	15.2
350.0	1.36	1.42	15.1
400.0	1.47	1.93	14.7

V_{CC} = 8V

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.0	1.35	1.35	15.6
10.0	1.14	1.14	15.7
50.0	1.05	1.10	15.8
100.0	1.07	1.24	15.7
150.0	1.10	1.36	15.6
200.0	1.11	1.41	15.6
250.0	1.14	1.38	15.6
300.0	1.26	1.29	15.6

Linear S Parameters at 5 Vdc

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
5.0	0.129	-91	5.27	-174	0.08	5	0.123	110
10.0	0.059	-97	5.90	-179	0.09	2	0.058	114
50.0	0.006	154	5.37	162	0.10	-10	0.060	-125
100.0	0.021	27	5.56	142	0.10	-22	0.139	-138
150.0	0.035	-28	[illegible]	123	0.10	-33	0.197	-161
200.0	0.051	-58	5.75	104	0.10	-43	0.217	174
250.0	0.079	-94	5.70	85	0.10	-55	0.207	145
300.0	0.108	-129	5.74	[illegible]	0.10	-67	0.169	97
350.0	0.151	-163	5.78	42	0.10	-82	0.172	28
400.0	0.189	156	[illegible]	16	0.10	-101	0.316	-34
450.0	0.214	118	[illegible]	-10	0.10	-120	0.495	-74

1

WJ-A88

5 TO 500 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH GAIN: 18.7 dB (TYP.)
- HIGH OUTPUT POWER: +20.5 dBm (TYP.)
- HIGH THIRD ORDER I.P.: +30 dBm (TYP.)

Specifications*

Characteristics	Typical	Guaranteed 0° – 50°C	Guaranteed -54°C – +85°C
Frequency (Min.)	2-500 MHz	5-500 MHz	5-500 MHz
Small Signal Gain (Min.)	18.7 dB	18.0 dB	17.5 dB
Gain Flatness (Max.)	±0.3 dB	±0.5 dB	±0.7 dB
Noise Figure (Max.) +15 V	6.5 dB	7.5 dB	8.0 dB
+12 V	4.5 dB	5.5 dB	6.0 dB
Power Output at 1 dB Compression (Min.)	+20.5 dBm	+19.5 dBm	+19.0 dBm
VSWR (Max.) Input/Output	1.5:1	1.8:1	2.0:1
DC Current (Max.) at 15 Volts	79 mA	83 mA	87 mA

*Measured in a 50-ohm system at 15 Vdc.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +41 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +38 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +30 dBm (Typ.)

Absolute Maximum Ratings

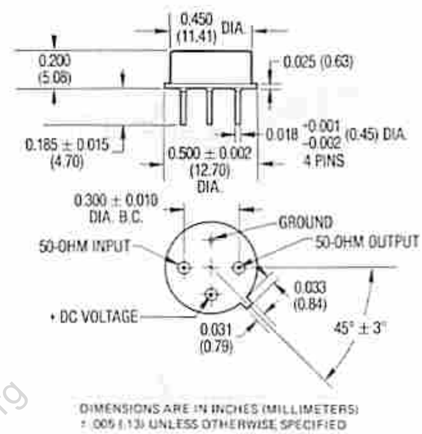
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . +100°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . +100°C

Weight

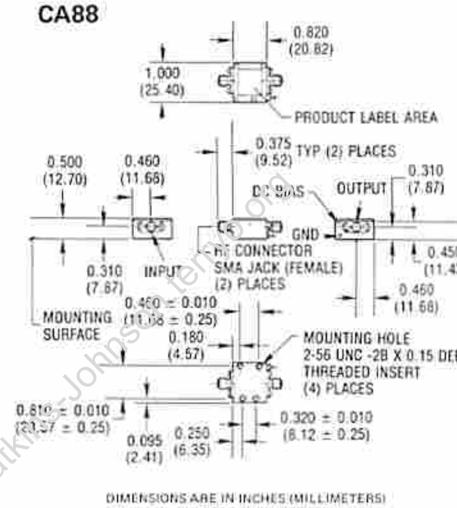
approximately 2.0 grams (0.07 oz.)

Outline Drawings

A88

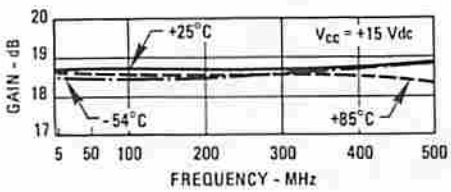


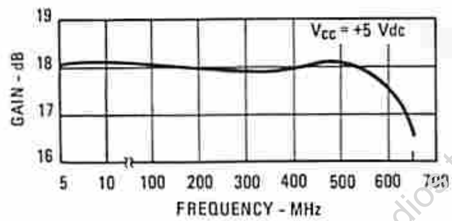
CA88



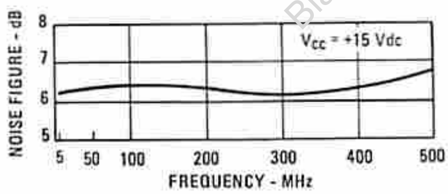
Typical Performance at 25°C

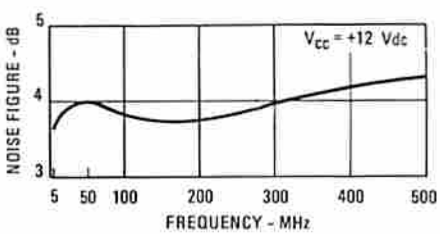
Gain

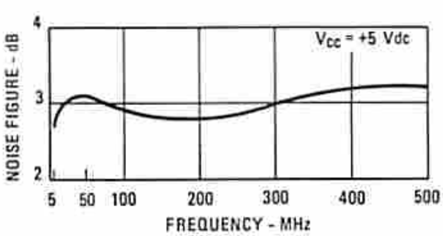




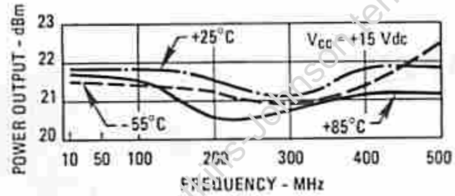
Noise Figure

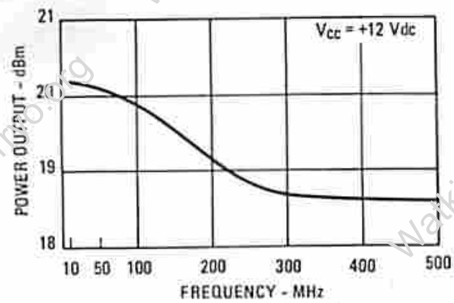


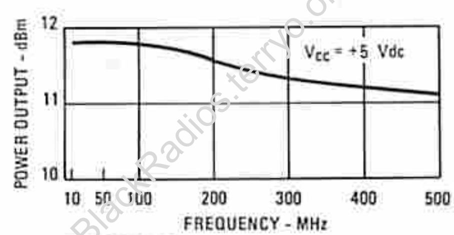




Power Output*

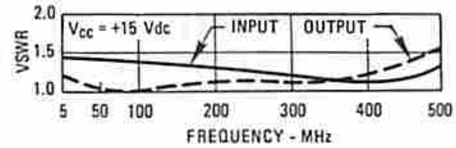


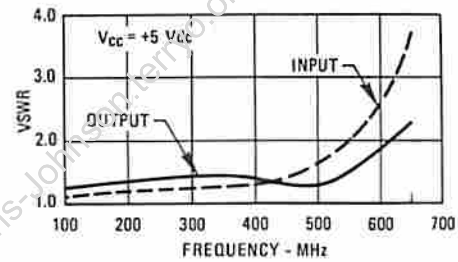




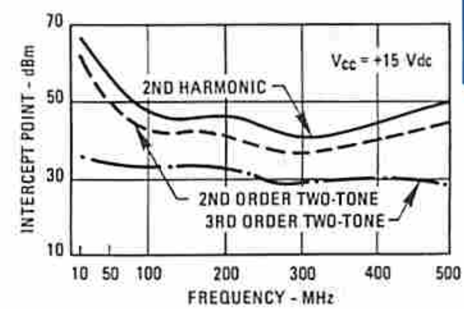
*at 1 dB Gain Compression

VSWR





Intercept Point



1

Typical Automatic Test Data

V_{CC} = +15.0 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
2.0	1.63	1.61	18.6
5.0	1.45	1.19	18.6
10.0	1.43	1.09	18.7
20.0	1.42	1.05	18.7
50.0	1.43	1.01	18.7
100.0	1.40	1.04	18.7
200.0	1.31	1.10	18.7
300.0	1.18	1.11	18.8
400.0	1.07	1.18	18.9
500.0	1.32	1.54	18.9
600.0	2.07*	3.11*	18.3

V_{CC} = +12.0 Vdc

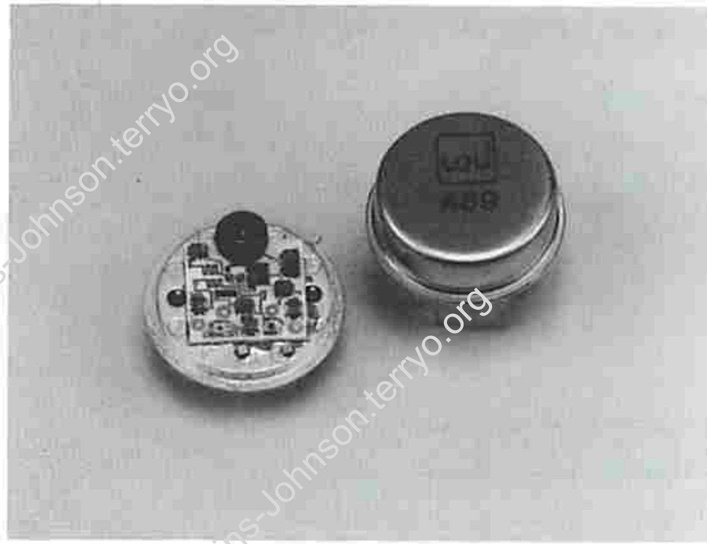
FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
100.0	[illegible]	1.1	18.2
200.0	[illegible]	1.1	18.6
300.0	1.1	1.2	18.7
400.0	1.1	1.2	19.1
500.0	1.4	1.5	19.2
600.0	2.2	3.0	18.3

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
0.5	0.121	-11	[illegible]	-92	0.03	-2	0.796	-127
2.0	0.241	-120	8.48	-156	0.06	27	0.234	125
5.0	0.185	-157	8.55	-170	0.06	9	0.088	112
10.0	0.176	-172	8.61	-179	0.06	3	0.044	112
20.0	0.175	179	8.65	175	0.06	-0	0.025	109
50.0	0.177	[illegible]	8.64	164	0.06	-5	0.006	176
100.0	0.166	142	8.60	146	0.06	-11	0.021	-132
200.0	0.135	102	8.57	112	0.06	-22	0.046	-137
300.0	0.082	55	8.69	78	0.07	-34	0.054	-178
400.0	0.032	-72	8.90	40	0.08	-51	0.082	101
500.0	0.137	167	8.85	-2	0.09	-73	0.213	41
600.0	0.349	107	8.19	-50	0.10	-104	0.513	-2

WJ-A89

50 TO 800 MHz
TO-8 CASCADABLE AMPLIFIER



- HIGH REVERSE ISOLATION: ⩾29 dB (TYP.)
- LOW INPUT VSWR: 1.4:1 (TYP.)
- LOW NOISE: 4.5 dB (TYP).
- MEDIUM LEVEL OUTPUT: 17.5 (TYP.)

Specifications*

Characteristics	Typical	Guaranteed 0° – +50°C	Guaranteed -54°C – +85°C
Frequency (Min.)	50-800 MHz	100-800 MHz	100-800 MHz
Small Signal Gain (Min.)	22.0 dB	21.0 dB	20.5 dB
Gain Flatness (Max.)	±0.5 dB	±0.8 dB	±1.0 dB
Noise Figure (Max.)	4.5 dB	5.5 dB	6.0 dB
Power Output at 1 dB Compression (Min.)	17.5 dBm	16.5 dBm	16.0 dBm
VSWR (Max.)			
Input	1.4:1	1.8:1	2.0:1
Output	1.7:1	2.0:1	2.2:1
DC Current (Max.) at 15 Volts	42 mA	48 mA	50 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 42 dBm (Typ.)
Second Order Two-Tone Intercept Point . . . . 35 dBm (Typ.)
Third-Order Two-Tone Intercept Point . . . . 30 dBm (Typ.)

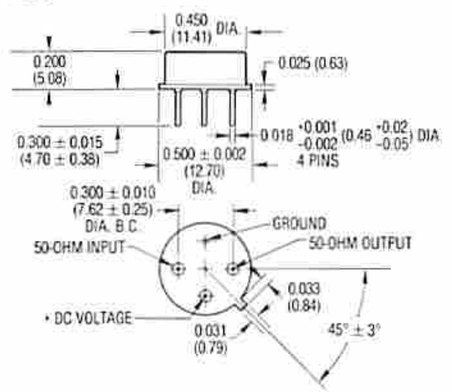
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . 17 Volts
Maximum Continuous RF Input Power . . . . 10 dBm
Maximum Short Term RF Input Power(1 Minute Max.) . . . . 50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 µsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

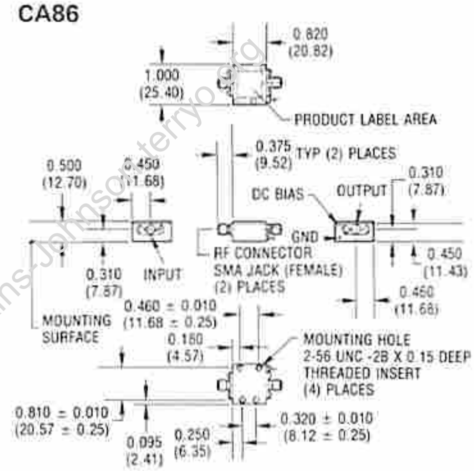
Outline Drawings

A86



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CA86



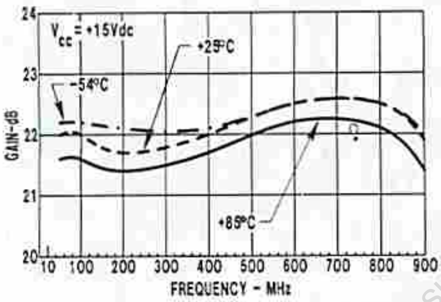
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

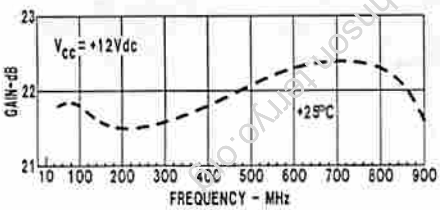
WJ-CA89 is standard.

WJ-CA89C installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

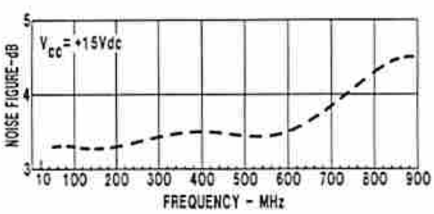
Typical Performance at 25°C

Gain vs. Temperature vs. Frequency

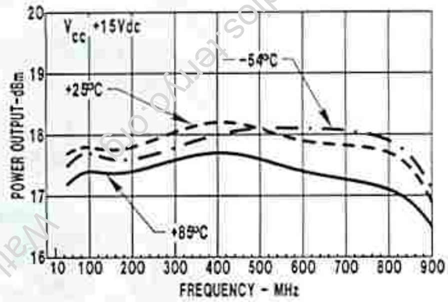


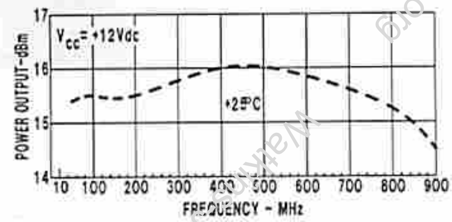


Noise Figure



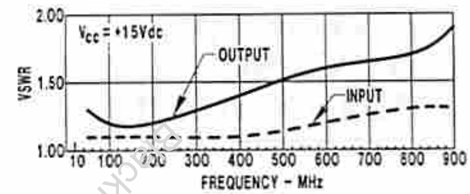
Power Output*

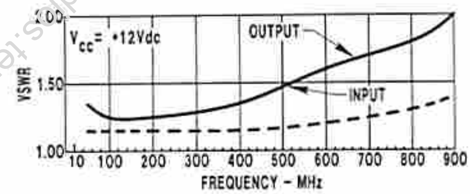




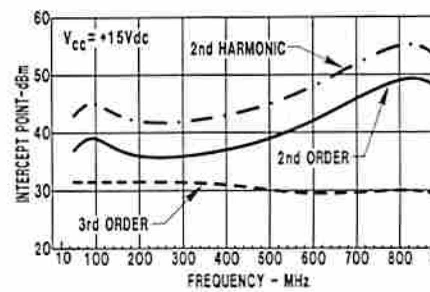
*at 1 dB Gain Compression

Input/Output VSWR





Intercept Point



1

Typical Automatic Test Data

V_{cc} = 15 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
50.0	1.1	1.3	22.0
100.0	1.1	1.2	22.0
200.0	1.1	1.2	21.7
300.0	1.1	1.3	21.8
400.0	1.1	1.4	22.0
500.0	1.1	1.5	22.3
600.0	1.2	1.6	22.5
700.0	1.2	1.7	22.5
800.0	1.3	1.7	22.5
900.0	1.3	1.9	21.9

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
50.0	.056	-82	12.648	-140	.026	-6	.120	130
100.0	.036	-88	12.549	-103	.026	-15	.103	123
200.0	.047	-92	12.222	-26	.026	-31	.101	82
300.0	.051	-123	12.281	51	.025	-47	.121	30
400.0	.055	-141	12.552	119	.027	-62	.149	-17
500.0	.060	-154	12.989	-166	.026	-84	.189	-66
600.0	.076	-165	13.294	-92	.025	-106	.228	-113
700.0	.094	179	13.458	-21	.024	-128	.248	-164
800.0	.115	168	13.289	48	.023	-154	.260	135
900.0	.148	159	12.491	103	.022	179	.311	70

V_{cc} = 12 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
50.0	1.1	1.3	21.8
100.0	1.1	1.2	21.8
200.0	1.1	1.2	21.5
300.0	1.1	1.2	21.6
400.0	1.1	1.3	21.8
500.0	1.2	1.4	22.1
600.0	1.2	1.6	22.3
700.0	1.3	1.7	22.4
800.0	1.3	1.8	22.3
900.0	1.4	2.0	21.7

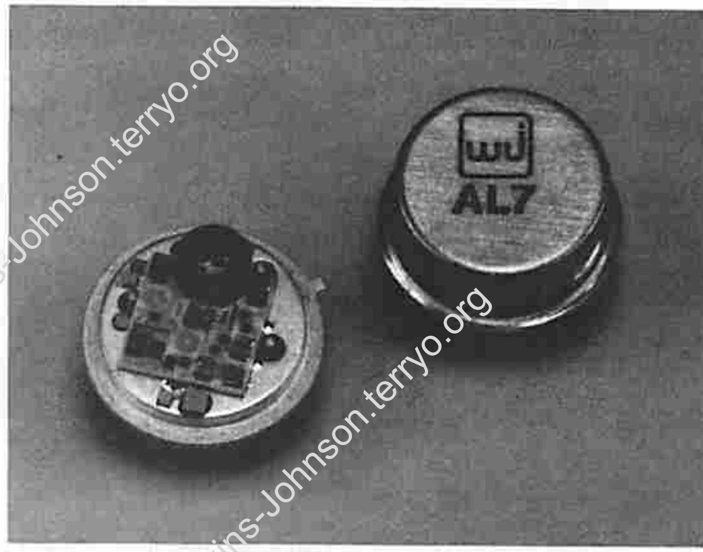
Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
50.0	.063	-68	12.329	-140	.027	-5	.111	127
100.0	.047	-85	12.252	-103	.027	-16	.093	122
200.0	.058	-78	11.926	-27	.026	-32	.092	81
300.0	.062	-109	12.011	51	.026	-48	.110	26
400.0	.066	-127	12.306	119	.027	-64	.139	-23
500.0	.073	-141	12.756	-166	.026	-85	.182	-73
600.0	.090	-155	13.080	-93	.025	-108	.223	-121
700.0	.112	-172	13.245	-22	.024	-131	.249	-173
800.0	.140	175	13.030	46	.023	-158	.276	125
900.0	.181	162	12.158	101	.020	175	.343	63

WJ-AL7

50 TO 500 MHz TO-8 CASCADABLE LIMITING AMPLIFIER

- SYMMETRICAL CLIPPING: GOOD EVEN-ORDER SUPPRESSION
- HIGH GAIN: 13 dB (TYP.)
- LOW VSWR: < 1.5:1 (TYP.)
- FAST PULSE RECOVERY TIME: < 50 NSEC



Specifications*

Characteristics	Typical	Guaranteed[1] 0°-50°C	-54°C-+85°C
Frequency (Min.)	20-550 MHz	50-500 MHz	50-500 MHz
Small Signal Gain (Min.)	13.0 dB	12.0 dB	11.0 dB
Gain Flatness (Max.)	±0.2 dB	±0.5 dB	±0.7 dB
Noise Figure (Max.)			
50-300 MHz	5.0 dB[2]	6.0 dB	6.5 dB
300-500 MHz	5.5 dB[2]	6.5 dB	7.0 dB
Power Output at 1 dB Compression (Min.)			
50-500 MHz	-1.5 dBm	-5.0 dBm	-7.0 dBm
Output Limiting Level (Max.)			
+10 dBm	0.5 dBm	1.5 dBm	2.5 dBm
VSWR (Max.)			
Input	1.1:1	1.7:1	1.7:1
Output	<1.5:1	2.0:1	2.0:1
DC Current at 15 Volts (Max.)	54 mA	57 mA	59 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Notes:

1. Third-Order I.P. (linear region) +20 dBm (Typ.)
2. Linear Region.

Absolute Maximum Ratings

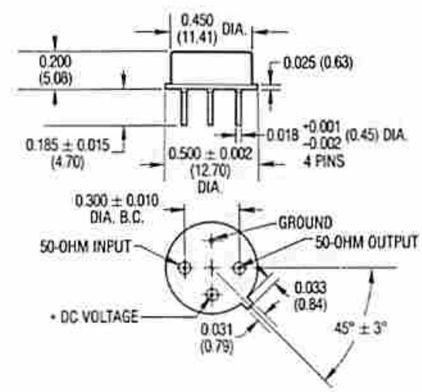
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . +125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term CW Input Power (1 Minute Max.) . . . . +50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight

approximately 2.0 grams (0.07 oz.)

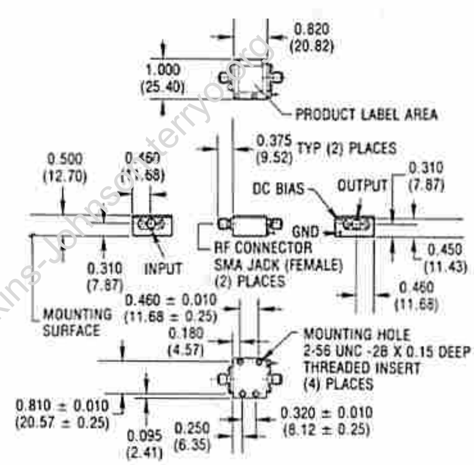
Outline Drawings

AL7



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CLA7



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C

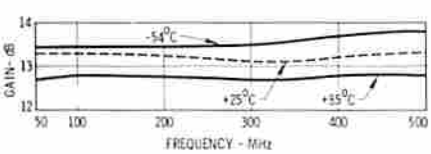
The model WJ-AL7 incorporates a balanced-bridge Schottky di ode output limiter using thin-film assembly techniques integrated with a medium-level input 20-500 MHz, 14 dB gain amplifier. The balanced-bridge yields symmetrical clipping of the signal which reduces even-order harmonic distortion. Its functional schematic is shown in Figure 1. Diodes D1 through D4 are used to provide the primary limiting, while diodes D5 through D8 provide hard limiting.

The WJ-AL7 is virtually identical to the WJ-LA7 except that the amplifier is placed in front of the limiter as opposed to the limiter in front of the amplifier. The pulse-recovery time is therefore the same. (Under 50 nsec for a single unit).

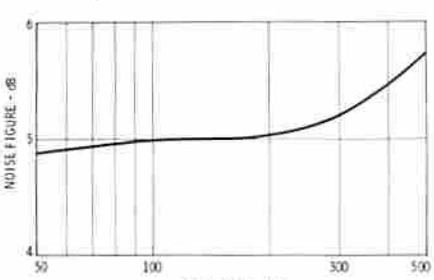
Reversing the positions results in an improved input noise figure and a reduced output power level.

The units are designed for cascaded operation with each additional stage offering approximatley 12 dB of increased limiting range.

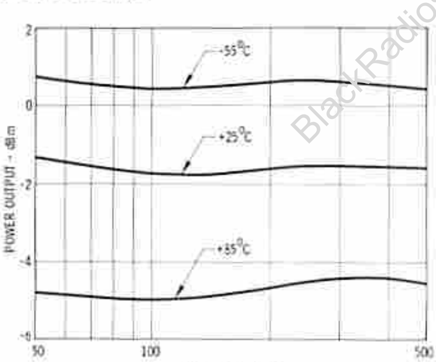
Gain (Linear)



Noise Figure

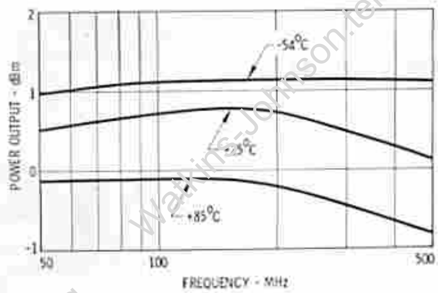


Power Output*

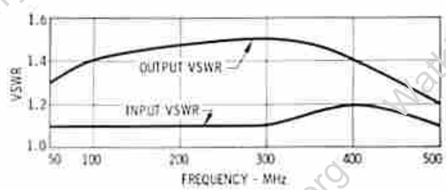


*at 1 dB Gain Compression

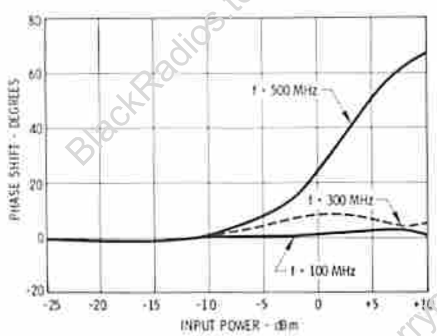
Power Output in Saturation



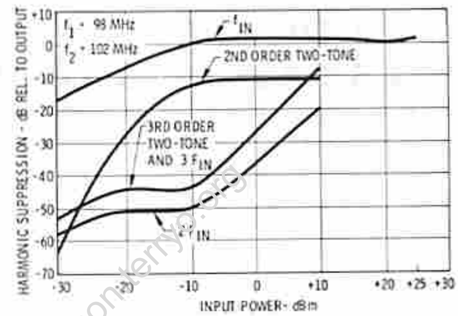
VSWR



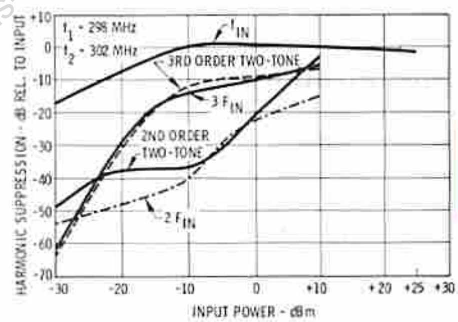
Phase Shift



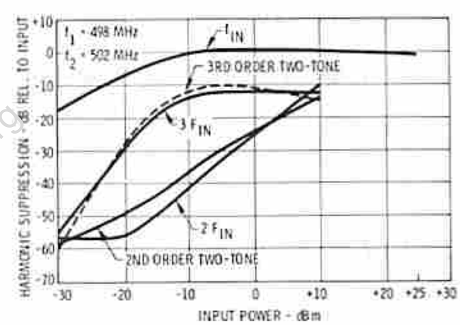
Harmonic Suppression (Curve A)



Harmonic Suppression (Curve B)



Harmonic Suppression (Curve C)



Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.4	13.1
200.	1.0	1.4	13.0
300.	1.1	1.5	12.9
400.	1.2	1.5	12.1
500.	1.0	1.2	13.2
600.	1.9	1.3	13.0

Linear S-Parameters

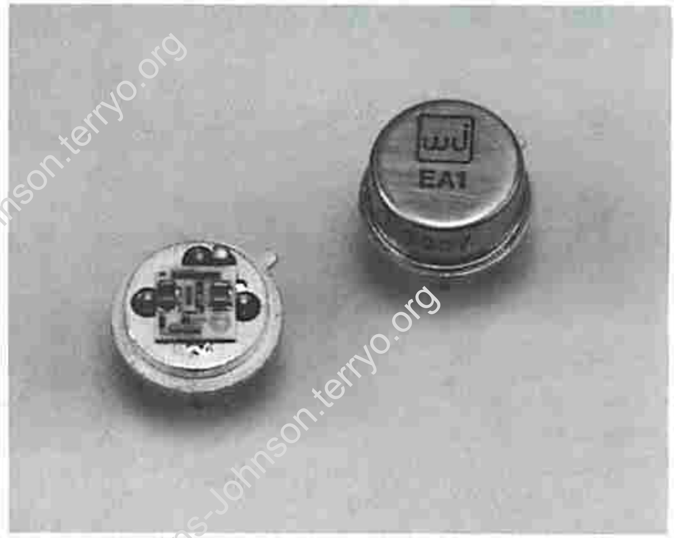
FREQ MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.02	[illegible]	4.54	158.0	.09	-2.3	.15	-31.1
200.	.02	[illegible]	4.49	133.3	.09	-7.4	.17	-52.4
300.	.07	[illegible]	4.44	108.3	.09	-14.3	.19	-78.2
400.	.02	-59.7	4.51	82.5	.10	-22.7	.19	-102.2
500.	.09	-26.2	4.57	52.3	.11	-37.9	.11	-129.0
600.	[illegible]	1.4	4.45	13.4	.11	-60.9	.12	-5.2
700.	.31	-44.7	3.25	-31.9	.09	-90.1	.44	-49.7
800.	.29	-61.6	1.66	-70.7	.06	-114.8	.60	-87.2

1

WJ-EA1

5 TO 400 MHz
TO-5 CASCADABLE AMPLIFIER

- LOW COST
- LOW NOISE: 4.3 dB (TYP.)
- ULTRA SMALL SIZE



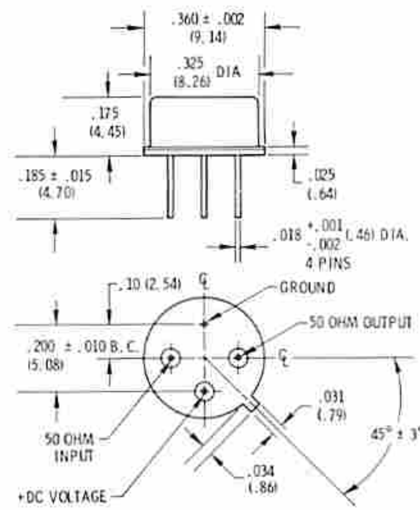
Specifications *

Characteristics	Guaranteed 0° - 50°C	-54°C - +85°C
Frequency (Min.)	5-400 MHz	5-400 MHz
Small Signal Gain (Min.)	14.0 dB	13.0 dB
Gain Flatness (Typ.)	±0.5 dB	
Noise Figure (Typ.)	4.3 dB	
Power Output at 1 dB Compression (Min.)	-2.5 dBm	-3.0 dBm
VSWR (Typ.)		
Input	2.0:1	
Output	1.9:1	
DC Current at +15 Volts	10 mA	

*Measured in a 50-ohm system at 15 Vdc Nominal.

Outline Drawing

EA1/EA4



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .005 (.13) UNLESS OTHERWISE SPECIFIED

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +9 dBm
Second Order Two Tone Intercept Point . . . . +5 dBm
Third Order Two Tone Intercept Point . . . . +13 dBm

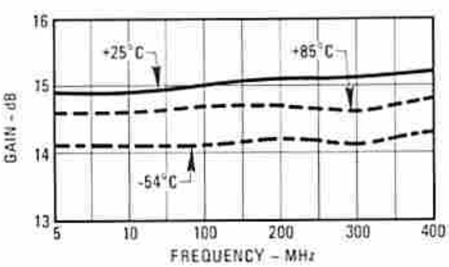
Absolute Maximum Ratings

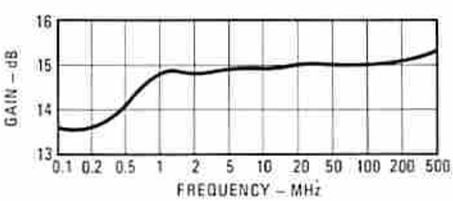
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum CW Input Power (1 Minute Max.) . . . . +50 Milliwatts
Maximum Peak Power (3 μsec Max.) . . . . 0.5 Watt
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.27 grams (0.08 oz.)

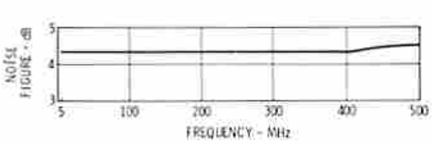
Typical Performance at 25°C

Gain

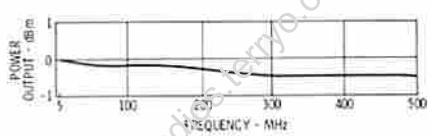




Noise Figure

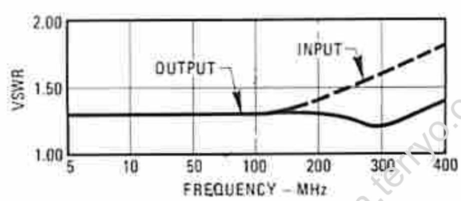


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = 15 V

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.00	1.3	1.3	14.9
10.00	1.3	1.3	14.9
20.00	1.3	1.3	15.0
50.00	1.3	1.3	14.9
100.00	1.3	1.3	15.0
200.00	1.4	1.3	15.1
300.00	1.6	1.2	15.1
400.00	1.8	1.4	15.2

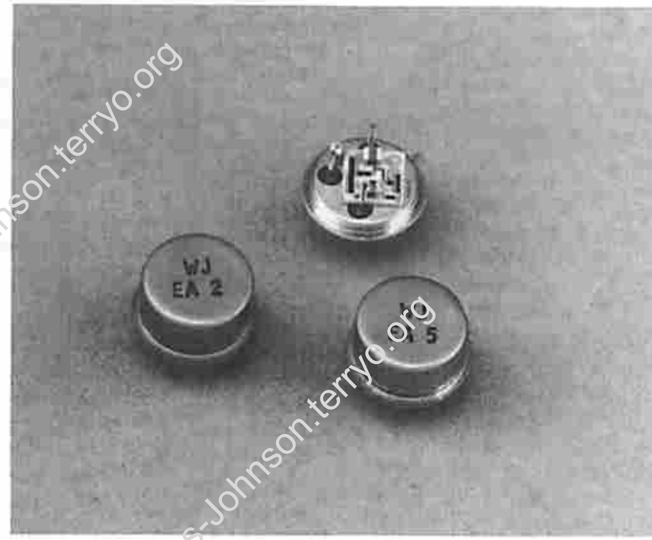
Linear S-Parameters, V_{CC} = 15 V

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
5.0	0.141	-167	5.58	-174.8	0.09	3.1	0.141	-7
10.0	0.140	-173	5.57	-178.4	0.09	-1.0	0.142	-5
20.0	0.138	-175	5.61	178.1	0.09	-5.3	0.145	-4
50.0	0.138	-173	5.57	172.3	0.09	-4.2	0.141	-4
100.0	0.143	-166	5.62	163.2	0.09	-5.4	0.138	-4
200.0	0.170	-152	5.68	145.0	0.09	-9.1	0.118	3
300.0	0.223	-144	5.68	126.5	0.10	-15.0	0.111	18
400.0	0.298	-143	5.75	107.1	0.11	-18.0	0.161	46

WJ-EA2/EA5

5 TO 400 MHz
TO-5 CASCADABLE AMPLIFIER

- LOW COST
- MEDIUM OUTPUT LEVEL +9 dBm (TYP.)
- ULTRA SMALL SIZE



Specifications*

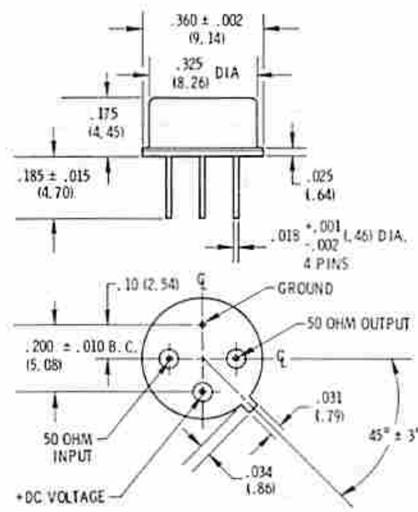
Characteristics	Guaranteed 0° – +50°C	-54° – +85°C
Frequency (Min.)	5-400 MHz	5-400 MHz
Small Signal Gain (Min.)	13.0 dB	12.5 dB
Gain Flatness (Typ.)	< ±0.3 dB	
Noise Figure (Typ.)	5.7 dB	
Power Output at 1 dB Compression		
Typical	+9 dBm	
Minimum	+6.5 dBm	+6.0 dBm
VSWR (Typ.) Input/Output	< 1.8:1	
DC Current at 15 Volts (Max.)	27 mA	29 mA

*Measured in a 50-ohm system at 15 Vdc ±1% Nominal.

Note: The EA5 is the same as the EA2 except three external capacitors are required which allows an increase of the low frequency bandwidth.

Outline Drawing

EA2/EA5



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +33 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +28 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +21 dBm (Typ.)

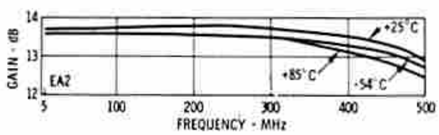
Absolute Maximum Ratings

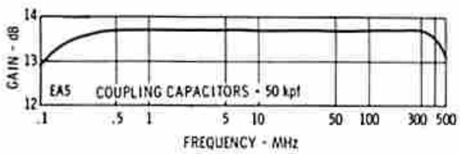
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . 13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . +50 Milliwatts
Maximum Peak Power (3 μsec Max. . . . . 0.5 Watt
"S" Series Burn-In Temperature (Case) . . . . +100°C

Weight approximately 1.0 grams (0.04 oz.)

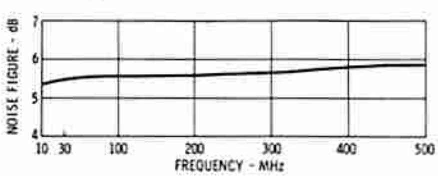
Typical Performance at 25°C

Gain

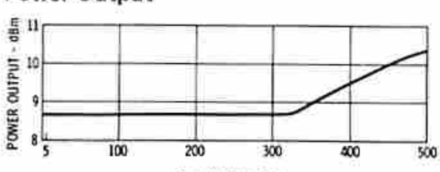




Noise Figure

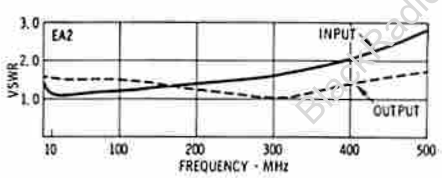


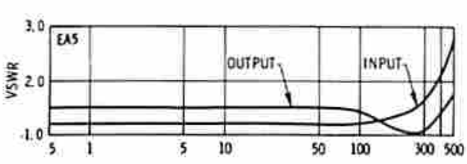
Power Output*



*at 1 dB Gain Compression

VSWR





Typical Automatic Test Data

V_{CC} = 15 V

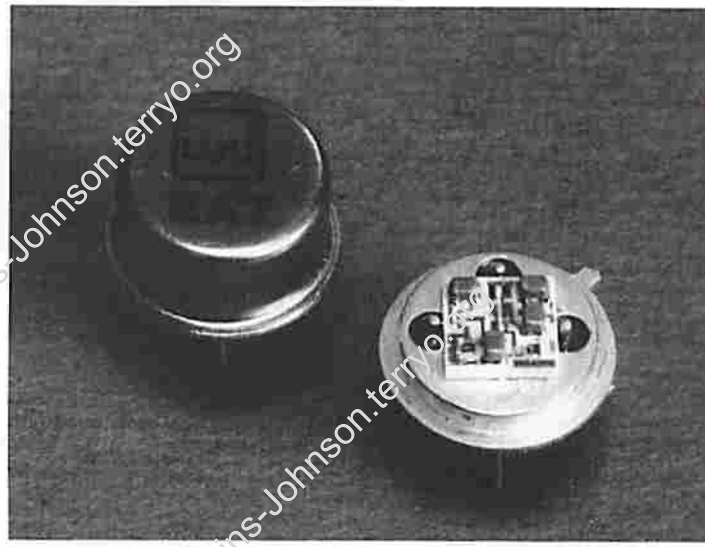
FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.5	13.7
200.	1.3	1.3	13.7
300.	1.6	1.4	13.7
400.	2.3	1.3	13.5
500.	2.9	1.7	13.1
600.	3.7	1.9	12.2

Linear S-Parameters

FREQ MHZ	DEV LIN 0 DEG	REL 0 DEG	GAIN DEV DB	ABS GAIN DB	GROUP DELAY N-SEC
100.	-.91	.00	.14	13.60	.36
200.	.75	12.97	.16	13.69	.34
300.	1.22	24.74	.13	13.67	.29
400.	-1.06	33.77	-.16	13.38	.25

WJ-EA7

5 TO 250 MHz TO-5 CASCADABLE AMPLIFIER



- HIGH OUTPUT LEVEL: 16 dBm (TYP)
- LOW VSWR: ⩽1.5:1 (TYP)
- WIDE SUPPLY RANGE: 12 TO 15 VOLTS

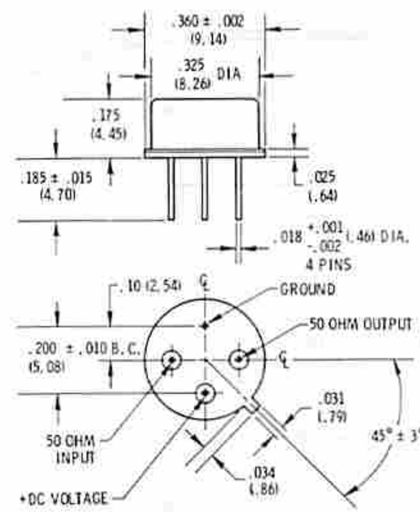
Specifications*

Characteristics	Typical	Guaranteed 0° - +50°C	Guaranteed -54° - +85°C
Frequency (Min.)	1-250 MHz	5-250 MHz	5-250 MHz
Small Signal Gain (Min.)	9.5 dB	8.5 dB	8.0 dB
Gain Flatness (Max.)	±.5 dB	±.8 dB	±1.0 dB
Noise Figure (Max.)	6.0 dB	6.5 dB	7.0 dB
Power Output at 1 dB Compression (Min.)	16.0 dBm	15.0 dBm	14.0 dBm
VSWR (Max.) Input	1.4:1	1.8:1	2.1:1
VSWR (Max.) Output	1.5:1	2.0:1	2.1:1
DC Current (Max.) at 15 Volts	60 mA	64 mA	67 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Outline Drawings

EA7



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

WJ-CA package is not available for TO-5's.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point	38 dBm (Typ.)
Second Order Two Tone Intercept Point	33 dBm (Typ.)
Third Order Two Tone Intercept Point	28 dBm (Typ.)

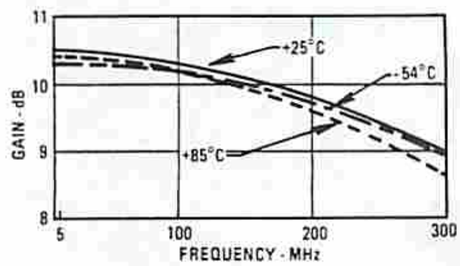
Absolute Maximum Ratings

Storage Temperature	-62°C to +125°C
Maximum Case Temperature	+125°C
Maximum DC Voltage	+17 Volts
Maximum Continuous RF Input Power	+13 dBm
Maximum Short Term RF Input Power (1 Minute Max.)	+50 Milliwatts
Maximum Peak Power	0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case)	125°C

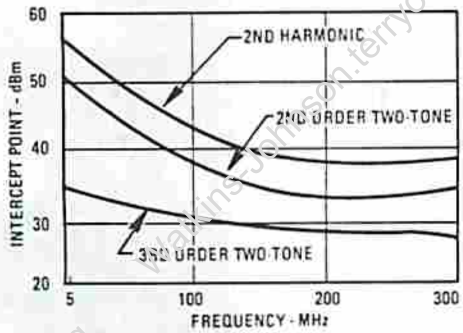
Weight approximately 1.0 grams (0.04 oz.)

Typical Performance at 25°C

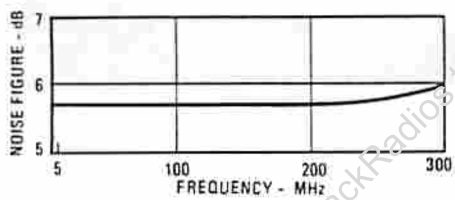
Gain



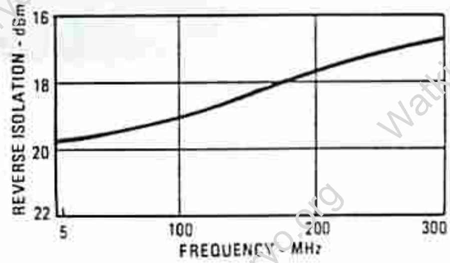
Intercept Point



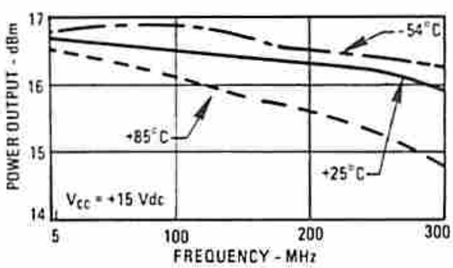
Noise Figure

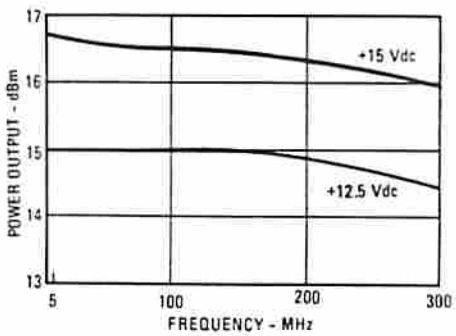


Reverse Isolation



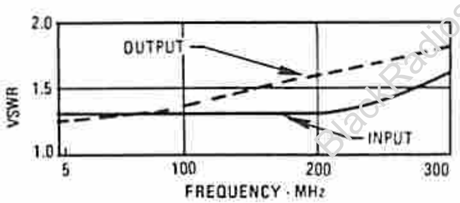
Power Output*





* at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
1.00	1.3	1.2	10.5
2.00	1.3	1.2	10.6
5.00	1.3	1.2	10.6
10.00	1.3	1.2	10.6
50.00	1.3	1.2	10.5
100.00	1.3	1.3	10.4
150.00	1.3	1.4	10.1
200.00	1.4	1.5	9.7
250.00	1.5	1.7	9.3
300.00	1.7	1.9	8.9
350.00	1.9	2.0	8.3

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.121	-4	3.34	-175	0.11	2	0.072	-13
2.0	0.121	-9	3.38	-176	0.11	-0	0.073	-6
5.0	0.118	-9	3.40	-178	0.11	-1	0.074	-17
10.0	0.121	-22	3.40	-180	0.11	-1	0.077	-21
50.0	0.120	-30	3.37	169	0.11	1	0.098	-54
100.0	0.125	-69	3.32	156	0.12	2	0.141	-82
150.0	0.136	-108	3.19	139	0.12	1	0.167	[illegible]
200.0	0.149	-140	3.04	126	0.13	-0	0.215	-109
250.0	0.192	-168	2.92	119	0.14	-4	0.260	-121
300.0	0.248	172	2.70	106	0.15	-9	0.302	-133
350.0	0.304	154	2.60	94	0.15	-13	[illegible]	-142

WJ-EA15

5 TO 1000 MHz
TO-5 CASCADABLE AMPLIFIER

- LOW NOISE: 3.6 dB (TYP.)
- MEDIUM LEVEL: +8.5 dBm OUTPUT (TYP.)
- SMALL SIZE: TO-5

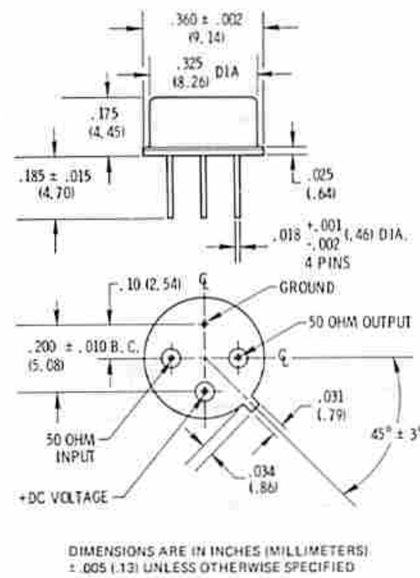
Specifications*

Characteristics	Typ.	Guaranteed 0° - +50°C	Guaranteed -54° - +85°C
Frequency (Min.)	3-1100 MHz	5-1000 MHz	5-1000 MHz
Small Signal Gain (Min.)	14.0 dB	13.0 dB	12.5 dB
Gain Flatness (Max.)	±.2 dB	±.5 dB	±.7 dB
Noise Figure (Max.)	3.6 dB	4.5 dB	5.0 dB
Power Output at 1 dB Compression (Min.)			
5-500 MHz	8.5 dBm	7.0 dBm	6.0 dBm
500-1000 MHz	10.0 dBm	8.5 dBm	7.5 dBm
VSWR (Max.)			
Input	1.6:1	2.1:1	2.2:1
Output	1.6:1	2.1:1	2.2:1
DC Current (Max.) at +15 Volts	24 mA	27 mA	29 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Outline Drawings

EA15



*WJ-CA package is not available for TO-5's.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 32 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 26 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 20 dBm (Typ.)

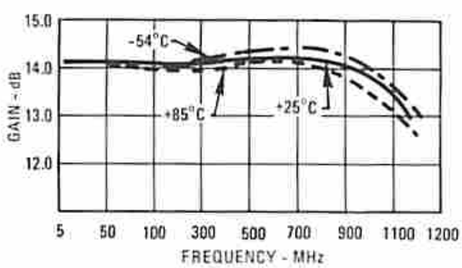
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . +125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

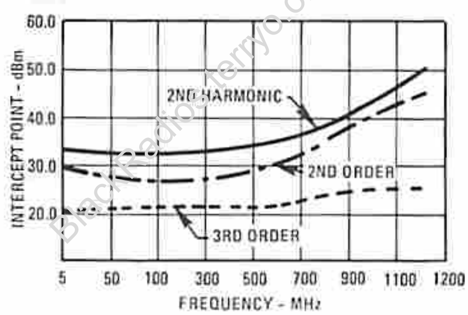
Weight approximately 1.0 grams (0.04 oz.)

Typical Performance at 25°C

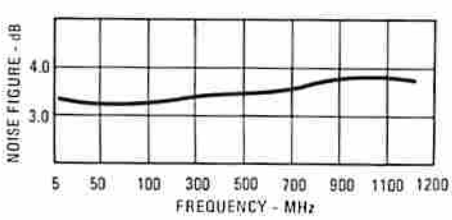
Gain



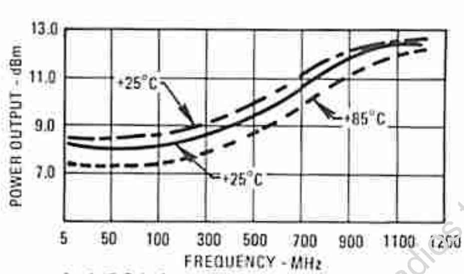
Intercept Point



Noise Figure

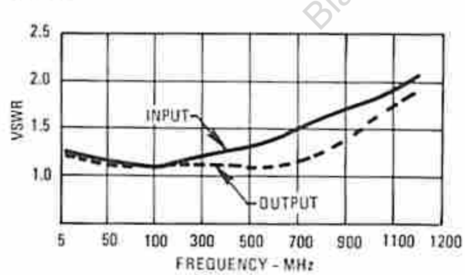


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
1.00	4.9	3.7	8.2
2.00	1.8	2.1	12.7
5.00	1.1	1.2	14.0
10.00	1.1	1.2	14.0
50.00	[illegible]	1.1	13.9
100.00	1.1	1.1	14.0
200.00	1.1	1.1	14.0
300.00	1.2	1.1	14.0
400.00	1.2	1.2	14.1
500.00	1.3	1.2	14.1
600.00	1.4	1.2	14.1
700.00	1.4	1.2	14.1
800.00	1.5	1.3	14.0
900.00	1.7	1.4	14.0
1000.00	1.9	1.5	13.7
1100.00	1.8	1.8	13.4
1200.00	1.9	1.8	12.9

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.664	-67	[illegible]	-94	0.06	91	0.702	-69
2.0	0.286	-101	4.32	-131	0.10	47	0.347	-107
5.0	0.062	-77	5.02	-158	0.10	16	0.105	-128
10.0	0.059	-53	5.03	-169	0.10	8	0.070	-133
50.0	0.041	-59	4.98	176	0.11	-1	0.062	-167
100.0	0.049	-78	5.02	168	0.11	-4	0.060	-173
200.0	0.054	[illegible]	5.00	148	0.11	-9	0.064	163
300.0	0.090	[illegible]	5.03	137	0.11	-14	0.057	141
400.0	0.106	-122	5.05	121	0.11	-19	0.077	130
500.0	0.136	-131	5.05	101	0.11	-24	0.098	148
600.0	[illegible]	-145	5.05	89	0.11	-29	0.082	145
700.0	0.181	-151	5.08	73	0.11	-33	0.085	129
800.0	0.200	-164	5.03	51	0.11	-37	0.125	113
900.0	0.256	-180	5.00	38	0.11	-42	0.168	125
1000.0	0.310	177	4.86	19	0.11	-47	0.208	105
1100.0	0.297	170	4.66	0	0.11	-53	0.293	107
1200.0	0.321	151	4.39	-19	0.11	-58	0.287	92

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WJ-EA17

5 TO 1000 MHz
TO-5 CASCADABLE AMPLIFIER

- MEDIUM OUTPUT LEVEL: +13.5 dBm (TYP.)
- EXTRA SMALL SIZE: TO-5 PACKAGE

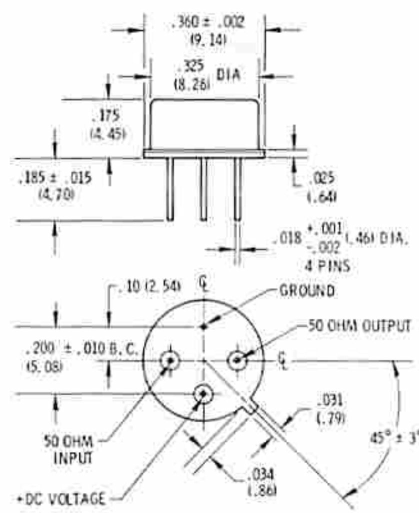
Specifications*

Characteristics	Typ.	Guaranteed 0° - +50°C	Guaranteed -54° - +85°C
Frequency (Min.)	2-1200 MHz	5-1000 MHz	5-1000 MHz
Small Signal Gain (Min.)	11.5 dB	10.5 dB	10.0 dB
Gain Flatness (Max.)	±.2 dB	±.7 dB	±1.0 dB
Noise Figure (Max.)	4.8 dB	5.5 dB	6.0 dB
Power Output at 1 dB Compression (Min.)	13.5 dBm	11.0 dBm	10.5 dBm
VSWR (Max.)			
Input	1.6:1	1.9:1	2.0:1
Output	1.6:1	1.9:1	2.0:1
DC Current (Max.) at +15 Volts	43 mA	47 mA	49 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Outline Drawings

EA17



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 30 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 25 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 20 dBm (Typ.)

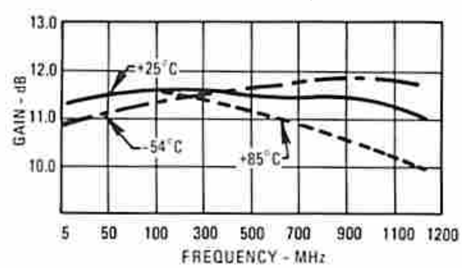
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt
. . . . (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

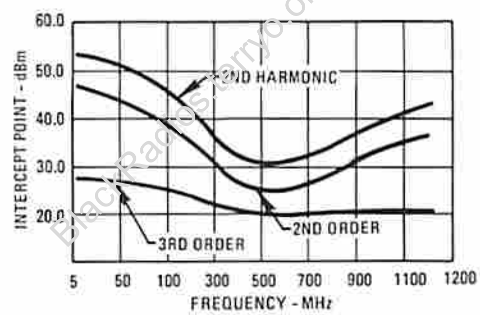
Weight approximately 1.0 grams (0.04 oz.)

Typical Performance at 25°C

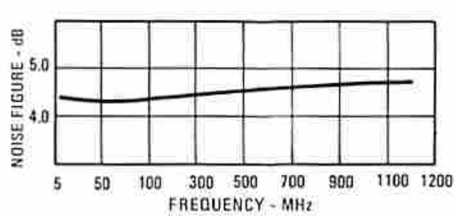
Gain



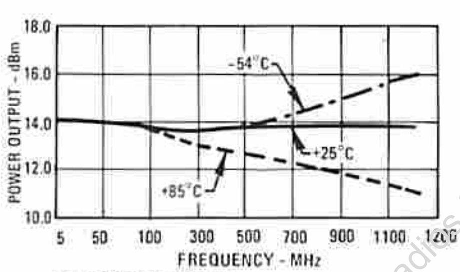
Intercept Point



Noise Figure

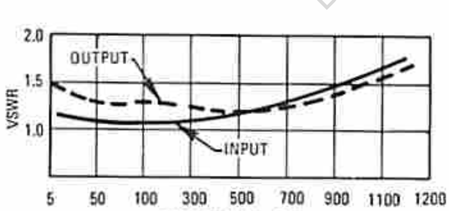


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
1.00	5.9	6.6	4.9
2.00	2.2	2.5	9.9
5.00	1.4	1.6	11.3
10.00	1.2	1.4	11.4
50.00	[illegible]	1.4	11.5
100.00	1.2	1.4	11.6
200.00	1.1	1.4	11.6
300.00	1.2	1.3	11.5
400.00	1.2	1.3	11.5
500.00	1.2	1.3	11.5
600.00	1.3	1.3	11.3
700.00	1.3	1.2	11.4
800.00	1.3	1.2	11.3
900.00	1.4	1.3	11.4
1000.00	1.6	1.4	11.4
1100.00	1.5	1.6	11.2
1200.00	1.6	1.6	11.2

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.708	-58	[illegible]	-91	0.06	95	0.737	-64
2.0	0.379	-87	[illegible]	-128	0.10	54	0.433	-100
5.0	0.153	-102	3.69	-156	0.12	20	0.216	-131
10.0	0.099	-117	3.73	-168	0.12	12	0.177	-151
50.0	0.066	-152	3.77	177	0.12	-0	0.166	-174
100.0	0.071	-157	3.79	168	0.12	-4	0.163	180
200.0	0.066	-167	3.79	148	0.12	-10	0.158	166
300.0	0.089	[illegible]	3.77	137	0.12	-15	0.138	156
400.0	0.092	-167	3.75	121	0.12	-20	0.139	145
500.0	0.105	-165	3.74	102	0.12	-26	0.144	156
600.0	0.121	-169	3.69	91	0.12	-31	0.114	157
700.0	[illegible]	-169	3.72	75	0.12	-35	0.097	154
800.0	[illegible]	-175	3.69	55	0.12	-40	0.103	146
900.0	0.179	176	3.71	43	0.12	-45	0.146	160
1000.0	0.219	-179	3.70	26	0.12	-49	0.150	147
1100.0	0.216	179	3.63	4	0.12	-54	0.239	144
1200.0	0.243	164	3.64	-10	0.12	-59	0.230	134

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WJ-EA41

1000 TO 4000 MHz TO-5 CASCADABLE AMPLIFIER

- WIDE BANDWIDTH: 1000 TO 4000 MHz
- MEDIUM OUTPUT POWER: +12 dBm (TYP.)
- LOW NOISE: 3.5 dB (TYP.)
- MEDIUM THIRD ORDER INTERCEPT POINT: 25 dBm (TYP.)
- EXTRA SMALL SIZE: TO-5 PACKAGE

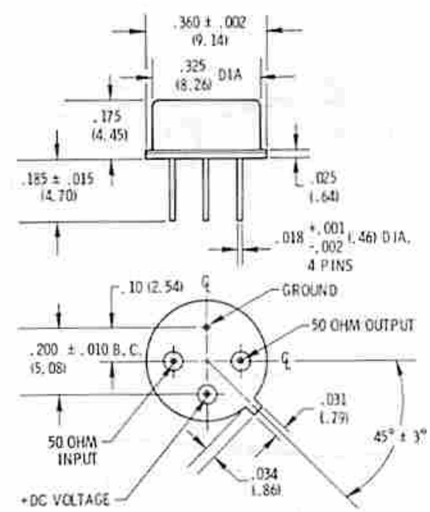
Specifications*

Characteristics	Typical	Guaranteed 0° - +50°C	Guaranteed -54° - +85°C
Frequency (Min.)	800-4200 MHz	1000-4000 MHz	1000-4000 MHz
Small Signal Gain (Min.)	8.0 dB	7.0 dB	6.5 dB
Gain Flatness (Max.)	±.4 dB	±.7 dB	±.9 dB
Noise Figure (Max.)	3.5 dB	5.0 dB	5.5 dB
Power Output at 1 dB Compression (Min.)	12.0 dBm	11.0 dBm	10.5 dBm
VSWR (Max.)			
Input	1.6:1	2.1:1	2.2:1
Output	1.6:1	2.1:1	2.2:1
DC Current (Max.) at +5 Volts	35 mA	40 mA	42 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Outline Drawings

EA41



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . .35 dBm (Typ.)
Second Order Two Tone Intercept Point .30 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . .23 dBm (Typ.)

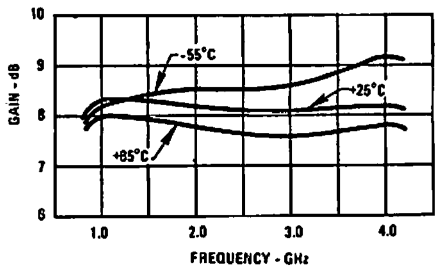
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . +125°C
Maximum DC Voltage . . . . .6 Volts
Maximum Continuous RF Input Power . . . . +14 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . .50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt
. . . . (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

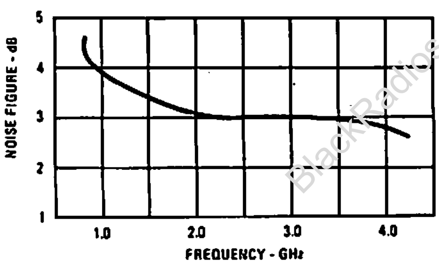
Weight approximately 1.0 grams (0.04 oz.)

Typical Performance at 25°C

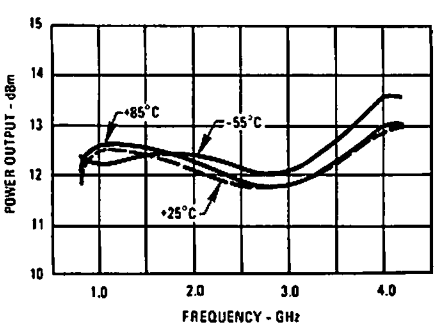
Gain



Noise Figure

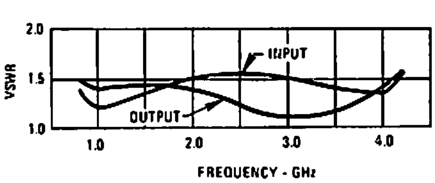


Power Output*

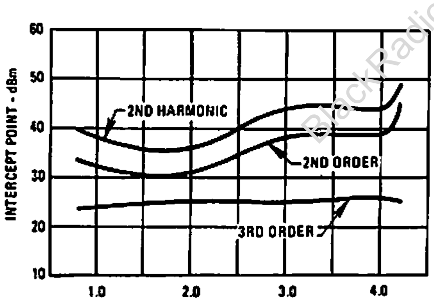


*at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{cc} = +5 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
800.0	1.4	1.4	7.8
900.0	1.1	1.3	8.1
1000.0	1.1	1.3	8.2
1100.0	1.2	1.3	8.3
1200.0	1.2	1.3	8.2
1300.0	1.3	1.3	8.2
1400.0	1.3	1.3	8.2
1500.0	1.3	1.4	8.1
1600.0	1.4	1.4	8.1
1700.0	1.4	1.4	8.1
1800.0	1.4	1.4	8.1
1900.0	1.4	1.4	8.0
2000.0	1.4	1.4	8.1
2100.0	1.4	1.3	8.0
2200.0	1.4	1.3	8.0
2300.0	1.4	1.3	8.0
2400.0	1.4	1.3	8.0

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
2500.0	1.5	1.3	8.1
2600.0	1.5	1.2	8.0
2700.0	1.5	1.2	8.0
2800.0	1.5	1.2	8.0
2900.0	1.5	1.2	8.1
3000.0	1.5	1.2	8.0
3100.0	1.4	1.1	8.1
3200.0	1.4	1.1	8.1
3300.0	1.4	1.1	8.1
3400.0	1.3	1.1	8.1
3500.0	1.3	1.1	8.1
3600.0	1.2	1.1	8.2
3700.0	1.1	1.2	8.1
3800.0	1.1	1.2	8.2
3900.0	1.1	1.3	8.2
4000.0	1.2	1.4	8.3
4100.0	1.2	1.4	8.2
4200.0	1.4	1.5	8.2

Linear S-Parameters

FREQUENCY MHZ	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
800.0	.171	163	2.466	[illegible]	.156	64	.151	-83
900.0	.069	112	[illegible]	-159	.159	44	.145	-117
1000.0	.058	41	2.576	-175	.157	29	.144	-138
1100.0	.085	3	[illegible]	172	.155	17	.143	-153
1200.0	.108	-15	2.579	159	.153	7	.144	-165
1300.0	.128	-30	2.570	145	.151	-4	.147	-176
1400.0	.138	-40	2.567	135	.148	-13	.148	175
1500.0	.146	-49	2.554	125	.146	-21	.151	169
1600.0	.150	-57	2.551	116	.144	-28	.152	163
1700.0	.154	-66	2.535	105	.141	-36	.154	156
1800.0	.157	-73	2.538	97	.139	-43	.154	152
1900.0	.159	-80	2.524	88	.137	-50	.154	148
2000.0	.161	-86	2.536	80	.134	-56	.152	144
2100.0	.169	-94	2.516	70	.132	-64	.147	142
2200.0	.173	-100	2.519	62	.131	-70	.142	139
2300.0	.178	-105	2.520	55	.129	-76	.136	138
2400.0	.181	-110	2.521	47	.127	-82	.128	135
2500.0	.186	-116	2.529	38	.125	-88	.119	134
2600.0	.189	-120	2.517	31	.124	-94	.110	132
2700.0	.191	-124	2.523	24	.122	-100	.101	132
2800.0	.192	-129	2.522	15	.122	-107	.088	130
2900.0	.191	-133	2.532	7	.121	-112	.082	130
3000.0	.187	-137	2.525	-0	.122	-118	.070	127
3100.0	.181	-141	2.533	-8	.120	-124	.061	123
3200.0	.170	-147	2.528	-16	.121	-131	.051	113
3300.0	.158	-151	2.537	-24	[illegible]	-137	.044	101
3400.0	.140	-155	2.544	-31	[illegible]	-143	.041	82
3500.0	.120	-161	2.545	-38	.122	-149	.044	58
3600.0	.090	-170	2.560	-47	.121	-156	.058	36
3700.0	.063	177	2.554	-55	.122	-162	.077	22
3800.0	.035	149	2.577	[illegible]	.122	-168	.097	14
3900.0	.032	75	2.580	[illegible]	.122	-174	.120	6
4000.0	.071	33	2.586	-80	.123	179	.151	-1
4100.0	.111	20	[illegible]	-88	.123	173	.176	-7
4200.0	.152	12	2.569	-96	.124	169	.200	-11

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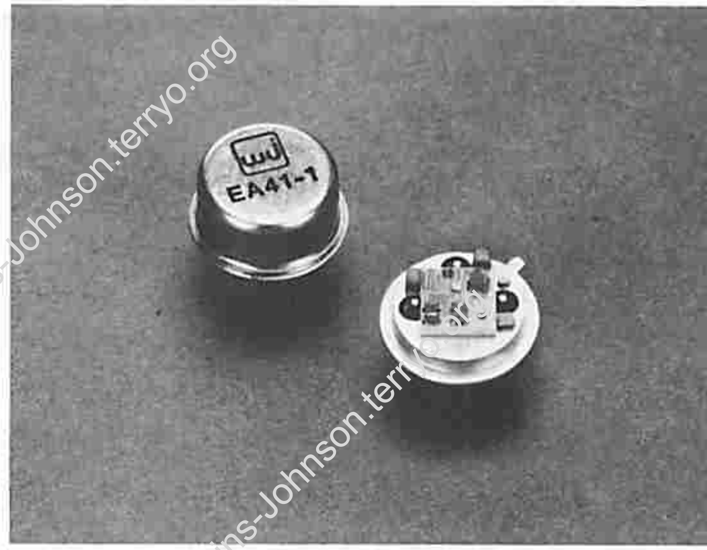
WJ-EA41-1

1000 TO 4000 MHz
TO-5 CASCADABLE AMPLIFIER

- WIDE BANDWIDTH: 1000-4000 MHz
- HIGH OUTPUT POWER: +19 dBm (TYP.)
- LOW NOISE: 3.5 dB (TYP.)
- HIGH THIRD ORDER INTERCEPT POINT: 30 dBm (TYP.)
- EXTRA SMALL SIZE: TO-5 PACKAGE
- VARIABLE VOLTAGE: +5 TO +8 Vdc



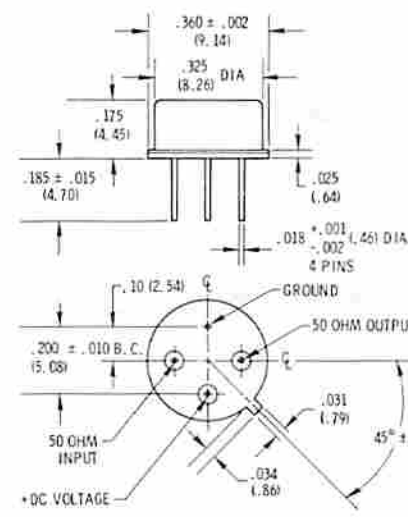
Specifications*

Characteristics	Typical	Guaranteed 0° - +50°C	Guaranteed -54° - +85°C
Frequency (Min.)	800-4200 MHz	1000-4000 MHz	1000-4000 MHz
Small Signal Gain (Min.)	9.0 dB	8.0 dB	7.5 dB
Gain Flatness (Max.)	±.4 dB	±.7 dB	±.9 dB
Noise Figure (Max.)	3.5 dB	5.0 dB	5.5 dB
Power Output at 1 dB Compression (Min.)	19.0 dBm	17.5 dBm	17.0 dBm
VSWR (Max.) Input	1.6:1	2.0:1	2.1:1
VSWR (Max.) Output	1.4:1	2.0:1	2.1:1
DC Current (Max.) at +8 Volts	68 mA	76 mA	78 mA

*Measured in a 50-ohm system at +8 Vdc Nominal.

Outline Drawings

EA41-1



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

*WJ-CA package is not available for TO-5's.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 40 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 35 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 30 dBm (Typ.)

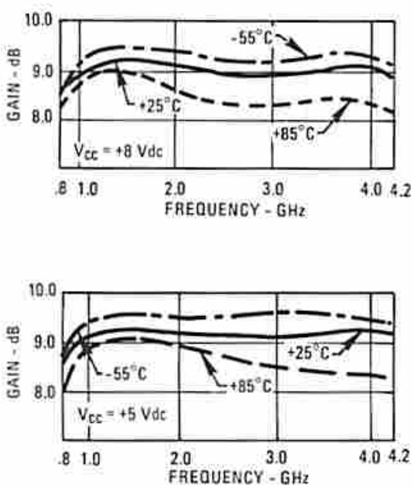
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . +100°C
Maximum DC Voltage . . . . 9 Volts
Maximum Continuous RF Input Power . . . . +14 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt
. . . . (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . +100°C

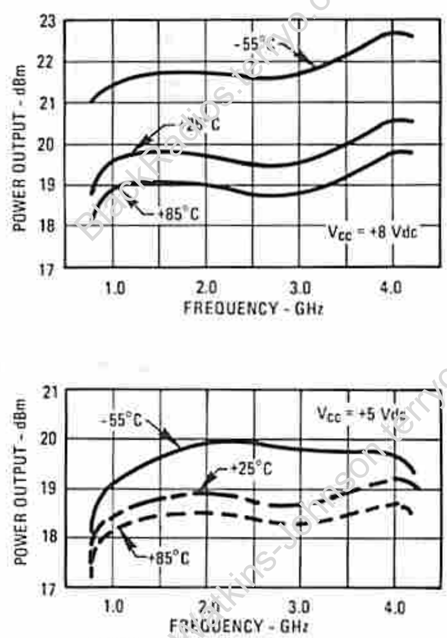
Weight approximately 1.0 grams (0.04 oz.)

Typical Performance at 25°C

Gain

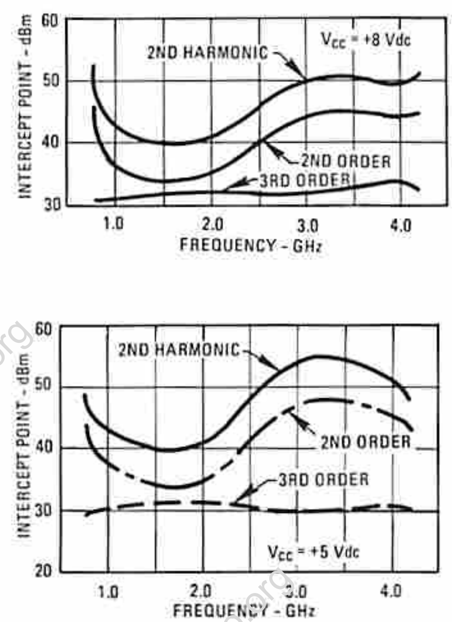


Power Output*

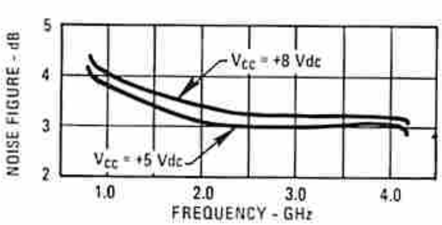


*at 1 dB Gain Compression

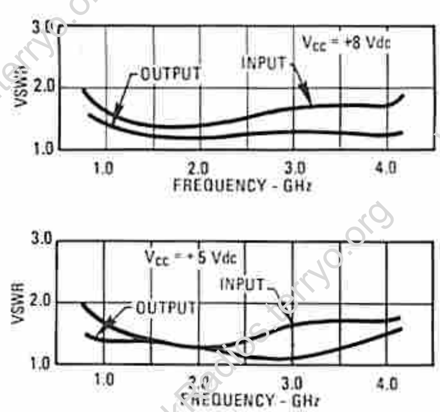
Intercept Point



Noise Figure



VSWR



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Typical Automatic Test Data

V_{cc} = +8 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB	FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
800.0	2.0	1.5	8.4	2600.0	1.5	1.1	9.0
900.0	1.7	1.4	8.8	2700.0	1.5	1.1	8.9
1000.0	1.6	1.3	9.0	2800.0	1.5	1.1	8.9
1100.0	1.4	1.3	9.1	2900.0	1.5	1.1	8.9
1200.0	1.3	1.3	9.2	3000.0	1.5	1.1	8.9
1300.0	1.3	1.3	9.2	3100.0	1.5	1.1	8.9
1400.0	1.2	1.3	9.2	3200.0	1.5	1.1	8.9
1500.0	1.2	1.3	9.2	3300.0	1.5	1.1	9.0
1600.0	1.2	1.2	9.2	3400.0	1.5	1.1	9.0
1700.0	1.2	1.2	9.2	3500.0	1.5	1.1	9.0
1800.0	1.2	1.2	9.2	3600.0	1.5	1.1	9.0
1900.0	1.2	1.2	9.1	3700.0	1.5	1.1	9.1
2000.0	1.2	1.2	9.1	3800.0	1.5	1.1	9.1
2100.0	1.3	1.2	9.1	3900.0	1.6	1.1	9.1
2200.0	1.3	1.2	9.1	4000.0	1.7	1.1	9.1
2300.0	1.3	1.1	9.0	4100.0	1.7	1.2	9.0
2400.0	1.4	1.1	9.0	4200.0	1.8	1.2	8.9
2500.0	1.4	1.1	9.0				

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
800.0	.337	64	2.632	-165	.147	38	.202	-25
900.0	.265	49	2.758	177	.152	22	.167	-56
1000.0	.216	37	2.827	163	.154	10	.146	-80
1100.0	.177	24	2.863	151	.153	-0	.133	-101
1200.0	.144	12	2.876	140	.152	-10	.123	-121
1300.0	.112	-4	2.889	129	.151	-20	.117	-142
1400.0	.091	-20	2.889	118	.149	-29	.113	-157
1500.0	.077	-40	2.886	109	.147	-36	.112	-170
1600.0	.070	-62	2.884	100	.144	-44	.109	178
1700.0	.070	-88	2.872	90	.141	-52	.107	167
1800.0	.070	-106	2.872	81	.138	-59	.102	158
1900.0	.080	-121	2.859	73	.136	-66	.098	152
2000.0	.100	-131	2.865	65	.133	-72	.090	146
2100.0	.120	-142	2.843	55	.129	-80	.080	145
2200.0	.134	-148	2.840	47	.127	-86	.070	144
2300.0	.148	-154	2.832	40	.124	-92	.060	147
2400.0	.160	-159	2.825	32	.122	-98	.049	151
2500.0	.174	-165	2.817	23	.119	-105	.042	166
2600.0	.184	-170	2.807	16	.116	-111	.030	-179
2700.0	.192	-174	2.797	9	.114	-117	.041	-162
2800.0	.203	-180	2.793	0	.112	-124	.046	-148
2900.0	.208	175	2.794	-7	.110	-130	.051	-141
3000.0	.212	170	2.800	-14	.109	-135	.056	-135
3100.0	.212	163	2.798	-22	.106	-142	.064	-134
3200.0	.211	155	2.797	-31	.105	-149	.065	-130
3300.0	.211	148	2.816	-38	.104	-154	.065	-128
3400.0	.207	139	2.823	-45	.104	-160	.062	-125
3500.0	.205	129	2.824	-53	.102	-166	.057	-120
3600.0	.204	116	2.831	-62	.100	-172	.050	-108
3700.0	.206	104	2.845	-70	.100	-178	.046	-92
3800.0	.214	92	2.846	-78	.099	176	.045	-75
3900.0	.227	79	2.844	-86	.099	171	.054	-57
4000.0	.248	64	2.837	-96	.097	166	.067	-42
4100.0	.269	53	2.826	-104	.097	160	.083	-37
4200.0	.295	44	2.797	-113	.097	156	.097	-31

V_{cc} = +5 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB	FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
800.0	2.0	1.4	8.5	2500.0	1.4	1.2	9.2
900.0	1.7	1.3	8.8	2600.0	1.4	1.2	9.1
1000.0	1.6	1.3	9.1	2700.0	1.4	1.1	9.2
1100.0	1.4	1.3	9.2	2800.0	1.5	1.1	9.1
1200.0	1.3	1.3	9.2	2900.0	1.5	1.1	9.1
1300.0	1.3	1.3	9.3	3000.0	1.5	1.0	9.1
1400.0	1.2	1.4	9.3	3100.0	1.5	1.0	9.1
1500.0	1.2	1.4	9.3	3200.0	1.5	1.0	9.1
1600.0	1.2	1.4	9.3	3300.0	1.5	1.1	9.1
1700.0	1.2	1.4	9.2	3400.0	1.5	1.1	9.2
1800.0	1.2	1.4	9.2	3500.0	1.5	1.1	9.2
1900.0	1.2	1.4	9.2	3600.0	1.5	1.2	9.2
2000.0	1.2	1.3	9.2	3700.0	1.5	1.2	9.2
2100.0	1.3	1.3	9.2	3800.0	1.6	1.3	9.2
2200.0	1.3	1.3	9.2	3900.0	1.5	1.3	9.3
2300.0	1.3	1.3	9.2	4000.0	1.6	1.4	9.3
2400.0	1.4	1.2	9.1	4100.0	1.6	1.5	9.2
				4200.0	1.7	1.5	9.2

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
800.0	.336	66	2.652	-165	.142	39	.166	-37
900.0	.270	51	2.766	178	.147	24	.148	-72
1000.0	.223	40	2.842	165	.148	13	.142	-98
1100.0	.180	27	2.881	152	.147	1	.142	-122
1200.0	.140	15	2.895	141	.147	-8	.143	-141
1300.0	.120	1	2.911	130	.145	-17	.147	-158
1400.0	.097	-15	2.916	119	.143	-26	.150	-172
1500.0	.083	-33	2.910	110	.142	-33	.153	177
1600.0	.074	-55	2.909	100	.139	-41	.154	165
1700.0	.072	-77	2.898	91	.137	-48	.155	156
1800.0	.076	-94	2.898	83	.135	-55	.153	148
1900.0	.086	-111	2.889	74	.133	-62	.151	141
2000.0	.097	-122	2.899	66	.130	-67	.146	135
2100.0	.115	-133	2.880	57	.128	-75	.137	130
2200.0	.128	-140	2.881	49	.125	-81	.126	124
2300.0	.141	-146	2.881	42	.123	-86	.116	121
2400.0	.152	-152	2.865	33	.121	-92	.101	116
2500.0	.166	-156	2.882	25	.120	-98	.087	113
2600.0	.174	-161	2.865	18	.118	-104	.073	108
2700.0	.184	-165	2.870	10	.116	-110	.059	106
2800.0	.191	-170	2.857	3	.115	-115	.046	100
2900.0	.197	-175	2.861	-5	.114	-121	.033	95
3000.0	.200	179	2.857	-13	.114	-128	.023	75
3100.0	.202	174	2.857	-21	.112	-134	.017	47
3200.0	.199	166	2.861	-29	.112	-140	.021	9
3300.0	.190	159	2.857	-37	.112	-146	.031	-9
3400.0	.192	150	2.870	-44	.112	-151	.042	-15
3500.0	.188	141	2.873	-52	.111	-157	.059	-17
3600.0	.184	122	2.887	-60	.110	-163	.075	-18
3700.0	.185	115	2.886	-68	.110	-169	.097	-20
3800.0	.181	99	2.898	-77	.110	-175	.119	-21
3900.0	.201	85	2.902	-85	.110	180	.143	-23
4000.0	.220	71	2.911	-94	.105	175	.168	-25
4100.0	.244	57	2.900	-102	.110	168	.192	-28
4200.0	.272	48	2.869	-111	.110	164	.213	-30

WJ-EA51

5 TO 250 MHz
TO-5 CASCADABLE AMPLIFIER

- LOW NOISE: 3.0 dB (TYP.)
- HIGH GAIN: 17.0 dB (TYP.)
- LOW OUTPUT VSWR: 1.2:1 (TYP.)
- POWER EFFICIENT: 5 VOLTS Vcc @ 12.5 mA
- COST EFFICIENCY: MINIMUM PARTS COUNT
- EXTRA SMALL SIZE: TO-5 PACKAGE.

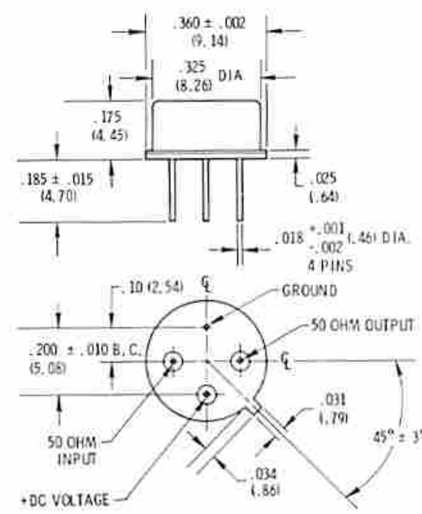
Specifications *

Characteristics	Typical	Guaranteed 0°C - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	1 - 300 MHz	5 - 250 MHz	5 - 250 MHz
Small Signal Gain (Min.)	17 dB	16 dB	15.5 dB
Gain Flatness (Max.)	± .4 dB	± .7 dB	± 1.0 dB
Noise Figure (Max.)	3.0 dB	3.5 dB	4.0 dB
Power Output at 1 dB Compression (Min.)	1.8 dBm	1.0 dBm	-1.0 dBm
VSWR (Max.) Input	1.5:1	2.0:1	2.0:1 [1]
VSWR (Max.) Output	1.2:1	1.6:1	1.7:1
DC Current (Max.) at 5 Volts	12.5 mA	14.5 mA	16.5 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.
Notes: 1. Input VSWR 2.2:1 max. above 200 MHz.

Outline Drawing

EA51



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 20 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 14 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 13 dBm (Typ.)

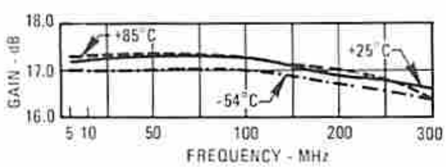
Absolute Maximum Ratings

Storage Temperature . . . . +62°C to 125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . 9 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
'S' Series Burn-In Temperature . . . . 125°C

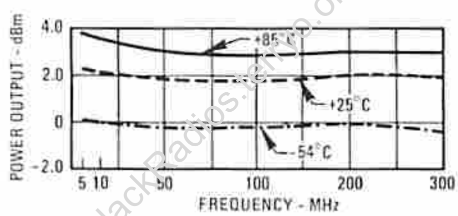
Weight approximately 1.0 grams (0.04 oz.)

Typical Performance at 25°C

Gain

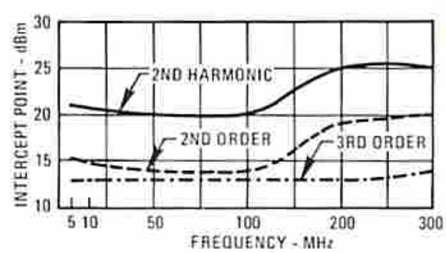


Power Output*

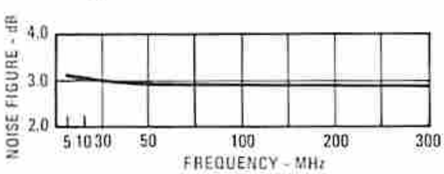


*at 1 dB Gain Compression

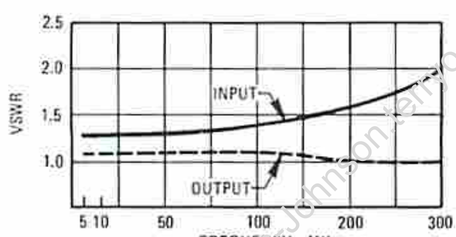
Intercept Point



Noise Figure



VSWR



Typical Automatic Test Data

V_{CC} = +5 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
1.0	1.3	1.2	17.6
2.0	1.3	1.1	17.6
5.0	1.3	1.1	17.7
10.0	1.3	1.1	17.8
50.0	1.3	1.1	17.8
100.0	1.5	1.1	17.7
150.0	1.6	1.1	17.6
200.0	1.8	1.1	17.4
250.0	2.0	1.0	17.1
300.0	2.2	1.0	16.9

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.131	-31	7.55	-160	0.06	16	0.062	-60
2.0	0.130	-13	7.62	-169	0.06	7	0.060	-27
5.0	0.131	-6	7.70	-175	0.06	-0	0.064	-20
10.0	0.121	-8	7.77	-178	0.06	-1	0.060	[illegible]
50.0	0.146	-38	7.75	172	0.06	-2	0.060	[illegible]
100.0	0.186	-60	7.66	162	0.06	-1	0.059	-31
150.0	0.229	-72	7.55	151	0.06	-1	0.047	-49
200.0	0.280	-85	7.40	137	0.06	-1	[illegible]	-70
250.0	0.328	-97	7.15	127	0.07	-0	[illegible]	-70
300.0	0.370	-105	6.98	117	0.07	-2	0.003	-36
350.0	0.423	-114	6.72	107	0.07	-4	0.027	142

WJ-EA53

5 TO 250 MHz
TO-5 CASCADABLE AMPLIFIER

- LOW NOISE: 2.0 dB (TYP.)
- HIGH GAIN: 22 dB (TYP.)
- LOW OUTPUT VSWR: 1.2:1 (TYP.)
- POWER EFFICIENT: 5 VOLTS Vcc @ 15 mA
- COST EFFICIENT: MINIMUM PARTS COUNT
- EXTRA SMALL SIZE: TO-5 PACKAGE.

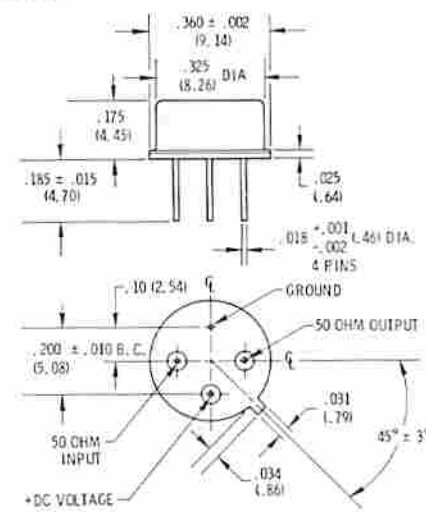
Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	-54° - +85°C
Frequency (Min.)	1 - 300 MHz	5 - 250 MHz	5 - 250 MHz
Small Signal Gain (Min.)	22.0 dB	20.5 dB	19.5 dB
Gain Flatness (Max.)	±.6 dB	±.9 dB	±1.0 dB
Noise Figure (Max.)	2.0 dB	2.8 dB	3.2 dB
Power Output at 1 dB Compression (Min.)	4.5 dBm	2.5 dBm	2.0 dBm
VSWR (Max.) Input	1.5:1	1.8:1	2.0:1
VSWR (Max.) Output	1.2:1	1.5:1	1.7:1
DC Current (Max.) at 5 Volts	15 mA	18 mA	20 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Outline Drawings

EA53



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point .... 23 dBm (Typ.)
Second Order Two Tone Intercept Point .... 18 dBm (Typ.)
Third Order Two Tone Intercept Point .... 16 dBm (Typ.)

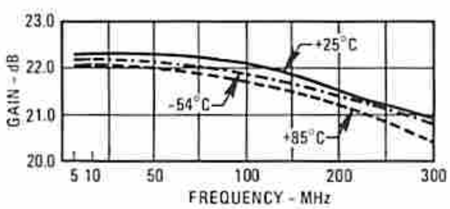
Absolute Maximum Ratings

Storage Temperature .... 62°C to 125°C
Maximum Case Temperature .... 125°C
Maximum DC Voltage .... 9 Volts
Maximum Continuous RF Input Power .... +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) .... 50 Milliwatts
Maximum Peak Power .... 0.5 Watt (3 μsec Max.)
'S' Series Burn-In Temperature (Case) .... 125°C

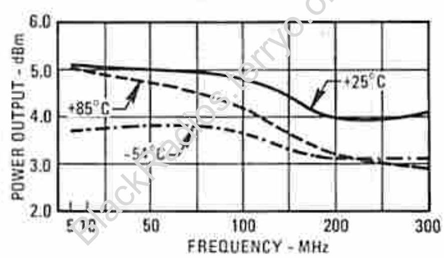
Weight approximately 1.0 grams (0.04 oz.)

Typical Performance at 25°C

Gain

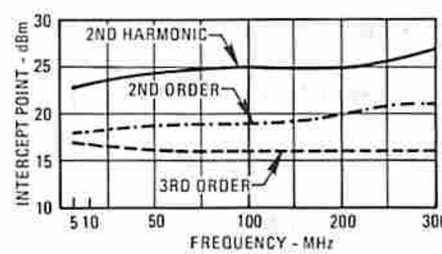


Power Output*

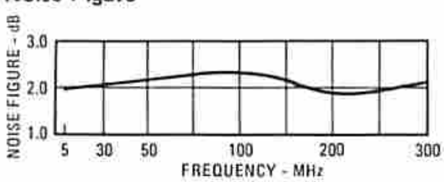


*at 1 dB Gain Compression

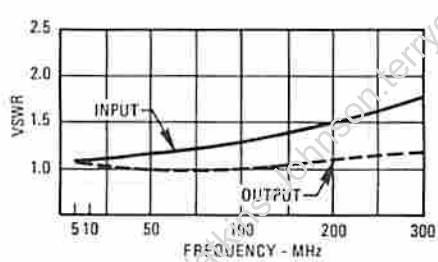
Intercept Point



Noise Figure



VSWR



1

Typical Automatic Test Data

V_{CC} = +5 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
1.0	1.2	1.2	22.4
2.0	1.1	1.1	22.6
5.0	1.1	1.1	22.7
10.0	1.1	1.0	22.7
50.0	1.1	1.0	22.7
100.0	1.3	1.1	22.4
150.0	1.4	1.1	22.2
200.0	1.5	1.1	21.9
250.0	1.7	1.2	21.4
300.0	1.8	1.2	[illegible]

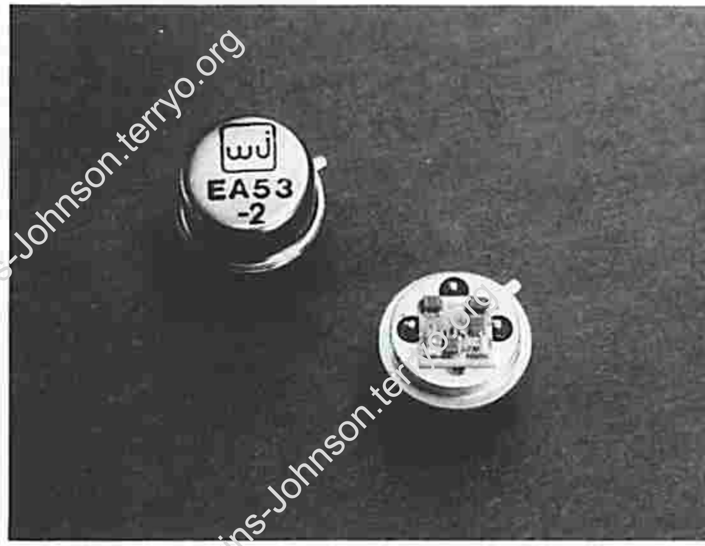
Linear S-Parameters

FREQUENCY MHZ	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
1.0	0.076	-83	13.18	-159	0.04	12	0.090	-109
2.0	0.040	-55	13.46	-168	0.04	7	0.042	-119
5.0	0.031	-24	13.62	-175	0.04	1	0.031	-117
10.0	0.031	-20	13.58	-178	0.04	-2	0.022	-123
50.0	0.069	-73	13.60	170	0.04	-2	0.017	[illegible]
100.0	0.117	-88	13.23	158	0.04	-1	0.028	[illegible]
150.0	0.160	-93	12.94	146	0.04	5	0.041	176
200.0	0.209	-101	12.38	130	0.04	4	[illegible]	164
250.0	0.258	-109	11.73	120	0.05	4	[illegible]	136
300.0	0.294	-114	11.08	109	0.05	7	0.090	120
350.0	0.340	-120	10.55	103	0.05	4	0.119	116

WJ-EA53-2

5 TO 500 MHz
TO-5 CASCADABLE AMPLIFIER

- HIGH GAIN: 19 dB (TYP.)
- MEDIUM OUTPUT POWER: 11 dBm TYP
- SMALL SIZE: TO-5



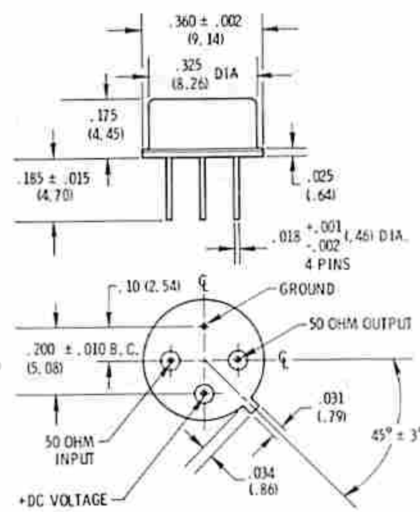
Specifications*

Characteristic	Typical	Guaranteed 0° - 50°C	Guaranteed -54° - +85°C
Frequency (Min.)	2-600 MHz	5-500 MHz	5-500 MHz
Small Signal Gain (Min.)	19.0 dB	18.5 dB	17.5 dB
Gain Flatness (Max.)	±.2 dB	±.5 dB	±1.0 dB
Noise Figure (Max.)	3.6 dB	4.0 dB	4.5 dB
Power Output at 1 dB Compression (Min.)	+11.0 dBm	+10.0 dBm	+9.0 dBm
VSWR (Max.) Input/Output	1.5:1	2.0:1	2.0:1
DC Current (Max.) at 15 Volts	33 mA	37 mA	40 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Outline Drawings

EA53-2



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .005 (.13) UNLESS OTHERWISE SPECIFIED

*WJ-CA package is not available for TO-5.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 46 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 30 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 24 dBm (Typ.)

Absolute Maximum Ratings

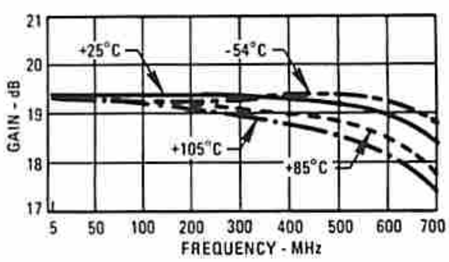
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . +100°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . 13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
Maximum Peak Power . . . . .5 Watt
(3 µsec Max.)
"S" Series Burn-In Temperature (Case) . . . . +100°C

Weight approximately 1.0 grams (0.04 oz.)

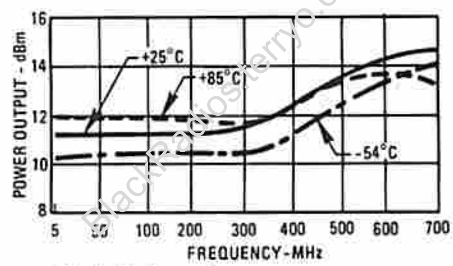
Typical Performance at 25°C

1

Gain

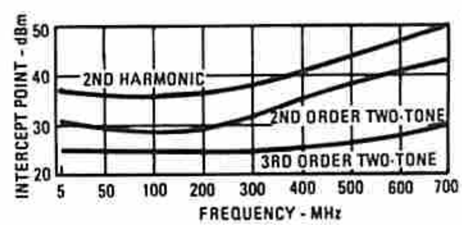


Power Output*

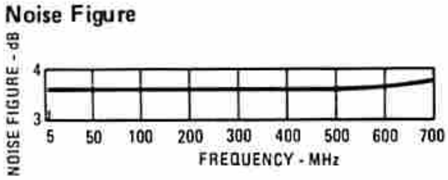


*at 1 dB Gain Compression

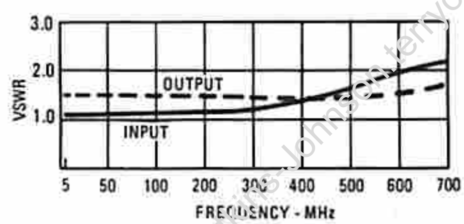
Intercept Point



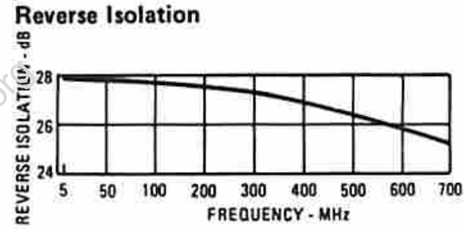
Noise Figure



VSWR



Reverse Isolation



Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
1.00	1.3	1.4	19.2
2.00	1.2	1.4	19.2
5.00	1.1	1.4	19.3
10.00	1.1	1.4	19.4
50.00	1.1	1.4	19.4
100.00	1.2	1.4	19.3
200.00	1.2	1.4	[illegible]
300.00	1.3	1.4	[illegible]
400.00	1.5	1.4	[illegible]
500.00	1.7	1.4	19.1
600.00	2.0	1.5	19.0
700.00	2.2	1.7	18.5

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.123	-120	9.12	-161	0.04	11	0.172	-19
2.0	0.081	-128	9.17	-160	0.04	5	0.153	-11
5.0	0.060	-155	9.25	-175	0.04	-1	0.163	-8
10.0	0.055	-162	9.33	-177	0.04	-2	0.162	-8
50.0	0.057	-158	9.33	173	0.04	-4	0.164	-15
100.0	0.073	-145	9.23	162	0.04	-5	0.163	-26
200.0	0.098	-140	9.12	138	[illegible]	-8	0.158	-39
300.0	0.137	-134	9.12	121	[illegible]	-13	0.153	-70
400.0	0.199	-141	9.18	100	[illegible]	-16	0.164	-107
500.0	0.250	-140	9.02	75	0.05	-21	0.169	-133
600.0	0.320	-156	8.87	55	0.05	-25	0.207	-170
700.0	0.383	-172	8.40	31	0.06	-26	0.252	150

WJ-EA54

10 TO 250 MHz
TO-5 CASCADABLE AMPLIFIER

- TWO STAGES: 27 dB GAIN (TYP.)
- LOW VSWR: 1.2:1 (TYP.)
- POWER EFFICIENT: 5 VOLTS Vcc @ 30 mA
- COST EFFICIENT: MINIMUM PARTS COUNT.
- EXTRA SMALL SIZE: TO-5 PACKAGE.

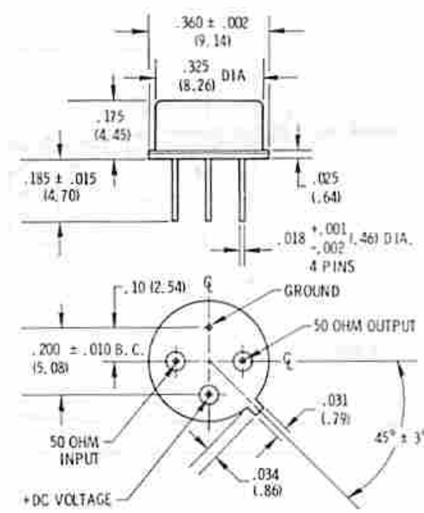
Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54° - +85°C
Frequency (Min.)	5 - 350 MHz	10 - 250 MHz	10 - 250 MHz
Small Signal Gain (Min.)	27.0 dB	25 dB	24 dB
Gain Flatness (Max.)	±.7 dB	±1.0 dB	±1.2 dB
Noise Figure (Max.)	3.8 dB	4.5 dB	5.0 dB
Power Output at 1 dB Compression (Min.)	5.0 dBm	4.0 dBm	2.0 dBm
VSWR (Max.) Input/Output	1.2:1	1.7:1	1.8:1
DC Current (Max.) at 5 Volts	30 mA	33 mA	36 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Outline Drawings

EA54



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .005 (.13) UNLESS OTHERWISE SPECIFIED

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 33 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 28 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 16 dBm (Typ.)

Absolute Maximum Ratings

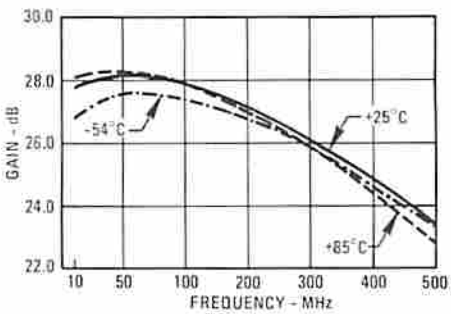
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . 7 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)

'S' Series Burn-In Temperature (Case) . . . . 125°C

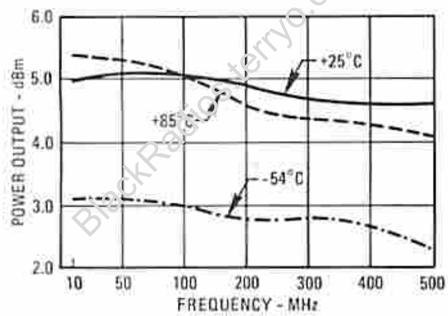
Weight approximately 1.0 grams (0.04 oz.)

Typical Performance at 25°C

Gain

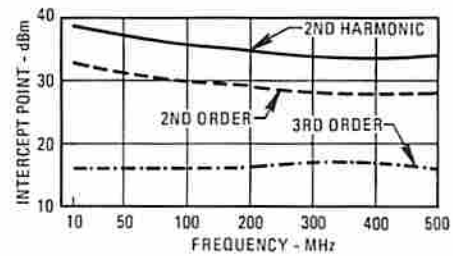


Power Output*

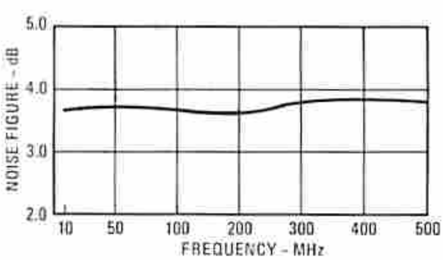


*at 1 dB Gain Compression

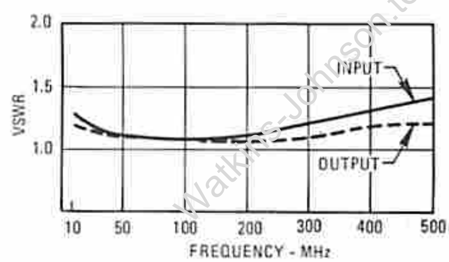
Intercept Point



Noise Figure



VSWR



Typical Automatic Test Data

V_{CC} = +5 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.0	1.4	1.3	27.5
10.0	1.2	1.2	[illegible]
50.0	1.1	1.1	[illegible]
100.0	1.1	1.1	28.2
150.0	1.1	1.1	28.0
200.0	1.2	1.1	27.6
250.0	1.2	1.2	27.0
300.0	1.3	1.2	26.5
350.0	1.2	1.2	25.9

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.588	-53	12.66	121	0.01	32	0.546	-61
2.0	0.348	-64	20.58	66	0.00	51	0.301	-71
5.0	0.170	-75	24.76	28	0.01	16	0.137	-85
10.0	0.096	-79	25.85	13	0.01	6	0.074	-97
50.0	0.041	-88	26.50	-11	0.01	-9	0.033	-130
100.0	0.049	-95	25.76	-26	0.01	10	0.033	-131
150.0	0.064	-95	25.25	-36	0.01	-1	0.037	-127
200.0	0.081	-102	23.65	-54	0.01	22	0.052	-127
250.0	0.101	-108	22.46	-67	0.01	15	0.070	-125
300.0	0.126	-117	21.12	[illegible]	0.01	21	0.075	-126
350.0	0.145	-121	19.74	-91	0.01	22	0.080	-131

1

WJ-EA54-2

5 TO 500 MHz
TO-5 CASCADABLE AMPLIFIER

- TWO STAGE: 29.5 dB GAIN (TYP.)
- MEDIUM OUTPUT POWER: 9.5 dBm (TYP.)
- COST EFFICIENT: MINIMUM PARTS COUNT
- EXTRA SMALL SIZE: TO-5 PACKAGE

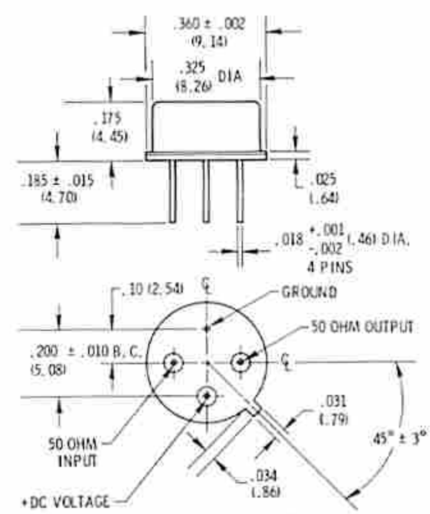
Specifications*

Characteristics	Typ.	Guaranteed 0° - +50°C	Guaranteed -54° - +85°C
Frequency (Min.)	3-600 MHz	5-500 MHz	5-500 MHz
Small Signal Gain (Min.)	29.5 dB	28.5 dB	27.5 dB
Gain Flatness (Max.)	±.4 dB	±.8 dB	±1.0 dB
Noise Figure (Max.)	4.5 dB	5.0 dB	5.5 dB
Power Output at 1 dB Compression (Min.)	9.5 dBm	8.0 dBm	6.0 dBm
VSWR (Max.)			
Input	1.3:1	1.8:1	2.0:1
Output	1.6:1	2.0:1	2.1:1
DC Current (Max.) at +15 Volts	55 mA	59 mA	62 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Outline Drawings

EA54-2



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

*WJ-CA package is not available for TO-5's.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . .38 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . .34 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . .20 dBm (Typ.)

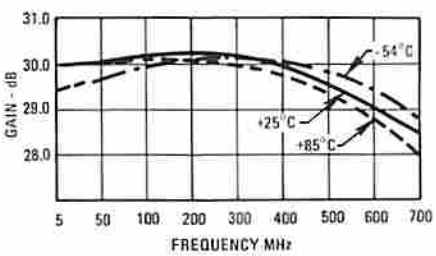
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . +100°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +12 dBm
Maximum Short Term RF Input Power (1 Minute Max.). . . . . 50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt
. . . . (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . +100°C

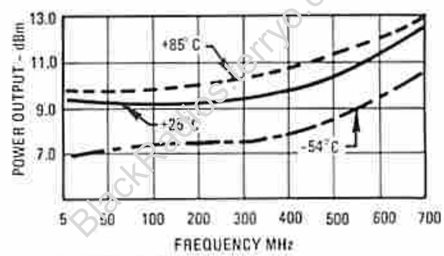
Weight approximately 1.0 grams (0.04 oz.)

Typical Performance at 25°C

Gain

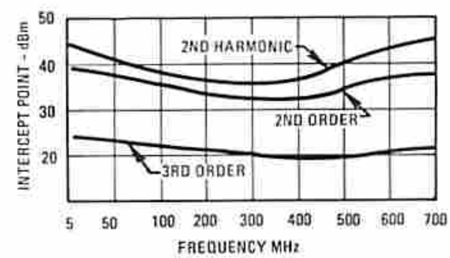


Power Output*

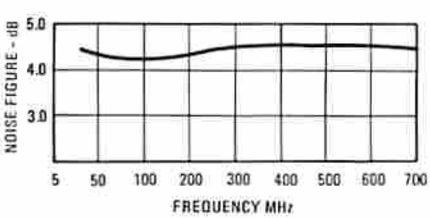


*at 1 dB Gain Compression

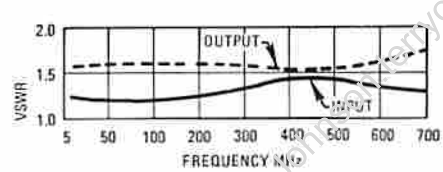
Intercept Point



Noise Figure



VSWR



Typical Automatic Test Data

V_{cc} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
1.00	3.3	3.2	26.2
2.00	2.0	1.0	28.6
5.00	1.3	1.6	29.7
10.00	1.2	1.5	29.9
50.00	1.1	1.5	30.0
100.00	1.1	1.5	30.1
200.00	1.2	1.4	30.0
300.00	1.2	1.4	30.0
400.00	1.3	1.4	29.9
500.00	1.2	1.3	29.6
600.00	1.2	1.3	29.0
700.00	1.2	1.3	28.3

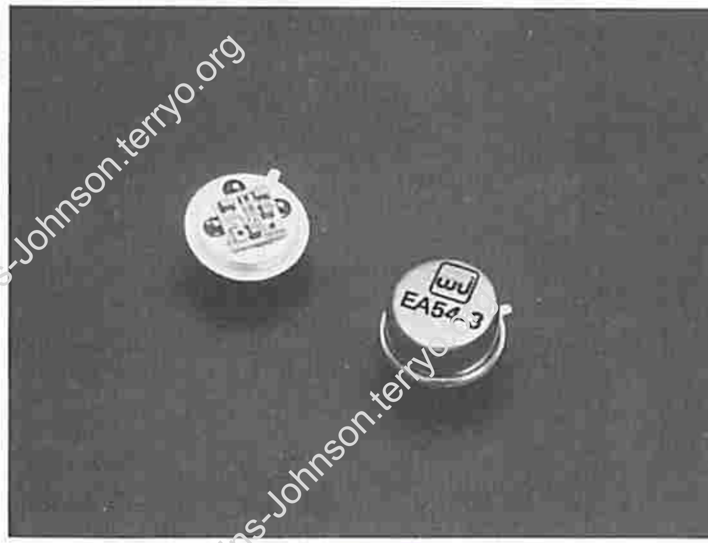
Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.536	-67	20.35	102	0.00	57	0.526	-40
2.0	0.326	-79	26.08	58	0.00	25	0.282	-46
5.0	0.135	-99	30.72	23	0.00	8	0.219	-22
10.0	0.076	-115	31.30	10	0.00	3	0.211	-16
50.0	0.044	-145	31.79	-9	0.00	5	0.190	-10
100.0	0.053	-150	31.81	-22	0.00	8	0.194	-15
200.0	0.083	-149	31.72	-48	0.00	13	0.178	-36
300.0	0.096	-162	31.72	-73	0.00	20	0.162	-56
400.0	0.111	-170	31.21	-94	0.00	29	0.149	-76
500.0	0.108	168	30.13	-125	0.01	30	0.130	-112
600.0	0.101	156	28.07	-152	0.01	32	0.121	-159
700.0	0.085	139	26.07	-174	0.01	31	0.149	155

WJ-EA54-3

5 TO 300 MHz
TO-5 CASCADABLE AMPLIFIER

- LOW NOISE: 2.7 dB (TYP.)
- HIGH GAIN: 36.5 dB (TYP.)
- LOW COST
- SMALL SIZE: TO-5



Specifications*

Characteristics	Typical	Guaranteed[1] 0° - +50°C	Guaranteed[1] -54°C - +85°C
Frequency (Min.)	5-350 MHz	5-300 MHz	5-300 MHz
Small Signal Gain (Min.)	36.5 dB	35.0 dB	34.0 dB
Gain Flatness (Max.)	±0.4 dB	±0.7 dB	±0.8 dB
Noise Figure (Max.)	2.7 dB	3.6 dB	4.0 dB
Power Output at 1 dB Compression (Min.)	9.0 dBm	7.5 dBm	6.5 dBm
VSWR (Max.)			
Input	1.6:1	1.8:1	1.9:1
Output	1.4:1	1.8:1	1.9:1
DC Current (Max.) at +15 Volts	33.0 mA	36.0 mA	37.0 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Typical Intermodulation Performance at 25°C

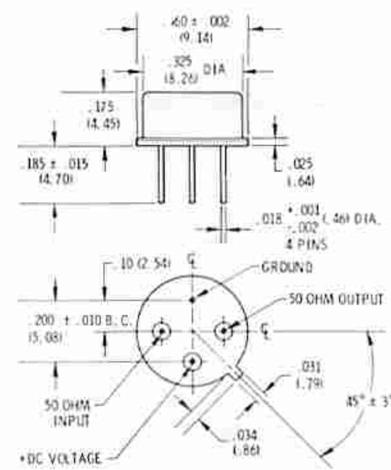
Second Order Harmonic Intercept Point . . . . 33.0 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 28.0 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 20.0 dBm (Typ.)

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . +125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
Maximum Peak Power . . . . 0.5 Watt
. . . . (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Outline Drawing

EA54-3



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.005 (.13) UNLESS OTHERWISE SPECIFIED

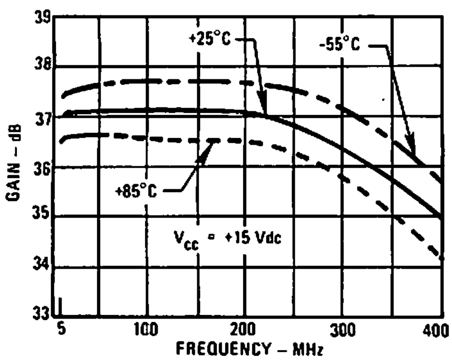
Weight

approximately 1.0 grams (0.04 oz.)

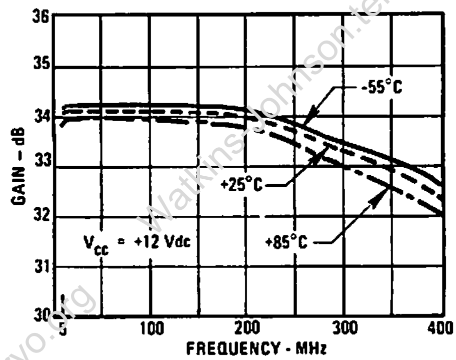
WJ-CA package is not available for TO-5's.

Typical Performance at 25°C

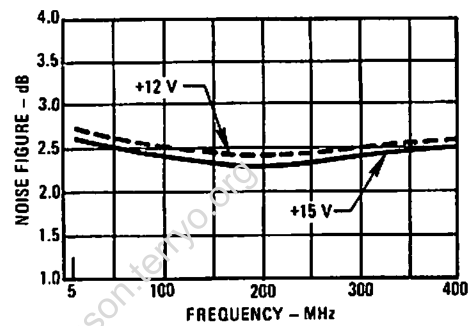
Gain



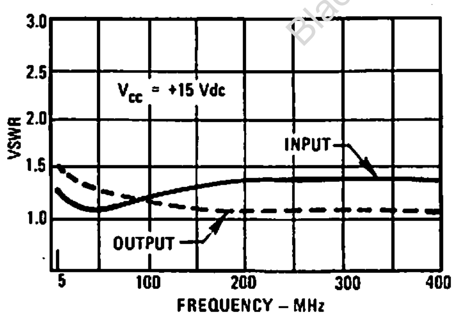
Gain



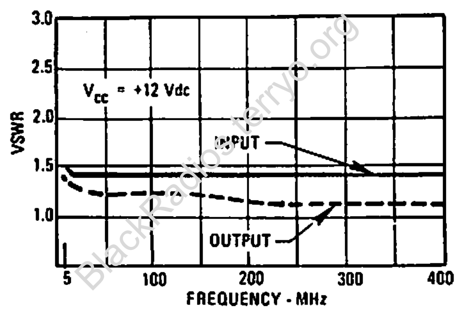
Noise Figure vs. Frequency



VSWR

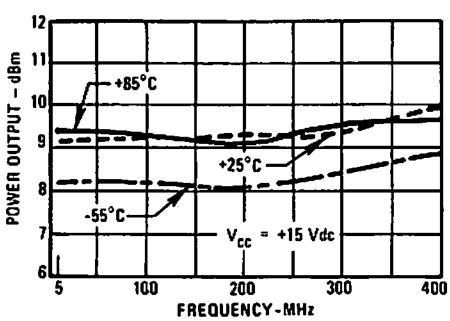


VSWR



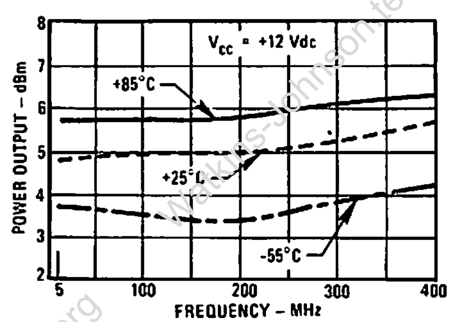
1

Power Output*



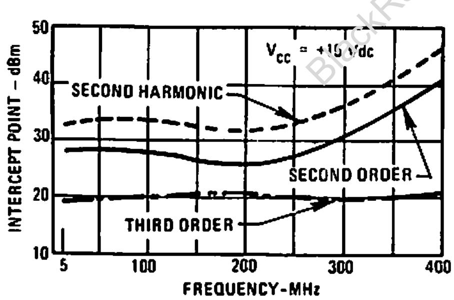
*at 1 dB Gain Compression

Power Output*

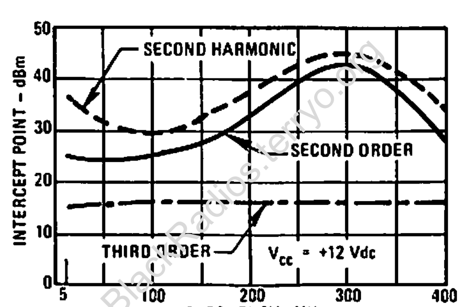


*at 1 dB Gain Compression

Intercept Point



Intercept Point



Typical Automatic Test Data

V_{CC} = +12 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
1.0	2.2	2.8	31.7
2.0	1.7	2.0	33.3
5.0	1.5	1.4	34.0
10.0	1.4	1.3	34.1
50.0	1.4	1.2	34.0
100.0	1.4	1.2	34.1
150.0	1.4	1.2	34.0
200.0	1.4	1.1	34.0
250.0	1.4	1.1	33.7
300.0	1.4	1.1	33.3
350.0	1.4	1.0	32.9
400.0	1.4	1.0	32.3

Linear S-Parameters

Frequency MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.377	-56	38.53	99	0.00	51	0.471	-41
2.0	0.271	-39	46.37	51	0.00	35	0.330	-48
5.0	0.200	-25	[illegible]	20	0.00	5	0.182	-42
10.0	0.180	-17	[illegible]	8	0.00	0	0.137	-31
50.0	0.170	-23	50.38	-13	0.00	0	0.107	-17
100.0	0.171	-40	50.62	-29	0.00	2	0.096	-17
150.0	0.175	-56	50.13	-46	0.01	9	0.080	-28
200.0	0.178	-73	49.93	-63	0.01	7	0.069	-32
250.0	0.173	-88	48.64	-79	0.01	15	0.049	-51
300.0	0.174	-102	46.46	-96	0.01	16	0.026	-51
350.0	0.163	-113	43.97	-112	0.01	15	0.011	-16
400.0	0.160	-128	41.08	-124	0.01	24	0.016	66

V_{CC} = +15 Vdc

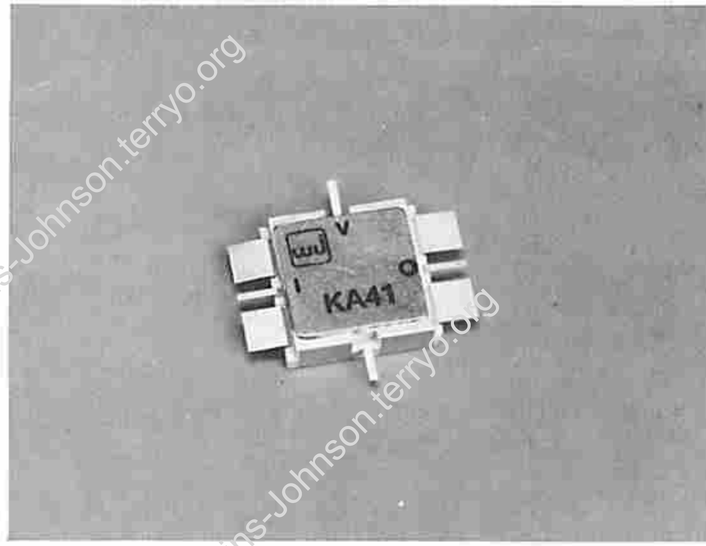
FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
1.0	2.8	2.5	34.1
2.0	1.7	1.9	36.2
5.0	1.3	1.5	37.0
10.0	1.2	1.4	37.1
50.0	1.1	1.3	37.1
100.0	1.2	1.2	37.2
150.0	1.3	1.2	37.1
200.0	1.4	1.1	37.1
250.0	1.4	1.1	36.8
300.0	1.4	1.0	[illegible]
350.0	1.4	1.0	35.7
400.0	1.4	1.1	34.9

Linear S-Parameters

Frequency MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.469	-71	50.66	112	0.00	-6	0.433	-44
2.0	0.253	-67	64.71	57	0.00	43	0.321	-44
5.0	0.123	-64	70.55	22	0.00	15	0.195	-39
10.0	0.078	-57	71.24	9	0.00	4	0.157	-27
50.0	0.064	-71	71.23	-13	0.00	2	0.125	-22
100.0	0.091	-94	72.06	-30	0.00	0	0.109	-25
150.0	0.133	-117	71.58	-48	0.00	7	0.087	-42
200.0	0.159	-134	71.31	-65	0.00	10	0.062	-51
250.0	0.160	-151	69.19	-83	0.01	20	0.043	-83
300.0	0.174	-165	65.10	-101	0.01	22	0.013	-152
350.0	0.169	180	60.67	-118	0.01	22	0.021	125
400.0	0.177	168	55.47	-130	0.01	28	0.043	102

WJ-KA41

1 TO 4 GHz CERAMIC AMPLIFIER



- WIDE BANDWIDTH: 1-4 GHz
- MEDIUM OUTPUT LEVEL: 12.0 dBm (TYP.)
- LOW NOISE: 4.0 dB (TYP.)
- EXCELLENT GAIN BLOCK
- GaAs FET DESIGN

Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54° - +85°C
Frequency (Min.)	0.9-4.2 GHz	1-4 GHz	1-4 GHz
Small Signal Gain (Min.)	8.5 dB	7.0 dB	6.5 dB
Gain Flatness (Max.)	±0.4 dB	±0.7 dB	±0.9 dB
Noise Figure (Max.)	4.0 dB	5.0 dB	5.5 dB
Power Output at 1 dB Compression (Min.)	12.0 dBm	11.0 dBm	10.5 dBm
VSWR (Max.)			
Input	1.6:1	2.1:1	2.2:1
Output	1.4:1	2.1:1	2.2:1
DC Current (Max.) at +5 Volts	35 mA	40 mA	42 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Typical Intermodulation Performance at 25°C

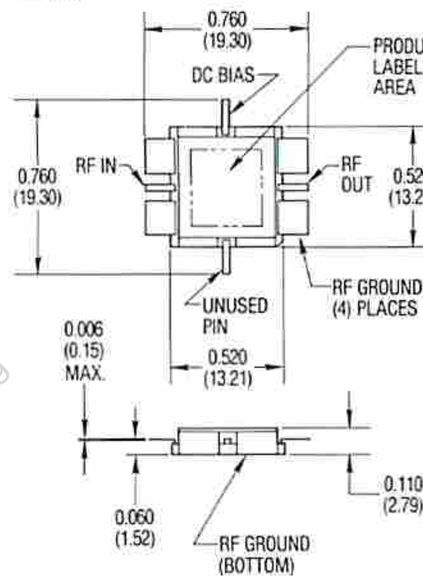
Second Order Harmonic Intercept Point . . . . 45 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 40 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 25 dBm (Typ.)

Absolute Maximum Ratings

Storage Temperature . . . . -64°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +6 Volts
Maximum Continuous RF Input Power . . . . +10 dBm
Maximum Short Term RF Input (1 Minute Max.) . . . . 50 Milliwatts
Maximum Peak Power . . . . 0.25 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Outline Drawings

KA41

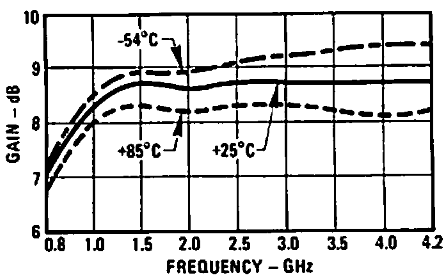


DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

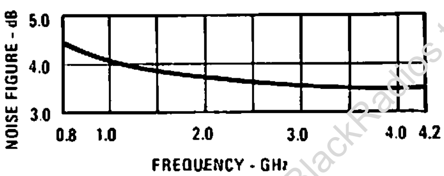
Weight approximately 1.7 grams (0.06 oz.)

Typical Performance at 25°C

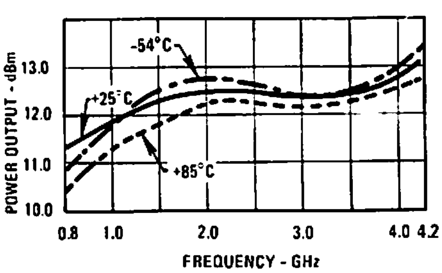
Gain



Noise Figure

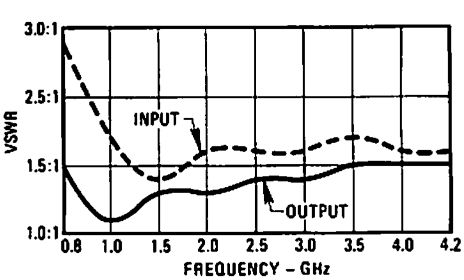


Power Output*

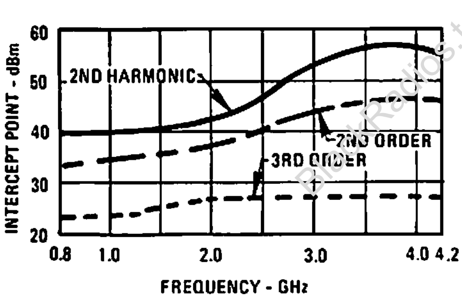


*at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{CC} = +5 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB	FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
800.0	2.4	1.5	7.11	2600.0	1.6	1.4	8.68
900.0	2.0	1.2	7.90	2700.0	1.6	1.4	8.71
1000.0	1.7	1.1	8.27	2800.0	1.6	1.4	8.73
1100.0	1.5	1.1	8.52	2900.0	1.6	1.4	8.75
1200.0	1.4	1.2	8.61	3000.0	1.6	1.4	8.74
1300.0	1.4	1.2	8.67	3100.0	1.6	1.4	8.73
1400.0	1.4	1.2	8.67	3200.0	1.7	1.5	8.74
1500.0	1.4	1.3	8.65	3300.0	1.7	1.5	8.73
1600.0	1.3	1.3	8.64	3400.0	1.7	1.5	8.71
1700.0	1.5	1.3	8.64	3500.0	1.7	1.5	8.71
1800.0	1.6	1.3	8.63	3600.0	1.7	1.5	8.72
1900.0	1.6	1.3	8.61	3700.0	1.7	1.5	8.71
2000.0	1.6	1.3	8.60	3800.0	1.6	1.5	8.70
2100.0	1.6	1.3	8.62	3900.0	1.6	1.5	8.71
2200.0	1.6	1.3	8.64	4000.0	1.6	1.5	8.69
2300.0	1.6	1.4	8.63	4100.0	1.6	1.5	8.69
2400.0	1.6	1.4	8.65	4200.0	1.6	1.5	8.68
2500.0	1.6	1.4	8.68				

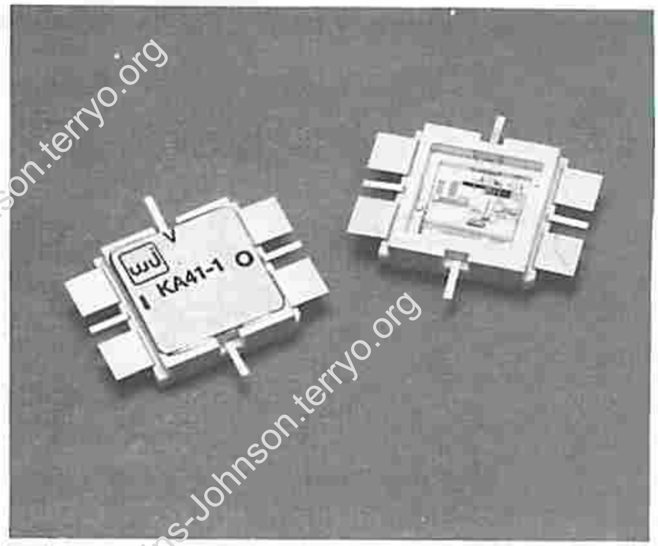
Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
800.0	.418	40	2.267	-153	.136	40	.195	29
900.0	.326	25	2.492	-176	.146	19	.104	-9
1000.0	.255	2	2.592	165	.149	1	.061	-66
1100.0	.201	-21	2.666	148	.150	-14	.066	-123
1200.0	.173	-46	2.695	132	.149	-28	.085	-152
1300.0	.160	-69	2.715	118	.148	-41	.100	-169
1400.0	.163	-90	2.713	104	.146	-53	.107	180
1500.0	.177	-123	2.707	91	.144	-64	.112	173
1600.0	.192	-137	2.704	79	.142	-74	.115	168
1700.0	.204	-149	2.704	67	.140	-84	.120	164
1800.0	.210	-159	2.701	56	.138	-93	.124	161
1900.0	.229	-169	2.694	45	.137	-103	.130	158
2000.0	.235	-178	2.693	34	.135	-111	.132	155
2100.0	.242	173	2.697	24	.133	-120	.140	150
2200.0	.245	163	2.705	13	.132	-129	.145	146
2300.0	.245	152	2.701	2	.130	-137	.151	141
2400.0	.245	142	2.708	-8	.130	-146	.157	136
2500.0	.245	130	2.717	-19	.128	-154	.162	130
2600.0	.243	119	2.717	-29	.127	-162	.167	125
2700.0	.241	107	2.727	-39	.126	-170	.171	119
2800.0	.241	95	2.733	-49	.125	-179	.174	114
2900.0	.240	83	2.737	-60	.124	174	.177	108
3000.0	.243	70	2.737	-70	.123	166	.180	102
3100.0	.244	58	2.733	-80	.122	158	.182	96
3200.0	.246	46	2.734	-90	.121	150	.184	90
3300.0	.249	34	2.731	-100	.120	142	.185	84
3400.0	.250	22	2.727	-110	.118	135	.186	78
3500.0	.249	11	2.726	-120	.117	127	.185	72
3600.0	.248	-1	2.730	-130	.117	119	.187	66
3700.0	.247	-13	2.726	-140	.116	111	.186	60
3800.0	.244	-26	2.721	-150	.114	104	.186	53
3900.0	.239	-39	2.723	-160	.113	96	.187	47
4000.0	.235	-52	2.719	-170	.112	88	.187	40
4100.0	.233	-66	2.719	180	.111	81	.187	33
4200.0	.231	-81	2.717	170	.111	73	.187	26

1

WJ-KA41-1

1 TO 4 GHz
CERAMIC AMPLIFIER



- WIDE BANDWIDTH: 1-4 GHz
- HIGH OUTPUT POWER: +19 dBm (TYP.)
- LOW NOISE: 3.0 dB (TYP.)
- HIGH THIRD ORDER INTERCEPT POINT: 30 dBm

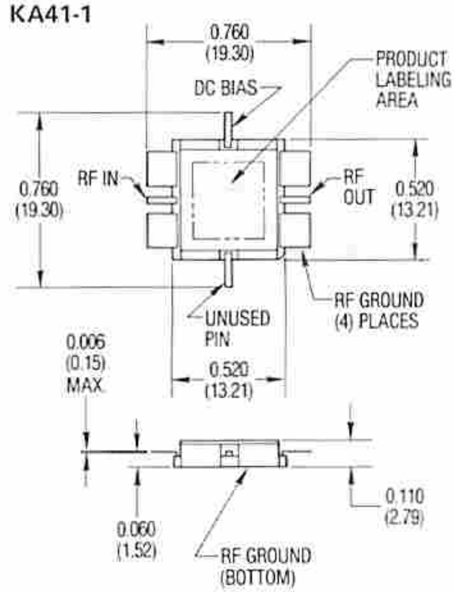
Specifications*

Characteristics	Typ.	Guaranteed 0° - 50°C	-54°C - +85°C
Frequency (Min.)	.8-4.2 GHz	1-4 GHz	1-4 GHz
Small Signal Gain (Min.)	8.5 dB	7.5 dB	7.0 dB
Gain Flatness (Max.)	±.3 dB	±.7 dB	±1.0 dB
Noise Figure (Max.)	4.0 dB	4.8 dB	5.3 dB
Power Output at 1 dB Compression (Min.)	19 dBm	17.0 dBm	16.5 dBm
VSWR (Max.)			
Input	1.7:1	2.0:1	2.1:1
Output	1.4:1	2.0:1	2.1:1
DC Current (Max.) at +12 Volts	70 mA	77 mA	79 mA

*Measured in a 50-ohm system at +12 Vdc Nominal.

Outline Drawings

KA41-1



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.005 (.13) UNLESS OTHERWISE SPECIFIED

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . .49 dBm (Typ.)
Second Order Two Tone Intercept Point .43 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . .30 dBm (Typ.)

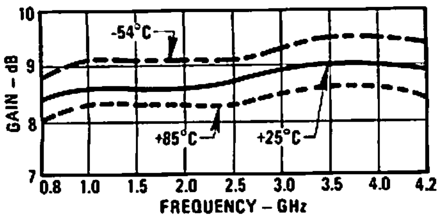
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . +125°C
Maximum DC Voltage . . . . 13 Volts
Maximum Continuous RF Input Power . . . . +14 dBm
Maximum Short Term RF Intput Power (1 Minute Max.) . . . . .50 Milliwatts
Maximum Peak Power . . . . 0.25 Watt
. . . . (3μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

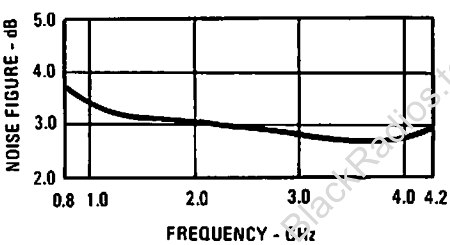
Weight approximately 1.7 grams (0.06 oz.)

Typical Performance at 25°C

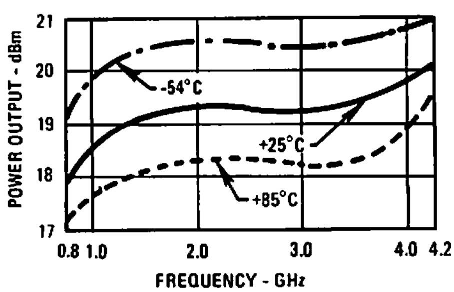
Gain



Noise Figure

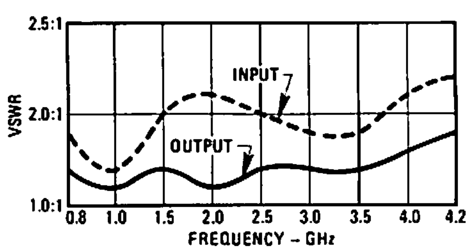


Power Output*

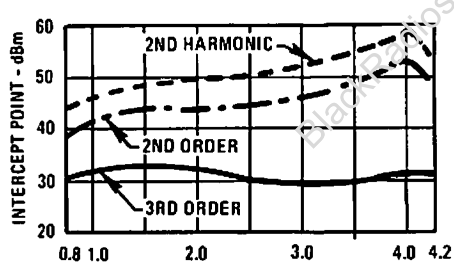


*at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{cc} = +12 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
800.0	1.4	1.2	8.35
900.0	1.2	1.1	8.50
1000.0	1.2	1.1	8.64
1100.0	1.3	1.2	8.66
1200.0	1.3	1.2	8.64
1300.0	1.4	1.2	8.62
1400.0	1.5	1.2	8.59
1500.0	1.5	1.2	8.57
1600.0	1.5	1.1	8.58
1700.0	1.6	1.1	8.58
1800.0	1.6	1.1	8.59
1900.0	1.6	1.1	8.61
2000.0	1.6	1.1	8.62
2100.0	1.6	1.1	8.64
2200.0	1.6	1.1	8.67
2300.0	1.6	1.1	8.66
2400.0	1.6	1.2	8.70
2500.0	1.5	1.2	8.74

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
2600.0	1.5	1.2	8.77
2700.0	1.5	1.2	8.81
2800.0	1.5	1.2	8.84
2900.0	1.4	1.2	8.86
3000.0	1.4	1.2	8.89
3100.0	1.4	1.2	8.91
3200.0	1.4	1.2	8.92
3300.0	1.4	1.2	8.94
3400.0	1.4	1.2	8.95
3500.0	1.4	1.2	8.96
3600.0	1.4	1.3	8.99
3700.0	1.4	1.3	8.98
3800.0	1.4	1.3	8.98
3900.0	1.5	1.3	8.98
4000.0	1.6	1.3	8.95
4100.0	1.6	1.3	8.93
4200.0	1.7	1.4	8.88

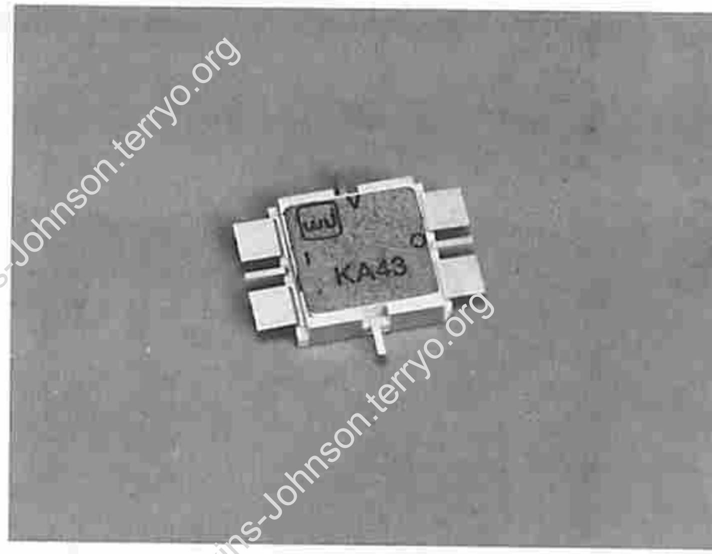
Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
800.0	.174	8	2.614	-180	.154	22	.076	39
900.0	.100	-40	2.685	160	.158	2	.034	95
1000.0	.091	-94	2.705	144	.158	-14	.063	121
1100.0	.115	-129	2.711	129	.157	-28	.084	115
1200.0	.143	-147	2.704	116	.156	-41	.093	103
1300.0	.165	-160	2.698	103	.154	-52	.094	90
1400.0	.184	[illegible]	2.688	91	.152	-63	.089	75
1500.0	.199	-178	2.683	79	.150	-74	.079	59
1600.0	.213	175	2.684	68	.149	-84	.070	41
1700.0	.225	169	2.685	57	.148	-94	.060	21
1800.0	.232	163	2.690	46	.146	-103	.053	-2
1900.0	.237	157	2.694	36	.144	-113	.049	-28
2000.0	.236	150	2.697	26	.143	-122	.054	-51
2100.0	.237	145	2.703	15	.141	-130	.057	-71
2200.0	.235	136	2.713	5	.140	-139	.062	-87
2300.0	.229	128	2.711	-5	.138	-148	.067	-101
2400.0	.222	119	2.723	-15	.137	-156	.072	-114
2500.0	.216	108	2.737	-26	.135	-166	.076	-124
2600.0	.207	98	2.746	-36	.134	-174	.081	-134
2700.0	.199	86	2.756	-46	.132	178	.084	-142
2800.0	.190	73	2.767	-56	.132	169	.087	-149
2900.0	.183	60	2.775	-66	.130	160	.090	-155
3000.0	.177	46	2.782	-76	.128	152	.092	-161
3100.0	.171	30	2.790	-86	.126	143	.095	-166
3200.0	.168	15	2.792	-96	.124	135	.098	-171
3300.0	.163	-1	2.799	-106	.122	127	.101	-175
3400.0	.161	-17	2.801	-116	.120	118	.104	-180
3500.0	.160	-34	2.806	-126	.118	109	.109	177
3600.0	.162	-52	2.815	-135	.116	101	.115	172
3700.0	.170	-71	2.812	-147	.113	93	.120	168
3800.0	.181	-89	2.812	-157	.111	85	.126	163
3900.0	.197	-106	[illegible]	-167	.108	76	.133	158
4000.0	.217	-123	[illegible]	-178	.106	68	.139	153
4100.0	.243	-138	2.794	172	.103	59	.145	148
4200.0	.271	-152	2.781	162	.100	52	.150	142

WJ-KA43

1.0 TO 4.0 GHz CERAMIC AMPLIFIER

- ULTRA-WIDE BANDWIDTH: 1-4 GHz
- HIGH GAIN 21 dB (TYP.)
- LOW NOISE: 4.5 dB (TYP.)
- MEDIUM OUTPUT POWER: 11.5 dBm (TYP.)
- GaAs FET DESIGN



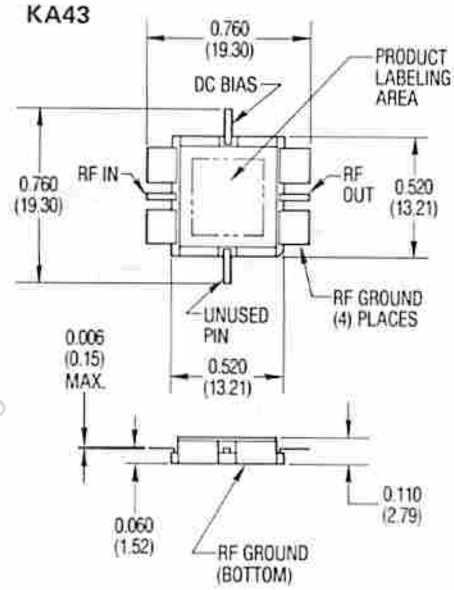
Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	0.8-4.0 GHz	1.0-4.0 GHz	1.0-4.0 GHz
Small Signal Gain (Min.)	21.0 dB	19.5 dB	18.0 dB
Gain Flatness (Max.)	±0.7 dB	±0.9 dB	±1.2 dB
Noise Figure (Max.)	4.5 dB	5.3 dB	5.8 dB
Power Output at 1 dB Compression (Min.)	11.5 dBm	10.5 dBm	9.5 dBm
VSWR (Max.)			
Input	1.7:1	2.1:1	2.3:1
Output	1.7:1	2.1:1	2.3:1
DC Current (Max.) at +5 Volts	115 mA	140 mA	150 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Outline Drawings

KA43



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.005 (.13) UNLESS OTHERWISE SPECIFIED

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point .... 35 dBm (Typ.)
Second Order Two Tone Intercept Point .... 31 dBm (Typ.)
Third Order Two Tone Intercept Point .... 22 dBm (Typ.)

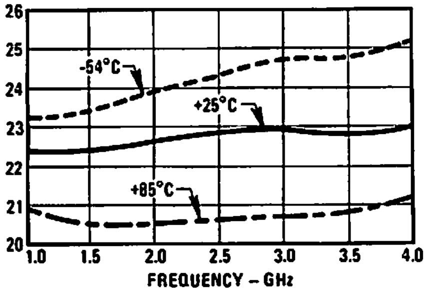
Absolute Maximum Ratings

Storage Temperature .... -65°C to +125°C
Maximum Case Temperature .... 125°C
Maximum DC Voltage .... +6 Volts
Maximum Continuous RF Input Power .... +7 dBm
Maximum Short Term RF Input Power (1 Minute Max.) .... 100 Milliwatts
Maximum Peak Power .... 0.25 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) .... 125°C

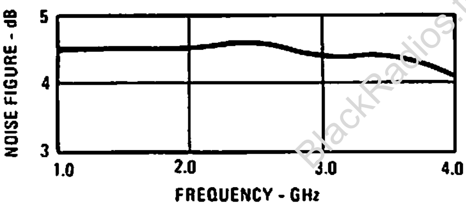
Weight approximately 1.7 grams (0.06 oz.)

Typical Performance at 25°C

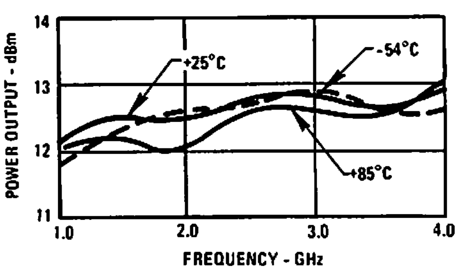
Gain



Noise Figure

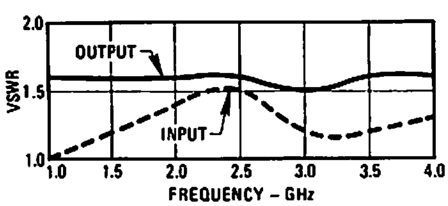


Power Output*

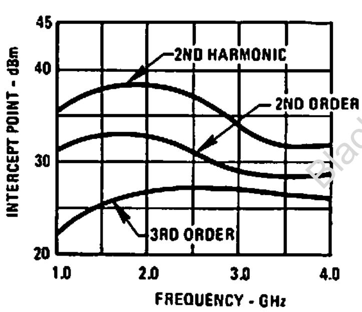


*at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{CC} = +5 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB	FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
800.0	1.2	1.5	22.29	2600.0	1.5	1.6	22.85
900.0	1.1	1.6	22.46	2700.0	1.4	1.6	22.88
1000.0	1.0	1.5	22.41	2800.0	1.4	1.5	22.91
1100.0	1.0	1.6	22.43	2900.0	1.3	1.5	22.94
1200.0	1.1	1.5	22.38	3000.0	1.2	1.5	22.91
1300.0	1.1	1.6	22.37	3100.0	1.2	1.5	22.92
1400.0	1.2	1.6	22.37	3200.0	1.1	1.6	22.85
1500.0	1.2	1.6	22.41	3300.0	1.1	1.6	22.82
1600.0	1.2	1.6	22.46	3400.0	1.1	1.5	22.78
1700.0	1.3	1.6	22.48	3500.0	1.2	1.6	22.76
1800.0	1.3	1.6	22.47	3600.0	1.2	1.6	22.76
1900.0	1.4	1.6	22.49	3700.0	1.2	1.6	22.76
2000.0	1.4	1.6	22.55	3800.0	1.2	1.6	22.78
2100.0	1.5	1.6	22.60	3900.0	1.3	1.6	22.90
2200.0	1.5	1.6	22.65	4000.0	1.3	1.6	22.97
2300.0	1.5	1.6	22.71	4100.0	1.3	1.6	23.05
2400.0	1.6	1.6	22.74	4200.0	1.3	1.5	23.15
2500.0	1.5	1.6	22.82				

Linear S-Parameters

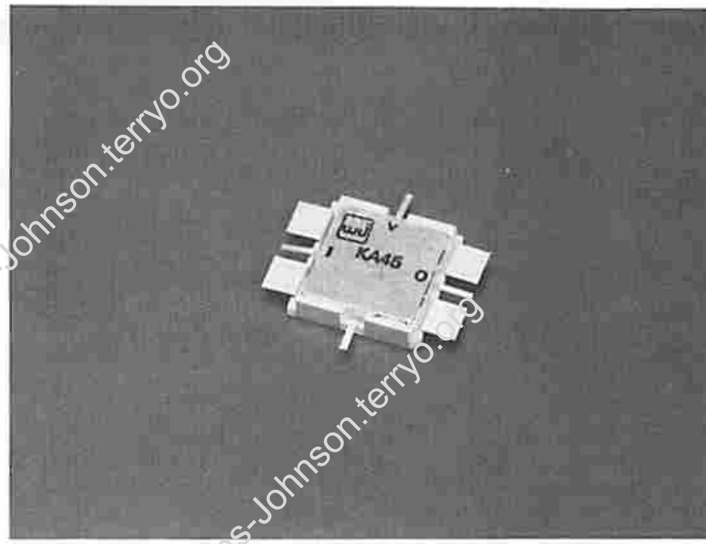
FREQUENCY MHZ	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
800.0	.095	93	13.022	-157	.003	172	.216	-87
900.0	.032	92	13.27[illegible]	163	.003	116	.238	-89
1000.0	.018	74	13.[illegible]	130	.004	31	.237	-95
1100.0	.020	22	13.232	100	.004	-0	.222	-100
1200.0	.032	-35	13.153	73	.003	6	.215	-102
1300.0	.053	-56	13.143	48	.004	-23	.216	-103
1400.0	.072	-70	13.136	23	.002	-46	.221	-105
1500.0	.086	-77	13.202	-0	.004	-73	.224	-109
1600.0	.099	-83	13.273	-23	.002	-141	.228	-113
1700.0	.121	-91	13.309	-45	.003	-127	.230	-117
1800.0	.1[illegible]	-98	13.295	-66	.004	-107	.237	-122
1900.0	.159	-106	13.325	-87	.001	-110	.239	-126
2000.0	.180	-112	13.405	-108	.001	-138	.239	-129
2100.0	.199	-119	13.493	-129	.003	-142	.236	-134
2200.0	.210	-129	13.566	-149	.002	-179	.237	-139
2300.0	.215	-138	13.667	-169	.003	153	.234	-143
2400.0	.216	-148	13.715	170	.002	73	.231	-147
2500.0	.206	-160	13.832	150	.002	71	.221	-151
2600.0	.199	-171	13.876	130	.001	-22	.218	-155
2700.0	.174	177	13.929	111	.004	87	.216	-158
2800.0	.155	164	13.980	91	.002	137	.212	-162
2900.0	.127	150	14.028	71	.003	9	.212	-165
3000.0	.099	132	13.987	52	.001	109	.212	-168
3100.0	.075	109	13.989	32	.001	107	.214	-170
3200.0	.055	76	13.891	13	0.003	66	.221	-173
3300.0	.051	38	13.842	-7	.004	-16	.220	-178
3400.0	.062	8	13.772	-25	.004	-61	.225	177
3500.0	.072	-20	13.735	-44	.002	-79	.228	171
3600.0	.084	-38	13.747	-63	.003	-9	.228	166
3700.0	.103	-56	13.736	-82	.004	-13	.222	160
3800.0	.107	-68	13.779	-101	.001	47	.228	155
3900.0	.123	-82	13.972	-120	.003	-85	.222	149
4000.0	.128	-94	14.075	-139	.002	39	.220	141
4100.0	.136	-104	14.207	-158	.005	-88	.221	133
4200.0	.134	-113	14.368	-178	.004	-103	.218	127

1

WJ-KA45

1 TO 4 GHz CERAMIC AMPLIFIER

- ULTRA WIDE BANDWIDTH: 1-4 GHz
- HIGH GAIN: 17.5 dB (TYP.)
- LOW NOISE: 4.5 dB (TYP.)
- HIGH OUTPUT POWER: 19.0 dBm (TYP.)
- GaAs FET DESIGN



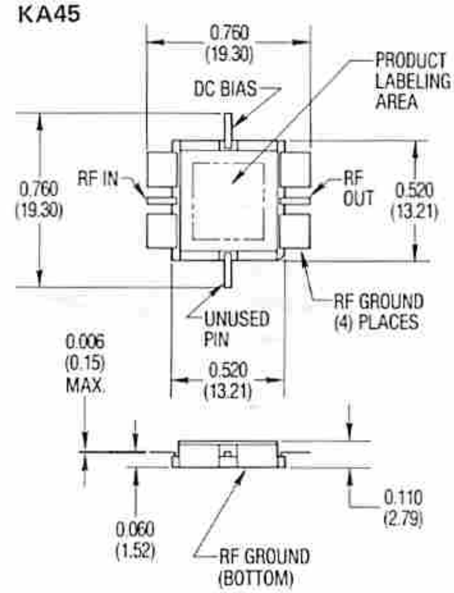
Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	1-4 GHz	1-4 GHz	1-4 GHz
Small Signal Gain (Min.)	17.5 dB	16.5 dB	15.5 dB
Gain Flatness (Max.)	±0.6 dB	±0.8 dB	±1.0 dB
Noise Figure (Max.)	4.5 dB	5.5 dB	6.0 dB
Power Output at 1 dB Compression (Min.)	19.0 dBm	18.0 dBm	17.0 dBm
VSWR (Max.) Input	1.8:1	2.1:1	2.2:1
VSWR (Max.) Output	1.8:1	2.1:1	2.2:1
DC Current (Max.) at +15 Volts	120 mA	125 mA	130 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Outline Drawings

KA45



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point	45 dBm (Typ.)
Second Order Two Tone Intercept Point	40 dBm (Typ.)
Third Order Two Tone Intercept Point	30 dBm (Typ.)

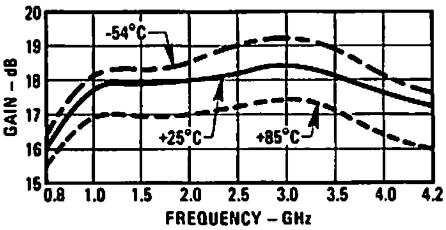
Absolute Maximum Ratings

Storage Temperature	-65°C to +125°C
Maximum Case Temperature	+100°C
Maximum DC Voltage	+16 Volts
Maximum Continuous RF Input Power	7 dBm
Maximum Short Term RF Input Power (1 Minute Max.)	100 Milliwatts
Maximum Peak Power	0.25 Watt 3 µsec Max.)
"S" Series Burn-In Temperature (Case)	+100°C

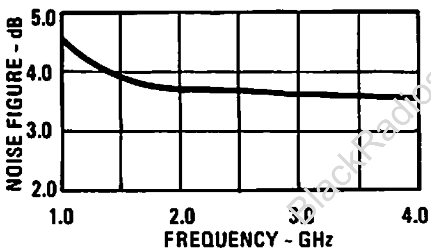
Weight approximately 1.7 grams (0.06 oz.)

Typical Performance at 25°C

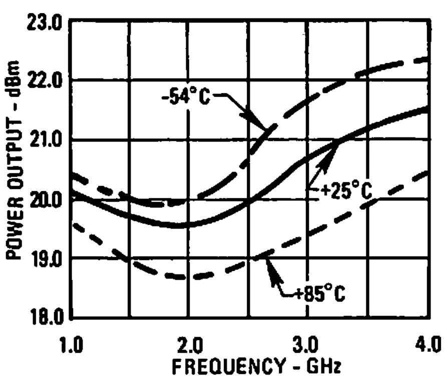
Gain



Noise Figure

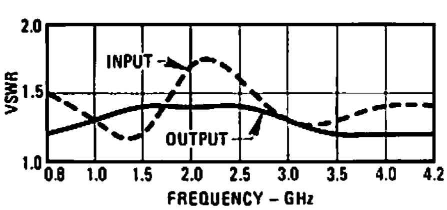


Power Output*

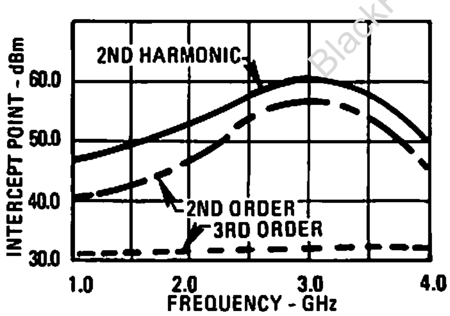


*at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{CC} = +15 Vdc

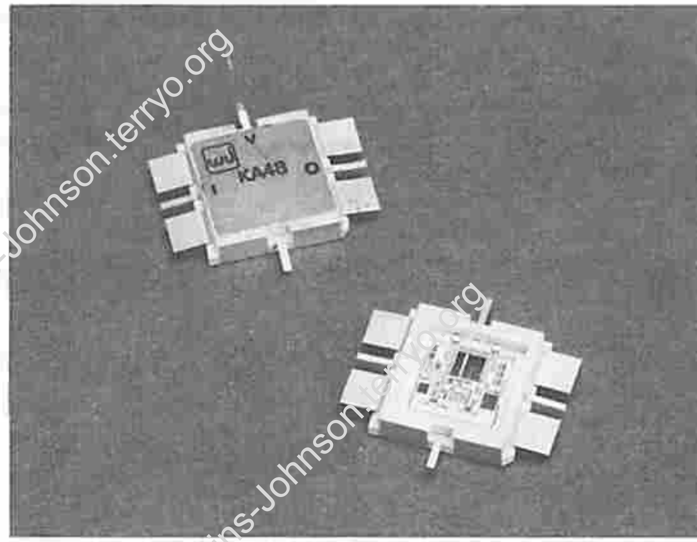
FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
800.0	1.5	1.2	15.95
1000.0	1.3	1.3	17.71
1200.0	1.1	1.4	17.85
1400.0	1.1	1.4	17.94
1600.0	1.3	1.4	17.91
1800.0	1.5	1.4	17.92
2000.0	1.7	1.4	17.95
2200.0	1.8	1.4	18.03
2400.0	1.7	1.4	18.13
2600.0	1.6	1.4	18.27
2800.0	1.4	1.3	18.32
3000.0	1.3	1.3	18.41
3200.0	1.2	1.2	18.30
3400.0	1.3	1.2	18.22
3600.0	1.3	1.2	18.06
3800.0	1.4	1.2	17.82
4000.0	1.4	1.2	17.57
4200.0	1.4	1.2	17.15

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
800.0	.198	55	6.276	103	.013	159	.087	27
1000.0	.143	-69	7.681	36	.014	101	.124	-28
1200.0	.050	-116	7.812	-6	.016	66	.163	-56
1400.0	.044	-32	7.890	-39	.015	41	.178	-79
1600.0	.139	-44	7.864	-68	.016	26	.180	-96
1800.0	.216	-64	7.873	-93	.014	12	.179	-112
2000.0	.265	-85	7.901	-116	.013	-7	.176	-127
2200.0	.282	-125	7.970	-139	.013	-19	.173	-140
2400.0	.268	-147	8.065	-161	.011	-30	.165	-154
2600.0	.335	-173	8.197	176	.012	-41	.152	-166
2800.0	.178	164	8.241	154	.010	-54	.138	-177
3000.0	.117	125	8.324	132	.009	-73	.121	176
3200.0	.075	53	8.297	109	.007	-80	.107	172
3400.0	.117	-6	8.147	87	.006	-99	.094	171
3600.0	.134	-42	7.998	65	.007	-100	.084	170
3800.0	.149	-74	7.784	42	.007	-132	.078	-170
4000.0	.183	-97	7.556	18	.005	-166	.087	-169
4200.0	.165	-118	7.280	-6	.004	-174	.108	-167

WJ-KA48

1.0 TO 4.0 GHz CERAMIC AMPLIFIER



- ULTRA-WIDE BANDWIDTH: 1-4 GHz
- HIGH OUTPUT POWER: 24.5 dBm (TYP.)
- MEDIUM GAIN: 16.0 dB (TYP.)
- GaAs FET AMPLIFIER
- KA48-1 12V MODEL WITH SAME RF SPECS

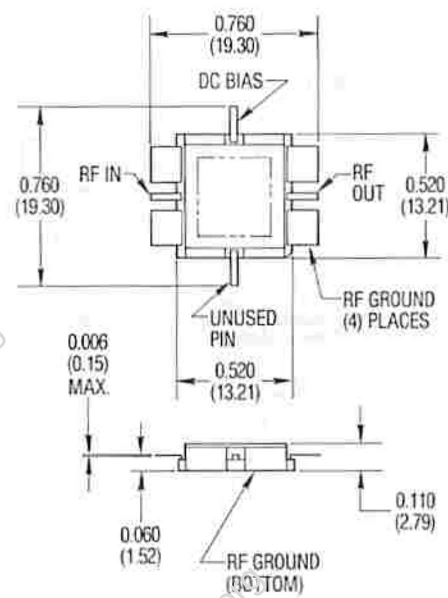
Specifications*

Characteristics	Typical	Guaranteed 0° – +50°C	Guaranteed -54° – +85°C
Frequency (Min.)	.8-4.2 GHz	1.0-4.0 GHz	1.0-4.0 GHz
Small Signal Gain (Min.)	16.0 dB	14.5 dB	14.0 dB
Gain Flatness (Max.)	±.4 dB	±.7 dB	±.8 dB
Noise Figure (Max.)	5.5 dB	7.0 dB	7.5 dB
Power Output at 1 dB Compression (Min.)	24.0 dBm	22.5 dBm	21.5 dBm
VSWR (Max.)			
Input	1.7:1	2.0:1	2.2:1
Output	1.5:1	1.8:1	2.0:1
DC Current (Max.) at 15 Volts	225 mA	235 mA	245 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Outline Drawings

KA48



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.005 (.13) UNLESS OTHERWISE SPECIFIED

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . . +49 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . . +44 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . . +33 dBm (Typ.)

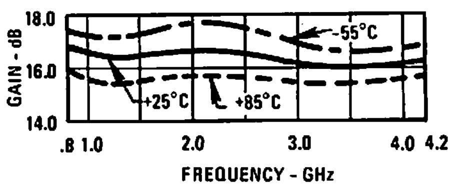
Absolute Maximum Ratings

Storage Temperature . . . . . -62°C to +125°C
Maximum Case Temperature . . . . . +85°C
Maximum DC Voltage . . . . . +16 Volts
Maximum Continuous RF Input Power . . . . . +17 dBm
Maximum Short Term RF Power (1 Minute Max.) . . . . . 100 Milliwatts
Maximum Peak Power . . . . . ¼ Watt
. . . . . (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . . +85°C

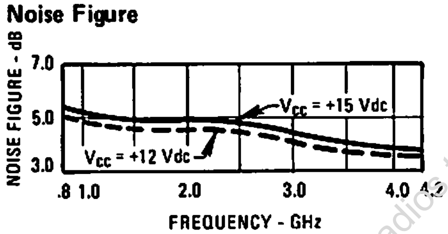
Weight approximately 1.7 grams (0.06 oz.)

Typical Performance at 25°C

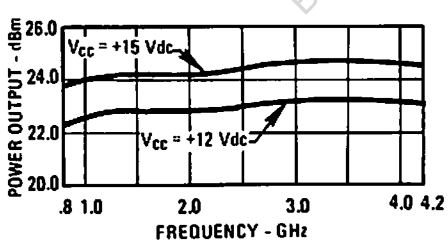
Gain

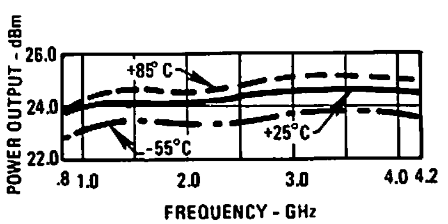


Noise Figure



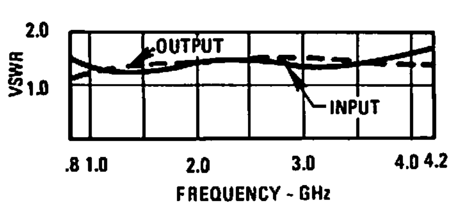
Power Output*



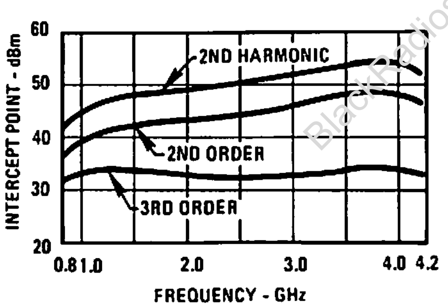


*at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{cc} = +15 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB	FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
800.0	1.6	1.1	16.87	2500.0	1.4	1.3	16.45
900.0	1.5	1.2	16.69	2600.0	1.4	1.3	16.41
1000.0	1.4	1.2	16.57	2700.0	1.3	1.4	16.36
1100.0	1.4	1.2	16.45	2800.0	1.3	1.4	16.32
1200.0	1.3	1.3	16.43	2900.0	1.2	1.4	16.27
1300.0	1.3	1.3	16.44	3000.0	1.2	1.4	16.21
1400.0	1.2	1.4	16.48	3100.0	1.2	1.5	16.17
1500.0	1.2	1.4	16.51	3200.0	1.2	1.5	16.12
1600.0	1.2	1.4	16.57	3300.0	1.2	1.5	16.09
1700.0	1.3	1.4	16.61	3400.0	1.3	1.5	16.06
1800.0	1.3	1.4	16.62	3500.0	1.3	1.5	16.05
1900.0	1.4	1.4	16.62	3600.0	1.4	1.5	16.04
2000.0	1.4	1.3	16.62	3700.0	1.5	1.5	16.06
2100.0	1.5	1.3	16.59	3800.0	1.5	1.5	16.09
2200.0	1.5	1.3	16.57	3900.0	1.5	1.5	16.12
2300.0	1.5	1.3	16.51	4000.0	1.6	1.4	16.18
2400.0	1.5	1.3	16.47	4100.0	1.7	1.4	16.23
				4200.0	1.7	1.4	16.29

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
800.0	.227	-89	6.972	7	.030	69	.041	142
900.0	.190	-151	6.828	-28	.029	35	.074	147
1000.0	.175	-177	6.736	-56	.028	12	.086	148
1100.0	.159	168	6.648	-80	.027	-10	.102	149
1200.0	.139	160	6.63[illegible]	-102	.027	-28	.122	145
1300.0	.118	157	6.634	-123	.026	-45	.141	137
1400.0	.099	162	6.672	-143	.025	-61	.156	126
1500.0	.087	163	6.693	-163	.024	-76	.164	113
1600.0	.094	176	6.736	178	.024	-91	.168	99
1700.0	.112	-178	6.767	159	.023	-105	.167	85
1800.0	.137	-175	6.779	141	.022	-119	.161	69
1900.0	.159	-178	6.790	123	.022	-133	.153	53
2000.0	.176	178	6.775	105	.021	-146	.145	33
2100.0	.191	170	6.754	87	.020	-159	.138	14
2200.0	.197	161	6.734	70	.019	-171	.136	-5
2300.0	.196	150	6.692	52	.018	175	.134	-23
2400.0	.189	140	6.662	35	.017	163	.135	-42
2500.0	.177	127	6.648	17	.016	152	.140	-59
2600.0	.160	113	6.611	1	.016	139	.146	-75
2700.0	.139	97	6.578	-16	.014	127	.154	-90
2800.0	.116	78	6.550	-33	.014	116	.164	-103
2900.0	.096	54	6.509	-50	.013	103	.173	-116
3000.0	.080	25	6.468	-67	.012	93	.182	-129
3100.0	.074	-10	6.436	-83	.012	84	.189	-140
3200.0	.080	-45	6.400	-100	.011	75	.195	-152
3300.0	.095	-76	6.375	-116	.011	62	.199	-163
3400.0	.116	-100	6.353	-133	.010	51	.201	-174
3500.0	.130	-121	6.344	-149	.010	43	.202	175
3600.0	.163	-138	6.341	-166	.009	35	.200	164
3700.0	.186	-155	6.350	177	.009	21	.197	154
3800.0	.207	-170	6.374	160	.009	11	.193	143
3900.0	.229	175	6.396	142	.008	1	.188	132
4000.0	.244	161	6.441	125	.008	-8	.182	121
4100.0	.256	147	6.477	107	.009	-19	.176	109
4200.0	.262	133	6.527	88	.009	-30	.168	97

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Typical Automatic Test Data

V_{cc} = +12 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
800.0	1.5	1.2	17.21
900.0	1.4	1.3	16.97
1000.0	1.4	1.3	16.83
1100.0	1.4	1.3	16.73
1200.0	1.3	1.4	16.74
1300.0	1.3	1.4	16.76
1400.0	1.2	1.5	16.84
1500.0	1.2	1.6	16.91
1600.0	1.2	1.6	16.98
1700.0	1.2	1.6	17.06
1800.0	1.3	1.6	17.11
1900.0	1.4	1.6	17.14
2000.0	1.4	1.6	17.15
2100.0	1.5	1.6	17.15
2200.0	1.5	1.6	17.12
2300.0	1.5	1.5	17.06
2400.0	1.5	1.5	17.02

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
2500.0	1.5	1.5	16.98
2600.0	1.4	1.6	16.91
2700.0	1.4	1.6	16.84
2800.0	1.3	1.6	16.76
2900.0	1.3	1.6	16.67
3000.0	1.2	1.6	16.57
3100.0	1.2	1.7	16.48
3200.0	1.3	1.7	16.37
3300.0	1.2	1.7	16.28
3400.0	1.2	1.7	16.18
3500.0	1.3	1.7	16.11
3600.0	1.4	1.7	16.05
3700.0	1.4	1.7	16.00
3800.0	1.5	1.7	15.98
3900.0	1.6	1.7	15.96
4000.0	1.7	1.7	15.99
4100.0	1.7	1.7	16.00
4200.0	1.7	1.6	16.07

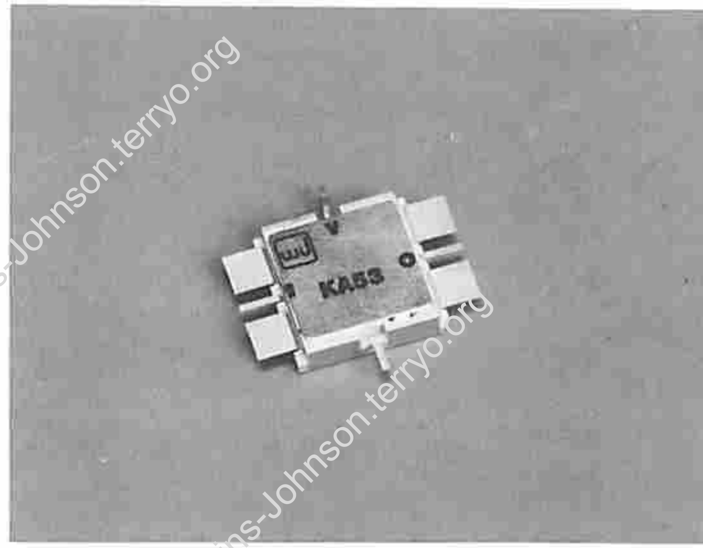
Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
800.0	.207	-106	7.250	5	.028	67	.092	157
900.0	.182	-156	7.052	-29	.026	35	.119	150
1000.0	.173	178	6.944	-56	.026	13	.129	148
1100.0	.158	162	6.866	-80	.025	-7	.143	146
1200.0	.138	153	6.871	-101	.024	-25	.162	142
1300.0	.116	148	6.886	-122	.023	-39	.182	135
1400.0	.095	152	6.948	-142	.023	-54	.202	125
1500.0	.080	159	7.007	162	.022	-70	.217	114
1600.0	.082	176	7.065	179	.022	-83	.226	102
1700.0	.099	-173	7.127	161	.022	-98	.231	84
1800.0	.125	-169	7.168	143	.022	-111	.231	75
1900.0	.150	-172	7.196	124	.021	-123	.229	61
2000.0	.171	-176	7.205	106	.021	-134	.225	44
2100.0	.190	177	7.205	88	.020	-148	.219	28
2200.0	.199	168	7.180	70	.020	-161	.216	12
2300.0	.202	158	7.131	52	.018	-173	.214	-4
2400.0	.199	147	7.095	35	.018	174	.212	-19
2500.0	.191	135	7.066	17	.017	163	.213	-34
2600.0	.176	122	7.006	0	.017	151	.216	-49
2700.0	.157	107	6.949	-17	.016	139	.221	-64
2800.0	.134	89	6.889	-33	.015	127	.228	-78
2900.0	.112	68	6.813	-50	.015	116	.235	-91
3000.0	.092	43	6.738	-67	.014	107	.242	-104
3100.0	.079	11	6.665	-84	.014	96	.249	-116
3200.0	.077	-26	6.582	101	.013	86	.254	-128
3300.0	.086	-60	6.514	-117	.012	75	.258	-140
3400.0	.105	-89	6.441	-134	.012	63	.262	-151
3500.0	.128	-112	6.387	-150	.013	53	.264	-162
3600.0	.153	-132	6.349	-167	.012	41	.264	-173
3700.0	.178	-149	6.308	177	.013	31	.263	177
3800.0	.203	-165	6.293	160	.012	22	.262	166
3900.0	.228	180	6.280	143	.011	11	.260	155
4000.0	.246	165	6.300	126	.012	3	.256	144
4100.0	.262	150	6.311	108	.012	-12	.252	132
4200.0	.273	135	6.360	91	.012	-22	.245	120

WJ-KA53

1.0 TO 5.0 GHz CERAMIC AMPLIFIER

- ULTRA WIDE BANDWIDTH: 1-5 GHz
- HIGH GAIN = 21 dB (TYP.)
- MEDIUM OUTPUT POWER +11.5 dBm (TYP.)
- LOW NOISE: 4.5 dB (TYP.)
- GaAs FET DESIGN

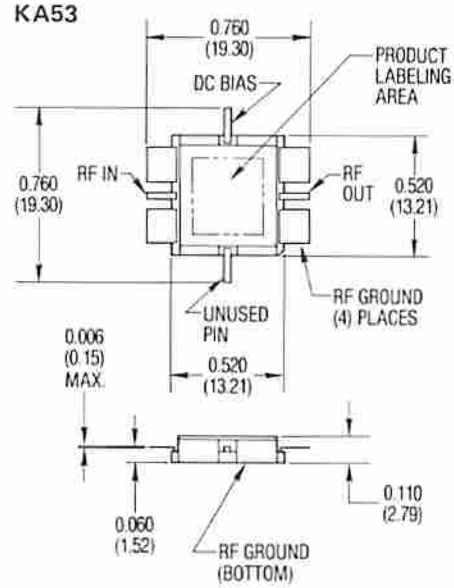


Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	0.8-5.0 GHz	1.0-5.0 GHz	1.0-5.0 GHz
Small Signal Gain (Min.)	21.0 dB	19.5 dB	18.0 dB
Gain Flatness (Max.)	±0.7 dB	±0.9 dB	±12 dB
Noise Figure (Max.)	4.5 dB	5.3 dB	5.8 dB
Power Output at 1 dB Compression (Min.)	11.5 dBm	10.5 dBm	9.5 dBm
VSWR (Max.)			
Input	1.7:1	2.1:1	2.3:1
Output	1.7:1	2.1:1	2.3:1
DC Current (Max.) at +5 Volts	115 mA	140 mA	150 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Outline Drawings



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 35 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 31 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 22 dBm (Typ.)

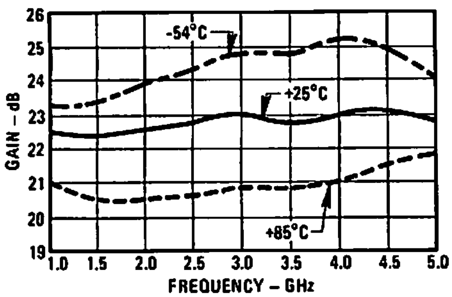
Absolute Maximum Ratings

Storage Temperature . . . . -64°C to +125°C
Maximum Case Temperature . . . . +125°C
Maximum DC Voltage . . . . +6 Volts
Maximum Continuous RF Input Power . . . . +7 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
Maximum Peak Power . . . . 0.25 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

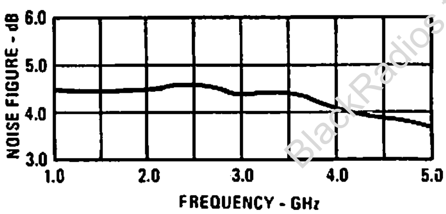
Weight approximately 1.7 grams (0.06 oz.)

Typical Performance at 25°C

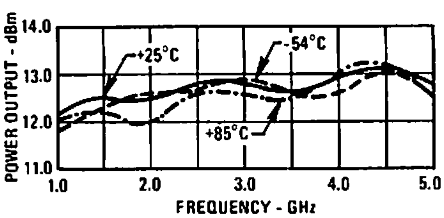
Gain



Noise Figure

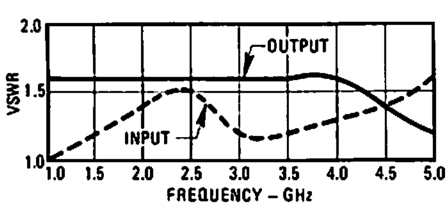


Power Output*

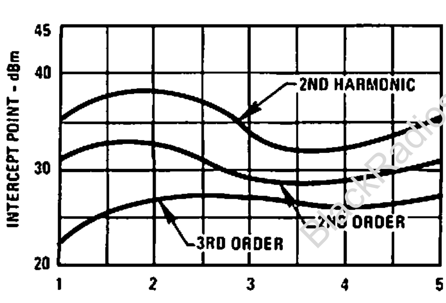


*at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{CC} = +5 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
800.0	1.2	1.6	22.33
1000.0	1.0	[illegible]	22.47
1200.0	1.1	1.6	22.41
1400.0	1.1	1.6	22.42
1600.0	1.2	1.6	22.47
1800.0	1.3	1.6	22.53
2000.0	[illegible]	1.6	22.59
2200.0	[illegible]	1.6	22.68
2400.0	[illegible]	1.6	22.75
2600.0	1.5	1.6	22.86
2800.0	1.4	1.5	22.93
3000.0	1.2	1.6	22.96
3200.0	1.1	1.5	22.88
3400.0	1.1	1.6	22.81
3600.0	1.2	1.6	22.79
3800.0	1.3	1.6	22.80
4000.0	1.3	1.6	22.98
4200.0	1.3	1.5	23.15
4400.0	1.3	1.5	23.21
4600.0	1.4	1.4	23.03
4800.0	1.5	1.3	22.87
5000.0	1.6	1.2	22.77
5200.0	1.8	1.1	22.79

Linear S-Parameters

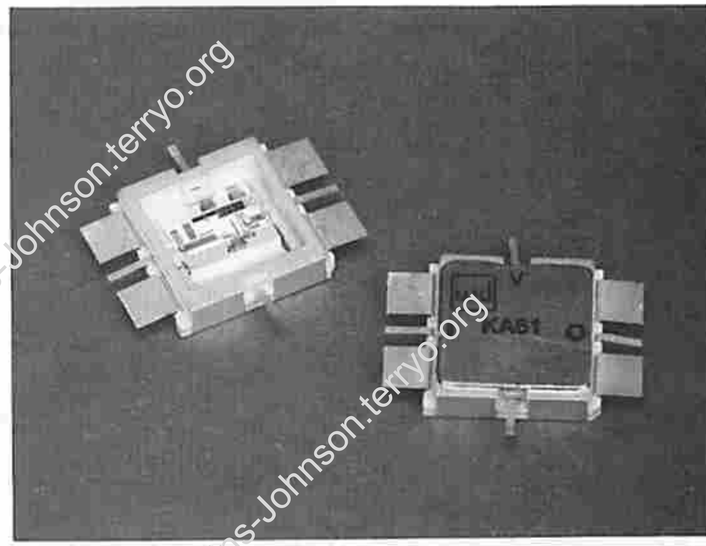
FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
800.0	.093	93	13.075	-156	.005	171	.217	-87
1000.0	.023	[illegible]	13.291	130	.004	36	.235	-94
1200.0	.031	[illegible]	13.191	73	.002	18	.218	-102
1400.0	.068	-61	13.218	23	.003	-11	.218	-105
1600.0	[illegible]	-86	13.296	-23	.005	-101	.228	-114
1800.0	[illegible]	-98	13.384	-66	.003	-132	.234	-121
2000.0	[illegible]	-113	13.471	-108	.002	-185	.242	-129
2200.0	.209	-130	13.608	-149	.003	176	.232	-138
2400.0	.218	-149	13.727	170	.002	169	.229	-147
2600.0	.196	-171	13.985	130	.005	157	.220	-155
2800.0	.152	164	14.013	91	0.000	170	.211	-161
3000.0	.097	133	14.055	51	.001	37	.216	-166
3200.0	.058	77	13.930	12	.002	151	.214	-175
3400.0	.058	4	13.824	-26	.003	3	.226	177
3600.0	.082	-41	13.784	-63	.001	-47	.225	167
3800.0	.114	-69	13.884	-101	.003	-70	.224	155
4000.0	.132	-94	14.093	-139	.002	-46	.225	142
4200.0	.139	-114	14.375	-178	.001	-11	.212	126
4400.0	.144	-127	14.476	141	[illegible]	-87	.189	106
4600.0	.157	-133	14.176	100	[illegible]	147	.160	86
4800.0	.200	-148	13.917	59	.003	-173	.126	57
5000.0	.243	-152	13.762	19	.003	-101	.080	18
5200.0	.279	-163	13.784	-23	.001	153	.040	-48

1

WJ-KA61

2 TO 6 GHz CERAMIC AMPLIFIER

- WIDE BANDWIDTH: 2-6 GHz
- MEDIUM OUTPUT LEVEL: 12.0 dBm (TYP.)
- LOW NOISE: 3.5 dB (TYP.)
- EXCELLENT GAIN BLOCK
- GaAs FET DESIGN



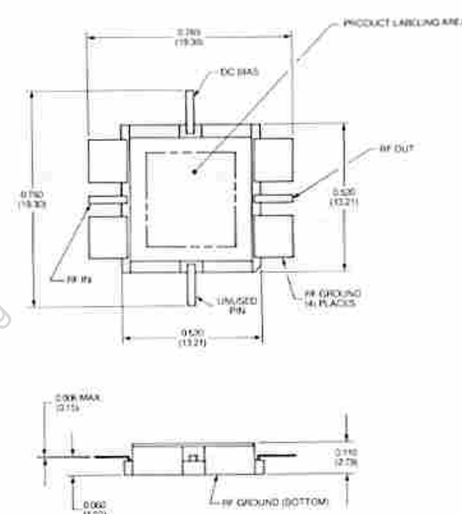
Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54° - +85°C
Frequency (Min.)	1.8-6.2 GHz	2-6 GHz	2-6 GHz
Small Signal Gain (Min.)	7.5 dB	6.5 dB	6.0 dB
Gain Flatness (Max.)	±0.4 dB	±0.7 dB	±0.9 dB
Noise Figure (Max.)	3.5 dB	4.5 dB	5.0 dB
Power Output at 1 dB Compression (Min.)	12.0 dBm	10.5 dBm	10.0 dBm
VSWR (Max.)			
Input	1.7:1	2.1:1	2.2:1
Output	1.4:1	2.1:1	2.2:1
DC Current (Max.) at +5 Volts	35 mA	40 mA	42 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Outline Drawing

KA61



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .005 (.13) UNLESS OTHERWISE SPECIFIED

Weight

approximately 1.7 grams (0.06 oz.)

Typical Intermodulation Performance at 25°C

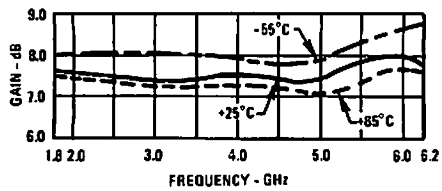
Second Order Harmonic Intercept Point . . . . 42 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 37 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 26 dBm (Typ.)

Absolute Maximum Ratings

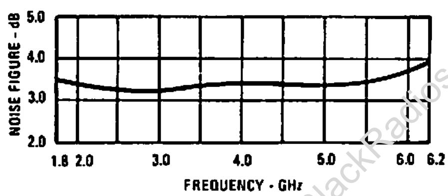
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . 6 Volts
Maximum Continuous RF Input Power . . . . +10 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 20 Milliwatts
Maximum Peak Power . . . . 0.5 Watt
. . . . (3 µsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Typical Performance at 25°C

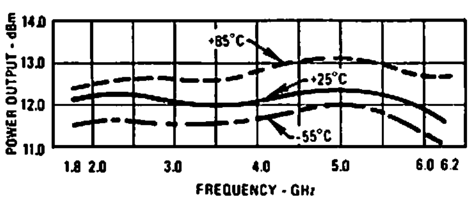
Gain



Noise Figure

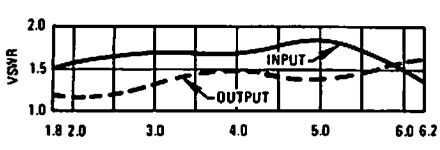


Power Output*

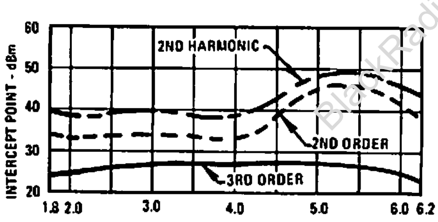


* at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{CC} = +5 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
1800.0	1.5	1.3	7.59
2000.0	1.5	1.2	7.60
2200.0	1.6	1.2	7.62
2400.0	1.6	1.2	7.59
2600.0	1.7	1.2	7.62
2800.0	1.6	1.2	7.60
3000.0	1.7	1.3	7.59
3200.0	1.7	1.3	7.53
3400.0	1.8	1.3	7.42
3600.0	1.7	1.3	7.36
3800.0	1.7	1.3	7.34
4000.0	1.7	1.3	7.50
4200.0	1.6	1.4	7.58
4400.0	1.5	1.4	7.62
4600.0	1.5	1.4	7.63
4800.0	1.5	1.4	7.59
5000.0	1.5	1.4	7.67
5200.0	1.5	1.4	7.56
5400.0	1.6	1.4	7.63
5600.0	1.7	1.4	7.63
5800.0	1.6	1.4	7.80
6000.0	1.5	1.5	7.79
6200.0	1.8	1.6	7.31

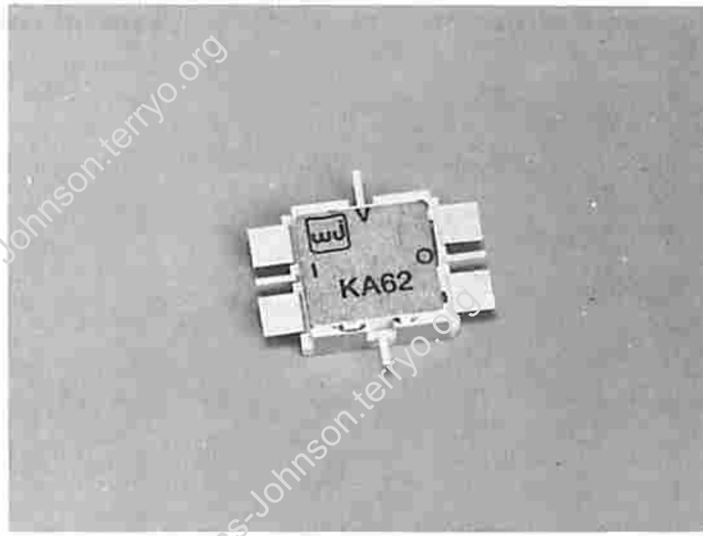
Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
1800.0	.190	-144	2.395	124	.153	-23	.116	65
2000.0	.207	-167	2.400	111	.149	-32	.103	38
2200.0	.230	171	2.404	98	.144	-39	.093	6
2400.0	.236	140	2.397	86	.142	-47	.088	-24
2600.0	.252	127	2.404	74	.141	-56	.090	-54
2800.0	.244	108	2.399	62	.138	-64	.103	-75
3000.0	.251	88	2.396	51	.128	-71	.114	-99
3200.0	.255	54	2.381	39	.124	-77	.131	-118
3400.0	.275	34	2.350	27	.121	-82	.139	-136
3600.0	.270	20	2.335	17	.119	-89	.142	-147
3800.0	.260	6	2.329	6	.119	-96	.145	-158
4000.0	.251	-16	2.372	-6	.114	-103	.149	-167
4200.0	.220	-28	2.394	-17	.111	-108	.160	-172
4400.0	.208	-46	2.404	-29	.113	-113	.151	177
4600.0	.203	-65	2.406	-41	.114	-121	.164	170
4800.0	.189	-85	2.395	-53	.113	-131	.166	161
5000.0	.198	-111	2.417	-66	.104	-139	.160	153
5200.0	.210	-135	2.388	-80	.101	-144	.155	142
5400.0	.239	-152	2.406	-94	.104	-150	.153	136
5600.0	.256	-161	2.407	-107	.106	-157	.162	126
5800.0	.227	[illegible]	2.455	-124	.109	-169	.182	109
6000.0	.184	-140	2.451	-142	.112	177	.214	77
6200.0	.277	-107	2.321	-164	.104	159	.235	34

1

WJ-KA62

2 TO 6 GHz
CERAMIC AMPLIFIER



- ULTRA WIDE BANDWIDTH
- MEDIUM GAIN BLOCK: 15 dB
- MEDIUM OUTPUT POWER: +12.5 dBm (TYP.)
- GOOD NOISE FIGURE: 4.0 dB (TYP.)
- LOW CURRENT DRAIN: 65 mA (TYP.)

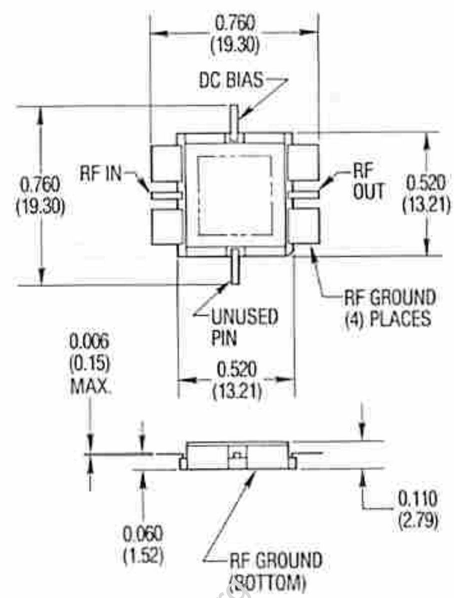
Specifications*

Characteristic	Typical	Guaranteed 0° - +50°C	Guaranteed -54° - +85°C
Frequency (Min.)	1.8-6.2 GHz	2-6 GHz	2-6 GHz
Small Signal Gain (Min.)	15.0 dB	13.0 dB	12.5 dB
Gain Flatness (Max.)	±.4 dB	±.8 dB	±1.1 dB
Noise Figure (Max.)	4.0 dB	5.0 dB	5.5 dB
Power Output at 1 dB Compression (Min.)	12.5 dBm	10.5 dBm	10.0 dBm
VSWR (Max.)			
Input	1.6:1	2.1:1	2.2:1
Output	1.5:1	2.1:1	2.2:1
DC Current (Max.) at +5 Volts	65 mA	72 mA	74 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Outline Drawings

KA62



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.005 (.13) UNLESS OTHERWISE SPECIFIED

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 40 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 35 dBm (Typ.)
Third Order Two Tone Intercept Point .25 dBm (Typ.)

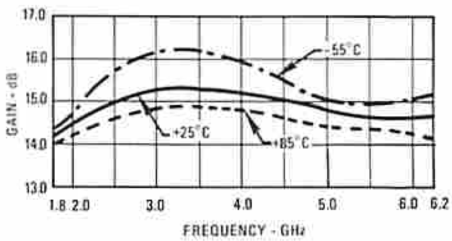
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to 125°C
Maximum Case Temperature . . . . +125°C
Maximum DC Voltage . . . . .6 Volts
Maximum Continuous RF Input Power . . . . +7 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . Milliwatts
Maximum Peak Power . . . . 0.25 Watts
. . . .(3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

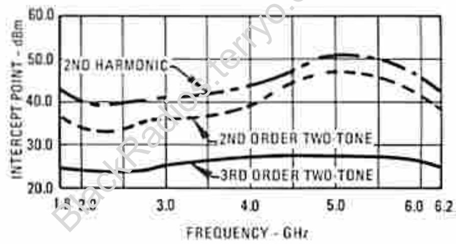
Weight approximately 1.7 grams (0.06 oz.)

Typical Performance at 25°C

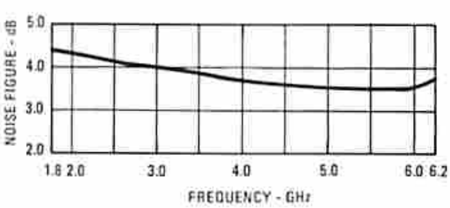
Gain



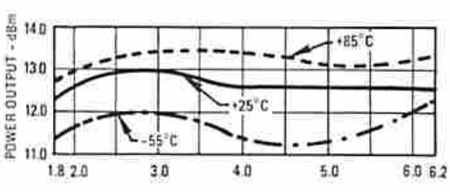
Intercept Point



Noise Figure

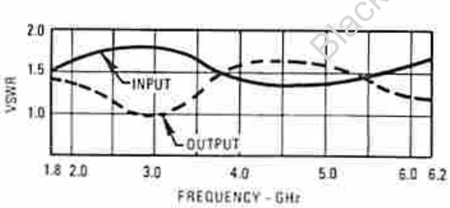


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = +5 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB	FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
1800.0	1.5	1.2	14.31	4200.0	1.3	1.4	15.07
2000.0	1.5	1.2	14.61	4400.0	1.3	1.5	15.06
2200.0	1.6	1.1	14.85	4600.0	1.2	1.5	15.08
2400.0	1.7	1.1	15.04	4800.0	1.2	1.5	15.10
2600.0	1.7	1.1	15.18	5000.0	1.2	1.5	15.12
2800.0	1.7	1.0	15.28	5200.0	1.3	1.5	15.08
3000.0	1.7	1.1	15.33	5400.0	1.4	1.5	14.97
3200.0	1.6	1.1	15.38	5600.0	1.4	1.4	14.79
3400.0	1.6	1.2	15.34	5800.0	1.5	1.3	14.74
3600.0	1.5	1.2	15.27	6000.0	[illegible]	1.1	14.77
3800.0	1.4	1.3	15.17	6200.0	1.6	1.1	14.73
4000.0	1.4	1.4	15.11				

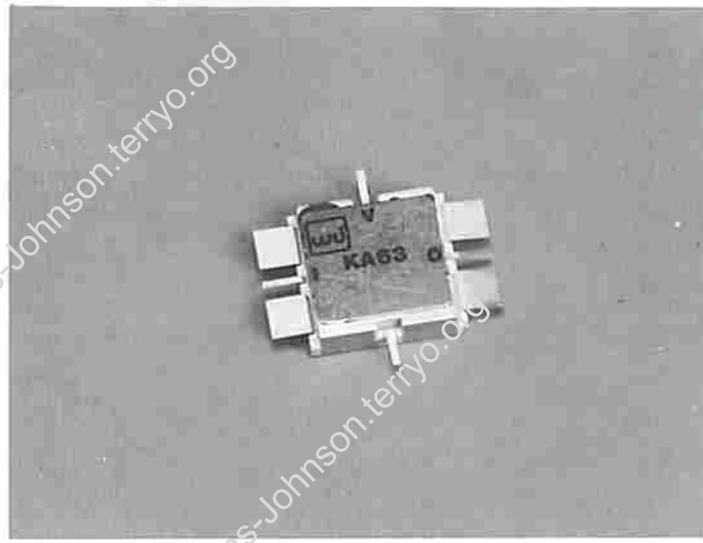
Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1800.0	.184	-129	5.194	-161	.020	-99	.093	-155
2000.0	.208	-130	5.375	171	.020	-114	.082	-174
2200.0	.232	-136	5.524	143	.019	-133	.067	165
2400.0	.250	-148	5.648	115	.019	-151	.049	150
2600.0	.262	-162	5.739	88	.018	-169	.028	141
2800.0	.264	-177	5.805	61	.017	175	.010	-174
3000.0	.256	168	5.842	34	.016	159	.028	-117
3200.0	.234	138	5.877	7	.016	142	.054	-124
3400.0	.217	117	5.846	-19	.015	124	.083	-136
3600.0	.198	96	5.799	-45	.013	113	.110	-150
3800.0	.179	74	5.738	-70	.013	97	.134	-165
4000.0	.158	52	5.694	-95	.013	79	.158	-179
4200.0	.139	30	5.666	-120	.011	70	.177	167
4400.0	.117	5	5.659	-145	.011	55	.193	153
4600.0	.093	-23	5.673	-169	.011	40	.205	139
4800.0	.085	-63	5.688	165	.010	29	.211	125
5000.0	[illegible]	-101	5.704	140	.010	19	.211	111
5200.0	.123	-127	5.677	114	.010	6	.202	97
5400.0	.150	-142	5.605	89	.011	-6	.187	82
5600.0	.179	-149	5.490	63	.013	-16	.158	65
5800.0	.215	-157	5.461	40	.015	-35	.118	55
6000.0	.212	-151	5.476	12	.012	-77	.052	10
6200.0	.201	-154	5.454	-15	.011	-83	.053	-14

WJ-KA63

2 TO 6 GHz CERAMIC AMPLIFIER

- ULTRA WIDE BANDWIDTH: 2-6 GHz
- HIGH GAIN: 18.5 dB (TYP.)
- MEDIUM OUTPUT POWER: 13.0 dBm (TYP.)
- LOW POWER SUPPLY VOLTAGE: +5 VDC
- GaAs FET DESIGN



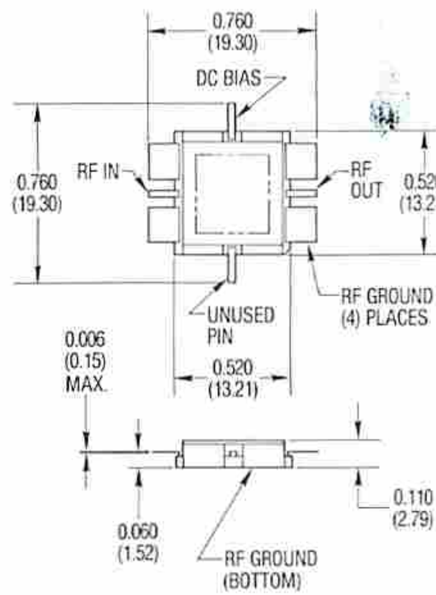
Specifications*

Characteristics	Typical	Guaranteed 0° - +50°C	Guaranteed -54° - +85°C
Frequency (Min.)	1.8-6.2 GHz	2-6 GHz	2-6 GHz
Small Signal Gain (Min.)	18.5 dB	16.5 dB	15.5 dB
Gain Flatness (Max.)	±.5 dB	±1.0 dB	±1.2 dB
Noise Figure (Max.)	5.5 dB	7.0 dB	7.5 dB
Power Output at 1 dB Compression (Min.)	13.0 dBm	11.0 dBm	10.5 dBm
VSWR (Max.) Input	1.7:1	2.2:1	2.3:1
VSWR (Max.) Output	1.7:1	2.2:1	2.3:1
DC Current (Max.) at +5 Volts	120 mA	135 mA	140 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Outline Drawings

KA63



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 38 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 30 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 25 dBm (Typ.)

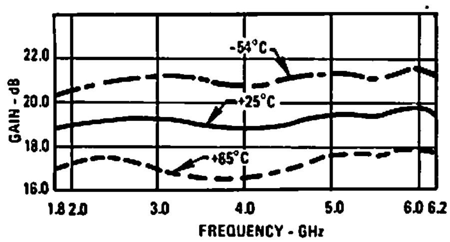
Absolute Maximum Ratings

Storage Temperature . . . . -64°C to +125°C
Maximum Case Temperature . . . . +125°C
Maximum DC Voltage . . . . +6 Volts
Maximum Continuous RF Input Power . . . . 7 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . +100 Milliwatts
Maximum Peak Power . . . . 0.25 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

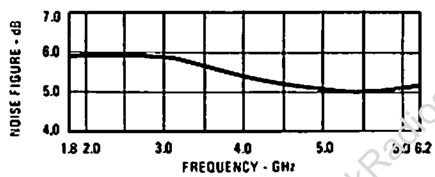
Weight approximately 1.7 grams (0.06 oz.)

Typical Performance at 25°C

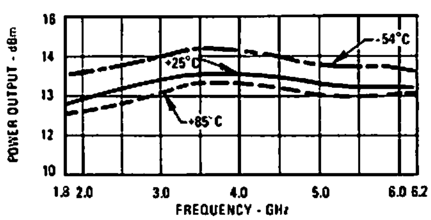
Gain



Noise Figure

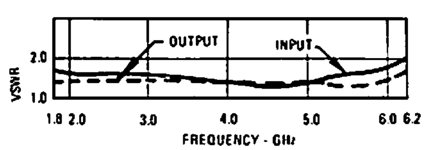


Power Output*

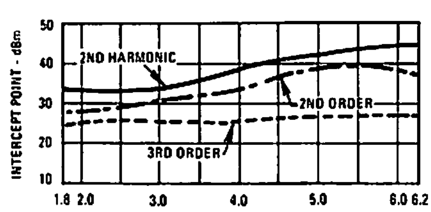


*at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{CC} = +5 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
1800.0	1.7	1.4	18.65
2000.0	1.6	1.4	18.87
2200.0	1.6	1.4	19.02
2400.0	1.6	1.4	19.09
2600.0	1.6	1.4	19.13
2800.0	1.6	1.4	19.16
3000.0	1.6	1.4	19.17
3200.0	1.6	1.4	19.15
3400.0	1.5	1.4	19.09
3600.0	1.5	1.4	18.97
3800.0	1.5	1.4	18.87
4000.0	1.4	1.4	18.82
4200.0	1.4	1.4	18.83
4400.0	1.3	1.4	18.90
4600.0	1.3	1.4	19.04
4800.0	1.3	1.4	19.23
5000.0	1.4	1.4	19.45
5200.0	1.5	1.2	19.42
5400.0	1.5	1.1	19.31
5600.0	1.4	1.0	19.21
5800.0	1.4	1.2	19.16
6000.0	1.7	1.5	19.84
6200.0	1.9	1.6	19.45

Linear S-Parameters

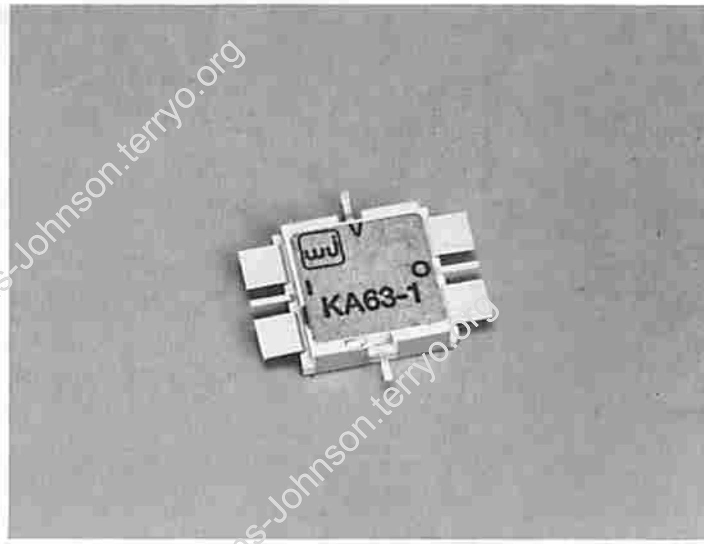
FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1800.0	.256	-160	8.557	-15	.003	-115	.176	-26
2000.0	.244	-166	8.782	-52	.002	-137	.170	-46
2200.0	.239	-170	8.933	-88	.002	-144	.165	-64
2400.0	.240	179	9.010	-123	.003	154	.163	-80
2600.0	.243	159	9.044	-158	.002	157	.164	-95
2800.0	.240	141	9.078	168	0.000	174	.165	-110
3000.0	.235	121	9.087	135	0.000	-159	.169	-124
3200.0	.239	98	9.064	102	.002	-2	.170	-137
3400.0	.229	75	9.002	70	.001	26	.171	-150
3600.0	.219	51	8.883	37	.001	-29	.170	-163
3800.0	.204	28	8.781	6	.002	-55	.170	-175
4000.0	.181	4	8.725	-26	.002	-79	.168	174
4200.0	.154	-23	8.741	-57	.001	12	.169	163
4400.0	.128	-57	8.808	-88	.001	-33	.165	152
4600.0	.113	-101	8.951	-121	.002	-95	.164	142
4800.0	.129	-145	9.148	-153	0.000	37	.160	128
5000.0	.156	179	9.390	173	.002	-4	.151	112
5200.0	.185	166	9.359	139	.003	-179	.088	121
5400.0	.192	134	9.299	103	.004	25	.064	96
5600.0	.169	110	9.134	67	.004	-2	.011	141
5800.0	.155	96	9.082	33	.003	-46	.109	-151
6000.0	.253	57	9.622	-8	.008	-91	.187	173
6200.0	.318	13	9.383	-52	.006	-90	.237	158

1

WJ-KA63-1

2 TO 6 GHz CERAMIC AMPLIFIER

- ULTRA WIDE BANDWIDTH: 2-6 GHz
- HIGH GAIN: 20 dB (TYP.)
- MEDIUM OUTPUT POWER: 16.0 dBm (TYP.)
- LOW POWER SUPPLY VOLTAGE: +5 VDC
- GaAs FET DESIGN



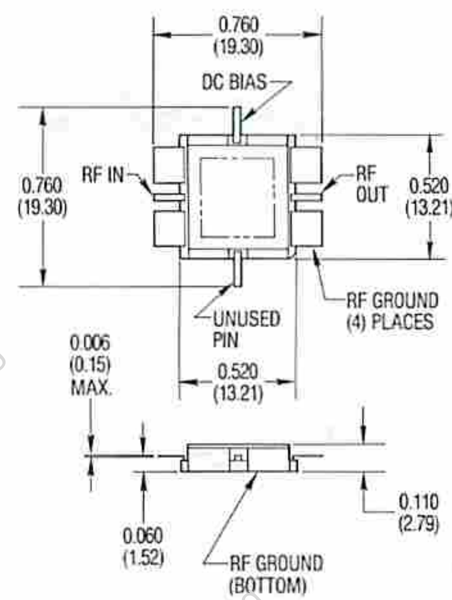
Specifications*

Characteristic	Typical	Guaranteed 0° - +50°C	Guaranteed -54° - +85°C
Frequency (Min.)	1.8-6.2 GHz	2-6 GHz	2-6 GHz
Small Signal Gain (Min.)	20.0 dB	17.0 dB	16.0 dB
Gain Flatness (Max.)	±.5 dB	±1.0 dB	±1.2 dB
Noise Figure (Max.)	5.5 dB	7.0 dB	7.5 dB
Power Output at 1 dB Compression (Min.)	16.0 dBm	13.0 dBm	12.5 dBm
VSWR (Max.) Input	1.7:1	2.2:1	2.3:1
VSWR (Max.) Output	1.4:1	2.0:1	2.1:1
DC Current (Max.) at +5 Volts	120 mA	135 mA	140 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Outline Drawings

KA63-1



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .005 (.13) UNLESS OTHERWISE SPECIFIED

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 54 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 50 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 32 dBm (Typ.)

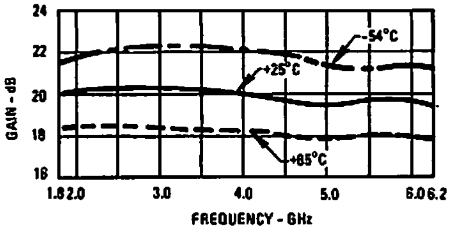
Absolute Maximum Ratings

Storage Temperature . . . . -64°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +6 Volts
Maximum Continuous RF Input Power . . . . +7 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
Maximum Peak Power . . . . 0.25 Watt (3μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

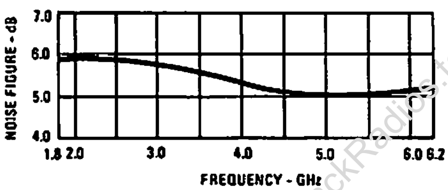
Weight approximately 1.0 grams (0.04 oz.)

Typical Performance at 25°C

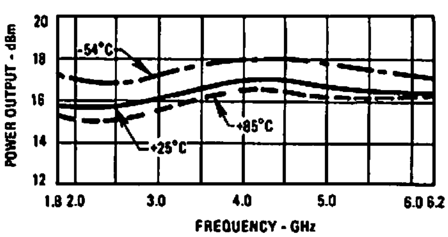
Gain



Noise Figure

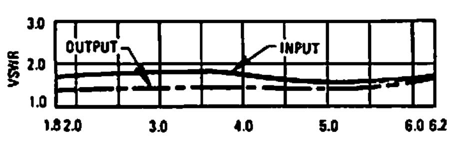


Power Output*

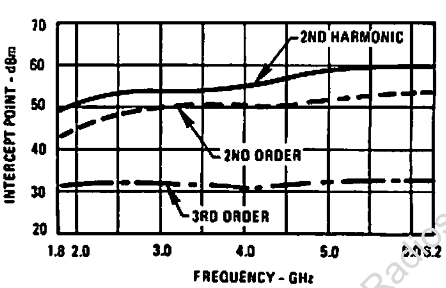


*at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{cc} = +5 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
1000.0	1.7	1.3	20.08
2000.0	1.6	1.3	20.18
2200.0	1.6	1.3	20.24
2400.0	1.5	1.3	20.20
2600.0	1.5	1.3	20.11
2800.0	1.5	1.3	20.06
3000.0	1.5	1.3	19.97
3200.0	1.5	1.3	19.92
3400.0	[illegible]	1.2	19.89
3600.0	1.5	1.2	19.87
3800.0	1.5	1.2	19.92
4000.0	1.6	1.2	20.00
4200.0	1.6	1.2	20.10
4400.0	1.6	1.2	20.10
4600.0	1.7	1.2	20.09
4800.0	1.7	1.2	19.98
5000.0	1.7	1.3	19.82
5200.0	1.6	1.3	19.76
5400.0	1.4	1.3	19.70
5600.0	1.2	1.4	19.84
5800.0	1.1	1.4	19.87
6000.0	1.5	1.4	19.62
6200.0	1.8	1.4	19.29

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
1000.0	.256	-152	10.094	-18	.002	-105	.144	-21
2000.0	.239	-157	10.200	-53	.001	-123	.133	-44
2200.0	.224	[illegible]	10.285	-88	.002	-87	.122	-66
2400.0	.213	[illegible]	10.233	-122	.004	-174	.121	-84
2600.0	.205	174	10.132	-155	.004	-176	.116	-100
2800.0	.199	157	10.064	173	.002	-84	.117	-114
3000.0	[illegible]	140	9.965	142	.001	59	.114	-125
3200.0	[illegible]	106	9.900	110	.002	26	.115	-136
3400.0	[illegible]	80	9.876	79	.001	-62	.103	-145
3600.0	.197	50	9.853	48	.004	3	.099	-151
3800.0	.208	34	9.911	17	.003	128	.096	-157
4000.0	.221	10	10.001	-14	.001	77	.082	-161
4200.0	.232	-14	10.111	-46	.002	130	.071	-153
4400.0	.243	-39	10.117	-78	.001	12	.072	-144
4600.0	.250	-64	10.102	-111	.001	77	077	-136
4800.0	.261	-86	9.973	-145	.001	-100	094	-128
5000.0	.251	-108	9.798	-177	.001	36	.114	-130
5200.0	.227	-128	9.726	150	.003	169	.137	-137
5400.0	.171	-145	9.745	117	.001	48	.146	-145
5600.0	.080	-160	9.815	81	[illegible]	-112	.153	-151
5800.0	.045	-4	9.849	44	.002	25	.153	-159
6000.0	.201	-20	9.573	5	.003	-26	.152	-165
6200.0	.209	-40	9.217	-36	.003	77	.151	-179

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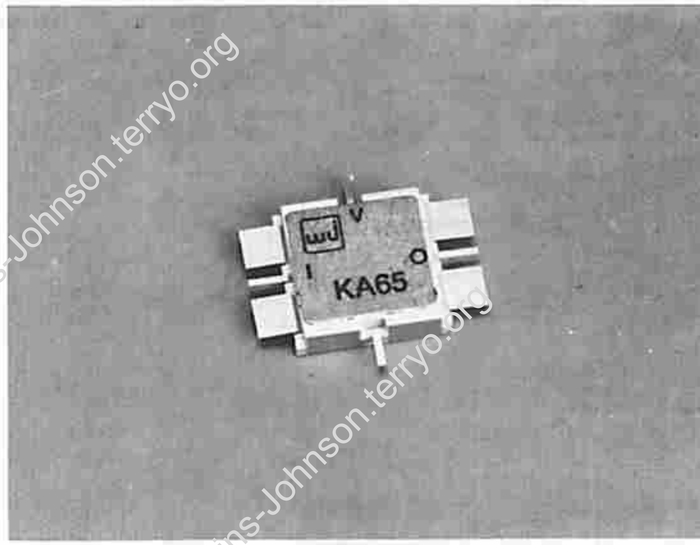
WJ-KA65

2 TO 6 GHz CERAMIC AMPLIFIER



- WIDE BANDWIDTH
- GOOD OUTPUT POWER: 19.0 dBm (Typ.)
- EXCELLENT GAIN, POWER BLOCK
- GaAs F.E.T. DESIGN

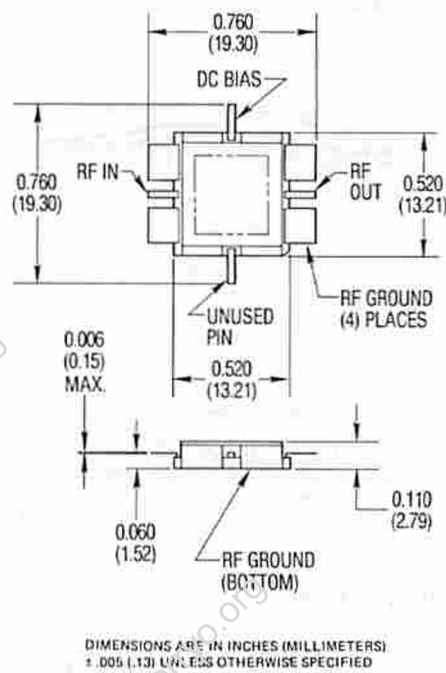
Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -55° - +85°C
Frequency (Min.)	1.8-6.2 GHz	2-6 GHz	2-6 GHz
Small Signal Gain (Min.)	14.5 dB	12.5 dB	12.0 dB
Gain Flatness (Max.)	±0.5 dB	±1.0 dB	±1.2 dB
Noise Figure (Max.)	4.5 dB	6.0 dB	6.5 dB
Power Output at 1 dB Compression (Min.)	19.0 dBm	17.0 dBm	16.5 dBm
VSWR (Max.) Input	1.5:1	2.1:1	2.2:1
VSWR (Max.) Output	1.3:1	2.1:1	2.2:1
DC Current (Max.) at 12 Volts	115 mA	125 mA	130 mA

Notes:
*Measured in a 50-ohm system at +12 Vdc Nominal.

Outline Drawings

KA65



Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 50 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 45 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 26 dBm (Typ.)

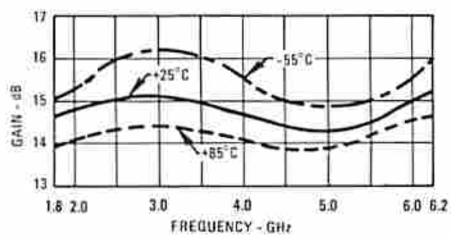
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . 13 Volts
Maximum Continuous RF Input Power . . . . +7 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 50 Milliwatts
Maximum Peak Power . . . . 0.25 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

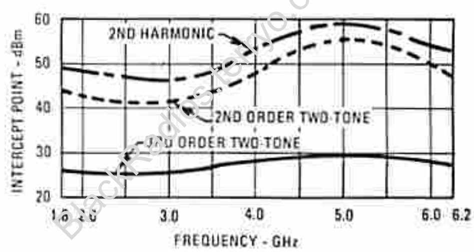
Weight approximately 1.7 grams (0.06 oz.)

Typical Performance at 25°C

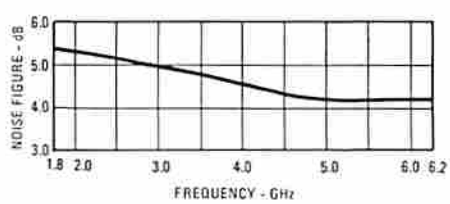
Gain



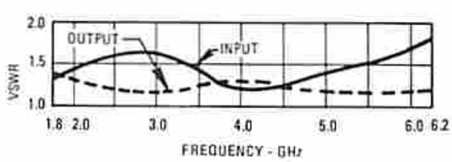
Intercept Point



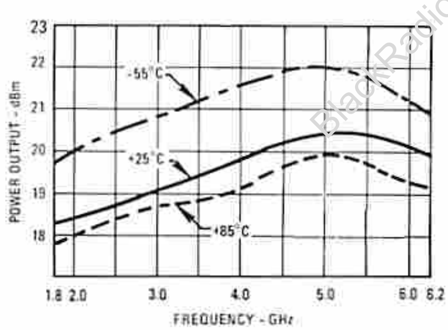
Noise Figure



VSWR



Power Output*



*at 1 dB Gain Compression

Typical Automatic Test Data

V_{CC} = +12 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
1800.0	1.3	1.3	14.64
2000.0	1.4	1.3	14.86
2200.0	1.5	1.2	15.04
2400.0	1.6	1.2	15.11
2600.0	[illegible]	1.2	15.11
2800.0	[illegible]	1.2	15.07
3000.0	1.6	1.2	14.98
3200.0	1.5	1.3	14.87
3400.0	1.6	1.3	14.66
3600.0	1.5	1.4	14.48
3800.0	1.4	1.4	14.33
4000.0	1.3	1.4	14.40

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
4200.0	1.1	1.4	14.38
4400.0	1.1	[illegible]	14.30
4600.0	1.2	1.3	14.29
4800.0	1.3	1.3	14.26
5000.0	1.4	1.2	14.33
5200.0	1.6	1.1	14.30
5400.0	1.7	1.0	14.46
5600.0	1.7	1.1	14.55
5800.0	1.6	1.2	14.72
6000.0	1.6	1.3	15.22
6200.0	1.5	1.3	15.53

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1800.0	.144	-166	5.394	-88	.024	-30	.139	-159
2000.0	.160	-168	5.531	-106	.024	-43	.124	-175
2200.0	.207	-178	5.647	-124	.022	-50	.101	178
2400.0	.225	167	5.698	-142	.021	-66	.082	174
2600.0	.243	148	5.695	-160	.019	-75	.073	-174
2800.0	.234	132	5.671	176	.018	-76	.079	-163
3000.0	.234	109	5.612	167	.018	-96	.098	-160
3200.0	.215	93	5.538	150	.014	-106	.121	-162
3400.0	.217	57	5.407	134	.011	-111	.142	-167
3600.0	.195	39	5.299	119	.012	-119	.161	-175
3800.0	.161	19	5.209	105	.011	-134	.169	174
4000.0	.122	-18	5.245	90	.009	-136	.173	166
4200.0	.066	[illegible]	5.236	75	.008	-129	.169	157
4400.0	.067	-107	5.190	60	.008	-165	.158	148
4600.0	.087	-155	5.182	45	.004	-163	.142	138
4800.0	[illegible]	175	5.167	30	.006	-162	.119	128
5000.0	[illegible]	159	5.204	15	.004	-157	.089	120
5200.0	.238	144	5.188	-1	.003	-180	.054	116
5400.0	.255	139	5.284	-16	.004	-141	.019	144
5600.0	.254	126	5.338	-32	.003	-138	.041	-129
5800.0	.232	135	5.446	-48	.004	-117	.093	-127
6000.0	.240	128	5.767	-65	.007	-178	.136	-151
6200.0	.192	109	5.980	-85	.004	103	.148	-159

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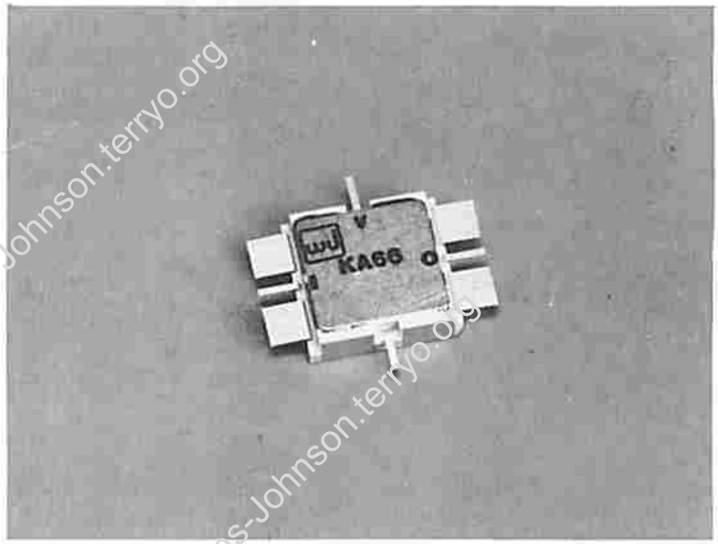
WJ-KA66

2 TO 6 GHz CERAMIC AMPLIFIER

- ULTRA WIDE BANDWIDTH: 2-6 GHz
- HIGH GAIN: +20 dB (TYP.)
- HIGH OUTPUT POWER: +20 dBm (TYP.)
- LOW NOISE: 5.0 dB (TYP.)
- GaAs FET DESIGN



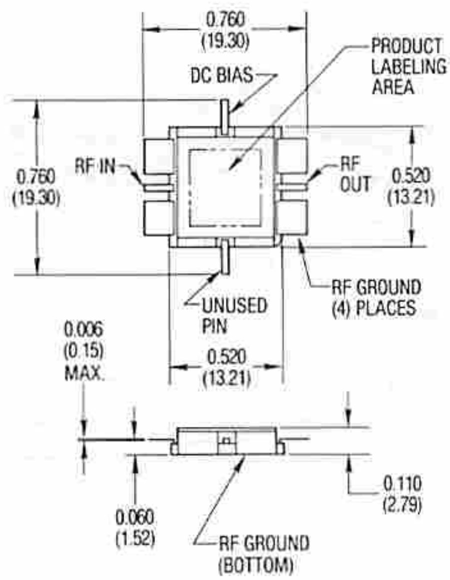
Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	1.8-6.2 GHz	2-6 GHz	2-6 GHz
Small Signal Gain (Min.)	20.0 dB	17.0 dB	16.0 dB
Gain Flatness (Max.)	±0.5 dB	±1.1 dB	±1.3 dB
Noise Figure (Max.)	5.0 dB	6.5 dB	7.0 dB
Power Output at 1 dB Compression (Min.)	+20.0 dBm	17.0 dBm	16.5 dBm
VSWR (Max.)			
Input	1.7:1	2.2:1	2.3:1
Output	1.5:1	2.2:1	2.3:1
DC Current (Max.) at +12 Volts	200 mA	215 mA	220 mA

*Measured in a 50-ohm system at +12 Vdc Nominal.

Outline Drawings

KA66



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.005 (.13) UNLESS OTHERWISE SPECIFIED

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point .... 52 dBm (Typ.)
Second Order Two Tone Intercept Point .... 46 dBm (Typ.)
Third Order Two Tone Intercept Point .... 30 dBm (Typ.)

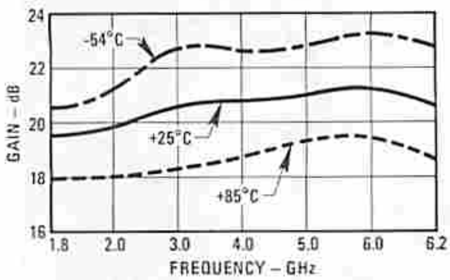
Absolute Maximum Ratings

Storage Temperature .... +64°C to +125°C
Maximum Case Temperature .... 71°C
Maximum DC Voltage .... 13 Volts
Maximum Continuous RF Input Power .... +7 dBm
Maximum Short Term RF Input Power (1 Minute Max.) .... 100 Milliwatts
Maximum Peak Power .... 0.25 Watt
3 μsec Max.)
"S" Series Burn-In Temperature (Case) .... +71°C

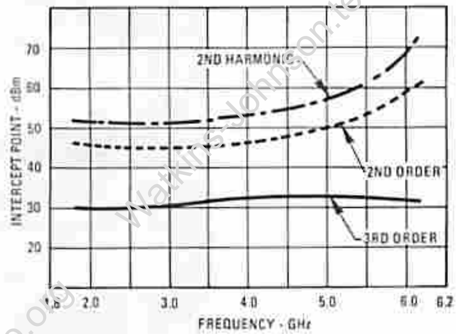
Weight approximately 1.7 grams (0.06 oz.)

Typical Performance at 25°C

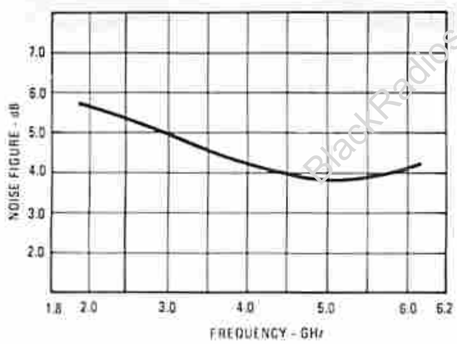
Gain



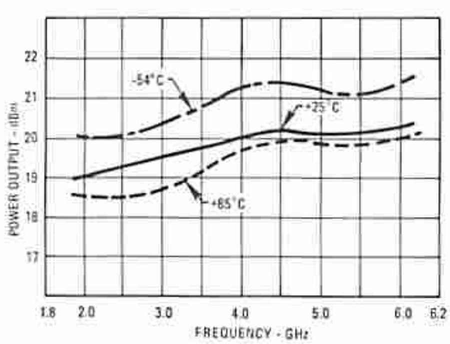
Intercept Point



Noise Figure

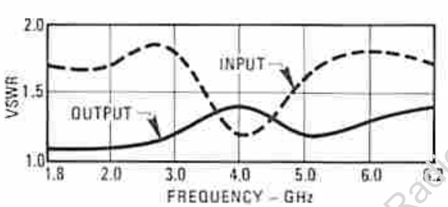


Power Output*



*at 1 dB Gain Compression

VSWR



Typical Automatic Test Data

V_{CC} = +12 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
1800.0	1.7	1.1	19.46
2000.0	1.7	1.1	19.83
2200.0	1.8	1.1	20.13
2400.0	[illegible]	1.1	20.33
2600.0	[illegible]	1.1	20.48
2800.0	1.8	1.1	20.57
3000.0	1.8	1.2	20.63
3200.0	1.7	1.2	20.66
3400.0	1.6	1.3	20.63
3600.0	1.5	1.3	20.64
3800.0	1.3	1.4	20.65
4000.0	1.2	1.4	20.75
4200.0	1.1	1.4	20.88
4400.0	1.2	1.4	20.95
4600.0	1.3	1.3	20.99
4800.0	1.5	1.3	20.98
5000.0	1.6	1.2	20.97
5200.0	1.7	1.1	20.94
5400.0	1.7	1.0	20.92
5600.0	1.8	1.1	21.06
5800.0	1.7	1.2	20.99
6000.0	1.8	1.3	[illegible]
6200.0	1.7	1.4	20.62

Linear S-Parameters

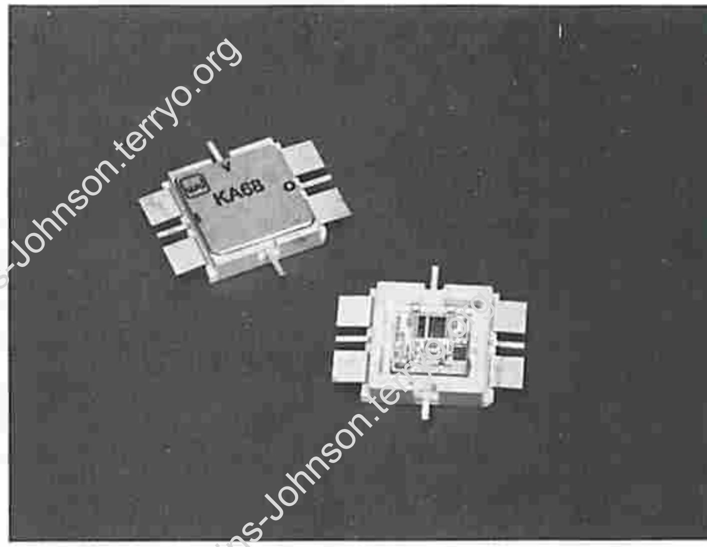
FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
1800.0	.251	-170	9.395	-55	.004	-132	.029	[illegible]
2000.0	.259	-176	9.806	-93	.003	-169	.039	[illegible]
2200.0	[illegible]	171	10.147	-130	.001	-177	.044	-106
2400.0	.286	157	10.386	-167	.003	130	.049	-113
2600.0	.293	140	10.563	156	.004	117	[illegible]	-115
2800.0	.291	121	10.677	120	.002	18	.070	-122
3000.0	.282	100	10.758	84	.002	79	.083	-128
3200.0	.260	80	10.787	47	.000	60	.104	-138
3400.0	.228	59	10.752	12	.003	15	.122	-148
3600.0	.186	37	10.761	-22	.003	-7	.141	-161
3800.0	.135	14	10.776	-57	.001	[illegible]	.158	-174
4000.0	.081	-21	10.900	-91	.003	[illegible]	.174	173
4200.0	.051	-93	11.071	-126	.001	-86	.181	158
4400.0	.087	-153	11.155	-162	.002	-52	.173	142
4600.0	.143	-179	11.205	162	[illegible]	-106	.148	128
4800.0	.196	167	11.197	125	.003	-79	.119	118
5000.0	.237	155	11.179	88	.003	-111	.077	110
5200.0	.263	144	11.142	51	.001	-55	.042	111
5400.0	.270	137	11.112	13	.002	-125	.019	-170
5600.0	.276	130	11.302	-27	.003	-72	.061	-160
5800.0	.247	123	11.202	-70	.002	-109	.079	-123
6000.0	.283	112	11.430	-114	.003	-56	.132	-134
6200.0	.265	78	10.740	-166	.003	-114	.172	-131

1

WJ-KA68

2.0 TO 6.0 GHz CERAMIC AMPLIFIER

- ULTRA-WIDE BANDWIDTH: 2-6 GHz
- HIGH OUTPUT POWER: 22.0 dBm (TYP.)
- MEDIUM GAIN: 13.0 dB (TYP.)
- GaAs FET AMPLIFIER



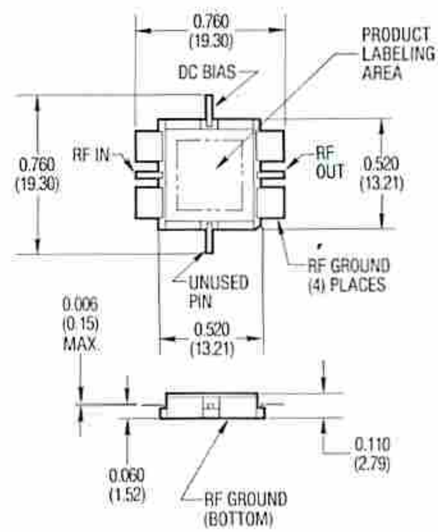
Specifications*

Characteristics	Typical	Guaranteed 0° – +50°C	Guaranteed -54° – +85°C
Frequency (Min.)	1.8-6.1 GHz	2.0-6.0 GHz	2.0-6.0 GHz
Small Signal Gain (Min.)	13.0 dB	11.5 dB	11.0 dB
Gain Flatness (Max.)	±0.5 dB	±0.8 dB	±1.0 dB
Noise Figure (Max.)	6.0 dB	7.5 dB	8.0 dB
Power Output at 1 dB Compression (Min.)	22.5 dBm	20.5 dBm	19.5 dBm
VSWR (Max.)			
Input	1.7:1	2.0:1	2.2:1
Output	1.5:1	1.8:1	2.0:1
DC Current (Max.) at +12 Volts	225 mA	235 mA	245 mA

*Measured in a 50-ohm system at +12 Vdc Nominal.

Outline Drawing

KA68



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.005 (.13) UNLESS OTHERWISE SPECIFIED

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +50.0 dBm (Typ.)
Second Order Two-Tone Intercept Point . . . . +45.0 dBm (Typ.)
Third-Order Two-Tone Intercept Point . . . . +32.0 dBm (Typ.)

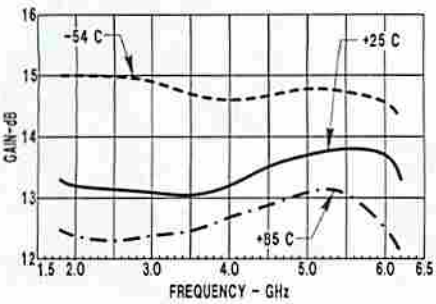
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . +95°C
Maximum DC Voltage . . . . +13 Volts
Maximum Continuous RF Input Power . . . . +17 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
Maximum Peak Power . . . . 1/4 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 95°C

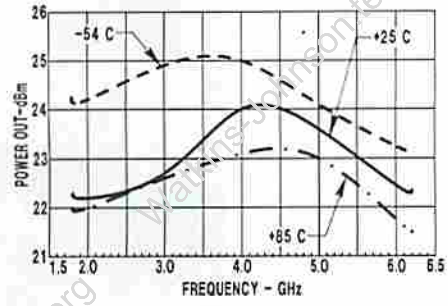
Weight approximately 1.7 grams (0.06 oz.)

Typical Performance at 25°C

Gain

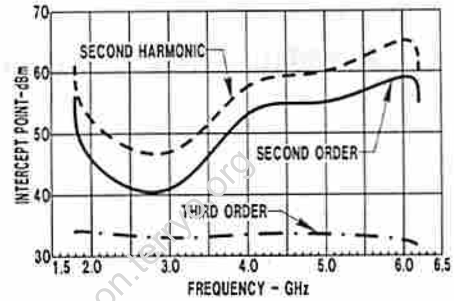


Power Output*

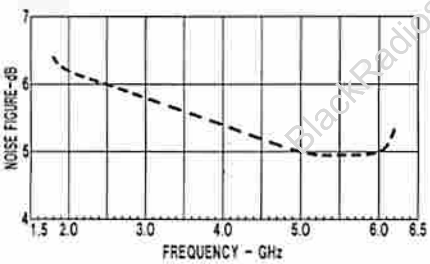


*at 1 dB Gain Compression

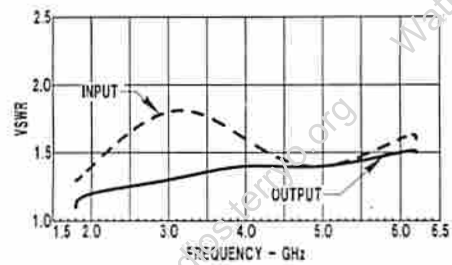
Intercept Point



Noise Figure



VSWR



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Typical Automatic Test Data

V_{cc} = 12 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
1800.0	1.3	1.0	13.3
2000.0	1.4	1.0	13.2
2200.0	1.5	1.1	13.2
2400.0	1.5	1.1	13.2
2600.0	1.5	1.1	13.2
2800.0	1.5	1.1	13.1
3000.0	1.5	1.1	13.1
3200.0	1.5	1.1	13.0
3400.0	1.4	1.2	13.0
3600.0	1.2	1.2	13.1
3800.0	1.1	1.2	13.1
4000.0	1.1	1.2	13.2
4200.0	1.2	1.2	13.3
4400.0	1.4	1.2	13.4
4600.0	1.5	1.1	13.6
4800.0	1.6	1.1	13.7
5000.0	1.6	1.1	13.7
5200.0	1.6	1.1	13.8
5400.0	1.4	1.2	13.7
5600.0	1.2	1.3	13.8
5800.0	1.2	1.4	13.8
6000.0	1.5	1.4	13.8
6200.0	1.6	1.5	13.3

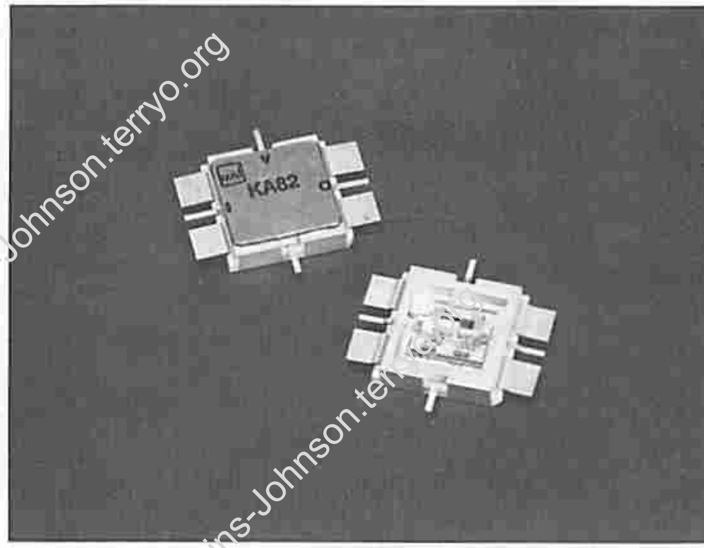
Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
1800.0	.138	-52	4.620	178	.024	-113	.004	149
2000.0	.171	-98	4.587	145	.023	-135	.019	27
2200.0	.190	-131	4.584	114	.022	-157	.032	-6
2400.0	.196	-163	4.587	84	.021	-179	.044	-17
2600.0	.198	164	4.558	54	.020	159	.052	-33
2800.0	.203	136	4.526	27	.018	139	.053	-53
3000.0	.206	118	4.498	-2	.017	119	.055	-86
3200.0	.192	87	4.483	-31	.015	99	.065	-121
3400.0	.155	63	4.482	-60	.014	79	.079	-146
3600.0	.108	33	4.494	-89	.013	59	.090	-160
3800.0	.050	-17	4.518	-115	.012	43	.096	-167
4000.0	.059	-112	4.565	-144	.012	25	.096	-173
4200.0	.105	-158	4.621	-174	.011	7	.086	-177
4400.0	.151	169	4.700	155	.010	-12	.075	180
4600.0	.189	136	4.781	124	.010	-28	.060	176
4800.0	.217	108	4.838	94	.010	-42	.048	178
5000.0	.231	77	4.870	61	.010	-60	.049	-166
5200.0	.221	46	4.881	26	.011	-81	.069	-160
5400.0	.172	11	4.867	-10	.011	-103	.104	-163
5600.0	.108	-44	4.902	-48	.010	-127	.137	-173
5800.0	.104	-142	4.926	-89	.010	-151	.159	180
6000.0	.197	147	4.909	-131	.010	-178	.178	174
6200.0	.237	87	4.622	176	.009	149	.192	170

WJ-KA82

2.0 TO 8.0 GHz CERAMIC AMPLIFIER

- WIDEBAND PERFORMANCE
- LOW POWER CONSUMPTION
- MEDIUM POWER OUTPUT



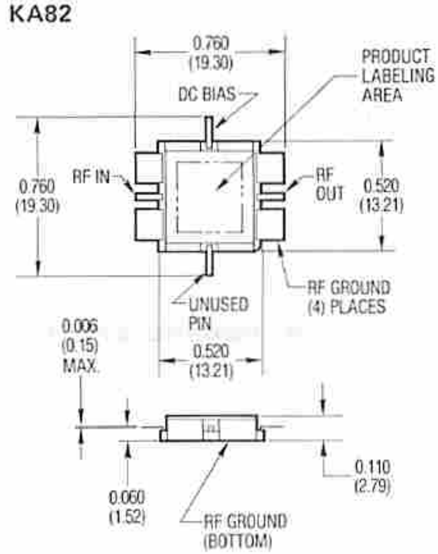
Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54° - +85°C
Frequency (Min.)	1-8 GHz	2-8 GHz	2-8 GHz
Small Signal Gain (Min.)	13.5 dB	12.0 dB	11.5 dB
Gain Flatness (Max.)	±0.5 dB	±0.8 dB	±1.0 dB
Noise Figure (Max.)	4.5 dB	5.5 dB	6.0 dB
Power Output at 1 dB Compression (Min.)	+13.0 dBm	+11.5 dBm	11.0 dBm
VSWR (Max.)			
Input	1.8:1	2.1:1	2.2:1
Output	1.7:1	2.1:1	2.2:1
DC Current (Max.) at +5 Volts	55 mA	65 mA	70 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Outline Drawing

KA82



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +40 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +45 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +25 dBm (Typ.)

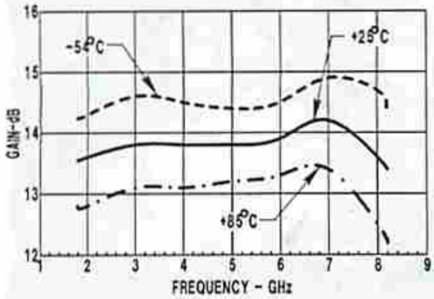
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to 125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . 6 Volts
Maximum Continuous RF Input Power . . . . +7 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
Maximum Peak Power . . . . 0.5 Watt
. . . . (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

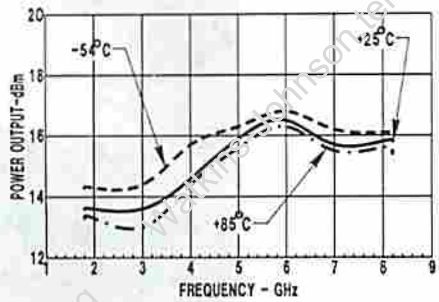
Weight approximately 1.7 grams (0.06 oz.)

Typical Performance at 25°C

Gain

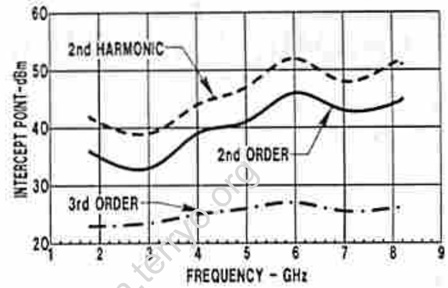


Power Output *

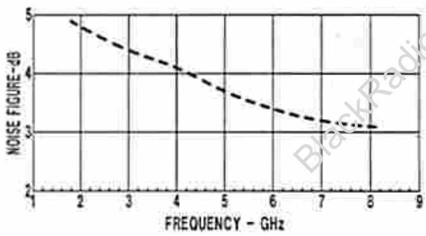


*at 1 dB Gain Compression

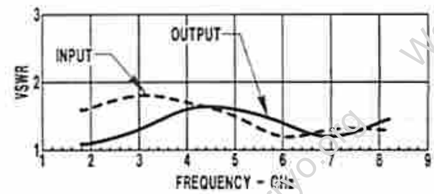
Intercept Point



Noise Figure



VSWR



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Typical Automatic Test Data

V_{cc} = 5 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
1800.0	1.7	1.2	13.7
2000.0	1.8	1.3	13.7
2200.0	1.8	1.3	13.8
2400.0	1.9	1.4	13.8
2600.0	1.9	1.4	13.9
2800.0	1.9	1.5	13.9
3000.0	1.9	1.5	14.0
3200.0	1.8	1.5	14.0
3400.0	1.8	1.5	14.1
3600.0	1.8	1.6	14.1
3800.0	1.8	1.6	14.0
4000.0	1.7	1.6	14.0
4200.0	1.6	1.7	14.0
4400.0	1.5	1.7	14.0
4600.0	1.4	1.7	14.0
4800.0	1.4	1.7	14.0
5000.0	1.3	1.6	14.1
5200.0	1.3	1.6	14.1
5400.0	1.3	1.5	14.2
5600.0	1.2	1.5	14.2
5800.0	1.2	1.4	14.2
6000.0	1.1	1.4	14.3
6200.0	1.2	1.3	14.3
6400.0	1.2	1.2	14.4
6600.0	1.2	1.1	14.4
6800.0	1.3	1.2	14.3
7000.0	1.3	1.4	14.2
7200.0	1.4	1.5	14.1
7400.0	1.3	1.6	13.8
7600.0	1.3	1.6	13.6
7800.0	1.3	1.5	13.5
8000.0	1.3	1.4	13.4
8200.0	1.4	1.3	13.2

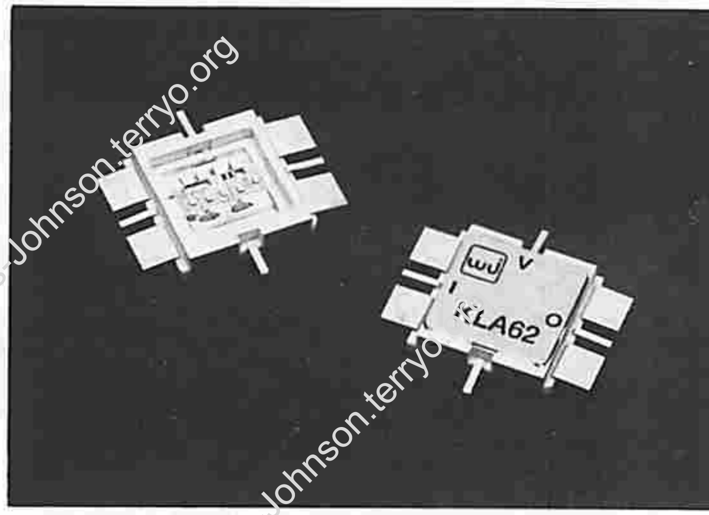
Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
1800.0	.267	-120	4.823	[illegible]	.018	-67	.102	-67
2000.0	.278	-119	4.863	-176	.018	-80	.117	-63
2200.0	.293	-120	4.887	161	.018	-92	.139	-62
2400.0	.305	-124	[illegible]	139	.018	-105	.160	-61
2600.0	.308	-131	[illegible]	117	.018	-117	.177	-63
2800.0	.306	-139	4.976	97	.018	-128	.188	-65
3000.0	.304	-150	5.012	75	.018	-141	.197	-70
3200.0	.297	-163	5.027	53	.018	-154	.204	-77
3400.0	.294	[illegible]	5.052	31	.018	-166	.212	-86
3600.0	.289	170	5.053	9	.018	-180	.221	-96
3800.0	.281	158	5.040	-10	.018	169	.233	-106
4000.0	.261	144	5.022	-32	.019	156	.245	[illegible]
4200.0	.233	131	5.002	-53	.019	143	.255	-126
4400.0	.202	115	5.005	-74	.019	129	.261	-135
4600.0	.172	95	5.005	-95	.020	116	[illegible]	-144
4800.0	.153	76	5.015	-115	.020	103	.253	-154
5000.0	.143	53	5.043	-137	.021	90	.241	-166
5200.0	.139	32	5.072	-158	.021	75	.226	-179
5400.0	.129	15	5.110	-180	.022	61	.211	168
5600.0	.109	-3	5.132	158	.023	[illegible]	.195	155
5800.0	.082	-29	5.138	136	.024	[illegible]	.178	143
6000.0	.065	-65	5.170	115	.025	19	.160	135
6200.0	.070	-108	5.204	93	.027	5	.134	129
6400.0	.090	-132	5.224	69	.029	-11	.096	133
6600.0	.110	-142	5.229	45	.031	-26	.067	166
6800.0	.126	-145	5.202	21	.033	-43	.099	-153
7000.0	.141	-147	5.140	-2	.035	-57	.158	-143
7200.0	.152	-150	5.050	-25	.037	-72	.212	-143
7400.0	.147	-152	4.888	-50	.039	-88	.235	-146
7600.0	.126	-153	4.787	-75	.043	-105	.235	-148
7800.0	.116	-144	[illegible]	-102	.046	-124	.215	-154
8000.0	.135	-146	4.697	-128	.049	-143	.188	-161
8200.0	.173	-172	4.594	-160	.052	-165	.129	180

WJ-KLA62

2.0 TO 6.0 GHz CERAMIC AMPLIFIER

- SYMMETRICAL CLIPPING: GOOD EVEN ORDER SUPPRESSION
- HIGH OUTPUT LEVEL: +13.0 dBm (TYP.)
- MEDIUM GAIN: 11.5 dB (TYP.)
- WIDE BANDWIDTH: 1.8-6.2 GHz (TYP.)



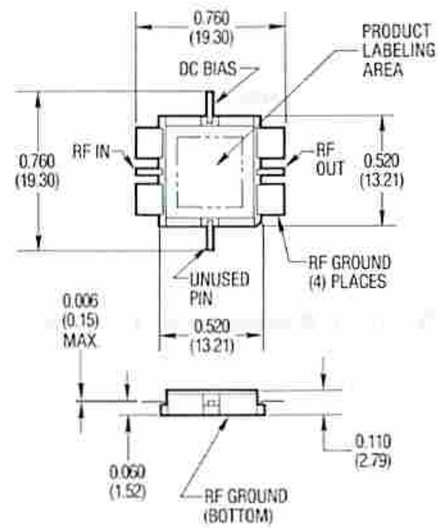
Specifications*

Characteristics	Typical	Guaranteed 0° - +50°C	-54° - +85°C
Frequency (Min.)	1.8-6.2 GHz	2.0-6.0 GHz	2.0 - 6.0 GHz
Small Signal Gain (Min.)	11.5 dB	10.0 dB	9.0 dB
Gain Flatness (Max.)	±0.5 dB	±0.8 dB	±1.0 dB
Noise Figure (Max.)	7.5 dB	8.5 dB	9.0 dB
Power Output at 1 dB Compression (Min.)	13.0 dBm	11.0 dBm	10.0 dBm
Output Limiting Level (Max.) +17 dBm Input	14.5 dBm	16.5 dBm	17.0 dBm
VSWR (Max.)			
Input	1.8:1	2.2:1	2.3:1
Output	1.4:1	1.9:1	2.0:1
DC Current (Max.) at +12 Volts	72 mA	85 mA	95 mA

*Measured in a 50-ohm system at +12 Vdc Nominal.

Outline Drawing

KLA62



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . .47 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . .40 dBm (Typ.)
Third Order Two-Tone Intercept Point . . . . .24 dBm (Typ.)

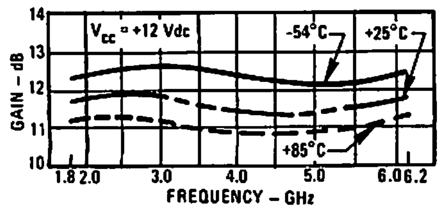
Absolute Maximum Ratings

Storage Temperature . . . . -65°C to +125°C
Maximum Case Temperature . . . . +125°C
Maximum DC Voltage . . . . +13 Volts
Maximum Continuous RF Input Power . . . . +17 dBm
Maximum Short Term RF Input Power (1 Minute Max.). . . . . 100 Milliwatts
"S" Series Burn-In Temperature (Case) . . . . +100°C

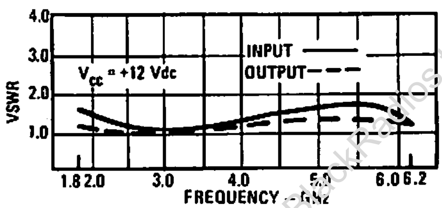
Weight approximately 1.7 grams (0.06 oz.)

Typical Performance at 25°C

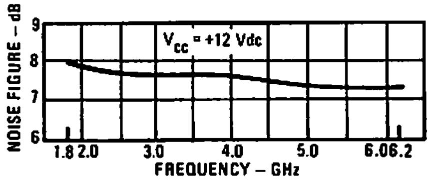
Gain



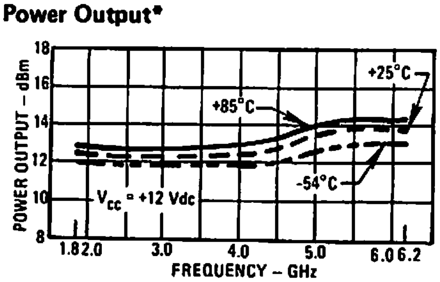
VSWR



Noise Figure

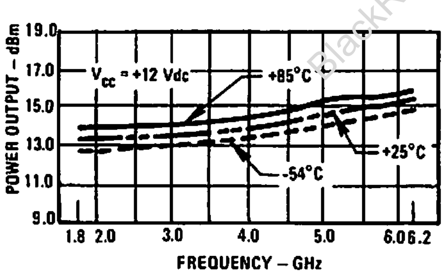


Power Output*

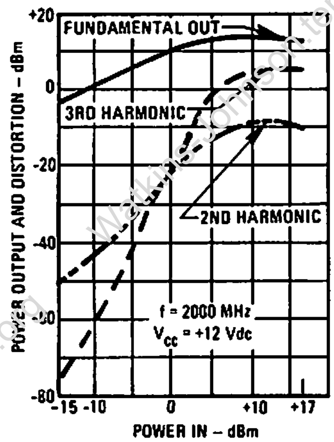


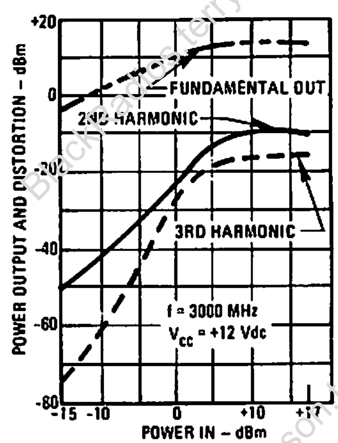
* at 1 dB Gain Compression

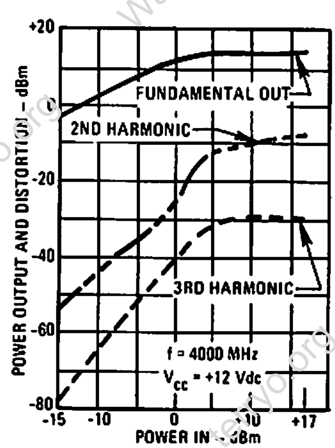
Maximum Limiting Level @ P_{IN} = +17 dBm



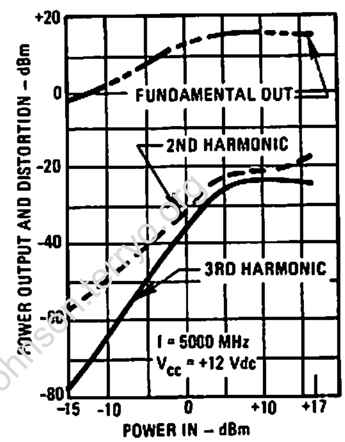
Power Output and Distortion

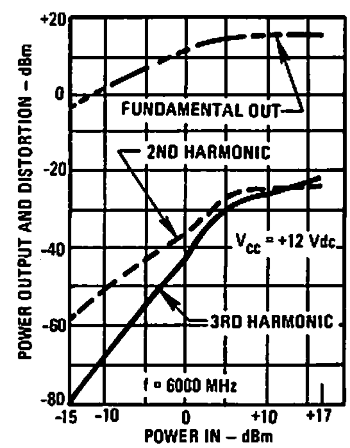






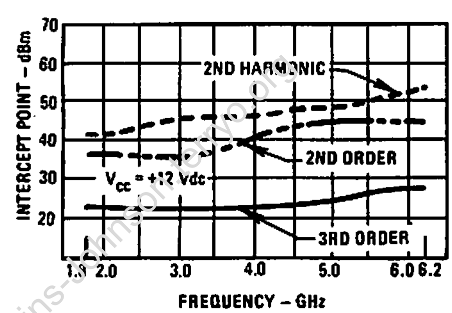
Power Output and Distortion



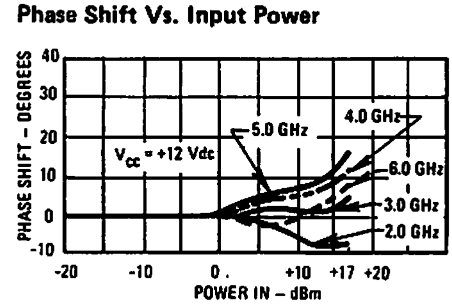


1

Intercept Point



Phase Shift Vs. Input Power



Typical Automatic Test Data

V_{cc} = +15 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
1800.0	1.6	1.2	11.7
2000.0	1.5	1.1	11.8
2200.0	1.4	1.1	11.9
2400.0	1.4	1.0	11.9
2600.0	1.3	1.1	11.9
2800.0	1.2	1.1	11.9
3000.0	1.1	1.1	11.8
3200.0	1.1	1.1	11.7
3400.0	1.1	1.1	11.6
3600.0	1.1	1.1	11.5
3800.0	1.2	1.2	11.5
4000.0	1.3	1.2	11.5
4200.0	1.4	1.2	11.4
4400.0	1.4	1.2	11.4
4600.0	1.5	1.2	11.5
4800.0	1.5	1.2	11.5
5000.0	1.5	1.1	11.5
5200.0	1.6	1.0	11.5
5400.0	1.6	1.1	11.5
5600.0	1.6	1.2	11.6
5800.0	1.5	1.3	11.7
6000.0	1.4	1.3	11.8
6200.0	1.3	1.3	11.9

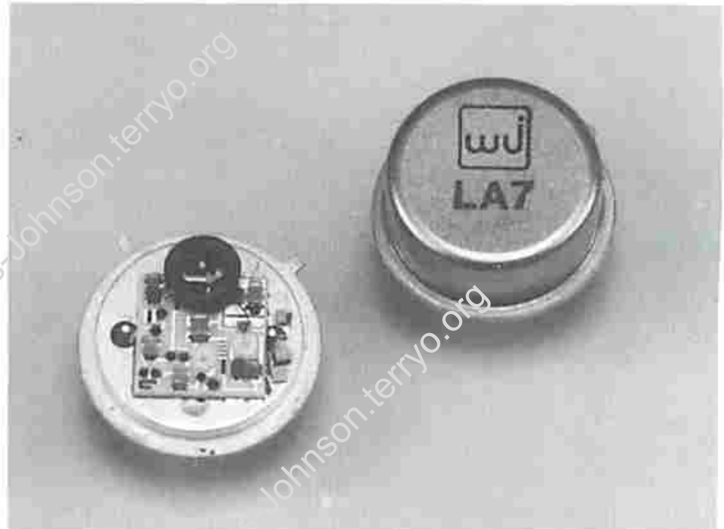
Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1800.0	.227	-140	3.840	156	.015	-124	.077	175
2000.0	.203	-145	3.893	127	.015	-144	.058	163
2200.0	.177	-151	3.931	98	.015	-153	.034	167
2400.0	.149	-157	3.947	71	.014	179	.014	-161
2600.0	.117	-168	3.958	43	.014	161	.025	-85
2800.0	.087	-176	3.947	15	.013	143	.046	-83
3000.0	.065	-179	3.910	-14	.013	124	.057	-96
3200.0	.052	-174	3.849	-41	.012	106	.057	-118
3400.0	.051	-159	3.799	-67	.012	90	.053	-142
3600.0	.068	-143	3.779	-94	.012	72	.057	-169
3800.0	.096	-142	3.766	-121	.011	53	.071	167
4000.0	.126	-146	3.748	-148	.011	38	.087	149
4200.0	.153	-155	3.738	-175	.010	23	.099	136
4400.0	.173	-166	[illegible]	159	.010	8	.102	127
4600.0	.169	180	3.741	132	.010	-7	.093	119
4800.0	.201	164	3.752	105	.009	-20	.072	114
5000.0	.212	149	3.755	77	.010	-35	.041	119
5200.0	.223	137	3.764	51	.009	-51	.023	171
5400.0	.226	125	3.780	23	.010	-65	.052	-143
5600.0	.223	116	3.807	-5	.010	-84	.087	-145
5800.0	.205	108	3.855	-34	.010	-102	.117	-155
6000.0	.169	99	3.896	-63	.010	-119	.138	-168
6200.0	.123	87	3.941	-91	.012	-136	.140	173

WJ-LA7

50 TO 500 MHz TO-8 CASCADABLE LIMITING AMPLIFIER

- SYMMETRICAL CLIPPING, GOOD EVEN-ORDER SUPPRESSION
- HIGH OUTPUT LEVEL: +12 dBm (TYP.)
- LOW VSWR: 1.3:1 (TYP.)
- HIGH THIRD-ORDER INTERCEPT POINT: +28 dBm (TYP.)
- FAST PULSE RECOVERY TIME: < 50 NSEC



Specifications *

Characteristic	Typical	Guaranteed 0°-50°C	Guaranteed -54°C-+85°C
Frequency (Min.)	20-550 MHz	50-500 MHz	50-500 MHz
Small Signal Gain (Min.)	12.6 dB	12.0 dB	11.0 dB
Gain Flatness (Max.)	±0.2 dB	±0.5 dB	±0.7 dB
Noise Figure (Max.)			
50-300 MHz	7.0 dB	8.0 dB	8.5 dB
300-500 MHz	7.5 dB	8.5 dB	9.0 dB
Power Output at 1 dB Compression (Min.)			
50-300 MHz	+12.0 dBm	+11.0 dBm	+8.0 dBm
300-500 MHz	+11.5 dBm	+10.0 dBm	+7.0 dBm
Output Limiting Level (Max.) PIN = +20 dBm	+17.5 dBm	+16.0 dBm	+17.0 dBm
VSWR (Max.) Input/Output	1.3:1	1.7:1	2.0:1
DC Current (Max.) at 15 Volts	54 mA	56 mA	58 mA

*Measured in a 50-ohm system at 15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Third Order Two Tone Intercept Point . . . . +28 dBm (Typ.) Linear Region Only

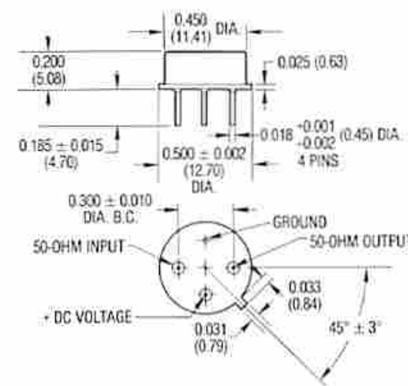
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . +125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . 200 Milliwatts
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 400 Milliwatts
Maximum Peak Power . . . . 1 Watt 27 dBm (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

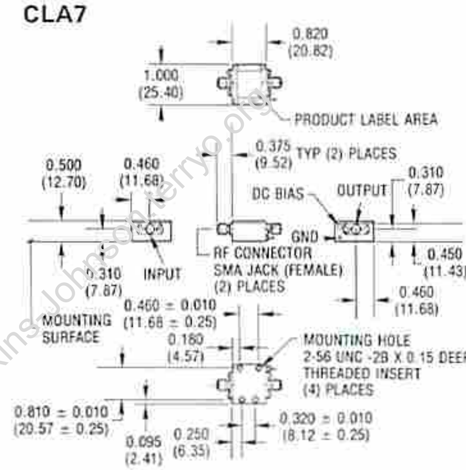
Outline Drawings

LA7



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CLA7

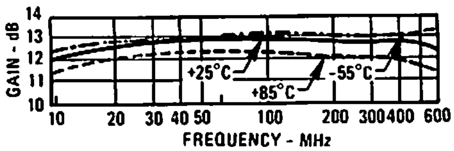


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

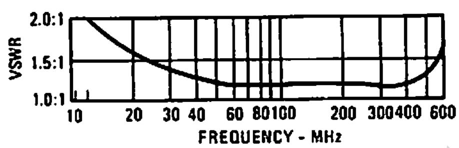
WJ CLA7 is standard WJ LA7 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers

Typical Performance at 25°C

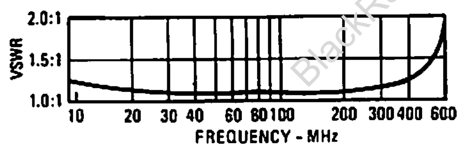
Gain



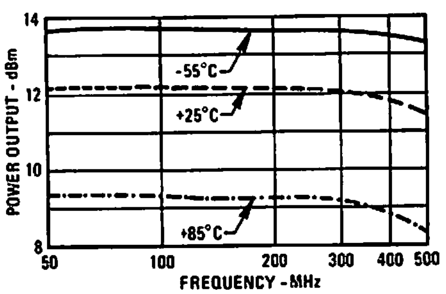
VSWR Output



VSWR Input

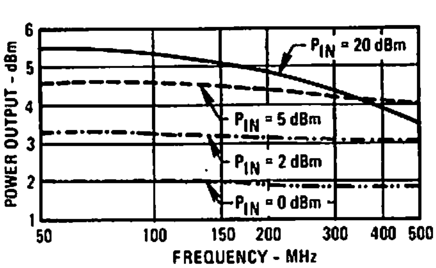


Power Output Over Temperature*

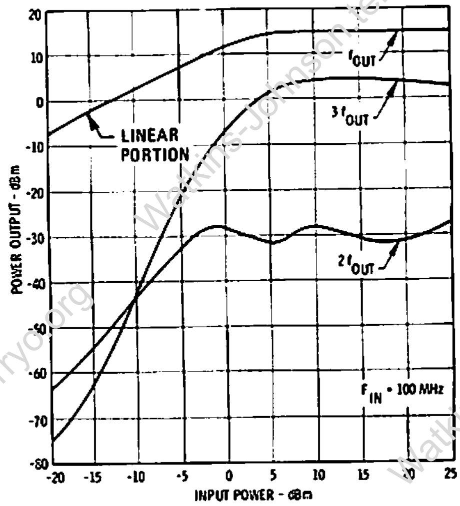


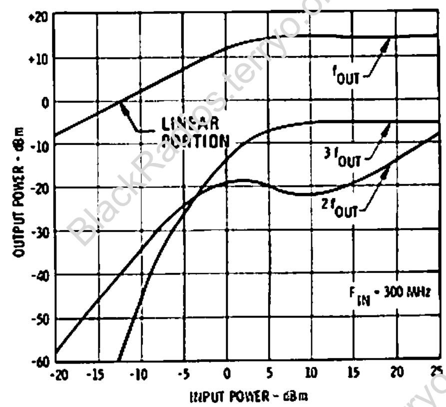
*at 1 dB Gain Compression

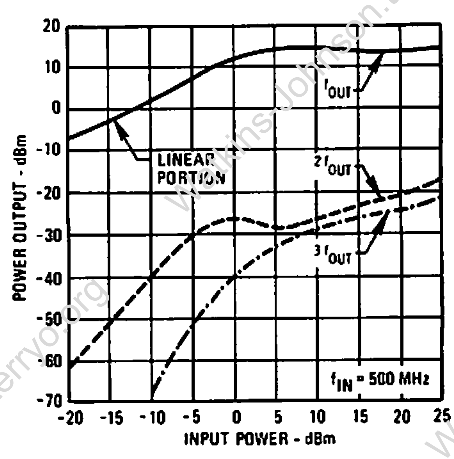
Power Output vs. Frequency



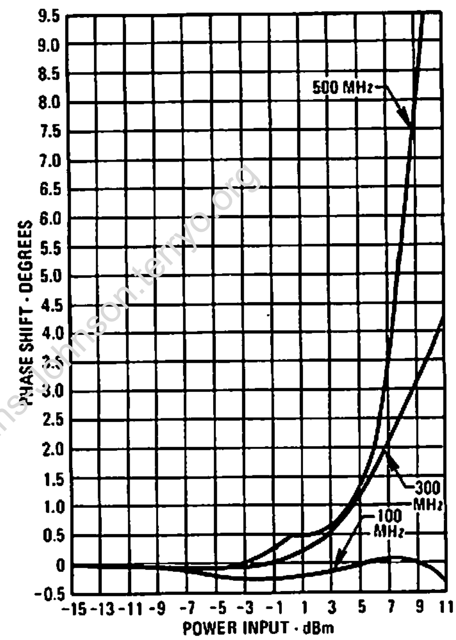
Power Output and Distortion Products







Phase Shift vs. Input Power



1

Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.1	12.9
200.	1.2	1.1	12.7
300.	1.2	1.2	12.7
400.	1.2	1.2	12.6
500.	1.3	1.4	12.6
600.	1.8	2.0	12.3
700.	2.8	3.4	11.0
800.	3.9	5.8	8.1

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.07	-40.8	4.40	150.6	.09	-9.9	.03	-48.4
200.	.08	-31.6	4.32	120.7	.09	-20.3	.05	-83.9
300.	.09	-35.2	4.31	92.5	.09	-32.7	.08	-122.1
400.	.09	-24.9	4.28	63.0	.10	-47.7	.10	-164.4
500.	.13	-2.5	4.29	29.7	.10	-67.0	.16	131.5
600.	.27	-6.5	4.13	-10.2	.10	-92.0	.33	80.4
700.	.47	-32.8	3.54	-54.3	.09	-122.0	.55	37.1
800.	.59	-64.6	2.54	-96.0	.07	-152.9	.71	-6.4

Three Cascaded LA7's

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.1	37.7
200.	1.2	1.2	37.3
300.	1.4	1.4	37.2
400.	1.3	1.5	37.6
500.	1.2	1.4	38.0

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.07	-9.5	77.03	77.9	.00	8.9	.05	-49.3
200.	.11	-13.5	73.61	-15.6	.00	-70.0	.09	-72.6
300.	.16	-36.7	72.65	-109.9	.00	-135.2	.16	-103.7
400.	.14	-66.0	75.76	152.3	.00	-165.3	.21	-160.6
500.	.11	-33.1	79.05	45.3	.00	124.2	.17	122.4

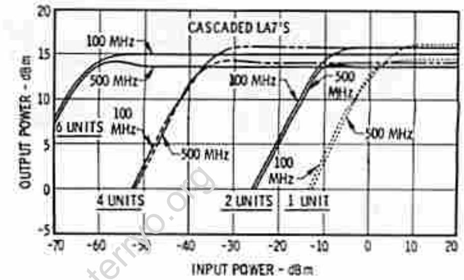
Two Cascaded LA7's

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.1	25.2
200.	1.2	1.2	25.0
300.	1.3	1.4	24.9
400.	1.3	1.3	25.0
500.	1.3	1.2	25.0

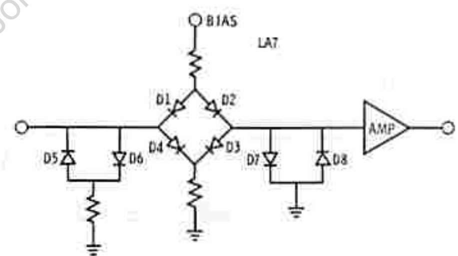
Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.05	-4.6	18.18	-73.5	.01	-34.6	.06	-49.4
200.	.10	-7.2	17.85	-142.4	.01	-65.1	.10	-85.4
300.	.13	-31.1	17.56	150.3	.01	-95.4	.15	-123.0
400.	.13	-49.5	17.69	81.9	.01	-134.7	.15	-177.4
500.	.14	-39.7	17.70	6.0	.01	178.0	.09	72.5

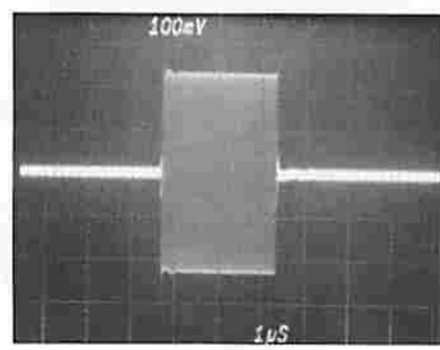
Limiting Characteristics



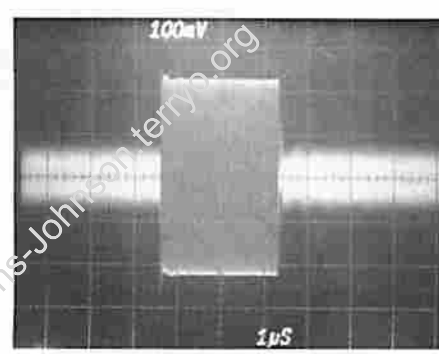
Schematic Diagram



Output Response, 6 Cascaded LA7's



-45 dBm Input CW Pulse



+5 dBm Input CW Pulse

WJ-LA17

10 TO 1000 MHz TO-8 CASCADABLE LIMITING AMPLIFIER

- SYMMETRICAL CLIPPING: GOOD EVEN-ORDER SUPPRESSION
- HIGH OUTPUT LEVEL: +10 dBm (TYP.)
- HIGH GAIN: 11.5 dB (TYP.)
- HIGH THIRD-ORDER INTERCEPT POINT: +28 dBm (TYP.)
- FAST PULSE RECOVERY TIME: <50 NSEC

1

Specifications *

Characteristic	Typ.	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	5-1100 MHz	10-1000 MHz	10-1000 MHz
Small Signal Gain (Min.)	11.5 dB	10.5 dB	9.5 dB
Gain Flatness (Max.)	±0.3 dB	±0.5 dB	±0.7 dB
Noise Figure (Max.)	5.8 dB	6.7 dB	7.2 dB
Power Output at 1 dB Compression (Min.)	10.0 dBm	7.0 dBm	7.0[1] dBm
Output Limiting Level (Max.) P_{IN} = +20 dBm	15.0 dBm	16.0 dBm	17.0 dBm
VSWR (Max.) Input/Output	≤1.7:1	1.9:1	2.0:1
DC Current (Max.) at 15 Volts	55 mA	57 mA	59 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Notes:

1. Power output at +85°C is 5.0 dBm.

Typical Intermodulation Performance at 25°C

Third Order Two Tone Intercept Point . . . . . . +28 dBm (Typ.) Linear Region Only

Absolute Maximum Ratings

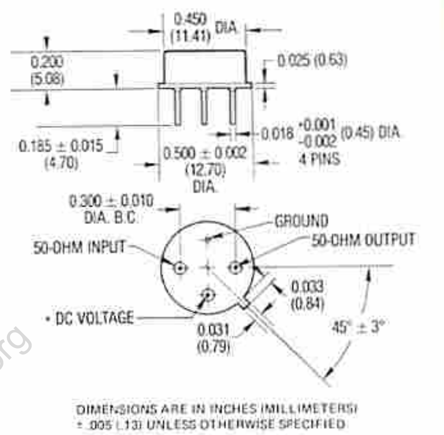
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +23 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 200 Milliwatts
Maximum Peak Power . . . . 1 Watt (3 μ sec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight

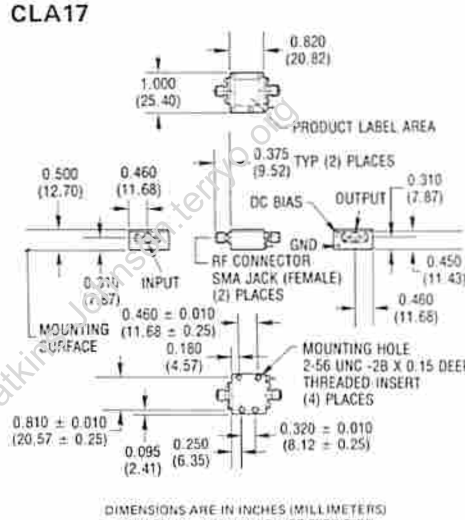
approximately 2.0 grams (0.07 oz.)

Outline Drawings

LA17

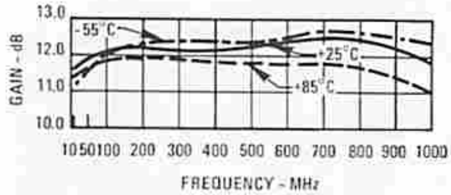


CLA17

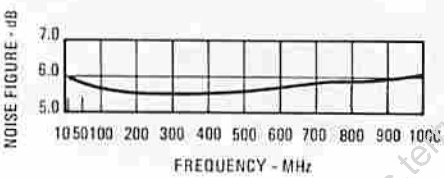


Typical Performance at 25°C

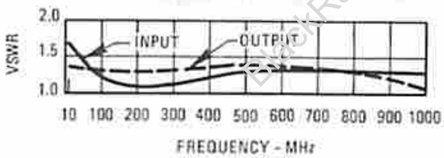
Gain



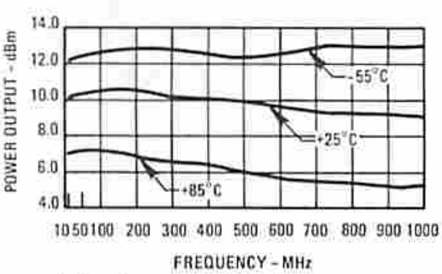
Noise Figure



VSWR

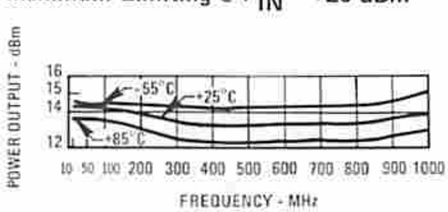


Power Output*

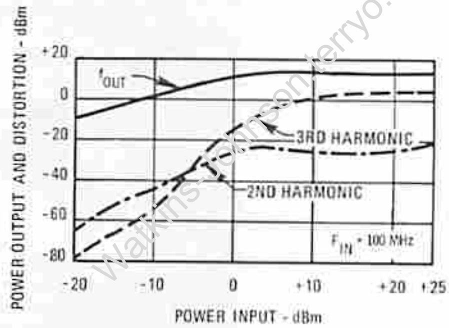


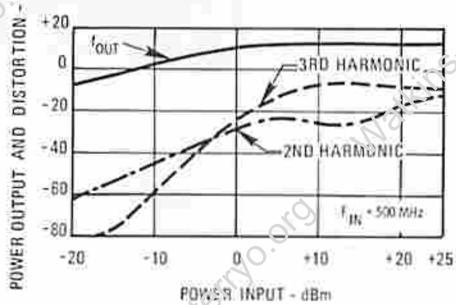
*at 1 dB Gain Compression

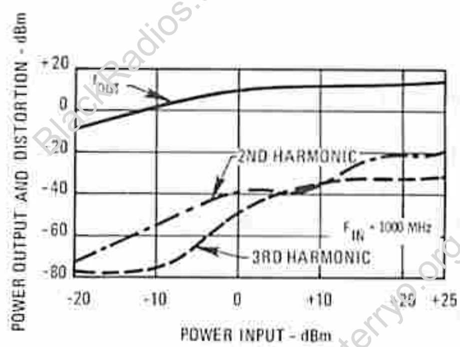
Maximum Limiting @ P_{IN} = +20 dBm



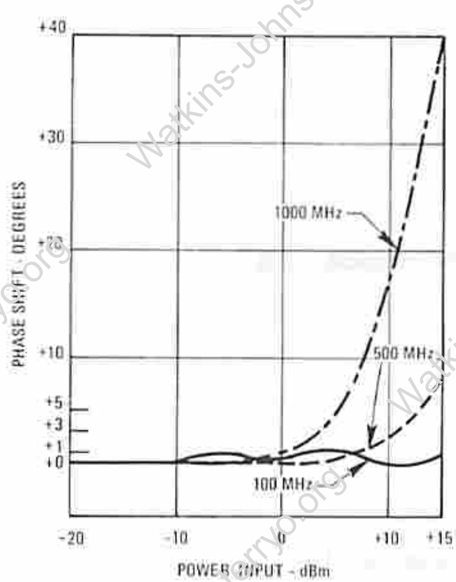
Power Output and Distortion



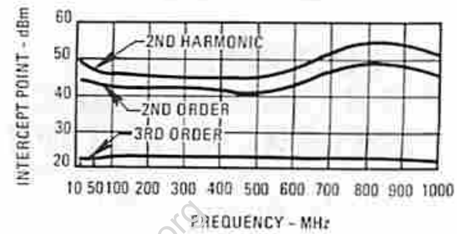




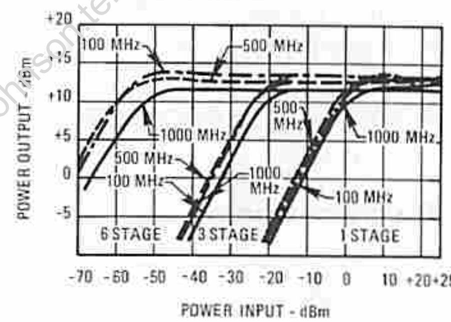
Phase Shift vs Input Power



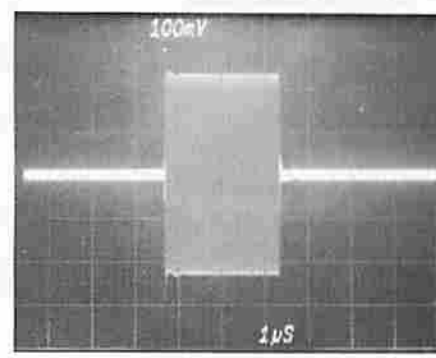
Intercept Point



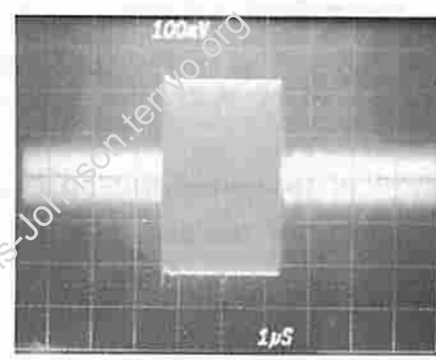
Limiting Characteristics



Output Response, 6 Cascaded LA17's



−45 dBm Input CW Pulse



+5 dBm Input CW Pulse

Typical Automatic Test Data

V_{CC} = +15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.3	1.2	11.0
200.	1.2	1.2	12.0
300.	1.2	1.3	12.2
400.	1.3	1.3	12.2
500.	1.3	1.3	12.2
600.	1.4	1.3	12.3
700.	1.4	1.3	12.4
800.	1.3	1.2	12.2
900.	1.3	1.2	12.1
1000.	1.3	1.1	11.6
1100.	1.4	1.2	10.9

Linear S-Parameters

FREQ MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.14	-51.1	3.71	169.0	.09	1.5	.11	123.3
200.	.10	-34.9	3.99	147.5	.09	-4.1	.11	100.1
300.	.10	-25.5	4.07	128.7	.10	-9.5	.12	74.4
400.	.12	-28.3	4.06	109.5	.10	-15.1	.12	50.4
500.	.14	-33.4	4.08	88.4	.10	-20.0	.13	26.9
600.	.15	-45.1	4.10	68.3	.11	-26.9	.13	5.6
700.	.15	-55.3	4.17	47.5	.11	-32.1	.13	-14.4
800.	.15	-65.3	4.09	25.5	.11	-39.4	.11	-33.4
900.	.13	-68.9	4.01	2.4	.12	-46.8	.08	-43.5
1000.	.12	-60.4	3.82	-21.9	.12	-55.9	.04	-11.4
1100.	.15	-49.8	3.50	-47.4	.13	-65.5	.09	26.[illegible]

Three Cascaded LA17's

V_{CC} = +15 V

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
100.0	1.1	1.3	34.8
200.0	1.0	1.3	34.5
300.0	1.0	1.3	34.3
400.0	1.0	1.4	34.2
500.0	1.1	1.5	34.6
600.0	1.3	1.6	35.0
700.0	1.5	1.5	35.0
800.0	1.5	1.2	34.7
900.0	1.5	1.2	34.2
1000.0	1.4	1.2	33.4
1100.0	1.5	1.2	32.0
1200.0	1.5	1.3	29.8
1300.0	1.6	1.4	26.3

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.0	0.024	-147	54.66	120	0.00	-29	0.124	148
200.0	0.007	-174	53.03	45	0.00	-66	0.124	125
300.0	0.004	-65	52.0[illegible]	-20	0.00	-98	0.142	95
400.0	0.022	7	51.58	-93	0.00	-100	0.175	63
500.0	0.064	-27	53.80	-162	0.00	-134	0.212	18
600.0	0.130	-59	56.36	125	0.00	-174	0.223	-36
700.0	0.185	-94	56.20	49	0.00	136	0.191	-94
800.0	0.202	-121	54.0[illegible]	-24	0.00	123	0.110	-156
900.0	0.192	-148	51.1[illegible]	-101	0.00	97	0.071	135
1000.0	0.177	-159	46.94	179	0.00	56	0.071	101
1100.0	0.186	-164	39.91	94	0.00	7	0.106	43
1200.0	0.200	-165	30.95	7	0.00	-17	0.141	-31
1300.0	0.240	-171	20.5[illegible]	-82	0.00	-75	0.173	-70

1

WJ-LA45

1000 TO 4000 MHz TO-8 CASCADABLE LIMITING AMPLIFIER

- SYMMETRICAL CLIPPING: GOOD EVEN ORDER SUPPRESSION
- HIGH OUTPUT LEVEL: +14.0 dBm (TYP.)
- MEDIUM GAIN: 11.5 dB (TYP.)
- WIDE BANDWIDTH: 0.8-4.2 GHz (TYP.)

Specifications *

Characteristic	Typical	Guaranteed 0° - +50°C	Guaranteed -54° - +85°C
Frequency (Min.)	800-4200 MHz	1000-4000 MHz	1000-4000 MHz
Small Signal Gain (Min.)	11.5 dB	10.0 dB	9.0 dB
Gain Flatness (Max.)	±.5 dB	±.8 dB	±1.0 dB
Noise Figure (Max.)	8.0 dB	9.5 dB	10.0 dB
Power Output at 1 dB Compression (Min.)	14.0 dBm	12.5 dBm	11.5 dBm
Output Limiting Level (Max.) +17 dBm Input	15.5 dBm	17.0 dBm	17.5 dBm
VSWR (Max.) Input	1.7:1	2.1:1	2.2:1
VSWR (Max.) Output	1.6:1	2.0:1	2.1:1
DC Current (Max.) at +15 Volts	110 mA	115 mA	120 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Harmonic Intercept Point . . . . +50.0 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +46.0 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +24.0 dBm (Typ.)

Absolute Maximum Ratings

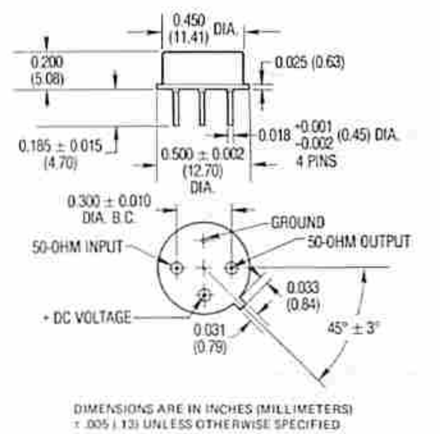
Storage Temperature . . . . -65°C to +125°C
Maximum Case Temperature . . . . +100°C
Maximum DC Voltage . . . . +16 Volts
Maximum Continuous RF Input Power . . . . +17.0 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
"S" Series Burn-In Temperature (Case) . . . . +100°C

Weight

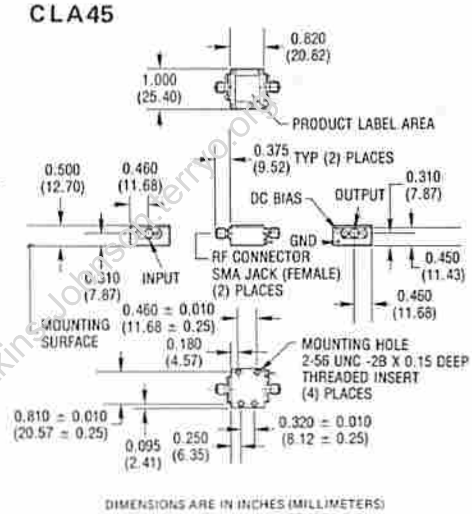
approximately 2.0 grams (0.07 oz.)

Outline Drawings

LA45



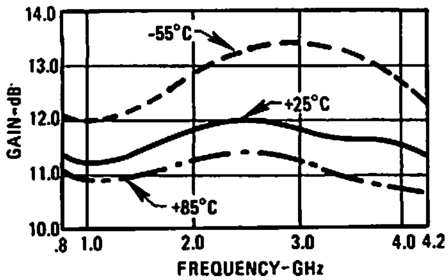
CLA45



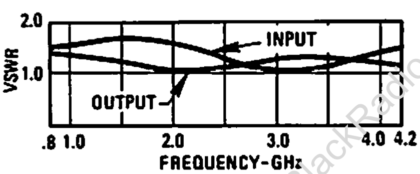
*WJ-CLA45 is standard.
WJ-LA45 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

Typical Performance at 25°C

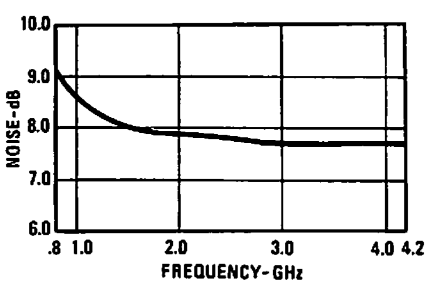
Gain



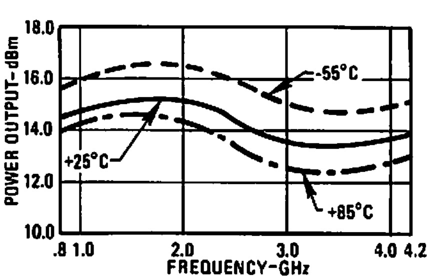
VSWR

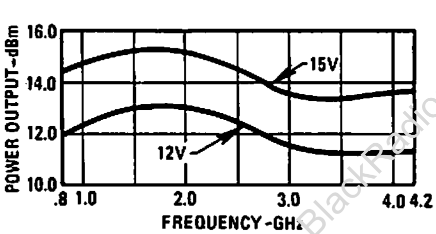


Noise Figure



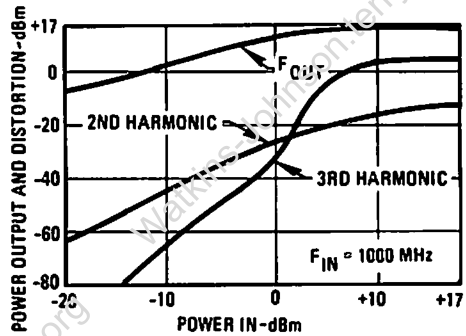
Power Output*

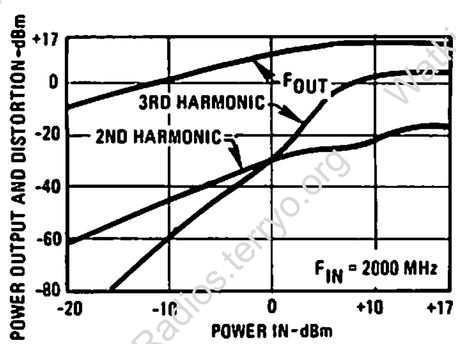


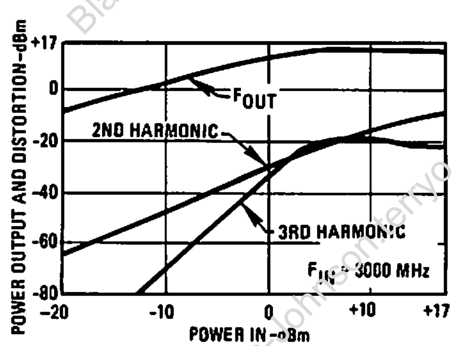


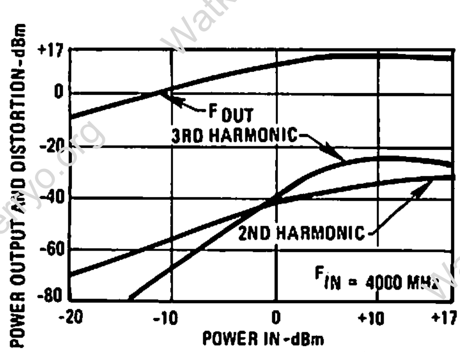
*at 1 dB Gain Compression

Power Output and Distortion

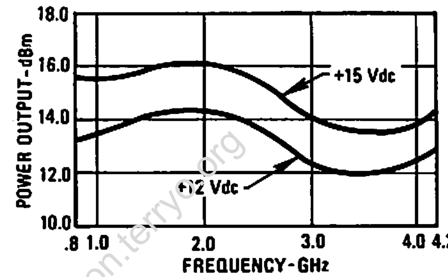


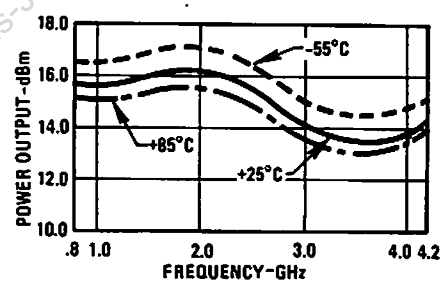




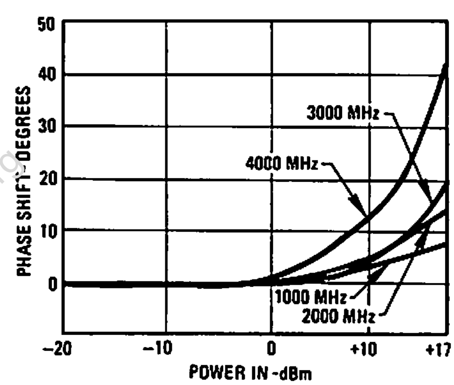


Maximum Limiting Level
@ Pin = +17 dBm

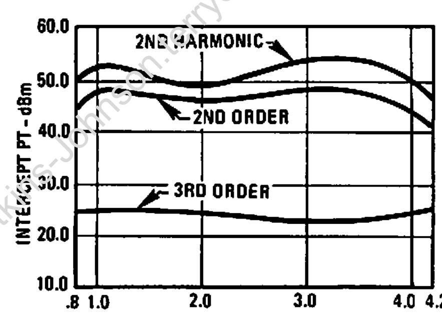




Phase Shift vs. Input Power



Intercept Point



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Typical Automatic Test Data

V_{cc} = +12 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
800.0	1.6	1.3	10.9
900.0	1.6	1.3	10.8
1000.0	1.6	1.3	10.8
1100.0	1.6	1.2	10.9
1200.0	1.6	1.2	11.0
1300.0	1.7	1.2	11.1
1400.0	1.7	1.1	11.2
1500.0	1.8	1.1	11.3
1600.0	1.8	1.1	11.4
1700.0	1.8	1.1	11.5
1800.0	1.8	1.1	11.6
1900.0	1.7	1.2	11.7
2000.0	1.7	1.2	11.8
2100.0	1.6	1.3	11.9
2200.0	1.5	1.4	11.9
2300.0	1.4	1.4	12.0
2400.0	1.3	1.5	12.0
2500.0	1.2	1.5	12.0
2600.0	1.2	1.6	12.0
2700.0	1.1	1.6	12.0
2800.0	1.0	1.7	12.0
2900.0	1.0	1.7	11.9
3000.0	1.0	1.7	11.9
3100.0	1.1	1.6	11.9
3200.0	1.1	1.6	11.8
3300.0	1.1	1.6	11.8
3400.0	1.1	1.6	11.7
3500.0	1.1	1.5	11.7
3600.0	1.2	1.5	11.7
3700.0	1.2	1.5	11.6
3800.0	1.2	1.4	11.6
3900.0	1.3	1.4	11.5
4000.0	1.4	1.4	11.4
4100.0	1.4	1.4	11.3
4200.0	1.5	1.3	11.2

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
800.0	.222	-6	3.504	42	.022	110	.123	54
900.0	.216	-12	3.462	16	.021	84	.125	48
1000.0	.220	-9	3.466	-5	.021	63	.119	37
1100.0	.229	-7	3.493	-23	.020	46	.107	25
1200.0	.242	-7	3.535	-41	.020	31	.092	12
1300.0	.256	-8	3.572	-57	.020	18	.074	-2
1400.0	[illegible]	-11	3.621	-72	.020	4	.055	-19
1500.0	.280	-26	3.670	-87	.019	-7	.037	-54
1600.0	.284	-30	3.720	-101	.019	-18	.027	-91
1700.0	.285	-34	3.773	-115	.019	-28	.025	-144
1800.0	.280	-38	3.819	-128	.019	-38	[illegible]	-171
1900.0	.272	-42	3.863	-141	.019	-47	.080	173
2000.0	.257	-45	3.907	-154	.019	-56	.105	163
2100.0	.233	-43	3.935	-168	.018	-66	.131	152
2200.0	.204	-45	3.957	179	.018	-75	.155	144
2300.0	.168	-48	3.975	166	.018	-83	.177	137
2400.0	.133	-51	3.988	153	.017	-92	.197	130
2500.0	.101	-57	3.993	140	.017	-100	.214	124
2600.0	.071	-56	3.994	127	.017	-108	.228	117
2700.0	.039	-56	3.984	115	.016	-116	.239	111
2800.0	.013	-55	3.971	103	.016	-124	.245	106
2900.0	.005	106	3.957	91	.015	-131	.248	100
3000.0	.018	86	3.934	79	.015	-138	.247	94
3100.0	.030	92	3.917	67	.015	-146	.244	89
3200.0	.030	73	3.902	55	.015	-153	.238	84
3300.0	.040	50	3.885	43	.014	-160	.230	79
3400.0	.050	39	3.863	31	.014	-168	.220	73
3500.0	.054	23	3.846	19	.014	-175	.210	67
3600.0	.070	3	3.826	7	.014	179	.199	61
3700.0	.087	-8	3.812	-5	.014	171	.188	55
3800.0	.104	-20	3.789	-17	.013	164	.177	48
3900.0	.127	-30	3.754	-29	.013	157	.167	40
4000.0	.155	-37	3.718	-41	.013	149	.158	31
4100.0	.166	-43	3.680	-54	.013	142	.150	23
4200.0	.186	[illegible]	3.639	-66	.012	135	.143	13

V_{cc} = +15 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
800.0	1.5	1.4	11.3
900.0	1.5	1.4	11.1
1000.0	1.5	1.4	11.1
1100.0	1.5	1.3	11.1
1200.0	1.6	1.3	11.2
1300.0	1.6	1.3	11.3
1400.0	1.7	1.2	11.4
1500.0	1.7	1.2	11.5
1600.0	1.7	1.1	11.6
1700.0	1.7	1.1	11.7
1800.0	1.7	1.1	11.8
1900.0	1.7	1.1	11.8
2000.0	1.6	1.1	11.9
2100.0	1.5	1.1	12.0
2200.0	1.4	1.2	12.0
2300.0	1.3	1.2	12.1
2400.0	1.2	1.3	12.1
2500.0	1.2	1.3	12.1
2600.0	1.1	1.3	12.1
2700.0	1.0	1.4	12.0
2800.0	1.0	1.4	12.0
2900.0	1.1	1.4	12.0
3000.0	1.1	1.3	11.9
3100.0	1.1	1.3	11.9
3200.0	1.1	1.3	11.9
3300.0	1.1	1.3	11.8
3400.0	1.1	1.3	11.8
3500.0	1.1	1.2	11.8
3600.0	1.2	1.2	11.8
3700.0	1.2	1.2	11.7
3800.0	1.3	1.2	11.7
3900.0	1.3	1.1	11.6
4000.0	1.4	1.1	11.6
4100.0	1.4	1.1	11.5
4200.0	1.5	1.1	11.4

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
800.0	.209	-13	3.668	42	.024	110	.152	46
900.0	.198	-13	3.603	16	.023	83	.156	41
1000.0	.201	-10	3.592	-6	.023	61	.153	31
1100.0	.211	-7	3.607	-24	.022	44	.146	20
1200.0	.227	-8	3.633	-41	.022	28	.134	9
1300.0	.244	-10	3.660	-58	.021	14	.118	-1
1400.0	.259	-14	3.702	-73	.021	0	.101	-12
1500.0	.269	-26	3.741	-86	.021	-11	.082	-24
1600.0	.273	-31	3.788	-102	.021	-23	.063	-38
1700.0	.273	-35	3.834	-116	.020	-34	.045	-58
1800.0	.266	-39	3.873	-129	.020	-44	.032	-95
1900.0	.257	-43	[illegible]	-142	.020	-54	.033	-144
2000.0	.240	-46	3.948	-156	.019	-63	.048	-174
2100.0	.213	-44	3.976	-170	.019	-73	.067	165
2200.0	.183	-46	3.995	178	.018	-83	.086	152
2300.0	.145	-48	4.008	165	.018	-92	.105	143
2400.0	.108	-51	4.017	152	.018	-101	.121	134
2500.0	.077	-55	4.019	139	.017	-110	.134	127
2600.0	.048	-50	4.017	127	.016	-118	.144	121
2700.0	.018	-32	4.004	114	.016	-126	.150	115
2800.0	.014	70	3.991	102	.016	-134	.153	109
2900.0	.028	91	3.974	90	.015	-142	.152	105
3000.0	.041	84	3.953	78	.014	-149	.140	100
3100.0	.051	84	3.937	66	.014	-157	[illegible]	97
3200.0	.050	70	3.924	54	.014	-165	.135	94
3300.0	.059	53	3.910	43	.013	-170	.126	91
3400.0	067	42	3.893	31	.013	-180	.116	88
3500.0	.069	28	3.885	19	.012	174	.105	86
3600.0	.081	8	3.872	7	.012	162	.094	83
3700.0	.097	-3	3.864	-4	.011	[illegible]	.084	81
3800.0	.112	-17	3.848	-16	.011	154	.073	79
3900.0	.132	-28	3.824	-28	.011	146	.062	76
4000.0	.158	-36	3.800	-41	.011	139	.052	74
4100.0	.168	-43	3.768	-53	.010	132	.042	72
4200.0	.186	-54	3.736	-65	.010	125	.033	69

WJ-LA45-1

1000 TO 4000 MHz TO-8 CASCADABLE LIMITING AMPLIFIER

- SYMMETRICAL CLIPPING: GOOD EVEN ORDER SUPPRESSION
- HIGH OUTPUT LEVEL: +17 dBm (TYP.)
- MEDIUM GAIN: 14.0 dB, (TYP.)
- WIDE BANDWIDTH: 0.8-4.2 GHz (TYP.)

1

Specifications*

Characteristic	Typical	Guaranteed 0° - +50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	800-4200 MHz	1000-4000 MHz	1000-4000 MHz
Small Signal Gain (Min.)	14.0 dB	13.0 dB	12.0 dB
Gain Flatness (Max.)	±0.5 dB	±0.8 dB	±1.0 dB
Noise Figure (Max.)	7.5 dB	9.0 dB	9.5 dB
Power Output at 1 dB Compression (Min.)	17.0 dBm	15.5 dBm	14.5 dBm
Output Limiting Level (Max.) +17 dBm Input	18.5 dBm	20.5 dBm	21.0 dBm
VSWR (Max.) Input	1.8:1	2.1:1	2.2:1
VSWR (Max.) Output	1.6:1	2.0:1	2.1:1
DC Current (Max.) at +15 Volts	110 mA	115 mA	120 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Harmonic Intercept Point . . . . +53.0 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +48.0 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +27.0 dBm (Typ.)

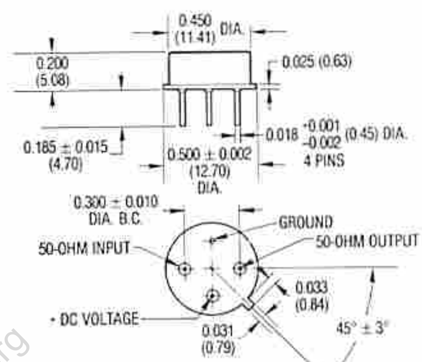
Absolute Maximum Ratings

Storage Temperature . . . . -65°C to +125°C
Maximum Case Temperature . . . . +100°C
Maximum DC Voltage . . . . +16 Volts
Maximum Continuous RF Input Power . . . . +17.0 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
"S" Series Burn-In Temperature (Case) . . . . +100°C

Weight approximately 2.0 grams (0.07 oz.)

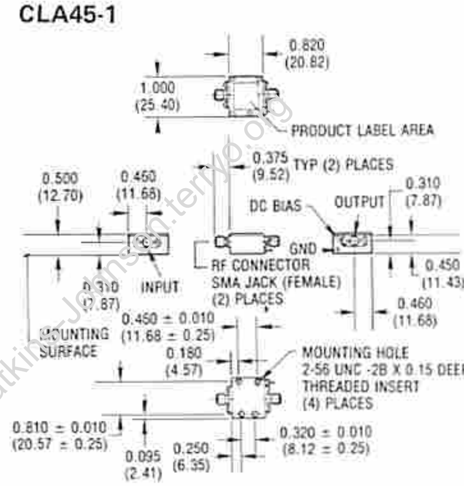
Outline Drawings

LA45-1



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CLA45-1

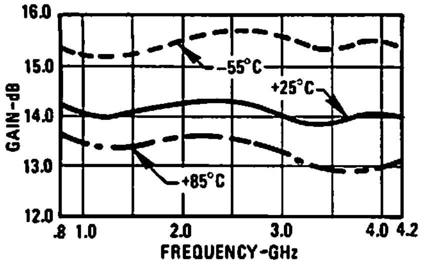


DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

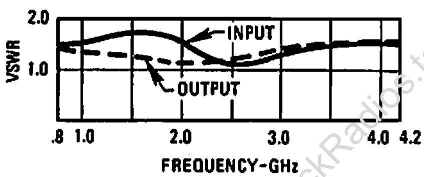
*WJ-CLA45-1 is standard.
WJ-LA45-1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

Typical Performance at 25°C

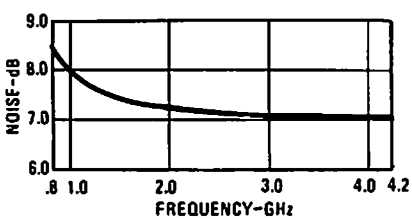
Gain



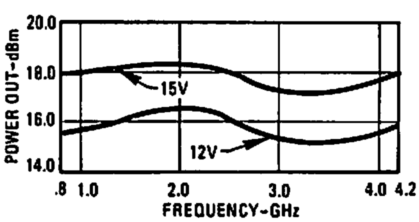
VSWR

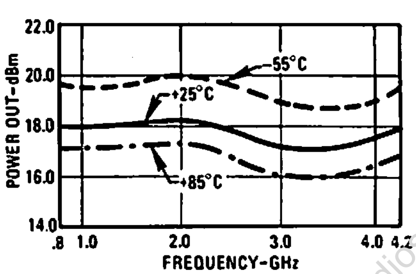


Noise Figure



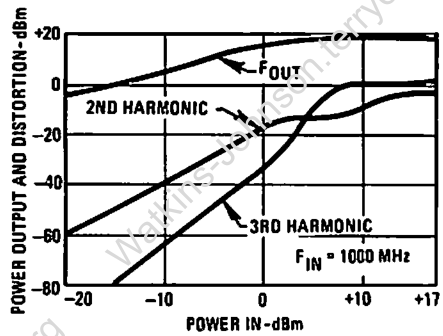
Power Output*

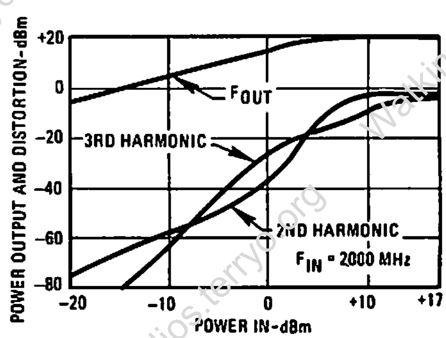


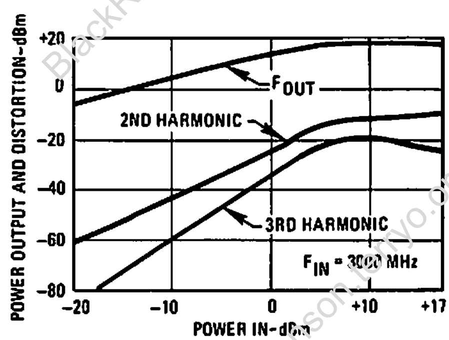


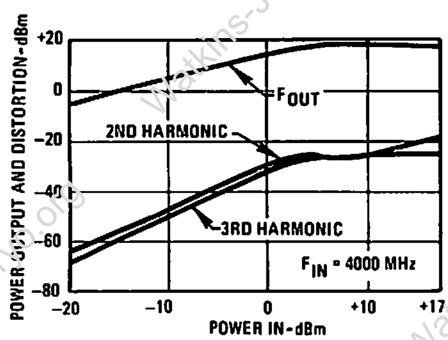
*at 1 dB Gain Compression

Power Output and Distortion

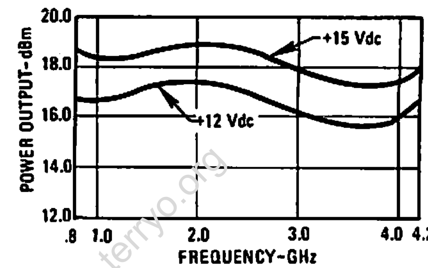


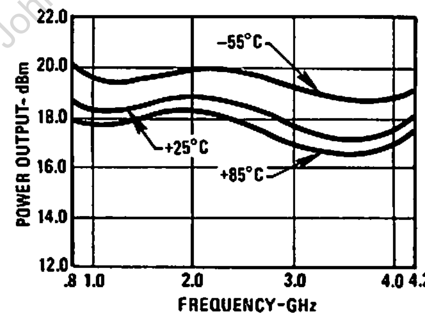




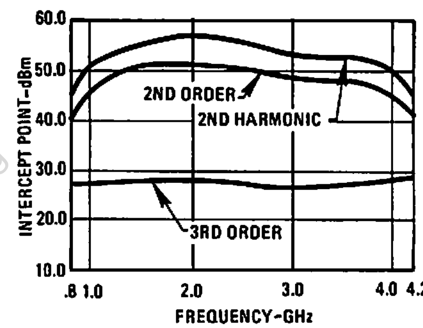


Maximum Limiting Level @ Pin = +17 dBm

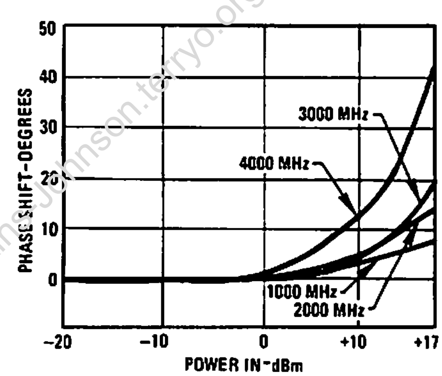




Intercept Point



Phase Shift vs. Input Power



Typical Automatic Test Data

V_{cc} = +12 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
800.0	1.5	1.3	13.8
900.0	1.5	1.4	13.7
1000.0	1.5	1.3	13.7
1100.0	1.6	1.3	13.7
1200.0	1.6	1.3	13.7
1300.0	1.7	1.2	13.7
1400.0	1.8	1.2	13.8
1500.0	1.8	1.1	13.8
1600.0	1.8	1.1	13.9
1700.0	1.8	1.1	14.0
1800.0	1.8	1.0	14.0
1900.0	1.7	1.0	14.1
2000.0	1.7	1.1	14.1
2100.0	1.6	1.1	14.2
2200.0	1.5	1.2	14.2
2300.0	1.4	1.3	14.2
2400.0	1.2	1.3	14.2
2500.0	1.2	1.4	14.2
2600.0	1.1	1.4	14.2
2700.0	1.1	1.5	14.2
2800.0	1.1	1.5	14.1
2900.0	1.2	1.5	14.1
3000.0	1.2	1.5	14.0
3100.0	1.2	1.6	14.0
3200.0	1.3	1.6	14.0
3300.0	1.3	1.6	13.9
3400.0	1.3	1.6	13.9
3500.0	1.3	1.6	13.9
3600.0	1.3	1.6	13.9
3700.0	1.3	1.6	13.9
3800.0	1.4	1.6	13.9
3900.0	1.4	1.5	13.9
4000.0	1.5	1.5	13.9
4100.0	1.5	1.5	13.9
4200.0	1.5	1.5	13.8

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
800.0	.197	4	4.919	45	.014	114	.145	75
900.0	.203	3	4.867	18	.014	80	.150	69
1000.0	.213	4	4.852	-4	.014	67	.145	61
1100.0	.226	4	4.850	-23	.014	50	.136	51
1200.0	.241	2	4.862	-41	.014	35	.122	41
1300.0	.257	-1	4.863	-57	.014	22	.106	32
1400.0	.273	-6	4.888	-72	.014	8	.088	24
1500.0	.285	-23	4.913	-87	.014	-3	.069	16
1600.0	.288	-28	4.945	-101	.014	-14	.049	9
1700.0	.288	-33	4.985	-114	.013	-24	.028	0
1800.0	.282	-37	5.020	-128	.013	-35	.005	+30
1900.0	.272	-42	5.064	-141	.013	-44	.020	178
2000.0	.255	-46	5.096	-154	.013	-53	.043	171
2100.0	.226	-46	5.122	-167	.013	-63	.069	162
2200.0	.193	-50	5.132	180	.013	-71	.092	156
2300.0	.151	-55	5.139	167	.013	-60	.114	151
2400.0	.110	-62	5.145	154	.012	-89	.136	146
2500.0	.074	-76	5.145	141	.012	-97	.155	141
2600.0	.040	-95	5.134	129	.012	-106	.173	136
2700.0	.025	-170	5.115	117	.012	-114	.187	131
2800.0	.048	144	5.091	104	.012	-122	.199	127
2900.0	.073	130	5.063	93	.011	-130	.209	123
3000.0	.891	118	5.033	81	.011	-137	.215	120
3100.0	.110	111	5.011	69	.011	-144	.220	116
3200.0	.114	102	4.993	57	.011	-152	.224	112
3300.0	.122	89	4.980	46	.010	-160	.226	109
3400.0	.132	79	4.965	34	.010	-168	.226	105
3500.0	.134	70	4.968	22	.010	-176	.226	101
3600.0	.138	55	4.972	10	.010	178	.224	97
3700.0	.148	43	4.979	-2	.010	171	.222	92
3800.0	.153	29	4.980	-14	.009	163	.219	87
3900.0	.164	15	4.974	-26	.009	155	.215	81
4000.0	.196	2	4.968	-39	.009	146	.210	74
4100.0	.195	-7	4.950	-51	.009	139	.205	67
4200.0	.203	-20	4.926	-64	.009	130	.199	60

V_{cc} = +15 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
800.0	1.5	1.4	14.3
900.0	1.4	1.5	14.1
1000.0	1.5	1.5	14.0
1100.0	1.5	1.4	14.0
1200.0	1.6	1.4	14.0
1300.0	1.7	1.4	14.0
1400.0	1.7	1.3	14.0
1500.0	1.6	1.3	14.0
1600.0	1.8	1.3	14.1
1700.0	1.8	1.2	14.1
1800.0	1.8	1.2	14.2
1900.0	1.7	1.1	14.2
2000.0	1.6	1.1	14.3
2100.0	1.5	1.1	14.3
2200.0	1.4	1.1	14.3
2300.0	1.3	1.1	14.3
2400.0	1.2	1.2	14.3
2500.0	1.1	1.2	14.3
2600.0	1.0	1.2	14.2
2700.0	1.1	1.3	14.2
2800.0	1.1	1.3	14.1
2900.0	1.2	1.3	14.0
3000.0	1.3	1.4	14.0
3100.0	1.3	1.4	13.9
3200.0	1.3	1.4	13.9
3300.0	1.3	1.4	13.9
3400.0	1.4	1.4	13.8
3500.0	1.4	1.5	13.9
3600.0	1.4	1.5	13.9
3700.0	1.4	1.5	13.9
3800.0	1.4	1.5	13.9
3900.0	1.4	1.5	13.9
4000.0	1.5	1.5	14.0
4100.0	1.5	1.5	14.0
4200.0	1.5	1.4	13.9

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
800.0	.189	-10	5.162	46	.017	114	.178	62
900.0	.183	-12	5.070	17	.016	86	.186	57
1000.0	.192	-9	5.027	-5	.016	64	.187	47
1100.0	.210	-8	5.007	-24	.016	47	.183	37
1200.0	.232	-9	5.007	-42	.015	30	.174	27
1300.0	.250	-13	4.996	-58	.015	16	.162	17
1400.0	.267	-17	5.000	-74	.015	2	.148	8
1500.0	.278	-22	5.025	-89	.015	-10	.132	-2
1600.0	.282	-28	5.051	-103	.015	-21	.116	-12
1700.0	.282	-33	5.081	-117	.014	-32	.098	-23
1800.0	.275	-38	5.113	-130	.014	-43	.080	-36
1900.0	.263	-44	5.146	-143	.014	-53	.064	-54
2000.0	.244	-40	5.179	-156	.014	-63	.053	-78
2100.0	.212	-48	5.195	-170	.014	-72	.048	-111
2200.0	.176	-52	5.199	177	.013	-82	.053	-140
2300.0	.133	-58	5.194	165	.013	-91	.065	-161
2400.0	.090	-67	5.188	152	.012	-100	.080	-176
2500.0	.053	-87	5.175	139	.012	-110	.095	174
2600.0	.024	[illegible]	5.152	126	.012	-119	.110	166
2700.0	.038	149	5.111	114	.011	-127	.123	160
2800.0	.069	130	5.076	102	.011	-135	.135	155
2900.0	.094	122	5.041	90	.011	-143	.145	151
3000.0	.112	111	5.003	79	.010	-152	.154	148
3100.0	.129	105	4.975	67	.010	-158	.163	145
3200.0	.132	96	4.954	55	.009	-167	.171	143
3300.0	.141	85	4.936	44	.009	-175	.178	140
3400.0	.150	75	4.919	32	.009	177	.184	137
3500.0	.151	66	4.933	21	.008	169	.189	134
3600.0	.154	52	4.940	9	.008	164	.192	130
3700.0	.161	40	4.956	-3	.008	157	.194	127
3800.0	.167	27	4.964	-15	.007	148	.194	122
3900.0	.175	13	4.976	-27	.007	140	.193	118
4000.0	.195	1	4.988	-39	.007	131	.190	113
4100.0	.202	-8	4.991	-51	.007	123	.187	108
4200.0	.208	-21	4.979	-64	.006	114	.183	102

1

WJ-PA2

10 TO 300 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT POWER: +25 dBm (TYP.)
- HIGH EFFICIENCY
- WIDE POWER SUPPLY RANGE: +12 TO +24 VOLTS

Specifications*

Characteristics	Typical	Guaranteed 0° -50°C	Guaranteed -54°C - +71°C
Frequency (Min.)	5-350 MHz	10-300 MHz	10-300 MHz
Small Signal Gain (Min.)	12.5 dB	11.5 dB	11.0 dB
Gain Flatness (Max.)	±0.5 dB	±0.8 dB	±1.0 dB
Noise Figure (Max.)			
V_{CC} = +24 V	8.0 dB	9.5 dB	10.0 dB
V_{CC} = +15 V	7.5 dB	9.0 dB	9.5 dB
Power Output at 1 dB Compression (Min.)			
V_{CC} = +24 V	+25 dBm	+24 dBm	+23.5 dBm
V_{CC} = +15 V	+21 dBm	+19.5 dBm	+19.0 dBm
VSWR (Max.)			
Input	<1.5:1	1.8:1	2.0:1
Output	<1.7:1	2.0:1	2.2:1
DC Current			
At 24 V (Max.)	95 mA	100 mA	105 mA
At 15 V (Max.)	58 mA	61 mA	64 mA

*Measured in a 50-ohm system at +24 Vdc Nominal.

Typical Intermodulation Performance at 25°C (At +24 Vdc)

Second Order Harmonic Intercept Point . . . . +63 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +56 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +38 dBm (Typ.)

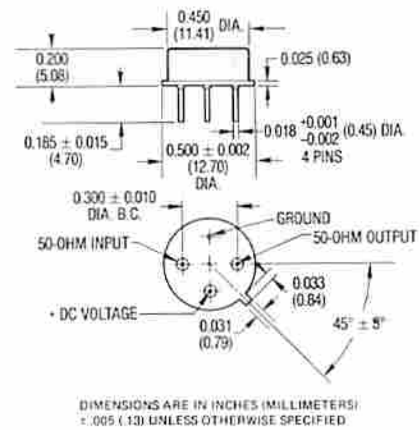
Absolute Maximum Ratings (At +24 Vdc)

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 71°C
Maximum DC Voltage . . . . +25 Volts
Maximum Continuous RF Input Power . . . . 20 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . . . +200 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 71°C

Proper heatsinking required to insure reliable performance.

Outline Drawings

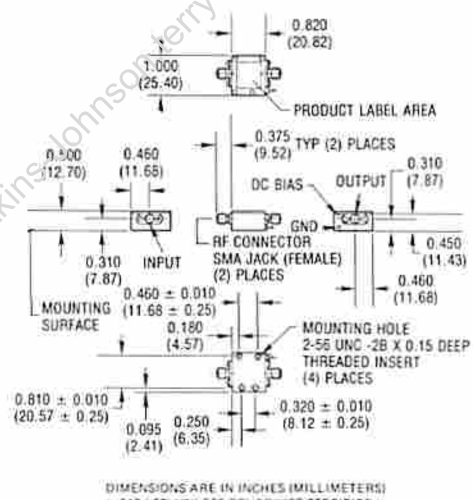
PA2



Weight

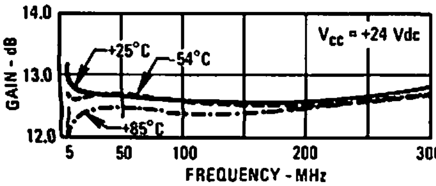
approximately 2.0 grams (0.07 oz.)

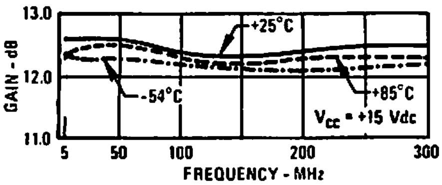
CPA2

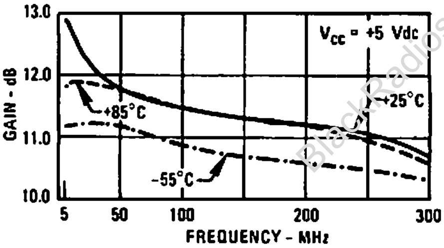


Typical Performance at 25°C

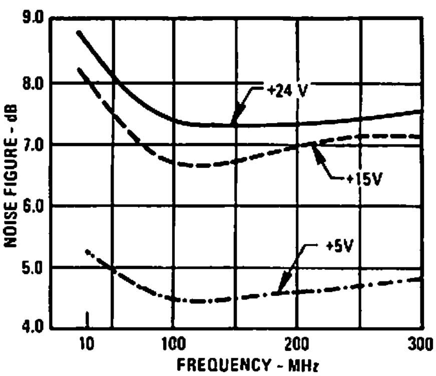
Gain



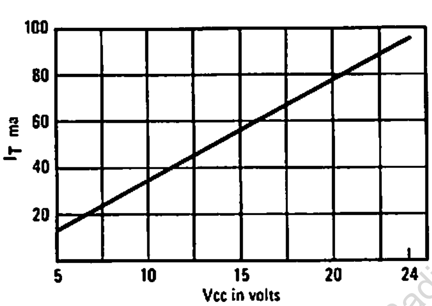




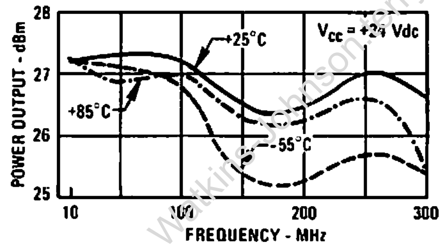
Noise Figure

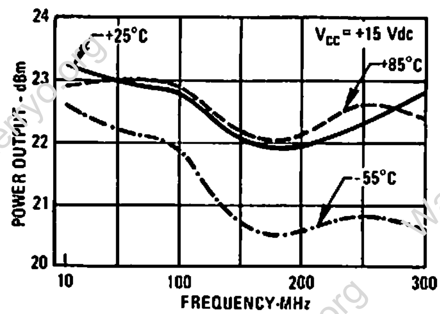


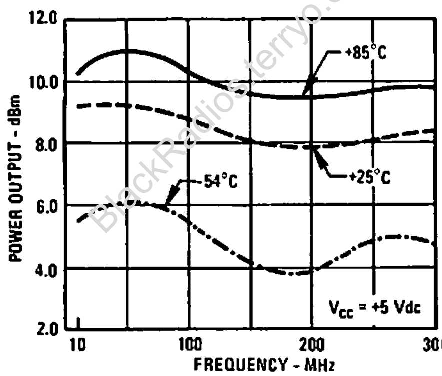
I_t vs Vcc



Power Output*

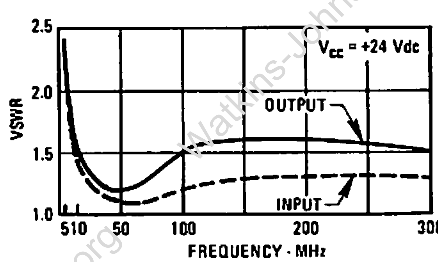


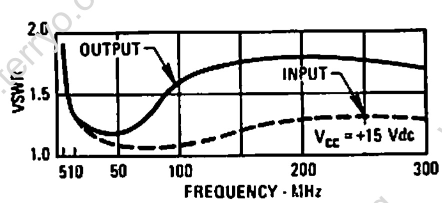


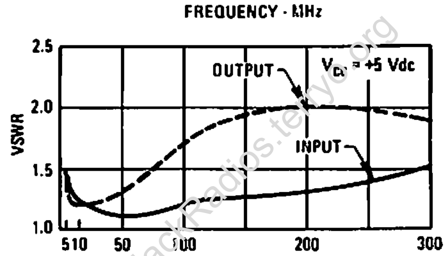


* at 1 dB Gain Compression

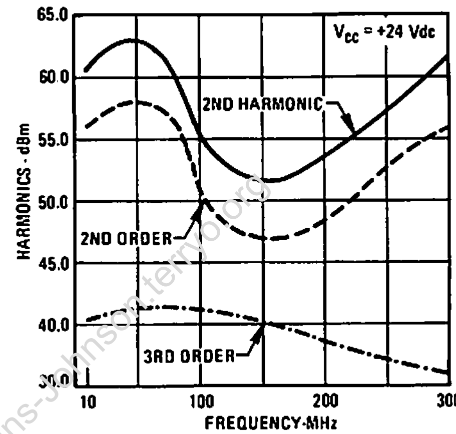
VSWR

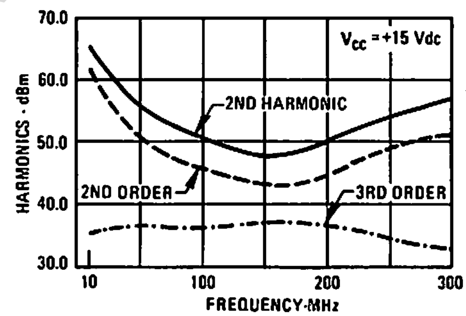


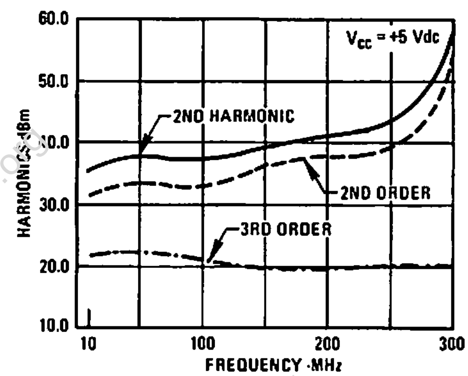




Harmonics







Typical Automatic Test Data

V_{CC} = +24 Vdc

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.4	12.5
150.	1.2	1.6	12.3
200.	1.2	1.5	12.4
250.	1.3	1.4	12.7
300.	1.3	1.5	12.8
350.	1.5	2.9	11.8

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.04	54.5	4.22	136.4	.12	-24.6	.18	-149.7
150.	.08	14.2	4.12	113.5	.12	-37.7	.23	-163.5
200.	.09	-30.0	4.15	89.3	.13	-50.4	.21	173.7
250.	.12	-80.0	4.29	63.3	.13	-67.2	.15	126.3
300.	.14	-139.9	4.36	32.9	.14	-89.2	.21	23.1
350.	.18	155.0	3.91	-2.3	.13	-114.6	.49	-31.9
400.	.22	97.7	3.01	-37.4	.11	-138.4	.74	-68.7

V_{CC} = +5 Vdc

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.7	11.5
150.	1.1	1.9	11.1
200.	1.2	1.9	11.1
250.	1.4	1.7	11.3
300.	1.6	1.9	11.0
350.	1.8	3.7	9.3

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.03	-26.2	3.76	130.1	.13	-23.3	.25	-136.2
150.	.07	-33.0	3.59	105.1	.13	-35.3	.32	-161.3
200.	.10	-82.4	3.60	77.4	.14	-47.4	.30	168.0
250.	.17	-120.8	3.65	49.8	.15	-65.7	.25	115.6
300.	.22	-168.1	3.54	16.3	.16	-89.9	.32	26.9
350.	.28	143.2	2.91	-21.6	.15	-117.2	.58	-32.9
400.	.27	101.4	2.11	-55.0	.12	-141.0	.78	-71.2

V_{CC} = +15 Vdc

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.5	12.4
150.	1.1	1.7	12.1
200.	1.2	1.7	12.2
250.	1.3	1.5	12.5
300.	1.4	1.6	12.6
350.	1.5	3.2	11.5

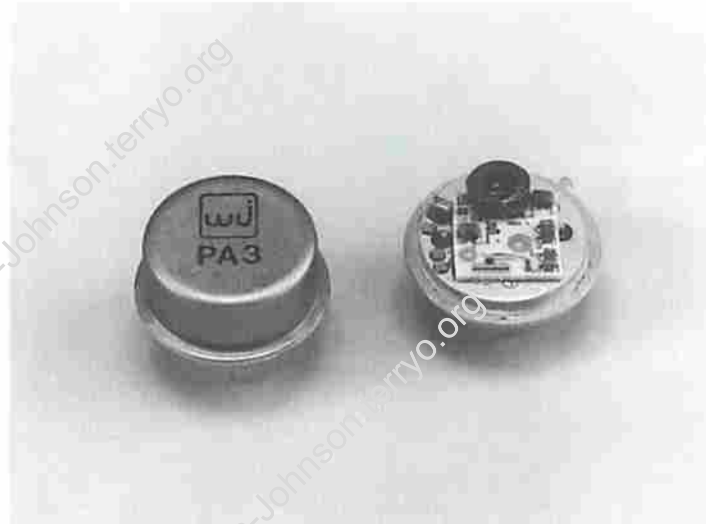
Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.04	68.5	4.16	135.2	.12	-24.5	.20	-145.0
150.	.07	18.3	4.05	112.3	.12	-36.9	.26	-162.3
200.	.08	-34.1	4.08	88.0	.13	-49.5	.25	172.5
250.	.11	-87.9	4.23	61.9	.13	-66.7	.19	124.8
300.	.15	-148.1	4.27	30.9	.14	-88.8	.24	29.7
350.	.21	150.9	3.77	-5.0	.14	-114.8	.52	-29.7
400.	.24	98.2	2.84	-40.1	.11	-138.8	.75	-68.4

WJ-PA3

5 TO 500 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT POWER: +24.5 dBm (TYP.), V_{CC} = +15 V
- HIGH THIRD ORDER INTERCEPT POINT: 34.0 dBm (TYP.)
- HIGH GAIN: 14.5 dB (TYP.)
- LOW VSWR: < 1.5:1 (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0° -50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	3-600 MHz	5-500 MHz	5-500 MHz
Small Signal Gain (Min.)	14.5 dB	13.5 dB	13.0 dB
Gain Flatness (Max.)	±0.4 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	7.5 dB	9.0 dB	9.5 dB
Power Output at 1 dB Compression (Min.)			
V_{CC} = +15 V	+24.5 dBm	+23.0 dBm[1]	+22.5 dBm[2]
V_{CC} = +12 V	+23.0 dBm	+20.0 dBm	+20.0 dBm
VSWR (Max.) Input/Output	< 1.5:1	2.0	2.0:1
DC Current (Max.)			
At 15 V	130 mA	134 mA	141 mA
At 12 V	98 mA	100 mA	105 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Notes:
1. +22.5 dBm: 400-500 MHz.
2. +22.0 dBm: 400-500 MHz.
3. 71°C max. case temperature at 15 Vdc, 100°C max. case temperature at 12 Vdc.

Absolute Maximum Ratings
(At 15 Vdc)

Storage Temperature . . . . -62°C to +125°C

Maximum Case Temperature[4] . . . . 71°C

Maximum DC Voltage . . . . +18 Volts

Maximum Continuous RF Input Power . . . . +17 dBm

Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts

Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)

"S" Series Burn-In Temperature (Case) . . . . 71°C

Proper heatsinking is required to insure reliable performance.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +50 dBm (Typ.)

Second Order Two Tone Intercept Point . . . . +40 dBm (Typ.)

Third Order Two Tone Intercept Point . . . . +34 dBm (Typ.)

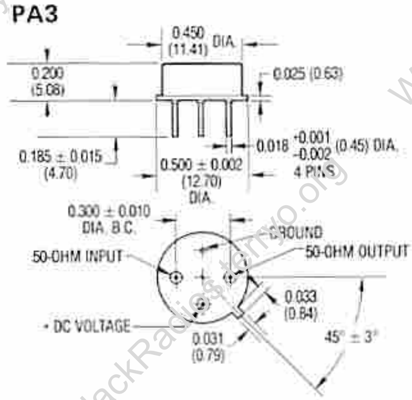
DC Volts . . . . +15 (Nom.)

Weight

approximately 2.0 grams (0.07 oz.)

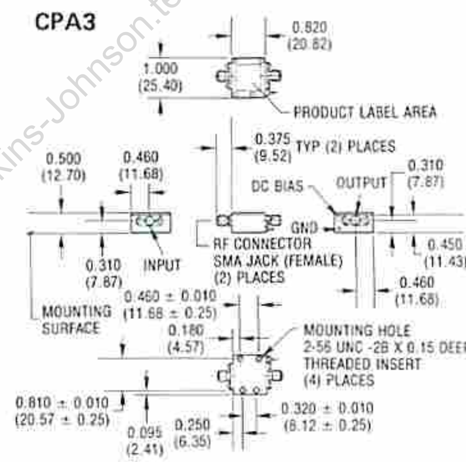
Outline Drawings

PA3



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CPA3

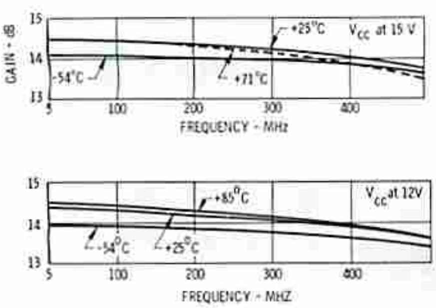


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

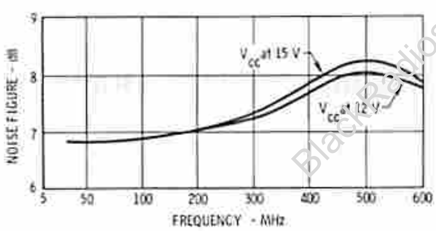
*WJ CPA3 is standard WJ PA3 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

Typical Performance at 25°C

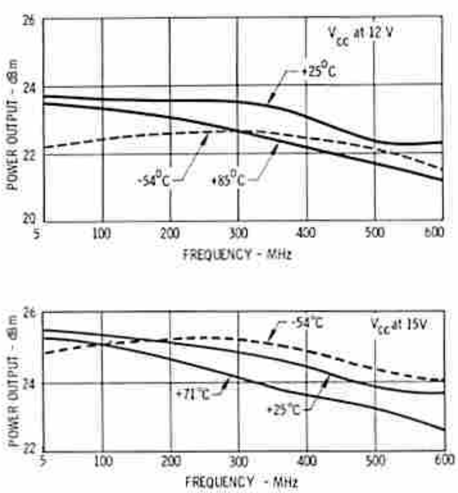
Gain



Noise Figure

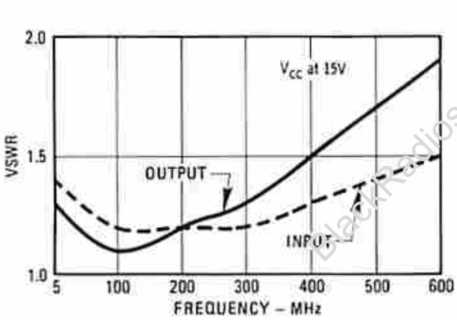


Power Output*

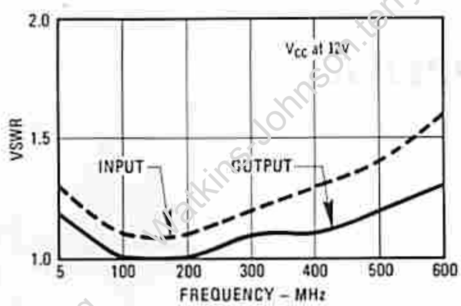


* at 1 dB Gain Compression

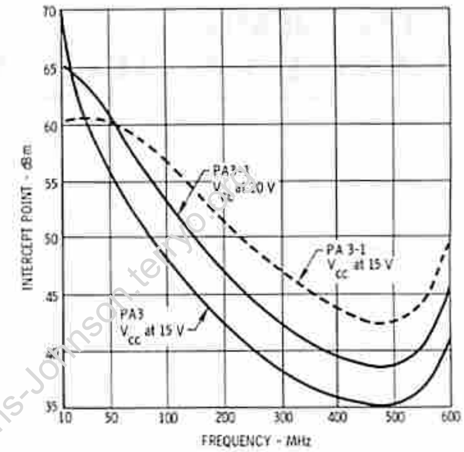
VSWR



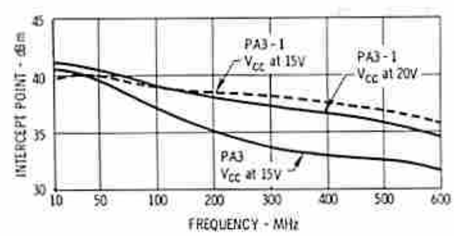
VSWR



Second Order Intercept Point



Third Order Intercept Point



1

Typical Automatic Test Data

V_{CC} = 12 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.0	14.1
200.	1.1	1.0	13.6
300.	1.2	1.1	13.0
400.	1.3	1.1	12.4
500.	1.4	1.2	11.9
600.	1.6	1.3	11.7

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.06	159.1	5.08	164.9	.11	6.1	.01	-42.3
200.	.07	101.2	4.80	150.5	.11	9.2	.02	-80.3
300.	.08	76.8	4.47	138.0	.11	12.0	.04	-101.6
400.	.11	42.0	4.18	127.7	.11	13.9	.06	-115.8
500.	.17	12.0	3.93	118.5	.10	15.3	.08	-122.7
600.	.24	-13.2	3.86	111.1	.08	17.9	.13	-123.9
700.	.32	-44.6	4.36	108.9	.02	50.0	.26	-123.1
800.	2.58	-99.6	20.56	97.7	1.26	147.3	6.02	-128.0

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.1	14.4
200.	1.2	1.2	14.3
300.	1.2	1.3	14.1
400.	1.3	1.5	13.9
500.	1.4	1.7	13.6
600.	1.5	1.9	13.4

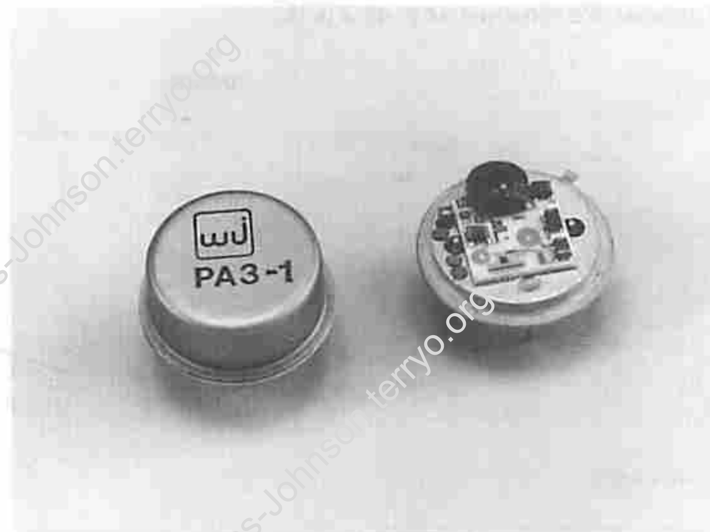
Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.08	[illegible]	5.28	167.1	.11	3.6	.05	-72.5
200.	.09	162.0	5.18	154.1	.11	4.2	.09	-109.1
300.	.10	145.5	5.05	141.2	.12	4.5	.14	-133.9
400.	.12	117.2	4.98	128.9	.12	3.8	.20	-155.6
500.	.15	86.2	4.81	115.7	.13	.1	.26	-177.8
600.	.22	57.8	4.67	100.2	.13	-4.4	.32	158.0
700.	.29	35.7	4.61	82.7	.14	-12.1	.39	129.9
800.	.44	14.3	4.38	64.5	.14	-23.4	.46	94.6

WJ-PA3-1

5 TO 500 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT POWER: +25.0 dBm (TYP.), V_{CC} = +20 V
- HIGH THIRD ORDER INTERCEPT POINT: 38.0 dBm (TYP.)
- HIGH GAIN: 14.5 dB (TYP.)



Specifications *

Characteristics	Typical	Guaranteed 0° – 50°C	Guaranteed -54°C – +85°C[1]
Frequency (Min.)	3-600 MHz	5-500 MHz	5-500 MHz
Small Signal Gain (Min.)	14.5 dB	13.5 dB	13.0 dB
Gain Flatness (Max.)	±0.3 dB	±0.5 dB	±0.7 dB
Noise Figure (Max.)	7.0 dB	8.5 dB	9.0 dB
Power Output at 1 dB Compression (Min.)			
V_{CC} = +15 V	+22.5 dBm	+20.0 dBm	+20.0 dBm
V_{CC} = +20 V	+25.0 dBm	+23.0 dBm	+22.5 dBm
VSWR (Max.) Input/Output	< 1.5:1	2.0:1	2.0:1
DC Current (Max.)			
At 15 V	91 mA	95 mA	100 mA
At 20 V	132 mA	136 mA	142 mA

*Measured in a 50-ohm system at 15 Vdc Nominal.

Notes:

1. +71°C max. case temperature at 20 Vdc.

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C

Maximum Case Temperature[1] (At 15 Vdc) . . . . 100°C

Maximum DC Voltage . . . . +22 Volts

Maximum Continuous RF Input Power . . . . 17 dBm

Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts

Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)

"S" Series Burn-In Temperature (Case) (At 15 Vdc) . . . . 100°C

Proper heatsinking is required to insure reliable performance.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +52 dBm (Typ.)

Second Order Two Tone Intercept Point . . . . +46 dBm (Typ.)

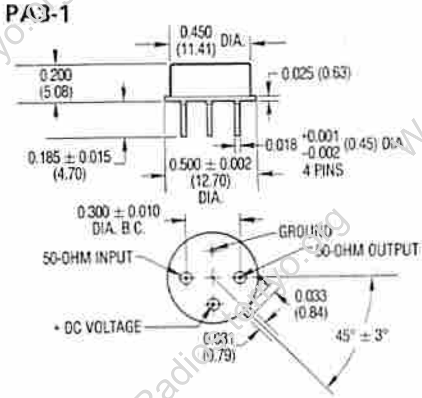
Third Order Two Tone Intercept Point . . . . +38 dBm (Typ.)

Weight

approximately 2.0 grams (0.07 oz.)

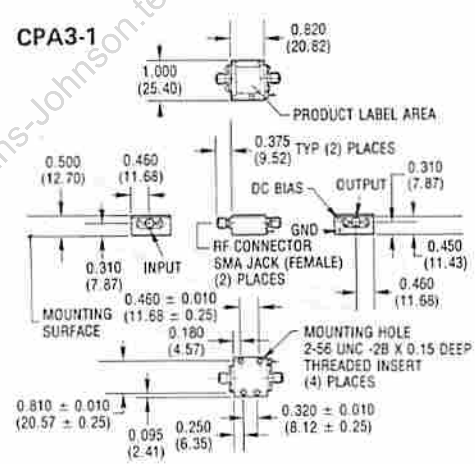
Outline Drawings

PA3-1



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

CPA3-1

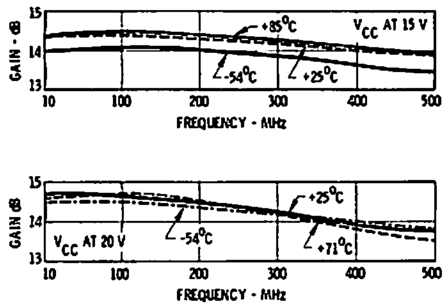


DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

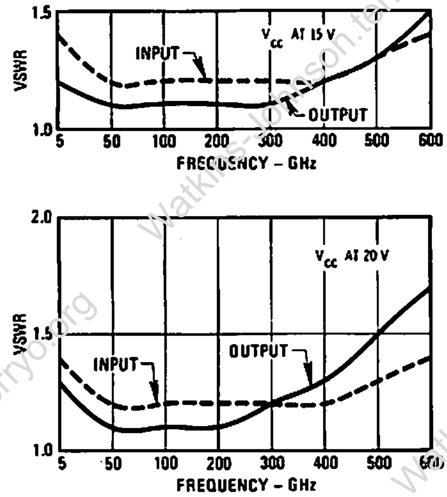
*WJ CPA3-1 is standard WJ-PA3-1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

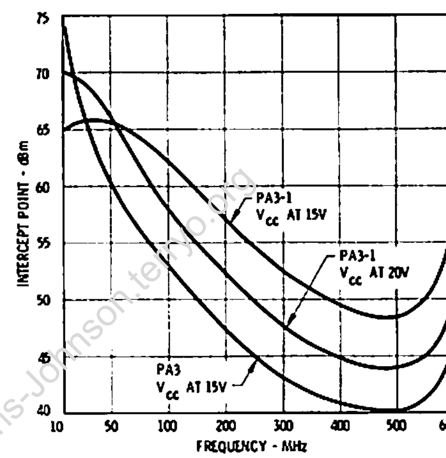
Gain



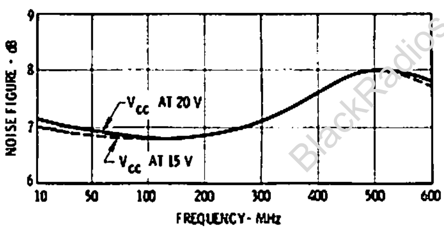
VSWR



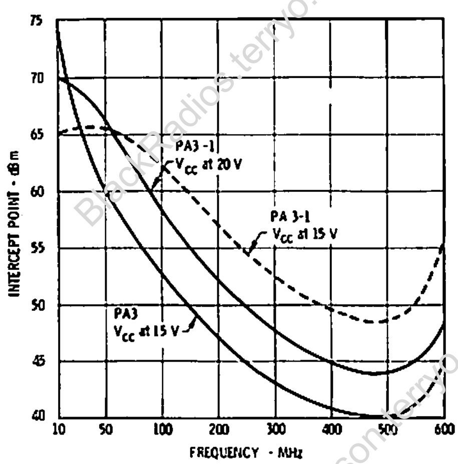
Second Order Two-Tone Intercept Point



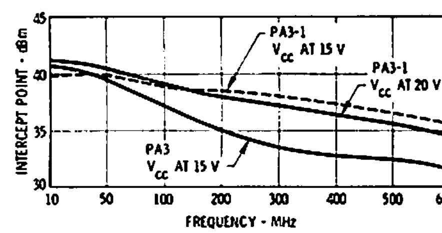
Noise Figure



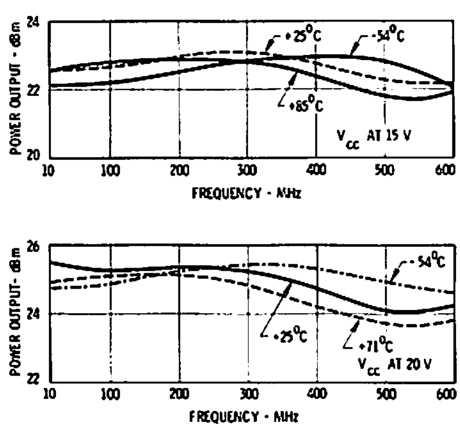
Second Harmonic Intercept Point



Third Order Two-Tone Intercept Point



Power Output*



*At 1 dB GAIN COMPRESSION

Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.1	14.5
200.	1.2	1.1	14.4
300.	1.2	1.1	14.2
400.	1.2	1.2	14.0
500.	1.3	1.3	13.8
600.	1.4	1.5	13.6

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.10	175.7	5.34	167.7	.11	2.3	.03	-177.4
200.	.10	156.9	5.25	154.6	.11	1.6	.04	-166.9
300.	.10	136.6	5.13	141.8	.11	.9	.07	[illegible]
400.	.11	107.1	5.00	129.2	.12	-1.0	.10	[illegible]
500.	.12	72.3	4.90	116.5	.12	-4.1	.15	161.6
600.	.16	42.9	4.79	101.9	.12	-8.5	.21	140.3
700.	.23	22.5	4.76	85.1	.12	-16.1	[illegible]	114.5
800.	.35	6.2	4.68	67.4	.13	-27.6	[illegible]	81.0

V_{CC} = 20 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.1	14.4
200.	1.2	1.1	14.2
300.	1.2	1.2	14.1
400.	1.2	1.3	14.0
500.	1.3	1.5	13.8
600.	1.4	1.7	13.6

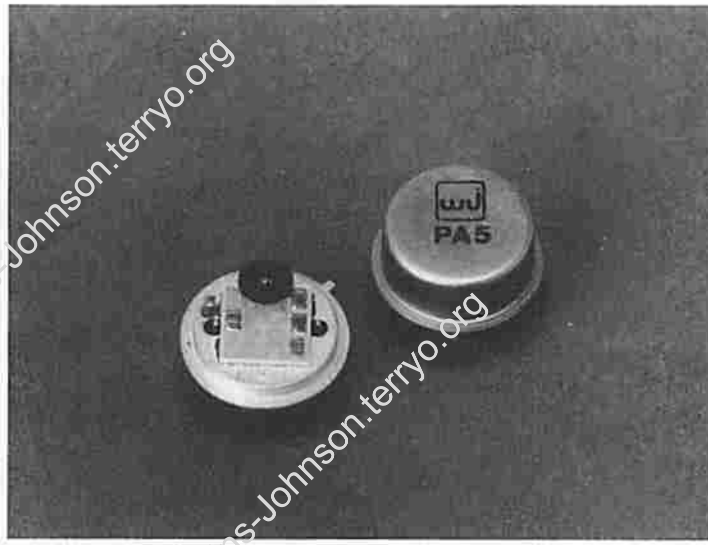
Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.11	171.5	5.23	167.8	.11	3.4	.02	-126.3
200.	.10	152.6	5.14	155.3	.11	2.9	.06	-133.1
300.	.10	122.0	5.04	143.0	.12	2.8	.09	-149.2
400.	.11	100.0	4.99	131.0	.12	1.3	.14	-166.1
500.	.12	69.2	4.87	118.3	.12	-1.2	.19	174.0
600.	.16	40.9	4.78	103.7	.13	-5.4	.26	151.4
700.	.22	22.2	4.80	86.7	.13	-12.7	.36	124.9
800.	.34	7.8	4.72	69.0	.14	-24.3	.47	91.4

WJ-PA5

10 TO 500 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH THIRD ORDER IM: ⩾+40 dBm (TYP; 10-100 MHz)
- HIGH OUTPUT POWER: +25 dBm (TYP; 10-500 MHz)
- LOW VSWR: <1.5:1 (TYP)
- OPERATION FROM +12 VDC TO +15 VDC FULLY CHARACTERIZED



Specifications*

Characteristics	Typical	Guaranteed 0° -50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	10-500 MHz	10-500 MHz	10-500 MHz
Small Signal Gain (Min.)	9.4 dB	8.5 dB	8.0 dB
Gain Flatness (Max.)	±0.2 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)			
10-70 MHz	8.5 dB	9.5 dB	10.0 dB
70-500 MHz	7.8 dB	8.8 dB	9.3 dB
Power Output at 1 dB Compression (Min.)	+25.0 dBm	+23.5 dBm	+23.5 dBm
VSWR (Max.) Input/Output	1.5:1	1.7:1	2.0:1
DC Current at +15 Volts (Max.)	130 mA	133 mA	136 mA

*Measured in a 50-ohm system at +15Vdc nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . . +60 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . . +54 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . . +35 dBm (Typ.)

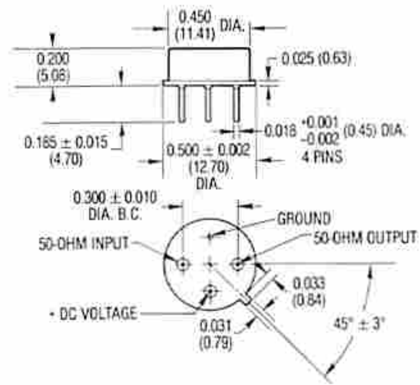
Absolute Maximum Ratings

Storage Temperature . . . . . -62°C to +125°C
Maximum Case Temperature . . . . . +71°C
Maximum DC Voltage . . . . . +22 Volts
Maximum Continuous RF Input Power . . . . . +20 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . . 200 Milliwatts
Maximum Peak Power . . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . . 71°C
Proper heatsinking required to insure reliable performance.

Weight approximately 2.0 grams (0.07 oz.)

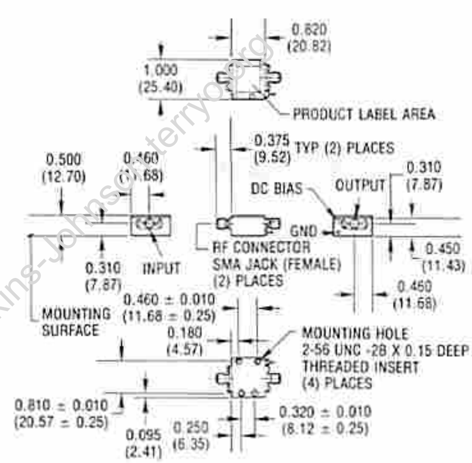
Outline Drawings

PA5



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CPA5

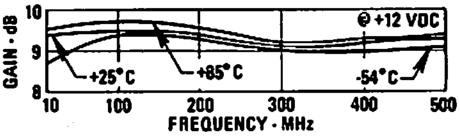


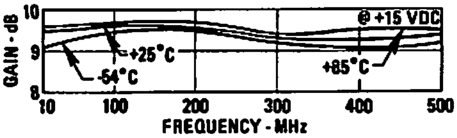
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

WJ-CPA5 is standard and WJ-PA5 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range See Cascaded Thin Film Amplifiers.

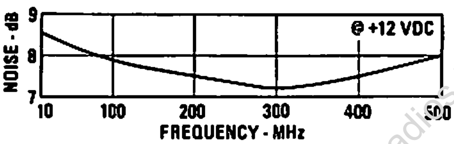
Typical Performance at 25°C

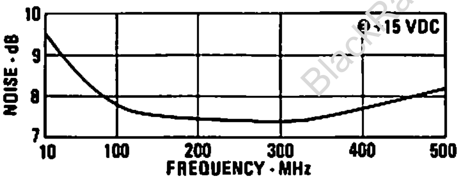
Gain



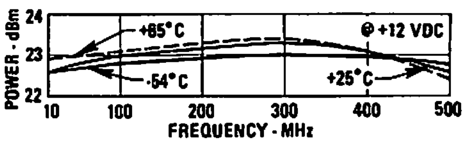


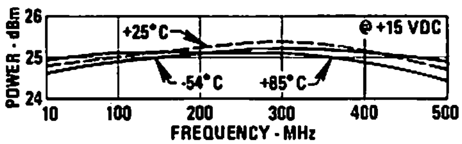
Noise Figure





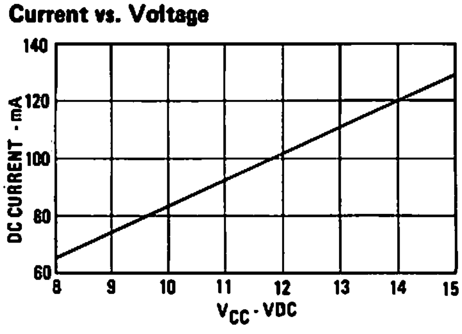
Power Output*



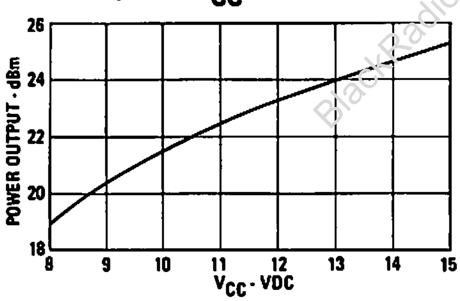


*at 1 dB Gain Compression

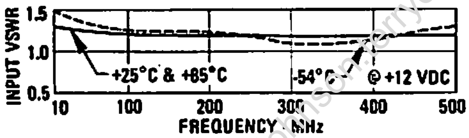
Current vs. Voltage

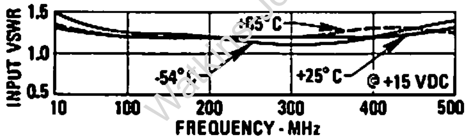


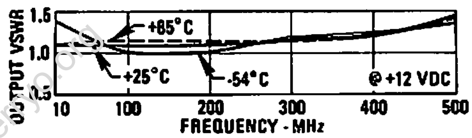
Power Output vs. V_{CC}

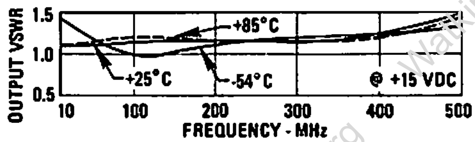


VSWR

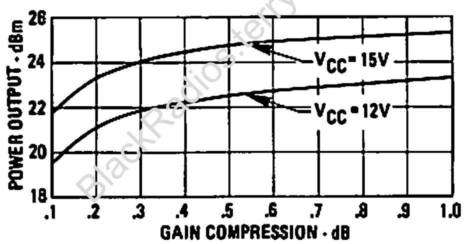




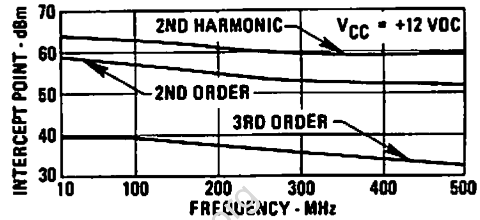


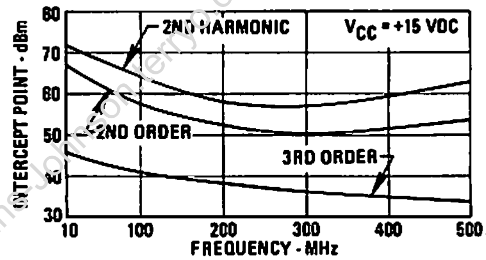


Power Output vs. Gain Compression

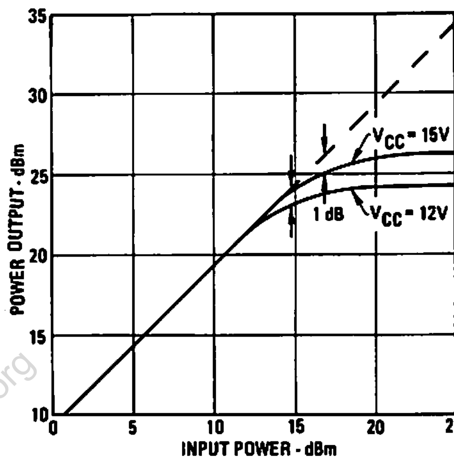


Intercept Point





Power Output vs. Power Input



1

Typical Automatic Test Data

V_{CC} = 12 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.1	9.5
200.	1.1	1.0	9.4
300.	1.1	1.1	9.2
400.	1.1	1.2	9.1
500.	1.1	1.4	9.1
600.	1.2	[illegible]	9.2

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.1	9.6
200.	1.1	1.1	9.5
300.	1.1	1.1	9.3
400.	1.1	1.2	9.3
500.	1.2	1.4	[illegible]
600.	1.3	1.7	9.5

Linear S-Parameters

V_{CC} = 12 V

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.09	169.9	2.98	157.1	.17	-11.0	.05	176.0
200.	.07	135.1	2.94	132.9	.16	-25.4	.01	134.2
300.	.03	95.2	2.87	108.7	.16	-39.1	.03	-43.7
400.	.03	-15.8	2.85	85.0	.16	-53.1	.09	-60.9
500.	.07	-67.7	2.84	61.3	.14	-67.6	.18	-74.3
600.	.09	-109.4	2.89	36.5	.12	-78.6	.25	-69.7
700.	.09	-175.0	2.94	9.6	.11	-80.3	.30	-116.3
800.	.16	93.1	2.82	-22.6	.13	-81.9	.32	-144.6

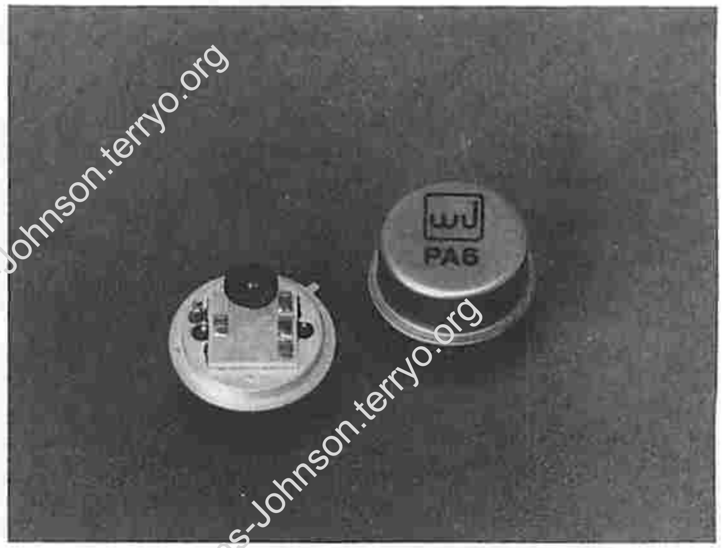
V_{CC} = 15V

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.08	163.8	[illegible]	157.8	.17	-11.9	.06	163.6
200.	.06	125.0	2.97	134.4	.16	-25.7	.03	110.7
300.	.04	65.6	2.90	110.7	.16	-40.6	.03	-.6
400.	.06	-15.2	2.90	87.7	.15	-55.0	.10	-44.3
500.	.10	[illegible]	2.91	64.4	.14	-70.5	.16	-62.3
600.	.14	-95.0	2.99	40.2	.12	-82.7	.27	-80.5
700.	.13	[illegible]	3.07	13.8	.10	-84.2	.33	-106.3
800.	.13	118.7	2.99	-18.2	.11	-79.9	.36	-134.7

WJ-PA6

10 TO 500 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH THIRD ORDER IM:
  ⩾ +40 dBm (TYP.; 10-300 MHz)
- HIGH OUTPUT POWER:
  +26.5 dBm (TYP.; 10-500 MHz)
- LOW VSWR: < 1.5:1 (TYP.)
- OPERATION FROM +15 VDC TO +20 VDC FULLY CHARACTERIZED



Specifications*

Characteristics	Typical	Guaranteed 0° -50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	10-500 MHz	10-500 MHz	10-500 MHz
Small Signal Gain (Min.)	9.5 dB	8.5 dB	8.0 dB
Gain Flatness (Max.)	±0.2 dB	±0.5 dB	±1.0 dB
Noise Figure (Max.)			
10-100 MHz	8.5 dB	9.5 dB	10.0 dB
100-500 MHz	7.8 dB	8.8 dB	9.3 dB
Power Output at 1 dB Compression (Min.)	+26.5 dBm	+25 dBm	+25 dBm
VSWR (Max.) Input/Output	1.5:1	1.7:1	2.0:1
DC Current at +20 Volts (Max.)	150 mA	154 mA	158 mA

*Measured in a 50-ohm system at +20 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +60 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +55 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +35 dBm (Typ.)

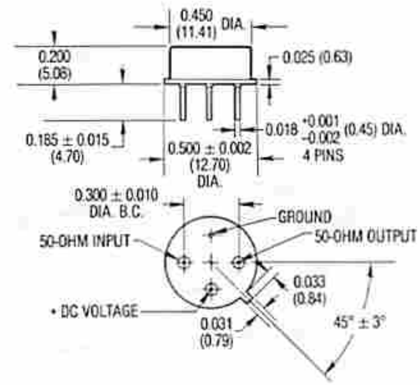
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature (At +20 Vdc) . . . . 71°C
Maximum DC Voltage . . . . +22 Volts
Maximum Continuous RF Input Power . . . . 20 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 200 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) (At +20 Vdc) . . . . 71°C
Proper heatsinking required to insure reliable performance.

Weight approximately 2.0 grams (0.07 oz.)

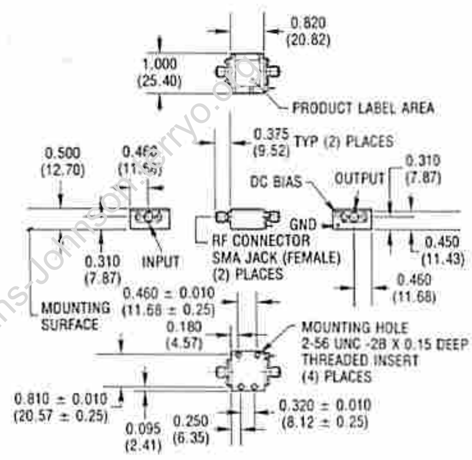
Outline Drawings

PA6



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CPA6

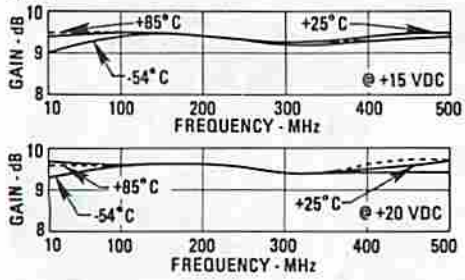


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

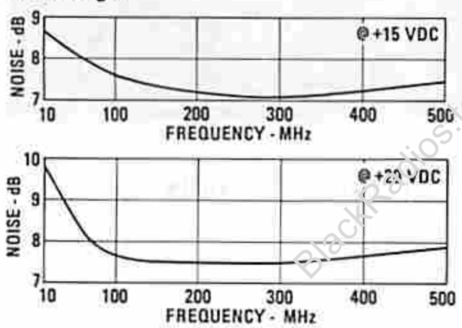
WJ-CPA6 is standard and WJ-PA6 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

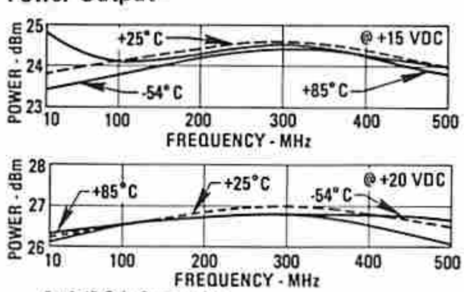
Gain



Noise Figure

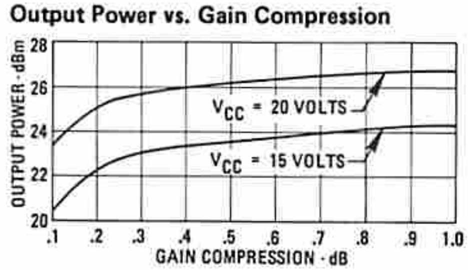


Power Output*

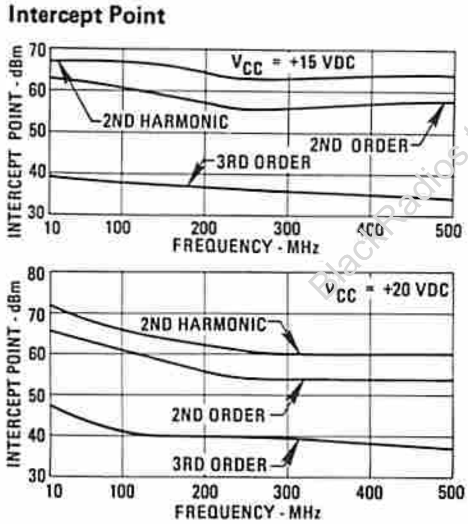


*at 1 dB Gain Compression

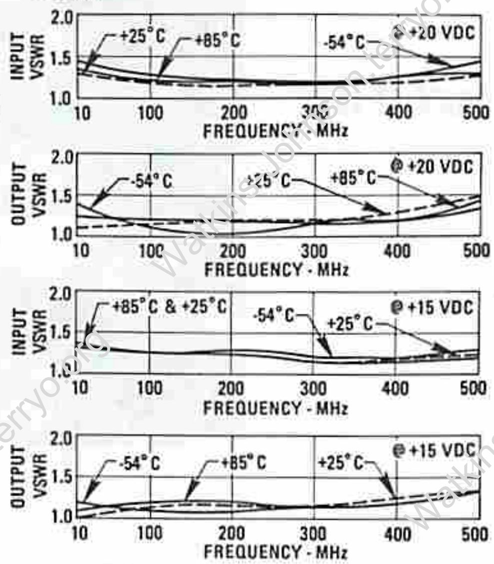
Output Power vs. Gain Compression



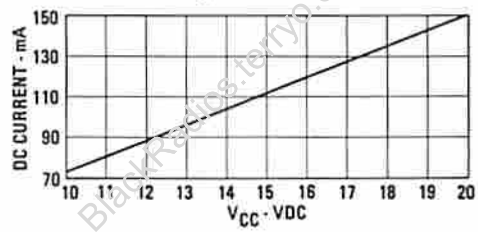
Intercept Point



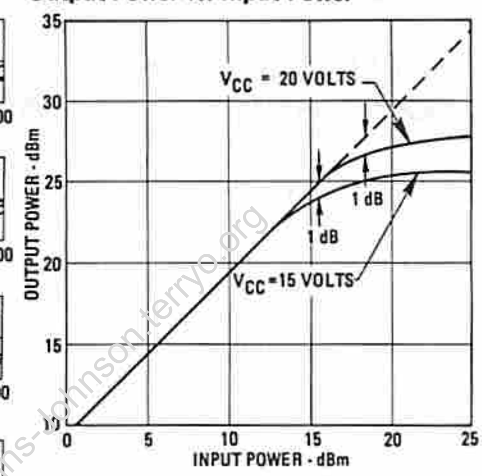
VSWR



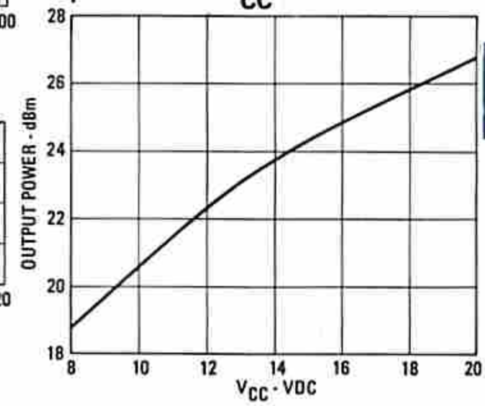
Current vs. Voltage



Output Power vs. Input Power



Output Power vs. V_{CC}



1

Typical Automatic Test Data

V_{CC} = 12 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.1	9.4
200.	1.1	1.0	9.3
300.	1.1	1.1	9.0
400.	1.1	1.2	9.0
500.	1.1	1.5	8.9
600.	1.2	1.7	[illegible]

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.1	9.5
200.	1.1	1.0	9.4
300.	1.1	1.1	9.2
400.	1.1	1.2	9.2
500.	1.2	1.5	9.2
600.	1.3	1.8	9.4

V_{CC} = 20 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.1	9.6
200.	1.1	1.1	9.5
300.	1.1	1.1	9.4
400.	1.2	1.3	9.4
500.	1.3	1.5	9.4
600.	1.4	1.9	9.3

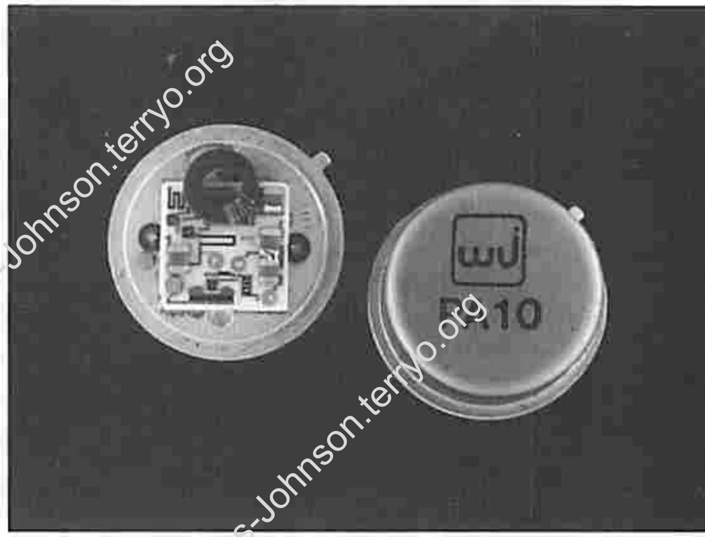
Linear S-Parameters (V_{CC} = 20 V)

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.08	160.0	3.02	158.5	.17	-13.2	.07	157.2
200.	.07	111.3	2.99	135.8	.17	-27.1	.04	107.7
300.	.05	46.9	2.94	112.9	.16	-42.4	.04	13.9
400.	.09	-14.3	2.94	90.3	.15	-58.6	.11	-34.2
500.	.14	-52.6	2.96	67.3	.14	-75.1	.21	-55.5
600.	.17	-88.2	3.05	43.3	.11	-90.2	.31	-74.5
700.	.16	-131.9	3.13	17.5	.09	-94.0	.39	-98.5
800.	.12	150.1	3.06	-14.4	.09	-81.6	.44	-125.5

WJ-PA10

10 TO 1000 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT POWER: +24.5 dBm (TYP.), V_{CC} = 20 V
- WIDE POWER SUPPLY RANGE: +12 TO +20 VOLTS
- WIDE BANDWIDTH: 10 TO 1000 MHz
- LOW VSWR: < 1.5:1 (TYP.)



Specifications *

Characteristics	Typical	Guaranteed 0° -50°C	Guaranteed -54°C - +85°C [1]
Frequency (Min.)	5-1100 MHz	10-1000 MHz	10-1000 MHz
Small Signal Gain (Min.)	10.0 dB	9.5 dB	9.0 dB[2]
Gain Flatness (Max.)	< ±0.2 dB	±0.5 dB	±0.7 dB
Noise Figure (Max.)	8.5 dB	9.5 dB	10.0 dB
Power Output at 1 dB Compression (Min.)			
V_{cc} = 15 V	+22.5 dBm	+20.0 dBm	+20.0 dBm
V_{cc} = 20 V	+24.5 dBm	+23.0 dBm	+23.0 dBm
VSWR (Max.) Input/Output	< 1.5:1	2.0:1	2.0:1
DC Current (Max.)			
At 15 V	95 mA	100 mA	105 mA
At 20 V	130 mA	132 mA	134 mA

*Measured in a 50-ohm system with V_{cc} = 15 Vdc Nominal.

Notes:

1. +71°C max. case temperature when V_{cc} = 20 Vdc.

Typical Intermodulation Performance at 25°C (Typ. @ +15 Vdc)

Second Order Harmonic Intercept Point . . . . > +50.0 dBm
Second Order Two Tone Intercept Point . . . . +45.0 dBm
Third Order Two Tone Intercept Point . . . . +36.0 dBm

Absolute Maximum Ratings

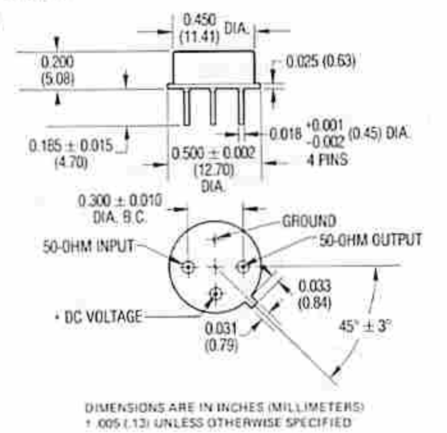
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature (At 15 Vdc) . . . . 100°C
Maximum DC Voltage . . . . +22 Volts
Maximum Continuous RF Input Power . . . . 17 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . . . 100 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 µsec Max.)
"S" Series Burn-In Temperature (Case) (At 15 Vdc) . . . . 100°C

Proper heatsinking required to insure reliable performance.

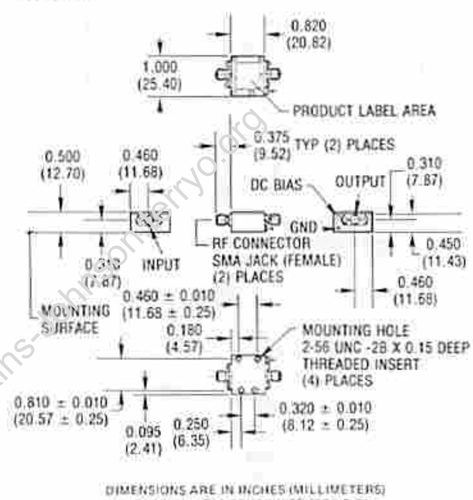
Weight approximately 2.0 grams (0.07 oz.)

Outline Drawings

PA10



CPA10

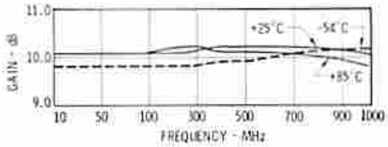


WJ-CPA10 is standard WJ-PA10 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

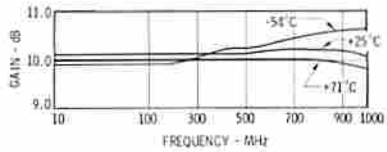
Typical Performance at 25°C

Gain

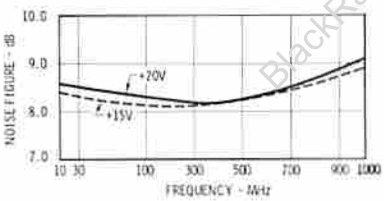
15 V



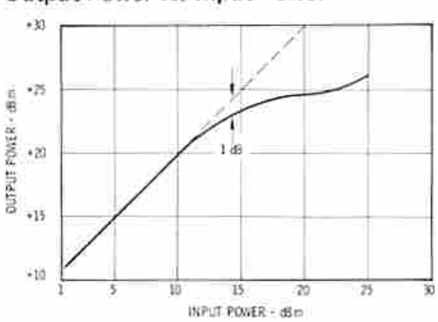
20 V



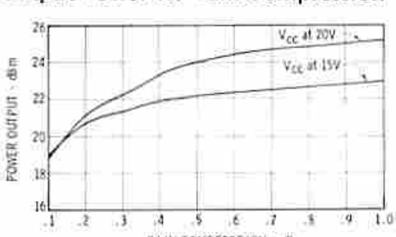
Noise Figure



Output Power vs. Input Power

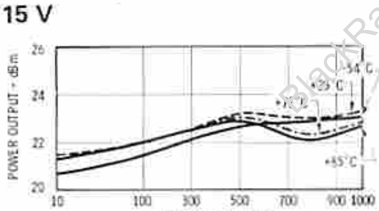


Output Power vs. Gain Compression



Power Output*

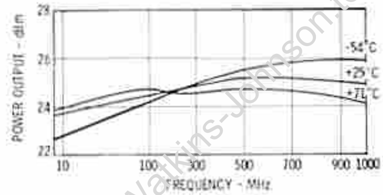
15 V



*at 1 dB Gain Compression

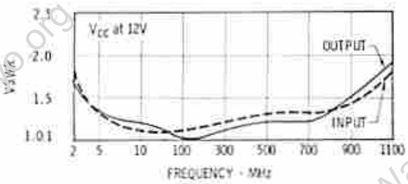
Power Output*

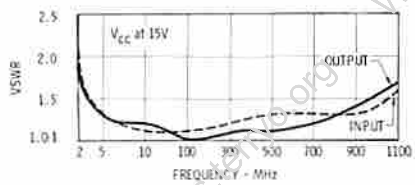
20 V

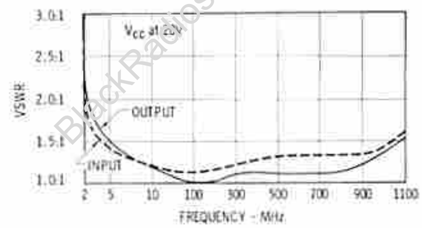


*at 1 dB Gain Compression

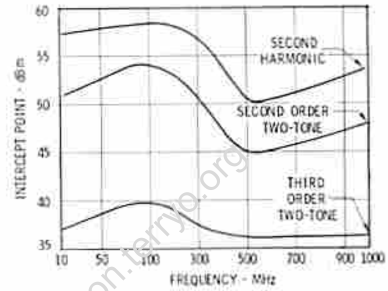
VSWR

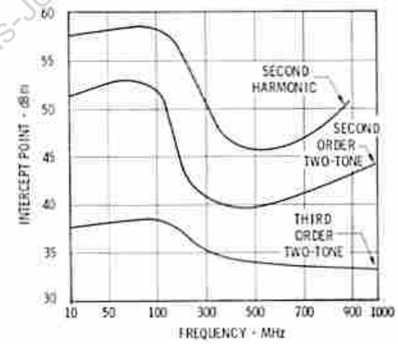






Intercept Point





Typical Automatic Test Data

V_{CC} = 12 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.0	10.0
200.	1.2	1.1	9.9
300.	1.2	1.1	[illegible]
400.	1.2	1.2	[illegible]
500.	1.3	1.2	[illegible]
600.	1.3	[illegible]	[illegible]
700.	1.3	[illegible]	9.9
800.	1.3	[illegible]	9.9
900.	1.4	[illegible]	9.9
1000.	1.5	1.7	9.8
1100.	1.8	1.9	9.6

Linear S-Parameters

FREQ MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.06	-157.2	3.16	159.4	.15	-6.2	.02	-40.4
200.	.07	-146.6	3.13	143.6	.15	-10.8	.04	-55.1
300.	.09	-136.1	3.13	128.4	.15	[illegible]	.05	-69.9
400.	.10	-139.0	3.13	113.1	.16	[illegible]	.07	-82.7
500.	.12	-143.6	3.14	97.4	.16	-24.5	.08	-90.6
600.	.13	-157.5	3.12	80.5	.17	-32.0	.09	-119.5
700.	.14	-176.9	3.12	62.9	.18	-38.5	.11	-147.1
800.	.14	155.6	3.12	43.9	.18	-46.6	.13	-179.7
900.	.16	118.1	3.13	24.6	.19	-56.0	.20	153.7
1000.	.20	81.1	3.10	4.5	.20	-67.5	.25	130.1
1100.	.27	52.6	3.03	-16.7	.21	-80.6	.31	109.1
1200.	.36	25.6	2.91	-38.2	.21	-94.0	.35	87.5

1

Typical Automatic Test Data (continued)

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.0	10.1
200.	1.1	1.0	10.0
300.	1.2	1.1	10.1
400.	1.2	1.1	10.1
500.	1.3	1.1	10.1
600.	1.3	1.2	10.0
700.	1.3	1.2	10.0
800.	1.3	1.2	10.0
900.	1.3	1.4	10.0
1000.	1.4	1.6	10.0
1100.	1.6	1.7	9.9

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.05	−154.9	3.18	159.9	.15	−6.3	.01	−3.5
200.	.06	−143.1	3.17	144.3	.15	−10.4	.02	−56.5
300.	.08	−134.6	3.19	128.7	.15	−15.3	.04	−59.1
400.	.10	−134.9	3.18	113.5	.15	−20.4	.06	−67.2
500.	.11	−139.7	3.18	98.0	.16	−26.5	.07	−80.7
600.	.13	−151.5	3.17	81.6	.16	−33.2	.08	−102.7
700.	.13	−170.2	3.16	64.1	.17	−48.0	.08	−135.2
800.	.12	164.3	3.17	45.6	.18	−47.6	.11	−170.2
900.	.13	124.4	3.18	26.6	.18	−56.7	.16	157.8
1000.	.18	85.0	3.17	6.8	.19	−67.5	.22	133.9
1100.	.24	55.0	3.13	−14.0	.20	−80.1	.27	113.2
1200.	.33	28.9	3.04	−35.7	.21	−93.0	.31	91.3

V_{CC} = 20 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.0	10.2
200.	1.1	1.0	10.3
300.	1.2	1.1	10.2
400.	1.2	1.1	10.2
500.	1.3	1.1	10.2
600.	1.3	1.1	10.1
700.	1.3	1.1	10.0
800.	1.3	1.1	10.0
900.	1.3	1.2	10.0
1000.	1.4	1.4	10.0
1100.	1.6	1.5	9.9

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.05	−145.5	3.25	160.8	.15	−6.5	.02	118.9
200.	.06	−137.7	3.26	143.9	.15	−11.4	.00	32.5
300.	.09	−131.9	3.25	120.2	.15	−16.5	.02	−24.3
400.	.10	−133.8	3.23	112.9	.15	−22.0	.04	−39.0
500.	.12	−139.8	3.22	97.3	.16	−28.3	.06	−51.8
600.	.13	−152.1	3.19	80.7	.16	−35.2	.06	−75.7
700.	.13	−170.9	3.18	63.4	.16	−41.0	.06	−106.4
800.	.12	163.6	3.17	45.8	.17	−49.4	.06	−154.2
900.	.13	123.4	3.18	26.2	.17	−58.2	.10	162.9
1000.	.17	84.3	3.17	6.6	.18	−68.5	.16	136.0
1100.	.24	54.8	3.13	−13.9	.19	−80.4	.20	116.7
1200.	.32	20.3	3.05	−35.5	.19	−92.5	.24	94.0

WJ-PA10-1

10 TO 1000 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT POWER: +22 dBm (TYP.)
- WIDE BANDWIDTH: 10-1000 MHz
- LOW VSWR: 1.6:1 (TYP.)
- V_{CC} = +12 VOLTS

Specifications*

Characteristics	Typical	Guaranteed 0° -50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	5-1100 MHz	10-1000 MHz	10-1000 MHz
Small Signal Gain (Min.)	10.0 dB	9.5 dB	9.0 dB
Gain Flatness (Max.)	< ±0.2 dB	±0.5 dB	±0.7 dB
Noise Figure (Max.)	8.5 dB	9.5 dB	10.0 dB
Power Output at 1 dB Compression (Min.)	+22.0 dBm	+21.0 dBm	+20.0 dBm
VSWR (Max.) Input/Output	1.6:1	2.0:1	2.0:1
DC Current (Max.) at 12 Volts	98 mA	101 mA	105 mA

* Measured on a 50 ohm system at +12 Vdc nominal. The WJ-PA10-1 is similar to the WJ-PA10 except its DC bias has been designed for +12 volt operation to yield +20 dBm minimum output power opposed to +15 volts required on the WJ-PA10.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +44 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +38 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +35 dBm (Typ.)

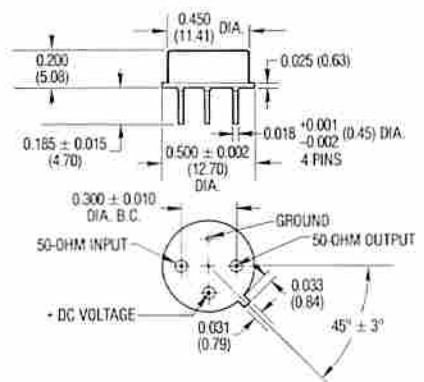
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 100°C
Maximum DC Voltage . . . . +16 Volts
Maximum Continuous RF Input Power . . . . +17 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 100°C
Proper heatsinking required to insure reliable performance.

Weight approximately 2.0 grams (0.07 oz.)

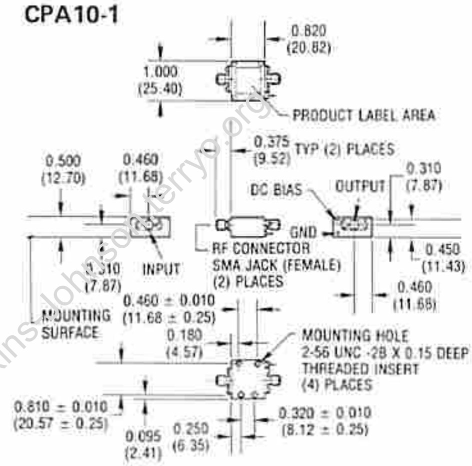
Outline Drawings

PA10-1



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CPA10-1

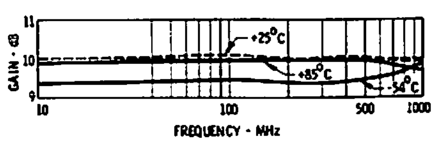


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

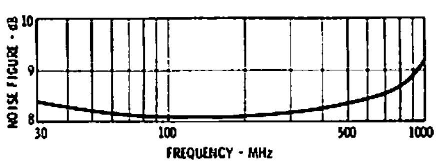
WJ CPA10-1 is standard WJ PA10-1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

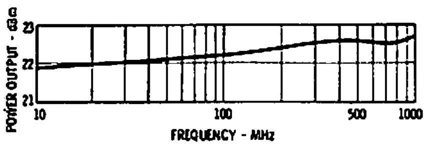
Gain



Noise Figure

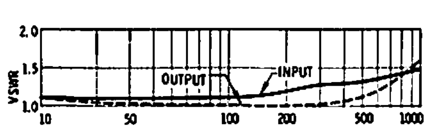


Power Output*

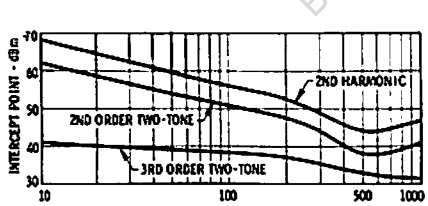


*at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{CC} = 12 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.0	10.1
200.	1.2	1.0	10.0
300.	1.2	[illegible]	10.0
400.	1.3	[illegible]	10.1
500.	1.3	1.1	10.0
600.	1.3	1.2	10.0
700.	1.4	1.3	10.0
800.	1.4	1.3	9.9
900.	1.4	1.5	9.9
1000.	1.5	1.6	10.0
1100.	1.7	1.9	9.9

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.07	-156.6	3.10	173.3	.16	6.1	.00	129.7
200.	.08	-153.5	3.17	165.4	.16	10.2	.01	-106.7
300.	.10	-154.5	3.17	157.6	.16	14.3	.02	-104.9
400.	.12	-158.9	3.19	150.2	.16	18.1	.04	-113.7
500.	.13	-164.0	3.16	142.2	.17	21.6	.06	-126.2
600.	.14	-174.8	3.15	134.0	.17	23.9	.08	-142.6
700.	.16	171.2	3.16	125.6	.18	25.0	.11	-160.6
800.	.17	153.6	3.11	116.7	.19	27.3	.15	-177.1
900.	.18	127.4	3.10	107.2	.19	28.1	.19	163.4
1000.	.21	93.6	3.15	96.5	.21	27.1	.24	141.0
1100.	.27	57.7	3.12	85.3	.22	23.9	.30	115.8
1200.	.30	21.6	2.97	73.1	.23	10.1	.36	88.0

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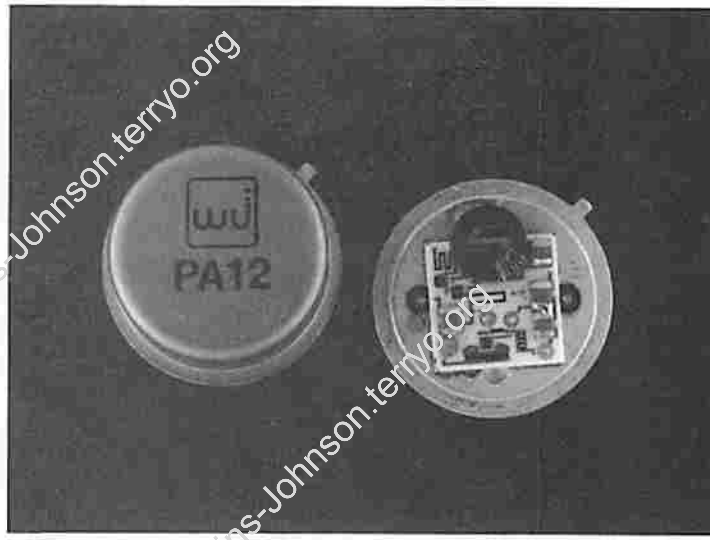
WJ-PA12

10 TO 1200 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT POWER: +24.5 dBm (TYP.), V_{CC} = 20 V
- WIDE POWER SUPPLY RANGE: +12 TO +20 VOLTS
- WIDE BANDWIDTH: 10 TO 1200 MHz
- LOW VSWR: < 1.5:1 (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0° -50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	5-1300 MHz	10-1200 MHz	10-1200 MHz
Small Signal Gain (Min.)	9.5 dB	9.0 dB	8.5 dB[2]
Gain Flatness (Max.)	< ±0.2 dB	±0.5 dB	±0.7 dB
Noise Figure (Max.)	8.5 dB	9.5 dB	10.0 dB
Power Output at 1 dB Compression (Min.)			
V_{cc} = 15 V	+22.5 dBm	+20.0 dBm	+19.5 dBm
V_{cc} = 20 V	+24.5 dBm	+23.0 dBm	+22.5 dBm
VSWR (Max.) Input/Output	< 1.5:1	2.0:1	2.0:1
DC Current (Max.)			
At 15 V	95 mA	100 mA	105 mA
At 20 V	130 mA	132 mA	134 mA

*Measured in a 50-ohm system with V_{cc} = 15 V Nominal.

Typical Intermodulation Performance at 25°C (Typ. @ +15 Vdc)

Second Order Harmonic Intercept Point . . . . > +45 dBm
Second Order Two Tone Intercept Point . . . . +45.0 dBm
Third Order Two Tone Intercept Point . . . . +35.0 dBm

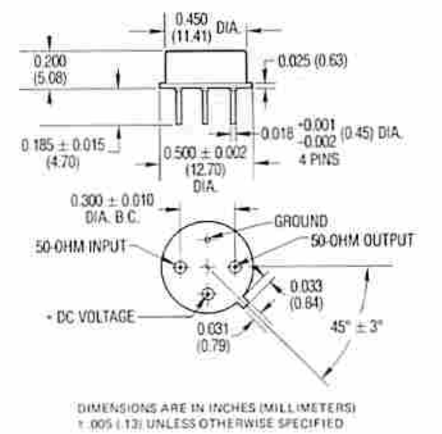
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 85°C
Maximum DC Voltage . . . . +22 Volts
Maximum Continuous RF Input Power . . . . +17 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) (At 15 Vdc) . . . . 85°C
Proper heatsinking required to insure reliable performance.

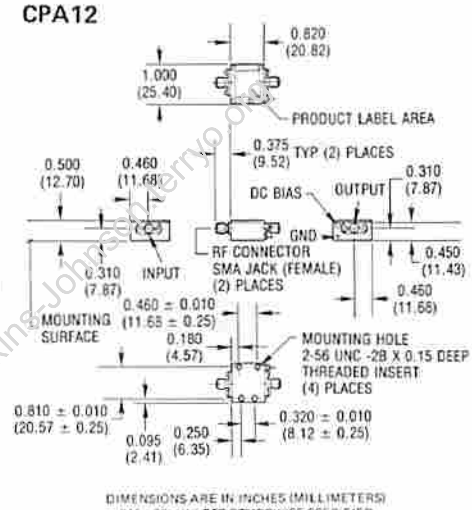
Weight approximately 2.0 grams (0.07 oz.)

Outline Drawings

PA12



CPA12

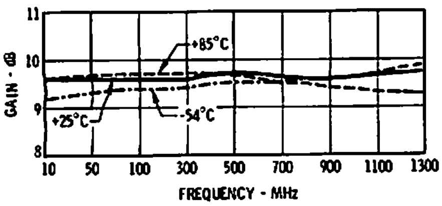


WJ CPA12 is standard WJ PA12 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers

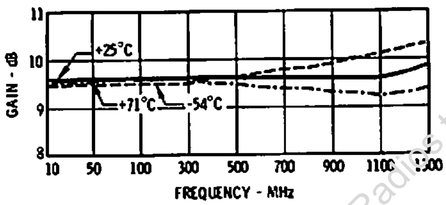
Typical Performance at 25°C

Gain

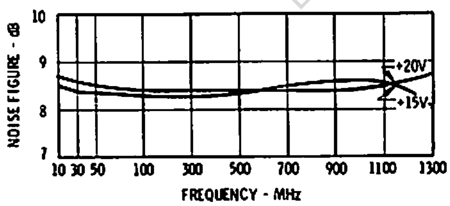
15 V



20 V

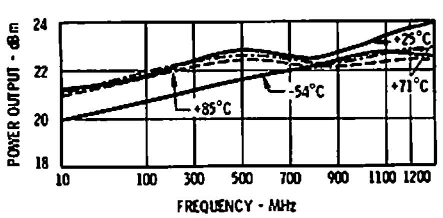


Noise Figure

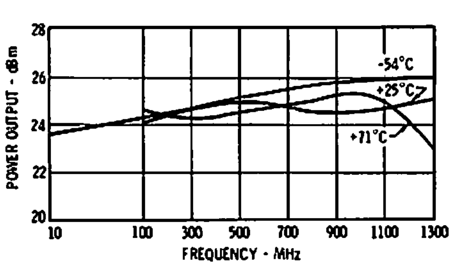


Power Output*

15 V

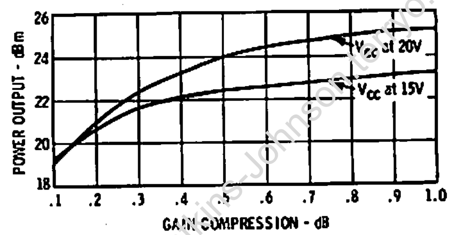


20 V

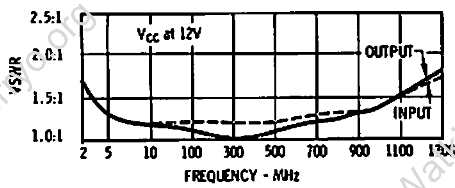


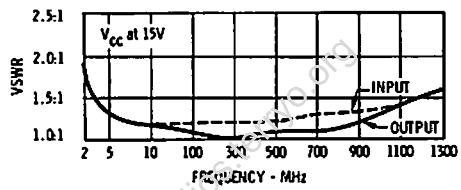
*at 1 dB Gain Compression

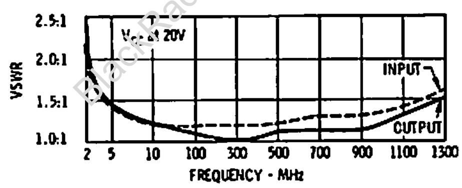
Output Power vs. Gain Compression



VSWR

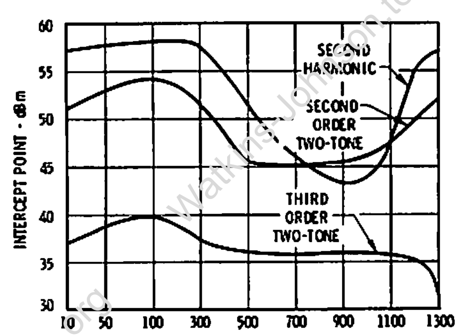




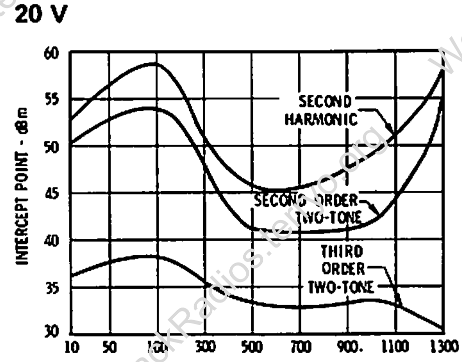


Intercept Point

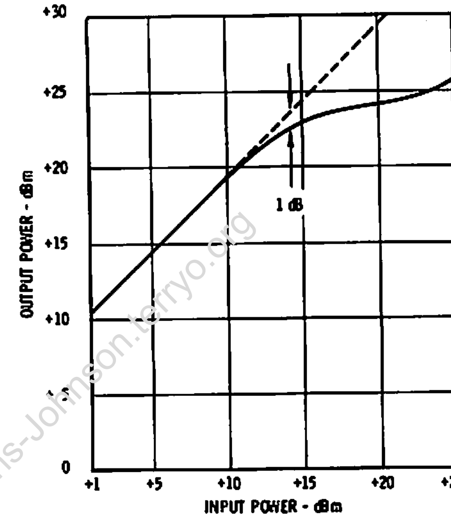
15 V



20 V



Output Power vs. Input Power



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Typical Automatic Test Data

V_{CC} = 12 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.1	9.3
200.	1.2	1.0	9.2
300.	1.2	1.0	9.2
400.	1.2	1.1	9.2
500.	1.2	1.1	9.2
600.	1.3	1.1	9.2
700.	1.3	1.2	9.1
800.	1.3	1.2	9.1
900.	1.3	1.3	9.1
1000.	1.4	1.4	9.1
1100.	1.5	1.5	9.1
1200.	1.6	1.6	9.0
1300.	1.7	1.8	8.9

Linear S-Parameters

FREQ MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.08	-164.4	2.92	162.3	.17	-4.7	.03	174.3
200.	.09	-153.3	2.89	148.4	.17	-6.9	.02	-172.5
300.	.09	-143.5	2.90	135.1	.17	-9.9	.02	-136.7
400.	.10	-138.5	2.89	122.1	.17	-13.6	.04	-105.0
500.	.11	-137.7	2.88	108.6	.17	-17.0	.05	-95.1
600.	.12	-142.1	2.87	94.7	.18	-22.4	.07	-100.1
700.	.13	-153.5	2.84	79.5	.18	-27.0	.08	-127.3
800.	.13	-169.9	2.84	63.9	.19	-32.2	.10	-140.3
900.	.14	167.7	2.85	48.2	.19	-38.1	.13	-170.3
1000.	.16	143.1	2.86	32.3	.20	-44.9	.16	169.5
1100.	.19	119.9	2.85	15.9	.21	-53.2	.20	153.3
1200.	.22	95.1	2.82	-1.9	.22	-62.0	.24	138.3
1300.	.26	68.6	2.79	-20.3	.23	-72.5	.28	122.1
1400.	.32	40.0	2.70	[illegible]	.23	-85.0	.29	103.0
1500.	.40	8.7	2.50	-59.4	.23	-98.6	.28	83.7

V_{CC} = 20 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.1	9.5
200.	1.2	1.1	9.4
300.	1.2	1.0	9.5
400.	1.2	1.0	9.5
500.	1.2	1.1	9.4
600.	1.3	1.1	9.3
700.	1.3	1.1	9.2
800.	1.3	1.1	9.2
900.	1.3	1.1	9.2
1000.	1.3	1.2	9.3
1100.	1.4	1.3	9.3
1200.	1.5	1.4	9.3
1300.	1.6	1.5	9.3

Linear S-Parameters

FREQ MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.08	-161.5	2.98	162.7	.17	-5.3	.06	153.2
200.	.08	-151.3	2.97	148.7	.17	-8.2	.04	137.0
300.	.09	-141.8	2.98	135.3	.17	-11.9	.02	118.1
400.	.09	-135.7	2.98	121.8	.17	-16.2	.02	19.4
500.	.10	-134.9	2.94	108.1	.17	-20.9	.04	-20.3
600.	.11	-137.8	2.92	94.7	.17	-25.8	.05	-42.8
700.	.12	-148.0	2.89	80.0	.17	-30.6	.05	-63.0
800.	.12	-162.8	2.89	64.7	.17	-35.9	.06	-90.9
900.	.13	175.2	2.89	49.5	.18	-41.3	.06	-125.6
1000.	.14	150.6	2.91	34.0	.18	-47.4	.08	-157.4
1100.	.16	126.8	2.91	18.1	.19	-54.6	.11	179.1
1200.	.19	102.2	2.91	.6	.19	-62.0	.15	162.4
1300.	.23	75.4	2.91	-17.5	.20	-71.0	.18	145.9
1400.	.28	46.2	2.86	-36.4	.21	-81.8	.21	126.9
1500.	.37	14.4	2.70	-56.6	.20	-94.5	.21	107.4

V_{CC} = 15 V

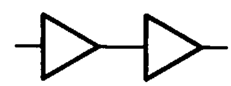
FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.1	9.4
200.	1.2	1.1	9.3
300.	1.2	1.0	9.3
400.	1.2	1.0	9.4
500.	1.2	1.1	9.3
600.	1.2	1.1	9.3
700.	1.3	1.1	9.2
800.	1.3	1.2	9.2
900.	1.3	1.2	9.2
1000.	1.3	1.3	9.3
1100.	1.4	1.4	9.3
1200.	1.5	1.5	9.3
1300.	1.6	1.6	9.3

Linear S-Parameters

FREQ MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.08	-165.2	2.95	162.6	.17	-4.0	.04	163.7
200.	.08	-154.4	2.90	149.0	.17	-7.5	.03	162.0
300.	.08	-143.5	2.93	135.8	.17	-10.6	.01	-171.2
400.	.09	-136.9	2.94	122.7	.17	-14.5	.02	-88.9
500.	.10	-134.5	2.92	109.3	.17	-18.8	.04	-72.9
600.	.11	-136.0	2.91	95.6	.17	-23.6	.05	-87.0
700.	.12	-147.1	2.89	81.0	.18	-28.3	.06	-108.0
800.	.12	-162.2	2.89	65.7	.18	-33.5	.07	-132.5
900.	.13	176.4	2.90	50.2	.19	-39.1	.10	-158.6
1000.	.14	151.9	2.92	34.7	.19	-45.6	.12	178.6
1100.	.17	128.4	2.92	18.6	.20	-53.4	.16	161.3
1200.	.20	103.2	2.92	1.0	.21	-61.4	.21	146.9
1300.	.24	76.2	2.91	-17.2	.22	-71.3	.24	130.7
1400.	.29	46.7	2.85	-36.4	.23	-83.3	.26	112.3
1500.	.30	14.0	2.60	-56.6	.22	-96.6	.26	90.0

TYPICAL CASCADED V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.1	19.2
200.	1.1	1.1	19.0
300.	1.2	1.1	18.9
400.	1.3	1.2	18.8
500.	1.4	1.4	18.6
600.	1.6	1.5	18.6
700.	1.7	1.7	18.5
800.	1.8	1.9	18.6
900.	1.7	1.9	18.8
1000.	1.5	1.8	19.1
1100.	1.2	1.5	19.3
1200.	1.1	1.3	19.3
1300.	1.3	1.3	19.5
1400.	2.5	1.8	20.1



Linear S-Parameters

FREQ MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.04	-155.3	9.07	-25.5	.03	-.7	.04	-.6
200.	.04	-104.3	8.90	-47.6	.02	-.2	.04	-9.5
300.	.07	-65.6	8.82	-69.4	.02	.7	.06	-5.7
400.	.12	-51.8	8.75	-91.2	.03	-1.4	.10	.2
500.	.17	-47.3	8.56	-112.9	.03	-3.0	.15	-.7
600.	.23	-48.4	8.40	-135.2	.03	-5.0	.21	-7.5
700.	.26	-51.2	8.43	-156.2	.03	-7.8	.26	-14.7
800.	.28	-56.6	8.58	-177.2	.03	-10.3	.30	-24.8
900.	.25	-65.3	8.72	160.4	.03	-14.9	.31	-38.4
1000.	.19	-75.2	8.99	134.5	.04	-21.6	.28	-54.4
1100.	.10	-83.7	9.17	106.4	.04	-31.1	.21	-71.2
1200.	.06	-63.9	9.25	77.6	.05	-43.6	.12	-78.5
1300.	.13	-83.9	9.47	46.0	.05	-58.3	.12	-57.6
1400.	.43	-133.9	10.07	6.4	.06	-83.0	.20	-76.8
1500.	.07	171.1	7.81	-47.0	.05	-123.2	.49	-130.4

WJ-PA12-1

10 TO 1200 MHz TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT POWER: +22 dBm (TYP.) AT 12 VOLTS V_{CC}
- WIDE BANDWIDTH: 10-1200 MHz
- LOW VSWR: < 1.5:1 (TYP.)
- V_{CC} = 12 VOLTS

Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	5-1300 MHz	10-1200 MHz	10-1200 MHz
Small Signal Gain (Min.)	9.0 dB	8.5 dB	8.0 dB
Gain Flatness (Max.)	±0.2 dB	±0.5 dB	±0.7 dB
Noise Figure (Max.)	8.5 dB	9.5 dB	10.0 dB
Power Output at 1 dB Compression (Min.)	+22.0 dBm	+20.0 dBm	+19.5 dBm
VSWR (Max.) Input/Output	1.5:1	2.0:1	2.0:1
DC Current (Max.) at 12 Volts	97 mA	101 mA	106 mA

*Measured in a 50-ohm system at 12 Vdc Nominal.

Notes:

1. The WJ-PA12-1 is similar to the WJ-PA12 except its DC bias has been designed for +12 volt operation to yield +20 dBm minimum output power as opposed to +15 Volts required on the WJ-PA12.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +45 dBm (Typ.)
Second Order Two-Tone Intercept Point . . . . +39 dBm (Typ.)
Third Order Two-Tone Intercept Point . . . . +32 dBm (Typ.)

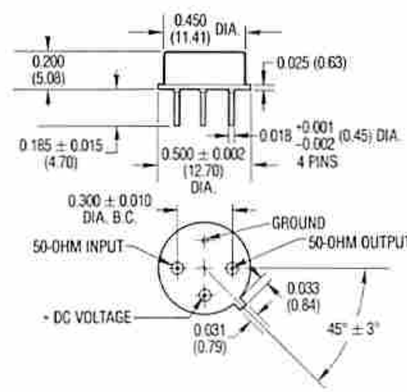
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . +100°C
Maximum DC Voltage . . . . +16 Volts
Maximum Continuous RF Input Power . . . . +17 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 100°C

Weight approximately 2.0 grams (0.07 oz.)

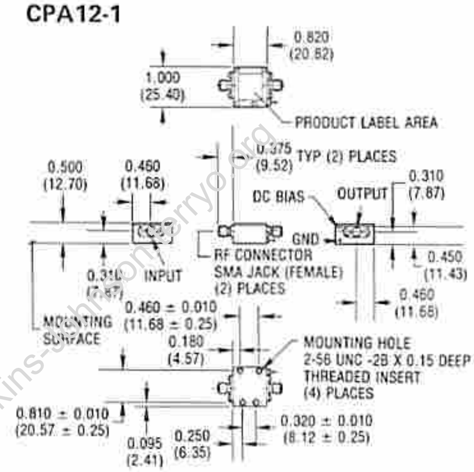
Outline Drawings

PA12-1



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CPA12-1

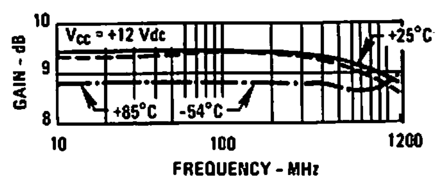


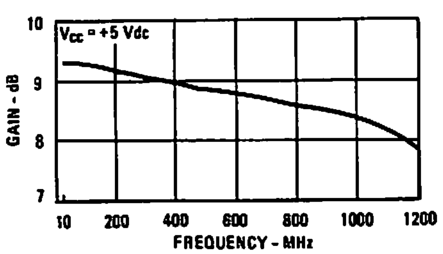
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

WJ CPA12-1 is standard WJ-PA12-1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

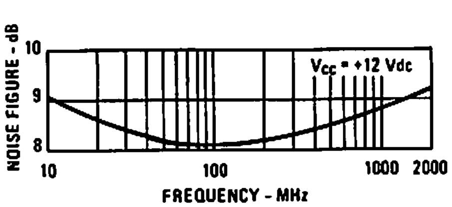
Typical Performance at 25°C

Gain

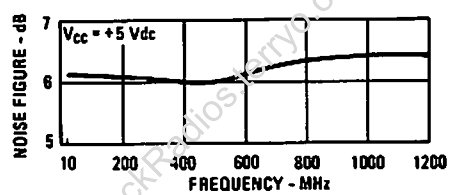




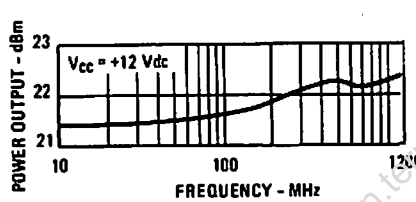
Noise Figure

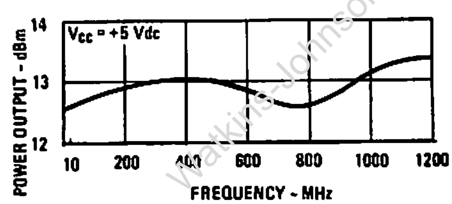


Noise Figure



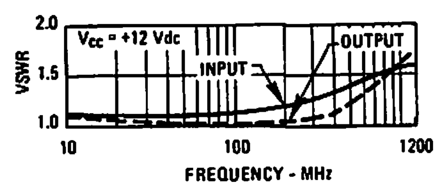
Power Output*

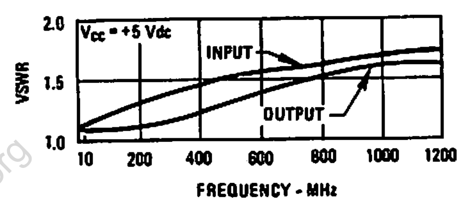




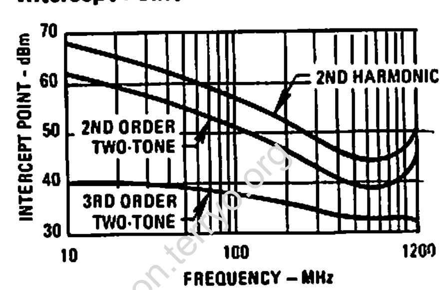
*at 1 dB Gain Compression

VSWR





Intercept Point



Typical Automatic Test Data

V_{cc} = +12 Vdc

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.0	9.4
200.	1.2	1.0	9.4
300.	1.2	1.1	9.3
400.	1.3	1.1	9.3
500.	1.4	1.2	9.2
600.	1.4	1.2	9.1
700.	1.5	1.3	9.1
800.	1.5	1.4	9.0
900.	1.5	1.5	9.0
1000.	1.5	1.6	9.1
1100.	1.6	1.7	9.0
1200.	1.6	1.7	[illegible]
1300.	[illegible]	[illegible]	[illegible]

Linear S-Parameters

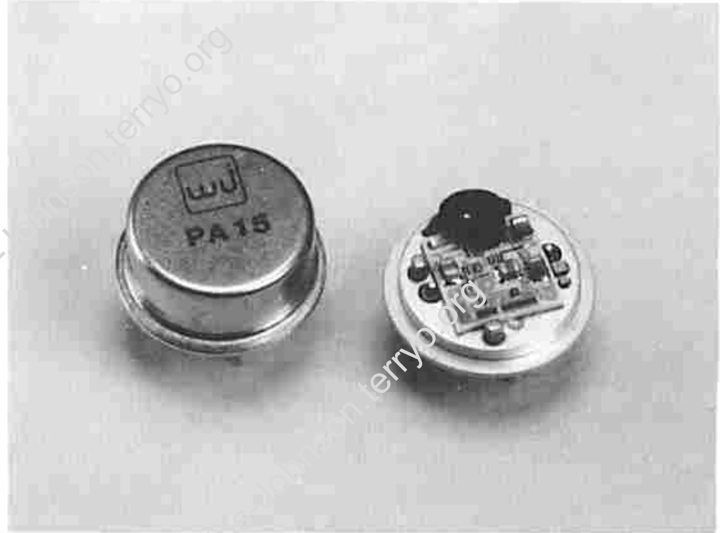
FREQ MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.06	[illegible]	[illegible]	[illegible]	.16	6.8	.01	8.0
200.	.08	-105.1	2.34	167.0	.16	11.0	.02	-46.5
300.	.11	-129.1	2.32	159.9	.17	15.5	.04	-69.5
400.	.13	-144.2	2.32	153.3	[illegible]	19.9	.06	-82.5
500.	.16	-149.3	2.22	146.3	[illegible]	24.1	.08	-97.0
600.	.17	-157.5	2.06	139.4	.18	27.2	.11	-110.4
700.	.19	-167.6	2.06	132.7	.19	30.2	.13	-123.3
800.	.20	-170.7	2.01	125.0	.19	32.7	.17	-137.8
900.	.21	166.0	2.02	[illegible]	.19	34.9	.19	-151.9
1000.	.21	145.1	2.04	110.3	.21	36.1	.22	-170.0
1100.	.22	117.0	2.02	102.2	.22	36.9	.25	168.3
1200.	.24	83.1	[illegible]	92.4	.23	35.3	.27	144.8
1300.	.29	42.5	[illegible]	81.3	.24	31.4	.29	117.2
1400.	.40	4.8	[illegible]	67.0	.25	23.8	.31	82.6
1500.	.52	-22.5	2.47	52.8	.24	14.4	.32	47.9

1

WJ-PA15

10 TO 1000 MHz
TO-8 CASCADABLE AMPLIFIER

- HIGH OUTPUT POWER: 27.0 dBm (TYP.) 10-500 MHz
- HIGH THIRD-ORDER I.P.: +38 dBm (TYP.)
- HIGH GAIN: 13.5 dB (TYP.)
- NOISE FIGURE: 6.0 dB (TYP.)
- HIGH OUTPUT POWER AT V_{CC} = 12 VOLTS: >23 dBm
- HIGH DYNAMIC ARTICULATION +118 dBm



Specifications*

Characteristics	Typical	Guaranteed 0° -50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	5-1100 MHz	10-1000 MHz	10-1000 MHz
Small Signal Gain (Min.)	13.5 dB	12.5 dB	12.0 dB
Gain Flatness (Max.)	<±0.3 dB	±0.5 dB	±0.7 dB
Noise Figure (Max.)			
30-500 MHz	6.0 dB	7.0 dB	7.5 dB
10-1000 MHz	7.0 dB	8.5 dB	9.0 dB
Power Output at 1 dB Compression (Min.)			
10-500 MHz	27.0 dBm	26.0 dBm	25.5 dBm
500-1000 MHz	25.5 dBm	23.5 dBm	23.0 dBm
VSWR (Max.)			
Input	< 1.5:1	2.0:1	2.0:1
Output	< 2.0:1	2.3:1	2.3:1
DC Current (Max.) at 15 Volts	216 mA	225 mA	227 mA

*Measured in a 50-ohm system at 15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . ≥45 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . ≥40 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +38 dBm (Typ.)

Absolute Maximum Ratings

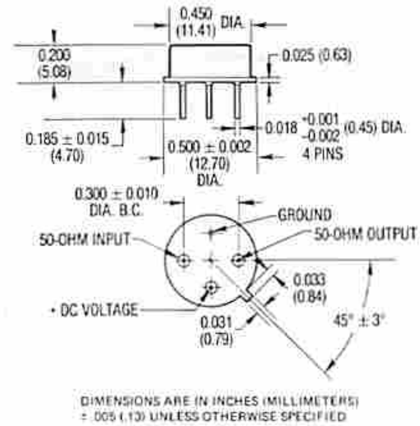
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 85°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +17 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 µsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 85°C

Proper heatsinking required to insure reliable performance.

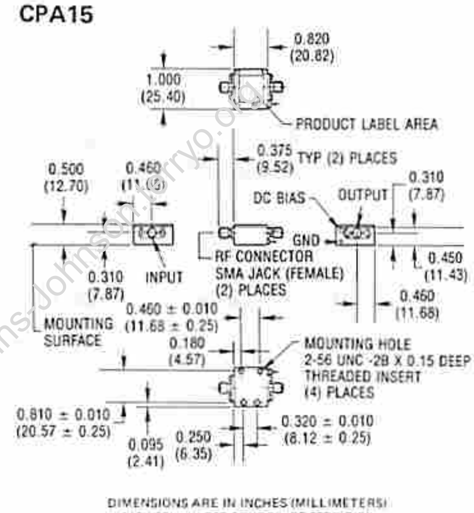
Weight approximately 2.0 grams (0.07 oz.)

Outline Drawings

PA15

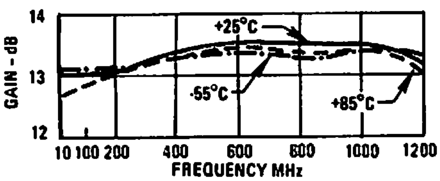


CPA15

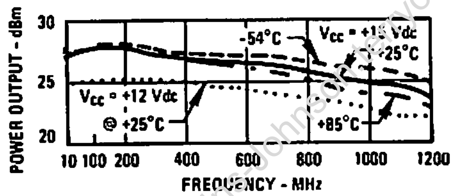


Typical Performance at 25°C

Gain

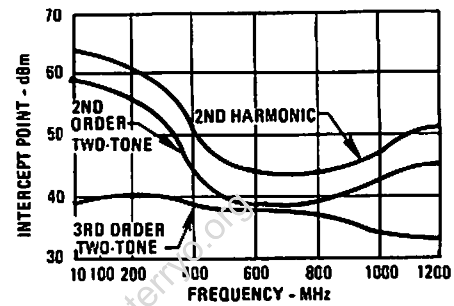


Power Output*

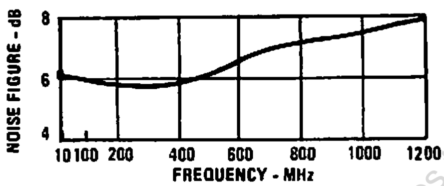


* at 1 dB Gain Compression

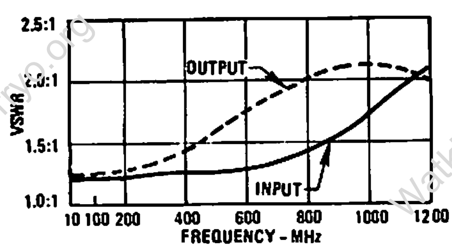
Intercept Point



Noise Figure



VSWR



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Typical Automatic Test Data

V_{CC} = +12 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.0	1.36	1.38	12.9
10.0	1.26	1.22	13.1
50.0	1.25	1.14	13.2
100.0	1.25	1.18	13.2
200.0	1.26	1.25	13.2
300.0	1.26	1.37	13.2
400.0	1.27	1.55	13.2
500.0	1.29	1.69	13.2
600.0	1.24	1.68	13.1
700.0	1.29	1.79	13.2
800.0	1.38	1.86	13.1
900.0	1.47	2.02	13.2
1000.0	1.63	2.05	13.0
1100.0	1.98	2.29	13.0
1200.0	2.14	2.29	12.7

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
5.0	0.152	-119	4.40	-167	0.13	12	0.159	134
10.0	0.116	-145	4.53	-172	0.13	5	0.098	143
50.0	0.111	-170	4.56	175	0.13	-3	0.067	-175
100.0	0.112	178	4.59	164	0.13	-6	0.084	-155
200.0	0.116	179	4.58	151	0.13	-12	0.112	[illegible]
300.0	0.116	174	4.56	133	0.13	-18	0.157	-143
400.0	0.119	170	4.58	119	0.13	-23	0.216	-147
500.0	0.128	165	4.56	101	0.13	-30	0.255	-150
600.0	0.108	166	4.54	87	0.14	-37	0.255	-163
700.0	0.127	177	4.56	69	0.14	-42	0.282	-174
800.0	0.159	-172	4.51	55	0.14	-48	0.301	-179
900.0	0.191	-170	4.55	38	0.14	-56	0.338	178
1000.0	0.240	-176	4.47	21	0.15	-59	0.344	164
1100.0	0.329	170	4.44	3	0.15	-70	0.393	145
1200.0	0.363	161	4.30	-14	0.16	-75	0.393	123

V_{CC} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.0	1.43	1.59	12.0
10.0	1.29	1.30	13.1
50.0	1.25	1.16	13.3
100.0	1.25	1.18	13.2
200.0	1.26	1.23	13.3
300.0	1.26	1.34	13.3
400.0	1.25	1.48	13.3
500.0	1.27	1.61	13.4
600.0	1.21	[illegible]	13.3
700.0	1.24	[illegible]	13.4
800.0	1.31	1.78	13.4
900.0	1.41	1.95	13.5
1000.0	1.55	1.99	13.3
1100.0	1.89	2.26	13.3
1200.0	2.04	2.27	13.2

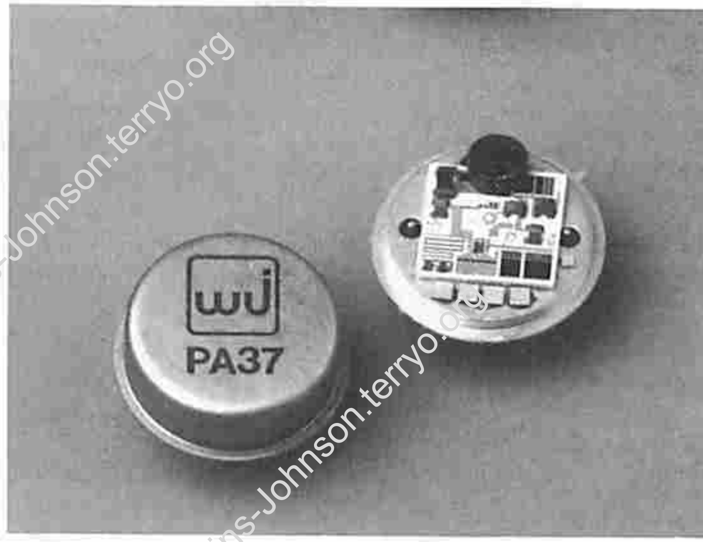
Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
5.0	0.178	-109	4.35	-164	0.12	[illegible]	0.228	134
10.0	0.126	-139	4.53	-171	0.13	[illegible]	0.132	138
50.0	0.111	-169	4.61	176	0.13	-3	0.074	177
100.0	0.112	170	4.60	165	0.13	-6	0.084	-162
200.0	0.116	176	4.63	151	0.13	-12	0.104	-149
300.0	0.115	170	4.61	134	0.13	-19	0.145	-148
400.0	0.113	165	4.63	120	0.13	-24	0.195	-148
500.0	0.118	161	4.67	102	0.13	-31	0.233	-149
600.0	0.096	160	4.64	89	0.14	-37	0.233	-162
700.0	0.107	175	4.66	71	0.14	-44	0.257	-173
800.0	0.135	-168	4.67	57	0.14	-49	0.281	-177
900.0	0.171	-165	4.71	40	0.14	-56	0.322	-179
1000.0	0.217	-171	4.64	24	0.14	-60	0.332	169
1100.0	0.307	174	4.61	6	0.15	-70	0.386	150
1200.0	0.342	165	[illegible]	-12	0.15	-75	0.389	127

WJ-PA37

200 TO 2000 MHz TO-8B[1] CASCADABLE AMPLIFIER

- HIGH DYNAMIC RANGE: +122 dB (1 MHz BANDWIDTH)
- HIGH OUTPUT LEVEL: +23 dBm (TYP.)
- HIGH THIRD ORDER INTERCEPT POINT: 38 dBm (TYP.)
- NEW STATE-OF-THE-ART GaAs FET TO-8B AMPLIFIER
- LOW NOISE: 3.5 dB (TYP.)



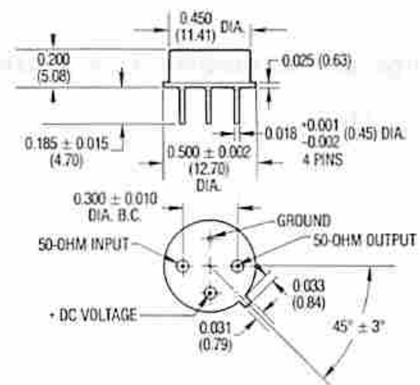
Specifications *

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed -54°C-+85°C
Frequency (Min.)	100–2000 MHz	200–2000 MHz	200–2000 MHz
Small Signal Gain (Min.)	9.5 dB	8.0 dB	7.5 dB
Gain Flatness (Max.)	±0.5 dB	±0.8 dB	±1.0 dB
Noise Figure (Max.)	<4.0 dB	5.0 dB	5.5 dB
Power Output at 1 dB Compression (Min.) 200-1000	23.0 dBm	22.0 dBm	21.0 dBm
Power Output at 1 dB Compression (Min.) 200-2000	22.0 dBm	20.0 dBm	19.5 dBm
VSWR (Max.) Input/Output	1.7:1	2.0:1	2.2:1
DC Current (Max.) at 15 Volts	175 mA	180 mA	184 mA

*Measured in a 50 ohm system at +15 Vdc Nominal
1. TO-8B is larger than standard TO-8 package.

Outline Drawings

PA37



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point .... 45 dBm (Typ.)
Second Order Two Tone Intercept Point .... 40 dBm (Typ.)
Third Order Two-Tone Intercept Point .... 32 dBm (Typ.)

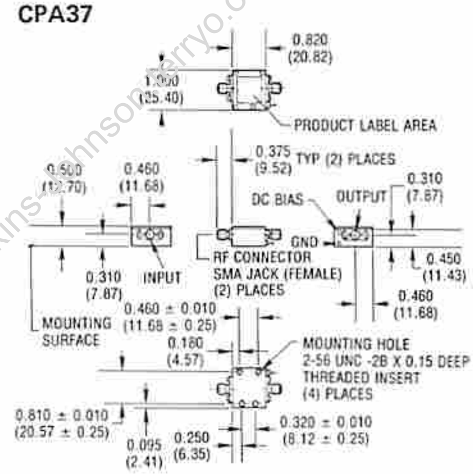
Absolute Maximum Ratings

Storage Temperature	-62°C to +125°C
Maximum Case Temperature	85°C
Maximum DC Voltage	+17 Volts
Maximum Continuous RF Input Power	50 Milliwatts
Maximum Short Term RF Input Power (1 Minute Max.)	100 Milliwatts
Maximum Peak Power	1 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case)	85°C

Proper heat sinking required to insure reliable performance.

Weight approximately 3.0 grams (0.11 oz.)

CPA37

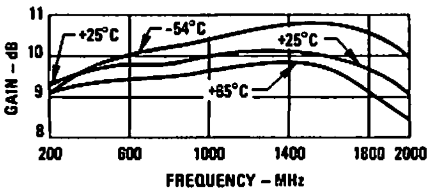


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

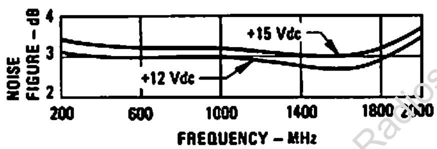
*WJ-CPA37 is standard and WJ-PA37 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

Gain

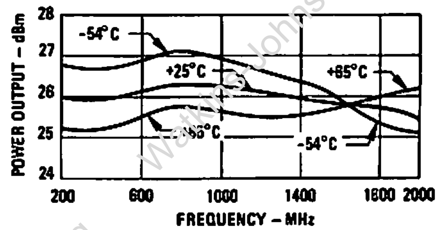


Noise Figure

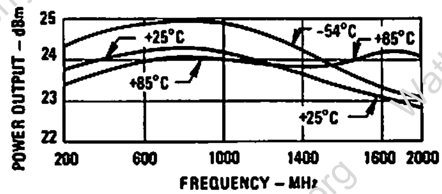


Power Output*

15V



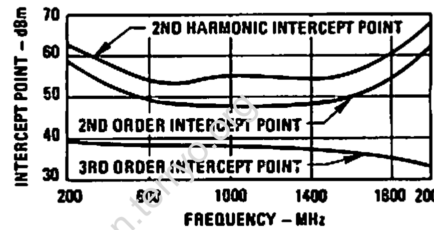
12V



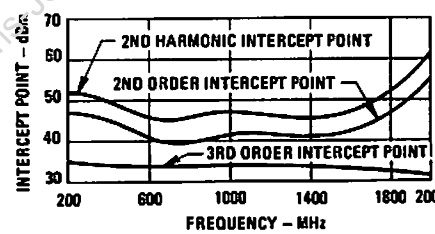
*at 1 dB Gain Compression

Intercept Point

15V

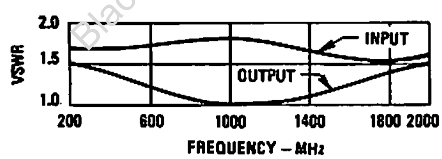


12V

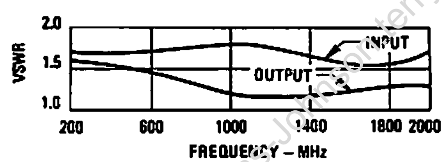


VSWR

15V



12V



Typical Automatic Test Data

V_{cc} = +12 Vdc

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
200.	1.7	1.6	8.7
300.	1.7	1.5	9.2
400.	1.7	1.3	9.3
500.	1.7	1.4	9.4
600.	1.8	1.3	9.3
700.	1.9	1.3	9.4
800.	1.9	1.2	9.3
900.	2.0	1.2	9.3
1000.	2.0	1.1	9.3
1100.	2.0	1.1	9.3
1200.	1.9	1.1	9.3
1300.	1.9	1.1	9.4
1400.	1.7	1.1	9.6
1500.	1.6	1.2	9.5
1600.	1.4	1.2	9.5
1700.	1.3	1.3	9.3
1800.	1.2	1.4	9.2
1900.	1.3	1.4	8.9
2000.	1.5	1.5	8.5
2100.	1.7	1.5	8.0
2200.	2.1	1.5	7.2

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200.	.27	-63.1	2.72	171.6	.12	-14.0	.22	-141.7
300.	.23	-75.6	2.87	154.0	.12	-17.2	.20	-167.4
400.	.25	-86.7	2.93	139.1	.11	-21.5	.19	175.4
500.	.27	-95.8	2.94	124.8	.11	-24.6	.17	158.6
600.	.29	-104.9	2.93	111.4	.12	-28.2	.15	[illegible]
700.	.30	-114.4	2.94	98.3	.11	-31.7	.13	133.8
800.	.32	-123.1	2.93	85.5	.12	-36.5	.10	124.4
900.	.33	-131.5	2.93	72.9	.12	-40.9	.08	118.1
1000.	.33	-141.1	2.92	60.0	.12	-45.3	.06	114.2
1100.	.33	-151.3	2.92	46.8	.12	-50.0	.04	119.8
1200.	.32	-161.2	2.93	33.2	.13	-54.7	.04	143.5
1300.	.30	-171.8	2.96	19.2	.13	-60.1	.05	155.2
1400.	.27	173.7	3.00	5.1	.14	-63.6	.07	152.4
1500.	.22	161.0	2.99	-9.2	.14	-70.3	.09	140.9
1600.	.17	142.0	2.97	-23.9	.15	-77.8	.11	126.7
1700.	.11	111.6	2.93	-39.6	.16	-85.5	.13	111.2
1800.	.09	53.4	2.89	-55.5	.16	-93.7	.16	92.7
1900.	.13	.7	2.79	-72.4	.17	-103.5	.18	72.3
2000.	.21	-26.3	2.66	-89.0	.15	-113.3	.20	53.6
2100.	.27	-47.4	2.50	-126.1	.18	-123.7	.20	33.5
2200.	.33	-66.2	2.28	-123.1	.18	-135.3	.21	13.6

V_{cc} = +15 Vdc

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
200.	1.7	1.5	9.1
300.	1.6	1.4	9.6
400.	1.6	1.4	9.8
500.	1.6	1.3	9.8
600.	1.7	1.2	9.8
700.	1.8	1.2	9.8
800.	1.8	1.1	9.8
900.	1.9	1.1	9.8
1000.	1.9	1.0	9.8
1100.	1.9	1.0	9.8
1200.	1.9	1.1	9.8
1300.	1.8	1.1	9.9
1400.	1.7	1.2	10.1
1500.	1.6	1.2	10.0
1600.	1.4	1.3	10.0
1700.	1.3	1.3	9.9
1800.	1.2	1.4	9.8
1900.	1.2	1.4	9.5
2000.	1.4	1.5	9.2
2100.	1.6	1.5	8.7
2200.	2.0	1.5	7.9

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200.	.25	-66.0	2.85	172.3	.13	-14.8	.20	-137.5
300.	.23	-78.0	3.01	154.7	.12	-18.7	.17	-164.7
400.	.23	-88.1	3.07	139.8	[illegible]	-23.5	.15	176.8
500.	.24	-96.1	3.09	125.6	.12	-27.0	.13	158.7
600.	.26	-104.2	3.09	112.2	.12	-31.0	.11	145.2
700.	.28	-112.9	3.09	99.1	.11	-35.0	.08	131.2
800.	.29	-121.0	3.09	86.[illegible]	.12	-40.0	.06	120.0
900.	.31	-128.9	3.09	[illegible]	.12	-44.6	.03	112.4
1000.	.31	-137.8	3.09	60.9	.12	-49.0	.00	167.0
1100.	.32	-147.6	3.09	47.9	.12	-53.7	.02	-116.7
1200.	.31	-156.9	3.10	34.2	.12	-58.7	.05	-130.8
1300.	.29	-166.6	3.14	20.3	.12	-63.7	.07	-144.7
1400.	.26	-177.8	3.19	6.1	.13	-67.2	.09	-161.0
1500.	.22	169.3	3.17	-8.2	.13	-72.7	.11	-179.0
1600.	.17	153.2	3.17	-22.8	.13	-78.6	.12	162.1
1700.	.12	127.5	3.13	-38.4	.14	-85.4	.14	141.3
1800.	.08	77.8	3.09	-54.5	.15	-92.8	.15	121.8
1900.	.10	10.1	3.00	-71.4	.15	-101.7	.18	98.5
2000.	.18	-22.0	2.87	-88.0	.16	-110.9	.19	77.5
2100.	.23	-42.6	2.72	-105.2	.16	-121.1	.19	56.8
2200.	.32	-62.9	2.49	-122.7	.16	-132.2	.20	34.9

WJ-PA38

200 TO 2000 MHz
TO-8 CASCADABLE AMPLIFIER

- WIDE BANDWIDTH
- HIGH OUTPUT LEVEL: +24.0 dBm (TYP.)
- GaAs FET AMPLIFIER
- LOW NOISE: 4.0 dB (TYP.)
- HIGH THIRD ORDER INTERCEPT POINT

1

Specifications*

Characteristics	Typ.	Guaranteed 0° -50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	200-2400 MHz	200-2000 MHz	200-2000 MHz
Small Signal Gain (Min.)	10.0 dB	8.5 dB	8.0 dB
Gain Flatness (Max.)	±.3 dB	±.7 dB	±1.0 dB
Noise Figure (Max.)	4.0 dB	4.7 dB	5.2 dB
Power Output at 1 dB Compression (Min.)	24.0 dBm	22.5 dBm	22.0 dBm
VSWR (Max.)			
Input	1.7:1	1.9:1	2.0:1
Output	1.5:1	1.9:1	2.0:1
DC Current (Max.) at +15 Volts	150 mA	158 mA	160 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . .65 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . .60 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . .39 dBm (Typ.)

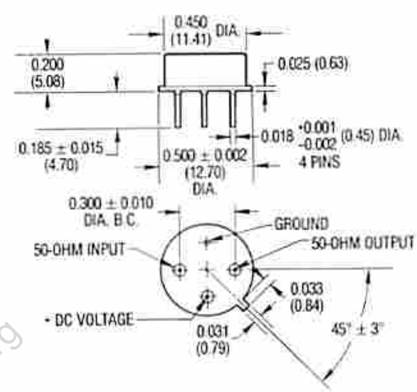
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 85°C
Maximum DC Voltage . . . . 16 Volts
Maximum Continuous RF Input Power . . . . 50 Milliwatts
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
Maximum Peak Power . . . . 1 Watt
(3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 85°C

Weight approximately 2.0 grams (0.07 oz.)

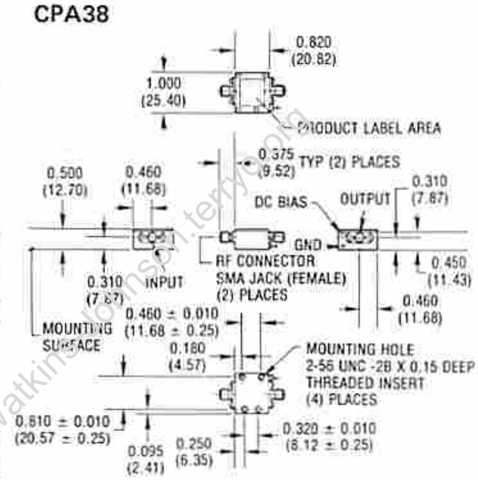
Outline Drawings

PA38



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.005 (.13) UNLESS OTHERWISE SPECIFIED

CPA38

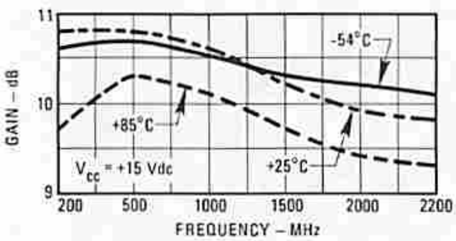


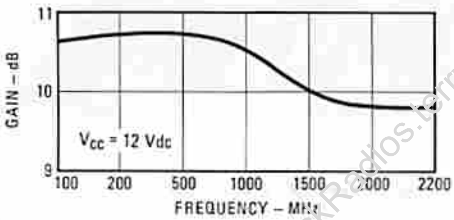
DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

*WJ-CA PA38 is standard.
*WJ-PA38 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

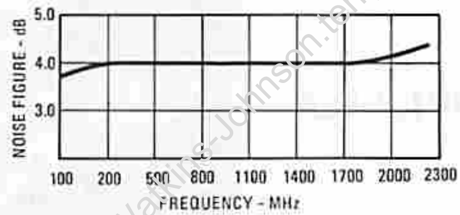
Typical Performance at 25°C

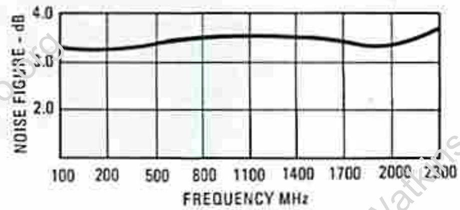
Gain



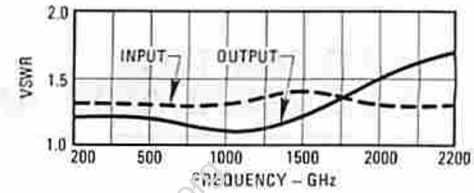


Noise Figure

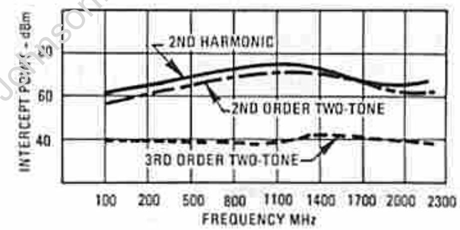




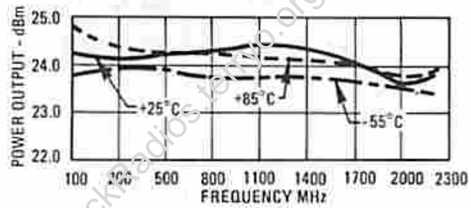
VSWR

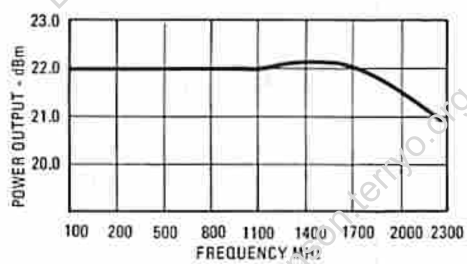


Intercept Point



Power Output*





*at 1 dB Gain Compression.

Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
100.0	1.4	1.2	10.7
200.0	1.3	1.2	10.8
500.0	1.3	1.2	10.8
1000.0	1.3	1.1	10.6
1500.0	1.4	1.2	10.2
2000.0	1.3	1.5	9.9
2200.0	1.3	1.7	9.8

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.0	.163	-36	3.409	178	.128	-10	.106	-152
200.0	.135	-31	3.468	164	.127	-14	.093	178
500.0	.116	-28	3.456	130	.125	-30	.091	142
1000.0	.144	-52	3.376	78	.122	-58	.060	133
1500.0	.165	-93	3.225	26	.108	-86	.106	139
2000.0	.119	-153	3.112	-27	.112	-112	.211	118
2200.0	.113	149	3.080	-49	.113	-124	.261	107

V_{CC} = +12 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
100.0	1.4	1.3	10.6
200.0	1.3	1.3	10.7
500.0	1.3	1.2	10.7
1000.0	1.3	1.2	10.5
1500.0	1.4	1.3	10.0
2000.0	1.3	1.6	9.8
2200.0	1.2	1.7	9.8

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.0	.163	-33	3.383	177	.125	-10	.124	-156
200.0	.140	-20	3.437	163	.124	-13	.112	177
500.0	.123	-28	3.421	130	.123	-29	.111	145
1000.0	.148	-53	3.334	78	.122	-56	.084	129
1500.0	.168	-94	3.179	27	.120	-83	.125	127
2000.0	.121	-152	3.074	-26	.121	-110	.223	109
2200.0	.110	147	3.073	-48	.121	-123	.263	97

WJ-PA38-2

100 TO 2600 MHz
TO-8 CASCADABLE AMPLIFIER

- ULTRA WIDE BANDWIDTH: 100-2700 MHz (TYP)
- HIGH OUTPUT LEVEL: +23.4 dBm (TYP.)
- GaAsFET AMPLIFIER
- HIGH THIRD ORDER INTERCEPT POINT: 32 dBm (TYP.)

1

Specifications *

Characteristics	Typical	Guaranteed 0° -50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	200-2800 MHz	200-2600 MHz	200-2600 MHz
Small Signal Gain (Min.)	8.5 dB	7.5 dB	7.0 dB
Gain Flatness (Max.)	±.2 dB	±.7 dB	±1.0 dB
Noise Figure (Max.) 200-2600	4.5 dB	5.5 dB	6.0 dB
Power Output at 1 dB Compression (Min.)	23.5 dBm	22.0 dBm	21.4 dBm
VSWR (Max.) Input	1.2:1	1.9:1	2.0:1
VSWR (Max.) Output	1.5:1	1.9:1	2.0:1
DC Current (Max.) at +15 Volts	150 mA	158 mA	160 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 55 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . .48 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 32 dBm (Typ.)

Absolute Maximum Ratings

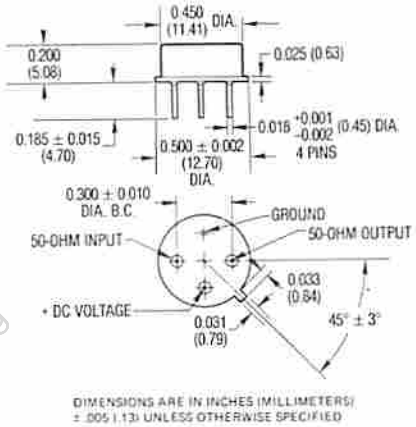
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 85°C
Maximum DC Voltage . . . . +16 Volts
Maximum Continuous RF Input Power . . . . 50 Milliwatts
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
Maximum Peak Power . . . . 1 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 85°C
Proper heat sinking required to insure reliable performance.

Weight

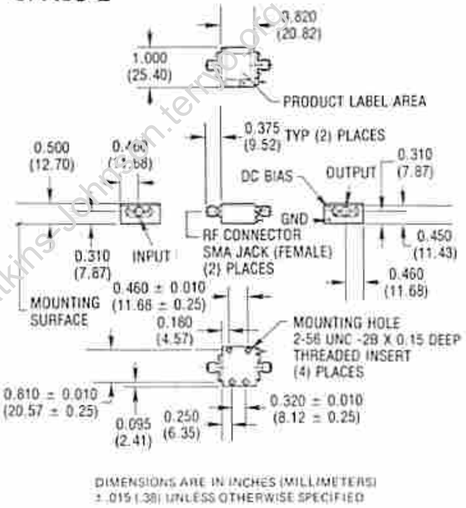
approximately 2.0 grams (0.07 oz.)

Outline Drawings

PA38-2



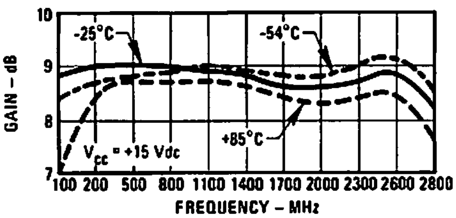
CPA38-2

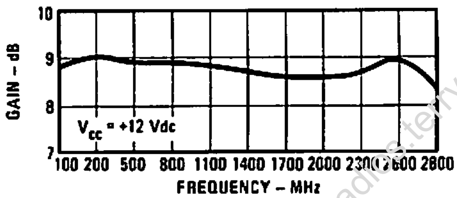


*WJ CPA38-2 is standard and WJ PA38-2 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

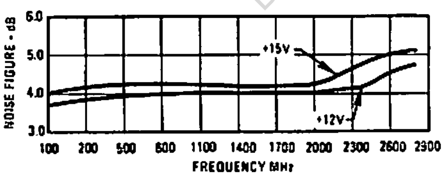
Typical Performance at 25°C

Gain

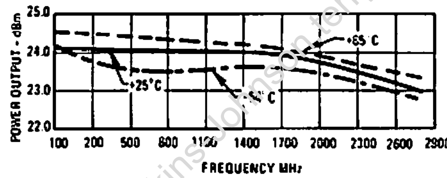


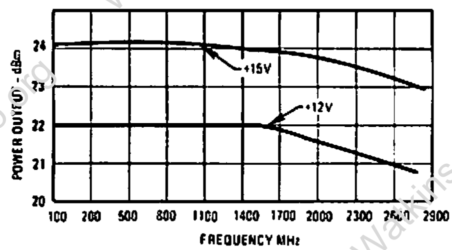


Noise Figure



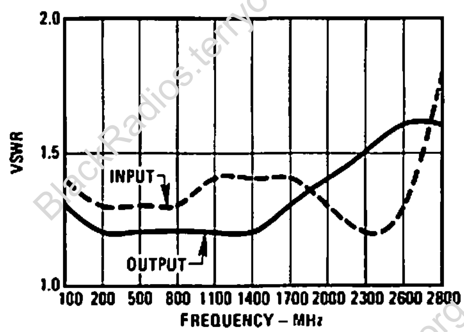
Power Output*



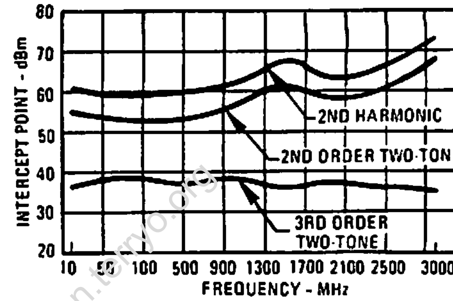


*at 1 dB Gain Compression

VSWR



Third Order Two Tone Intercept Point



Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
100.0	1.4	1.3	8.8
200.0	1.3	1.2	9.0
300.0	1.3	1.2	8.9
400.0	1.3	1.2	8.9
500.0	1.3	1.2	9.0
600.0	1.3	1.2	9.0
700.0	1.3	1.2	9.0
800.0	1.3	1.2	9.0
900.0	1.3	1.2	8.9
1000.0	1.3	1.2	8.9
1100.0	1.4	1.2	8.9
1200.0	1.4	1.2	8.9
1300.0	1.4	1.2	8.8
1400.0	1.4	1.2	8.8
1500.0	1.4	1.3	8.7
1600.0	1.4	1.3	8.7
1700.0	1.4	1.3	8.6
1800.0	1.4	1.4	8.6
1900.0	1.4	1.4	8.6
2000.0	1.3	1.4	8.6
2100.0	1.3	1.5	8.6
2200.0	1.3	1.5	8.6
2300.0	1.2	1.5	8.7
2400.0	1.2	1.6	8.6
2500.0	1.2	1.6	8.7
2600.0	1.3	1.6	8.8
2700.0	1.5	1.6	8.6
2800.0	1.8	1.6	8.2

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.0	.157	-38	[illegible]	169	.148	-21	.112	-152
200.0	.124	-29	2.812	142	.145	-37	.102	179
300.0	.118	-24	2.799	118	.144	-54	.095	162
400.0	.121	-26	2.788	99	.145	-69	.090	156
500.0	.115	-27	2.813	77	.144	-86	.097	150
600.0	.116	-29	2.815	55	.142	-104	.101	143
700.0	.120	-30	2.812	33	.141	-121	.102	136
800.0	.126	-34	2.804	11	.140	-139	.100	133
900.0	.134	-38	2.798	-9	.139	-155	.099	133
1000.0	.142	-43	2.787	-31	.138	-172	.098	133
1100.0	.150	-49	2.776	-53	.137	170	[illegible]	135
1200.0	.166	-55	2.757	-74	.134	155	.117	131
1300.0	.171	-61	2.744	-93	.134	140	.122	132
1400.0	.178	-70	2.732	-115	.132	122	.128	133
1500.0	.182	-79	2.711	-137	.131	105	.139	133
1600.0	.183	-89	2.695	-159	.130	87	.149	132
1700.0	.180	-99	2.684	-178	.128	72	.159	129
1800.0	.176	-109	2.674	160	.127	55	.169	126
1900.0	.166	-121	2.676	138	.127	37	.178	122
2000.0	.151	-131	2.680	116	.127	20	.184	116
2100.0	.141	-144	2.686	97	.127	5	.188	113
2200.0	.124	-161	2.693	74	.129	-13	.197	110
2300.0	.102	174	2.714	51	.132	-32	.211	104
2400.0	.083	135	2.764	28	.133	-51	.220	95
2500.0	.083	81	2.792	3	.132	-70	.215	84
2600.0	.123	44	[illegible]	-20	.132	-86	.210	78
2700.0	.191	18	[illegible]	-46	.132	-105	.204	69
2800.0	.278	-1	2.588	-73	.131	-125	.197	63

V_{cc} = +12

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
100.0	1.4	1.3	8.8
200.0	1.3	1.3	9.0
300.0	1.3	1.3	8.9
400.0	1.3	1.3	8.9
500.0	1.3	1.3	8.9
600.0	1.3	1.3	8.9
700.0	1.3	1.3	8.9
800.0	1.3	1.3	8.9
900.0	1.3	1.3	8.9
1000.0	1.3	1.3	8.9
1100.0	1.4	1.3	8.8
1200.0	1.4	1.3	8.8
1300.0	1.4	1.3	8.8
1400.0	1.4	1.3	8.7
1500.0	1.4	1.3	8.7
1600.0	1.4	1.4	8.6
1700.0	1.4	1.4	8.6
1800.0	1.4	1.4	8.5
1900.0	1.4	1.4	8.6
2000.0	1.4	1.4	8.6
2100.0	1.3	1.5	8.6
2200.0	1.3	1.5	8.6
2300.0	1.2	1.5	8.7
2400.0	1.2	1.6	8.8
2500.0	1.2	1.5	8.9
2600.0	1.3	1.5	8.9
2700.0	1.5	1.5	8.6
2800.0	1.8	1.5	8.3

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.0	.155	-35	2.762	168	.144	-21	.131	-158
200.0	.128	-29	2.804	141	.141	-37	.122	177
300.0	.119	-25	2.801	118	.140	-53	.119	162
400.0	.119	-24	2.792	99	.141	-68	.116	155
500.0	.118	-24	2.797	77	.140	-85	.119	147
600.0	.122	-27	2.793	55	.139	-102	.121	141
700.0	.126	-29	2.792	33	.139	-120	.123	137
800.0	.132	-33	2.783	11	.138	-137	.121	133
900.0	.140	-37	2.779	-9	.137	-152	.120	131
1000.0	.147	-43	2.770	-30	.137	-170	.118	129
1100.0	.155	-48	2.760	-52	.135	172	.118	130
1200.0	.160	-56	2.771	-74	.135	153	.096	138
1300.0	.164	-62	2.760	-94	.133	137	.102	141
1400.0	.171	-71	2.745	-116	.132	119	.110	143
1500.0	.173	-80	2.725	-138	.129	102	.122	143
1600.0	.175	-90	[illegible]	-160	.127	84	.135	143
1700.0	.171	-100	[illegible]	-179	.126	68	.147	140
1800.0	.167	-110	2.683	159	.123	51	.159	137
1900.0	.157	-122	2.682	137	.122	34	.171	133
2000.0	.144	-133	2.689	115	.121	16	.178	127
2100.0	.130	[illegible]	2.694	95	.120	2	.185	124
2200.0	.112	[illegible]	2.703	72	.120	-16	.195	121
2300.0	.091	173	2.708	49	.121	-33	.207	115
2400.0	.079	133	2.704	26	.123	-51	.222	110
2500.0	.094	77	2.731	2	.124	-71	.235	99
2600.0	.140	41	2.748	-21	.122	-88	[illegible]	89
2700.0	.209	15	2.692	-47	.120	-106	[illegible]	81
2800.0	.295	-3	2.576	-74	.119	-125	.223	74

1

WJ-PA48

1.0 TO 4.0 GHz
TO-8B CASCADABLE AMPLIFIER

- ULTRA-WIDE BANDWIDTH: 1-4 GHz
- HIGH OUTPUT POWER: 25.0 dBm (TYP.)
- MEDIUM GAIN: 16.0 dB (TYP.)
- GaAs FET AMPLIFIER
- PA48-1: +12V AMP WITH SAME RF SPECS AS PA48

Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	.8-4.2 GHz	1.0-4.0 GHz	1.0-4.0 GHz
Small Signal Gain (Min.)	16.0 dB	14.0 dB	13.5 dB
Gain Flatness (Max.)	±.4 dB	±.7 dB	±.8 dB
Noise Figure (Max.)	5.5 dB	7.0 dB	7.5 dB
Power Output at 1 dB Compression (Min.)	24.0 dBm	22.5 dBm	21.5 dBm
VSWR (Max.)			
Input	1.7:1	2.0:1	2.2:1
Output	1.6:1	1.9:1	2.1:1
DC Current (Max.) at +15 Volts	225 mA	235 mA	245 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . .+50 dBm (Typ.)
Second Order Two Tone Intercept Point . . . .+45 dBm (Typ.)
Third Order Two Tone Intercept Point . . . .+34 dBm (Typ.)

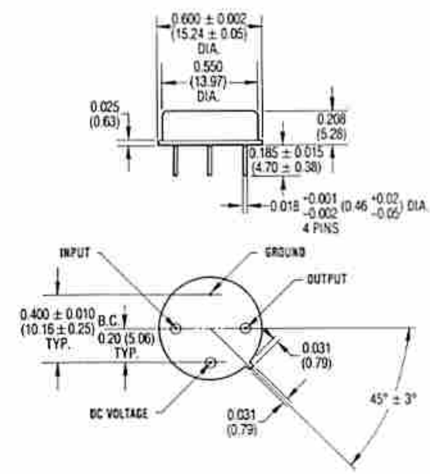
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 85°C
Maximum DC Voltage . . . . +16 Volts
Maximum Continuous RF Input Power . . . . +17 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
Maximum Peak Power . . . . 1/4 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 85°C

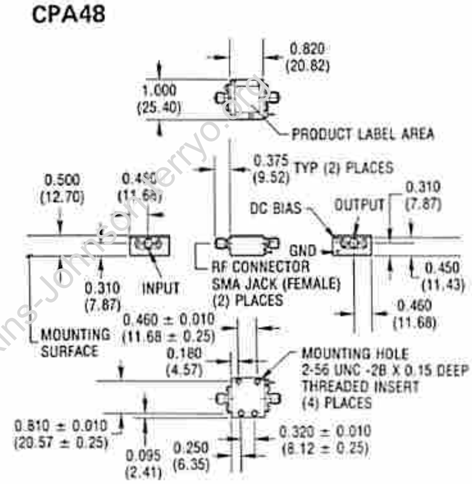
Weight approximately 3.0 grams (0.11 oz.)

Outline Drawings

PA48



CPA48

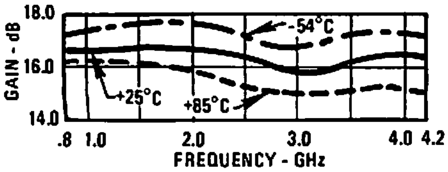


DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

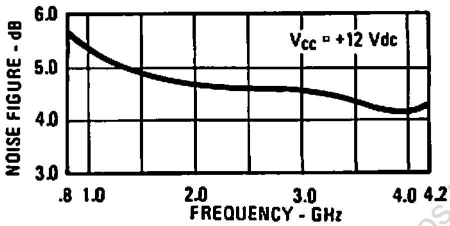
WJ-CA PA48 is standard.
WJ-PA48 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

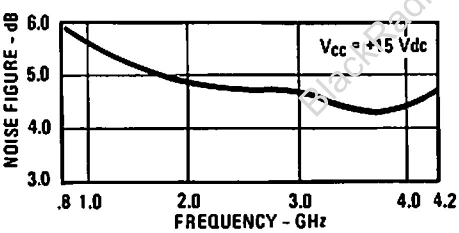
Typical Performance at 25°C

Gain

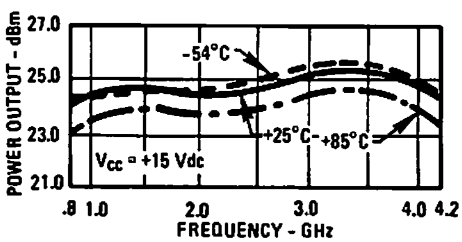


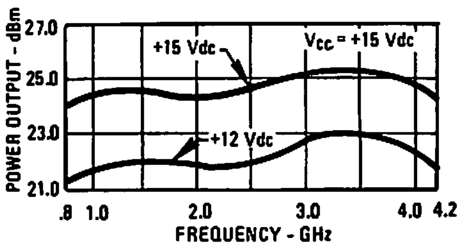
Noise Figure





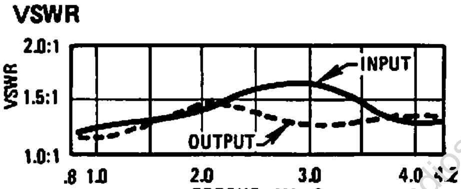
Power Output*



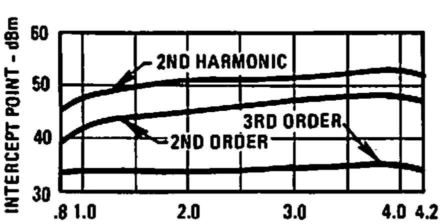


*at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{cc} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB	FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
800.0	1.1	1.1	16.4	2500.0	1.8	1.3	15.8
900.0	1.2	1.2	16.4	2600.0	1.8	1.2	15.8
1000.0	1.3	1.3	16.4	2700.0	1.8	1.1	15.8
1100.0	1.3	1.3	16.4	2800.0	1.8	1.1	15.8
1200.0	1.2	1.3	16.4	2900.0	1.8	1.1	15.8
1300.0	1.2	1.4	16.4	3000.0	1.7	1.1	15.9
1400.0	1.1	1.4	16.4	3100.0	1.6	1.2	16.0
1500.0	1.1	1.5	16.4	3200.0	1.5	1.2	16.1
1600.0	1.1	1.5	16.4	3300.0	1.3	1.3	16.2
1700.0	1.2	1.5	16.3	3400.0	1.2	1.3	16.3
1800.0	1.2	1.5	16.3	3500.0	1.1	1.4	16.4
1900.0	1.3	1.5	16.2	3600.0	1.0	1.4	16.5
2000.0	1.4	1.5	16.1	3700.0	1.0	1.4	16.6
2100.0	1.4	1.5	16.0	3800.0	1.1	1.3	16.6
2200.0	1.5	1.4	16.0	3900.0	1.1	1.3	16.5
2300.0	1.6	1.4	15.9	4000.0	1.0	1.3	16.4
2400.0	1.7	1.3	15.8	4100.0	1.1	1.2	16.2
				4200.0	1.3	1.1	15.9

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
800.0	.057	80	6.628	21	.028	68	.035	-154
900.0	.097	122	6.643	-10	.028	41	.085	158
1000.0	.119	116	6.645	-33	.027	20	.112	144
1100.0	.120	105	6.639	-55	.026	2	.130	135
1200.0	.101	91	6.639	-75	.025	-14	.145	130
1300.0	.074	72	6.631	-93	.025	-28	.161	124
1400.0	.049	37	6.620	-111	.024	-42	.176	118
1500.0	.039	-32	6.612	129	.023	-55	.190	112
1600.0	.053	-84	6.582	-145	.023	-67	.201	106
1700.0	.079	-113	6.552	-162	.022	-79	.208	100
1800.0	.105	-132	6.511	-177	.021	-89	.211	94
1900.0	.133	-148	6.453	168	.020	-100	.210	88
2000.0	.155	-162	6.407	153	.020	-110	.202	82
2100.0	.166	-178	6.314	137	.019	-121	.194	77
2200.0	.192	168	6.277	123	.018	-131	.181	72
2300.0	.223	157	6.228	108	.017	-141	.164	68
2400.0	.252	148	6.188	94	.016	-150	.143	65
2500.0	.274	140	6.167	79	.016	-160	.118	63
2600.0	.287	132	6.150	65	.015	-170	.093	64
2700.0	.297	126	6.140	51	.014	-178	.069	71
2800.0	.296	120	6.143	37	.013	173	.051	91
2900.0	.283	115	6.183	23	.013	165	.050	122
3000.0	.259	108	6.229	8	.012	154	.066	142
3100.0	.233	104	6.294	-7	.012	146	.089	149
3200.0	.189	98	6.382	-22	.012	136	.110	150
3300.0	.147	90	6.476	-37	.011	126	.127	149
3400.0	.107	84	6.551	-53	.011	114	.141	147
3500.0	.062	86	6.642	-70	.010	102	.150	144
3600.0	.019	90	6.705	-87	.010	90	.153	140
3700.0	.012	-180	6.743	-105	.009	76	.153	137
3800.0	.029	-163	6.744	-123	.009	61	.148	134
3900.0	.028	-165	6.708	-142	.008	42	.137	131
4000.0	.005	25	6.632	-163	.008	24	.119	130
4100.0	.052	15	6.4[illegible]	176	.008	-1	.091	132
4200.0	.115	-14	6.[illegible]03	153	.007	-30	.061	152

1

Typical Automatic Test Data (continued)

V_{cc} = +12 Vdc

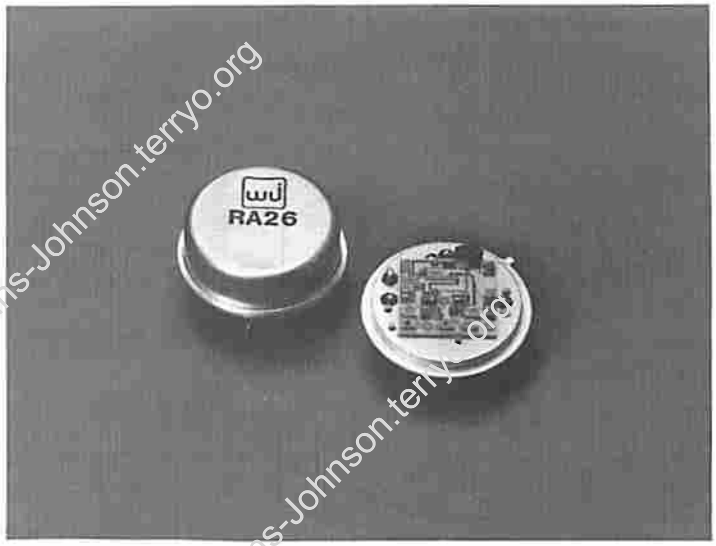
FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
800.0	1.1	1.2	16.8
900.0	1.2	1.3	16.8
1000.0	1.3	1.4	16.8
1100.0	1.3	1.4	16.8
1200.0	1.2	1.5	16.8
1300.0	1.2	1.5	16.8
1400.0	1.1	1.6	16.8
1500.0	1.1	1.6	16.8
1600.0	1.1	1.7	16.8
1700.0	1.1	1.7	16.8
1800.0	1.2	1.8	16.8
1900.0	1.3	1.8	16.7
2000.0	1.3	1.8	16.6
2100.0	1.3	1.8	16.5
2200.0	1.4	1.7	16.5
2300.0	1.5	1.7	16.4
2400.0	1.6	1.6	16.4
2500.0	1.7	1.6	16.3
2600.0	1.8	1.5	16.3
2700.0	1.8	1.4	16.3
2800.0	1.8	1.3	16.3
2900.0	1.8	1.3	16.3
3000.0	1.7	1.2	16.3
3100.0	1.6	1.2	16.4
3200.0	1.5	1.1	16.5
3300.0	[illegible]	1.1	16.6
3400.0	1.3	1.1	16.7
3500.0	1.1	1.1	16.8
3600.0	1.1	1.1	16.9
3700.0	1.1	1.1	16.9
3800.0	1.1	1.1	17.0
3900.0	1.1	1.1	17.0
4000.0	1.1	1.1	17.1
4100.0	1.1	1.0	17.0
4200.0	1.2	1.1	16.9

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
800.0	.057	89	[illegible]	19	.025	66	.091	-175
900.0	.102	122	6.879	-11	.025	41	.133	161
1000.0	.124	116	6.883	-34	.024	21	.155	150
1100.0	.125	105	6.881	-55	.023	5	.171	143
1200.0	.110	92	6.894	-74	.023	-10	.186	138
1300.0	.086	75	6.906	-93	.023	-24	.203	132
1400.0	.060	50	6.914	-110	.022	-37	.221	127
1500.0	.041	-1	6.925	-127	.022	-48	.238	121
1600.0	.041	-59	6.916	-144	.021	-60	.253	[illegible]
1700.0	.062	-99	6.906	-160	.021	-71	.266	[illegible]
1800.0	.087	-123	6.880	-175	.020	-81	.275	104
1900.0	.113	-140	6.835	169	.019	-92	.280	98
2000.0	.136	-156	6.791	154	.019	-101	[illegible]	92
2100.0	.148	-173	6.696	139	.019	-111	[illegible]	86
2200.0	.173	173	6.663	124	.018	-121	.271	81
2300.0	.206	161	6.618	118	.017	-130	.260	76
2400.0	.236	152	6.572	95	.017	-139	.245	71
2500.0	.260	144	6.547	81	.016	-148	.224	66
2600.0	.275	137	6.533	66	.015	[illegible]	.202	62
2700.0	.287	130	6.514	52	.015	-165	.176	59
2800.0	.289	124	6.502	38	.015	-175	.148	56
2900.0	.279	120	6.534	24	.014	177	.121	56
3000.0	.257	113	6.568	9	.014	169	.095	60
3100.0	.234	109	6.614	-5	.014	160	.076	68
3200.0	.192	104	6.689	-20	.014	150	.063	81
3300.0	.152	97	6.771	-36	.013	141	.059	97
3400.0	.113	92	6.833	-51	.013	129	.060	109
3500.0	.070	97	6.918	-68	.013	119	.062	118
3600.0	.027	114	6.985	-84	.013	107	.062	124
3700.0	.025	170	7.037	-102	.012	93	.061	129
3800.0	.043	-173	7.074	-120	.012	79	.059	134
3900.0	.051	-179	7.099	-139	.011	63	.053	138
4000.0	.035	142	7.132	-158	.011	45	.042	144
4100.0	.059	73	7.107	-180	.011	21	.024	172
4200.0	.110	25	7.003	157	.010	-5	.041	-112

WJ-RA26

10 TO 1500 MHz
TO-8B[1] CASCADABLE AMPLIFIER



- HIGH GAIN – THREE STAGES: 27.5 dB (TYP.)
- MEDIUM OUTPUT LEVEL: +14.5 dBm (TYP.)
- THIRD-ORDER I.P.: +27 dBm (TYP.)
- HIGH REVERSE ISOLATION: >40 dB (TYP.)

1

Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54° - +85°C
Frequency (Min.)	5-1550 MHz	10-1500 MHz	10-1500 MHz
Small Signal Gain (Min.)	27.5 dB	26.0 dB	25.0 dB
Gain Flatness (Max.)	±0.4 dB	±0.8 dB	±1.2 dB
Noise Figure (Max.)			
10-1000 MHz	4.5 dB	5.0 dB	5.5 dB
1000-1500 MHz	5.5 dB	6.0 dB	6.5 dB
Power Output at 1 dB Compression (Min.)	+14.5 dBm	+13.5 dBm	+12.5 dBm
VSWR (Max.) Input/Output	1.6:1	2.0:1	2.0:1
DC Current (Max.) at 15 Volts	82 mA	85 mA	87 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Notes:

1. TO-8B is larger than standard TO-8 package. (See outline drawing).

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 41 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 37 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 27 dBm (Typ.)

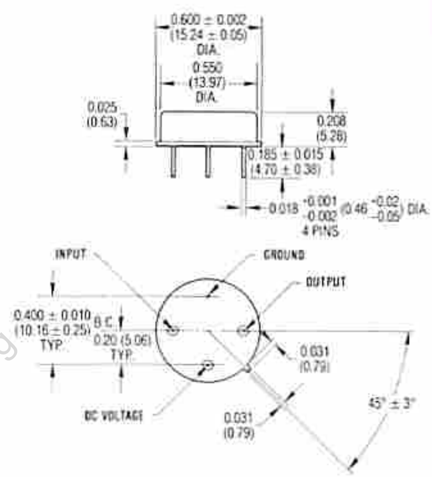
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +6 dBm
Maximum Short Term Input Power (1 Minute Max.) . . . . +100 Milliwatts
Maximum Peak Power . . . . 0.5 Watt
(3 µsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

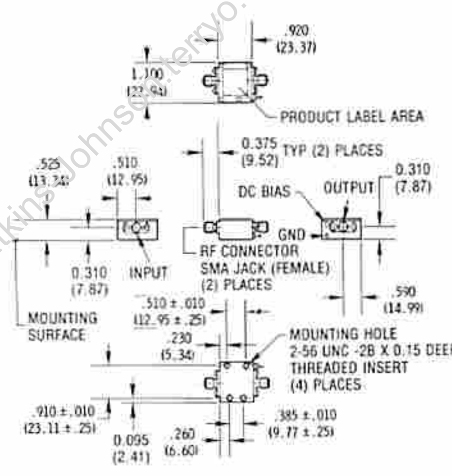
Outline Drawings

RA26



NOTE: DIMENSIONS ARE IN INCHES (MILLIMETERS).
ALL DIMENSIONS ARE X.XXX ± 0.005, UNLESS OTHERWISE STATED.

CRA26

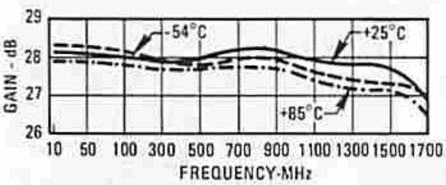


DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

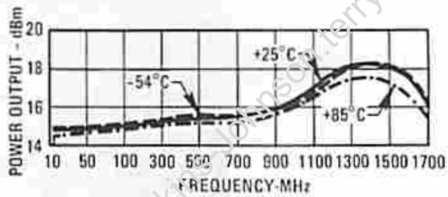
WJ-RA26 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

Typical Performance at 25°C

Gain

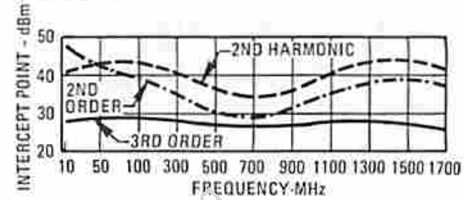


Power Output*

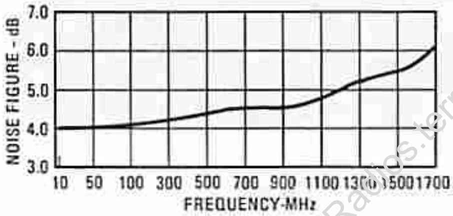


*at 1 dB Gain Compression

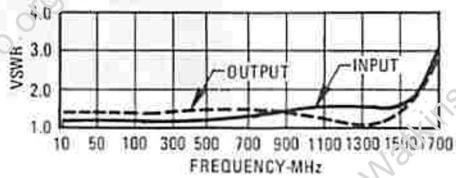
Intercept Point



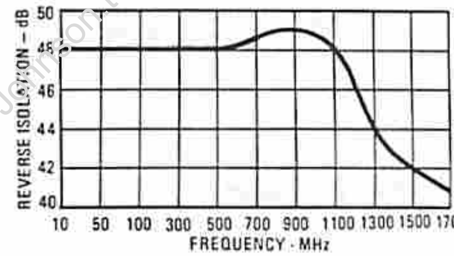
Noise Figure



VSWR



Reverse Isolation



Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
100.0	1.1	1.3	27.5
200.0	1.2	1.4	27.3
300.0	1.2	1.4	27.5
400.0	1.3	1.4	27.5
500.0	1.2	1.5	27.6
600.0	1.2	1.5	28.0
700.0	1.3	1.5	28.1
800.0	1.3	1.5	28.1
900.0	1.4	1.4	28.1
1000.0	1.5	1.3	27.9
1100.0	1.5	1.2	27.8
1200.0	1.5	1.2	27.6
1300.0	1.5	1.2	27.4
1400.0	1.5	1.3	27.5
1500.0	1.6	1.5	27.7
1600.0	2.0	2.2	27.7
1700.0	3.0	3.0	26.1

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.0	0.056	-35	23.71	146	0.00	53	0.127	4
200.0	0.080	-53	23.17	113	0.00	44	0.151	-27
300.0	0.102	-77	23.71	78	0.00	-109	0.155	-41
400.0	0.113	-90	23.71	44	0.00	-163	0.175	-62
500.0	0.103	-95	23.99	12	0.00	-35	0.191	-78
600.0	0.109	-102	25.12	-23	0.00	-30	0.206	-97
700.0	0.112	-106	25.41	-58	0.00	-98	0.206	-115
800.0	0.128	-113	25.41	-96	0.00	-40	0.200	-136
900.0	0.163	-115	25.41	-134	0.00	-40	0.179	-156
1000.0	0.189	-118	24.83	-169	0.00	-145	0.139	-175
1100.0	0.208	-128	24.55	154	0.00	-98	0.105	168
1200.0	0.205	-147	23.99	119	0.00	-84	0.085	142
1300.0	0.200	-167	23.44	81	0.00	-153	0.077	101
1400.0	0.197	155	23.71	45	0.00	167	0.117	46
1500.0	0.233	103	24.27	[illegible]	0.00	171	0.215	8
1600.0	0.334	39	24.27	-42	0.00	174	0.366	-26
1700.0	0.503	-16	20.18	-97	0.00	145	0.502	-61

V_{CC} = +12 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
100.0	1.2	1.3	26.8
200.0	1.2	1.4	26.5
300.0	1.3	1.4	26.7
400.0	1.3	1.4	26.7
500.0	1.3	1.5	26.8
600.0	1.3	1.5	27.1
700.0	1.3	1.5	27.1
800.0	1.4	1.5	27.1
900.0	1.4	1.5	27.0
1000.0	1.5	1.4	26.8
1100.0	1.5	1.3	26.7
1200.0	1.5	1.3	26.6
1300.0	1.6	1.3	26.6
1400.0	1.7	1.5	26.6
1500.0	2.0	1.9	26.7
1600.0	2.7	2.7	26.1
1700.0	3.9	3.5	23.6

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.0	0.105	-25	21.88	145	0.01	29	0.128	1
200.0	0.108	-57	21.13	110	0.00	84	0.154	[illegible]
300.0	[illegible]	-75	21.63	75	0.00	90	0.159	-50
400.0	0.128	-90	21.63	41	0.00	22	0.181	[illegible]
500.0	0.132	-98	21.88	8	0.00	-86	0.190	[illegible]
600.0	0.136	-105	22.65	-30	0.00	-38	[illegible]	[illegible]
700.0	0.142	-116	22.65	-64	0.00	-61	[illegible]	-121
800.0	0.156	-122	22.65	-104	0.00	-78	[illegible]	-142
900.0	0.184	-129	22.39	-141	0.00	-69	0.196	-162
1000.0	0.202	-134	21.06	-176	0.00	-99	0.152	173
1100.0	0.213	-143	21.63	146	0.00	-90	0.132	152
1200.0	0.212	-166	21.38	111	0.00	-106	0.123	118
1300.0	0.219	171	21.38	73	0.00	-116	0.127	79
1400.0	0.250	128	21.38	33	0.00	[illegible]	0.200	41
1500.0	0.335	75	21.63	-12	0.00	[illegible]	0.317	6
1600.0	0.460	22	20.18	-64	0.00	158	0.461	[illegible]
1700.0	0.593	-26	15.14	-115	[illegible]	127	0.155	-66

V_{CC} = +5 Vdc

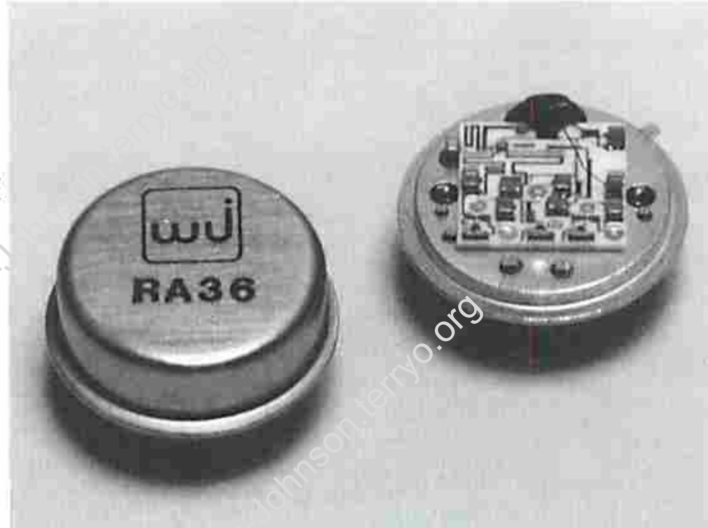
FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
100.0	1.4	1.3	24.0
200.0	1.4	1.4	23.8
300.0	1.4	1.4	23.9
400.0	1.5	1.5	23.7
500.0	1.5	1.5	23.5
600.0	1.5	1.5	23.6
700.0	1.6	1.5	23.3
800.0	1.7	1.5	23.0
900.0	1.7	1.4	22.8
1000.0	1.8	1.4	22.6
1100.0	1.8	1.4	22.7
1200.0	1.8	1.4	22.7
1300.0	2.1	1.5	23.0
1400.0	2.6	1.9	22.8
1500.0	3.5	2.5	22.0
1600.0	4.4	3.0	19.9
1700.0	5.0	3.3	16.4

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.0	0.155	-26	15.85	141	0.00	-12	0.145	-6
200.0	0.156	-55	15.45	102	0.00	-66	0.175	-39
300.0	0.176	-77	15.17	64	0.00	15	0.171	-54
400.0	0.190	-87	[illegible]	27	0.00	-30	0.164	-76
500.0	0.186	-100	14.96	-11	0.00	-43	0.153	-92
600.0	0.210	-111	15.14	-48	0.00	-39	0.203	-113
700.0	0.226	-124	14.62	-85	0.00	-43	0.202	-129
800.0	0.253	-136	14.13	-125	0.00	-57	0.190	-150
900.0	0.271	[illegible]	13.80	-163	0.00	-64	0.183	-169
1000.0	0.281	-161	13.49	161	0.00	-51	0.161	170
1100.0	0.293	179	13.65	124	0.00	-122	0.150	145
1200.0	0.292	151	13.65	86	0.00	-135	0.164	110
1300.0	0.361	122	14.13	43	0.00	-124	0.207	72
1400.0	0.445	79	13.80	-1	0.00	-155	0.311	31
1500.0	0.552	35	12.59	-54	0.00	168	0.429	-10
1600.0	0.627	-9	9.89	-103	0.00	130	0.500	-46
1700.0	0.669	-41	6.61	-147	0.00	122	0.500	76

WJ-RA36

100 TO 2000 MHz
TO-8B[1] CASCADABLE AMPLIFIER



- HIGH GAIN — THREE STAGES: 24.0 dB (TYP.)
- LOW VSWR: 1.4:1 (TYP.)
- HIGH OUTPUT LEVEL: +13.0 dBm (TYP.)

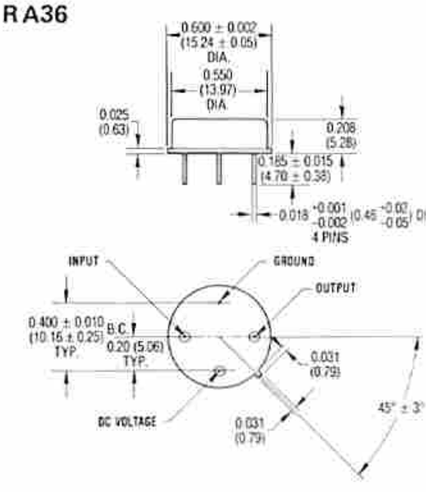
Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	50-2100 MHz	100-2000 MHz	100-2000 MHz
Small Signal Gain (Min.)	24.0 dB	23.0 dB	22.0 dB
Gain Flatness (Max.)	±0.5 dB	±0.9 dB	±1.0 dB
Noise Figure (Max.)	5.5 dB	6.5 dB	7.0 dB
Power Output at 1 dB Compression (Min.)	13.0 dBm	12.0 dBm	11.5 dBm
VSWR (Max.) Input/Output	1.4:1	1.8:1	2.0:1
DC Current (Max.) at +15 Volts	76 mA	81 mA	85 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.
Notes:
1. TO-8B is larger than standard TO-8 package. (See outline drawing.)

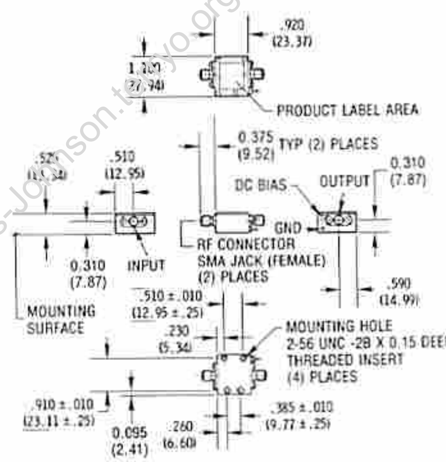
Outline Drawings

RA36



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .005 (.13) UNLESS OTHERWISE SPECIFIED

CRA36



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

*WJ-CRA36 is standard WJ-RA36 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point	40 dBm (Typ.)
Second Order Two Tone Intercept Point	34 dBm (Typ.)
Third Order Two Tone Intercept Point	22 dBm (Typ.)

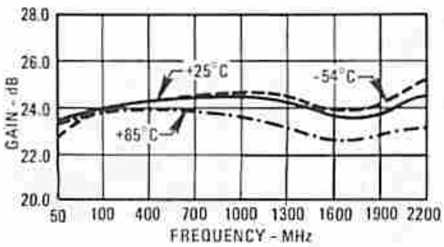
Absolute Maximum Ratings

Storage Temperature	-62°C to +125°C
Maximum Case Temperature	125°C
Maximum DC Voltage	+17 Volts
Maximum Continuous RF Input Power	+10 dBm
Maximum Short Term RF Input Power (1 Minute Max.)	+50 Milliwatts
Maximum Peak Power	.5 Watt (3 μsec Max.)
'S' Series Burn-In Temperature (Case)	125°C

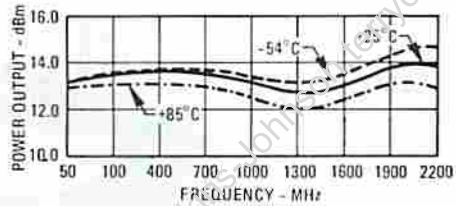
Weight approximately 3.0 grams (0.11 oz.)

Typical Performance at 25°C

Gain

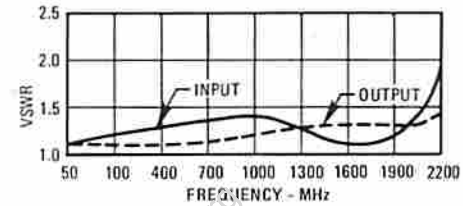


Power Output*

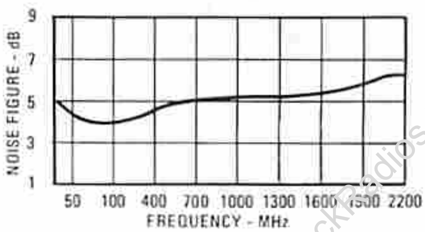


*at 1 dB Gain Compression

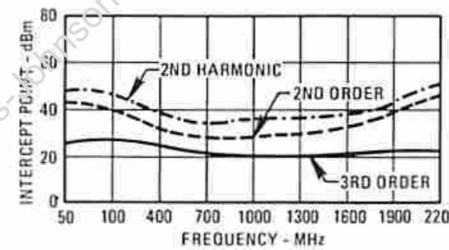
VSWR



Noise Figure



Intercept Point



Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
100.0	1.1	1.3	23.1
200.0	1.1	1.2	23.6
300.0	1.1	1.2	23.6
400.0	1.2	1.3	23.8
500.0	1.2	1.3	23.8
600.0	1.2	1.3	24.0
700.0	1.2	1.3	24.1
800.0	1.2	1.3	24.1
900.0	1.3	1.3	24.1
1000.0	1.3	1.4	24.1
1100.0	1.3	1.4	24.2
1200.0	1.2	1.5	24.1
1300.0	1.2	1.5	24.1
1400.0	1.2	1.5	23.8
1500.0	1.2	1.5	23.6
1600.0	1.2	1.6	23.7
1700.0	1.1	1.5	23.6
1800.0	1.2	1.4	23.5
1900.0	1.3	1.5	23.9
2000.0	1.4	1.5	24.6
2100.0	1.7	1.4	24.6

V_{CC} = +12 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
100.0	1.1	1.1	23.3
200.0	1.1	1.1	23.6
300.0	1.1	1.1	23.6
400.0	1.1	1.2	23.7
500.0	1.2	1.2	23.6
600.0	1.2	1.2	23.8
700.0	1.2	1.2	23.9
800.0	1.2	1.2	23.9
900.0	1.2	1.2	23.9
1000.0	1.2	1.3	23.9
1100.0	1.2	1.3	23.9
1200.0	1.2	1.3	23.9
1300.0	1.2	1.4	23.8
1400.0	[illegible]	1.4	23.6
1500.0	1.1	1.4	23.4
1600.0	1.1	1.4	23.5
1700.0	1.1	1.4	23.4
1800.0	1.2	1.2	23.3
1900.0	1.3	1.3	23.6
2000.0	1.4	1.3	24.1
2100.0	1.8	1.2	24.1

Linear S-Parameters

FREQUENCY MHz	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.0	0.056	-37	14.29	167	0.00	99	0.129	-52
200.0	0.052	-16	15.14	133	0.00	3	0.103	-48
300.0	0.058	-12	15.14	105	0.00	129	0.101	-54
400.0	0.087	-15	15.49	78	0.00	-12	0.115	-50
500.0	0.095	-21	15.49	50	0.00	-37	0.114	-61
600.0	0.105	-28	15.85	21	0.00	-63	0.118	-72
700.0	0.108	-35	16.03	-6	0.00	-37	0.126	-74
800.0	0.109	-50	16.03	-36	0.00	-52	0.122	-81
900.0	0.113	-53	16.03	-63	0.00	176	0.141	-90
1000.0	0.120	-71	16.03	-94	0.00	-133	0.157	-98
1100.0	0.113	-76	16.22	-122	0.00	-113	0.168	-92
1200.0	0.109	-85	16.03	-140	0.00	-133	0.185	-106
1300.0	0.098	-100	16.03	-177	[illegible]	-96	0.211	-111
1400.0	0.090	-112	15.49	156	0.00	8	0.208	-116
1500.0	0.088	-123	15.14	127	0.00	-153	0.211	-128
1600.0	0.076	-149	15.31	100	0.00	-156	0.233	-137
1700.0	0.067	178	15.14	[illegible]	0.00	112	0.212	-149
1800.0	0.086	131	14.96	[illegible]	0.00	145	0.171	-156
1900.0	0.112	101	15.67	[illegible]	0.00	115	0.197	-164
2000.0	0.173	79	16.98	-17	0.00	145	0.195	-174
2100.0	0.267	58	[illegible]	-51	0.00	176	0.170	163
2200.0	0.403	34	16.60	-91	0.00	-183	0.189	131

WJ-RA38

200 TO 2000 MHz
TO-8B[1] CASCADABLE AMPLIFIER

- HIGH GAIN - TWO STAGES: 16.0 dB (TYP.)
- LOW VSWR: <1.8:1 (TYP.)
- HIGH OUTPUT LEVEL: 18.5 dBm (TYP.)

Specifications*

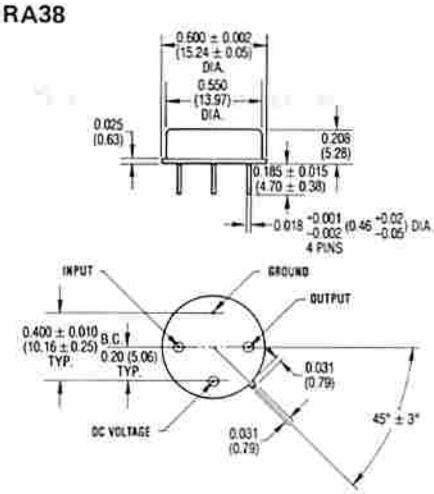
Characteristics	Typical	Guaranteed 0° -50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	200-2000 MHz	200-2000 MHz	200-2000 MHz
Small Signal Gain (Min.)	16.0 dB	14.5 dB	13.5 dB
Gain Flatness (Max.)	±0.5 dB	±1.0 dB	±1.2 dB
Noise Figure (Max.)			
200-1750 MHz	6.0 dB	6.7 dB	7.0 dB
200-2000 MHz	6.8 dB	7.5 dB	8.0 dB
Power Output at 1 dB Compression (Min.)			
200-1800 MHz	18.5 dBm	17.5 dBm	16.5 dBm
1800-2000 MHz	17.0 dBm	16.0 dBm	15.5 dBm
VSWR (Max.) Input/Output	<1.8:1	2.3:1	2.3:1
DC Current at 15 Volts (Max.)	127 mA	132 mA	133 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Notes: 1. TO-8B is larger than standard TO-8 package.

Outline Drawing

RA38



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +39 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +35 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +25 dBm (Typ.)

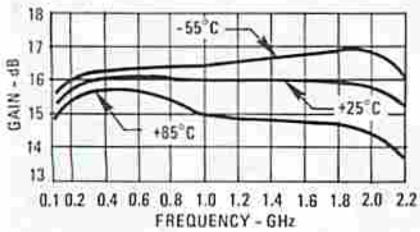
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 100°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Input Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 100°C

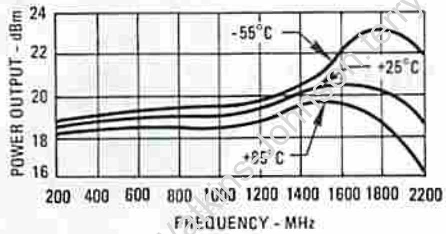
Weight approximately 3.0 grams (0.11 oz.)

Typical Performance at 25°C

Gain

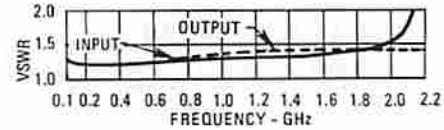


Power Output*

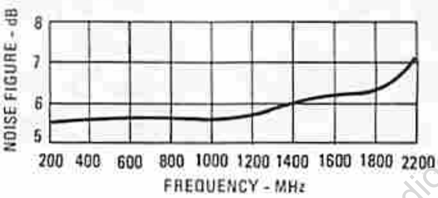


*at 1 dB Gain Compression

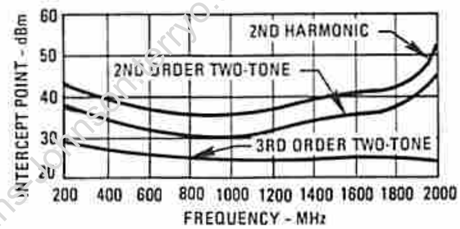
VSWR



Noise Figure



Intercept Point



Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
200.	1.2	1.2	15.8
300.	1.2	1.2	16.0
400.	1.2	1.2	16.1
500.	1.3	1.2	16.1
600.	1.3	1.2	16.2
700.	1.3	1.3	16.0
800.	1.3	1.3	16.1
900.	1.3	1.3	16.0
1000.	1.3	1.4	16.0
1100.	1.4	1.4	15.9
1200.	1.4	1.4	15.9
1300.	1.4	1.4	15.9
1400.	1.4	1.4	16.0
1500.	1.3	1.4	16.0
1600.	1.3	1.4	16.0
1700.	1.2	1.4	15.9
1800.	1.2	1.4	15.9
1900.	1.2	1.3	15.9
2000.	1.4	1.3	15.8
2100.	1.8	1.3	15.6
2200.	2.3	1.3	15.3

Linear S-Parameters

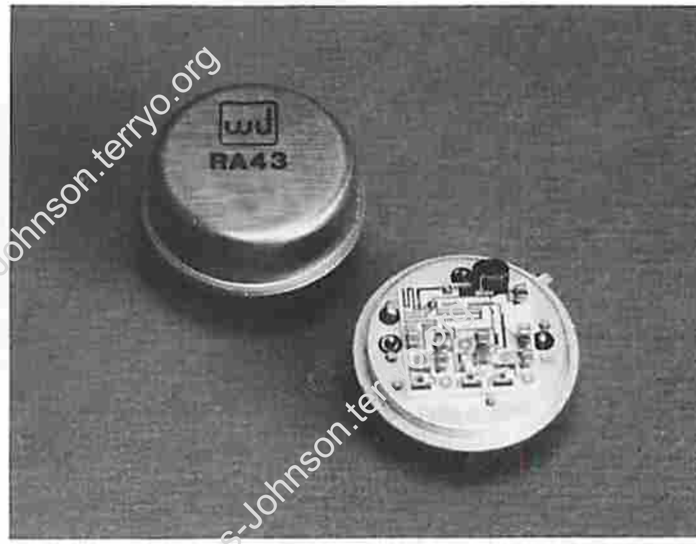
FREQ MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
200.	.10	-86.9	6.14	-28.0	.04	-.1	.08	-170.6
300.	.10	-99.9	6.34	-51.3	.04	-9.9	.08	165.8
400.	.11	-108.9	6.36	-71.4	.04	-18.1	.08	145.2
500.	.12	-112.4	6.40	-89.5	.04	-23.7	.09	126.2
600.	.12	-117.7	6.43	-108.5	.04	-30.1	.10	108.1
700.	.13	-120.2	6.34	-126.7	.04	-35.1	.12	88.6
800.	.13	-123.5	6.39	-145.8	.04	-42.0	.13	72.0
900.	.14	-125.7	6.34	-164.6	.04	-48.6	.14	54.4
1000.	.14	-127.9	6.27	176.3	.04	-55.7	.15	36.6
1100.	.15	-130.8	6.24	157.1	.04	-63.0	.16	18.1
1200.	.15	-133.8	6.20	137.8	.04	-69.6	.16	-.3
1300.	.16	-138.7	6.24	119.2	.04	-77.5	.16	-20.5
1400.	.15	-145.3	6.29	101.0	.04	-84.6	.16	-40.9
1500.	.14	-154.2	6.32	82.8	.04	-91.7	.16	-61.4
1600.	.13	-169.1	6.34	64.4	.04	-98.9	.16	-82.9
1700.	.10	169.8	6.27	45.5	.04	-106.3	.16	-103.5
1800.	.08	128.9	6.25	25.5	.05	-113.8	.15	-123.7
1900.	.10	72.1	6.21	4.3	.05	-121.5	.14	-142.7
2000.	.18	35.1	6.18	-18.1	.05	-129.9	.13	-160.0
2100.	.28	12.2	6.00	-41.7	.05	-139.6	.13	177.5
2200.	.39	-8.3	5.83	-64.6	.05	-148.8	.12	167.3

1

WJ-RA43

1000 TO 4000 MHz TO-8B[1] CASCADABLE AMPLIFIER

- ULTRA-WIDE BANDWIDTH: 1-4 GHz
- HIGH GAIN: 21 dB (TYP.)
- LOW NOISE: 4.5 dB (TYP.)
- MEDIUM OUTPUT POWER: 11.5 dBm (TYP.)
- GaAs FET DESIGN



Specifications *

Characteristics	Typical	Guaranteed 0°C- 50°C	Guaranteed -54° - +85°C
Frequency (Min.)	800-4000 MHz	1000-4000 MHz	1000-4000 MHz
Small Signal Gain (Min.)	21.0 dB	19.5 dB	18.0 dB
Gain Flatness (Max.)	± 0.7 dB	± 0.9 dB	± 1.2 dB
Noise Figure (Max.)	4.5 dB	5.3 dB	5.8 dB
Power Output at 1 dB Compression (Min.)	12.0 dBm	10.5 dBm	9.5 dBm
VSWR (Max.) Input/Output	1.4:1	2.0:1	2.0:1
DC Current (Max.) at 5 Volts	115 mA	140 mA	155 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Notes:

1. TO-8B is larger than standard TO-8 package. (See outline drawing).

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . . 35 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . . 31 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . . 22 dBm (Typ.)

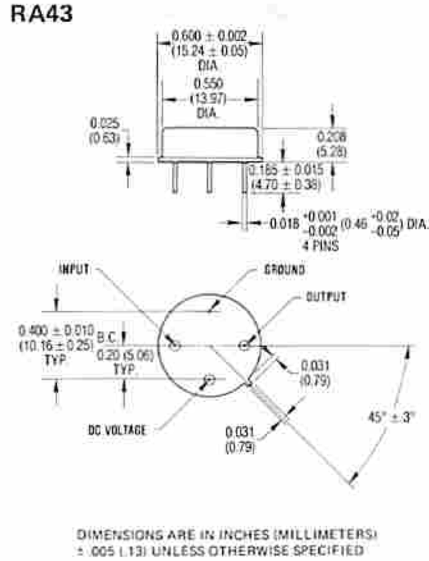
Absolute Maximum Ratings

Storage Temperature . . . . . -64°C to +125°C
Maximum Case Temperature . . . . . 125°C
Maximum DC Voltage . . . . . +6 Volts
Maximum Continuous RF Input Power . . . . . +7 dBm
Maximum Short Term Input Power (1Minute Max.) . . . . . +100 Milliwatts
Maximum Peak Power . . . . . 0.25 Watt (3 µsec Max.)
"S" Series Burn-In Temperature (Case) . . . . . 125°C

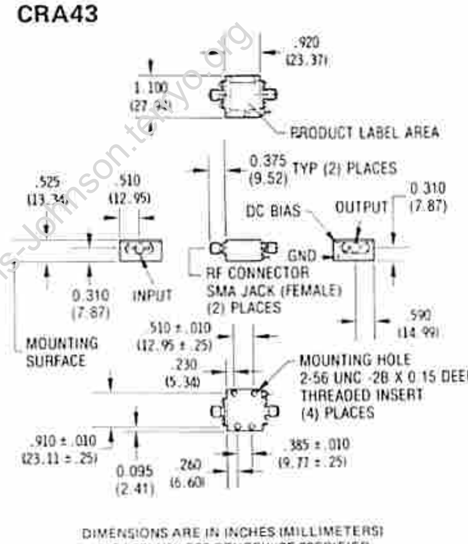
Weight approximately 3.0 grams (0.11 oz.)

Outline Drawings

RA43

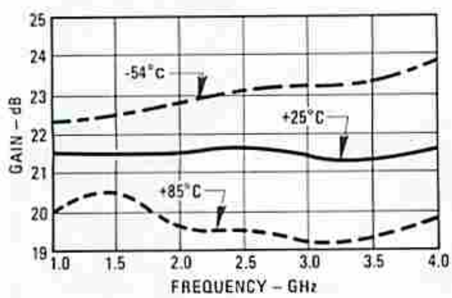


CRA43

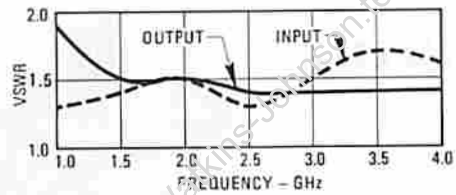


Typical Performance at 25°C

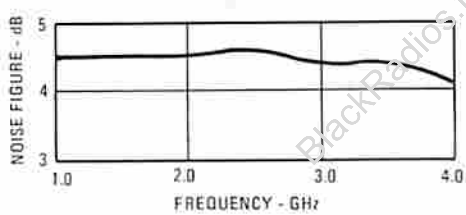
Gain vs. Temperature



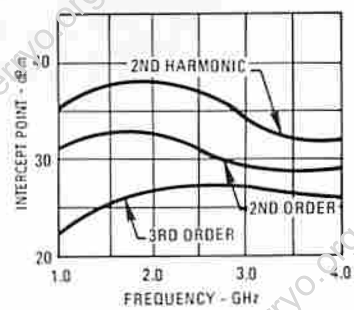
VSWR



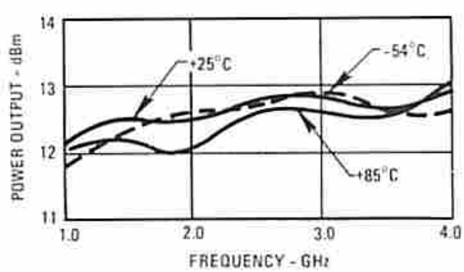
Noise Figure



Intercept Point



Power Output* vs. Temperature



*at 1 dB Gain Compression

Typical Automatic Test Data

V_{CC} = +5 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
800.0	1.3	2.2	21.32
900.0	1.3	2.1	21.39
1000.0	1.3	1.9	21.45
1100.0	1.3	1.7	21.51
1200.0	1.3	1.6	21.53
1300.0	1.3	1.5	21.54
1400.0	1.3	1.5	21.51
1500.0	1.4	1.5	21.48
1600.0	1.4	1.5	21.47
1700.0	1.4	1.5	21.45
1800.0	1.4	1.5	21.43
1900.0	1.4	1.5	21.45
2000.0	1.5	1.5	21.49
2100.0	1.4	1.5	21.50
2200.0	1.4	1.5	21.55
2300.0	1.4	1.5	21.56
2400.0	1.3	1.5	21.59
2500.0	1.3	1.4	21.60
2600.0	1.3	1.4	21.58
2700.0	1.3	1.4	21.53
2800.0	1.4	1.4	21.51
2900.0	1.5	1.4	21.43
3000.0	1.5	1.4	21.36
3100.0	1.6	1.4	21.29
3200.0	1.7	1.4	21.25
3300.0	1.7	1.4	21.23
3400.0	1.7	1.4	21.21
3500.0	1.7	1.4	21.25
3600.0	1.7	1.4	21.29
3700.0	1.7	1.4	21.35
3800.0	1.6	1.4	21.40
3900.0	1.6	1.4	21.40
4000.0	1.6	1.4	21.56
4100.0	1.5	1.4	21.61
4200.0	1.5	1.5	21.60

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
800.0	.147	143	11.644	-116	.004	84	.381	[illegible]
900.0	.143	120	11.736	-153	.004	66	.351	-59
1000.0	.140	100	11.815	178	.005	40	.315	-62
1100.0	.139	86	11.895	152	.002	42	.272	-62
1200.0	.139	74	11.929	129	.004	23	.237	-60
1300.0	.142	65	11.939	107	.003	5	.214	-56
1400.0	.146	57	11.897	86	.004	-16	.202	-51
1500.0	.153	51	11.864	67	.002	-21	.200	-47
1600.0	.162	44	11.845	48	.003	-13	.203	-44
1700.0	.172	38	11.823	30	.003	[illegible]	.206	-43
1800.0	.179	31	11.785	13	.002	-100	.209	-45
1900.0	.182	23	11.812	-4	.002	-60	.213	-47
2000.0	.184	16	11.870	-21	.002	-102	.210	-49
2100.0	.177	9	11.883	-37	.002	-117	.206	-54
2200.0	.165	-3	11.949	-53	.002	-149	.202	-59
2300.0	.150	-17	11.971	-70	.003	-166	.192	-64
2400.0	.138	-33	12.012	-86	.001	-133	.185	-71
2500.0	.131	-55	12.020	-100	.003	-135	.177	-77
2600.0	.133	-76	11.992	-118	.002	-165	.168	-83
2700.0	.144	-96	11.920	[illegible]	.003	-147	.168	-90
2800.0	.165	-112	11.898	150	.001	141	.163	-97
2900.0	.189	-124	11.786	165	.001	107	.160	-104
3000.0	.212	-134	11.691	180	.002	130	.160	-111
3100.0	.232	-141	[illegible]	165	.002	115	.162	-116
3200.0	.246	-146	11.548	150	.002	126	.162	-122
3300.0	.257	-150	11.515	136	.003	126	.167	-127
3400.0	.262	-153	11.493	121	.004	95	.171	-132
3500.0	.262	[illegible]	11.543	107	.003	112	.172	-137
3600.0	.259	-158	11.601	92	.003	68	.175	-140
3700.0	.251	-160	11.687	78	.003	65	.175	-144
3800.0	.245	-162	11.744	63	.004	68	.178	-148
3900.0	.234	-164	11.857	48	.001	74	.178	-151
4000.0	[illegible]	-166	11.967	33	.002	42	.182	-155
4100.0	.216	-168	12.039	17	.004	63	.182	-159
4200.0	.210	-170	12.131	1	.002	50	.189	-165

WJ-RA46

1 TO 4 GHz TO-8B CASCADABLE AMPLIFIER

- HIGH GAIN: 25.5 dB (TYP.)
- MEDIUM OUTPUT POWER: +19.0 dBm (TYP.)
- LOW NOISE: 4.0 dB (TYP.)
- GaAs FET Design

Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	.8-4.2 GHz	1-4 GHz	1-4 GHz
Small Signal Gain (Min.)	25.5 dB	24.0 dB	23.5 dB
Gain Flatness (Max.)	±0.5 dB	±0.8 dB	±1.0 dB
Noise Figure (Max.)	4.5 dB	5.2 dB	5.7 dB
Power Output at 1 dB Compression (Min.)	19.0 dBm	17.0 dBm	16.5 dBm
VSWR (Max.)			
Input	1.6:1	2.0:1	2.1:1
Output	1.5:1	2.0:1	2.1:1
DC Current (Max.) at +12 Volts	175 mA	185 mA	190 mA

*Measured in a 50-ohm system at +12 Vdc Nominal.

Notes:

1. TO-8B is larger than standard TO-8 package. (See outline drawing).

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . .55 dBm (Typ.)
Second Order Two Tone Intercept Point .50 dBm (Typ.)
Third Order Two Tone Intercept Point .30 dBm (Typ.)

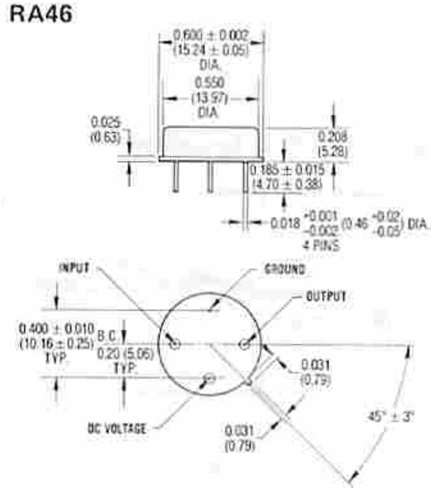
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 100°C
Maximum DC Voltage . . . . 13 Volts
Maximum Continuous RF Input Power . . . . +7 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . +100 Milliwatts
Maximum Peak Power . . . . 0.25 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 100°C

Weight approximately 3.0 grams (0.11 oz.)

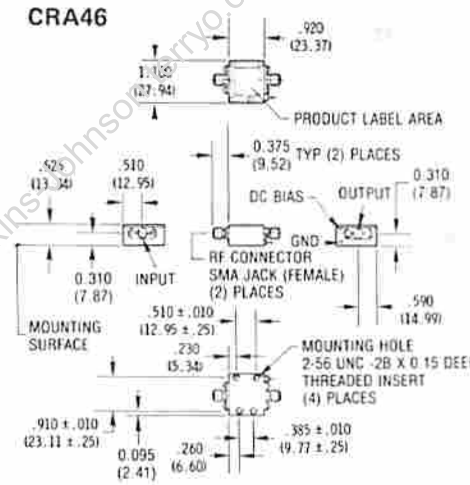
Outline Drawings

RA46



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CRA46

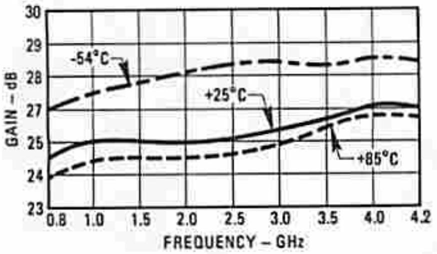


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

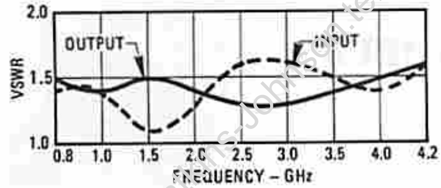
*WJ-CA RA46 is standard.
WJ-RA46 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

Typical Performance at 25°C

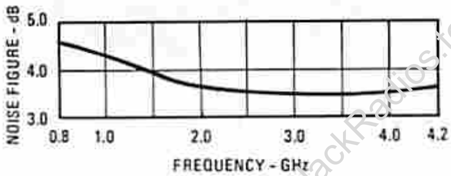
Gain



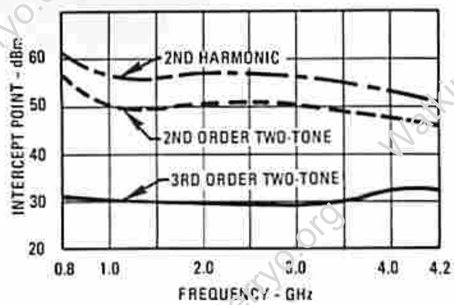
VSWR



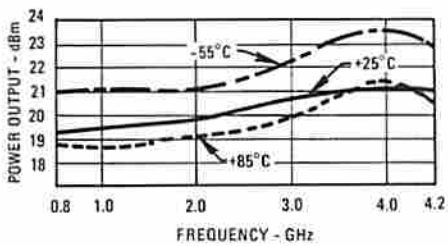
Noise Figure



Intercept Point



Power Output*



*at 1 dB Gain Compression

Typical Automatic Test Data

V_{CC} = +12 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
800.0	1.4	1.5	25.5
1000.0	1.4	1.4	26.0
1200.0	1.3	1.5	26.1
1400.0	1.1	1.5	26.0
1600.0	1.0	1.5	26.0
1800.0	1.1	1.4	25.9
2000.0	1.3	1.4	26.0
2200.0	1.4	1.4	26.0
2400.0	1.6	1.3	26.0
2600.0	1.7	1.3	26.1
2800.0	1.7	1.3	26.2
3000.0	1.6	1.3	26.4
3200.0	1.5	1.3	26.4
3400.0	1.5	1.3	26.6
3600.0	1.4	1.4	26.8
3800.0	1.3	1.5	26.9
4000.0	1.4	1.5	27.1
4200.0	1.6	1.6	27.0

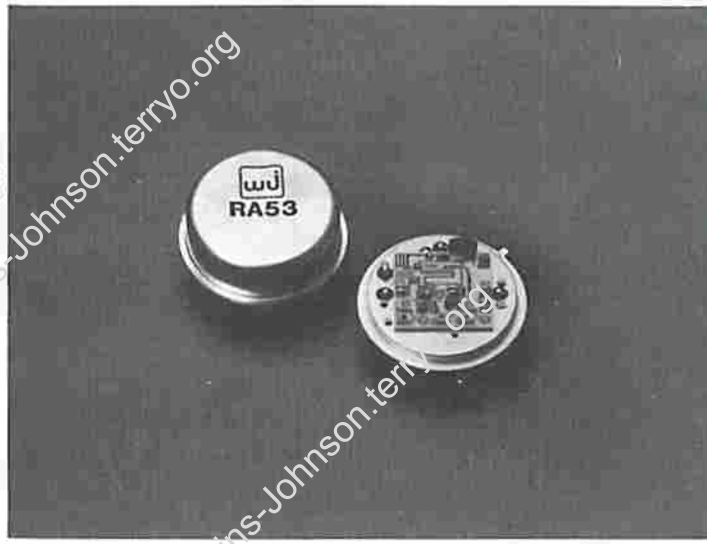
Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
800.0	.165	-126	18.851	-151	.003	54	.215	26
1000.0	.150	-121	19.889	142	.003	7	.180	30
1200.0	.114	-144	20.070	88	.003	-16	.190	26
1400.0	.053	178	19.954	42	.002	-43	.196	17
1600.0	.023	47	19.898	-0	.002	-75	.192	6
1800.0	.069	-22	19.798	-38	.002	-84	.180	-7
2000.0	.127	-57	19.863	-75	.002	-104	.168	-23
2200.0	.179	-86	19.989	-114	.002	-108	.155	-41
2400.0	.221	-109	20.024	-151	.001	-122	.142	-58
2600.0	.246	-132	20.268	173	.001	-160	.133	-75
2800.0	.249	-152	20.504	140	.001	-173	.122	-93
3000.0	.239	-174	20.813	104	.000	-143	.116	-114
3200.0	.214	162	20.960	68	.001	-121	.116	-137
3400.0	.184	135	21.349	31	.000	-146	.130	-158
3600.0	.151	101	21.805	-7	.001	-103	.154	-174
3800.0	.135	60	22.193	-42	.001	-114	.184	177
4000.0	.158	12	22.526	-82	.001	-95	.215	170
4200.0	.233	-27	22.290	-124	.001	-139	.238	164

WJ-RA53

1000 TO 5000 MHz
TO-8B[1] CASCADABLE AMPLIFIER

- ULTRA-WIDE BANDWIDTH: 1-5 GHz
- HIGH GAIN: 21 dB (TYP.)
- LOW NOISE 4.5 dB (TYP.)
- MEDIUM OUTPUT POWER: 11.5 dBm (TYP.)
- GaAs FET DESIGN



Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54° – +85°C
Frequency (Min.)	800-5000 MHz	1000-5000 MHz	1000-5000 MHz
Small Signal Gain (Min.)	21.0 dB	19.5 dB	18.0 dB
Gain Flatness (Max.)	±0.7 dB	±0.9 dB	±1.2 dB
Noise Figure (Max.)	4.5 dB	5.3 dB	5.8 dB
Power Output at 1 dB Compression (Min.)	11.5 dBm	10.5 dBm	9.5 dBm
VSWR (Max.) Input/Output	1.7:1	2.1:1	2.3:1
DC Current (Max.) at 5 Volts	115 mA	140 mA	150 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Notes:

1. TO-8 B is larger than standard TO-8 package. (See outline drawing).

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 35 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 31 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 22 dBm (Typ.)

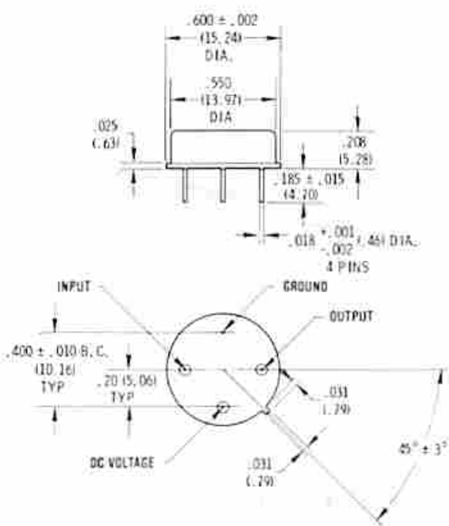
Absolute Maximum Ratings

Storage Temperature . . . . -64°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +6 Volts
Maximum Continuous RF Input Power . . . . +7 dBm
Maximum Short Term Input Power (1 Minute Max.) . . . . +100 Milliwatts
Maximum Peak Power . . . . 0.25 Watt (3 µsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Weight approximately 3.0 grams (0.11 oz.)

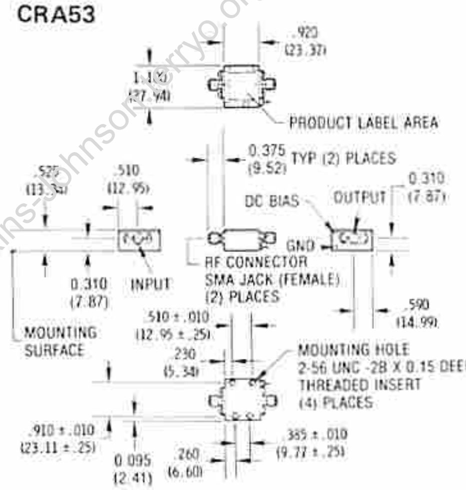
Outline Drawings

RA53



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.005 (.13) UNLESS OTHERWISE SPECIFIED

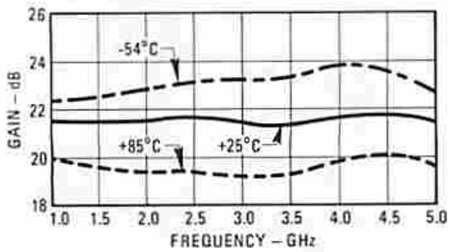
CRA53



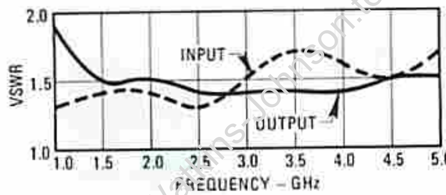
DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C

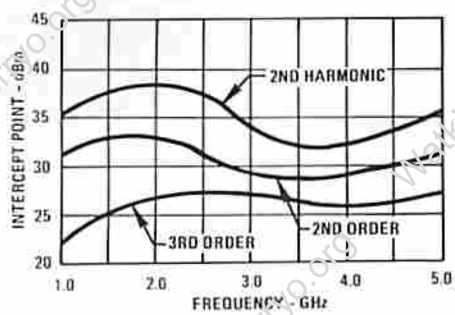
Gain



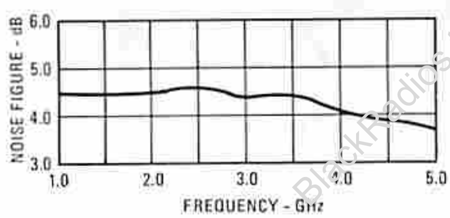
VSWR



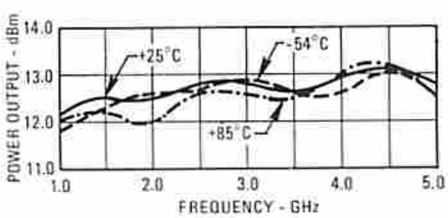
Intercept Point



Noise Figure



Power Output*



*at 1 dB Gain Compression

Typical Automatic Test Data

V_{CC} = +5 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
800.0	1.3	2.2	21.38
1000.0	1.3	1.9	21.47
1200.0	1.3	1.6	21.53
1400.0	1.3	1.5	21.48
1600.0	1.4	1.5	21.45
1800.0	1.4	1.5	21.43
2000.0	1.4	1.5	21.48
2200.0	1.4	1.5	21.56
2400.0	1.3	1.4	21.62
2600.0	1.3	1.4	21.62
2800.0	1.4	1.4	21.56
3000.0	1.5	1.4	21.41
3200.0	1.6	1.4	21.29
3400.0	1.7	1.4	21.24
3600.0	1.7	1.4	21.32
3800.0	1.6	1.4	21.44
4000.0	1.6	1.4	21.55
4200.0	1.5	1.4	21.64
4400.0	1.5	1.5	21.68
4600.0	1.5	1.5	21.65
4800.0	1.6	1.5	21.56
5000.0	1.7	1.5	[illegible]
5200.0	1.8	1.5	[illegible]

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
800.0	.142	149	11.716	-118	.004	88	.381	-55
1000.0	.139	105	11.839	178	.005	47	.311	-62
1200.0	.137	84	11.924	129	.004	14	.238	-60
1400.0	.143	67	11.854	86	.003	-40	.202	-51
1600.0	.159	46	11.814	48	.002	-22	.202	-45
1800.0	.177	32	11.791	13	.002	-58	.207	-46
2000.0	.180	18	11.854	-20	.003	-93	.208	-49
2200.0	.163	-1	11.971	-53	.002	-117	.197	-60
2400.0	.135	-31	12.055	-86	.002	-164	.182	-72
2600.0	.127	-74	12.057	-118	0.000	-67	.169	-86
2800.0	.160	-112	11.961	-150	.003	162	.160	-100
3000.0	.208	-134	11.766	-180	.002	144	.158	-113
3200.0	.244	-146	11.607	150	.001	111	.161	-125
3400.0	.260	-153	11.540	121	.004	103	.164	-135
3600.0	.256	-159	11.647	92	.003	85	.171	-143
3800.0	.242	-162	11.798	62	.002	88	.174	-151
4000.0	.223	-166	11.949	32	.001	[illegible]	.176	-158
4200.0	.205	-171	12.074	1	.003	42	.179	-167
4400.0	.202	-178	12.127	-31	.002	77	.187	179
4600.0	.210	173	12.092	-64	.003	42	.194	158
4800.0	.231	165	12.000	-97	.003	40	.200	136
5000.0	.252	159	11.804	-132	.002	55	.212	115
5200.0	.276	158	11.453	-160	.002	54	.212	97

1

WJ-RA62

2 TO 6 GHz
TO-8B CASCADABLE AMPLIFIER

- ULTRA WIDE BANDWIDTH
- MEDIUM GAIN BLOCK
- MEDIUM OUTPUT POWER: +13.0 dBm (TYP.)
- GOOD NOISE FIGURE: 4.0 dB (TYP.)
- LOW CURRENT DRAIN: 65 mA (TYP.)

Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	1.5-6.2 GHz	2-6 GHz	2-6 GHz
Small Signal Gain (Min.)	16.0 dB	14.0 dB	13.5 dB
Gain Flatness (Max.)	±0.4 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	4.0 dB	5.0 dB	5.5 dB
Power Output at 1 dB Compression (Min.)	+13.0 dBm	+12.0 dBm	+11.5 dBm
VSWR (Max.)			
Input	1.5:1	2.0:1	2.0:1
Output	1.3:1	2.0:1	2.0:1
DC Current (Max.) at +5 Volts	65 mA	72 mA	74 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Notes:
1. TO-8 B is larger than standard TO-8 package. (See outline drawing).

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . . . 45 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . . . 40 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . . . 28 dBm (Typ.)

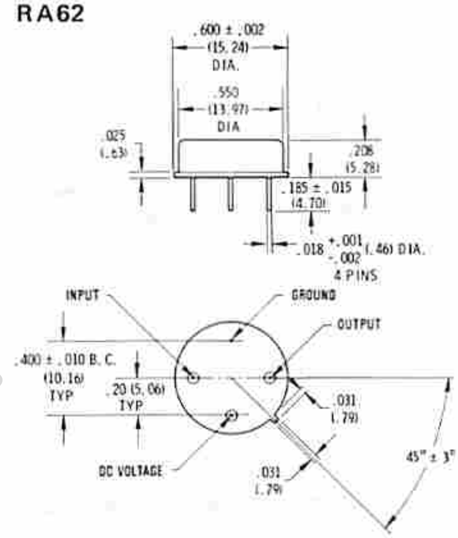
Absolute Maximum Ratings

Storage Temperature . . . . . . -62°C to 125°C
Maximum Case Temperature . . . . . . 125°C
Maximum DC Voltage . . . . . . +6 Volts
Maximum Continuous RF Input Power . . . . . . +7 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . . . 100 Milliwatts
Maximum Peak Power . . . . . . .5 Watt
. . . . . . (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . . . 125°C

Weight approximately 3.0 grams (0.11 oz.)

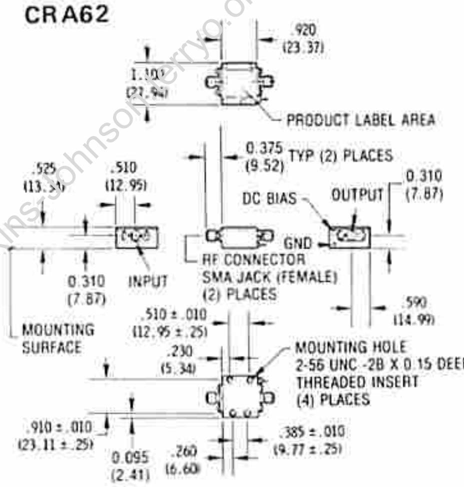
Outline Drawings

RA62



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.005 (.13) UNLESS OTHERWISE SPECIFIED

CRA62

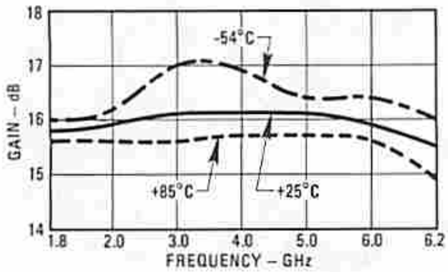


DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

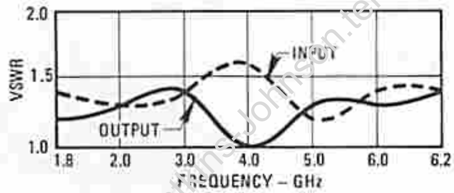
*WJ-CRA62 is standard WJ-RA36 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

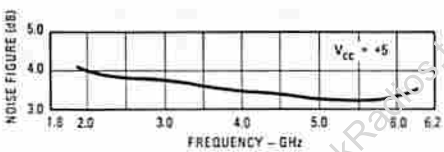
Gain



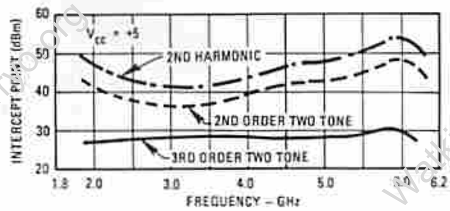
VSWR



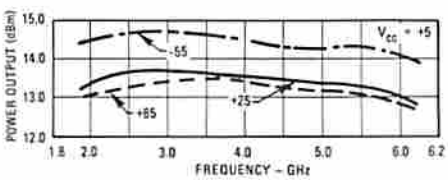
Noise Figure



Intercept Point



Power Output*



*at 1 dB Gain Compression

Typical Automatic Test Data

V_{cc} = +5 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
1800.0	1.4	1.2	15.8
2000.0	1.3	1.3	15.9
2200.0	1.2	1.4	16.0
2400.0	1.2	1.4	16.1
2600.0	1.2	1.5	16.1
2800.0	1.3	1.5	16.1
3000.0	1.4	1.4	16.1
3200.0	1.5	1.3	16.1
3400.0	1.5	1.2	16.1
3600.0	1.6	1.1	16.1
3800.0	1.6	1.0	16.1
4000.0	1.6	1.0	16.1
4200.0	1.5	1.0	16.1
4400.0	1.4	1.1	16.1
4600.0	1.3	1.2	15.0
4800.0	1.2	1.2	16.1
5000.0	1.2	1.3	16.1
5200.0	1.2	1.3	16.3
5400.0	1.3	1.3	16.4
5600.0	1.3	1.3	16.4
5800.0	1.3	1.3	16.2
6000.0	1.4	1.3	15.9
6200.0	1.4	1.4	15.5

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22		K
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG	
1800.0	.171	6	6.157	-133	.025	-55	.056	72	3.217
2000.0	.132	-18	6.255	-156	.024	-70	.121	78	3.246
2200.0	.099	-45	6.329	-173	.024	-84	.150	78	3.308
2400.0	.085	-87	6.376	160	.023	-97	.174	76	3.308
2600.0	.096	-125	[illegible]	138	.022	-110	.189	72	3.427
2800.0	.123	-151	[illegible]	116	.021	-121	.185	67	3.544
3000.0	.155	-168	6.407	95	.021	-133	.164	63	3.617
3200.0	.189	-180	6.378	73	.020	-145	.128	58	3.765
3400.0	.212	172	6.371	53	.019	-155	.090	56	3.936
3600.0	.230	164	6.363	32	.019	-166	.051	56	4.039
3800.0	.231	156	6.356	11	.018	-175	.024	65	4.178
4000.0	.218	148	6.364	-10	.018	175	.013	74	4.248
4200.0	.192	137	6.369	-32	.018	165	.019	52	[illegible]
4400.0	.152	125	6.375	-52	.018	156	.039	33	[illegible]
4600.0	.126	111	6.344	-73	.018	145	.073	25	4.322
4800.0	.099	89	6.351	-95	.018	133	.109	14	4.251
5000.0	.088	57	6.400	-116	.019	119	.135	[illegible]	4.129
5200.0	.098	21	6.532	-137	.019	106	.139	-12	4.055
5400.0	.115	-13	6.625	-161	.018	92	.131	-29	4.110
5600.0	.135	-41	6.601	174	.018	80	.119	-51	4.180
5800.0	.147	-65	6.493	148	.018	65	[illegible]	-79	4.277
6000.0	.151	-87	6.255	122	.017	52	.142	-102	4.493
6200.0	.151	-103	5.961	97	.017	38	.170	-118	4.698

1

WJ-RA63

2 TO 6 GHz
TO-8B CASCADABLE AMPLIFIER

- ULTRA WIDE BANDWIDTH: 2-6 GHz
- HIGH GAIN: +18.5 dB (TYP.)
- MEDIUM OUTPUT POWER: +13 dBm (TYP.)
- LOW POWER SUPPLY VOLTAGE: +5 VDC
- GaAs FET DESIGN

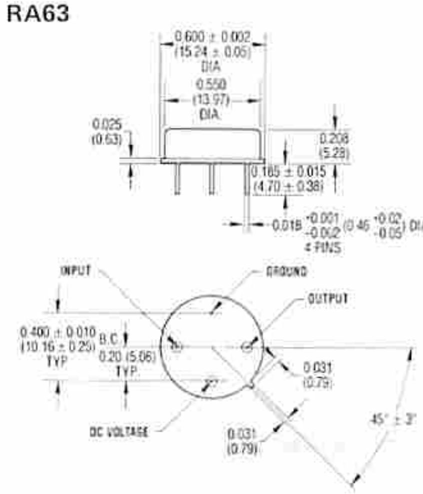
Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	1.8-6.2 GHz	2-6 GHz	2-6 GHz
Small Signal Gain (Min.)	18.5 dB	16.5 dB	15.5 dB
Gain Flatness (Min.)	±0.5 dB	±1.0 dB	±1.2 dB
Noise Figure (Max.)	5.5 dB	7.0 dB	7.5 dB
Power Output at 1 dB Compression (Min.)	13.0 dBm	10.0 dBm	9.5 dBm
VSWR (Max.)			
Input	1.7:1	2.2:1	2.3:1
Output	1.7:1	2.2:1	2.3:1
DC Current (Max.) at +5 Volts	120 mA	135 mA	140 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Outline Drawing

RA63



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .005 (.13) UNLESS OTHERWISE SPECIFIED

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point .... 38 dBm (Typ.)
Second Order Two Tone Intercept Point .... 30 dBm (Typ.)
Third Order Two Tone Intercept Point .... 25 dBm (Typ.)

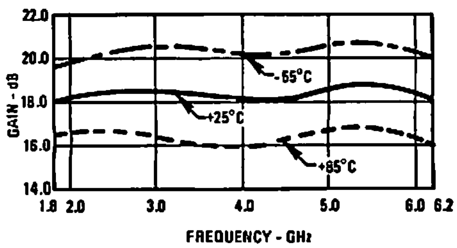
Absolute Maximum Ratings

Storage Temperature .... -64°C to 125°C
Maximum Case Temperature .... 125°C
Maximum DC Voltage .... +6 Volts
Maximum Continuous RF Input Power .... +7 dBm
Maximum Short Term RF Input Power (1 Minute Max.) .... 100 Milliwatts
Maximum Peak Power .... 0.25 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) .... 125°C

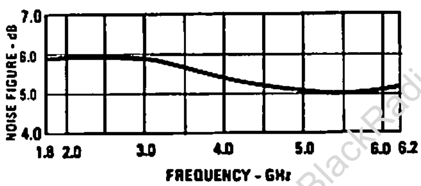
Weight approximately 3.0 grams (0.11 oz.)

Typical Performance at 25°C

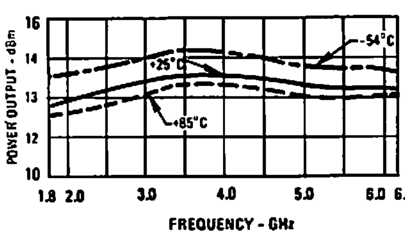
Gain



Noise Figure

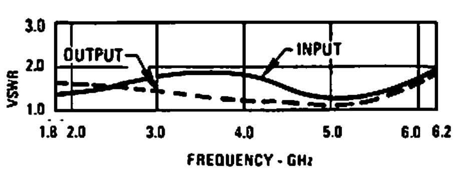


Power Output*

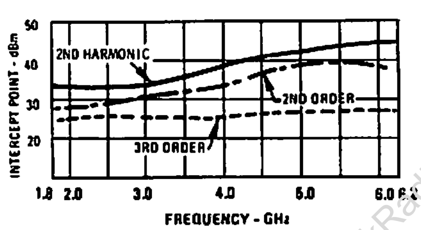


*at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{CC} = +5 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
1800.0	1.4	1.6	18.04
2000.0	1.4	1.6	18.23
2200.0	1.4	1.5	18.37
2400.0	1.4	1.5	18.45
2600.0	1.5	1.5	18.47
2800.0	1.6	1.4	18.45
3000.0	1.7	1.4	18.39
3200.0	1.9	1.3	18.27
3400.0	1.8	1.3	18.17
3600.0	1.8	1.3	18.13
3800.0	1.8	1.2	18.12
4000.0	1.8	1.2	18.16
4200.0	1.7	1.2	18.27
4400.0	1.6	1.2	18.37
4600.0	1.4	1.2	18.45
4800.0	1.3	1.1	18.51
5000.0	1.3	1.0	18.58
5200.0	1.2	1.1	18.66
5400.0	1.2	1.2	18.72
5600.0	1.3	1.3	18.74
5800.0	1.5	1.4	18.65
6000.0	1.8	1.6	18.44
6200.0	1.9	1.8	18.09

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1800.0	.164	-60	7.976	53	.004	-56	.218	34
2000.0	.154	-53	8.156	26	.003	-83	.217	32
2200.0	.154	-67	8.292	-0	.004	-69	.211	30
2400.0	.162	-79	8.361	-26	.004	-92	.199	27
2600.0	[illegible]	-95	8.387	-52	.002	-104	.186	23
2800.0	.226	-110	8.370	-77	.003	-126	.171	18
3000.0	.271	-121	8.304	-101	.002	-128	.156	10
3200.0	.309	-128	8.191	-125	.001	-115	.141	-1
3400.0	.275	-134	8.097	-140	.002	155	.126	-13
3600.0	.283	-139	8.063	-170	.003	70	.118	-27
3800.0	.287	-144	8.056	167	.001	128	.109	-42
4000.0	.289	-150	8.090	145	.002	131	.105	-53
4200.0	.277	-158	8.190	122	.001	144	.098	-62
4400.0	.224	-168	8.290	99	.001	25	.084	-69
4600.0	.181	-180	8.370	75	.001	-33	.070	-74
4800.0	.147	170	8.425	52	.002	35	.045	-86
5000.0	.117	164	8.493	27	.003	-12	.018	-110
5200.0	.087	177	8.572	3	.001	-23	.027	128
5400.0	.081	-145	8.625	-23	.003	-55	.073	108
5600.0	.130	-116	8.645	-49	.002	-104	.125	103
5800.0	.203	-105	8.557	-77	.002	-89	.180	97
6000.0	.277	-103	8.352	-105	.002	-119	.237	90
6200.0	.318	-104	8.030	-135	.003	-110	.285	82

1

WJ-RA63-1

2 TO 6 GHz
TO-8B CASCADABLE AMPLIFIER

- ULTRA WIDE BANDWIDTH: 2-6 GHz
- HIGH GAIN: 19.5 dB (TYP.)
- MEDIUM OUTPUT POWER: 16.0 dBm (TYP.)
- LOW POWER SUPPLY VOLTAGE: +5 VDC
- GaAs FET DESIGN

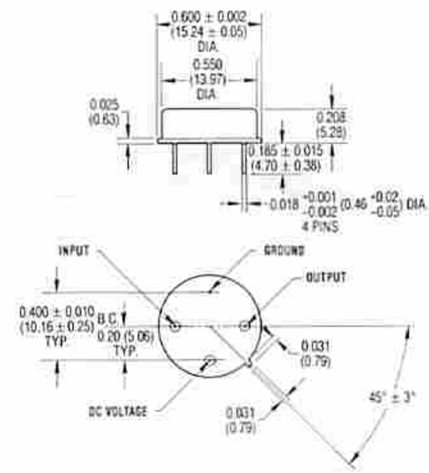
Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	1.8-6.2 GHz	2-6 GHz	2-6 GHz
Small Signal Gain (Min.)	19.5 dB	16.5 dB	15.5 dB
Gain Flatness (Max.)	±0.5 dB	±1.0 dB	±1.2 dB
Noise Figure (Max.)	5.5 dB	7.0 dB	7.5 dB
Power Output at 1 dB Compression (Min.)	16.0 dBm	13.0 dBm	12.5 dBm
VSWR (Max.)			
Input	1.7:1	2.2:1	2.3:1
Output	1.7:1	2.0:1	2.1:1
DC Current (Max.) at +5 Volts	120 mA	135 mA	140 mA

*Measured in a 50-ohm system at +5 Vdc Nominal.

Outline Drawing

RA63-1



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . 54 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . 50 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 32 dBm (Typ.)

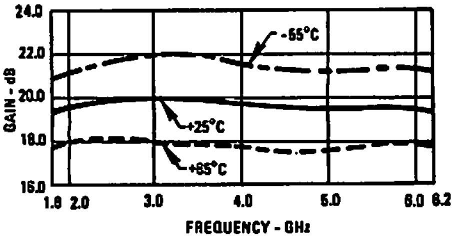
Absolute Maximum Ratings

Storage Temperature . . . . -64°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +6 Volts
Maximum Continuous RF Input Power . . . . +7 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
Maximum Peak Power . . . . 0.25 Watt (3μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

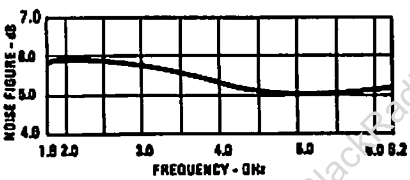
Weight approximately 3.0 grams (0.11 oz.)

Typical Performance at 25°C

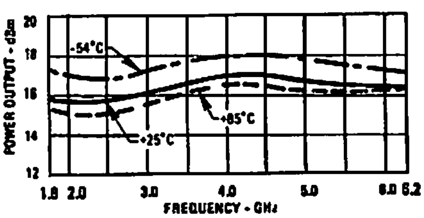
Gain



Noise Figure

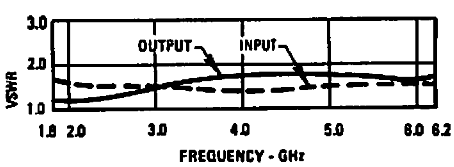


Power Output*

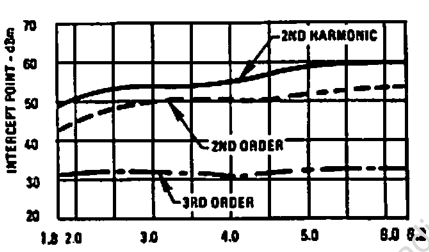


*at 1 dB Gain Compression

VSWR



Intercept Point



Typical Automatic Test Data

V_{cc} = +5 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
1800.0	1.2	1.7	19.33
2000.0	1.1	1.7	19.50
2200.0	1.1	1.7	19.61
2400.0	1.2	1.6	19.72
2600.0	1.3	1.6	19.77
2800.0	1.4	1.6	19.81
3000.0	1.5	1.5	19.79
3200.0	1.6	1.5	19.74
3400.0	1.7	1.5	19.70
3600.0	1.7	1.5	19.69
3800.0	1.7	1.4	19.67
4000.0	1.7	1.4	19.67
4200.0	1.7	1.4	19.68
4400.0	1.7	1.4	19.64
4600.0	1.8	1.4	19.56
4800.0	1.8	1.4	19.48
5000.0	1.8	1.5	19.48
5200.0	1.8	1.5	19.38
5400.0	1.7	1.5	19.43
5600.0	1.6	1.5	19.48
5800.0	1.5	1.5	19.51
6000.0	1.5	1.5	19.48
6200.0	1.7	1.5	19.34

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1800.0	.099	-90	9.2[illegible]	55	.004	-30	.260	75
2000.0	.069	-115	9.[illegible]2	28	.004	-37	.262	72
2200.0	.068	-137	9.550	2	.004	-42	.249	71
2400.0	.088	-151	9.682	-23	.006	-61	.239	71
2600.0	.114	-154	9.739	-49	.004	-70	.224	73
2800.0	.152	-157	9.779	-73	.004	-112	.217	74
3000.0	.188	-1[illegible]	9.766	-97	.004	-97	.209	74
3200.0	.231	-1[illegible]9	9.705	-121	.002	-128	.206	73
3400.0	.255	-171	9.659	-144	.004	-139	.197	70
3600.0	.26[illegible]	-174	9.651	-167	.003	-109	.191	67
3800.0	.26[illegible]	179	9.628	170	.002	-131	.182	61
4000.0	.265	170	9.632	147	.002	-145	.170	54
4200.0	.259	158	9.635	124	.002	-158	.173	48
4400.0	.261	143	9.593	101	.001	171	.176	42
4600.0	.275	129	9.501	77	.003	-159	.178	37
4800.0	.289	117	9.417	54	.002	-134	.183	34
5000.0	.298	108	9.333	31	.002	-139	.186	34
5200.0	.291	99	9.310	8	.001	-95	.188	34
5400.0	.266	88	9.368	-15	.001	-172	.195	36
5600.0	.234	72	9.417	-40	.002	-167	.201	38
5800.0	.209	48	9.455	-65	.001	115	.208	42
6000.0	.215	28	9.423	-92	.001	133	.213	43
6200.0	.250	-6	9.271	-119	.002	14[illegible]	.214	42

1

WJ-RA66

10 TO 1000 MHz
TO-8B[1] CASCADABLE AMPLIFIER

- HIGH GAIN – THREE STAGES: 37 dBm (TYP.)
- LOW NOISE: ≤3.5 dB (TYP.)
- HIGH OUTPUT LEVEL: >15.5 dBm (TYP.)
- LOW VSWR: 1.3:1 (TYP.)
- GOOD THIRD ORDER I.P.: 30 dBm (TYP.)
- HIGH REVERSE ISOLATION: >50 dB (TYP.)

Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54° - +85°C
Frequency (Min.)	5-1000 MHz	10-1000 MHz	10-1000 MHz
Small Signal Gain (Min.)	37.0 dB	35.0 dB	34.0 dB
Gain Flatness (Max.)	±0.6 dB	±1.0 dB	±1.3 dB
Noise Figure (Max.)	3.5 dB	4.5 dB	5.0 dB
Power Output at 1 dB Compression (Min.)	15.5 dBm	14.0 dBm	13.0 dBm
VSWR (Max.) Input/Output	1.3:1	1.8:1	2.0:1
DC Current (Max.) at 15 Volts	81 mA	85 mA	87 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Notes:

1. TO-8B is larger than standard TO-8 package. (See outline drawing).

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point .... 55 dBm (Typ.)
Second Order Two Tone Intercept Point .... 45 dBm (Typ.)
Third Order Two Tone Intercept Point .... 30 dBm (Typ.)

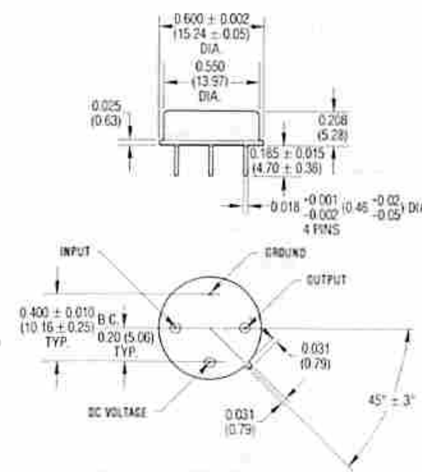
Absolute Maximum Ratings

Storage Temperature .... -62°C to +125°C
Maximum Case Temperature .... 125°C
Maximum DC Voltage .... +17 Volts
Maximum Continuous RF Input Power .... +6 dBm
Maximum Short Term Input Power (1 Minute Max.) .... +100 Milliwatts
Maximum Peak Power .... 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) .... 125°C

Weight approximately 3.0 grams (0.11 oz.)

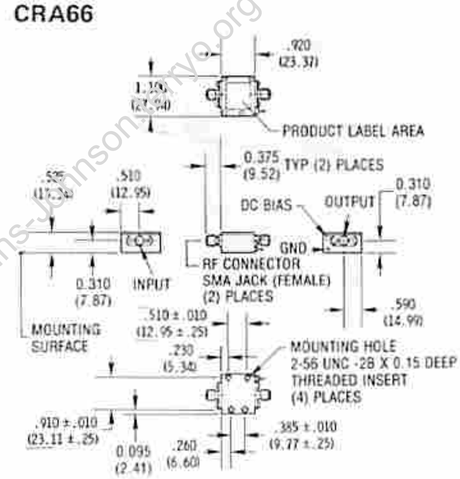
Outline Drawings

RA66



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CRA66

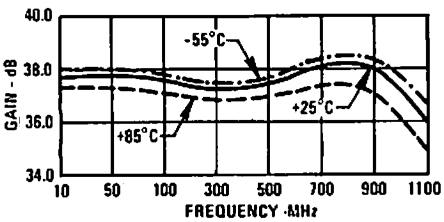


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

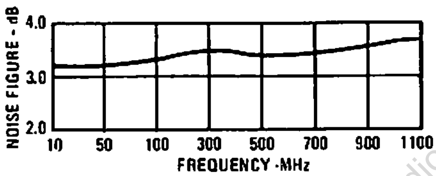
*WJ-CRA66 is standard WJ-RA66 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

Typical Performance at 25°C

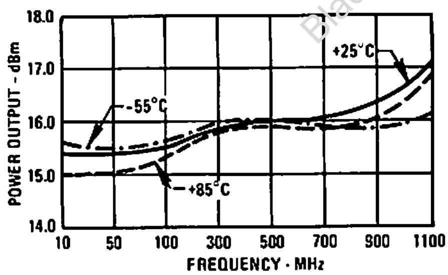
Gain



Noise Figure

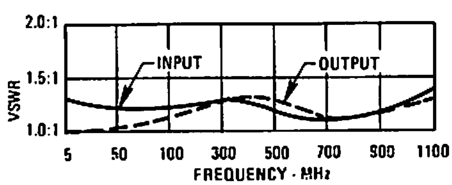


Power Output*

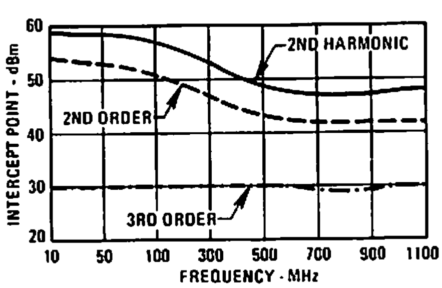


*at 1 dB Gain Compression

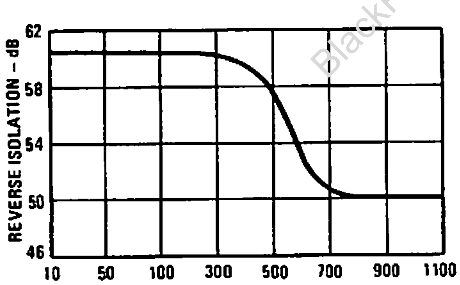
VSWR



Intercept Point



Reverse Isolation



Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
1.00	1.7	1.8	37.2
2.00	1.4	1.2	[illegible]
5.00	1.2	1.1	38.0
10.00	1.2	1.1	38.0
50.00	1.1	1.1	38.0
100.00	1.1	1.1	37.8
200.00	1.1	1.1	37.5
300.00	1.1	1.2	37.4
400.00	1.1	1.3	37.4
500.00	1.1	1.2	37.5
600.00	1.1	1.2	37.8
700.00	1.0	1.1	38.1
800.00	1.1	1.3	38.2
900.00	1.0	1.2	37.7
1000.00	1.1	1.2	36.9
1100.00	1.2	1.3	35.6
1200.00	1.4	1.3	34.1

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.252	-66	72.175	-140	0.001	-15	0.280	163
2.0	0.153	-99	78.741	-163	0.001	-39	0.087	124
5.0	0.086	-137	79.263	-175	0.001	18	0.030	128
10.0	0.071	-160	79.100	180	0.001	-9	0.029	86
50.0	0.067	163	79.186	163	0.002	-1	0.025	88
100.0	0.066	141	77.781	145	0.001	-10	0.056	17
200.0	0.063	107	75.175	111	0.001	-4	0.067	45
300.0	0.058	83	74.075	78	0.001	54	0.107	48
400.0	0.051	67	74.066	46	0.002	-31	0.115	34
500.0	0.045	58	74.893	13	0.001	-20	0.103	16
600.0	0.040	48	77.954	-22	0.002	11	0.037	27
700.0	0.020	61	80.212	-59	0.002	-15	0.070	12
800.0	0.052	112	81.546	-96	0.002	-28	0.120	77
900.0	0.016	-161	76.632	-139	0.003	-34	0.108	45
1000.0	0.060	-173	69.901	-178	0.003	-51	0.092	58
1100.0	0.106	177	60.514	144	0.003	-52	0.117	62
1200.0	0.177	169	50.654	108	0.003	-39	0.139	86

V_{CC} = +12 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
1.00	1.7	1.8	36.5
2.00	1.3	1.2	37.3
5.00	1.2	1.1	37.3
10.00	1.1	1.0	37.4
50.00	1.1	1.1	37.3
100.00	1.1	1.1	37.1
200.00	1.1	1.2	36.9
300.00	1.1	1.2	36.7
400.00	1.1	1.3	36.7
500.00	1.1	1.2	36.9
600.00	1.1	1.2	37.1
700.00	1.0	1.1	37.3
800.00	1.1	1.2	37.2
900.00	1.1	1.3	36.9
1000.00	1.2	1.2	36.0
1100.00	1.4	1.3	34.8
1200.00	1.6	1.4	33.4

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.258	-63	66.660	-141	0.001	103	0.281	158
2.0	0.147	-93	73.500	-164	0.001	37	0.075	120
5.0	0.072	-127	73.145	-175	0.002	22	0.032	104
10.0	0.054	-152	73.835	180	0.002	27	0.020	95
50.0	0.047	161	73.054	162	0.002	-35	0.026	66
100.0	0.048	135	72.784	145	0.001	-36	0.039	89
200.0	0.048	94	70.176	110	0.001	-48	0.072	56
300.0	0.046	69	68.323	77	0.002	5	0.087	46
400.0	0.040	47	68.321	44	0.002	8	0.116	33
500.0	0.032	35	69.944	10	0.002	-23	0.088	20
600.0	0.027	14	71.883	-25	0.002	-21	0.082	32
700.0	0.008	-64	73.154	-62	0.003	-30	0.067	45
800.0	0.043	-175	72.834	-100	0.003	-39	0.093	78
900.0	0.052	-145	69.816	-142	0.002	-16	0.114	42
1000.0	0.096	-169	62.993	179	0.004	-51	0.096	67
1100.0	0.151	-178	55.194	140	0.004	-91	0.123	68
1200.0	0.227	167	46.647	105	0.004	-59	0.162	87

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Typical Automatic Test Data (continued)

V_{CC} = +5 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
1.00	1.8	1.8	32.3
2.00	1.4	1.2	33.1
5.00	1.2	1.1	33.2
10.00	1.1	1.1	33.2
50.00	1.1	1.1	33.2
100.00	1.1	1.1	33.0
200.00	1.2	1.1	32.7
300.00	1.2	1.1	32.5
400.00	1.2	1.1	32.3
500.00	1.2	1.1	32.2
600.00	1.3	1.2	32.1
700.00	1.4	1.2	31.8
800.00	1.5	1.2	31.5
900.00	1.6	1.2	30.9
1000.00	1.8	1.2	30.3
1100.00	2.1	1.3	29.4
1200.00	2.7	1.6	28.4

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
1.0	0.291	-47	41.190	-142	0.001	74	0.295	156
2.0	0.160	-55	45.408	-165	0.002	7	0.083	92
5.0	0.084	-42	45.671	-176	0.002	-3	0.045	45
10.0	0.065	-27	45.604	179	0.002	-7	0.046	32
50.0	0.057	-8	45.559	161	0.003	-8	0.046	20
100.0	0.061	-5	44.799	141	0.002	-5	0.050	16
200.0	0.072	-14	43.386	104	0.002	-11	0.051	20
300.0	0.081	-30	42.060	67	0.002	176	0.060	34
400.0	0.089	-49	41.131	31	0.002	-20	0.062	36
500.0	0.100	-69	40.888	-6	0.002	-19	0.054	44
600.0	0.123	-90	40.232	-43	0.003	-9	0.073	49
700.0	0.151	-115	38.905	-81	0.003	-49	0.076	53
800.0	0.169	-140	37.400	-119	0.004	-31	0.100	62
900.0	0.233	-154	35.210	-158	0.003	-29	0.081	53
1000.0	0.297	-173	32.687	164	0.004	-64	0.090	65
1100.0	0.364	172	29.608	124	0.004	-53	0.134	97
1200.0	0.453	156	26.255	86	0.005	-76	0.231	99

WJ-RA69

10 TO 1000 MHz
TO-8B[1] CASCADABLE AMPLIFIER

- HIGH GAIN – TWO STAGES: 25.0 dB (TYP.)
- HIGH OUTPUT POWER: ⩾23.0 dBm (TYP.)
- HIGH THIRD ORDER I.P.: 34 dBm (TYP.)
- NEW SIZE: TO-8B[1]

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Specifications*

Characteristics	Typical	Guaranteed 0° -50° C	-54°C - +85°C
Frequency (Min.)	5-1100 MHz	10-1000 MHz	10-1000 MHz
Small Signal Gain (Min.)	25.0 dB	24.0 dB	23.0 dB
Gain Flatness (Max.)	±0.3 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	4.5 dB	5.0 dB	5.5 dB
Power Output at 1 dB Compression (Min.)			
V_{CC} = +15 Vdc	+23.0 dBm	+20.0 dBm	+20.0 dBm
V_{CC} = +12 Vdc	+20.5 dBm	+18.0 dBm	+18.0 dBm
VSWR (Max.) Input/Output	1.5:1	2.0:1	2.0:1
DC Current at 15 Volts	130 mA	138 mA	145 mA
DC Current at 12 Volts	104 mA	110 mA	114 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.
Notes:
1. TO-8B is larger than standard TO-8 package. (See outline drawing).

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . +60 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . +55 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . +34 dBm (Typ.)

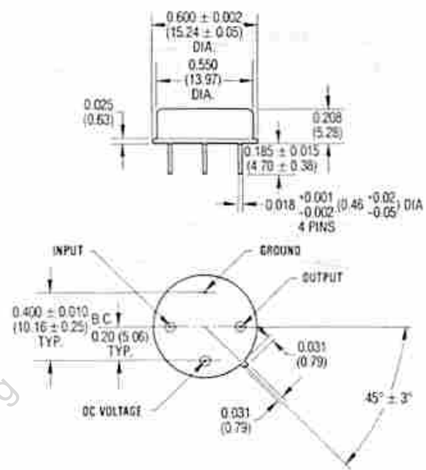
Absolute Maximum Ratings (At 15 Vdc)

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . +100°C
Maximum DC Voltage . . . . +17 Volts
Maximum Continuous RF Power . . . . +13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . +100°C

Weight
approximately 3.0 grams (0.11 oz.)

Outline Drawings

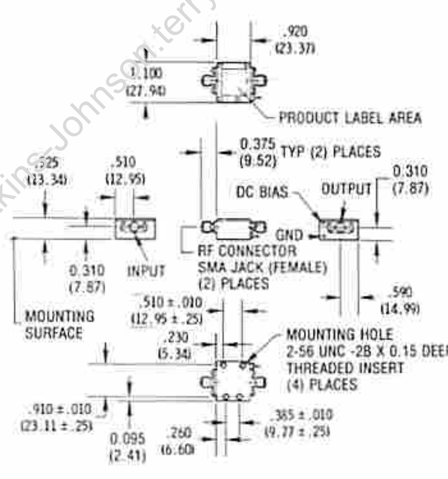
RA69



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

NOTE: RA69 amplifier is in new TO-8B package which is slightly larger than standard TO-8 outline.

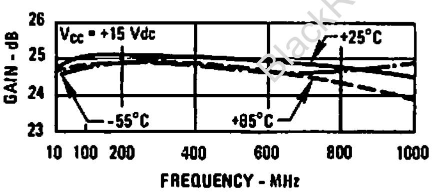
CRA69

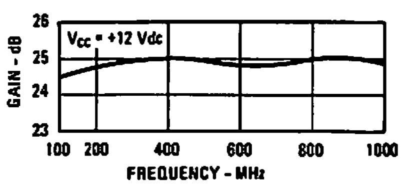


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

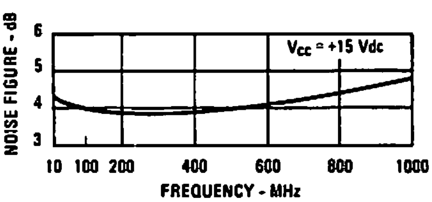
Typical Performance at 25°C

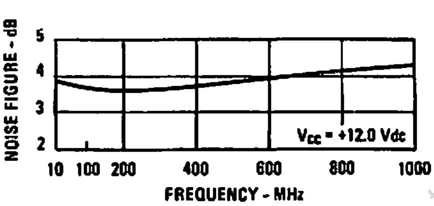
Gain



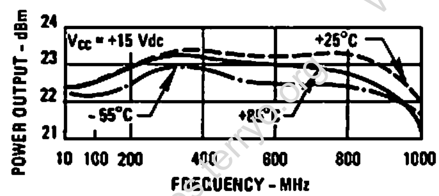


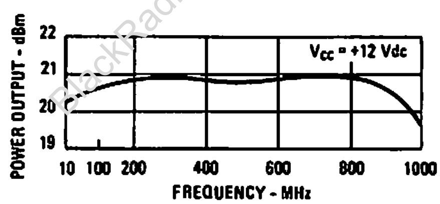
Noise Figure



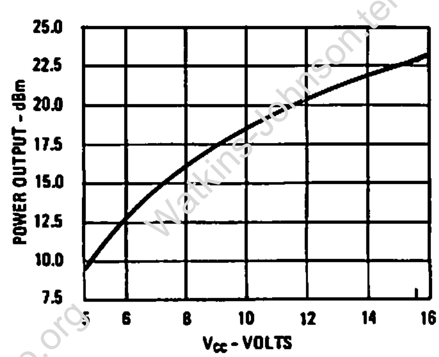


Power Output*



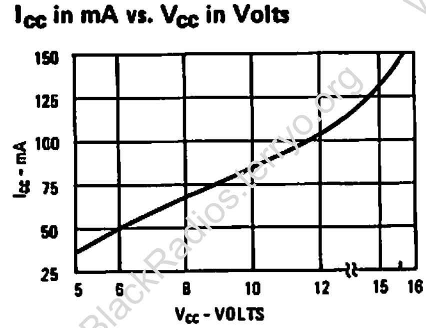


Power Output* vs. V_{CC} at 500 MHz

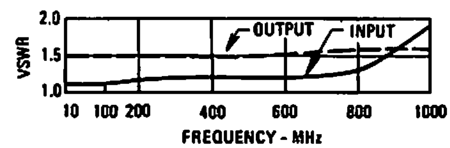


*at 1 dB Gain Compression

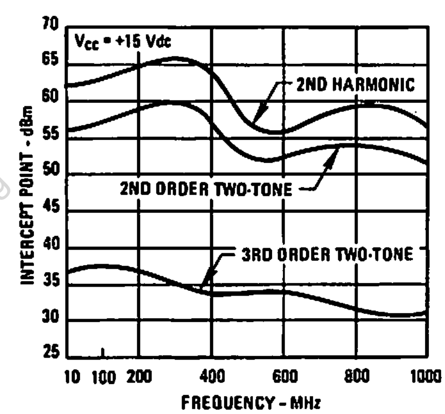
I_{CC} in mA vs. V_{CC} in Volts

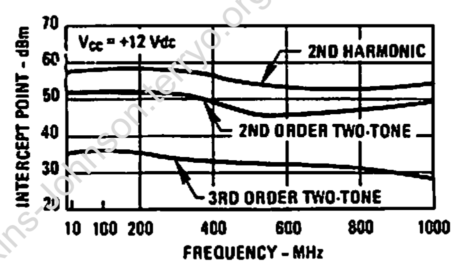


VSWR



Intercept Point





Typical Automatic Test Data

V_{CC} = +12.0 Vdc

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.2	24.5
200.	1.1	1.2	24.8
300.	1.1	1.3	25.0
400.	1.1	1.3	25.0
500.	1.2	1.3	24.9
600.	1.2	1.3	24.9
700.	1.2	1.3	24.8
800.	1.2	1.3	25.0
900.	1.2	1.3	25.0
1000.	1.5	1.4	24.8
1100.	2.4	1.7	24.1
1200.	4.2	2.3	22.3

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.06	1.6	16.87	-23.4	.02	-3.0	.10	-6.9
200.	.06	7.7	17.29	-47.4	.02	-6.6	.10	-22.9
300.	.06	20.9	17.83	-72.9	.02	-9.1	.11	-37.9
400.	.06	31.6	17.77	-98.7	.02	-12.9	.12	-53.2
500.	.09	34.5	17.56	-124.1	.02	-16.7	.13	-68.7
600.	.10	26.1	17.57	-150.4	.02	-21.5	.14	-88.2
700.	.10	7.6	17.36	-177.4	.02	-28.7	.13	-111.2
800.	.08	-26.5	17.73	155.8	.02	-36.2	.12	-142.8
900.	.07	-118.6	17.74	126.4	.02	-47.5	.11	166.1
1000.	.20	173.3	17.41	93.7	.03	-63.4	.16	102.0
1100.	.41	133.2	16.06	57.4	.03	-84.7	.27	50.8
1200.	.61	99.2	13.00	20.1	.03	-108.5	.39	9.9

V_{CC} = +15.0 Vdc

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.1	1.2	24.7
200.	[illegible]	1.2	25.0
300.	1.1	1.2	25.2
400.	1.2	1.3	25.2
500.	1.2	1.3	25.1
600.	1.3	1.3	25.1
700.	1.3	1.3	25.1
800.	1.2	1.2	25.2
900.	1.1	1.2	25.2
1000.	1.4	1.3	25.0
1100.	2.2	1.7	24.3
1200.	3.6	2.2	22.5

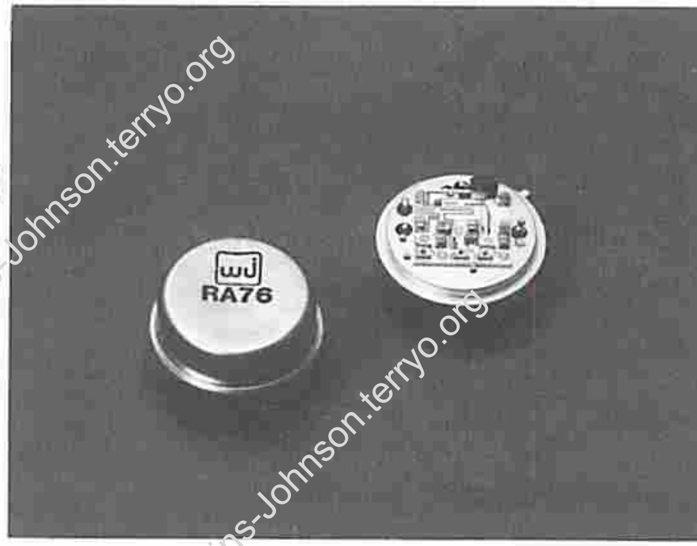
Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.06	7.1	17.25	-23.3	.02	-4.4	.10	-6.6
200.	.06	14.1	17.72	-47.0	.02	-5.5	.10	-22.9
300.	.06	26.2	18.27	-72.2	.02	-10.0	.11	-38.6
400.	.07	33.6	18.21	-97.7	.02	-14.1	.12	-54.4
500.	.09	[illegible]	18.05	-122.9	.02	-18.4	.12	-70.0
600.	.11	[illegible]	18.09	-149.1	.02	-23.7	.13	-90.0
700.	.11	8.7	17.93	-176.0	.02	-31.2	.12	-113.3
800.	.09	-21.2	18.30	157.1	.02	-38.7	.10	-146.7
900.	[illegible]	-103.9	18.27	127.7	.02	-49.1	.10	156.8
1000.	[illegible]	175.5	17.82	95.3	.03	-64.9	.15	91.9
1100.	.37	134.1	16.41	59.7	.03	-85.1	.26	44.2
1200.	.57	100.6	13.41	23.2	.02	-107.4	.37	6.6

WJ-RA76

10 TO 500 MHz
TO-8B[1] CASCADABLE AMPLIFIER

- HIGH GAIN — THREE STAGES: 40.5 dB (TYP.)
- LOW NOISE: ≤3.0 dB (TYP.)
- HIGH OUTPUT LEVEL: 15 dBm (TYP.)
- LOW VSWR: 1.3:1 (TYP.)
- GOOD THIRD ORDER I.P.: +26 dBm (TYP.)
- HIGH REVERSE ISOLATION: >50 dB (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54° - +85°C
Frequency (Min.)	5-550 MHz	10-500 MHz	10-500 MHz
Small Signal Gain (Min.)	40.5 dB	38.5 dB	37.5 dB
Gain Flatness (Max.)	±0.6 dB	±0.9 dB	±1.2 dB
Noise Figure (Max.)	3.0 dB	3.8 dB	4.3 dB
Power Output at 1 dB Compression (Min.)	+15.0 dBm	+13.3 dBm	+12.3 dBm
VSWR (Max.) Input/Output	1.3:1	1.8:1	2.0:1
DC Current (Max.) at 15 Volts	81 mA	85 mA	87 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Notes:

1. TO-8B is larger than standard TO-8 package. (See outline drawing).

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point .... 42 dBm (Typ.

Second Order Two Tone Intercept Point .... 35 dBm (Typ.)

Third Order Two Tone Intercept Point .... 26 dBm (Typ.)

Absolute Maximum Ratings

Storage Temperature .... -62°C to +125°C

Maximum Case Temperature .... 125°C

Maximum DC Voltage .... +17 Volts

Maximum Continuous RF Input Power .... +6 dBm

Maximum Short Term Input Power (1 Minute Max.) .... +100 Milliwatts

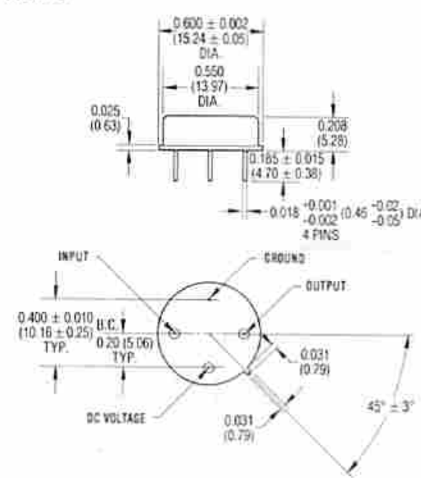
Maximum Peak Power .... 0.5 Watt (3 μsec Max.)

"S" Series Burn-In Temperature (Case) .... 125°C

Weight approximately 3.0 grams (0.11 oz.)

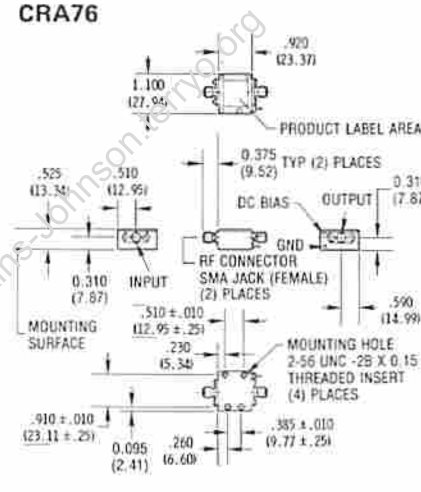
Outline Drawings

RA76



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CRA76

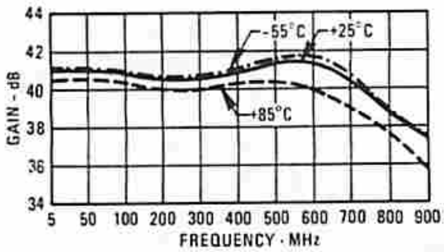


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

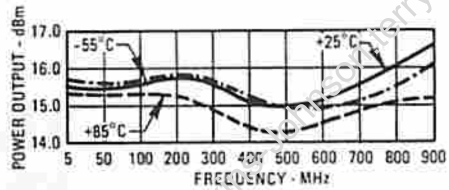
*WJ-CRA76 is standard WJ-RA76 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

Typical Performance at 25°C

Gain

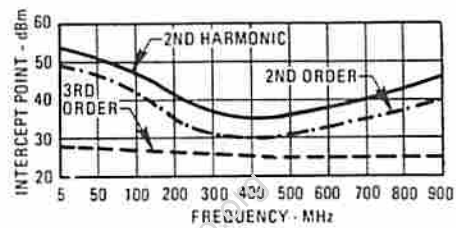


Power Output*

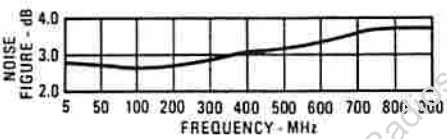


*at 1 dB Gain Compression

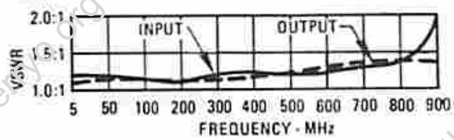
Intercept Point



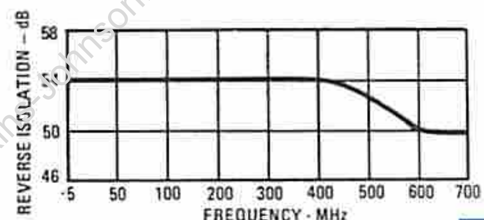
Noise Figure



VSWR



Reverse Isolation



1

Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
1.00	1.2	2.5	38.1
2.00	1.2	1.8	40.1
5.00	1.2	1.2	41.3
10.00	1.2	1.2	41.4
50.00	1.2	1.2	41.4
100.00	1.1	1.2	41.1
200.00	1.1	1.1	40.7
300.00	1.2	1.2	40.7
400.00	1.2	1.2	40.9
500.00	1.2	1.4	41.3
600.00	1.1	1.4	41.1
700.00	1.3	1.5	39.9

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG.	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.108	-171	80.439	-151	0.002	-129	0.425	-125
2.0	0.081	-81	100.867	-145	0.002	-48	0.284	147
5.0	0.083	-150	116.365	-170	0.002	18	0.102	106
10.0	0.073	-168	117.179	-178	0.002	-160	0.090	152
50.0	0.071	177	117.221	157	0.002	-29	0.086	178
100.0	0.064	-180	114.017	131	0.002	-67	0.101	-179
200.0	0.063	-161	108.696	84	0.002	-48	0.047	156
300.0	0.084	-158	107.957	38	0.002	159	0.082	164
400.0	0.095	-176	110.834	-10	0.002	-13	0.080	[illegible]
500.0	0.076	148	116.689	-62	0.002	-45	0.168	[illegible]
600.0	0.044	54	113.699	-119	0.002	-41	0.178	142
700.0	0.120	-15	98.890	-177	0.002	-6	0.186	67

V_{CC} = +12 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
1.00	1.2	2.6	37.4
2.00	1.2	1.8	39.3
5.00	1.1	1.3	40.7
10.00	1.1	1.1	40.7
50.00	1.1	1.1	40.8
100.00	1.1	1.1	40.5
200.00	1.1	1.1	40.1
300.00	1.2	1.1	40.0
400.00	1.2	1.2	40.2
500.00	1.2	1.2	40.5
600.00	1.1	1.2	40.2
700.00	1.2	1.5	39.2

Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.102	-173	74.165	-153	0.002	31	0.452	-124
2.0	0.089	-63	91.912	-144	0.002	-38	0.269	159
5.0	0.068	-139	108.601	-170	0.002	117	0.124	119
10.0	0.054	-164	108.164	-179	0.002	-19	0.060	148
50.0	0.054	-176	109.462	157	0.002	-24	0.053	[illegible]
100.0	0.054	-168	106.411	131	0.002	-74	0.048	-178
200.0	0.067	-147	101.485	82	0.002	176	0.067	[illegible]
300.0	0.091	-153	99.640	35	0.002	36	0.040	-114
400.0	0.105	-168	102.295	-13	0.002	146	[illegible]	-151
500.0	0.079	161	105.331	-65	0.002	-66	[illegible]	176
600.0	0.026	90	102.325	-122	0.002	43	[illegible]	109
700.0	0.083	-10	91.398	-180	0.003	-96	0.196	18

V_{CC} = +5 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
1.00	1.1	2.2	32.9
2.00	1.4	1.9	34.7
5.00	1.2	1.1	36.5
10.00	1.1	1.1	36.5
50.00	1.1	[illegible]	36.5
100.00	1.2	[illegible]	36.2
200.00	1.3	1.1	35.6
300.00	1.4	1.2	35.1
400.00	1.4	1.3	34.7
500.00	1.4	1.3	34.4
600.00	1.3	1.3	33.7
700.00	1.3	1.3	33.2

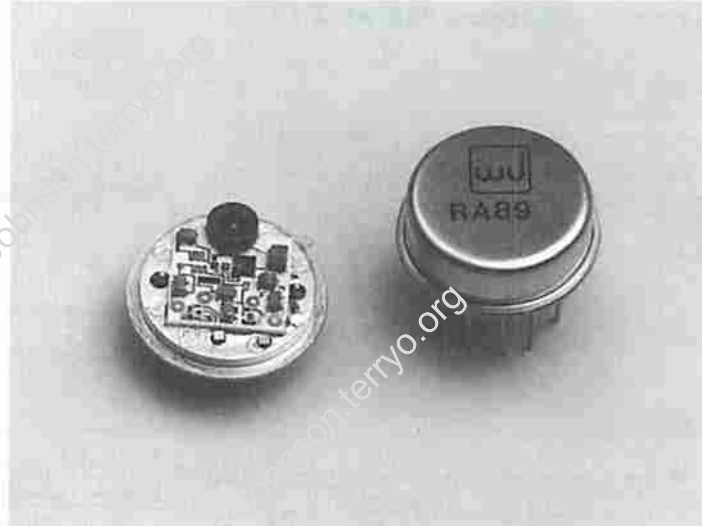
Linear S-Parameters

FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
1.0	0.035	-50	44.293	-158	0.002	-31	0.384	-117
2.0	0.154	-28	54.195	-144	0.002	42	0.300	156
5.0	0.081	-40	67.015	-170	0.002	-26	0.060	75
10.0	0.063	-32	66.820	-179	0.002	36	0.029	28
50.0	0.066	-46	66.662	154	0.002	-108	0.029	-84
100.0	0.087	-70	64.884	125	0.002	11	0.042	-100
200.0	0.130	-98	60.575	71	0.002	4	0.044	-117
300.0	0.157	-123	56.561	19	0.002	-144	0.090	-145
400.0	0.166	-144	54.304	-33	0.002	-35	0.118	-157
500.0	0.152	-161	52.261	-87	0.002	-42	0.140	170
600.0	0.137	-178	48.611	-142	0.003	-59	0.144	127
700.0	0.137	144	45.550	161	0.004	-105	0.114	94

WJ-RA89

5 TO 500 MHz
TO-8B[1] CASCADABLE AMPLIFIER

- HIGH GAIN — TWO STAGES: 26.5 dB (TYP.)
- HIGH OUTPUT POWER: ≤21.5 dBm (TYP.)
- HIGH THIRD-ORDER INTERCEPT POINT: 35 dBm (TYP.)
- NEW SIZE: TO-8B[1]



Specifications *

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	3 – 700 MHz	5 – 500 MHz	5 – 500 MHz
Small Signal Gain (Min.)	26.5 dB	25.5 dB	25.0 dB
Gain Flatness (Max.)	±0.2 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)	3.7 dB	4.5 dB	5.0 dB
Power Output at 1 dB Compression (Min.) V_{CC} = +15 V	≥21.5 dBm	20.5 dBm	20.0 dBm
V_{CC} = +12 V	≥19.5 dBm	19.0 dBm	18.0 dBm
VSWR (Max.) Input/Output	1.5:1	1.8:1	2.0:1
DC Current at 12 Volts	102 mA	108 mA	111 mA
DC Current at 15 Volts	130 mA	136 mA	139 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.

Notes: 1. TO-8B is larger than standard TO-8 package. (See outline drawing).

Typical Intermodulation Performance at 25°C

Second Order Harmonic IP . . . . >65.0 dBm (Typ.)

Second Order Two Tone IP . . . . >55.0 dBm (Typ.)

Third Order Two Tone IP . . . . >35.0 dBm (Typ.)

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C

Maximum Case Temperature . . . . 100°C

Maximum DC Voltage . . . . +17 Volts

Maximum Continuous RF Input Power . . . . 13 dBm

Maximum Short Term RF Input Power (1 Minute Max.) . . . . 50 Milliwatts

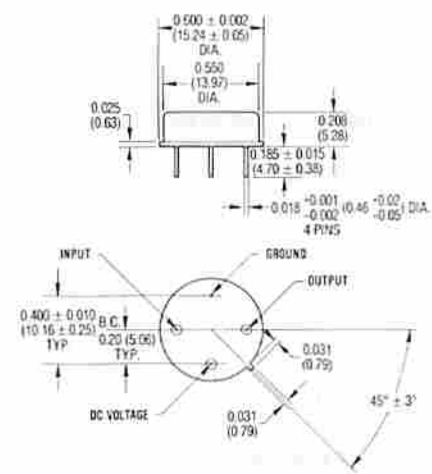
Maximum Peak Power . . . . 0.5 Watt (3 μsec Max.)

"S" Series Burn-In Temperature (Case) . . . . 100°C

Weight approximately 3.0 grams (0.11 oz.)

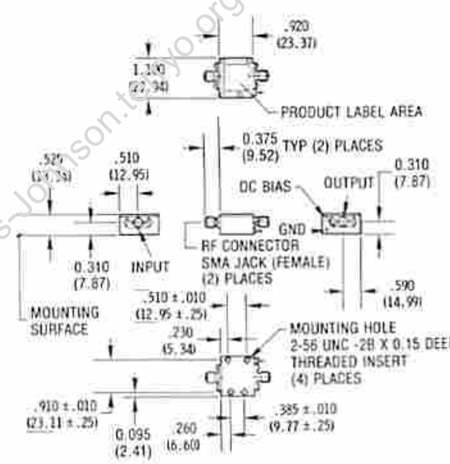
Outline Drawings

RA89



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CRA89

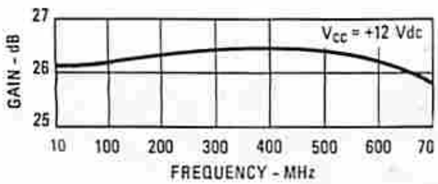


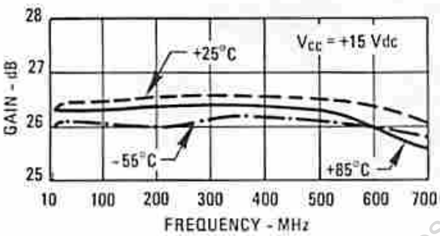
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

NOTE: RA89 amplifier is in new TO-8B package which is slightly larger than standard TO-8 outline

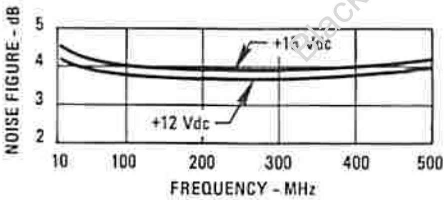
Typical Performance at 25°C

Gain

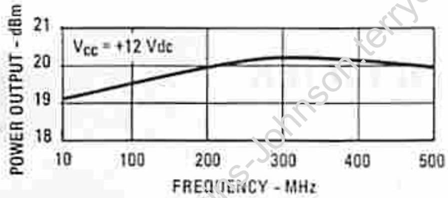


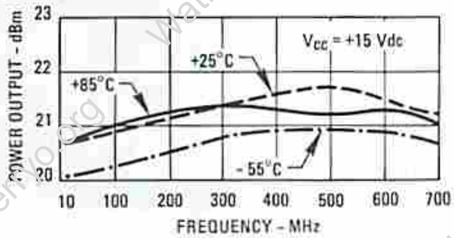


Noise Figure



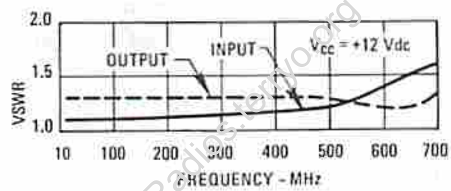
Power Output*

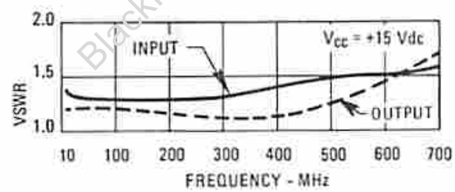




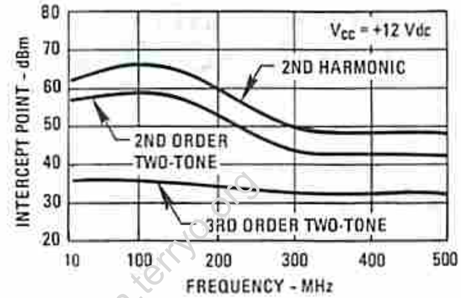
*at 1 dB Gain Compression

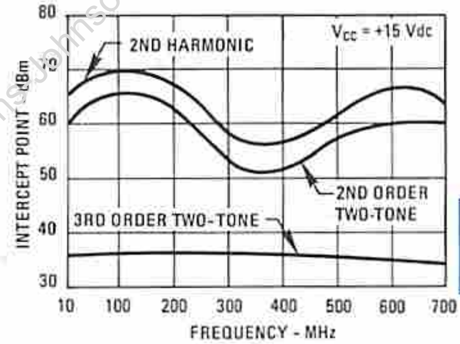
VSWR





Intercept Point





1

Typical Automatic Test Data

V_{CC} = +12 Vdc

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.3	26.2
200.	1.2	1.4	26.4
300.	1.1	1.5	26.2
400.	1.1	1.6	26.1
500.	1.2	1.7	25.9
600.	1.4	1.7	25.8

V_{CC} = +15 Vdc

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.2	1.4	26.4
200.	1.2	1.4	26.5
300.	1.1	1.4	26.4
400.	1.0	1.5	26.3
500.	1.1	1.6	26.1
600.	1.3	1.6	26.1

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.03	174.3	20.40	-26.3	.02	3.3	.15	-17.4
200.	.07	163.6	20.77	-51.3	.02	2.8	.16	-42.6
300.	.05	163.9	20.37	[illegible]	.02	3.3	.19	-61.0
400.	.03	-145.0	20.19	[illegible]	.02	.3	.22	-79.9
500.	.07	-100.6	19.62	[illegible]	.02	-.6	.25	-96.5
600.	.16	-106.8	19.45	-163.2	.02	-4.9	.27	-115.4

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.11	160.2	20.91	-27.3	.02	4.2	.15	-14.4
200.	.03	156.6	21.24	-51.2	.01	2.9	.16	-42.2
300.	.06	149.1	20.89	-78.7	.02	2.0	.18	-60.0
400.	.02	171.3	20.72	-107.4	.02	-2.1	.20	-77.0
500.	.05	-93.5	20.19	-136.4	.02	-3.6	.22	-93.7
600.	.14	-101.0	20.11	-165.7	.02	-5.6	.24	-111.3

WJ-RA89-1

10 TO 500 MHz
TO-8B CASCADABLE AMPLIFIER

- HIGH GAIN—TWO STAGES: 30 dB (TYP.)
- HIGH OUTPUT POWER: 21.5 dBm (TYP.)
- HIGH THIRD ORDER I.P.: +36 dBm (TYP.)
- LOW NOISE: 3.2 dB (TYP.)
- LOW VSWR: <1.5:1 (TYP.)
- NEW SIZE: TO-8B[1]
- WIDE POWER SUPPLY RANGE: 5-15 VOLTS

Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)	5-600 MHz	10-500 MHz	10-500 MHz
Small Signal Gain (Min.)	30.0 dB	29.0 dB	28.0 dB
Gain Flatness (Max.)	±0.3 dB	±0.7 dB	±1.0 dB
Noise Figure (Max.)			
+15V	3.2 dB	4.5 dB	5.0 dB
+12V	2.7 dB	4.0 dB	4.5 dB
Power Output at 1 dB Compression (Min.)			
+15V	21.5 dBm	20.0 dBm	20.0 dBm
+12V	18.5 dBm	18.0 dBm	17.0 dBm
VSWR (Max.) Input/Output	<1.5:1	1.8:1	2.0:1
DC Current (Max.) at			
15V	130 mA	137 mA	140 mA
12V	102 mA	103 mA	111 mA

*Measured in a 50-ohm system at +15 Vdc Nominal.
Notes: 1. TO-8B is larger than standard TO-8 package. (See outline drawing).

Typical Intermodulation Performance at 25°C

Second Order Harmonic Intercept Point . . . . >57 dBm (Typ.)
Second Order Two Tone Intercept Point . . . . >50 dBm (Typ.)
Third Order Two Tone Intercept Point . . . . 36 dBm (Typ.)

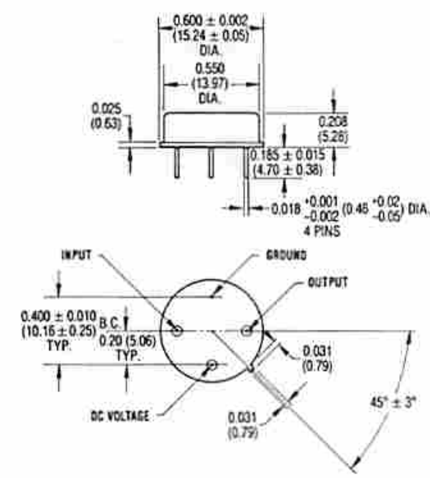
Absolute Maximum Ratings (at +15Vdc)

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 100°C
Maximum DC Voltage . . . . 17 Volts
Maximum Continuous RF Power . . . . 13 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 50 Milliwatts
Maximum Peak Power . . . . 0.5 Watt (3 µsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 100°C

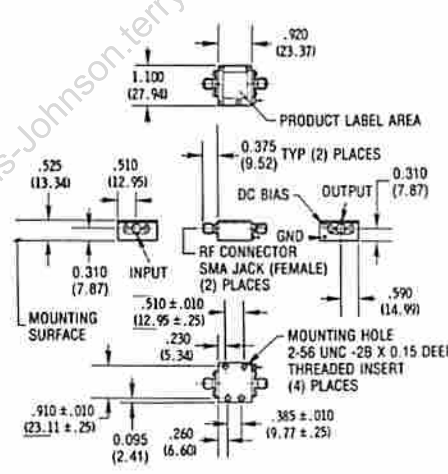
Weight approximately 3.0 grams (0.11 oz.)

Outline Drawings

RA89-1



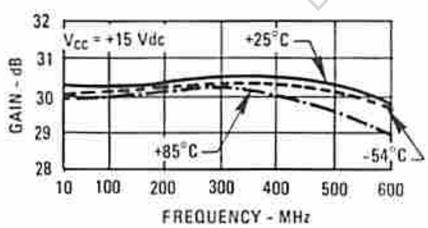
CRA89-1

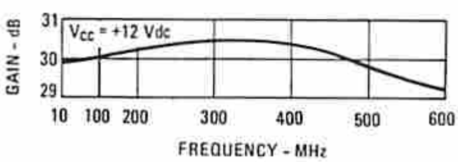


Typical Performance at 25°C

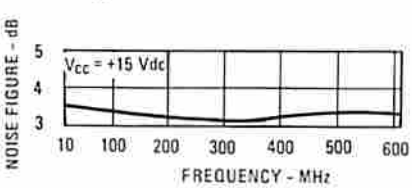
1

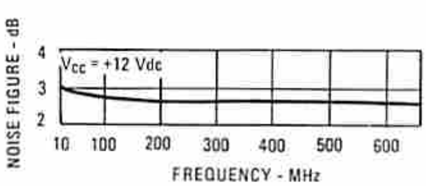
Gain



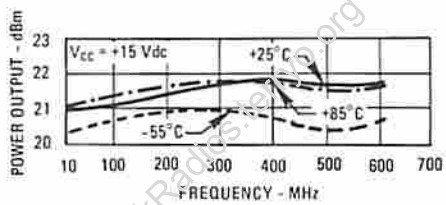


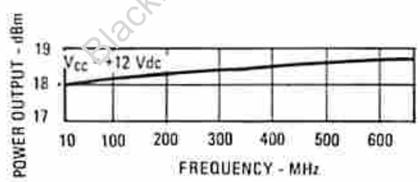
Noise Figure

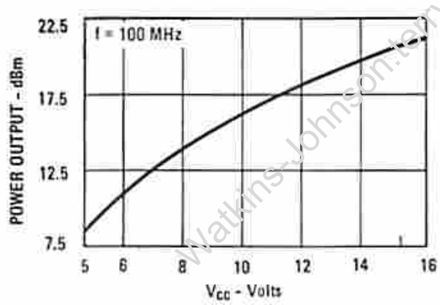




Power Output*

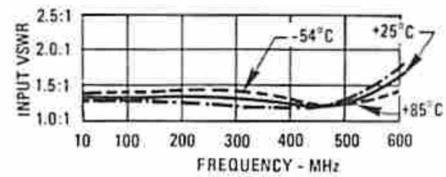


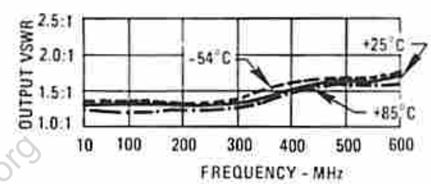




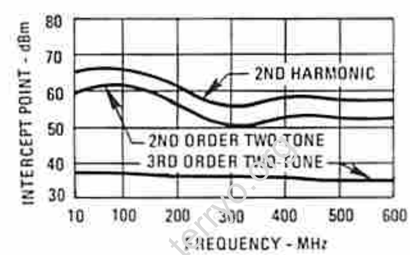
*at 1 dB Gain Compression

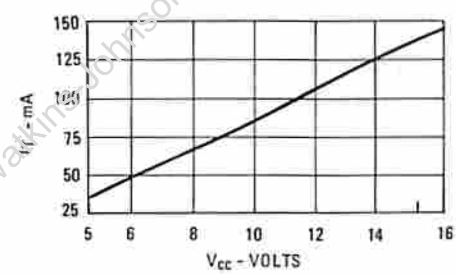
VSWR





Intercept Point





Typical Automatic Test Data

V_{CC} = +15 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.0	1.3	1.4	30.0
10.0	1.3	1.2	30.1
50.0	1.3	1.2	30.1
100.0	1.3	1.2	30.1
200.0	1.2	1.2	30.1
300.0	1.2	1.3	30.2
400.0	1.2	1.4	30.1
500.0	1.4	1.5	29.8
600.0	1.7	1.5	29.3

Linear S-Parameters

FREQUENCY MHZ	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
5.0	0.135	173	31.67	11	0.01	9	0.154	76
10.0	0.124	175	31.92	4	0.01	3	0.100	51
50.0	0.117	179	31.83	-14	0.01	-4	0.075	-8
100.0	0.119	-177	31.86	-30	0.01	-5	0.080	-36
200.0	0.107	-178	32.16	-60	0.01	-6	0.105	-72
300.0	0.095	-164	32.42	-93	0.01	-9	0.137	-95
400.0	0.111	-146	31.83	-126	0.01	-9	0.166	-116
500.0	0.166	-132	31.00	-160	0.01	-17	0.188	-141
600.0	0.252	-133	29.10	167	0.01	-26	0.212	-172
700.0	0.367	-140	26.29	129	0.02	-32	0.209	159

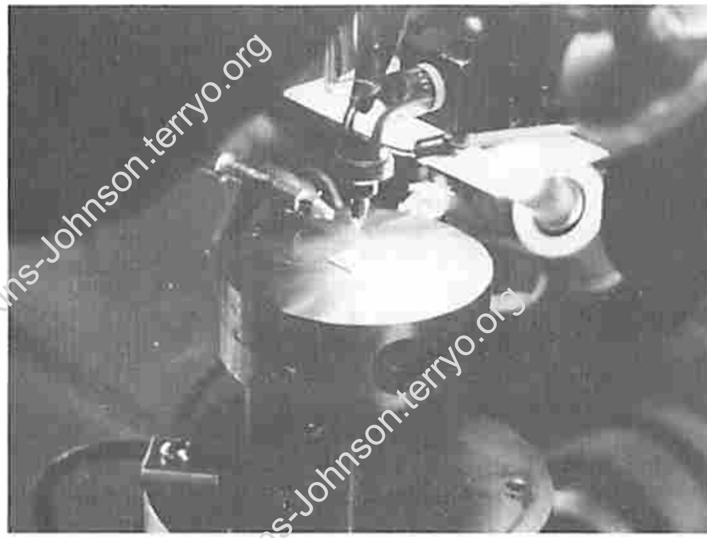
V_{CC} = +12 Vdc

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
5.0	1.3	1.3	29.7
10.0	1.2	1.2	29.8
50.0	1.2	1.2	29.8
100.0	1.2	1.2	29.8
200.0	1.2	1.2	29.8
300.0	1.2	1.4	29.9
400.0	1.3	1.5	29.8
500.0	1.5	1.6	29.5
600.0	1.8	1.7	28.9

Linear S-Parameters

FREQUENCY MHZ	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
5.0	0.122	174	30.60	[illegible]	0.01	6	0.140	72
10.0	0.111	175	30.84	[illegible]	0.01	2	0.095	45
50.0	0.106	180	30.75	-14	0.01	-1	0.077	-10
100.0	0.108	-174	[illegible]	-30	0.01	-4	0.081	-37
200.0	0.098	-171	[illegible]	-61	0.01	-5	0.110	-70
300.0	0.095	-153	[illegible]	-94	0.01	-8	0.151	-92
400.0	0.125	-136	30.75	-127	0.01	-9	0.186	-115
500.0	0.199	-129	29.94	-162	0.01	-15	0.217	-138
600.0	0.296	-134	27.83	165	0.01	-24	0.249	-169
700.0	0.419	-144	24.88	126	0.02	-33	0.256	162

APPLICATION INFORMATION FOR THIN FILM CASCADABLE AMPLIFIERS



INSIDE THE TO-8 AMPLIFIER: BASIC CIRCUIT CONCEPTS

This discussion covers the basic circuit concept behind the cascadable amplifier and details some of the techniques that are used to maintain hardware stability in the application of the units. The fundamental common denominator to most broadband cascadable amplifiers is collector-to-base, shunt-resistive feedback and series-emitter resistive feedback, as shown in Figure 1. There are some reactive feedback methods that have been employed both in combination with and without resistive feedback to reduce the degradation that the resistive feedback has on the noise figure. However, the consideration of these design schemes is beyond the scope of this article.

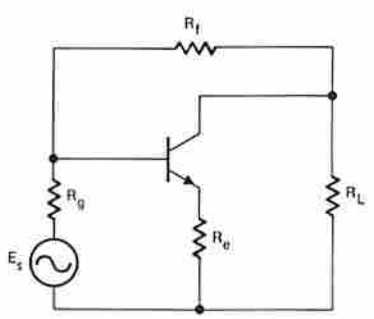


Fig. 1 – Resistive Feedback.

The typical transducers used in the TO-8's are microwave bipolar transistors which have a nominal 6 dB/octave gain slope, as shown in Figure 2. The amplifier gain curve can be flattened using pure, resistive feedback with no reactive elements up to a frequency where the open loop gain is approximately 10 dB greater than the closed loop gain. Then, reactive elements must be used to provide input and output match and to "gain-peak" the amplifier to obtain the highest gain bandwidth product. A typical RF circuit excluding DC biasing, coupling, and bypass capacitors is shown in Figure 3. The parasitic elements, such as header capacitance and bondwire inductance, are absorbed into the circuit elements. Manual computer optimization is used on a specially developed W-J computer program that is specifically designed for analyzing cascadable amplifier circuits.

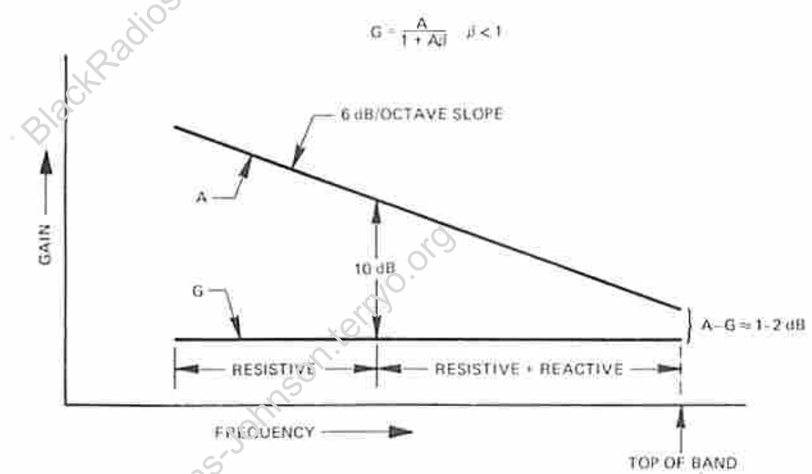


Fig. 2 – Open Loop Versus Closed Loop Gain.

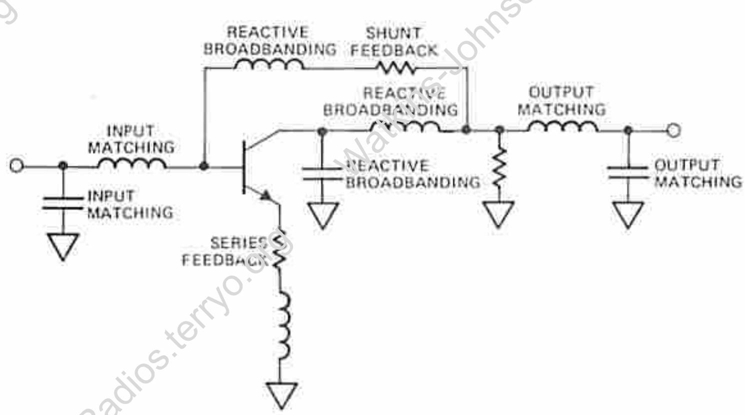


Fig. 3 – Typical RF Circuit.

This program uses conventional matrix techniques to treat each circuit element and uses fixed topology. Single-stage gain typically runs from 6 to 25 dB, with R_e ranging from 20 to 0 ohms and R_f ranging from 150 to 1000 ohms, as illustrated in Figure 4. For low noise circuits, R_e usually goes to zero, since the transistor is normally biased for less than 10 mA collector current and the internal R_e, which can be approximately by $.026/I_c$, acts as sufficient emitter feedback. The curves in Figure 5 show the gain, the input and output impedance as a function of R_e with a fixed R_f. R_e is fixed and R_f varied in Figure 6, which shows the inverse gain relationship between these two resistors. It is this property of the microwave bipolar transistor that allows various gain options to be realized. For a fixed value of R_e, to obtain as close to a 50-ohm input and output impedance

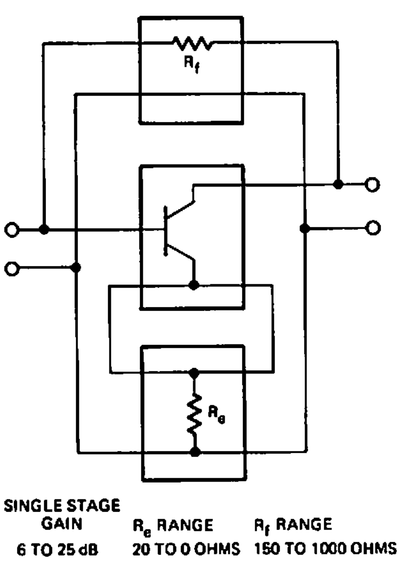


Fig. 4 — Two-port Topology.

as possible, a certain value of R_f which will dictate the gain is required. For higher gain, a lower value of R_e is chosen, which requires an increase in the value of R_f. The gain that can be obtained at the top of the band is typically within 2 dB of the transducer's open-loop gain. To obtain more than

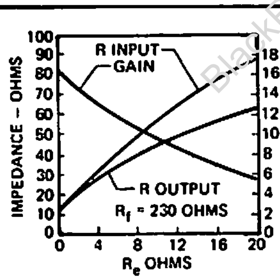


Fig. 5 — Gain and Impedance.

this gain from the device usually results in both lack of unconditional stability and increased input VSWR.

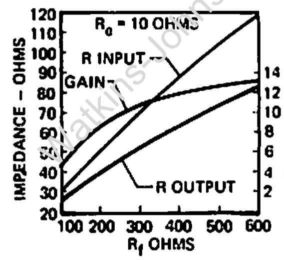


Fig. 6 — Gain and Impedance Versus Collector-base Resistance.

Noise-Figure Degradation

For a rough first approximation of the quantitative degradation in noise figure that the resistive feedback elements cause, the following derivations may be used. The approximation excludes the actual transistor and its noise properties from the analysis. This contributes to the degree of accuracy of the approximation; but, its purpose is to obtain, by simple calculation, what degradation can be expected. This type of approximation is particularly useful when it is desired to determine the influence of changing the feedback elements on noise figure to obtain different gain levels.

When the gain of the bipolar transistor is significantly reduced by feedback, its open loop noise characteristics change such that the amplifier does not respond as readily to changes in source impedance. The transistor will generally operate better when essentially matched to its input impedance. As discussed earlier, the cascadable amplifier must have close to a 50-ohm input and output impedance. For the purpose of the following analysis it will be assumed that the input and output impedance is 50 ohms.

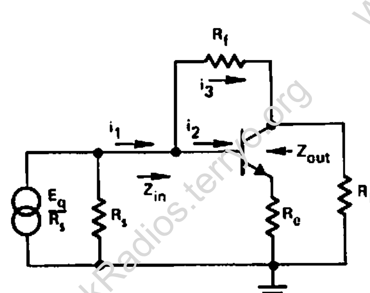


Fig. 7 — Noise Figure Degradation.

The equivalent circuit for the transistor circuit in Figure 7 can be changed to that shown in Figure 8 for determining the resistive losses caused by the feedback elements. In effect, the emitter feedback resistor, R_e, can be considered a loss element in series with R_1, the effective input resistance of the transistor. The emitter resistor can be treated as a voltage-dividing element where the signal-to-noise ratio is increased by this voltage division.

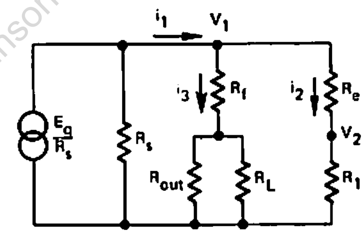


Fig. 8 — Equivalent Circuit for Noise Figure Degradation.

Letting $Z_{in} = R_{out} = R_L = 50$ ohms and solving for R_1,

$$R_1 = \frac{(R_f + 25)\,50}{R_f - 25} - R_e \qquad (1)$$

The input power to the network when $Z_{in} = 50$ ohms is $50i^2$. The power delivered to R_1 is $R_1(i_2)^2$. Taking the ratio of delivered power to input power yields:

$$\text{Power ratio} = \frac{R_1\,(i_2)^2}{50(i_1)^2} \qquad (2)$$

Using current division, and solving for i_2, gives:

$$i_2 = \frac{i_1\,(R_f + 25)}{R_f + 25 + R_e + R_1} \qquad (3)$$

Substituting equation 3 into equation 2 yields:

$$\text{Power ratio} = 10 \log \frac{(R_f+25)^2\,R_1}{50(R_f+25+R_e+R_1)^2} \qquad (4)$$

For an amplifier with an R_e of 12 ohms and R_f of 240 ohms, the degradation of the noise figure calculates to 1.85 dB. At the other end of the scale a low noise amplifier might have an R_f of 400 ohms and an R_e of zero ohms, from which only 0.54-dB degradation is calculated.

Empirical data show that using equations 1 and 4 can be made slightly more accurate by adding a correction factor of 0 dB for a 20-dB or higher gain stage and 0.5 dB for a 7.5-dB gain stage, with linear interpolation in between.

Output Power

The output power of the TO-8 feedback amplifier is a direct function of the collector current. The great majority of cascadable amplifiers use direct capacitively coupled outputs, i.e., circuits without impedance transforming devices and, as a result, are voltage limited. Nonsymmetrical clipping occurs on the cutoff portion of the AC swing, as shown in Figure 9. The steep AC load line is a result of the direct coupling to the 50 ohm load impedance. For greater output power at a given collector current, the equivalent AC load impedance must be raised. This reduces the slope of the AC load line, thereby providing greater AC swing in the cutoff part of the cycle. This effect can be observed by comparing V_p to V_p' in Figure 9.

For wideband operation and good impedance matching, it is generally not practical to use a transforming device, except for the VHF and lower UFH frequency ranges. The WJ-PA2 A87 series, A81/A82 series and the A67 series use autoformers in the collector circuit for higher and more efficient output power, but are limited to below 800 MHz operation. Because of the sensitivity of the output power to the AC load line, the voltage limiting is a direct function of the load impedance. Higher than 50 ohms for the load will result in greater than the nominal output power, and lower than 50 ohms will reduce the available output power.

DC Biasing

Depending on RF requirements and cost considerations, several schemes are used to provide the DC biasing in the cascadable amplifiers. In the low-cost scheme shown in Figure 10, the collector feedback resistor serves the dual purpose of providing base bias and collector-to-base shunt feedback. This approach is used in TO-5 packages and is represented by the W-J EA series, such as the EA2 amplifier. Compromised performance results because the ultra-small size does not allow input or output matching. The unit operates essentially with resistive matching, except that a series peaking inductor is used in the collector line. In addition, the value of R_1 is typically less than 150 ohms, which causes substantial noise figure degradation because the value of R_f must be chosen to set the gain and provide a reasonable input and output match. This requires that R_1 have a low enough value to enable it to pass the excess bleeder current. Since the compromised performance of the circuit shown in Figure 10 has no R_3, in comparison to the circuit shown in Figure 11, the voltage at the base will be low, which also necessitates that R_1 be low. In order to reduce the current flow, V_{CE} is set low, thereby reducing the maximum available gain in this type of design.

The passive bias circuit shown in Figure 11 overcomes noise figure and gain problems by using a separate R_f resistor and an emitter resistor to provide both DC feedback for temperature stability and to raise the voltage level at the base so that R_1 can be larger in value. The parallel combination of R_1 and R_2 provide a minimum amount of shunting and its accompanying noise figure increase and gain reduction.

A third scheme uses a PNP low frequency transistor to bias the RF tran-

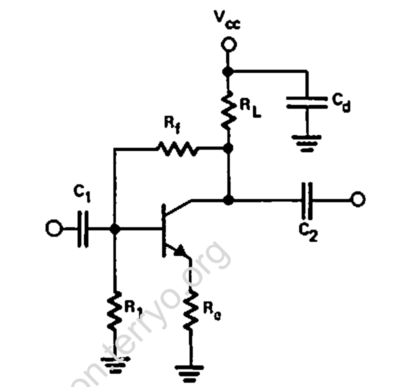


Fig. 10 – Low-cost Bias: Compromised Performance.

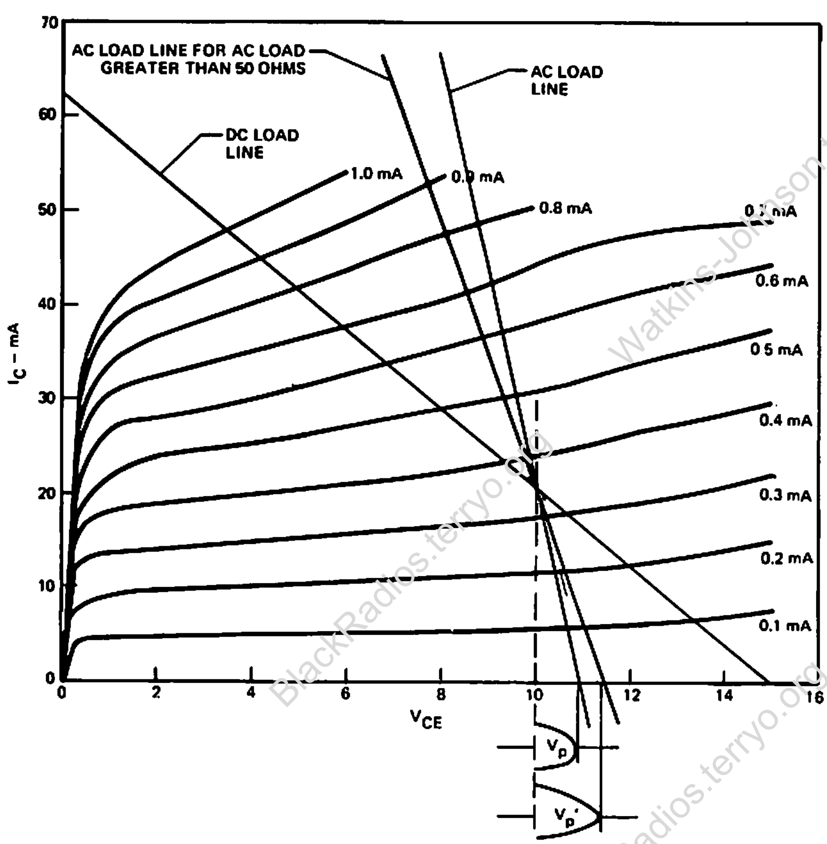


Fig. 9 – AC Output Power Swing.

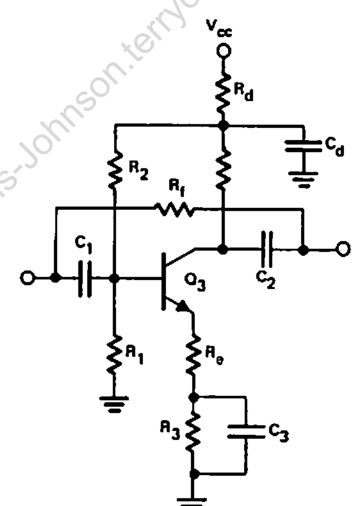


Figure 11 – Passive Bias: Full Performance.

1

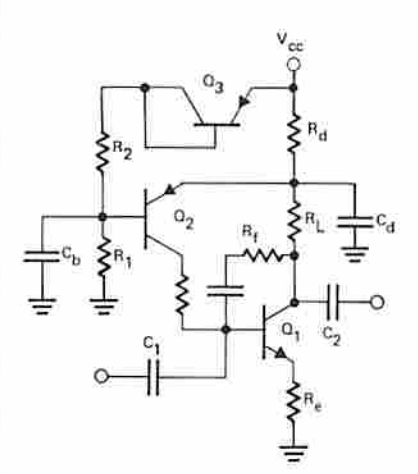


Fig. 12 — Active Bias: Full Performance.

sistor, as shown in Figure 12. This approach virtually eliminates base shunting and, in addition, does not have an element in the emitter circuit which minimizes degeneration because of additional parasitic inductance in the emitter leg. This circuit is temperature-stable because if I_c in the RF transistor goes up, the voltage across the sense resistor, R_d, will go up, causing V_{BE} across Q_2 to go down. This action reduces the base drive to Q_1, causing I_c to go down. When R_d is less than about 300 ohms, it is usually necessary to include Q_3 to track the base-emitter voltage of Q_2 over temperature as the differential voltages on R_d can become comparable in magnitude to the normal base-emitter voltage change that occurs as a function of temperature.

The circuit of Figure 13 is used for the higher-level cascadable amplifiers, which differ from the type shown in Figure 12 by the addition of an RF choke. The choke does not limit current, and for higher-level units, particularly if it is not desired to raise V_{cc} above 15 volts, it does not shunt the output and absorb RF power. Most W-J amplifiers that provide +13 dBm or greater output power utilize an RF choke for power supply decoupling.

One method of providing bias for two cascaded RF stages in a single TO-8 is demonstrated in Figure 14. Here, the active bias circuit of Figure 12 is expanded to provide bias from a single transistor for both RF transistors. The limitation of this circuit is that the collector current of each RF transistor (Q_1 and Q_2) must be close enough in value so that each transistor will receive its proportionate amount of correcting currents from Q_3 when the circuit is operated over wide temperature ranges.

To summarize these bias schemes, the circuit in Figure 10 is used where minimum cost and size are the dominant factors. The circuit in Figure 11 is used where higher performance is desired, but the frequency of operation is usually limited to 500 MHz or below. The circuit will be less sensitive to sub-band oscillators (see section on sub-band oscillations), since no active device is used in the bias circuit.

The bias circuit shown in Figure 12 is not frequency-limited, and offers the maximum gain obtainable from the RF transistor. The circuit of Figure 13 is used where it is desired to obtain higher power than possible from the circuit of Figure 12. The circuit of Figure 14 minimizes the area required for high performance applications when two stages in a single TO-8 package are used.

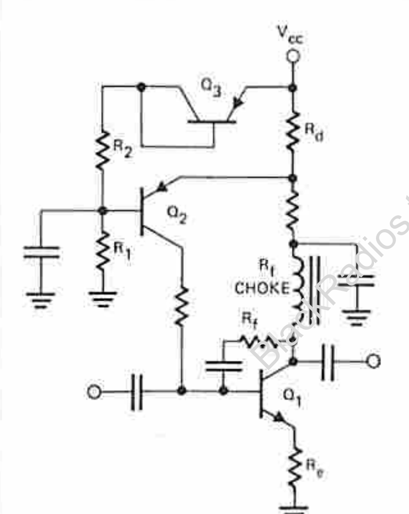


Fig. 13 — Linear Power Amplifier: Active Bias.

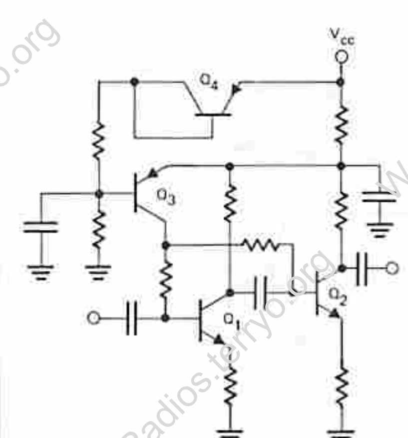


Fig. 14 — Two-stage Active Bias.

Performance Parameters Cascading Rules

The wide selection of amplifiers combined with the WJ-G1 gain control module, offers extensive flexibility in achieving any desired gain, frequency, noise figure, VSWR and power output.

The following sections give a few simple rules to use when cascading these amplifiers.

Gain

The typical cascaded gain will be the sum of the individual unit typical gains. The overall gain specification should not exceed the sum of the minimum gains as specified for each unit. The cascaded gain of the A15, A17 and PA10 shown in Figure 15. An overall gain of 37 ±0.4 dB is achieved from 10-1000 MHz.

Gain Flatness

Each cascadable amplifier is flat across its respective band to within ±0.3 dB. The cascaded gain flatness for up to 4 units typically will be less than ±1.0 dB. However, for a conservative specification, ±1.5 dB should be used when the full bandwidth is required.

Fig. 15 — Gain of the A15, A17 and PA10 Cascade.

The gain characteristics of three A5s in cascade are shown in Figure 16 for V_{CC} values of 15 V, 12 V, 10 V, and 8 V. Note that the gain flatness remains virtually unchanged for voltages ranging from 8 to 15 volts. The total power drain for the three units is only 288 mW at 8 volts compared to 1120 mW at 15 volts. This cascade is very useful in applications with limited power drain.

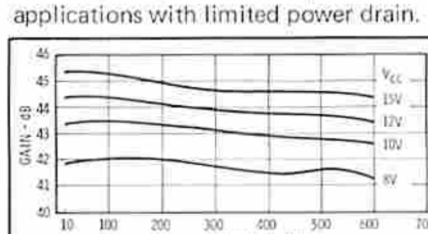


Fig. 16 — Gain Performance of Three A5 Amplifiers in Cascade for V_{CC} Values of 15V, 12V, 10V and 8V.

Cascaded Noise Figure

The overall noise figure measured at the input amplifier of a cascade will increase due to the second stage contribution. The overall noise figure of a cascade can be calculated using the following equation:

$$F = F_1 + \frac{F_2 - 1}{G_1} + \ldots + \frac{F_N - 1}{G_1 G_2 \ldots G_{N-1}}$$

where F_N is the noise figure of the Nth stage of G_N is the gain of the Nth stage. All terms are numeric ratios and not in dB.

Table 1 gives the second stage contribution for the gains available from the cascadable amplifiers. For example, a typical cascade would be an A1 followed by two A5s. If both A5s have a 5.0 dB noise figure, from Table 1, the contribution of the second A5 to the first A5 is only 0.093 dB. In this example, the second stage contribution to the overall noise figure is virtually the same even if the A1 (first stage Noise Figure of 3 dB) is cascaded with one or more A5s. The contribution given from Table 1 is 0.146 dB. If the second stage were an A1 (3 dB Noise Figure) instead of an A5, then the contribution would be 0.068 dB or an improvement of only 0.08 dB.

The disadvantages of cascading two or more low noise amplifiers are lower input power for 1 dB gain compression and larger gain variation over temperature because of the low bias level on the transistor. For example, the individual data sheet on the low-level A3 amplifier shows a gain variation of approximately ±0.5 dB over a temperature range of −54°C to +100°C. The variation for the A5 over the same temperature range is typically less than ±0.3 dB. The main advantages of cascading low-level amplifiers are lower power drain and better limiting action to high-level signals.

Impedance

The Watkins-Johnson Company cascadable amplifiers are designed for 50-ohm input and output impedance by using both collector-to-base and emitter resistive feedback. In addition, LC matching and reactive feedback compensation are used to obtain matching at the high end of the band. The photograph in Figure 17 shows the cascaded input and output impedance of an A11/A15 cascaded. In this case the cascaded VSWR is improved slightly over the unit VSWR. Most Watkins-Johnson cascadable amplifiers offer a bandwidth of 6-8 octaves. In general, the impedance is between 40-60 ohms and is essentially resistive below 1½ octaves from the high end of the band.

Table 1 – Second-Stage Noise Figure Contribution – dB

First Stage Gain dB	First Stage Noise Figure dB	Second Stage Noise Figure 3 dB	5 dB	8 dB	10 dB	12 dB	15 dB	20 dB
20 dB	8.0	0.007	0.015	0.040	0.060	0.100	0.206	0.633
	5.0	0.014	0.03	0.070	0.120	0.200	0.401	1.183
	3.0	0.022	0.05	0.110	0.190	0.310	0.620	1.750
	1.5	0.039	0.07	0.160	0.270	0.430	0.852	2.307
15 dB	8.0	0.220	0.047	0.114	0.190	0.310	0.620	1.750
	5.0	0.043	0.093	0.225	0.370	0.600	1.160	2.989
	3.0	0.068	0.146	0.351	0.580	0.920	1.718	4.098
	1.5	0.096	0.205	0.488	0.800	1.250	2.267	5.074
10 dB	8.0	0.07	0.150	0.350	0.580	0.920	1.718	4.098
	5.0	0.14	0.290	0.670	1.090	1.670	2.941	6.160
	3.0	0.21	0.450	1.030	1.620	2.420	4.039	7.754
	1.5	0.30	0.620	1.390	2.140	3.120	5.008	9.036
7 dB	8.0	0.140	0.290	0.670	1.090	1.670	2.941	6.160
	5.0	0.270	0.560	1.260	1.950	2.870	4.672	8.601
	3.0	0.410	0.850	1.850	2.790	3.950	6.088	10.374
	1.5	0.570	1.160	2.430	3.560	4.910	7.264	11.756

VSWR

The VSWR on most of the amplifiers is specified at a maximum of 2.0:1. The cascaded VSWR will be typically less than 2.0:1 across the entire band, but can be greater than 2.0:1 in certain cases. About 1½ octaves below the high end of the band there is virtually no degradation when cascading, and the 2.0:1 cascaded specification can be easily achieved. In general, when covering the entire bandwidth, the cascaded VSWR should be specified 2.5:1 maximum, with amplifiers that have a 2.0:1 specification.

Output Power

When cascading the cascadable amplifiers, there is no degradation in output power of the last stage provided that the driver stage provides sufficient power. Figure 18 shows the gain compression versus output power for various models. The curves extend from the uncompressed region of 2 dB of gain compression. The threshold compression point is defined as the 0.1-dB gain compression point and is the level of output power that the amplifier can deliver to the next stage without undergoing any significant loss of power output for the cascade.

The curves of Figure 18 show the additional compression that can be expected if the driving stage does not provide sufficient power. The necessary drive power is calculated by using the following equation:

$$P_D = P_o - G_o + 1$$

where P_o is the output power and G_o is the uncompressed gain of the stage being driven. The minimum P_D is the threshold compression point as previously defined.

Typically threshold compression points for several Watkins-Johnson

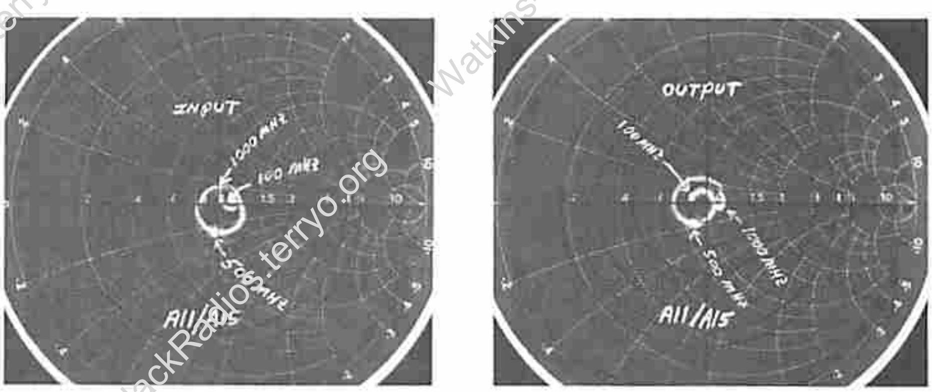


Fig. 17 – Input and Output Impedance of an A11/A15 Cascade.

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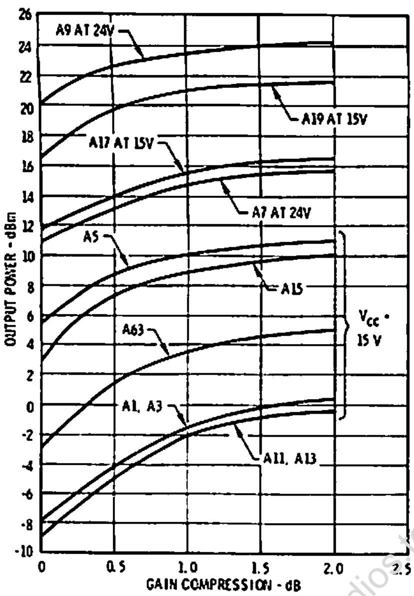

Fig. 18 — Gain Compression Versus Output Power.

Company cascadable amplifiers are given in the first column of Table 2. The center columns show the threshold driving power required to obtain the output power listed in the right hand column. This table is generated by using the above equation. Table 2 shows that a P_D of +11.5 dBm is required to drive the A9 to a P_o of +22 dBm output power. The A7 provides this amount of power at its threshold compression point. The A19 requires +15 dBm. The A17 provides +15 dBm at its 1 dB compression point; hence, an output power reduction of 1 dB would typically result when cascading the A17 and A19. The A17 requires +4.0 dBm to obtain a +15 dBm output which is provided by the A15. If lower noise is needed, then the A63 should be used, which is compressed about 1 dB at the +4 dBm output level. Thus, the overall result when cascading the A63, A17 and A19 is approximately a 2 dB loss in output power. The measured output power of this cascade is shown in Figure 19 The output powers shown in Figure 18 were measured at 100 MHz. Generally, the output power increases as the high end of the band is approached because of the reactive matching effect.

Table 2 — Typical Threshold Compression Point

Model	$P_{Threshold}$ (0.1 dB Comp. Pt.)	$P_{Driver\ Min.}$ (0.1 dB Comp. Pt.)	$P_{Out\ Typ.}$ (1.0 dB Comp. Pt.)
PA10 & PA12	+19.0	+13.0	+22.5
A9	+21.0	+11.5	+22.0
A19	+17.0	+15.0	+21.0
A17	+12.5	+4.0	+15.0
A7	+11.5	0	+14.0
A5	+6.5	-6.0	+8.0
A15	+4.0	-7.0	+7.0
A63	-2.0	-12.0	+3.0
A1 & A3	-7.0	-15.0	-1.0
All	-8.0	-16.0	-2.0
A79	+20.7	+9.4	+22.4
A82	+17.0	+0.2	+20.7
A87-2	+6.3	-4.7	+10.3
A86	+2.1	-19.1	+7.9
PA3	+21.1	+11.6	+25.1
A59	+20.6	+12.4	+22.4
RA89	+19.5	-2.3	+21.2
A88	+18.1	+2.4	+20.4
A58	+18.2	+9.2	+19.2
A72	+12.7	-0.7	+13.3
A74	+6.9	-19.4	+8.6
A83	-4.6	-29.8	-0.8
PA15	+22.4	+14.3	+26.8
A19-1	+20.9	+12.8	+23.3
A66-1	+12.1	-10.1	+15.9
A18-1	+11.7	+1.8	+15.8
A12	-0.7	-6.5	+8.5
A39	+20.8	+16.4	+22.9
A38	+18.8	+14.3	+20.8
A36-1	+6.1	+0.4	+15.4

The output power of a single stage is measured using a 50 ohm source and a 50 ohm load. The output power of the driving amplifier can be affected by the load (input impedance of next stage) presented to it. This can cause some minor differences to occur that are not fully explained by considering compression alone. In general, if the effective load presented to the driver stage is greater than 50 ohms, then more output power power can be obtained from the driver stage. Conversely, if the load presented is less than 50 ohms, then a reduction may result.

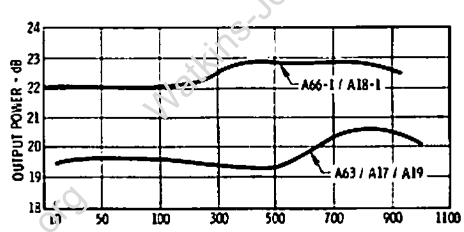

Fig 19 — Power Output of the A66-1, A18-1 A63, A17 and A19 Cascade.

The WJ-A9 can be driven to provide 200-300 mW (+25 dBm) of output power with additional compression, and the A19 can be driven to provide 150-200 mW (+23 dBm) maximum. Beyond these limits, the bias current of the amplifiers will increase because of the RF signal effect on the base bias tends to cause Class C operation. Because the gain of the A19 is lower than the A9, a larger RF signal will be present at the base, which causes the base bias to be affected at a lower output power than on the A9. For maximum reliability it is not recommended that the A9 or A19 be operated above these output power levels.

The A63/A17/A19 was introduced in late 1974 and has remained a state-of-the-art cascade for several years. New for 1983 is a cascaded combination providing equal or superior results using only two TO-8 amplifiers as shown in Fig. 19A.

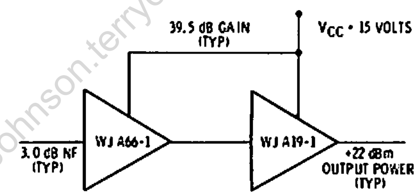

Fig. 19A

The A66-1/A19-1 cascade provides about 3 dBm higher output power, equal NF to the WJ-A63, and 4 dB higher gain. The primary reason for the higher output of this cascade is simply that the A19-1 requires about 4 dB less drive power (see gain compression curves in Fig. 18) than the A19 because of its higher gain.

There are now within the Watkins-Johnson product line of cascadable amplifier models that more than double the output power of the industry pace setting A9 and A19 TO-8 amplifier. The WJ-PA3 will provide a minimum of 200 milliwatts at 15 volts and, in addition, offer 3.5 dB higher gain than the WJ-A9 amplifier.

For applications out to 1000 MHz, the WJ-PA10 will provide a minimum of 200 milliwatts of output power (@ 20V Vcc) with a 3.5 dB more gain than the WJ-A19 amplifier. And now there is the WJ-PA15 TO-8 amplifier that provides 3.0 dB even higher gain (13.5 dB typically) out to 1000 MHz and 200 milliwatts minimum output power using only a 15 volt Vcc supply. In addition, the WJ-PA15 provides a typical output power of 0.5 watt out to 500 MHz.

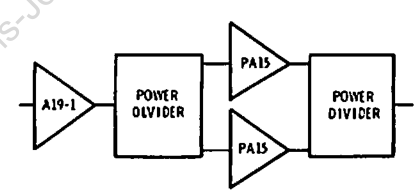

Fig. 20 — Higher Output Power by Paralleled Amplifier Operation.

When the output power required is higher than that which is provided by a single output stage, then the units can be paralleled using reactive power dividers as shown in Fig. 20. Nearly 3 dB of additional output power can be obtained using this method. An example of paralleled output (saturated) power is shown in Fig. 20A.

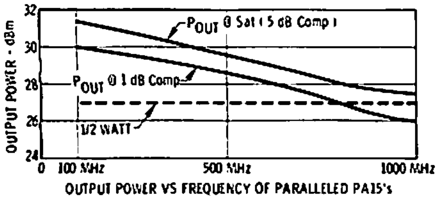

Fig. 20A

When the paralleled pair of PA15's is driven by a WJ-A19-1 or WJ-PA10 amplifier, there is virtually no change in the output power.

Saturated Output Power

Several new amplifier gain compression versus output power curves have been added in Fig. 21A through Fig. 21D. These curves show the gain compression characteristic for many newer generation TO-8 amplifiers for input levels that cause the onset of compression to moderate levels of saturation where the gain compression is 5 to 10 dB.

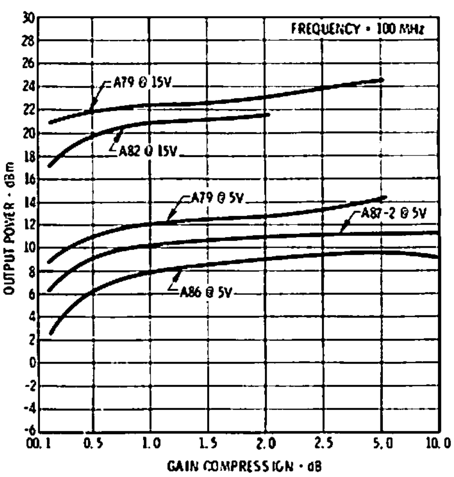

Fig. 21A

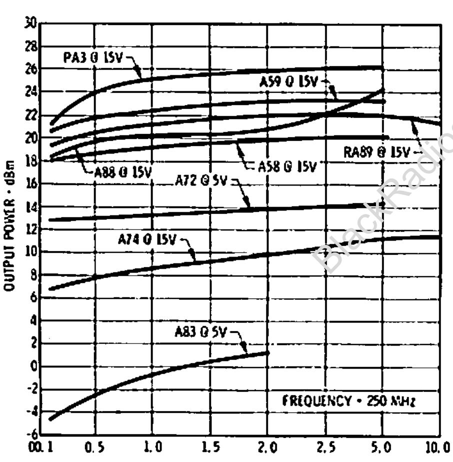

Fig. 21B

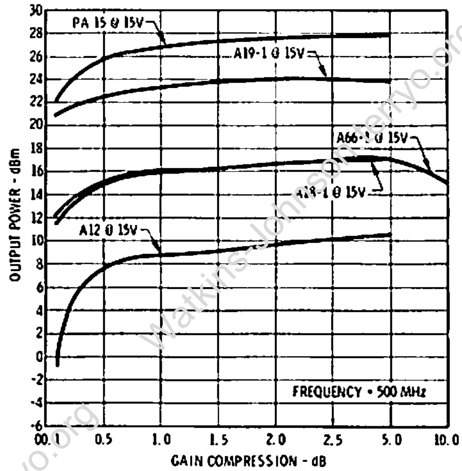

Fig. 21C

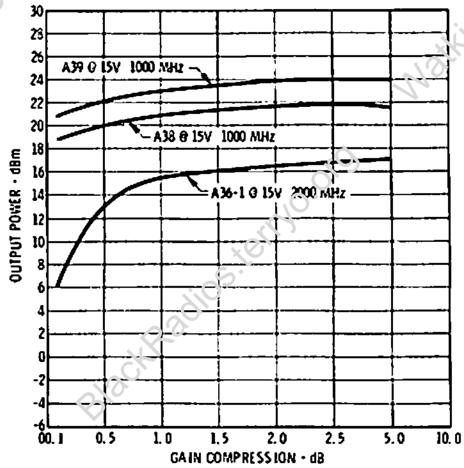

Fig. 21D

These curves demonstrate a relatively monotonic characteristic of gain compression for moderate saturation levels.

What happens when the W-J Cascadable Amplifiers are driven into heavy saturation depends on the bias design of the circuit and whether or not the units are single-stage or two-stage. Figures 22A

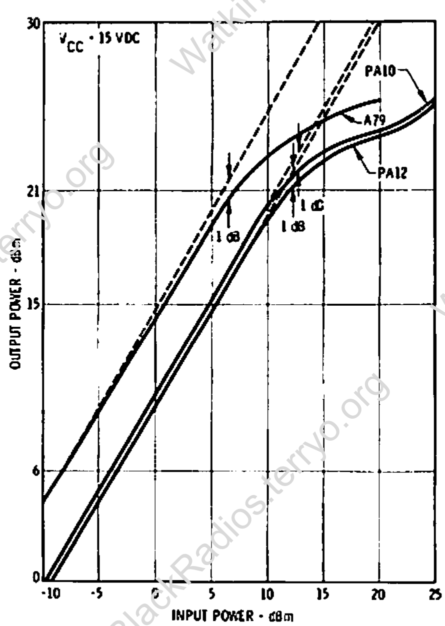

Fig. 22A

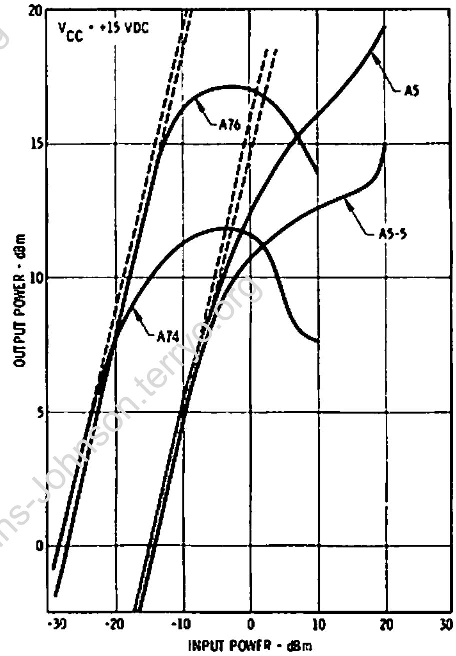

Fig. 22B

and 22B give some exemplary curves of overdrive conditions.

Distortion Products and Intercept Point

Due to the inherent nonlinearities of the amplifiers, intermodulation and harmonic distortion products are generated which limit the dynamic range. The level of the distortion product relative to the signal level can be calculated from the intercept point, or conversely, the intercept point can be calculated from the relative suppression. The intercept point (I.P.) is the theoretical point of intersection of the fundamental slope with the slope of the distortion product, and is shown in Figure 23 for the WJ-A9

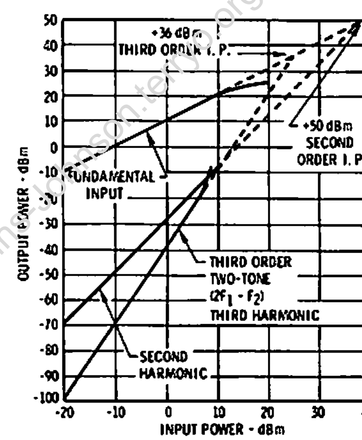

Fig. 23 — Output Power Versus Input Power of the WJ-A9 Amplifier.

amplifier. Third order two-tone distortion is the mixing of two signals applied at the input of the amplifier. These third-order products will appear at the

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frequencies $2f_1 - f_2$, $2f_1 + f_2$, $2f_2 + f_1$ and $2f_2 - f_1$. Two-tone second-order products will appear at the frequencies $f_1 + f_2$ and $f_1 - f_2$. The intercept point can be calculated from equation 1:

$$1)\ \text{I.P.} = \frac{R_{dB}}{n-1} + S_{dBm}$$

where R is the relative suppression below the fundamental in dB, n is the order number and S is the absolute signal level in dBm. If the intercept point is known, the relative suppression can be calculated by equation 2:

$$2)\ R_{dB} = (n-1)\ (\text{I.P.} - S)$$

The intercept point will be the output intercept point if S is the output signal level and it will be the input intercept point if S is the input signal level.

For example, what is the typical third-order two-tone intercept point for the A9? From Figure 23, the value of R is 52 dB for an output power of +10 dBm. Using equation 1:

$$\text{I.P.} = \frac{52}{3-1} + 10 = +36\ \text{dBm}$$

Table 3 shows a summary of the second-order harmonic, third-order harmonic and third-order, two-tone intercept point for several amplifiers. The second-order two-tone intercept points are not shown since they are approximately equal to the second-order harmonic intercept points.

Table 3 — Second-Order Harmonic, Third-Order Harmonic and Third-Order, Two-Tone Intercept Points for Several Amplifiers

Model	Second-Order Harmonic I.P.	Third-Order Harmonic I.P.	Third-Order Two-Tone I.P.
A5	+40 dBm	+27 dBm	+22 dBm
A7	+45 dBm	+30 dBm	+26 dBm
A9	+50 dBm	+36 dBm	+36 dBm
A11	+15 dBm	+13 dBm	+10 dBm
A15	+35 dBm	+24 dBm	+20 dBm
A17	+45 dBm	+32 dBm	+29 dBm
A19	+46 dBm	+34 dBm	+34 dBm

The A9, A19, and A17 output third-order two-tone intercept points versus frequency are shown in Figure 24. Note how the A17 I.P. approaches the A19 I.P. at the high end of the band. When cascading amplifiers, if the driving

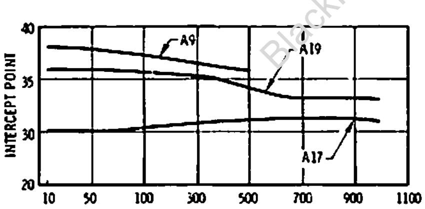


Fig. 24 — A9, A19 and A17 Output Third-Order Two-Tone Intercept Point Versus Frequency.

amplifier output intercept point is equal to the input intercept point of the amplifier being driven, then each amplifier would contribute equally, causing a 3-dB reduction in the output intercept point of the output stage. If there is 6 dB of margin on the driver stage, then approximately 1 dB of degradation could result. As a rough rule of thumb, the output intercept point will be typically 12 dB higher than the output power on the Watkins-Johnson Company cascadable amplifiers. Any degradation in output power will generally cause degradation in the intercept point.

Intercept Degradation

Distortion in RF Signal Processing is often a baffling problem for the designer. Basic understanding of what causes distortion, and how it propagates within the system will help optimize performance. Intermodulation Distortion is of key interest in a newly developed system.

The Two-Tone Intercept Point is often used as a measure of intermodulation distortion in signal processing devices. When amplifiers are cascaded the degradation of the intercept point can be easily determined.

When a signal is amplified, the output is characterized by the primary frequencies, f_1 and f_2, and their intermodulation products. (Table 1) To specify the level of distortion due to the intermodulation products, the intercept point definition was created which, simply stated, defines the nth order output intercept point as,

$$(1)\qquad {}^{n}IP = \frac{{}^{n}R}{(n-1)} + P_o$$

${}^{n}R$ is the relative suppression of the nth order product in dB and P_o is the total power output of the amplifier in dBm.

When two amplifiers are cascaded, the cascade intercept point is a function of the intercepts of the individual amplifiers and the gain of the system. To understand the degradation of intercept point, the relative suppression of intermodulation products must be understood.

Relative suppression is the ratio of the total output power (mw) to the power level of an intermodulation spur. This is valid for all orders.

$$(2)\qquad {}^{n}r = \frac{P_o}{{}^{n}S}$$

In a two-amplifier system (see Figure 25), if the individual suppression characteristics are known, the total suppression can be determined.

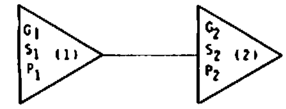


Fig. 25

Both amplifiers generate intermodulation products, ${}^{n}S_1$ and ${}^{n}S_2$ respectively. The first product, ${}^{n}S_1$ is amplified by the gain of the second amplifier and then combines with ${}^{n}S_2$. If it is assumed that all input and output impedances match, then the intermodulation products' sum is,

$$(3)\qquad \sqrt{S_T^n} = \sqrt{S_1^n X g_2} + \sqrt{S_2^n}$$

The Gain of the second amplifier is represented by g_2. With some mathematical manipulation, a formula for the total relative suppression ${}^{n}r_T$ can be obtained:

$$(3a)\qquad \frac{\sqrt{S_T^n}}{\sqrt{P_o}} = \frac{\sqrt{S_1^n X g_2}}{\sqrt{P_o}} + \frac{\sqrt{S_2^n}}{\sqrt{P_o}}$$

$$(3b)\qquad \frac{\sqrt{S_T^n}}{\sqrt{P_o}} = \frac{\sqrt{S_1^n X g_2}}{\sqrt{P_1 X g_2}} + \frac{\sqrt{S_2^n}}{\sqrt{P_o}}$$

$$(4)\qquad \frac{1}{\sqrt{r_T^n}} = \frac{1}{\sqrt{r_1^n}} + \frac{1}{\sqrt{r_2^n}}$$

$$(4a)\qquad r_T^{n\,-1/2} = r_1^{n\,-1/2} + r_2^{n\,-1/2}$$

If the cascaded relative suppression is known, the degraded intercept point can be calculated:

$$(4b)\qquad \left(r_T^n\right)^{\left(\frac{1}{n-1}\right)\frac{-(n-1)}{2}} = \left(r_1^n\right)^{\left(\frac{1}{n-1}\right)\frac{-(n-1)}{2}} + \left(r_2^n\right)^{\left(\frac{1}{n-1}\right)\frac{-(n-1)}{2}}$$

$$(4c)\qquad \left[r_T^{n\left(\frac{1}{n-1}\right)} P_o\right]^{\frac{-(n-1)}{2}} = \left[\left(r_1^{n\left(\frac{1}{n-1}\right)}\right)^{\frac{-(n-1)}{2}} + \left(r_2^{n\left(\frac{1}{n-1}\right)}\right)^{-\left(\frac{n-1}{2}\right)}\right] P_o^{-\left(\frac{n-1}{2}\right)}$$

$$(4d)\qquad \left[r_T^{n\left(\frac{1}{n-1}\right)} P_o\right]^{\frac{-(n-1)}{2}} = \left[\left(r_1^{n\left(\frac{1}{n-1}\right)} P_o\right)^{\frac{-(n-1)}{2}} + \left(r_2^{\left(\frac{1}{n-1}\right)} P_o\right)^{\frac{-(n-1)}{2}}\right]$$

$$(5)\qquad \left[r_T^{n\left(\frac{1}{n-1}\right)} P_o\right]^{\frac{-(n-1)}{2}} = \left(r_1^{n\left(\frac{1}{n-1}\right)} P_1\, g_2\right)^{\frac{-(n-1)}{2}} + \left(r_2^{n\left(\frac{1}{n-1}\right)} P_2\right)^{-\left(\frac{n-1}{2}\right)}$$

If equation (1) is converted from dBm to mW, it can be substituted into (5) and a formula for cascaded intercept point can be obtained:

(1) $$IP^n = \frac{R^n}{n-1} + P_o$$

(1a) $$IP^n = n_r^{\left(\frac{1}{n-1}\right)} P_o$$

Rewriting (5) using (1a):

(6) $$IP_T^{n\,\frac{-(n-1)}{2}} = \left(IP_1^n\, g_2\right)^{\frac{-(n-1)}{2}} + \left(IP_2^n\right)^{-\frac{(n-1)}{2}}$$

This can be generalized to the case of x amplifiers in cascade:

(7) $$IP_T^{n\,\frac{-(n-1)}{2}} = \sum_{i=1}^{x} \left(IP_i^n\, g_{(i+1,x)}\right)^{\frac{-(n-1)}{2}}$$

The gain term represents the gain following the i th amplifier. This formula is valid for all orders. However, it gives worst case performance, assuming a perfect 50Ω system. If a severe mismatch occurs in the cascade, further degradation can result.

This formula can be easily validated experimentally. Looking at the Watkins-Johnson A5-5 in cascade with the PA3 the intercept point at 33.0 dBm can be measured using the individual amplifier characteristics (see Figure 26) and the

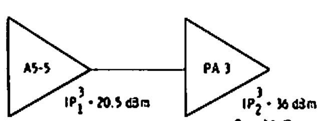


Fig. 26

cascade formula, it can be seen that the 3 dB degradation in third order intercept point is to be expected:

IP_1^3 = 20.5 dBm = 112 mW

IP_2^3 = 36.0 dBm = 3981 mW

g_2 = 14.7 dB = 29.5

$IP_T^{3\,-1}$ = [(112 mW) (29.5)]$^{-1}$ + [3981 mW]$^{-1}$

IP_T^3 = 1808 mW = 32.6 dBm

The intercept formula can be used to introduce several rules of thumb for cascading amplifiers. The first rule applies (see Figure 27) when the output inter-

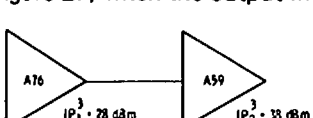


Fig. 27

cept point of the first amplifier equals the input intercept point of the second. Each amplifier will contribute equally to the intermodulation product, causing a 3 dB degradation in total output intercept point.

IP_1^3 = 28 dBm = 630.0 mW

IP_2^3 = 38 dBm = 6309 mW

g_2 = 10 dB = 10

$IP_T^{3\,-1}$ = [(630.9 mW) (10)]$^{-1}$ + [6309 mW]$^{-1}$

IP_T^3 = 3154 mW = 35.0 dBm

Δ ip = 3 dB

The second rule is demonstrated when the output intercept point of the first amplifier is much greater than the input intercept point of the second amplifier. (See Figure 28.)

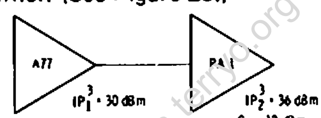


Fig. 28

IP_1^3 = 30 dBm = 1000 mW

IP_2^3 = 36 dBm = 3981 mW

g_2 = 12 dB = 15.8

$IP_T^{3\,-1}$ = [(1000 mW) (15.8)]$^{-1}$ + [(3981 mW)]$^{-1}$

IP_T^3 = 3182 mW = 35.0 dBm

Δ ip = 1 dB

In this case, a 6 dB overlay causes a 1 dB degradation in intercept point. The third rule of thumb is that a mismatch of intercept point will cause degradation equal to or greater than the mismatch itself. In the last example, the output intercept point of the first amplifier is 6 dB less than the input intercept point of the second. (See Figure 29.)

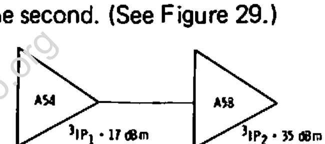


Fig. 29

IP_1^3 = 19 dBm = 79.4 mW

IP_2^3 = 35 dBm = 3162 mW

g_2 = 10 dB = 10

$IP_T^{3\,-1}$ = [(79.4 mW) (10)]$^{-1}$ + [3162 mW]$^{-1}$

IP_T^3 = 634.8 mW = 28.0 dBm

Δ ip = 7 dBm

Intermodulation distortion can be reduced through careful design. The general cascade formula can be used to calculate degradation in intercept point. For quick estimation in cascading, the following three rules of thumb can be used:

1) If the output intercept point equals the input intercept point, a 3 dB degradation will result.
2) If the output intercept point is much greater (> 6 dB) than the input, IP less than 1 dB degradation can be expected.
3) If the output IP is much less (< 6 dB) than the input IP, degradation equal to the mismatch, or more, can be expected.

Through the use of the three rules and the general cascade formula, intermodulation distortion can be minimized

Intercept Degradation and Dynamic Range

The dynamic range (DR) of cascadable amplifiers for a single input signal can be defined as: the difference between the input signal level that causes 1 dB of gain compression and the minimum input signal level that can be detected above the amplifier's noise level. This minimum detectable signal (defined as 3 dB above the noise level) MDS, can be expressed in dBm by the equation:

$$MDS = -111\ \text{dB/MHz} + B + NF$$

where B is the bandwidth relative to 1 MHz in dB, and NF is the noise figure measured at the amplifier input.

The input signal or drive power (P_D) that produces 1 dB of gain compression is given by the equation:

$$P_D = P_{output} - \text{Gain} + 1\ \text{dB}$$

where P_{output} is the output power at the 1 dB compression point. The dynamic range, therefore, is the difference between P_D and MDS:

$$DF = P_D - MDS$$

Using the data given in Figure 15 (A63, A17, A19) and a 1 MHz bandwidth, DR is calculated as:

DR = (P_{output} − Gain + 1 dB) − (−111 dBm/MHz + B + NF)
DR = (+19 − 35 + 1) − (−111 + 0 + 4)
DR = 92 dB (1 MHz bandwidth)

For a 500 MHz bandwidth there would be a 27 dB reduction in the overall dynamic range for the above example

1

$(10 \log \frac{500}{1} = 27 \text{ dB})$.

Another definition of dynamic range is the "spurious-free" region which characterizes the effective performance of an amplifier with more than one signal applied to the input. For the case of input signals at equal level, the spurious-free dynamic range, $DR_{spur\text{-}free}$, is given by the equation:

$$DR_{spur\text{-}free} = 2/3 \text{ (I.P. - Gain - MDS)}$$

where I.P. is the third order two-tone intercept point in dBm. Using the same example and an I.P. of +32 dBm for a A19 amplifier, the spurious-free dynamic range is:

$$DR_{spur\text{-}free} = 2/3 \; (+32 - 35 - (-111 + 0 + 4.0)$$

$$DR_{spur\text{-}free} = 69 \text{ dB (1 MHz bandwidth)}$$

Phase Linearity and Group Delay

The Watkins-Johnson Company cascadable amplifiers offer excellent linearity and relatively constant group delay because of thin-film integrated construction. Phase linearity is the best fit straight line to the phase response curve and is expressed in degrees deviation. Computer printouts of phase linearities from an automatic network analysis system are shown in Tables 4 and 5. The first column shows the deviation from linear phase and the last column shows the group delay.

The phase linearity of the WJ-A5 is typically less than ±2° across a 10-500 MHz band. The phase linearity of WJ-A15 is typically <±6° across its entire 5-1000 MHz band and the WJ-A25 is typically less than ±7° across its entire 5-1500 MHz band. Substantial improvement in phase linearity can be obtained by not using the upper end of the band. Table 4 compares the phase linearity of the A15 across the 110-510 MHz and 110-1010 MHz bands. The linearity across the 110-510 MHz band is typically within ±0.5°. The A25 phase linearity is typically ±1.8° up to 1000 MHz as shown in Table 5.

The cascaded phase linearity will be equal to or less than the sum of the individual stage linearity. Thus, 2 stages of A15s would typically have ±1.0° phase linearity up to 500 MHz, but would degrade to about ±12° up to 1000 MHz.

The phase linearity of the A34 is shown in Table 6. The A34 is a two stage 100-2000 MHz unit which offers typically ±3.5° across its entire bandwidth. Also shown is the phase linearity for the 500-1500 MHz band for which the A34 yields typically <±1.0°

The Group delay is defined as the rate of change of phase shift versus frequency $\frac{d\theta}{d\omega}$ (omega)

The group delay is calculated by taking the phase difference over a given frequency band and then dividing by that frequency band. Both the phase and frequency are in radians. The group delay can be expressed in units of time by the mathematical relationship

$$t_d \text{ (seconds)} = \frac{\text{frequency (Hz) X } 360^\circ}{\text{Phase (degrees)}}$$

The group delay for the A25 amplifier is typically less than 0.5 nanoseconds up to 1000 MHz as shown from Table 5.

The excellent phase linearily and constant group delay properties of the A25 make it an ideal choice for Gigabit Data Rate Systems. A convenient carrier frequency for the quadriphase modulated phase shift keying (QPSK) is 1 GHz, where the A25 provides high phase linearity and constant group delay.

Table 4 — Deviation from Linear Phase, Gain and Group Delay of the WJ-A15 Cascadable Amplifier

FREQ MHZ	DEV LIN 0 DEG	REL 0 DEG	GAIN DEV DB	ABS GAIN DB	GROUP DELAY N-SEC
100.	.24	.00	.12	14.91	.50
200.	-.37	-18.07	.11	14.90	.49
300.	-.13	-35.28	.11	14.89	.47
400.	.40	-52.21	.07	14.85	.49
500.	-.14	-70.20	-.12	14.67	.50

FREQ MHZ	DEV LIN 0 DEG	REL 0 DEG	GAIN DEV DB	ABS GAIN DB	GROUP DELAY N-SEC
100.	-3.78	.00	.19	14.92	.50
200.	-2.40	-18.06	.14	14.87	.49
300.	-.30	-35.41	.16	14.89	.48
400.	2.01	-52.54	.08	14.81	.49
500.	3.42	-70.57	-.09	14.65	.52
600.	3.60	-89.83	-.16	14.58	.55
700.	3.08	-109.79	-.09	14.64	.56
800.	2.06	-130.26	-.05	14.68	.61
900.	-1.61	-153.37	-.05	14.69	.65
1000.	-6.08	-177.28	-.19	14.55	.66

Table 5 — Deviation from Linear Phase, Gain and Group Delay of the WJ-A25 Cascadable Amplifier

FREQ MHZ	DEV LIN 0 DEG	REL 0 DEG	GAIN DEV DB	ABS GAIN DB	GROUP DELAY N-SEC
100.	-1.04	.00	.14	10.58	.37
200.	-.75	-13.24	.06	10.50	.37
300.	-.43	-26.45	.14	10.58	.36
400.	.51	-39.03	.09	10.53	.35
500.	1.70	-51.37	.05	10.49	.37
600.	1.23	-65.37	-.10	10.34	.39
700.	.51	-79.61	-.13	10.32	.39
800.	.31	-93.34	-.10	10.35	.39
900.	-.23	-107.40	-.14	10.30	.41
1000.	-1.80	-122.50	-.12	10.32	.42

FREQ MHZ	DEV LIN 0 DEG	REL 0 DEG	GAIN DEV DB	ABS GAIN DB	GROUP DELAY N-SEC
100.	-4.02	.00	.16	10.61	.37
200.	-2.90	-13.22	.08	10.53	.37
300.	-1.86	-26.52	.22	10.66	.36
400.	-.17	-39.16	.10	10.54	.35
500.	1.68	-51.65	.01	10.46	.37
600.	2.12	-65.55	-.11	10.34	.39
700.	2.29	-79.72	-.14	10.31	.39
800.	2.92	-93.42	-.13	10.32	.39
900.	3.20	-107.48	-.17	10.28	.40
1000.	2.49	-122.53	-.15	10.29	.41
1100.	2.14	-137.21	-.03	10.42	.41
1200.	1.89	-151.80	-.04	10.41	.42
1300.	.37	-167.65	-.05	10.39	.47
1400.	-3.05	-185.41	-.11	10.33	.50
1500.	-7.09	-203.79	-.22	10.23	.51

Table 6 – Deviation from Linear Phase, Gain and Group Delay of the WJ-A34 Cascadable Amplifier

FREQ MHZ	DEV LIN Θ DEG	REL Θ DEG	GAIN DEV DB	ABS GAIN DB	GROUP DELAY N-SEC
500.	.24	.00	.28	16.55	.54
600.	-.48	-19.40	.36	16.63	.52
700.	.16	-37.45	.33	16.60	.50
800.	.97	-55.32	.21	16.48	.52
900.	.30	-74.68	-.01	[illegible]	.55
1000.	-.91	-94.57	-.17	16.10	.53
1100.	-.41	-112.75	-.25	16.02	.51
1200.	-.21	-131.23	-.36	15.91	.52
1300.	-.70	-150.41	-.25	16.02	.51
1400.	.22	-168.16	-.19	16.08	.50
1500.	.01	-186.26	-.23	16.04	.50

FREQ MHZ	DEV LIN Θ DEG	REL Θ DEG	GAIN DEV DB	ABS GAIN DB	GROUP DELAY N-SEC
100.	2.09	.00	.28	16.58	.61
200.	-.74	-21.83	.19	16.49	.58
300.	-1.31	-41.41	.18	16.48	.54
400.	-1.62	[illegible]	.26	16.55	[illegible]
500.	-.89	-79.00	.23	16.52	.51
600.	-.51	-97.62	.33	16.63	.51
700.	.15	-115.96	.32	16.61	.51
800.	.78	-134.34	.20	16.50	.52
900.	.64	-153.48	-.00	16.30	.55
1000.	-.48	-173.60	-.15	16.15	.54
1100.	-.06	-192.19	-.19	16.11	.52
1200.	.11	-211.02	-.30	16.08	.53
1300.	.06	-230.08	-.29	16.00	.51
1400.	1.18	-247.96	-.23	16.07	.50
1500.	2.43	-265.71	-.28	16.01	.52
1600.	1.80	-285.34	-.33	15.97	.55
1700.	.93	-305.22	-.27	16.03	.55
1800.	.07	-325.08	-.16	16.14	.56
1900.	-1.01	-345.17	-.21	16.09	.58
2000.	-3.59	-366.75	-.06	16.24	.60

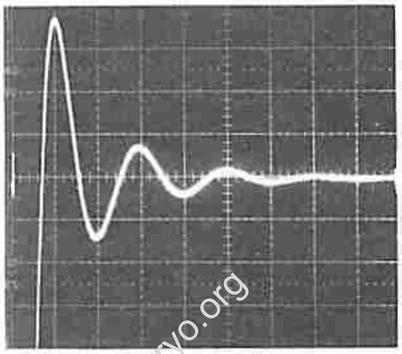


Fig. 32 – Two Cascaded A5s.

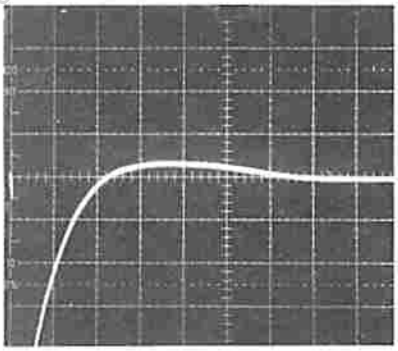


Fig. 33 – Single A15.

Figure 30 shows the phase shift of a WJ-A15 amplifier operating at 1) room temperature, 2) at −54°C and 3) at +100°C. There is virtually no change in linearity over this temperature range. Phase tracking is typically within ±2° between units.

Pulse Response

The recovery time of the A5, A15 and A3 amplifiers to a 1 volt, 50 nsec video pulse are shown in Figures 31, 33 and 35 respectively; each amplifier consists as a single stage. Figures 31, 34 and 36 show the recovery time when the amplifier consists of two stages.

Each amplifier has a circuit feature that is different from the other two. Figures 31 and 32 represent the RF choke decoupling from the power supply (in addition to an RC network). Figures 33 and 34 represent active bias, and Figures 35 and 36 represent the resistive decoupling and passive emitter bias. The recovery time of the A5 is faster than the A15. The A3 yielded the lowest overshoot and the fastest recovery time. Table 7 shows the typical recovery time of each amplifier for various input pulse levels.

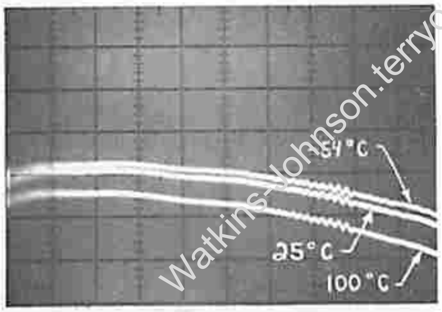


Fig. 30 – Phase Shift of the WJ-A15 Amplifier.

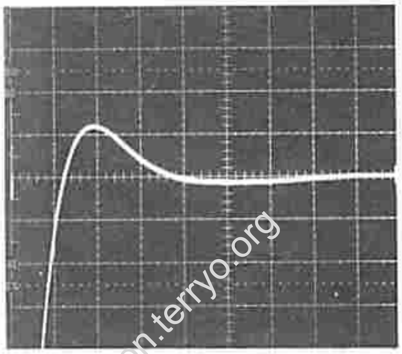


Fig. 34 – Two Cascaded A15s.

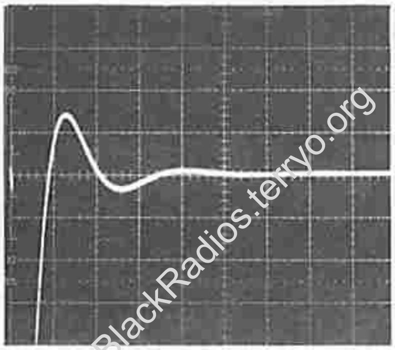


Fig. 31 – Single A5.

Table 7 – Amplifier Recovery Time (To a 1 mV Settling Level) After a 50 nsec Input Pulse is Applied

Model	0.1 Volt Input	1.0 Volt Input
A3	0.8 μsec	1.0 μsec
A5, A7	2.0 μsec	2.5 μsec
A9	1.3 μsec	1.5 μsec
A1, A11, A11-1, A15	3.0 μsec	3.5 μsec
A17	2.5 μsec	3.5 μsec
A19	0.8 μsec	1.5 μsec
A25	2.0 μsec	3.5 μsec
G1		1.5 μsec

1

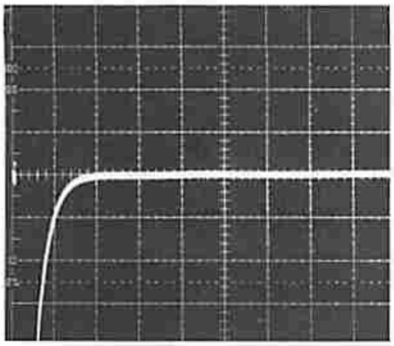


Fig. 35 – Single A3.

SCALES COMMON TO FIGURES 9 TO 14:
VERTICAL = 0.1 VOLT/DIV.
HORIZONTAL = 0.5 μSEC/DIV.

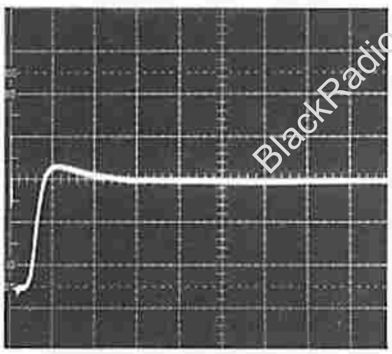


Fig. 36 – Two Cascaded A3s.

INPUT PULSE:
MAGNITUDE = 1.0 VOLT
WIDTH = 50 nSEC.
RISETIME = ~ 4 nSEC.

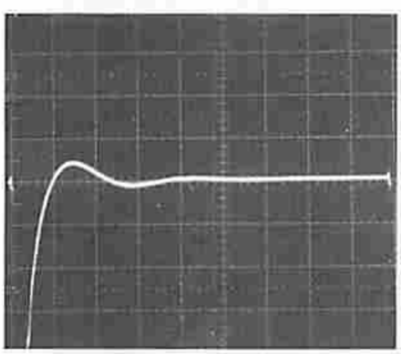


Fig. 37 – Two Cascaded A5s with 50 pF Series Capacitor on Input.

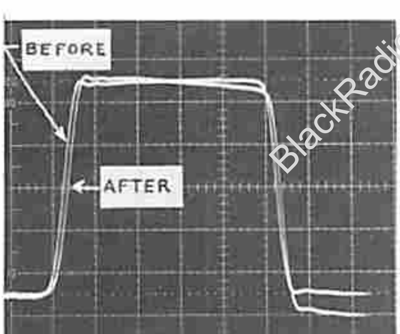


Fig. 38 – Single A25.

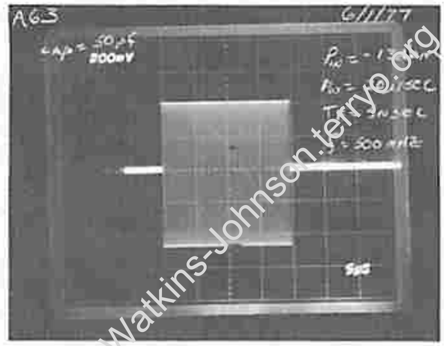


Fig. 39 – A63 with 50 pF Series Capacitors on Input and Output at 1 dB Compression.

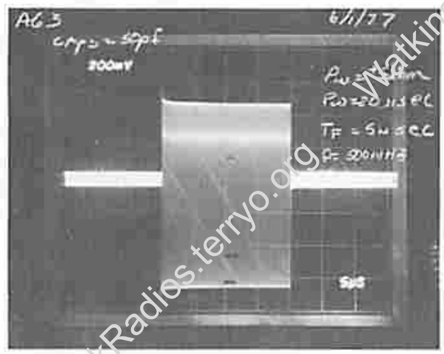


Fig. 39A – A63 with 50 pF Series Capacitors on Input and Output in Heavy Saturation.

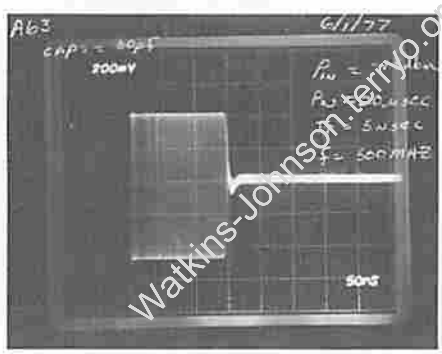


Fig. 40 – A63 with 50 pF Series Capacitors on Input and Output at 1 dB Compression.

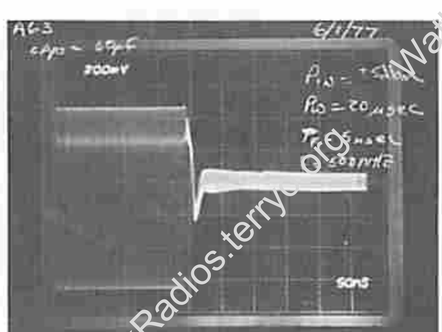


Fig. 40A – A63 with 50 pF Series Capacitors on Input and Output in Heavy Saturation.

The overshoot and recovery time of the two cascaded A5s, shown in Figure 32, are reduced by adding a 50 pF capacitance in series with the input signal, and is shown in Figure 37. The recovery time is decreased from 3.5 μsec to approximately 1 μsec (to a 10 mV level). The response of the WJ-A25 to a 50 nsec, 0.1 video pulse is shown in Figure 38. The pulse is shown both before and after passing through the A25. The pulse droop is only 5%, indicating an excellent low frequency response down to approximately 1 MHz. Both the input pulse and the output pulse exhibit a rise time of approximately 4.5 nanoseconds, thus, demonstrating the ultra-wide bandwidth property of the A25 amplifier.

A CW pulse will recover faster than a video pulse, as shown by Figure 39. Here a 500 MHz 20 μsec wide CW pulse is shown after passing through the WJ-A63. The input power level was sufficient to cause approximately 1 dB of compression. The input and output lines are AC coupled with 50 pf capacitors which yield a recovery time as as shown by Figure 40 of approximately 20 nsec. Without the capacitors the recovery time (not shown) is 250-300 nsec.

When the unit is driven with a +5 dBm input signal, which is sufficient to cause heavy saturation, the recovery time increases to only approximately 25 nsec as shown by Figure 40A. When the 50 pf capacitors are not used, severe pulse distortion occurs and the recovery time in the saturation mode extends to approximately 5 μsec.

Temperature

Each Watkins-Johnson Company cascadable amplifier has been designed for optimum performance over a full temperature range. Typical gain changes over ambient temperature ranges of −54°C to +85°C is less than ±0.3 dB for the 5-500 MHz units, and less than ±1.0 dB for the higher frequency units. The actual temperature performance of an A63 amplifier over a 10 to 1000 MHz bandwidth is shown in Figure 41.

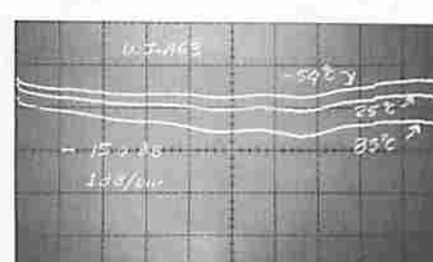


Fig. 41 – WJ-A63 Temperature Performance.

The A63 amplifier gain is typically 16 dB across its full bandwidth at 25°C, with less than 0.8 dB degradation at 85°C. The temperature performance of the WJ-A15 is shown in Figure 42. Again, there is only about an 0.8 dB loss of gain at 85°C. The temperatures are ambient with the 85°C temperature line representing a unit's case temperature of about 95°C on the A15. Figure 43 shows the WJ-A33 TO-8 amplifier temperature performance across the 1.0 to 2.0 GHz frequency range. Note at 100°C and 2 GHz the gain changed by only 0.9 dB, and by only 0.4 dB at 71°C. These

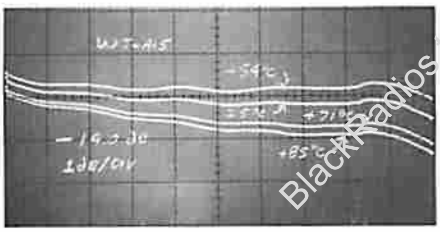


Fig. 42 — WJ-A15 Temperature Performance.

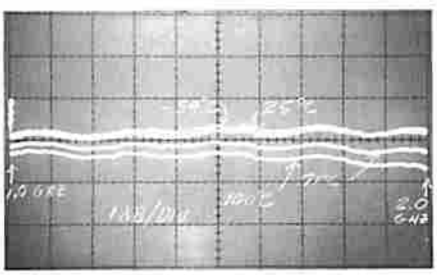


Fig. 43 — WJ-A33 Temperature Performance.

photographs display the excellent temperature performance engineered into the Watkins-Johnson Company cascadable amplifiers.

Table 8 shows some actual amplifier case temperatures when the ambient temperature is at 25°C. In a typical application, the units are mounted with the case making good contact to the ground plane of the circuit board.

Table 8 — Actual Amplifier Case Temperature When the Ambient Temperature is at 25°C

Model	T Case	V_{CC}	Dissipation Watts	Thermal Impedance Case to Ambient with Circuit Board, θ_{CS}	Approx. Area of Circuit Board
A5	32°C	15V	0.37	19°C/W	10 in²
A7	42°C	24V	1.00	17°C/W	10 in²
A17	36°C	15V	0.66	17°C/W	10 in²
A19	49°C	15V	1.5	16°C/W	10 in²
A9	64°C	24V	2.6	15°C/W	10 in²
A19	32°C	15V	1.50	4.5°C/W	40 in²
A9	34°C	24V	2.60	3.5°C/W	40 in²

Because the A7, A9, and A19 dissipate 1 watt or more of power, 20 in^2 of area should be used for the A7, 30 in^2 for the A19 and 40 in^2 for the A9, to maintain less than a 10°C rise in case temperature above ambient.

Case Temperature Regulation

By using the WJ-331240 proportional controller, the case temperature on the TO-8 Amplifier can be held to a much narrower range than it would be without it. This, in turn, would reduce the gain variation as a function temperature. Many of the W-J TO-8's exhibit excellent gain stability as a function of temperature and, hence would not benefit as much as the controller.

Figures 44, 46, 48, and 50 are examples of gain temperature variation as a function of ambient temperature. Figures 45, 47, 49, and 51 are examples of case temperature variation with and without the controller. For example, the WJ-A5 at its worst case frequency (500 MHz) varies approximately .5 dB over the case temperature range of −54°C to +85°C without the controller. It decreases to .3 dB with the controller as shown in Figure 44. Figure 45 shows the change in case temperature for that range. The WJ-A59 amplifier shows a similar improvement in Figure 46.

A more substantial improvement can be obtained at the high end of the band on the two-stage high frequency amps such as the A64 and A36-1. A 1200 MHz which is worst case for the A64, the gain variation is reduced from 1.3 dB to .4 dB as shown in Figure 48. The worst case point on the A36-1 (2300 MHz) improved from 2.6 dB to .9 dB.

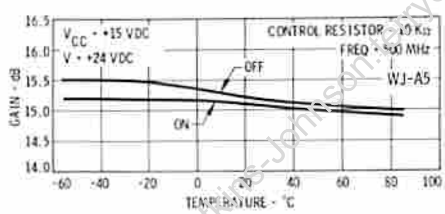


Fig. 44 — Gain vs. Temperature.

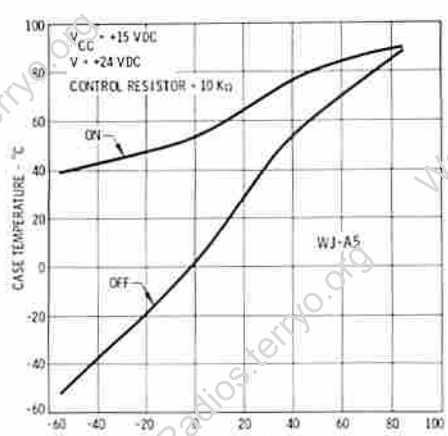


Fig. 45 — Case Temperature vs. Ambient Temperature.

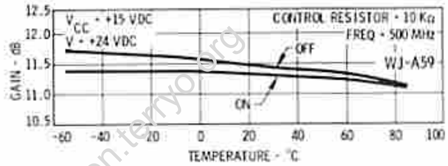


Fig. 46 — Gain vs. Temperature.

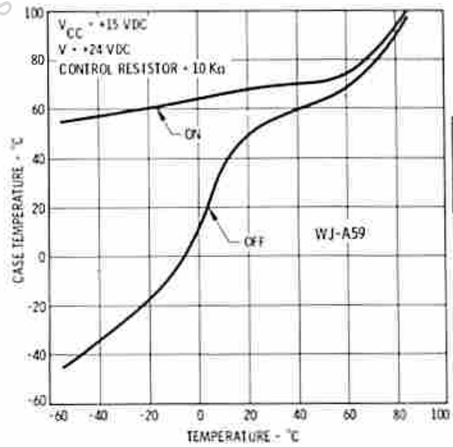


Fig. 47 — Case Temperature vs. Ambient Temperature.

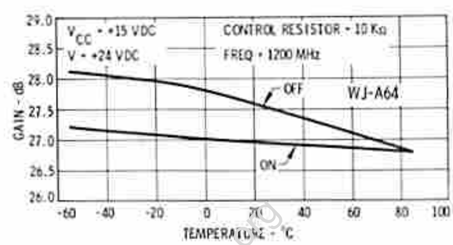


Fig. 48 — Gain vs. Temperature.

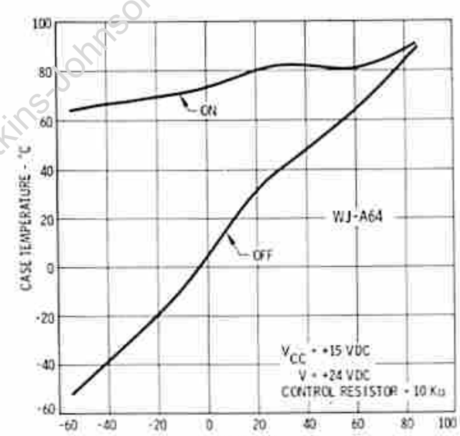


Fig. 49 — Case Temperature vs. Ambient Temperature

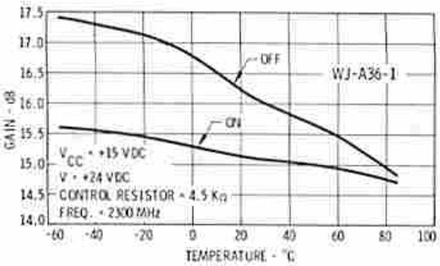


Fig. 50 — Gain vs. Temperature.

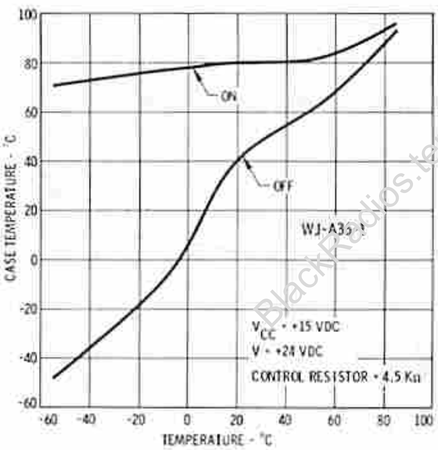


Fig. 51 — Case Temperature vs. Ambient Temperature

Frequency Stability

Each W-J cascadable amplifier has been designed to be unconditionally stable with load VSWR's of any phase angle. In order to realize inherent stability, certain installation procedures and methods must be employed.

Instability falls typically into two types: 1) Sub-band oscillations in the 100 kHz to 1 MHz region and, 2) out-of-band oscillations above the frequency band. Occasionally in-band oscillations can occur, but are much more rare and are usually related to poor circuit board grounding.

Grounding

The necessity for good grounding cannot be over emphasized. The following measures provide acceptable grounding. First, the entire TO-8 case should be completely grounded across its entire surface to the circuit board. The circuit board, in turn, must be properly grounded on both sides. Shown in Figure 52 are both sides of a typical TO-8 circuit board used for mounting the TO-8's. The board ground planes are connected on the edges by the mounting screws and the case to which it is mounted. In addition, a series of small plated through-holes are placed parallel to the RF circuit trace for the purpose of reducing the inductive reactance between the two ground planes. Insufficient ground connections can result in midband or high-end out-of-band spurious responses. The W-J TO-8 mounting kit (No. 251050-001) is the preferred technique for holding the TO-8 to the ground plane. A conductive epoxy ring that fits around the periphery of the bottom of the case is also an acceptable method, where space is at a premium.

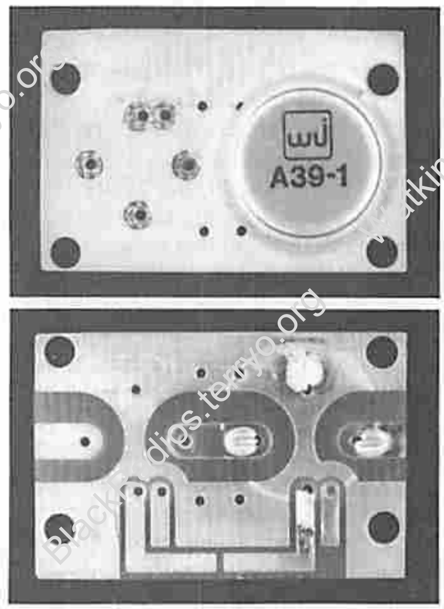


Fig. 52. Typical TO-8 Circuit Board.

Sub-band Instability

Much attention has been given to the problems of sub-band potential instability in recent years with improved techniques used in the design of biasing circuitry of the Watkins-Johnson line of cascadable amplifiers. This effort has resulted in a vastly reduced problem in using these amplifiers with any type of load or source condition over the full operating temperature range.

It is, however, still important to add an additional 0.05 to 0.1 μf decoupling capacitor to the Vcc part for insured isolation from power supply related feedback. In addition, if the power supply bias lines are not properly shielded, radiation from these lines can occur causing instability. This is particularly important when high gain levels of 60 dB or higher are used.

Radiative Feedback Oscillation

Radiative feedback oscillation can occur when a high gain chain is used where the RF output voltage is in phase with the input voltage (even number of stages), and the output signal radiates back to the input because of the antenna action of both the output and input circuit traces. The solution here is simply to keep output and input traces as short as possible and as far from each other as possible. For gain of over 60 dB, it is advisable to shield the input from the output by using a separate cavity for the input gain stages.

Out-of-band High Frequency Oscillations

High frequency oscillations can occur as a result of poor circuit board and amplifier case grounding. In addition, if the grounding is marginal, the units may be more susceptible to oscillation under certain load conditions. A bare lead of only one-half inch in length used to connect the RF signal from its source to the input port of the amplifier may result in oscillations. It is much better to use a properly grounded circuit board with a microstrip transmission line or coax cable. Any open lines, whether on the V_{CC} port or in the RF signal path may require ferrite beads to prevent them from acting as radiators or receptors.

Power Supply Selection

The majority of Watkins-Johnson Company's cascadable amplifiers operate from a nominal 15 volt dc power supply. The gain versus power supply voltage for many amplifiers is shown in Figure 53. Low level amplifiers such as the A1, A3, and A11 are represented by the curve shown for the A11 amplifier. Because of the relatively low bias level on these amplifiers, the power supply should be regulated to within 0.5 volt of the nominal 15 volt level. The higher level amplifiers such as the A5, A15, and A17 are much more tolerate and can be operated on a power supply

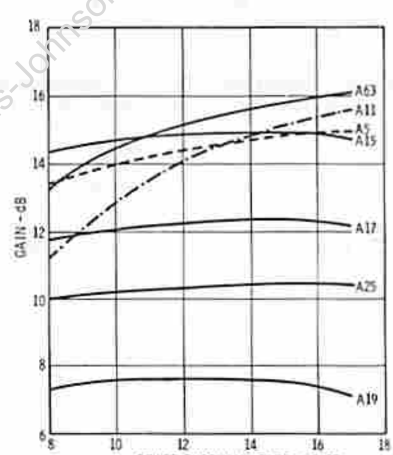


Fig. 53 — Gain Versus Power Supply Voltage.

voltage as low as 8 volts. The A15 and A25 amplifiers are extremely flat over the range of 8 to 16 volts. This extreme flatness results in an amplifier that is relatively immune to power supply ripple translating to changes in gain. In addition, 0.6 to 1.0 dB improvement in noise figure can be obtained by operating the A5, A15, or A25 at 8 volts.

Up to 4 stages may be cascaded in a common assembly without RF shielding between each unit. A typical 4 stage assembly providing 60 dB of gain could be configured as shown in Figure 54. There is no bandwidth shrinkage when cascading the amplifiers because of the broadband feedback techniques employed.

In the assembly shown the WJ-A3 is used as the first stage followed by two WJ-A5s and one WJ-A7 as post amplifiers. The 0.1 μF capacitor is placed across the dc bias line to suppress any tendency toward sub-band oscillation.

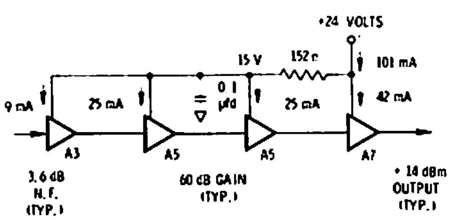


Fig. 54 — Typical Four Stage Cascade.

Noise Measurement

The noise figure that is measured on an amplifier depends to some degree on the system used to make the measurement. A few years ago the HP340B automatic system was very popular but has not been in close agreement with the more recent AILTECH type automatic system. The AIL system, when used with a properly calibrated noise source, gives results that are typically within 0.2 dB of a hot/cold standard.

The test set-up shown in Figure 55 shows one method of making NF measurements using W-J TO-8 cascadable amplifiers for gain blocks. This represents a very accurate, fast production method of noise measurement using the ratio of Hot noise power to Cold noise power called the P-factor.

The G1 is placed between the two A7s to provide gain adjust, which, in this case, is controlled using a coarse and fine pot for setting the reference

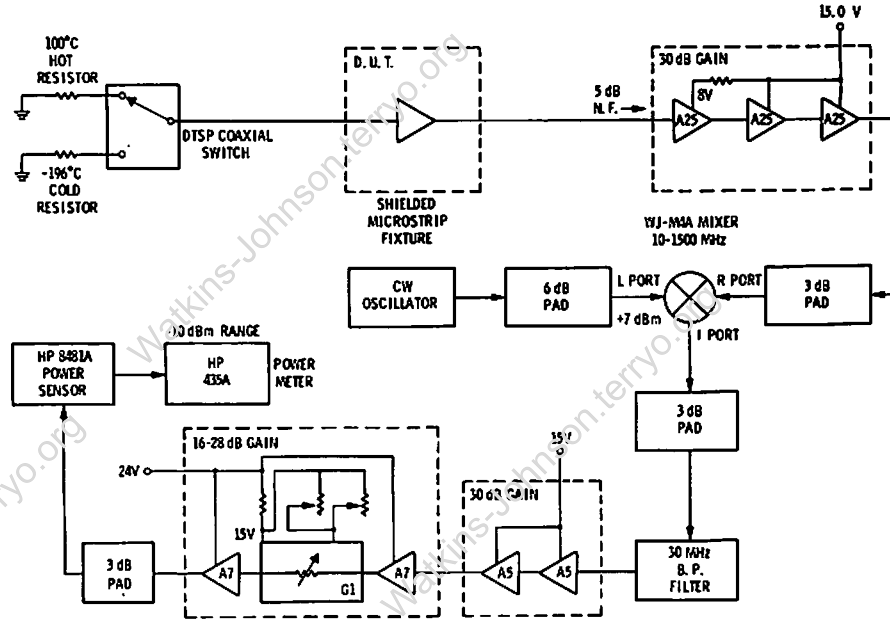


Fig. 55 — Hot-Cold Cascadable Amplifier Noise Set-Up.

on the power meter. The A7s are used to obtain maximum dynamic range. Using the hot resistor, a minimum of 20 dB above full scale is required by the output amplifier to maintain linearity and not compress the noise peaks. Using the −10 dBm range on the power meter requires +13 dBm output from the A7 in front of the 3 dB pad.

Using the three A33s as a post amplifier pvovides 30 dB of gain in front of the mixer which isolates the mixer so that the set-up is independent of the mixer noise figure.

D.L. Cheadle, "Measure Mixer Noise Figure with Your Power Meter", *Microwaves,* March 1975.

High Level Mixer-Amplifier

Using the WJ-M9D high level mixer, and A9 and A7 amplifiers, as shown in Figure 56, a very high level converter can be realized. The example requires only −3 dBm from an L.O. source and can handle signal levels up to +5 dBm on the input with a conversion gain of 17 dB. The input intercept point is typically +15 dBm with a 9 dB noise figure.

This would be ideal as a second stage converter section or could be used directly as an RF front end in a high signal level environment when maximum signal handling capability is required. This system can provide a single-tone dynamic range of 105 dB in a 1 MHz bandwidth and a spurious-free dynamic range of 78 dB for multiple input tones.

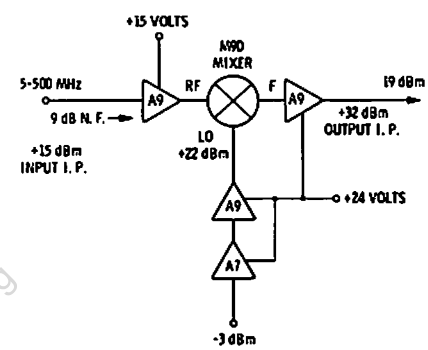


Fig. 56—High Level Mixer-Amplifier.

Automatic Gain Control Amplifier

A wideband high performance RF amplifier with AGC can be easily constructed using Watkins-Johnson Company TO-8 cascadable amplifiers, WJ-G1 gain control module and a few external components. A 50 to 300 MHz amplifier with the gain control set to provide +20 dBm output power and gain from 25 to 53 dB is shown in Figure 57. Table 9 gives the electrical performance characteristics of the amplifier.

The diode detects the RF power (about +10 dBm), resulting in a voltage which is compared to a reference voltage at the operational amplifier. Any difference voltage is amplified and used to control the G1 module, such that the power at the detector diode is held at +10 dBm. The diode is placed before the A9 to obtain 16 dB of isolation from variations in the output load. The WJ-A9 also amplifies the power to +20 dBm.

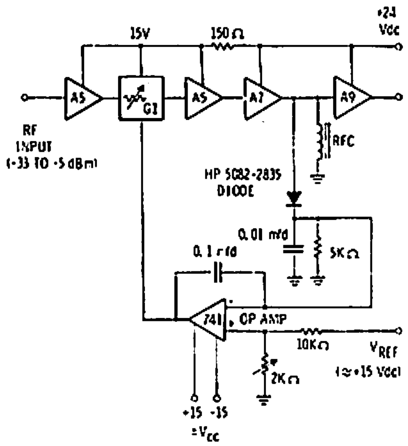


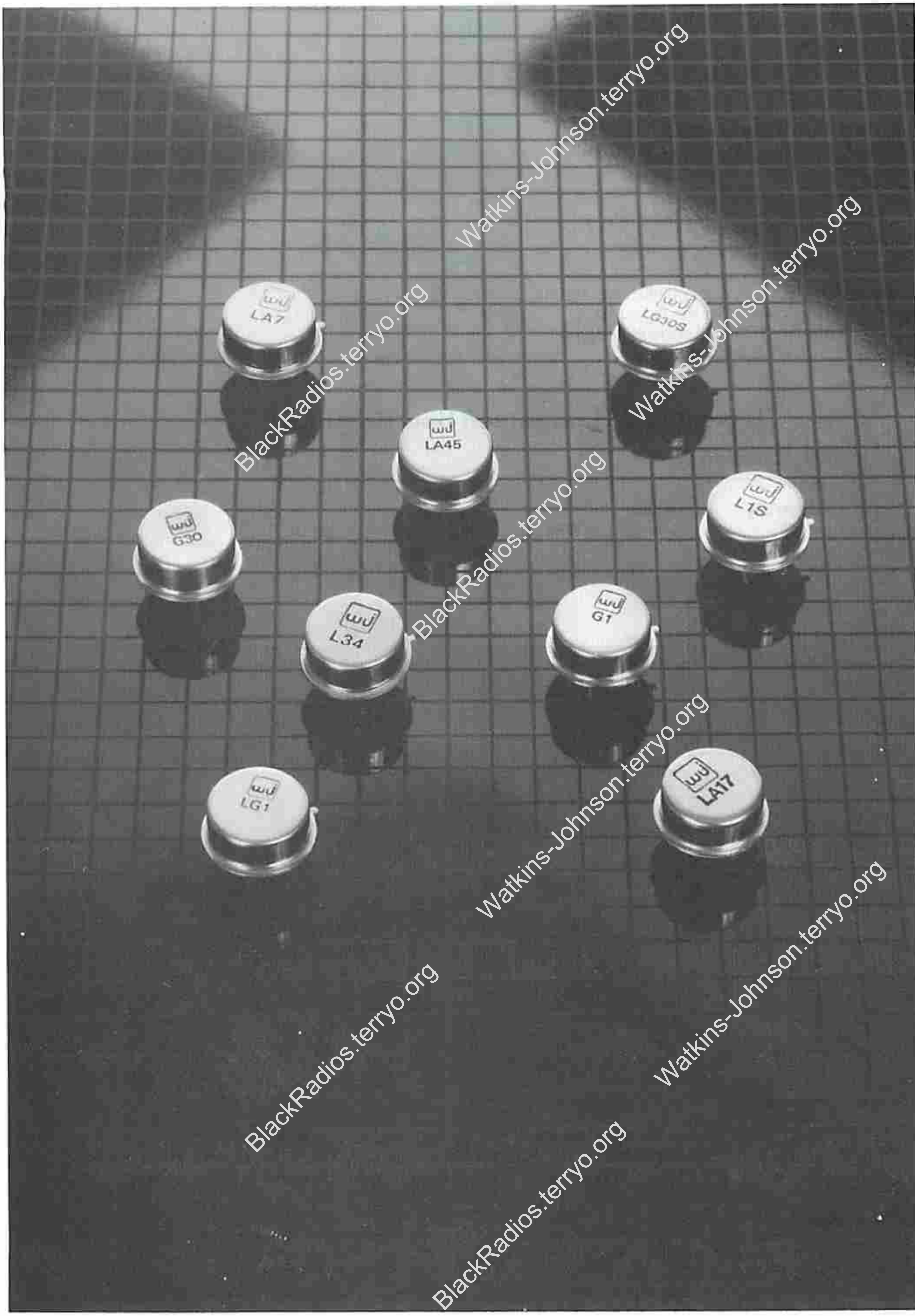
Fig. 57 — Automatic Gain Control Amplifier.

Table 9 — AGC Amplifier Electrical Performance

Frequency	50 to 300 MHz
RF Output	+20 ± 1 dBm for RF Input of −33 to −5 dBm (High Levels Saturate the A5)
VSWR In/Out	< 2.0:1
Harmonics	> 20 dB Down
DC Supply	24V at 225 mA, ±15V at 20 mA

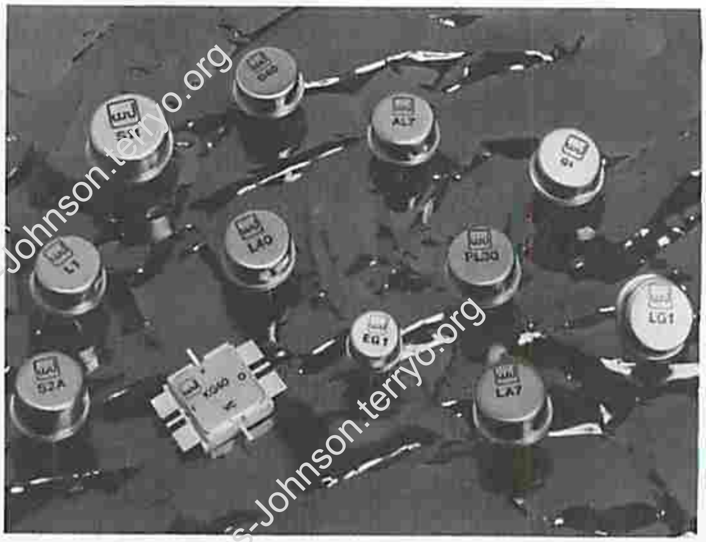
Special Purpose Hybrid Devices

2



Special Purpose Hybrid Devices

Attenuators, Linearizers, Limiter Amplifiers, Limiters, Detectors



Functional modules other than amplifiers are often required in most signal processing applications. For this reason, W-J offers a broad line of miniature TO-8 components designed to complement our W-J amplifiers and mixers.

Typical and Guaranteed Specifications

Voltage Controlled Attenuators

Model	Frequency Range MHz	Insertion Loss dB Typ.	Insertion Loss dB Max.	Attenuation dB Typ.	Attenuation dB Max.	VSWR Max.	Switching Speed µs 10-90% Typ.	Switching Speed µs 100% Max.	Control V	Control I(mA)	Bias V	Bias I(mA)	Package Type*
G1	5-500	2.0	2.5	36	31	2.2:1	4.0	125	0-15	0-7	15	15 (Max.)	TO-8
	5-1000	2.0	2.5	30	25	2.2:1	4.0	125	0-15	0-7	15	15 (Max.)	
	5-2000	2.8	3.3	23	18	2.2:1	4.0	125	0-15	0-7	15	15 (Max.)	
G2	5-500	2.5	3.0	35	31	1.8:1	4.0	125	0-15	0-7	5	6 (Max.)	TO-8
	5-1000	2.5	3.0	29	25	1.8:1	4.0	125	0-15	0-7	5	6 (Max.)	
	5-2000	2.8	3.5	23	18	2.5:1	4.0	125	0-15	0-7	5	6 (Max.)	
G30	100-500	2.3	2.8	45	40	1.8:1	0.1	6	0-15	0-10	15	10 (Max.)	TO-8
	500-1000	2.5	3.0	40	35	1.8:1	0.1	6	0-15	0-10	15	10 (Max.)	
	1000-2000	3.0	3.5	30	25	2.2:1	0.1	6	0-15	0-10	15	10 (Max.)	
G34	500-1000	2.5	3.0	40	35	1.8:1	0.5	4	0-15	0-10	15	10 (Max.)	TO-8
	1000-2000	3.0	3.5	35	30	1.8:1	0.5	4	0-15	0-10	15	10 (Max.)	
	2000-2400	3.3	4.0	30	25	2.0:1	0.5	4	0-15	0-10	15	10 (Max.)	
G40	500-2000	2.0	2.5	33	28	2.2:1	0.5	4	0-15	0-10	15	12 (Max.)	TO-8
	500-4000	3.0	3.5	28	23	2.2:1	0.5	4	0-15	0-10	15	12 (Max.)	
EG1	100-500	2.0	2.5	36	31	1.8:1	2.0	125	0-15	0-7	15	7 (Max.)	TO-5
	100-1000	2.0	2.5	29	24	1.8:1	2.0	125	0-15	0-7	15	7 (Max.)	
	100-2000	2.5	3.0	21	16	2.0:1	2.0	125	0-15	0-7	15	7 (Max.)	
KG40	500-2000	2.2	3.0	34	29	2.2:1	0.5	4	0-15	0-10	15	12 (Max.)	KA
	500-4000	3.0	3.5	24	19	2.2:1	0.5	4	0-15	0-10	15	12 (Max.)	
★ **RG45[1]**	**50-4000**	**2.0**	**2.5**	**33**	**30**	**1.9:1**	**5.0**	**10**	**0-15**	**0 to −5**	**±5**	**30 (Max.)**	**TO-88**

★ **NEW PRODUCT**

NOTE: 1. Preliminary specifications.

Attenuator Linearizers

Model	Typical Current Drain Min. Attenuation V−	Min. Attenuation V+	Min. Attenuation Vcon	Max. Attenuation V−	Max. Attenuation V+	Max. Attenuation Vcon	Linearity Specifications 25°C Typ.	25°C Max.	−54°C to +85°C Typ.	−54°C to +85°C Max.	Package Type*
LG1 Linearizer (Specifications apply to LG1 used in conjunction with G1 attenuator)	5 mA	31 mA	15 mA	5 mA	21 mA	2.5 mA	<±1 dB	±1.5 dB	<±1.5 dB	±2 dB	TO-8
LG30 Linearizer (Specifications apply to LG30 used in conjunction with G30 attenuator)	3 mA	12 mA	12 mA	15 mA	21 mA	6 mA	<±1 dB	±1.5 dB	<±1.5 dB	±2 dB	TO-8

*Outline drawings on these packages are on page 16.

Limiter Amplifiers

Model	Frequency Range MHz	Small Signal Gain dB Typ.	Small Signal Gain dB Min. 0/50C	Small Signal Gain dB Min. -54/85C	Gain Flatness ±dB Max. 0/50C	Gain Flatness ±dB Max. -54/85C	Noise Figure dB Typ.	Noise Figure dB Max. 0/50C	Noise Figure dB Max. -54/85C	Power Output At 1 dB Compression dBm Typ.	Power Output At 1 dB Compression dBm Min. 0/50C	Power Output At 1 dB Compression dBm Min. -54/85C	VSWR In/Out Max. 0/50C	VSWR In/Out Max. -54/85C	DC Volts Nom.	DC mA Typ.	Package Type*
LA7	50-300	12.6	12.0	11.0	0.5	0.7	7.0	8.0	8.5	12.0	11.0	8.0	1.7	2.0	15	54	TO-8
	300-500	12.6	12.0	11.0	0.5	0.7	7.5	8.5	9.0	11.5	10.0	7.0	1.7	2.0	15	54	TO-8
AL7	50-300	13.0	12.0	11.0	0.5	0.7	5.0	6.0	6.5	−1.5	-5.0	−7.0	1.7/2.0	1.7/2.0	15	54	TO-8
	300-500	13.0	12.0	11.0	0.5	0.7	5.5	6.5	7.0	−1.5	-5.0	−7.0	1.7/2.0	1.7/2.0	15	54	TO-8
LA17	10-1000	11.5	10.5	9.5	0.5	0.7	5.8	6.7	7.2	10.0	7.0	5.0	1.9	2.0	15	55	TO-8
LA45	1000-4000	11.5	10.0	9.0	0.8	1.0	8.0	9.5	10.0	14.0	12.5	11.5	2.1	2.2	15	110	TO-8
LA45-1	1000-4000	14.0	13.0	12.0	0.8	1.0	7.5	9.0	9.5	17.0	15.5	14.5	2.1	2.2	15	110	TO-8
KLA62	2000-6000	11.5	10.0	9.0	0.8	1.0	7.5	8.5	9.0	13.0	11.0	10.0	2.2	2.3	12	70	KA

Signal Limiters

Model	Frequency Range MHz	Insertion Loss[1] dB Typ.	Insertion Loss[1] dB Max.	Limiting Level (Max.) dBm 20V	Limiting Level (Max.) dBm 15V	Limiting Level (Max.) dBm 10V	VSWR Max.	Bias Voltage	Package Type*
L1	50-1000	1.9	3.0	0.0	-1.0	-4.0	2.0:1	5 to 20 V	TO-8
L2	5-500	2.0	2.5	+2.0	+1.0	-2.0	2.0:1	5 to 20 V	TO-8
L34	500-2400	2.9	3.7	+2.2	+1.0	-1.0	2.2:1	5 to 20 V	TO-8
L40	500-4000	3.5	4.5	+2.4	+1.0	-0.5	2.2:1	5 to 20 V	TO-8
★ EL40	1000-4000	3.8	4.5	—	+4.5	0.5	2.0:1	8 to 15 V	TO-5
★ KL80	1000-8000	4.0	5.0	--	+4.5	0.0	2.0:1	8 to 15 V	KA

★ NEW PRODUCTS

NOTE: 1. For bias levels ≥ +15 VDC.

Power Limiter

Model	Frequency Range MHz	Insertion Loss dB Typ.	Insertion Loss dB Max.	Limiting Threshold Typ.	Limiting Threshold -54/85C	VSWR Typ.	VSWR Max.	Package Type*
PL30	100-2000	0.9	1.0	10 dB	7.5	1.2:1	1.7:1	TO-8

Directional Level Detectors

Model	Frequency Range MHz	Insertion Loss Typ.	Insertion Loss Max.	DC Output[1] mV P_{IN} = +10 Typ.	DC Output[1] mV P_{IN} = +10 Max.	DC Output[1] mV P_{IN} = +6 Typ.	DC Output[1] mV P_{IN} = +6 Max.	Directivity[1,2] dB P_{IN} = +4 Typ.	Directivity[1,2] dB P_{IN} = +4 Min.	Isolation[1] dB In→ Typ.	Isolation[1] dB DC Out Min.	Isolation[1] dB Out→ Typ.	Isolation[1] dB DC Out Min.	VSWR	Package Type*
D2	10-1000	3.4	3.8	135	90	55	25	>35	20	>35	28	>40	32		TO-5
										>35	28	>40	32	<1.3:1	
	1000-2000	3.7	4.5	135	90	55	25	>20	10	>28	22	>32	26	<1.3:1	

NOTES:
1. Measured with 50 KΩ dB output load.
2. Directivity = 20 log (forward DC output ÷ reverse DC output)

Tangential TO-8 Level Detectors

Model	Frequency Range MHz	DC Output[1] mV Typ.)	Flatness[2] mV	Input Impedance	Output Offset Voltage mV	Package Type*
★ D3	10-1000	+90	±7	50Ω	205	TO-8
★ D3-1	10-1000	-50	±2	300Ω	205	TO-8

★ NEW PRODUCTS

NOTES:
1. Measured with 10 KΩ output load, 50 μA detector bias and P_{IN} = −10 dBm.
2. P_{IN} = −20 dBm.

*Outline drawings for these packages are on page 19.

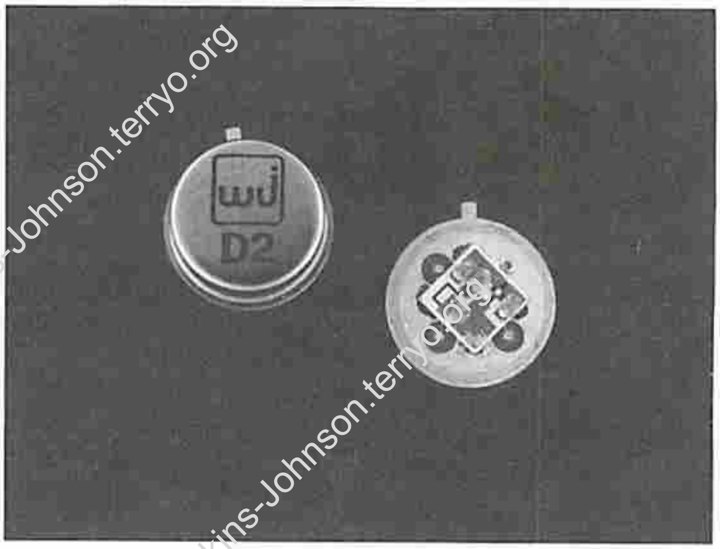
2

Special Purpose Hybrid Devices Technical Data Sheets

WJ-D2

10 TO 2000 MHz TO-5 DIRECTIONAL LEVEL DETECTOR

- HIGH DIRECTIVITY: 25 dB AT PIN = +6 dBm
- HIGH ISOLATION: 30 dB (TYP.)
- LOW VSWR: 1.3:1 (TYP.)
- LOW COST
- ULTRA SMALL SIZE



Specifications*

Characteristics	Typical	Guaranteed 0°-50°C	Guaranteed 0°-+85°C
Frequency Range	10-2300 MHz	10-2000 MHz	10-2000 MHz
Insertion Loss (Max.)			
10-1000 MHz	3.4 dB	3.8 dB	3.8 dB
1000-2000 MHz	3.7 dB	4.5 dB	4.5 dB
DC Output[1] (Min.)			
At Pin = +10 dBm			
10-2000 MHz	135 mV	90 mV	90 mV
At Pin = +6 dBm			
10-2000 MHz	55 mV	25 mV	25 mV
Directivity[1,2] (Min.)			
At Pin = +4 dBm			
10 - 250 MHz	> 40 dB	35 dB	35 dB
250 - 1000 MHz	> 30 dB	20 dB	20 dB
1000 - 2000 MHz	> 20 dB	10 dB	10 dB
Isolation[1] (Min.)			
Input → DC Output			
10-1000 MHz	> 35 dB	28 dB	28 dB
1000-2000 MHz	> 28 dB	22 dB	22 dB
Output → DC Output			
10-1000 MHz	> 40 dB	32 dB	32 dB
1000-2000 MHz	> 32 dB	26 dB	26 dB
VSWR Input/Output			
10-2000 MHz	< 1.3:1	1.4:1	1.5:1

*Measured in a 50-ohm system.

Notes:

1. Measured with 50K ohm dc output load.
2. Directivity = 20 log (Forward dc output ÷ Reverse dc output).
3. Video Bandwidth 10 kHz Typ.

Weight approximately 1.0 grams (0.04 oz.)

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C

Maximum Case Temperature . . . . 125°C

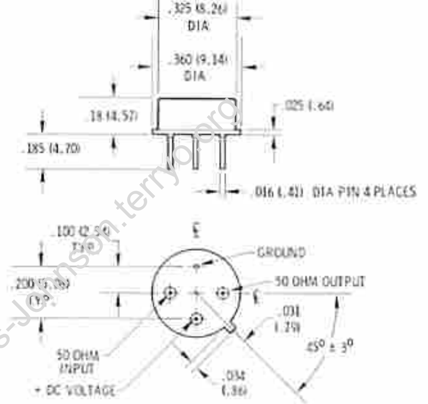
Maximum CW Input Power . . . . 50 Milliwatts

Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts

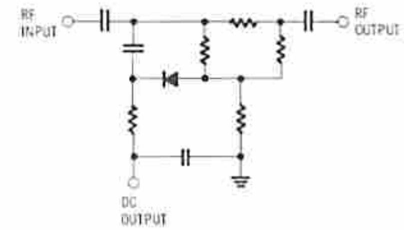
"S" Series Burn-In Temperature (Case) . . . . 125°C

Outline Drawing

D2

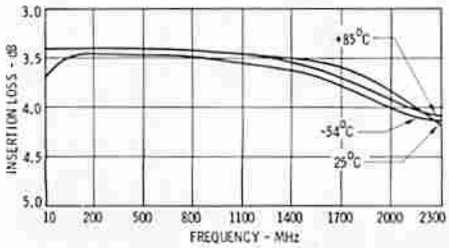


Schematic Diagram

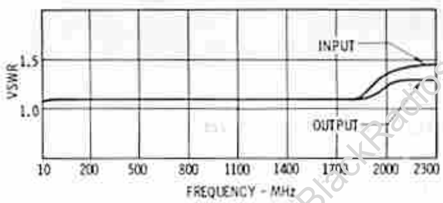


Typical Performance at 25°C

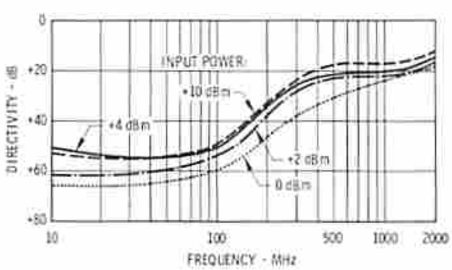
Insertion Loss



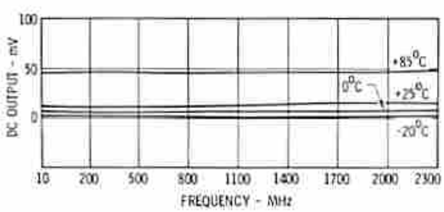
VSWR



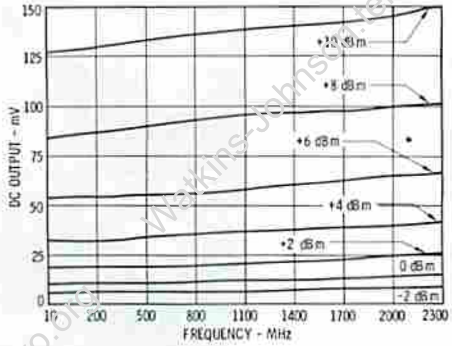
Directivity (50KΩ Load)



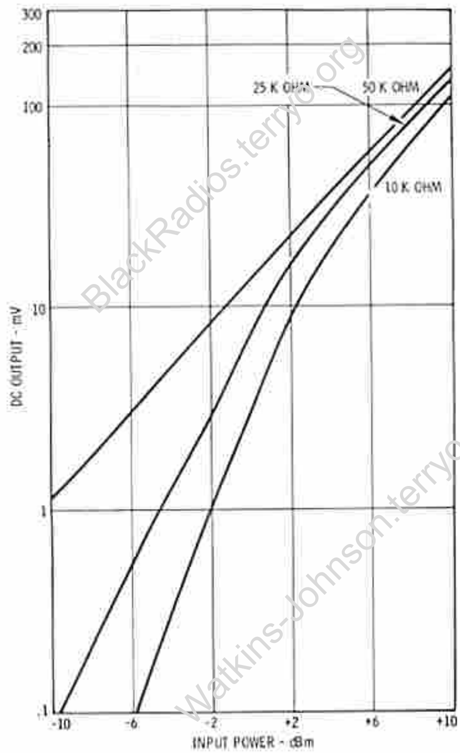
DC Output
PIN = 0 dBm (50KΩ Load)



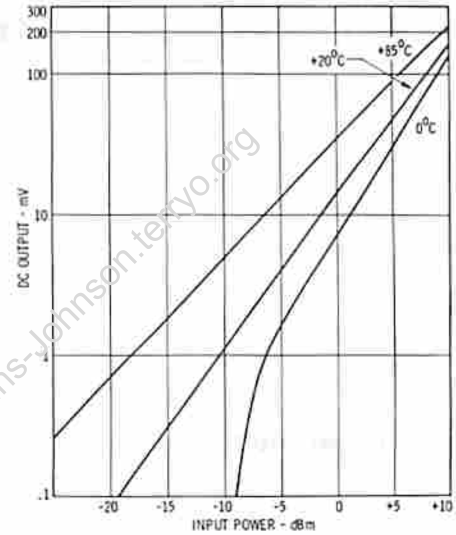
DC Output (50KΩ Load)



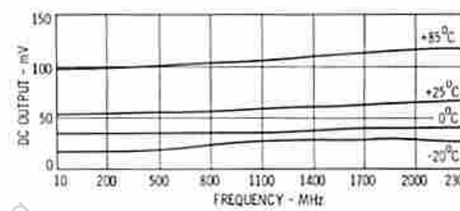
DC Output vs. Input Power vs. DC Output Loading at 2000 MHz



DC Output vs. Input Power at 2000 MHz



DC Output
PIN = +6 dBm (50KΩ Load)



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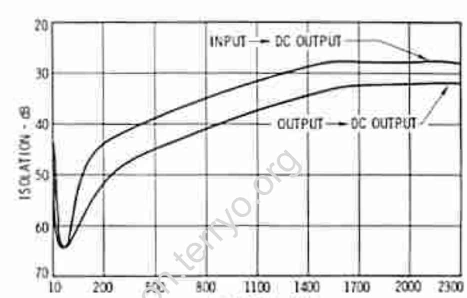
Isolation (50KΩ Load)



Typical Automatic Test Data

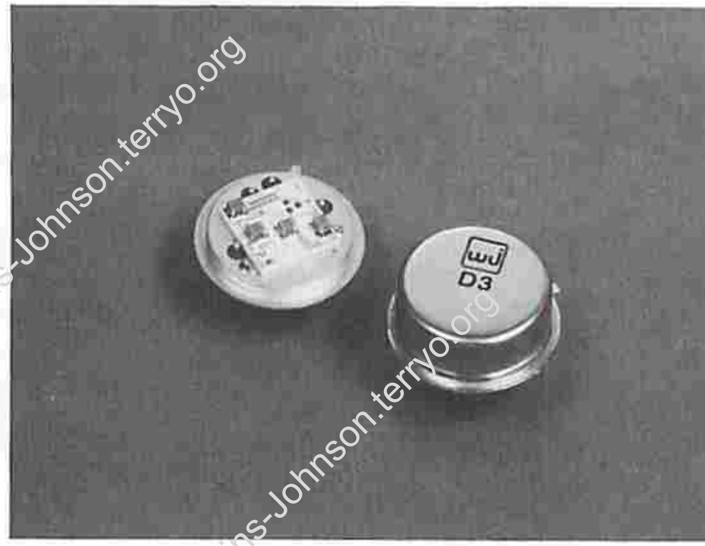
FREQ MHZ	VSWR IN	VSWR OUT	LOSS DB
100.	1.1	1.1	3.4
200.	1.1	1.1	3.4
300.	1.1	1.1	3.4
400.	1.1	1.1	3.5
500.	1.1	1.1	3.4
600.	1.1	1.1	3.5
700.	1.1	1.1	3.4
800.	1.1	1.1	3.4
900.	1.1	1.1	3.5
1000.	1.2	1.1	3.5
1100.	1.1	1.1	3.5
1200.	1.1	1.1	3.6
1300.	1.1	1.0	3.5
1400.	1.1	1.0	3.5
1500.	1.2	1.1	3.5
1600.	1.2	1.1	3.5
1700.	1.1	1.1	3.5
1800.	1.2	1.2	3.6
1900.	1.2	1.2	3.7
2000.	1.2	1.3	3.9
2100.	1.2	1.3	4.1
2200.	1.2	1.3	4.2
2300.	1.2	1.3	4.2

Linear S-Parameters

FREQ MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.04	-124.2	.67	12.6	.68	12.0	.04	-136.0
200.	.03	-83.4	.67	21.9	.68	21.0	.03	-112.7
300.	.04	-100.1	.68	30.9	.68	33.4	.04	-110.0
400.	.03	-74.6	.67	42.6	.67	42.9	.03	-98.3
500.	.06	-64.7	.68	53.0	.67	52.6	.05	-97.1
600.	.05	-66.1	.67	63.4	.67	63.3	.05	-74.9
700.	.06	-31.1	.67	73.8	.67	73.7	.05	-53.2
800.	.07	-34.0	.67	83.9	.67	84.0	.05	-43.1
900.	.06	-9.6	.67	94.9	.67	94.1	.05	-40.3
1000.	.07	-6.6	.67	105.2	.67	104.6	.04	-29.5
1100.	.06	.0	.67	115.7	.67	115.[illegible]	.04	-31.0
1200.	.06	25.3	.66	125.3	.67	125.6	.03	7.6
1300.	.07	32.2	.67	135.7	.66	135.0	.02	49.6
1400.	.06	43.1	.67	145.5	.66	145.4	.01	67.4
1500.	.07	65.0	.67	156.1	.67	155.5	.04	124.2
1600.	.07	67.4	.67	167.0	.66	166.2	.04	119.6
1700.	.07	107.0	.66	177.7	.66	176.6	.07	155.7
1800.	.07	99.6	.66	-172.0	.65	-172.7	.09	155.5
1900.	.07	117.5	.65	-162.7	.66	-163.2	.08	165.5
2000.	.10	145.5	.64	-151.9	.65	-151.9	.12	178.4
2100.	.09	144.5	.63	-141.9	.64	-142.0	.12	173.4
2200.	.10	159.7	.62	-131.1	.63	-131.3	.13	-172.1
2300.	.11	163.4	.62	-122.6	.63	-122.0	.15	-171.7

WJ-D3

10 TO 1000 MHz TO-8 LEVEL DETECTOR



- 50-OHM INPUT IMPEDANCE
- RF INPUT, DC OUTPUT
- ACTIVE INPUT CIRCUITRY

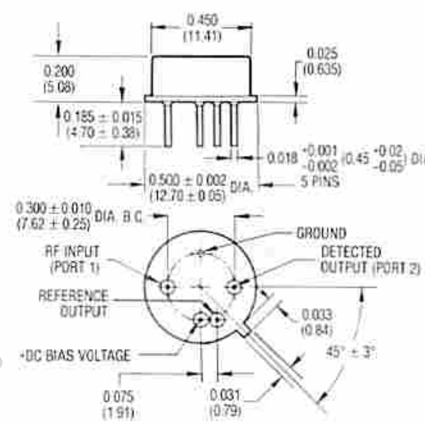
Specifications*

Characteristics	Typical	Guaranteed 0° - +50°C	Guaranteed -54° - +85°C
Frequency (Min.)	10–1000 MHz	10–1000 MHz	10–1000 MHz
Detected Voltage[1,2]	90 mV		
Variation Over Frequency[3]	±7 mV	±20 mV	
Variation Over Temperature[1,3]	±70 mV	±80 mV	±90 mV
Output Offset Voltage[1,4]	205 mV		
VSWR (Max.) Input	1.5:1	2.0:1	2.0:1
Output Capacitance	2.2 KpF		3.0 KpF
DC Current (Max.) at +15 Volts	10 mA	13 mA	14 mA

Notes:
*Measured in a 50-ohm system at +15.0 Vdc Nominal, 50 μA detector bias and 10KΩ load resistance.
1. 500 MHz
2. -10 dBm Input Power
3. -20 dBm Input Power
4. No RF Applied

Outline Drawing

D3



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

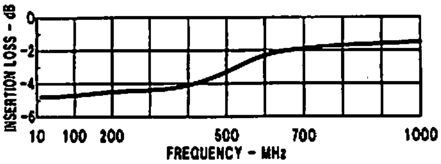
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Diode Bias Current . . . . +1 mA
Maximum CW Input Power . . . . 50 Milliwatts
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
"S" Series Burn-In Temperature (Case) . . . . 125°C

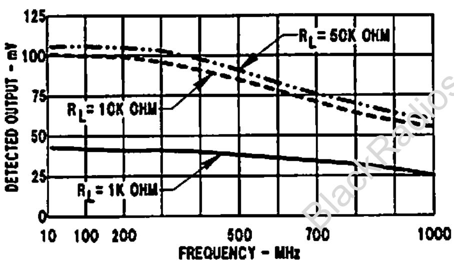
Weight approximately 2.0 grams (0.07 oz.)

Typical Performance at 25°C

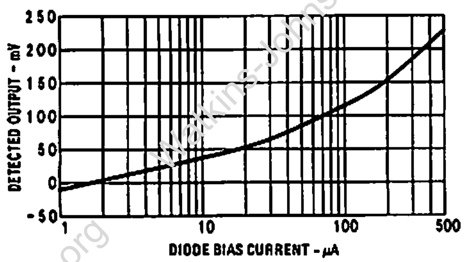
Insertion Loss vs. Frequency①
P_{IN} = -10 dBm (10K Ω Load)



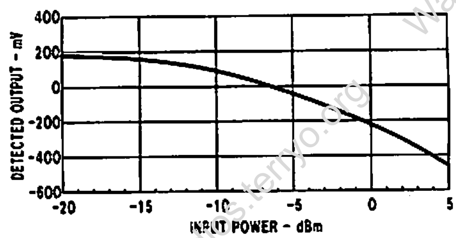
Detected Output vs. Frequency vs. R_L, P_{IN} = -10 dBm



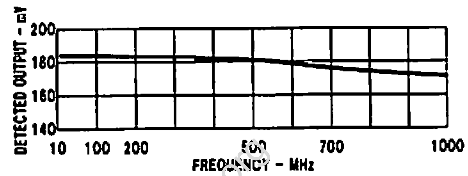
Detected Output vs. Diode Bias Current, F = 500 MHz, P_{IN} = -10 dBm (10K Ω Load)



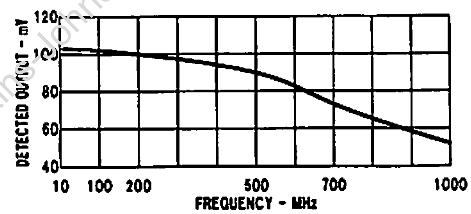
Detected Output vs. P_{IN}, F = 500 MHz (10K Ω Load)



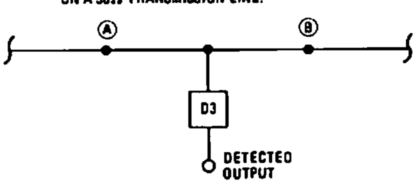
Detected Output vs. Frequency
P_{IN} = -20 dBm (10K Ω Load)



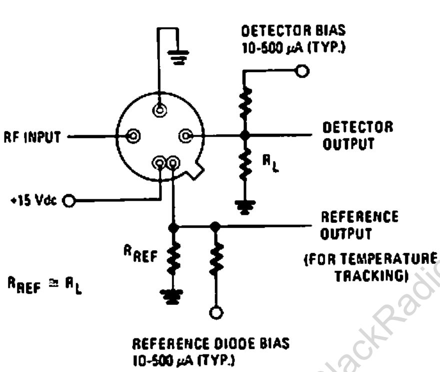
Detected Output vs. Frequency
P_{IN} = -10 dBm (10K Ω Load)



NOTES:
① INSERTION LOSS MEASURED BETWEEN POINTS Ⓐ AND Ⓑ ON A 50Ω TRANSMISSION LINE.

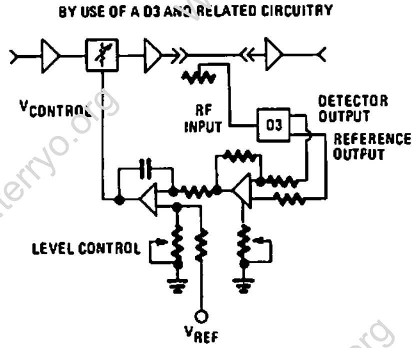


Typical Test Circuit



Typical Application Circuit

TEMPERATURE COMPENSATION AND LEVELING CONTROL BY USE OF A D3 AND RELATED CIRCUITRY



2

WJ-D3-1

10 TO 1000 MHz
TO-8 LEVEL DETECTOR

- 300-OHM INPUT IMPEDANCE
- RF INPUT, DC OUTPUT
- ACTIVE INPUT CIRCUITRY

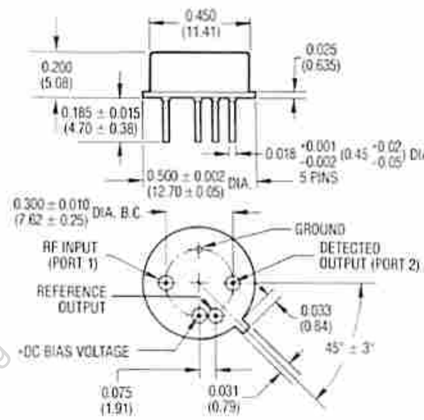
Specifications*

Characteristics	Typical	Guaranteed 0° - +50°C	Guaranteed -54° - +85°C
Frequency (Min.)	10–1000 MHz	10–1000 MHz	10–1000 MHz
Detected Voltage [1,2]	-50 mV		
Variation Over Frequency [3]	±2 mV	±20 mV	
Variation Over Temperature [1,3]	±70 mV	±80 mV	±90 mV
Output Offset Voltage [1,4]	205 mV		
Input Impedence	300Ω		
Output Capacitance	2.2 KpF		3.0 KpF
DC Current (Max.) at +15 Volts	10 mA	13 mA	14 mA

Notes:
*Measured in a 50-ohm system at +15.0 Vdc Nominal, 50 μA detector bias and 10KΩ load resistance.
1. 500 MHz
2. -10 dBm Input Power
3. -20 dBm Input Power
4. No RF Applied

Outline Drawing

D3-1



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .005 (.13) UNLESS OTHERWISE SPECIFIED

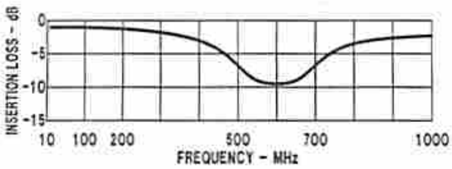
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Diode Bias Current . . . . +1 mA
Maximum CW Input Power . . . . 50 Milliwatts
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
"S" Series Burn-In Temperature (Case) . . . . 125°C

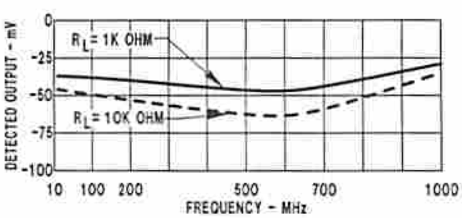
Weight approximately 2.0 grams (0.07 oz.)

Typical Performance at 25°C

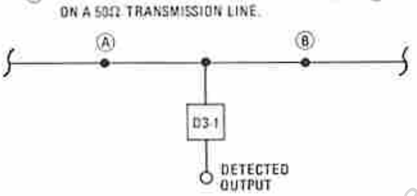
Insertion Loss vs. Frequency[1]
P_{IN} = -10 dBm (10KΩ Load)



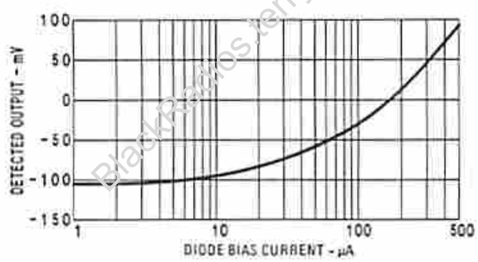
Detected Output vs. Frequency vs. R_L, P_{IN} = -10 dBm



NOTES:
① INSERTION LOSS MEASURED BETWEEN POINTS Ⓐ AND Ⓑ ON A 50Ω TRANSMISSION LINE.

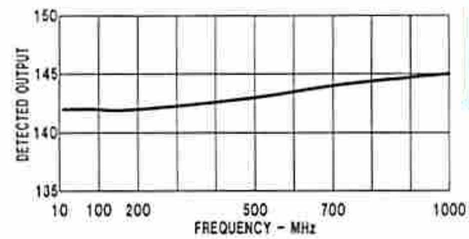


Detected Output vs. Diode Bias Current, F = 500 MHz, P_{IN} = -10 dBm, (10KΩ Load)

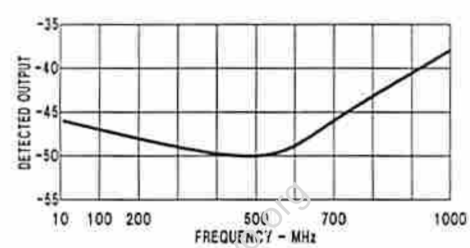


Detected Output vs P_{IN}, F = 500 MHz (10K Ω Load)

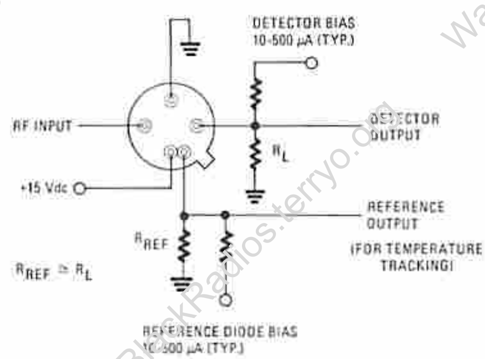
Detected Output vs. Frequency
P_{IN} = -10 dBm (10KΩ Load)



Detected Output vs. Frequency
P_{IN} = -20 dBm (10KΩ Load)



Typical Test Circuit



2

WJ-EG1

100 TO 2000 MHz TO-5 VOLTAGE-CONTROLLED ATTENUATOR MODULE

- LOW VSWR: <1.6:1 TYP.
- LOW INSERTION LOSS: 2.5 dB to 2000 MHz
- ULTRA SMALL SIZE: TO - 5
- LOW CURRENT DRAIN: 5 mA

Specifications*

Characteristics		Typ.	Guaranteed Min./Max.
Frequency Range			100 MHz to 2000 MHz
Maximum Attenuation Available			
100-500 MHz		36 dB	31 dB (Min.)
100-1000 MHz		29 dB	24 dB (Min.)
100-2000 MHz		21 dB	16 dB (Min.)
Insertion Loss (V_o = 15V)			
100-1000 MHz		2.0 dB	2.5 dB (Max.)
100-2000 MHz		2.5 dB	3.0 dB (Max.)
VSWR (Worst case in attenuation range)			
100-1000 MHz		<1.4:1	1.8:1 (Max.)
100-2000 MHz		<1.6:1	2.0:1 (Max.)
Flatness Over Frequency (Min. to 15 dB) (100-1000 MHz)		±0.5 dB	±1.0 dB
Bias Voltage			+15V
Bias Current		5 mA	7 mA (Max.)
Control Voltage			0 V to +15V
Control Current		5 mA	7 mA (Max.)
Response Time	**0 to 90%**	2 μsec	4 μsec (Max.)
	10 to 100%	75 μsec	125 μsec (Max.)

*Measured in a 50-ohm system, guaranteed at 25°C

Weight approximately 1.0 grams (0.04 oz.)

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C

Maximum Case Temperature . . . . 125°C

Maximum DC Voltage . . . . +18 Volts

Maximum Continuous RF Input Power . . . . 100 Milliwatts

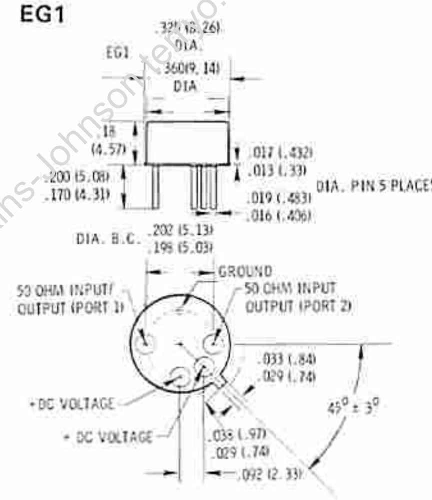
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 200 Milliwatts

Maximum Peak Power . . . . 1 Watt (3 μsec Max.)

"S" Series Burn-In Temperature (Case) . . . . 125°C

Outline Drawing

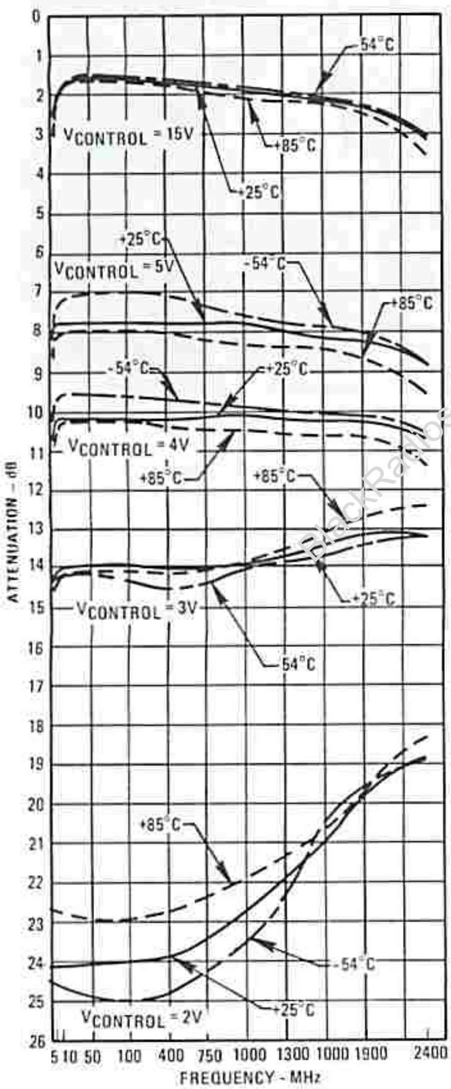
EG1



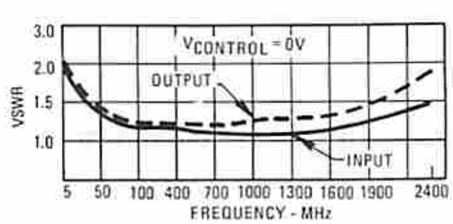
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

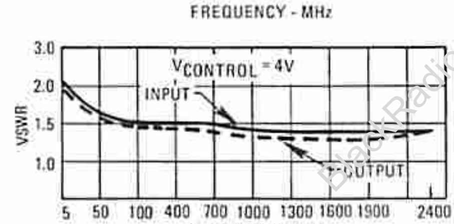
Typical Performance at 25°C in a 50 Ohm System (V$_{BIAS}$ = +15 Vdc, unless otherwise noted)

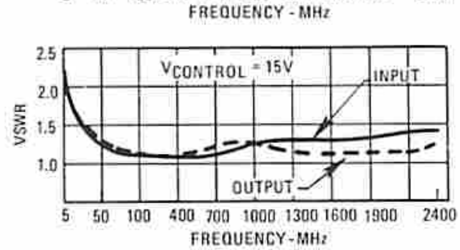
Attenuation vs. Frequency



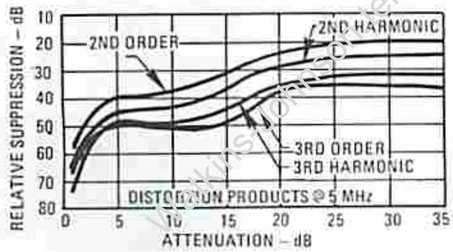
VSWR vs. Frequency



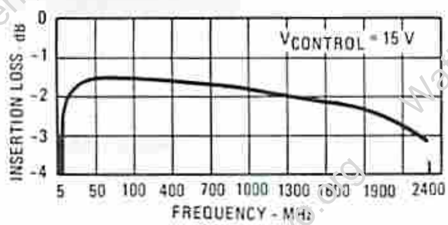




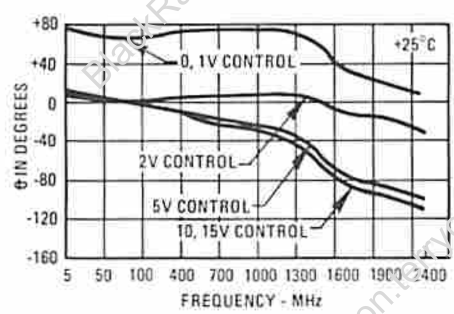
Distortion Products

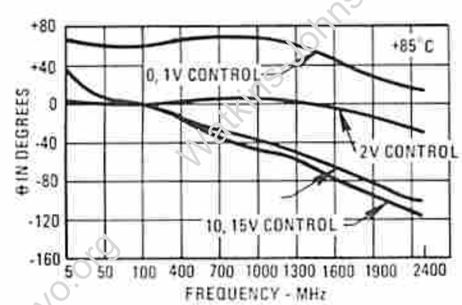


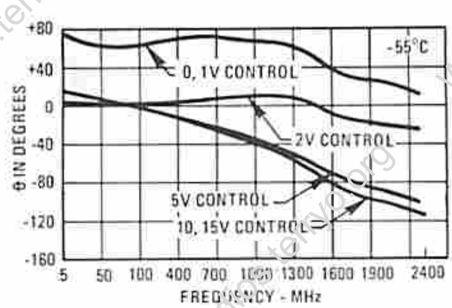
Insertion Loss vs. Frequency at V$_{CONTROL}$ = 15 V



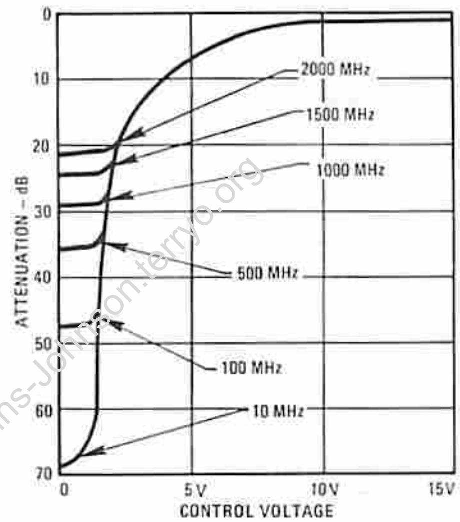
Phase vs. V$_{CONTROL}$ vs. Frequency vs. Phase of the Moon



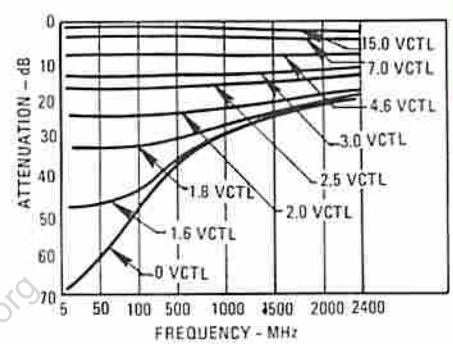




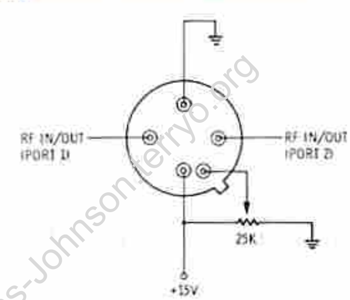
Attenuation vs. Control Voltage



Attenuation vs. V$_{CTL}$ vs. Frequency

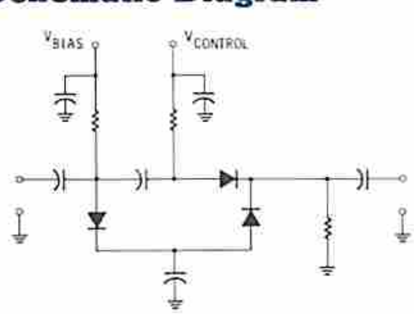


Typical Test Circuit



BOTTOM VIEW

Schematic Diagram

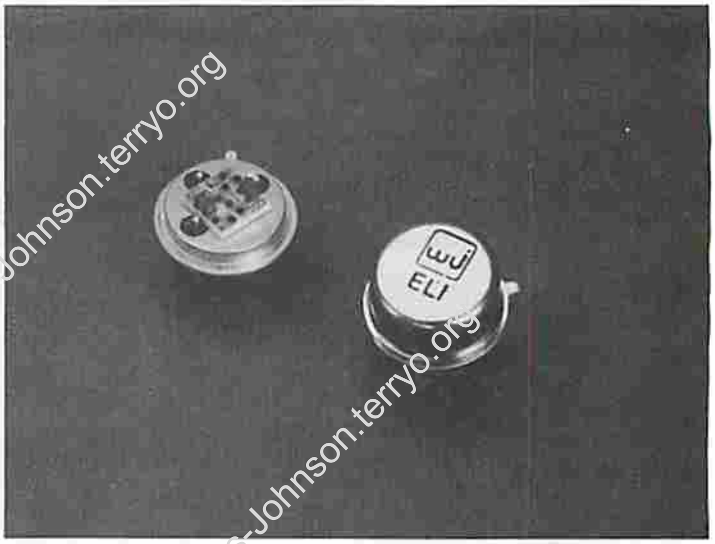


π PAD ATTENUATOR

WJ-EL1

50 TO 1000 MHz TO-5 THIN-FILM LIMITER MODULE

- VOLTAGE VARIABLE LIMITING LEVEL: -10 TO 0 dBm
- LOW INSERTION LOSS AT LOW INPUT LEVEL: < 2.0 dB
- LOW INPUT VSWR
- GOOD SUPPRESSION OF EVEN ORDER HARMONICS DUE TO BALANCED CIRCUIT DESIGN



Specifications *

Characteristics	Typ.	Guaranteed Max.
Frequency	50-1000	50-1000 MHz
Insertion Loss Pin ⩽ -20 dBm +15 ⩽ Bias ⩽ +20 Vdc	2.0 dB	2.5 dB
Input VSWR (Pin < +20 dBm, 10 ⩽ Bias ⩽ 20 Volts)	1.7:1	2.0:1
Output VSWR (Pin < -10 dBm, 10 < Bias ⩽ 20 Volts)	1.7:1	2.0:1
Max. Output Level Pin = +20 dBm at 15 Vdc		2.5 dBm
Typical Bias Current: at 15 Vdc at 20 Vdc	 7 mA 10 mA	

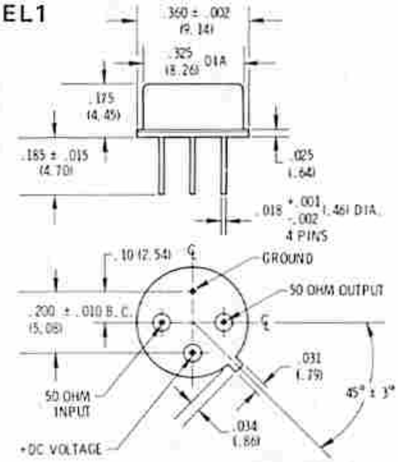
*Measured in a 50-ohm system, guaranteed at 25°C.

Limiting and Insertion Loss Characteristics (25°C)

Bias Voltage	Output Level at Limiting Threshold (1 dB Compression) Typ.	Max. Output Limiting Level (+20 dBm Input) Typ.	Insertion Loss (500 MHz) Typ.	Insertion Loss (1000 MHz) Typ.
+20 Volts	-2.0	+2.5 dBm	1.8 dB	1.8 dB
+15 Volts	-2.5	+1.2 dBm	2.0 dB	2.0 dB
+10 Volts	-4.0	-1.0 dBm	2.5 dB	2.5 dB
+5 Volts	-10.0	-7 dBm	3.5 dB	3.5 dB

Outline Drawing

EL1



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

Weight 1.0 grams (0.04 oz.) max.

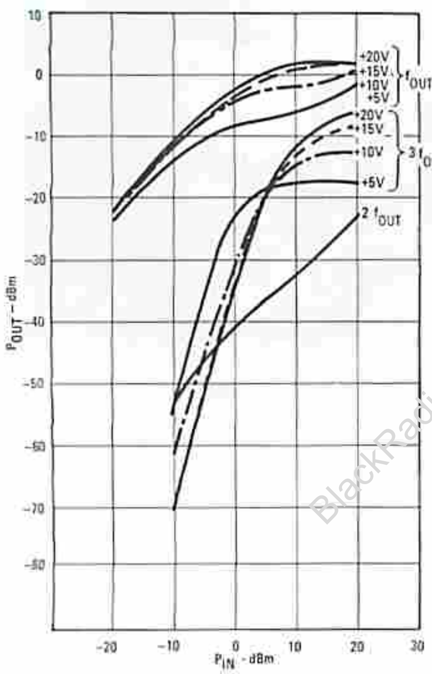
WJ-CA package is not available for TO-5's.

Absolute Maximum Ratings

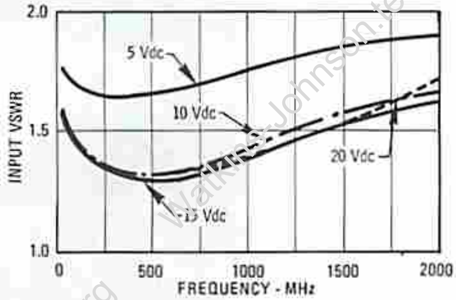
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . 125°C
Maximum DC Voltage . . . . . . +25 Vdc
Maximum Continuous RF Input Power . . . . +20 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 400 Milliwatts
Maximum Peak Power . . . . 1 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Typical Performance at 25°C

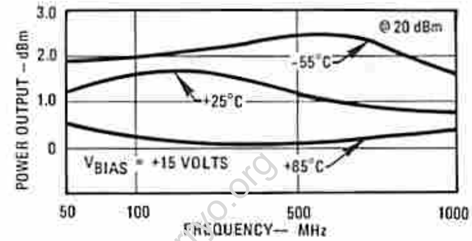
Limiting Characteristics vs. Input Level and DC Bias



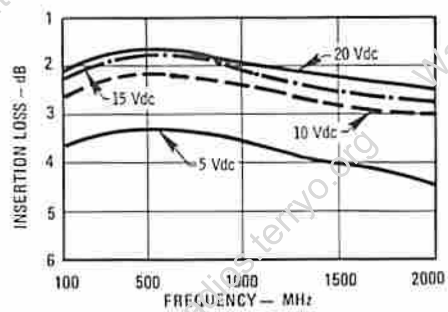
Input VSWR vs. Frequency



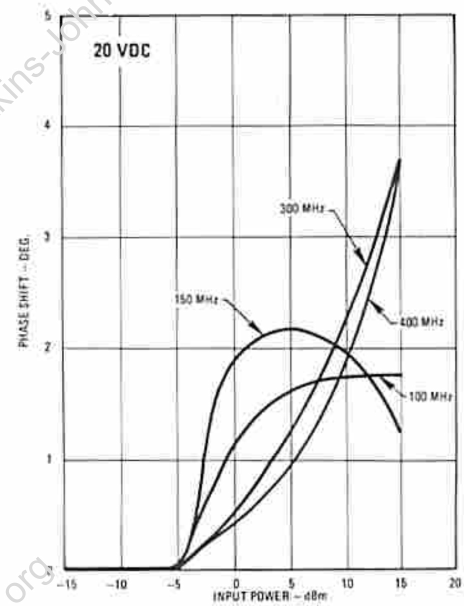
Maximum Limiting Level



Insertion Loss



Phase Shift vs. Input Power



Typical Automatic Test Data

V_{CC} = 15 V

FREQUENCY MHZ	VSWR IN	VSWR OUT	GAIN DB
50.00	1.7	1.7	-2.3
100.00	1.4	1.4	-1.9
200.00	1.3	1.3	-1.8
300.00	1.3	1.2	-1.8
400.00	1.2	1.2	-1.8
500.00	1.3	1.2	-1.8
600.00	1.3	1.2	-1.9
700.00	1.2	1.3	-1.9
800.00	1.4	1.3	-2.0
900.00	1.1	1.3	-2.0
1000.00	1.2	1.3	-2.0
1100.00	1.3	1.4	-2.1
1200.00	1.3	1.4	-2.2

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
50.0	0.264	-57	0.77	12	0.77	12	0.260	-56
100.0	0.162	-50	0.80	2	0.80	2	0.162	-53
200.0	0.114	-51	0.81	-8	0.81	-8	0.113	-48
300.0	0.114	-56	0.81	-15	0.81	-15	0.090	-58
400.0	0.088	-58	0.81	-22	0.81	-22	0.100	-53
500.0	0.136	-63	0.81	-28	0.81	-28	0.071	-35
600.0	0.119	-104	0.81	-34	0.80	-34	0.100	-69
700.0	0.107	-87	0.80	-40	0.81	-40	0.115	-79
800.0	0.161	-102	0.80	-46	0.80	-46	0.136	-69
900.0	0.067	-137	0.80	-52	0.80	-52	0.108	-115
1000.0	0.074	-130	0.79	-57	0.79	-57	0.126	-105
1100.0	0.121	-128	0.78	-63	0.76	-64	0.151	-155
1200.0	0.140	-129	0.77	-69	0.78	-69	0.152	-144

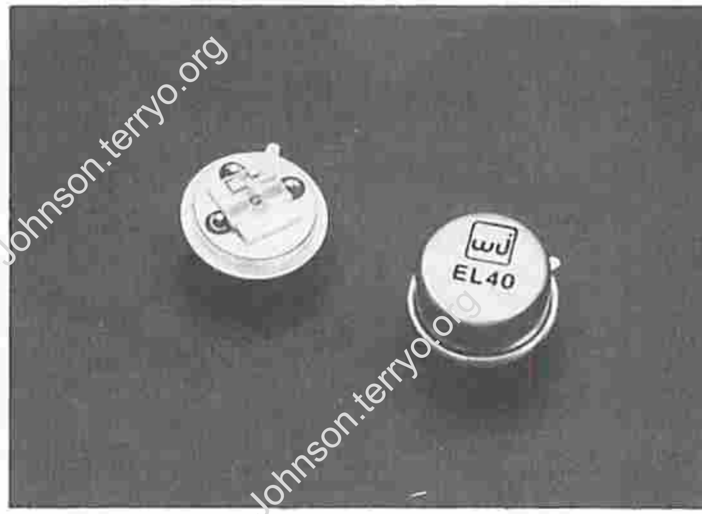
Deviation from Linear Phase, Gain and Group Delay

FREQUENCY MHZ	DEV LIN Φ DEG	REL Φ DEG	GAIN DEV DB	ABS GAIN DB	GROUP DELAY NSEC
50.0	6.04	0.00	-0.12	-2.29	0.533
100.0	0.66	-9.60	0.23	-1.94	0.270
200.0	-2.50	-19.62	0.36	-1.81	0.201
300.0	-2.07	-26.84	0.38	-1.79	0.183
400.0	-2.62	-33.44	0.37	-1.80	0.171
500.0	-2.16	-39.84	0.38	-1.79	0.221
600.0	-1.23	-45.76	0.29	-1.88	0.231
700.0	-0.42	-51.96	0.29	-1.88	0.195
800.0	0.35	-57.89	0.21	-1.96	0.177
900.0	1.20	-63.90	0.18	-1.99	0.172
1000.0	2.75	-69.20	0.12	-2.05	0.166

WJ-EL40

1000 TO 4000 MHz TO-5 LIMITER MODULE

- VOLTAGE VARIABLE LIMITING LEVEL: -3 TO 4.5 dBm
- GOOD SUPPRESSION OF EVEN ORDER HARMONICS DUE TO BALANCED CIRCUIT DESIGN: > 40 dB AT +5 dBm INPUT (TYP.)



Specifications*

Characteristics	Typical	Guaranteed Min./Max.
Frequency	800–4200 MHz	1000–4000 MHz
Insertion Loss $P_{IN} \leq -20$ dBm $+8 \leq$ Bias $\leq +15$ Vdc	< 3.8 dB	4.5 dB (Max.)
Input VSWR $P_{IN} \leq -10$ dBm $+8 \leq$ Bias $\leq +15$ Vdc	< 1.6:1	2.0:1 (Max.)
Output VSWR $P_{IN} \leq -10$ dBm $+8 \leq$ Bias $\leq +15$ Vdc	< 1.6:1	2.0:1 (Max.)
Input Signal (Max.)		+17 dBm
Bias		
At +15 Vdc	10.0 mA	
At +12 Vdc	8.0 mA	
At +10 Vdc	6.5 mA	
At +8 Vdc	5.0 mA	

*Measured in a 50-ohm system, guaranteed at 25° C.

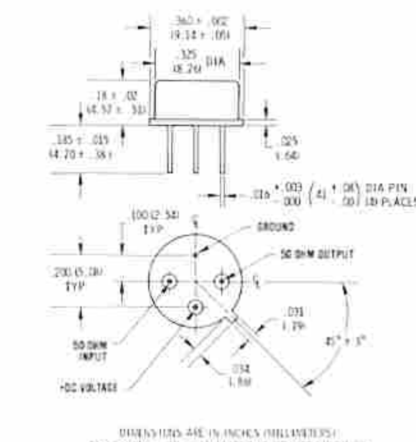
Limiting and Insertion Loss Characteristics (25°C)

Bias Voltage	Output Level at Limiting Threshold (1 dB Comp)		Max. Output at Limiting Level (+17 dBm Input)		Insertion Loss (4000 MHz)	
	Typ.	Max.	Typ.	Max.	Typ.	Max.
+15 Volts	3.0	4.3	4.5[1]	5.5[1]	3.7	4.5
+12 Volts	1.5	3.0	2.5[1]	3.5[1]	3.8	4.5
+10 Volts	-0.5	1.0	0.5[1]	1.5[1]	3.9	4.5
+8 Volts	-3.0	-1.5	-1.5[1]	-0.5[1]	4.2	4.5

Notes:
1. At 1000 MHz

Outline Drawing

EL40



Weight

approximately 1.0 grams

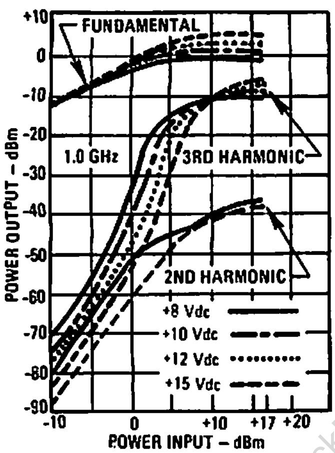
WJ-CA package is not available for TO-5's.

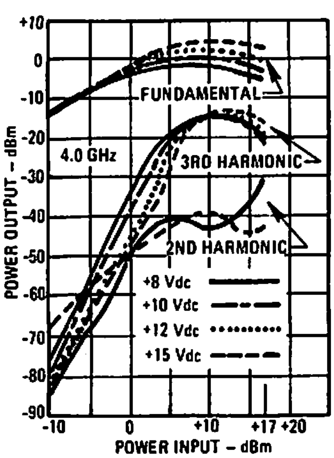
Absolute Maximum Ratings

Storage Temperature. . . . . -62°C to +125°C
Maximum Case Temperature. . . . . +105°C
Maximum DC Voltage . . . . . . 16 Volts
Maximum Continuous RF Input Power . . . . +17 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
Maximum Peak Power . . . . . . 0.2 Watt
. . . . 3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 105°C

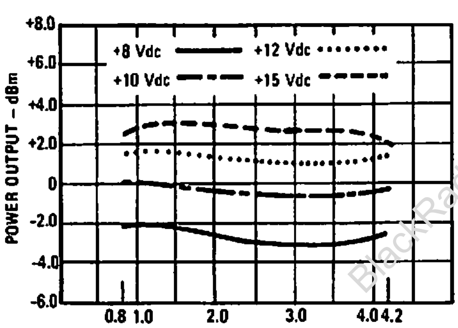
Typical Performance at 25°C

Limiting Characteristics vs. Input Level and DC Bias



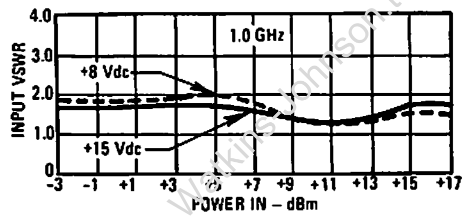


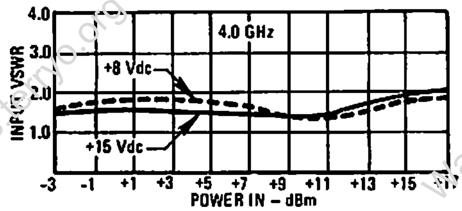
Power Output *



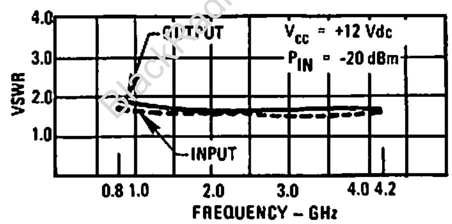
* at 1 dB Gain Compression

Input VSWR vs. Input Power

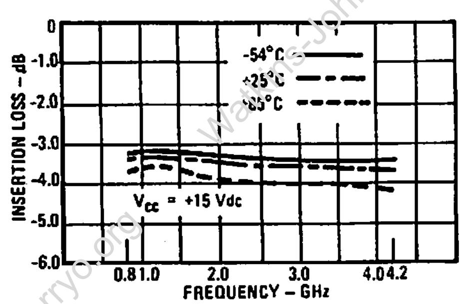




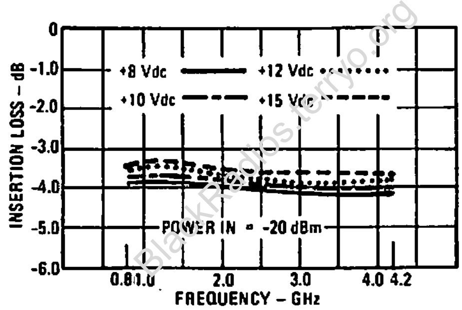
VSWR vs. Frequency



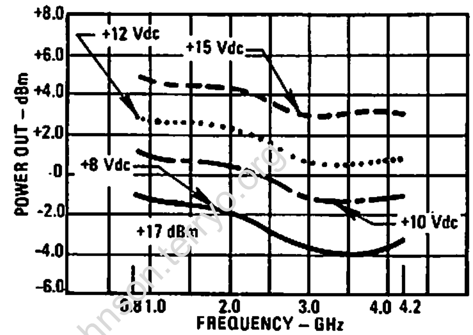
Insertion Loss vs. Temperature

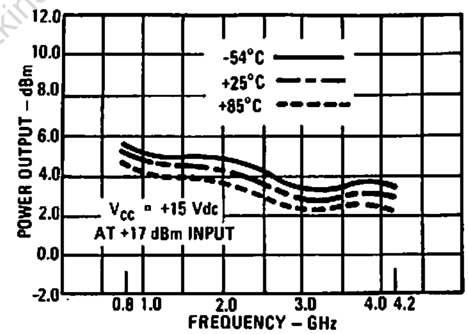


Insertion Loss vs. Frequency



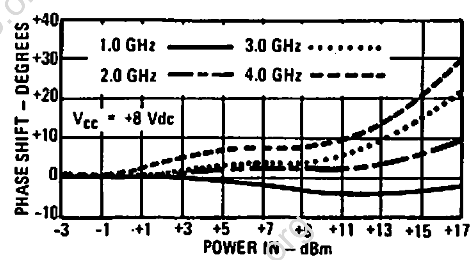
Maximum Limiting Level

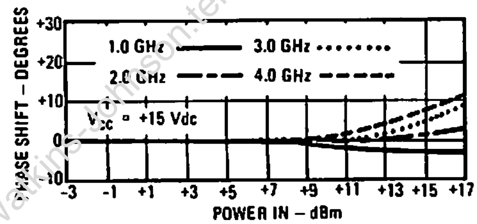




2

Phase Shift vs. Input Power





Typical Automatic Test Data

V_{cc} = +8 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
800.0	1.8	1.8	-3.7
900.0	1.7	1.7	-3.6
1000.0	1.7	1.7	-3.6
1100.0	1.6	1.6	-3.6
1200.0	1.6	1.6	-3.6
1300.0	1.6	1.6	-3.6
1400.0	1.6	1.6	-3.7
1500.0	1.6	1.6	-3.7
1600.0	1.6	1.6	-3.7
1700.0	1.6	1.6	-3.7
1800.0	1.6	1.6	-3.8
1900.0	1.6	1.6	-3.8
2000.0	1.6	1.6	-3.8
2100.0	1.6	1.6	-3.9
2200.0	1.5	1.6	-3.9
2300.0	1.5	1.6	-4.0
2400.0	1.5	1.6	-4.0
2500.0	1.5	1.5	-4.0
2600.0	1.5	1.5	-4.0
2700.0	1.5	1.5	-4.0
2800.0	1.5	1.5	-4.0
2900.0	1.5	1.5	-4.1
3000.0	1.4	1.5	-4.1
3100.0	1.4	1.5	-4.1
3200.0	1.4	1.5	-4.1
3300.0	1.4	1.5	-4.1
3400.0	1.4	1.5	-4.1
3500.0	1.4	1.4	-4.1
3600.0	1.4	1.4	-4.1
3700.0	1.4	1.4	-4.1
3800.0	1.4	1.4	-4.0
3900.0	1.4	1.4	-4.0
4000.0	1.4	1.4	-4.0
4100.0	1.4	1.4	-4.0
4200.0	1.4	1.4	-4.0

Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
800.0	.281	-68	.655	-10	.655	-10	.278	-67
900.0	.266	-71	.658	-14	.659	-15	.261	-69
1000.0	.253	-73	.659	-19	.659	-19	.250	-72
1100.0	.245	-76	.660	-24	.660	-24	.240	-75
1200.0	[illegible]	-79	.660	-27	.659	-28	.235	-78
1300.0	.234	-82	.659	-31	.657	-32	.231	-81
1400.0	.232	-85	.657	-35	.656	-36	.230	-84
1500.0	.230	-88	.655	-39	.654	-40	.229	-87
1600.0	.229	-91	.652	-43	.651	-43	[illegible]	-90
1700.0	.227	-94	.650	-46	.648	-47	.229	-93
1800.0	.227	-96	.646	-50	.646	-50	.230	-95
1900.0	.225	-99	.645	-54	.642	-54	.230	-98
2000.0	.223	-99	.643	-58	.642	-58	.221	-98
2100.0	.220	-102	.641	-61	.639	-61	.222	-100
2200.0	.216	-104	.636	-64	.636	-66	.224	-102
2300.0	.210	-105	.635	-68	.633	-68	.223	-103
2400.0	.207	-106	.632	-71	.632	-71	.219	-104
2500.0	.201	-106	.631	-75	.631	-75	.215	-105
2600.0	.196	-107	.630	-78	.629	-78	.212	-105
2700.0	.192	-106	.629	-81	.627	-82	.208	-105
2800.0	.186	-107	.628	-85	.627	-85	.203	-105
2900.0	.184	-107	.626	-89	.627	-89	.199	-105
3000.0	.181	-107	.626	-92	.626	-92	.197	-104
3100.0	.178	-108	.626	-96	.628	-96	.194	-105
3200.0	.176	-108	.625	-100	.627	-100	.191	-105
3300.0	.171	-108	.624	-103	.626	-104	.187	-106
3400.0	.173	-109	.625	-107	.626	-107	.184	-106
3500.0	.172	-109	.625	-111	.627	-111	.180	-107
3600.0	.172	-111	.626	-114	.628	-115	.177	-107
3700.0	.174	-112	.627	-118	.629	-119	.172	-108
3800.0	.171	-114	.629	-123	.630	-123	.169	-108
3900.0	.174	-115	.630	-127	.630	-127	.168	-109
4000.0	[illegible]	-117	.629	-131	.631	-131	.166	-110
4100.0	.172	-119	.629	-135	.632	-135	.163	-111
4200.0	.170	-119	.629	-139	.629	-140	.158	-111

V_{cc} = +15 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
800.0	1.8	1.7	-3.3
900.0	1.7	1.7	-3.2
1000.0	1.6	1.6	-3.2
1100.0	1.6	1.6	-3.2
1200.0	1.6	1.6	-3.2
1300.0	1.6	1.6	-3.2
1400.0	1.6	1.5	-3.2
1500.0	1.5	1.5	-3.3
1600.0	1.5	1.5	-3.3
1700.0	1.5	1.5	-3.3
1800.0	1.5	1.5	-3.4
1900.0	1.5	1.5	-3.4
2000.0	1.5	1.5	-3.4
2100.0	1.5	1.5	-3.4
2200.0	1.5	1.5	-3.5
2300.0	1.5	1.5	-3.5
2400.0	1.4	1.5	-3.5
2500.0	1.4	1.4	-3.5
2600.0	1.4	1.4	-3.5
2700.0	1.4	1.4	-3.6
2800.0	1.4	1.4	-3.6
2900.0	1.4	1.4	-3.6
3000.0	1.3	1.4	-3.6
3100.0	1.3	1.4	-3.6
3200.0	1.3	1.4	-3.6
3300.0	1.3	1.4	-3.7
3400.0	1.3	1.4	-3.7
3500.0	1.3	1.3	-3.7
3600.0	1.3	1.3	-3.7
3700.0	1.3	1.3	-3.7
3800.0	1.3	1.3	-3.7
3900.0	1.3	1.3	-3.7
4000.0	1.3	1.4	-3.7
4100.0	1.3	1.4	-3.7
4200.0	1.3	1.4	-3.7

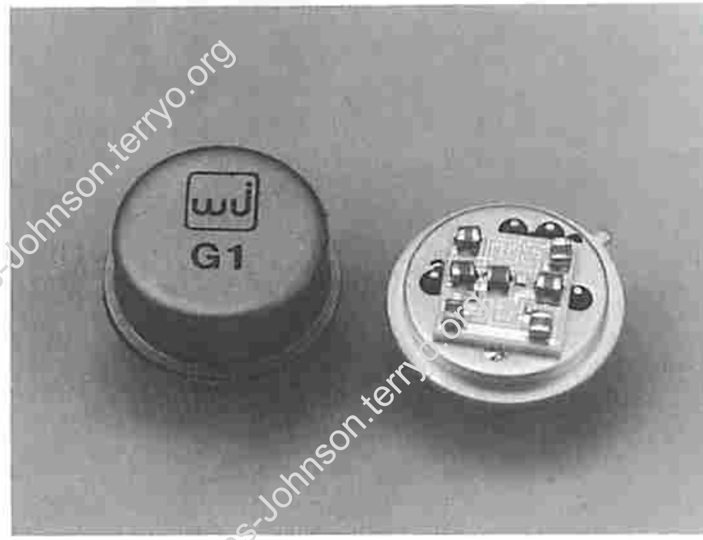
Linear S-Parameters

FREQUENCY	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
800.0	.274	-74	.680	-9	.690	-9	.271	-73
900.0	.257	-77	[illegible]	-14	.693	-14	.252	-76
1000.0	.242	-80	.691	-18	.695	-19	.239	-79
1100.0	.233	-83	.692	-23	.695	-23	.228	-82
1200.0	.225	-86	.692	-27	.695	-27	.221	-85
1300.0	.220	-88	.692	-31	.693	-31	.217	-88
1400.0	.217	-91	.690	-35	.692	-35	.214	-91
1500.0	.214	-95	.688	-39	.690	-39	.212	-95
1600.0	.211	-97	.685	-43	.688	-43	.212	-98
1700.0	.210	-100	.683	-46	.684	-46	.210	-100
1800.0	.208	-102	.680	-50	.683	-50	.211	-103
1900.0	.205	-105	.677	-53	.679	-54	.209	-105
2000.0	.202	-106	.677	-57	.679	-57	.198	-105
2100.0	.198	-108	.675	-60	.676	-60	.197	-107
2200.0	.193	-110	.670	-64	.675	-64	.197	-108
2300.0	.186	-111	.669	-67	.671	-67	.194	-109
2400.0	.181	-111	.668	-70	.672	-70	.188	-110
2500.0	.175	-112	.666	-74	.669	-74	.183	-110
2600.0	.168	-112	.665	-77	.668	-77	.178	-110
2700.0	.164	-112	.664	-81	.667	-81	.172	-109
2800.0	.156	-111	.663	-85	.667	-85	.167	-108
2900.0	.152	-111	.661	-88	.665	-89	.162	-106
3000.0	.148	-111	.660	-92	.666	-92	.159	-105
3100.0	.144	-111	.660	-95	.667	-96	.157	-103
3200.0	.142	-111	.658	-98	.665	-100	.154	-103
3300.0	.135	-110	.657	-102	.663	-104	.152	-102
3400.0	.136	-111	.656	-106	.663	-107	.150	-101
3500.0	.134	-110	.655	-109	.663	-111	.147	-100
3600.0	.133	-112	.654	-113	.663	-115	.146	-99
3700.0	.134	-111	.654	-117	.661	-119	.145	-98
3800.0	.129	-113	.654	-121	.661	-123	.145	-97
3900.0	.131	-113	.653	-124	.662	-127	.147	-96
4000.0	.127	-113	.651	-128	.660	-131	.151	-96
4100.0	.130	-115	.650	-132	.661	-135	.153	-96
4200.0	.128	[illegible]	.650	-136	.657	-139	.157	-94

WJ-G1

5 TO 2000 MHz TO-8 VOLTAGE-CONTROLLED ATTENUATOR MODULE

- LOW VSWR: < 1.5:1 TYP.
- LOW INSERTION LOSS: 2.0 dB TO 1000 MHz
- LOW DISTORTION: TYP. +25 dBm RELATIVE SUP. INTERCEPT POINT AT V CONTROL = +15 V



Specifications*

Characteristics	Typ.	Guaranteed Min./Max.
Frequency Range		5 MHz to 2000 MHz
Maximum Attenuation Available		
5-500 MHz	36 dB	31 dB (Min.)
5-1000 MHz	30 dB	25 dB (Min.)
5-2000 MHz	23 dB	18 dB (Min.)
Insertion Loss (V_o = 15 V)		
5-1000 MHz	2.0 dB	2.5 dB (Max.)
5-2000 MHz	2.5 dB	3.0 dB (Max.)
VSWR (Worst case in attenuation range)		
5-2000 MHz	⩽1.8:1	2.2:1 (Max.)
Flatness Over Frequency (Min. to 15 dB) (5-1000 MHz)	±0.5 dB	±1.0 dB
Bias Voltage		+15 V
Bias Current		15 mA (Max.)
Control Voltage		0 V to +15 V
Control Current		7 mA (Max.)
Response Time		
10% - 90%	2 μsec	4 μsec
0% - 100%	75 μsec	125 μsec (Max.)

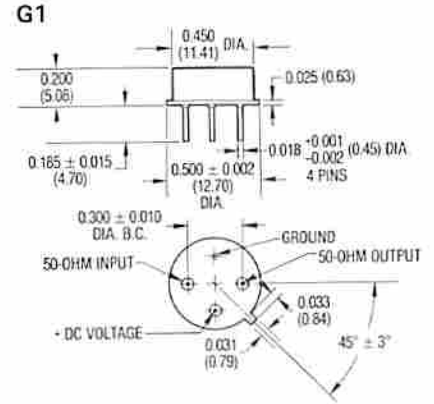
*Measured in a 50-ohm system, guaranteed at 25°C

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . +125°C
Maximum DC Voltage . . . . +18 Volts
Maximum Continuous RF Input Power . . . . 100 Milliwatts
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 200 Milliwatts
Maximum Peak Power . . . . 1 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

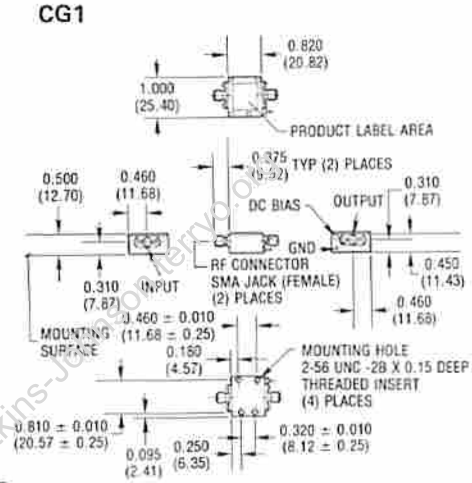
Outline Drawings

G1



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CG1



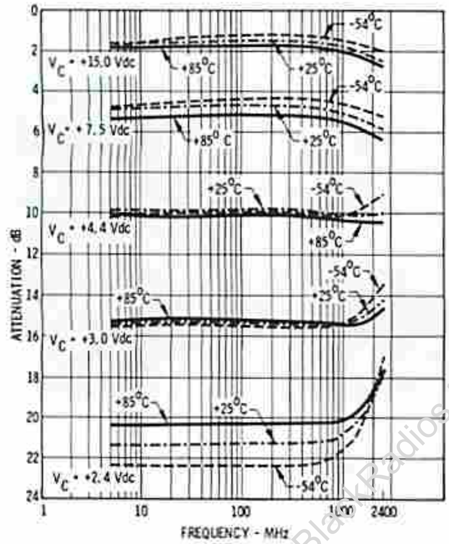
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

*WJ-CG1 is standard WJ-G1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

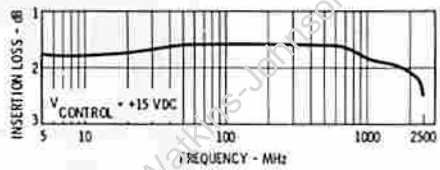
Weight 2.27 grams (0.08 oz.) max.

Typical Performance at 25°C in a 50 Ohm System (V_{BIAS} = +15 Vdc, unless otherwise noted)

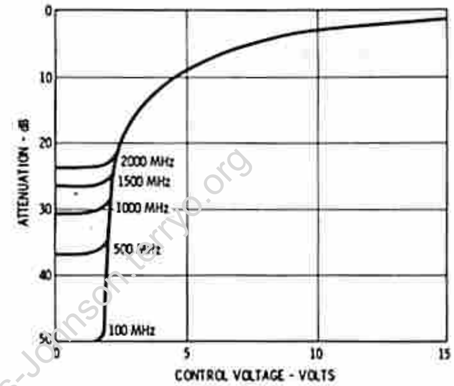
Attenuation vs. Frequency



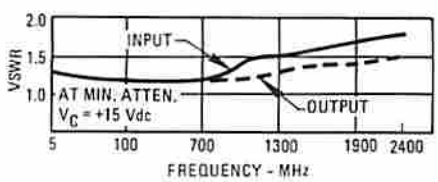
Insertion Loss vs. Frequency at $V_{CONTROL}$ = 15 V

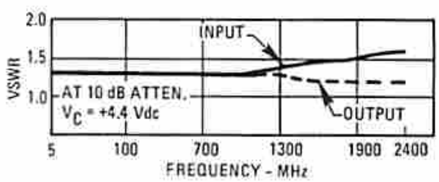


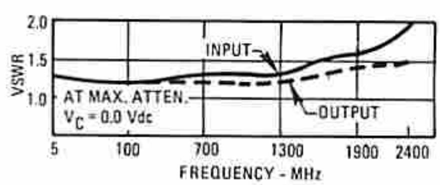
Attenuation vs. Control Voltage



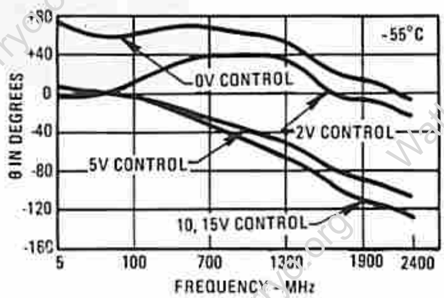
VSWR vs. Frequency

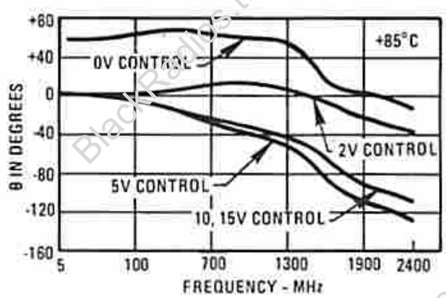


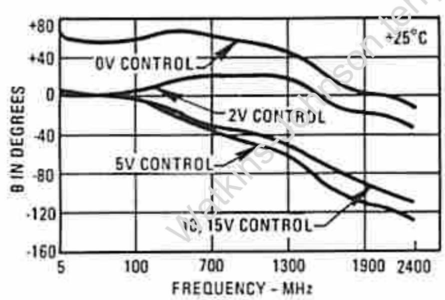




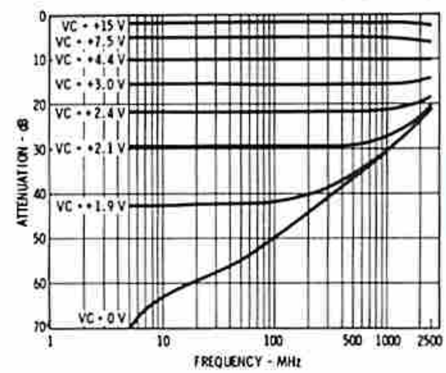
Phase vs. V_{CTL} vs. Frequency vs. Phase of the Moon



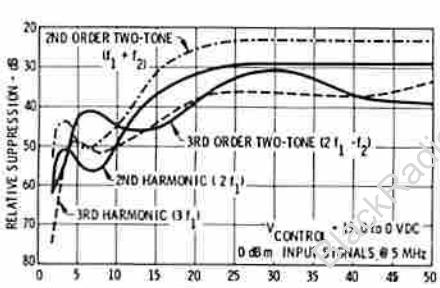




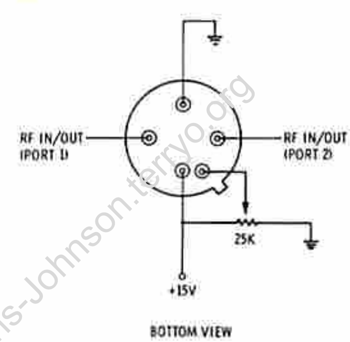
Attenuation vs. V_{CTL} vs. Frequency



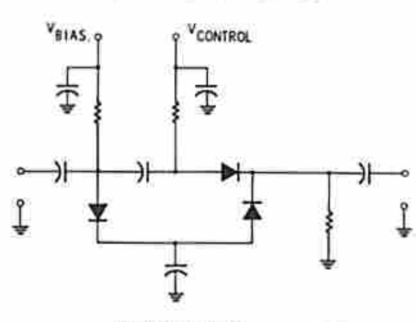
Distortion Products



Typical Test Circuit



Schematic Diagram

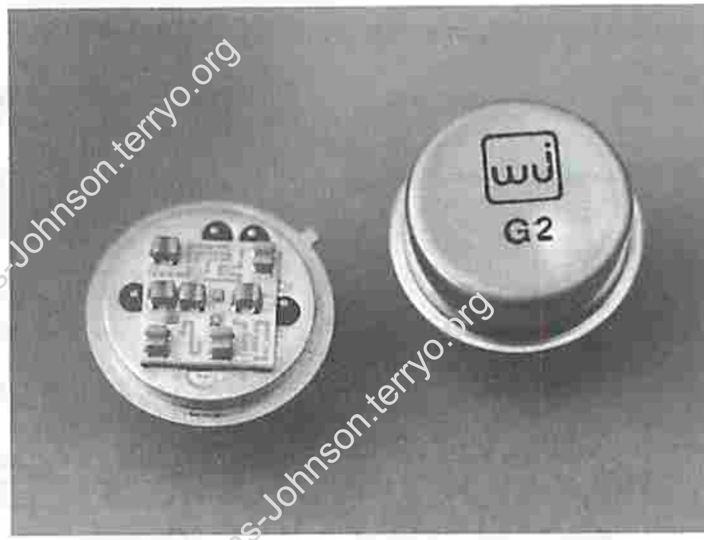


2

WJ-G2

5 TO 2000 MHz TO-8 VOLTAGE-CONTROLLED ATTENUATOR MODULE

- LOW VSWR < 1.5:1 TYP.
- LOW INSERTION LOSS: TYP. 2.5 dB TO 1000 MHz
- LOW DISTORTION TYP. > 50 dB HARMONIC SUPPRESSION AT V CONTROL = +15 V
- HIGH EFFICIENCY, 6 mA AT +5 VOLTS BIAS



Specifications*

Characteristics	Typical	Guaranteed -54°C - +85°C
Frequency Range	5 to 2200 MHz	5 MHz to 2000 MHz
Maximum Attenuation Available		
5-500 MHz	35 dB	31 dB (Min.)
5-1000 MHz	29 dB	25 dB (Min.)
5-2000 MHz	23 dB	18 dB (Min.)
Insertion Loss (V_C = 15 V)		
5-1000 MHz	2.5 dB	3.0 dB (Max.)
5-2000 MHz	2.8 dB	3.5 dB (Max.)
VSWR (Worst case in attenuation range)		
5-1000 MHz	⩽ 1.3:1	1.8:1 (Max.)
5-2000 MHz	⩽ 1.5:1	2.5:1 (Max.)
Flatness Over Frequency (Min. to 15 dB) (5-1000 MHz)	±.4 dB	±1.0 dB
Bias Voltage		+5 V
Bias Current		6 mA (Max.)
Control Voltage		0 V to +15 V
Control Current		7 mA (Max.)
Switching Speed 0 to 100%	75 μsec	125 μsec (Max.)

*Measured in a 50-ohm system at 5.0 Vdc Nominal.

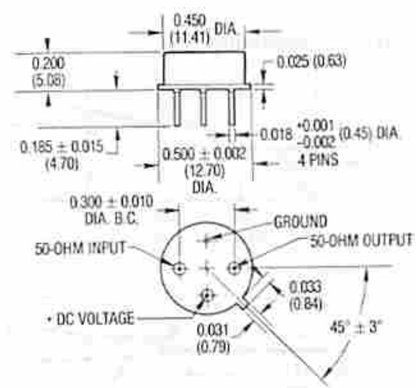
Absolute Maximum Ratings

Storage Temperature .... -62°C to +125°C
Maximum Case Temperature .... 125°C
Maximum DC Control Voltage .... +18 Volts
Maximum DC Bias Voltage .... +10 Volts
Maximum Continuous RF Input Power .... 100 Milliwatts
Maximum Short Term RF Input Power (1 Minute Max.) .... 200 Milliwatts
Maximum Peak Power .... 1 Watt (3 μsec Max.)
"S" Series Burn-in Temperature (Case) .... 125°C

Weight 2.27 grams (0.08 oz.) max.

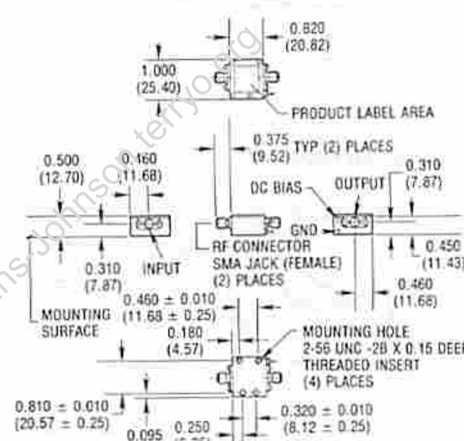
Outline Drawings

G2



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CG2

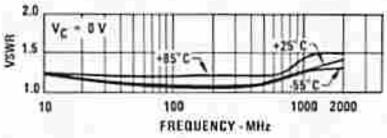


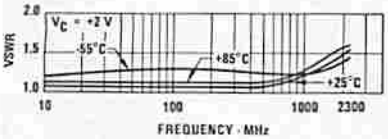
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

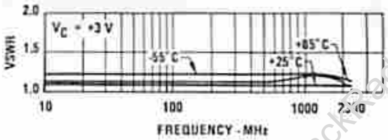
WJ-CG2 is standard WJ-G2 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

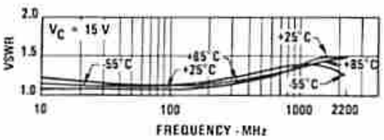
Typical Performance at 25°C in a 50 Ohm System (V_{BIAS} = +5 Vdc, unless otherwise noted)

Input VSWR vs. Frequency

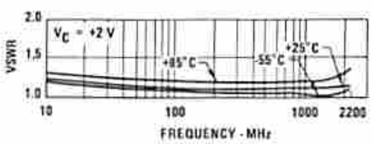


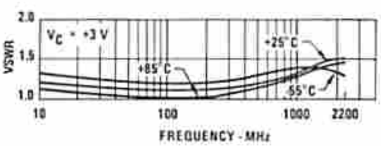


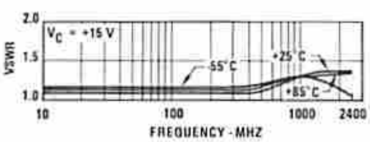




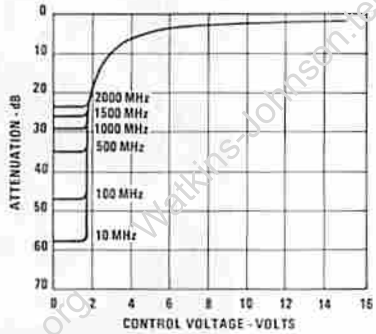
Output VSWR vs. Frequency



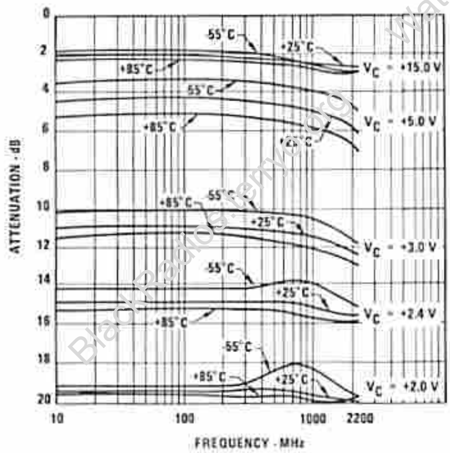


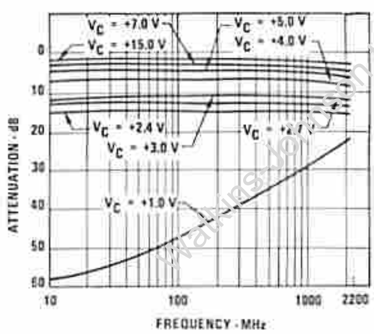


Attenuation vs. Control Voltage

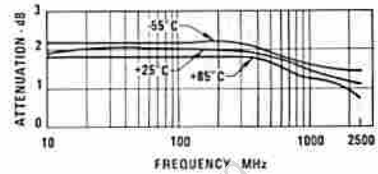


Attenuation vs. Frequency

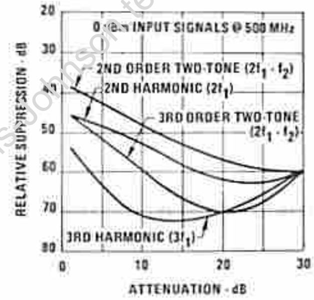




Insertion Loss vs. Frequency

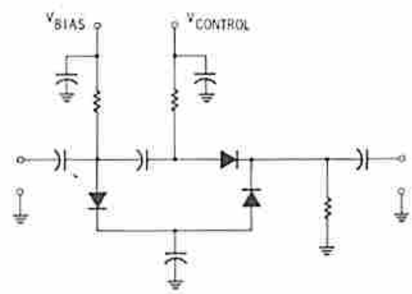


Distortion Products



2

Schematic Diagram



π PAD ATTENUATOR

WJ-G30

100 TO 2000 MHz TO-8 VOLTAGE-CONTROLLED ATTENUATOR MODULE

- FAST SWITCHING: < 100 nsec TYP.; 0 TO 90%; 3 μsec TYP.; 0 TO 100%
- HIGH DYNAMIC RANGE: 40 dB TYP. TO 1000 MHz
- LOW VSWR: 1.5:1 TYP.

Guaranteed Specifications*

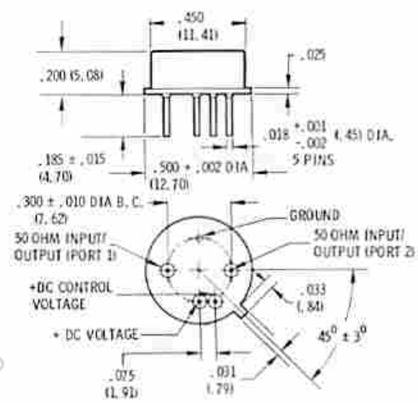
Characteristics	Typical	Min./Max.
Frequency Range	50-2300 MHz	100-2000 MHz
Maximum Attenuation Available		
100-500 MHz	>45 dB	40 dB, Min.
500-1000 MHz	>40 dB	35 dB, Min.
1000-2000 MHz	>30 dB	25 dB, Min.
Insertion Loss		
100-500 MHz	<2.3 dB	2.8 dB, Max.
500-1000 MHz	<2.5 dB	3.0 dB, Max.
1000-2000 MHz	<3.0 dB	3.5 dB, Max.
VSWR		
100-1000 MHz	<1.4:1	1.8:1, Max.
1000-2000 MHz		
0-25 dB Attenuation	1.4:1	2.0:1, Max.
>25 dB Attenuation	<1.7:1	2.2:1, Max.
Flatness Over Frequency (Min. to 25 dB)		
100-1000 MHz	±0.5 dB	±1.0 dB
1000-2000 MHz	±1.0 dB	±1.5 dB
Switching Speed		
10 to 90%	<100 nsec	400 nsec
0 to 100%	<3 μsec	6 μsec Max.
Bias Voltage		+15 V
Bias Current	6.7 mA	10 mA, Max.
Control Voltage		0 V to +15 V
Control Current		10 mA, Max.

*Measured in a 50-ohm system, guaranteed at 25°C at 15.0 Vdc Nominal.

Weight approximately 2.0 grams (0.07 oz.)

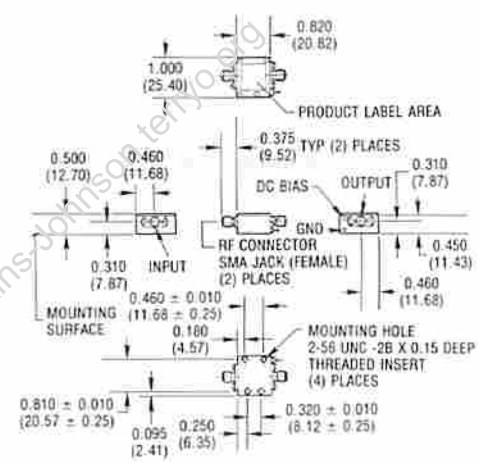
Outline Drawings

G30



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .005 (.13) UNLESS OTHERWISE SPECIFIED

CG30

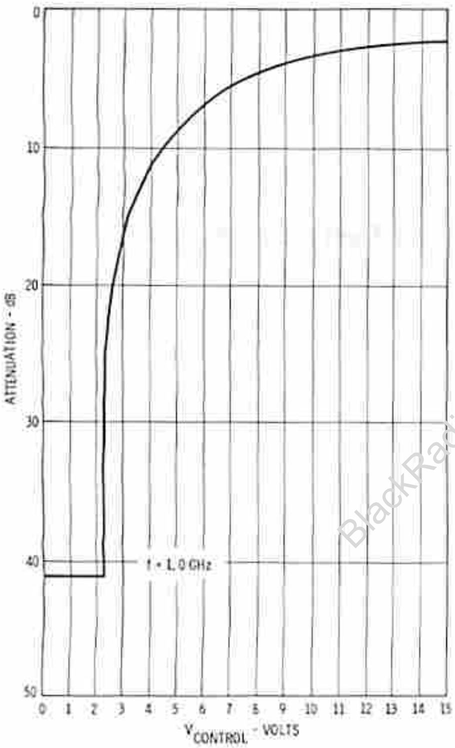


DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

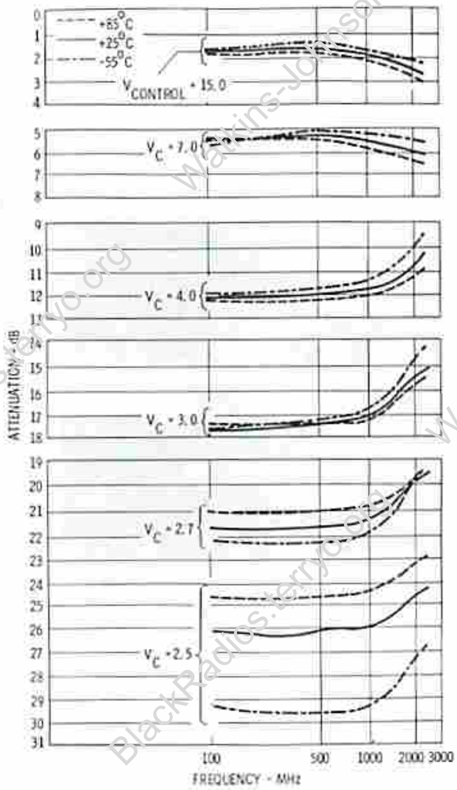
WJ-CG30 is standard WJ-G30 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C (V_{BIAS} = +15 Vdc, unless otherwise noted)

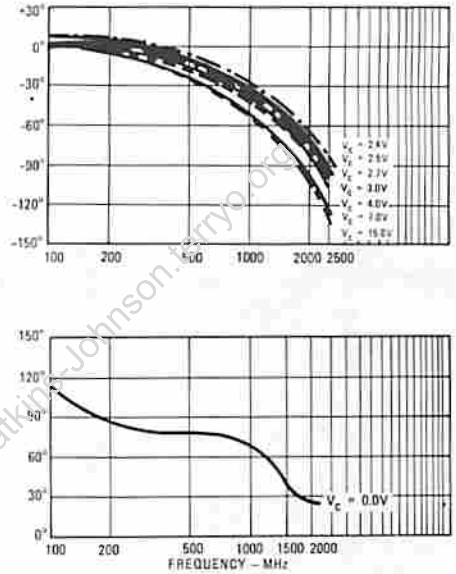
Attenuation vs. Control Voltage



Attenuation vs. $V_{CONTROL}$ vs. Frequency

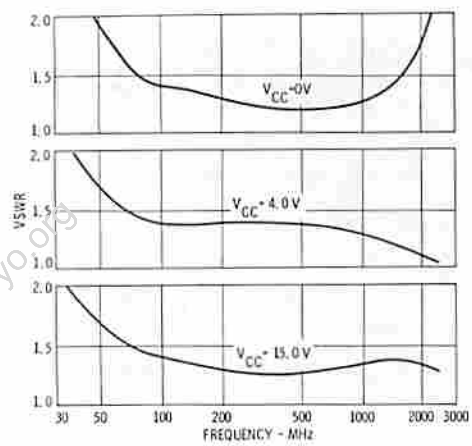


Phase vs. $V_{CONTROL}$ vs. Frequency



2

VSWR (In/Out) vs. Frequency



Absolute Maximum Ratings

Storage Temperature
. . . . -62°C to +125°C

Maximum Case Temperature
. . . . 125°C

Maximum DC Voltage
. . . . +18 Volts

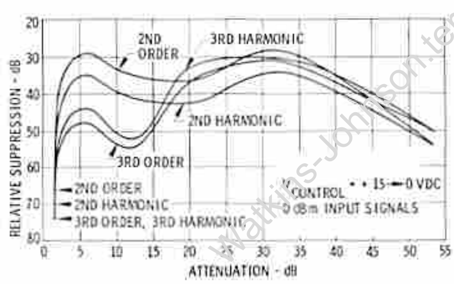
Maximum Continuous RF Input Power
. . . . 100 Milliwatts

Maximum Short Term RF Input Power (1 Minute Max.)
. . . . 200 Milliwatts

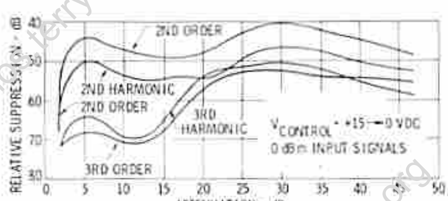
Maximum Peak Power
. . . . 1 Watt
(3 μsec Max.)

"S" Series Burn-In Temperature (Case)
. . . . 125°C

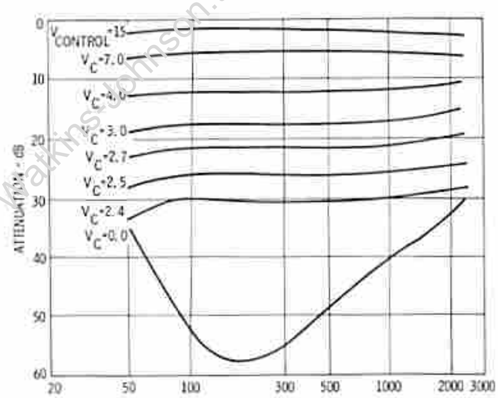
Distortion Products vs. Attenuation at 100 MHz



Distortion Products vs. Attenuation at 500 MHz



Attenuation vs. $V_{CONTROL}$ vs. Frequency



Typical Switching Performance at 25°C

The switching speed of the WJ-G30 is shown in Figure 2 with the horizontal scale set at 50 µsec/div. The high speed of this attenuator is apparent, particularly when comparing it to the standard WJ-G1 attenuator shown in Figure 1. The G1 takes approximately 80 µsec to settle while the G30 takes less than 4 µsec. An expanded scale is shown in Figure 3 for the G30 with the horizontal scale set at 2 µsec/div.

The input level for Figures 1 through 3 was +7 dBm. These figures are representative of the switching characteristics. The switching speed can change to some degree as a function of attenuation and input levels.

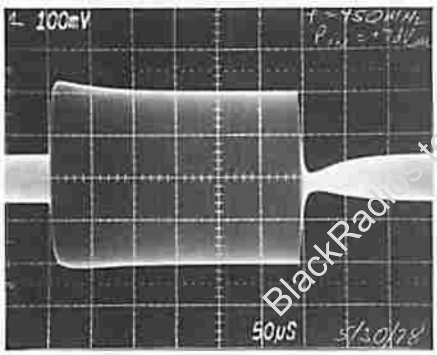


Fig. 1

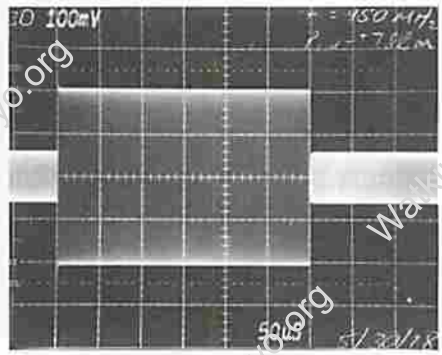


Fig. 2

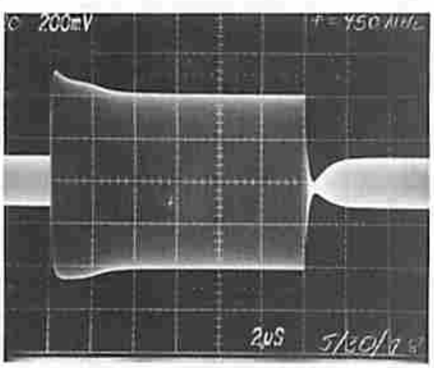
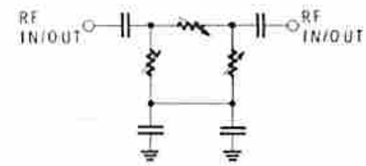


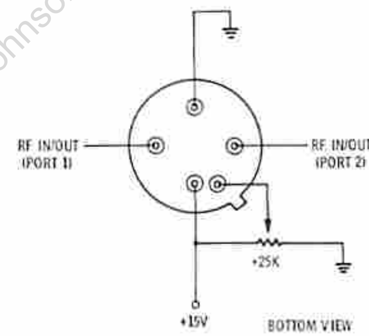
Fig. 3

Functional Block Diagram



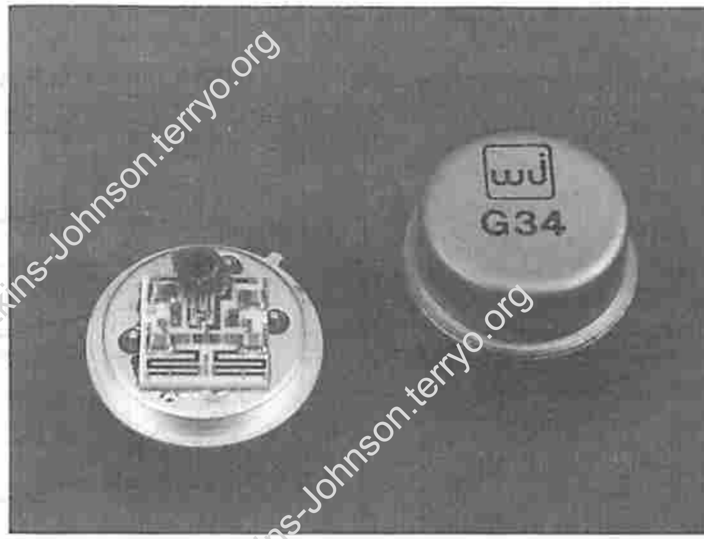
π PAD ATTENUATOR

Typical Test Circuit



WJ-G34

500 TO 2400 MHz TO-8 VOLTAGE-CONTROLLED ATTENUATOR MODULE



- FAST SWITCHING: < 500 nsec TYP.; 10 TO 90%; < 1.0 μsec TYP; 0 to 100%
- HIGH DYNAMIC RANGE: 30 dB TYP. TO 2400 MHz
- LOW VSWR: 1.5:1 TYP.
- EXCELLENT FLATNESS OVER FREQUENCY: ±0.5 dB TYP.

Specifications*

Characteristics	Typical	Guaranteed Min./Max.
Frequency Range	200-2600 MHz	500-2400 MHz
Maximum Attenuation Available		
500-1000 MHz	>40 dB	35 dB, Min.
1000-2000 MHz	>35 dB	30 dB, Min.
2000-2400 MHz	>30 dB	25 dB, Min.
Insertion Loss		
500-1000 MHz	2.5 dB	3.0 dB, Max.
1000-2000 MHz	3.0 dB	3.5 dB, Max.
500-2400 MHz	3.3 dB	4.0 dB, Max.
VSWR		
500-2000 MHz	<1.3:1	1.8:1, Max.
2000-2400 MHz	<1.5:1	2.0:1, Max.
Flatness Over Frequency (Min. to 25 dB)		
500-2400 MHz	±0.5 dB	±1.0 dB
Switching Speed		
10 to 90%	<500 nsec	800 nsec
0 to 100%	<2.0 μsec	4.0 μsec
Bias Voltage		+15 V
Bias Current	6.5 mA	10 mA, (Max.)
Control Voltage		0 V to +15 V

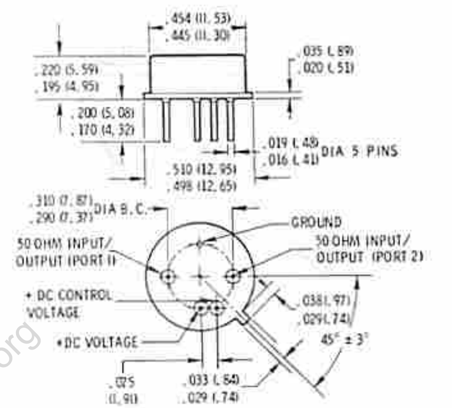
*Measured in a 50-ohm system, guaranteed at 25°C at 15 Vdc Nominal.

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . +125°C
Maximum DC Voltage . . . . +10 Volts
Maximum Continuous RF Input Power . . . . 100 Milliwatts
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 200 Milliwatts
Maximum Peak Power . . . . 1 Watt (3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . 125°C

Outline Drawings

G34

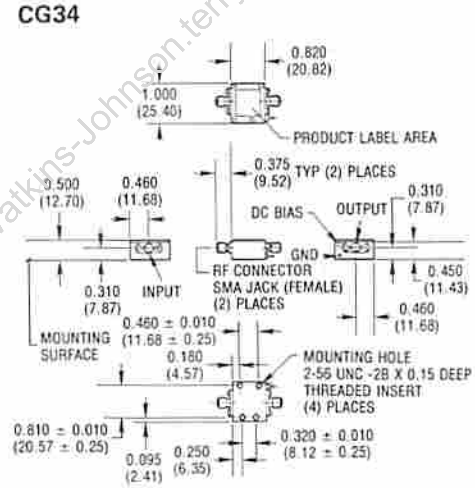


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

Weight

approximately 2.0 grams (0.07 oz.)

CG34



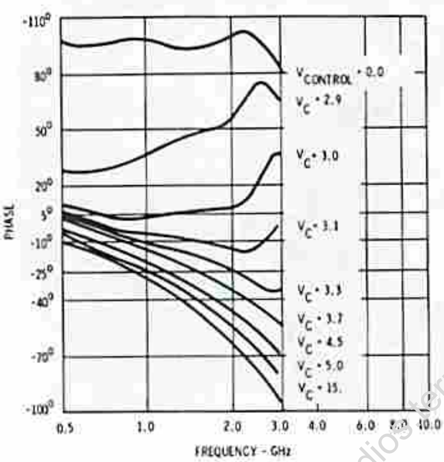
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

WJ CG34 is standard WJ G34 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

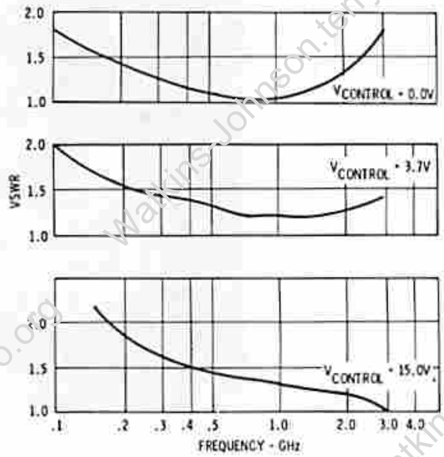
2

Typical Performance at 25°C (V$_{BIAS}$ = +15 Vdc unless otherwise noted)

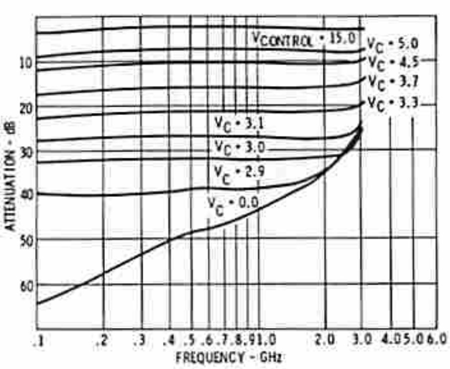
Phase vs. Frequency vs. Attenuation



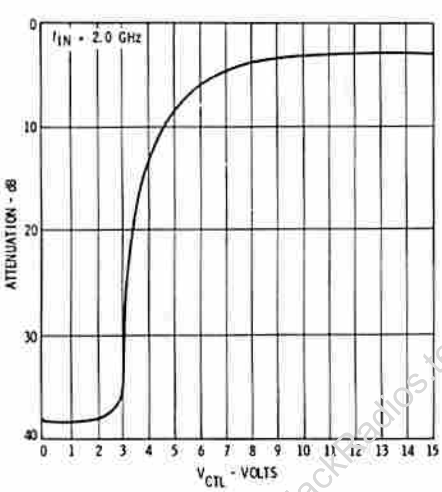
VSWR (In/Out) vs. Frequency



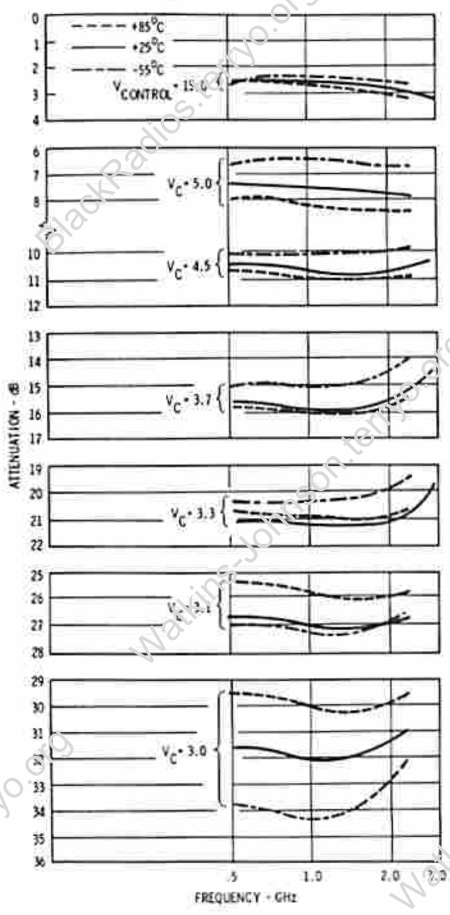
Attenuation vs. V$_{CONTROL}$ vs. Frequency



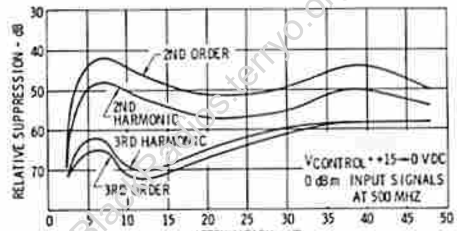
Attenuation vs. V$_{CONTROL}$



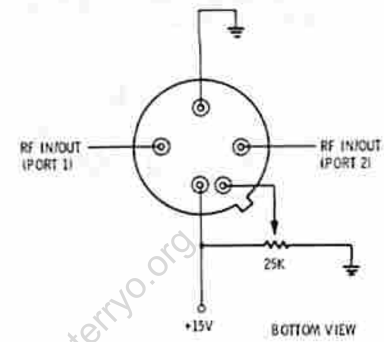
Attenuation vs. V$_{CONTROL}$ vs. Frequency



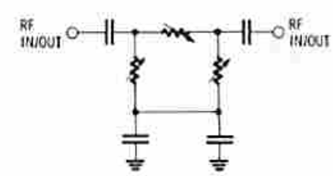
Distortion Products vs. Frequency



Typical Test Circuit



Functional Block Diagram



π PAD ATTENUATOR

Typical Switching Performance at 25°C

The switching speed of the WJ-G34 is shown in Figure 2 with the horizontal scale set at 2 µsec/div. The very high speed of this attenuator is apparent, and offers even quicker switching than the WJ-G30 attenuator shown in Figure 1. The G30 takes approximately 3 µsec to settle while the G34 switching is less than 1 µsec. An expanded scale is shown in Figure 3 for the G34 with the horizontal scale set at 500 nsec/div.

The input level for Figures 1 through 3 was +7 dBm. These figures are representative of the switching characteristics. The switching speed can change to some degree as a function of attenuation and input levels.

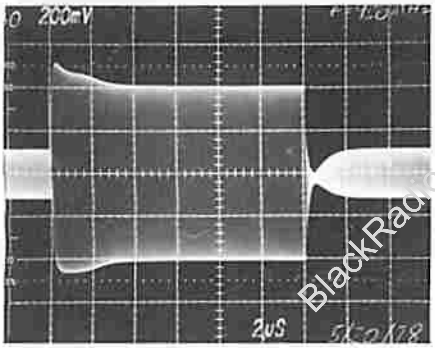


Fig. 1

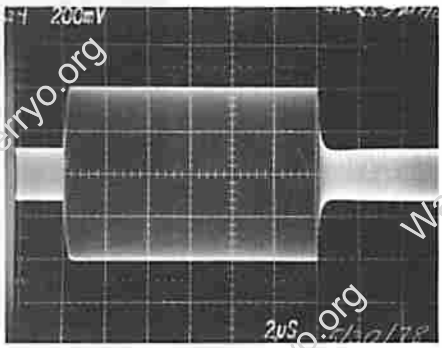


Fig. 2

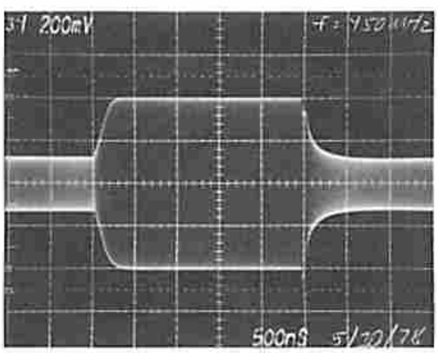


Fig. 3

2

WJ-G40

500 TO 4000 MHz TO-8 VOLTAGE-CONTROLLED ATTENUATOR MODULE

- WIDE BAND PERFORMANCE
- EXCELLENT INSERTION LOSS: ≤3.0 dB (TYP.)
- LOW VSWR: 1.5:1 (TYP.)
- HIGH DYNAMIC RANGE: 20 dB (TYP.) TO 3000 MHz
- FAST SWITCHING: <500 nsec (TYP.) 10 to 90%
  <2 μsec (TYP.) 0 TO 100%

Specifications*

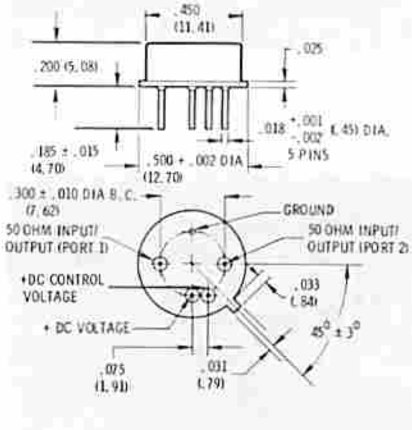
Characteristics	Typical	Guaranteed Min./Max.
Frequency Range	500-4200 MHz	500-4200 MHz
Maximum Attenuation Available		
500-1000 MHz	>39 dB	34 dB Min.
1000-2000 MHz	>33 dB	28 dB Min.
2000-4000 MHz	>30 dB	25 dB Min.
3000-4000 MHz	>28 dB	23 dB Min.
Insertion Loss		
500-2000 MHz	2.0 dB	2.5 dB Max.
2000-4000 MHz	3.0 dB	3.5 dB Max.
VSWR		
500-3000 MHz	≤1.5:1	2.2:1 Max.
3000-4000 MHz	≤1.7:1	2.2:1 Max.
Flatness Over Frequency (Min. to 20 dB)		
500-3000 MHz	±0.6 dB Max.	±1.2 dB Max.
500-4000 MHz	±1.4 dB Max.	±2.0 dB Max.
Switching Speed		
10 to 90%	<500 nsec	800 nsec
0 to 100%	<2 μsec	4.0 μsec
Bias Voltage		+15V
Bias Current	8.0 mA	12 mA Max.
Control Voltage		0V to 15V
Control Current	6.0 mA	10 mA Max.

*Measured in a 50-ohm system, guaranteed at 25°C.

Weight approximately 2.0 grams (0.07 oz.)

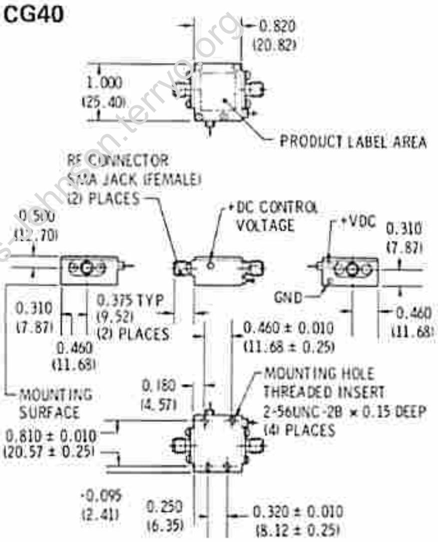
Outline Drawings

G40



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

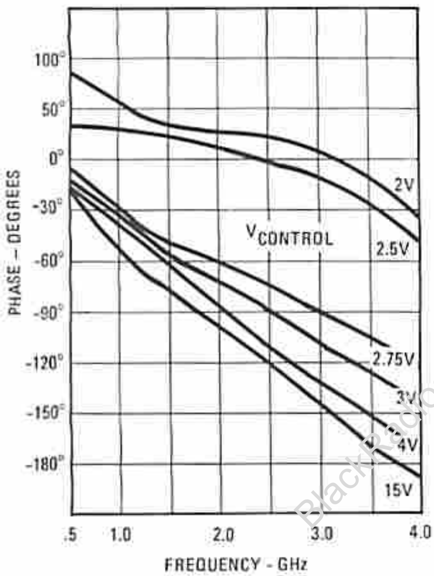
CG40



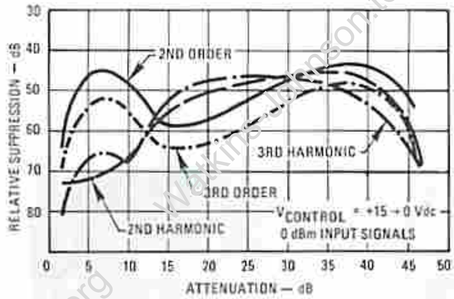
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C

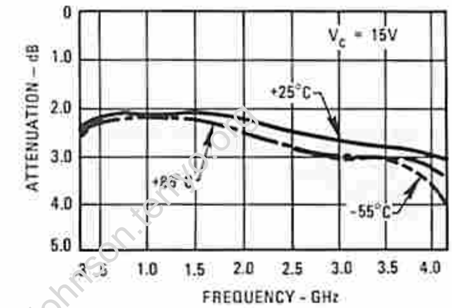
Phase vs. $V_{Control}$ vs. Frequency



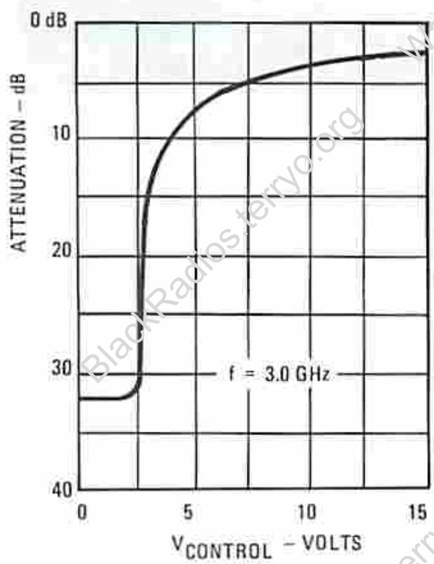
Distortion Products vs. Attenuation at 500 MHz

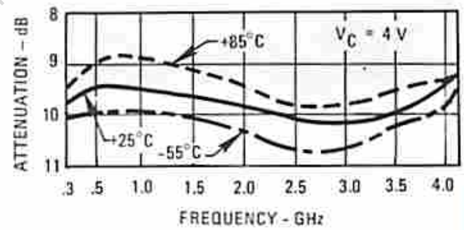


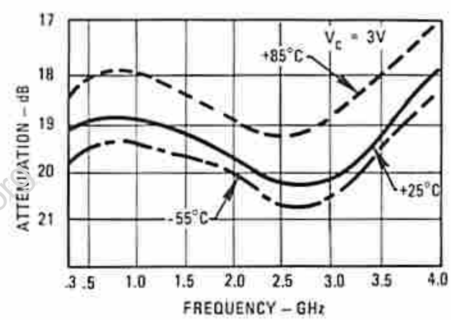
Attenuation vs. $V_{Control}$ vs. Frequency



Attenuation vs. Control Voltage



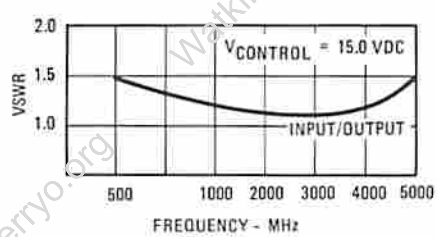


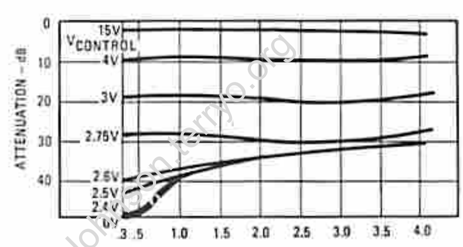


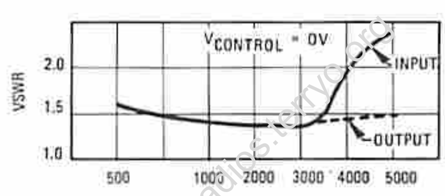
Absolute Maximum Ratings

Storage
  Temperature. . . . . -62°C to +125°C
Maximum Case
  Temperature. . . . . 125°C
Maximum DC Voltage . . . . . +18 Volts
Maximum Continuous
  RF Input Power . . . . 100 Milliwatts
Maximum Short Term RF
  Input Power
  (1 Minute Max.) . . . . 200 Milliwatts
Maximum Peak
  Power . . . . (3 μsec Max.) 1 Watt
"S" Series Burn-In
  Temperature (Case) . . . . 125°C

VSWR







2

Typical Switching Performance at 25°C

The switching speed of the WJ-G40 is shown in Figure 1 with the horizontal scale set at 2 μS. The very high speed of this attenuator is apparent and an expanded view of the switching is shown in Figure 2. Note the WJ-G40 settles in less than 1 μS.

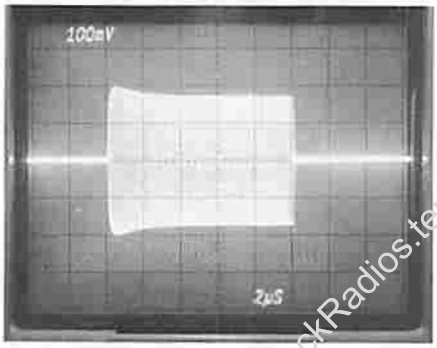


Fig. 1

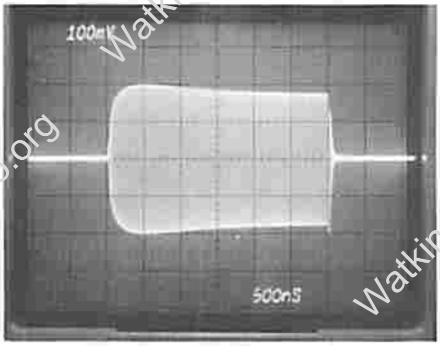
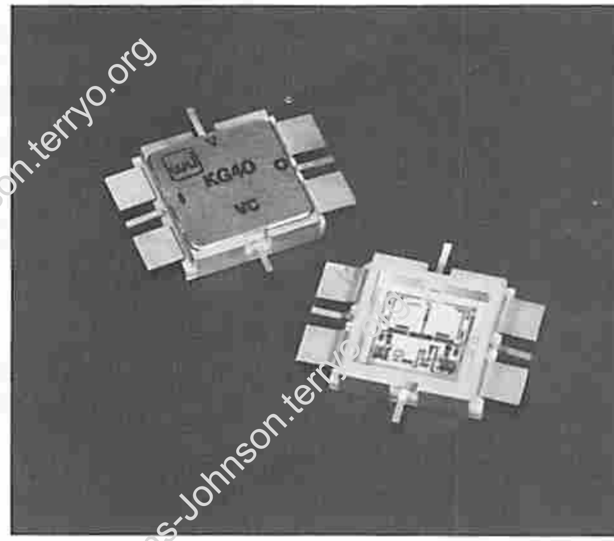


Fig. 2

WJ-KG40

500 TO 4000 MHz CERAMIC VOLTAGE-CONTROLLED ATTENUATOR MODULE



- WIDEBAND PERFORMANCE
- EXCELLENT INSERTION LOSS: ≤3.0 dB (TYP.)
- HIGH DYNAMIC RANGE: 20 dB (TYP.) TO 3000 MHz
- FAST SWITCHING: <500 nsec (TYP.) 10 TO 90%
  <2 μsec (TYP.) 0 TO 100%

Specifications*

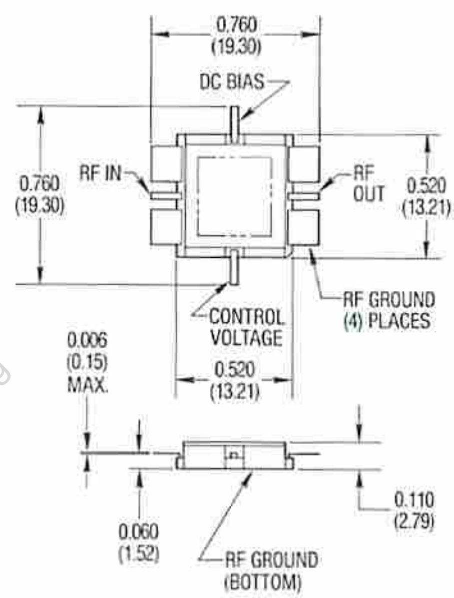
Characteristics	Typical	Guaranteed Min./Max.
Frequency Range	500–4200 MHz	500–4000 MHz
Maximum Attenuation Available		
500–1000 MHz	>40 dB	35 dB Min.
1000–2000 MHz	>34 dB	29 dB Min.
2000–3000 MHz	>29 dB	29 dB Min.
3000–4000 MHz	>24 dB	19 dB Min.
Insertion Loss		
500–2000 MHz	2.2 dB	3.0 dB Max.
2000–4000 MHz	3.0 dB	3.5 dB Max.
VSWR		
Input/Output	≤1.7:1	2.2:1 Max.
Flatness (Min. to 15 dB)	±0.90 Max.	±1.2 dB Max.
Switching Speed		
10 to 90%	<500 nsec	800 nsec
0 to 100%	<2 μsec	4.0 μsec
Bias Voltage		+15V
Bias Current	8.0 mA	12 mA Max.
Control Voltage		0V to 15V
Phase Shift (per 250 MHz)	30°	

*Measured in a 50-ohm system, guaranteed at 25°C.

Weight approximately 1.7 grams (0.06 oz.)

Outline Drawings

KG40



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.005 (.13) UNLESS OTHERWISE SPECIFIED

Absolute Maximum Ratings

Storage Temperature . . . . . −62°C to +125°C
Maximum Case Temperature . . . . +125°C
Maximum DC Voltage . . . . +18 Volts
Maximum Continues RF Input Power . . . . 100 Milliwatts
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 200 Milliwatts
Maximum Peak Power . . . . 1 Watt
. . . .(3 μsec Max.)
"S" Series Burn-In Temperature (Case) . . . . . . +125°C

Typical Switching Performance at 25°C

The switching speed of the WJ-KG40 is shown in Figure 1. The worst case is shown here for a 450 MHz input signal. Figure 2 is the same KG40 with the horizontal scale set at 2 μsec/div. This shows more clearly the 0-100% switching time of approximately 2 μseconds.

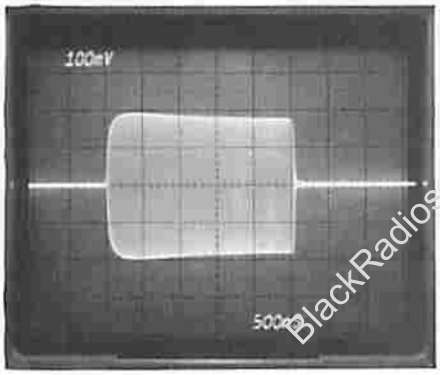


Fig. 1

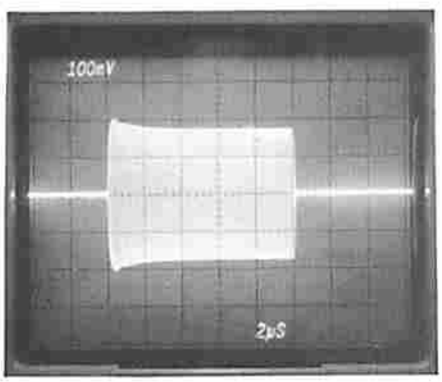
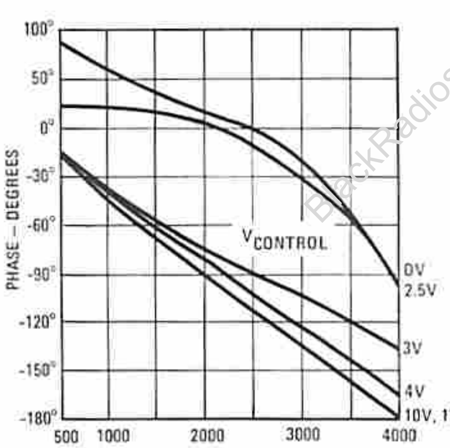


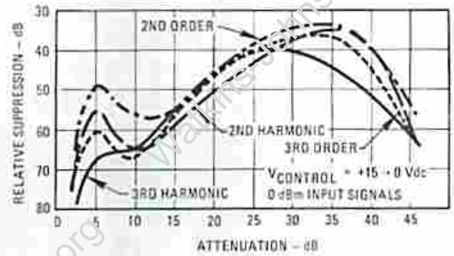
Fig. 2

Typical Performance at 25°C

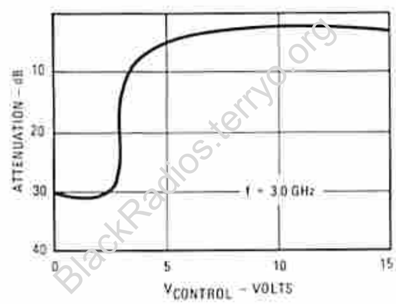
Phase vs. $V_{Control}$ vs. Frequency



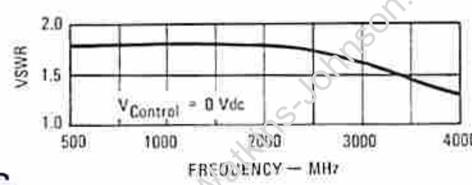
Distortion Products vs. Attenuation at 500 MHz

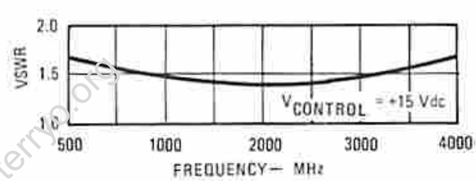


Attenuation vs. Control Voltage

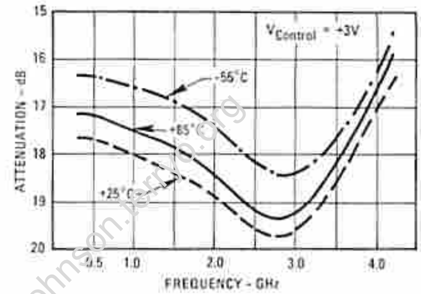


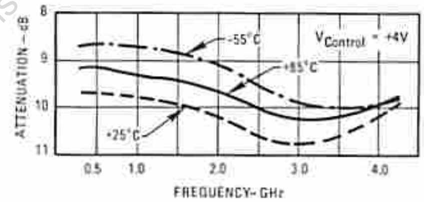
VSWR

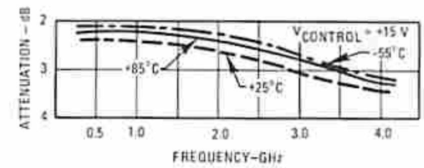


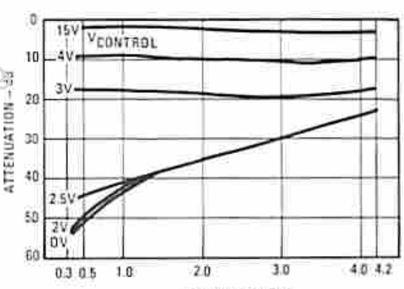


Attenuation vs. $V_{Control}$ vs. Frequency



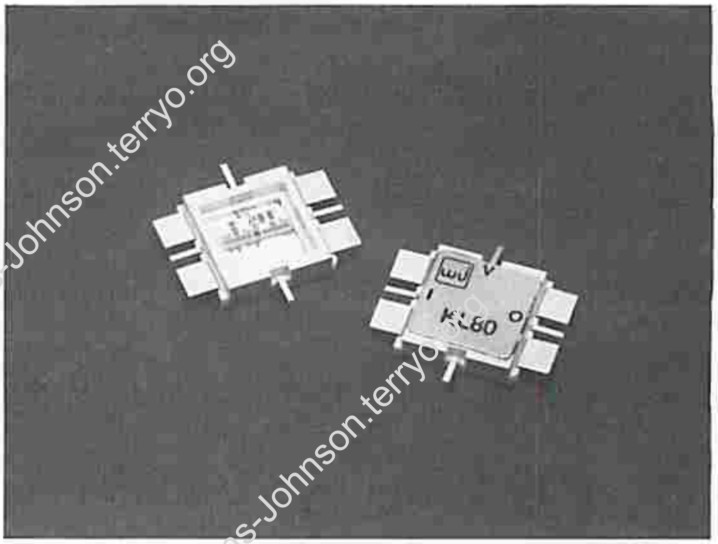






WJ-KL80

1.0 TO 8.0 GHz CERAMIC LIMITER MODULE



- VOLTAGE VARIABLE LIMITING LEVEL: -2.5 TO +3.5 dBm
- ULTRA-WIDE BANDWIDTH: 800 TO 8200 MHz (TYP.)
- GOOD SUPPRESSION OF EVEN ORDER HARMONICS DUE TO BALANCED CIRCUIT DESIGN: > 40 dB AT +5 dBm INPUT (TYP.)
- LOW PIECE PART COUNT

Specifications*

Characteristics	Typical	Guaranteed Min./Max.
Frequency	800-8200 MHz	1000-8000 MHz
Insertion Loss $P_{IN} \leqslant -10$ dBm $+8 \leqslant$ Bias $\leqslant +15$ Vdc	< 4.0 dB	5.0 dB (Max.)
Input VSWR $P_{IN} \leqslant -10$ dBm $+8 \leqslant$ Bias $\leqslant +15$ Vdc	< 1.6:1	2.0:1 (Max.)
Output VSWR $P_{IN} \leqslant -10$ dBm $+8 \leqslant$ Bias $\leqslant +15$ Vdc	< 1.6:1	2.0:1 (Max.)
Input Signal (Max.)		+17 dBm
Bias		
At +15 Vdc	10.0 mA	
At +12 Vdc	8.0 mA	
At +10 Vdc	6.5 mA	
At +8 Vdc	5.0 mA	

*Measured in a 50-ohm system, guaranteed at 25°C.

Absolute Maximum Ratings

Storage Temperature. . . . . -62°C to +125°C
Maximum Case Temperature. . . . . +105°C
Maximum DC Voltage . . . . . . 16 Volts
Maximum Continuous RF Input Power . . . . +17 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 100 Milliwatts
Maximum Peak Power . . . . . . 0.2 Watt . . . .(3 μsec Max.)
"S" Series Burn-In Temperature (Case). . . . . . . 105°C

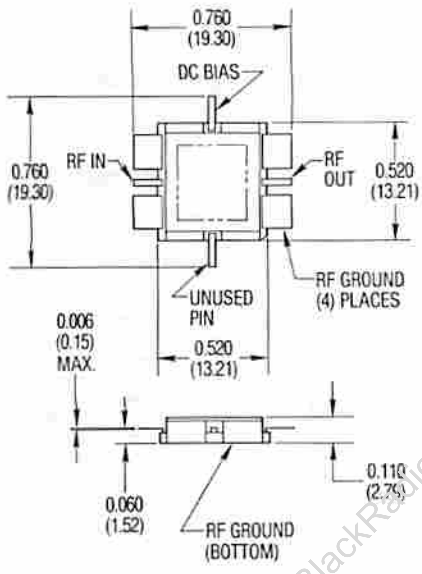
Limiting and Insertion Loss Characteristics (25°C)

Bias Voltage	Output Level at Limiting (1 dB Comp)		Max. Output at Limiting (+17 dBm Input)		Insertion (6000 MHz)		Insertion (8000 Max.)	
	Typ.	Max.	Typ.	Max.	Typ.	Max.	Typ.	Max.
+15 Volts	3.0	4.3	4.0[1] 4.0[2]	5.0[1] 5.0[2]	3.8	4.5	4.2	5.0
+12 Volts	1.5	2.5	2.0[1] 3.0[2]	3.0[1] 4.0[2]	3.9	4.5	4.3	5.0
+10 Volts	-0.5	1.0	0[1] 2.0[2]	1.0 3.0	4.0	4.5	4.4	5.0
+8 Volts	-2.5	-1.0	-2.0[1] 1.0[2]	-1.0[1] 2.0[2]	4.2	4.5	4.5	5.0

Notes: 1. At 1000 MHz 2. At 7000 MHz

Outline Drawing

KL80



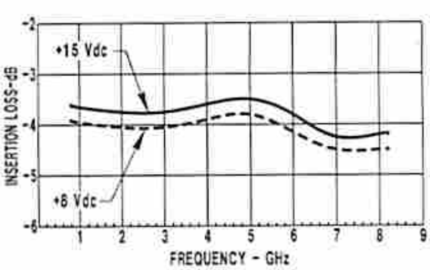
DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .005 (.13) UNLESS OTHERWISE SPECIFIED

Weight

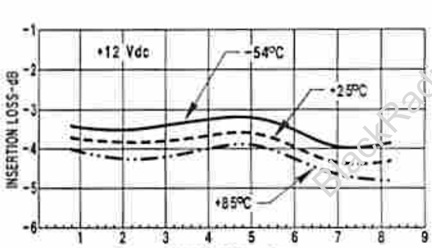
approximately 2.27 grams (0.08 oz.)

Typical Performance at 25°C

Insertion Loss vs. Frequency

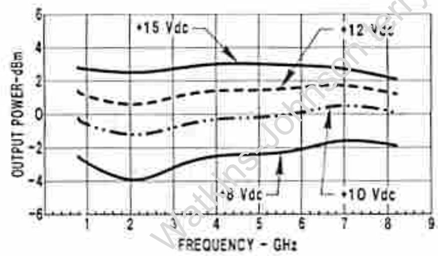


Insertion Loss



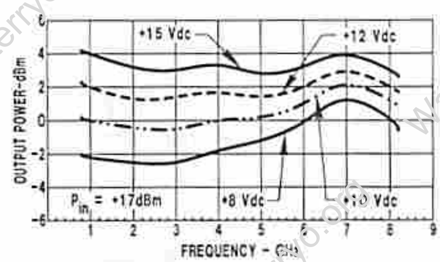
Typical Performance at 25°C (Cont.)

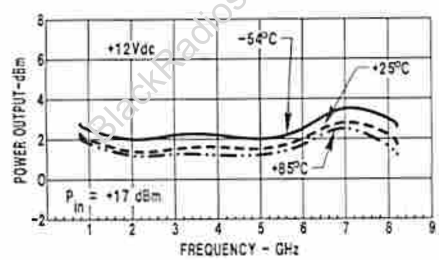
Power Output*



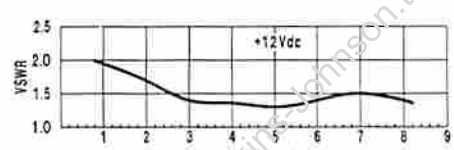
*at 1 dB Gain Compression

Maximum Limiting Level

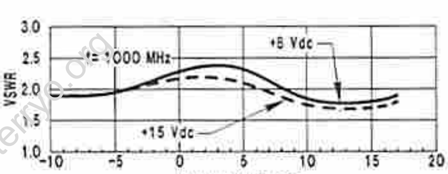


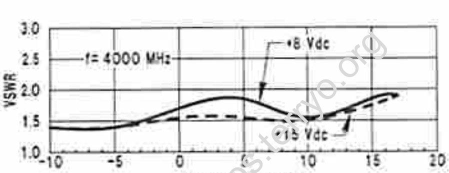


VSWR

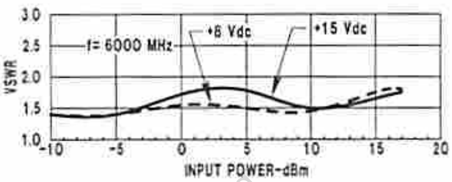


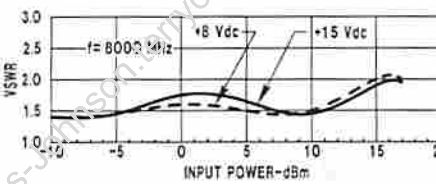
Input VSWR vs. Input Power



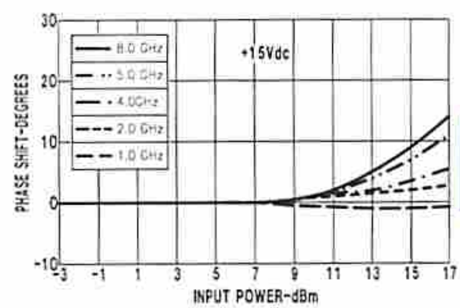


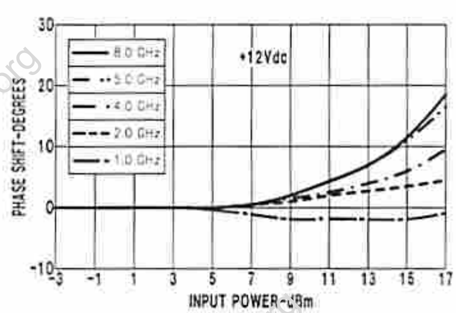
Input VSWR vs. Input Power

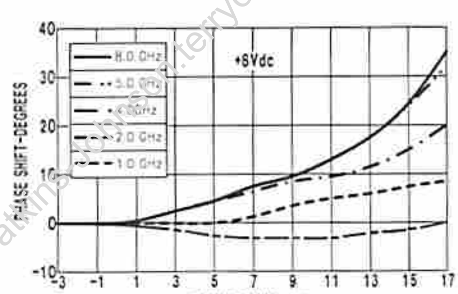




Phase Shift vs. Input Power

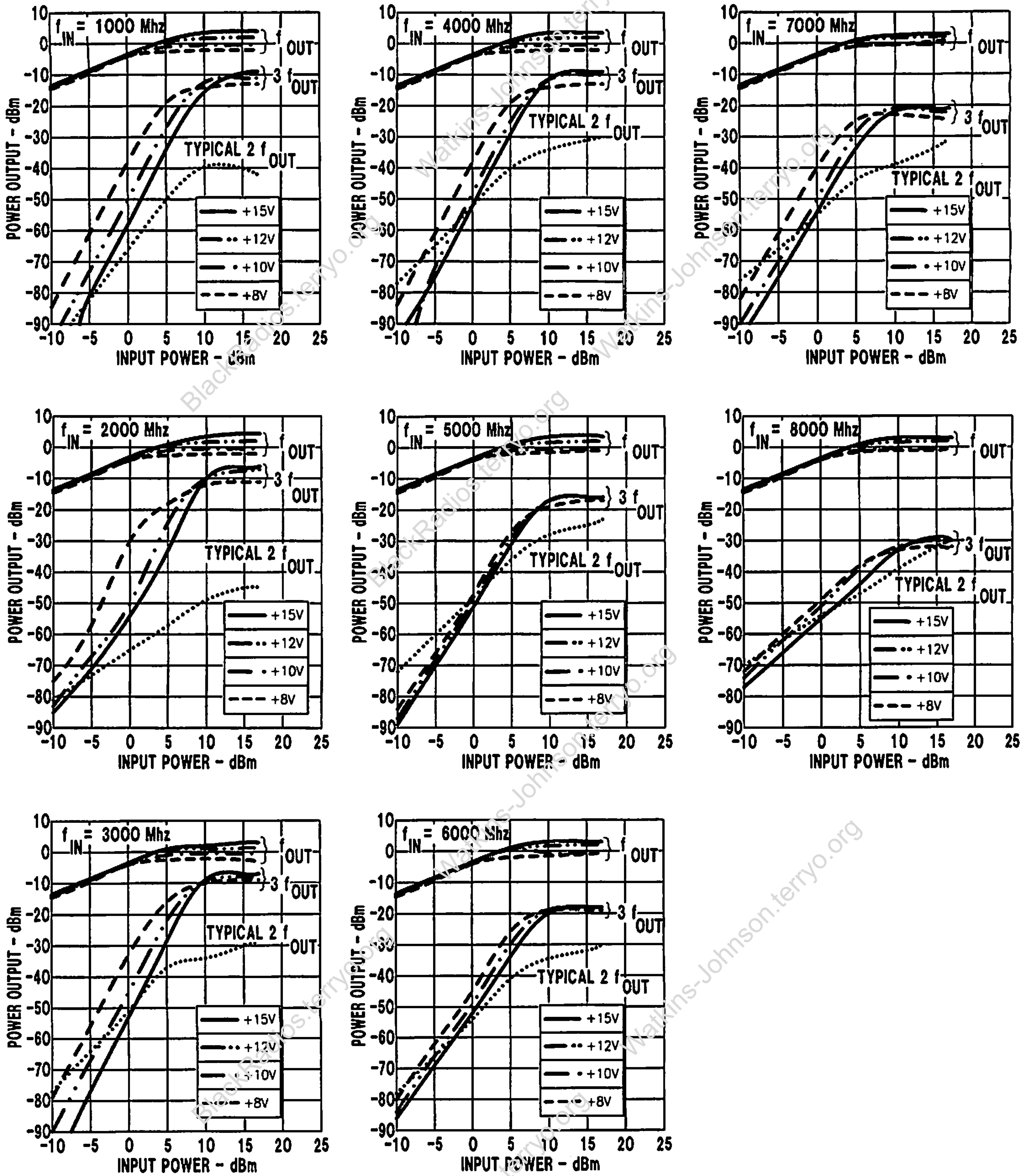






Typical Performance at 25°C (Cont.)

Limiting Characteristics vs. Input Level and D.C. Bias



Typical Performance at 25°C

V_{cc} = 12 Vdc

FREQUENCY MHz	VSWR IN	VSWR OUT	GAIN DB
800.0	2.0	2.0	-3.8
1000.0	1.9	1.9	-3.8
1200.0	1.9	1.9	-3.8
1400.0	1.8	1.9	-3.9
1600.0	1.7	1.8	-3.9
1800.0	1.7	1.7	-3.9
2000.0	1.6	1.6	-3.9
2200.0	1.6	1.5	-3.9
2400.0	1.5	1.5	-3.9
2600.0	1.5	1.4	-3.9
2800.0	1.5	1.4	-3.9
3000.0	1.4	1.4	-3.9
3200.0	1.4	1.4	-3.9
3400.0	1.4	1.4	-4.0
3600.0	1.4	1.5	-4.0
3800.0	1.4	1.5	-4.0
4000.0	1.4	1.5	-3.7
4200.0	1.5	1.5	-3.5
4400.0	1.4	1.5	-3.5
4600.0	1.4	1.4	-3.5
4800.0	1.3	1.4	-3.5
5000.0	1.3	1.3	-3.6
5200.0	1.3	1.3	-3.6
5400.0	1.3	1.3	-3.7
5600.0	1.3	1.2	-3.7
5800.0	1.4	1.2	-3.8
6000.0	1.5	1.3	-3.9
6200.0	1.5	1.3	-4.0
6400.0	1.5	1.4	-4.1
6600.0	1.5	1.4	-4.1
6800.0	1.4	1.5	-4.3
7000.0	1.5	1.6	-4.5
7200.0	1.5	1.6	-4.5
7400.0	1.5	1.6	-4.5
7600.0	1.5	1.6	-4.5
7800.0	1.5	1.5	-4.4
8000.0	1.3	1.4	-4.3
8200.0	1.2	1.3	-4.2

Linear S-Parameters

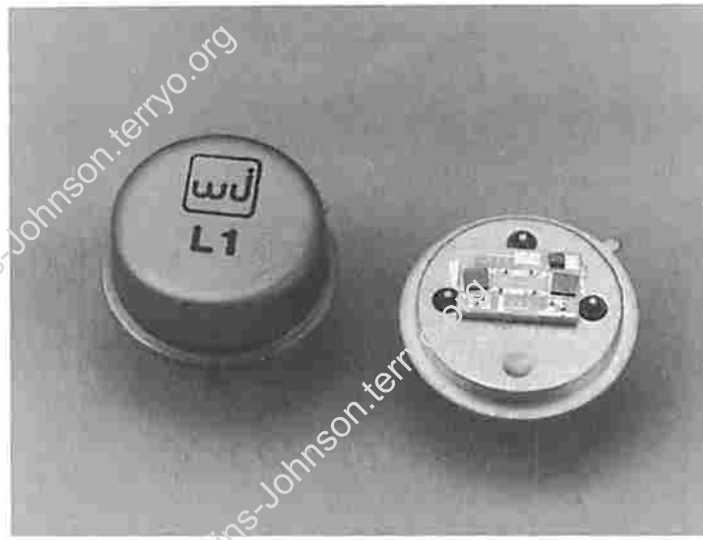
FREQUENCY MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
800.0	.336	-100	.647	-37	.646	-37	.333	-102
1000.0	.315	-115	.647	-51	.644	-52	.319	-114
1200.0	.300	[illegible]	.645	-67	.640	-67	.311	-127
1400.0	.289	-136	.642	-80	.635	-80	.304	-136
1600.0	.273	-145	.639	-93	.634	-93	.291	-143
1800.0	.254	-151	.638	-105	.632	-105	.269	-149
2000.0	.237	-156	.640	-117	.635	-118	.240	-153
2200.0	.224	-160	.639	-130	.637	-130	.215	-157
2400.0	.211	-163	.641	-142	.637	-143	.193	-163
2600.0	.197	-169	.642	-157	.639	-157	.176	-170
2800.0	.185	-177	.640	-169	.638	-169	.171	-179
3000.0	.175	173	.640	178	.637	178	.172	170
3200.0	.162	163	.636	165	.637	165	.178	160
3400.0	.154	154	.634	153	.631	153	.183	152
3600.0	.150	149	.630	141	.626	141	.184	148
3800.0	.158	147	.629	130	.629	129	.193	147
4000.0	.184	138	.653	116	.649	116	.214	140
4200.0	.190	126	.665	102	.658	102	.209	128
4400.0	.182	114	.666	89	.661	89	.193	117
4600.0	.165	100	.665	76	.660	75	.176	102
4800.0	.144	83	.665	62	.662	62	.159	83
5000.0	.126	60	.663	49	.661	49	.145	63
5200.0	.115	33	.658	35	.657	35	.133	40
5400.0	.125	2	.654	20	.653	20	.118	15
5600.0	.147	-19	.650	7	.648	7	.107	-12
5800.0	.173	-34	.645	-6	.643	-6	.105	-40
6000.0	.193	-46	.639	-19	.636	-19	.116	-63
6200.0	.204	-57	.633	-32	.629	-33	.135	-77
6400.0	.204	-64	.626	-45	.620	-46	.155	-83
6600.0	.192	-67	.620	-58	.614	-59	.174	-84
6800.0	.179	-65	.612	-74	.606	-74	.198	-79
7000.0	.196	-62	.593	-85	.587	-85	.230	-75
7200.0	.189	-60	.598	-96	.594	-97	.229	-73
7400.0	.204	-59	.596	-109	.590	-109	.237	-69
7600.0	.206	-64	.597	-122	.593	-122	.230	-72
7800.0	.185	-72	.604	-135	.604	-135	.205	-81
8000.0	.144	-83	.612	-149	.614	-149	[illegible]	-101
8200.0	.074	-102	.619	-166	.619	-166	.139	-138

2

WJ-L1

50 TO 1000 MHz TO-8 THIN-FILM LIMITER MODULE

- VOLTAGE VARIABLE LIMITING LEVEL: -10 TO 0 dBm
- LOW INSERTION LOSS AT LOW INPUT LEVELS: < 2.0 dB
- LOW INPUT VSWR
- GOOD SUPPRESSION OF EVEN ORDER HARMONICS DUE TO BALANCED CIRCUIT DESIGN
- EXCELLENT PHASE RESPONSE (0.3 DEGREE/dB TYP.) TO 160 MHz



Specifications *

Characteristics	Min.	Typ.	Guaranteed Max.
Frequency (1 dB Bandwidth)	50 MHz		1000 MHz
Frequency Response Variation	N/A	0.1 dB/100 MHz	0.25 dB/100 MHz
Input VSWR (Pin < +20 dBm, 10 ≤ Bias ≤ 20 Volts)		1.7:1	2.0:1
Output VSWR (Pin < -10 dBm, 10 < Bias ≤ 20 Volts)		1.7:1	2.0:1
Max. Recommended Input Signal Level			+26 dBm
Typical Bias Current:			
at 15 Vdc		7 mA	
at 20 Vdc		10 mA	

*Measured in a 50-ohm system at +15 Vdc Nominal.

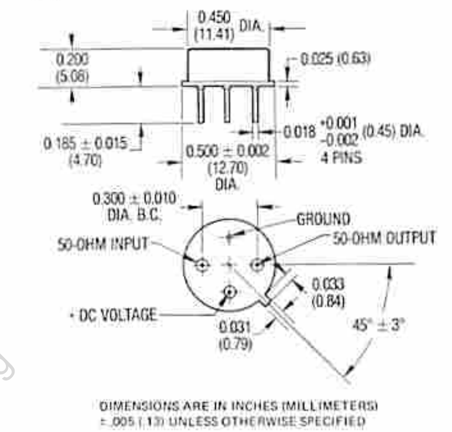
Limiting and Insertion Loss Characteristics (25°C)

Bias Voltage	Output Level at Limiting Threshold (1 dB Compression) Typ.	Max. Output Limiting Level (+20 dBm Input) Typ.	Insertion Loss (500 MHz) Typ.	Insertion Loss (1000 MHz) Typ.
+20 Volts	0 dBm	0 dBm	1.6 dB	2.0 dB
+15 Volts	-2 dBm	-1 dBm	1.9 dB	2.5 dB
+10 Volts	-6 dBm	-4 dBm	2.5 dB	3.1 dB
+5 Volts	-13 dBm	-9 dBm	4.3 dB	5.2 dB

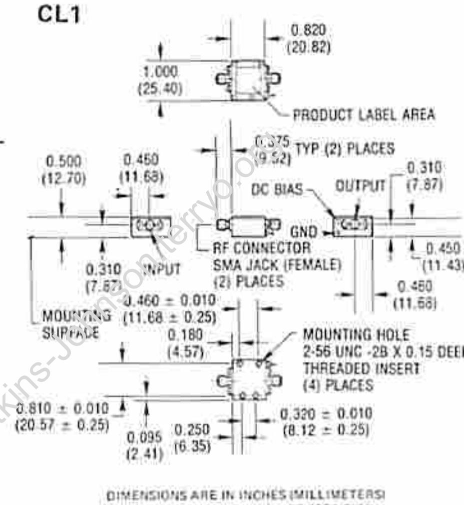
Weight approximately 2.0 grams (0.07 oz.)

Outline Drawings

L1



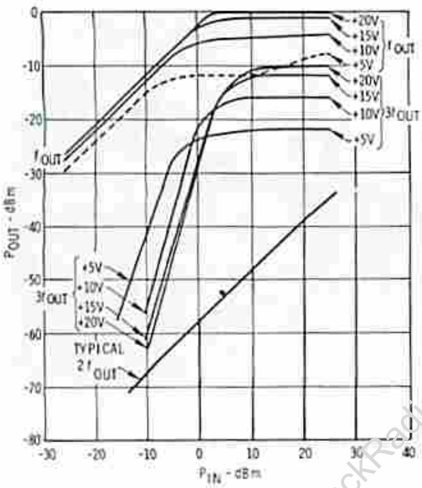
CL1



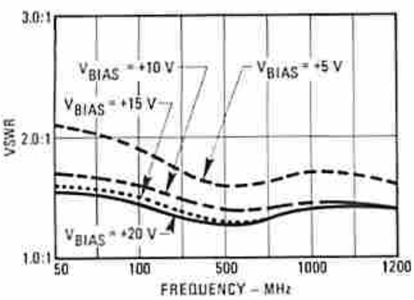
WJ-CL1 is standard WJ-L1 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

Typical Performance at 25°C

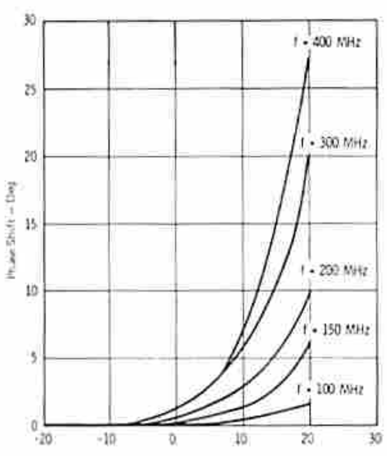
Limiting Characteristics vs. Input Level and D.C. Bias



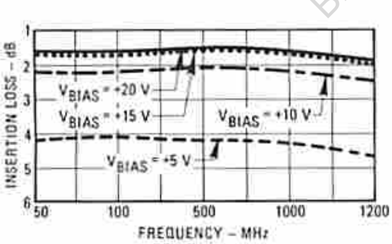
Input VSWR



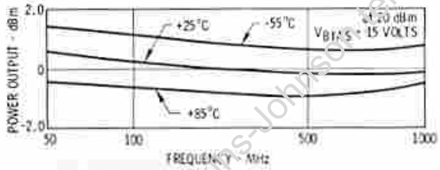
Phase Shift vs. Input Power



Insertion Loss



Maximum Limiting Level



Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C

Maximum Case Temperature . . . . 125°C

Maximum DC Voltage . . . . . +25 Volts

Maximum Continuous RF Input Power . . . . 20 dBm

Maximum Short Term RF Input Power (1 Minute Max.) . . . . 400 Milliwatts

Maximum Peak Power . . . . 1 Watt (3 µsec Max.)

"S" Series Burn-In Temperature (Case) . . . . 125°C

Typical Automatic Test Data

V_{CC} = 15 V

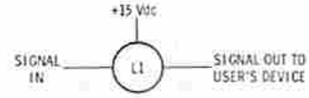
FREQ MHZ	VSWR IN	VSWR OUT	LOSS DB
100.	1.5	1.5	1.2
200.	1.3	1.3	1.5
300.	1.3	1.3	1.5
400.	1.3	1.3	1.5
500.	1.3	1.3	1.6
600.	1.3	[illegible]	1.6
700.	1.3	1.4	1.6
800.	1.4	1.4	1.6
900.	1.4	1.4	1.7
1000.	1.4	1.5	1.7
1100.	1.4	1.5	1.9
1200.	1.4	1.5	2.0

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.19	-62.4	.02	14.2	.02	14.3	.19	-63.0
200.	.12	-66.0	.04	14.1	.04	14.0	.14	-65.7
300.	.12	-72.4	.04	16.0	.04	16.0	.12	-72.4
400.	.12	-82.4	.04	21.0	.04	20.5	.13	-81.0
500.	.13	-91.0	.03	[illegible]	.03	24.4	.14	-90.9
600.	.14	-101.4	.03	28.4	.03	28.2	.15	-98.2
700.	.14	-112.0	.03	32.7	.03	32.2	.15	-107.6
800.	.15	-120.3	.03	35.7	.02	35.0	.17	-114.8
900.	.16	-129.1	[illegible]	40.0	.02	39.5	.18	-122.0
1000.	.16	-138.3	[illegible]	44.6	.02	42.9	.19	-129.9
1100.	.17	-148.7	.01	48.7	.00	46.7	.19	-138.2
1200.	.17	-155.5	.79	52.0	.79	52.3	.20	-144.1

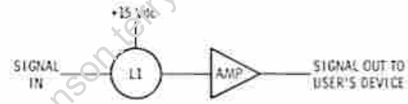
Typical Applications

1. User wants to limit signal to his device to a level of 0 dBm.



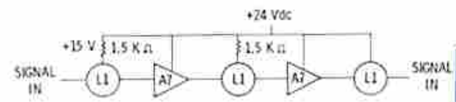
In this case the signal into the user's device will not exceed 0 dBm for incident signal levels to the WJ-L1 as high as +25 dBm.

2. User wants to limit signal to his device to a level above 0 dBm.



In this case the signal into the user's device will be limited to the output of the amplifier with a maximum of 0 dBm to the amplifier input. (Example: If a WJ-A7 is used with +24V DC bias an output signal of +13 dBm could be available to the user's device.)

3. Wide input range with constant output.



In this case the output signal level will be typically 0 dBm ±0.5 dBm for input level variation from -25 dBm to +25 dBm. Up to six pairs of limiters and amplifiers can be cascaded for extended dynamic range.

2

WJ-L2

5 TO 500 MHz TO-8 THIN-FILM LIMITER MODULE

- VOLTAGE VARIABLE LIMITING LEVEL: –2 TO +2 dBm
- LOW INSERTION LOSS AT LOW INPUT LEVELS: ⩽ 2.0 dB (TYP.)
- LOW VSWR: < 1.5:1 (TYP.)
- GOOD SUPPRESSION OF EVEN ORDER HARMONICS DUE TO BALANCED CIRCUIT DESIGN: >55 dB AT 10 dBm INPUT (TYP.)
- EXCELLENT PHASE LINEARITY: ⩽ ±0.2°

Specifications*

Characteristics	Typical	Guaranteed Min./Max.
Frequency	5-500 MHz	5-500 MHz
Insertion Loss		
P_{IN} ⩽ -20 dBm		
+15 ⩽ Bias ⩽ +20 Vdc		
5-200 MHz	1.5 dB	2.0 dB
200-500 MHz	2.0 dB	2.5 dB
VSWR	1.5:1	1.7:1
P_{IN} ⩽ -10 dBm		
+10 ⩽ Bias ⩽ +20 Vdc		
Output VSWR	1.5:1	2.0:1
P_{IN} ⩽ +10 dBm		
+10 ⩽ Bias ⩽ +20 Vdc		
Input Signal (Max.)		+26 dBm
Bias Current		
At +20 Vdc	8.5 mA	
At +15 Vdc	6.5 mA	
At +10 Vdc	4.0 mA	

*Measured in a 50-ohm system, guaranteed at 25°C at +15 Vdc Nominal.

Limiting and Insertion Loss Characteristics (25°C)*

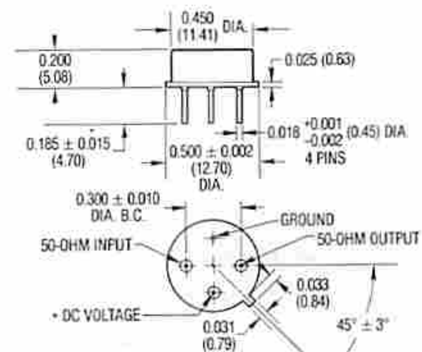
Bias Voltage	Output Level at Limiting Threshold (1 dB Comp) Typ.	Max. Output Limiting Level (+20 dBm Input) Typ.	Insertion Loss Typ.
+20 Volts	-0.5	+2.0	1.5
+15 Volts	-1.5	+1.0	1.7
+10 Volts	-4.0	-2.0[1]	2.0
+5 Volts	-11.0	-7.0[1]	3.4

Notes: 1. At 100 MHz.

Weight approximately 2.0 grams (0.07 oz.)

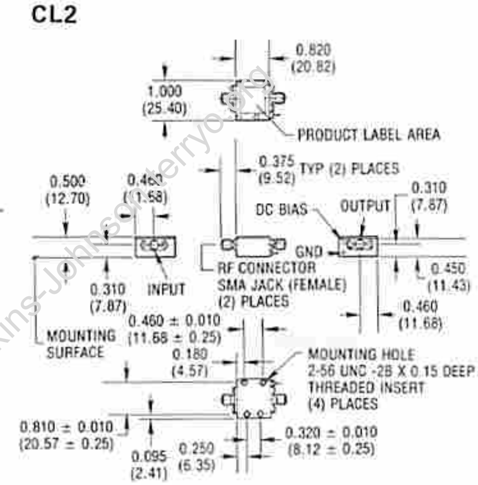
Outline Drawings

L2



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CL2

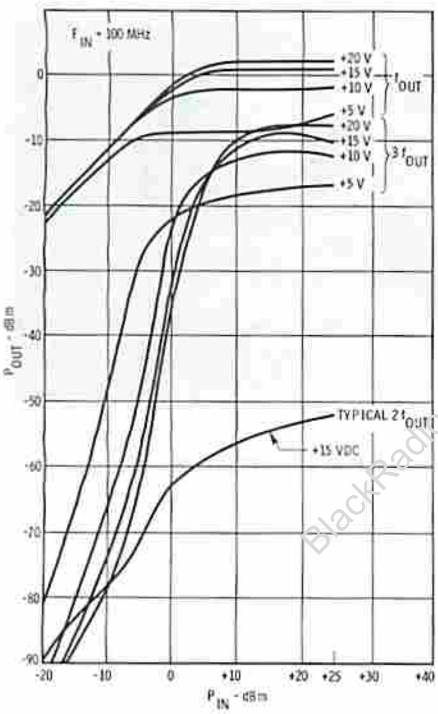


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

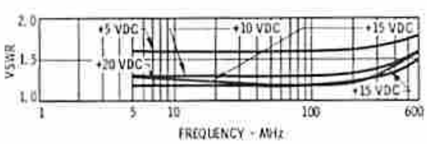
WJ CL2 is standard WJ-L2 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

Typical Performance at 25°C

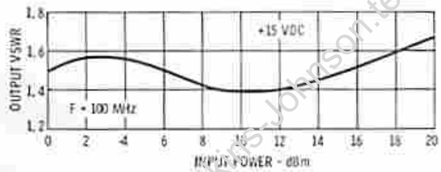
Limiting Characteristics



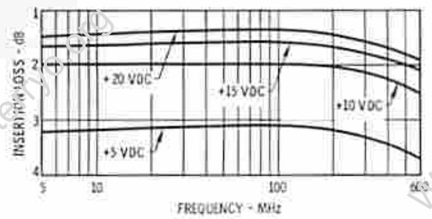
Input VSWR



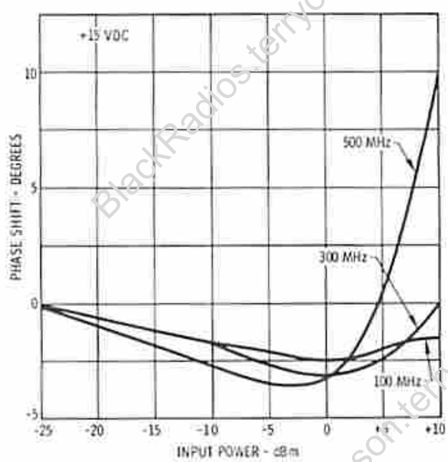
Output VSWR



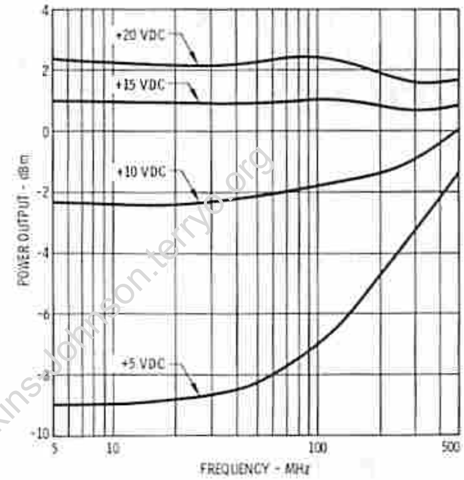
Insertion Loss

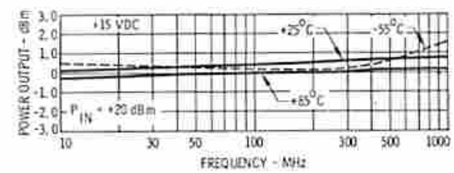


Phase Shift



Maximum Limiting Level





2

Absolute Maximum Ratings

Storage Temperature
. . . . -62°C to +125°C

Maximum Case Temperature
. . . . 125°C

Maximum DC Voltage
. . . . +25 Vdc

Maximum Continuous RF Input Power
. . . . +23 dBm

Maximum Short Term RF Input Power (1 Minute Max.)
. . . . 400 Milliwatts

Maximum Peak Power
. . . . 1 Watt
(3 μsec Max.)

"S" Series Burn-In Temperature (Case) . . . . 125°C

Typical Automatic Test Data

V_{CC} = 15V

FREQ MHZ	VSWR IN	VSWR OUT	LOSS DB
100.	1.2	1.2	1.7
200.	1.3	1.3	1.8
300.	1.3	1.4	1.9
400.	1.4	1.5	2.1
500.	1.5	1.6	2.3
600.	1.6	1.7	2.5
700.	1.7	1.8	2.7

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.10	-39.6	.82	-16.0	.82	-15.9	.10	-40.8
200.	.12	-70.4	.81	-32.0	.81	-32.0	.12	-75.0
300.	.15	-104.8	.80	-47.7	.80	-47.6	.15	-100.5
400.	.18	-130.9	.78	-63.0	.79	-63.1	.19	-127.7
500.	.21	-152.9	.76	-78.9	.77	-78.9	.22	-149.3
600.	.24	-175.3	.75	-94.7	.75	-95.0	.26	-169.9
700.	.27	164.9	.73	-109.7	.73	-110.3	.28	171.8

WJ-L34

500 TO 2400 MHz TO-8 VOLTAGE-CONTROLLED ATTENUATOR MODULE

- VOLTAGE VARIABLE LIMITING LEVEL: -2 TO +2 dBm
- LOW INSERTION LOSS AT LOW INPUT LEVELS: ⩽3.0 dB (TYP.)
- GOOD SUPPRESSION OF EVEN ORDER HARMONICS DUE TO BALANCED CIRCUIT DESIGN: >50 dB AT 0 dBm INPUT (TYP.)

Specifications*

Characteristics	Typical	Guaranteed Min./Max.
Frequency	500–2600 MHz	500-2400 MHz
Insertion Loss $P_{IN} \leqslant -20$ dBm, $+15 \leqslant$ Bias $\leqslant +20$ Vdc	2.9 dB	3.7 dB (Max.)
Input VSWR $P_{IN} \leqslant -10$ dBm, $+10 \leqslant$ Bias $\leqslant +20$ Vdc	<1.6:1	2.0:1 (Max.)
Output VSWR $P_{IN} \leqslant +10$ dBm, $+10 \leqslant$ Bias $\leqslant +20$ Vdc	<1.8:1	2.2:1 (Max.)
Input Signal (Max.)		+26 dBm
Bias		
At +20 Vdc	8.5 mA	
At +15 Vdc	6.5 mA	
At +10 Vdc	4.0 mA	

*Measured in a 50-ohm system, guaranteed at 25°C.

Limiting and Insertion Loss Characteristics (25°C)*

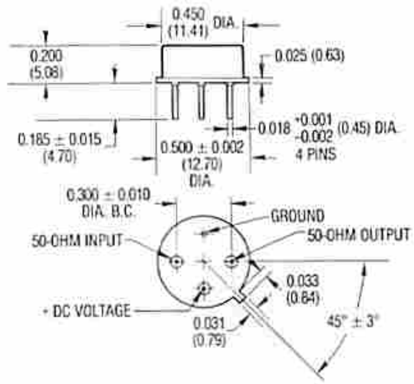
Bias Voltage	Output Level at Limiting Threshold (1 dB Comp) Typ.	Max. Output at Limiting Level (+20 dBm Input) Typ.	Insertion Loss (1000 MHz) Typ.
+20 Volts	-2.0	+2.2	2.4
+15 Volts	-2.5	+1.0	2.6
+10 Volts	-4.2	-1.0[1]	2.8
+5 Volts	-10.5	-3.0[1]	4.0

Notes:
1. At 1000 MHz

Weight approximately 2.0 grams (0.07 oz.)

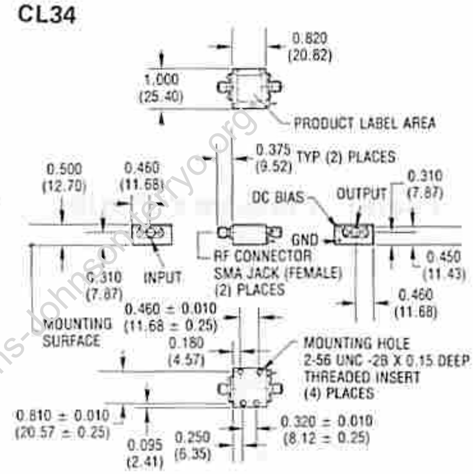
Outline Drawings

L34



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

CL34

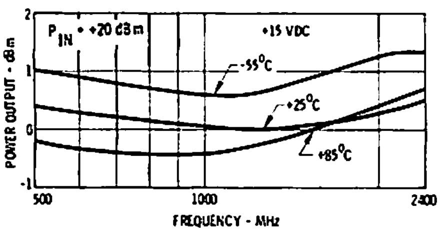


DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

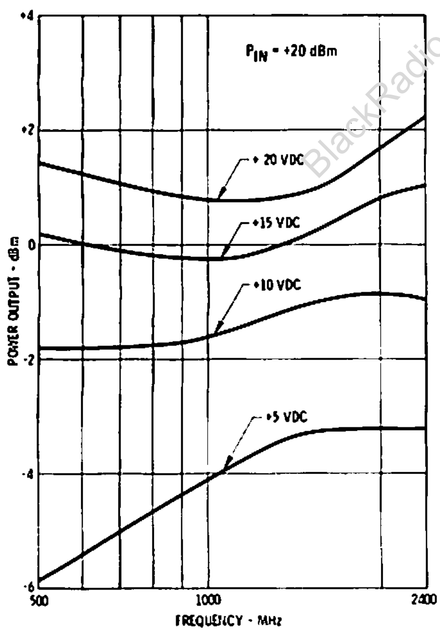
WJ CL34 is standard WJ-L34 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

Typical Performance at 25°C

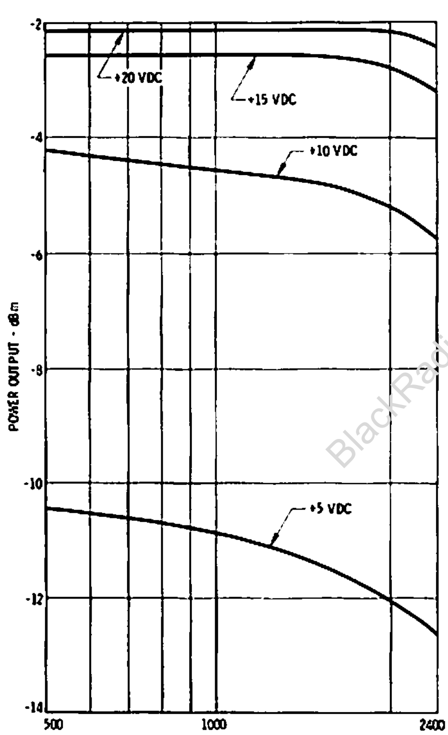
Maximum Limiting Level Over Temperature



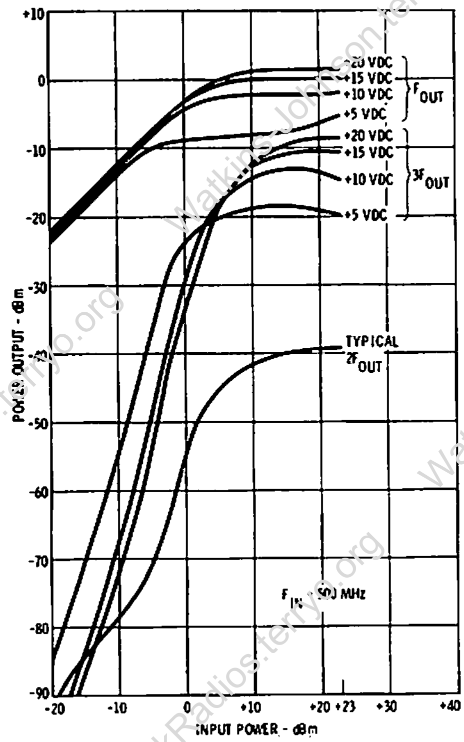
Maximum Limiting Level vs. Bias Voltage

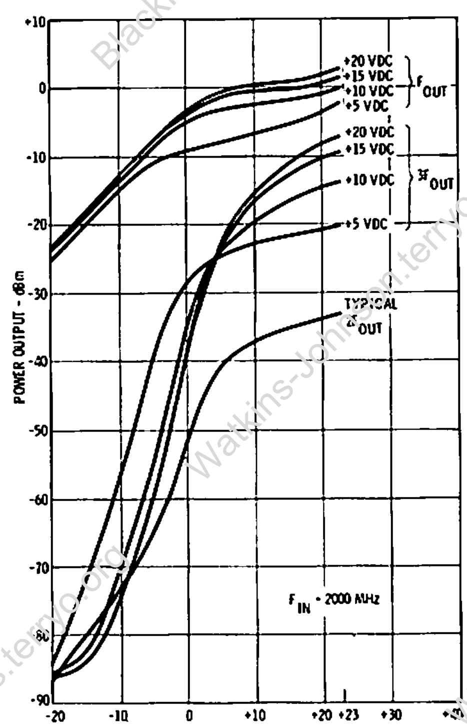


Power Output at 1 dB Compression Point

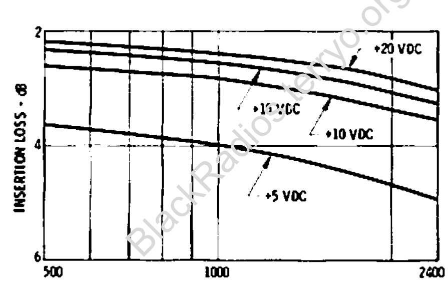


Limiting Characteristics

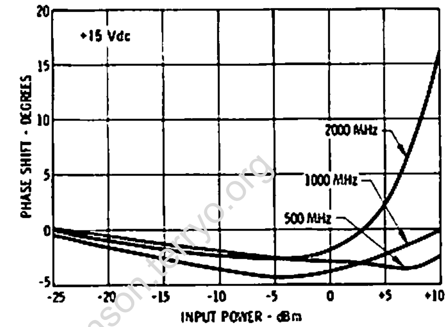




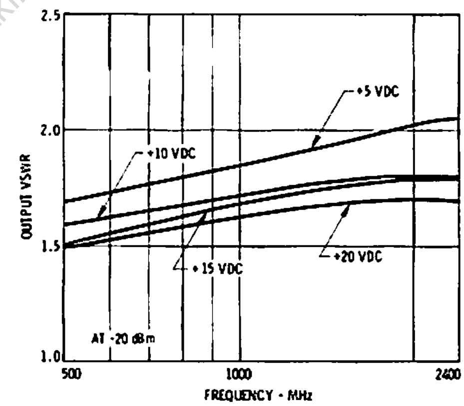
Insertion Loss



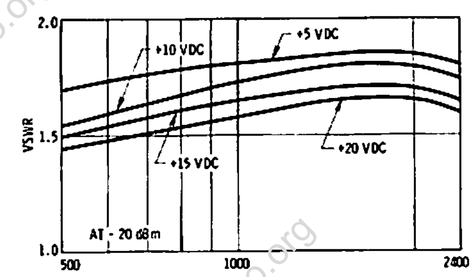
Phase Shift vs. Input Power



Output VSWR vs. Frequency



Input VSWR vs. Frequency



2

Typical Automatic Test Data

V_{CC} = 15 V

FREQ MHZ	VSWR IN	VSWR OUT	LOSS DB
500.	1.6	1.6	2.4
600.	1.5	1.6	2.3
700.	1.5	1.6	2.3
800.	1.5	1.6	2.3
900.	1.5	1.6	2.3
1000.	1.5	1.6	2.4
1100.	1.5	1.6	2.5
1200.	1.6	1.6	2.5
1300.	1.6	1.7	2.7
1400.	1.6	1.7	2.8
1500.	1.6	1.7	2.8
1600.	1.6	1.7	2.9
1700.	1.6	1.7	2.9
1800.	1.6	1.7	2.9
1900.	1.6	1.7	2.9
2000.	1.5	1.7	3.0
2100.	1.6	1.8	3.1
2200.	1.6	1.8	3.0
2300.	1.5	1.7	2.9
2400.	1.5	1.7	3.2
2500.	1.5	1.7	3.4
2600.	1.4	1.7	3.2

MAX= 3.6 MIN= 2.3 FLAT +/- .6

Linear S-Parameters

FREQ MHZ	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
500.	.22	-78.2	.76	37.1	.76	36.9	.24	-75.5
600.	.21	-85.0	.76	41.5	.77	41.2	.23	-80.7
700.	.20	-92.0	.76	47.0	.77	46.2	.23	-86.2
800.	.21	-99.4	.77	50.5	.77	50.5	.22	-91.7
900.	.21	-105.4	.77	55.9	.76	55.2	.24	-96.6
1000.	.21	-111.7	.76	61.9	.76	61.0	.24	-101.8
1100.	.21	-118.3	.75	67.0	.74	66.8	.24	-107.3
1200.	.22	-124.1	.75	71.4	.74	71.9	.24	-111.8
1300.	.22	-128.6	.73	78.4	.73	77.9	.25	-116.0
1400.	.22	-135.0	.73	84.4	.71	84.4	.25	-120.8
1500.	.22	-140.3	.72	90.2	.71	90.3	.25	-125.7
1600.	.22	-144.6	.72	96.7	.71	96.8	.26	-129.4
1700.	.23	-150.2	.72	102.7	.70	103.2	.26	-133.9
1800.	.22	-154.2	.71	109.0	.70	109.5	.26	-136.5
1900.	.22	-160.4	.72	115.0	.70	115.7	.26	-140.9
2000.	.21	-165.3	.71	120.8	.70	121.8	.26	-144.0
2100.	.22	-172.4	.70	126.1	.71	126.5	.28	-154.6
2200.	.22	-178.7	.71	131.2	.70	132.2	.27	-158.4
2300.	.21	178.0	.71	137.8	.70	137.9	.27	-159.5
2400.	.20	172.5	.69	142.1	.70	143.4	.26	-163.4
2500.	.19	168.2	.68	149.1	.69	148.9	.26	-164.3
2600.	.18	165.8	.69	155.1	.70	155.1	.25	-166.1

Absolute Maximum Ratings

Storage Temperature
. . . . -62°C to +125°C

Maximum Case Temperature
. . . . 125°C

Maximum DC Voltage
. . . .+25 Vdc

Maximum Continuous RF Input Power
. . . . 20 dBm

Maximum Short Term RF Input Power . . . . 400 Milliwatts

Maximum Peak Power . . . . 1 Watt (3 μsec Max.)

"S" Series Burn-In Temperature (Case) . . . . 125°C

WJ-L40

500 TO 4000 MHz TO-8 THIN-FILM LIMITER MODULE

- VOLTAGE VARIABLE LIMITING LEVEL: -2 TO +2 dBm
- GOOD SUPPRESSION OF EVEN ORDER HARMONICS DUE TO BALANCED CIRCUIT DESIGN: > 40 dB AT 10 dBm INPUT (TYP.)

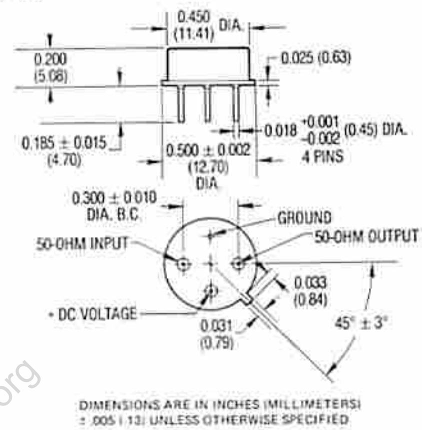
Specifications*

Characteristic	Typical	Guaranteed
Frequency	500-4200 MHz	500-4000 MHz
Insertion Loss (Max.) $P_{IN} \leqslant -20$ dBm $+15 \leqslant$ Bias $\leqslant +20$ Vdc	<3.5 dB	4.5 dB
Input VSWR (Max.) $P_{IN} \leqslant -10$ dBm $+10 \leqslant$ Bias $\leqslant +20$ Vdc	<1.6:1	2.0:1
Output VSWR (Max.) $P_{IN} \leqslant +10$ dBm $+10 \leqslant$ Bias $\leqslant +20$ Vdc	<1.8:1	2.2:1
Input Signal (Max.)		+26 dBm
Bias At +20 Vdc At +15 Vdc At +10 Vdc	 8.5 mA 6.5 mA 4.0 mA	

*Measured in a 50-ohm system, guaranteed at 25°C.

Outline Drawings

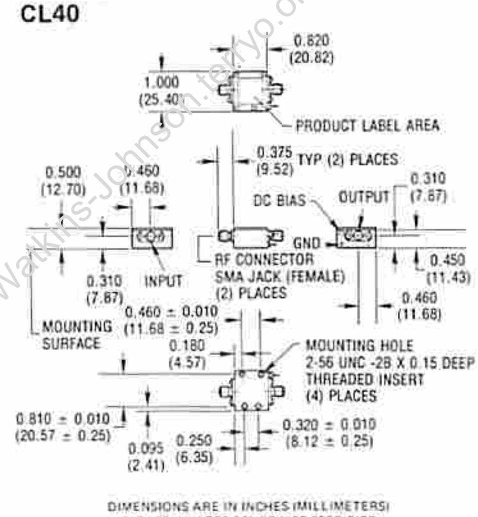
L40



Weight

approximately 2.0 grams (0.07 oz.)

CL40



WJ CPA10 is standard WJ PA10 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range.

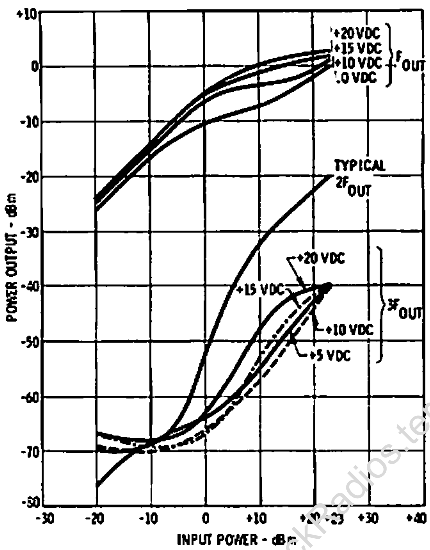
Limiting and Insertion Loss Characteristics (25°C)

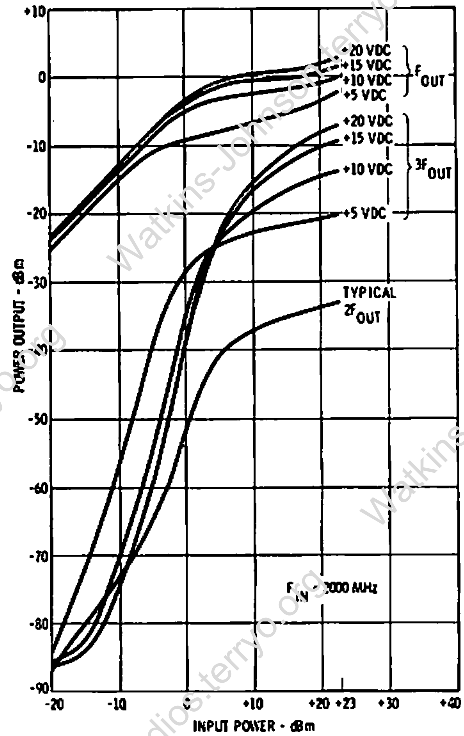
Bias Voltage	Output Level at Limiting Threshold (1 dB Comp) Typ.	Max. Output at Limiting Level (+20 dBm Input) Typ.	Insertion Loss (4000 MHz) Typ.
+20 Volts	-2.0	+2.4[1]	3.8
+15 Volts	-2.5	+1.0[1]	4.0
+10 Volts	-4.2	-0.5[2]	4.5
+5 Volts	-10.5	-2.0[2]	6.1

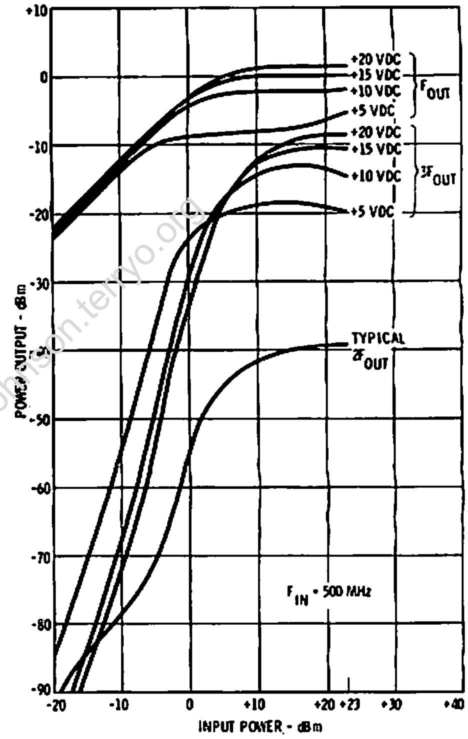
Notes:
1. At 3000 MHz
2. At 4000 MHz

Typical Performance at 25°C

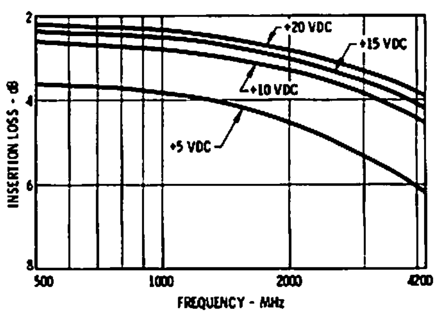
Limiting Characteristics vs. Input Level and D.C. Bias



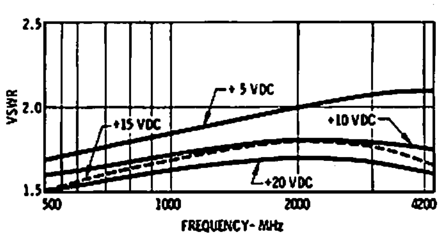




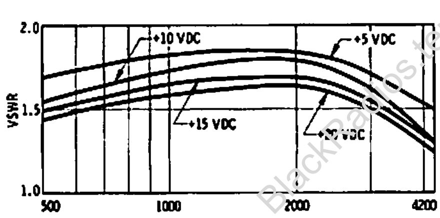
Insertion Loss vs. Frequency



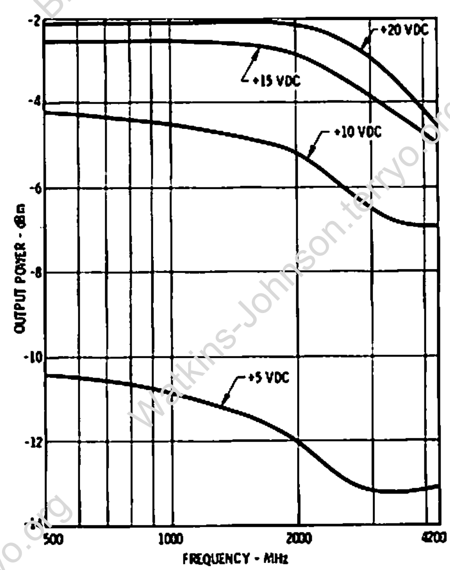
Output VSWR vs. Frequency



Input VSWR vs. Frequency

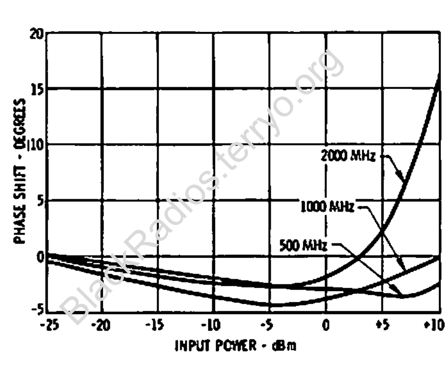


Power Output*

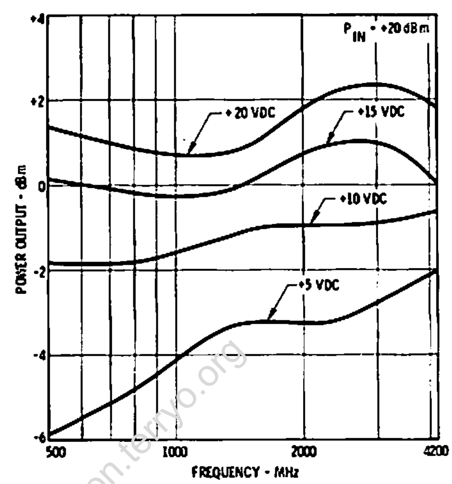


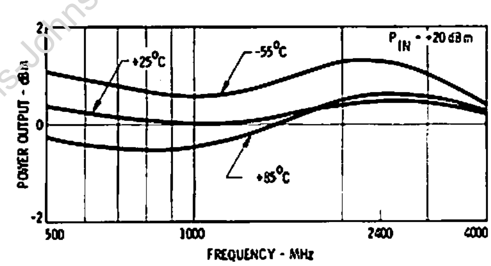
*at 1 dB Gain Compression

Input Power vs. Phase Shift



Maximum Limiting Level





Typical Automatic Test Data

$V_{CC} = 15$ V

FREQ MHZ	VSWR IN	VSWR OUT	LOSS DB
500.	1.6	1.6	2.5
600.	1.5	1.6	2.4
700.	1.5	1.6	2.4
800.	1.5	1.6	[illegible]
900.	1.5	1.6	[illegible]
1000.	1.5	1.6	2.4
1100.	1.5	1.6	2.5
1200.	1.6	1.6	2.5
1300.	1.6	1.7	2.7
1400.	1.6	1.7	2.8
1500.	1.6	1.7	2.9
1600.	1.6	1.7	2.9
1700.	1.6	1.7	2.9
1800.	1.6	1.7	2.9
1900.	1.6	1.7	2.9
2000.	1.5	1.7	3.0
2100.	1.6	1.8	3.1
2200.	1.6	1.8	3.0
2300.	1.5	1.7	2.9
2400.	1.5	1.7	[illegible]
2500.	1.5	1.7	3.4
2600.	1.4	1.7	[illegible]
2700.	1.4	1.6	3.4
2800.	1.4	1.6	[illegible]
2900.	1.4	1.6	[illegible]
3000.	1.3	1.5	[illegible]
3100.	1.3	1.5	[illegible]
3200.	1.3	1.5	3.5
3300.	1.3	1.5	[illegible]
3400.	1.3	1.5	[illegible]
3500.	1.3	1.5	[illegible]
3600.	1.3	1.5	[illegible]
3700.	1.3	1.5	[illegible]
3800.	1.3	1.5	[illegible]
3900.	1.3	1.5	[illegible]
4000.	1.3	1.6	4.0
4100.	1.3	1.6	4.0
4200.	1.4	1.6	[illegible]
4300.	1.4	1.6	[illegible]
4400.	1.4	1.6	4.5

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
500.	.22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.22	[illegible]
600.	.21	-84.9	[illegible]	41.5	[illegible]	41.2	.22	[illegible]
700.	.20	-91.9	[illegible]	47.0	[illegible]	46.2	.22	[illegible]
800.	.21	-99.1	[illegible]	50.5	[illegible]	50.5	.22	[illegible]
900.	.21	-105.4	[illegible]	56.0	[illegible]	55.2	.24	[illegible]
1000.	.21	-111.5	[illegible]	62.0	[illegible]	61.1	.24	-100.9
1100.	.21	-118.1	[illegible]	[illegible]	.74	66.9	.24	-107.1
1200.	.22	-122.9	[illegible]	[illegible]	.74	72.0	[illegible]	-111.7
1300.	.22	-128.5	[illegible]	[illegible]	[illegible]	78.1	[illegible]	-116.1
1400.	.22	-135.2	[illegible]	84.2	.71	84.4	.25	-120.7
1500.	.22	-140.2	[illegible]	90.4	.71	90.2	.25	-125.5
1600.	.22	-144.5	.72	96.9	.71	[illegible]	.26	-129.2
1700.	.22	-150.1	.71	102.0	.70	[illegible]	.26	-133.7
1800.	.22	-154.2	.71	109.0	.70	109.5	.26	-136.5
1900.	.22	-160.4	.72	115.1	.70	115.7	.26	-140.7
2000.	.21	-165.0	.71	120.9	.70	121.0	.26	-144.1
2100.	.20	-172.2	.70	126.2	.70	126.5	.26	-154.0
2200.	.22	-178.4	.71	131.2	.70	132.1	.27	-150.5
2300.	.21	172.1	.71	137.0	.70	137.6	.27	-159.0
2400.	.20	[illegible]	.69	142.1	.70	143.2	.26	-164.0
2500.	.19	168.2	.68	148.9	.69	148.7	.26	-165.1
2600.	.18	165.5	.69	154.9	.70	154.0	.25	[illegible]
2700.	.17	159.0	.67	160.5	.68	160.7	.24	[illegible]
2800.	.16	154.1	.68	166.2	.67	165.6	.22	[illegible]
2900.	.15	147.6	.67	172.4	.67	171.6	.22	[illegible]
3000.	.14	140.1	.67	178.1	.67	178.4	.21	[illegible]
3100.	.13	126.2	[illegible]	-176.0	.66	-175.7	.20	[illegible]
3200.	.12	[illegible]	[illegible]	-169.9	.67	-170.0	.21	-174.2
3300.	.12	124.2	[illegible]	-164.2	.67	-164.4	.20	[illegible]
3400.	.11	119.0	[illegible]	-158.0	.66	-158.9	.20	[illegible]
3500.	.11	[illegible]	[illegible]	-153.1	.66	-153.2	.20	[illegible]
3600.	.11	[illegible]	.66	-148.0	.66	-148.2	.21	[illegible]
3700.	.11	[illegible]	.65	-142.8	.65	-142.6	.21	[illegible]
3800.	.12	[illegible]	.66	-137.6	.65	-137.6	.21	[illegible]
3900.	.12	82.6	.64	-132.4	.64	-132.2	.22	168.8
4000.	[illegible]	[illegible]	.62	-126.5	.63	-126.6	.22	164.0
4100.	[illegible]	71.2	.62	-121.0	.61	-121.0	.22	161.6
4200.	.15	65.1	.61	-116.7	.61	-116.5	.22	156.1
4300.	.17	61.2	.62	-109.4	.62	-110.9	.24	151.7
4400.	.18	54.2	.60	-104.1	.60	-104.4	.24	146.9

Absolute Maximum Ratings

Storage Temperature
. . . . -62°C to +125°C

Maximum Case Temperature
. . . . 125°C

Maximum DC Voltage
. . . . +25 Vdc

Maximum Continuous RF Input Power
. . . . +30 dBm

Maximum Short Term RF Input Power (1 Minute Max.)
. . . . 4 Watts

Maximum Peak Power
. . . . 10 Watts
(3 μsec Max.)

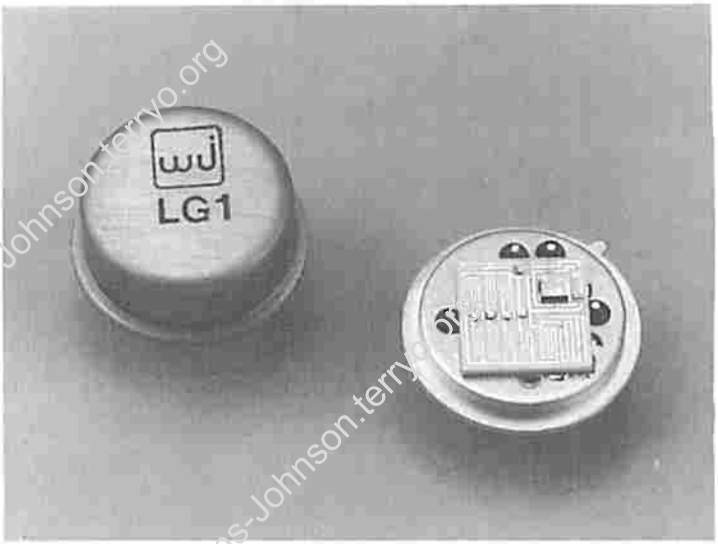
"S" Series Burn-In Temperature (Case) . . . . 125°C

2

WJ-LG1

TO-8 THIN-FILM LINEARIZER

- WIDE TEMPERATURE OPERATION
- YIELDS LINEAR ATTENUATION (dB) FOR LINEAR VOLTAGE
- SMALL SIZE: TO-8



Linearity Specifications *

Temperature	Typ.	Guaranteed Max.
25°C	<±1 dB	±1.5 dB
-54°C to +85°C	<±1.5 dB	±2 dB

*Frequency: 10 - 1000 MHz; attenuation range: 3 to 20 dB

Typical Current Drain

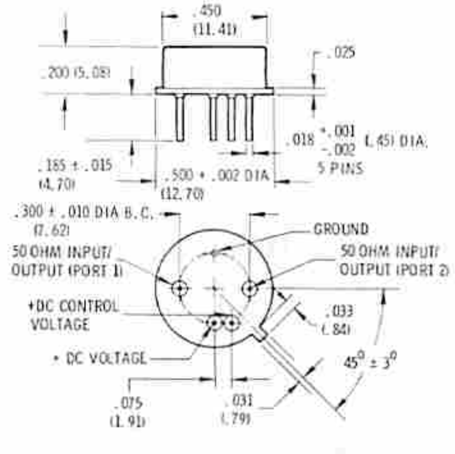
	Control Voltage = -10 V at Min. Attenuation	Control Voltage = 0 V at Max. Attenuation
V-	5 mA	5 mA
V+	24 mA	11 mA
V_{CON}	15 mA	2.5 mA

Combination of LG1 Plus G1

V-	5 mA	5 mA
V+	31 mA	21 mA
V_{CON}	15 mA	2.5 mA

Outline Drawing

LG1

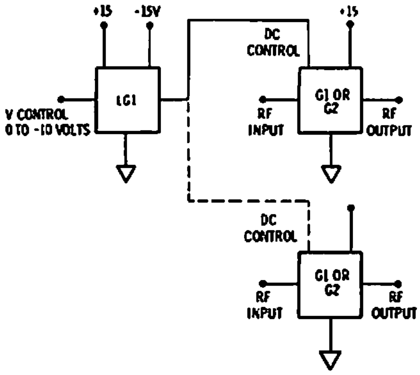


DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .005 (.13) UNLESS OTHERWISE SPECIFIED

Absolute Maximum Ratings

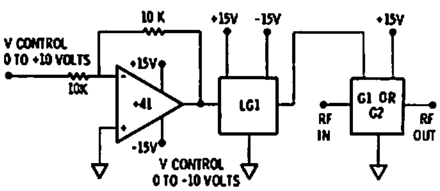
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
"S" Series Burn-in Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)



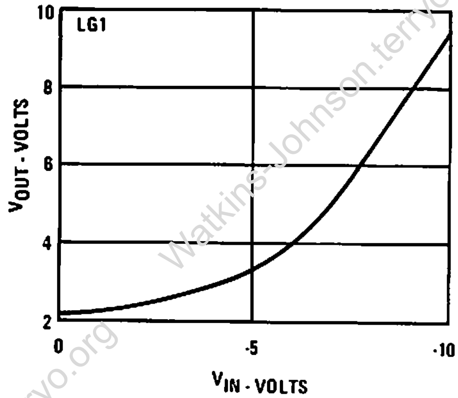
The LG1 can drive two G1's or G2's as shown above. The LG1 has a response time of 30 μs over its entire band of control voltage. The response time of the G1 or G2 is typically 80-100 μs.

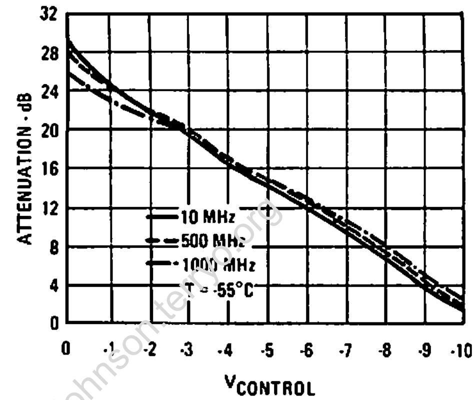
If a positive control voltage is desired the following circuit may be used. The op-amp buffer can also generate a very low source resistance in the order of thousandth of an ohm.



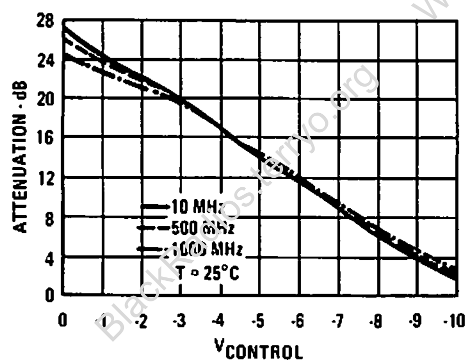
Typical Performance at 25°C

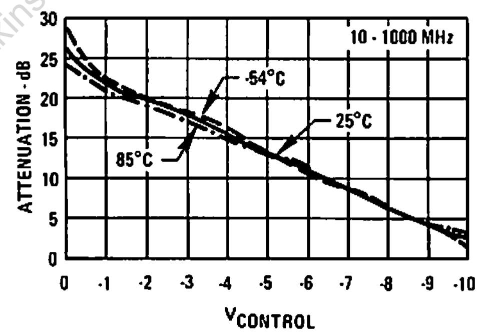
Output Voltage vs. Input Voltage

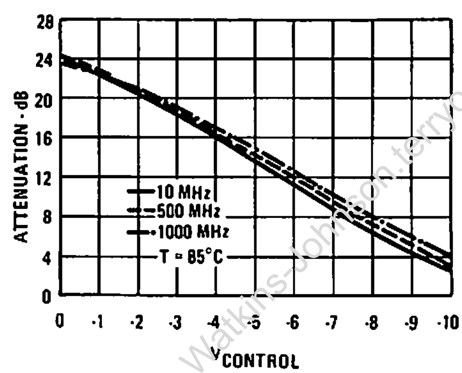




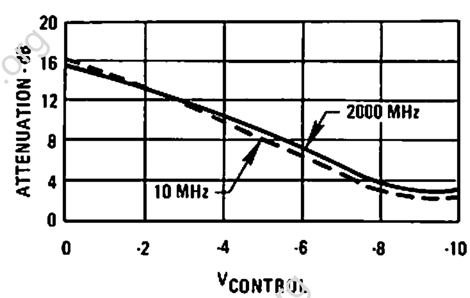
Attenuation of LG1 and G1 in Cascade vs. Control Voltage







Attenuation of LG1 and G2 in Cascade vs. Control Voltage



2

WJ-LG30

TO-8 THIN FILM LINEARIZER FOR THE WJ-G30

- WIDE TEMPERATURE OPERATION
- YIELDS LINEAR ATTENUATION (dB) FOR LINEAR VOLTAGE
- SMALL SIZE: TO-8

Linearity Specifications*

Temperature	Typ.	Max.
25°C	< ±1 dB	±1.5 dB
-54°C to +85°C	< ±1.5 dB	±2 dB

*Frequency: 100-2000 MHz; attenuation range: 3 to 25 dB

Typical Current Drain

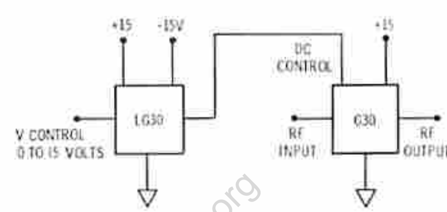
	Control Voltage = 0 V at Min. Attenuation	Control Voltage = 15 V at Max. Attenuation
V-	3 mA	15 mA
V+	5 mA	14 mA
V_{CON}	12 mA	6 mA

Combination of LG30 Plus G30

V-	3 mA	15 mA
V+	12 mA	21 mA
V_{CON}	12 mA	6 mA

The WJ-LG30 module is a voltage controlled voltage source. The WJ-LG30 is designed to drive the WJ-G30, a voltage controlled attenuator module. The combination of the LG30 and G30 modules has a typical attenuation characteristic which is linear with control voltage provided the following conditions are met:

1. positive supply = 15V ± 1%
2. negative supply = -15V ± 1%
3. source resistance of variable supply ≤ 1Ω



The LG30 has a response time of 2 μs over its entire band of control voltage. The response time of the G30 is typically 6 μs.

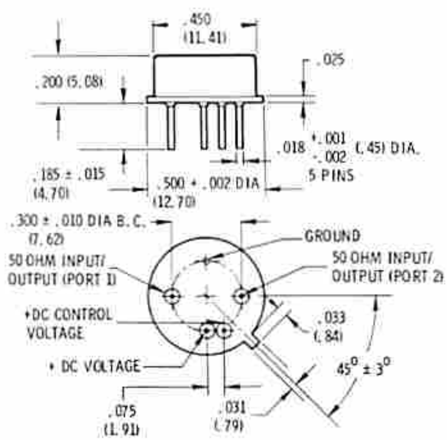
Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . 125°C
Maximum DC Voltage . . . . +17 Volts
"S" Series Burn-in Temperature (Case) . . . . 125°C

Weight approximately 2.0 grams (0.07 oz.)

Outline Drawing

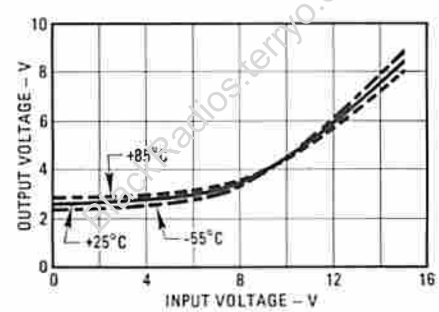
LG30



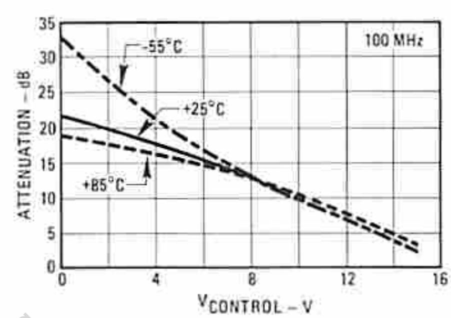
DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .005 (.13) UNLESS OTHERWISE SPECIFIED

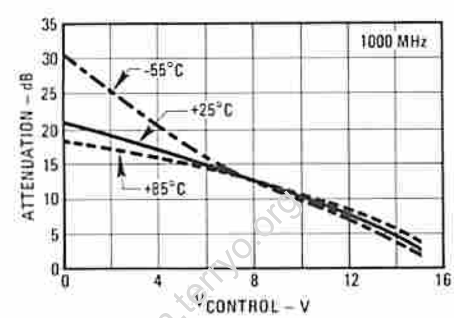
Typical Performance at 25°C

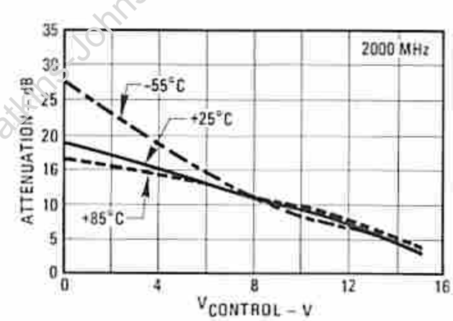
V_{Out} vs. $V_{Control}$



Attenuation vs. $V_{Control}$







2

WJ-PL30

100 TO 2000 MHz
TO-8 THIN-FILM
PROTECTIVE POWER LIMITER

- LOW INSERTION LOSS: ≤ 0.4 dB (TYP.)
- LOW INPUT AND OUTPUT VSWR: ≤ 1.2 (TYP.)
- HIGH CW INPUT POWER: 30 dBm

Specifications*

Characteristic	Typical	Guaranteed −54°C-+85°C
Frequency (Min.)		100-2000 MHz
Insertion Loss at +20 dBm Input		
100-1000 MHz	0.3 dB	0.5 dB
1000-2000 MHz	0.9 dB	1.0 dB
Leakage Power (Input Power +30 dBm CW)	+17 dBm	+20 dBm
Limiting Threshold (Input for 1 dB Compression)	+10 dBm	+7.5 dBm
VSWR (Max.) Input/Output P_{IN} ≤ 10 dBm	1.2:1	1.7:1

* Measured in a 50-ohm system.

Absolute Maximum Ratings

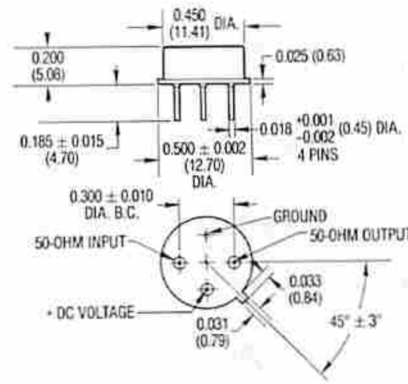
Storage Temperature . . . . −62°C to +125°C
Maximum Case Temperature . . . . +125°C
Maximum Continuous RF Input Power . . . . +30 dBm
Maximum Short Term RF Input Power (1 Minute Max.) . . . . 2.0 Watts
Maximum Peak Power . . . . 50 Watt
(1 μ sec Pulse and 0.001 Duty Cycle Max.)
"S" Series Burn-In Temperature (No Applied Voltage) (Case) . . . . +125°C

Weight

approximately 2.0 grams (0.07 oz.)

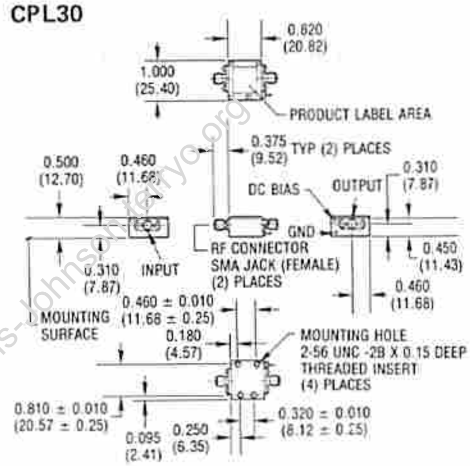
Outline Drawings

PL30



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

CPL30

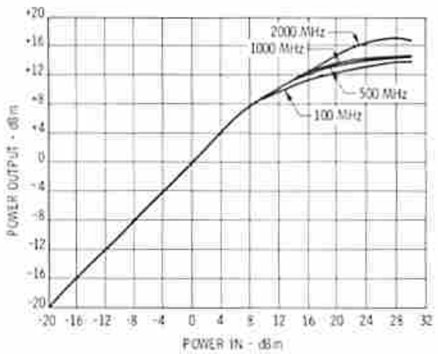


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

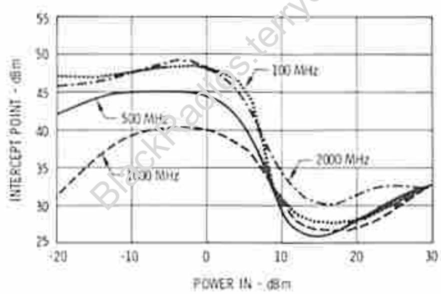
*WJ CPL30 is standard WJ PL30 installed in miniature SMA connector housing and guaranteed over 0°C to 50°C temperature range. See Cascaded Thin Film Amplifiers.

Typical Performance at 25°C

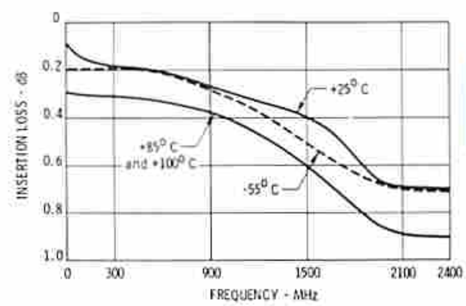
Output Power vs. Input Power



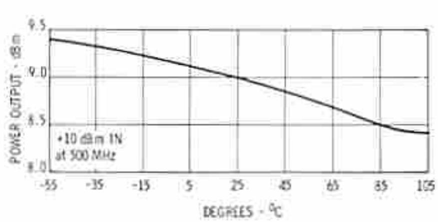
2nd Harmonic Intercept Point vs. Input Power



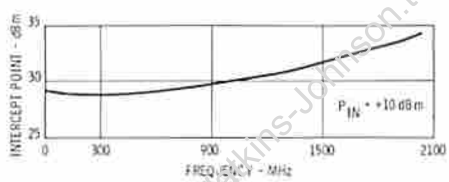
Insertion Loss vs. Frequency



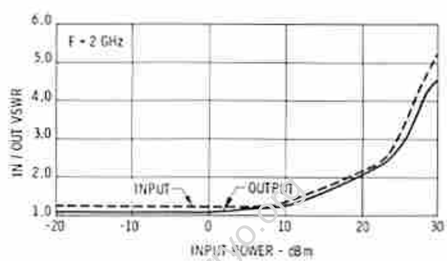
Output Power vs. Temperature



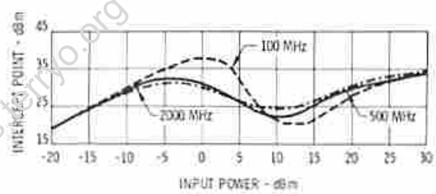
2nd Harmonic Intercept Point vs. Frequency



VSWR

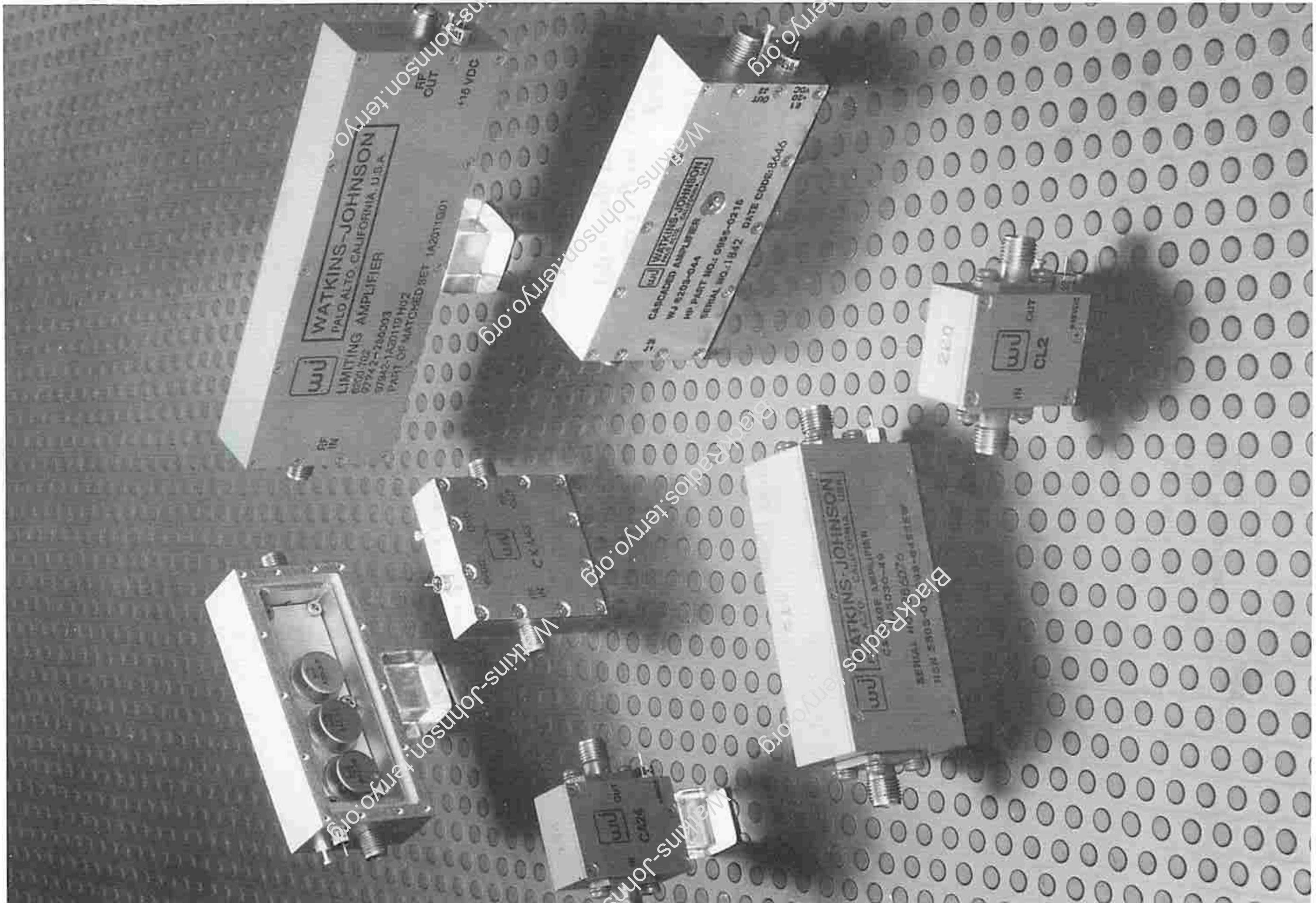


3rd Order Two Tone Intercept Point vs. Input Power



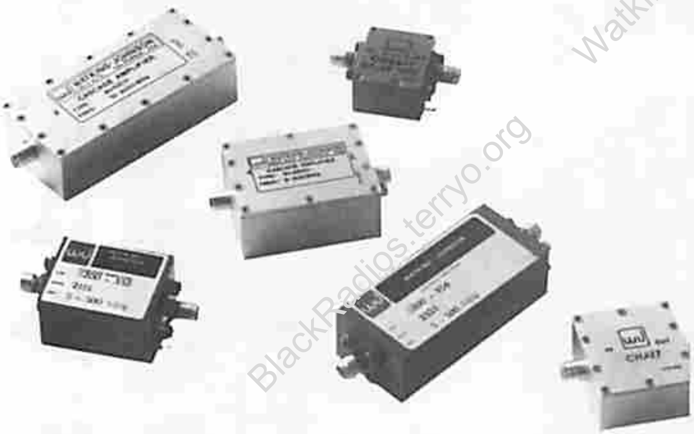
2

Cascaded Amplifiers



Cascaded Amplifiers 2 to 6000 MHz

- HF, VHF, UHF, L BAND, S BAND
- NOISE FIGURES STARTING FROM 1.5 dB
- OUTPUT POWERS AS HIGH AS +30 dBm
- OVER 400 MODELS TO CHOOSE FROM



CA, CRA, CTA and CHA Series

Every TO-8 amplifier (as well as attenuator, limiter, and limiter/amplifier) is available in miniature SMA housings. For 0° to 50°C operation the CA housing affords the most economical approach to obtaining full TO-8 performance in a connectorized package. Example: A customer wishing an A75 in this package would order a CA75 (L1 becomes CL1, G30 becomes CG30 and RA89 becomes CRA89).

For those applications where wider temperature ranges (up to -54°C/+85°C) will be encountered, W-J recommends the CTA option. (A75 becomes CTA75, L1 becomes CTL1, G30 becomes CTG30 and RA89 becomes CTRA89).

In harsh environments where high reliability is required, W-J offers the rugged CHA housing. This package is designed to pass MIL-E-5400, Class II environmental testing. Usually a Hi-Rel "S" Series TO-8 amplifier (or equivalent) is used inside. Therefore, an A75S becomes a CHA75S, an L1S becomes a CHL1S, and a G30S becomes a CHG30S, etc.

Looking for the right amplifier to fit your needs?

When it comes to the variety of amplifiers that we offer, there are literally thousands of different combinations possible using our TO-8 modules.

W-J can usually tailor an amplifier to your specific needs. This is especially true if you require:

1. Specially Guaranteed Electrical Performance
2. +5 to +24 VDC Bias
3. Variable Gain (DC Controlled)
4. Limiting Amplifiers
5. Hi-Rel
6. Type N or SMA Male Connectors
7. Integral Power Supplies Available 115/220 VAC

Have Questions? Give us a call and we'll be happy to discuss our standard 6200 Series or special models more suited to your needs.

Our Amplifier Applications Engineering group is located in Palo Alto, California, at 3333 Hillview Avenue, telephone (415) 493-4141, ext. 2638. Or contact your nearest W-J Field Sales Office.

Common Environmental Specifications for Hi-Rel Cascaded Amplifiers

Environment	Method	Procedure
Humidity	MIL-STD-202 106	
Thermal Shock	MIL-STD-202 107	Condition A
	MIL-STD-810 C 503.1	
Vibration	MIL-STD-202 201	
	MIL-STD-202 204	Condition A, C, D
Shock	MIL-STD-202 213	Condition C
	MIL-STD-810 C 516.2	Procedure I
Salt Fog	MIL-STD-202 101	Condition B
Altitude	MIL-STD-202 105	Condition C
High Temperature Testing	MIL-STD-810 501.1C	Procedure I, II
Low Temperature Testing	MIL-STD-810C 502.1	Procedure I

CASCADED THIN FILM AMPLIFIERS

Cascading Examples

Take a requirement that needs +23 dBm output power, 3.0 dB Max. noise figure, and 44 dB Min. gain over the full 5-500 MHz band. A quick look at the W-J cascadable amplifier selection charts, starting on page 14, shows that the WJ-A1 has a 3.0 dB Max. noise figure, and that the WJ-PA3 will yield a +23 dBm output power. The A1 has 15 dB Min. gain, and the PA3 has 13.5 dB Min. gain. This gives 28.5 dB gain so that the addition of 15.5 is still needed.

The drive power required can be determined by taking the power of the output stage, subtracting its gain and adding 2 dB to avoid compression in the driver stage. For a more accurate determination see power output curves on page 126.

P drive = 23 - 13.5 +2 = 12.5

A look at the selection chart shows the WJ-77 will provide this output power across the 5-500 MHz band with 16 dB minimum gain. The power required to drive the A77 is 12.5 - 16 + 2 = -1.5 dBm. The WJ-A1 provides -1 dBm Typ. which is adequate to drive the A77. Using these amplifiers yields the sum of 16 + 16.5 + 14 = 46.5 dB gain, which is the sum of the individual typical gains. The performance of this cascade is shown in Figure 1. Note that 46.5 dB was indeed obtained and that the gain flatness was less than ±1 dB. Using the rules stated for cascaded gain, the minimum gain specification should be 15 + 16 + 13.5 - 0.5 = 44 dB.

Another example is shown in Figure 2 where the WJ-A11-1 is cascaded with the WJ-A15. Each of these cascades are shown in the cascaded combination sections. The WJ-6200-637 is the A1, A77, and PA3 assembled and tested in a 3 stage housing with SMA female connections, and the WJ-6201-423 is the A11-1 and A15 assembled and tested in a 2-stage housing.

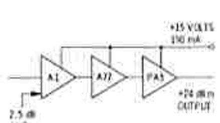
Figure 3 shows the performance of the WJ-6206-411 over the full 100-3000 MHz band. This unit is assembled and tested in a 2-stage housing with SMA female connectors, and features 27 dB gain with 10.5 dBm power output.

Typical Cascaded Combinations

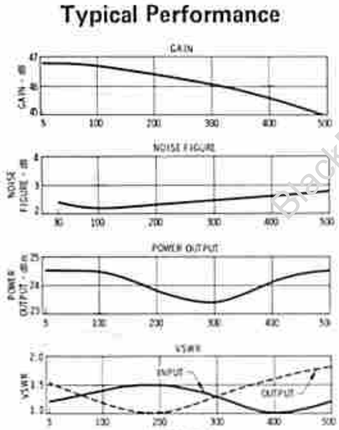
6200-637
5-500 MHz

FREQ MHz	VSWR IN	VSWR OUT	GAIN DB
100	1.3	1.1	47.0
200	1.4	1.1	46.8
300	1.4	1.4	46.5
400	1.2	1.6	45.9
500	1.2	1.7	45.3

Figure 1



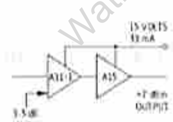
Typical Performance



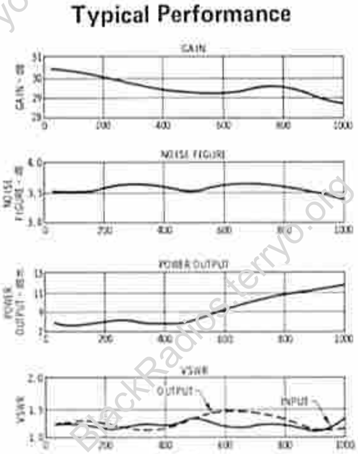
6201-423
10-1000 MHz

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.0	1.2	30.7
200.	1.0	1.4	30.5
300.	1.1	1.4	30.0
400.	1.2	1.4	29.3
500.	1.3	1.3	28.8
600.	1.4	1.3	28.6
700.	1.5	1.3	29.0
800.	1.6	1.3	29.7
900.	1.6	1.6	30.3
1000.	1.5	1.8	29.3

Figure 2



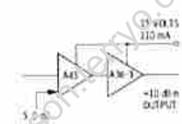
Typical Performance



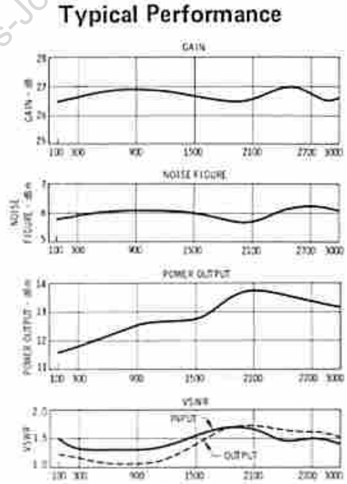
6206-411
100-3000 MHz

FREQ MHz	VSWR IN	VSWR OUT	GAIN DB
100	1.2	1.2	26.5
200	1.2	1.2	26.7
300	1.2	1.2	26.8
400	1.2	1.2	26.9
500	1.2	1.2	26.9
600	1.2	1.2	26.9
700	1.2	1.2	27.0
800	1.3	1.2	27.0
900	1.3	1.2	27.1
1000	1.4	1.2	27.1
1100	1.5	1.2	27.1
1200	1.5	1.3	27.1
1300	1.6	1.3	27.0
1400	1.7	1.4	27.0
1500	1.7	1.5	26.8
1600	1.8	1.5	26.7
1700	1.8	1.6	26.5
1800	1.8	1.7	26.4
1900	1.8	1.7	26.3
2000	1.8	1.7	26.4
2100	1.8	1.7	26.6
2200	1.7	1.7	26.7
2300	1.6	1.7	26.8
2400	1.5	1.7	27.0
2500	1.4	1.7	27.0
2600	1.4	1.8	26.5
2700	1.4	1.8	26.4
2800	1.3	1.8	26.2
2900	1.2	1.7	26.3
3000	1.0	1.8	26.2

Figure 3



Typical Performance

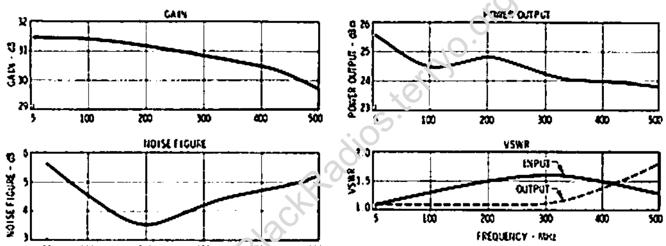


3

6200-670
5-500 MHz

FREQ MHz	VSWR IN	VSWR OUT	GAIN DB
100	1.3	1.1	31.6
200	1.4	1.1	31.4
300	1.5	1.3	31.1
400	1.4	1.6	30.7
500	1.3	1.8	29.9

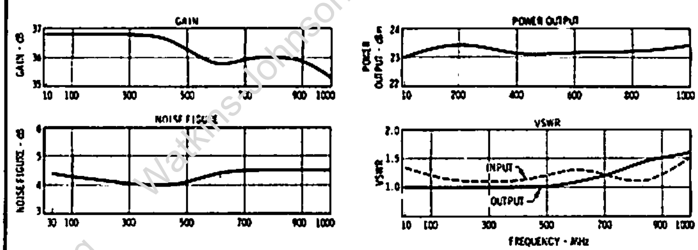
Typical Performance



6201-448
10-1000 MHz

FREQ MHz	VSWR IN	VSWR OUT	GAIN DB
100	1.2	1.0	36.8
200	1.1	1.0	36.8
300	1.1	1.0	36.8
400	1.1	1.0	36.7
500	1.2	1.0	36.2
600	1.3	1.1	35.8
700	1.2	1.2	36.0
800	1.1	1.4	36.0
900	1.2	1.5	35.9
1000	1.5	1.6	35.3

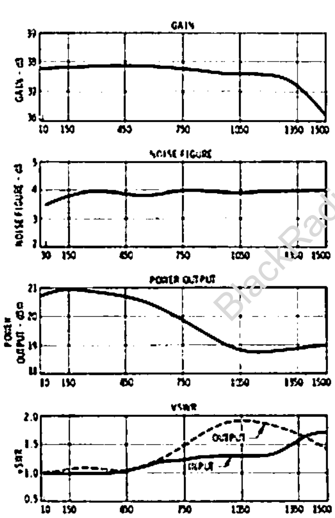
Typical Performance



6202-425
10-1500 MHz

FREQ MHz	VSWR IN	VSWR OUT	GAIN DB
100	1.0	1.1	33.4
200	1.0	1.1	38.5
300	1.0	1.0	38.2
400	1.1	1.0	38.4
500	1.1	1.1	33.6
600	1.1	1.2	38.8
700	1.1	1.3	38.8
800	1.1	1.4	33.0
900	1.2	1.6	37.9
1000	1.4	1.7	38.2
1100	1.5	1.8	38.6
1200	1.5	1.7	38.4
1300	1.4	1.7	37.6
1400	1.4	1.6	37.2
1500	1.5	1.4	36.8

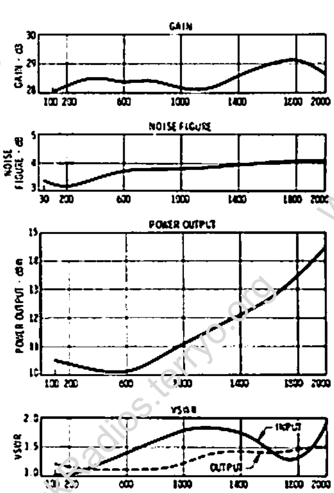
Typical Performance



6203-413
30-2000 MHz

FREQ MHz	VSWR IN	VSWR OUT	GAIN DB
100	1.0	1.2	28.0
200	1.0	1.1	28.3
300	1.1	1.1	28.3
400	1.2	1.1	28.5
500	1.3	1.1	28.4
600	1.4	1.1	28.3
700	1.5	1.1	28.4
800	1.6	1.1	28.2
900	1.7	1.2	28.2
1000	1.8	1.2	28.2
1100	1.8	1.3	28.1
1200	1.8	1.4	28.1
1300	1.8	1.4	28.4
1400	1.7	1.4	28.6
1500	1.6	1.4	28.6
1600	1.5	1.4	29.0
1700	1.3	1.4	29.0
1800	1.3	1.5	29.1
1900	1.5	1.5	28.9
2000	2.0	1.5	28.6

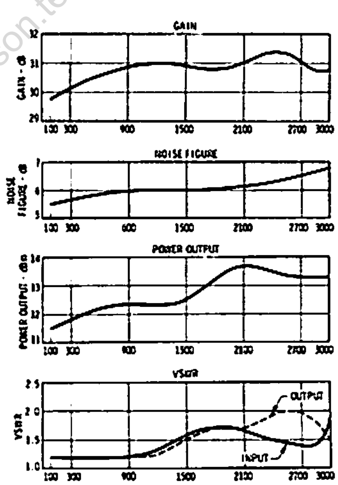
Typical Performance



6206-413
100-3000 MHz

FREQ MHz	VSWR IN	VSWR OUT	GAIN DB
100	1.2	1.2	29.7
200	1.2	1.2	30.0
300	1.2	1.2	30.1
400	1.2	1.2	30.3
500	1.2	1.2	30.4
600	1.2	1.2	30.5
700	1.2	1.2	30.6
800	1.2	1.2	30.6
900	1.2	1.2	30.8
1000	1.3	1.2	30.9
1100	1.3	1.2	30.9
1200	1.4	1.3	31.0
1300	1.4	1.4	31.0
1400	1.5	1.4	30.9
1500	1.6	1.5	30.8
1600	1.7	1.6	30.7
1700	1.7	1.6	30.6
1800	1.7	1.7	30.6
1900	1.7	1.7	30.5
2000	1.7	1.7	30.6
2100	1.7	1.6	30.9
2200	1.6	1.6	31.0
2300	1.5	1.7	31.0
2400	1.5	1.8	31.2
2500	1.5	1.9	31.2
2600	1.4	2.0	30.7
2700	1.3	1.9	30.5
2800	1.3	1.8	30.0
2900	1.5	1.6	30.0
3000	1.9	1.5	30.1

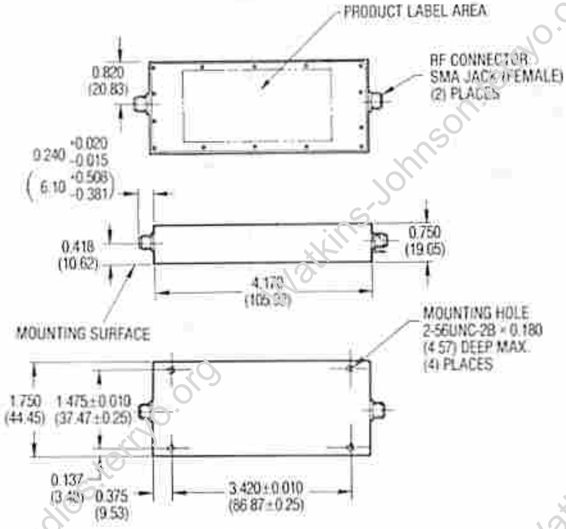
Typical Performance



Outline Drawings

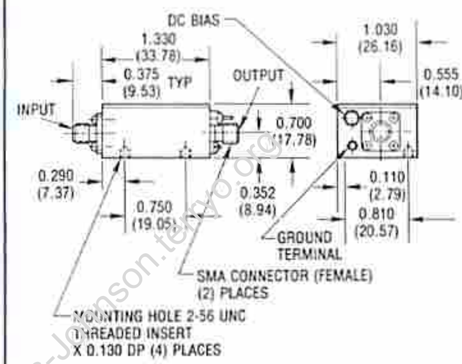
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.005 (.13) UNLESS OTHERWISE SPECIFIED

W-J Limiting Amplifier Series (Eight-Stage)



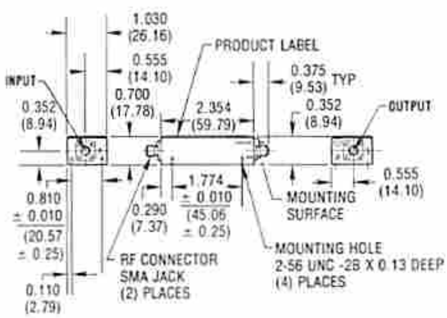
UNIT WEIGHT: 6.2 OUNCES MAX. (175.8 GRAMS)

WJ-6200 to WJ-6206 Series (Two-Stage)



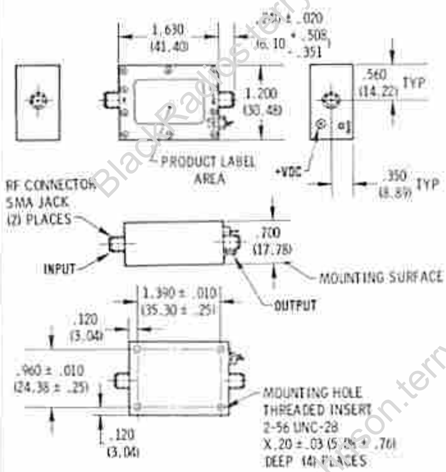
DIMENSIONS ARE IN INCHES (MILLIMETERS)
WEIGHT: APPROXIMATELY 1.5 OZ.

WJ-6200 to WJ-6206 Series (Three- and Four-Stage)



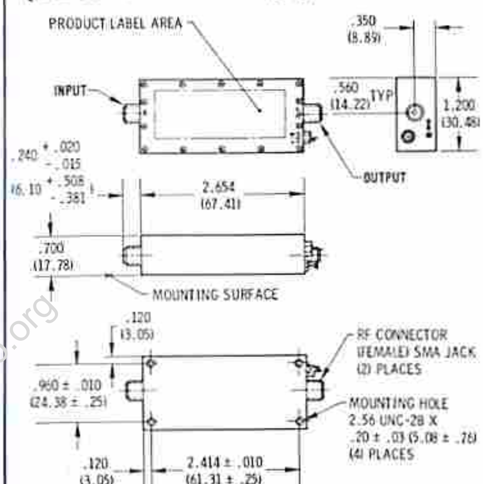
DIMENSIONS ARE IN INCHES (MILLIMETERS)
WEIGHT: APPROXIMATELY 2.0 OZ.

WJ-6200 to WJ-6206 Hi-Rel Series (Two-Stage)



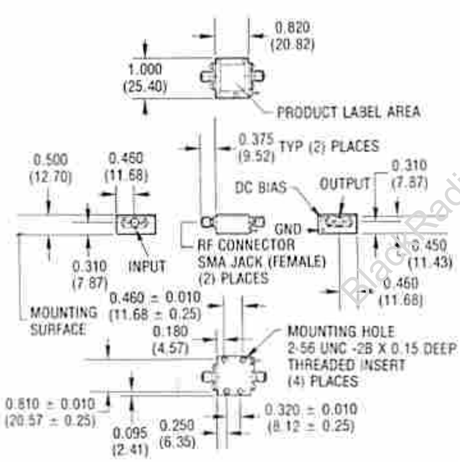
DIMENSIONS ARE IN INCHES (MILLIMETERS)
WEIGHT: APPROXIMATELY 2.0 OZ.

WJ-6200 to WJ-6206 Hi-Rel Series (Three- and Four-Stage)



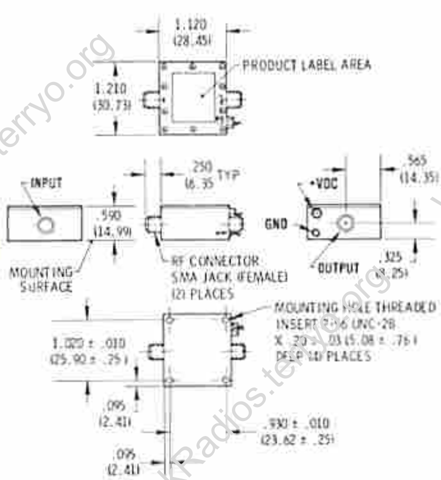
DIMENSIONS ARE IN INCHES (MILLIMETERS)
WEIGHT: APPROXIMATELY 2.5 OZ.

CA and CT Series



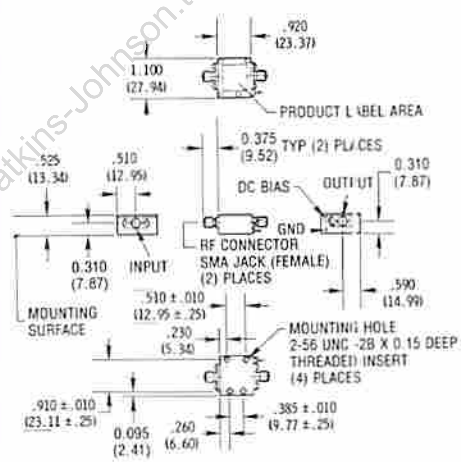
WEIGHT: APPROXIMATELY 0.71 OZ.

Hi-Rel CHA Series



WEIGHT: APPROXIMATELY 1.0 OZ.

CRA Series



UNIT WEIGHT: 1.0 OUNCES MAX (20.0 GRAMS)

3

Guaranteed Specifications at 25°C

Model	Noise Figure dB Max.	Gain dB Typ.	Gain dB Min.	Gain Flatness dB Typ.	Gain Flatness dB Max.	VSWR In/Out Typ.	VSWR In/Out Max.	Power Output dBm Min.	3rd Order Intercept dBm Typ.	Supply Voltage + Volts Nom.	Current mA Typ.	Outline Drawing
5 TO 250 MHz												
6200-501	3.0	22.0	20.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+18	33	+15	80	A
6200-502	2.5	16.0	15.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+11.5	27	+15	25	A
6200-503	3.0	39.5	36.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+7	20	+15	33	A
6200-504	3.0	53.0	49.5	±1.2	±2.0	1.5-2.0:1	2.5:1	+18	31	+15	98	B
HIGH EFFICIENCY — +5 Vdc BIAS												
6200-505 (10-250 MHz)	3.5	51.0	49.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+9	22	+5	26	A
6200-601 (10-500 MHz)	4.0	44.7	43.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+10	22	+5	43	A
10 TO 400 MHz												
6200-510	3.0	29.5	28.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+7	21	+15	36	A
6200-511	3.0	29.5	28.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+10	23	+15	50	A
6200-512	3.0	41.0	38.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+12	27	+15	75	A
6200-513	3.0	41.5	38.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	33	+15	138	B
6200-514	3.0	42.5	40.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+6	19	+15	40	A
6200-515	3.0	42.5	40.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+15	30	+15	67	B
6200-516	3.0	44.5	41.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	35	+15	148	B
6200-517	3.0	44.5	41.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+22	32	+15	180	B
6200-518	3.0	52.5	48.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	35	+15	163	B
6200-519	3.0	55.0	52.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+15	29	+15	71	B
6200-520	3.0	55.5	51.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	36	+15	173	B
6200-521	3.0	55.5	51.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+22	33	+15	205	B
6200-522	3.5	27.5	26.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+14	27	+15	43	A
6200-523	3.5	30.0	28.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+14	27	+15	42	A
6200-524	3.5	30.0	28.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+13	26	+15	56	A
6200-525	3.5	41.5	38.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	35	+15	144	B
6200-526	5.5	40.0	38.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+15	29	+15	65	A
6200-527	5.5	51.5	48.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	36	+15	153	B
6200-528	5.5	53.5	50.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+12	27	+15	103	A
6200-529	5.5	54.5	51.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	37	+15	163	B
6200-530	5.5	54.5	51.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+22	34	+15	195	B
6200-531	5.5	55.0	52.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+6	19	+15	68	A
6200-532	6.0	24.0	22.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	37	+15	119	A
6200-533	6.0	26.5	24.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	36	+15	132	A
6200-534	6.0	27.0	25.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	37	+15	129	A
6200-535	6.0	27.0	25.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+23	34	+15	161	A
6200-536	6.0	29.5	27.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	37	+15	142	A
6200-537	6.0	29.5	27.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+23	33	+15	174	A
6200-538	7.0	37.5	36.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	36	+15	157	A
6200-539	7.0	38.5	36.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+16	31	+15	100	A
6200-540	7.0	40.0	37.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	37	+15	167	A
6200-541	7.0	40.0	37.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+22	33	+15	199	A
5 TO 500 MHz												
6200-610	2.5	35.5	33.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+8	23	+15	44	A
6200-611	2.5	35.5	33.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+12.5	25	+15	58	A
6200-612	2.5	37.0	35.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+15	28	+15	64	A
6200-613	2.5	41.5	39.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+7	21	+15	38	A
6200-614	2.5	43.5	39.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	35	+15	167	B
6200-615	2.5	47.0	43.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	35	+15	152	B
6200-616[1]	2.5	47.0	45.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+22	32	+20	159	B
6200-617	2.5	48.0	46.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+14	28	+15	76	A
6200-618	2.5	50.5	47.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+7	20	+15	54	A
6200-619	2.5	51.5	49.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	35	+15	164	B
6200-620	2.5	51.5	49.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+23	33	+15	194	B
6200-621	2.5	53.0	49.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+17	31	+15	103	B

NOTE:
1. V_{CC} = 20 volts.

(Continued)

SELECTION CHART

Guaranteed Specifications at 25°C (Continued)

Model	Noise Figure dB Max.	Gain dB Typ.	Gain dB Min.	Gain Flatness dB Typ.	Gain Flatness dB Max.	VSWR In/Out Typ.	VSWR In/Out Max.	Power Output dBm Min.	3rd Order Intercept dBm Typ.	Supply Voltage + Volts Nom.	Current mA Typ.	Outline Drawing
5 TO 500 MHz CONTINUED												
6200-622	2.5	58.0	55.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+15	29	+15	88	B
6200-623	2.5	60.0	56.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	36	+15	164	B
6200-624[1]	3.0	26.5	24.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+7	20	+15	39	A
6200-625	3.0	31.0	29.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+7	21	+15	34	A
6200-626	3.0	33.0	31.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+13	26	+15	59	A
6200-627	3.0	35.5	33.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	34	+15	124	A
6200-628[1]	3.0	35.5	33.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	32	+15	154	A
6200-629[1]	3.0	36.0	34.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+13	27	+15	68	A
6200-630	3.0	37.0	35.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+7	21	+15	33	A
6200-631	3.0	37.5	36.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+15	29	+15	74	A
6200-632	3.0	42.0	40.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+7	21	+15	48	A
6200-633[1]	3.0	42.5	39.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+18	32	+15	118	B
6200-634	3.0	44.0	42.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+14	28	+15	71	A
6200-635	3.0	44.0	41.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	35	+15	142	B
6200-636	3.0	46.0	43.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+7	20	+15	49	A
6200-637	3.0	47.0	44.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+22	32	+15	189	B
6200-638	3.0	49.0	47.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+14	28	+15	86	A
6200-639	3.0	49.0	46.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	36	+15	162	B
6200-640	3.0	51.0	48.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+7	20	+15	64	A
6200-641	3.0	55.5	52.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	36	+15	159	B
6200-642	3.0	59.0	56.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+14	28	+15	111	B
6200-643	3.0	60.5	57.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	36	+15	174	B
6200-644	5.5	25.5	23.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+8	23	+15	55	A
6200-645	5.5	26.5	24.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+16	31	+15	90	A
6200-646	5.5	29.5	27.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	34	+15	125	A
6200-647	5.5	29.5	27.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	32	+15	155	A
6200-648	5.5	31.5	30.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+15	29	+15	75	A
6200-649	5.5	39.5	37.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	36	+15	150	A
6200-650	5.5	42.5	40.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	35	+15	162	A
6200-651	5.5	42.5	40.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+23	33	+15	192	A
6200-652	5.5	43.0	41.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+14	28	+15	87	A
6200-653	5.5	44.5	41.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	34	+15	140	A
6200-654	5.5	44.5	41.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	31	+15	170	A
6200-655	5.5	45.0	42.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+7	20	+15	65	A
6200-656	5.5	46.0	43.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	37	+15	175	B
6200-657	5.5	46.0	43.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+23	34	+15	205	B
6200-658[1]	5.5	49.5	46.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+23	35	+15	222	B
6200-659	5.5	54.5	51.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	36	+15	175	B
6200-660	5.5	58.0	55.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+14	28	+15	102	A
6200-661	5.5	57.0	54.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	36	+15	187	B
6200-662	5.5	57.0	54.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+23	33	+15	217	B
6200-663	6.0	23.0	20.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	37	+15	153	A
6200-664	6.0	26.5	24.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	36	+15	132	A
6200-665	6.0	28.0	26.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	36	+15	138	A
6200-666	6.0	29.5	27.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	35	+15	130	A
6200-667	6.0	29.5	27.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+22	33	+15	160	A
6200-668	6.0	28.0	26.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+18	33	+15	115	A
6200-669	6.0	31.0	29.0	±0.8	±1.5	1.2-1.5:1	2.0:1	+20	37	+15	150	A
6200-670	6.0	31.0	29.0	±0.8	±1.5	1.2-1.5:1	2.0:1	+23	34	+15	180	A
5 TO 1000 MHz												
6201-410	3.0	26.5	24.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+7	19	+15	39	A
6201-411	3.0	30.5	29.0	±0.8	±1.5	1.5-2.0:1	2.0:1	+6	19	+15	33	A
6201-412	3.0	31.0	29.0	±0.8	±1.5	1.5-2.0:1	2.2:1	-4	10	+15	18	A
6201-413	3.0	38.5	35.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+14	27	+15	83	B
6201-414	3.0	41.0	38.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+8	23	+15	63	B
6201-415	3.0	42.0	39.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+7	20	+15	44	A
6201-416	3.0	42.5	39.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+14	27	+15	77	B

NOTE:
1. 10-500 MHz.

(Continued)

Guaranteed Specifications at 25°C (Continued)

Model	Noise Figure dB Max.	Gain dB Typ.	Gain dB Min.	Gain Flatness dB Typ.	Gain Flatness dB Max.	VSWR In/Out Typ.	VSWR In/Out Max.	Power Output dBm Min.	3rd Order Intercept dBm Typ.	Supply Voltage + Volts Nom.	Current mA Typ.	Outline Drawing
5 TO 1000 MHz CONTINUED												
6201-417	3.0	45.5	41.0	±1.2	±2.0	1.5-2.0:1	2.5:1	+18	31	+15	183	B
6201-418	3.0	48.5	44.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	33	+15	178	B
6201-419[2]	3.0	48.5	44.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+22	32	+20	213	B
6201-420	3.0	52.5	49.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	34	+15	172	B
6201-421[2]	3.0	52.5	49.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+22	32	+20	207	B
6201-432	4.0	26.5	24.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+8	22	+15	44	A
6201-454	4.0	27.5	25.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+17	30	+15	117	A
6201-433	4.0	28.0	25.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+13	25	+15	58	A
6201-434	4.0	30.5	29.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+7	21	+15	38	A
6201-435	4.0	35.0	31.5	±0.8	±1.5	1.5-2.0:1	2.5:1	+17	30	+15	58	B
6201-436	4.0	38.0	35.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	33	+15	153	B
6201-455	4.0	39.0	36.0	±1.2	±2.0	1.5-2.0:1	2.5:1	+20	34	+15	159	B
6201-437	4.0	42.0	39.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+7	20	+15	49	A
6201-438	4.0	48.5	44.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	34	+15	183	B
6201-439	4.0	52.5	49.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	34	+15	177	B
6201-440	4.3	36.5	33.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+8	23	+15	65	A
6201-441	4.3	38.0	34.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+14	27	+15	79	A
6201-442	4.3	45.0	40.5	±1.2	±2.0	1.5-2.0:1	2.5:1	+18	31	+15	179	B
6201-443	4.3	48.0	44.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	34	+15	174	B
6201-444	4.3	52.0	48.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+7	20	+15	70	A
6201-445	6.5	26.5	24.5	±0.8	±1.5	1.2-1.5:1	2.0:1	+14	28	+15	68	A
6201-446	6.5	33.5	30.5	±0.8	±1.5	1.5-2.0:1	2.5:1	+18	31	+15	168	B
6201-447[2]	6.5	34.5	33.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+22	35	+20	252	B
6201-448	6.5	36.5	34.0	±0.8	±1.5	1.2-1.5:1	2.0:1	+20	34	+15	163	B
6201-449	8.0	19.0	16.5	±0.8	±1.5	1.5-2.0:1	2.5:1	+18	32	+15	144	A
6201-450	8.0	22.0	20.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	34	+15	139	A
6201-451	8.0	22.5	20.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+14	28	+15	74	A
6201-452	10.0	20.0	19.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	36	+15	190	A
6201-453[2]	10.0	20.0	19.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+22	36	+20	225	A
10 TO 1200 MHz												
6201-510	4.3	35.5	33.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+15	28	+15	130	A
6201-511	4.3	44.0	40.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	32	+15	180	B
6201-512	4.3	46.5	43.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	33	+15	175	B
5 TO 1500 MHz												
6202-410	4.5	21.5	20.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+5	17	+15	33	A
6202-412	4.5	30.0	27.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+12	24	+15	83	B
6202-413	4.5	31.5	30.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+7	20	+15	43	A
6202-415	4.5	32.5	30.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+13	25	+15	78	B
6202-416	4.5	38.5	35.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	30	+15	186	B
6202-417	4.5	40.0	37.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+12	25	+15	93	B
6202-418	4.5	41.0	38.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	31	+15	181	B
6202-419	4.5	42.5	40.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+13	27	+15	88	B
6202-420	4.5	48.5	45.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+19	31	+15	196	B
6202-421	4.5	51.0	48.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+19	32	+15	191	B
6202-422	5.5	28.5	26.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+12	26	+15	84	A
6202-423	5.5	30.0	38.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+7	21	+15	58	A
6202-424	5.5	31.0	29.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+13	27	+15	79	A
6202-425	5.5	37.0	34.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	31	+15	187	B
6202-426	5.5	38.5	35.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+13	26	+15	108	B
6202-427	5.5	39.5	37.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	32	+15	182	B
6202-428	5.5	40.0	38.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+7	21	+15	68	A
6202-429	5.5	41.0	38.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+13	27	+15	103	B
6202-430	5.5	47.0	44.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+19	31	+15	211	B
6202-431	5.5	49.5	46.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+19	32	+15	206	B
6202-432	7.5	19.5	18.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	32	+15	148	A

NOTES:
1. 10-500 MHz.
2. V_{CC} = 20 volts.

(Continued)

Guaranteed Specifications at 25°C (Continued)

Model	Noise Figure dB Max.	Gain dB Typ.	Gain dB Min.	Gain Flatness dB Typ.	Gain Flatness dB Max.	VSWR In/Out Typ.	VSWR In/Out Max.	Power Output dBm Min.	3rd Order Intercept dBm Typ.	Supply Voltage + Volts Nom.	Current mA Typ.	Outline Drawing
5 TO 1500 MHz CONTINUED												
6202-433	8.0	18.5	16.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+13	26	+15	74	A
6202-434	8.0	21.0	19.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+13	27	+15	69	A
6202-435	8.0	27.0	24.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	31	+15	177	B
6202-436	8.0	29.5	27.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	32	+15	172	B
6202-437	9.5	17.0	15.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	32	+15	153	A
10 TO 2000 MHz												
6203-410	4.5	21.5	19.5	±0.8	±1.5	1.5-2.0:1	2.5:1	+1	13	+15	23	A
6203-411	4.5	21.5	20.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+3	17	+15	33	A
6203-412[3]	4.5	27.5	26.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+6	17	+15	43	A
6203-413[3]	4.5	28.0	26.5	±0.8	±1.5	1.5-2.0:1	2.5:1	+11	21	+15	74	A
6203-414	4.5	31.0	28.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+11	24	+15	78	B
6203-415[3]	4.5	36.5	34.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+12	24	+15	88	B
6203-416[3]	4.5	37.0	34.5	±0.8	±1.5	1.5-2.0:1	2.5:1	+13	26	+15	119	B
6203-417[3]	4.5	37.0	33.5	±0.8	±1.5	1.5-2.0:1	2.5:1	+17	29	+15	183	B
6203-418[3]	4.5	43.0	40.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+17	30	+15	224	B
6203-419[3]	4.5	43.5	41.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+6	18	+15	77	B
6203-420[3]	4.5	44.0	41.5	±0.8	±1.5	1.5-2.0:1	2.5:1	+11	23	+15	106	B
6203-421	6.0	19.0	16.5	±0.8	±1.5	1.5-2.0:1	2.5:1	+10	23	+15	59	A
6203-422	6.0	20.0	17.5	±0.8	±1.5	1.5-2.0:1	2.5:1	+7	20	+15	38	A
6203-423[3]	6.0	26.0	23.5	±0.8	±1.5	1.5-2.0:1	2.5:1	+6	18	+15	48	A
6203-424[3]	6.0	26.5	24.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+12	22	+15	79	A
6203-425	6.0	35.5	32.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+13	27	+15	124	B
6203-426	6.0	35.5	31.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+19	30	+15	188	B
6203-427[3]	6.0	43.5	39.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+12	23	+15	113	B
6203-428[3]	6.0	52.5	47.0	±1.2	±2.0	1.5-2.0:1	2.5:1	+13	27	+15	158	B
6203-429[3]	6.5	24.0	22.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+17	29	+15	130	B
6203-430[3]	6.5	25.5	23.5	±0.8	±1.5	1.5-2.0:1	2.5:1	+13	27	+15	110	A
6203-431[3]	6.5	26.0	24.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+7	20	+15	58	A
6203-432[3]	6.5	30.5	27.5	±0.8	±1.5	1.5-2.0:1	2.5:1	+20	32	+15	235	B
6203-433[3]	6.5	32.0	30.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+6	18	+15	68	A
6203-434[3]	6.5	32.0	29.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+19	31	+15	215	B
6203-435[3]	6.5	32.5	30.5	±0.8	±1.5	1.5-2.0:1	2.5:1	+11	23	+15	99	A
6203-436[3]	6.5	39.0	36.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+15	28	+15	204	B
6203-437[3]	6.5	49.5	45.5	±1.2	±2.0	1.5-2.0:1	2.5:1	+11	23	+15	133	B
6203-438	7.0	19.0	17.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+13	26	+15	69	A
6203-439	7.0	26.5	22.5	±0.8	±1.5	1.5-2.0:1	2.5:1	+18	30	+15	174	B
6203-440	7.0	27.5	23.5	±0.8	±1.5	1.5-2.0:1	2.5:1	+17	30	+15	134	B
6203-441	7.0	33.0	29.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+18	32	+15	229	B
6203-442	8.5	14.0	12.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+20	33	+15	170	B
6203-443	8.5	16.5	13.5	±0.8	±1.5	1.5-2.0:1	2.5:1	+18	31	+15	150	B
6203-444	8.5	17.5	14.5	±0.8	±1.5	1.5-2.0:1	2.5:1	+17	33	+15	110	B
6203-445	8.5	23.0	20.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+20	33	+15	215	B
10 TO 2300 MHz												
6204-410	7.0	32.0	30.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+11	23	+15	130	A
6204-411	7.0	43.5	40.5	±0.8	±1.5	1.5-2.0:1	2.5:1	+11	23	+15	175	B
1500 TO 2300 MHz												
6204-412	7.0	30.5	28.5	±0.8	±1.5	1.5-2.0:1	2.5:1	+11	23	+15	99	A
100 TO 2600 MHz												
6205-410	7.0	42.5	39.5	±0.8	±1.5	1.5-2.0:1	2.5:1	+11	23	+15	175	B
6205-411	7.2	27.0	25.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+11	23	+15	110	B
6205-412	7.2	38.5	35.5	±0.8	±1.5	1.5-2.0:1	2.5:1	+11	23	+15	155	B
100 TO 3200 MHz												
6206-414	7.2	22.0	20.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+6.5	21	+15	90	A
6206-415	7.2	31.5	24.5	±0.8	±1.5	1.5-2.0:1	2.5:1	+6.5	21	+15	135	B

NOTES:
1. 10-500 MHz.
2. V_{CC} = 20 volts.
3. 100-2000 MHz.

(Continued)

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Guaranteed Specifications at 25°C (Continued)

Model	Noise Figure dB Max.	Gain dB Typ.	Gain dB Min.	Gain Flatness dB Typ.	Gain Flatness dB Max.	VSWR In/Out Typ.	VSWR In/Out Max.	Power Output dBm Min.	3rd Order Intercept dBm Typ.	Supply Voltage + Volts Nom.	Current mA Typ.	Outline Drawing
10 TO 400 MHz CASCADED AMPLIFIERS WITH TYPICALLY ≥ +20 dBm POWER OUT												
6200-513	3.0	41.5	38.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	33	+15	138	B
6200-516	3.0	44.5	41.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	35	+15	148	B
6200-517	3.0	52.5	48.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	35	+15	163	B
6200-518	3.0	52.5	48.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	35	+15	163	B
6200-520	3.0	55.5	51.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	36	+15	173	B
6200-521	3.0	55.5	51.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+22	33	+15	205	B
6200-525	3.5	41.5	38.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	35	+15	144	B
6200-527	5.5	51.5	48.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	36	+15	153	B
6200-529	5.5	54.5	51.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	37	+15	163	B
6200-530	5.5	54.5	51.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+22	34	+15	195	B
6200-532	6.0	24.0	22.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	37	+15	119	A
6200-533	6.0	26.5	24.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	36	+15	132	A
6200-534	6.0	27.0	25.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	37	+15	129	A
6200-535	6.0	27.0	25.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+23	34	+15	161	A
6200-536	6.0	29.5	27.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	37	+15	142	A
6200-537	6.0	29.5	27.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+23	33	+15	174	A
6200-538	7.0	37.5	36.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	36	+15	157	A
6200-540	7.0	40.0	37.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	37	+15	167	A
6200-541	7.0	40.0	37.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+22	33	+15	199	A
5 TO 500 MHz												
6200-614	2.5	43.5	39.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	35	+15	167	B
6200-615	2.5	47.0	43.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	35	+15	152	B
6200-616[2]	2.5	47.0	45.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+22	32	+20	159	B
6200-619	2.5	51.5	49.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	35	+15	164	B
6200-620	2.5	51.5	49.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+23	33	+15	194	B
6200-623	2.5	60.0	56.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	36	+15	164	B
6200-627	3.0	35.5	33.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	34	+15	124	A
6200-628[1]	3.0	35.5	33.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	32	+15	154	A
6200-635	3.0	44.0	41.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	35	+15	142	B
6200-637	3.0	47.0	44.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+22	32	+15	169	B
6200-639	3.0	49.0	46.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	36	+15	162	B
6200-641	3.0	55.5	52.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	36	+15	159	B
6200-643	3.0	60.5	57.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	36	+15	174	B
6200-646	5.5	29.5	27.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	34	+15	125	A
6200-647	5.5	29.5	27.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	32	+15	155	A
6200-649	5.5	39.5	37.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	36	+15	150	A
6200-650	5.5	42.5	40.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	35	+15	162	A
6200-651	5.5	42.5	40.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+23	33	+15	192	A
6200-653	5.5	44.5	41.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	34	+15	140	A
6200-654	5.5	44.5	41.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	31	+15	170	A
6200-656	5.5	46.0	43.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	37	+15	175	B
6200-657	5.5	46.0	43.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+23	34	+15	205	B
6200-658[1]	5.5	49.5	46.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+23	35	+15	222	B
6200-659	5.5	54.5	51.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	36	+15	175	B
6200-661	5.5	57.0	54.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	36	+15	187	B
6200-662	5.5	57.0	54.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+23	33	+15	217	B
6200-663	6.0	23.0	20.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	37	+15	153	A
6200-664	6.0	26.5	24.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	36	+15	132	A
6200-665	6.0	28.0	26.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	36	+15	138	A
6200-666	6.0	29.5	27.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	36	+15	130	A
6200-667	6.0	29.5	27.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+22	33	+15	160	A
6200-669	6.0	31.0	29.0	±0.8	±1.5	1.2-1.5:1	2.0:1	+20	37	+15	150	A
6200-670	6.0	31.0	29.0	±0.8	±1.5	1.2-1.5:1	2.0:1	+23	34	+15	180	A

NOTES:
1. 10-500 MHz.
2. V_{CC} = 20 volts.

(Continued)

Guaranteed Specifications at 25°C (Continued)

Model	Noise Figure dB Max.	Gain dB Typ.	Gain dB Min.	Gain Flatness dB Typ.	Gain Flatness dB Max.	VSWR In/Out Typ.	VSWR In/Out Max.	Power Output dBm Min.	3rd Order Intercept dBm Typ.	Supply Voltage + Volts Nom.	Current mA Typ.	Outline Drawing
5 TO 1000 MHz												
6201-418	3.0	48.5	44.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	33	+15	178	B
6201-419[2]	3.0	48.5	44.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+22	32	+20	213	B
6201-420	3.0	52.5	49.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	34	+15	172	B
6201-421[2]	3.0	52.5	49.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+22	32	+20	207	B
6201-436	4.0	38.0	35.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	33	+15	153	B
6201-438	4.0	48.5	44.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	34	+15	183	B
6201-439	4.0	52.5	49.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	34	+15	177	B
6201-443	4.3	48.0	44.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	34	+15	174	B
6201-456	4.5	41.0	38.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+23	37	+15	280	B
6201-447[2]	6.5	34.5	33.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+22	35	+20	252	B
6201-448	6.5	36.5	34.0	±0.8	±1.5	1.2-1.5:1	2.0:1	+20	34	+15	163	B
6201-450	8.0	22.0	20.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	34	+15	139	A
6201-452	10.0	20.0	19.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+20	36	+15	190	A
6201-453[2]	10.0	20.0	19.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+22	36	+20	225	A
10 TO 1200 MHz												
6201-511	4.3	44.0	40.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	32	+15	180	B
6201-512	4.3	46.5	43.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+20	33	+15	175	B
10 TO 1500 MHz												
6202-416	4.5	38.5	35.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	30	+15	186	B
6202-418	4.5	41.0	38.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	31	+15	181	B
6202-420	4.5	48.5	45.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+19	31	+15	196	B
6202-421	4.5	51.0	48.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+19	32	+15	191	B
6202-425	5.5	37.0	34.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	31	+15	187	B
6202-427	5.5	39.5	37.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	32	+15	182	B
6202-430	5.5	47.0	44.5	±1.2	±2.0	1.5-2.0:1	2.2:1	+19	31	+15	211	B
6202-431	5.5	49.5	46.0	±1.2	±2.0	1.5-2.0:1	2.2:1	+19	32	+15	206	B
6202-432	7.5	19.5	18.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	32	+15	148	A
6202-435	8.0	27.0	24.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	31	+15	177	B
6202-436	8.0	29.5	27.0	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	32	+15	172	B
6202-437	9.5	17.0	15.5	±0.8	±1.5	1.5-2.0:1	2.2:1	+19	32	+15	153	A
100 TO 2000 MHz												
6203-432	6.5	30.5	27.5	±0.8	±1.5	1.5-2.0:1	2.5:1	+20	32	+15	235	B
10 TO 2000 MHz												
6203-442	8.5	14.0	12.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+20	33	+15	170	B
6203-445	8.5	23.0	20.0	±0.8	±1.5	1.5-2.0:1	2.5:1	+20	33	+15	215	B

NOTES:
1. 10-500 MHz.
2. V_{CC} = 20 volts.

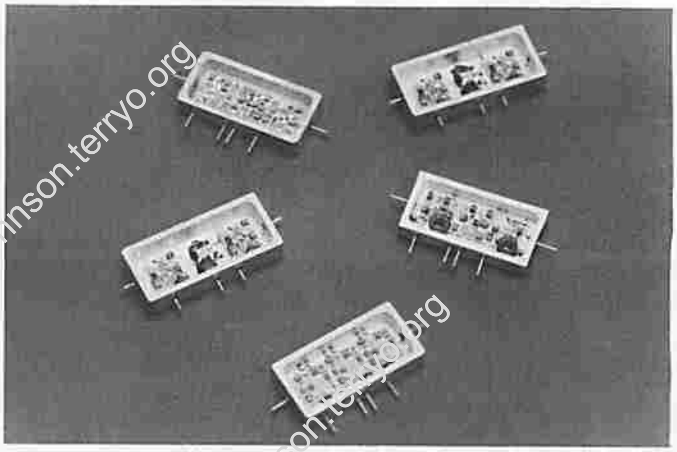
3

Integrated Components

4

Integrated Components

Watkins-Johnson Company has answered the challenge of improving performance, reducing size and weight, and satisfying budget restraints by introducing its new component-integration product capability. By combining standard amplifiers, mixers, limiters, variable attenuators, switches, and other catalog products into small MIC-integrable packages, numerous benefits are provided.



Mixer Preamplifiers (Guaranteed at +25° C)

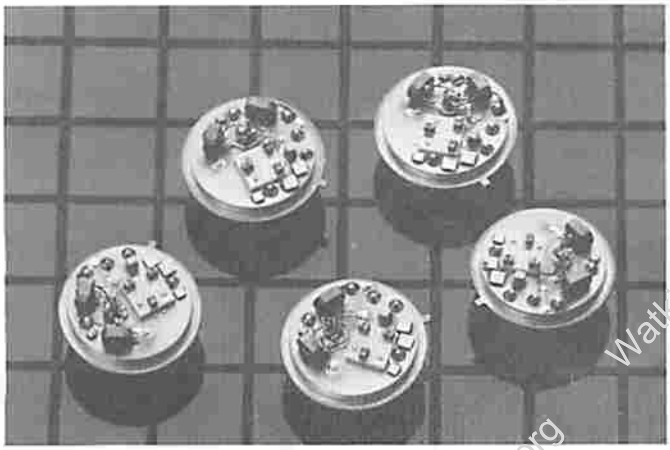
Model[1]	Description[3]	Frequency RF/LO (GHz)	Frequency IF (MHz)	Conversion Gain (dB) (Min.)	Noise Figure (dB) (Typ.)	Power Output at 1-dB Comp. (dBm) (Min.)	DC Volts (Nom.)	DC mA (Typ.)	Package Type
6242-1005	M2T/A75	0.5-2.0	10-500	11.5	11.0	+8.0	15	26	MP1
6242-1110	M2AX/EA54-2X	0.2-2.0	10-200	23.0	7.5	+4.0	12	27	TO-8B[2]
6243-1206	M4T/A11-2/A15	0.05-3.0	10-1000	18.0	11.0	+7.0	15	35	MP3
6242-1402	M8H-7X/EA53/EA7	2-6	10-250	23.0	8.0	+10.0	15	75	MP1
6243-1800	M52X/A70/A72	2-18	10-200	13.5	9.0	+11.0	15	45	MP4
6243-1701	M86/A70/A70-1	6-18	10-200	9.0	8.0	+12.5	15	27	MP4
6242-1705	M86/A75	6-18	10-500	12.0	9.5	+8.0	15	26	MP2
6243-1707	M86/A32-1/A32-1	6-18	100-2000	15.0	9.5	+10.0	5	130	MP4
6242-1702	M86/EA53/EA7	9-10	70	25.0	7.5	+12.5	15	75	MP2
6242-1802	M52X/EA53/EA7	2-18	10-200	25.0	9.5	+12.0	15	75	MP2
6243-1803	M52X/EA53/EA7/PA2	2-18	10-200	38.0	9.5	+21.0	15	135	MP4
6242-1809	M52X/KA62	2-18	2000-6000	4.0	11.5	+10.5	5	62	MP2

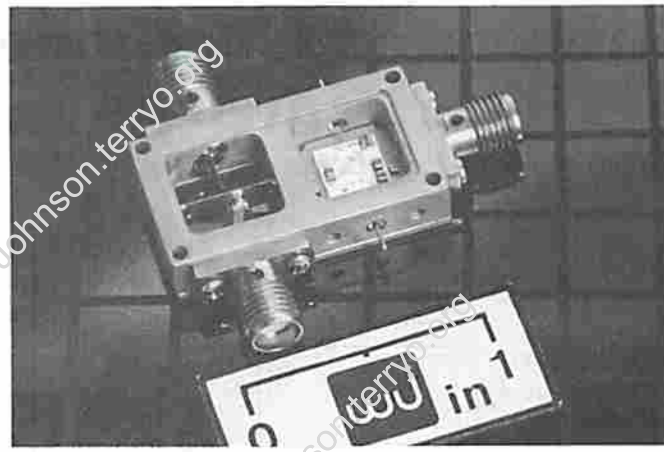
NOTES:
1. LO power is nominally +10 dBm for all these models.
2. All Watkins-Johnson Company EA series amplifiers can be used with the WJ-M2AX or WJ-M2BX mixers in the TO-8B package.
3. Other configurations are available. Consult factory.

AGC Amplifiers (Guaranteed at +25° C)

Model	Description[2]	Frequency (MHz)	Gain[1] (dB) (Min.)	Noise Figure (dB) Max.)	Power[1] Output at 1-dB Comp. (dBm) (Min.)	Attenuation Range (dB) (Typ.)	3rd Order[1] Intercept Power (dBm) (Typ.)	VSWR In/Out (Max.)	DC Volts (Nom.)	DC mA (Typ.)	Package Type
6243-0001	G1/RA89/G1	5-500	20.0	7.5	+17.5	50	+15	2:1	15	169	MP3
6243-0007	RA69/G1/RA69	10-1000	47.0	5.5	+20.0	25	+30	2:1	15	280	MP3
6243-0003	G30/RA36/G30	100-2000	15.0	10.5	+8.0	40	+15	2:1	15	105	MP3
6243-0004	RA36/G30/RA36	100-2000	40.5	7.0	+11.5	20	+19	2:1	15	180	MP3
6243-0010	G30/RA43/G30	1000-2000	11.0	9.5	+6.0	40	+16	2:1	15/5	20/155	MP3
6243-0005	G40/RA43/G40	1000-4000	11.0	9.5	+6.0	40	+16	2.2:1	15/5	24/155	MP3
6243-0006	RA43/G40/RA43	1000-4000	32.5	6.0	+9.5	20	+19	2:1	15/5	12/140	MP3

NOTES:
1. Low-loss state.
2. Other configurations are available. Consult factory.





Standard Products

Cascaded Limiting Amplifiers (Guaranteed at +25° C)

Model	Description[2]	Frequency (MHz)	Gain (dB) (Min.)	Noise Figure (dB) (Typ.)	Power Output at 1-dB Comp. (dBm) (Min.)	VSWR In/Out (Max.)	DC		Package Type
							Volts (Nom.)	mA (Typ.)	
6242-0501	LA7/LA7	50-500	22.0	9.5	+10.0	2:1	15	108	MP1
6243-0501	LA7/LA7/LA7	50-500	33.0	9.5	+10.0	2:1	15	162	MP3
6243-0505	LA7/LA7/LA7	50-500	33.0	9.5	+10.0	2:1	15	162	FP1
6242-0502	LA17/LA17	10-1000	19.0	7.6	+7.0	2:1	15	110	MP1
6243-0502	LA17/LA17/LA17	10-1000	28.5	7.6	+7.0	2:1	15	165	MP3
6243-0506	LA17/LA17/LA17	10-1000	28.5	7.6	+7.0	2:1	15	165	FP1
6242-0503	LA45/LA45-1	1000-4000	21.0	10.0	+14.5	2.3:1	15	210	MP1
6243-0503	LA45/LA45/LA45-1	1000-4000	30.0	10.0	+14.5	2.3:1	15	315	MP3
6242-0504	KLA62/KLA62	2000-6000	20.0	9.5	+10.0	2.3:1	12	140	MP1
6243-0504	KLA62/KLA62/KLA62	2000-6000	30.0	9.5	+10.0	2.3:1	12	210	MP3

NOTES:
1. These models may be cascaded together for wider limiting dynamic range.
2. Other configurations are available. Consult factory.

4

Active Frequency Doublers (Guaranteed at +25° C)

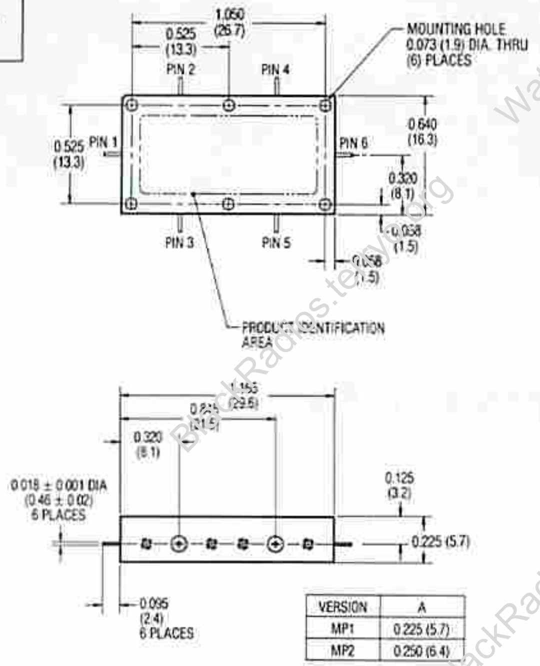
Model	Description[3]	Frequency (Output) (GHz)	Second Harmonic Conversion Gain (dB) (Min.)	Input Power Range (dBm) (Nom.)	DC		Package Type)	Harmonic Suppression[2]				
					Volts (Typ.)	mA (Typ.)		Input Power (dBm)	dBc (Typ.) 1	3	4	5
6242-0901	FD25/A18-1	0.01-1.0	1.0	+9 to +12	15	44	MP1	+10	31	41	24	53
6242-0902	A18-1/FD25	0.02-2.0	1.0	-7 to -1	15	44	MP1	-2	31	30	14	41
6242-0903	FD25/A36-2	0.1-2.5	1.0	+8 to +10	15	63	MP1	+9	36	38	22	52
6243-0904	A36-2/PA38-2/FD25H	0.2-4.5	6.0	-5 to -2	15	233	MP3	-3	18	23	19	33
6242-0905[1]	KA82/FD93	4.0-16.0	0.0	-5 to 0	5	60	MP2	-3	15	31	18	35

NOTES:
1. Preliminary specification.
2. Relative to second harmonic output power level. Values vary with input frequency.
3. Other configurations are available. Consult factory.

Integrated Components Outline Drawings

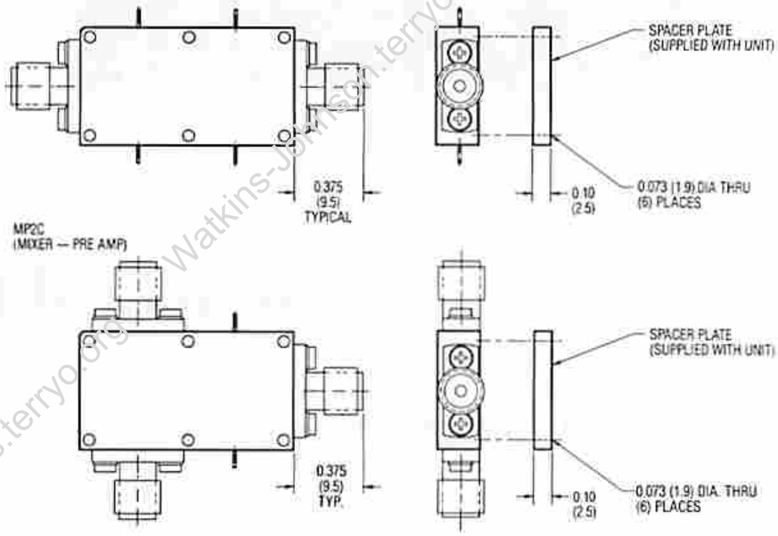
(Suffix C on model number indicates connectors.)

MP1 MP2

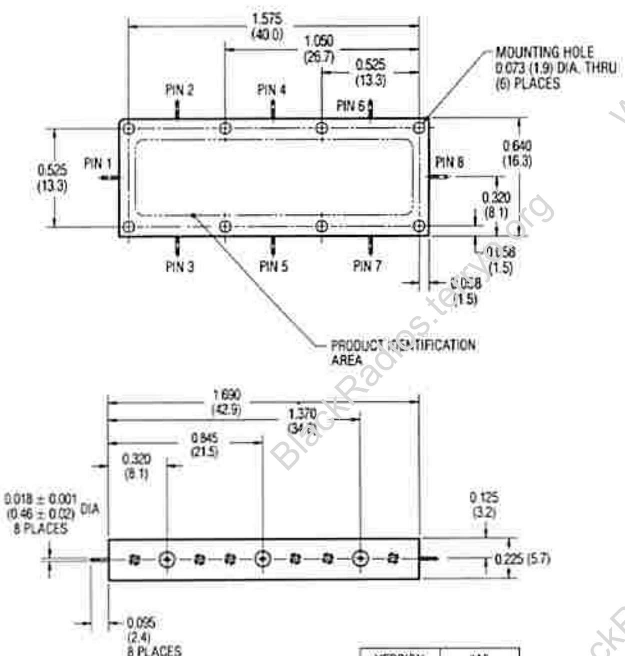


VERSION	A
MP1	0.225 (5.7)
MP2	0.250 (6.4)

MP1C MP2C

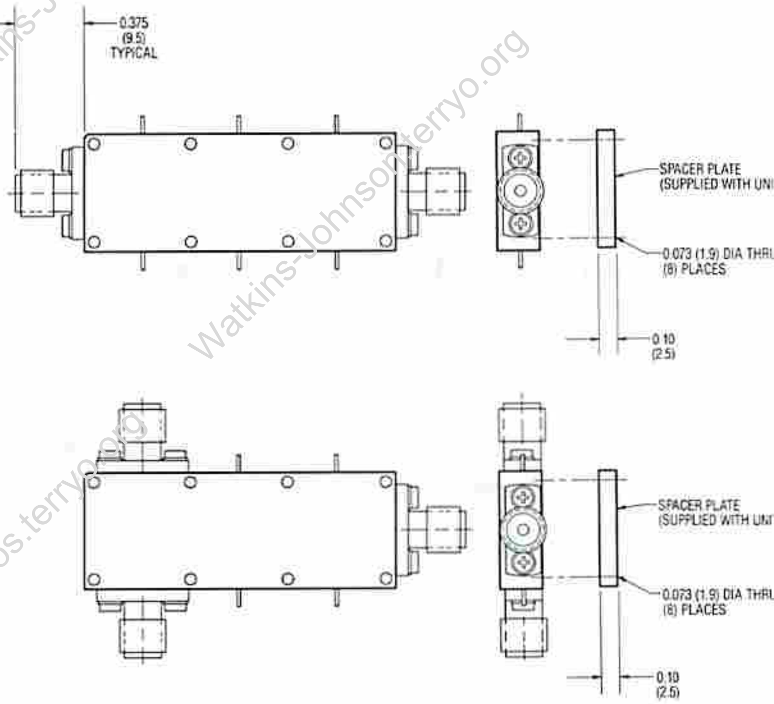


MP3 MP4 MP5

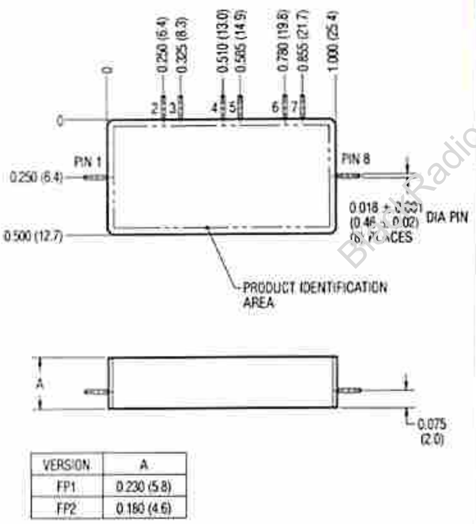


VERSION	"A"
MP3	0.225 (5.7)
MP4, MP5	0.250 (6.4)

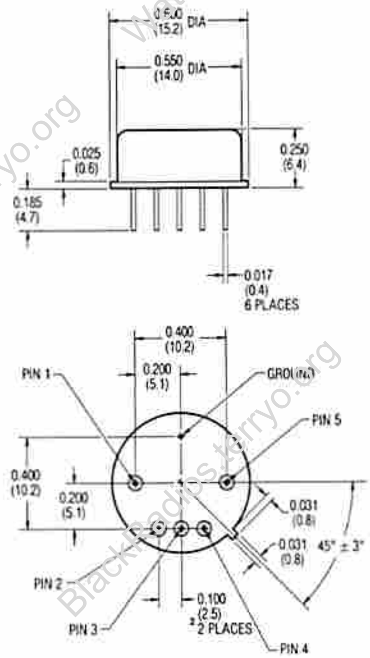
MP3C MP4C MP5C



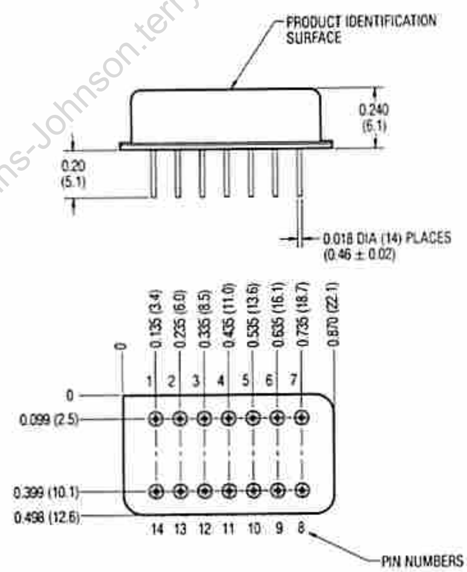
FP1
FP2



TO-8B



DP3



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Pin Locations

Product Type	Model Numbers	Pin Numbers 1	2	3	4	5	6	7	8	9	10	Package Style
Mixer Preamplifiers	6242-1005, 6242-1402, 6242-1702, 6242-1705, 6242-1802, 6242-1809	X	RF_{IN}	LO_{IN}	V_{DC}	GND_{DC}	IF_{OUT}	X	X	X	X	MP1, MP2
	6243-1206, 6243-1701, 6243-1707, 6243-1800, 6243-1803	X	RF_{IN}	LO_{IN}	V_{DC}	GND_{DC}	V_{DC}	GND_{DC}	IF_{OUT}	X	X	MP3, MP4
	6242-1110	RF_{IN}	LO_{IN}	GND_{DC}	V_{DC}	IF_{OUT}	X	X	X	X	X	TO-8B
AGC Amplifiers	6243-0001, 6243-0003, 6243-0005, 6243-0010	RF_{IN}	V_{DC}	V_{CTRL}	V_{DC}	GND_{DC}	V_{DC}	V_{CTRL}	RF_{OUT}	X	X	MP3
	6243-0004, 6243-0006, 6243-0007	RF_{IN}	V_{DC}	GND_{DC}	V_{DC}	V_{CTRL}	V_{DC}	GND_{DC}	RF_{OUT}	X	X	MP3
Limiting Amplifiers	6242-0501, 6242-0502, 6242-0503, 6242-0504	RF_{IN}	V_{DC}	GND_{DC}	V_{DC}	GND_{DC}	RF_{OUT}	X	X	X	X	MP1
	6243-0501, 6243-0502, 6243-0503, 6243-0504	RF_{IN}	V_{DC}	GND_{DC}	V_{DC}	GND_{DC}	V_{DC}	GND_{DC}	RF_{OUT}	X	X	MP3
	6243-0505, 6243-0506	RF_{IN}	V_{DC}	GND_{DC}	V_{DC}	GND_{DC}	V_{DC}	GND_{DC}	RF_{OUT}	X	X	FP2
Active Frequency Doublers	6242-0902, 6242-0905	RF_{IN}	V_{DC}	GND_{DC}	GND_{DC}	GND_{DC}	RF_{OUT}	X	X	X	X	MP1, MP2
	6242-0901, 6242-0903	RF_{IN}	GND_{DC}	GND_{DC}	V_{DC}	GND_{DC}	RF_{OUT}	X	X	X	X	MP1
	6243-0904	RF_{IN}	V_{DC}	GND_{DC}	V_{DC}	GND_{DC}	GND_{DC}	GND_{DC}	RF_{OUT}	X	X	MP3

Integrated Components Technical Data Sheets

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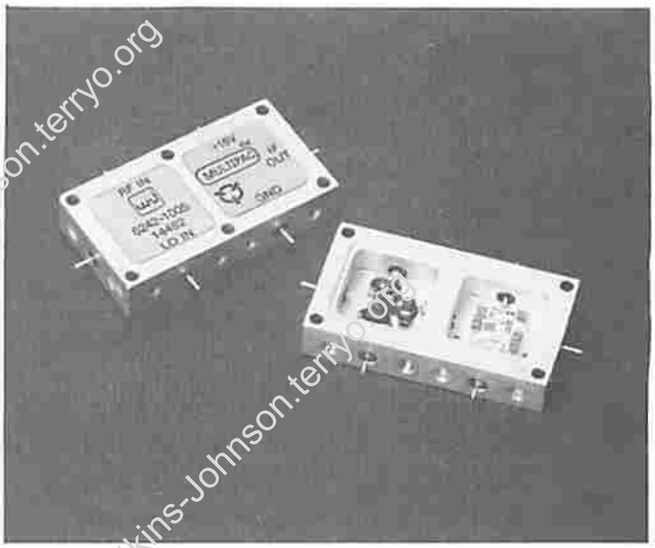
WJ-6242-1005

0.5 TO 2.0 GHz DOWNCONVERTER



- BROADBAND RF
- HIGH ISOLATION
- MEDIUM POWER LEVEL: +9 dBm (TYP.)
- LOW NOISE: 11 dB (TYP.)

Specifications*

Characteristics	Typical	Guaranteed 0° - 50°C	Guaranteed -54°C - +85°C
Frequency (Min.)			
RF	500-2000 MHz	500-2000 MHz	500-2000 MHz
LO	500-2000 MHz	500-2000 MHz	500-2000 MHz
IF	10-500 MHz	10-500 MHz	10-500 MHz
Conversion Gain (Min.)	13.0 dB	11.5 dB	11.0 dB
Gain Flatness (Max.)			
RF	±0.75 dB	±1.0 dB	±1.0 dB
IF	±0.35 dB	±0.6 dB	±0.75 dB
Noise Figure (Max.)	11 dB	14 dB	15 dB
Power Output at 1 dB Compression (Min.)	+9 dBm	+8 dBm	+8 dBm
VSWR (Max.)			
RF	2.0:1		
LO	2.0:1		
IF	1.4:1	2.0:1	2.2:1
Isolation (Min.)			
L to R	34 dB	27 dB	25 dB
L to I	52 dB	22 dB	20 dB
R to I	40 dB	10 dB	5 dB
DC Current at 15 Volts	26 mA	27 mA	29 mA

*Measured in a 50-ohm system, using push-on connectors, with LO power of +13 dBm. Typical values are at 25°C.

Absolute Maximum Ratings

Ambient Operating Temperature
. . . . -54°C to +105°C

Storage Temperature
. . . . -62°C to +125°C

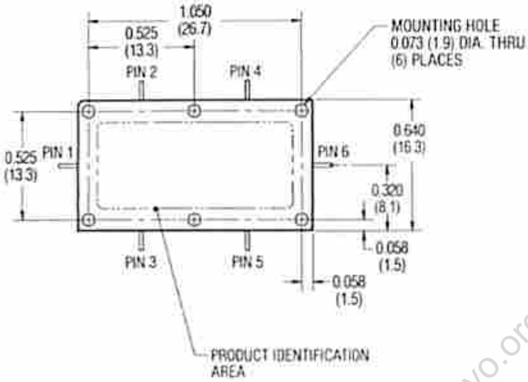
Maximum Case Temperature
. . . . +125°C

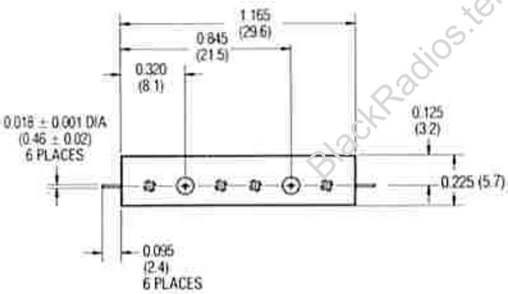
Maximum DC Voltage
. . . . +21 Volts

Maximum Continous RF Input Power
. . . . +13 dBm

Outline Drawings

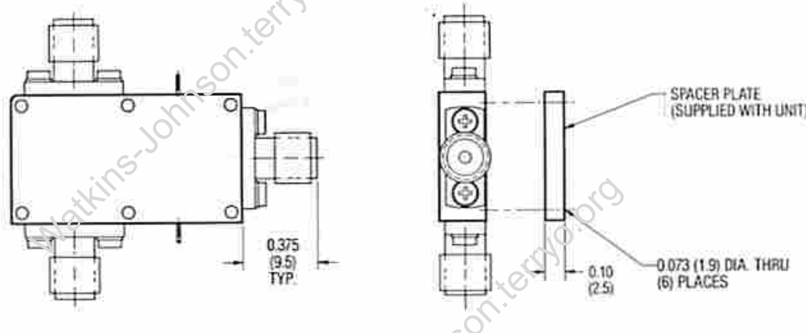
6242-1005





DIMENSIONS ARE IN INCHES (MILLIMETERS)

6242-1005C



DIMENSIONS ARE IN INCHES (MILLIMETERS)

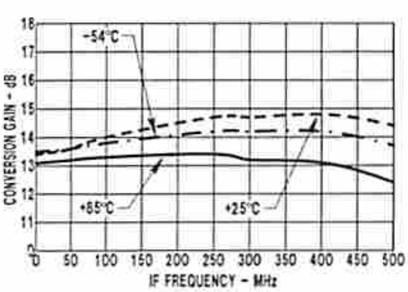
Weight

6242-1005: 17 grams (0.59 oz.) max.
6242-1005C: 24 grams (0.85 oz.) max.

Pin Number	1	2	3	4	5	6
Designation	N.C.	RF_{IN}	LO_{IN}	V_{DC}	N.C.	IF_{OUT}

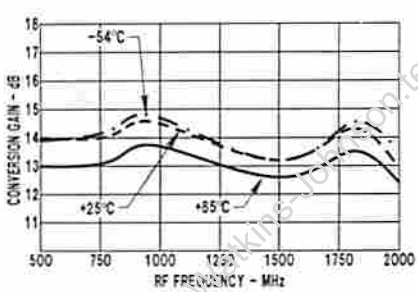
Typical Performance at 25°C

Conversion Gain vs. IF Frequency



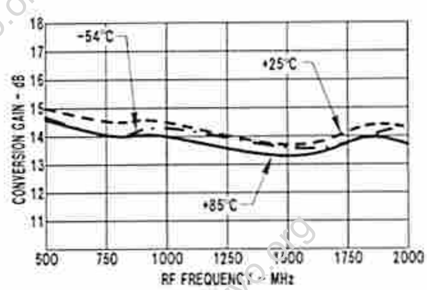
NOTES:
1. LO: 1.5 GHz @ +13 dBm

Conversion Gain vs. RF Frequency



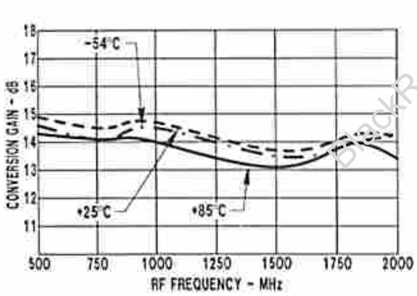
NOTES:
1. LO: 750 TO 2250 MHz @ +13 dBm
2. RF: 500 TO 2000 MHz @ -10 dBm
3. IF: 250 MHz
4. LO > RF

Conversion Gain vs. RF Frequency

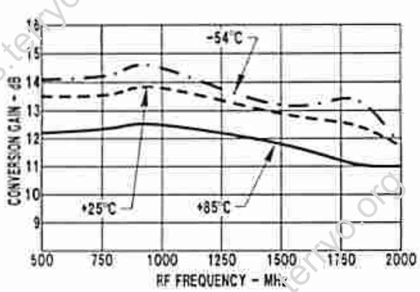


NOTES:
1. LO: 490 TO 1990 MHz @ +13 dBm
2. RF: 500 TO 2000 MHz @ -10 dBm
3. IF: 10 MHz
4. LO < RF

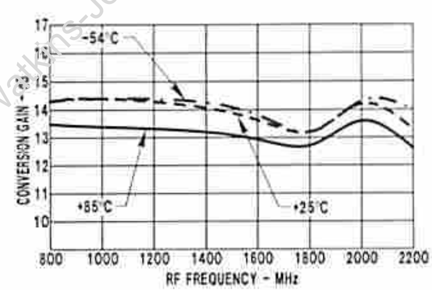
Conversion Gain vs. RF Frequency



NOTES:
1. LO: 510 TO 2010 MHz @ +13 dBm
2. RF: 500 TO 2000 MHz @ -10 dBm
3. IF: 10 MHz
4. LO > RF



NOTES:
1. LO: 1000 TO 2500 MHz @ +13 dBm
2. RF: 500 TO 2000 MHz @ -10 dBm
3. IF: 500 MHz
4. LO > RF

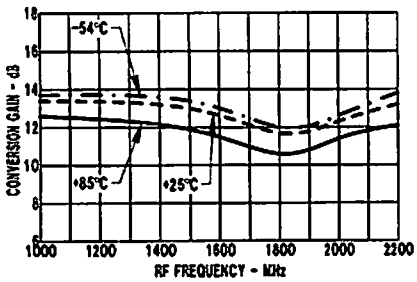


NOTES:
1. LO: 550 TO 1950 MHz @ +13 dBm
2. RF: 800 TO 2200 MHz @ -10 dBm
3. IF: 250 MHz
4. LO < RF

4

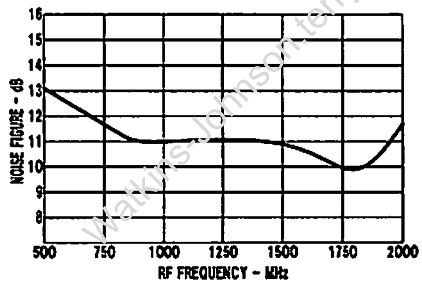
Typical Performance at 25°C (Cont.)

Conversion Gain vs. RF Frequency



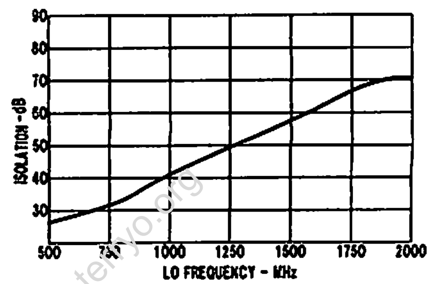
NOTES:
1. LO: 500 TO 1700 MHz @ +13 dBm
2. RF: 1000 TO 2200 MHz @ -10 dBm
3. IF: 500 MHz
4. LO < RF

Noise Figure vs. RF Frequency



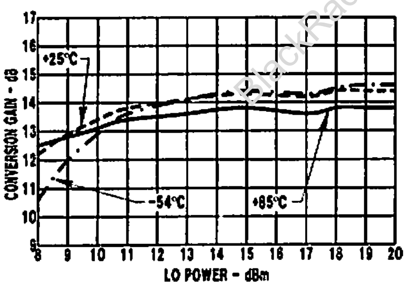
NOTES:
1. LO: 530 TO 2030 MHz @ +13 dBm
2. RF: 500 TO 2000 MHz @ -10 dBm
3. IF: 30 MHz

L–I Isolation



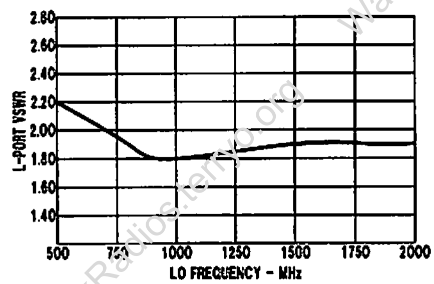
NOTES:
1. LO POWER = +13 dBm

Conversion Gain vs. LO Power



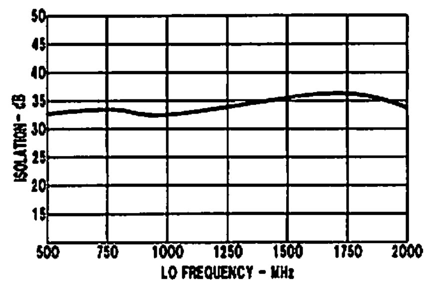
NOTES:
1. LO: 2000 MHz @ +8 TO +20 dBm
2. RF: 1750 MHz @ -10 dBm
3. IF: 250 MHz

L-Port VSWR



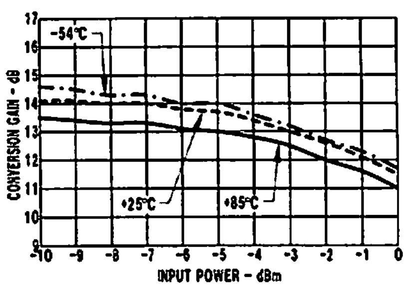
NOTES:
1. LO: 500 TO 2000 MHz @ +13 dBm

L – R Isolation



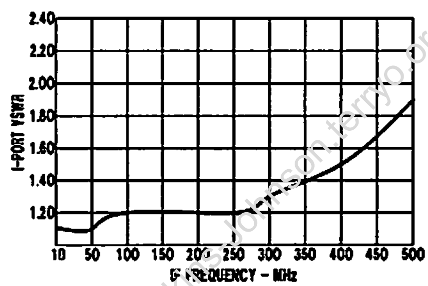
NOTES:
1. LO POWER @ +13 dBm

Conversion Gain vs. RF Input Power



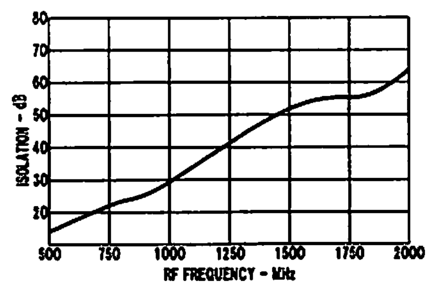
NOTES:
1. LO: 1500 MHz @ +13 dBm
2. RF: 1250 MHz @ -10 TO 0 dBm
3. IF: 250 MHz

I-Port VSWR



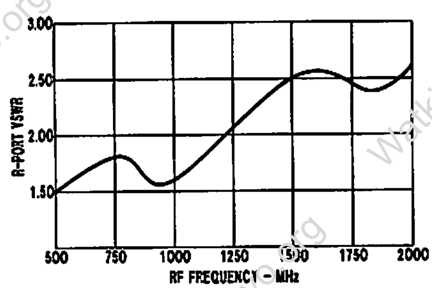
NOTES:
1. IF: 10 TO 500 MHz @ -10 dBm
2. LO: 1000 MHz @ +13 dBm

R – I Isolation



NOTES:
1. LO: 530 TO 2030 MHz @ +13 dBm
2. RF: 500 TO 2000 MHz @ -10 dBm

R-Port VSWR

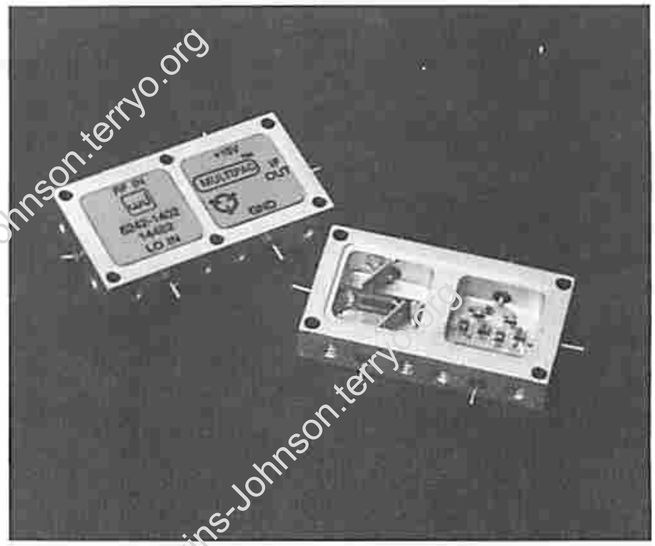


NOTES:
1. LO: 530 TO 2030 MHz @ +13 dBm
2. RF: 500 TO 2000 MHz @ -10 dBm

WJ-6242-1402

2.0 TO 6.0 GHz DOWNCONVERTER

- HIGH CONVERSION GAIN
- LOW NOISE
- MEDIUM OUTPUT POWER
- MULTIPAC™ PACKAGE



Specifications*

Characteristics	Typical	Guaranteed 0° to +50°C	Guaranteed -54° to +85°C
Frequency (Min.)			
RF	2.0-6.0 GHz	2.0-6.0 GHz	2.0-6.0 GHz
LO	2.0-6.0 GHz	2.0-6.0 GHz	2.0-6.0 GHz
IF	5-250 MHz	10-250 MHz	10-250 MHz
Conversion Gain (Min.)	25.0 dB	23.0 dB	22.0 dB
Gain Flatness (Max.)			
RF	±0.75 dB	±1.5 dB	±2.0 dB
IF	±0.5 dB	±1.0 dB	±1.5 dB
Noise Figure (Max.)	8.0 dB	9.5 dB	10.0 dB
Power Output at 1 dB Compression (Min.)	+11.0 dBm	+10.0 dBm	+9.0 dBm
VSWR (Max.)			
RF	3.0:1		
LO 2.5-6.0 GHz	3.0:1		
IF	1.3:1	1.7:1	2.0:1
Isolation (Min.)			
L to R	30 dB	22 dB	20 dB
L to I	40 dB	10 dB	10 dB
R to I	32 dB	20 dB	20 dB
DC Current at +15 Volts	75 mA	80 mA	90 mA
Third-Order Output Intercept	+26 dBm		

* Measured in a 50-ohm system, using push-on connectors, with LO power of +10 dBm. Typical values are at 25°C.

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C

Maximum Case Temperature . . . . +125°C

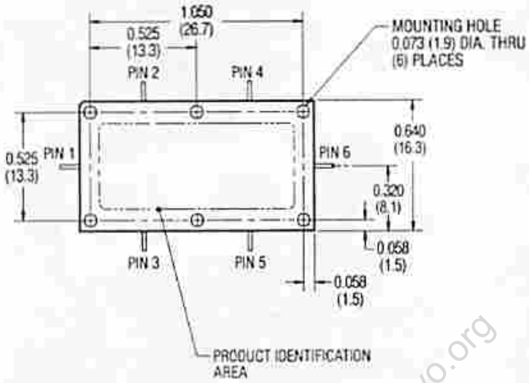
Maximum DC Voltage . . . . +17 Volts

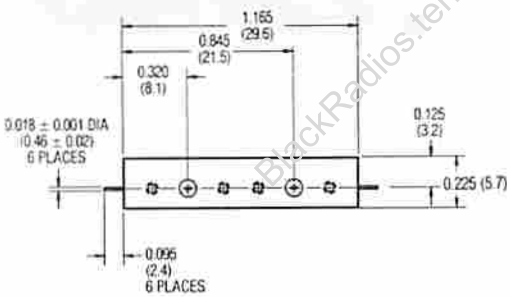
Maximum Continuous RF Input Power . . . . +20 dBm

4

Outline Drawings

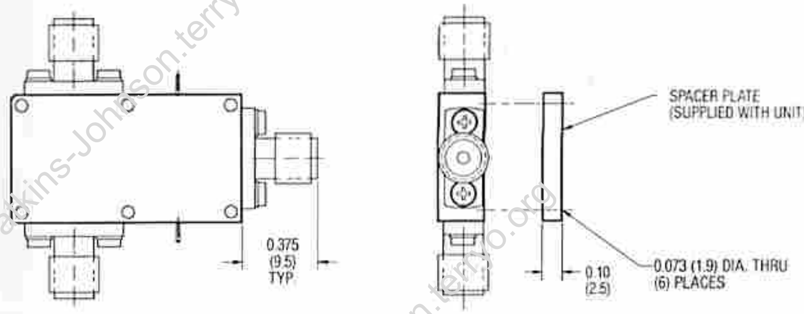
6242-1402





DIMENSIONS ARE IN INCHES (MILLIMETERS)

6242-1402C



DIMENSIONS ARE IN INCHES (MILLIMETERS)

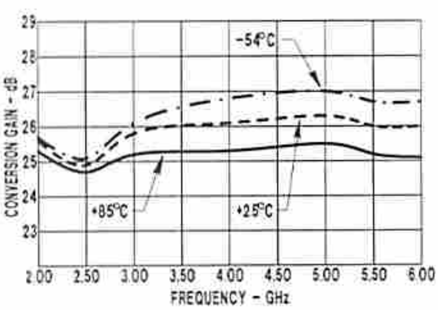
Weight

6242-1402: 17.0 grams (0.60 oz.) max.
6242-1402C: 24.0 grams (0.85 oz.) max.

Pin Number	1	2	3	4	5	6
Designation	N.C.	RF_{IN}	LO_{IN}	V_{DC}	N.C.	IF_{OUT}

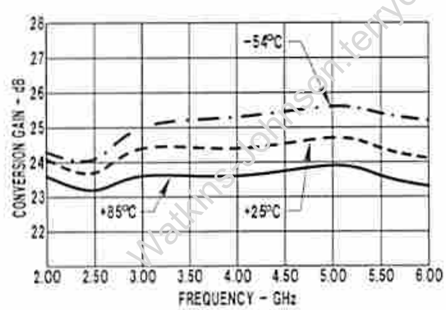
Typical Performance at 25°C

Conversion Gain



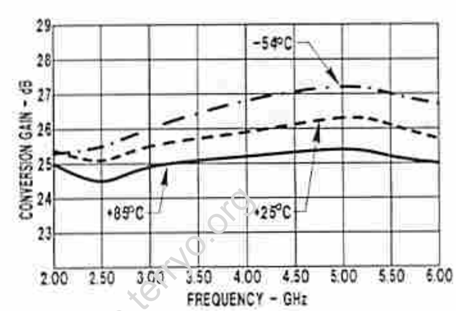
NOTES:
1. LO: 2.01 TO 6.01 GHz @ +10 dBm
2. RF: 2.0 TO 6.0 GHz
3. IF: 10 MHz
4. LO > RF

Conversion Gain

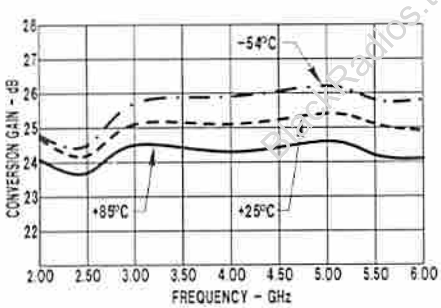


NOTES:
1. LO: 2.20 TO 6.20 GHz @ +10 dBm
2. RF: 2.0 TO 6.0 GHz
3. IF: 200 MHz
4. LO > RF

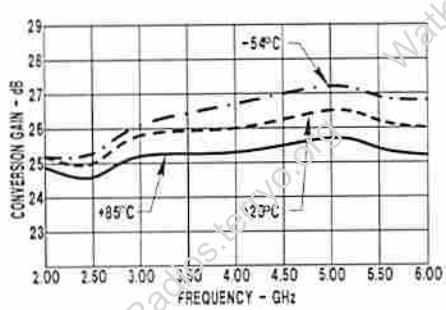
Conversion Gain



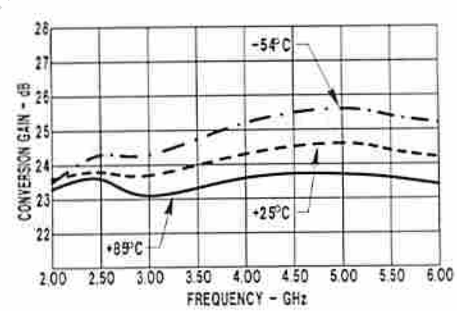
NOTES:
1. LO: 1.9 TO 5.9 GHz @ +10 dBm
2. RF: 2.0 TO 6.0 GHz
3. IF: 100 MHz
4. LO < RF



NOTES:
1. LO: 2.10 TO 6.10 GHz @ +10 dBm
2. RF: 2.0 TO 6.0 GHz
3. IF: 100 MHz
4. LO > RF



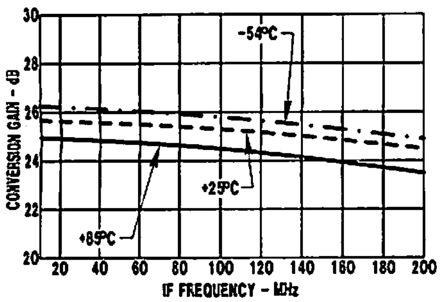
NOTES:
1. LO: 1.90 TO 5.30 GHz
2. RF: 2.0 TO 6.0 GHz
3. IF: 10 MHz
4. LO < RF



NOTES:
1. LO: 1.80 TO 5.80 GHz @ +10 dBm
2. RF: 2.0 TO 6.0 GHz
3. IF: 200 MHz
4. LO < RF

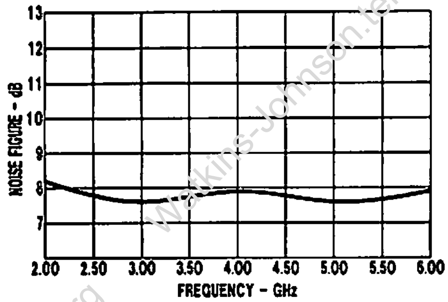
Typical Performance at 25°C (Cont.)

Conversion Gain vs. IF Frequency



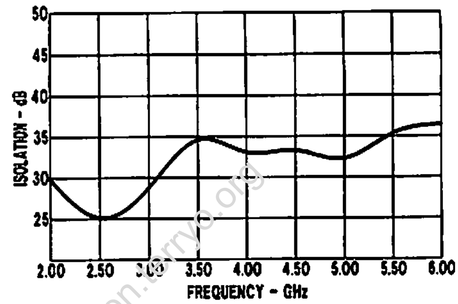
NOTES:
1. LO: 4.0 GHz @ +10 dBm
2. LO > RF

Noise Figure

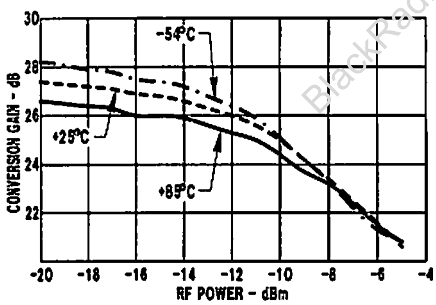


NOTES:
1. IF: 30 MHz
2. LO > RF

L to R Isolation

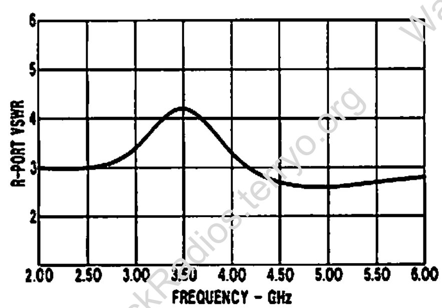


Conversion Gain vs. RF Power



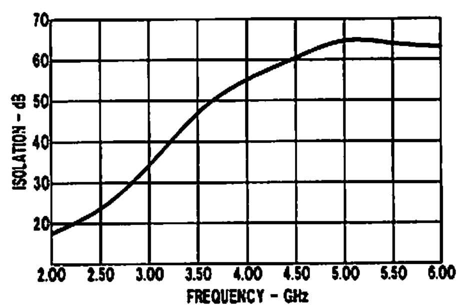
NOTES:
1. LO: 4.0 GHz @ +10 dBm
2. RF: 3.9 GHz

R-Port VSWR

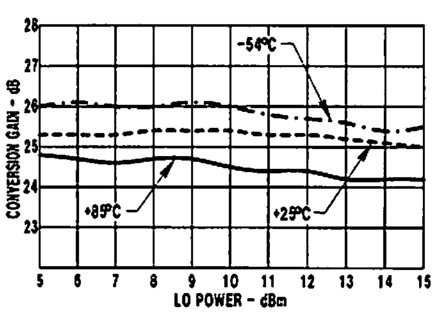


NOTES:
1. LO: 2.1 TO 6.1 GHz @ +10 dBm
2. RF: 2.0 TO 6.0 GHz @ -20 dBm

L to I Isolation

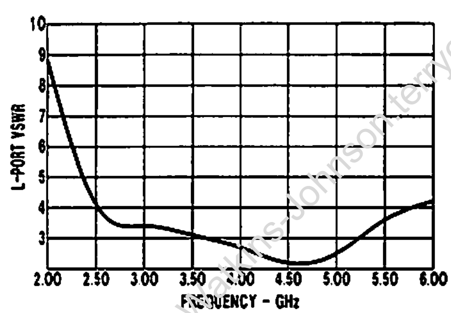


Conversion Gain vs. LO Power



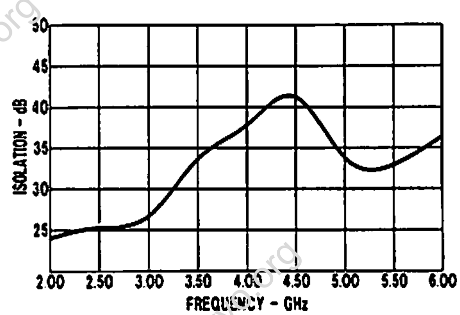
NOTES:
1. LO: 4.0 GHz
2. RF: 3.9 GHz

L-Port VSWR



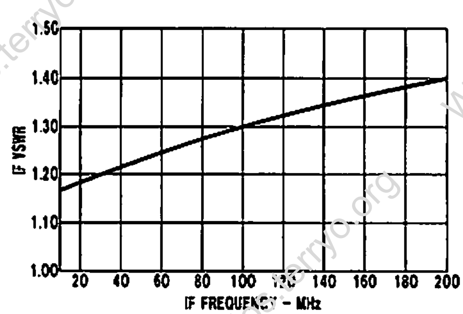
NOTES:
1. LO: 2.0 TO 6.0 GHz @ +10 dBm

R to I Isolation



NOTES:
1. LO: 2.1 TO 6.1 GHz @ +10 dBm
2. RF: 2.0 TO 6.0 GHz

IF VSWR

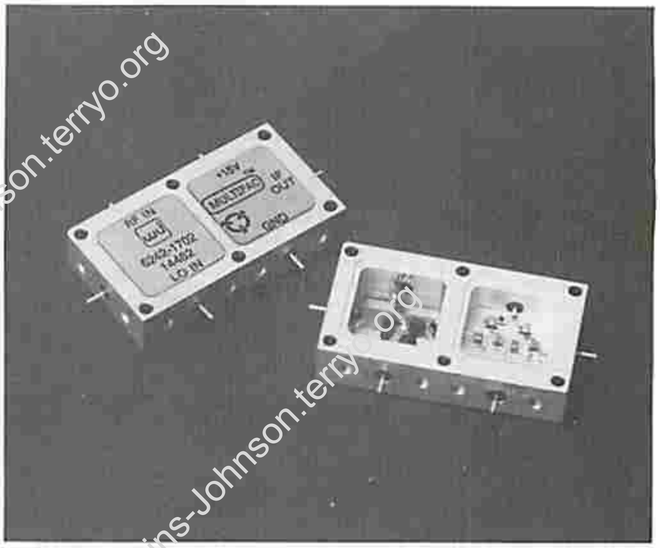


NOTES:
1. LO: 4.0 GHz @ +10 dBm

4

WJ-6242-1702

9 TO 10 GHz DOWNCONVERTER



- LOW NOISE
- HIGH CONVERSION GAIN
- MEDIUM OUTPUT POWER
- MULTIPAC™ PACKAGE

Specifications*

Characteristics	Typical	Guaranteed 0° to +50°C	-54° to +85°C
Frequency (Min.)			
RF	8.0-11.0 GHz	9.0-10.0 GHz	9.0-10.0 GHz
LO	8.0-10.0 GHz	9.0-10.0 GHz	9.0-10.0 GHz
IF	50-100 MHz	70 MHz	70 MHz
Conversion Gain (Min.)	27.5 dB	25.0 dB	24.0 dB
Gain Flatness (Max.)			
RF	±0.5 dB	±1.0 dB	±1.0 dB
IF	±0.5 dB	±1.0 dB	±1.0 dB
Noise Figure (Max.)	7.25 dB	8.0 dB	8.5 dB
Power Output at 1 dB Compression (Min.)	+13.5 dB	+12.5 dB	+12.0 dB
VSWR (Max.)			
RF	2.2:1		
LO	1.5:1		
IF	1.4:1	1.7:1	2.0:1
Isolation (Min.)			
L to R	35 dB	30 dB	30 dB
L to I	55 dB	45 dB	45 dB
R to I	25 dB	18 dB	18 dB
DC Current at +15 Volts	75 mA	80 mA	90 mA
Third-Order Output Intercept	+26 dBm		

* Measured in a 50-ohm system, using push-on connectors, with LO power of +10 dBm. Typical values are at 25°C.

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C

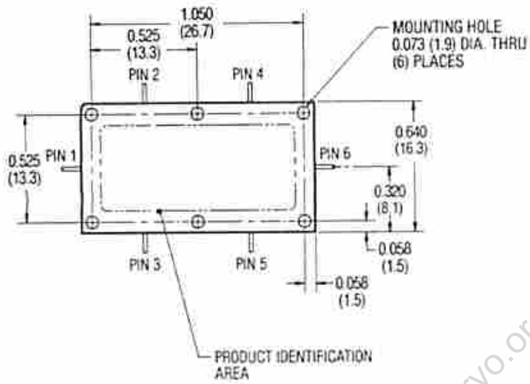
Maximum Case Temperature . . . . +125°C

Maximum DC Voltage . . . . +17 Volts

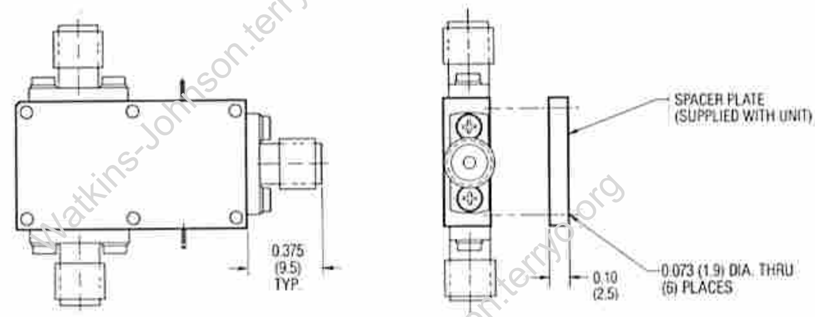
Maximum Continuous RF Input Power . . . . +20 dBm

Outline Drawings

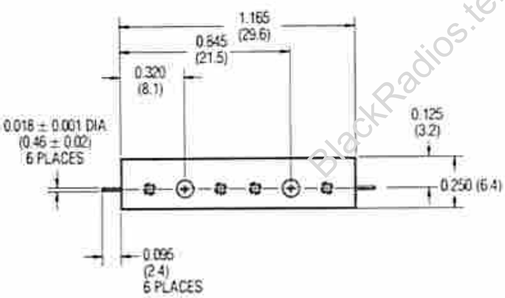
6242-1702



6242-1702C



DIMENSIONS ARE IN INCHES (MILLIMETERS)



DIMENSIONS ARE IN INCHES (MILLIMETERS)

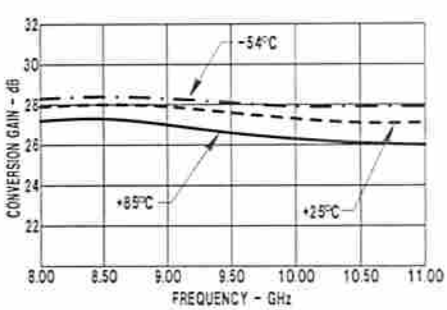
Weight

6242-1702: 17.5 grams (0.62 oz.) max.
6242-1702C: 26.5 grams (0.93 oz.) max.

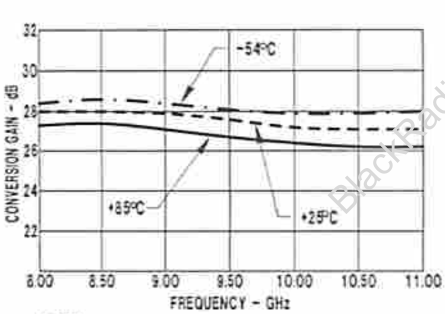
Pin Number	1	2	3	4	5	6
Designation	N.C.	RF_{IN}	LO_{IN}	V_{DC}	N.C.	IF

Typical Performance at 25°C

Conversion Gain

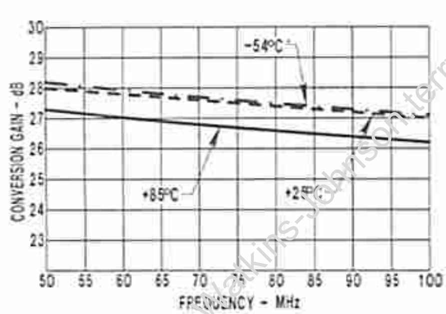


NOTES:
1. LO: 8.07 TO 11.07 GHz @ +10 dBm
2. RF: 8.00 TO 11.00 GHz
3. IF: 70 MHz
4. LO > RF



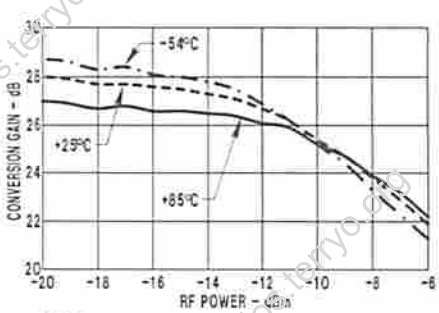
NOTES:
1. LO: 7.93 TO 10.93 @ +10 dBm
2. RF: 8.0 TO 11.0 GHz
3. IF: 70 MHz
4. LO < RF

Conversion Gain vs. IF Frequency



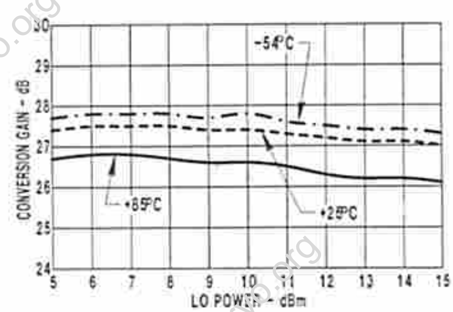
NOTES:
1. LO: 9.5 GHz @ +10 dBm
2. RF: 9.40 TO 9.45 GHz

Conversion Gain vs. RF Power



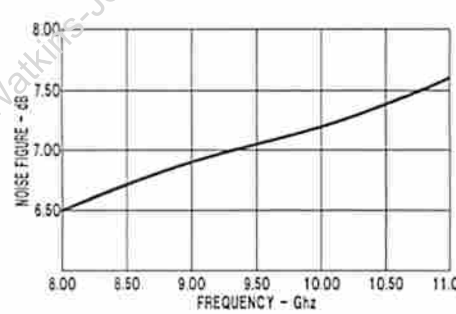
NOTES:
1. LO: 9.5 GHz @ +10 dBm
2. RF: 9.43 GHz

Conversion Gain vs. LO Power



NOTES:
1. LO: 9.5 GHz
2. RF: 9.43 GHz

Noise Figure

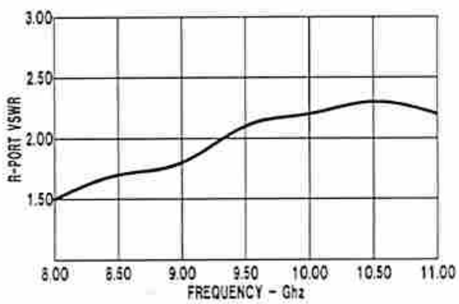


NOTES:
1. IF: 70 MHz

4

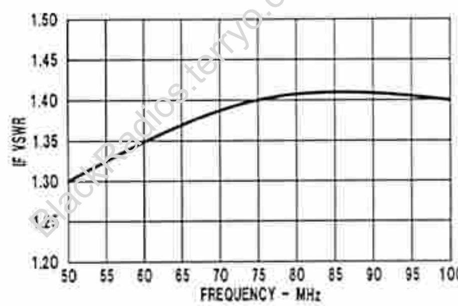
Typical Performance at 25°C (Cont.)

R-Port VSWR

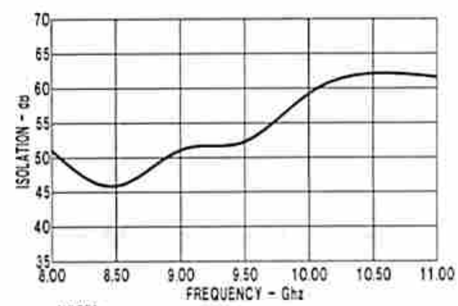


NOTES:
1. LO: 8.07 TO 11.07 GHz @ +10 dBm
2. RF: 8.0 TO 11.0 GHz

IF VSWR

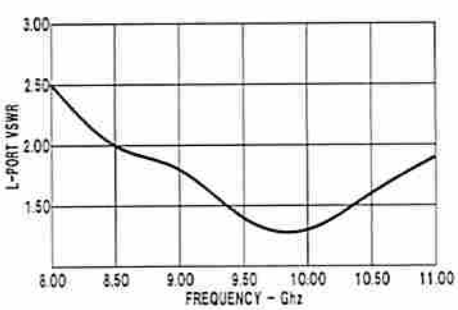


L to I Isolation



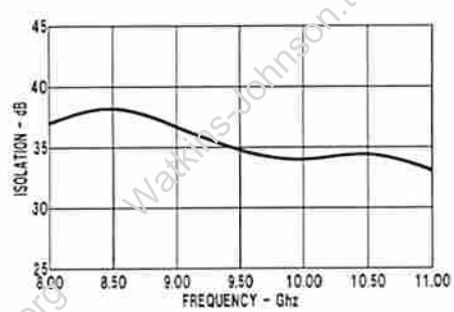
NOTES:
1. LO: 8.0 TO 11.0 GHz @ +10 dBm

L-Port VSWR



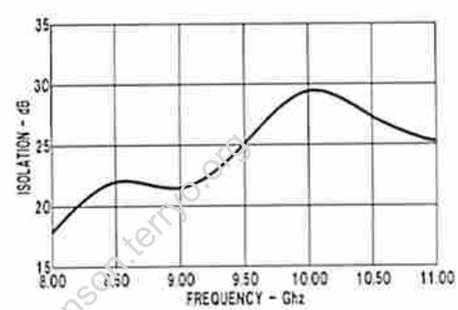
NOTES:
1. LO: 8.0 TO 11.0 GHz @ +10 dBm

L to R Isolation



NOTES:
1. LO: 8.0 TO 11.0 GHz @ +10 dBm

R to I Isolation

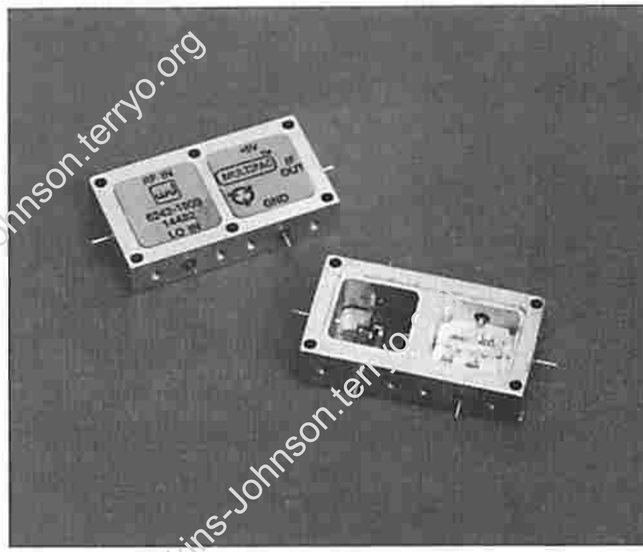


NOTES:
1. LO: 8.07 TO 11.07 GHz @ +10 dBm
2. RF: 8.00 TO 11.00 GHz

WJ-6242-1809

2 TO 18 GHz DOWNCONVERTER

- MULTIOCTAVE: 2 to 18 GHz
- LOW NOISE FIGURE: 11.5 (TYP.)
- FET IF AMPLIFIER
- LOW DC POWER CONSUMPTION: 62 mA @ 5 V (TYP.)



Specifications*

Characteristics	Typical	Guaranteed 0° to +50°C	Guaranteed -54° to +85°C
Frequency (Min.)			
RF	2-18 GHz	2-18 GHz	2-18 GHz
LO	2-18 GHz	2-18 GHz	2-18 GHz
IF	2-6 GHz	2-6 GHz	2-6 GHz
Conversion Gain (Min.)	9.0 dB	4.0 dB	3.5 dB
Gain Flatness (Max.)			
RF	±1.5 dB	±2.5 dB	±3.0 dB
IF	±1.0 dB	±1.25 dB	±1.5 dB
Noise Figure (Max.)	11.5 dB	14.5 dB	15.0 dB
Power Output at 1 dB Compression (Min.)	+12.5 dBm	+10.5 dBm	+10.0 dBm
VSWR (Max.)			
RF	2.0:1		
LO	1.8:1		
IF	1.3:1	2.0:1	2.0:1
Isolation (Min.)			
L to R	20 dB	15 dB	10 dB
L to I 2-6 GHz	15 dB	0 dB	0 dB
L to I 6-18 GHz	40 dB	20 dB	20 dB
R to I 2-6 GHz	10 dB	0 dB	0 dB
R to I 6-17 GHz	30 dB	10 dB	10 dB
DC Current at +5 Volts	62 mA	66 mA	70 mA
Third-Order Output Intercept	+23 dBm		

Notes:

1. Measured in a 50-ohm system, using push-on connectors, with LO power of +10 dBm. Typical values are at 25°C.

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C

Maximum Case Temperature . . . . +125°C

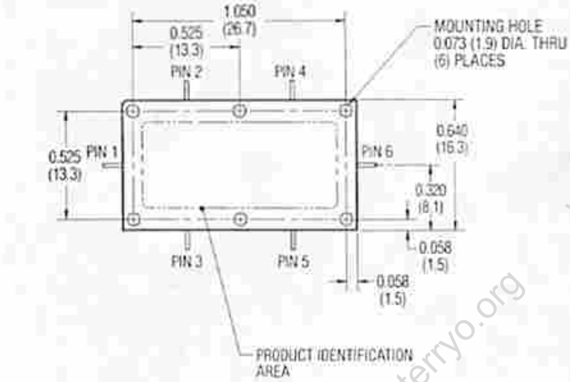
Maximum DC Voltage . . . .+6 Volts

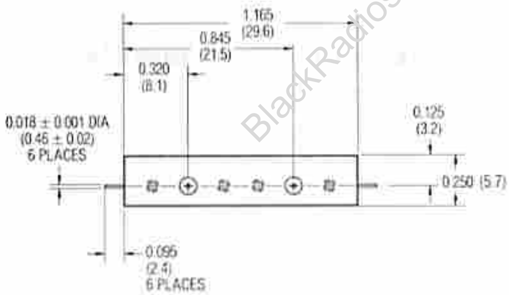
Maximum Continuous RF Input Power 400 mW @ +25°C, 150 mW @ +100°C

4

Outline Drawings

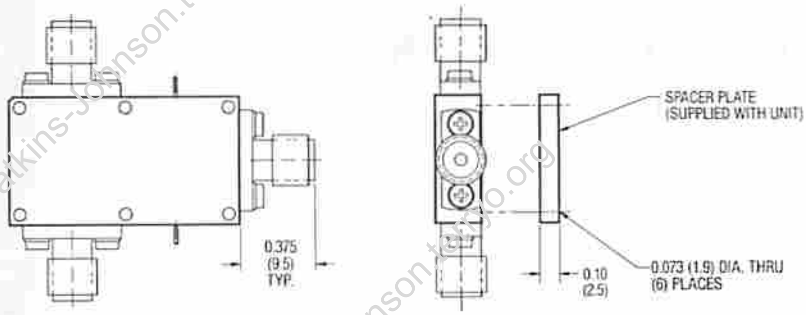
6242-1809





DIMENSIONS ARE IN INCHES (MILLIMETERS)

6242-1809C



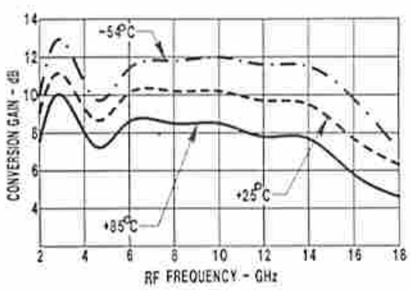
DIMENSIONS ARE IN INCHES (MILLIMETERS)

Weight 6242-1809: 17.5 grams (0.62 oz.) max.
6242-1809C: 26.5 grams (0.93 oz.) max.

Pin Number	1	2	3	4	5	6
Designation	N.C.	RF_{IN}	LO_{IN}	V_{DC}	N.C.	IF_{OUT}

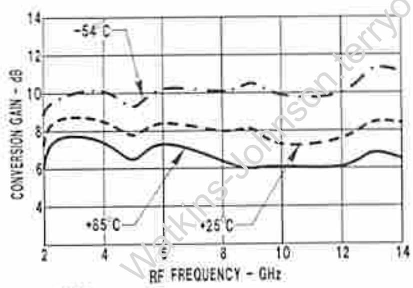
Typical Performance at 25°C

Conversion Gain vs. RF Frequency



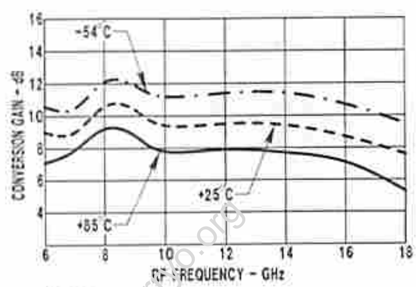
NOTES:
1. LO: 4.0 TO 20.0 GHz @ +10 dBm
2. RF: 2.0 TO 18.0 GHz @ -10 dBm
3. IF: 2.0 GHz
4. LO > RF

Conversion Gain vs. RF Frequency

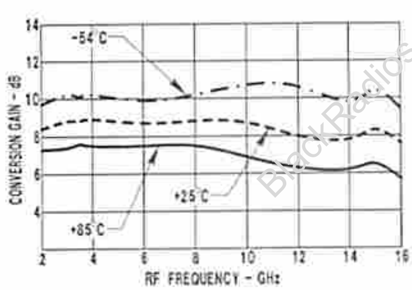


NOTES:
1. LO: 8.0 TO 20.0 GHz @ +10 dBm
2. RF: 2.0 TO 14.0 GHz @ -10 dBm
3. IF: 6.0 GHz
4. LO > RF

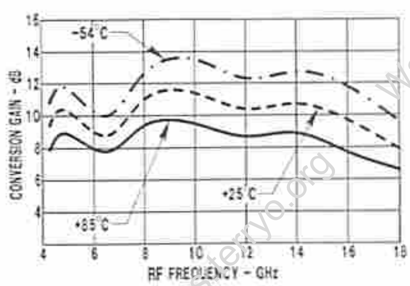
Conversion Gain vs. RF Frequency



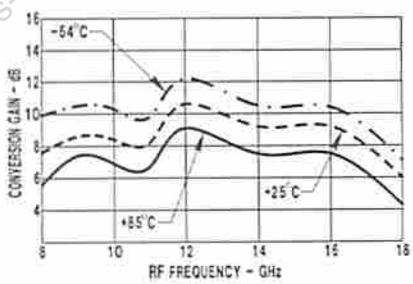
NOTES:
1. LO: 2.0 TO 14.0 GHz @ +10 dBm
2. RF: 6.0 TO 18.0 GHz @ -10 dBm
3. IF: 4.0 GHz
4. LO < RF



NOTES:
1. LO: 6.0 TO 20.0 GHz @ +10 dBm
2. RF: 2.0 TO 16.0 GHz @ -10 dBm
3. IF: 4.0 GHz
4. LO > RF



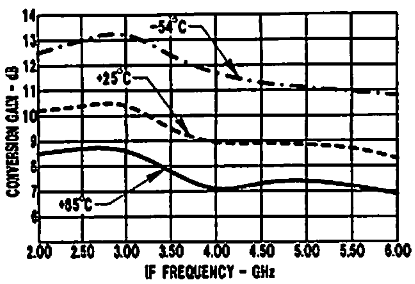
NOTES:
1. LO: 2.0 TO 18.0 GHz @ +10 dBm
2. RF: 4.0 TO 18.0 GHz @ -10 dBm
3. IF: 2.0 GHz
4. LO < RF



NOTES:
1. LO: 2.0 TO 12.0 GHz @ +10 dBm
2. RF: 8.0 TO 18.0 GHz @ -10 dBm
3. IF: 6.0 GHz
4. LO < RF

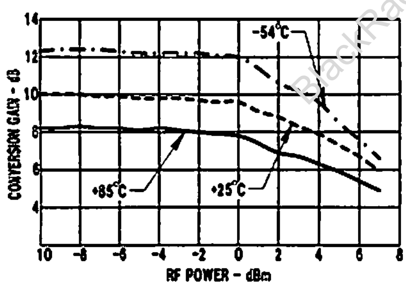
Typical Performance at 25°C (Cont.)

Conversion Gain vs. IF Frequency



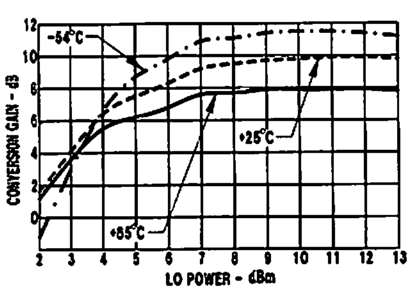
NOTES:
1. LO: 18.0 GHz @ +10 dBm
2. RF: 10.0 TO 14.0 GHz @ -10 dBm

Conversion Gain vs. RF Input Power



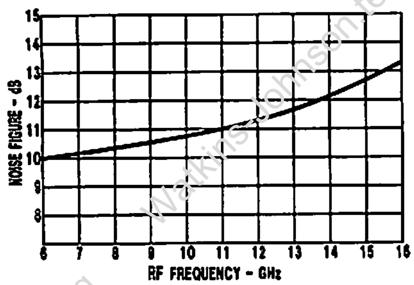
NOTES:
1. LO: 13.0 GHz
2. RF: 11.0 GHz

Conversion Gain vs. LO Power



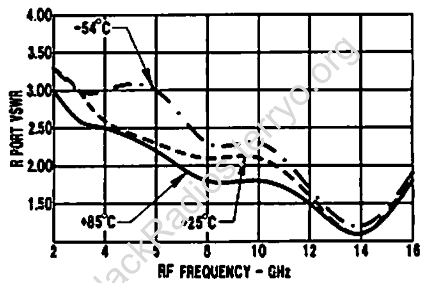
NOTES:
1. LO: 13.0 GHz
2. RF: 11.0 GHz

Noise Figure vs. RF Frequency



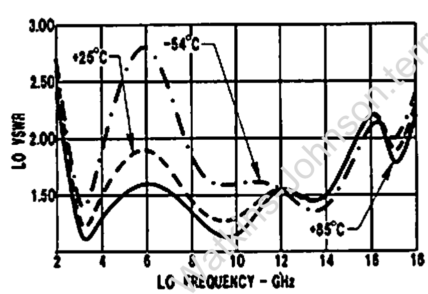
NOTES:
1. LO: 8.0 TO 18.0 GHz @ +10 dBm
2. RF: 6.0 TO 16.0 GHz @ -10 dBm
3. IF: 2.0 GHz
4. LO > RF

R-Port VSWR

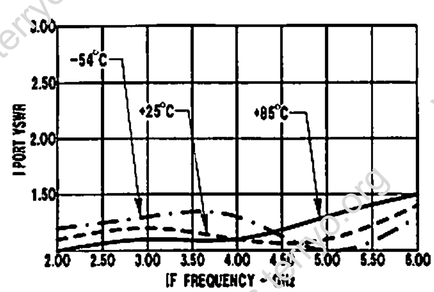


NOTES:
1. LO: 8.0 TO 20.0 GHz @ +10 dBm
2. RF: 2.0 TO 16.0 GHz @ -10 dBm

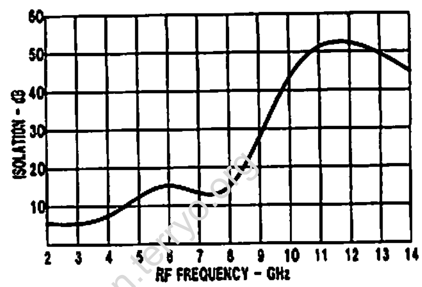
L-Port VSWR



IF VSWR

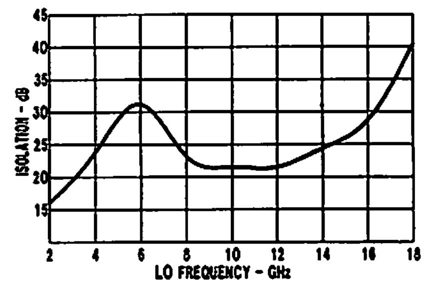


R to I Isolation

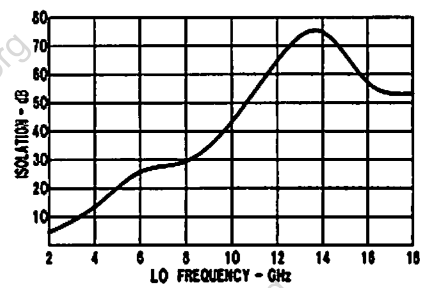


NOTES:
1. RF: 2.0 TO 14.0 GHz @ -20 dBm
2. LO: 8.0 TO 20.0 GHz @ +10 dBm
3. IF: 6 GHz

L to R Isolation



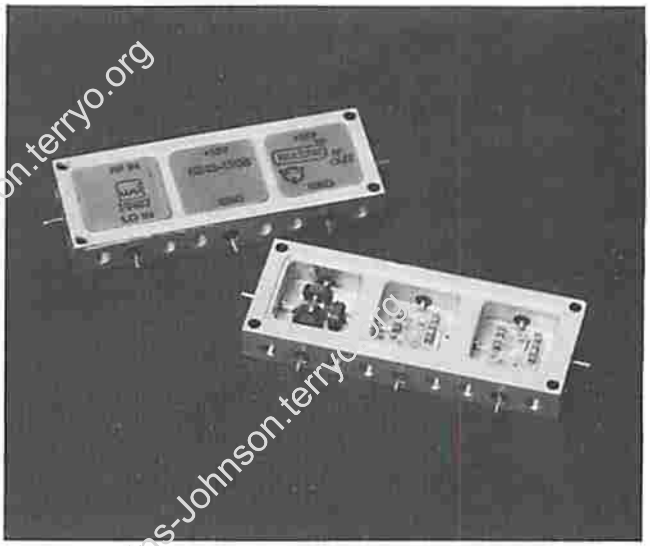
L to I Isolation



4

WJ-6243-1206

0.05 TO 3.0 GHz DOWNCONVERTER



- INSENSITIVE TO SYSTEM MISMATCH (CLASS IV MIXER)
- HIGH GAIN: 23 dB (TYP.)
- LOW DC POWER CONSUMPTION: 35 mA @ 15 V (TYP.)
- MEDIUM OUTPUT POWER: +7 dBm (TYP.)

Specifications*

Characteristics	Typical	Guaranteed 0° - +50°C	Guaranteed -54° - +85°C
Frequency (Min.)			
RF	0.05-3.0 GHz	0.05-3.0 GHz	0.05-3.0 GHz
LO	0.05-3.0 GHz	0.05-3.0 GHz	0.05-3.0 GHz
IF	10-1000 MHz	10-1000 MHz	10-1000 MHz
Conversion Gain (Min.)	20.0 dB	18.0 dB	17.0 dB
Gain Flatness (Max.)			
RF	±1.25 dB	±1.5 dB	±2.0 dB
IF	±2.0 dB	±2.25 dB	±2.5 dB
Noise Figure (Max.)	11.0 dB	12.0 dB	13.0 dB
Power Output at 1 dB Compression (Min.)	+9.0 dBm	+7.0 dBm	+6.5 dBm
VSWR (Max.)			
RF	2.5		
LO	2.0		
IF	1.8:1	2.1:1	2.3:1
Isolation (Min.)			
L to R	35 dB	30 dB	30 dB
L to I	20 dB	3 dB	0 dB
R to I 10-1200 MHz	-10 dB	-15 dB	-15 dB
R to I 1200-3000 MHz	15 dB	10 dB	10 dB
DC Current at 15.0 Volts	35.0 mA	36.0 mA	37.0 mA
Third-Order Output Intercept	+16.0 dBm		

*Measured in a 50-ohm system, using push-on connectors, with LO power of +10 dBm. Typical values are at 25°C.

Absolute Maximum Ratings

Storage Temperature . . . . -62°C to +125°C

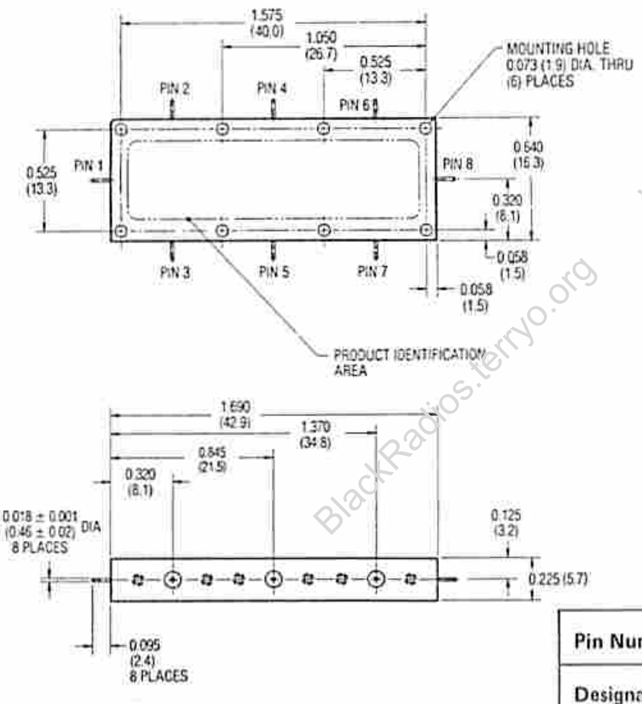
Maximum Case Temperature . . . . +125°C

Maximum DC Voltage . . . . +21 Volts

Maximum Continuous RF Input Power . . . . +20 dBm

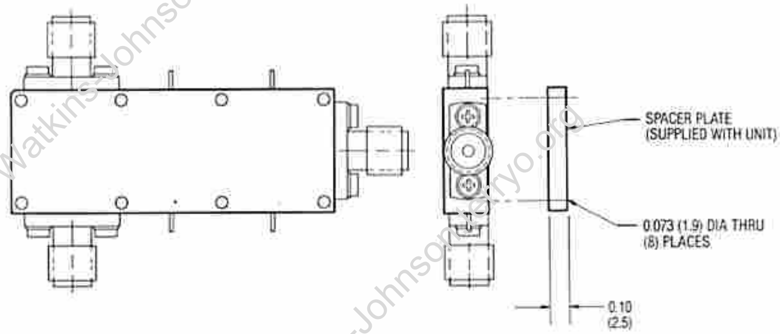
Outline Drawings

6243-1206



DIMENSIONS ARE IN INCHES (MILLIMETERS)

6243-1206C



DIMENSIONS ARE IN INCHES (MILLIMETERS)

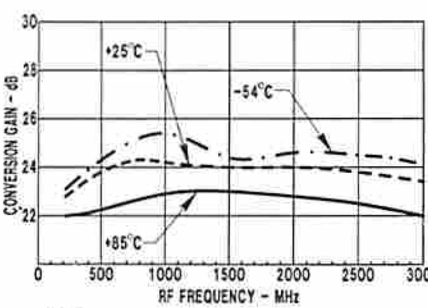
Weight

6243-1206: 25.0 grams (0.88 oz.) max.
6243-1206C: 33.0 grams (1.16 oz.) max.

Pin Number	1	2	3	4	5	6	7	8
Designation	N.C.	RF_{IN}	LO_{IN}	V_{DC}	N.C.	V_{DC}	N.C.	IF_{OUT}

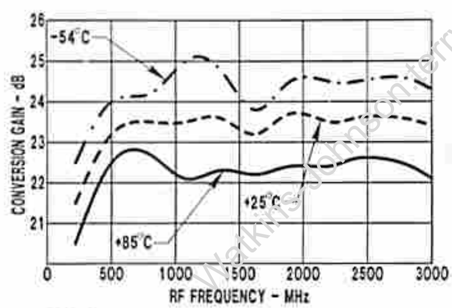
Typical Performance at 25°C

Conversion Gain vs. RF Frequency



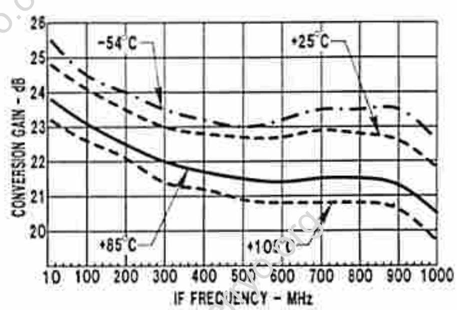
NOTES:
1. IF: 100 MHz
2. LO > RF

Conversion Gain vs. RF Frequency

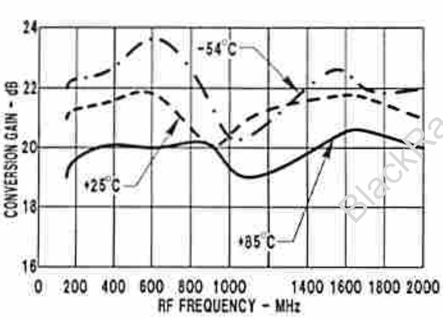


NOTES:
1. IF: 100 MHz
2. LO < RF

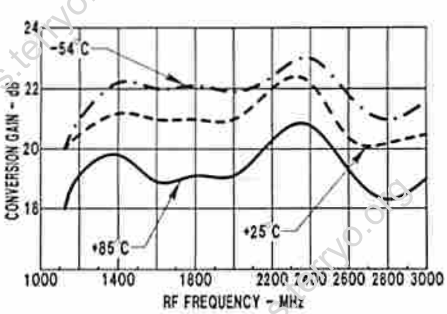
Conversion Gain vs. IF Frequency



NOTES:
1. LO: 2.5 GHz @ +10 dBm
2. RF: 1.5-2.49 GHz
3. LO > RF

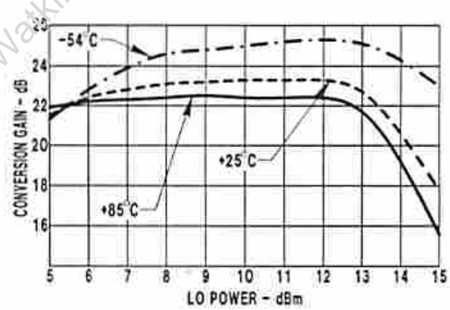


NOTES:
1. IF: 1000 MHz
2. LO > RF



NOTES:
1. IF: 1000 MHz
2. LO < RF

Conversion Gain vs. LO Power

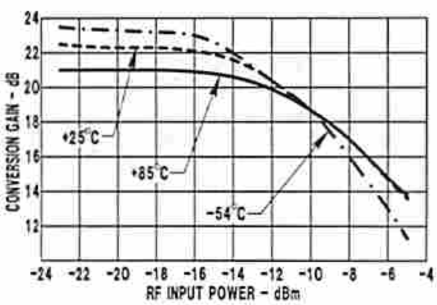


NOTES:
1. LO: 1000 MHz
2. RF: 900 MHz

4

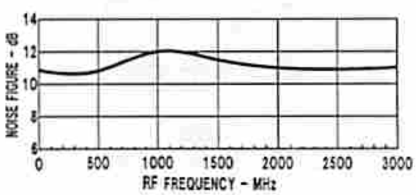
Typical Performance at 25°C (Cont.)

Conversion Gain vs. RF Input Power



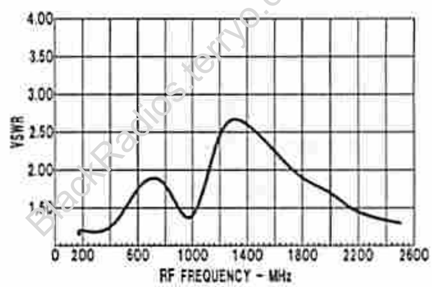
NOTES:
1. 1.5 GHz @ +10 dBm
2. RF: 1 GHz

Noise Figure vs. RF Frequency

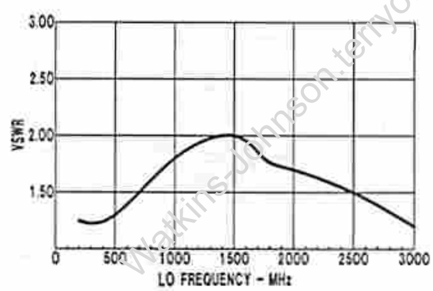


NOTES:
1. IF: 30 MHz
2. LO > RF

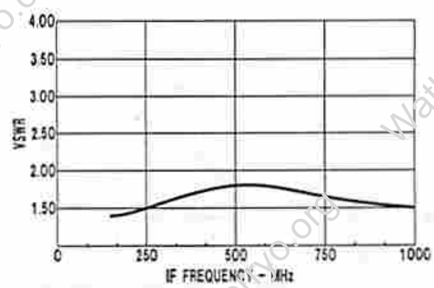
R-Port VSWR



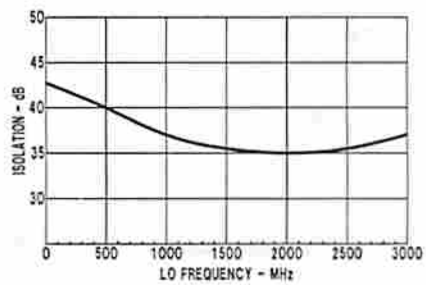
L-Port VSWR



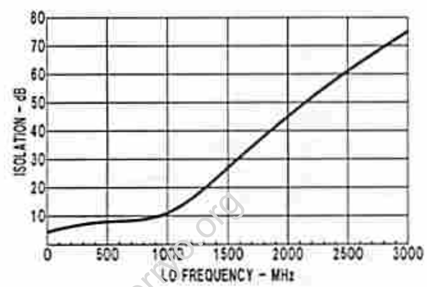
I-Port VSWR



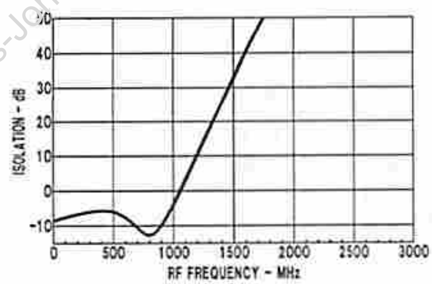
L to R Isolation



L to I Isolation

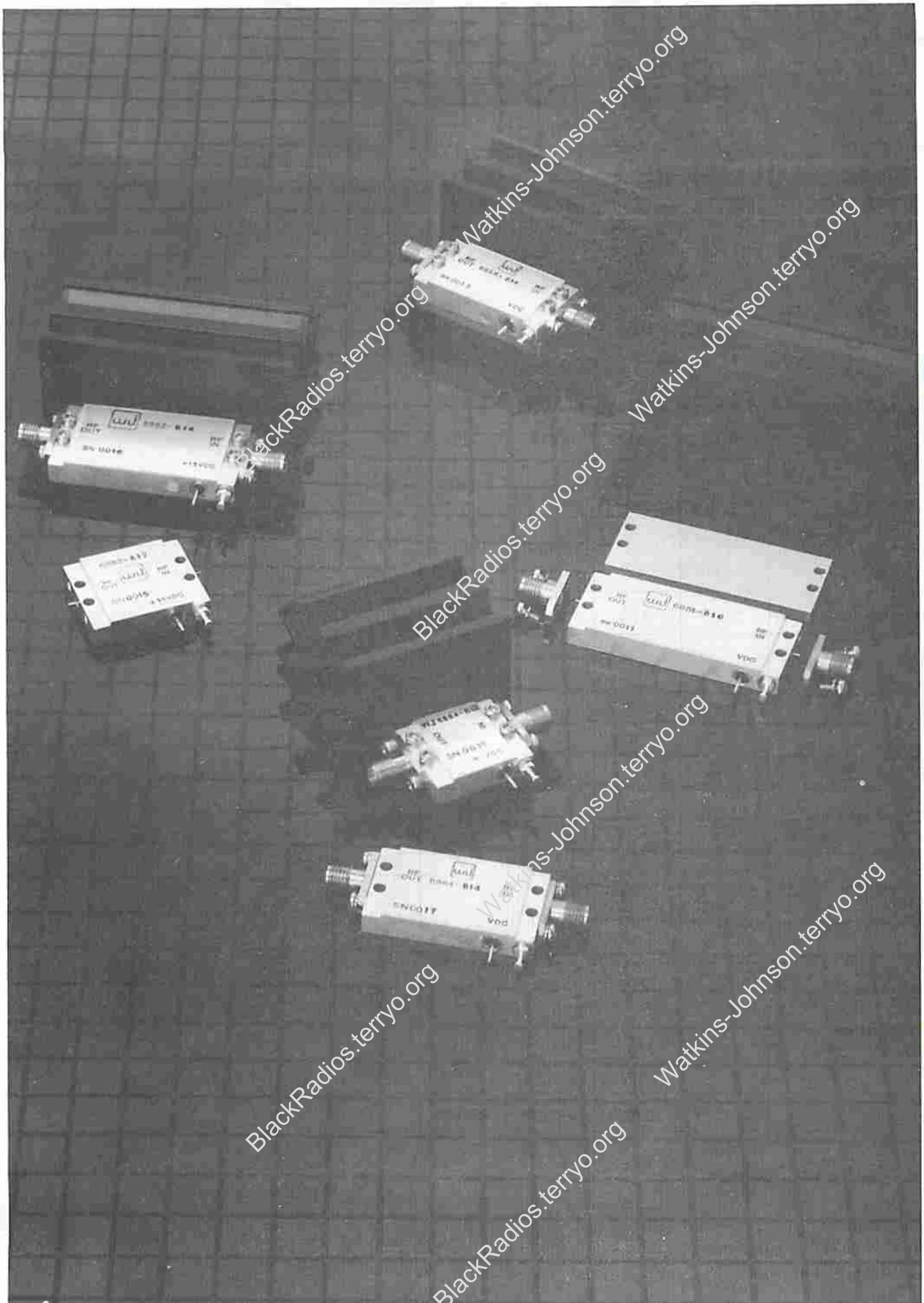


R to I Isolation

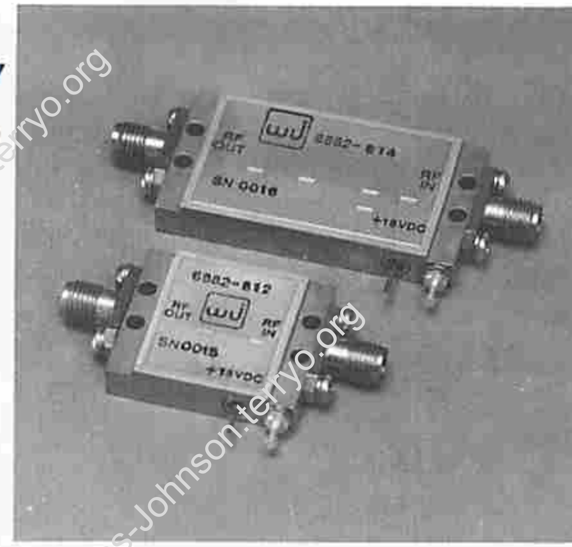


Multi-Stage Microwave Amplifiers

5



WJ-6882-812, -813, -814, -824



2 TO 8 GHz MICROWAVE AMPLIFIERS

- GAIN 21–44 dB (4 MODELS)
- NOISE FIGURE: 3.5 dB (TYP.)
- OUTPUT POWER: +20 & +25 dBm
- INTERNAL VOLTAGE REGULATION

Typical and Guaranteed Specifications (+25°C)

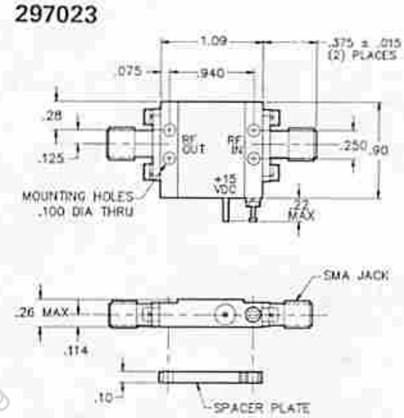
WJ-6882	-812	-813	-814	-824	Units
Frequency	2.0-8.0	2.0-8.0	2.0-8.0	2.0-8.0	GHz
RF Gain					
Typical	24	36	48	44	dB
Minimum	21	33	44	40	dB
Gain Flatness (Maximum)	±0.75	±1.0	±1.0	±1.0	dB
Noise Figure					
Typical	3.5	3.5	3.5	3.5	dB
Maximum	4.0	4.0	4.0	4.0	dB
Power Output at 1 dB Compression (Min.)	+20	+20	+20	+25	dBm
Intercept Point (Typical)					
3rd Order Two Tone	+30	+30	+30	+36	dBm
2nd Harmonic	+48	+48	+48	+54	dBm
VSWR (Maximum)					
Input	2.0:1	2.0:1	2.0:1	2.0:1	
Output	1.7:1	1.7:1	1.7:1	1.7:1	
DC Current (Maximum)	185	265	325	475	mA
DC Operating Voltage					
Minimum	+10.5	+10.5	+10.5	+12.0	Volts
Maximum	+18	+18	+18	+18	Volts
Outline Drawing	297023	297024	297024	297024	

Absolute Maximum Ratings

Case Operating Temperature . . . . -54° to +100°C
Storage Temperature . . . . -62° to +125°C
Short Therm (1 Hour) CW Input Level . . . . +20 dBm
Peak Pulsed (10 μsec) Input Level. . . . . +24 dBm
DC Reverse Voltage . . . . -40 Volts

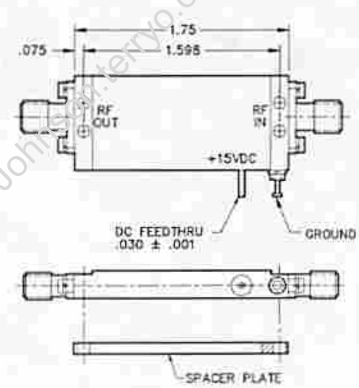
Outline Drawings

297023



Weight 1.2 oz. max.

297024

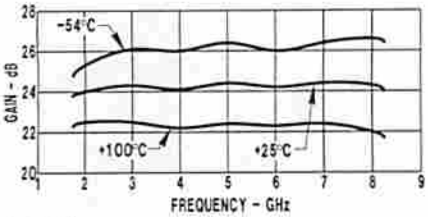


Weight 1.4 oz. max.

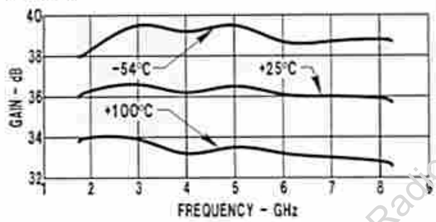
Typical Performance

Gain

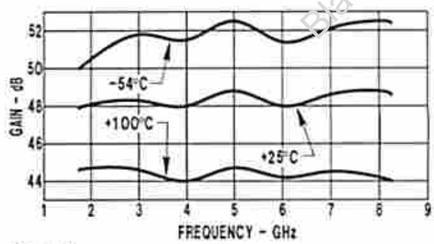
(-812)



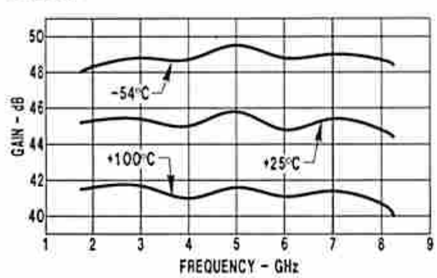
(-813)



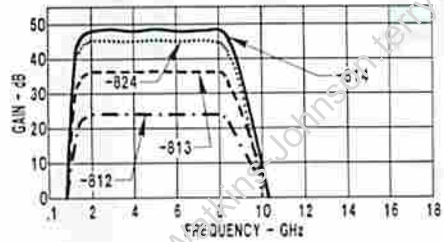
(-814)



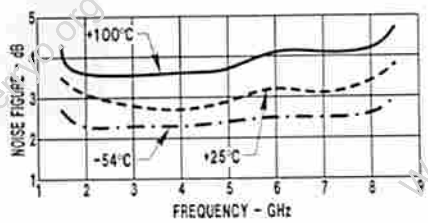
(-824)



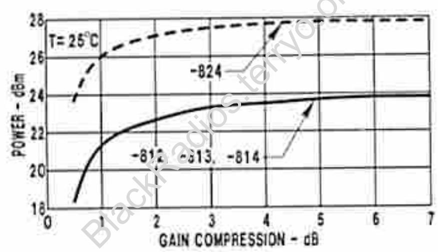
Broadband Gain



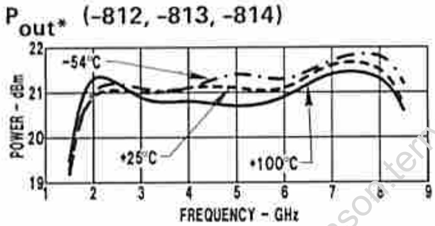
Noise Figure
(All Models)



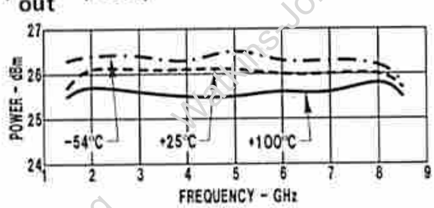
Power Output



P_{out}* (-812, -813, -814)

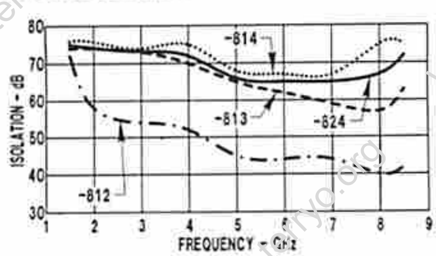


P_{out}* (-824)

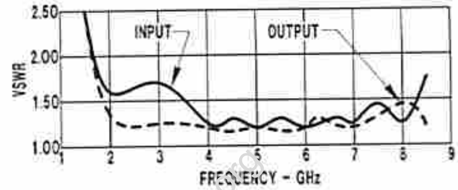


*at 1 dB Gain Compression

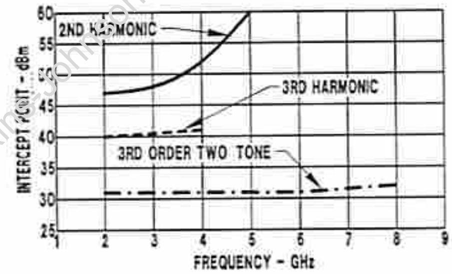
Reverse Isolation



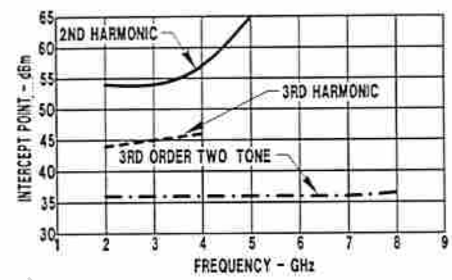
VSWR
(All Models)



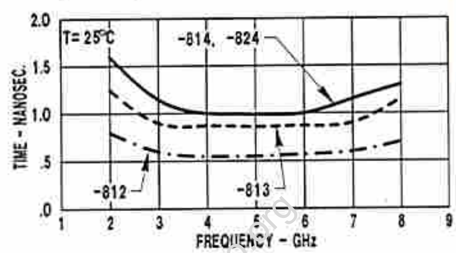
Intercept Point
(-812, -813, -814)



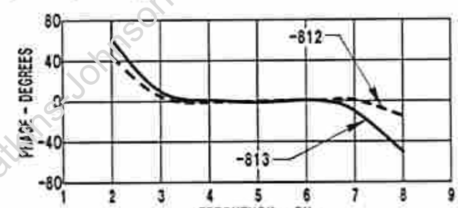
(-824)



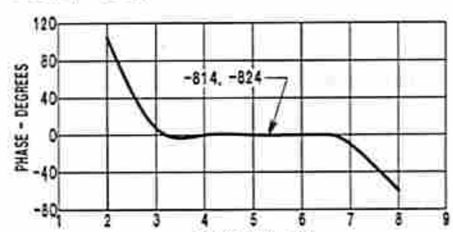
Group Delay



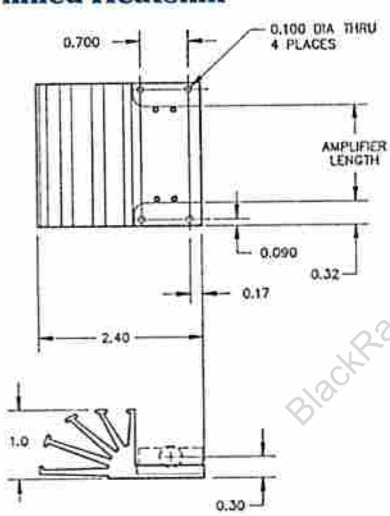
Deviation from Linear Phase
(-812, -813)



(-814, -824)

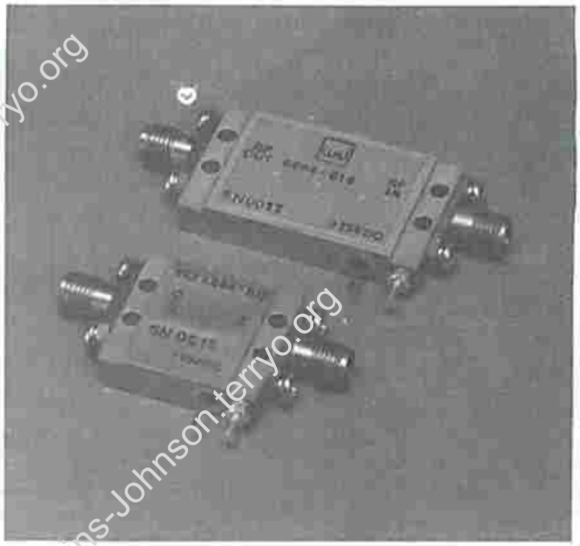


Finned Heatsink



Notes:
Dimensions are in inches. Tolerances: X.XXX ± 0.005, X.XX ± 0.02 inches. Amplifiers are supplied with RF connectors installed and mounted on a heatsink. A spacer plate and mounting fasteners are provided for alternate mounting configurations. The heatsink is easily removed, but is recommended for incoming test and laboratory applications. RF connectors can be removed for "drop in" microstrip applications. RF pin dimensions: 0.015 dia. x 0.07 long.

WJ-6884-812, -813, -814, -824



5 TO 12 GHz MICROWAVE AMPLIFIERS

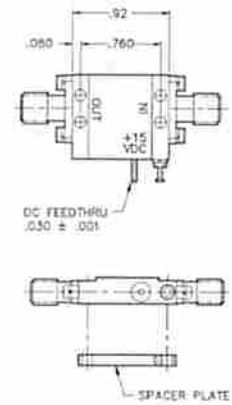
- GAIN 16–34 dB (4 MODELS)
- NOISE FIGURE: 4.2 dB (TYP.)
- OUTPUT POWER: +18 & +23 dBm
- INTERNAL VOLTAGE REGULATION

Typical and Guaranteed Specifications (+25°C)

WJ-6884	-812	-813	-814	-824	Units
Frequency	5.0-12.0	5.0-12.0	5.0-12.0	5.0-12.0	GHz
RF Gain					
Typical	19	27	38	34	dB
Minimum	16	25	34	30	dB
Gain Flatness (Maximum)	±0.75	±0.75	±0.75	±1.0	dB
Noise Figure					
Typical	4.2	4.2	4.2	4.2	dB
Maximum	4.8	4.8	4.8	4.8	dB
Power Output at 1 dB Compression (Min.)	+18	+18	+18	+23	dBm
Intercept Point (Typical)					
3rd Order Two Tone	+28	+28	+28	+33	dBm
2nd Harmonic	+35	+35	+35	+40	dBm
VSWR (Maximum)					
Input	2.0:1	2.0:1	2.0:1	2.0:1	
Output	1.7:1	1.7:1	1.7:1	1.7:1	
DC Current (Maximum)	150	220	290	450	mA
DC Operating Voltage					
Minimum	+9.0	+9.0	+9.0	+12.0	Volts
Maximum	+18.0	+18.0	+18.0	+18.0	Volts
Outline Drawing	297016	297017	297017	297017	

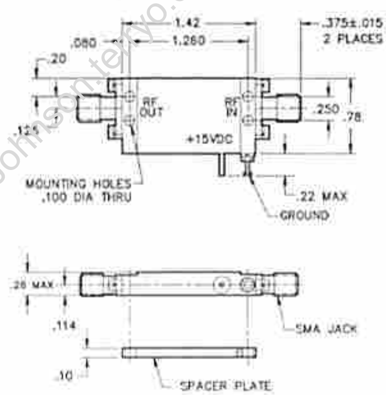
Outline Drawings

297016



Weight 1.2 oz. max.

297017



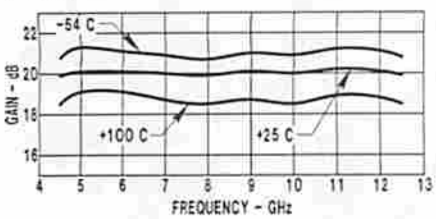
Weight 1.4 oz. max.

Absolute Maximum Ratings

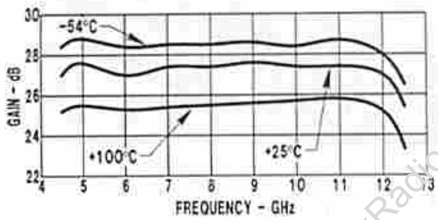
Case Operating Temperature . . . . -54° to +100°C
Storage Temperature . . . . -62° to +125°C
Short Therm (1 Hour) CW Input Level . . . . +18 dBm
Peak Pulsed (10 μsec) Input Level. . . . . +23 dBm
DC Reverse Voltage . . . . -40 Volts

Typical Performance

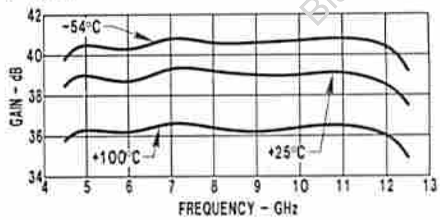
Gain
(-812)



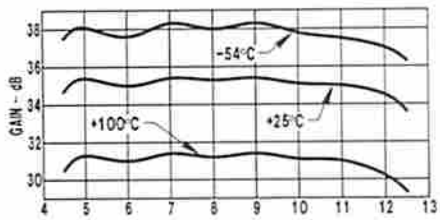
(-813)



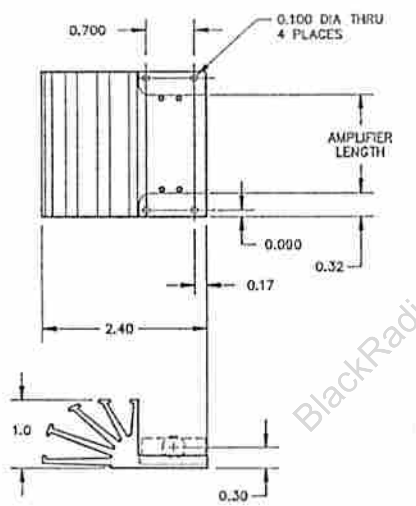
(-814)



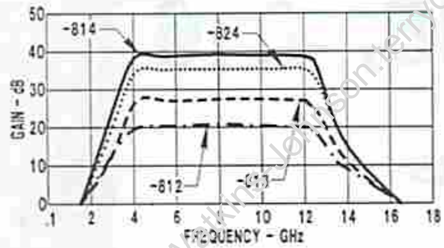
(-824)



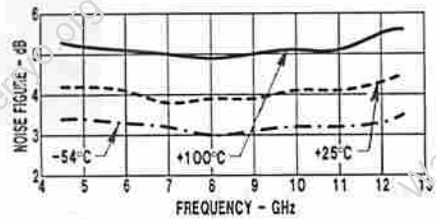
Finned Heatsink



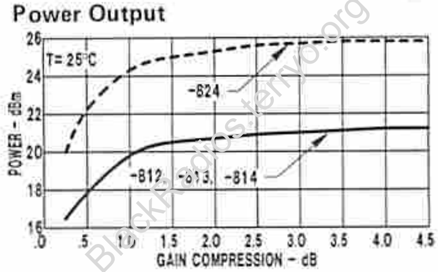
Broadband Gain



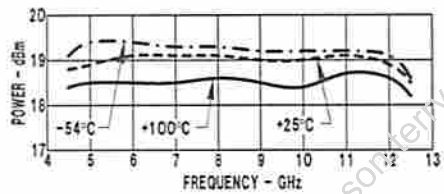
Noise Figure
(All Models)



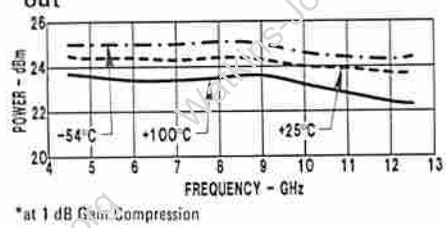
Power Output



P_{out}* (-812, -813, -814)

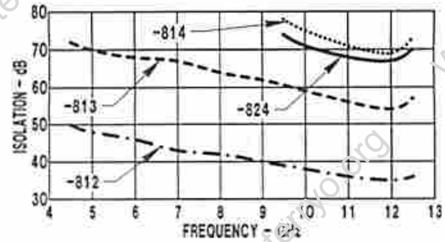


P_{out}* (-824)

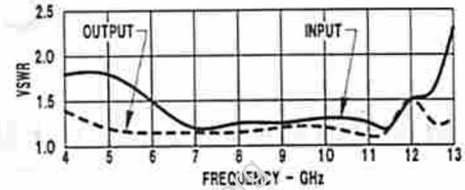


*at 1 dB Gain Compression

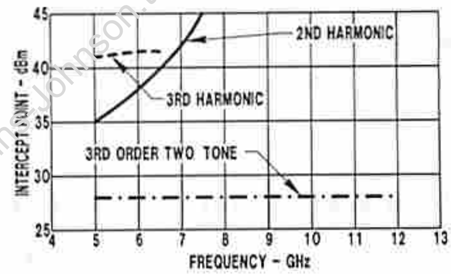
Reverse Isolation



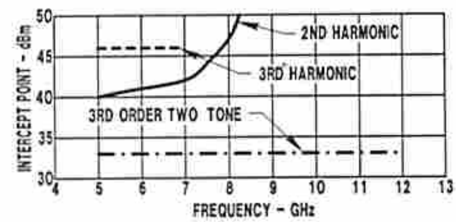
VSWR
(All Models)



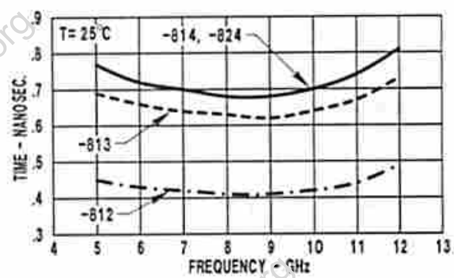
Intercept Point
(-812, -813, -814)



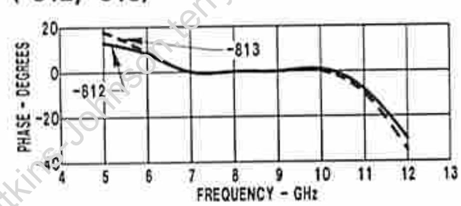
(-824)



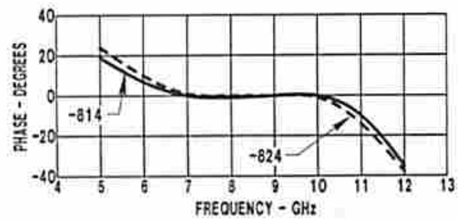
Group Delay



Deviation from Linear Phase
(-812, -813)



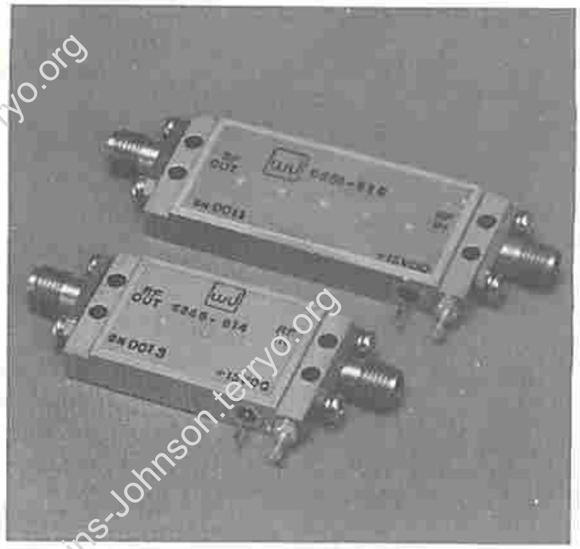
(-814, -824)



Notes:
Dimensions are in inches. Tolerances: X.XXX ± 0.005, X.XX ± 0.02 inches. Amplifiers are supplied with RF connectors installed and mounted on a heatsink. A spacer plate and mounting fasteners are provided for alternate mounting configurations. The heatsink is easily removed, but is recommended for incoming test and laboratory applications. RF connectors can be removed for "drop in" microstrip applications. RF pin dimensions: 0.015 dia. x 0.07 long.

5

WJ-6885-813, -814, -815, -816



6 TO 18 GHz MICROWAVE AMPLIFIERS

- GAIN 15 – 33 dB (4 MODELS)
- NOISE FIGURE: 6.0 dB (TYP.)
- OUTPUT POWER: +15 dBm
- INTERNAL VOLTAGE REGULATION

Typical and Guaranteed Specifications (+25°C)

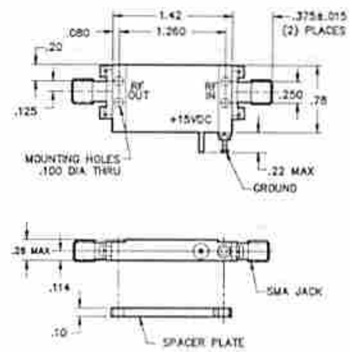
WJ-6885	-813	-814	-815	-816	Units
Frequency	6.0-18.0	6.0-18.0	6.0-18.0	6.0-18.0	GHz
RF Gain					
Typical	17	23	29	36	dB
Minimum	15	21	26	33	dB
Gain Flatness (Maximum)	±1.0	±1.5	±1.5	±1.75	dB
Noise Figure					
Typical	6.0	6.0	6.0	6.0	dB
Maximum	7.5	7.5	7.5	7.5	dB
Power Output at 1 dB Compression (Min.)	+15	+15	+15	+15	dBm
Intercept Point (Typical)					
3rd Order Two Tone	+25	+25	+25	+25	dBm
2nd Harmonic	+35	+35	+35	+35	dBm
VSWR (Maximum)					
Input	2.2:1	2.2:1	2.2:1	2.2:1	
Output	2.0:1	2.0:1	2.0:1	2.0:1	
DC Current (Maximum)	220	290	360	430	mA
DC Operating Voltage					
Minimum	+9.0	+9.0	+9.0	+9.0	Volts
Maximum	+18.0	+18.0	+18.0	+18.0	Volts
Output Drawing	297017	297017	297014	297014	

Absolute Maximum Ratings

Case Operating Temperature . . . . -54° to +100°C
Storage Temperature . . . . -62° to +125°C
Short Therm (1 Hour) CW Input Level . . . . +18 dBm
Peak Pulsed (10 μsec) Input Level . . . . +23 dBm
DC Reverse Voltage . . . . -40 Volts

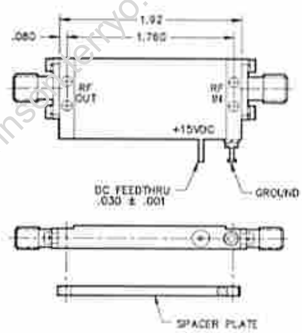
Outline Drawings

297017



Weight 1.4 oz. max.

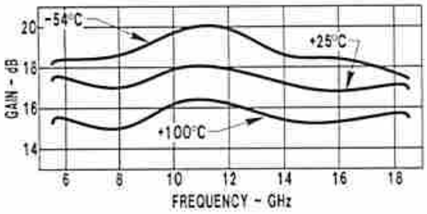
297014



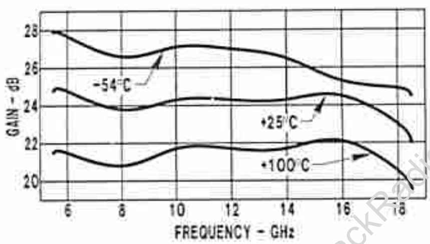
Weight 1.7 oz. max.

Typical Performance

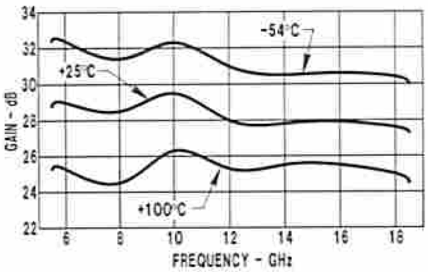
Gain
(-813)



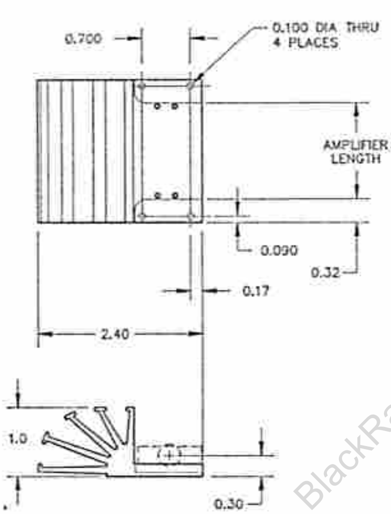
(-814)



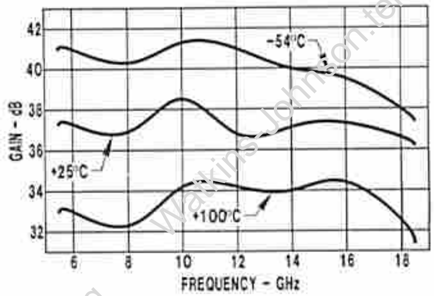
(-815)



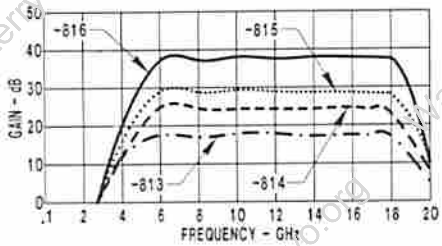
Finned Heatsink



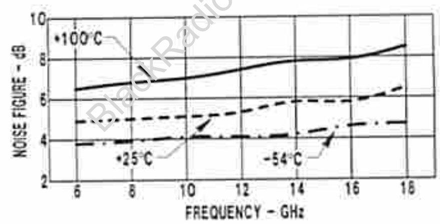
Gain
(-816)



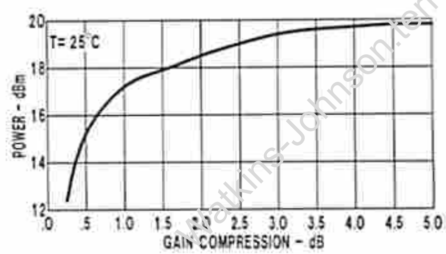
Broadband Gain



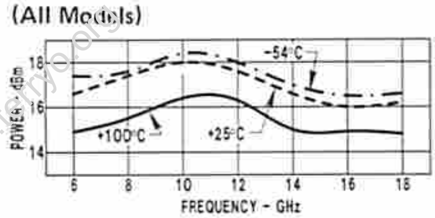
Noise Figure
(All Models)



Power Output
(All Models)

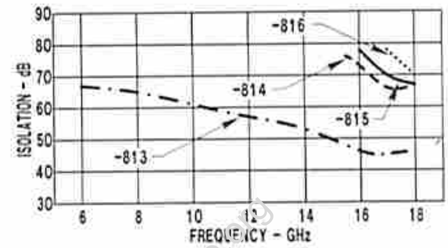


P_{out}*
(All Models)

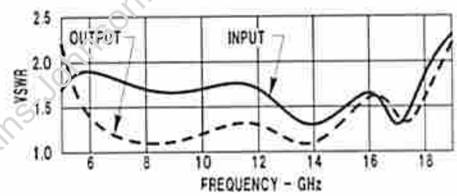


*at 1 dB Gain Compression

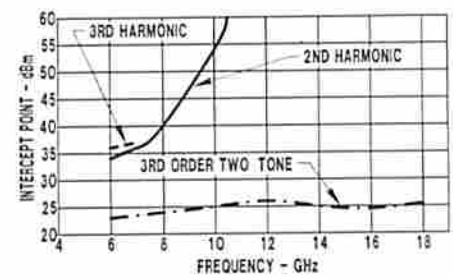
Reverse Isolation



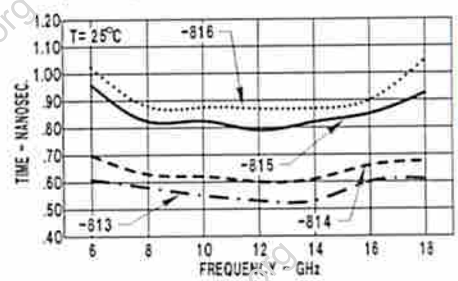
VSWR
(All Models)



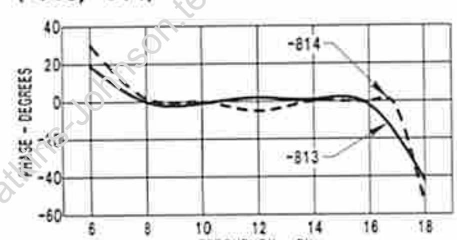
Intercept Point
(All Models)



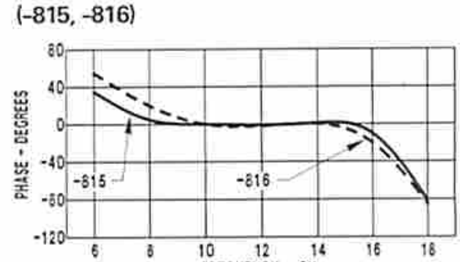
Group Delay



Deviation from Linear Phase
(-813, -814)



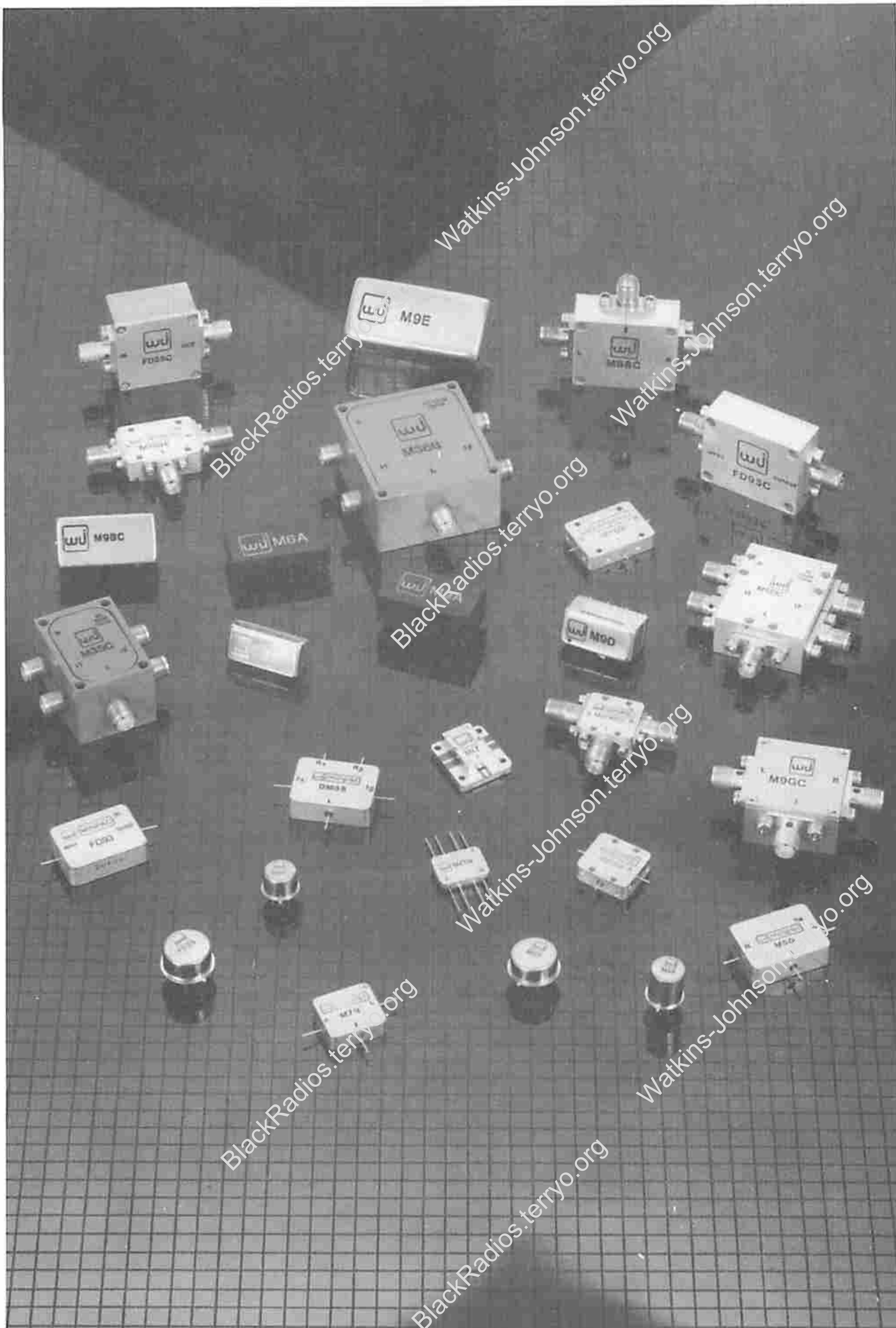
(-815, -816)



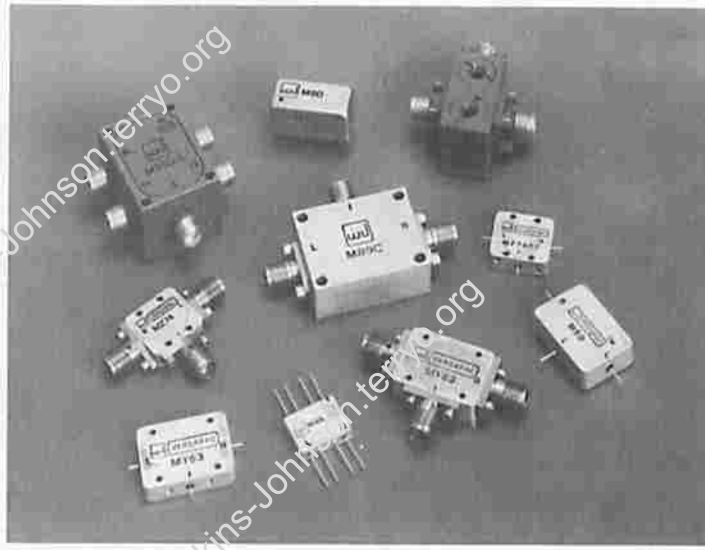
Notes:
Dimensions are in inches. Tolerances: X.XXX ± 0.005, X.XX ± 0.02 inches. Amplifiers are supplied with RF connectors installed and mounted on a heatsink. A spacer plate and mounting fasteners are provided for alternate mounting configurations. The heatsink is easily removed, but is recommended for incoming test and laboratory applications. RF connectors can be removed for "drop in" microstrip applications. RF pin dimensions: 0.015 dia. x 0.07 long.

5

Frequency Mixers



6



FREQUENCY MIXERS

- DC TO 24 GHz
- HIGH PERFORMANCE
- WIDEBAND OPERATION
- GUARANTEED SPECIFICATIONS
- HI-REL SCREENING AVAILABLE

Description: Watkins-Johnson provides a full line of high performance mixers covering frequency ranges as low as 10 kHz to 12 MHz and as broadband as 1 GHz to 24 GHz. Included in this line are both high level and low level mixers. Some mixers have been designed to be stripline compatable while other have been optimized for maximum performance and smallest possible size for PC board installation. There is even a series of mixers specially designed for the satellite communication bands (WJ-M62, M64, M65, M81, M79H).

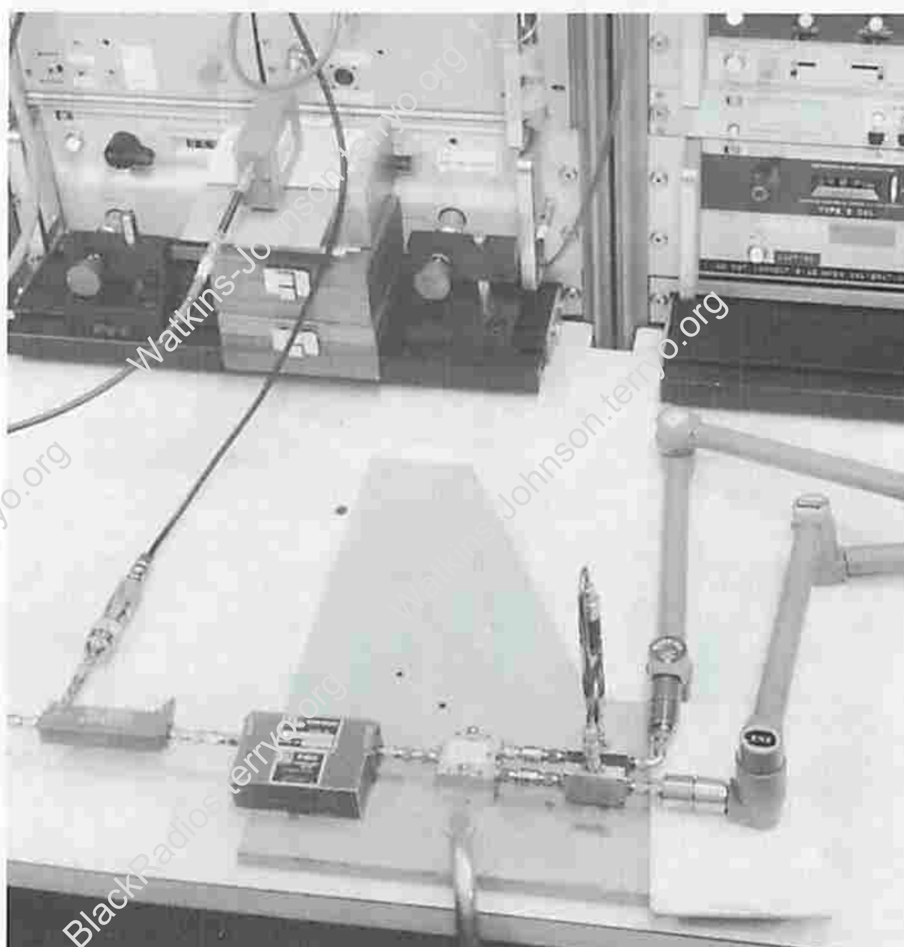
W-J mixers are available in many sizes and package styles. Most connector versions come with BNC connectors if the operating frequency range is below 1 GHz while microwave mixers are normally supplie with SMA connectors.

Construction. Single-balanced mixers incorporate two Schottky-barrier diodes and a wideband balanced transformer. Double-balanced, low-level mixers incorporate four Schottky-barrier diodes and two wideband transformers. High-level double-balanced mixers have additional diodes and/or matching resistors. The design objective in all units has been to match the diodes and construct the balanced transformers for optimum balance and minimum noise figure.

In order to improve performance and raliability while minimizing size, Watkins-Johnson has also developed a line of thin film mixers. In the low frequency range W-J provided the M9G and M9H high level mixers which operate to 1500 MHz.

To meet the demand of increased miniaturization, Watkins-Johnson has expanded the line of mixers available in the "Y" and "Z" style VERSAPAC® cases. Both designs feature low profiles and built in mounting holes. These design qualities allow the packages to be integrated into a system using a minimum amount of board space and height. In addition, the VERSAPAC® cases are hermetic and employ matched glass technology in their glass to metal seals, resulting in outstanding resistance to environmental extremes encountered in Hi-Rel programs. VERSAPAC® are available with field replaceable SMA connectors or stripline compatible packaging.

Environmental Performance: All units are designed and constructed to meet their specifications over -54°C to +100°C and after exposure to any or all of the following tests per MIL-STD-202F.



Special Reliability Testing: Starting with the original design concept, quality is built into each mixer. With this advantage, W-J is uniquely ready to provide a higher degree of reliability than is normally available from a standard product for todays long-life satellite and other high MTBF systems.

Three Approaches to Hi-Rel: As a result of contributing to numerous hi-rel programs in recent years, W-J has found the need for three basic approaches to hi-rel production. While all hi-rel programs are designed to eliminate early failures, only the initial part cost versus failure consequence cost will determine which program should be specified.

Ultra Hi-Rel: On applications where extremely long life, very severe environments, or personnel safety is a concern, the customer may elect to perform a design review where all parts, materials, and processes are analyzed with the particular application in mind. Parts and materials are qualified prior to use, 100% pre-cap inspections are performed, full environmental screening is performed on the end item, and full qualification to near destructive levels is performed on a sample of the lot. This program is the most costly, but assures that all details are considered.

Hi-Rel Existing Design: This type of program employs the same basic controls as the ultra hi-rel, except there is no design review with the customer and all controls are performed under existing Watkins-Johnson procedures. Once again, parts, materials, and processes used will be those developed and proven on earlier programs. Semiconductors may be prescreened, and devices built on a hi-rel-dedicated line. The screening will again be performed on the end item and may also include a qualification program.

Screened Standard: The third and most cost-effective hi-rel program is commonly used on airborne applications and high-MTBF ground equipment. This procedure employs products from our standard finished goods inventory which are subjected to environmental screening, using the procedures found in MIL-STD-202, MIL-STD-750, and/or MIL-STD-883. Delivery on this type of device is normally between ten to fifteen weeks after receipt of order.

Typical 100% Screening Programs are as follows:

Test	**Mixer (Per MIL-STD-202) Method**	**Condition**
Bake	---	24 hrs., 100°C
Thermal Shock	107	-65°C to +125°C, 5 cycles
Vibration	214	22½ g-rms, 15 min./axis
Seal Test	112	1 x 10^{-8} cc/sec
Burn-in	---	96 hrs., DC bias
Final Electrical		Per applicable document
Final Visual	---	

Guaranteed to withstand the following requirements:

Exposure	**Method**	**Test Condition**
Temperature Cycle	102A	C
Thermal Shock	107D	B
Altitude	105C	G
H.F. Vibration	204C	D
Mechanical Shock	213B	C
Random Vibration (15 minutes per axis)	214	IIF
Solderability	208C	
Terminal Strength	211A	C
Resistance to Soldering Heat	210A	B

Hermetically sealed units meet the requirements of Method 106D of MIL-STD-202F when exposed to humidity.

W-J Hi-Rel Team: W-J has found that a permanent dedicated hi-rel program group is needed to respond properly to the wide variety of program requirements. This group includes hi-rel engineering experts and specially qualified technicians and assemblers.

Selecting the Right Mixer

Because Watkins-Johnson has such a broad line of frequency mixers it often appears that more than one mixer will fulfill the necessary requirements for a given application. In order to help you select the proper mixer we are providing easy-to-use mixer selection charts on the accompanying pages. Once the choice has been narrowed down it may be necessary to compare the detailed specifications and typical data presented on pages 358 through 583 of this catalog.

A check list of important parameters is detailed below with helpful hints geared toward aiding you in the proper selection of mixers.

Input Frequencies: Select a mixer so the input frequencies are in the middle of the frequency range for the mixer. This will normally insure minimum noise figure and VSWR.

IF Frequency: Most W-J low frequency mixers coverage for DC to a few hundreds MHz on the I-port. Many microwave mixers have broadband IF's up to 12 GHz. Biasable mixers generally have a low frequency cut-off near 5 MHz.

Single-Balanced vs. Double-Balanced: In a double-balanced mixer all three ports are isolated from each other. In a single-balanced mixer only the L-port is isolated. For mixing applications where price is the ultimate factor and some sacrifice in IMD and isolation is acceptable, the single-balanced mixer is recommended. Phase detection is an important application for the single-balanced mixer since R to I isolation is not required.

High Level or Low Level: For most applications, a low-level (+7 dBm or +10 dBm LO drive) mixer is recommended. In the cases where the desired compression level, 3rd order two-tone performance, or harmonic intermodulation performance (harmonics of f_R greater than or equal to 2) cannot be obtained with a low-level mixer, then a high level mixer is recommended.

Conversion Loss/Noise Figure: The typical specifications in the accompanying tables are conservative in nature to cover worst possible operating conditions. Actual conversion loss or noise figure is typically 1 dB better than these numbers, especially over narrow frequency ranges and at reduced operating temperatures. Check individual data pages for guaranteed performance.

Package: Small size is featured and a number of pacakge styles are available. Miniature TO-5, TO-8 and flat pack 8-pin packages are available to 2.5 GHz. A PC mounted package WJ-M5H is available to 6.2 GHz. For MIC mounting, miniature flat pack carriers WJ-M15, M16, M17, M18, and M21 cover the 2.5 to 18 GHz range. The WJ-M15C through M21C connector versions are unique in that the flat pack carrier can be removed from the connector package and "dropped in" and MIC assembly once the breadboard design is completed.

Package: Small size is featured and and extremely large variety of package styles are available. Miniature TO-5, TO-8 and flat pack 8-pin packages are used in designs covering 1 MHz to 6 GHz. A PC mounted package, Model No. M5H, operates at frequencies to 6.2 GHz. For MIC mounting miniature flat pack carriers WJ-M15, M16, and M17 cover the 2 to 16 GHz range. The connectorized models, M15C to M17C, are also ideal for prototyping, since after the breadboard design is complete, the flat pack carrier can be removed from the connectorized package and "dropped in" the MIC assembly.

Watkins-Johnson continues to be a leader in miniaturization of microwave mixers with the introduction and expansion of the "Y" and "Z" VERSAPAC® mixer package lines. Both package styles feature low profiles and built in mounting holes to allow the system designer to use less board space and height in mixer integration. Low cost MINPAC™ mixers are also available for systems where board space is less critical. See further data on M50 to MZ93 mixers on the following pages.

Typical Specifications

REMEMBER: WE DO SPECIALS!

Model	RF Frequency	LO Power Nominal dBm	Conversion Loss (Noise Figure) Typ. dB	IF Frequency	I_R Level at 1 dB Compression Point Typ. dBm	Isolation Typ. dB L-R	Isolation Typ. dB L-I	Input Intercept Point Typ. dBm	Package Type	Hermetic Seal	Outline Drawing	Page No.
DC to 250 MHz				MHz								
M6H	0.002-12	7	5.0	DC-12	0	42	35	13	PC	Yes	298500	578
M6J	0.002-12	7	5.0	DC-12	0	42	35	13	PC	No	295450	579
M6D-50	0.05-200	7	5.5	DC-200	-2	50	50	10	PC	Yes	298572	566
M6A	0.05-200	7	5.5	DC-200	1	48	43	13	PC	No	295436	562
M6D	0.05-200	7	5.5	DC-200	0	50	50	13	PC	Yes	298572	567
M9A	0.05-200	13	6.5	DC-200	10	40	35	23	PC	No	295450	596
M9AC	0.05-200	13	6.5	DC-200	10	40	35	23	PC	Yes	298640	597
DC to 500 MHz				MHz								
M6	0.2-300	7	6.0	DC-300	0	40	40	13	PC	No	295450	560
M9E	1-400	27	6.0	DC-400	20	35	45	32	PC	Yes	298641	604
M9D	2-400	20	6.0	DC-800	15	45	40	30	PC	Yes	298500	602
M6K	5-400	7	6.0	DC-400	0	30	25	13	PC	No	295450	580
M6KC	5-400	7	6.0	DC-400	0	30	25	13	PC	Yes	298640	581
M6E-50	5-500	7	6.5	DC-500	-2	50	45	10	PC	Yes	298572	570
M9C	0.4-500	13	7.0	DC-500	10	35	35	23	PC	Yes	298640	601
M9B	0.5-500	17	7.0	DC-500	8	50	40	23	PC	No	295450	598
M9BC	0.5-500	17	7.0	DC-500	8	50	40	23	PC	Yes	298640	600

(Continued)

Model	RF Frequency	LO Power Nominal dBm	Conversion Loss (Noise Figure) Typ. dB	IF Frequency	f_R Level at 1 dB Compression Point Typ. dBm	Isolation Typ. dB L-R	Isolation Typ. dB L-I	Input Intercept Point Typ. dBm	Package Type	Hermetic Seal	Outline Drawing	Page No.
DC to 500 MHz Continued												
M1	0.2-500	7	6.0	DC-500	0	40	33	17	BNC,	No	298576	520
									SMA	No	298575	520
M6F	0.2-500	7	6.5	DC-500	1	50	45	13	PC	No	295436	574
M6V	0.4-500	7	5.5	DC-500	0	50	30	13	TO-5	Yes	298643	586
M6E	5-500	7	6.5	DC-500	0	50	45	13	PC	Yes	298572	568
★ **M6EH**	**5-500**	**20**	**5.5**	**DC-500**	**13**	**50**	**45**	**28**	**PC**	**Yes**	**298572**	**572**
M6T	10-500	7	6.0	DC-500	0	33	26	13	TO-5	Yes	298642	584
DC to 2000 MHz				MHz								
M1A	3-1000	7	6.0	DC-1000	0	35	30	15	BNC,	No	298576	522
									SMA	No	298575	522
M6R	10-1000	7	6.5	DC-1000	0	35	25	13	TO-5	Yes	298643	582
M2E	10-1000	25	7.0	DC-600	20	30	22	30	TO-8	Yes	295826	538
M2EC	10-1000	25	7.0	DC-600	20	30	22	30	SMA	Yes	296261	538
M1A-11	3-1200	7	6.0	DC-1200	0	35	30	15	BNC	No	298576	523
M2A	10-1500	7	7.0	DC-800	0	35	25	12	TO-8	Yes	298634	534
M2AC	10-1500	7	7.0	DC-800	0	35	25	12	SMA	No	296261	534
M4A	10-1500	7	6.5	DC-1000	0	35	30	13	Flatpack	Yes	296960	546
M4B	10-1500	13	7.5	DC-1000	7	35	30	22	Flatpack	Yes	296960	548
M5D	100-1500	7	7.0	DC-500	0	35	30	13	PC	Yes	298500	556
M2B	10-1600	13	6.5	DC-1000	7	44	30	22	TO-8	Yes	298634	536
M2BC	10-1600	13	6.5	DC-1000	7	44	30	22	SMA	No	296261	536
M9G	10-1500	20	7.0	DC-600	14	23	17	21	TO-8	Yes	295826	608
M9GC	10-1500	20	7.0	DC-600	14	23	17	21	SMA	Yes	296261	608
M9H	10-1500	20	7.0	DC-600	15	24	20	24	TO-8	Yes	295826	610
M9HC	10-1500	20	7.0	DC-600	15	24	20	24	SMA	Yes	296261	610
M2T	10-2400	13	7.0	1-1000	9	37	43	24	TO-8	Yes	298677	544
M2TC	10-2400	13	7.5	1-1000	9	37	43	24	SMA	No	296731	544
M1J	300-2000	7	6.5	DC-1000	0	45	30	15	SMA	Yes	298541	527
M6G	600-2000	7	6.5	DC-300	0	25	23	15	TO-5	Yes	298643	576
0.5 to 4.5 GHz				GHz								
M4G	0.8-2.2	7	6.5	DC-1.5	0	30	25	13	Flatpack	Yes	296960	550
M2G	1.0-2.2	7	6.5	DC-1.5	1.5	35	30	12	TO-8	Yes	295826	542
M2GC	1.0-2.2	7	6.5	DC-1.5	1.5	35	30	12	SMA	No	296261	542
M4T	0.001-3.4	10	7.0	0.001-2.0	7	35	35	18	Flatpack	Yes	296960	552
★ **M4TH**	**0.001-3.4**	**23**	**7.5**	**0.001-2.0**	**17**	**35**	**35**	**29**	**Flatpack**	**Yes**	**296960**	**554**
★ **M8T**	**0.001-3.4**	**10**	**7.0**	**0.001-2.0**	**7**	**40**	**40**	**18**	**TO-8**	**Yes**	**297547**	**592**
★ **M8TC**	**0.001-3.4**	**10**	**7.5**	**0.001-2.0**	**7**	**40**	**40**	**18**	**SMA**	**No**	**297548**	**592**
★ **M8TH**	**0.001-3.4**	**23**	**7.5**	**0.001-2.0**	**17**	**35**	**35**	**29**	**TO-8**	**Yes**	**297547**	**594**
★ **M8THC**	**0.001-3.4**	**23**	**8.0**	**0.001-2.0**	**17**	**35**	**35**	**29**	**SMA**	**No**	**297548**	**594**
M1K	1.0-4.0	20	6.0	DC-1.0	13	30	20	28	SMA	Yes	298541	530
M72	2.0-4.0	13	7.0	DC-1.0	10	30	30	17	MINPAC	Yes	295758	672
M72C	2.0-4.0	13	7.0	DC-1.0	10	30	30	17	SMA	Yes	296010	672
M1G	1.0-4.2	7	5.5	DC-1.0	0	35	25	10	SMA	Yes	298541	524
M8H-3	3.7-4.2	7	4.5	DC-2.0	0	40	21	13	TO-8	Yes	295826	588
M8HC-3	3.7-4.2	7	4.5	DC-2.0	0	40	21	13	SMA	No	296261	588
M62	3.7-4.2	9	5.2	DC-1.45	3	40	30	11	MINPAC	Yes	295758	662
M62C	3.7-4.2	9	5.2	DC-1.45	3	40	30	11	SMA	Yes	296010	662
0.5 to 12.0 GHz				GHz								
M63	2.5-5.5	9	5.4	DC-1.5	2	40	27	10	MINPAC	Yes	295758	664
M63C	2.5-5.5	9	5.4	DC-1.5	2	40	27	10	SMA	Yes	296010	664
MY63	2.5-5.5	9	5.4	DC-1.5	2	40	27	10	VERSAPAC	Yes	296874	664
MY63C	2.5-5.5	9	5.4	DC-1.5	2	40	27	10	SMA	Yes	296898	664
M63H	2.5-6.0	20	6.0	DC-1.5	14	37	21	25	MINPAC	Yes	295758	666
M63HC	2.5-6.0	20	6.0	DC-1.5	14	37	21	25	SMA	Yes	296010	666
MY63H	2.5-6.0	20	6.0	DC-1.5	14	37	21	25	VERSAPAC	Yes	296874	666
MY63HC	2.5-6.0	20	6.0	DC-1.5	14	37	21	25	SMA	Yes	296898	666
★ **MZ6310**	**2.5-5.5**	**10**	**6.0**	**DC-1.5**	**3**	**45**	**35**	**15**	**VERSAPAC**	**Yes**	**296953**	**734**
★ **MZ6310C**	**2.5-5.5**	**10**	**6.0**	**DC-1.5**	**3**	**45**	**35**	**15**	**VERSAPAC**	**Yes**	**296954**	**734**
M8H-7	2.4-6.0	7	4.5	DC-2.0	0	40	21	13	TO-8	Yes	295826	590
M8HC-7	2.4-6.0	7	4.5	DC-2.0	0	40	21	13	SMA	No	296261	590
M15	2.0-6.0	7	6.5	DC-1.5	2	15	15	15	MIC	No	298526	620

★ **NEW PRODUCTS**

(Continued)

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Model	RF Frequency	LO Power Nominal dBm	Conversion Loss (Noise Figure) Typ. dB	IF Frequency	f_R Level at 1 dB Compression Point Typ. dBm	Isolation Typ. dB L-R	Isolation Typ. dB L-I	Input Intercept Point Typ. dBm	Package Type	Hermetic Seal	Outline Drawing	Page No.
0.5 to 12.0 GHz Continued												
M15C	2.0-6.0	7	6.5	DC-1.5	2	15	15	15	SMA	No	298527	620
M1H	1.8-6.2	7	6.0	DC-2.0	-2	35	20	15	SMA	Yes	298541	526
M5H	1.8-6.2	7	5.8	DC-2.0	0	35	30	13	PC	Yes	296368	558
M12	4.0-8.0	13	6.0	0.005-3.0	8	25	30	20	SMA	No	298516	612
M14	4.0-8.0	7	5.5	DC-2.0	2	30	30	10	SMA	No	298573	616
M16	4.0-9.0	7	7.0	DC-3.0	4	15	12	15	MIC	No	298526	622
M16C	4.0-9.0	7	7.0	DC-3.0	4	15	12	15	SMA	No	298527	622
MY84	1.8-10.0	9	6.5	DC-1.0	4	35	30	11	VERSAPAC	Yes	296874	696
M76	4.5-9.5	10	5.8	DC-2.0	6	35	22	13	MINPAC	Yes	295813	678
M76C	4.5-9.5	10	5.8	DC-2.0	6	35	22	13	SMA	Yes	295984	678
MY76	4.5-9.5	10	5.8	DC-2.0	6	35	22	13	VERSAPAC	Yes	296874	678
MY76C	4.5-9.5	10	5.8	DC-2.0	6	35	22	13	SMA	Yes	296898	678
M76H	4.5-9.5	20	6.0	DC-2.0	15	35	26	24	MINPAC	Yes	295813	680
M76HC	4.5-9.5	20	6.0	DC-2.0	15	35	26	24	SMA	Yes	295984	680
MY76H	4.5-9.5	20	6.0	DC-2.0	15	35	26	24	VERSAPAC	Yes	296874	680
MY76HC	4.5-9.5	20	6.0	DC-2.0	15	35	26	24	SMA	Yes	296898	680
MY84C	1.8-10.0	9	6.5	DC-1.0	4	35	30	11	SMA	Yes	296898	696
M12A	4.0-12.0	13	6.5	0.005-4.0	8	25	30	20	SMA	No	298516	614
6.0 to 18.0 GHz				GHz								
M66	10.95-12.2	10	5.8	DC-2.0	4	35	28	18	MINPAC	Yes	295813	668
M66C	10.95-12.2	10	5.8	DC-2.0	4	35	28	18	SMA	Yes	295984	668
M77	8.0-12.5	10	5.5	DC-2.5	4	35	30	15	MINPAC	Yes	295813	682
M77C	8.0-12.5	10	5.5	DC-2.5	4	35	30	15	SMA	Yes	295984	682
MY77	8.0-12.5	10	5.5	DC-2.5	4	35	30	15	VERSAPAC	Yes	296874	682
MY77C	8.0-12.5	10	5.5	DC-2.5	4	35	30	15	SMA	Yes	296898	682
M14A	6.0-14.0	7	6.5	DC-2.0	2	30	30	10	SMA	No	298573	618
M67	9.0-15.0	10	6.0	DC-2.5	4	35	25	18	MINPAC	Yes	295813	670
M67C	9.0-15.0	10	6.0	DC-2.5	4	35	25	18	SMA	Yes	295984	670
M17	6.0-16.0	7	6.5	DC-3.0	4	15	15	15	MIC	No	298526	624
M17C	6.0-16.0	7	6.5	DC-3.0	4	15	15	15	SMA	No	298527	624
★ **MZ7407**	**6.0-18.0**	**7**	**7.0**	**DC-3.0**	**3**	**33**	**32**	**10**	**VERSAPAC**	**Yes**	**296953**	**736**
★ **MZ7407C**	**6.0-18.0**	**7**	**7.0**	**DC-3.0**	**3**	**33**	**32**	**10**	**SMA**	**Yes**	**296954**	**736**
M74	7.0-18.0	10	6.2	DC-3.0	4	32	29	15	MINPAC	Yes	296763	674
M74C	7.0-18.0	10	6.2	DC-3.0	4	32	29	15	SMA	Yes	296764	674
★ **MZ7410**	**6.0-18.0**	**10**	**7.0**	**DC-3.0**	**4**	**32**	**29**	**15**	**VERSAPAC**	**Yes**	**296953**	**738**
★ **MZ7410C**	**6.0-18.0**	**10**	**7.0**	**DC-3.0**	**4**	**32**	**29**	**15**	**SMA**	**Yes**	**296954**	**738**
★ **MZ7420**	**6.0-18.0**	**20**	**7.5**	**DC-3.0**	**15**	**23**	**25**	**21**	**VERSAPAC**	**Yes**	**296953**	**740**
★ **MZ7420C**	**6.0-18.0**	**20**	**7.5**	**DC-3.0**	**15**	**23**	**25**	**21**	**SMA**	**Yes**	**296954**	**740**
M79	7.0-18.0	10	6.2	DC-3.0	4	32	29	15	MINPAC	Yes	295777	684
M79C	7.0-18.0	10	6.2	DC-3.0	4	32	29	15	SMA	Yes	296342	684
M79H	7.0-18.0	20	7.5	DC-3.0	15	33	30	23	MINPAC	Yes	295777	686
M79HC	7.0-18.0	20	7.5	DC-3.0	15	33	30	23	SMA	Yes	296342	686
M80L	7.0-18.0	0	8.0	DC-3.0	-2	32	30	3	MINPAC	Yes	295777	689
M80LC	7.0-18.0	0	8.0	DC-3.0	-2	32	30	3	SMA	Yes	296342	689
M80	7.0-18.0	7	7.5	DC-3.0	3	33	32	10	MINPAC	Yes	295777	687
M80C	7.0-18.0	7	7.5	DC-3.0	3	33	32	10	SMA	Yes	296342	687
M86	7.0-18.0	7	7.5	DC-3.0	3	33	32	10	MINPAC	Yes	296763	702
M86C	7.0-18.0	7	7.5	DC-3.0	3	33	32	10	SMA	Yes	296764	702
0.5 to 26.0 GHz												
★ **M85**	**2.0-18.0**	**7**	**7.0**	**DC-1.0**	**2**	**30**	**20**	**10**	**MINPAC**	**Yes**	**297551**	**698**
★ **M85C**	**2.0-18.0**	**7**	**7.0**	**DC-1.0**	**2**	**30**	**20**	**10**	**SMA**	**Yes**	**297552**	**698**
★ **MY85**	**2.0-18.0**	**7**	**7.0**	**DC-1.0**	**2**	**30**	**20**	**10**	**VERSAPAC**	**Yes**	**297553**	**698**
★ **MY85C**	**2.0-18.0**	**7**	**7.0**	**DC-1.0**	**2**	**30**	**20**	**10**	**SMA**	**Yes**	**297554**	**698**
M93	2.0-18.0	10	8.0	0.03-4.0	4	28	34	16	MINPAC	Yes	298501	723
M93C	2.0-18.0	10	8.0	0.03-4.0	4	28	34	16	SMA	Yes	298502	723
MY93	2.0-18.0	10	8.0	0.03-4.0	4	28	34	16	VERSAPAC	Yes	296953	723
MY93C	2.0-18.0	10	8.0	0.03-4.0	4	28	34	16	SMA	Yes	296874	723
★ **MZ9310**	**2.0-18.0**	**10**	**7.5**	**0.03-5.0**	**6**	**25**	**30**	**16**	**VERSAPAC**	**Yes**	**296953**	**746**
★ **MZ9310C**	**2.0-18.0**	**10**	**7.5**	**0.03-5.0**	**6**	**25**	**30**	**16**	**SMA**	**Yes**	**296954**	**746**
★ **MZ9313**	**2.0-8.0**	**13**	**7.5**	**0.03-5.0**	**8**	**25**	**30**	**16**	**VERSAPAC**	**Yes**	**296953**	**748**
★ **MZ9313C**	**2.0-8.0**	**13**	**7.5**	**0.03-5.0**	**8**	**25**	**30**	**16**	**SMA**	**Yes**	**296954**	**748**
M83	1.0-18.0	13	8.0	0.03-5.0	6	25	30	18	MINPAC	Yes	298501	692

★ NEW PRODUCTS

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	Model	RF Frequency	LO Power Nominal dBm	Conversion Loss (Noise Figure) Typ. dB	IF Frequency	f_R Level at 1 dB Compression Point Typ. dBm	Isolation Typ. dB L-R	Isolation Typ. dB L-I	Input Intercept Point Typ. dBm	Package Type	Hermetic Seal	Outline Drawing	Page No.
	0.5 to 26.0 Continued												
	M83C	1.0-18.0	13	8.0	0.03-5.0	6	30	30	18	SMA	Yes	298502	692
	MY82	2.0-18.0	13	8.0	0.03-5.0	6	30	30	18	VERSAPAC	Yes	296874	691
	MY82C	2.0-18.0	13	8.0	0.03-5.0	6	30	30	18	SMA	Yes	296898	691
	M83H	2.0-18.0	20	8.5	0.03-5.0	17	28	32	25	MINPAC	Yes	298501	694
	M83HC	2.0-18.0	20	8.5	0.03-5.0	17	28	32	25	SMA	Yes	298502	694
	MY83H	2.0-18.0	20	8.5	0.03-5.0	17	28	32	25	VERSAPAC	Yes	296874	694
	MY83HC	2.0-18.0	20	8.5	0.03-5.0	17	28	32	25	SMA	Yes	296898	694
	M89	2.0-18.0	10	8.0	1.0-8.0	4	28	32	16	MINPAC	Yes	298501	716
	M89C	2.0-18.0	10	8.0	1.0-8.0	4	28	32	16	SMA	Yes	298502	716
	MY89	2.0-18.0	10	8.0	1.0-8.0	4	28	32	16	VERSAPAC	Yes	296874	716
	MY89C	2.0-18.0	10	8.0	1.0-8.0	4	28	32	16	SMA	Yes	296898	716
★	**MZ8810**	**2.0-18.0**	**10**	**7.5**	**1.0-8.0**	**6**	**25**	**28**	**15**	**VERSAPAC**	**Yes**	**296953**	**742**
★	**MZ8810C**	**2.0-18.0**	**10**	**7.5**	**1.0-8.0**	**6**	**25**	**28**	**15**	**SMA**	**Yes**	**296954**	**742**
	M88	2.0-18.0	13	8.0	1.0-8.0	7	28	32	20	MINPAC	Yes	298501	708
	M88C	2.0-18.0	13	8.0	1.0-8.0	7	28	32	20	SMA	Yes	298502	708
	MY88	2.0-18.0	13	8.0	1.0-8.0	7	28	32	20	VERSAPAC	Yes	296874	708
	MY88C	2.0-18.0	13	8.0	1.0-8.0	7	28	32	20	SMA	Yes	296898	708
★	**MZ8813**	**2.0-18.0**	**13**	**7.5**	**1.0-8.0**	**8**	**25**	**28**	**16**	**VERSAPAC**	**Yes**	**296953**	**744**
★	**MZ8813C**	**2.0-18.0**	**13**	**7.5**	**1.0-8.0**	**8**	**25**	**28**	**16**	**SMA**	**Yes**	**296954**	**744**
	M88H	2.0-18.0	23	8.0	2.0-8.0	18	28	32	25	MINPAC	Yes	298501	712
	M88HC	2.0-18.0	21	8.0	2.0-8.0	18	28	32	25	SMA	Yes	298502	712
	MY88H	2.0-18.0	21	8.0	2.0-8.0	18	28	32	25	VERSAPAC	Yes	296874	712
	MY88HC	2.0-18.0	21	8.0	2.0-8.0	18	28	32	25	SMA	Yes	296898	712
	M87	0.5-19.0	13	8.5	0.03-5.0	7	30	30	18	MINPAC	Yes	297551	704
	M87C	0.5-19.0	13	8.5	0.03-5.0	7	30	30	18	SMA	Yes	297552	704
★	**MY87**	**0.5-19.0**	**13**	**8.5**	**0.03-5.0**	**7**	**30**	**30**	**18**	**VERSAPAC**	**Yes**	**296874**	**704**
★	**MY87C**	**0.5-19.0**	**13**	**8.5**	**0.03-5.0**	**7**	**30**	**30**	**18**	**SMA**	**Yes**	**296898**	**704**
	M52	2.0-24.0	10	8.0	0.1-5.0	5	25	30	15	MINPAC	Yes	297551	654
	M52C	2.0-24.0	10	8.0	0.1-5.0	5	25	30	15	SMA	Yes	297552	654
	MY52	2.0-24.0	10	8.0	0.1-5.0	5	25	30	15	VERSAPAC	Yes	297553	654
	MY52C	2.0-24.0	10	8.0	0.1-5.0	5	25	30	15	SMA	Yes	297554	654
★	**MZ5210**	**2.0-24.0**	**10**	**9.0**	**0.1-5.0**	**4**	**15**	**17**	**14**	**VERSAPAC**	**Yes**	**297555**	**732**
★	**MZ5210C**	**2.0-24.0**	**10**	**9.0**	**0.1-5.0**	**4**	**15**	**17**	**14**	**SMA**	**Yes**	**297556**	**732**
★	**M53**	**2.0-26.0**	**10**	**8.0**	**0.1-6.0**	**5**	**25**	**30**	**15**	**MINPAC**	**Yes**	**297551**	**658**
★	**M53C**	**2.0-26.0**	**10**	**8.0**	**0.1-6.0**	**5**	**25**	**30**	**15**	**SMA**	**Yes**	**297552**	**658**
	M50A	2.0-18.0	10	7.5	1.0-12.0	5	30	26	15	MINPAC	Yes	297551	642
	M50AC	2.0-18.0	10	7.5	1.0-12.0	5	30	26	15	SMA	Yes	297552	642
	M51	2.0-24.0	10	8.0	1.0-15.0	5	30	26	15	MINPAC	Yes	297551	650
	M51C	2.0-24.0	10	8.0	1.0-15.0	5	30	26	15	SMA	Yes	297552	650
	M50	2.0-26.0	10	8.0	1.0-15.0	5	30	26	15	MINPAC	Yes	297551	646
	M50C	2.0-26.0	10	8.0	1.0-15.0	5	30	26	15	SMA	Yes	297552	646
	MY50	2.0-26.0	10	8.0	1.0-15.0	5	30	26	15	VERSAPAC	Yes	297553	646
	MY50C	2.0-26.0	10	8.0	1.0-15.0	5	30	26	15	SMA	Yes	297554	646
★	**MZ5010**	**2.0-26.0**	**10**	**9.0**	**1.0-15.0**	**4**	**20**	**23**	**15**	**VERSAPAC**	**Yes**	**297555**	**730**
★	**MZ5010C**	**2.0-26.0**	**10**	**9.0**	**1.0-15.0**	**4**	**20**	**23**	**15**	**SMA**	**Yes**	**297556**	**730**

★ NEW PRODUCTS

6

Dual Mixers

Typical Specifications

Model	RF Frequency (GHz)	LO Power Nominal (dBm)	Conversion Loss (Noise Figure) Typ. (dB)	IF Frequency (MHz)	f_R Level at 1 dB Compression Point Typ. (dBm)	Isolation Typ. (dB) L-R	Isolation Typ. (dB) L-I	Isolation Typ. (dB) Channel-to-Channel	Conversion Loss Amplitude Match (dB)	Input Intercept Point Typ. (dBm)	Package Type	Hermetic Seal	Outline Drawing	Page No.
DM85	2-18	10	6.5	DC-1000	3	30	20	35	0.5	9.5	MINPAC	Yes	296778	510
DM85C	2-18	10	6.5	DC-1000	3	30	20	35	0.5	9.5	SMA	Yes	296779	510

★ NEW PRODUCTS

Frequency Doublers

Typical Specifications

Model	Input Frequency (GHz)	Input Power Nominal (dBm)	Conversion Loss Typical (dB)	Harmonic Suppression[1] (dB) 1 x f_{IN}	3 x f_{IN}	Package Type	Hermetic Seal	Outline Drawing	Page No.
FD25	0.005-2.4	10	11.5	35	40	TO-8	Yes	296783	512
FD25C	0.005-2.4	10	11.5	35	40	SMA	Yes	296810	512
FD25H	0.005-2.4	23	11.5	35	40	TO-8	Yes	296783	514
FD25HC	0.005-2.4	23	11.5	35	40	SMA	Yes	296810	514
FD93[1]	2.0-9.0	12	11.5	25	40	MINPAC®	Yes	296838	516
FD93C[1]	2.0-9.0	12	11.5	25	40	SMA	Yes	296849	516
FD93H[1]	2.0-9.0	20	11.5	26	40	MINPAC	Yes	296838	518
FD93HC[1]	2.0-9.0	20	11.5	26	40	SMA	Yes	296849	518

NOTE: 1. Harmonic Suppression is referenced to the input signal.

Image Reject/Suppression Mixers

Typical Specifications

Model	Frequency GHz	Conversion Loss (Noise Figure) Typ. dB	IF Frequency MHz	Image Rejection Typ. dB	Sideband Suppression Typ. dB	Carrier Suppression Typ. dB	Isolation Typ. L-R	L-I	Package Type	Outline Drawing	Page No.
Image Reject Mixers											
M33B	5.0-12.0	7.5	4-500[1]	22	----	----	30	25	SMA	296228	626
M33C	7.0-18.0	7.5	4-500[1]	22	----	----	30	23	SMA	296229	628
★ **M133**	**6.0-18.0**	**7.5**	**4-500[1]**	**22**	----	----	**30**	**35**	**SMA**	**297475**	726
★ **M133C**	**6.0-18.0**	**7.5**	**4-500[1]**	**22**	----	----	**30**	**35**	**SMA**	**297476**	726
Single Sideband Up-converters											
M34B	5.0-12.0	7.5	4-500	----	22	30	—	—	SMA	296228	630
M34C	8.0-18.0	7.5	4-500	----	22	22	—	—	SMA	296229	632
IF Quadrature Mixers											
M35B	5.0-12.0	7.5	DC-500	22	----	----	30	23	SMA	296228	634
M35C	7.0-18.0	7.5	DC-500	22	----	----	30	23	SMA	296229	636
★ **M333**	**6.0-18.0**	**7.5**	**DC-500**	**22**	----	----	**30**	**35**	**SMA**	**297475**	728
★ **M333C**	**6.0-18.0**	**7.5**	**DC-500**	**22**	----	----	**30**	**35**	**SMA**	**297476**	728
IF Quadrature Up-converters											
M36B	5.0-12.0	7.5	DC-500	----	22	30	—	—	SMA	296228	638
M36C	8.0-18.0	7.5	DC-500	----	22	22	—	—	SMA	296229	640

★ NEW PRODUCTS

NOTE:
1. IF bandwidth options are 10 to 20 MHz (-1), 20 to 40 MHz (-2), 40 to 80 MHz (-3), 80 to 160 MHz (-4), 100 to 200 MHz (-5), and 160 to 320 MHz (-6). Special octave or narrower bandwidth IF options are also available between 4 and 500 MHz.

Design Specifications

Environmental Performance

All units are designed and constructed to meet their specifications over -54°C to +100°C* and after exposure to any or all of the tests listed in Table 1 per MIL-STD-202F.

*Except W-J M1K, which is specified -54°C to +85°C.
*Except models with suffix "E".

Table 1. Environmental Tests per MIL-STD-202F

Exposure	Method	Test Condition
Temperature Cycle	102A	C
Thermal Shock	107D	B
Altitude	105C	G
H.F. Vibration	204C	D
Mechanical Shock	213B	C
Random Vibration (15 minutes per axis)	214	IIF
Solderability	208C	
Terminal Strength	211A	C
Resistance to Soldering Heat	210A	B

Hermetically sealed units meet the requirements of Method 106D of MIL-STD-202F when exposed to humidity.

Typical MTBF

Watkins-Johnson mixers are recognized worldwide for their quality and reliability. Table 2 presents sample calculated MTBF data that applies to the vast majority of our mixer product line. Please note that these calculations are for unscreened devices and that improved MTBF's can be obtained through optional screening (Hi-Rel) procedures.

Table 2. Sample Calculated* MTBF's per MIL-Handbook-217C

Mixer Type	Environment	
	+25°C, Ground Fixed (GF)	+85°C, Airborne Uninhabited (AUF)
Printed circuit mixers (M6D, M2A, etc.)	3 Million Hours	350 Thousand Hours
MINPAC™ MIC microwave mixers (M62, M88, etc.)	4 Million Hours	400 Thousand Hours
SMA connector microwave mixers (M14, M88C, etc.)	1.5 Million Hours	150 Thousand Hours

*Calculations based on using group IV diode data.

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Mixer Technical Data Sheets

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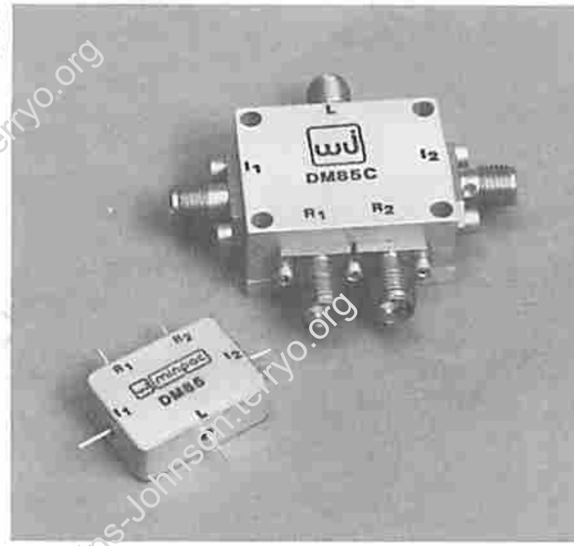
WJ-DM85/DM85C

DOUBLE-BALANCED DUAL MIXER

LO } RF } 2 TO 18 GHz
IF DC TO 1000 MHz
LO DRIVE +10 dBm (nominal)

- HERMETICALLY SEALED
- HIGH CHANNEL-TO-CHANNEL ISOLATION



Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test conditions
SSB Conversion Loss and SSB Noise Figure		6.5 dB	9.0 dB	f_R = 2 -18 GHz f_L = 2.0-18 GHz f_I = DC-500 MHz
		7.0 dB	10.0 dB	f_R = 2.0-18 GHz f_L = 2.0-18 GHz f_I = DC-1000 MHz
Isolation L to R	20 dB	25 dB		f_L = 2.0-4.0 GHz
L to R	25 dB	35 dB		f_L = 40-18.0 GHz
L to I	15 dB	20 dB		f_L = 2.0-18.0 GHz
Channel-to-Channel	25 dB	30 dB		f_R = 2-3.5 GHz
	30 dB	42 dB		f_R = 3.5-18 GHz
Conversion Compression			1.0 dB	f_R Level = +3 dBm
Third-Order Input Intercept Point		+13 dBm		f_{R1} = 4.0 GHz f_{R2} = 4.01 GHz both at -10 dBm f_L = 4.5 GHz +10 dBm
		+10 dBm		f_{R1} = 16.0 GHz f_{R2} = 16.01 GHz both at -10 dBm f_L = 15.5 GHz +10 dBm
Conversion Loss Amplitude Match		0.5 dB	1.5 dB	f_R = 2-18 GHz f_L = 2-18 GHz f_I = DC-1000 MHz

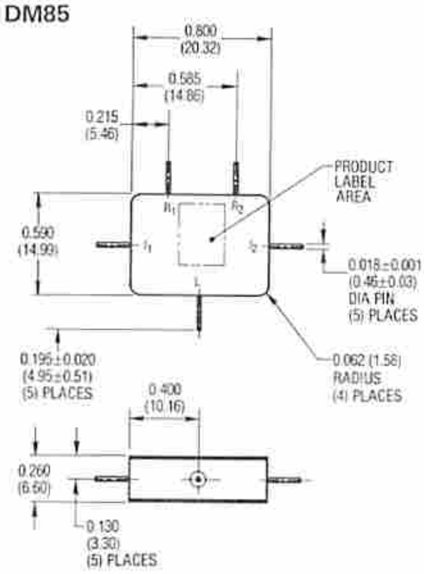
Notes:

1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified. The I-Port frequency range extends to DC for phase detection pulse modulation, or attenuator applications. I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Weight DM85: 10.2 grams (0.36 oz.)
DM85C: 47.1 grams (0.166 oz.)

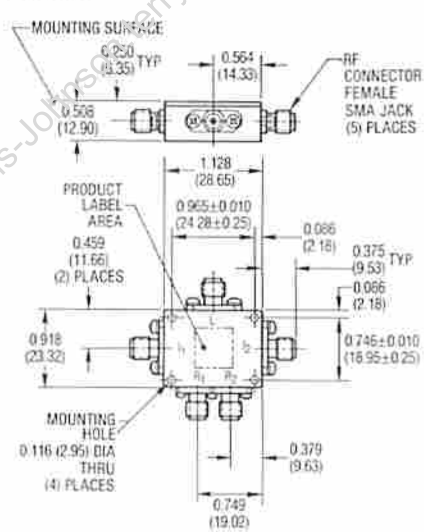
Outline Drawings

DM85



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

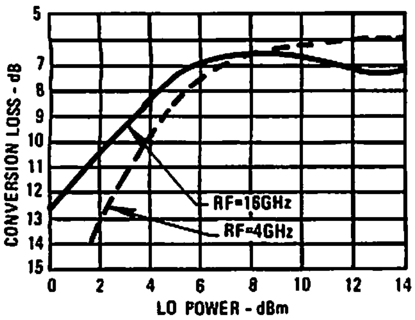
DM85C



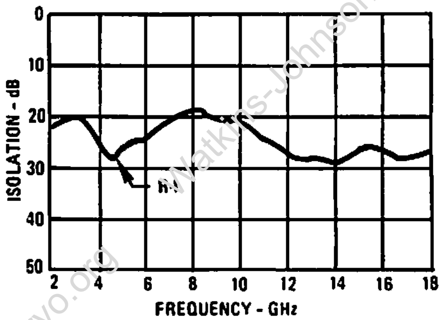
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C

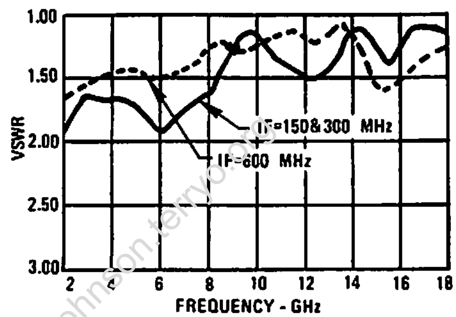
Conversion Loss vs. LO Power



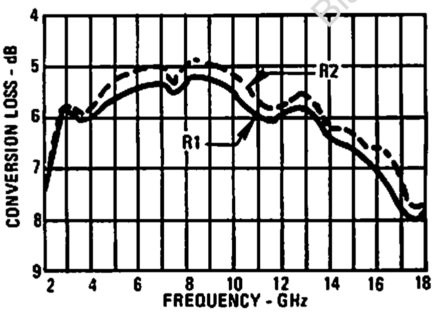
Isolation vs. Frequency



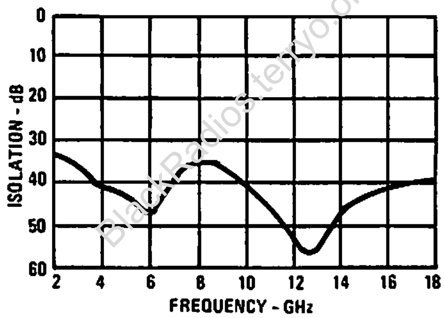
I Port VSWR vs. LO Frequency



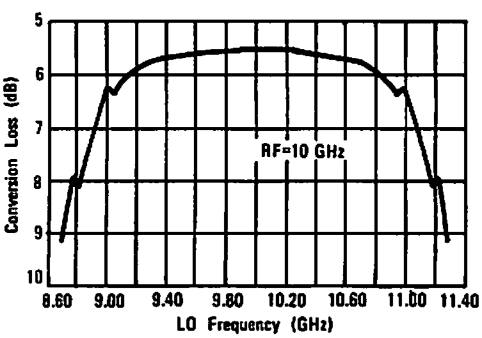
Conversion Loss vs. Frequency



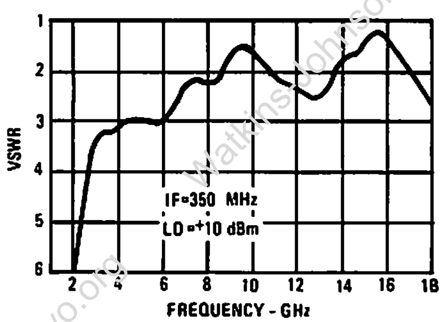
Isolation vs. Frequency Cross Channel



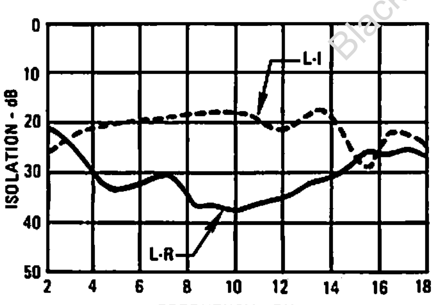
IF Frequency Response



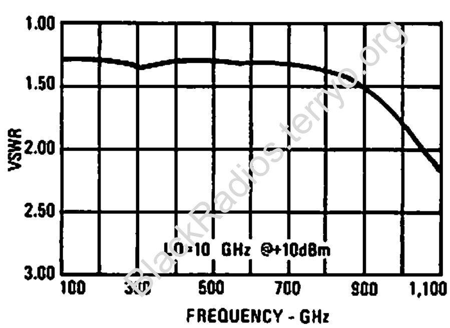
R Port VSWR vs. Frequency



Isolation vs. Frequency



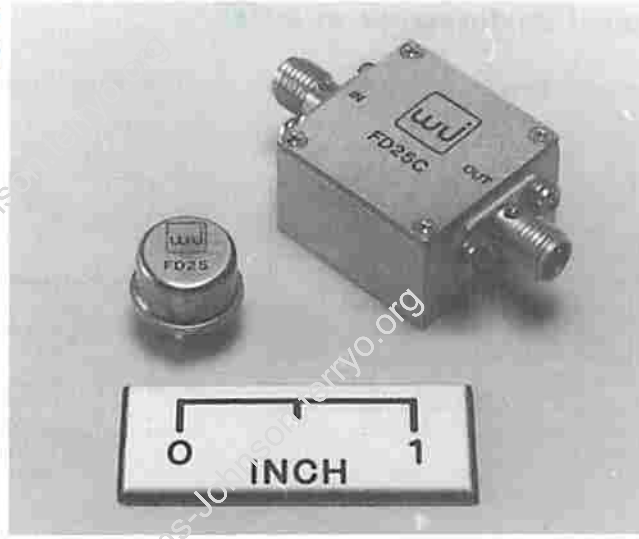
I Port VSWR vs. IF Frequency



WJ-FD25/FD25C

FREQUENCY DOUBLER

INPUT FREQUENCY 5 TO 2400 MHz
OUTPUT FREQUENCY 10 TO 4800 MHz
INPUT DRIVE LEVEL +10 dBm (nominal)



- HERMETICALLY SEALED
- LOW COST

The FD25 is a low cost broadband frequency doubler in a hermetically sealed TO-8 package. This frequency doubler is designed for low conversion loss 11.5 dBm Typ. and maximum suppression of the fundamental and third harmonics 40 dB Typ.

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
Conversion Loss		11.5 dB	13 dB	f_{in} 5 to 2400 MHz
Fundamental Suppression	30 dBc 25 dBc 20 dBc	40 dBc 35 dBc 30 dBc		f_{in} 5 to 500 MHz f_{in} 500 to 1000 MHz f_{in} 1000 to 2400 MHz
Third Harmonic Suppression	40 dBc 30 dBc 25 dBc	50 dBc 40 dBc 35 dBc		f_{in} 5 to 500 MHz f_{in} 500 to 1000 MHz f_{in} 1000 to 2400 MHz
Input/Output VSWR		1.5:1		f_{in} 5 to 2400 MHz f_{out} 10 to 4800 MHz

Notes:
1. Measured in 50-ohm system with f_{in} at +10 dBm.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

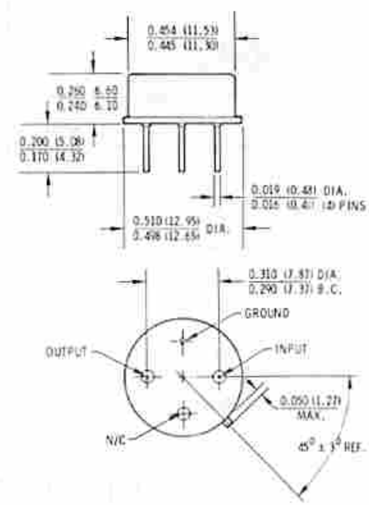
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . 23 dBm at 25°C, 20 dBm at 100°C

Weight

FD25: 2 grams (0.07 oz.) max.
FD25C: 20.14 grams (0.71 oz.) max.

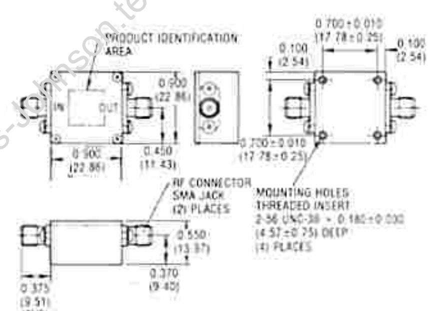
Outline Drawings

FD25



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

FD25C



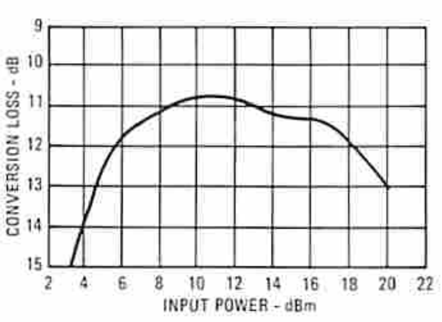
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C

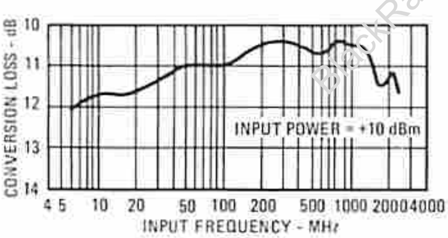
- *Drive Level:* The minimum recommended drive level is +8 dBm. This level has been established on the premise that a lower drive level will degrade the conversion loss and input VSWR over the full temperature and frequency range.

  The maximum recommended drive level is +13 dBm. This upper level is recommended to avoid excessive input VSWR and conversion loss.

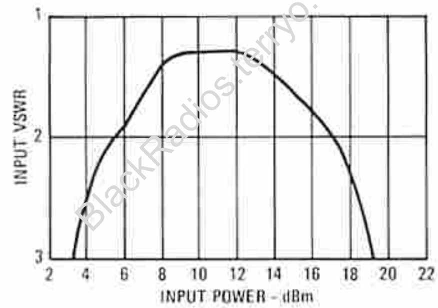
Conversion Loss vs. Input Power



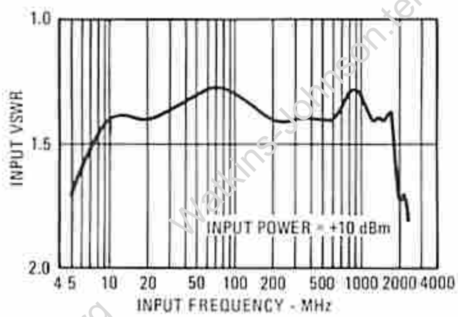
Input/Output Isolation



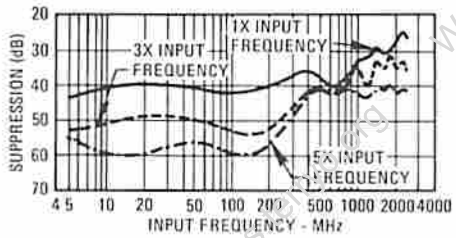
Input VSWR vs. Input Power



Input VSWR vs. Input Frequency



Suppression vs. Input Frequency



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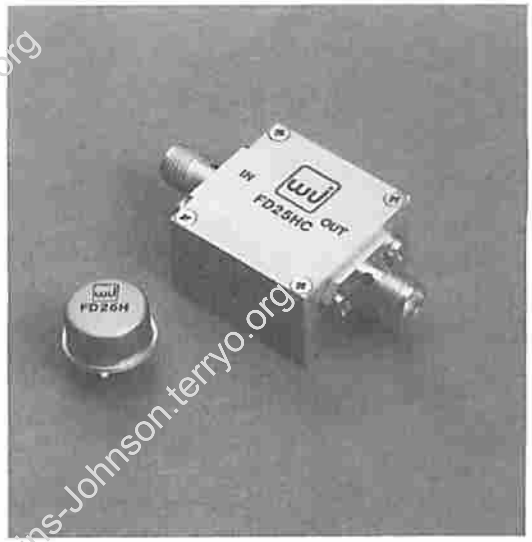
WJ-FD25H/FD25HC

FREQUENCY DOUBLER

INPUT FREQUENCY 5 TO 2400 MHz
OUTPUT FREQUENCY 10 TO 4800 MHz
INPUT DRIVE LEVEL +23 dBm (nominal)



- HERMETICALLY SEALED

The FD25H is a low cost broadband frequency doubler in a hermetically sealed TO-8 package. This frequency doubler is designed for low conversion loss 11.5 dB Typ. and maximum suppression of the fundamental and third harmonics 40 dB Typ.

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
Conversion Loss		11.5 dB	13.0 dB	f_{in} 5 to 2400 MHz
Fundamental Suppression	25 dBc 20 dBc	35 dBc 25 dBc		f_{in} 5 to 1000 MHz f_{in} 1000 to 2400 MHz
Third Harmonic Suppression	30 dBc 25 dBc	40 dBc 35 dBc		f_{in} 5 to 1000 MHz f_{in} 1000 to 2400 MHz
Input/Output VSWR		1.5:1		f_{in} 5 to 2400 MHz f_{out} 10 to 4800 MHz

Notes:
1. Measured in 50-ohm system with f_{in} at +23 dBm.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

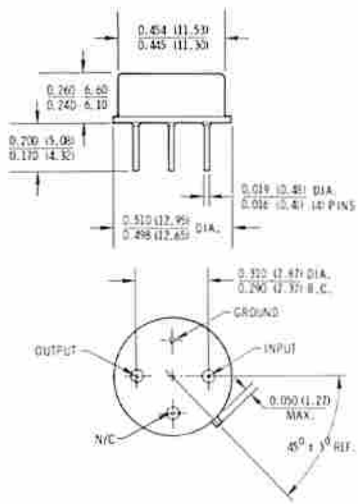
Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . 26 dBm at 25°C, 23 dBm at 100°C

Weight FD25H: 2 grams (0.07 oz.) max.
FD25HC: 20.14 grams (0.71 oz.) max.

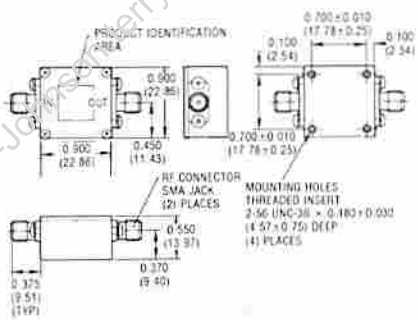
Outline Drawings

FD25H



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

FD25HC



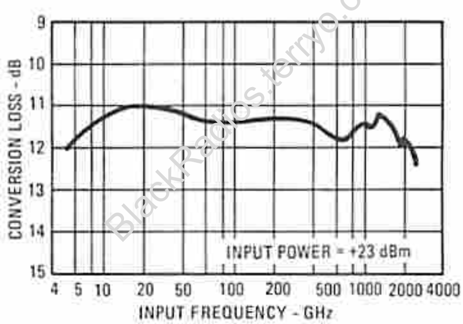
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C

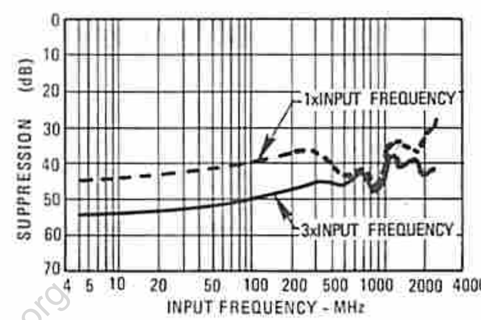
Drive Level: The minimum recommended drive level is +20 dBm. This level has been established on the premise that a lower drive level will degrade the conversion loss and input VSWR over the full temperature and frequency range.

The maximum recommended drive level is +26 dBm. This upper level is recommended to avoid excessive input VSWR and conversion loss.

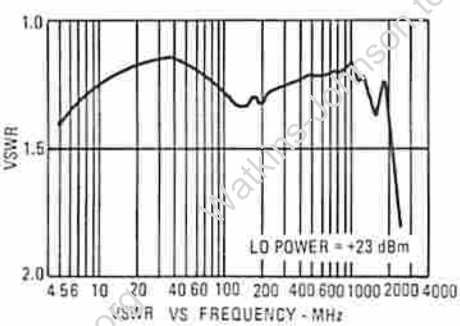
Conversion Loss vs. Input Frequency



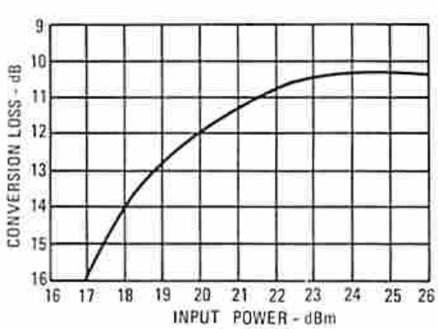
Harmonic Suppression vs. Input Frequency



VSWR vs. Frequency



Conversion Loss vs. Input Power

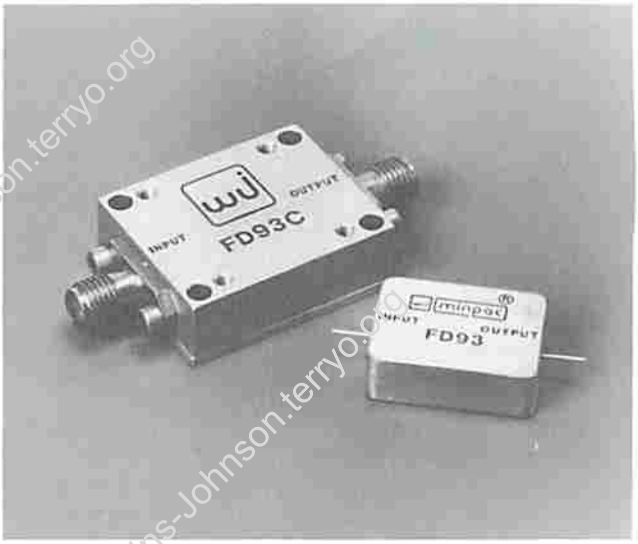


6

WJ-FD93/FD93C

FREQUENCY DOUBLER

INPUT FREQUENCY 2 TO 9 GHz
OUTPUT FREQUENCY 4 TO 18 GHz
INPUT DRIVE LEVEL +12 dBm (nominal)



- LOW VSWR
- BROADBAND
- HERMETICALLY SEALED

The WJ-FD93 is a broadband microwave frequency doubler in a hermetically sealed MINPAC™. The doubler is designed for low conversion loss and maximum suppression of the fundamental and third harmonics. The FD93 is an economical means of extending the local oscillator frequency range.

Guaranteed Specifications[1]

Characteristics	Min	Typ[2]	Max	Test Conditions
Conversion Loss (dB)		10.0 12.0	12.0 14.0	F_{in} = 2 to 4 GHz F_{in} = 4 to 9 GHz
Fundamental Isolation[3] (dB)	19	25		F_{in} = 2 to 9 GHz
Third Harmonic Suppression (dBc)	17	25		F_{in} = 2 to 6 GHz
Input VSWR		1.5:1		F_{in} = 2 to 9 GHz

Notes:
1. Measured in 50-ohm system with f_{in} at +12 dBm.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.
3. Fundamental isolation is referred to the input signal.

Absolute Maximum Ratings

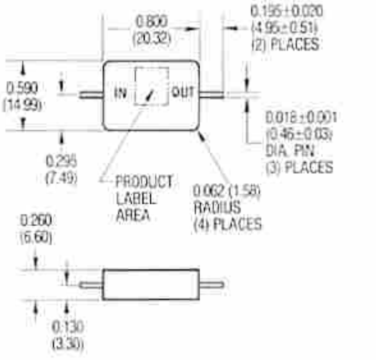
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . 23 dBm at 25°C, 20 dBm at 100°C

Weight

FD93: 12 grams (0.42 oz.) max.
FD93C: 40 grams (1.41 oz.) max.

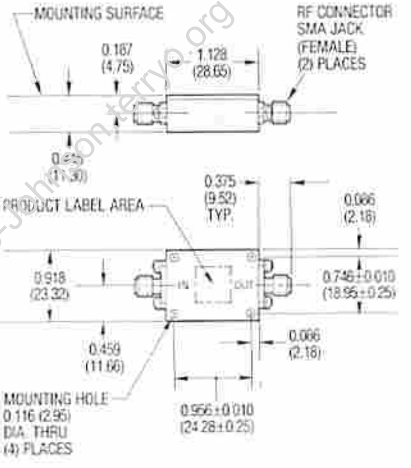
Outline Drawings

FD93



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

FD93C



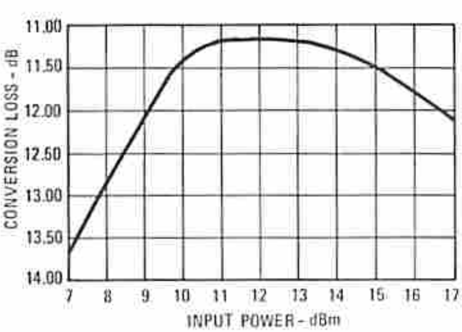
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C

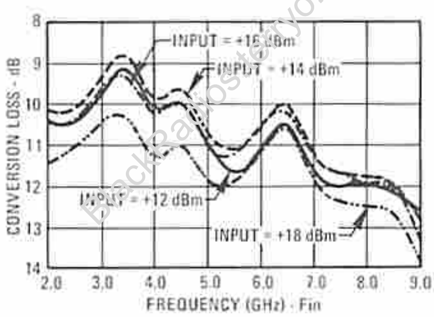
Drive Level: The minimum recommended drive level is +11 dBm. This level has been established on the premise that a lower drive level will degrade the conversion loss and input VSWR over the full temperature and frequency range.

The maximum recommended drive level is +15 dBm. This upper level is recommended to avoid excessive input VSWR and conversion loss.

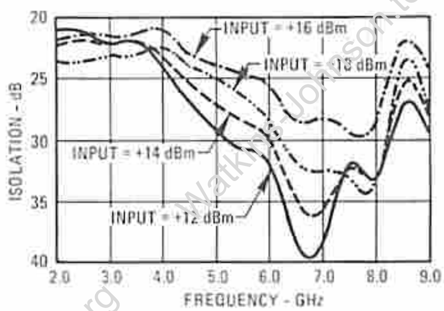
Conversion Loss vs. Input Power



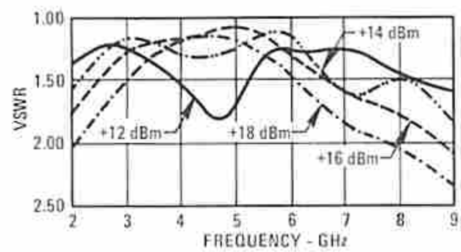
Conversion Loss vs. Input Frequency



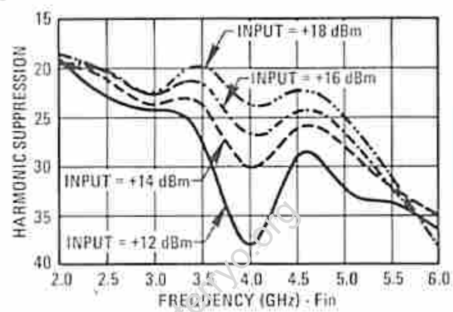
Input/Output Isolation



VSWR vs. Frequency



Suppression vs. Input Frequency

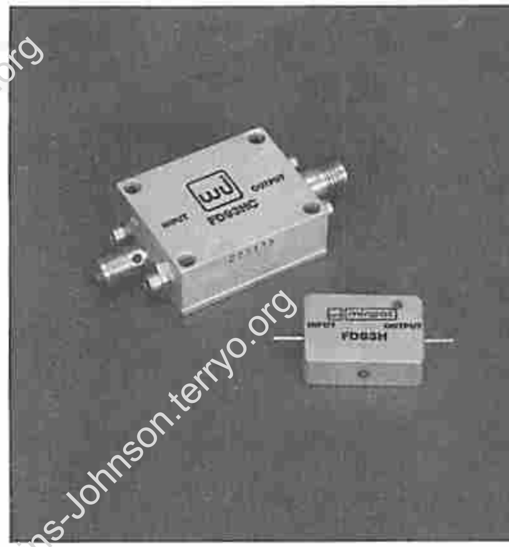


6

WJ-FD93H/FD93HC

FREQUENCY DOUBLER

INPUT FREQUENCY 2 TO 9 GHz
OUTPUT FREQUENCY 4 TO 18 GHz
INPUT DRIVE LEVEL +19 dBm (nominal)



- BROADBAND
- LOW VSWR
- HERMETICALLY SEALED

The WJ-FD93H is a broadband microwave frequency doubler in a hermetically sealed MINPAC™. The doubler is designed for low conversion loss and maximum suppression of the fundamental and third harmonics. The FD93H is an economical means of extending the local oscillator frequency range.

Guaranteed Specifications

Characteristics	Min	Typ[2]	Max	Test Conditions
Conversion Loss (dB)		11.0 12.0	12.0 14.0	F_{in} = 2 to 4 GHz F_{in} = 4 to 9 GHz
Fundamental Isolation[3] (dB)	19	25		F_{in} = 2 to 9 GHz
Third Harmonic Suppression (dBc)	16	25		F_{in} = 2 to 6 GHz
Input VSWR		1.5:1		F_{in} = 2 to 9 GHz

Notes:
1. Measured in 50-Ohm system with F_{in} at +19 dBm.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.
3. Fundamental isolation is referenced to the input signal.

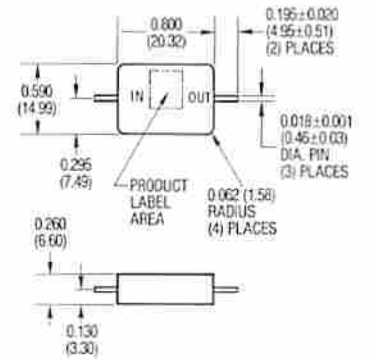
Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . 23 dBm at 25°C, 20 dBm at 100°C

Weight FD93H: 12 grams (0.42 oz.) max.
FD93HC: 40 grams (1.41 oz.) max.

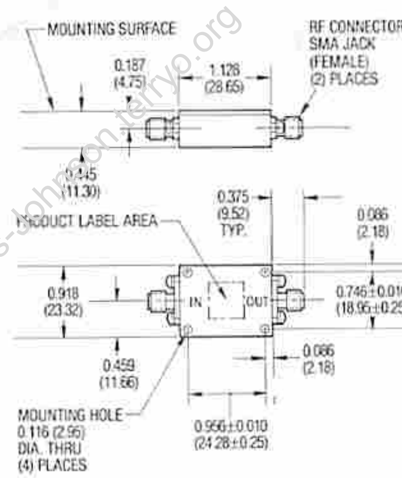
Outline Drawings

FD93H



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

FD93HC



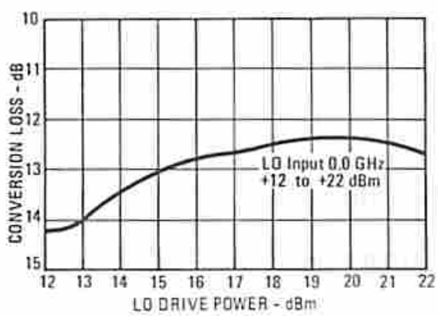
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C

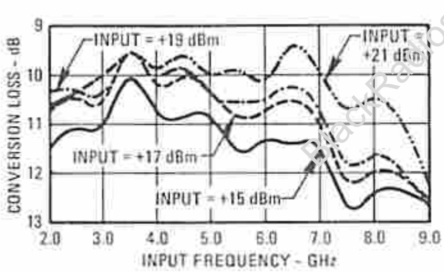
Drive Level: The minimum recommended drive level is +17 dBm. This level has been established on the premise that a lower drive level will degrade the conversion loss and input VSWR over the full temperature and frequency range.

The maximum recommended drive level is +21 dBm. This upper level is recommended to avoid excessive input VSWR and conversion loss.

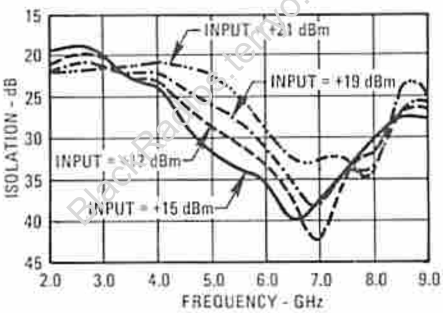
Conversion Loss Vs. LO Drive Power



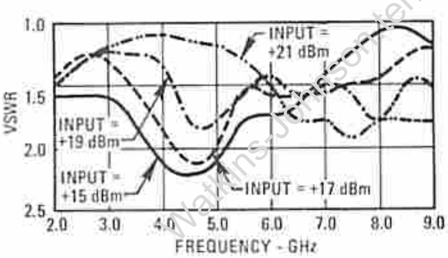
Conversion Loss vs. Input Frequency



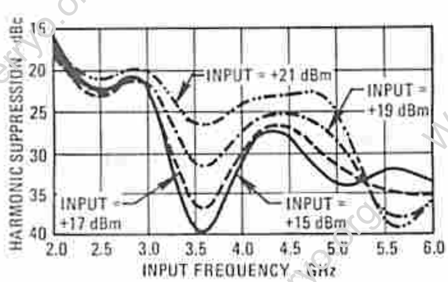
Isolation vs. Frequency



VSWR vs. Frequency



Suppression vs. Input Frequency



6

WJ-M1

DOUBLE-BALANCED MIXER

LO / RF } 0.2 TO 500 MHz
IF DC TO 500 MHz
LO DRIVE +7 dBm (nominal)

- LOW NOISE FIGURE: 6 dB (TYP.)
- HIGH ISOLATION: 50 dB (TYP.)

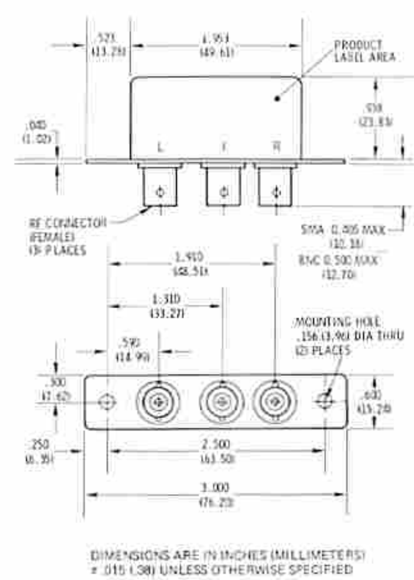
Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		6.0 dB	6.5 dB	f_L, f_R & f_I 1 MHz to 50 MHz
			8.5 dB	f_L, f_R & f_I 0.2 MHz to 500 MHz
Isolation[2]				
f_L at R	45 dB			f_L, f_R & f_I 0.2 MHz to 50 MHz
f_L at I	40 dB			
f_R at L		50 dB		
f_R at I		30 dB		
f_I at L		40 dB		
f_I at L		30 dB		
f_L at R	35 dB			f_L, f_R & f_I 50 MHz to 500 MHz
f_L at I	25 dB			
f_R at L		35 dB		
f_R at I		20 dB		
f_I at L		20 dB		
f_I at R		20 dB		
Conversion Compression		0.3 dB		f_R = +1 dBm
Conversion Densensitization Level		1.0 dB		f_{R2} = +1 dBm
		10.0 dB		f_{R2} = +10 dBm
Attenuator Insertion Loss		3 dB		I_I = 10 mA f_L 1 to 50 MHz
	45 dB			I_I = 0 mA f_L 0.2 to 50 MHz
Pulse Modulator Rise Time			1.0 ns	Pulse Input at I
Pulse Modulator Fall Time			1.0 ns	RF Input at L
Pulse Modulator On-Off Ratio	40 dB			f_L 0.2 to 50 MHz
	30 dB			f_L 50 to 500 MHz

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Outline Drawing

M1



Weight 45 grams (1.6 oz.) max.

Connectors BNC/SMA

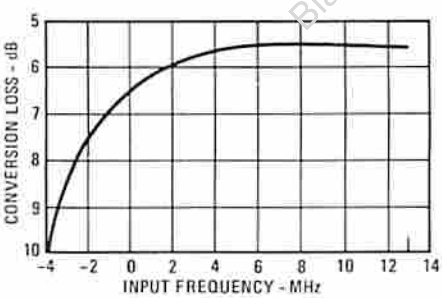
Absolute Maximum Ratings

Operating Temperature
- 0.2 to 0.4 MHz . . . . -20°C to +100°C
- 0.4 to 500 MHz. . . . . -54°C to +100°C

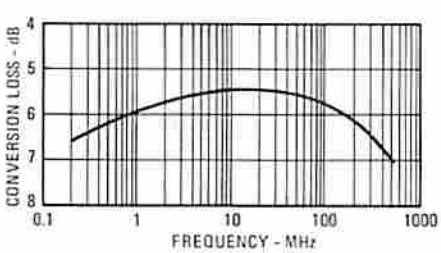
Storage Temperature . . . . -65°C to +100°C
Peak RF Input Power . . . . +17 dBm
Peak Input Current at 25°C . . . . 50 mA DC

Typical Performance at 25°C

Conversion Loss

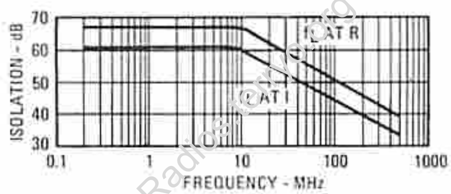


Conversion Loss vs. Drive Level: Conversion loss in an SSB system as a function of drive level (f_L level), with f_L and f_R at approximately 50 MHz and f_R level at –20 dBm.



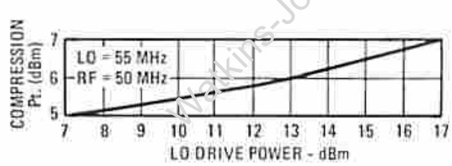
Conversion loss of the mixer when used in SSB system. The frequency ordinate refers to the inputs f_L and f_R with f_I any frequency less than 500 MHz for conversion loss measurements.

Isolation

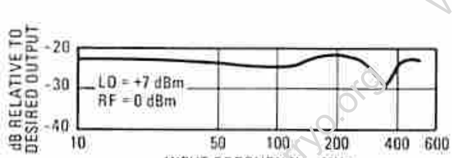


Level of the f_L signal at the R-port and I-port with respect to the available power of +7 dBm from a 50-ohm source used for f_L.

1 dB Compression Point vs. LO



Two-Tone Suppression vs. Frequency



6

WJ-M1A

DOUBLE-BALANCED MIXER

LO } 3 TO 1000 MHz
RF }
IF DC TO 1000 MHz
LO DRIVE +7 dBm (nominal)

- HIGH ISOLATION: > 45 dB (TYP.)[2]

Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.5 dB	f_L, f_R & f_I 10 MHz to 100 MHz
		10.0 dB	f_L, f_R & f_I 3 MHz to 1000 MHz
Mixer Isolation f_L at R	40 dB		3-100 MHz
f_L at I	40 dB		3-100 MHz
f_L at R	30 dB		100-1000 MHz
f_L at I	20 dB		100-1000 MHz

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications. I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

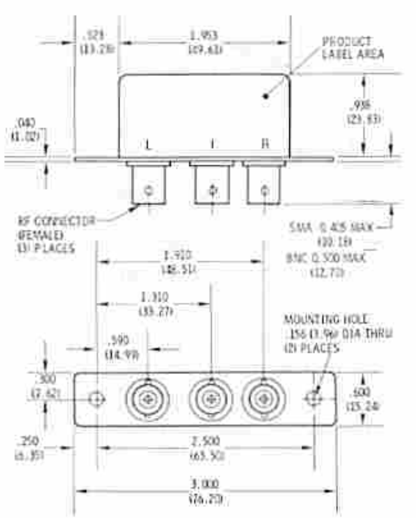
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak RF Input Power . . . . +17 dBm
Peak Input Current at 25°C . . . . 50 mA DC

Weight 45 grams (1.6 oz.) max.

Connectors BNC, SMA

Outline Drawing

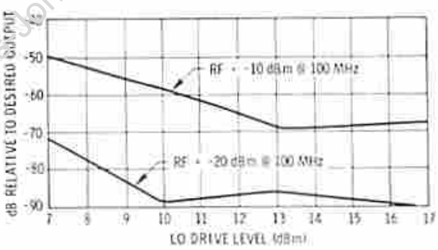
M1A



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±0.015 (0.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C

Two-Tone Suppression vs. Drive Level



WJ-M1A-11

DOUBLE-BALANCED MIXER

LO } 3 TO 1200 MHz
RF }
IF DC TO 1200 MHz
LO DRIVE +7 dBm (nominal)

- HIGH ISOLATION: > 45 dB (TYP.)[2]

Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.5 dB	f_L, f_R & f_I 10 MHz to 100 MHz
		10.0 dB	f_L, f_R & f_I 3 MHz to 1200 MHz
Isolation			
f_L at R	40 dB		3-100 MHz
f_L at I	40 dB		3-100 MHz
f_L at R	30 dB		100-1000 MHz
f_L at I	20 dB		100-1000 MHz

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

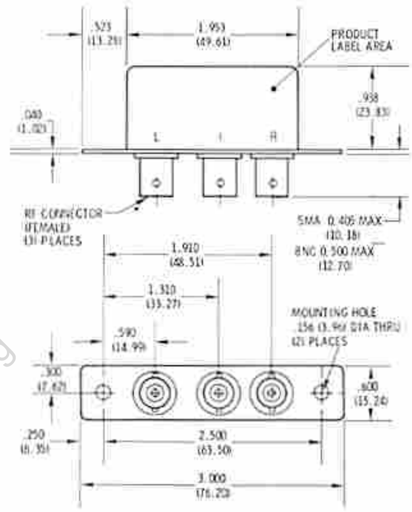
Storage Temperature . . . . -65°C to +100°C
Operating Temperature. . . . . -54°C to +100°C
Peak RF Input Power. . . . . +17 dBm
Peak Input Current at 25°C. . . . . 50 mA DC

Weight

45 grams (1.6 oz.) max.

Outline Drawings

M1A-11



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

WJ-M1G

DOUBLE-BALANCED MIXER

LO / RF } 1.0 TO 4.2 GHz
IF DC TO 1 GHz
LO DRIVE +7 dBm (nominal)

- HIGH ISOLATION: > 40 dB (TYP.)[2]
- LOW NOISE FIGURE: 5.3 dB (TYP.)[2]

Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.5 dB	f_L & f_R 1.5 to 4.2 GHz, f_I 0.01 to 1 GHz
		8.5 dB	f_L & f_R 1.0 to 1.5 GHz, f_I 10 to 500 MHz
Isolation f_L at R	30 dB		f_L 1.0 to 4.2 GHz
f_L at I	20 dB		

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications. I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

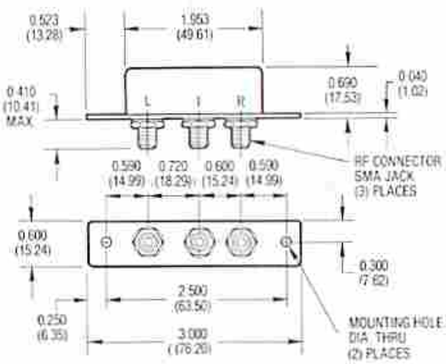
Absolute Maximum Ratings

Storage Temperature . . . . -65°C to +100°C
Operating Temperature. . . . . -54°C to +100°C
Peak RF Input Power. . . . . +17 dBm
Peak Input Current at 25°C. . . . . 50 mA DC

Weight 31 grams (1.1 oz.) max.

Outline Drawing

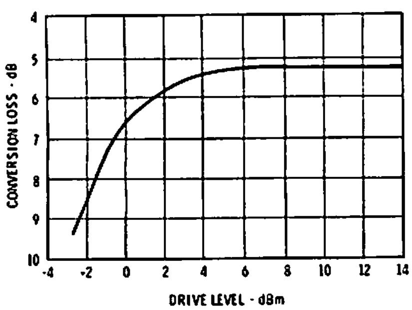
M1G



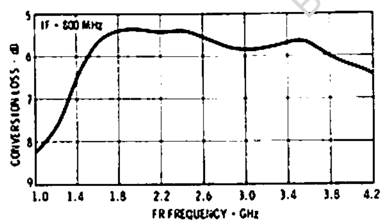
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

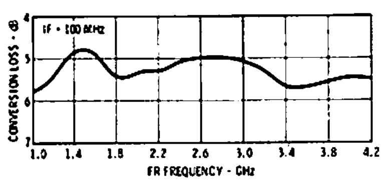
Typical Performance at 25°C

Conversion Loss



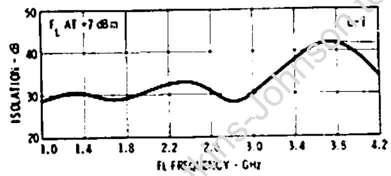
Conversion Loss vs. LO Drive Level: The minimum recommended drive level is +4 dBm. The maximum recommended drive level is +13 dBm.

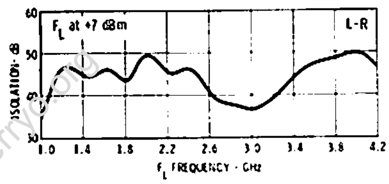




Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R) with f_I at 100 MHz and 800 MHz. Data plotted with an f_L level of +7 dBm.

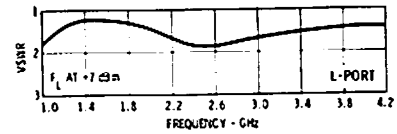
Isolation

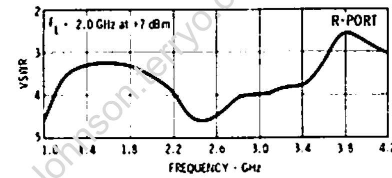


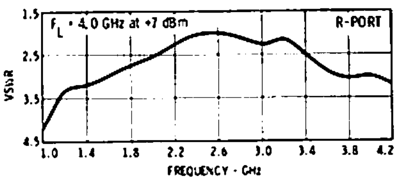


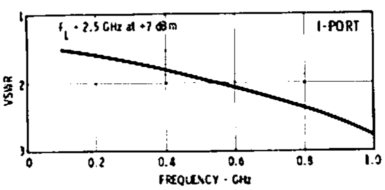
Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

VSWR









VSWR vs. Frequency: VSWR of the I- and R-ports in a 50-ohm system. Some variation in the R-port VSWR will occur as a function of the L-port frequency as shown above. Curves for R-port VSWR are plotted for L-port frequencies of 2 GHz and 4 GHz. For the best R-port VSWR, the f_L frequency should be greater than the input frequency at the R-port. A plot of I-port VSWR is also shown with f_R at 2 GHz and f_L greater than f_R.

WJ-M1H

DOUBLE-BALANCED MIXER

LO / RF } 1.8 TO 6.2 GHz
IF DC TO 2 GHz
LO DRIVE +7 dBm (nominal)

- HIGH ISOLATION: >35 dB (TYP.)[2]

Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
Conversion Loss and Noise Fixture		7.0 dB	f_L & f_R 1.8 to 4.2 GHz f_I 0.01 to 2 GHz
			f_L & f_R 4.2 to 6.2 GHz
		8.0 dB	f_I 10 to 500 MHz
		9.0 dB	f_I 500 MHz to 2 GHz
Isolation			
f_L at R	25 dB		f_L 1.8 to 4.2 GHz
f_L at R	15 dB		
f_L at R	20 dB		f_L 4.2 to 6.2 GHz
f_L at I	15 dB		
Mixer Compression		1.0 dB	f_R = -2 dBm f_L at +13 dBm
		1.0 dB	f_R = -4 dBm f_L at +7 dBm

Notes:

1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

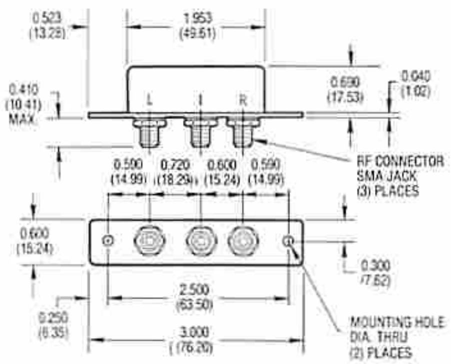
Absolute Maximum Ratings

Operating Temperature . . . . . -54°C to +100°C
Storage Temperature . . . . . -65°C to +100°C
Peak RF Input Power . . . . . +17 dBm
Peak Input Current at 25°C . . . . . 50 mA DC

Weight 31 grams (1.1 oz.) max.

Outline Drawing

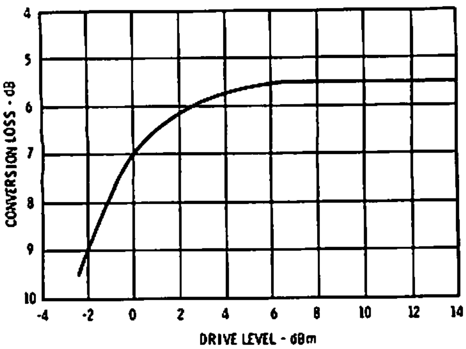
M1H



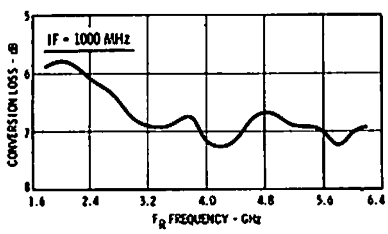
DIMENSIONS ARE IN INCHES (MILLIMETERS) ± 0.015 (0.38) UNLESS OTHERWISE SPECIFIED

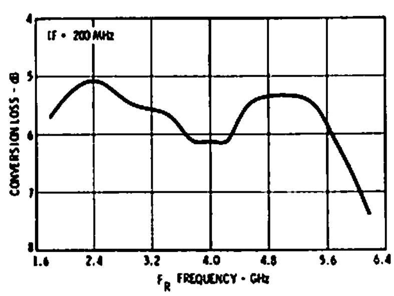
Typical Performance at 25°C

Conversion Loss



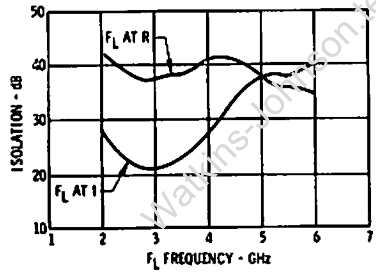
Conversion Loss vs. Drive Level: Conversion loss in an SSB system is a function of drive level (f_L with f_L and f_R at approximately 3 GHz and f_R level at -6 dBm.





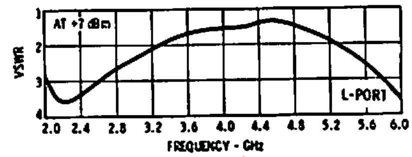
Conversion Loss vs. Input Frequency: The frequency ordinate refers to the report (f_R) with f_I at 200 MHz and 1000 MHz, data plotted with f_L at +7 dBm.

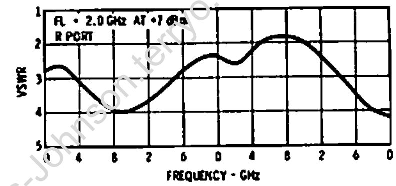
Isolation

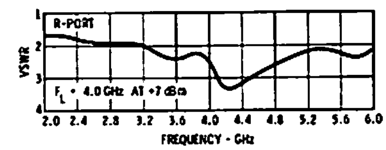


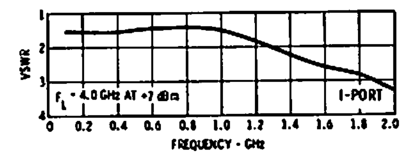
Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

VSWR









VSWR vs. Frequency: VSWR of the L- I- and R-ports in a 50-ohm system. Some variation in the R-port VSWR will occur as a function of the L-port frequency as shown above. Curves for R-port VSWR are plotted for L-port frequencies of 2 GHz and 4 GHz. A plot of I-port VSWR is also shown with f_L at 4 GHz.

6

WJ-M1J

DOUBLE-BALANCED MIXER

LO / RF } 300 TO 2000 MHz
IF DC TO 1000 MHz
LO DRIVE +7 dBm (nominal)

- HIGH ISOLATION: >50 dB (TYP.)

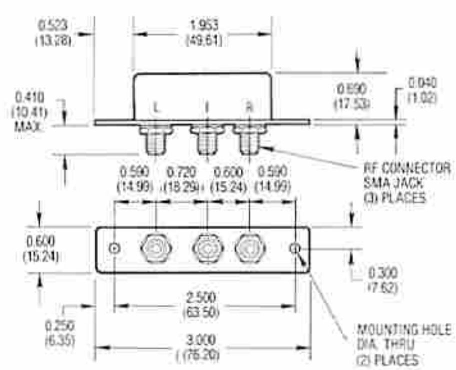
Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure				f_L & f_R = 1000 to 1700 MHz
		6.0 dB	7.5 dB	f_I = 10 to 500 MHz
		6.5 dB	8.0 dB	f_I = 500 to 1000 MHz
		8.0 dB	9.0 dB	f_L & f_R = 600 to 2000 MHz
				f_I = 10 to 1000 MHz
				f_L & f_R = 300 to 2000 MHz
		8.0 dB	9.0 dB	f_I = 10 to 450 MHz
		9.5 dB	10.0 dB	f_I = 450 to 1000 MHz
Isolation				
L to R	40 dB	45 dB		f_L = 300 to 1000 MHz
L to I	25 dB	35 dB		
L to R	35 dB	40 dB		f_L = 1000 to 2000 MHz
L to I	20 dB	30 dB		
Conversion Compression			1.0 dB	f_R level = 0 dBm
Densensitization Level			1.0 dB	f_R2 level = -2 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Outline Drawing

M1J



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±0.015 (0.38) UNLESS OTHERWISE SPECIFIED

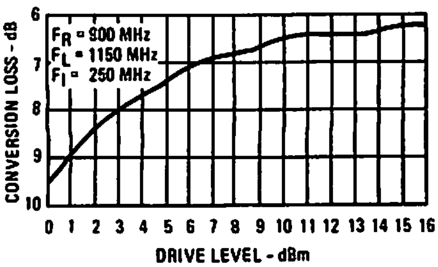
Absolute Maximum Ratings

Storage Temperature . . . . -65°C to +100°C
Operating Temperature . . . . -54°C to +100°C
Peak RF Input Power . . . . +26 dBm at 25°C, derate to +17 dBm at 100°C
Peak Input Current at 25°C . . . . 50 mA DC

Weight 31 grams (1.1 oz.) max.

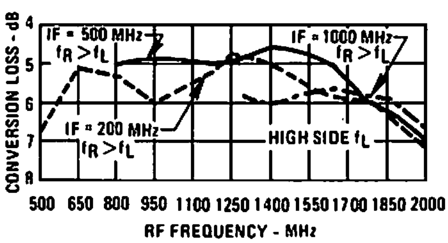
Typical Performance at 25°C

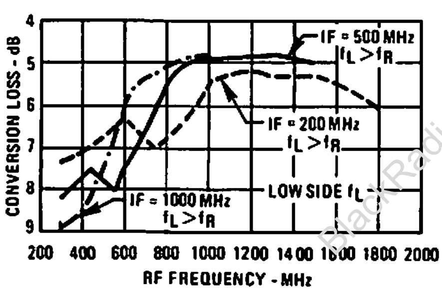
Conversion Loss



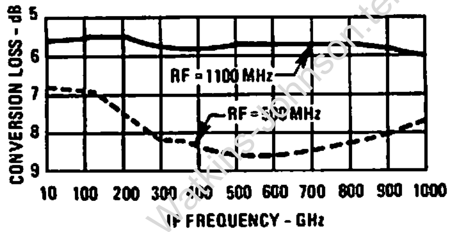
Conversion Loss vs. LO Drive Level: The minimum recommended drive level is +4 dBm. A lower drive level will degrade the conversion loss and noise figure over the full temperature and frequency range. Operation at +4 dBm is recommended to reduce the level of the intermodulation products in the last two rows of the intermodulation chart. It will also minimize the output noise below 2 kHz.

The maximum recommended drive level is +13 dBm. A higher drive level will significantly increase the noise figure and also degrade isolation. Operation at +13 dBm is recommended to achieve best two-tone performance and suppression of the intermodulation products in the rows above the second row in the intermodulation chart.



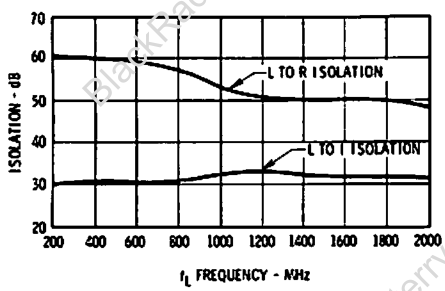


Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in SSB system. The frequency ordinate refers to the R-port (f_R) with f_I at 200, 500, and 1000 MHz. Data plotted with an f_L level of +7 dBm.



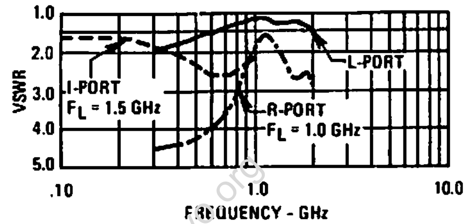
Conversion Loss vs. f_I Frequency: Conversion loss of the mixer when used in a SSB system. The frequency ordinate refers to the I-port when f_L is swept from 510 to 1500 MHz with f_R at 500 MHz and f_L swept from 1110 to 2100 MHz with f_R at 1100 MHz.

Isolation



Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

VSWR



VSWR vs. Frequency: VSWR of the L-, I-, and R-ports in a 50-ohm system with f_L at +7 dBm. Some variation in the R-port VSWR will occur as a function of the L-port frequency.

Harmonic Intermodulation

	0	f_L	$2f_L$	$3f_L$	$4f_L$	$5f_L$
$5f_R$	>71	>71	>71	>71	>71	>71
	>71	>71	>71	>71	>71	>71
$4f_R$	>71	>71	>71	>71	>71	>71
	>71	>71	>71	>71	>71	>71
$3f_R$	>71	53	68	56	71	51
	>71	63	67	61	>71	69
$2f_R$	61	50	65	50	67	66
	63	55	64	64	70	66
f_R	28	0	40	12	41	26
	29	0	41	10	42	19
	—	7	43	29	54	30
	—	3	36	27	54	29

Harmonic Intermodulation Products: Intermodulation signals which result from the mixing of mixer generated harmonics of the input signals are shown above. Mixing product suppression is indicated by the number of dB below the desired output level, $f_R - f_L$. Products are for the difference frequency $nf_L - mf_R$ and $mf_R - nf_L$. The performance was measured with f_R at 300 MHz, −10 dBm, and f_L = 299 MHz, +7 dBm for light area, +13 dBm for shaded area.

WJ-M1K

DOUBLE-BALANCED MIXER

LO / RF } 1.0 TO 4.0 GHz
IF DC TO 1000 MHz
LO DRIVE +20 dBm (nominal)

- HIGH INTERCEPT POINT: +28 dBm (TYP.)[2]

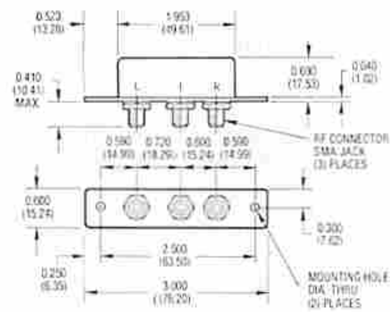
Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		8.0 dB	f_L 1.2 to 4.0 GHz f_R 1.2 to 3.5 GHz f_I 10 to 500 MHz $f_L > f_R$
		9.5 dB	f_L & f_R 1.0 to 4.0 GHz f_I 10 to 1000 MHz
Conversion Compression		1.0 dB	f_L = +20 dBm f_R = +13 dBm
Isolation			
f_L at R	20 dB		f_L 1.0 to 4.0 GHz
f_L at I	15 dB		f_L 2.0 to 4.0 GHz
f_L at I	10 dB		f_L 1.0 to 2.0 GHz

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Outline Drawing

M1K



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± 0.015 (0.38) UNLESS OTHERWISE SPECIFIED

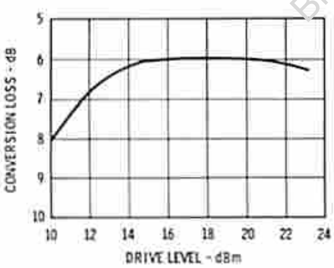
Absolute Maximum Ratings

Storage Temperature . . . . -65°C to +100°C
Operating Temperature
Without Specification Degradation . . . . -54°C to +85°C
With 0.5 dB Noise Figure Degradation . . . . -54°C to +100°C
Peak RF Input Power . . . . +26 dBm, at 25°C

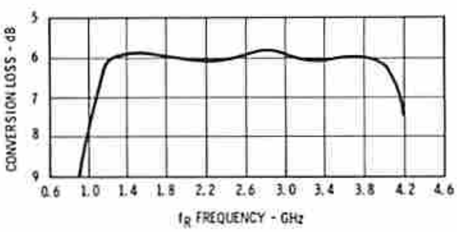
Weight 33 grams (1.164 oz.) max.

Typical Performance at 25°C

Conversion Loss

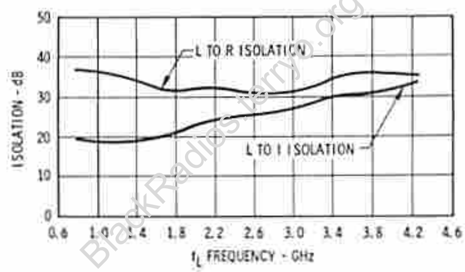


Conversion Loss vs. LO Drive Power: The minimum recommended drive level is +16 dBm. The maximum recommended drive level is +23 dBm.



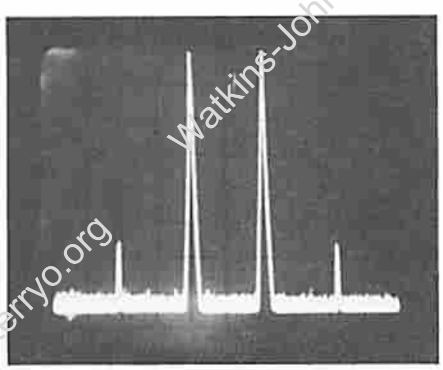
Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R) with f_I at 500 MHz and f_L greater than f_R. Data plotted with an f_L level of +20 dBm.

Isolation



Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

Two-Tone Intermodulation



Typical Two-Tone Intermodulation Performance: f_I = 500 MHz, f_R = 2.5 GHz ± 1 MHz, $f_L > f_R$, f_L = 3.0 GHz at +20 dBm, f_R at −10 dBm vertical scale 10 dB/cm.

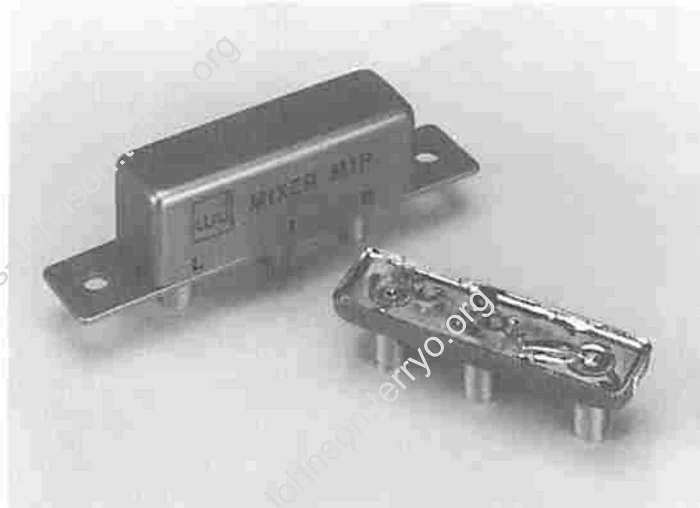
6

WJ-M1P

DOUBLE-BALANCED MIXER

LO, RF } 0.5 TO 4.0 GHz
IF 5 MHz TO 3.0 GHz
LO DRIVE +15 dBm (nominal)

- HIGH INTERCEPT POINT +25 dBm (TYP.)[2]
- BROADBAND



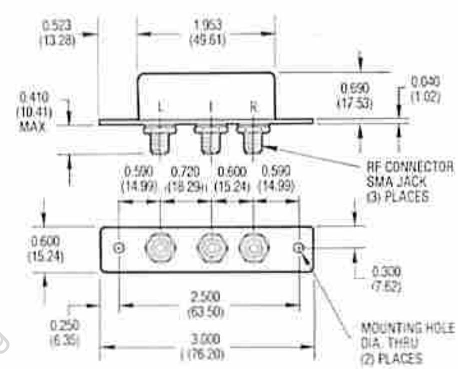
Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		9.5 dB	f_L & f_R 0.5 to 1 GHz, f_I 5 to 500 MHz
		10.0 dB	f_L & f_R 2 to 4 GHz, f_I 0.005 to 2 GHz
		12.0 dB	f_L & f_R 0.5 to 4 GHz, f_I 0.005 to 3 GHz
Isolation			
f_L at R	20 dB		f_L 0.5 to 4 GHz
f_L at I	20 dB		

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Outline Drawing

M1P



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

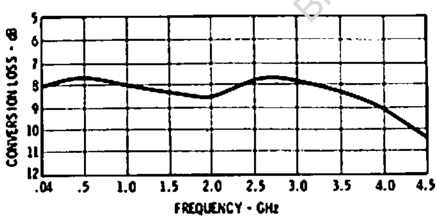
Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +85°C
Storage Temperature . . . . -65°C to +100°C
Peak RF Input Power . . . . +27 dBm RMS
Peak Input Current at +25°C . . . . 100 mA DC

Weight 31 grams (1.1 oz.) max.

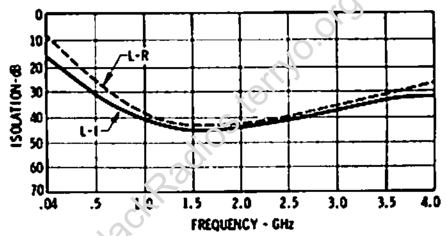
Typical Performance at 25°C

Conversion Loss



Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R) with f_I at 150 MHz. Data plotted with f_L of +15 dBm.

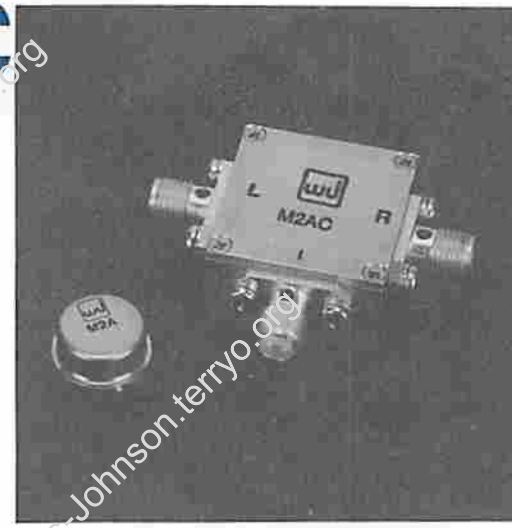
Isolation



Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

6

WJ-M2A/M2AC



DOUBLE-BALANCED MIXER

LO / RF } 10 TO 1500 MHz
IF DC TO 800 MHz
LO DRIVE +7 dBm (nominal)

- HIGH ISOLATION: 35 dB (TYP.)[2]

Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.2 dB	f_R 20 to 600 MHz, f_L 10 to 800 MHz, f_I 1 to 200 MHz
		8.2 dB	f_R 10 to 1500 MHz, f_L 10 to 1500 MHz, f_I 1 to 200 MHz
		9.0 dB	f_I 1 to 800 MHz
Isolation			
f_L at R	35 dB		f_L 10 to 500 MHz
f_L at I	30 dB		
f_L at R	28 dB		f_L 500 to 1200 MHz
f_L at I	20 dB		
f_L at R	25 dB		f_L 1200 to 1500 MHz
f_L at I	18 dB		
Conversion Compression		1.0 dB	f_R Level = 0 dBm
Desensitization Level		1.0 dB	f_{R2} Level = -2 dBm
Third Order Intercept Point		+12 dBm (Typ. Only)[2]	f_L = +7 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

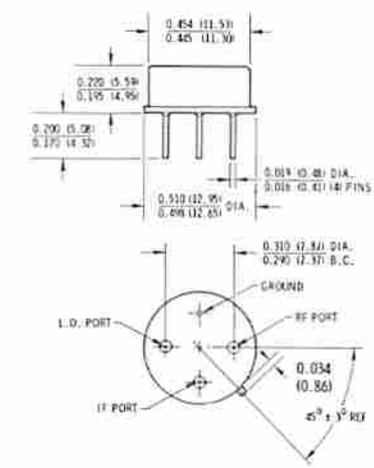
Operating Temperature*
10 to 20 MHz . . . . -20°C to +100°C
20 to 1500 MHz . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . . . +23 dBm at 25°C, derate to +17 dBm at 100°C
Peak Input Current at 25°C . . . . 50 mA DC

*For the SMA connector package operation within 0° to 50°C temperature range is recommended.

Weight M2A: 2 grams (0.07 oz.) max.
M2AC: 22 grams (0.78 oz.) max.

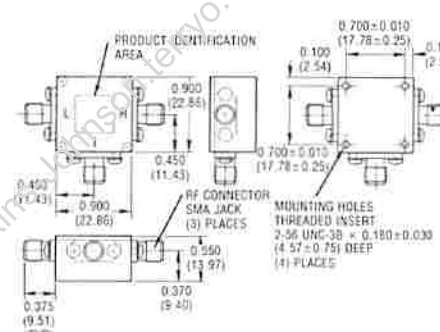
Outline Drawings

M2A



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

M2AC

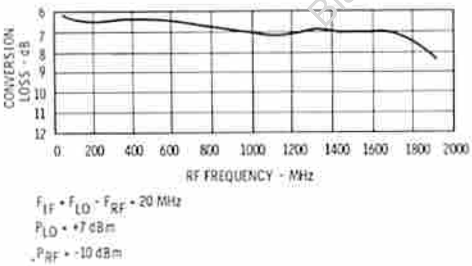


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

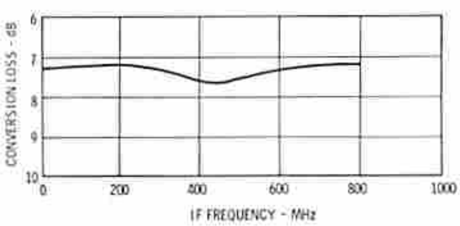
Typical Performance at 25°C

Conversion Loss

Conversion Loss vs. LO Drive Level: The minimum recommended drive level is +7 dBm. The maximum recommended drive level is +13 dBm.

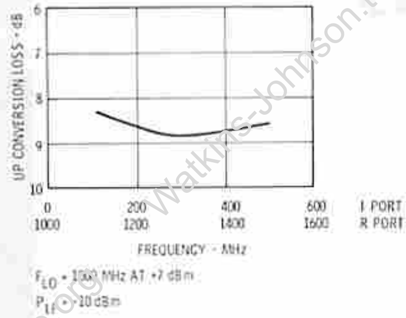


Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R) with f_I of 20 MHz. Data plotted with an f_L level of +7 dBm.



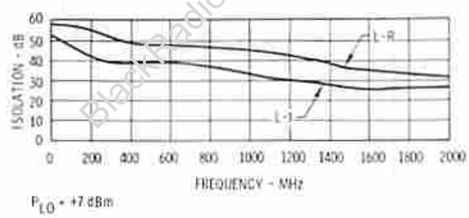
Conversion Loss vs. f_I Frequency: Conversion loss of the mixer when used in a SSB system. The frequency ordinate refers to the I-port (f_I) with f_R at 1000 MHz and f_L swept from 1000 to 1800 MHz.

Conversion Loss



Conversion Loss in Up Conversion Mode: The frequency coordinate refers to the frequencies fed into the I-port at -10 dBm. The LO frequency is 1000 MHz at +7 dBm input level. The output signal is at R-port.

Isolation



Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

Harmonic Intermodulation

M2A MIXER HARMONIC INTERMODULATION

Harmonics of f_{RF}	0	1	2	3	4	5
5			>64	>64	>64	>64
4		>64	>64	>64	>64	>64
3	55	56	54	60	60	54
2	61	47	64	48	>64	
1	18	0	30	17	43	
0		16	33	18		

Harmonics of f_{LO}

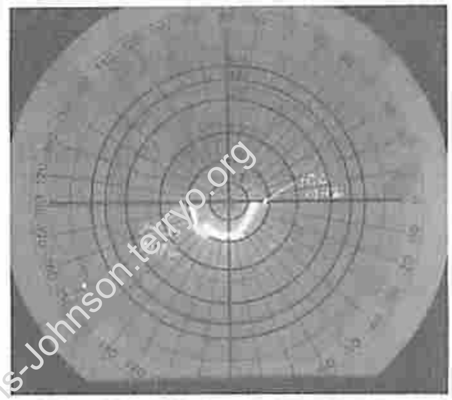
F_{RF} AND F_{LO} AT 500 AND 520 MHz, RESPECTIVELY.

M2A HARMONICS OF F_R

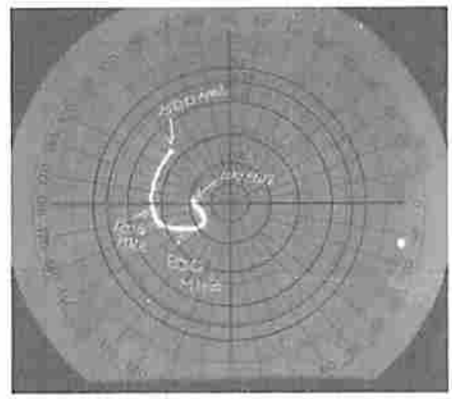
	F_R	dB SUPPRESSION
5	1500	49
4	1200	36
3	900	24
2	600	21
1	300	0

TEST CONDITIONS:
LO SIGNAL IS 1000 MHz AT +7 dBm
IF SIGNAL IS [illegible] MHz AT -10 dBm
300 MHz SIGNAL FROM R PORT IS SET AS REFERENCE AND ITS HARMONICS DATA TAKEN

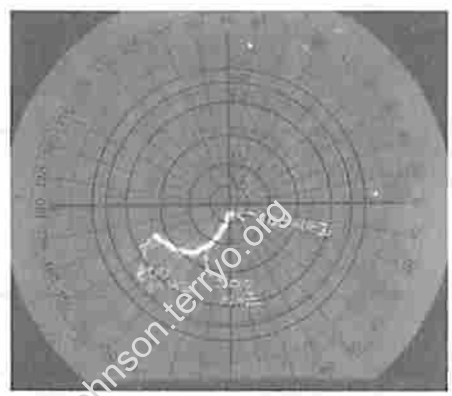
VSWR



M2A L-Port VSWR (0.1-1.5 GHz)



M2A R-Port VSWR (0.1-1.5 GHz)



M2A I-Port VSWR (0.1-0.8 GHz)

Reflection Coefficient vs. Frequency: Reflection coefficient of the L-, I- and R-ports in a 50-ohm system with f_L at +7 dBm. R- and I-port reflection coefficient is plotted for f_L at 1.0 GHz.

WJ-M2B/M2BC

DOUBLE-BALANCED MIXER

LO / RF } 10 TO 1600 MHz
IF DC TO 800 MHz
LO DRIVE +7 dBm (nominal)

- HIGH ISOLATION: 40 dB (TYP.)

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure			7.5 dB	f_R 20 to 800 MHz, f_L 10 to 800 MHz, f_I 0.4 to 200 MHz
			8.5 dB	f_R 10 to 1600 MHz, f_L 10 to 1600 MHz, f_I 0.4 to 800 MHz
Isolation				
f_L at R	40 dB			f_L 10 to 700 MHz
f_L at I	30 dB			
f_L at R	30 dB			f_L 700 to 1200 MHz
f_L at I	20 dB			
f_L at R	25 dB			f_L 1200 to 1600 MHz
f_L at I	18 dB			
Conversion Compression			1.0 dB	f_R = +7 dBm
Densensitization Level				f_R = +5 dBm
Third Order Intercept Point		+22 dB		f_L = +13 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average the average value measured at the specified condition.

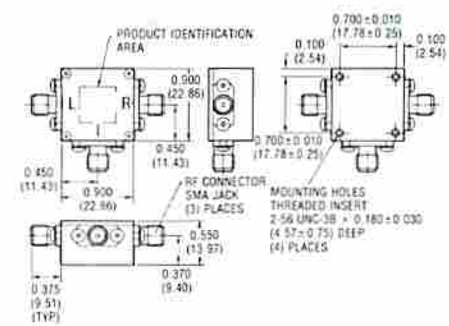
Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +23 dBm at 25°C, derate to +17 dBm 100°C
Peak Input Current at 25°C. . . . . 50 mA DC

Weight M2B: 2 Grams Max. (0.07 oz.)
M2BC: 20.15 Grams Max. (0.71 oz.)

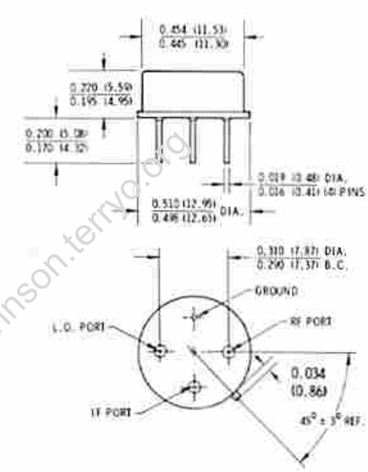
Outline Drawings

M2BC



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

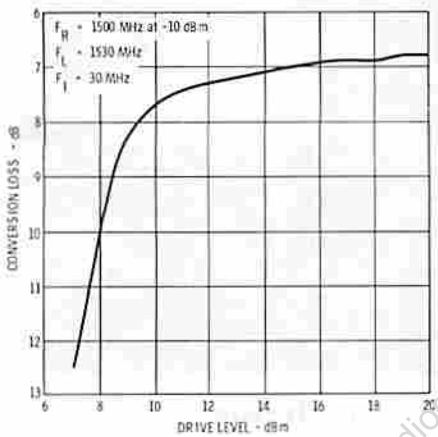
M2B



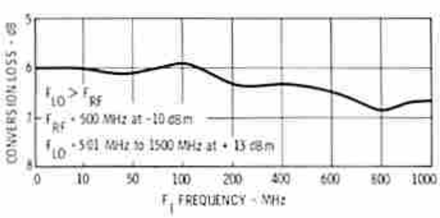
DIMENSIONS ARE IN INCHES (MILLIMETERS) ± 0.010 (0.25) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C

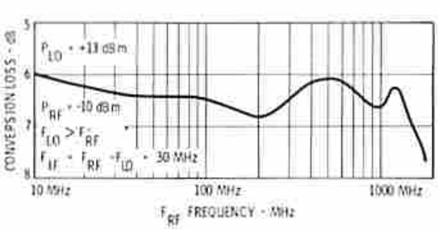
Conversion Loss



Conversion Loss vs. LO Drive Level: The minimum recommended drive level is +11 dBm. The maximum recommended drive level is +17 dBm.

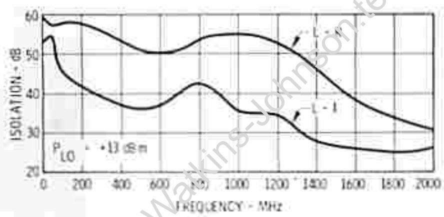


Conversion Loss vs. f_I Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the I-port (f_I) with f_R at 500 MHz and f_L from 501 to 1500 MHz.



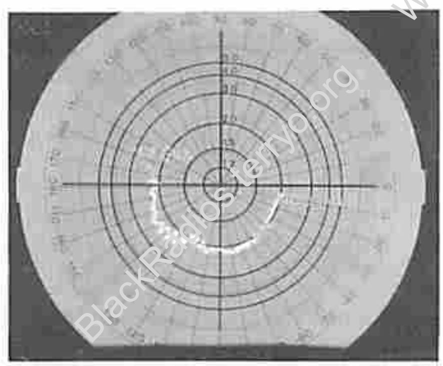
Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R) with f_I equal to 30 MHz. Data plotted with f_L level of +13 dBm.

Isolation

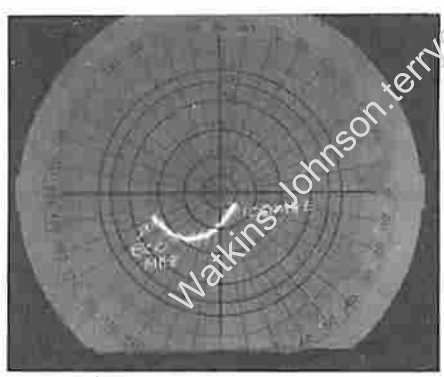


Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

VSWR

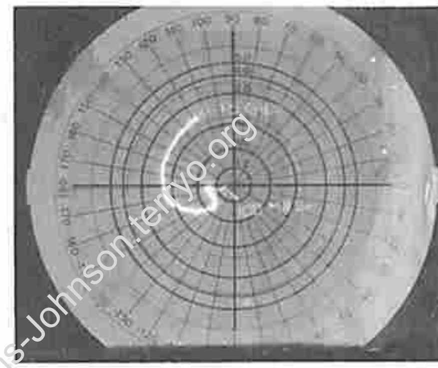


L-Port (0.1-1.5 GHz)



I-Port (0.1-0.8 GHz)

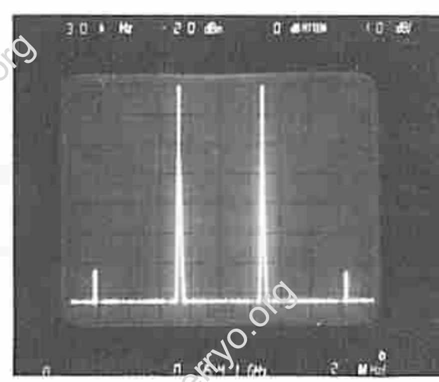
VSWR



R-Port (0.1-1.5 GHz)

Reflection Coefficient vs. Frequency: Reflection coefficient of the L-, I- and R-ports in a 50-ohm system with f_L at +13 dBm. R- and I-port reflection coefficient is plotted for $_L$ at 1.0 GHz.

Two-Tone Intermodulation Performance



f_{RF1} = 500 MHz f_{RF2} = 505 MHz
$P_{RF1} = P_{RF2}$ = -5 dBm
f_{LO} = 1150 MHz P_{LO} = +13 dBm
f_I = 641 MHz @ 10 dB/div.

Two-Tone Intermodulation Performance: The photo displays typical relative suppression of 3rd order two-tone measurement, with P_{FR1} equal to P_{FR2} at -5 dBm.

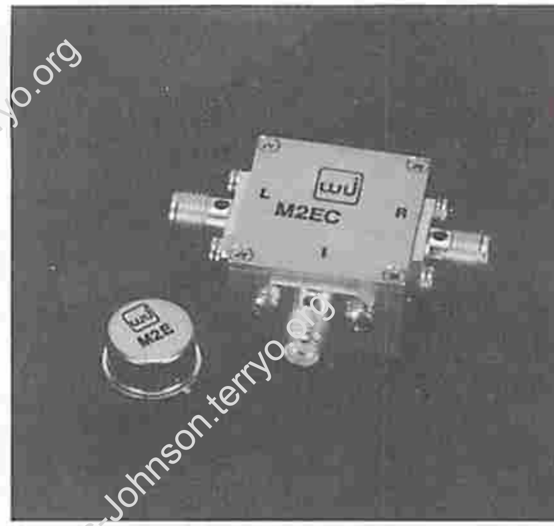
6

WJ-M2E / M2EC

DOUBLE-BALANCED MIXER

LO } 10 TO 1000 MHz
RF }
IF DC TO 600 MHz
LO DRIVE +20 dBm (nominal)

- HIGH INTERCEPT POINT: +30 dBm (TYP.)[2]
- HERMETICALLY SEALED



Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.5 dB	f_R 10 to 300 MHz, f_L 10 to 300 MHz, f_I 10 to 200 MHz
		9.0 dB	f_I 1 to 600 MHz
		9.5 dB	f_R 10 to 1000 MHz, f_L 10 to 1000 MHz, f_L 2 to 200 MHz
		10.0 dB	f_I 1 to 500 MHz
Isolation			
f_L at R	35 dB		f_L 10 to 100 MHz
f_L at I	35 dB		
f_L at R	25 dB		f_L 100 to 400 MHz
f_L at I	25 dB		
f_L at R	18 dB		f_L 400 to 1000 MHz
f_L at I	14 dB		
f_R at I	12 dB		f_R 10 to 1000 MHz
Conversion Compression		1.0 dB	f_R = +20 dBm, f_L = +25 dBm
Densensitization		1.0 dB	f_{R2} = +18 dBm, f_L = +25 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications. I Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

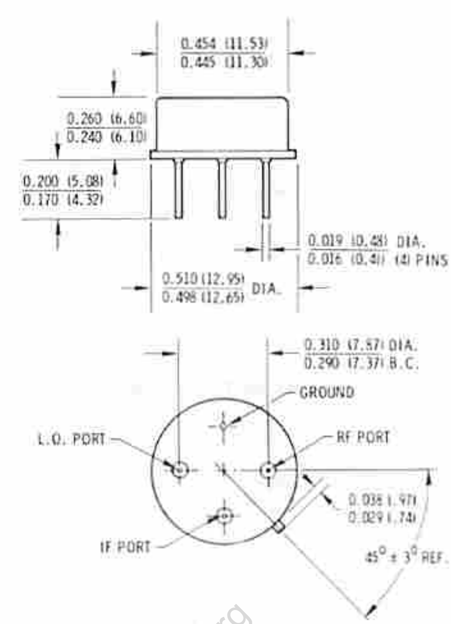
Operating Temperature* . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak RF Input Power at +85°C . . . . 27 dBm RMS, 30 dBm Peak
Peak Input Current at 25°C. . . . . 100 mA DC

*For the SMA connector package operation within 0° to 50°C temperature range is recommended.

Weight M2E: 2 grams (0.07 oz.) max.
M2EC: 22 grams (0.78 oz.) max.

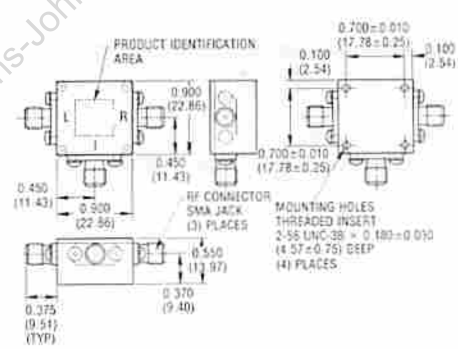
Outline Drawings

M2E



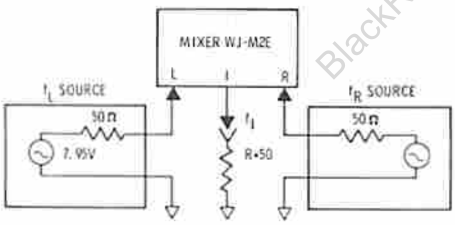
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

M2EC



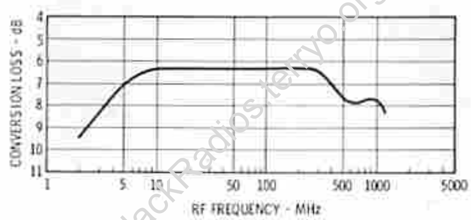
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C

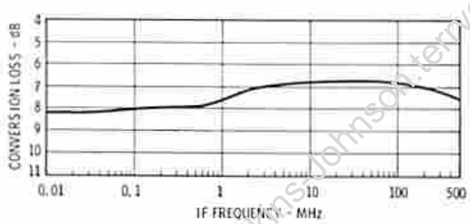


Mixer Test Circuit: When terminated as shown, the mixer impedance at the R- and I-ports is 50 ohms. The impedance at the L-port is nonlinear and is a function of the f_L level. For most applications, the f_L level should be as shown. This is equivalent to delivering 100 milliwatts (+20 dBm) into a 50 ohm load. The f_R level should be below 39.8 milliwatts (+16 dBm) in order to avoid conversion compression with f_L at +20 dBm.

Conversion Loss vs. Frequency

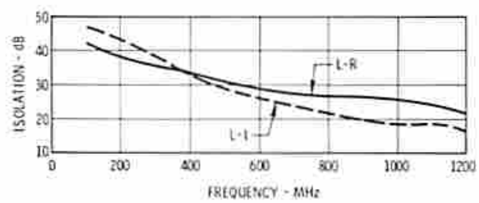


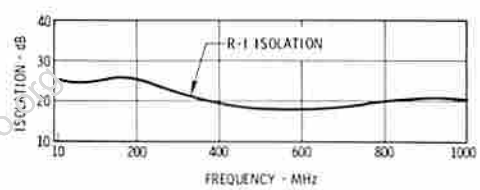
$f_{LO} > f_{RF}$
P_{LO} = +20 dBm
P_{RF} = -10 dBm
f_{IF} = BETWEEN 1 MHz and 100 MHz



$f_{LO} > f_{RF}$
P_{LO} = +20 dBm
f_{RF} = 100 MHz @ -10 dBm

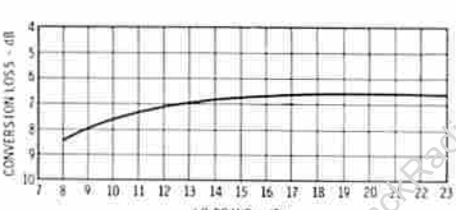
Isolation





f_{LO} = 700 MHz @ + 20 dBm
P_{RF} = -10 dBm

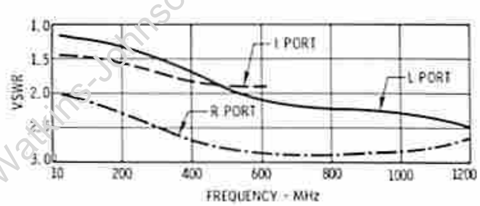
Conversion Loss vs. LO Drive



f_{LO} = 400 MHz
f_{RF} = 300 MHz @ -10 dBm

Drive Level: The minimum recommended drive level is +17 dBm. The maximum recommended drive level is +27 dBm.

VSWR



$P_{RF} = P_{IF}$ = -10 dBm
P_{LO} = +20 dBm
f_{LO} = 1000 MHz

6

Typical Two-Tone Intermodulation Performance at 25°C

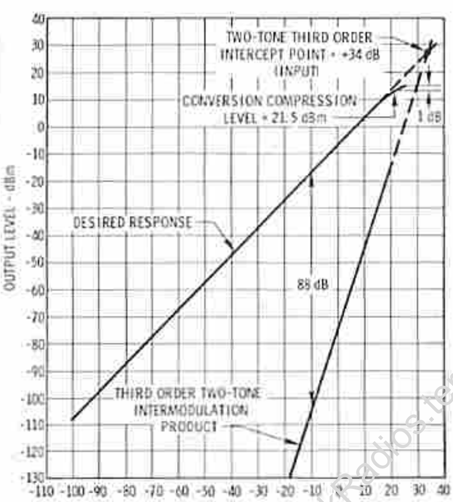
Definition: In a mixer application where the input must be wideband two signals (f_{R1} and f_{R2}) may mix with the local oscillator signal (f_L) to produce in-band, two-tone third-order intermodulation products $[(2f_{R2} - f_{R1}) \pm f_L]$.

Two-Tone Suppression vs. Input Level: With each dB decrease in input level, the 3rd order product is decreased an additional 2 dB. As shown, the WJ-M2E will reduce third-order products typically 68 dB with both input signals at 0 dBm and 88 dB with both input signals at −10 dBm. The input intercept point for the WJ-M2E is +34 dBm. This is about 24 dB higher than the intercept point for a standard low-level double-balanced mixer. The 1 dB compression level is typically +21.5 dBm as shown by the graph. This yields a dynamic range in a 1 MHz bandwidth of +126 dB using the following relationship: Dynamic Range = P_{input} − (−111 dBm/MHz + B + NF) where; P_{input} is the input level for 1 dB compression, B is the bandwidth relative to 1 MHz in dB and NF is the noise figure.

The spurious free dynamic range is given as follows:

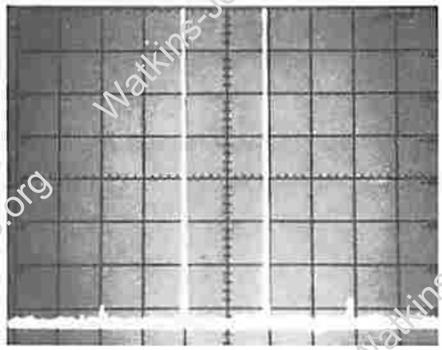
Spur free dynamic range = 2/3 (I.P. − (−111 dBm/MHz + B + NF)

$DR_{spur\ free}$ = 2/3 (34 + 111 − 6.5) = 92.3 dB in a 1 MHz bandwidth.



This performance represents the highest dynamic range achieved using passive components in an ultra small TO-8 package. The spectrum analyzer photos of Fig. 1 compare the M2E to the M9D mixer with the LO drive of each mixer at +23 dBm. The M2E provides nearly 70 dBm suppression to the third order at the 320 MHz frequencies.

M2E



M9D

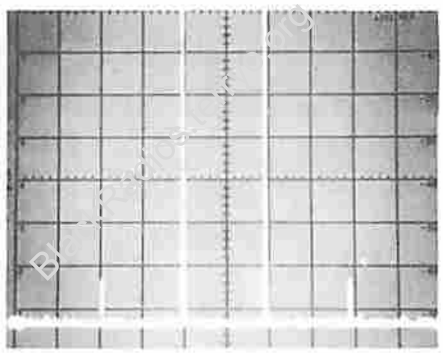


Fig. 1

The M2E is also compared with the pace setting WJ-M9E in Fig. 2. The M2E provided performance equal to the M9E with only +25 dBm LO drive compared with +27 dBm required on the M9E. In addition the frequency response of the M2E is extended to 1000 MHz, and it occupies only 1/10 the volume.

M2E

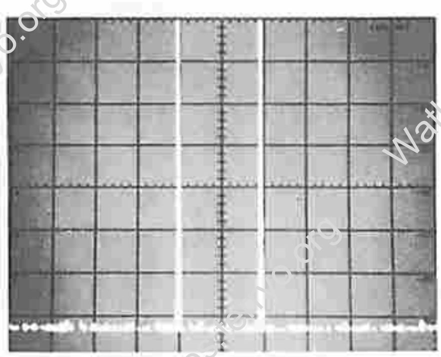


Fig. 2

M9E

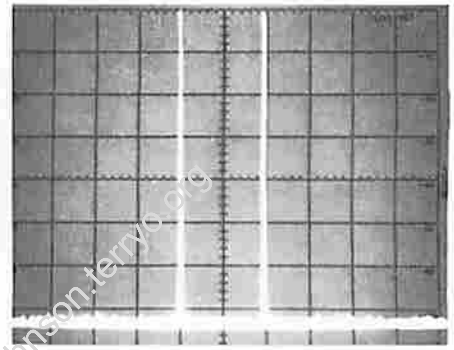


Fig. 2 (continued)

Third Order Performance When Used With LO Drive Amplifier and IF Amplifier: The third order IM intercept point is shown plotted in Fig. 3 compared using the WJ-PA2 as an LO drive amplifier to a padded LO source from a commercial test amplifier. Measured intercepts as high as +38 dBm were achieved both with and without the PA2. The WJ-PA2 is a TO-8 Amplifier that provides +25 dBm output power from 10 to 300 MHz with a nominal gain of 11 dB. The third order two-tone was equal to or better using the PA2 directly coupled to the LO port as compared to driving from a padded commercial source.

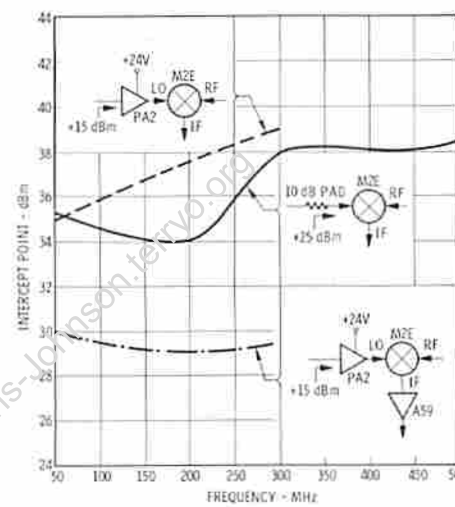


Fig. 3 Third-Order Input Intercept Point vs. Frequency

Typical Two-Tone Intermodulation Performance at 25°C

The input IM point was also measured using the A59 on the IF port of the M2E and this curve is also plotted in Fig. 3. There was a 4 or 5 dB decrease in IM point which is attributable to the intercept of the A59 being approximately equal to the output intercept point of the M2E. To minimize the reduction there should be at least a 6 dB intercept margin between the output IM point of one unit to the input IM point of one unit to the input point of the following unit.

The third order of the M2E versus frequency out to 500 MHz is shown plotted in Fig. 4 of three different LO drive levels. The curves show that the IM point is more constant at the +25 dBm LO drive level than at lower levels. Occasionally a lower level may cause better IM suppression due to phasing in the mixer diodes which cause partial cancellation. In general, the IM can be expected to vary as a function of LO drive about 1 dBm per dB of LO drive. This result is plotted in Fig. 5.

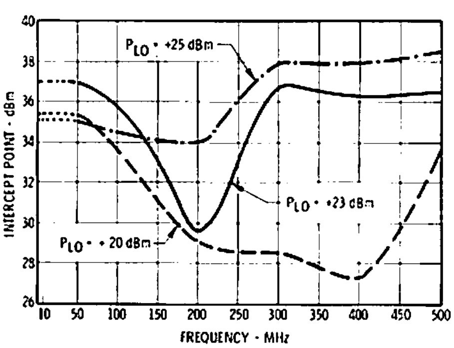


Fig. 4 Third-Order IM Point vs. Frequency and LO Drive.

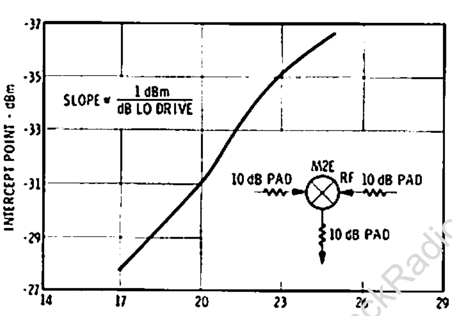


Fig. 5 Intercept Point vs. LO Drive

The output IM point is shown plotted in Fig. 6 for the PA driving the LO port for +15 dBm LO and +10 dBm LO levels with the A59 on the IF port.

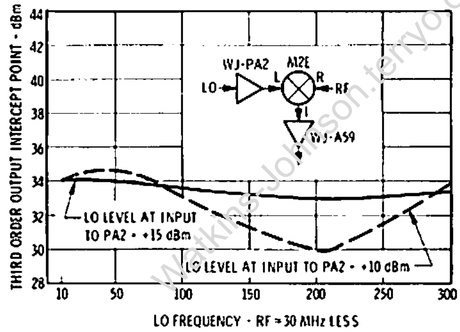


Fig. 6 Third-Order Output IM Point vs. Frequency

The output intercept is also plotted in Fig. 7 with an A59 on both the IF and RF ports for +15 dBm and +10 dBm to the input of the PA2.

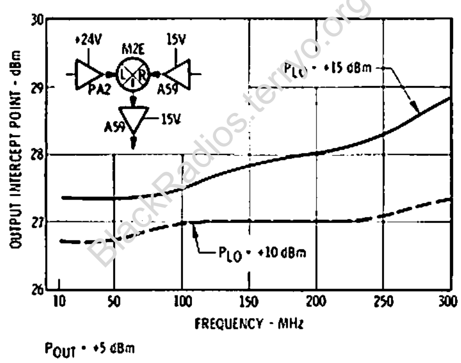


Fig. 7 Output Intercept Point vs. Frequency

Single Tone IM Signal Levels: Intermodulation signals resulting from the mixing of harmonics of the input signals are shown in Table 1 below for the WJ-M2E and WJ-M9E.

Harmonics of f_{RF}	Harmonics of f_{LO}: 0	1	2	3	4	5
5			>105 / 100	83 / 82	101 / >105	101 / >105
4	88 / 83	95 / 87	82 / 79	97 / 101	89 / >105	88 / 94
3	70 / 82	77 / 70	67 / 76	65 / 64	71 / 78	53 / 52
2	40 / 32	54 / 62	62 / 64	64 / 73	59 / 39	61 / 66
1	14 / 37	0 / 0	25 / 36	18 / 20	31 / [illegible]	36 / 36
0	M2E / M9E	7 / 3	17 / 8	8 / 15	[illegible] / 3	

f_{RF} and f_{LO} at 300 and 310 MHz, respectively
LO drive +25 dBm
RF signal level +0 dBm

Table 1

The data for this table was obtained using the setup shown in Fig. 8 where the LO port was direct coupled to the output of the WJ-PA2 TO-8 amplifier. Similar performance should be expected from other LO drive sources provided reasonable match is provided.

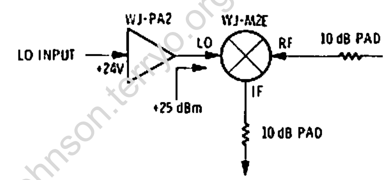


Fig. 8

Mixing products are indicated by the number of dB below the $f_L \pm f_R$ output. The typical performance in the table was obtained with f_R and f_L at 300 and 310 MHz respectively, f_L at +25 dBm, f_R at 0 dBm, and all resistive terminations.

For the odd f_R and f_L products and the even f_R and f_L products the two mixers are comparable. For the even f_L mixing with the odd f_R and the odd f_L mixing with the even f_R, the M9E typically offers a few dB higher suppression. Improved performance is obtained at lower frequencies for the even mixing with odd and the even mixing with even products. The odd mixing with odd are not suppressed because of mixer balance and therefore are more constant with frequency.

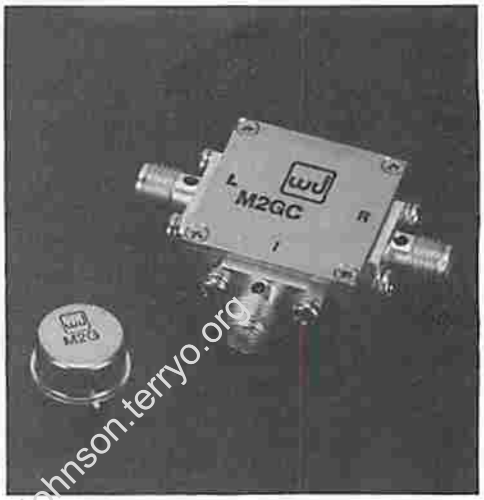
6

WJ-M2G/M2GC

DOUBLE-BALANCED MIXER

LO 800 TO 3500 MHz
RF 1000 TO 2200 MHz
IF DC TO 1500 MHz
LO DRIVE +7 dBm (nominal)

- HIGH ISOLATION: 30 dB (TYP.)[2]



Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		8.5 dB	f_L 800 to 3500 MHz f_R 1000 to 2200 MHz f_I 10 to 1500 MHz
Isolation			
f_L at R	25 dB		f_L 800 to 2000 MHz
f_L at R	20 dB		f_L 2000 to 3000 MHz
f_L at R	17 dB		f_L 3000 to 3500 MHz
f_L at I	20 dB		f_L 800 to 3500 MHz
Densensitization Level		1.0 dB	f_{R2} Level = -2 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

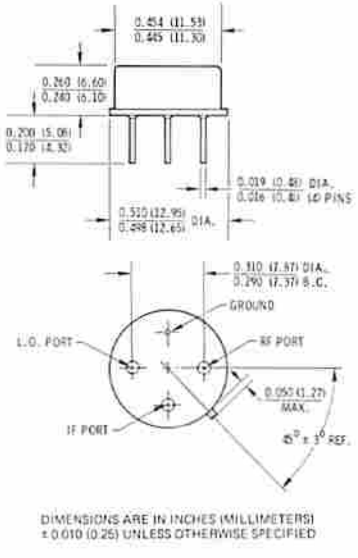
Operating Temperature*. . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak RF Input Power. . . . . +23 dBm at 25°C, derate to +17 dBm at 100°C
Peak Input Current at 25°C. . . . . 50 mA DC

*For the SMA connector package operation within 0° to 50°C temperature range is recommended.

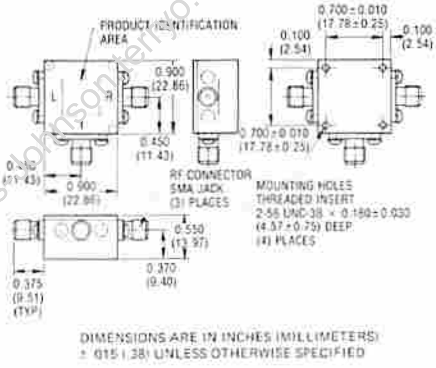
Weight M2G: 2 grams (0.07 oz.) max.
M2G2: 22 grams (0.78 oz.) max.

Outline Drawings

M2G

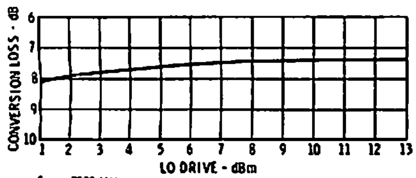


M2GC



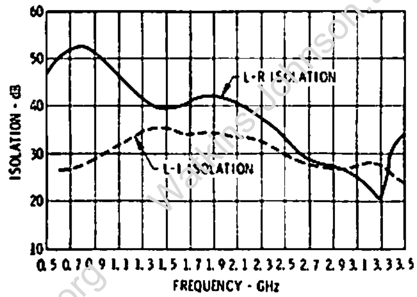
Typical Performance at 25°C

Conversion Loss



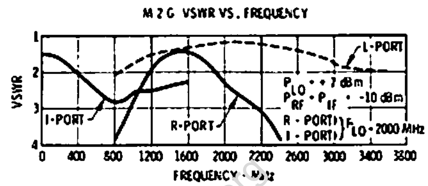
Conversion Loss vs. Drive Level: The minimum recommended drive level is +7 dBm. The maximum recommended drive level is +13 dBm.

Isolation

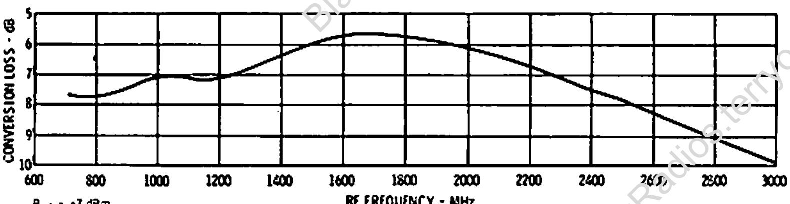


Isolation vs. Frequency: Level of the f_{LO} signal fed through to the R- and I-ports with respect to the level of the f_{LO} signal at the L-port.

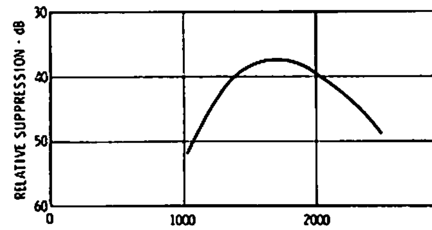
VSWR



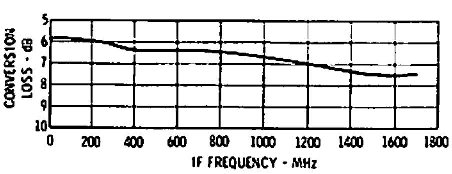
VSWR vs. Frequency: VSWR of the L-I- and R-ports in a 50-ohm system with f_L at +7 dBm. Some variation in the R-port VSWR will occur as a function of the L-port frequency. R-port VSWR is plotted for f_{LO} at 2.0 GHz. Also shown are the L-port VSWR and the I-port VSWR with f_{LO} at 2.0 GHz.



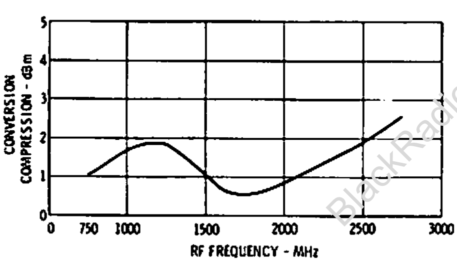
Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R) with f_{IF} of 100 MHz. Data plotted with an f_L level of +7 dBm.



Relative IM Suppression vs. Frequency: The curve displays typical relative suppression of 3rd order two-tone measurements. The frequency coordinate refers to one of the tones fed into the RF port. The other tone is 5 MHz higher than the first one. The IF frequency is at 100 MHz with the LO frequency on the high side.



Conversion Loss vs. f_I Frequency: Conversion loss of the mixer when used in a SSB system. The frequency ordinate refers to the I-port (f_I) with f_{RF} at 2000 MHz and f_{LO} swept from 2000 to 3700 MHz.



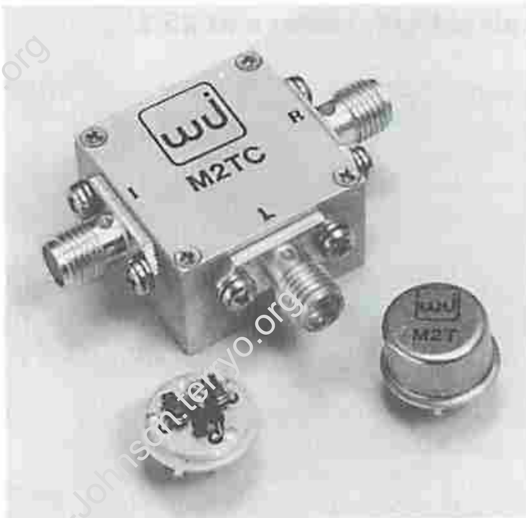
Conversion Compression (1 dB) vs. Frequency: The frequency coordinate refers to the frequencies fed into the RF port. The IF frequency is held constant at 100 MHz with the LO frequency on the high side.

6

WJ-M2T/M2TC

WIDEBAND TRIPLE-BALANCED (DOUBLE-DOUBLE) MIXER

LO, RF } 10 TO 2400 MHz
IF 1 TO 1000 MHz
LO DRIVE +13 dBm (nominal)



- HIGH INTERCEPT: +22 dBm (TYP.)
- BROADBAND
- HIGH ISOLATION: 42 dB (TYP.)

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.5 dB	9.0 dB[3]	f_R & f_L 10–2400 MHz, f_I = 1–1000 MHz
		7.0 dB	8.5 dB[3]	f_R & f_L 500–1500 MHz, f_I = 1000 MHz
Isolation f_L at R	35 dB	42 dB		f_L 10 to 2400 MHz
f_L at I	30 dB	42 dB		
1 dB Conversion Compression Point	+13 dBm	+13 dBm	+11 dBm	f_L Level = +18 dBm
		+11 dBm	+9 dBm	f_L Level = +13 dBm
Third Order Intercept Point		+22 dBm		f_L = Level = +16 dBm, f_{R1}, f_{R2} Level = 0 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.
3. Guaranteed values for M2TC are 0.5 dB worse than values listed.

Absolute Maximum Ratings

Operating Temperature* . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +25 dBm at 25°C, derate at +4 dBm
Peak Input Current at +25°C . . . . 75 mA DC

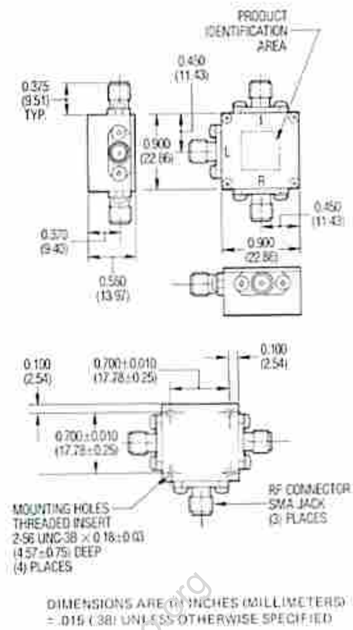
*For the SMA connector package operation within 0° to 50°C temperature range is recommended.

Weight

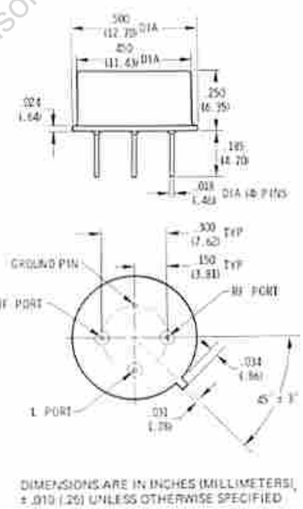
M2T: 2 grams (0.07 oz.) max.
M2TC: 22 grams (0.78 oz.) max.

Outline Drawings

M2TC

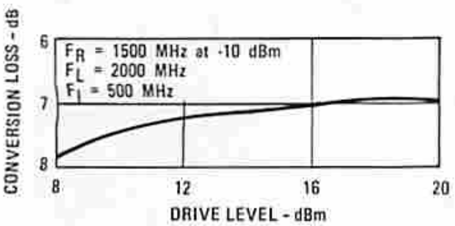


M2T

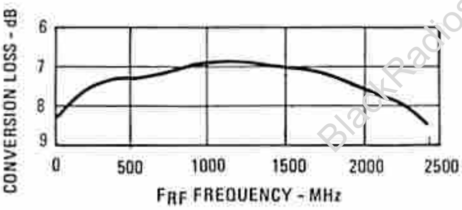


Typical Performance at 25°C

Conversion Loss

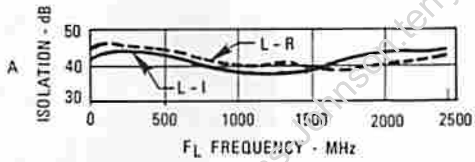


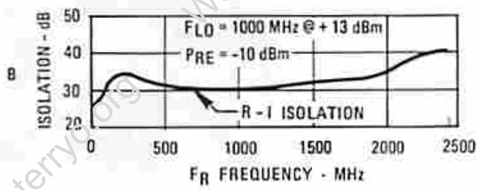
Conversion Loss vs. Drive Level: The minimum recommended drive level is +11 dBm. The maximum recommended drive level is +20 dBm.



Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R) with f_I equal to 100 MHz. Data plotted with f_L level of +13 dBm.

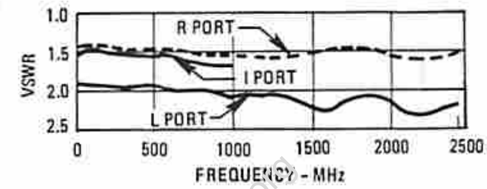
Isolation





Isolation vs. Frequency: A) Level of the f_L signal fed through the R- and I-ports with respect to the level of the f_L signal at the L-port. Data plotted with f_L level of +13 dBm. B) Level of the f_R signal fed through to the I-port with respect to the level of the f_R signal at the R-port.

VSWR



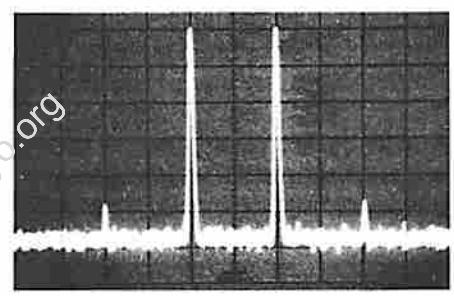
$P_{RF} = P_{IF} = -10$ dBm

$P_{LO} = +13$ dBm

$f_{LO} = 500$ MHz

VSWR vs. Frequency: VSWR of the L-I- and R-ports in a 50-ohm system with f_L at +13 dBm. Some variation in the R-port VSWR wil occur as a function of the L-port frequency. Both R-port and I-port VSWR are plotted for f_L at 500 MHz. Also shown is the L-port VSWR.

Two-Tone Intermodulation Performance



f_{RF1} = 1100 MHz f_{RF2} = 1110 MHz

$P_{RF1} = P_{RF2} = 0$ dBm

f_{LO} = 1600 MHz P_{LO} = +16 dBm

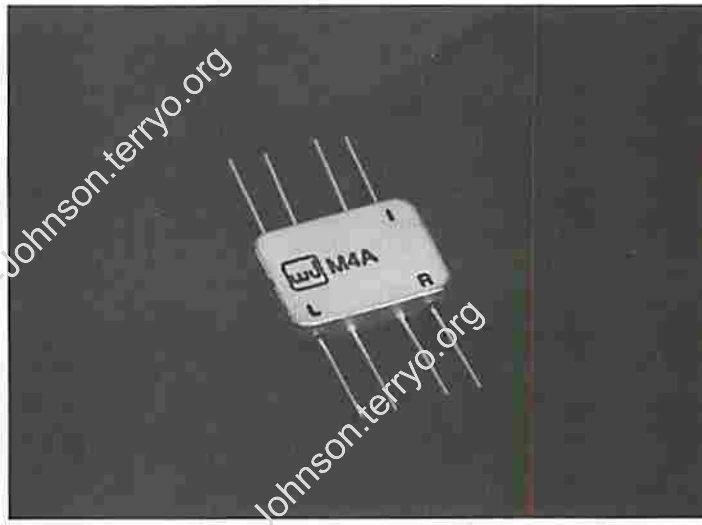
f_I = 500 MHz @ 10 dB/div.

Two-Tone Intermodulation Performance: The photo displays typical relative suppresion of 3rd order two-tone measurement, with $P_{FR}1$ equal to P_{FR2} at 0 dBm.

WJ-M4A

DOUBLE-BALANCED MIXER

LO / RF } 10 TO 1500 MHz
IF DC TO 1000 MHz
LO DRIVE +7 dBm (nominal)



- HIGH ISOLATION: 35 dB (TYP.)[2]
- QPL VERSION AVAILABLE!

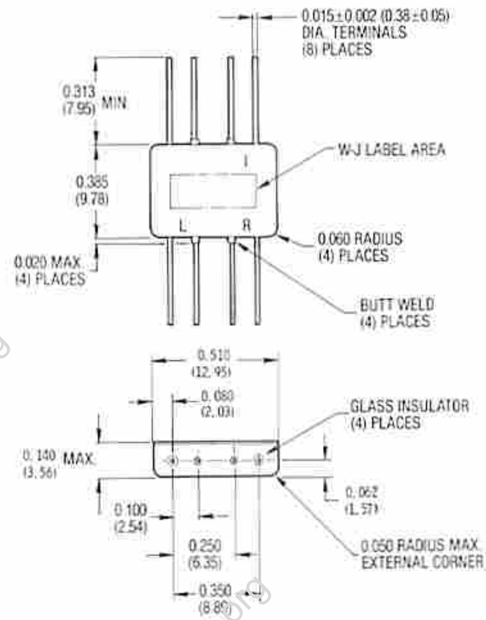
Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.0 dB	f_R 20 to 600 MHz f_L 10 to 600 MHz f_I 1 to 200 MHz
		8.0 dB	f_R 10 to 1200 MHz f_L 10 to 1400 MHz f_I 1 to 200 MHz
		8.5 dB	f_R 10 to 1500 MHz f_L 10 to 1500 MHz f_I 1 to 200 MHz
		9.5 dB	f_I 1 to 1000 MHz
Isolation f_L at R f_L at I	30 dB 30 dB		f_L 10 to 600 MHz
f_L at R f_L at I	25 dB 20 dB		f_L 600 to 1200 MHz
f_L at R f_L at I	25 dB 18 dB		f_L 1200 to 1500 MHz
Conversion Compression		1.0 dB	f_R Level = 0 dBm
Densensitization Level		1.0 dB	f_{R2} Level = -2 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications. I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Outline Drawing

M4A



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

Absolute Maximum Ratings

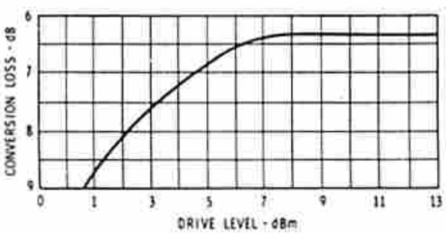
Operating Temperature
- 10 to 20 MHz . . . . . . -20°C to +100°C
- 20 to 1500 MHz . . . . . . -54°C to +100°C

Storage Temperature . . . . . . -65°C to +100°C
Peak Input Power . . . . . . +23 dBm at 25°C, derate to +17 dBm at 100°C
Peak Input Current at 25°C . . . . . . 50 mA DC

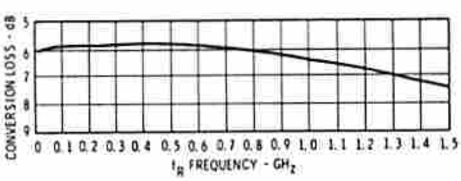
Weight 2 grams (0.07 oz.) max

Typical Performance at 25°C

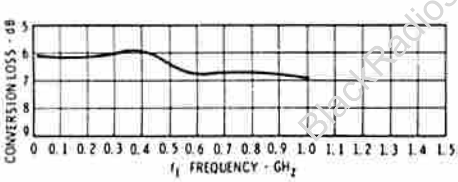
Conversion Loss



Conversion Loss vs. Drive Level: The maximum recommended drive level is +4 dBm. The maximum recommended drive level is +13 dBm.

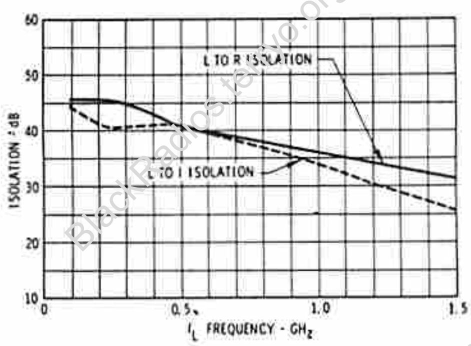


Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R) with f_I less than 200 MHz. Data plotted with an f_L level of +7 dBm.



Conversion Loss vs. f_I Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the I-port (f_I) with f_R at 200 MHz and f_L swept from 190 to 1200 MHz.

Isolation



Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-port with respect to the level of the f_L signal at the L-port.

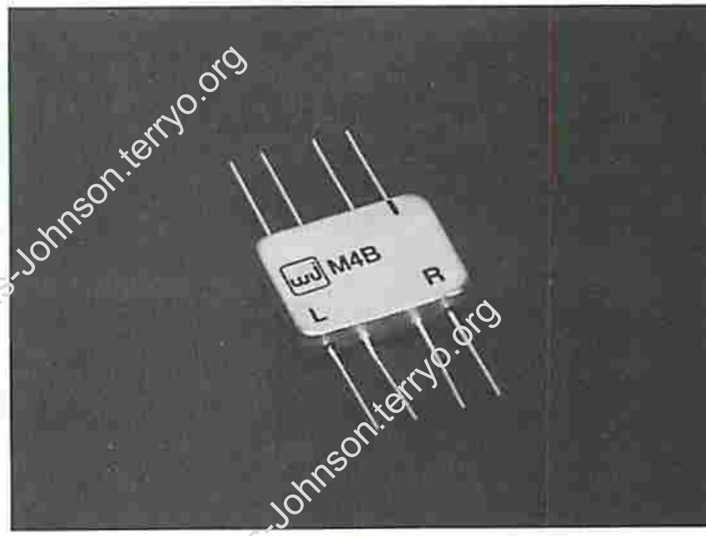
6

WJ-M4B

DOUBLE-BALANCED MIXER

LO / RF } 10 TO 1500 MHz
IF DC TO 1000 MHz
LO DRIVE +13 dBm (nominal)

- HIGH ISOLATION: 35 dB (TYP.)[2]



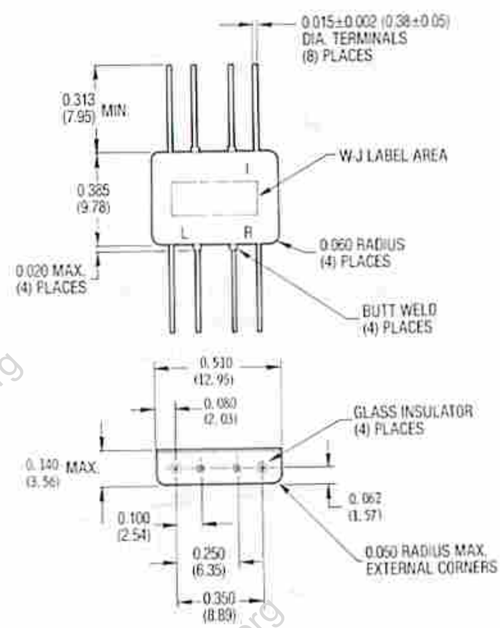
Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.5 dB	f_R 20 to 600 MHz f_L 10 to 800 MHz f_I 0.4 to 200 MHz
		8.0 dB	f_R 10 to 1200 MHz f_L 10 to 1200 MHz f_I 0.4 to 200 MHz
		8.5 dB	f_R 10 to 1500 MHz f_L 10 to 1500 MHz f_I DC to 200 MHz
		9.5 dB	f_I 0.4 to 1000 MHz
Isolation f_L at R f_L at I	35 dB 30 dB		f_L 10 to 600 MHz
f_L at R f_L at I	25 dB 25 dB		f_L 600-1200 MHz
f_L at R f_L at I	22 dB 18 dB		f_L 1200 to 1500 MHz
Conversion Compression		1.0 dB	f_R Level = +7 dBm
Densensitization Level		1.0 dB	f_{R2} Level = +5 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Outline Drawing

M4B



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

Absolute Maximum Ratings

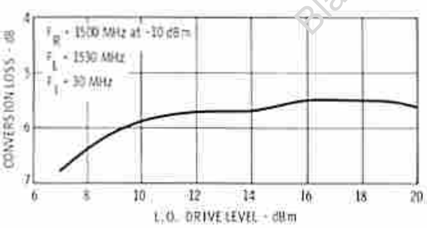
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak RF Input Power . . . . +23 dBm at 25°C, derate to +17 dBm at 100°C
Peak Input Current at 25°C . . . . 50 mA DC

Weight

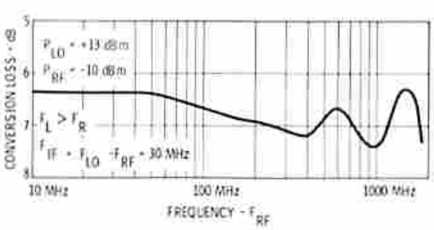
2 grams (0.07 oz.) max.

Typical Performance at 25°C

Conversion Loss

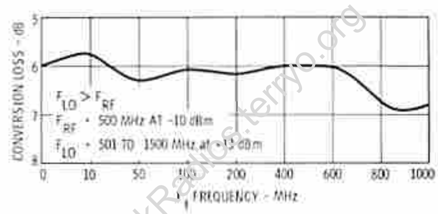


Conversion Loss vs. Drive Level: The minimum recommended drive level is +10 dBm. The maximum recommended drive level is +17 dBm.



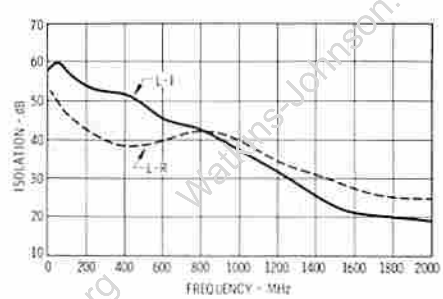
Conversion Loss vs. Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R) with f_I equal to 30 MHz. Data plotted with an f_L level of +13 dBm.

Conversion Loss



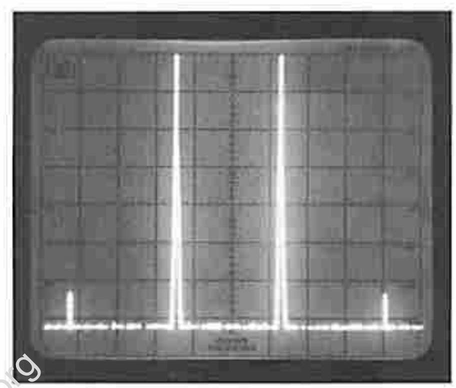
Conversion Loss vs. f_I Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the I-port (fI) with fR at 500 MHz and fL from 501 to 1500 MHz.

Isolation



Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

Two-Tone Intermodulation Performance



f_{RF1} = 500 MHz f_{RF2} = 500 MHz
$P_{RF1} = P_{RF2}$ = -5 dBm
f_L = 1250 MHz P_{LO} = +13 dBm
f_I = 750 MHz @ 10 dB/div.

Two-Tone Intermodulation Performance: The photo displays typical relative suppression of 3rd order two-tone measurement with P_{RF1} equal to P_{FR2} at -5 dBm.

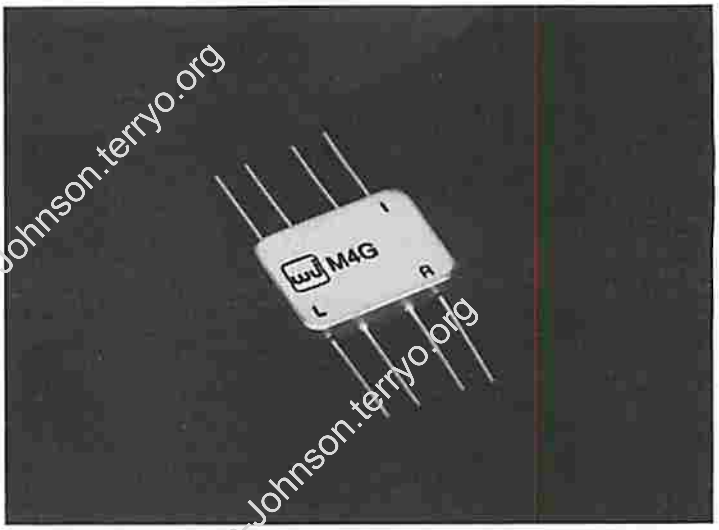
6

WJ-M4G

DOUBLE-BALANCED MIXER

LO 800 TO 3500 MHz
RF 800 TO 2400 MHz
IF DC TO 1500 MHz
LO DRIVE +7 dBm (nominal)

- LOW NOISE FIGURE: 6.5 dB (TYP.)[2]
- HIGH ISOLATION: 30 dB (TYP.)[2]



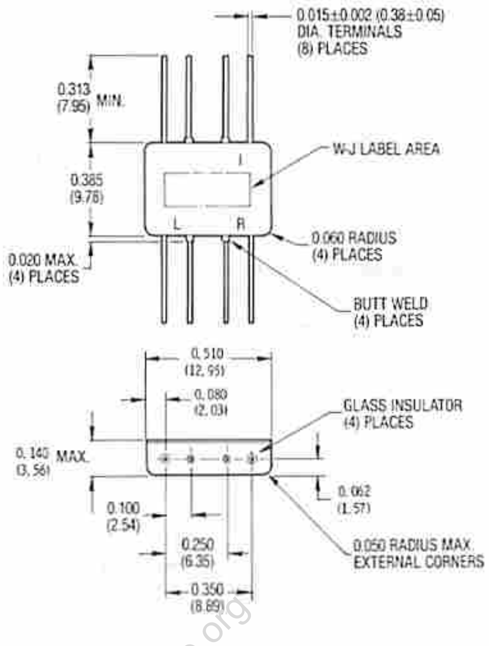
Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		8.0 dB	f_L 800 to 3500 MHz f_R 1000 to 2400 MHz f_I 10 to 1500 MHz
		8.5 dB	f_L 800 to 3500 MHz f_R 800 to 2400 MHz f_I 10 to 1500 MHz
Isolation f_L at R f_L at R f_L at I	 25 dB 20 dB 18 dB		 f_L 800 to 2000 MHz f_L 2000 to 3500 MHz f_L 800 to 3500 MHz
Conversion Compression		1.0 dB	f_R Level = 0 dBm
Densensitization Level		1.0 dB	f_{R2} Level = -2 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Outline Drawing

M4G



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

Absolute Maximum Ratings

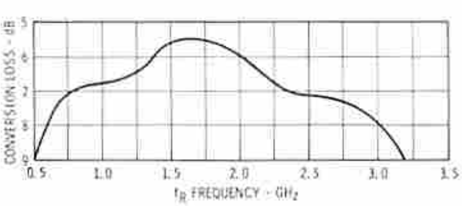
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak RF Input Power . . . . +23 dBm at 25°C, derate to +17 dBm at 100°C
Peak Input Current at 25°C . . . . 50 mA DC

Weight 2 grams (0.07 oz.) max.

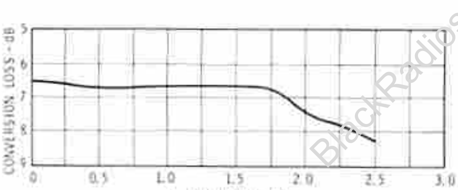
Typical Performance at 25°C

Conversion Loss

Conversion Loss vs. Drive Level: The minimum recommended drive level is +4 dBm. The maximum recommended drive level is +13 dBm.

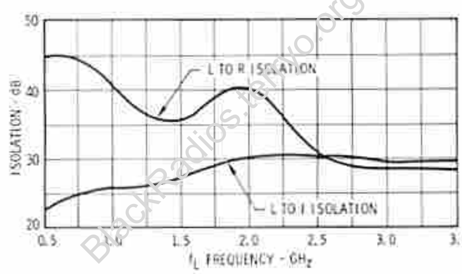


Conversion Loss vs. f_I Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the I-port (f_I) with f_R at 1.2 GHz and f_L swept from 1.2 to 3.7 GHz.



Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R) with f_I at 120 MHz and f_L less than f_R. Data plotted with an f_L level of +7 dBm.

Isolation



Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

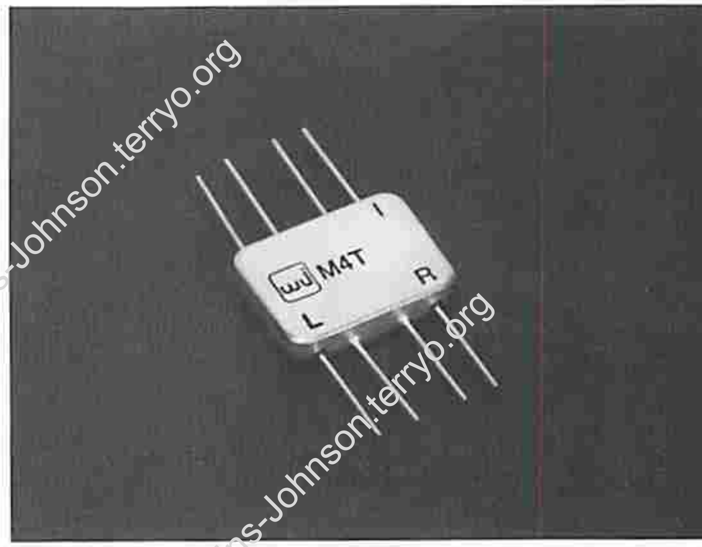
6

WJ-M4T

LOAD INSENSITIVE MIXER

LO, RF 1 TO 3400 MHz
IF 1 TO 2000 MHz
LO DRIVE +10 dBm (nominal)

- INSENSITIVE TO SYSTEM MISMATCH
- HIGH INTERCEPT +18 dBm (TYP.)[2]
- BROADBAND



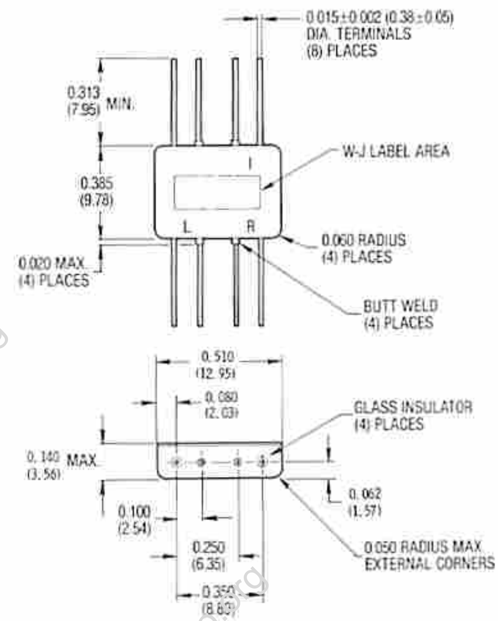
Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		6.0 dB	7.0 dB	f_L & f_R: 5-1000 MHz f_I 1-500 MHz
		7.0 dB	8.5 dB	f_L & f_R 1-3000 MHz f_I 1-1500 MHz
		8.0 dB	9.5 dB	f_L & f_R 1-3400 MHz f_I 1-2000 MHz
Isolation				
f_L at I	35 dB	40 dB		f_L 10-1500 MHz
	25 dB	30 dB		f_L 10-3400 MHz
f_L at R	35 dB	40 dB		f_L 10-2500 MHz
	25 dB	30 dB		f_L 1-3400 MHz
f_R at I		25 dB		f_R 1 to 3400 MHz
Third-Order Intercept Point		+18 dBm		LO 2000 MHz, +10 dBm f_{R1} = 1900 MHz, f_{R2} = 1910 MHz both at -10 dBm
Conversion Compression			1 dB	f_R at +7 dBm f_L at +13 dBm
Desensitization Level			1 dB	f_{R2} at +5 dBm f_L at +10 dBm
Third-Order Intermodulation Suppression Degradation		3 dB		IF VSWR 3:1

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Outline Drawing

M4T



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .010 (.25) UNLESS OTHERWISE SPECIFIED

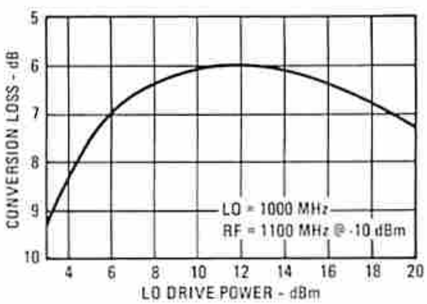
Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +27 dBm max. at 25°C, +23 dBm max. at 100°C

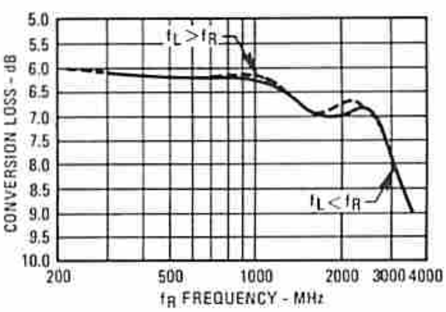
Weight 2 grams (0.07 oz.) max

Typical Performance at 25°C

Conversion Loss

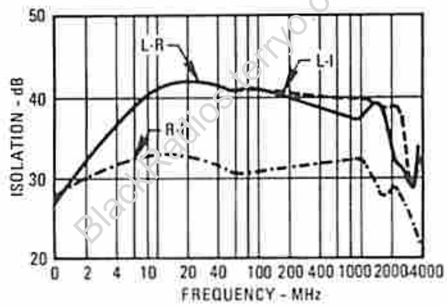


Conversion Loss vs. Drive Level: The minimum recommended drive level is +7 dBm. The maximum recommended drive level is +20 dBm.



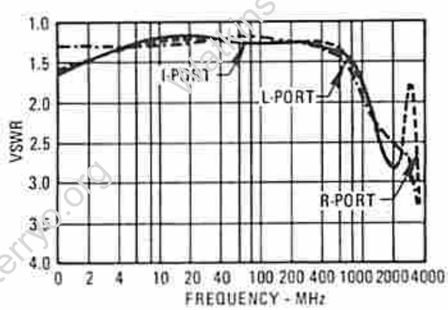
Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. Data plotted for a f_I of 100 MHz with f_L at +10 dBm.

Isolation



Isolation vs. Frequency: Level of f_L signal fed through to R- and I-port with respect to the level of the f_L signal at L-port. R-I Isolation plotted with f_L at 1500 MHz.

VSWR



VSWR vs. Frequency: VSWR is the L-, I-, and R-ports in a 50 ohm system with f_L at +10 dBm. R- and I-port VSWR plotted with f_L at 1500 MHz.

Typical Intermodulation Performance

HARMONICS OF f_R \ HARMONICS OF f_L	0	1	2	3	4	5	6	7	8
4	<70	<70	<70	<70	<70	<70	<70	<70	<70
3	<70	67	<70	61	<70	58	69	57	69
2	55	65	64	63	68	62	<70	63	<70
1	41	0	31	11	34	17	37	22	39
0	X	19	20	27	34	34	43	39	45

Test Conditions

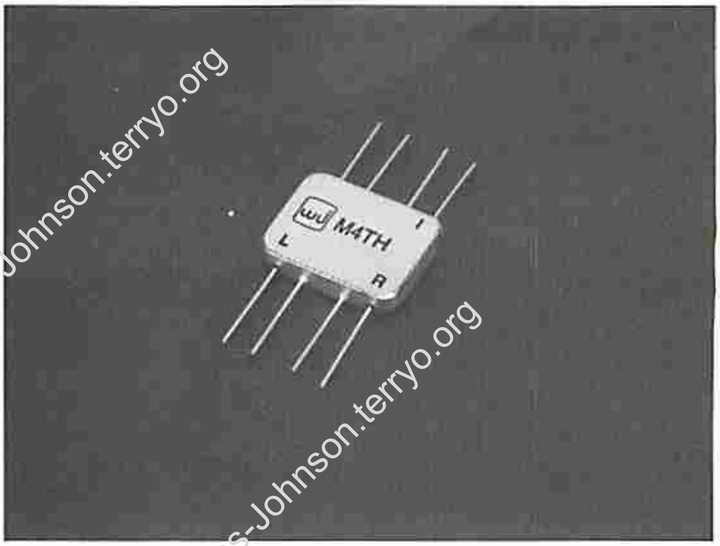
f_L = 200 MHz, +10 dBm
f_R = 210 MHz, -10 dBm

WJ-M4TH

WIDEBAND CLASS 4 MIXER

LO, RF 1 TO 3400 MHz
IF 1 TO 2000 MHz
LO DRIVE +23 dBm (nominal)

- INSENSITIVE TO SYSTEM MISMATCH
- HIGH INTERCEPT +29 dBm (TYP.)[2]
- BROADBAND



Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		6.5 dB	7.5 dB	f_L & f_R: 5-2000 MHz, f_I 1-500 MHz
		8.5 dB	10.0 dB	f_L & f_R: 1-3400 MHz, f_I 1-2000 MHz
Isolation f_L at I	30 dB	40 dB		f_L 10-1500 MHz
	25 dB	35 dB		f_L 10-3400 MHz
f_L at R	30 dB	35 dB		f_L 10-2500 MHz
	22 dB	35 dB		f_L 1-3400 MHz
f_R at I		21 dB		f_R 1 to 3400 MHz
Third-Order Intercept Point		+29 dBm		LO 1900 MHz +23 dBm, f_{R1} = 2000 MHz, f_{R2} = 2010 MHz both at 0 dBm
Conversion Compression			1 dB	f_R at +17 dBm, f_L at +23 dBm
Densensitization Level			1 dB	f_{R2} at +15 dBm, f_L at +23 dBm
Third-Order Intermodulation Suppression Degradation		3 dB		IF VSWR 3:1

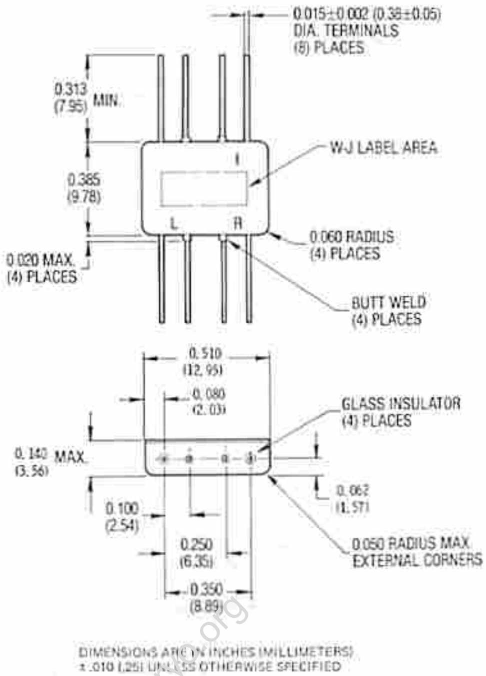
Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +30 dBm max. at 25°C, +27 dBm max. at 100°C

Outline Drawing

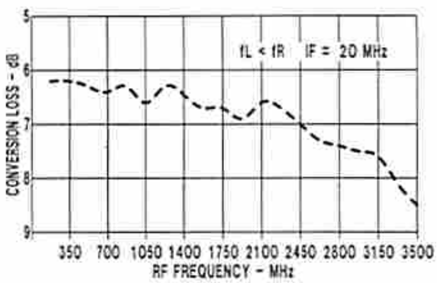
M4TH

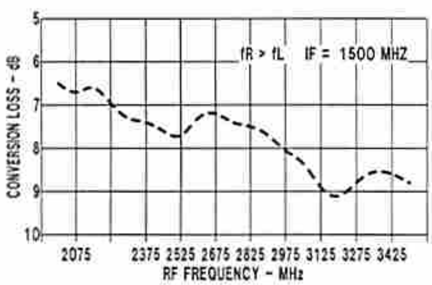


Weight 2 grams (0.07 oz.) max.

Typical Performance at 25°C

Conversion Loss vs. Frequency



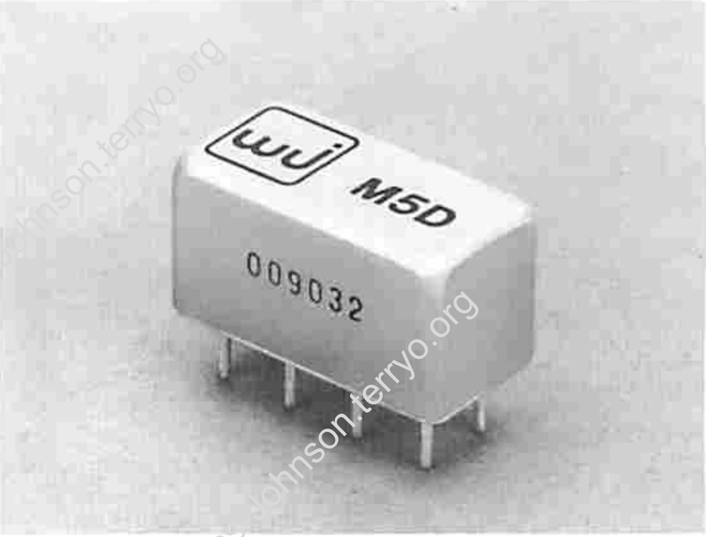


6

WJ-M5D

DOUBLE-BALANCED MIXER

LO / RF } 100 TO 1500 MHz
IF DC TO 500 MHz
LO DRIVE +7 dBm (nominal)



- HIGH ISOLATION: 40 dB (TYP.)[2]

Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		8.5 dB	f_L 300 to 1500 MHz f_R 300 to 1500 MHz f_I 1 to 120 MHz
		9.5 dB	f_L 100 to 1500 MHz f_R 100 to 1500 MHz f_{I1} to 500 MHz
Isolation f_L at R f_L at I f_R at I	 35 dB 25 dB 20 dB		f_L 100 to 1000 MHz f_R 100 to 1000 MHz
f_L at R f_L at I f_R at I	25 dB 20 dB 15 dB		f_L 1000 to 1500 MHz f_R 1000 to 1500 MHz
Conversion Compression		1.0 dB	f_R Level = 0 dBm
Densensitization Level		1.0 dB	f_{R2} Level = –2 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

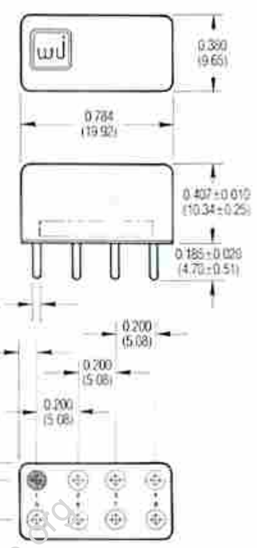
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +26 dBm at 25°C, derate to +17 dBm 100°C
Peak Input Current at 25°C . . . . 50 mA DC

Weight 5 grams (0.18 oz.) max

Outline Drawing

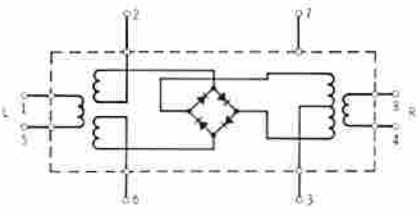
M5D

NOTES
1. W-J LOGO IS OVER PINS 1, 2, 5 AND 6
2. DIMENSIONS ARE IN INCHES (MILLIMETERS)
3. PIN NUMBERS ARE SHOWN FOR REFERENCE ONLY
4. INSULATOR AROUND PIN 1 IS A CONTRASTING COLOR
5. VENT HOLE SOLDER SEAL MAY EXTEND .025 (.64) MAX. BEYOND MAX. LENGTH SHOWN.



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .010 (.25) UNLESS OTHERWISE SPECIFIED

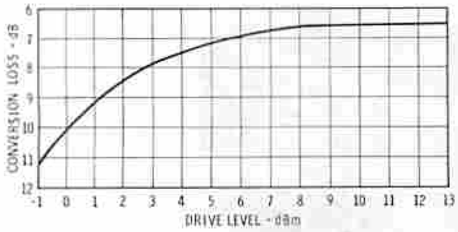
Schematic Diagram



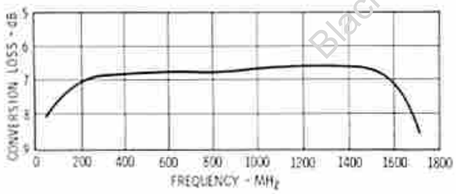
NOTE:
THE I PORT IS FORMED BY EXTERNALLY CONNECTING PINS 2 AND 6 TOGETHER TO FORM THE GROUNDED SIDE AND USING PIN 3 FOR THE UNGROUNDED SIDE. PINS 2, 6 AND 7 ARE INTERNALLY GROUNDED TO THE CASE.

Typical Performance at 25°C

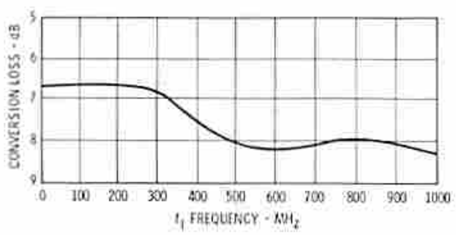
Conversion Loss



Conversion Loss vs. LO Drive Level: The minimum recommended drive level is +4 dBm. The maximum recommended drive level is +13 dBm.

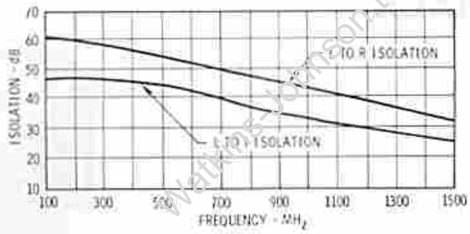


Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R) with f_I at 120 MHz. Data plotted with an f_L level of +7 dBm.



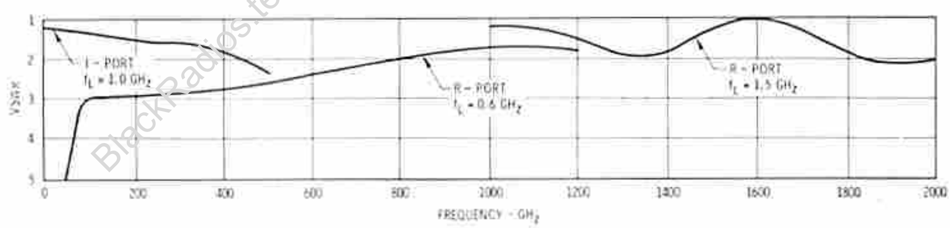
Conversion Loss vs. f_I Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the I-port (f_I), with f_R at 1250 MHz.

Isolation



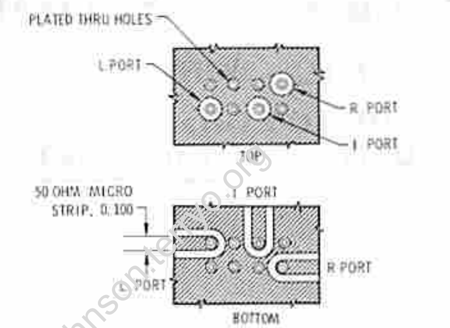
Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

VSWR



VSWR vs. Frequency: VSWR of the L- I- and R-ports in a 50-ohm system with f_I at +7 dBm. Some variation in the R-port VSWR wil occur as a function of the L-port frequency. R-port VSWR is plotted for f_L at 0.6 GHz and 1.5 GHz. Also shown is the I-port VSWR with f_L at 1.0 GHz. I-port VSWR is typically less than 2.0:1 from 100 to 1500 MHz.

Mounting Procedure



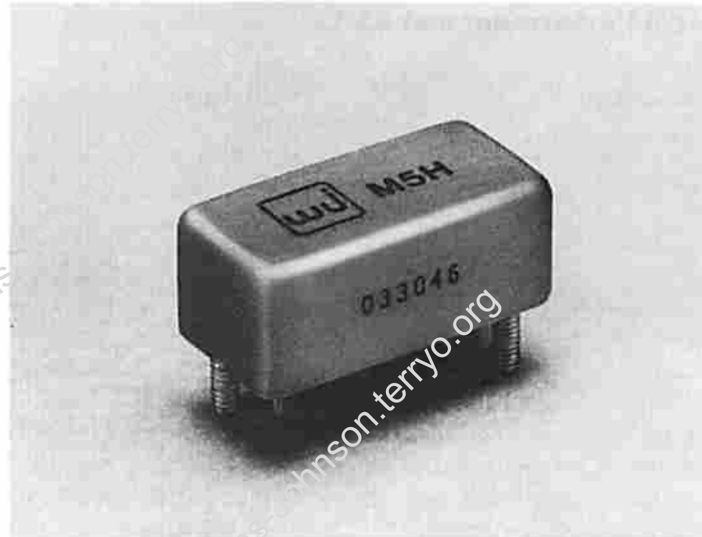
NOTES:
1. MATERIAL - G-10 EPOXY BOARD, 1/16" THICK, 2 OZ CU BOTH SIDES.
2. CROSS HATCHING REPRESENTS COPPER.
3. DIMENSIONS ARE IN INCHES.

6

WJ-M5H

DOUBLE-BALANCED MIXER

LO / RF } 1.8 TO 6.2 GHz
IF DC TO 2 GHz
LO DRIVE +7 dBm (nominal)



- LOW NOISE FIGURE: 5.8 dB (TYP.)[2]
- HIGH ISOLATION: 35 dB (TYP.)[2]

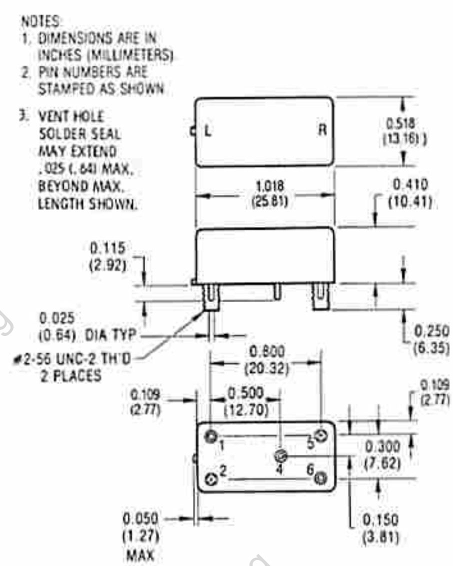
Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.5 dB	f_L & f_R 2.0 to 4.2 GHz, f_I 0.01 to 2 GHz
		8.0 dB	f_L & f_R 4.2 to 6.2 GHz, f_I 0.01 to 0.5 GHz
		8.5 dB	f_L & f_R 1.8 to 6.2 GHz, f_I 0.01 to 2 GHz
Isolation f_L at R	25 dB		f_L 1.8 to 6.2 GHz
f_L at I	20 dB		
Conversion Compression		1.0 dB	f_R at 0 dBm, f_L at +7 dBm
Densensitization Level		1.0 dB	f_{R2} at -2 dBm, f_L at +7 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

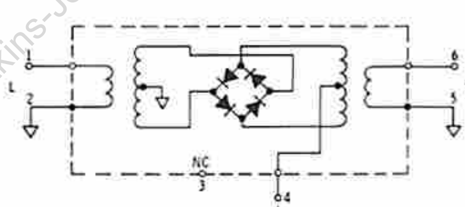
Outline Drawing

M5H



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

Schematic Diagram



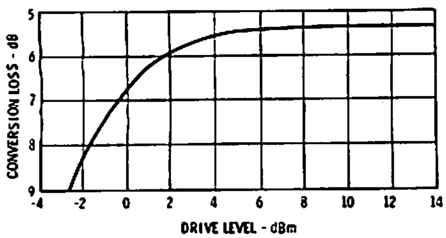
Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +17 dBm
Peak Input Current at 25°C . . . . 50 mA DC
Pin Temperature . . . . 260°C for 10 sec.

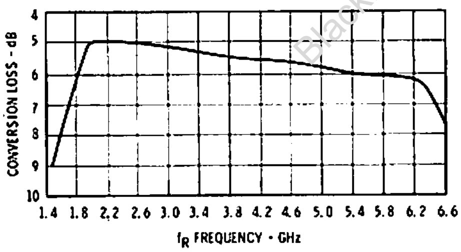
Weight 7 grams (0.247 oz.) max

Typical Performance at 25°C

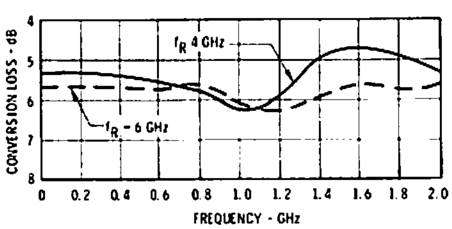
Conversion Loss



Conversion Loss vs. Drive Level: The minimum recommended drive level is +4 dBm. The maximum recommended drive level is +13 dBm.

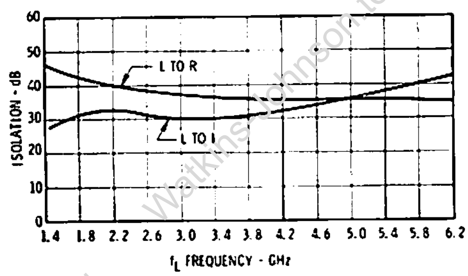


Conversion Loss vs. f_I Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the I-port (f_I). Curves are shown for f_R at 4 GHz with f_L swept from 2 to 4 GHz and f_R at 6 GHz with f_L swept from 4 to 6 GHz.



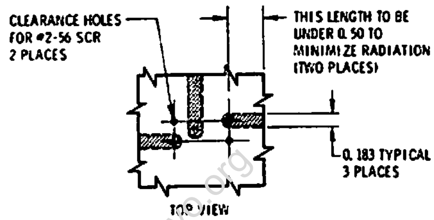
Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R) with f_I at 200 MHz. Data plotted with an f_I level of +7 dBm.

Isolation



Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

Recommended Mounting Procedure



NOTE:
1. CROSS HATCHED AREA EQUALS COPPER TRACE ON FAR SIDE.
2. BOARD MATERIAL - 3M COMPANY K6098 1/16" THICK.
3. DIMENSIONS ARE IN INCHES.

6

WJ-M6

DOUBLE-BALANCED MIXER

LO / RF } 0.2 TO 300 MHz
IF DC TO 300 MHz
LO DRIVE +7 dBm (nominal)

- HIGH ISOLATION 40 dBm (TYP.)
- LOW COST

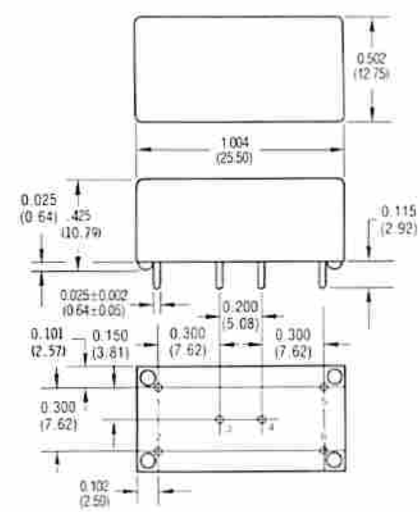
Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure			6.5 dB 8.5 dB	1 – 50 MHz 0.2 – 300 MHz
Isolation				
f_L at R	40 dB			0.2 – 50 MHz
f_L at I	40 dB			
f_R at L		50 dB		
f_R at I		30 dB		
f_L at R	25 dB			50 – 300 MHz
f_L at I	25 dB			
f_R at L		35 dB		
f_R at I		25 dB		
Conversion Compression		0.3 dB		f_R = +1 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Outline Drawing

M6



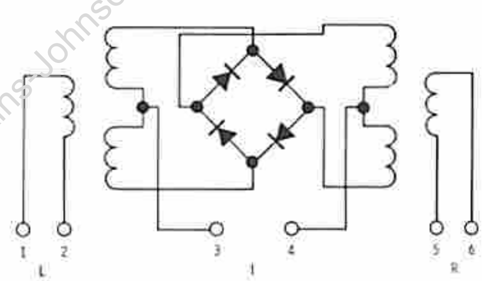
DIMENSIONS ARE IN INCHES (MILLIMETERS) ± 0.010 (0.25) UNLESS OTHERWISE SPECIFIED

Absolute Maximum Ratings

Operating Temperature* . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +17 dBm
Peak Input Current at 25°C . . . . 50 mA DC

*For input signals below 1 MHz, the temperature range is -20°C to +100°C.

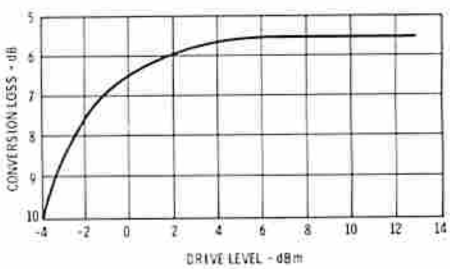
Schematic Diagram



Weight 4 grams (0.14 oz.) max.

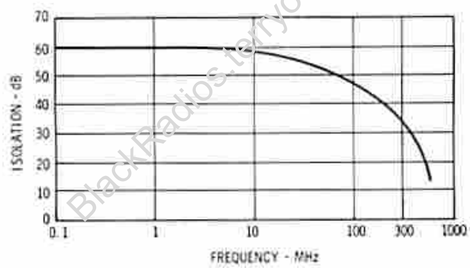
Typical Performance at 25°C

Conversion Loss

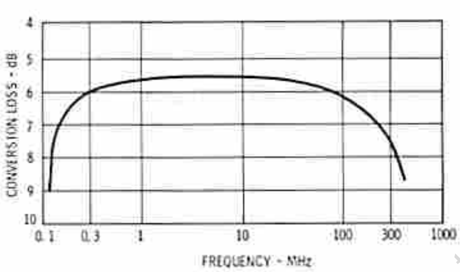


Conversion Loss vs. LO Drive Level: Conversion loss in an SSB system as a function of drive level (f_L level), with f_L and f_R at approximately 50 MHz and f_R level at -20 dBm.

Isolation



Isolation vs. Frequency: Level of the f_L signal at the R- and I-port with respect to the available power of +7 dBm from a 50-ohm source used for f_L.



Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the inputs f_L and f_R with f_I any frequency less than 300 MHz.

6

WJ-M6A

DOUBLE-BALANCED MIXER

LO, RF: 0.05 TO 200 MHz
IF DC TO 200 MHz
LO DRIVE +7 dBm (nominal)

- HIGH ISOLATION: 45 dB (TYP.)
- LOW NOISE FIGURE: 6 dB (TYP.)
- LOW COST

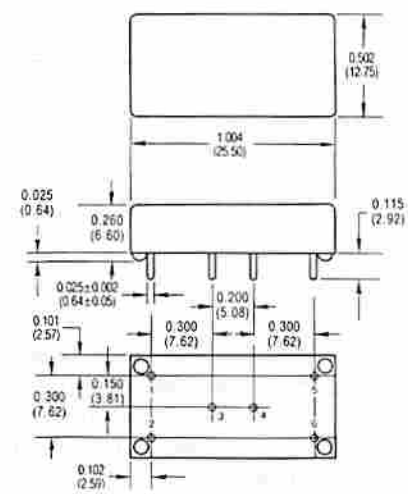
Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure			8.5 dB 6.5 dB 8.0 dB	0.05-0.2 MHz 0.20-50 MHz 50-200 MHz
Isolation f_L at R f_L at I f_R at L f_R at I	 40 dB 40 dB	 >45 dB >20 dB		0.05-30 MHz
f_L at R f_L at I f_R at L f_R at I	30 dB 25 dB	 >35 dB >15 dB		30-200 MHz
Conversion Compression		3.0 dB		f_R = +1 dBm
Conversion Densensitization Level		1.0 dB 10.0 dB		f_{R2} = +1 dBm f_{R2} = +10 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

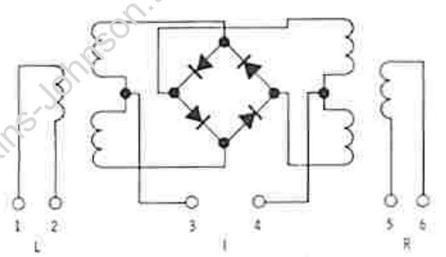
Outline Drawing

M6A



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

Schematic Diagram



FOR BEST ISOLATION OF THE HIGH-LEVEL (f_L) SIGNAL, GROUND PIN 3.

Absolute Maximum Ratings

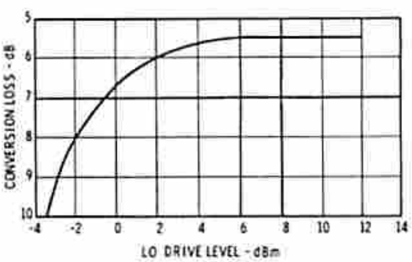
Operating Temperature* . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +17 dBm
Peak Input Current at 25°C. . . . . 50 mA DC

*For input signals below 100 kHz, the temperature range is -20°C to +100°C.

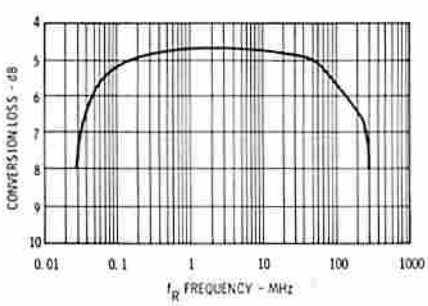
Weight approximately 3.0 grams (0.11 oz.)

Typical Performance at 25°C

Conversion Loss

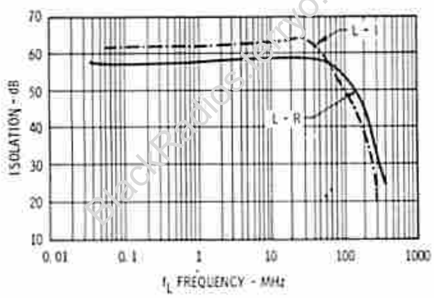


Conversion Loss vs. LO Drive Level: The minimum recommended drivel level is +4 dBm. The maximum recommended drive level is +13 dBm.



Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R) with f_I at 20 MHz. Data plotted with an f_L level of +7 dBm.

Isolation



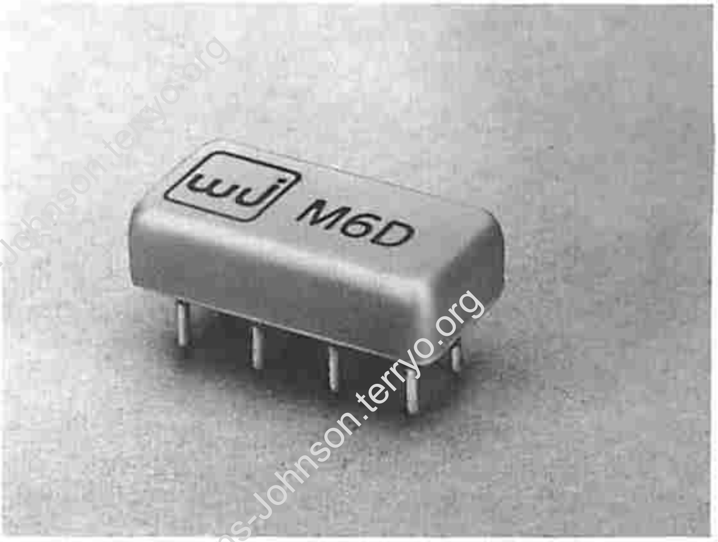
Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

6

WJ-M6D

DOUBLE-BALANCED MIXER

LO, RF } 0.05 TO 200 MHz
IF DC TO 200 MHz
LO DRIVE +7 dBm (nominal)



- HIGH ISOLATION: 45 dB (TYP.)[2]
- LOW COST
- QPL VERSION AVAILABLE! (See Section 7)

Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and Noise Figure		6.5 dB	f_L, f_R & f_I 0.2 to 50 MHz
		8.0 dB	f_L, f_R & f_I 50 to 200 MHz
		8.5 dB	f_L, f_R & f_I 0.05 to 0.2 MHz
Isolation			
f_L at R	45 dB		f_L 0.05 to 30 MHz
f_L at I	40 dB		
f_L at R	35 dB		f_L 30 to 200 MHz
f_L at I	30 dB		

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications; I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

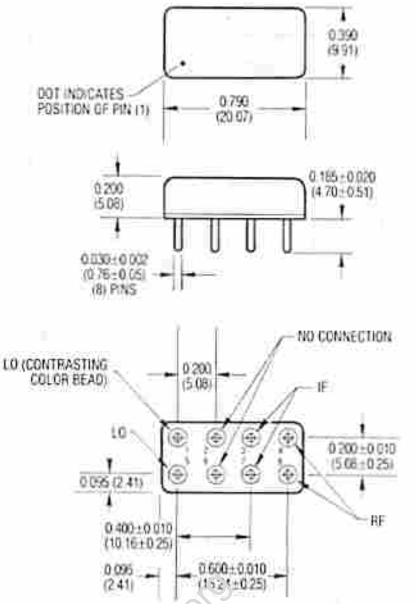
Operating Temperature* . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +17 dBm
Peak Input Current at 25°C . . . . 50 mA DC

*For input signals below 100 kHz, the temperature range is -20°C to +100°C.

Weight 5.0 grams (0.18 oz.) max

Outline Drawing

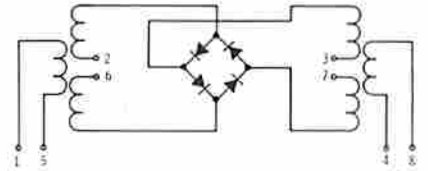
M6D



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

PIN NUMBERS ARE SHOWN FOR REFERENCE ONLY.

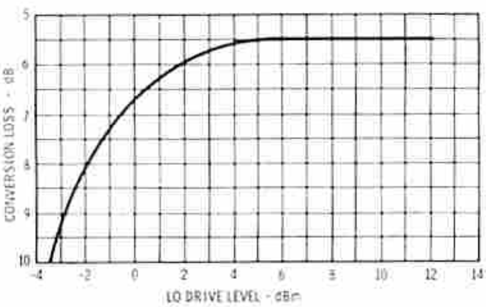
Schematic Diagram



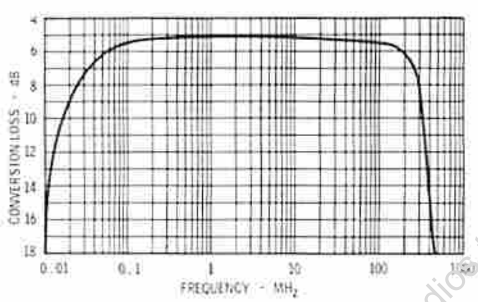
I-PORT: FORMED BY EXTERNALLY CONNECTING PINS 2 AND 6 TOGETHER AND PINS 3 AND 7 TOGETHER. BEST PERFORMANCE IS OBTAINED BY GROUNDING THE 2, 6 SIDE.

Typical Performance at 25°C

Conversion Loss

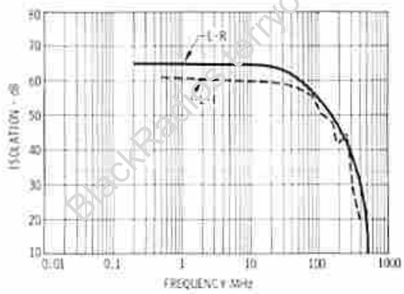


Conversion Loss vs. LO Drive Level: Conversion loss in an SSB system as a function of drive level (f_L level), with f_L and f_R at approximately 50 MHz and f_R level at -20 dBm.



Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the inputs f_L and f_R with f_I at 20 MHz.

Isolation



Isolation vs. Frequency: Level of the f_L signal at the R- and I-port with respect to the available power of +7 dBm from a 50-ohm source used for f_L.

Harmonic Intermodulation Products

SINGLE-TONE INTERMODULATION DISTORTION

HARMONICS OF f_R	HARMONICS OF f_L: 0	1	2	3	4	5
5	82	80	78	72	80	67
	82	80	80	75	83	73
4	89	86	>90	86	95	82
	89	82	90	82	90	80
3	58	56	63	54	68	50
	60	58	65	56	68	54
2	71	65	74	67	74	65
	71	64	74	65	74	63
1	16	0	28	11	34	22
	16	0	26	10	32	17
0		26	34	37	45	36
		24	30	37	41	34

0.05-200 MHz
CLASS I MIXER

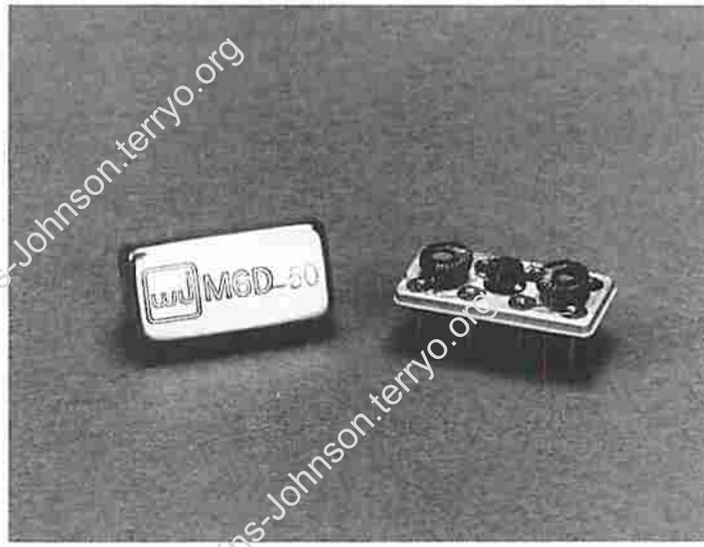
f_R = 49 MHz @ −10 dBm
f_L = 50 MHz
f_L = +10 dBm
f_L = +7 dBm

6

WJ-M6D-50

DOUBLE-BALANCED MIXER

LO } 0.05 TO 200 MHz
RF }
IF DC TO 200 MHz
LO DRIVE +7 dBm (nominal)



- HIGH ISOLATION: 40 dB (TYP.)[2]
- LOW COST

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		5.5 dB	6.5 dB	f_L & f_R 0.2 to 50 MHz, f_I DC 50 MHz
		7.5 dB	8.0 dB	f_L, f_R & f_I 50 to 200 MHz
		8.0 dB	8.5 dB	f_L, f_R & f_I 0.05 to 0.2 MHz
Isolation				
f_L at R	40 dB	55 dB		f_L 0.05 to 30 MHz
f_L at I	35 dB	50 dB		
f_L at R	35 dB	45 dB		f_L 30 to 200 MHz
f_L at I	30 dB	35 dB		

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

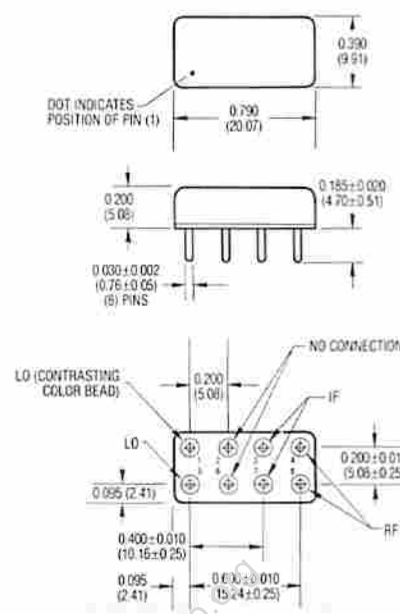
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +17 dBm
Peak Input Current at 25°C . . . . 50 mA DC

Weight

5.0 grams (0.18 oz.) max

Outline Drawing

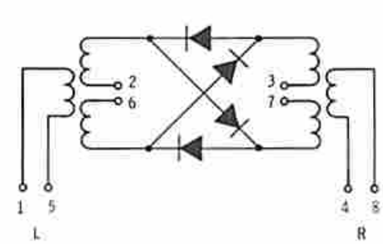
M6D-50



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

PIN NUMBERS ARE SHOWN FOR REFERENCE ONLY.

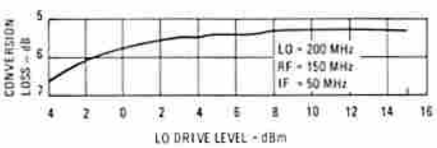
Schematic Diagram



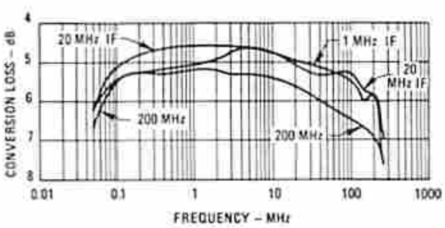
THE I - PORT IS FORMED BY EXTERNALLY CONNECTING PINS 2 AND 6 TOGETHER AND PINS 3 AND 7 TOGETHER. BEST PERFORMANCE IS OBTAINED BY GROUNDING THE 2, 6 SIDE.

Typical Performance at 25°C

Conversion Loss

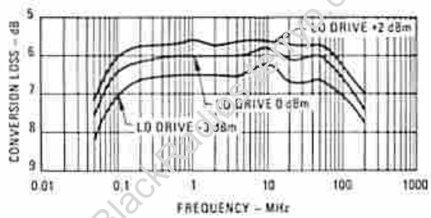


Conversion Loss vs. LO Drive Level: The minimum recommended drive level is 0 dBm. The maximum recommended drive level is +13 dBm.

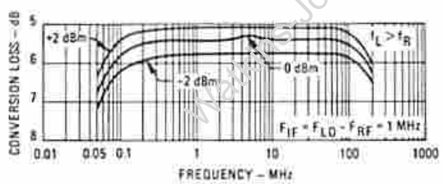


Conversion Loss vs. Frequency[1]*:* Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R) with f_I equal to 1 MHz, 20 MHz and 200 MHz. Data plotted with an f_L level of +7 dBm.

Conversion Loss

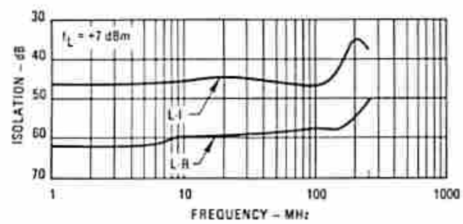


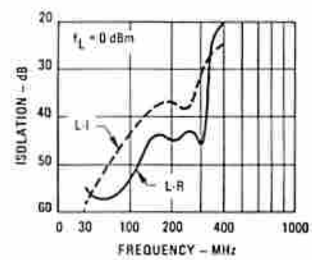
Conversion Loss vs. Frequency[2]*:* Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R) with f_I equal to 200 MHz. Data plotted with an f_L level of +2, 0, -3 dBm.



Conversion Loss vs. Frequency[3]*:* Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R) with f_I equal to 1 MHz. Data plotted with an f_L level of +2, 0, -2 dBm.

Isolation



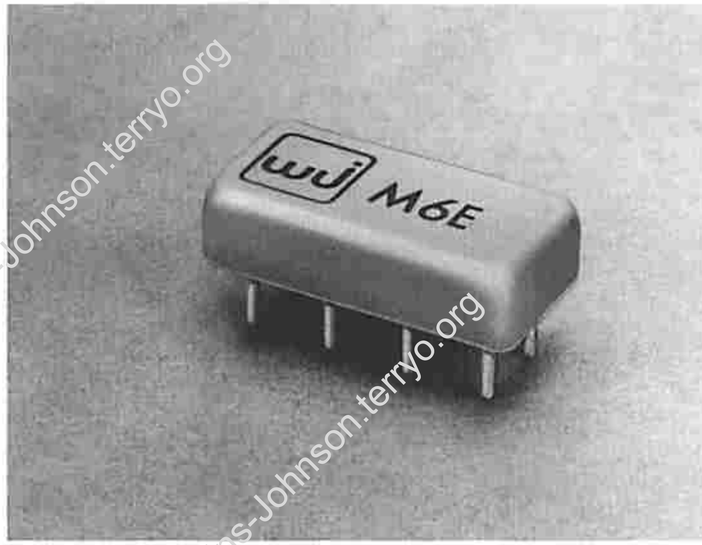


Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

WJ-M6E

DOUBLE-BALANCED MIXER

LO } 5 TO 500 MHz
RF
IF DC TO 500 MHz
LO DRIVE +7 dBm (nominal)



- HIGH ISOLATION: 40 dB (TYP.)[2]
- LOW COST
- QPL VERSION AVAILABLE! (See Section 7)

Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.0 dB	f_L, f_R & f_I 10 to 100 MHz
		8.0 dB	f_L & f_R 100 to 200 MHz f_I 10 to 200 MHz
		9.0 dB	f_L & f_R 5 to 500 MHz f_I 0.5 to 500 MHz
Isolation			
f_L at R	45 dB		f_L 5 to 50 MHz
f_L at I	40 dB		
f_L at R	30 dB		f_L 50 to 500 MHz
f_L at I	25 dB		

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

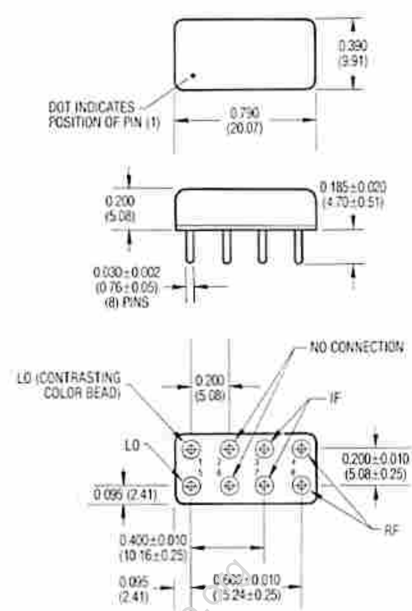
Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +17 dBm
Peak Input Current at 25°C . . . . 50 mA DC

Weight 5.0 grams (0.18 oz.) max

Outline Drawing

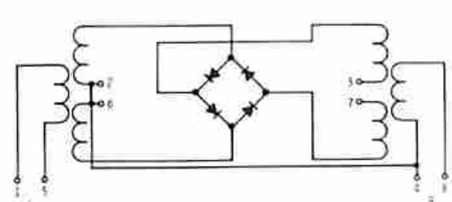
M6E



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

PIN NUMBERS ARE SHOWN FOR REFERENCE ONLY.

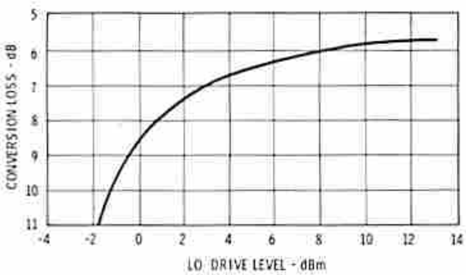
Schematic Diagram



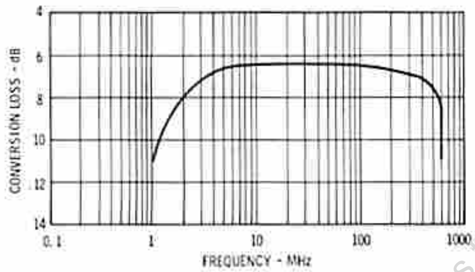
PINS 2, 4 AND 6 ARE INTERNALLY CONNECTED TO THE CASE. THE I-PORT IS FORMED BY EXTERNALLY CONNECTING PINS 3 AND 7 TOGETHER AND USING THE CASE FOR REFERENCE.

Typical Performance at 25°C

Conversion Loss

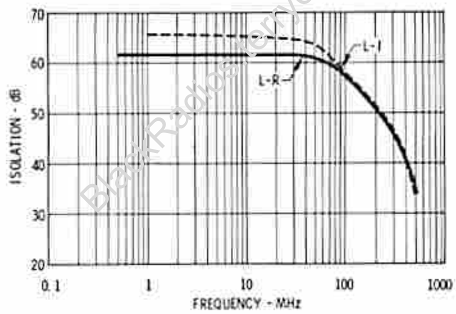


Conversion Loss vs. LO Drive Level: Conversion loss in an SSB system as a function of drive level (f_L level), with f_L and f_R at approximately 50 MHz and f_R level at -20 dBm.



Conversion Loss vs. Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the inputs f_L and f_R with f_I at 50 MHz.

Isolation



Isolation vs. Frequency – MHz: Level of the f_L signal at the R-port with respect to the available power of +7 dBm from a 50-ohm source used for f_L.

Harmonic Intermodulation Products:

SINGLE-TONE INTERMODULATION DISTORTION

HARMONICS OF f_R	0	1	2	3	4	5
5	>90	83	>90	78	>90	74
	>90	82	>90	78	>90	75
4	>90	>90	>90	>90	>90	>90
	>90	>90	>90	>90	>90	>90
3	65	62	68	54	72	53
	68	62	71	58	72	59
2	76	78	80	75	85	75
	78	77	83	75	86	74
1	24	0	40	13	43	28
	24	0	38	11	39	20
0		34	37	47	57	52
		32	33	44	48	46

HARMONICS OF f_L

0.5 - 500 MHz
CLASS I MIXER
(TYPE 2)
f_R = 49 MHz @ −10 dBm
f_L = 50 MHz
f_L = +10 dBm
f_L = +7 dBm

6

WJ-M6E-50

DOUBLE-BALANCED MIXER

LO } 5 TO 500 MHz
RF }
IF DC TO 500 MHz
LO DRIVE +7 dBm (nominal)

- HIGH ISOLATION: 40 dB (TYP.)[2]
- LOW COST

Guaranteed Specifications [1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		6.5 dB	7.0 dB	f_L, f_R & f_I 10 to 100 MHz
		7.5 dB	8.0 dB	f_L & f_R 100 to 200 MHz; f_I 10 to 200 MHz
		8.5 dB	9.0 dB	f_L & f_R 5 to 500 MHz; f_I 0.5 to 500 MHz
Isolation				
f_L at R	40 dB	50 dB		f_L 5 to 50 MHz
f_L at I	35 dB	45 dB		
f_L at R	30 dB	35 dB		f_L 50 to 500 MHz
f_L at I	25 dB	30 dB		

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

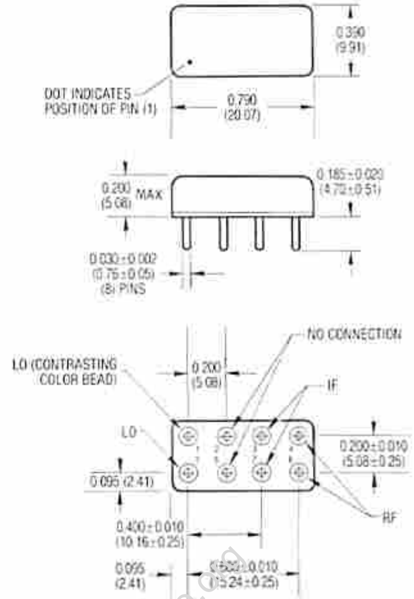
Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +17 dBm
Peak Input Current at 25°C . . . . 50 mA DC

Weight 5.0 grams (0.18 oz.) max.

Outline Drawing

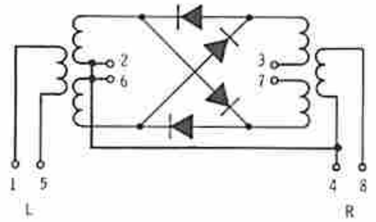
M6E-50



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

PIN NUMBERS ARE SHOWN FOR REFERENCE ONLY.

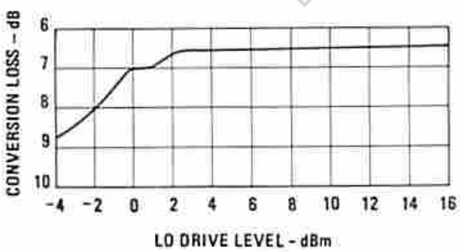
Schematic Diagram



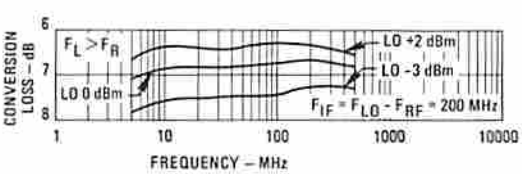
PINS 2, 4 AND 6 ARE INTERNALLY CONNECTED TO THE CASE. THE I-PORT IS FORMED BY EXTERNALLY CONNECTING PINS 3 AND 7 TOGETHER AND USING THE CASE FOR REFERENCE.

Typical Performance at 25°C

Conversion Loss

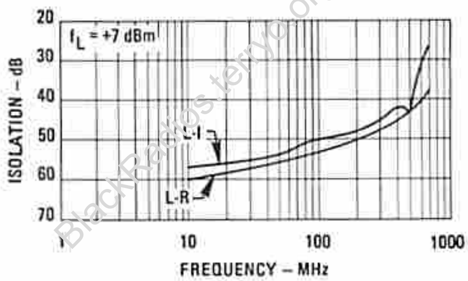


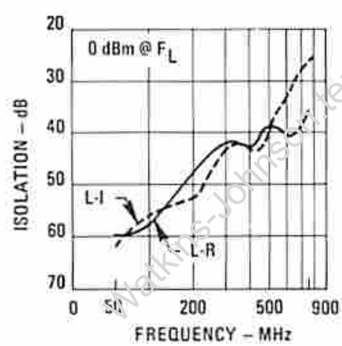
Conversion Loss vs. LO Drive Level: Conversion Loss in an SSB system as a function of drivel level (f_L level). The minimum recommended drive level is 0 dBm. The maximum drive level is +13 dBm.



Conversion Loss vs. Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R) with f_I equal to 200 MHz. Data plotted with an f_L level of +2, 0, -3 dBm.

Isolation





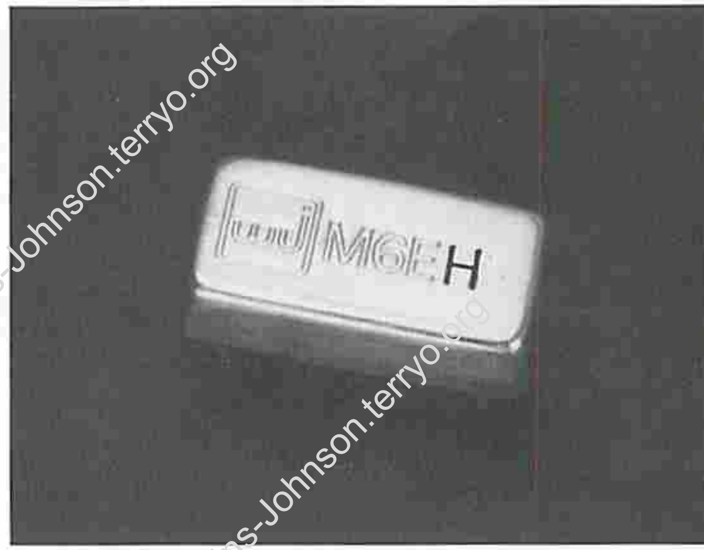
Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

6

WJ-M6EH

DOUBLE-BALANCED MIXER

LO 5 TO 750 MHz
RF 5 TO 500 MHz
IF DC TO 500 MHz
LO DRIVE +20 dBm (nominal)



- HIGH INTERCEPT POINT
- HIGH ISOLATION

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		5.5 dB	7.0 dB	f_L, f_R, f_I 10 to 100 MHz
		6.0 dB	7.5 dB	f_L, f_R = 100 to 250 MHz; f_I = 10 to 250 MHz
		6.5 dB	8.5 dB	f_L 5 to 750 MHz; f_R 5 to 500 MHz; f_I .5 to 500 MHz
Isolation f_L at R	40 dB	60 dB		f_L = 5 to 200 MHz
	30 dB	45 dB		f_L = 200 to 500 MHz
	20 dB	35 dB		f_L = 500 to 750 MHz
f_L at I	40 dB	55 dB		f_L = 5 to 200 MHz
	25 dB	40 dB		f_L = 200 to 500 MHz
	18 dB	30 dB		f_L = 500 to 750 MHz
Conversion Compression			1.0 dB	f_R = +13 dBm
Third Order Input Intercept		28.5 dBm		f_L 300 MHz +20 dBm; f_{R1} 250 MHz 0 dBm; f_{R2} 260 MHz 0 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

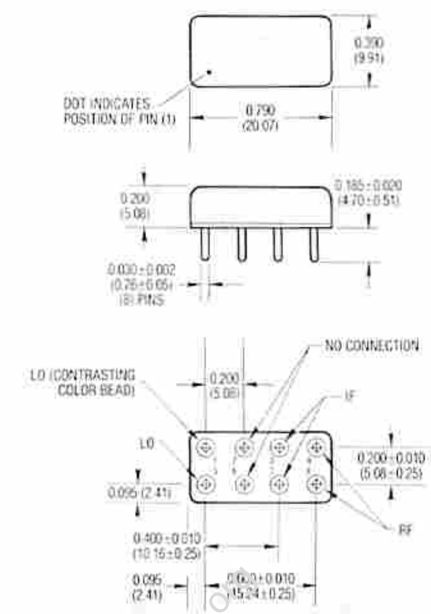
Absolute Maximum Ratings

Operating Temperature. . . . . -54°C to 100°C
Storage Temperature . . . . -65°C to 100°C
Peak Input Power . . . . +26 dBm
Peak Input Current at 25°C. . . . . 100 mA DC

Weight 5.0 grams (0.18 oz.) max

Outline Drawing

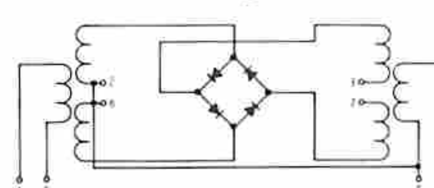
M6EH



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.010 (.25) UNLESS OTHERWISE SPECIFIED

PIN NUMBERS ARE SHOWN FOR REFERENCE ONLY.

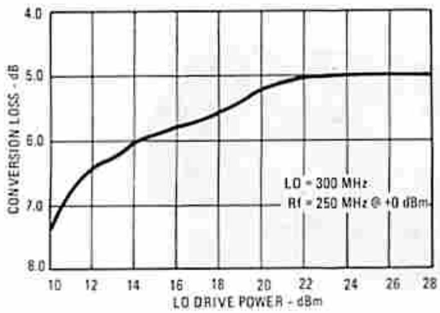
Schematic Diagram



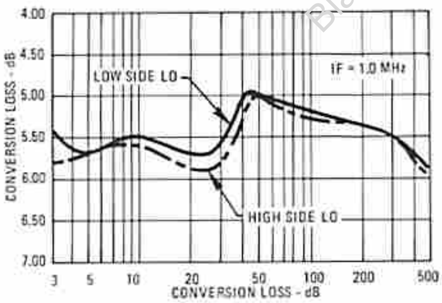
PINS 2, 4 AND 6 ARE INTERNALLY CONNECTED TO THE CASE. THE I PORT IS FORMED BY EXTERNALLY CONNECTING PINS 3 AND 7 TOGETHER AND USING THE CASE FOR REFERENCE.

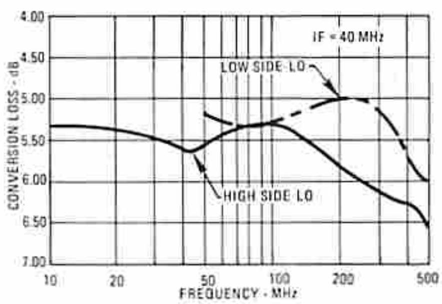
Typical Performance at 25°C

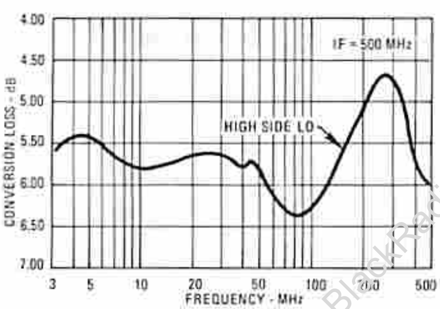
Conversion Loss



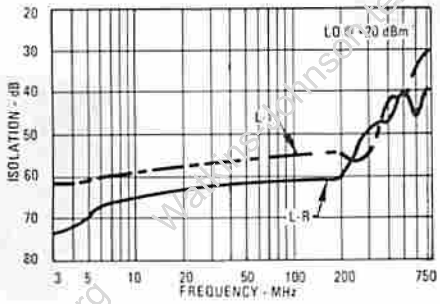
Conversion Loss vs. LO Drive Level: The maximum recommended drive level is +26 dBm.

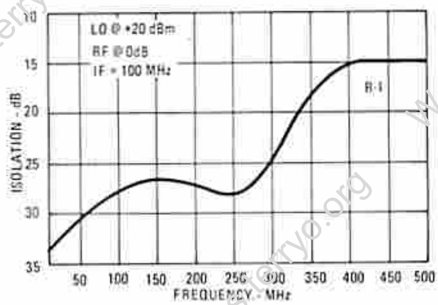




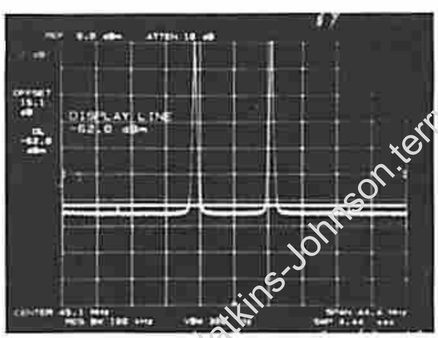


Isolation

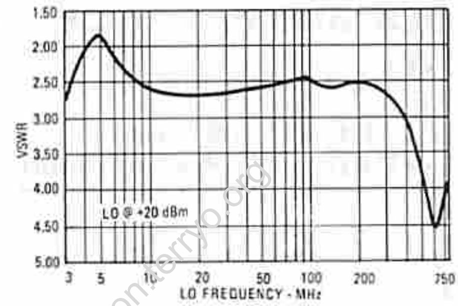




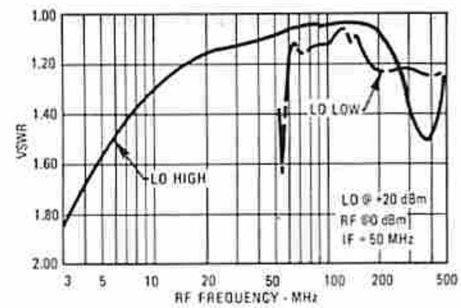
Typical Two-Tone Intermodulation Performance:



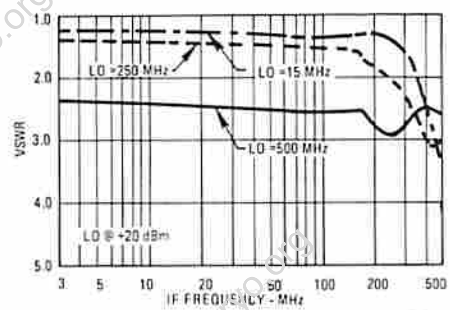
L-Port VSWR



R-Port VSWR



I-Port VSWR



6

WJ-M6F

DOUBLE-BALANCED MIXER

LO / RF } 2 TO 500 MHz
IF DC TO 500 MHz
LO DRIVE +7 dBm (nominal)

- LOW NOISE FIGURE: 6.5 dB (TYP.)
- HIGH ISOLATION: 50 dB (TYP.)

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.0 dB 8.0 dB 9.0 dB	5 – 100 MHz 100 – 200 MHz 2 – 500 MHz
Isolation			
f_L at R	40 dB		2 – 150 MHz
f_L at I	35 dB		
f_R at L		>45 dB	
f_R at I		>25 dB	
f_L at R	35 dB		150 – 500 MHz
f_L at I	25 dB		
f_R at L		>40 dB	
f_R at I		>15 dB	
Conversion Compression		0.3 dB	f_R = +1 dBm
Conversion Densensitization Level		1.0 dB 10.0 dB	f_{R2} = +1 dBm f_{R2} = +10 dBm

Notes:

1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

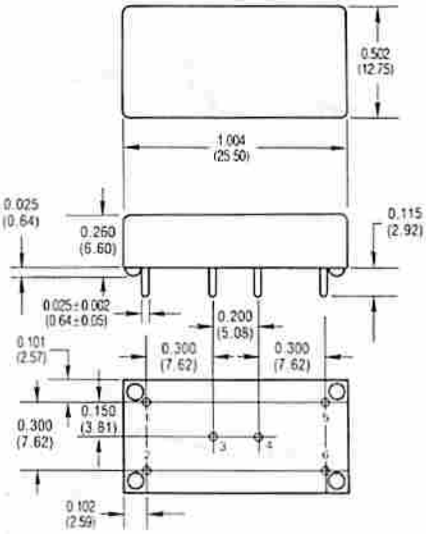
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +17 dBm
Peak Input Current at 25°C . . . . 50 mA DC

Weight

3 grams (0.11 oz.) max.

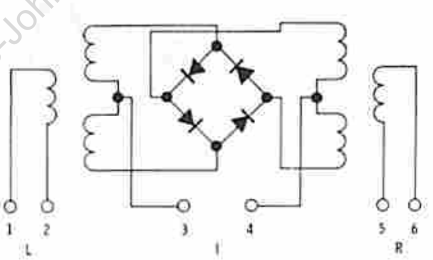
Outline Drawing

M6F



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

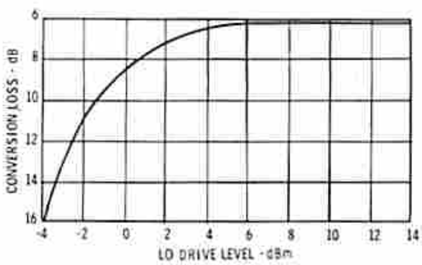
Schematic Diagram



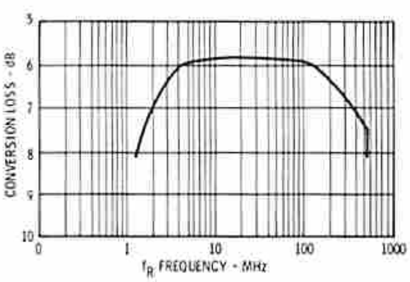
FOR BEST ISOLATION OF THE HIGH-LEVEL (f_L) SIGNAL, GROUND PIN 3.

Typical Performance at 25°C

Conversion Loss

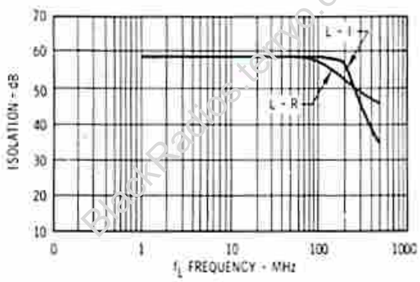


Conversion Loss vs. LO Drive Level: The minimum recommended drive level is +4 dBm. The maximum recommended drive level is +13 dBm.



Conversion Loss vs. Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R) with f_I to 1 MHz at 50 MHz. Data plotted with an f_L level of +7 dBm.

Isolation



Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

Harmonic Intermodulation Products:

SINGLE-TONE INTERMODULATION DISTORTION

Harmonics of f_R	Harmonics of f_L: 0	1	2	3	4	5
5	>90	87	90	74	>90	71
	>90	90	>90	82	>90	78
4	>90	>90	>90	>90	>90	>90
	>90	>90	>90	>90	>90	>90
3	69	74	76	57	76	53
	72	76	78	61	78	59
2	77	76	80	77	82	70
	80	78	82	78	82	71
1	30	0	40	13	44	25
	30	0	40	11	44	20
0		32	36	44	60	51
		30	32	42	50	51

2 - 500 MHz
CLASS I MIXER WITH BALUNS
f_R = 49 MHz @ −10 dBm
f_L = 50 MHz
f_L @ +10 dBm
f_L @ +7 dBm

6

WJ-M6G

DOUBLE-BALANCED MIXER

LO } 0.6 TO 2 GHz
RF }
IF DC TO 0.3 GHz
LO DRIVE +7 dBm (nominal)

- LOW NOISE FIGURE: 6.5 dB (TYP.)[2]
- HIGH ISOLATION: 25 dB (TYP.)[2]

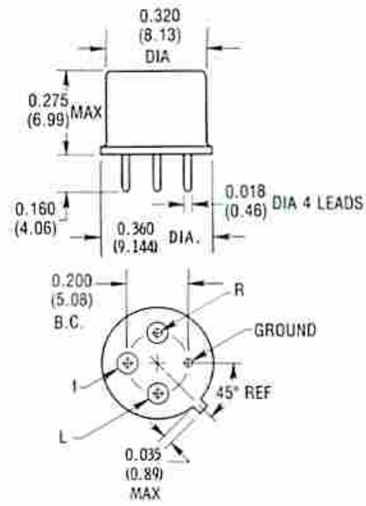
Guaranteed Specifications [1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		8.0 dB	f_R 1.3 to 2 GHz f_L 1.3 to 2 GHz f_I 0.01 to 0.3 GHz
		8.5 dB 9.0 dB	f_R 0.6 to 1.3 GHz f_L 0.6 to 1.3 GHz f_I 0.01 to 0.01 GHz f_I 0.01 to 0.3 GHz
Isolation			
f_L at R	25 dB		f_L 0.6 to 1 GHz
f_L at I	25 dB		
f_L at R	25 dB		f_L 1.0 GHz to 2.0 GHz
f_L at I	18 dB		
Conversion Compression		1.0 dB	f_R Level = 0 dBm
Densensitization Level		1.0 dB	f_{R2} Level = -2 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications. I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Outline Drawing

M6G



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

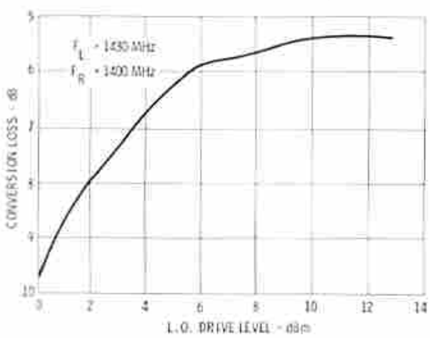
Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . . . +23 dBm at 25°C, derate to +17 dBm at 100°C
Peak Input Current at 25°C . . . . 50 mA DC

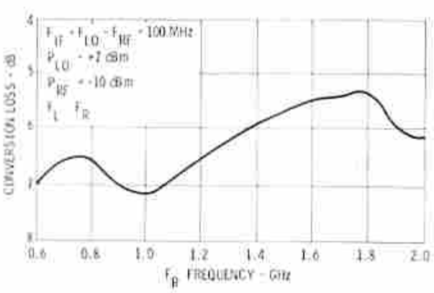
Weight 2 grams (0.07 oz.) max.

Typical Performance at 25°C

Conversion Loss

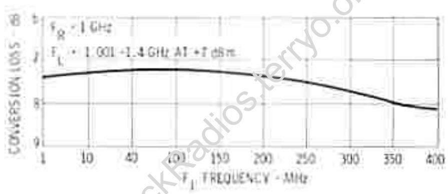


Conversion Loss vs. LO Drive Level: The minimum recommended drive level is +5 dBm. The maximum recommended drivel level is +13 dBm.



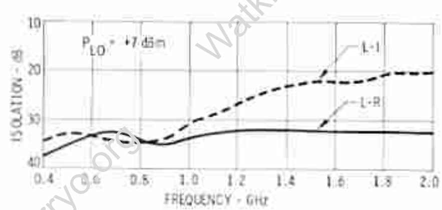
Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R) with f_I equal to 100 MHz. Data plotted with an f_L level of +7 dBm.

Conversion Loss



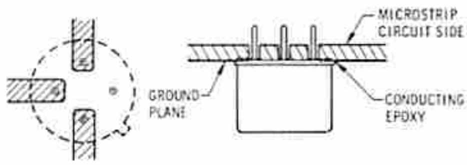
Conversion Loss vs. f_I Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the I-port (f_I).

Isolation



Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

Mounting Instructions



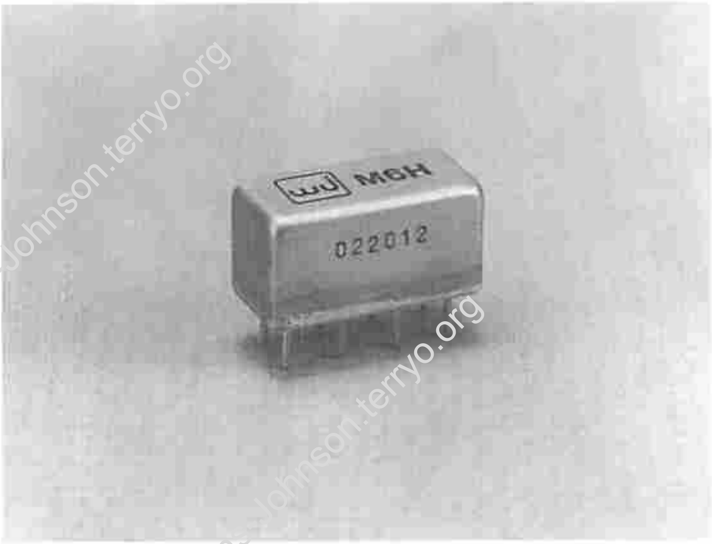
THE CASE OF THE M6G MIXER SHOULD BE GROUNDED TO THE CIRCUIT BOARD GROUND PLANE FOR BEST PERFORMANCE. CONDUCTIVE EPOXY IS RECOMMENDED RATHER THAN SOLDERING. CONDUCTIVE FILM EPOXIES CAN BE OBTAINED IN DIE CUT PREFORMS AND ARE QUITE SATISFACTORY.

6

WJ-M6H

DOUBLE-BALANCED MIXER

LO } 2 kHz TO 12 MHz
RF }
IF DC TO 12 MHz
LO DRIVE +7 dBm (nominal)



- LOW NOISE FIGURE: 5 dB (TYP.)[2]

Guaranteed Specifications [1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		6.0 dB	10 kHz – 5 MHz
		7.0 dB	2 kHz – 12 MHz
Isolation			
f_L at R	45 dB		2 kHz – 5 MHz
f_L at I	30 dB		
f_L at R	40 dB		5 MHz – 12 MHz
f_L at I	30 dB		

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

Operating Temperature* . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +17 dBm
Peak Input Current at 25°C. . . . . 50 mA DC

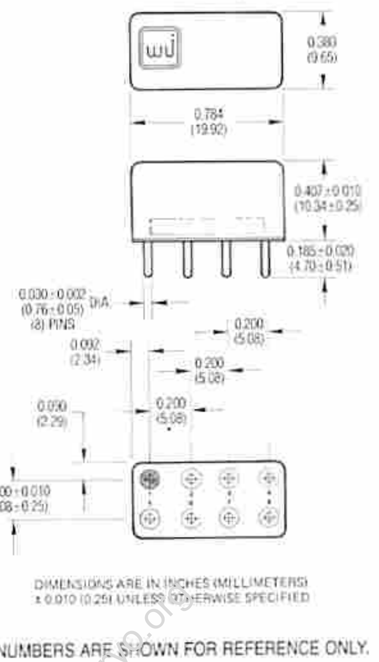
*For input signals below 3 kHz at L and R, the temperature range is 0°C to +100°C.

Weight

6 grams (0.21 oz.) max.

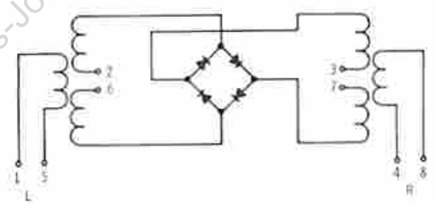
Outline Drawing

M6H



PIN NUMBERS ARE SHOWN FOR REFERENCE ONLY.

Schematic Diagram

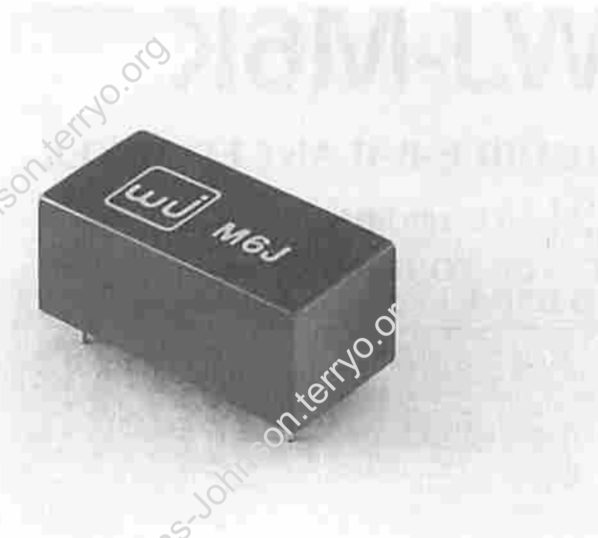


I-PORT: FORMED BY EXTERNALLY CONNECTING PINS 2 AND 6 TOGETHER AND PINS 3 AND 7 TOGETHER. BEST PERFORMANCE IS OBTAINED BY GROUNDING THE 2, 6 SIDE.

WJ-M6J

DOUBLE-BALANCED MIXER

LO / RF } 2 kHz TO 12 MHz
IF DC TO 12 MHz
LO DRIVE +7 dBm (nominal)



- LOW NOISE FIGURE: 5 dB (TYP.)[2]

Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		6.0 dB 7.0 dB	10 kHz – 5 MHz 2 kHz – 12 MHz
Isolation f_L at R f_L at I f_L at R f_L at I	 45 dB 40 dB 40 dB 30 dB		2 kHz – 5 MHz 5 MHz – 12 MHz

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

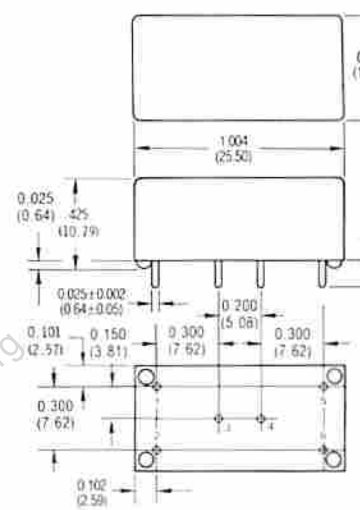
Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +17 dBm
Peak Input Current at 25°C. . . . . 50 mA DC

Weight 4 grams (0.14 oz.) max.

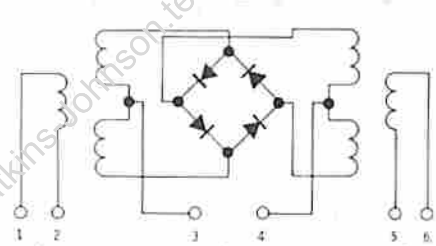
Outline Drawing

M6J



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .010 (.25) UNLESS OTHERWISE SPECIFIED

Schematic Diagram



6

WJ-M6K

DOUBLE-BALANCED MIXER

LO } 5 TO 400 MHz
RF }
IF DC TO 400 MHz
LO DRIVE +7 dBm (nominal)

- HIGH ISOLATION: 35 dB (TYP.)[2]
- LOW COST

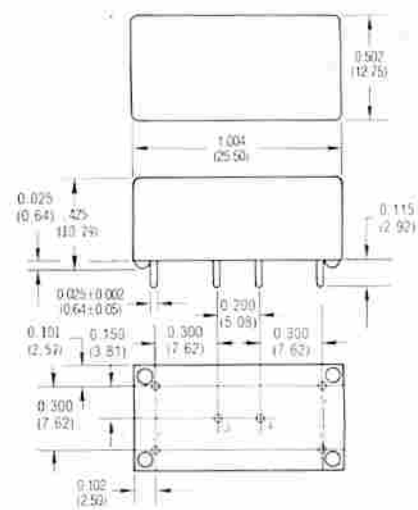
Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.5 dB	f_L & f_R 5-200 MHz; f_I 0.5-200 MHz
		9.0 dB	f_L & f_R 200-400 MHz; f_I 1-400 MHz
Isolation			
f_L at R	35 dB		f_L 5-100 MHz
f_L at I	30 dB		
f_L at R	25 dB		f_L 100-400 MHz
f_L at I	20 dB		

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications. I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Outline Drawing

M6K



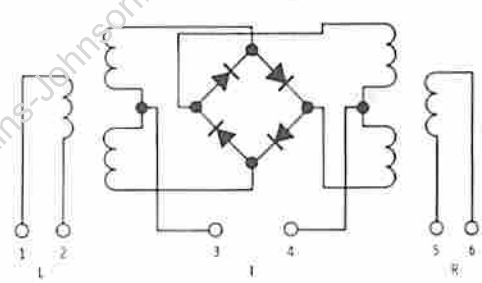
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

Absolute Maximum Ratings

Operating Temperature . . . . -65°C to +100°C
Storage Temperature . . . . -54°C to +100°C
Peak Input Power . . . . +17 dBm
Peak Input Current at 25°C . . . . 50 mA DC

Weight 4 grams (0.14 oz.) max.

Schematic Diagram



FOR BEST ISOLATION OF THE HIGH-LEVEL f_L SIGNAL, GROUND PIN 3.

WJ-M6KC

DOUBLE-BALANCED MIXER

LO } 5 TO 400 MHz
RF }
IF DC TO 400 MHz
LO DRIVE +7 dBm (nominal)

- HIGH ISOLATION: 35 dB (TYP.)[2]
- LOW COST

Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.5 dB	f_L & f_R 5 - 200 MHz f_I .5 - 200 MHz
		9.0 dB	f_L & f_R 200 - 400 MHz f_I 1 - 400 MHz
Isolation			
f_L at R	35 dB		f_L 5 - 100 MHz
f_L at I	30 dB		
f_L at R	25 dB		f_L 100 - 400 MHz
f_L at I	20 dB		

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

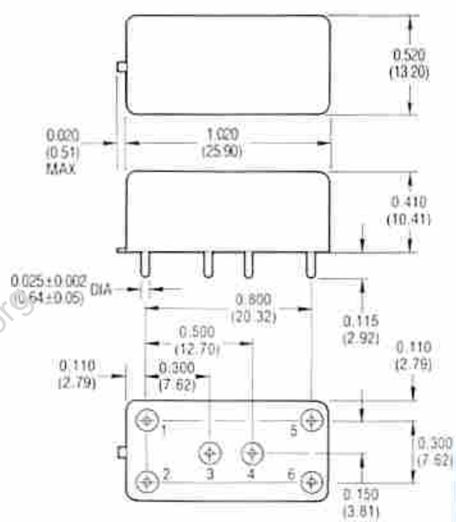
Absolute Maximum Ratings

Operating Temperature . . . . -54°C to 100°C
Storage Temperature . . . . -65°C to 100°C
Peak Input Power . . . . +17 dBm
Peak Input Current at 25°C. . . . . 50 mA DC

Weight 8 grams (0.28 oz.) max.

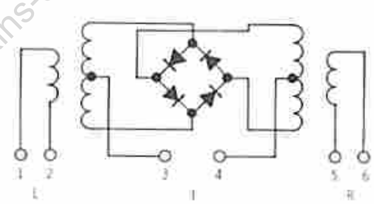
Outline Drawing

M6KC



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .010 (.25) UNLESS OTHERWISE SPECIFIED

Schematic Diagram



FOR BEST ISOLATION OF THE HIGH-LEVEL (f_L) SIGNAL, GROUND PIN 3.

6

WJ-M6R

DOUBLE-BALANCED MIXER

LO 10 TO 1200 MHz
RF 10 TO 1000 MHz
IF DC TO 1000 MHz
LO DRIVE +7 dBm (nominal)

- LOW NOISE FIGURE: 6 dB (TYP.)[2]
- HIGH ISOLATION: 40 dB (TYP.)[2]

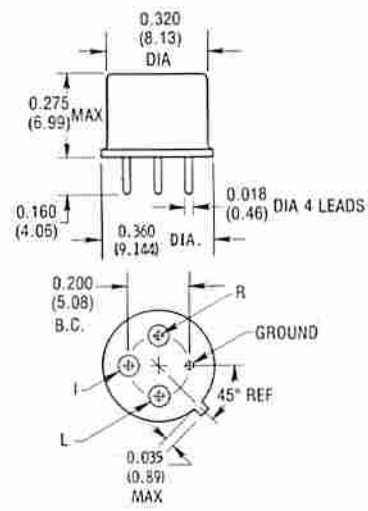
Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.0 dB	f_R 20 to 600 GHz f_L 10 to 1000 MHz f_I 1 to 500 MHz
		8.5 dB	f_R 10 to 1000 MHz f_L 10 to 1200 MHz f_I 1 to 200 MHz
		9.5 dB	f_I 1 to 1000 MHz
Isolation f_L at R f_L at I	45 dB 30 dB		f_L 10 to 100 MHz
f_L at R f_L at I	30 dB 20 dB		f_L 100 to 500 MHz
f_L at R f_L at I	22 dB 15 dB		f_L 500 to 1000 MHz
Conversion Compression		1.0 dB	f_R Level = 0 dBm
Densensitization Level		1.0 dB	f_{R2} Level = -2 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications. I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Outline Drawing

M6R



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

Absolute Maximum Ratings

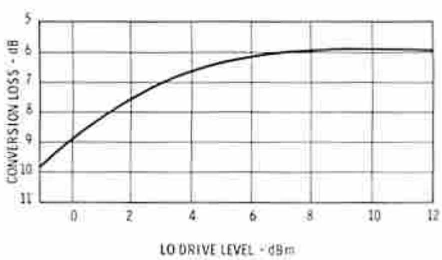
Operating Temperature.* . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +23 dBm at 25°C, derate to +17 dBm at 100°C
Peak Input Current at 25°C. . . . . 50 mA DC

*For input signals below 20 MHz, the temperature range is -20°C to +100°C.

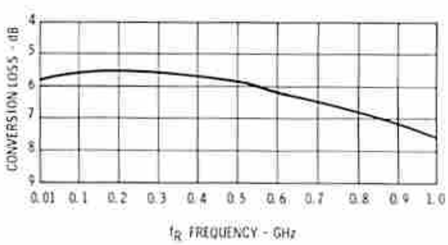
Weight 2 grams (0.07 oz.) max.

Typical Performance at 25°C

Conversion Loss

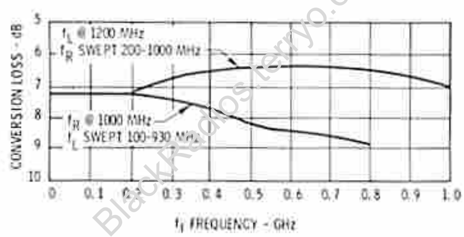


Conversion Loss vs. Drive Level: The minimum recommended drive level is +4 dBm. The maximum recommended drive level is +13 dBm.



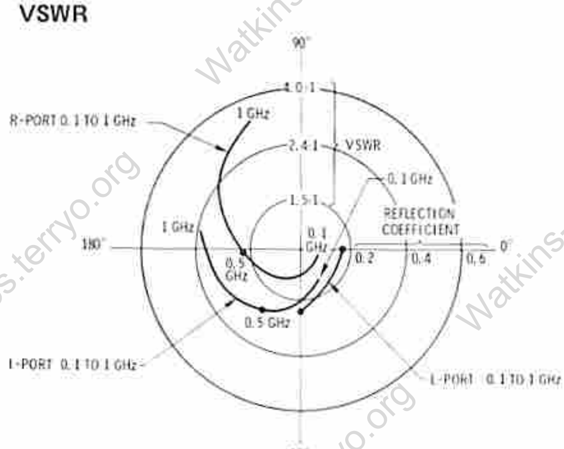
Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R) with f_I at 30 MHz. Data plotted with an f_L level of +7 dBm.

Conversion Loss



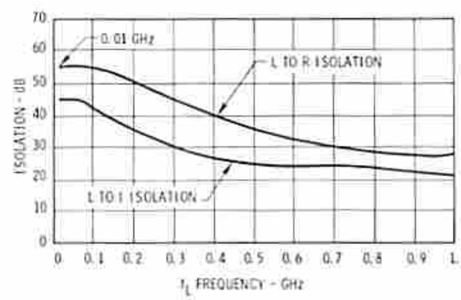
Conversion Loss vs. f_I Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the I-port (f_I).

VSWR



Reflection Coefficient vs. Frequency: Reflection coefficient of the L-, I- and R-ports in a 50-ohm system with f_L at +7 dBm. R- and I-port reflection coefficient is plotted for f_L at 0.5 MHz. Also shown is the L-port VSWR.

Isolation



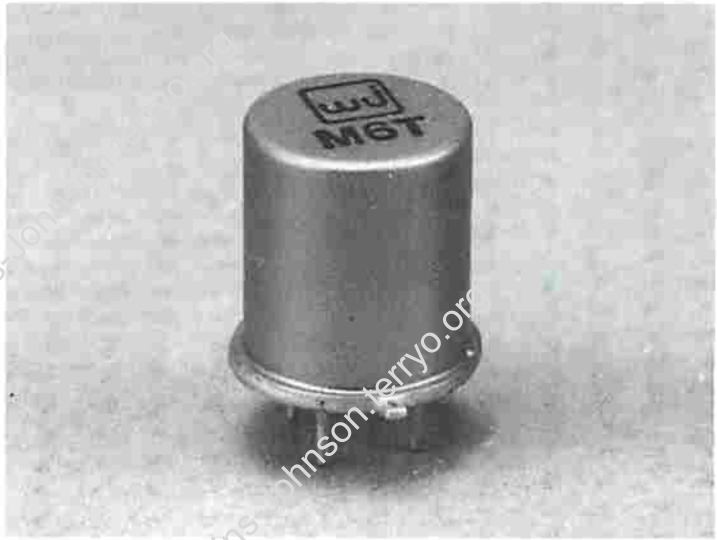
Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

6

WJ-M6T

DOUBLE-BALANCED MIXER

LO } 10 TO 500 MHz
RF }
IF DC TO 500 MHz
LO DRIVE +7 dBm (nominal)



- HIGH ISOLATION: 40 dB (TYP.)[2]
- QPL VERSION AVAILABLE! (See Section 7)

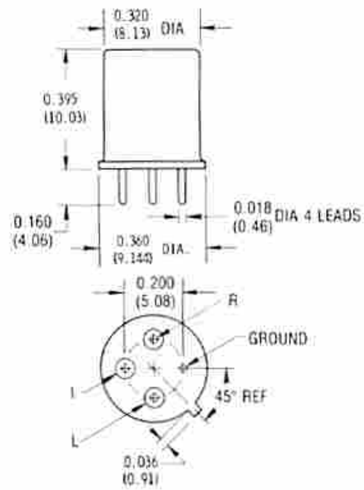
Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.0 dB	f_L & f_R 10 to 200 MHz, f_I 1 to 200 MHz
		8.0 dB	f_L & f_R 200 to 350 MHz, f_I 1 to 350 MHz
		9.0 dB	f_L & f_R 350 to 500 MHz, f_I 1 to 500 MHz
Isolation			
f_L at R	40 dB		f_L & f_R 10 to 50 MHz
f_L at I	35 dB		
f_L at R	35 dB		f_L & f_R 50 to 100 MHz
f_L at I	30 dB		
f_L at R	30 dB		f_L & f_R 100 to 200 MHz
f_L at I	25 dB		
f_L at R	25 dB		f_L & f_R 200 to 500 MHz
f_L at I	15 dB		

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Outline Drawing

M6T



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

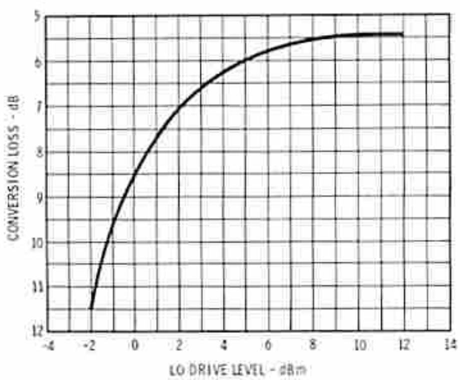
Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +17 dBm
Peak Input Current at 25°C. . . . . 50 mA DC

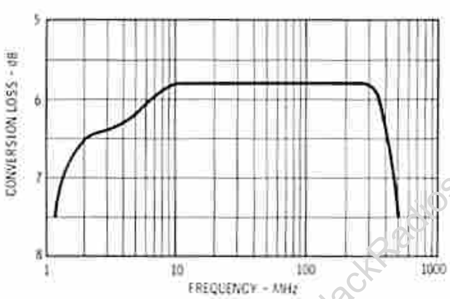
Weight 2 grams (0.07 oz.) max.

Typical Performance at 25°C

Conversion Loss

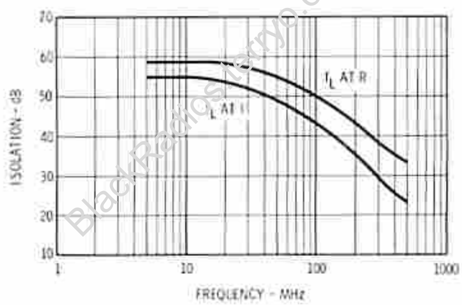


Conversion Loss vs. LO Drive Level: Conversion loss in an SSB system as a function of drive level (f_L level), with f_L and f_R at approximately 50 MHz and f_R level at -20 dBm.



Conversion Loss vs. Input Frequency: The frequency ordinate refers to the inputs f_L and f_R with 50 MHz. Noise figure performance is the same above 1 MHz.

Isolation



Isolation vs. Frequency: Level of the f_L signal fed through to the R-port with respect to the level of the f_L signal at the L-port.

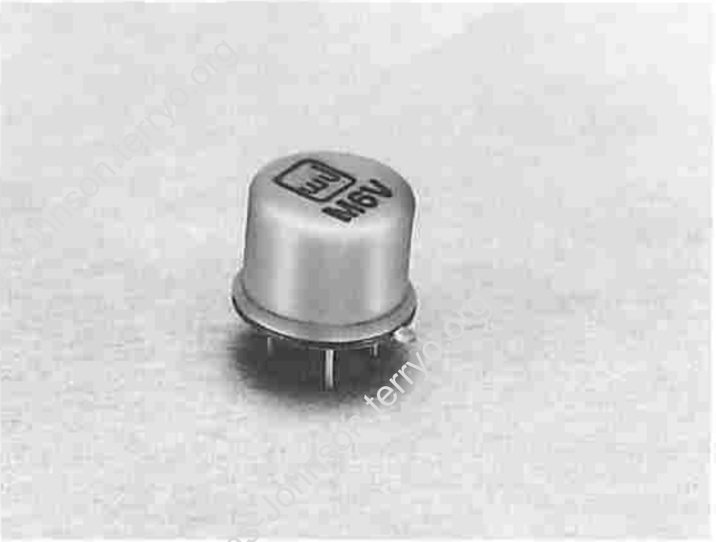
6

WJ-M6V

DOUBLE-BALANCED MIXER

LO } 0.4 TO 500 MHz
RF }
IF DC TO 500 MHz
LO DRIVE +7 dBm (nominal)

- LOW NOISE FIGURE: 5.5 dB (TYP.)[2]
- HIGH ISOLATION: 50 dB (TYP.)[2]
- QPL VERSION AVAILABLE! (See Section 7)



Guaranteed Specifications [1]

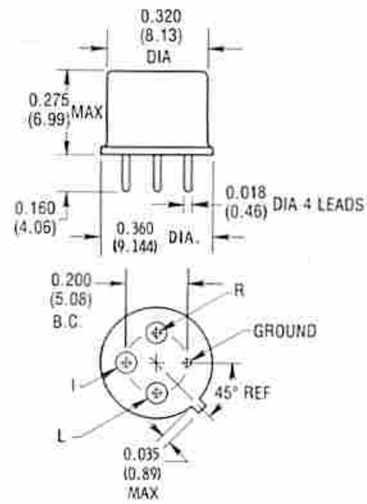
Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		6.5 dB 7.5 dB	f_L, f_R & f_I 1 to 200 MHz f_L, f_R & f_I 0.4 to 500 MHz
Isolation f_L at R f_L at I	 45 dB 30 dB		f_L 0.4 to 60 MHz
f_L at R f_L at I	30 dB 20 dB		f_L 60 to 500 MHz
Conversion Compression		1.0 dB	f_R Level = 0 dBm
Desensitization Level		1.0 dB	f_{R2} Level = -2 dBm

Notes:

1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Outline Drawing

M6V



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

Absolute Maximum Ratings

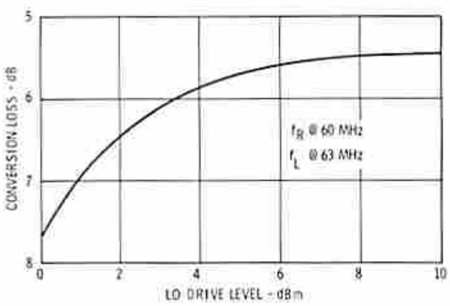
Operating Temperature.* . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +23 dBm at 25°C, derate to +17 dBm at 100°C
Peak Input Current at 25°C. . . . . 50 mA DC

*For input signals below 1 MHz, the temperature range is -20°C to +100°C.

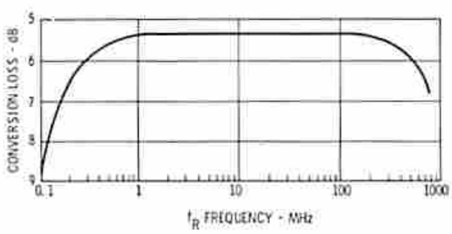
Weight 2 grams (0.07 oz.) max.

Typical Performance at 25°C

Conversion Loss

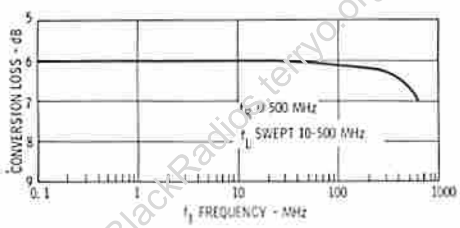


Conversion Loss vs. Drive Level: The minimum recommended drive level is +4 dBm. The maximum recommended drive level is +13 dBm.



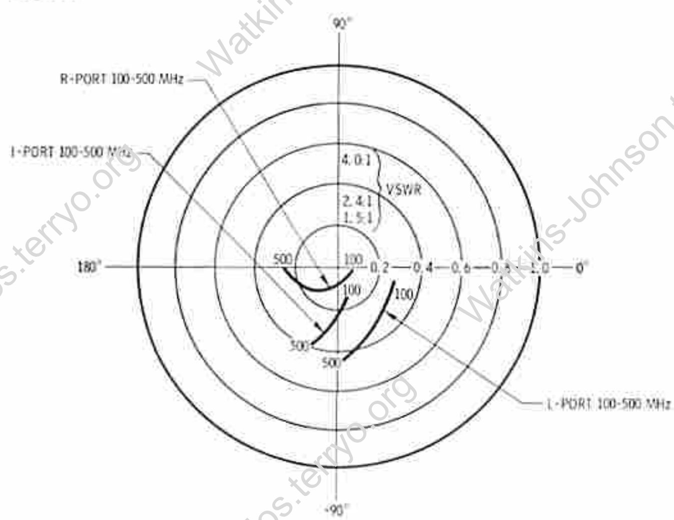
Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

Conversion Loss



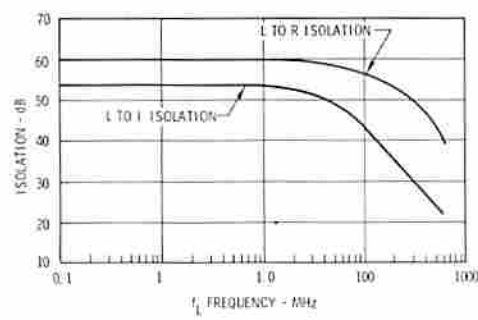
Conversion Loss vs. f_I Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the I-port (f_I).

VSWR



Reflection Coefficient vs. Frequency: Reflection coefficient of the L-, I- and R-ports in a 50-ohm system with f_L at +7 dBm. R- and I-port reflection coefficient is plotted for f_L at 250 MHz.

Isolation



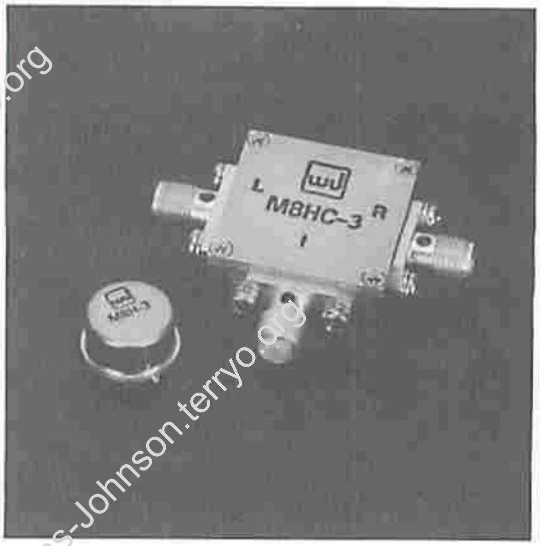
Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R). Data plotted with an f_L level of +7 dBm, f_I at 50 MHz.

6

WJ-M8H-3/M8HC-3

DOUBLE-BALANCED MIXER

LO 2.0 TO 6.0 GHz
RF 3.7 TO 4.2 GHz
IF DC to 2000 MHz
LO DRIVE +7 dBm (nominal)



- LOW NOISE FIGURE: 4.5 dB (TYP.)
- HIGH ISOLATION: 35 dB (TYP.)
- LOW COST

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		4.0 dB 4.5 dB	5.5 dB 6.0 dB	f_R = 3.7 to 4.2 GHz f_L = 2.0 to 6.0 GHz f_I = 30 to 2000 MHz, $f_L > f_R$ f_I = 30 to 2000 MHz, $f_L > f_R$
Isolation				
L to R	32 dB 25 dB	42 dB 37 dB		f_L = 2.0 to 4.0 GHz f_L = 4.0 to 6.0 GHz
L to I	16 dB	21 dB		f_L = 2.0 to 6.0 GHz
Conversion Compression			1.0 dB	f_R Level 0 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

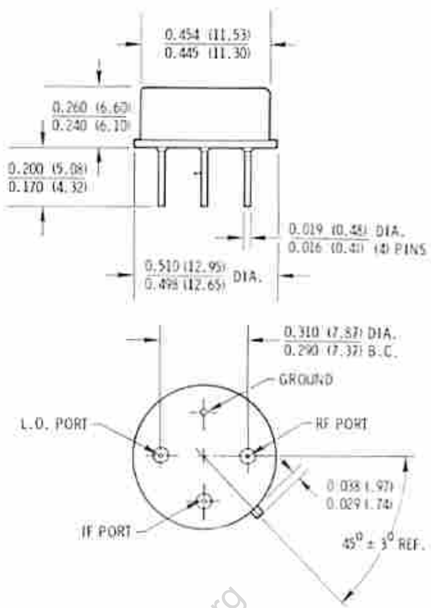
Absolute Maximum Ratings

Operating Temperature. . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +23 dBm at 25°C derate to +17 dBm at 100°C
Peak Input Current at 25°C. . . . . 50 mA DC

Weight 2 grams (0.07 oz.) max.

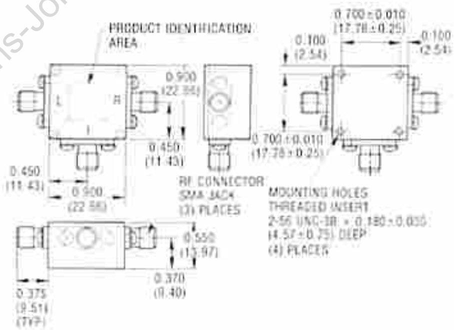
Outline Drawings

M8H-3



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.010 (.25) UNLESS OTHERWISE SPECIFIED

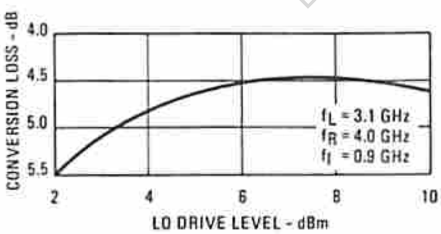
M8HC-3



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C

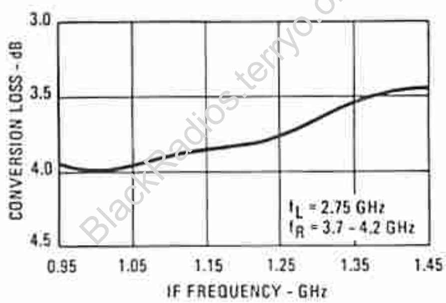
Conversion Loss



Conversion Loss vs. Drive Level: The minimum recommended drive level is +5 dBm. This level has been established on the premise that a lower drive level will degrade the conversion loss and noise figure over the full temperature and frequency range.

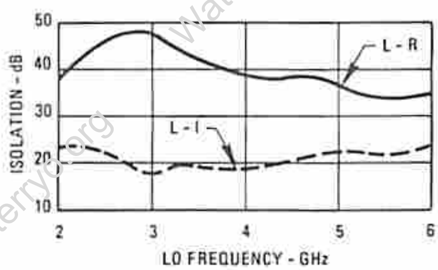
The maximum recommended drive level is +10 dBm. This upper level has been established by the desire to avoid a serious increase in noise figure and a loss of isolation.

Conversion Loss



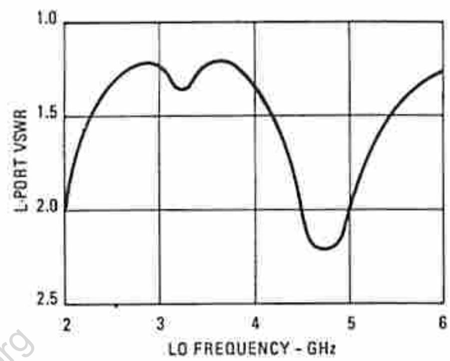
Conversion Loss vs. f_I Frequency: Conversion loss the mixer when used in an SSB system. The frequency ordinate refers to the I-port (f_I) with f_L at 2.75 GHz and f_R swept from 3.7 to 4.2 GHz.

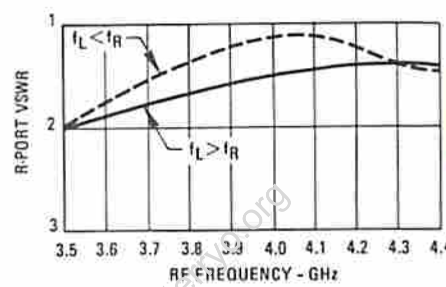
Isolation

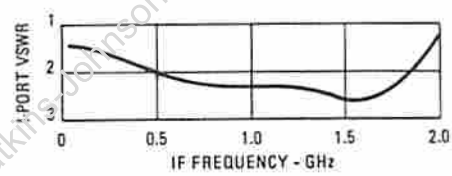


Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

VSWR







6

WJ-M8H-7/M8HC-7

DOUBLE-BALANCED MIXER

LO 2.0 TO 6.0 GHz
RF 2.4 TO 6.0 GHz
IF 30 to 2000 MHz
LO DRIVE +7 dBm (nominal)

- LOW NOISE FIGURE: 6.0 dB (TYP.)
- HIGH ISOLATION: 35 dB (TYP.)

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		4.0 dB	5.5 dB	f_R = 3.7 to 4.2 GHz, f_L = 2 to 6 GHz, f_I = 30 to 2000 MHz, $f_L < f_R$
		4.5 dB	6.0 dB	f_I = 30 to 2000 MHz, $f_L > f_R$
		6.0 dB	8.0 dB	f_R = 2.4 to 6 GHz, f_I = 30 to 2000 MHz
Isolation L to R	32 dB	42 dB		f_L = 2 to 4 GHz
	25 dB	37 dB		f_L = 4 to 6 GHz
L to I	16 dB	21 dB		f_L = 2 to 6 GHz
Conversion Compression			1.0 dB	f_R Level 0 dBm
Densensitization Level			1.0 dB	f_{R2} Level = 2 dBm
Third-Order Intercept Point		+13 dBm		f_L = +7 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

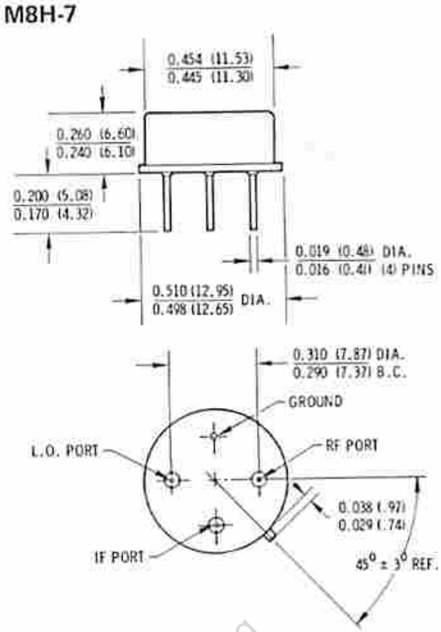
Absolute Maximum Ratings

Operating Temperature. . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +23 dBm at 25°C derate to +17 dBm at 100°C
Peak Input Current at 25°C. . . . . 50 mA DC

Weight 2 grams (0.07 oz.) max.

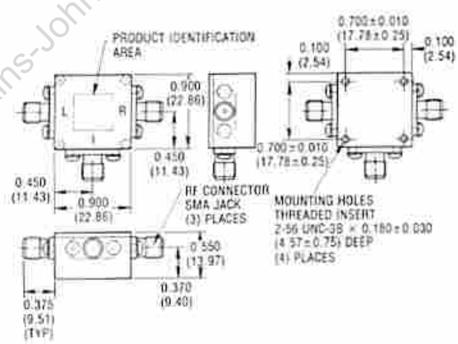
Outline Drawings

M8H-7



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .010 (.25) UNLESS OTHERWISE SPECIFIED

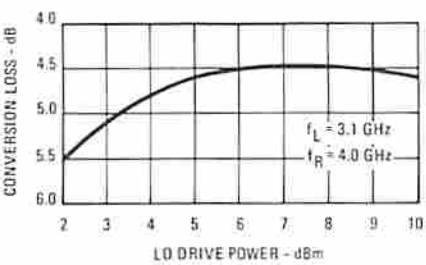
M8HC-7



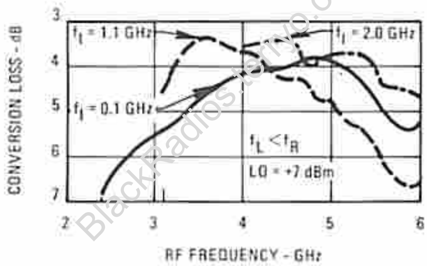
DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C

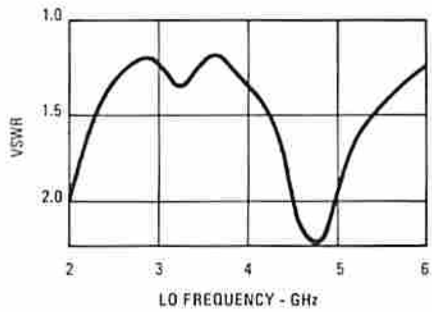
Conversion Loss



Conversion Loss



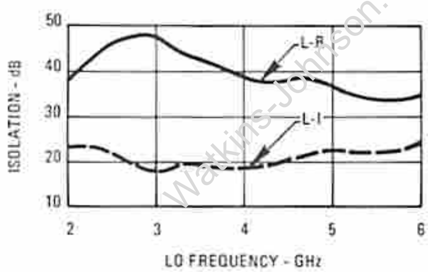
VSWR

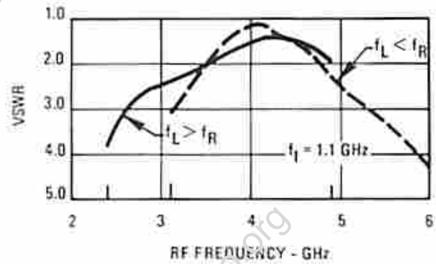


Conversion Loss vs. Drive Level: The minimum recommended drive level is +5 dBm. This level has been established on the premise that a lower drive level will degrade the conversion loss and noise figure over the full temperature and frequency range.

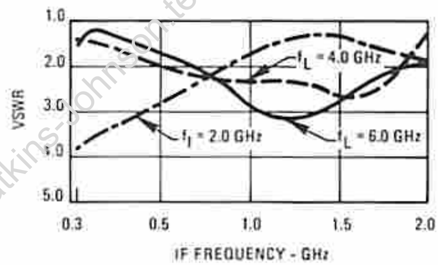
The maximum recommended drive level is +10 dBm. This upper level has been established by the desire to avoid a serious increase in noise figure and a loss of isolation.

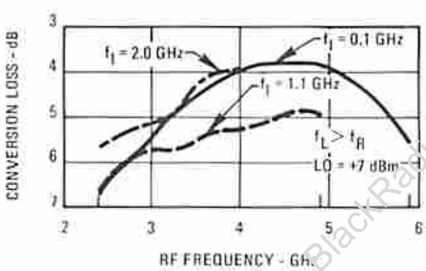
Isolation





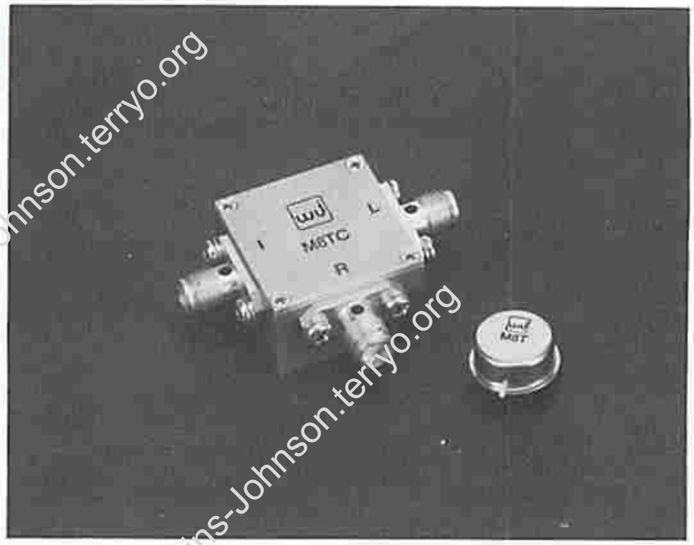
Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.





6

WJ-M8T/8TC



WIDEBAND CLASS 4 MIXER

LO, RF } 1 TO 3400 MHz
IF 1 TO 2000 MHz
LO DRIVE +10 dBm (nominal)

- INSENSITIVE TO SYSTEM MISMATCH
- HIGH INTERCEPT +18 dBm (TYP.)[2]
- BROADBAND

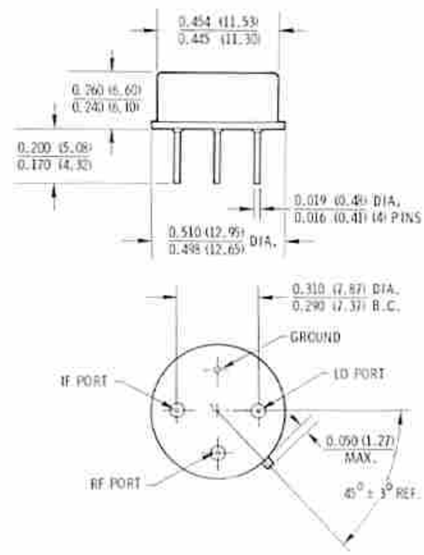
Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		6.0 dB	7.0 dB[3]	f_L & f_R 5-1000 MHz, f_I 1-500 MHz
		7.0 dB	8.0 dB[3]	f_L & f_R: 1-3000 MHz, f_I 1-1500 MHz
		8.0 dB	9.5 dB[3]	f_L & f_R 1-3400 MHz, f_I 1-2000 MHz
Isolation				
f_L at I	32 dB	40 dB		f_L 10-1500 MHz
	25 dB	35 dB		f_L 10-3400 MHz
f_L at R	35 dB	40 dB		f_L 10-2500 MHz
	25 dB	35 dB		f_L 1-3400 MHz
f_R at I		25 dB		f_L 1 to 3400 MHz
Third-Order Intercept Point		+18 dBm		LO 2000 MHz, +10 dBm, f_{R1} = 1900 MHz, f_{R2} = 1910 MHz both at -10 dBm
Conversion Compression			1 dB	f_R at +7 dBm, f_L at +13 dBm
Densensitization Level			1 dB	f_{R2} at +5 dBm, f_L at +10 dBm
Third-Order Intermodulation Suppression Degradation		3 dB		IF VSWR 3:1

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.
3. Guaranteed values for M8TC unit are 0.5 dB worse than values listed.

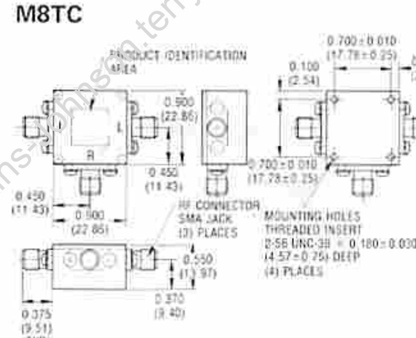
Outline Drawings

M8T



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .010 (.25) UNLESS OTHERWISE SPECIFIED

M8TC



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .010 (.25) UNLESS OTHERWISE SPECIFIED

Absolute Maximum Ratings

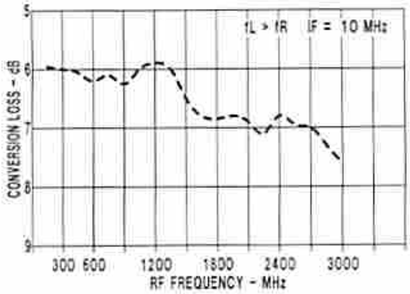
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +27 dBm max. at 25°C, +23 dBm max. at 100°C

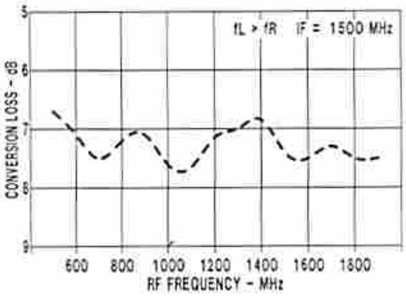
Weight

M8T: 2 grams (0.07 oz.) max.
M8TC: 22 grams (0.78 oz.) max.

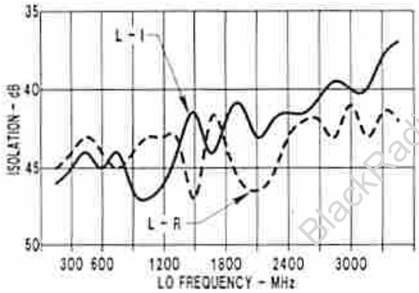
Typical Performance at 25°C

Conversion Loss vs. Frequency





Isolation vs. Frequency

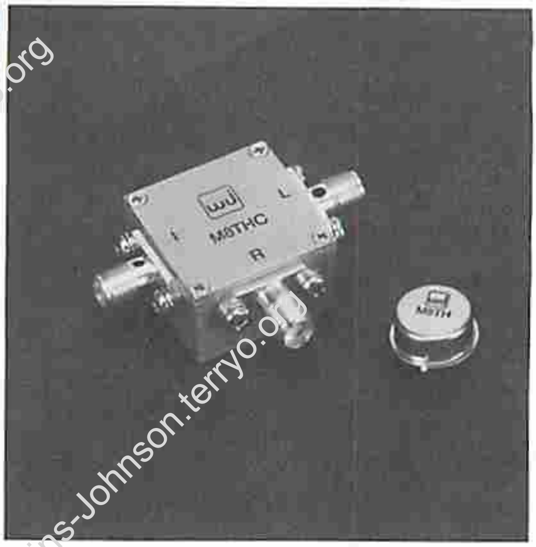


6

WJ-M8TH/8THC

WIDEBAND CLASS 4 MIXER

LO } 1 TO 3400 MHz
RF }
IF 1 TO 2000 MHz
LO DRIVE +23 dBm (nominal)



- INSENSITIVE TO SYSTEM MISMATCH
- HIGH INTERCEPT +29 dBm (TYP.)[2]
- BROADBAND

Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		6.5 dB	7.5 dB[3]	f_L & f_R: 5-2000 MHz, f_I 1-500 MHz
		8.5 dB	10.0 dB[3]	f_L & f_R: 1-3400 MHz, f_I 1-2000 MHz
Isolation				
f_L at I	3.0 dB	40 dB		f_L 10-1500 MHz
	25 dB	35 dB		f_L 10-3400 MHz
f_L at R	30 dB	37 dB		f_L 10-2500 MHz
	22 dB	35 dB		f_L 1-3400 MHz
f_R at I		21 dB		f_L 1 to 3400 MHz
Third-Order Intercept Point		+29 dBm		LO 1800 MHz, +22 dBm; f_{R1} = 1000 MHz, f_{R2} = 1010 MHz both at 0 dBm
Conversion Compression			1 dB	f_R at +17 dBm, f_L at +23 dBm
Densensitization Level			1 dB	f_{R2} at +15 dBm, f_L at +23 dBm
Third-Order Intermodulation Suppression Degradation		3 dB		IF VSWR 3:1

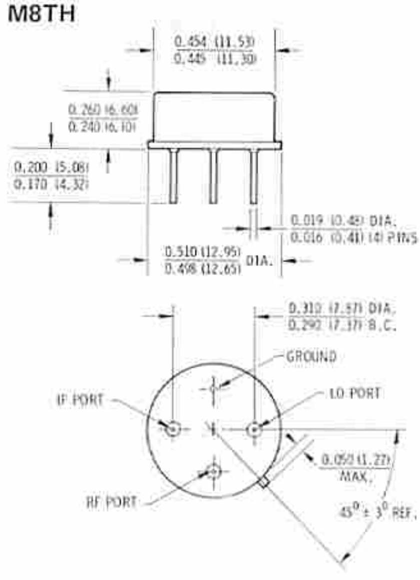
Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.
3. Add 0.5 dB for connectorized package.

Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +30 dBm max. at 25°C, +27 dBm max. at 100°C

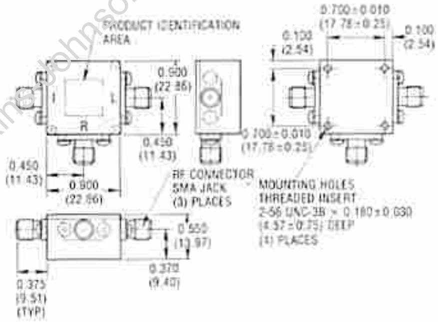
Outline Drawings

M8TH



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .010 (.25) UNLESS OTHERWISE SPECIFIED

M8THC



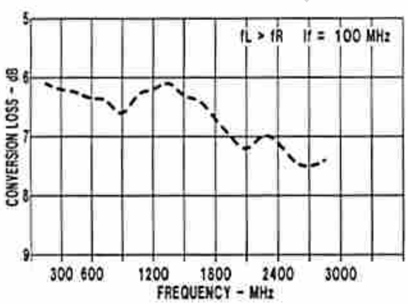
DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .010 (.25) UNLESS OTHERWISE SPECIFIED

Weight

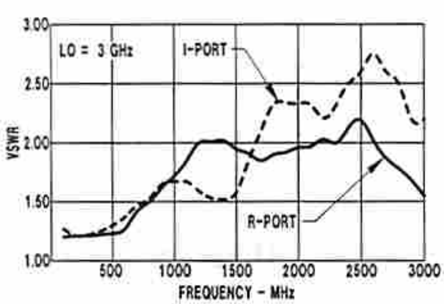
M8TH: 2 grams (0.07 oz.) max.
M8THC: 22 grams (0.78 oz.) max.

Typical Performance at 25°C

Conversion Loss vs. Frequency



VSWR vs. Frequency



6

WJ-M9A

DOUBLE-BALANCED MIXER

LO } 0.5 TO 200 MHz
RF }
IF DC TO 200 MHz
LO DRIVE +13 dBm (nominal)

- HIGH ISOLATION: 35 dB (TYP.)[2]

Guaranteed Specifications [1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and		7.5 dB	f_L & f_R 0.2 – 50 MHz f_I 0.05 to 50 MHz
SSB Noise Figure		9.0 dB	f_L & f_R 0.05 - 200 MHz f_I 0.05 to 200 MHz
Isolation			
f_L at R	45 dB		1 – 30 MHz
f_L at I	40 dB		1 – 30 MHz
f_L at R	30 dB		30 – 200 MHz
f_L at I	25 dB		30 – 200 MHz
Conversion Compression		1.0 dB	f_R = +10 dBm f_L = +17 dBm
Desensitization Level		1.0 dB	f_{R2} = +17 dBm f_L = +17 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

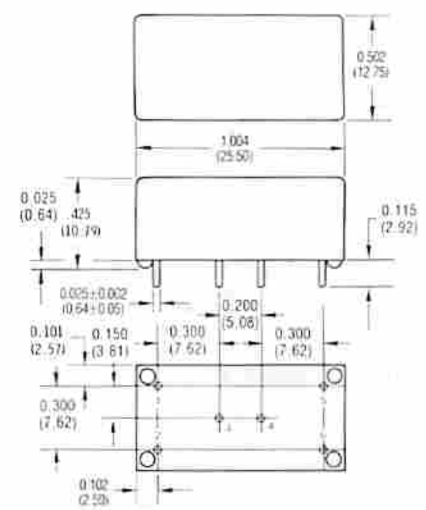
Operating Temperature* . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +17 dBm
Peak Input Current at 25°C . . . . 50 mA DC

*For input signals below 100 kHz, the temperature range is -20°C to +100°C.

Weight 4 grams (0.14 oz.) max.

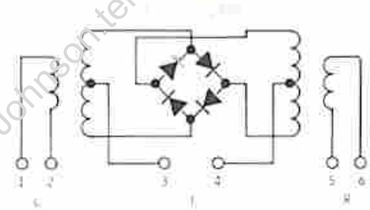
Outline Drawing

M9A



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .010 (.25) UNLESS OTHERWISE SPECIFIED

Schematic Diagram



FOR BEST ISOLATION OF THE HIGH-LEVEL f_L SIGNAL, GROUND PIN 3.

WJ-M9AC

DOUBLE-BALANCED MIXER

LO } 0.5 TO 200 MHz
RF }
IF DC TO 200 MHz
LO DRIVE +13 dBm (nominal)

- HIGH ISOLATION: 35 dB (TYP.)[2]
- QPL VERSION AVAILABLE! (See Section 7)

Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.5 dB	f_L & f_R 0.2 – 50 MHz; f_I 0.05 – 50 MHz
		9.0 dB	f_L & f_R 0.05 - 200 MHz; f_I 0.05 – 200 MHz
Isolation			
f_L at R	45 dB		f_L 0.05 – 30 MHz
f_L at I	40 dB		
f_L at R	25 dB		f_L 30 – 200 MHz
f_L at I	25 dB		
Conversion Compression		1.0 dB	f_R = +10 dBm; f_L = +17 dBm
Desensitization Level		1.0 dB	f_{R2} = +17 dBm; f_L = +17 dBm

Notes:
1. Measure in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

Operating Temperature* . . . . . -54°C to +100°C
Storage Temperature . . . . . -65°C to +100°C
Peak Input Power . . . . . +20 dBm
Peak Input Current at 25°C. . . . . 50 mA DC

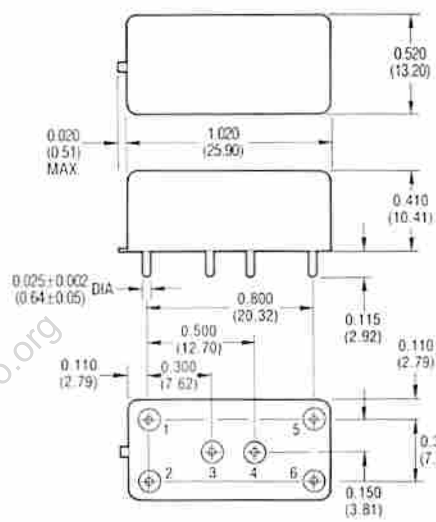
*For input signals below 100 kHz, the temperature range is -20°C to +100°C.

Weight

8 grams (0.28 oz.) max.

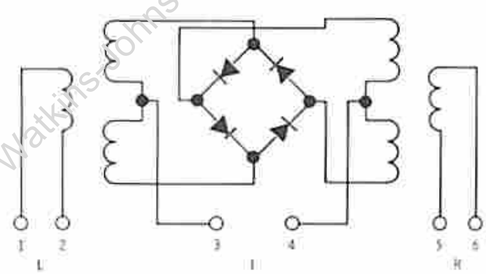
Outline Drawing

M9AC



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.010 (.25) UNLESS OTHERWISE SPECIFIED

Schematic Diagram



6

WJ-M9B

DOUBLE-BALANCED MIXER

LO } 0.5 TO 500 MHz
RF }
IF DC TO 500 MHz
LO DRIVE +17 dBm (nominal)

- SUPERIOR TWO-TONE PERFORMANCE
- EXCELLENT INTERMODULATION PERFORMANCE
- HIGH INTERCEPT PT: +25 dBm (TYP.)[2]
- HIGH ISOLATION: 40 dB (TYP.)[2]

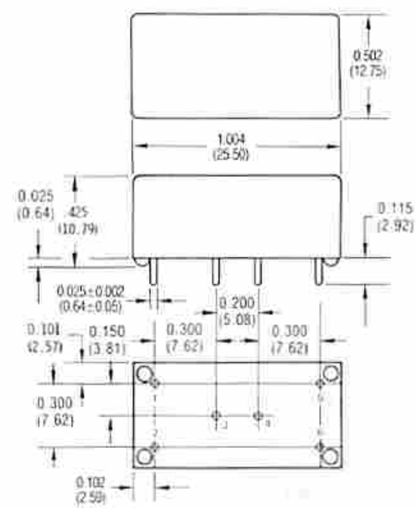
Guaranteed Specifications [1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.0 dB	f_L & f_R 0.5 to 30 MHz f_I 0.4 to 30 MHz
		7.5 dB	f_L & f_R 30 to 100 MHz f_I 0.4 to 100 MHz
		9.0 dB	f_L & f_R 100 to 500 MHz f_I 0.4 to 500 MHz
Isolation f_L at R f_L at I	55 dB 45 dB		f_L 0.5 to 30 MHz
f_L at R f_L at I	45 dB 35 dB		f_L 30 to 100 MHz
f_L at R f_L at I	35 dB 25 dB		f_L 100 to 500 MHz
f_L at I	20 dB		f_R 0.5 to 500 MHz
Conversion Compression		1.0 dB	f_R = +8 dBm f_L = +17 dBm
Densensitization Level		1.0 dB	f_{R2} = +17 dBm f_L = +17 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

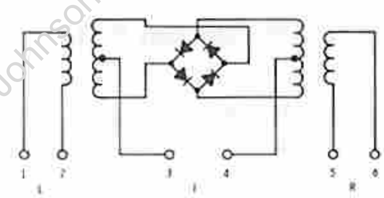
Outline Drawing

M9B



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

Schematic Diagram



FOR BEST ISOLATION OF THE HIGH-LEVEL (f_L) SIGNAL, GROUND PIN 3.

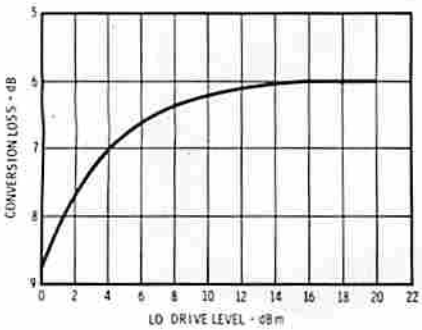
Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +23 dBm
Peak Input Current at 25°C . . . . 100 mA DC

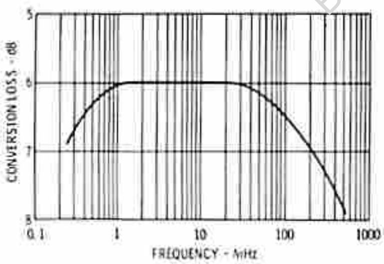
Weight 4 grams (0.14 oz.) max.

Typical Performance at 25°C

Conversion Loss

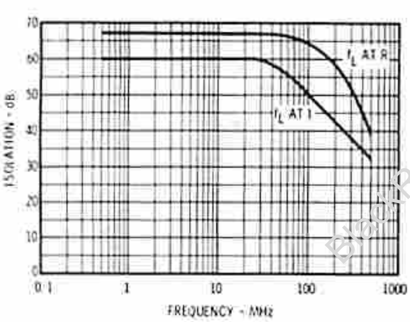


Conversion Loss vs. LO Drive Level: The minimum recommended drive level is +10 dBm. The maximum recommended drivel level is +20 dBm.



Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the inputs f_L and f_R with f_I any frequency less than 500 MHz for conversion loss measurements. Data plotted with an f_L level of +17 dBm.

Isolation



Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

Typical Intermodulation Performance at 25°C

Harmonic Intermodulation Products

SINGLE-TONE INTERMODULATION DISTORTION

HARMONICS OF f_R	0	1	2	3	4	5	6	7	8
7 (f_R @ 0 dBm)	>99	79	>99	78	>99	78	>99	81	>99
7 (f_R @ −10 dBm)	>90	>90	>90	>90	>90	>90	>90	>90	>90
6 (f_R @ 0 dBm)	>99	>99	>99	>99	>99	>99	>99	>99	>99
6 (f_R @ −10 dBm)	>90	>90	>90	>90	>90	>90	>90	>90	>90
5 (f_R @ 0 dBm)	93	73	87	[illegible]	88	66	85	64	82
5 (f_R @ −10 dBm)	>90	>90	>90	>90	>90	>90	>90	>90	>90
4 (f_R @ 0 dBm)	96	80	[illegible]	80	95	82	98	78	90
4 (f_R @ −10 dBm)	>90	>90	>90	>90	>90	>90	>90	>90	>90
3 (f_R @ 0 dBm)	63	58	65	60	65	55	64	54	66
3 (f_R @ −10 dBm)	87	77	87	78	>90	75	85	77	88
2 (f_R @ 0 dBm)	[illegible]	67	76	67	80	66	82	66	83
2 (f_R @ −10 dBm)	86	75	84	75	86	74	87	74	84
1 (f_R @ 0 dBm)	25	0	39	11	50	16	59	19	59
1 (f_R @ −10 dBm)	23	0	39	11	46	14	62	19	53
0 (f_R @ 0 dBm)		39	42	46	58	37	65	49	75
0 (f_R @ −10 dBm)		27	31	36	47	36	51	37	63

HARMONICS of f_L

0.5 - 500 MHz
CLASS II MIXER
(TYPE 2)

f_R @ 0 dBm
f_R @ −10 dBm
f_R = 49 MHz
f_L = 50 MHz
LO = +17 dBm

SINGLE-TONE INTERMODULATION DISTORTION

HARMONICS OF f_R	0	1	2	3	4	5	6	7	8
5 (LO = +20 dBm)	>90	>90	>90	>90	>90	>90	>90	>90	>90
5 (LO = +17 dBm)	>90	>90	>90	>90	>90	>90	>90	>90	>90
4 (LO = +20 dBm)	>90	>90	>90	>90	>90	>90	>90	>90	>90
4 (LO = +17 dBm)	>90	>90	>90	>90	>90	>90	>90	>90	>90
3 (LO = +20 dBm)	>90	85	>90	73	>90	80	>90	77	>90
3 (LO = +17 dBm)	90	77	89	68	90	79	90	73	88
2 (LO = +20 dBm)	81	85	85	82	86	80	85	75	90
2 (LO = +17 dBm)	74	81	82	78	85	80	87	75	90
1 (LO = +20 dBm)	28	0	45	10	52	13	56	18	57
1 (LO = +17 dBm)	29	0	44	10	52	14	57	19	60
0 (LO = +20 dBm)		23	23	38	38	40	47	38	50
0 (LO = +17 dBm)		26	28	38	43	40	50	[illegible]	55

HARMONICS of f_L

0.5 - 500 MHz
CLASS II MIXER
(TYPE 2)

f_R = 49 MHz @ −10 dBm FOR ALL CONDITIONS
f_L = 50 MHz
LO = +20 dBm
LO = +17 dBm

Intermodulation Signal Levels: Intermodulation signals resulting from the mixing of harmonics of the input signals are shown in the tables below. Mixing products are indicated by the number of dB below the $f_L \pm f_R$ output. The typical performance in Table I was obtained with f_L and f_R at approximately 50 MHz, f_L at +17 dBm, f_R at 0 dBm, and all resistive terminations. The typical performance in Table II was obtained under the same conditions as Table I but with f_R at −10 dBm. As a "rule-of-thumb" a decrease of 1 dB in the f_R level with result in an extra 1 dB of suppression for 2 f_R products; an extra 2 dB of suppression for 3 f_R products; an extra 3 dB of suppression for 4 f_R products, etc. Improved performance can also be achieved at lower frequencies.

Operation with the minimum recommended f_L level of +10 dBm will reduce the level of the intermods in the lower three rows of the intermod chart. A maximum f_L level of +20 dBm is recommended to achieve the best performance on intermods in the rows above the third in the intermod chart.

WJ-M9BC

DOUBLE-BALANCED MIXER

LO / RF } 0.5 TO 500 MHz
IF DC TO 500 MHz
LO DRIVE +17 dBm (nominal)

- SUPERIOR TWO-TONE PERFORMANCE
- EXCELLENT INTERMODULATION PERFORMANCE
- HIGH INTERCEPT PT: +25 dBm (TYP.)[2]
- HIGH ISOLATION: 40 dB (TYP.)[2]
- QPL VERSION AVAILABLE! (See Section 7)

Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.0 dB	f_L & f_R 0.5 to 30 MHz; f_I 0.4 to 30 MHz
		7.5 dB	f_L & f_R 30 to 100 MHz; f_I 0.4 to 100 MHz
		9.0 dB	f_L & f_R 100 to 500 MHz; f_I 0.4 to 500 MHz
Isolation: f_L at R	55 dB		f_L 0.5 to 30 MHz
f_L at I	45 dB		
f_L at R	45 dB		f_L 30 to 100 MHz
f_L at I	35 dB		
f_L at R	35 dB		f_L 100 to 500 MHz
f_L at I	25 dB		
f_L at I	20 dB		f_R 0.5 to 500 MHz
Conversion Compression		1.0 dB	f_R = +8 dBm; f_L = +17 dBm
Densensitization Level		1.0 dB	f_{R2} = +17 dBm; f_L = +17 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications. I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

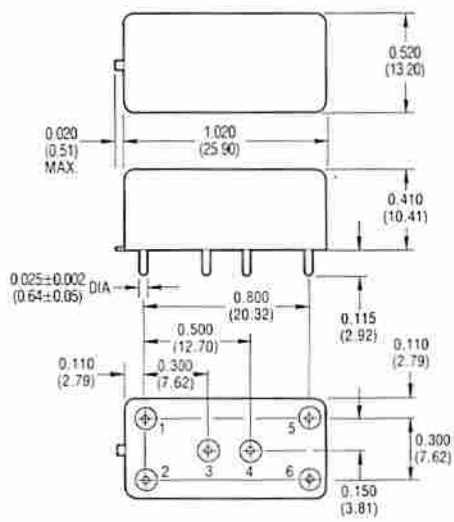
Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +23 dBm
Peak Input Current at 25°C . . . . 100 mA DC

Weight 8 grams (0.28 oz.) max.

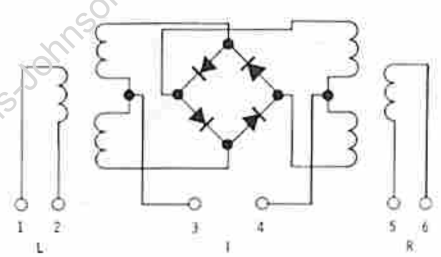
Outline Drawing

M9BC



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

Schematic Diagram



FOR BEST ISOLATION OF THE HIGH-LEVEL (f_L) SIGNAL, GROUND PIN 3.

WJ-M9C

DOUBLE-BALANCED MIXER

LO } 0.4 TO 500 MHz
RF }
IF DC TO 500 MHz
LO DRIVE +13 dBm (nominal)

- HIGH ISOLATION: 35 dB (TYP.)[2]
- QPL VERSION AVAILABLE! (See Section 7)

Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.5 dB	f_L & f_R 10 to 50 MHz f_I 1 to 50 MHz
		9.0 dB	f_L & f_R 0.4 to 500 MHz f_I 0.4 to 500 MHz
Isolation			
f_L at R	45 dB		0.4 – 50 MHz
f_L at I	40 dB		0.4 – 50 MHz
f_L at R	25 dB		50 – 500 MHz
f_L at I	25 dB		50 – 500 MHz
Conversion Compression		1.0 dB	f_R = +10 dBm f_L = +17 dBm
Desensitization Level		1.0 dB	f_{R2} = +17 dBm f_L +17 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

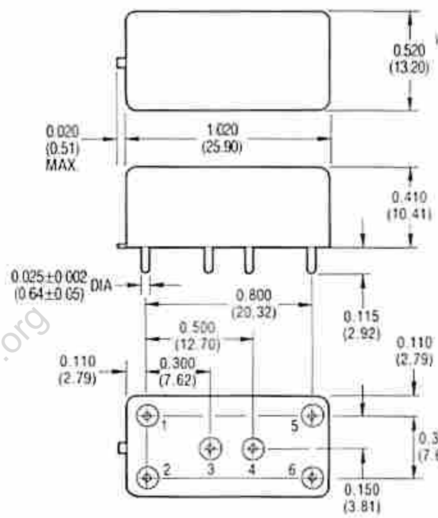
Operating Temperature. . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +23 dBm
Peak Input Current at 25°C. . . . . 100 mA DC

Weight

8 grams (0.28 oz.) max.

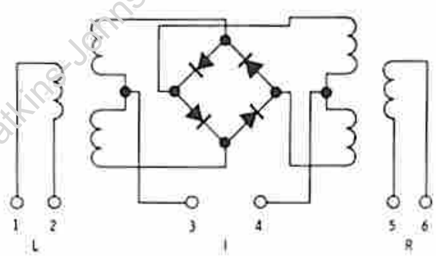
Outline Drawing

M9C



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .010 (.25) UNLESS OTHERWISE SPECIFIED

Schematic Diagram

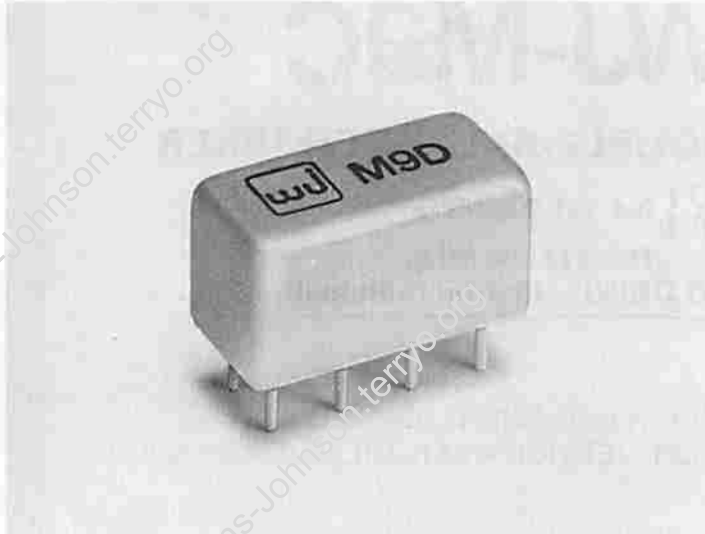


FOR BEST ISOLATION OF THE HIGH-LEVEL (f_L) SIGNAL, GROUND PIN 3.

WJ-M9D

DOUBLE-BALANCED MIXER

LO 2 TO 500 MHz
RF 2 TO 400 MHz
IF DC TO 800 MHz
LO DRIVE +20 dBm (nominal)



- HIGH INTERCEPT POINT: +30 dBm (TYP.)
- LOW NOISE FIGURE: 6 dB (TYP.)
- QPL VERSION AVAILABLE! (See Section 7)

Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		6.5 dB	f_L 5 to 200 MHz, f_R 20 to 80 MHz, f_I 5 to 80 MHz
		7.0 dB	f_I 0.4 to 120 MHz
		7.0 dB	f_L & f_R 5 to 300 MHz, f_I 5 to 80 MHz
		8.0 dB	f_I 0.4 to 300 MHz
		7.5 dB	f_L 5 to 470 MHz, f_R 5 to 400 MHz, f_I 5 to 80 MHz
		9.0 dB	f_L 2 to 500 MHz, f_R 2 to 400 MHz, f_I 0.4 to 800 MHz
Isolation f_L at R	40 dB		f_L 2 to 32 MHz
f_L at I	40 dB		
f_L at R	35 dB		f_L 32 to 100 MHz
f_L at I	35 dB		
f_L at R	25 dB		f_L 100 to 500 MHz
f_L at I	25 dB		
f_R at I	17 dB		f_R 2 to 400 MHz
Conversion Compression		1 dB	f_R at +15 dBm, f_L at +23 dBm
Desensitization		1 dB	f_{R2} at +13 dBm, f_L at +23 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

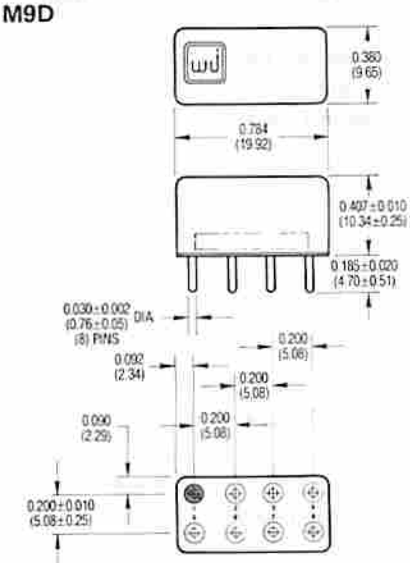
Absolute Maximum Ratings

Operating Temperature
- without specification of degradation . . . . . -54°C to +85°C
- with 0.5 dB noise figure degradation . . . . . -54°C to +100°C

Storage Temperature . . . . . -65°C to +100°C
Peak Input Power for any Single Port . . . . . +23 dBm RMS, +26 dBm Peak
Total Input Power for all Ports . . . . . +24 dBm RMS, +27 dBm Peak
Peak Input Current at 25°C . . . . . 100 mA DC

Outline Drawing

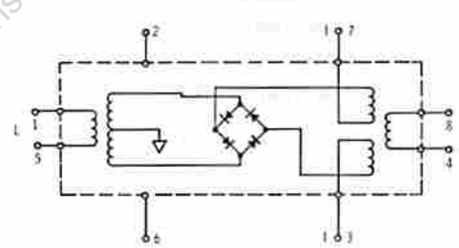
M9D



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

PIN NUMBERS ARE SHOWN FOR REFERENCE ONLY.

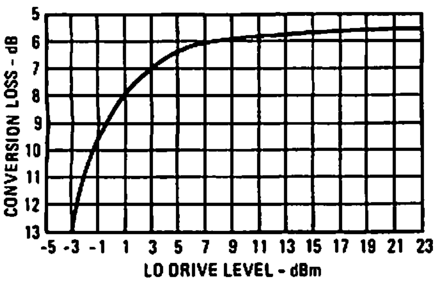
Schematic Diagram



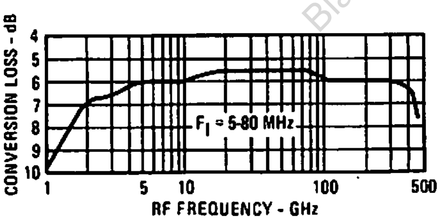
Weight 6 grams (0.21 oz.) max.

Typical Performance at 25°C

Conversion Loss

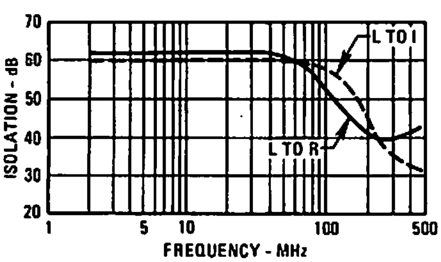


Conversion Loss vs. LO Drive Level: The minimum recommended drive level is +10 dBm. The maximum recommended drive level is +23 dBm.



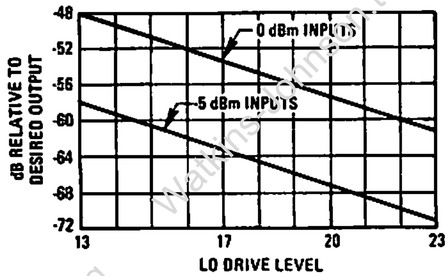
Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R) with f_I any frequency 5 – 80 MHz. Data plotted with an f_L level of +20 dBm.

Isolation

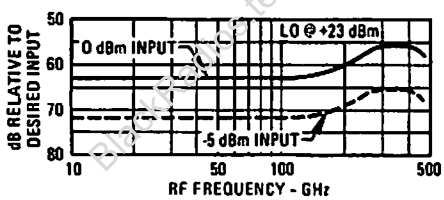


Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

Two-Tone Intermodulation

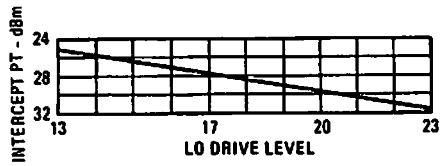


Two-Tone Suppression vs. Drive Level: The WJ-M9D is designed for superior two-tone performance with a low LO drive level. With only +20 dBm LO drive level, the third-order products will be reduced 68 dB with both input signals at -5 dBm.

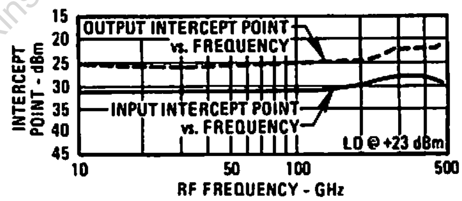


Two-Tone Suppression vs. Input Frequency: With each dB decrease in input level the third-order product is decreased an additional 2 dB. As shown, the WJ-M9D will reduce third-order products 62.5 dB with both input signals at 0 dB and 72 dB with both input signals at -5 dBm.

Third-Order Intercept Point



Input Intercept Point vs. Drive Level: With only +20 dBm LO drive level, this mixer has a +30 dBm input third-order intercept point.



Intercept Point vs. Frequency: The input intercept point of the WJ-M9D is +30 dBm. This is 15 dB higher than the intercept point for a low level double-balanced mixer. The output intercept point is equal to the input intercept point minus the conversion loss.

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WJ-M9E

DOUBLE-BALANCED MIXER

LO, RF } 1 TO 400 MHz
IF DC TO 400 MHz
LO DRIVE +27 dBm (nominal)

- HIGH-INTERCEPT POINT: 32.5 dBm (TYP.)[2]
- LOW NOISE FIGURE: 6 dB (TYP.)[2]

Guaranteed Specifications[1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		6.0 dB	f_L & f_R 2 to 50 MHz, f_I 2 to 100 MHz
		7.5 dB	f_L & f_R 1 to 100 MHz, f_I 0.4 to 400 MHz
		9.0 dB	f_L & f_R 1 to 400 MHz, f_I 0.4 to 200 MHz
Isolation			
f_L at R	45 dB		f_L 1 to 30 MHz
f_L at I	45 dB		
f_L at R	35 dB		f_L 30 to 100 MHz
f_L at I	40 dB		
f_L at R	25 dB		f_L 100 to 400 MHz
f_L at I	25 dB		
f_L at I	25 dB		f_R 1 to 400 MHz
Conversion Compression		1.0 dB	f_R Level = +20 dBm
Densensitization Level		1.0 dB	f_{R2} Level +18 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

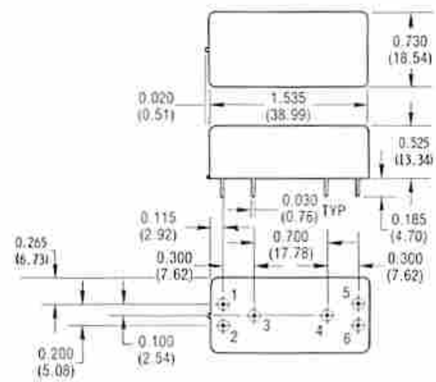
Absolute Maximum Ratings

Operating Temperature
With +27 dBm LO Power. . . . . -54°C to +71°C
With +24 dBm LO Power. . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to 100°C
Peak Input Power for any Single Port . . . . +30 dBm RMS, +33 dBm Peak
Total Input Power for All Ports . . . . +31.5 dBm RMS, +34.5 dBm Peak
Peak Input Current at 25°C. . . . . 200 mA DC

The power rating is applicable over a -54°C to +71°C, temperature range. Derate linearly to one-half power at 100°C.

Outline Drawing

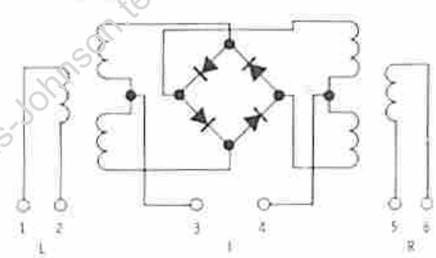
M9E



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .010 (.25) UNLESS OTHERWISE SPECIFIED

Weight 21 grams (0.74 oz.) max.

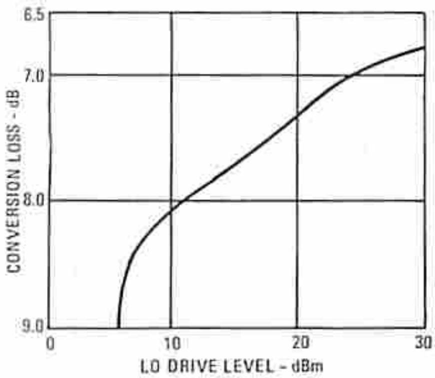
Schematic Diagram



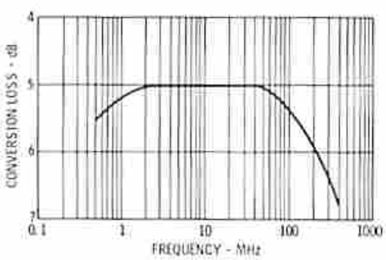
FOR BEST ISOLATION OF THE HIGH-LEVEL (f_L) SIGNAL, GROUND PIN 3.

Typical Performance at 25°C

Conversion Loss



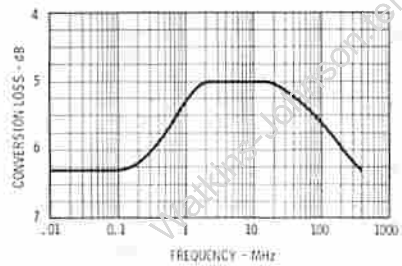
Conversion Loss vs. LO Drive Level: The minimum recommended drive level is +20 dBm. The maximum recommended drive level is +30 dBm.



Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the inputs f_L and f_R with f_I at 20 MHz for conversion loss measurements. Data plotted with an f_L level of +27 dBm.

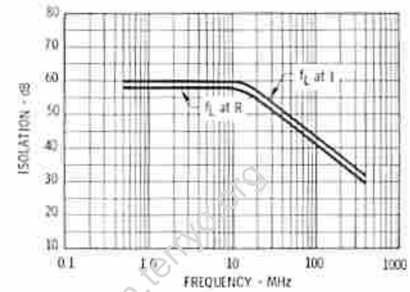
A 1 dB improvement in conversion loss can be made at 400 MHz by reversing the I- and R-ports i.e., by feeding the input signal into the I-port and taking the output from the R-port. At lower frequencies this performance improvement is not as significant. At 100 MHz, there is a 0.2 dB improvement while at 50 MHz and below there is no improvement.

Conversion Loss



Conversion Loss vs. Output Frequency: The frequency ordinate refers to the output f_I with f_R at 50 MHz. Data plotted with an f_L level of +27 dBm.

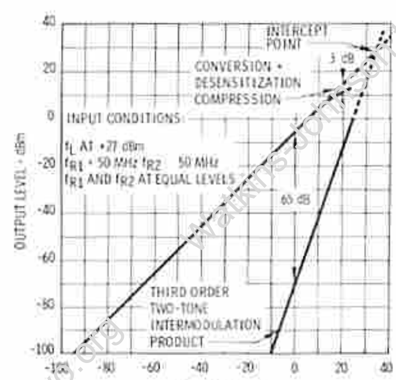
Isolation



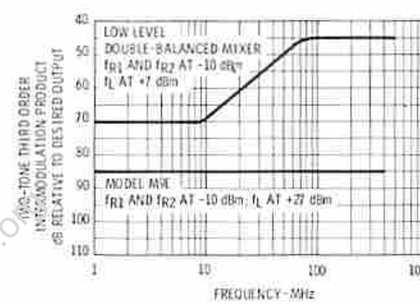
Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port. Maximum isolation can be obtained between the input signals by feeding the input signal (f_R) into the I-port with some sacrifice in two-tone performance.

Typical Two-Tone Performance at 25°C

Definition: In a mixer application where the input must be wideband, two signals (f_{R1} and f_{R2}) may mix with the local oscillator signal (f_L) to produce in-band, two-tone third-order intermodulation products $[2f_{R2} - f_{R1}) \pm f_L]$.

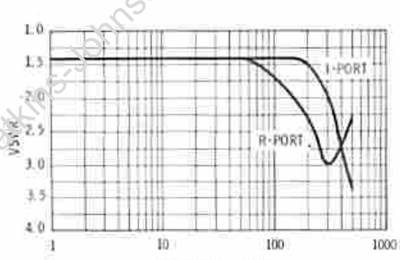


Two-Tone Supression vs. Input Level: With each dB decrease in input level, the third-order products 65 dB with both input signals at 0 dBm and 85 dB with both input signals at -10 dBm. The input intercept point for the WJ-M9E is at +32.5 dBm. This is 19 dB higher than the intercept point for a low-level double-balanced mixer like the WJ-M1. The 3 dB compression shown on the graph is a combination of both conversion compression and densensitization.



Two-Tone Suppression vs. Input Frequency: The two-tone performance of the WJ-M9E is constant across its frequency range. Other mixers, even other high level mixers, have a degradation in performance about 10 MHz.

VSWR



VSWR vs. Frequency: VSWR of the R- and I-ports in a 50-ohm system with f_L = 400 MHz at +27 dBm. Some variation in the I- and R-port VSWR will occur as a function of the L-port frequency. The L-port VSWR is typically less than 2.0 to 1 across its 1 to 400 MHz frequency band.

6

Typical Intermodulation Performance at 25°C

Intermodulation Signal Levels: Intermodulation signals resulting from the mixing of harmonics of the input signals are shown in the table below for the WJ-M9E. Mixing products are indicated by the number of dB below the $f_L \pm f_R$ output. The typical performance in the shaded portion of the table was obtained with f_L and f_R at approximately 50 MHz, f_L at +27 dBm, f_R at 0 dBm, and all resistive terminations. The typical performance in the other portion of the table was obtained under the same conditions as the shaded portion, but with f_R at -10 dBm. Note the improvement in suppression, especially with the higher order products of f_R, when the f_R level is reduced. Improved performance can also be achieved at lower frequencies.

For best suppression of f_R harmonics ≥2, an f_L level of +30 dBm is recommended. For best suppression of f_R harmonics <2, an f_L level less than +27 dBm but not less than +20 dB is recommended.

Harmonics of f_R									
7	>99 >90	>99 >90	>99 >90	>99 >90	>99 >90	>99 >90	>99 >90	>99 >90	>99 >90
6	>99 >90	>99 >90	>99 >90	97 >90	>99 >90	>99 >90	>99 >90	>99 >90	>99 >90
5	>99 >90	86 >90	>99 >90	95 >90	>99 >90	>99 >90	>99 >90	90 >90	>99 >90
4	88 >90	91 >90	>99 >90	92 >90	90 >90	95 >90	87 >90	94 >90	87 >90
3	81 >90	73 >90	85 >90	69 >90	85 >90	68 >90	85 >90	64 89	87 >90
2	64 73	71 83	62 75	70 79	63 80	70 80	61 77	62 82	64 79
1	24 24	0 0	35 34	11 11	42 42	19 18	50 49	39 37	49 49
0		29 18	20 10	32 23	24 14	29 19	27 17	30 21	29 19
	0	1	2	3	4	5	6	7	8

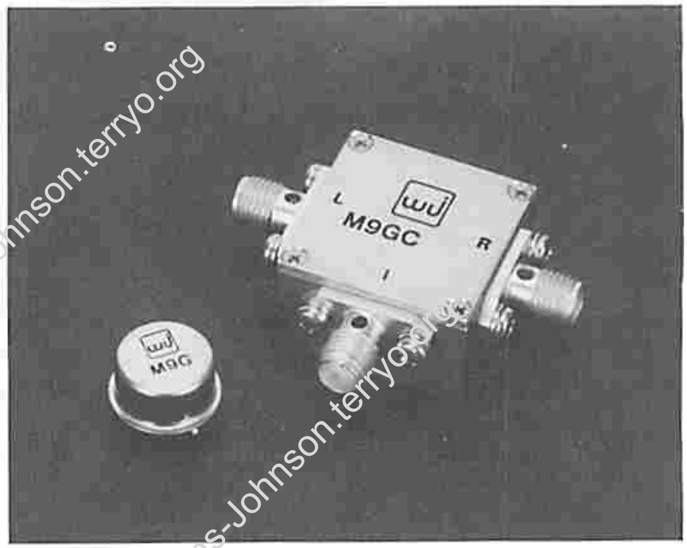
Harmonics of f_L

WJ-M9G/M9GC

DOUBLE BALANCED MIXER

LO 10 TO 1600 MHz
RF 10 TO 1500 MHz
IF DC TO 600 MHz
LO DRIVE +20 dBm (nominal)

- HIGH TYP. INTERCEPT POINT: +27 dBm (UPCONV.): +21 dBm (DOWNCONV.)
- MINIATURE PACKAGE: TO-8 (M9H), SMA CONNECTOR PACKAGE (M9GC)
- HERMETICALLY SEALED



Guaranteed Specifications [1]

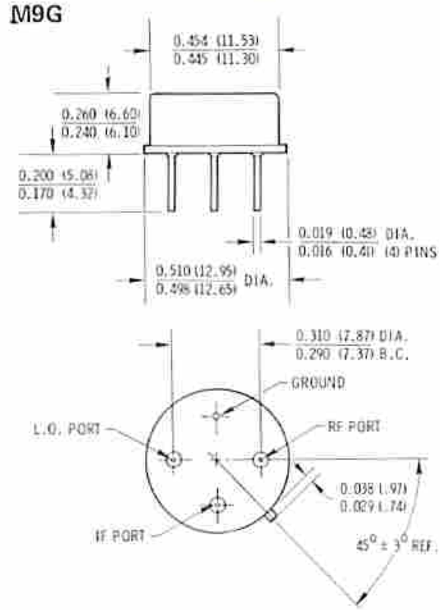
Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		8.0 dB	f_R 20 to 500 MHz f_L 10 to 700 MHz f_I 2 to 200 MHz
		8.5 dB	f_I DC to 600 MHz
		9.5 dB	f_R 10 to 1500 MHz f_L 10 to 1600 MHz f_I 2 to 200 MHz
		10.0 dB	f_I DC to 600 MHz
Isolation f_L at R f_L at I	30 dB 28 dB		f_L 10-500 MHz
f_L at R f_L at I	25 dB 16 dB		f_L 500-1000 MHz
f_L at R f_L at I	20 dB 13 dB		f_L 1000-1500 MHz
f_R at I	15 dB 9 dB		f_R 10-1000 MHz f_R 1000-1500 MHz
Conversion Compression		1.0 dB	f_R = +14 dBm f_L = +20 dBm f_R = +15 dBm f_L = +23 dBm
Densensitization		1.0 dB	f_{R2} = +13 dBm f_L = +23 dBm

Notes:

1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications. I-Port VSWR degrades from a 50-ohm system at low IF frequencies.

Outline Drawings

M9G

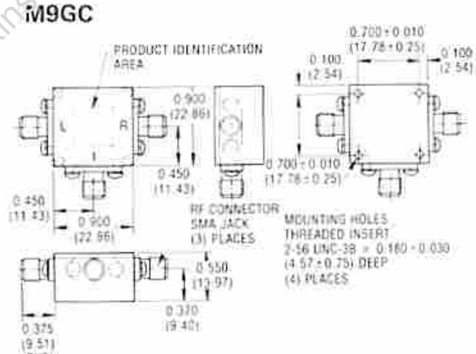


DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

Weight

M9G: 2 grams (0.07 oz.) max.
M9GC: 22 grams (0.78 oz.) max.

M9GC



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .010 (.25) UNLESS OTHERWISE SPECIFIED

Absolute Maximum Ratings

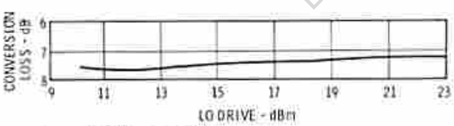
Operating Temperature

Without Specification Degradation . . . . -54°C to +85°C
With 0.5 dB Noise Figure Degradation. . . . . -54°C to +100°C

Storage Temperature . . . . -65°C to +100°C
Peak Input Power for any Single Port . . . . +23 dBm
Peak Input Power for all Ports . . . . +24 dBm

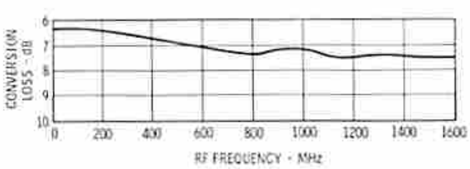
Typical Performance at 25°C

Conversion Loss vs. LO Drive

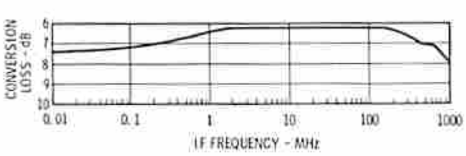


F_{RF} = 1000 MHz AT -10 dBm
F_{LO} = 1020 MHz

Conversion Loss vs. Frequency

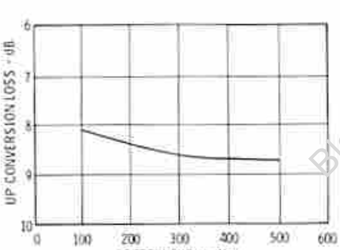


P_{RF} = -10 dBm
P_{LO} = +20 dBm
$F_{IF} = F_{LO} - F_{RF}$ = 20 MHz



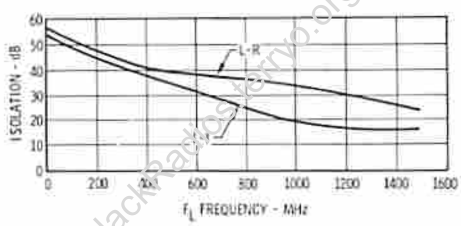
F_{RF} = 1000 MHz AT -10 dBm
P_{LO} = +20 dBm

Upconversion Loss vs. Frequency

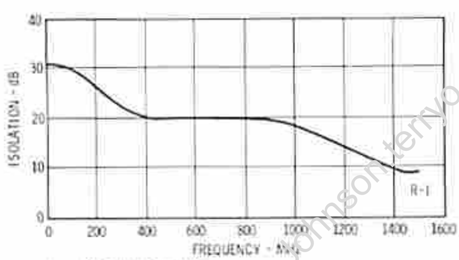


F_{LO} = 1000 MHz AT +20 dBm P_{IF} = -10 dBm

Isolation vs. Frequency

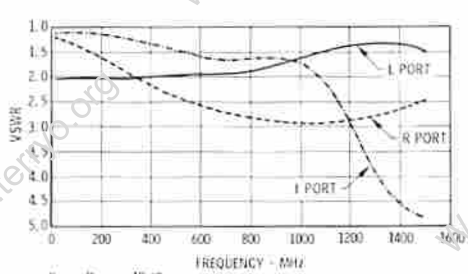


P_{LO} = +20 dBm



F_{LO} = 1000 MHz AT +20 dBm

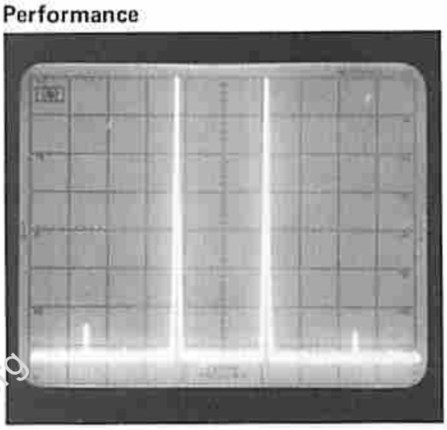
VSWR



$P_{RF} = P_{IF}$ = -10 dBm
P_{LO} = +20 dBm
F_{LO} = 1000 MHz

VSWR vs. Frequency: VSWR of the L-I- and R-ports in a 50-ohm system with f_L at +20 dBm. Some variation in the R-port VSWR will occur as a function of the L-port frequency. R-port VSWR is plotted for f_L at 1.0 GHz. Also shown are the L-port and f-port VSWR with f_L at 1.0 GHz.

Two-Tone Intermodulation Performance



f_{R1} = 430 MHz f_{R2} = 435 MHz
$P_{RF1} = P_{RF2}$ = -5 dBm
f_L = 486 MHz P_{LO} = +20 dBm
f_I = 56 MHz @ 10 dBm/div.

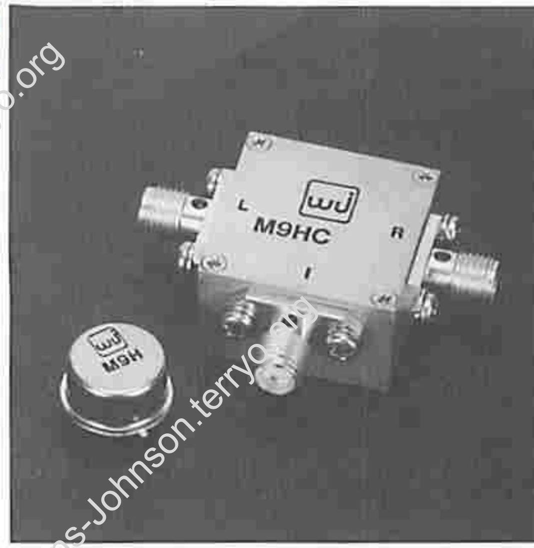
6

WJ-M9H/M9HC

DOUBLE-BALANCED MIXER

LO 10 TO 1600 MHz
RF 10 TO 1500 MHz
IF DC TO 600 MHz
LO DRIVE +20 dBm (nominal)

- HIGH TYP. INTERCEPT POINT: +30 dBm (UPCONV.): +24 dBm (DOWNCONV.)
- MINIATURE PACKAGE: TO-8 (M9H), SMA CONNECTOR PACKAGE (M9HC)
- HERMETICALLY SEALED



Guaranteed Specifications [1]

Characteristics	Min.	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		8.0 dB	f_R 20 to 400 MHz f_L 10 to 600 MHz f_I 2 to 200 MHz
		8.7 dB	f_I 1 to 600 MHz
		9.0 dB	f_R 10 to 1500 MHz f_L 10 to 1600 MHz f_I 2 to 200 MHz
		9.5 dB	f_I 1 to 600 MHz
Isolation f_L at R f_L at I	28 dB 28 dB		f_L 10-400 MHz
f_L at R f_L at I	23 dB 16 dB		f_L 400-1000 MHz
f_L at R f_L at I	20 dB 13 dB		f_L 1000-1500 MHz
f_R at I f_R at I	15 dB 8 dB		f_R 10-1000 MHz f_R 1000-1500 MHz
Conversion Compression		1.0 dB	f_R = +15 dBm f_L = +20 dBm f_R = +16 dBm f_L = +23 dBm
Densensitization		1.0 dB	f_{R2} = +14 dBm f_L = +23 dBm

Notes:

1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified. The I-Port frequency range extends to DC for phase detection pulse modulation, or attenuator applications. I-Port VSWR degrades from a 50-ohm system at low IF frequencies.

Absolute Maximum Ratings

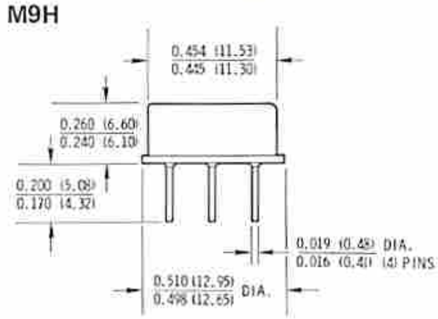
Operating Temperature

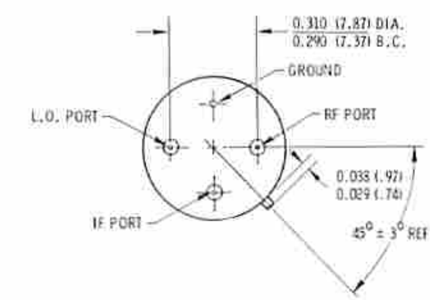
Without Specification Degradation . . . . -54°C to +85°C
With 0.5 dB Noise Figure Degradation . . . . -54°C to +100°C

Storage Temperature . . . . -65°C to +100°C
Peak Input Power for any Single Port . . . . +23 dBm
Peak Input Power for all Ports . . . . +24 dBm
Peak Input Current at 25°C . . . . 100 mA DC

Outline Drawings

M9H



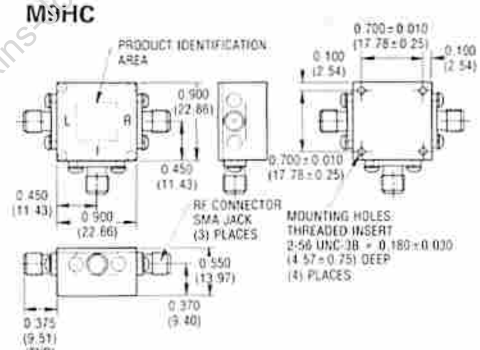


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

Weight

M9H: 2.0 grams (0.07 oz.) max.
M9HC: 20.14 grams (0.71 oz.) max.

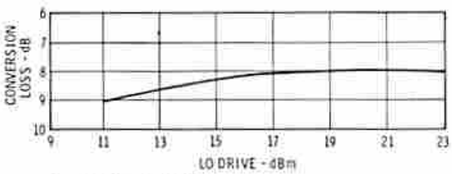
M9HC



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

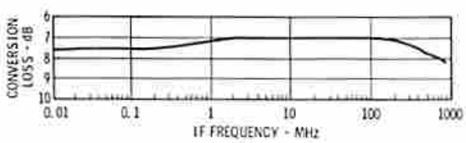
Typical Performance at 25°C

Conversion Loss vs. LO Drive

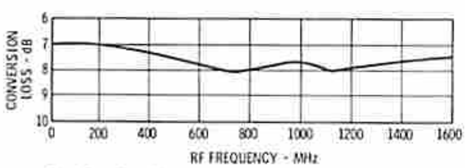


F_{RF} = 1000 MHz AT -10 dBm
F_{LO} = 1030 MHz

Conversion Loss vs. Frequency

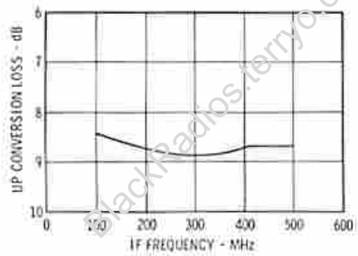


F_{RF} = 1000 MHz AT -10 dBm
P_{LO} = +20 dBm



$F_{IF} = F_{LO} - F_{RF}$ = 20 MHz
P_{RF} = -10 dBm
P_{LO} = +20 dBm

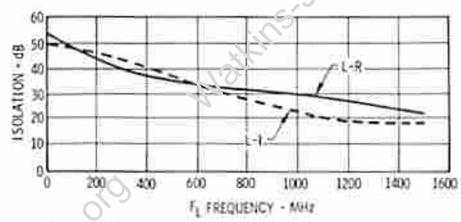
Upconversion Loss vs. Frequency



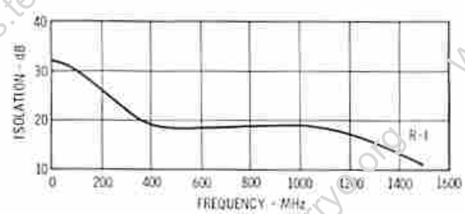
F_{LO} = 100 MHz AT +20 dBm $F_{RF} = F_{LO} + F_{IF}$
P_{LO} = -10 dBm

Conversion Loss in Upconversion Mode: The input signal is at the I-port and the output signal is at the R-port. LO port is equal to 1000 MHz at +20 dBm.

Isolation vs. Frequency

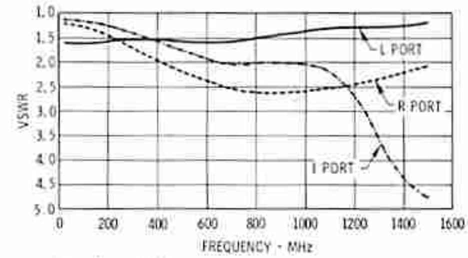


P_{LO} = +20 dBm



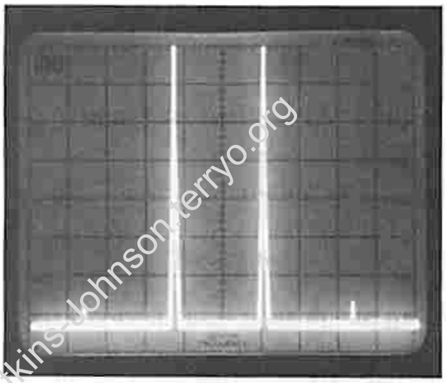
F_{LO} = 1000 MHz AT +20 dBm

VSWR



$P_{RF} = P_{IF}$ = -10 dBm
P_{LO} = +20 dBm
F_{LO} = 1000 MHz

Two-Tone Intermodulation Performance



f_{R1} = 430 MHz $f_{R}2$ = 425 MHz
$P_{RF1} = P_{RF2}$ = -5 dBm
f_L = 484 MHz P_{LO} = +20 dBm
f_I = 54 MHz @ 10 dBm/div.

Two-Tone Intermodulation Performance: The photo displays typical relative suppression of 3rd order two-tone measurement, with P_{RF1} equal to P_{RF2} at -5 dBm.

6

WJ-M12

DOUBLE-BALANCED MIXER

LO } 4 TO 8 GHz
RF }
IF 0.005 TO 3 GHz
LO DRIVE +13 dBm (nominal)

- LOW NOISE FIGURE: 6.0 dB (TYP.)
- FLAT IF RESPONSE: ± 0.5 dB (TYP.)

Guaranteed Specifications [1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		6.0 dB	8.0 dB	f_L & f_R 4 - 8 GHz f_I 5 MHz - 3 GHz
Isolation f_L at R f_L at I	 15 dB 18 dB	 25 dB 30 dB		 f_L 4 - 8 GHz f_L 4 - 8 GHz
Conversion Compression			1.0 dB	f_R at +8 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

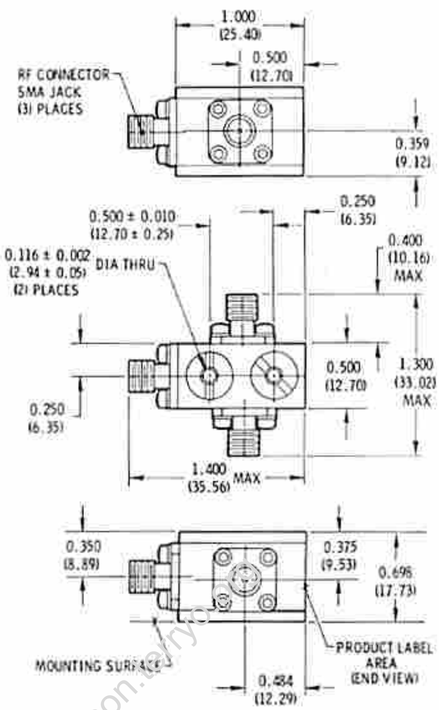
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +23 dBm max. at 25°C, +20 dBm max. at 100°C
Peak Input Current at 25°C . . . . 100 mA DC

Weight 42.5 grams (1.5 oz.) max.

Connectors SMA Female

Outline Drawing

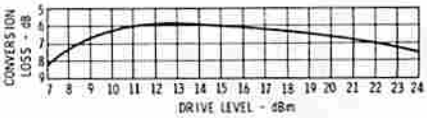
M12



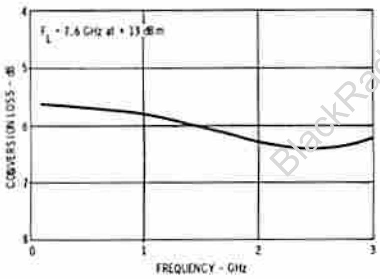
DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C

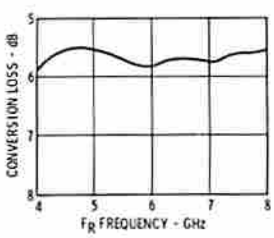
Conversion Loss



Conversion Loss vs. Drive Level: The minimum recommended drive level is +8 dBm. The maximum recommended drive level is +16 dBm.

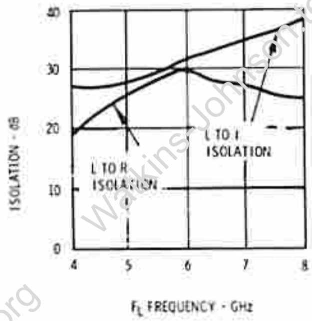


Conversion Loss vs. f_I Frequency (R- and I-Port Combined Frequency Responses). Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the I-port (f_I) with f_L at 7.6 GHz and f_R swept from 4.5 to 7.6 GHz.



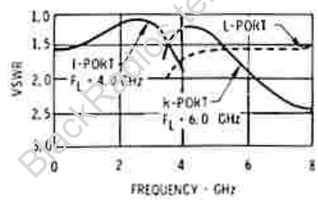
Conversion Loss vs. Input Frequency (R-Port Frequency Response). Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R) with f_I at 100 MHz and f_L greater than f_R. Data plotted with an f_L level of +13 dBm.

Isolation



Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

VSWR



VSWR vs. Frequency: VSWR of the L-, I- and R-ports in a 50-ohm system with f_L at +13 dBm. R-port VSWR is plotted from 3.5 to 8 GHz with f_L at 6.0 GHz. The R-port VSWR is practically independent of the L-port frequency. Also shown are the L-port VSWR and the I-port VSWR with f_L at 4.0 GHz.

Harmonic Intermodulation Products

HARMONICS OF f_R	1	2	3	4	5
3	X	65	65	65	56
2	35	62	52	X	X
1	0	27	X	X	X

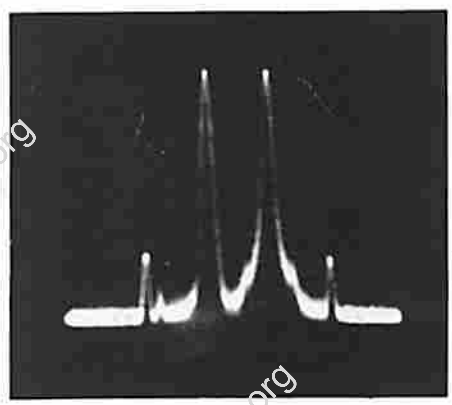
HARMONICS OF f_L

f_I = 1.8 GHz
f_L AND f_R BETWEEN 3.6 AND 7.2 GHz
f_L @ +13 dBm f_R @ -10 dBm

(ALL VALUES EXPRESSED AS dB BELOW DESIRED OUTPUT)

Harmonic Intermodulation Products: Intermodulation signals which result from the mixing of mixer generated harmonics of the input signals are shown. Mixing product suppression is indicated by the number of dB below the desired output level.

Typical Two-Tone Intermodulation



Typical Two-Tone Intermodulation Performance: f_I = 1.5 GHz, f_R = 6 GHz ± 1 MHz, f_R at -10 dBm. $f_L > f_R$ f_L = 7.5 GHz at +13 dBm. Vertical scale = 10 dB/cm.

6

WJ-M12A

DOUBLE-BALANCED MIXER

LO } RF } 4 TO 12 GHz
IF 0.05 TO 4 GHz
LO DRIVE +13 dBm (nominal)

- LOW NOISE FIGURE: 6.5 dB (TYP.)
- FLAT IF RESPONSE: ± 0.5 dB (TYP.)

Guaranteed Specifications [1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		6.5 dB	9.0 dB	f_L & f_R 4 - 12 GHz f_I 0.05 - 4 GHz
Isolation				
f_L at R	15 dB	25 dB		f_L 4 - 12 GHz
f_L at I	18 dB	30 dB		f_L 4 - 12 GHz
Conversion Compression			1.0 dB	f_R at +8 dBm

Notes:
1. Measure in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

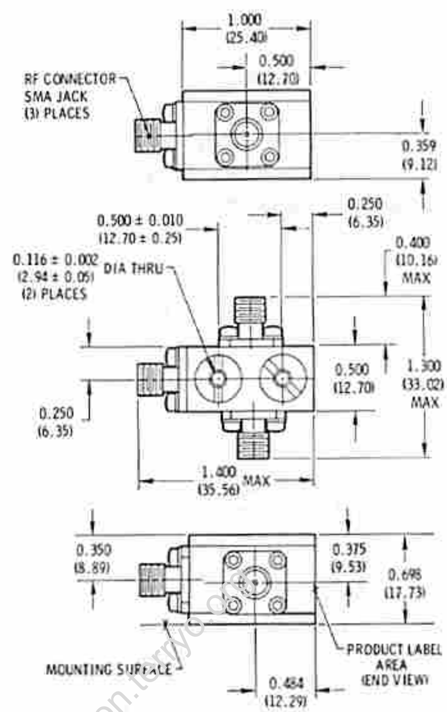
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +23 dBm max. at 25°C
Peak Input Current at 25°C . . . . 100 mA DC

Weight 42.5 grams (1.5 oz.) max.

Connectors SMA Female

Outline Drawing

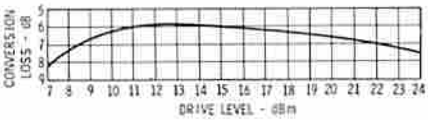
M12A



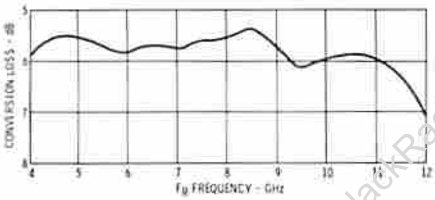
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C

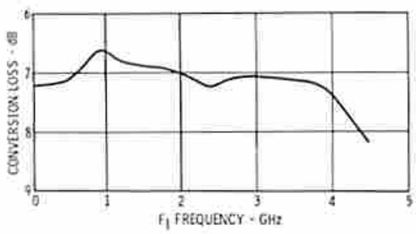
Conversion Loss



Conversion Loss vs. Drive Level: The minimum recommended drive level is +8 dBm. The maximum recommended drive level is +16 dBm.

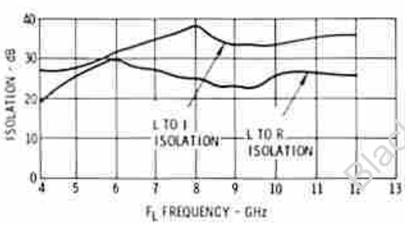


Conversion Loss vs. Input Frequency (R-Port Frequency Response). Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R) with f_I at 100 MHz and f_L greater than f_R. Data plotted with an f_L level of +13 dBm.



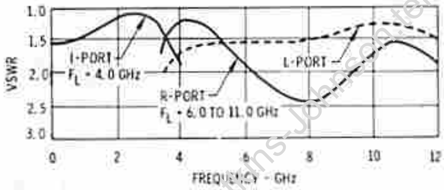
Conversion Loss vs f_I Frequency (I-Port Frequency Response). Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the I-port (f_I) with f_R at 12 GHz and f_L swept from 7.6 – 12 GHz.

Isolation



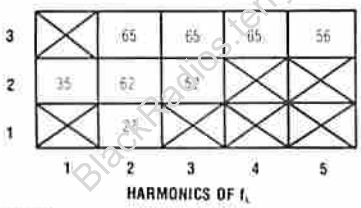
Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

VSWR



VSWR vs. Frequency: VSWR of the L-, I- and R-ports in a 50-ohm system with f_L at +13 dBm. R-port VSWR is plotted from 3.5 to 8 GHz with f_L at 6.0 GHz and from 8.0 to 14.0 GHz with f_L at 11 GHz. The R-port VSWR is practically independent of the L-port frequency. Also shown are the L-port VSWR and the I-port VSWR with f_L at 4.0 GHz

Harmonic Intermodulation Products



f_I = 1.8 GHz
f_L AND f_R BETWEEN 3.6 AND 7.2 GHz
f_L @ +13 dBm f_R @ -10 dBm
(ALL VALUES EXPRESSED AS dB BELOW DESIRED OUTPUT)

Harmonic Intermodulation Products: Intermodulation signals which result from the mixing of mixer generated harmonics of the input signals are shown. Mixing product suppresion is indicated by the number of dB below the desired output level.

Typical Conversion Loss of WJ-M12A Mixer

Final Test Report for WJ-M12A Mixer
Average Values of 83 Units
Conversion Loss (dB) (L.O. @ +13 dBm)

FRF (GHz)	FLO (GHz) 4.1	4.6	5.1	5.6	6.1	6.6	7.1	7.6	8.1
4.0	5.92	5.86	5.91	6.05	5.93	6.23	6.33		
4.5	5.48	5.54	5.44	5.64	5.74	5.83	6.12	6.18	
5.0	5.19	6.00	5.57	5.35	5.60	5.85	6.25	6.42	6.69
5.5	5.19	5.56	6.07	5.74	5.74	5.89	6.15	6.37	6.54
6.0	5.20	5.44	5.62	6.30	5.84	5.66	5.67	6.00	6.17
6.5	5.16	5.42	5.84	5.87	5.79	5.68	5.96	5.78	5.85
7.0	5.18	5.18	5.54	5.81	5.83	5.93	5.78	5.75	5.95
7.5		5.21	5.34	6.09	6.07	5.81	5.67	5.59	5.51
8.0			5.33	5.91	6.12	6.25	5.74	5.70	5.60
8.5				5.52	5.62	5.80	5.51	5.09	5.39
9.0				5.80	5.70	5.98	6.02	5.67	5.59
9.5				6.69	6.13	6.04	6.21	6.22	6.19
10.0				7.21	6.48	5.97	6.01	6.13	6.00
10.5					7.06	6.39	5.97	5.94	6.05
11.0						7.25	6.35	6.15	5.92
11.5							7.34	6.65	6.42
12.0								8.13	7.26

Typical Conversion Loss of WJ-M12A Mixer

Conversion Loss (dB) (L.O. @ +13 dBm)

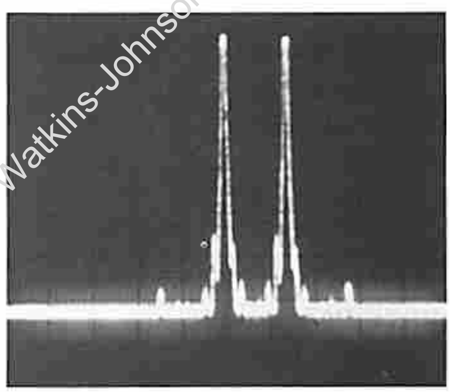
FRF (GHz)	FLO (GHz) 8.6	9.1	9.6	10.1	10.6	11.1	11.6	12.1
5.5	6.65	6.59	6.78	7.62				
6.0	6.43	6.35	6.20	6.30	7.27			
6.5	6.16	6.40	6.35	6.18	6.32	7.35		
7.0	5.87	6.24	6.30	6.20	6.13	6.24	7.52	
7.5	5.58	5.88	6.39	6.54	6.22	6.08	6.51	7.60
8.0	5.68	5.89	6.27	6.47	6.56	6.04	6.09	6.41
8.5	5.36	5.57	5.72	6.04	6.17	5.95	5.81	6.01
9.0	5.77	5.73	5.97	5.98	6.28	6.26	6.26	6.11
9.5	6.02	6.08	6.13	6.15	6.36	6.57	6.78	6.81
10.0	5.89	5.72	5.78	5.97	6.14	6.17	6.60	6.74
10.5	6.02	5.86	5.66	5.92	5.85	6.14	6.27	6.43
11.0	6.18	6.03	5.89	5.66	5.98	5.92	6.17	6.46
11.5	6.37	6.58	6.37	6.22	6.00	6.09	6.38	6.72
12.0	7.32	7.03	7.21	6.95	6.86	6.57	7.17	7.18

Final Test Report for WJ-M12A Mixer
Standard Deviation from the Average Values of 83 Units

FRF (GHz)	FLO (GHz) 4.1	4.6	5.1	5.6	6.1	6.6	7.1	7.6	8.1
4.0	.26	.30	.37	.47	.36	.34	.35		
4.5	.27	.25	.34	.37	.44	.34	.31	.29	
5.0	.28	.24	.23	.31	.35	.46	.34	.31	.30
5.5	.41	.35	.28	.31	.31	.33	.46	.34	.33
6.0	.34	.46	.39	.32	.22	.25	.27	.43	.33
6.5	.22	.35	.44	.36	.21	.18	.22	.23	.44
7.0	.23	.25	.36	.43	.31	.25	.24	.27	.28
7.5		.27	.26	.41	.45	.31	.29	.27	.31
8.0			.28	.30	.39	.45	.31	.32	.29
8.5				.24	.28	.36	.43	.33	.29
9.0				.38	.33	.36	.48	.48	.41
9.5				.44	.34	.29	.34	.43	.44
10.0				.61	.51	.33	.32	.36	.46
10.5					.68	.46	.32	.29	.37
11.0						.69	.42	.36	.34
11.5							.70	.46	.39
12.0								.69	.46

FRF (GHz)	8.6	9.1	9.6	10.1	10.6	11.1	11.6	12.1
5.5	.35	.36	.40	.62				
6.0	.32	.34	.37	.43	.73			
6.5	.32	.30	.33	.49	.47	.77		
7.0	.45	.36	.34	.38	.42	.51	.75	
7.5	.32	.49	.42	.42	.41	.45	.50	.76
8.0	.34	.35	.52	.38	.38	.44	.45	.52
8.5	.32	.34	.37	.52	.37	.45	.42	.42
9.0	.42	.39	.44	.47	.53	.46	.37	.43
9.5	.37	.38	.40	.46	.43	.60	.50	.38
10.0	.52	.38	.42	.51	.48	.50	.53	.46
10.5	.45	.48	.40	.48	.59	.42	.41	.48
11.0	.40	.50	.55	.45	.40	.42	.37	.46
11.5	.42	.49	.52	.53	.42	.46	.37	.42
12.0	.38	.42	.45	.49	.56	.50	.47	.46

Typical Two-Tone Intermodulation



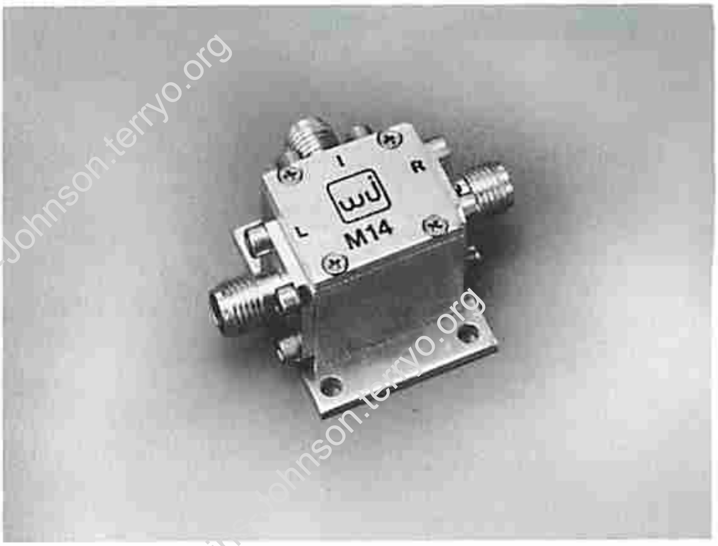
Typical Two-Tone Intermodulation Performance: f_I = 2 GHz, f_R = 8 GHz ± 1 MHz, f_R at −10 dBm. $f_L > f_R$, f_L = 10 GHz at +13 dBm. Vertical scale = 10 dB/cm.

WJ-M14

DOUBLE-BALANCED MIXER

LO 4 TO 9 GHz
RF 4 TO 8 GHz
IF DC to 2 GHz
LO DRIVE +7 dBm (nominal)

- HIGH ISOLATION: 35 dB (TYP.)
- LOW VSWR: < 2.0:1 (TYP.)
- LOW NOISE FIGURE: < 5.0 dB (TYP.)



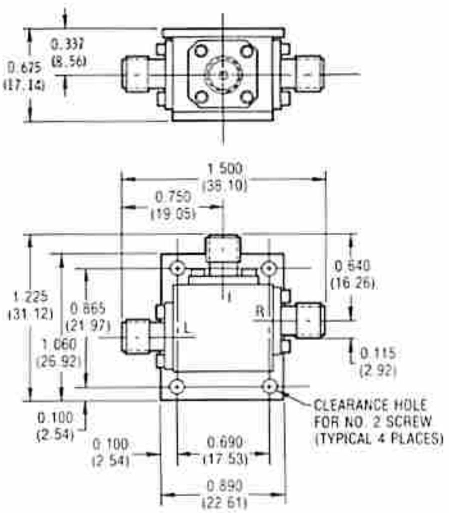
Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		5.0 dB	7.0 dB	f_R 5 to 7 GHz f_L 4 to 9 GHz f_I 0.05 to 2 GHz
		6.0 dB	8.0 dB	f_R 4 to 8 GHz f_L 4 to 9 GHz f_I 0.05 to 2 GHz
Isolation				
f_L at R	20 dB	30 dB		f_L 4 to 6 GHz
f_L at I	20 dB	30 dB		
f_L at R	20 dB	30 dB		f_L 6 to 9 GHz
f_L at I	25 dB	35 dB		
Conversion Compression			1.0 dB	f_R Level = +2 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Outline Drawings

M14



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

Absolute Maximum Ratings

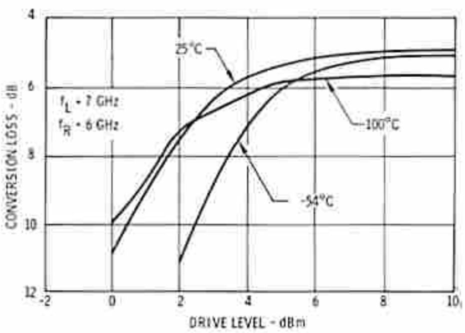
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +23 dBm max. at 25°C, +20 dBm max at 100°C
Peak Input Current at 25°C . . . . 100 mA DC

Weight 42.5 grams (1.5 oz.) max.

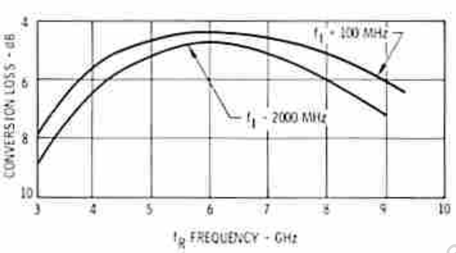
Connectors SMA Female

Typical Performance at 25°C

Conversion Loss

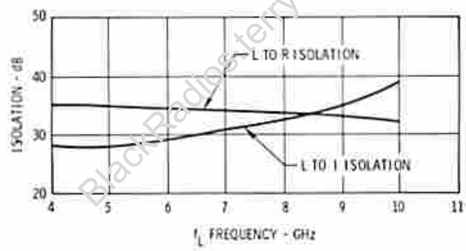


Conversion Loss vs. Drive Level: The minimum recommended drive level is +5 dBm. The maximum recommended drive level is +13 dBm.



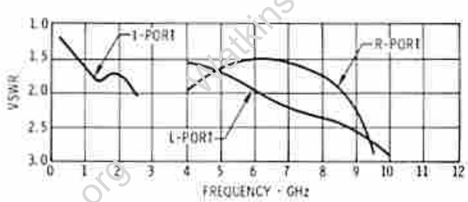
Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R). Data plotted with an f_L level of +7 dBm.

Isolation



Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

VSWR



VSWR vs. Frequency: VSWR of the L-, I- and R-ports in a 50-ohm system with f_L at +7 dBm. Only a small variation in the R-port VSWR will occur as a function of the L-port frequency.

Typical Harmonic IM Signals (dB Below Designed Output)

HARMONICS OF f_R \ HARMONICS OF f_L	0	1	2	3	4	5	6	7	8
7				52	70	>85	>85	>85	>85
6				85	85	85	>85	>85	>85
5			85	85	69	>85	>85	>85	>85
4			>85	67	>85	>85	>85	>85	
3	>50		>85	63	66	58	69	>85	
2	38	56	61	35	52	38			
1	20	0	40						
0									

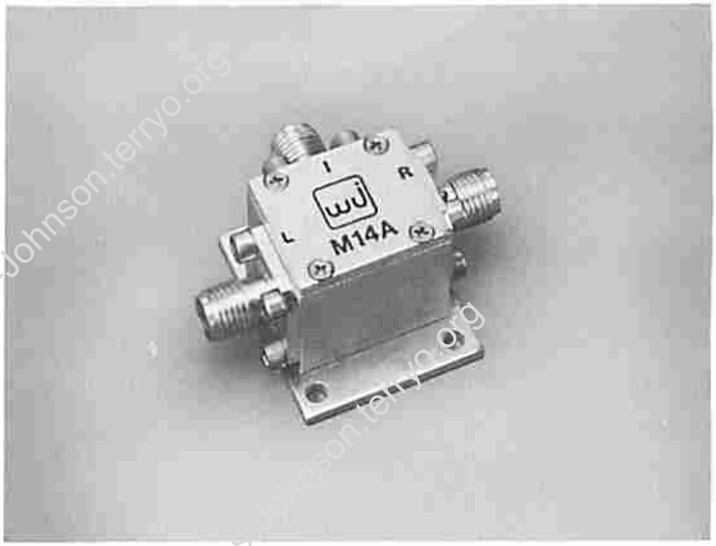
f_L = +7 dBm
f_R = −10 dBm

Harmonic Intermodulation Products: Intermodulation signals which result from the mixing of mixer generated harmonics of the input signals are shown. Mixing product suppresion is indicated by the number of dB below the desired output level.

WJ-M14A

DOUBLE-BALANCED MIXER

LO 4 TO 16 GHz
RF 6 TO 14 GHz
IF DC to 2 GHz
LO DRIVE +7 dBm (nominal)



- HIGH ISOLATION: 30 dB (TYP.)
- LOW VSWR: <2.0:1 (TYP.)
- LOW NOISE FIGURE: <6.0 dB (TYP.)

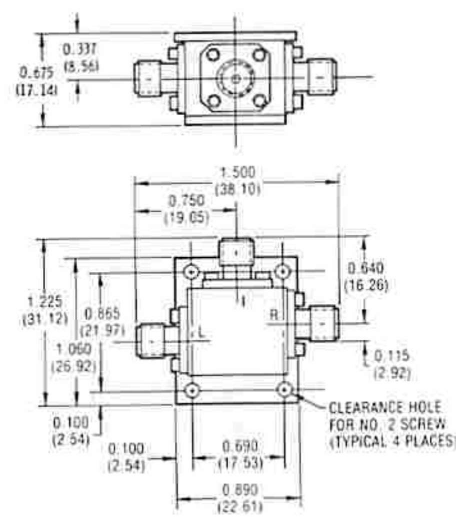
Guaranteed Specifications [1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		5.5 dB	8.0 dB	f_R 6 to 9 GHz f_L 5 to 10 GHz f_I 0.05 to 1 GHz
		7.5 dB	9.0 dB	f_R 6 to 14 GHz f_L 4 to 16 GHz f_I 0.05 to 2 GHz
Isolation				
f_R at R	20 dB	30 dB		f_L 4 to 6 GHz
f_L at I	12 dB	17 dB		
f_L at R	20 dB	30 dB		f_L 6 to 12 GHz
f_L at I	23 dB	35 dB		
f_L at R	15 dB	25 dB		f_L 12 to 16 GHz
f_L at I	28 dB	40 dB		
Conversion Compression			1.0 dB	f_R Level = +2 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications. I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Outline Drawing

M14A



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

Absolute Maximum Ratings

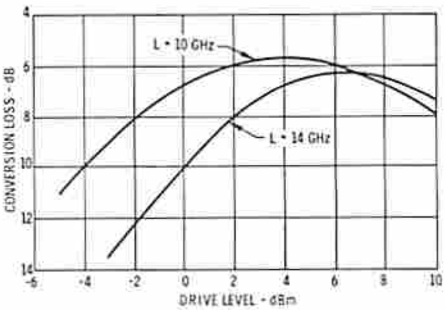
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +23 dBm at 25°C derate to +20 dBm at 100°C
Peak Input Current at 25°C . . . . 100 mA DC

Weight 42.5 grams (1.5 oz.) max.

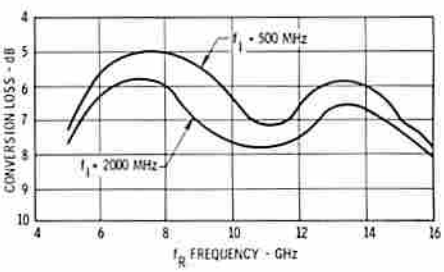
Connectors SMA Female

Typical Performance at 25°C

Conversion Loss

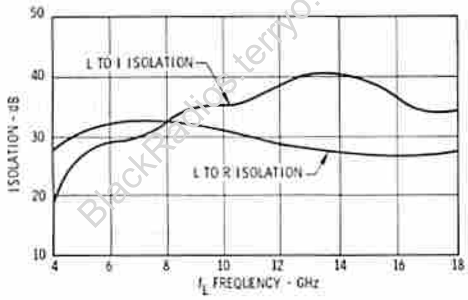


Conversion Loss vs. Drive Level: The minimum recommended drive level is +4 dBm. The maximum recommended drive level is +10 dBm.



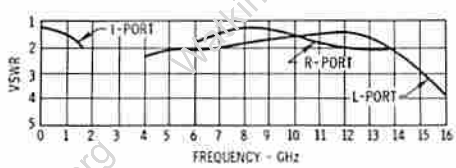
Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R). Data plotted with an f_L level of +7 dBm.

Isolation



Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

VSWR



VSWR vs. Frequency: VSWR of the L-, I- and R-ports in a 50-ohm system with f_L at +7 dBm. Only a small variation in the R-port VSWR will occur as a function of the L-port frequency.

Typical Harmonic IM Signals (dB Below Designed Output)

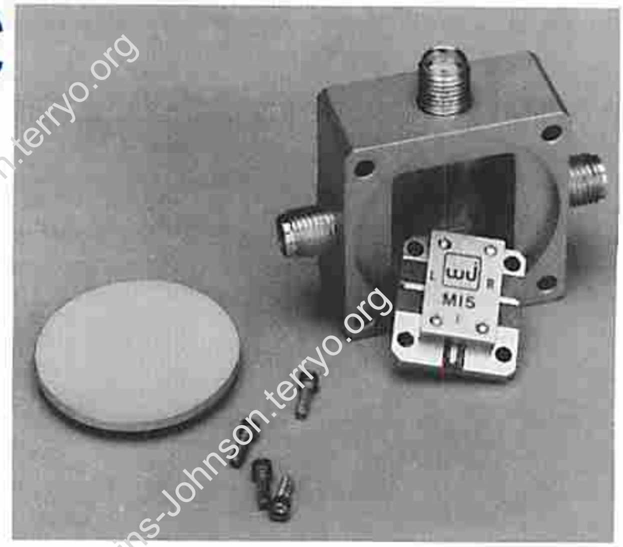
Harmonics of f_R \ Harmonics of f_L	0	1	2	3	4	5	6	7	8
7	X	X	X	80	69	74	>80	>80	>80
6	X	X	X	>80	>80	>80	>80	>80	79
5	X	X	>80	>80	45	>80	>80	>80	>80
4	X	X	>80	77	77	54	>80	53	>80
3	X	>80	>80	62	57	48	70	>80	>80
2	X	42	43	39	53	55	63	X	X
1	X	0	36	41	X	X	X	X	X
0	X	X	X	X	X	X	X	X	X

f_L = +7 dBm
f_R = −10 dBm

Harmonic Intermodulation Products: Intermodulation signals which result from the mixing of mixer generated harmonics of the input signals are shown. Mixing product suppresion is indicated by the number of dB below the desired output level.

6

WJ-M15/M15C



FLATPAC MIC DOUBLE-BALANCED MIXER

LO, RF } 2.0 TO 6.0 GHz
IF DC TO 1.5 GHz
LO DRIVE +7 dBm (nominal)

- DIRECTLY INTEGRABLE WITH MIC SUBASSEMBLIES
- LOW NOISE FIGURE/CONVERSION LOSS (TYP. 6.5 dB FOR 1 GHz IF)

Guaranteed Specifications [1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		 5.5 dB 6.5 dB 7.5 dB	 8.0 dB 9.0 dB 10.0 dB	f_L & f_R 2.5-5.0 GHz f_I 60 MHz to 500 MHz f_I 60 MHz to 1.0 GHz f_I 60 MHz to 1.5 GHz
		7.5 dB	10.0 dB	f_L & f_R 2.0-6.0 GHz f_L 60 MHz to 1.5 GHz
Isolation f_L at R f_L at I	 8 dB 10 dB	 15 dB 15 dB		 f_L 2.0-6.0 GHz f_L 2.0-6.0 GHz
Conversion Compression			1.0 dB	f_R Level = +2 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications. I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

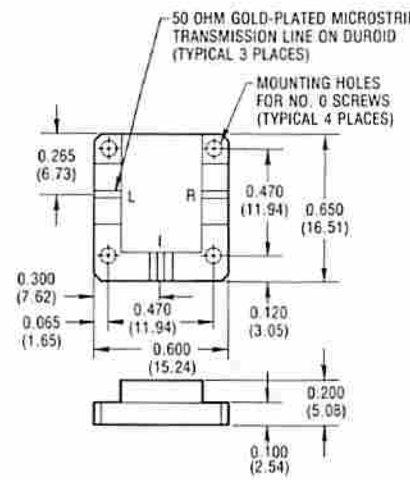
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +23 dBm max. at 25°C, +20 dBm max at 100°C
Peak Input Current at 25°C . . . . 100 mA DC

Weight

M15: 2 grams (0.07 oz.) max.
M15C: 30 grams (1.06 oz.) max.

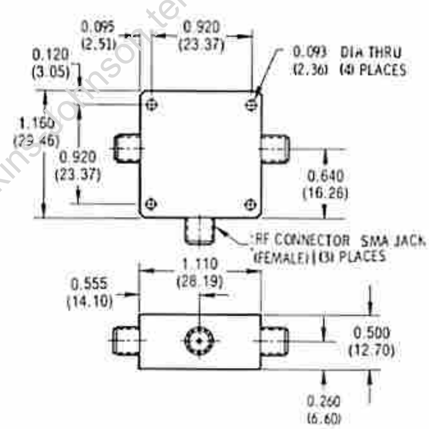
Outline Drawings

M15



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

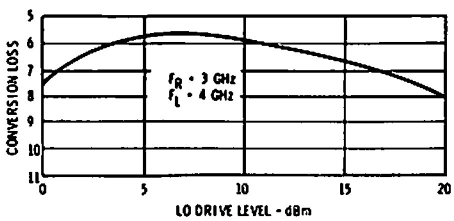
M15C



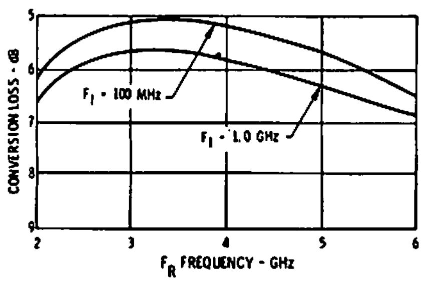
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

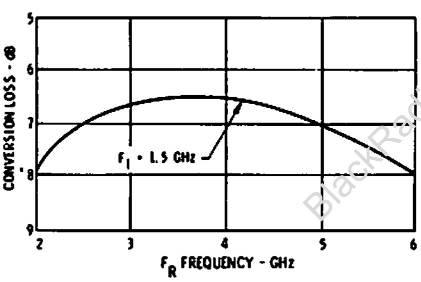
Typical Performance at 25°C

Conversion Loss



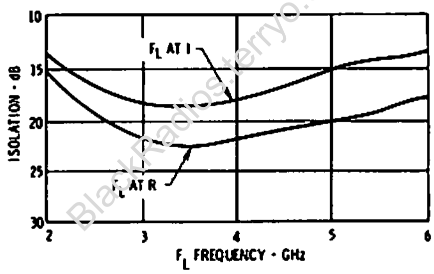
Conversion Loss vs. Drive Level: The minimum recommended drive level is +5 dBm. The maximum recommended drive level is +13 dBm.





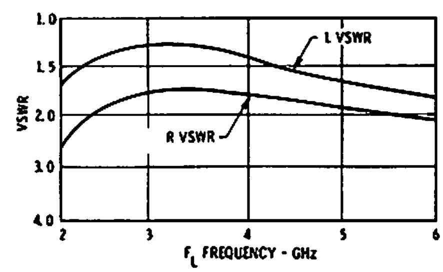
Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R). Data plotted with an f_L level of +7 dBm.

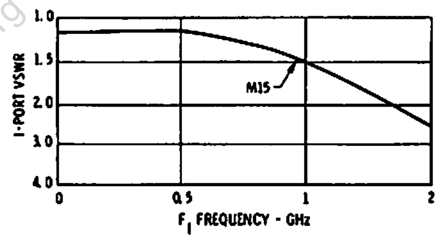
Isolation



Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

VSWR





VSWR vs. Frequency: VSWR of the L-, I- and R-ports in a 50-ohm system with f_L at +7 dBm. Only a small variation in the R-port VSWR will occur as a function of the L-port frequency.

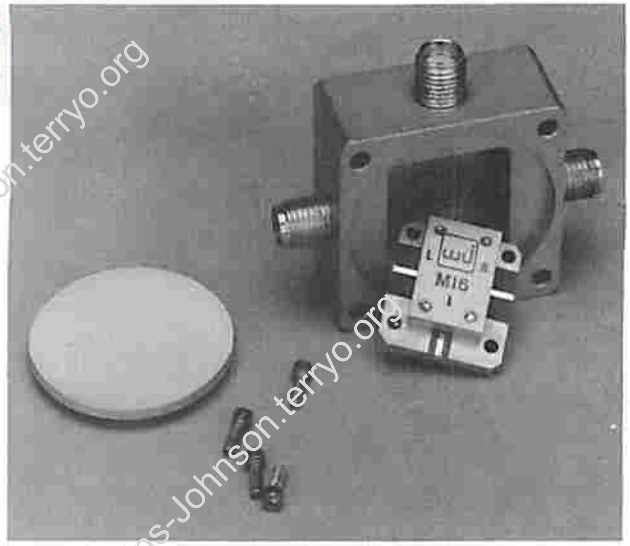
6

WJ-M16/M16C

FLATPAC MIC DOUBLE-BALANCED MIXER

LO, RF } 4 TO 9 GHz
IF DC TO 3 GHz
LO DRIVE +7 dBm (nominal)

- DIRECTLY INTEGRABLE WITH MIC SUBASSEMBLIES
- LOW NOISE FIGURE/CONVERSION LOSS (TYP. 7.0 dB)



Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure				f_L & f_R 4 - 9 GHz
		6.0 dB	8.5 dB	f_I 60 MHz to 1.0 GHz
		7.0 dB	9.0 dB	f_I 60 MHz to 2.0 GHz
		8.0 dB	10.0 dB	f_I 60 MHz to 3.0 GHz
Isolation				
f_L at R	9 dB	15 dB		f_L 4 - 9 GHz
f_L at I	7 dB	12 dB		f_L 4 - 9 GHz
Conversion Compression			1.0 dB	f_R Level = +3 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications. I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

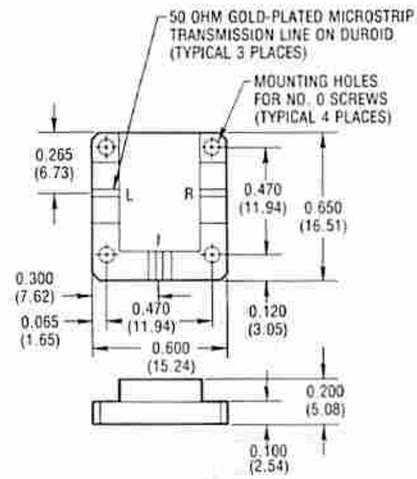
Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +23 dBm max. at 25°C, +20 dBm max at 100°C
Peak Input Current at 25°C. . . . . 100 mA DC

Weight M16: 2 grams (0.07 oz.) max.
M16C: 30 grams (1.06 oz.) max.

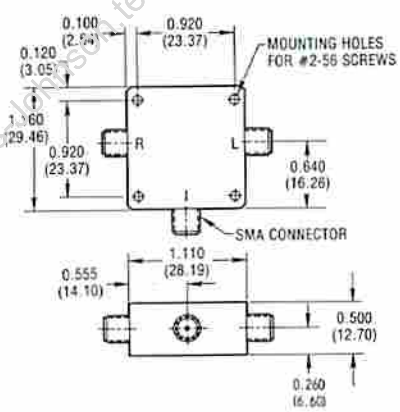
Outline Drawings

M16



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .010 (.25) UNLESS OTHERWISE SPECIFIED

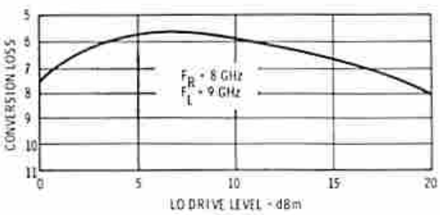
M16C



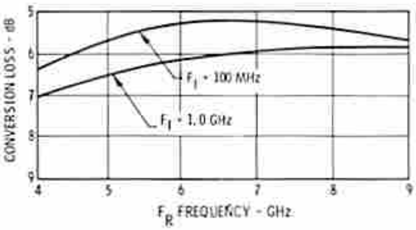
DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

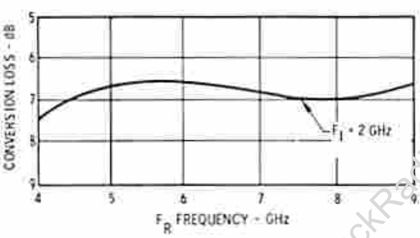
Typical Performance at 25°C

Conversion Loss

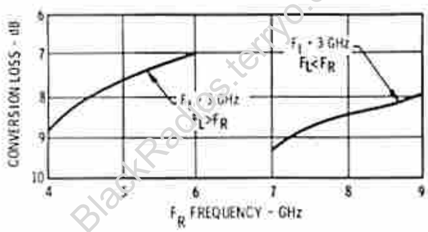


Conversion Loss vs. Drive Level: The minimum recommended drive level is +5 dBm. The maximum recommended drive level is +13 dBm.



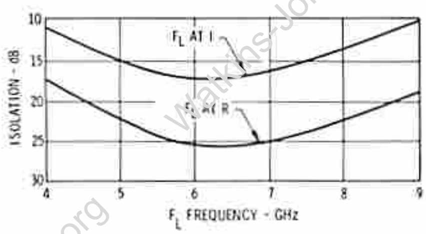


Conversion Loss



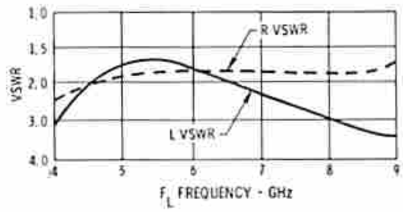
Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R). Data plotted with an f_L level of +7 dBm.

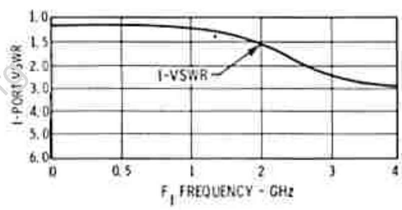
Isolation



Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

VSWR





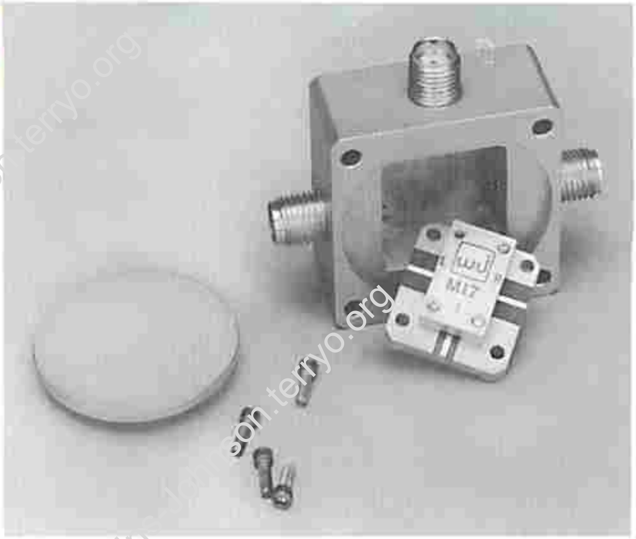
VSWR vs. Frequency: VSWR of the L-, I- and R-ports in a 50-ohm system with f_L at +7 dBm. Only a small variation in the R-port VSWR will occur as a function of the L-port frequency.

6

WJ-M17/M17C

FLATPAC MIC DOUBLE-BALANCED MIXER

LO } RF } 6 TO 16 GHz
IF DC TO 3 GHz
LO DRIVE +7 dBm (nominal)



- DIRECTLY INTEGRABLE WITH MIC SUBASSEMBLIES
- LOW NOISE FIGURE/ CONVERSION LOSS (TYP.) 6.5 dB

Guaranteed Specifications [1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		5.5 dB	8.0 dB	f_L & f_R 8 – 12 GHz f_I 0.06 to 1 GHz
		6.5 dB	9.0 dB	f_L & f_R 7 – 14 GHz f_I 0.06 to 2 GHz
		7.5 dB	10.5 dB	f_L & f_R 6 – 16 GHz f_I 0.06 to 3 GHz
Isolation				
f_L at R	8 dB	10 dB		f_L 6 – 6.7 GHz
f_L at R	10 dB	15 dB		f_L 6.7 – 16 GHz
f_L at I	10 dB	15 dB		f_L 6 – 16 GHz
Conversion Compression			1.0 dB	f_R Level = +3 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

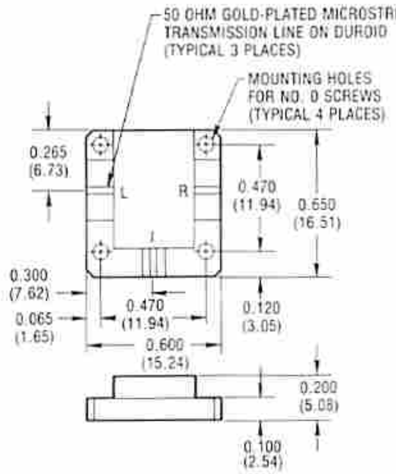
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +23 dBm max. at 25°C, +20 dBm max at 100°C
Peak Input Current at 25°C. . . . . .100 mA DC

Weight

M17: 2 grams (0.07 oz.) max.
M17C: 30 grams (1.06 oz.) max.

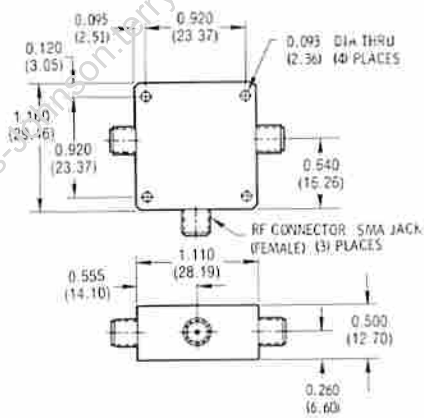
Outline Drawings

M17



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

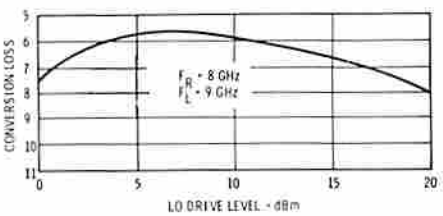
M17C



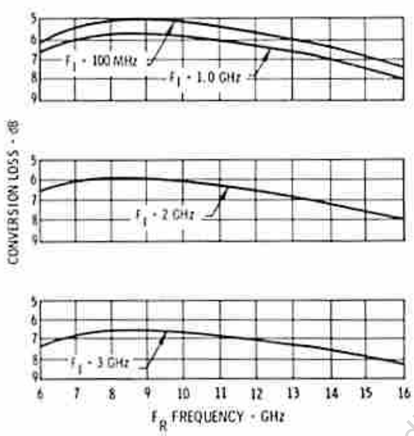
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C

Conversion Loss

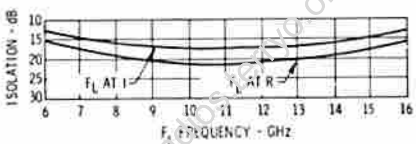


Conversion Loss vs. Drive Level: The minimum recommended drive level is +5 dBm. The maximum recommended drive level is +13 dBm.



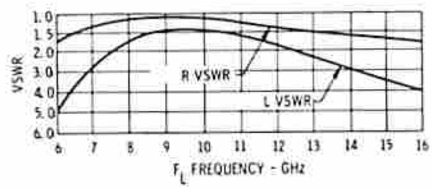
Conversion Loss vs. Input Frequency: Conversion loss of the mixer when used in an SSB system. The frequency ordinate refers to the R-port (f_R). Data plotted with an f_L level of +7 dBm.

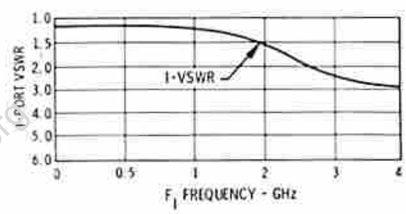
Isolation



Isolation vs. Frequency: Level of the f_L signal fed through to the R- and I-ports with respect to the level of the f_L signal at the L-port.

VSWR





VSWR vs. Frequency: VSWR of the L-, I- and R-ports in a 50-ohm system with f_L at +7 dBm. Only a small variation in the R-port VSWR will occur as a function of the L-port frequency.

WJ-M33B-X

IMAGE REJECT MIXER

LO } 5 TO 12 GHz
RF }
IF 4 TO 500 MHz
LO DRIVE +10 dBm (nominal)

- THIN-FILM
- LOW NOISE
- OCTAVE BANDWIDTH Ifs[1]

Guaranteed Specifications[2]

Characteristics	Min.	Typ.[3]	Max.	Test Conditions
Conversion Loss		7.5 dB 7.5 dB	9.0 dB 10.0 dB	6-12 GHz 5-12 GHz
Image Rejection	15 dB[4]	25 dB		5-12 GHz
Isolation L – R L – I	 20 dB 18 dB	 30 dB 25 dB		 5-12 GHz 5-12 GHz
VSWR L-Port R-Port I-Port		 2.5:1 1.4:1 1.2:1		 5-12 GHz 5-12 GHz 4-500 GHz

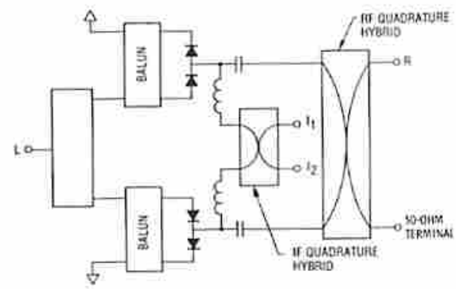
Notes:
1. Denote frequency band desired by replacing "X" with appropriate dash number. Options: 10-20 (-1), 20-40 (-2), 40-80 (-3), 80-160 (-4), 100-200 (-5) and 160-320 (-6) MHz IF, other wideband IF's are available from 4 to 500 MHz.
2. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
3. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.
4. Greater image rejection may be obtained by selection.
5. The 2 each 50-ohm terminations are not supplied.

Absolute Maximum Ratings

Operating Temperature. . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +17 dBm
Peak Input Current at 25°C. . . . . 50 mA DC

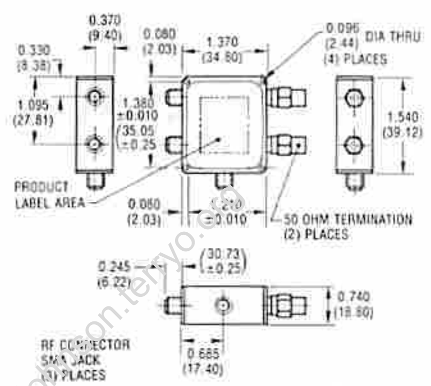
Weight M33B: 61 grams (2.15 oz.) max.

Schematic Diagram



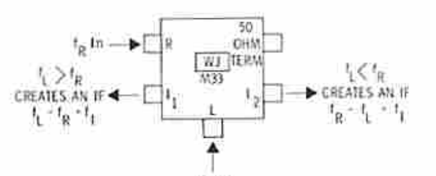
Outline Drawing

M33B



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

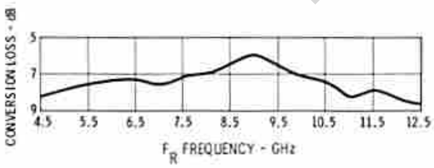
Port Functions



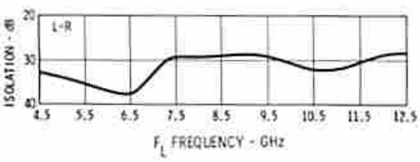
NOTE: THE UNUSED PORTS MUST BE TERMINATED WITH 50 OHM LOADS[5]

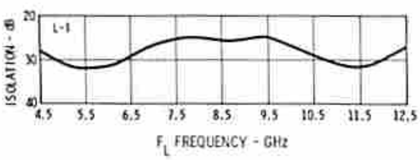
Typical Performance at 25°C

Conversion Loss vs. Frequency



Isolation vs. Frequency





VSWR vs. Frequency

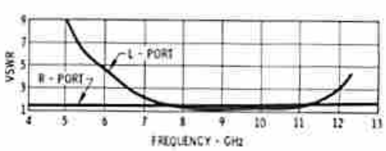
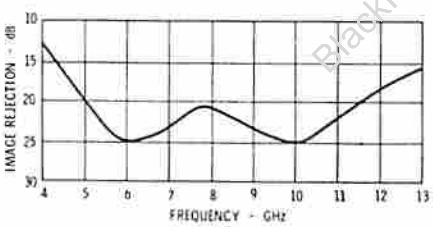


Image Rejection vs. Frequency

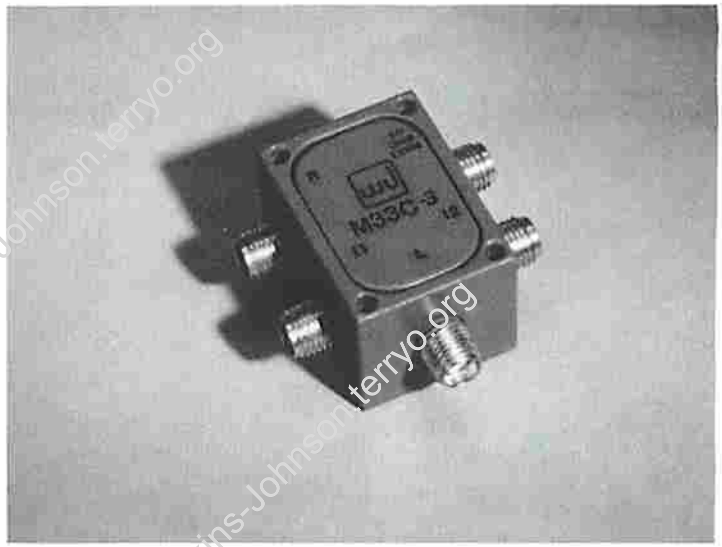


6

WJ-M33C-X

IMAGE REJECT MIXER

LO, RF } 7 TO 18 GHz
IF 4 TO 500 MHz
LO DRIVE +10 dBm (nominal)



- THIN-FILM
- LOW NOISE
- OCTAVE BANDWIDTH Ifs[1]

Guaranteed Specifications [2]

Characteristics	Min.	Typ.[3]	Max.	Test Conditions
Conversion Loss		7.5 dB 7.5 dB	9.0 dB 10.0 dB	7-17 GHz 7-18 GHz
Image Rejection	15 dB[4]	22 dB		7-18 GHz
Isolation L – R L – I	 20 dB 18 dB	 30 dB 23 dB		 7-18 GHz 7-18 GHz
VSWR L-Port R-Port I-Port	 	 2.5:1 1.7:1 1.2:1		 7-18 GHz 7-18 GHz 4-500 MHz

Notes:
1. Denote frequency band desired by replacing "X" with appropriate dash number. Options: 10-20 (-1), 20-40 (-2), 40-80 (-3), 80-160 (-4), 100-200 (-5) and 160-320 (-6) MHz IF, other wideband IF's are available from 4 to 500 MHz.
2. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
3. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.
4. Greater image rejection may be obtained by selection.
5. The 2 each 50-ohm terminations are not supplied.

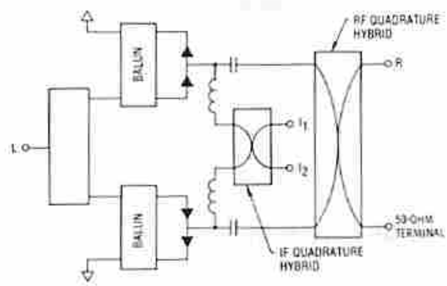
Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +17 dBm
Peak Input Current at 25°C . . . . 50 mA DC

Weight M33C: 31 grams (1.09 oz.) max.

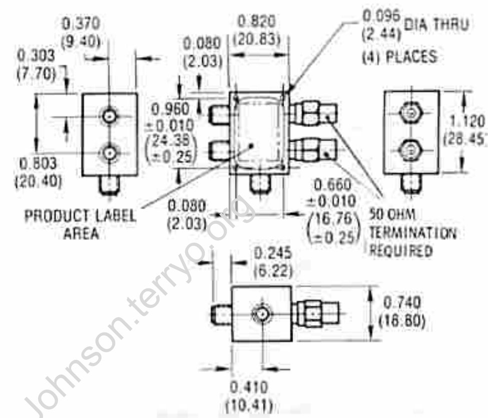
Connectors SMA Female

Schematic Diagram



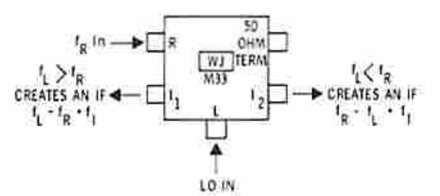
Outline Drawing

M33C



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

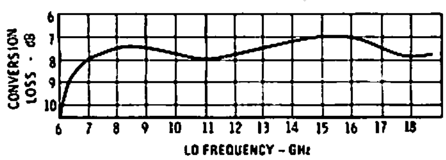
Port Functions



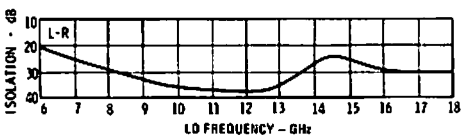
NOTE: THE UNUSED PORTS MUST BE TERMINATED WITH 50 OHM LOADS [5]

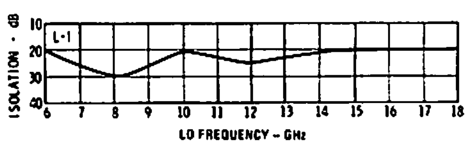
Typical Performance at 25°C

Conversion Loss vs. Frequency

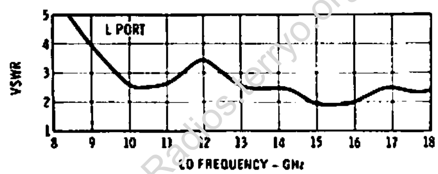


Isolation vs. Frequency





VSWR vs. Frequency



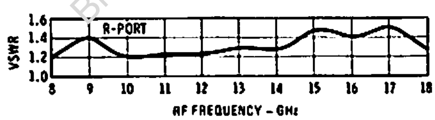
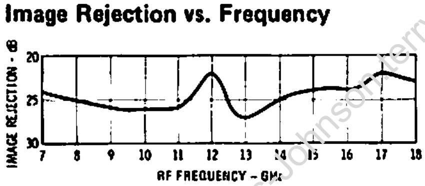


Image Rejection vs. Frequency



6

WJ-M34B-X

SINGLE SIDEBAND UP CONVERTER

LO } 5 TO 12 GHz
RF }
IF 4 TO 500 MHz
LO DRIVE +7 dBm (nominal)

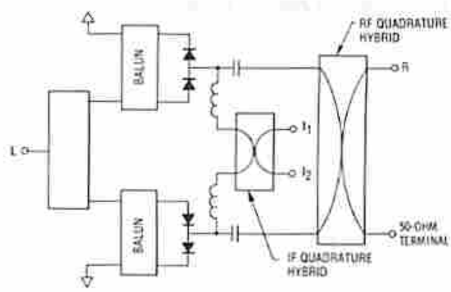
- THIN-FILM
- LOW NOISE
- OCTAVE BANDWIDTH Ifs[1]

Guaranteed Specifications[2]

Characteristions	Min.	Typ.[3]	Max.	Test Conditions
Conversion Loss		7.5 dB 7.5 dB	9.5 dB 13.0 dB	6-11 GHz 5-12 GHz
Sideband Suppression	15 dB[4]	22 dB		5-12 GHz
Carrier Suppression	20 dB	27 dB		5-12 GHz
Intermodulation Suppression $f_L \pm 2f_I$ $f_L \pm 3f_I$	 15 dB 14 dB	 26 dB 23 dB		 5-12 GHz 5-12 GHz
VSWR L-Port R-Port I-Port	 	 2.5:1 1.4:1 1.2:1		 5-12 GHz 5-12 GHz 4-500 MHz

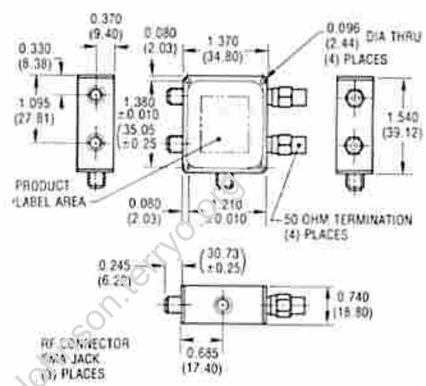
Notes:
1. Denote frequency band desired by replacing "X" with appropriate dash number. Options: 10-20 (-1), 20-40 (-2), 40-80 (-3), 80-160 (-4), 100-200 (-5) and 160-320 (-6) MHz IF, other wideband IF's are available from 4 to 500 MHz.
2. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
3. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.
4. Greater image rejection may be obtained by selection.
5. The 2 each 50-ohm terminations are not supplied.

Schematic Diagram



Outline Drawing

M34B



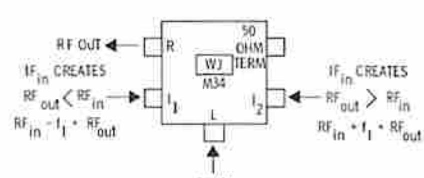
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

Absolute Maximum Ratings

Operating Temperature. . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +17 dBm
Peak Input Current at 25°C. . . . . 50 mA DC

Weight M34B: 61 grams (2.15 oz.) max.

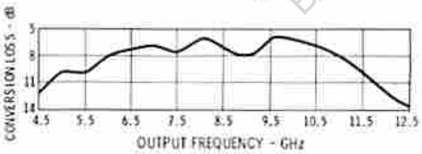
Port Functions



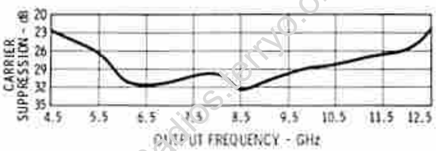
NOTE: THE UNUSED PORTS MUST BE TERMINATED WITH 50 OHM LOADS.[5]

Typical Performance at 25°C

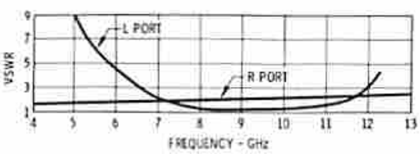
Conversion Loss vs. Frequency



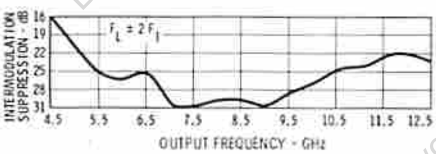
Carrier Suppression vs. Frequency



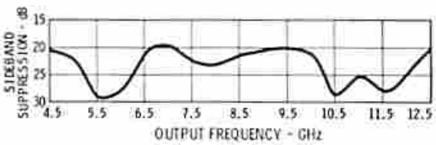
VSWR vs. Frequency

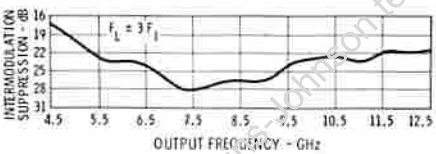


Intermodulation Suppression vs. Frequency



Sideband Suppression vs. Frequency





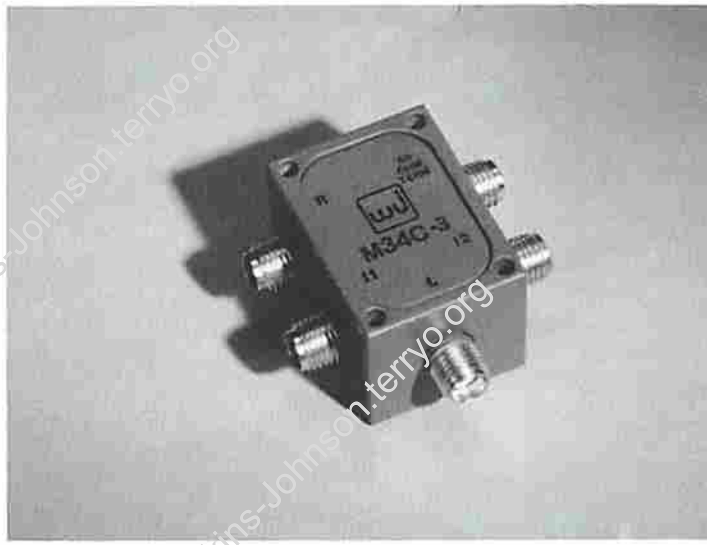
6

WJ-M34C-X

SINGLE SIDEBAND UP CONVERTER

LO / RF } 8 TO 18 GHz
IF 4 TO 500 MHz
LO DRIVE +7 dBm (nominal)

- THIN-FILM
- LOW NOISE
- OCTAVE BANDWIDTH Ifs[1]



Guaranteed Specifications[2]

Characteristics	Min.	Typ.[3]	Max.	Test Conditions
Conversion Loss		7.5 dB 7.5 dB	9.5 dB 11 dB	9-18 GHz 8-18 GHz
Sideband Suppression	15 dB[4]	22 dB		8-18 GHz
Carrier Suppression	15 dB	22 dB		8-18 GHz
Intermodulation Suppression $f_L \pm 2f_I$ $f_L \pm 3f_I$	 15 dB 15 dB 14 dB	 25 dB 22 dB 22 dB		 8-18 GHz 8-16 GHz 8-18 GHz
VSWR L-Port R-Port I-Port		 2.5:1 1.7:1 1.2:1		 8-18 GHz 8-18 GHz 4-500 MHz

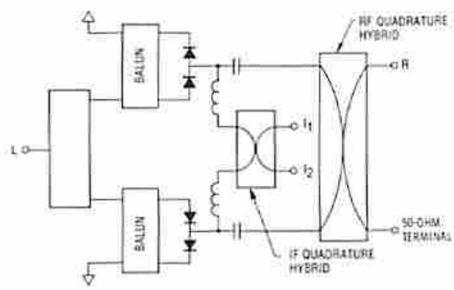
Notes:
1. Denote frequency band desired by replacing "X" with appropriate dash number. Options: 10-20 (-1), 20-40 (-2), 40-80 (-3), 80-160 (-4), 100-200 (-5) and 160-320 (-6) MHz IF, other wideband IF's are available from 4 to 500 MHz. Contact your field representative for additional information.
2. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
3. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.
4. Greater image rejection may be obtained by selection.
5. The 2 each 50-ohm terminations are not supplied.

Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +17 dBm
Peak Input Current at 25°C . . . . 50 mA DC

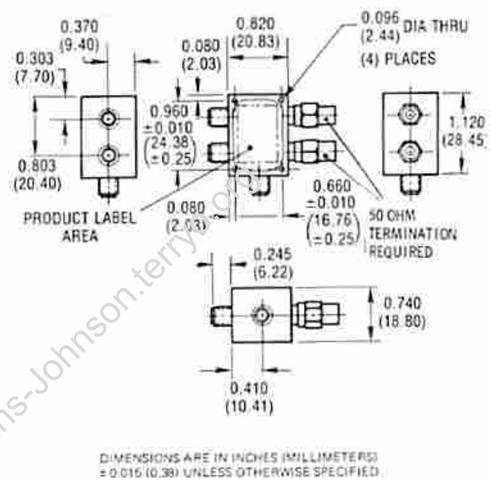
Weight M34C: 31 grams (1.09 oz.) max.

Schematic Diagram

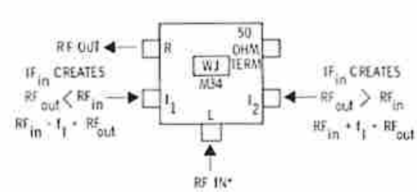


Outline Drawing

M34C



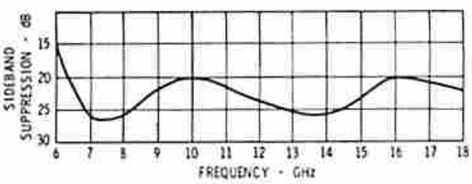
Port Functions



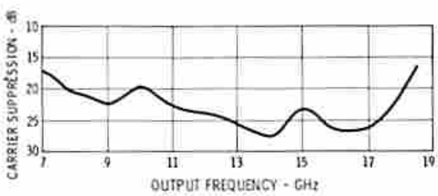
NOTE: THE UNUSED PORTS MUST BE TERMINATED WITH 50 OHM LOADS.[5]

Typical Performance at 25°C

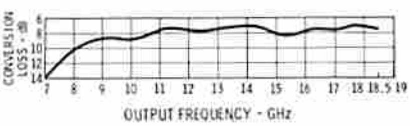
Sideband Suppression vs. Frequency



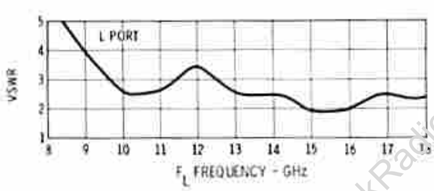
Carrier Suppression vs. Frequency

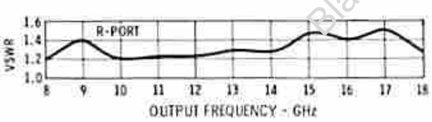


Conversion Loss vs. Frequency

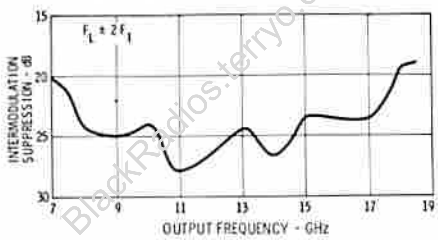


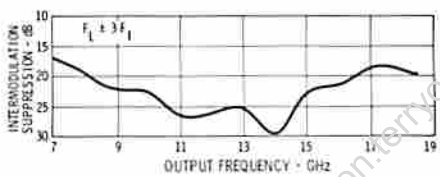
VSWR vs. Frequency





Intermodulation Suppression vs. Frequency





WJ-M35B

QUADRATURE IF MIXER

LO } 5 TO 12 GHz
RF }
IF DC TO 500 MHz
LO DRIVE +10 dBm (nominal)

- THIN-FILM
- LOW NOISE
- HIGH ISOLATION

Guaranteed Specifications [1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
Conversion Loss		7.5 dB 7.5 dB	9.0 dB 10.0 dB	6-12 GHz 5-12 GHz
Image Rejection[3]	15 dB[4]	25 dB		5-12 GHz
Isolation L – R L – I	 20 dB 18 dB	 30 dB 25 dB		 5-12 GHz 5-12 GHz
VSWR L-Port R-Port I-Port		 2.5:1 1.4:1 1.2:1		 5-12 GHz 5-12 GHz DC-500 MHz

Notes:

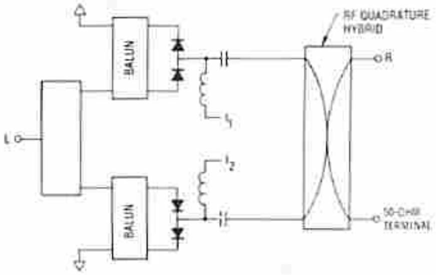
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified. The I-Port frequency range extends to DC, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.
3. Applies only for IF recombination erros of ± 0.4 dB in amplitude match and ± 2 degrees in quandrature phasing.
4. Greater image rejection may be obtained at certain frequencies in narrowband applications. Contact factory.

Absolute Maximum Ratings

Operating Temperature. . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +17 dBm
Peak Input Current at 25°C. . . . . 50 mA DC

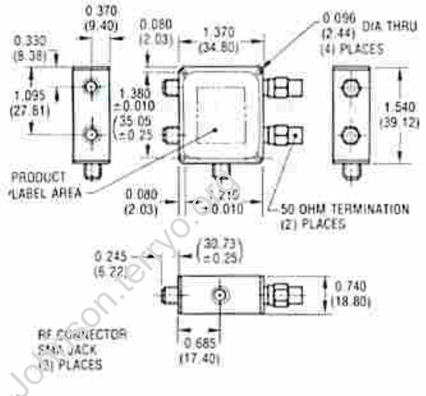
Weight M35B: 61 grams (2.15 oz.) max.

Schematic Diagram



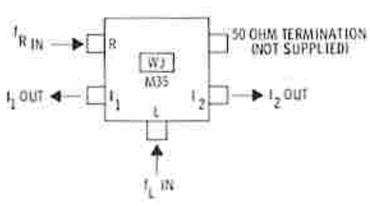
Outline Drawing

M35B



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

Port Functions

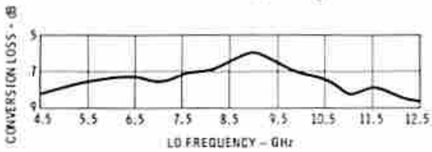


PHASE RELATIONSHIPS FOR IF OUTPUTS

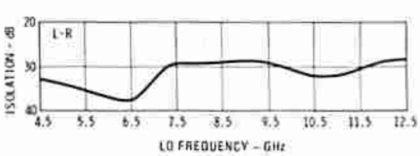
	I_1	I_2
$f_L > f_R$	0°	-90°
$f_L < f_R$	-90°	0°

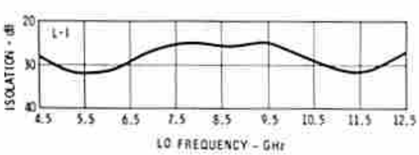
Typical Performance at 25°C

Conversion Loss vs. Frequency



Isolation vs. Frequency





VSWR vs. Frequency

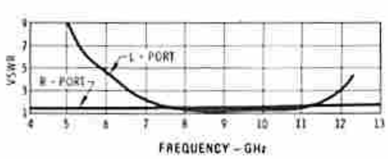
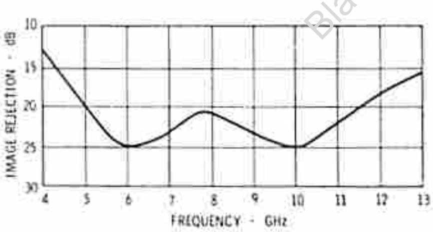


Image Rejection vs. Frequency

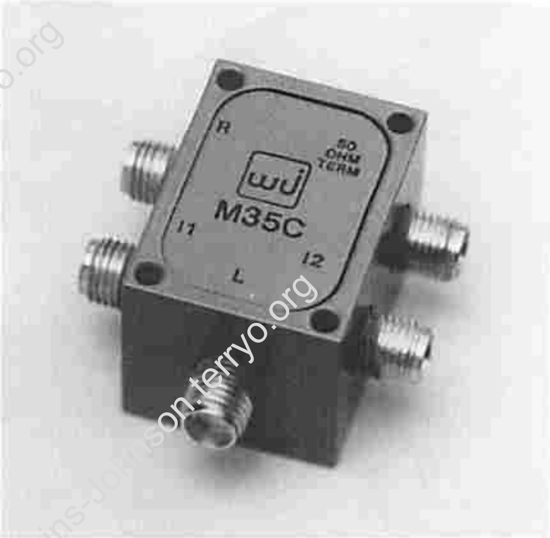


6

WJ-M35C

QUADRATURE IF MIXER

LO, RF 7 TO 18 GHz
IF DC TO 500 MHz
LO DRIVE +10 dBm (nominal)



- THIN-FILM
- LOW NOISE
- HIGH ISOLATION

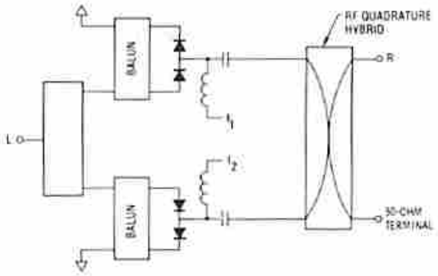
Guaranteed Specifications [1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
Conversion Loss		7.5 dB 7.5 dB	9.0 dB 9.5 dB	7-17 GHz 7-18 GHz
Image Rejection[3]	15 dB[4]	22 dB		7-18 GHz
Isolation L – R L – I	 20 dB 18 dB	 30 dB 23 dB		 7-18 GHz 7-18 GHz
VSWR L-Port R-Port I-Port		 2.5:1 1.7:1 1.2:1		 7-18 GHz 7-18 GHz DC-500 MHz

Notes:

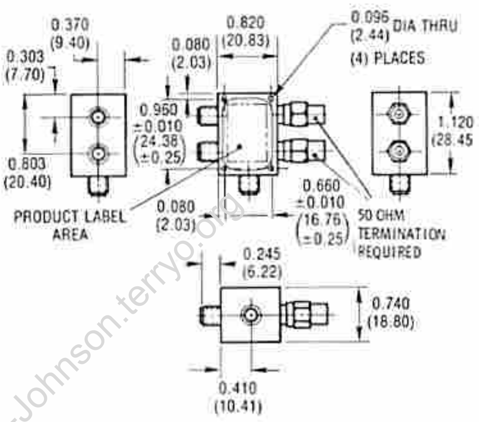
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified. The I-Port frequency range extends to DC, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.
3. Applies only for IF recombination erros of ± 0.4 dB in amplitude match and ± 2 degrees in quandrature phasing.
4. Greater image rejection may be obtained at certain frequencies in narrowband applications. Contact factory.

Schematic Diagram



Outline Drawing

M35C

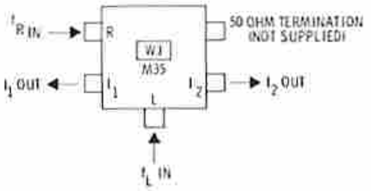


DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

Absolute Maximum Ratings

Operating Temperature . . . . . -54°C to +100°C
Storage Temperature . . . . . -65°C to +100°C
Peak Input Power . . . . . +17 dBm
Peak Input Current at 25°C . . . . . 50 mA DC

Port Functions



PHASE RELATIONSHIPS FOR IF OUTPUTS

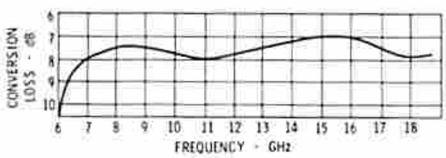
	I_1	I_2
$f_L > f_R$	0°	-90°
$f_L < f_R$	-90°	0°

Weight M35C: 31 grams (1.09 oz.) max.

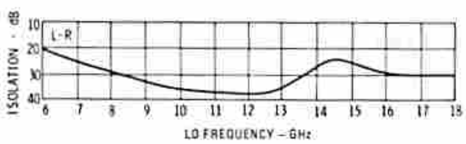
Connectors SMA Female

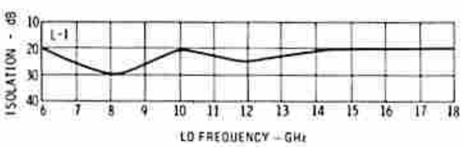
Typical Performance at 25°C

Conversion Loss vs. Frequency

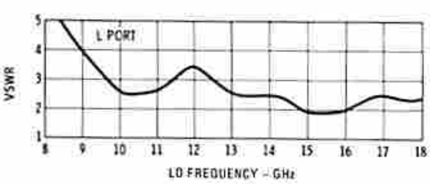


Isolation vs. Frequency





VSWR vs. Frequency



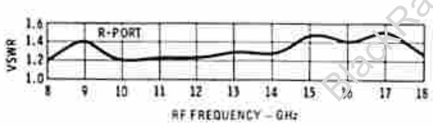
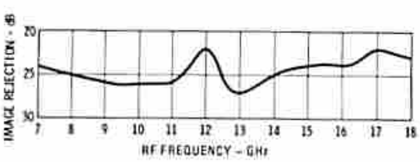


Image Rejection vs. Frequency



6

WJ-M36B

QUADRATURE IF UP CONVERTER

LO } 5 TO 12 GHz
RF }
IF DC TO 500 MHz

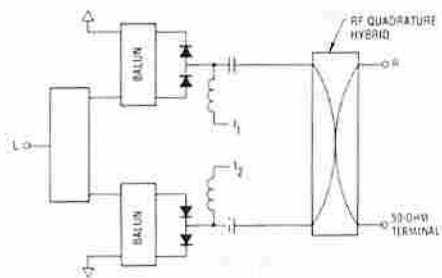
- THIN-FILM
- LOW NOISE
- HIGH ISOLATION

Guaranteed Specifications [1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
Conversion Loss		7.5 dB 7.5 dB	9.5 dB 11.0 dB	6-11 GHz 5-12 GHz
Sideband Suppression[3]	15 dB[4]	22 dB		5-12 GHz
Carrier Suppression	15 dB	27 dB		5-12 GHz
Intermodulation Suppression $f_L \pm 2f_I$ $f_L \pm 3f_I$	 15 dB 14 dB	 26 dB 23 dB		 5-12 GHz 5-12 GHz
VSWR L-Port R-Port I-Port		 2.5:1 1.4:1 1.2:1		 5-12 GHz 5-12 GHz DC-500 MHz

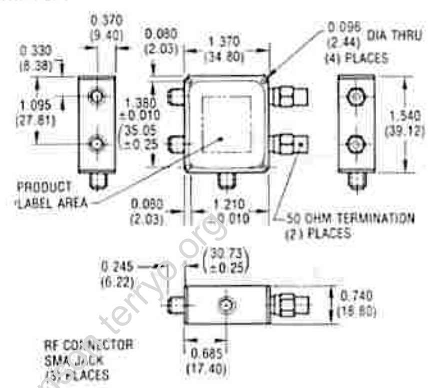
Notes:
1. Measured in a 50 ohm system with F_{I_1} and F_{I_2} at +4 dBm.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.
3. Applies only when both signal inputs match with ± 0.4 dB in amplitude and ± 2 degrees in phase.
4. Greater sideband suppression may be obtained at certain frequencies in narrowband applications. Contact factory.

Schematic Diagram



Outline Drawing

M36B

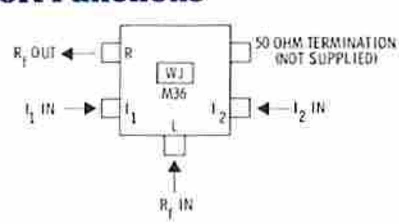


DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +17 dBm
Peak Input Current at 25°C . . . . 50 mA DC

Port Functions



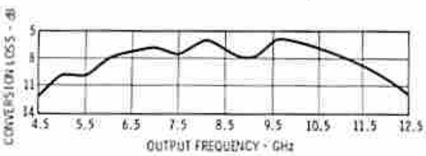
PHASE RELATIONSHIPS FOR SIDEBAND SELECTION

	I_1	I_2
R_f OUT < R_f IN	-90°	0°
R_f OUT > R_f IN	0°	-90°

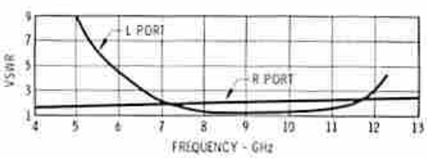
Weight M36B: 31 grams (1.09 oz.) max.

Typical Performance at 25°C

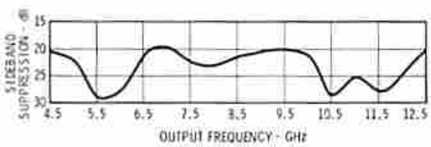
Conversion Loss vs. Frequency



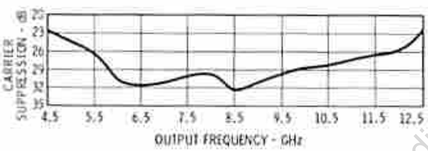
VSWR vs. Frequency



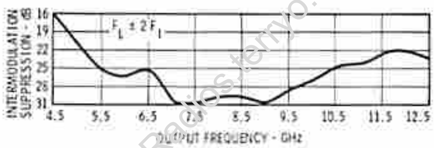
Sideband Suppression vs. Frequency

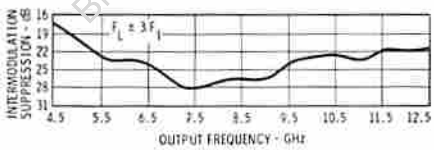


Carrier Suppression vs. Frequency



Intermodulation Suppression vs. Frequency





6

WJ-M36C

QUADRATURE IF UP CONVERTER

LO, RF } **8 TO 18 GHz**
IF DC TO 500 MHz

- THIN-FILM
- LOW NOISE
- HIGH ISOLATION

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
Conversion Loss		7.5 dB 7.5 dB	9.5 dB 11.0 dB	9–18 GHz 8–18 GHz
Sideband Suppression[4]	15 dB[3]	22 dB		8– 18 GHz
Carrier Suppression	15 dB	22 dB		8–18 GHz
Intermodulation Suppression				
$f_L \pm 2f_I$	15 dB	25 dB		8–18 GHz
$f_L \pm 3f_I$	15 dB 14 dB	22 dB		8–16 GHz 8–18 GHz
VSWR				
L-Port		2.5:1		8-18 GHz
R-Port		1.7:1		8-18 GHz
I-Port		1.2:1		DC–500 MHz

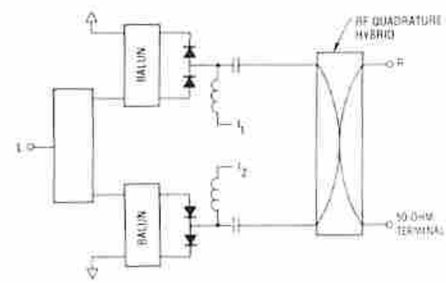
Notes:
1. Measured in a 50 ohm system with F_{I_1} and F_{I_2} at +4 dBm.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.
3. Applies only when both signal inputs match with ± 0.4 dB in amplitude and ± 2 degrees in phase.
4. Greater sideband suppression may be obtained at certain frequencies in narrowband applications. Contact factory.

Absolute Maximum Ratings

Operating Temperature. . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +17 dBm
Peak Input Current at 25°C. . . . . 50 mA DC

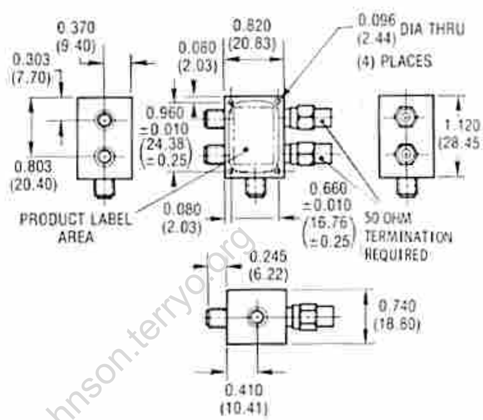
Weight M36C: 31 grams (1.09 oz.) max.

Schematic Diagram



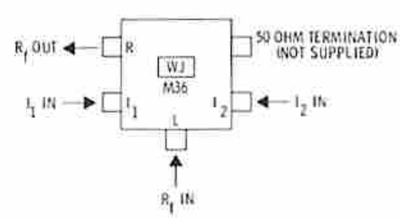
Outline Drawing

M36C



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

Port Functions

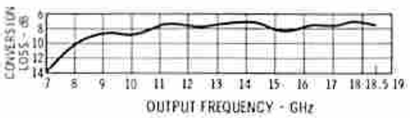


PHASE RELATIONSHIPS FOR SIDEBAND SELECTION

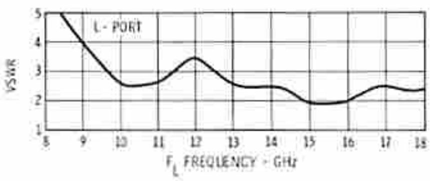
	I_1	I_2
R_f OUT < R_f IN	-90°	0°
R_f OUT > R_f IN	0°	-90°

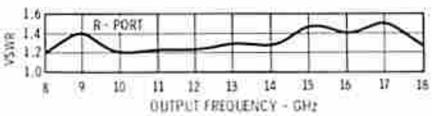
Typical Performance at 25°C

Conversion Loss vs. Frequency

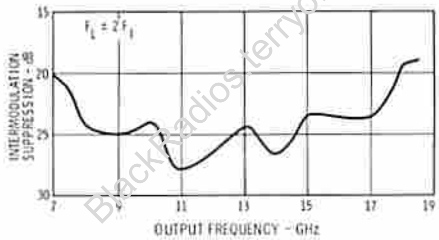


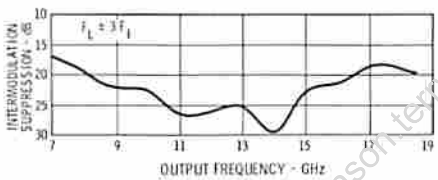
VSWR vs. Frequency



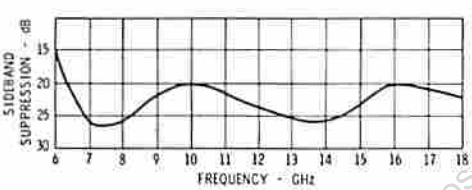


Intermodulation Suppression vs. Frequency

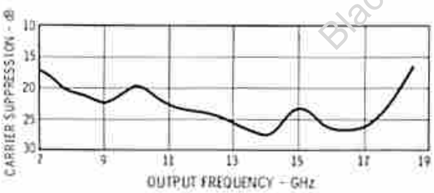




Sideband Suppression vs. Frequency



Carrier Suppression vs. Frequency

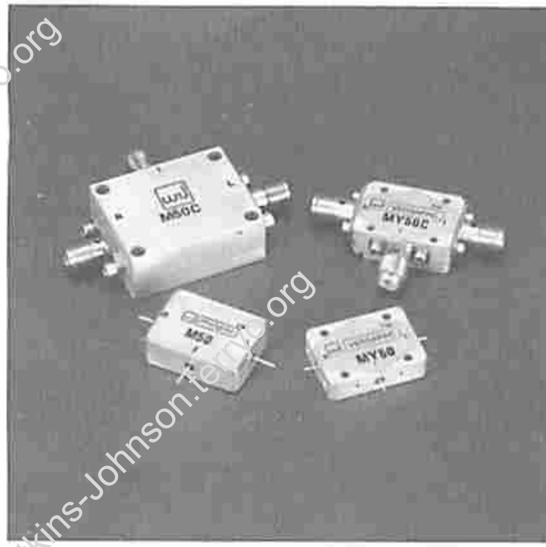


WJ-M50/M50C
WJ-MY50/MY50C

TRIPLE-BALANCED MIXER (DOUBLE-DOUBLE BALANCED MIXER)

LO, RF 2.0 TO 26.0 GHz
IF 1.0 TO 15.0 GHz
LO DRIVE +10 dBm (nominal)

- HERMETICALLY SEALED



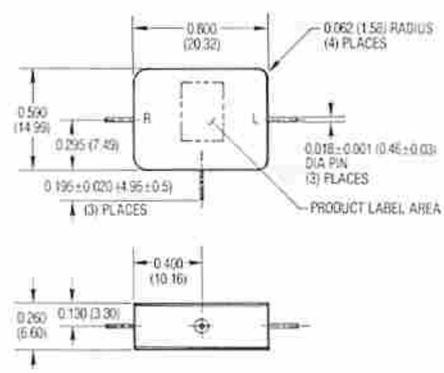
Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.5 dB	9.5 dB	f_R 2.5 to 18.0 GHz f_L 1.5 to 18.0 GHz f_I 2.0 to 10.0 GHz
		8.0 dB	10.5 dB	f_R 2.0 to 18.0 GHz f_L 1.5 to 26.0 GHz f_I 2.0 to 12.0 GHz
		9.0 dB	11.5 dB	f_R 2.0 to 26.0 GHz f_L 1.5 to 26.0 GHz f_I 1.0 to 12.0 GHz 1.0 to 15.0 GHz $f_L > f_R$
Isolation				
L to R	20 dB	30 dB		f_L 3.0 to 26.0 GHz
L to R	15 dB	22 dB		f_L 1.5 to 3.0 GHz
L to I	20 dB	30 dB		f_L 7.0 to 26.0 GHz
L to I	15 dB	22 dB		f_L 1.5 to 7.0 GHz
Conversion Compression			1.0 dB	f_R level +5.0 dBm f_L level +10.0 dBm
Third Order Input Intercept Point		+15 dBm		f_{R1} = 5.0 GHz, f_{R2} = 5.01 GHz both at 6 dBm f_L = 8.0 GHz at +10.0 dBm
		+15 dBm		f_{R1} = 25.0 GHz, f_{R2} = 25.01 GHz both at 6 dBm f_L = 15.0 GHz at +10.0 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

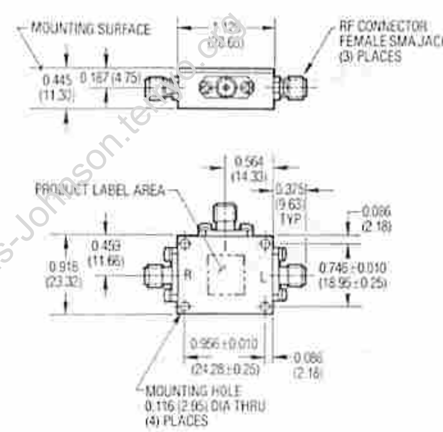
Outline Drawings

M50 (MINPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±0.010 (0.25) UNLESS OTHERWISE SPECIFIED

M50C (CONNECTORIZED)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±0.015 (0.38) UNLESS OTHERWISE SPECIFIED

Absolute Maximum Ratings

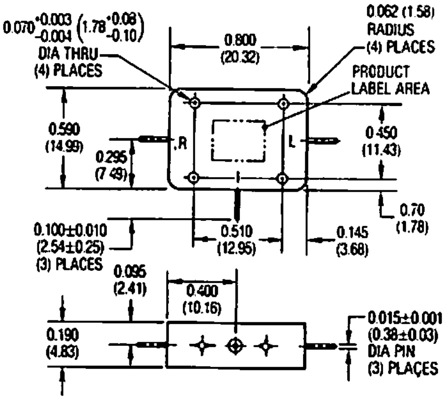
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . 26 dBm at 25°C, 22 dBm at 100°C

Weight

M50: 12 grams (0.42 oz.) max.
M50C: 40 grams (1.41 oz) max.
MY50: 12 grams (0.42 oz.) max.
MY50C: 18 grams (0.63 oz.) max.

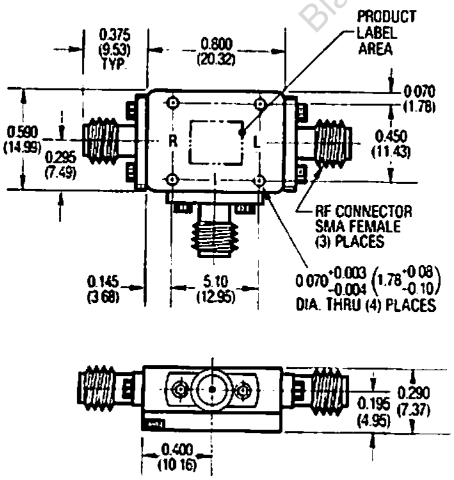
Outline Drawings

MY50 (VERSAPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .010 (.25) UNLESS OTHERWISE SPECIFIED

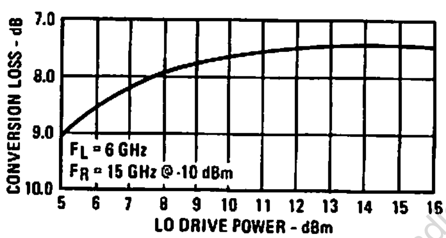
MY50C (CONNECTORIZED)

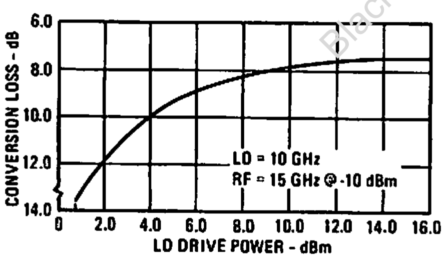


DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C*

Conversion Loss vs. LO Drive Level

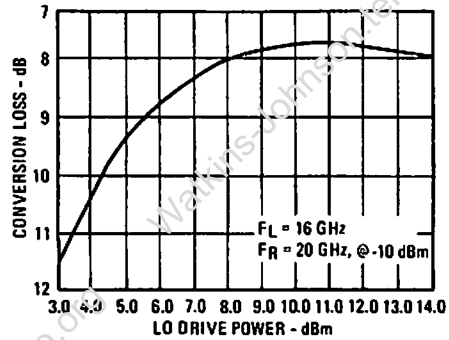


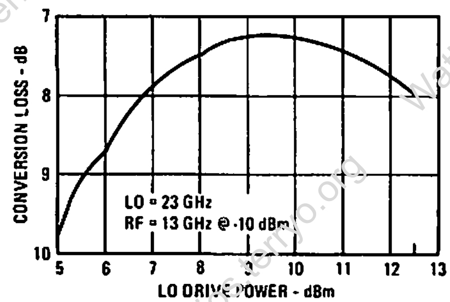


*Typical performance applies to the MINPAC™ model and does not necessarily reflect the performance of the VERSAPAC® model.

Typical Performance at 25°C*

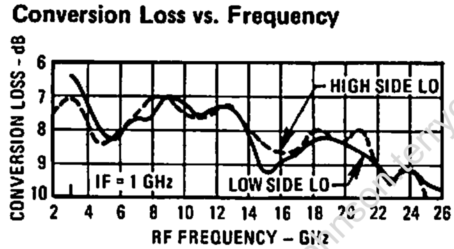
Conversion Loss vs. LO Drive Level

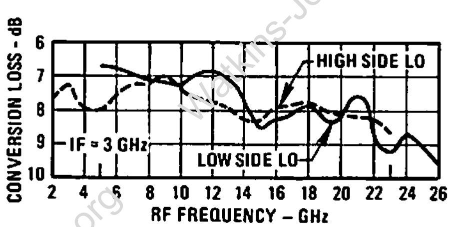


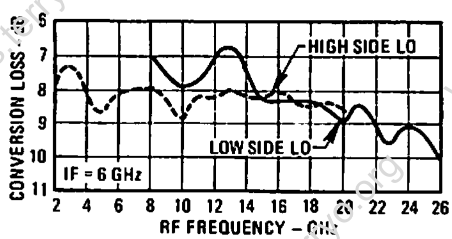


Drive Level: The maximum recommended drive level is +17 dBm.

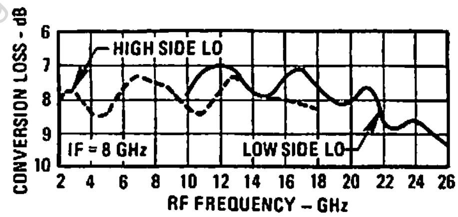
Conversion Loss vs. Frequency

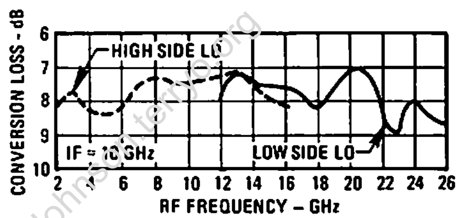


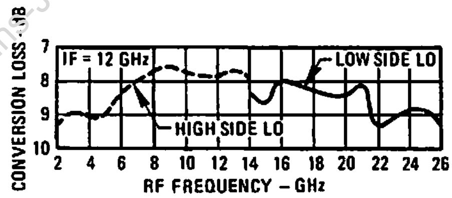


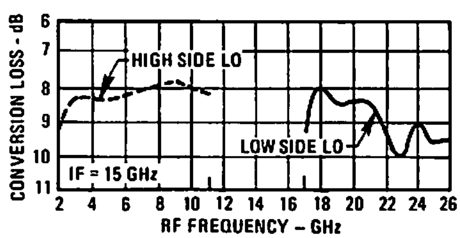


Conversion Loss vs. Frequency

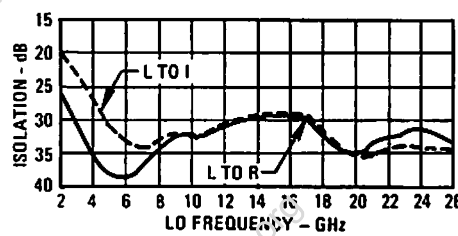


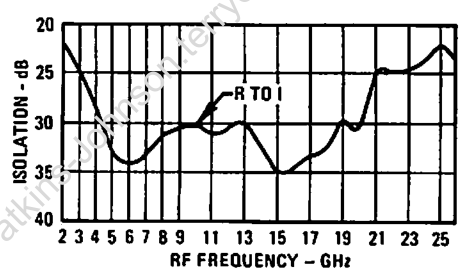




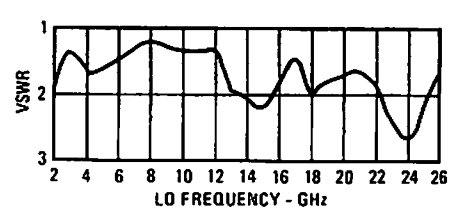


Isolation vs. Frequency





L-Port VSWR



(continued)

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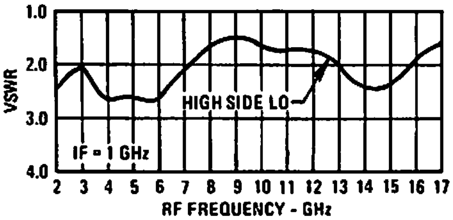
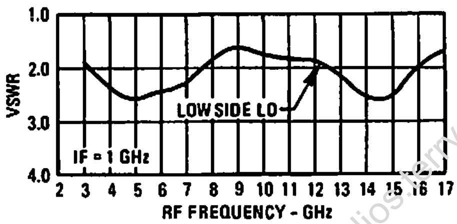
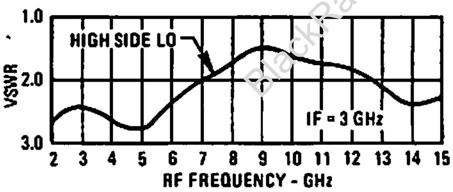
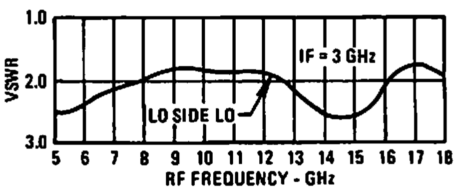
Typical Performance at 25°C*(Cont.)

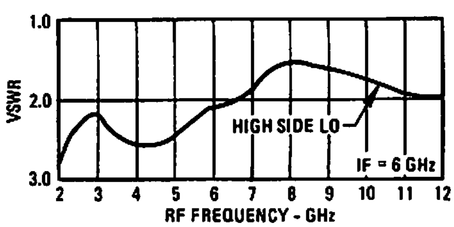
R-Port VSWR

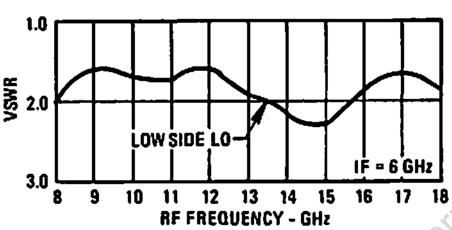


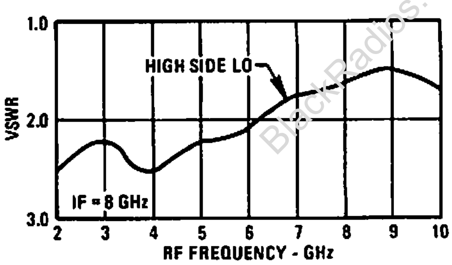




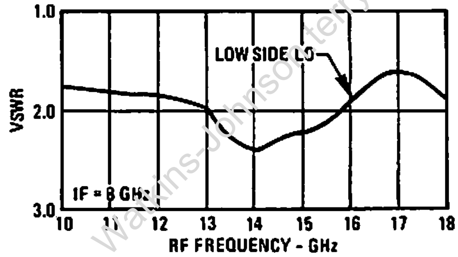


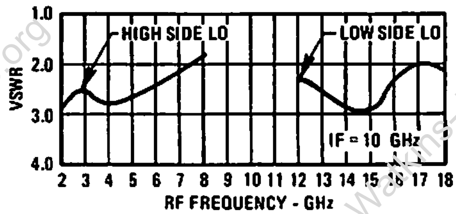


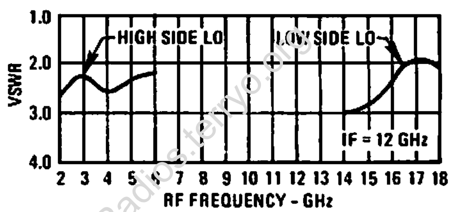


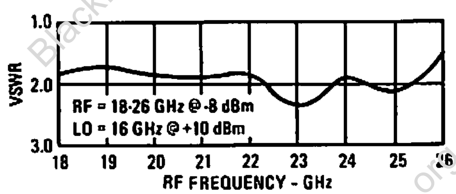


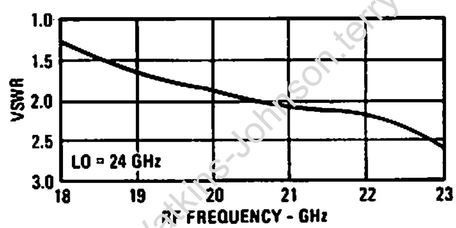
R-Port VSWR

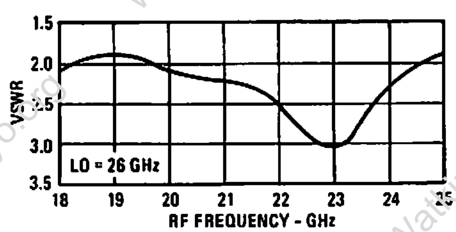




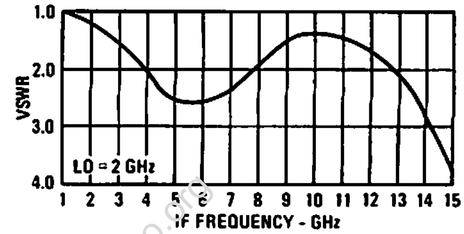


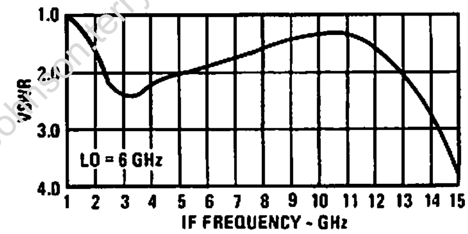


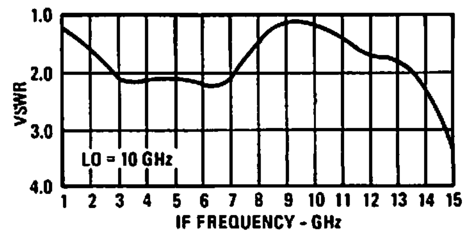


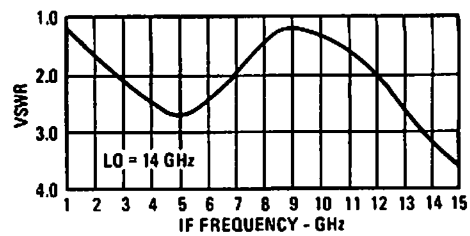


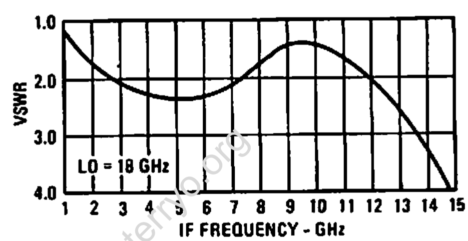
I-Port VSWR

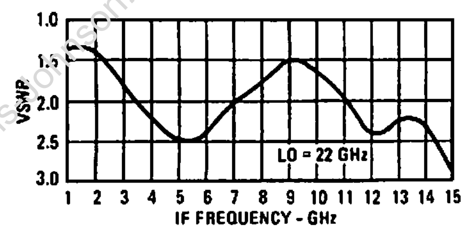


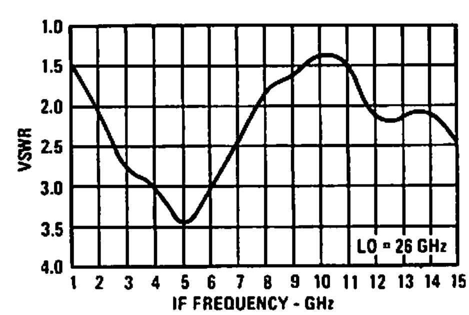












*Typical performance applies to the MINPAC™ model and does not necessarily reflect the performance of the VERSAPAC® model.

Typical Performance at 25°C (Cont.)

Harmonics of f_L	R - Port	I - Port	Test Conditions
f_L	-16 dBm	-10 dBm	f_L = 2 GHz at +10 dBm
2 f_L	-15 dBm	-23 dBm	
3 f_L	-24.5 dBm	-23 dBm	
4 f_L	-33 dBm	-41 dBm	
5 f_L	-33 dBm	-34 dBm	
6 f_L	-46 dBm	-45 dBm	
7 f_L	-41 dBm	-41 dBm	
8 f_L	-42 dBm	-48 dBm	
9 f_L	-47.2 dBm	-50 dBm	
10 f_L	-46 dBm	-51 dBm	
11 f_L	-49 dBm	-51 dBm	
f_L	-30 dBm	-24 dBm	f_L = 6 GHz at +10 dBm
2 f_L	-24 dBm	-34 dBm	
3 f_L	-30 dBm	-40 dBm	
f_L	-22 dBm	-23 dBm	f_L = 11 GHz at +10 dBm
2 f_L	-31 dBm	-28 dBm	

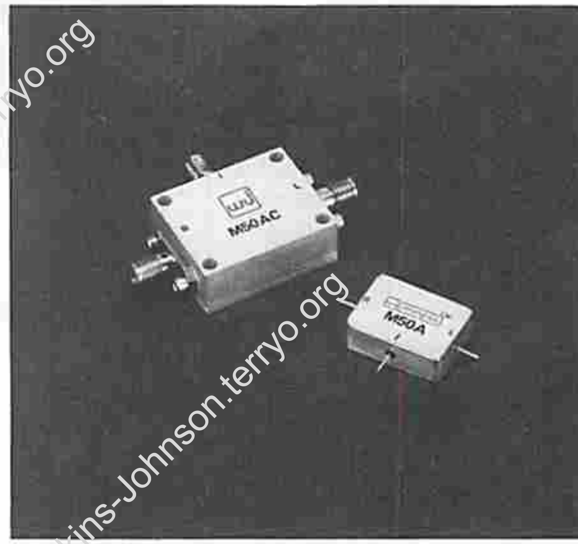
Single Tone IM	Typ.[2]	Test Conditions
f_L f_R		
1 x 1	0 dB	f_L = 2 GHz at +10 dBm f_R = 3.25 GHz at -10 dBm
1 x 2	44 dB	
1 x 3	> 65 dB	
2 x 1	36 dB	
2 x 2	50 dB	
3 x 1	14 dB	
3 x 2	48 dB	
3 x 3	67 dB	
4 x 1	35 dB	
4 x 2	55 dB	
5 X 1	28 dB	
5 x 3	—	
6 x 1	—	
6 x 2	60 dB	
7 x 1	33 dB	
7 x 3	> 65 dB	
f_L f_R		
1 x 1	0 dB	f_L = 4.1 GHz at +10 dBm f_R = 6.0 GHz at -10 dBm
1 x 2	55 dB	
1 x 3	> 60 dB	
2 x 1	35 dB	
2 x 2	60 dB	
3 x 1	19 dB	
3 x 2	> 58 dB	
3 x 3	63 dB	
4 x 1	41 dB	
4 x 2	> 62 dB	
5 x 1	30 dB	
5 x 3	—	
6 x 1	45 dB	
6 x 2	62 dB	
7 x 1	—	
7 x 3	> 60 dB	

WJ-M50A/M50AC

TRIPLE BALANCED MIXER

LO 1.5 TO 26.0 GHz
RF 2.0 TO 18.0 GHz
IF 1.0 TO 12.0 GHz
LO DRIVE +10 dBm (nominal)

- HERMETICALLY SEALED
- VERY WIDEBAND IF 1 TO 12 GHz
- HIGH COMPRESSION POINT



Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.5 dB	9.5 dB	f_R 2.5 to 18.0 GHz f_L 1.5 to 18.0 GHz f_I 2.0 to 10.0 GHz
		8.0 dB	10.5 dB	f_R 2.0 to 18.0 GHz f_L 1.5 to 18.0 GHz f_I 1.0 to 12.0 GHz
Isolation				
L to R	15 dB	22 dB		f_L 1.5 to 3.0 GHz
L to R	20 dB	30 dB		f_L 3.0 to 26.0 GHz
L to I	20 dB	30 dB		f_L 7.0 to 26.0 GHz
L to I	15 dB	22 dB		f_L 1.5 to 7.0 GHz
Conversion Compression			1.0 dB	f_R Level +5.0 dBm f_L Level +10.0 dBm
Third-Order Input Intercept		+15 dBm		f_{R1} = 5.0 GHz, f_{R2} = 5.01 GHz both at 6 dBm f_L = 8.0 GHz at +10.0 dBm
		+12 dBm		f_{R1} = 15.0 GHz, f_{R2} = 15.01 GHz both at 6 dBm f_L = 25.0 GHz at +10.0 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

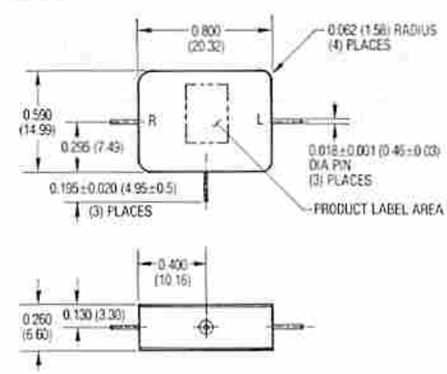
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +26 dBm max. at 25°C, +22 dBm max. at 100°C

Weight M50A: 12 grams (0.42 oz.) max.
M50AC: 40 grams (1.41 oz.) max.

Outline Drawings

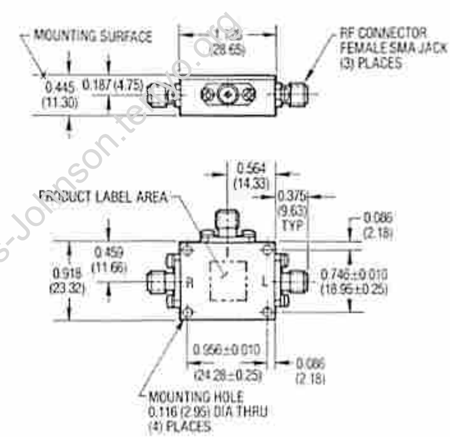
DIMENSIONS ARE IN INCHES (MILLIMETERS)

M50A



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.010 (.25) UNLESS OTHERWISE SPECIFIED

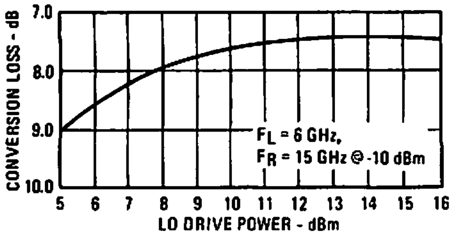
M50AC

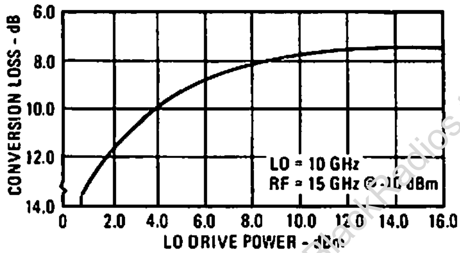


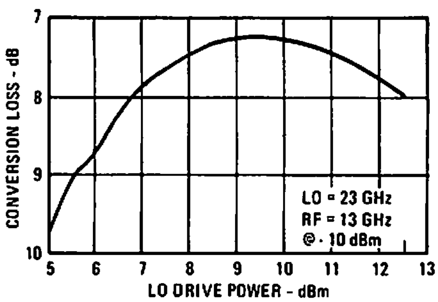
DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C

Drive Level

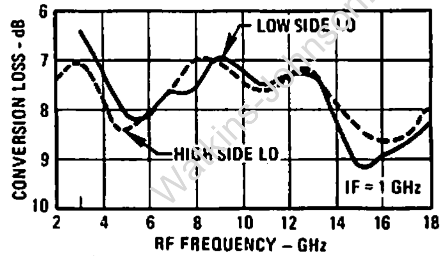


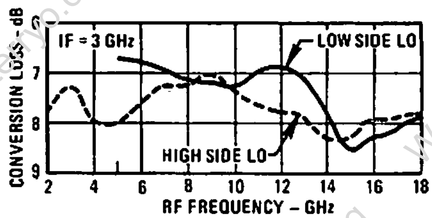


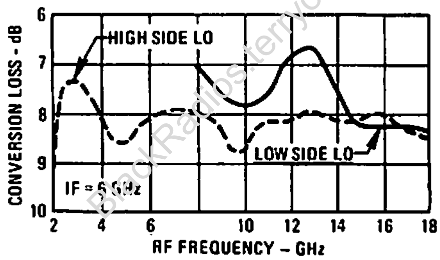


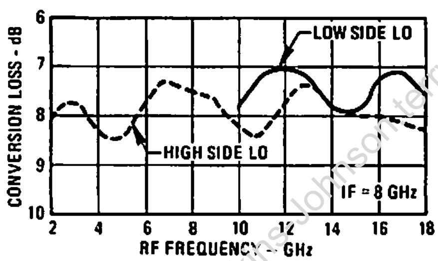
Drive Level: The maximum recommended drive level is +17 dBm.

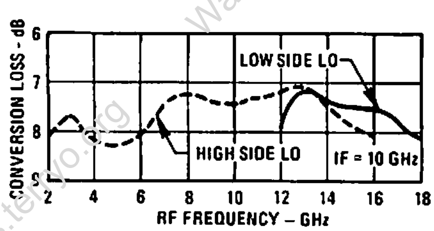
Conversion Loss vs. Frequency LO @ +10 dBm

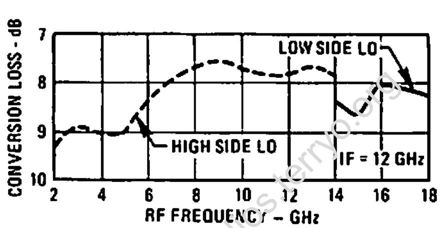




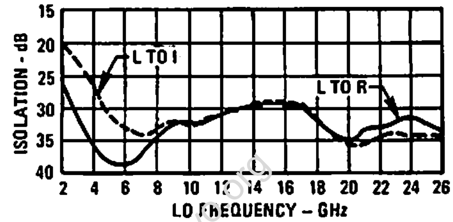


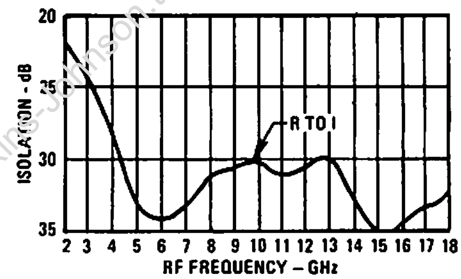




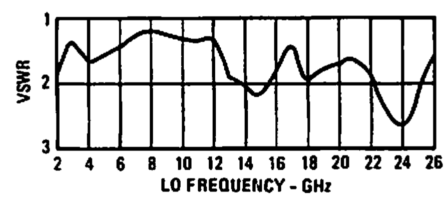


Isolation vs. Frequency

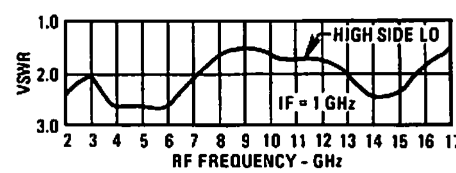


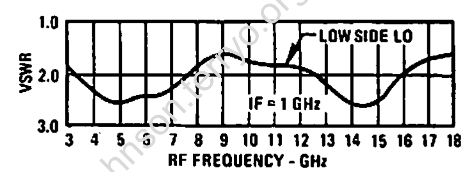


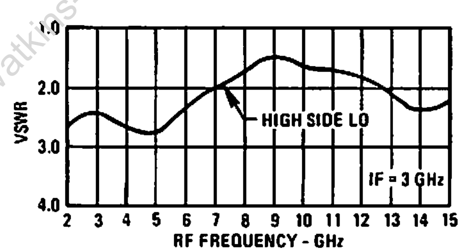
L-Port VSWR



R-Port VSWR LO @ +10 dBm







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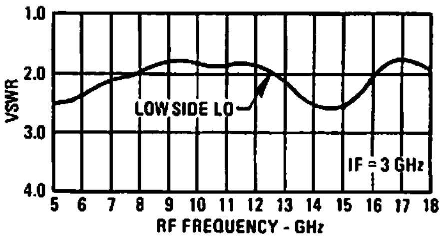
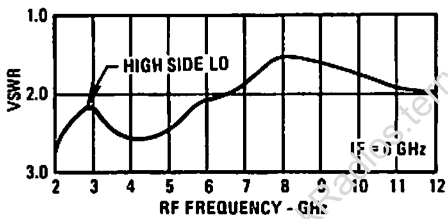
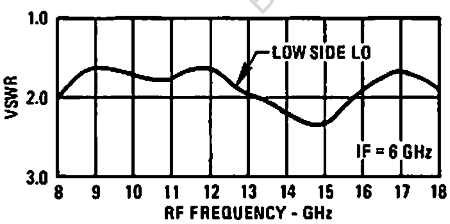
(continued)

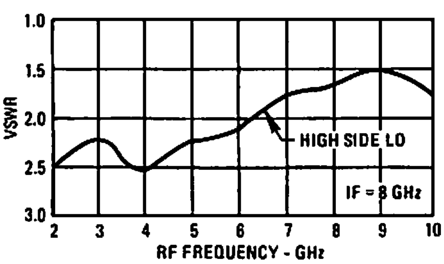
Typical Performance at 25°C (Cont.)

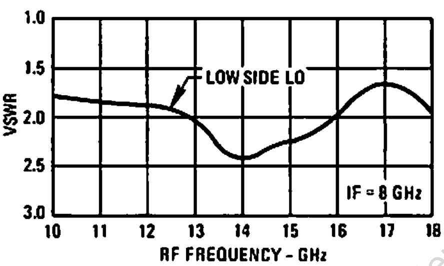
R-Port VSWR

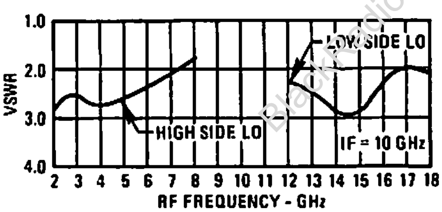




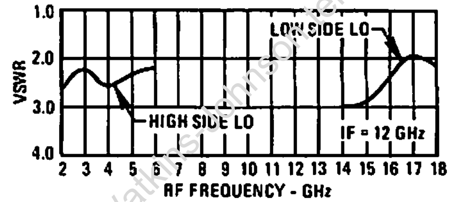




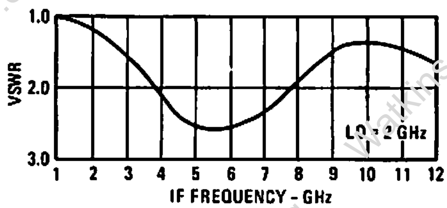


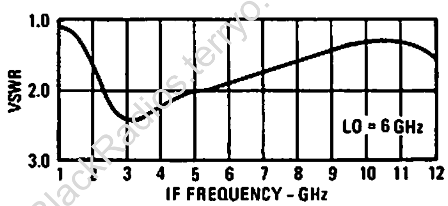


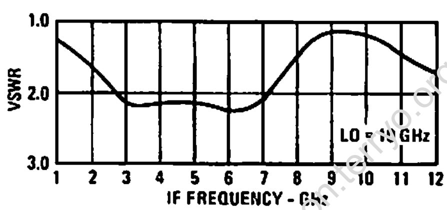
R-Port VSWR



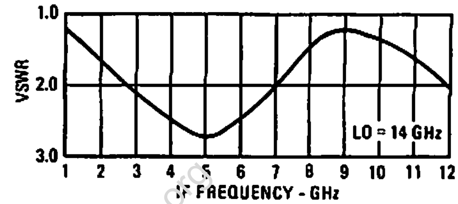
I-Port VSWR vs. Frequency, LO @ +10 dBm

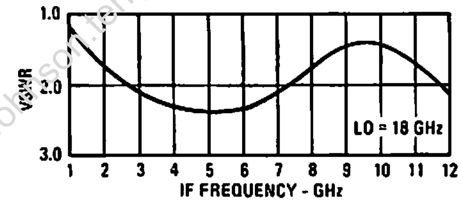


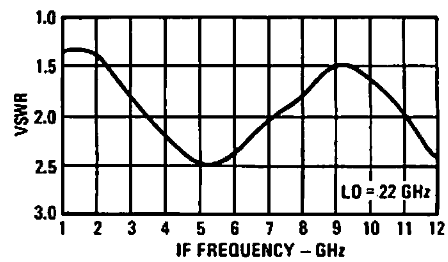


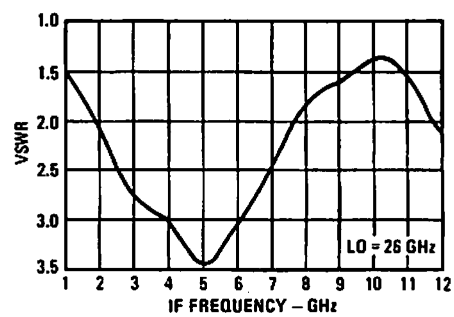


I-Port VSWR









Harmonics of f_L	R - Port	I - Port	Test Conditions
f_L	-16 dBm	-10 dBm	f_L = 2 GHz at +10 dBm
$2 f_L$	-15 dBm	-23 dBm	
$3 f_L$	-24.5 dBm	-23 dBm	
$4 f_L$	-33 dBm	-41 dBm	
$5 f_L$	-33 dBm	-34 dBm	
$6 f_L$	-46 dBm	-45 dBm	
$7 f_L$	-41 dBm	-41 dBm	
$8 f_L$	-42 dBm	-48 dBm	
$9 f_L$	-47.2 dBm	-50 dBm	
$10 f_L$	-46 dBm	-51 dBm	
$11 f_L$	-49 dBm	-51 dBm	
f_L	-30 dBm	-24 dBm	f_L = 6 GHz at +10 dBm
$2 f_L$	-24 dBm	-34 dBm	
$3 f_L$	-30dbm	-40 dBm	
f_L	-22 dBm	-23 dBm	f_L = 11 GHz at +10 dBm
$2 f_L$	-31 dBm	-28 dBm	

Typical Performance at 25°C (Cont.)

Single Tone IM	Typ.[2]	Test Conditions
f_L f_R		
1 x 1	0 dB	f_L = 2 GHz at +10 dBm
1 x 2	44 dB	f_R = 3.25 GHz at -10 dBm
1 x 3	> 65 dB	
2 x 1	36 dB	
2 x 2	50 dB	
3 x 1	14 dB	
3 x 2	48 dB	
3 x 3	67 dB	
4 x 1	35 dB	
4 x 2	55 dB	
5 X 1	28 dB	
5 x 3	—	
6 x 1	—	
6 x 2	60 dB	
7 x 1	33 dB	
7 x 3	> 65 dB	

Single Tone IM	Typ.[2]	Test Conditions
f_L f_R		
1 x 1	0 dB	f_L = 4.1 GHz at +10 dBm
1 x 2	55 dB	f_R = 6.0 GHz at -10 dBm
1 x 3	> 60 dB	
2 x 1	35 dB	
2 x 2	60 dB	
3 x 1	19 dB	
3 x 2	> 58 dB	
3 x 3	63 dB	
4 x 1	41 dB	
4 x 2	> 62 dB	
5 x 1	30 dB	
5 x 3	—	
6 x 1	45 dB	
6 x 2	62 dB	
7 x 1	—	
7 x 3	> 60 dB	

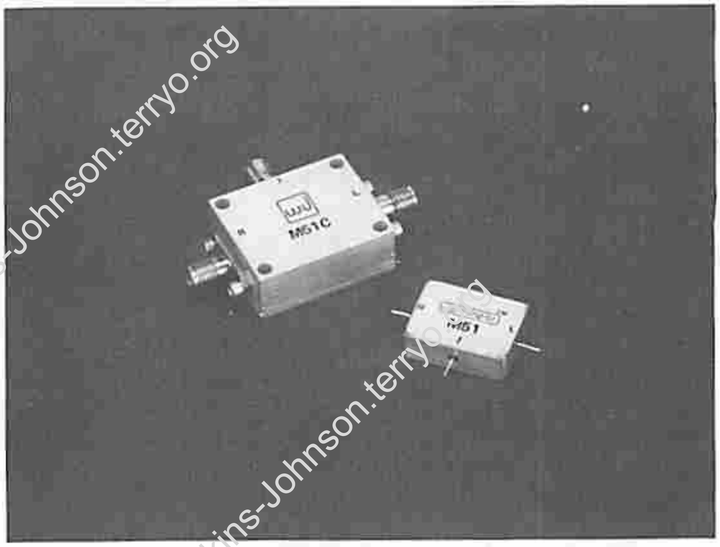
6

WJ-M51/M51C

TRIPLE BALANCED MIXER

LO 1.5 TO 24.0 GHz
RF 2.0 TO 24.0 GHz
IF 1.0 TO 15.0 GHz
LO DRIVE +10 dBm (nominal)

- HERMETICALLY SEALED
- VERY WIDEBAND IF 1 TO 12 GHz
- HIGH COMPRESSION POINT



Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.5 dB	9.5 dB	f_R 2.5 to 18.0 GHz f_L 1.5 to 18.0 GHz f_I 2.0 to 10.0 GHz
		8.0 dB	10.5 dB	f_R 2.0 to 18.0 GHz f_L 1.5 to 24.0 GHz f_I 1.0 to 12.0 GHz
		9.0 dB	11.5 dB	f_R 2.0 to 24.0 GHz f_L 1.5 to 24.0 GHz f_I 1.0 to 12.0 GHz 1.0 to 15.0 GHz $f_L > f_R$
Isolation				
L to R	15 dB	20 dB		f_L 1.5 to 3.0 GHz
L to R	20 dB	30 dB		f_L 3.0 to 24.0 GHz
L to I	20 dB	30 dB		f_L 7.0 to 24.0 GHz
L to I	15 dB	22 dB		f_L 1.5 to 7.0 GHz
Conversion Compression			1.0 dB	f_R Level +5.0 dBm f_L Level +10.0 dBm
Third-Order Input Intercept		+15 dBm		f_{R1} = 5.0 GHz, f_{R2} = 5.01 GHz both at 6 dBm f_L = 8.0 GHz at +10.0 dBm
		+15 dBm		f_{R1} = 16.0 GHz, f_{R2} = 16.01 GHz both at 6 dBm f_L = 18.0 GHz at +10.0 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +26 dBm max. at 25°C, +22 dBm max. at 100°C

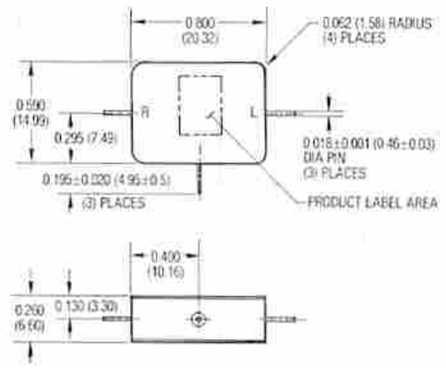
Weight

M51: 12 grams (0.42 oz.) max.
M51C: 40 grams (1.41 oz.) max.

Outline Drawings

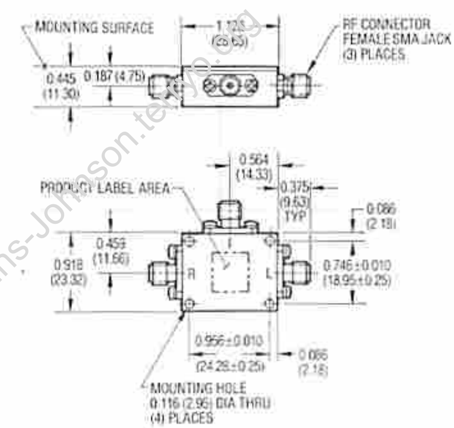
DIMENSIONS ARE IN INCHES (MILLIMETERS)

M51



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.010 (.25) UNLESS OTHERWISE SPECIFIED

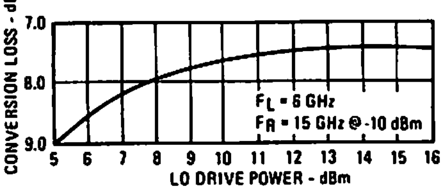
M51C

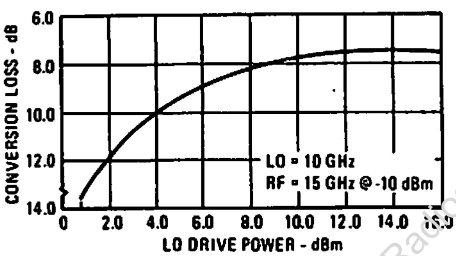


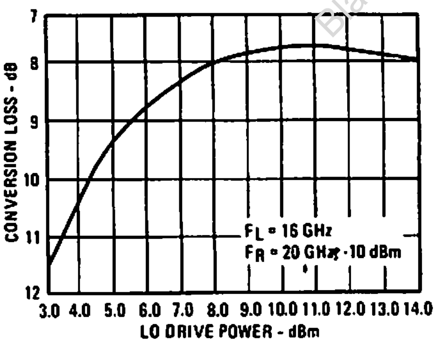
DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

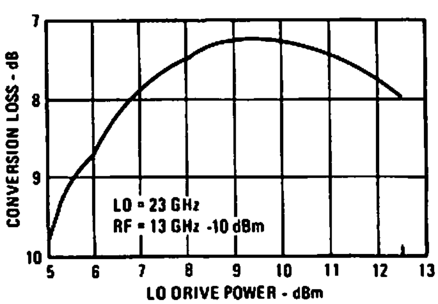
Typical Performance at 25°C

Drive Level



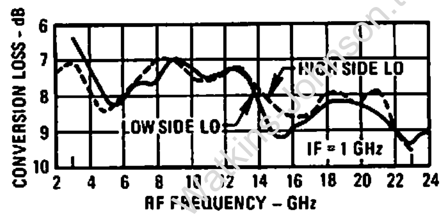


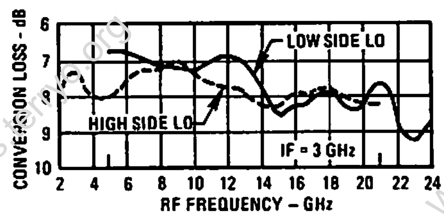


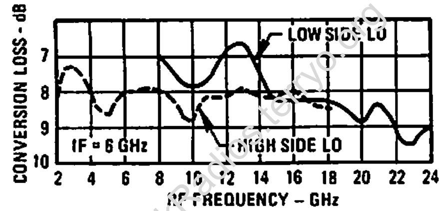


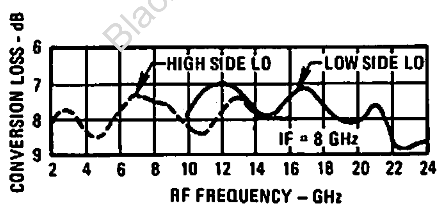
Drive Level: The maximum recommended drive level is +17 dBm.

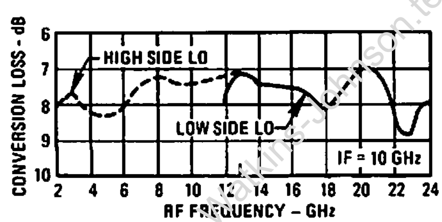
Conversion Loss vs. Frequency LO @ +10 dBm

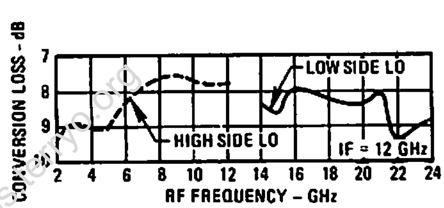


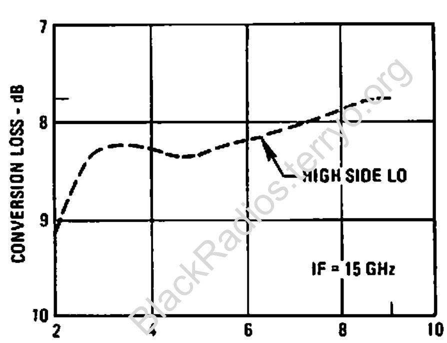




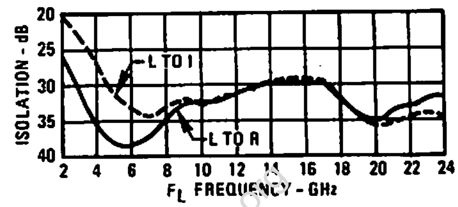


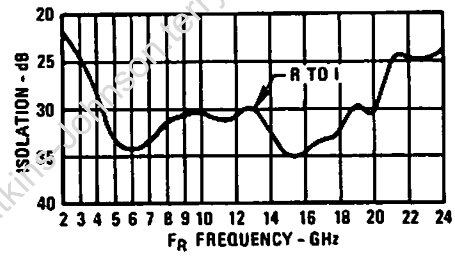




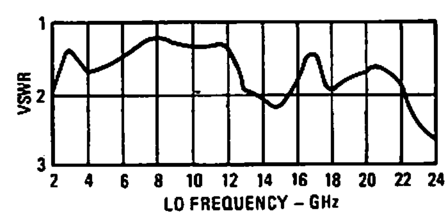


Isolation vs. Frequency

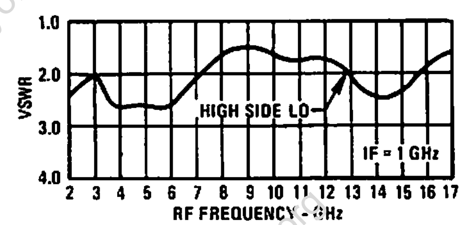


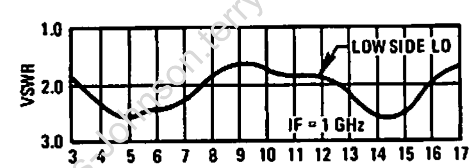


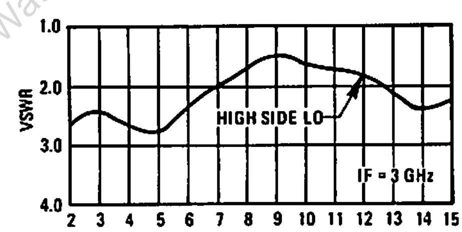
L-Port VSWR



R-Port VSWR LO @ +10 dBm





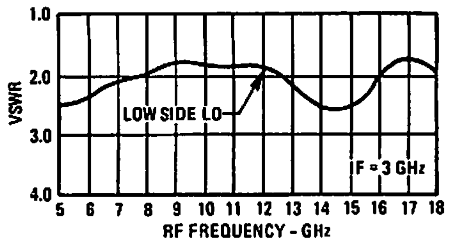


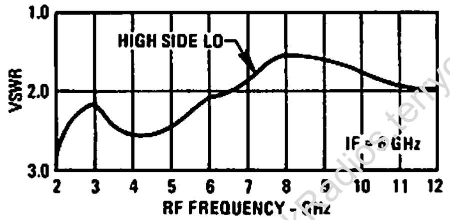
6

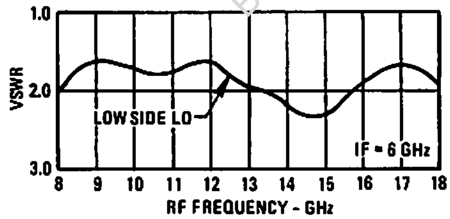
(continued)

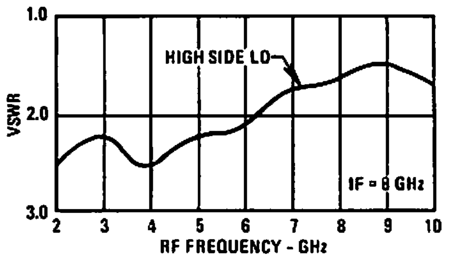
Typical Performance at 25°C (Cont.)

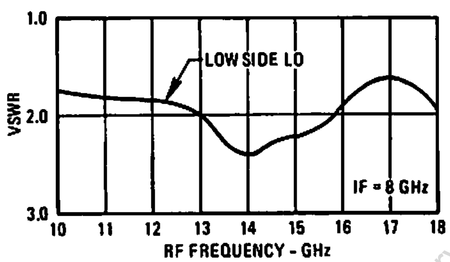
R-Port VSWR



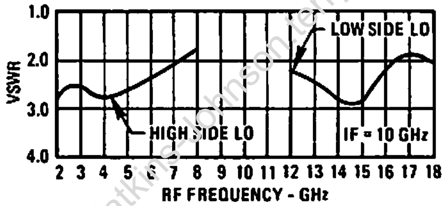


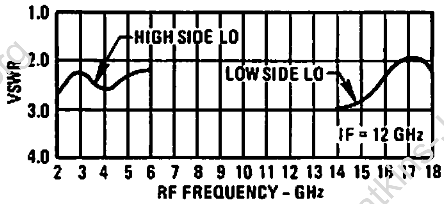


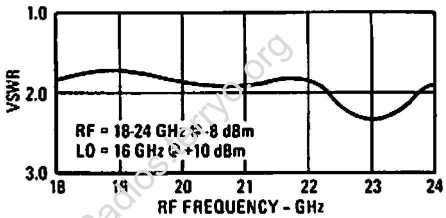


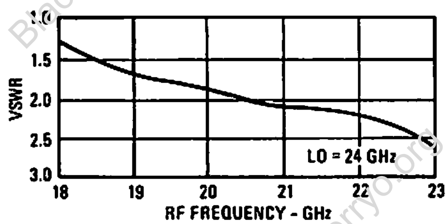


R-Port VSWR

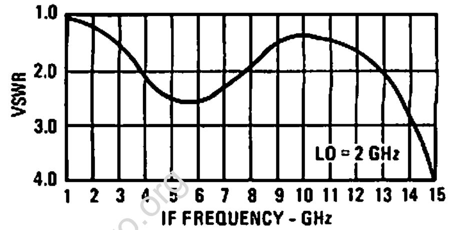


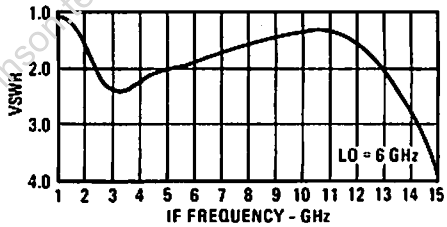


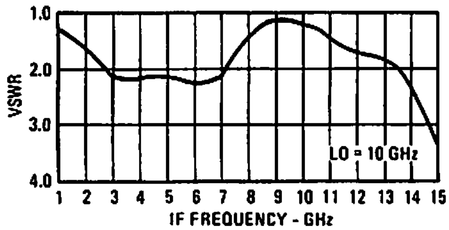


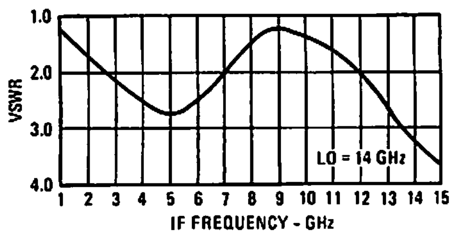


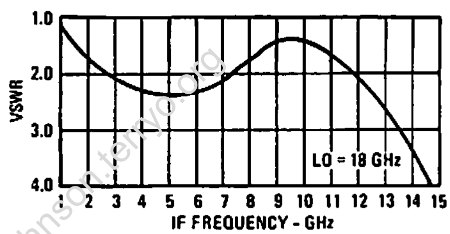
I-Port VSWR

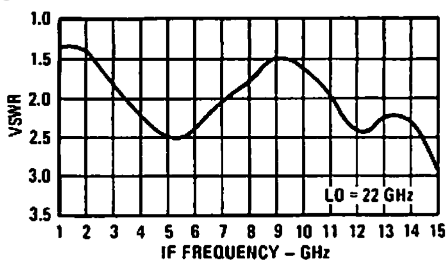












Typical Performance at 25°C (Cont.) [3]

Harmonics of f_L	R - Port	I - Port	Test Conditions
f_L	-16 dBm	-10 dBm	f_L = 2 GHz at +10 dBm
2 f_L	-15 dBm	-23 dBm	
3 f_L	-24.5 dBm	-23 dBm	
4 f_L	-33 dBm	-41 dBm	
5 f_L	-33 dBm	-34 dBm	
6 f_L	-46 dBm	-45 dBm	
7 f_L	-41 dBm	-41 dBm	
8 f_L	-42 dBm	-48 dBm	
9 f_L	-47.2 dBm	-50 dBm	
10 f_L	-46 dBm	-51 dBm	
11 f_L	-49 dBm	-51 dBm	
f_L	-30 dBm	-24 dBm	f_L = 6 GHz at +10 dBm
2 f_L	-24 dBm	-34 dBm	
3 f_L	-30dbm	-40 dBm	
f_L	-22 dBm	-23 dBm	f_L = 11 GHz at + 10 dBm
2 f_L	-31 dBm	-28 dBm	

Single Tone IM	Suppression Typ.[2]	Test Conditions
f_L f_R		
1 x 1	0 dB	f_L = 2 GHz at +10 dBm
1 x 2	44 dB	f_R = 3.25 GHz at -10 dBm
1 x 3	> 65 dB	
2 x 1	36 dB	
2 x 2	50 dB	
3 x 1	14 dB	
3 x 2	48 dB	
3 x 3	67 dB	
4 x 1	35 dB	
4 x 2	55 dB	
5 X 1	28 dB	
5 x 3	—	
6 x 1	—	
6 x 2	60 dB	
7 x 1	33 dB	
7 x 3	> 65 dB	
f_L f_R		
1 x 1	0 dB	f_L = 4.1 GHz at +10 dBm
1 x 2	55 dB	f_R = 6.0 GHz at -10 dBm
1 x 3	> 60 dB	
2 x 1	35 dB	
2 x 2	60 dB	
3 x 1	19 dB	
3 x 2	> 58 dB	
3 x 3	63 dB	
4 x 1	41 dB	
4 x 2	> 62 dB	
5 x 1	30 dB	
5 x 3	—	
6 x 1	45 dB	
6 x 2	62 dB	
7 x 1	—	
7 x 3	> 60 dB	

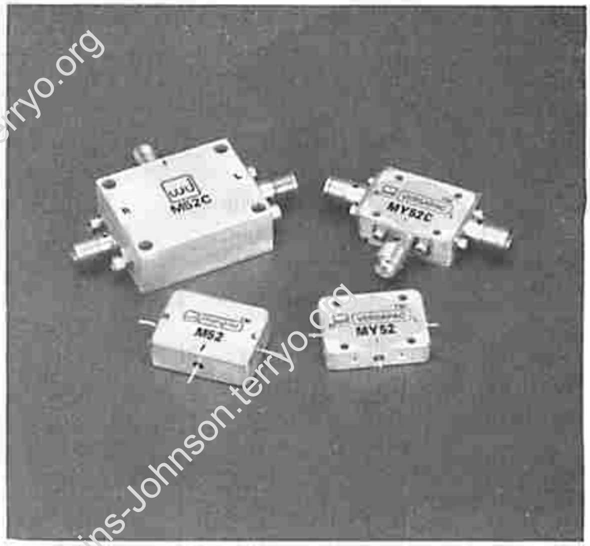
6

WJ-M52/M52C
WJ-MY52/MY52C

TRIPLE (DOUBLE-DOUBLE) BALANCED MIXER

LO, RF } 2.0 TO 24.0 GHz
IF 0.1 TO 5.0 GHz
LO DRIVE +10 dBm (nominal)

- HERMETICALLY SEALED
- HIGH COMPRESSION POINT



Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.0 dB	9.0 dB	f_R = 2-18 GHz f_L = 2-18 GHz f_I = 0.1-4 GHz
		8.5 dB	10.0 dB	f_R = 2-18 GHz f_L = 2-18 GHz f_I = 0.1-5 GHz
		8.0 dB	10.0 dB	f_R = 2-18 GHz f_L = 2-22 GHz f_I = 0.1-4 GHz
		9.0 dB	12.0 dB	f_R = 18-24 GHz f_L = 13-24 GHz f_I = 0.1-5 GHz
Isolation L – R	15 dB 20 dB 15 dB	18 dB 25 dB 20 dB		f_L = 2.0-3.0 GHz f_L = 4.0-23.0 GHz f_L = 23.0-24.0 GHz
L – I	22 dB	30 dB		f_L = 2.0-24.0 GHz
Conversion Compression			1.0 dB	f_R Level +5.0 dBm f_L Level +10.0 dBm
Third-Order Input Intercept		+16 dBm		RF_1 3.75 GHz -6 dBm RF_2 3.76 GHz -6 dBm LO 4.0 GHz +10 dBm
		+16 dBm		RF_1 13.0 GHz -6 dBm RF_2 13.01 GHz -6 dBm LO 11.0 GHz +10 dBm
		+13 dBm		RF_1 20.0 GHz -6 dBm RF_2 20.01 GHz -6 dBm LO 24.0 GHz +10 dBm

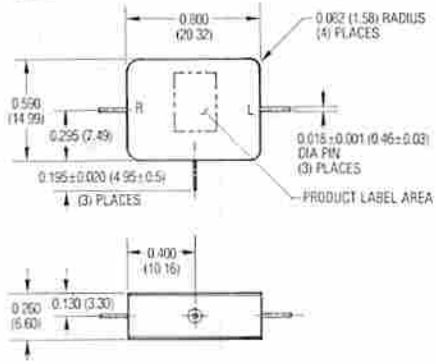
Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +26 dBm max. at 25°C, +22 dBm max. at 100°C

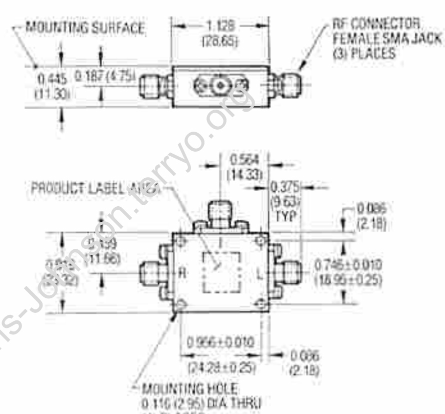
Outline Drawings

M52



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

M52C



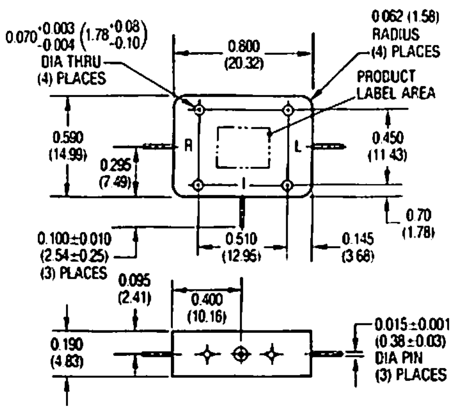
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

Weight

M52: 12 grams (0.42 oz.) max.
M52C: 40 grams (1.41 oz.) max.
MY52: 12 grams (0.42 oz.) max.
MY52C: 18 grams (0.63 oz.) max.

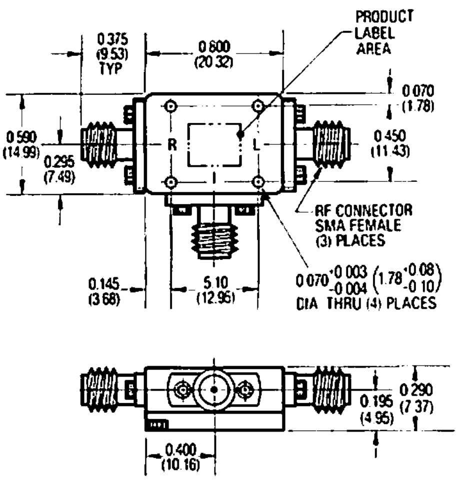
Outline Drawings

MY52



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.010 (.25) UNLESS OTHERWISE SPECIFIED

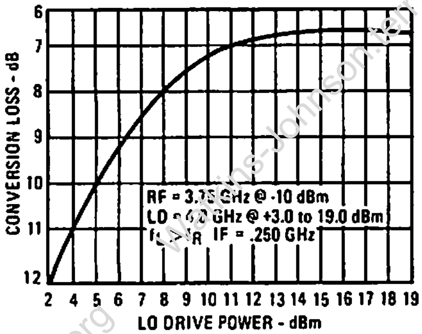
MY52C

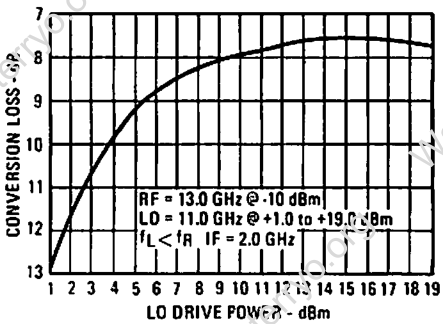


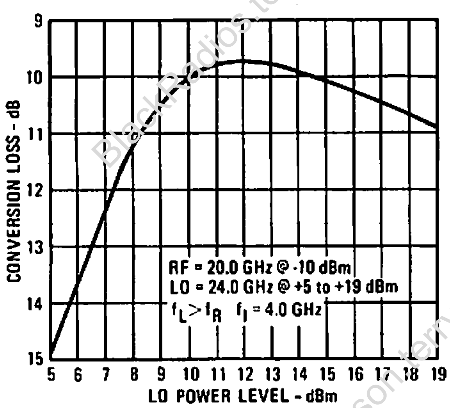
DIMENSIONS ARE IN INCHES (MILLIMETERS)
± 0.015 (0.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C *

Drive Level

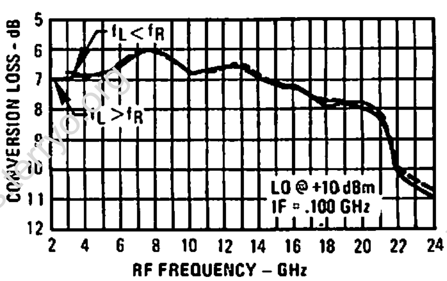


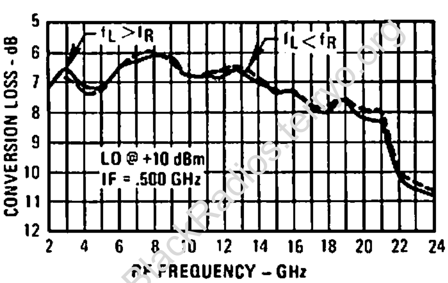




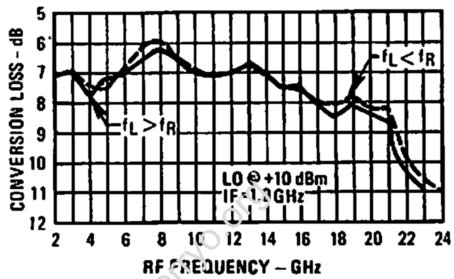
Drive Level: The maximum recommended drive level is +17 dBm.

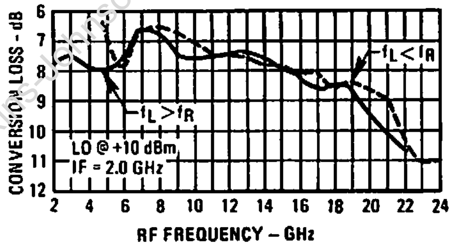
Conversion Loss vs. Frequency

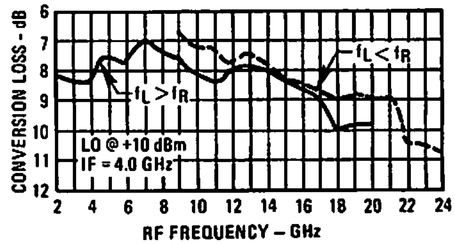


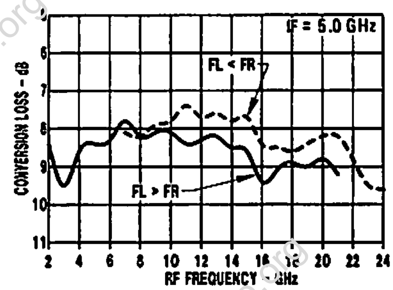


Conversion Loss vs. Frequency

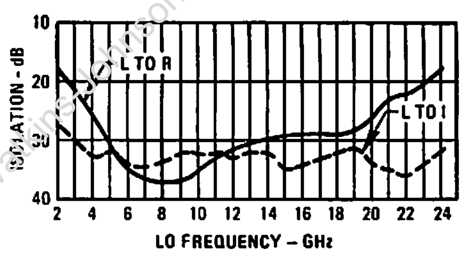


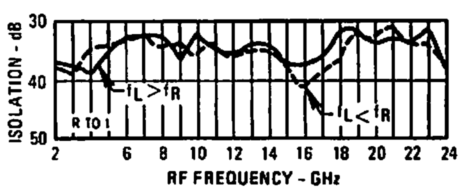






Isolation vs. Frequency





*Typical performance applies to the MINPAC™ model and does not necessarily reflect the performance of the VERSAPAC® model.

(continued)

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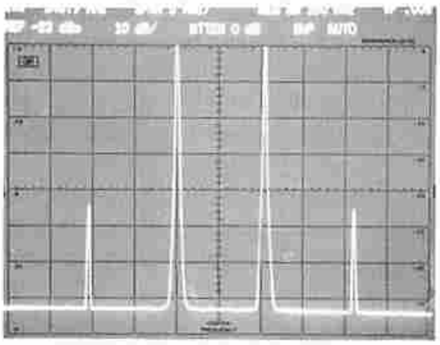
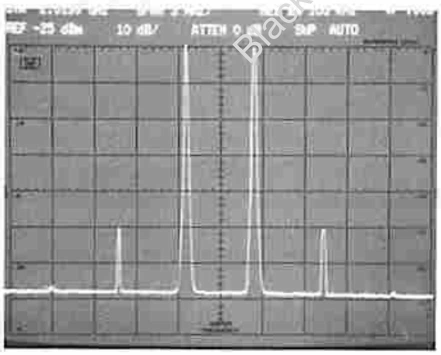
Typical Performance at 25°C * (Cont.)

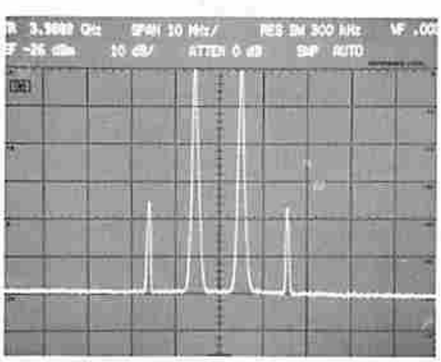
Third-Order Intercept Input



f_R = 3.75, 3.76 @ -6 dBm
LO = 4.0 GHz @ +10 dBm

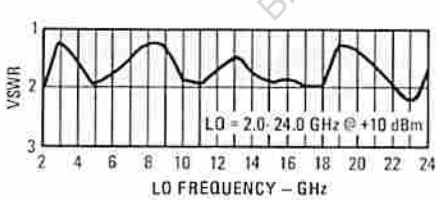


f_R = 13 GHz, 13.01 GHz @ -6 dBm
LO = 11.0 GHz @ +10 dBm

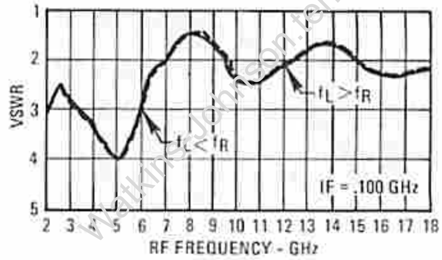


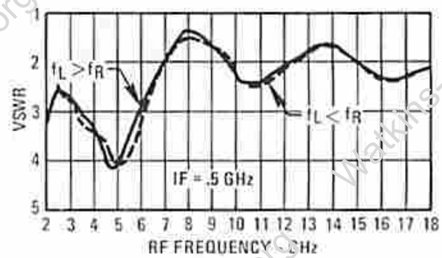
f_R = 20 GHz, 20.01 GHz @ -6 dBm
LO = 24 GHz @ +10 dBm

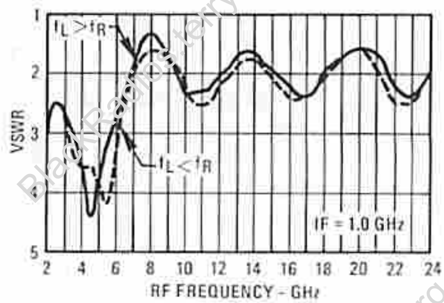
L-Port VSWR

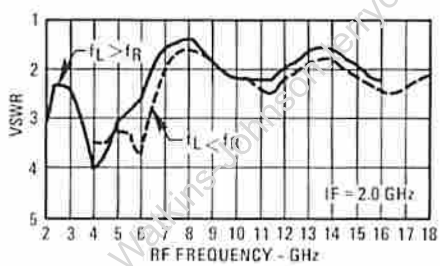


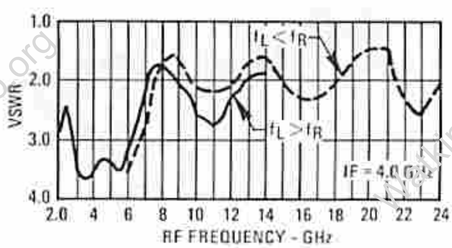
R-Port VSWR



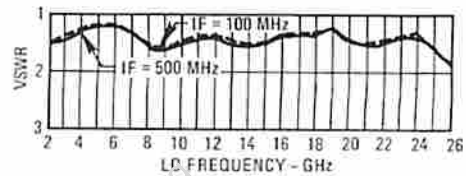


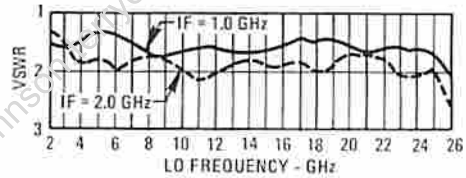


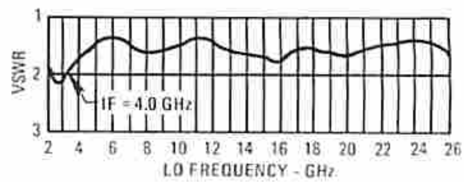




I-Port VSWR







*Typical performance applies to the MINPAC™ model and does not necessarily reflect the performance of the VERSAPAC® model.

Typical Performance at 25°C (Cont.)

Harmonics of f_L	R - Port	I - Port	Test Conditions
f_L	-8 dBm	-16 dBm	f_L = 2 GHz at +10 dBm
$2 f_L$	-27 dBm	-18 dBm	
$3 f_L$	-21 dBm	-34 dBm	
$4 f_L$	-31 dBm	-27 dBm	
$5 f_L$	-29 dBm	-41 dBm	
$6 f_L$	-49 dBm	-38 dBm	
$7 f_L$	-34 dBm	-46 dBm	
$8 f_L$	-49 dBm	-61 dBm	
$9 f_L$	-41 dBm	-53 dBm	
$10 f_L$	-54 dBm	-58 dBm	
$11 f_L$	-50 dBm	-58 dBm	
f_L	-24 dBm	-24 dBm	f_L = 6 GHz at +10 dBm
$2 f_L$	-25 dBm	-30 dBm	
$3 f_L$	-27 dBm	-32 dBm	
f_L	-23 dBm	-22 dBm	f_L = 11 GHz at +10 dBm
$2 f_L$	-38 dBm	-41 dBm	

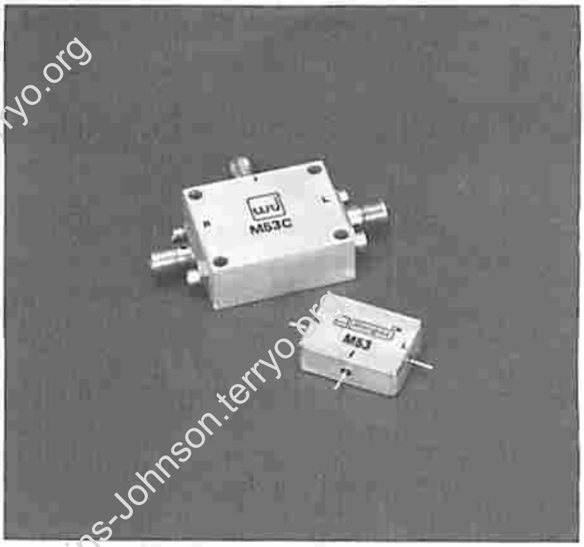
Single Tone Im f_L f_R	Typical Suppression	Test Conditions
f_L f_R		
1 x 1	0 dB	f_L = 2 GHz at +10 dBm f_R = 3.25 GHz at -10 dBm
1 x 2	39 dB	
1 x 3	48 dB	
2 x 1	33 dB	
2 x 2	40 dB	
3 x 1	14 dB	
3 x 2	47 dB	
3 x 3	65 dB	
4 x 1	45 dB	
4 x 2	43 dB	
5 x 1	19 dB	
5 x 3	62 dB	
6 x 2	42 dB	
7 x 3	55 dB	
f_L f_R		
1 x 1	0 dB	f_L = 4.1 GHz at +10 dBm f_R = 6.0 GHz at -10 dBm
1 x 2	56 dB	
2 x 1	31 dB	
2 x 2	48 dB	
3 x 1	15 dB	
3 x 2	51 dB	
3 x 3	57 dB	
4 x 1	43 dB	
4 x 2	44 dB	
5 x 3	54 dB	
7 x 3	67 dB	

6

WJ-M53/53C

TRIPLE-BALANCED (DOUBLE-DOUBLE) MIXER

LO / RF } 2.0 TO 26.0 GHz
IF 0.1 TO 6.0 GHz
LO DRIVE +10 dBm (nominal)



- HERMETICALLY SEALED
- WIDEBAND IF 0.1 to 6 GHz
- HIGH COMPRESSION POINT

Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.0 dB	9.0 dB	f_R = 2-18 GHz f_L = 2-18 GHz f_I = 0.1-4 GHz
		8.5 dB	10.5 dB	f_R = 2-18 GHz f_L = 2-18 GHz f_I = 0.1-6 GHz
		8.0 dB	10.0 dB	f_R = 2-18 GHz f_L = 2-22 GHz f_I = 0.1-4 GHz
		9.0 dB	12.0 dB	f_R = 18-26 GHz f_L = 13-26 GHz f_I = 0.1-6 GHz
Isolation L – R	15 dB 20 dB 15 dB	18 dB 25 dB 20 dB		f_L = 2.0-3.0 GHz f_L = 4.0-23.0 GHz f_L = 23.0-26 GHz
L – I	22 dB	30 dB		f_L = 2.0-26 GHz
Conversion Compression			1.0 dB	f_R Level +5.0 dBm f_L Level +10.0 dBm
Third-Order Input Intercept		+16 dBm		RF_1 3.75 GHz -6 dBm RF_2 3.76 GHz -6 dBm LO 4.0 GHz +10 dBm
		+16 dBm		RF_1 13.0 GHz -6 dBm RF_2 13.01 GHz -6 dBm LO 11.0 GHz +10 dBm
		+13 dBm		RF_1 20.0 GHz -6 dBm RF_2 20.01 GHz -6 dBm LO 24.0 GHz +10 dBm

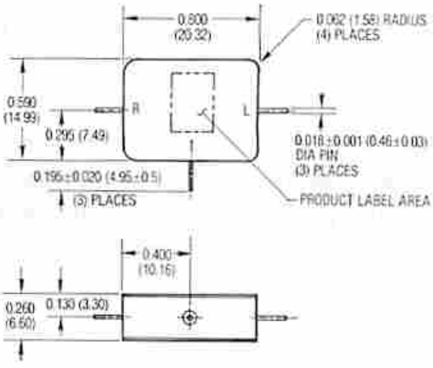
Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

Operating Temperature. . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +26 dBm max. at 25°C, +22 dBm max. at 100°C

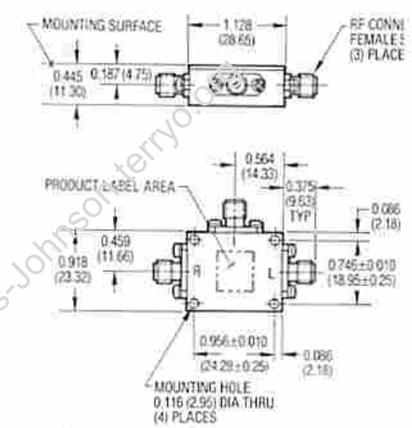
Outline Drawings

M53



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

M53C



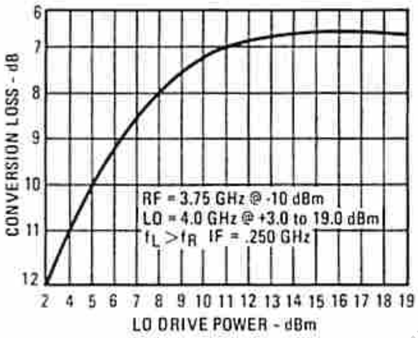
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

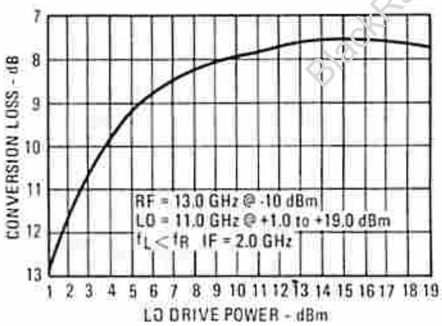
Weight

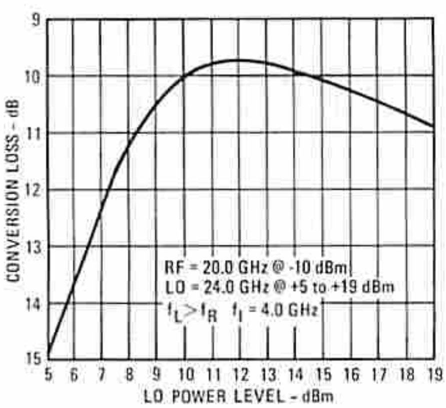
M52:	12 grams (0.42 oz.) max.
M52C:	40 grams (1.41 oz.) max.
MY52:	12 grams (0.42 oz.) max.
MY52C:	18 grams (0.63 oz.) max.

Typical Performance at 25°C

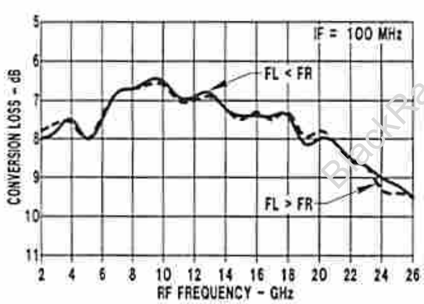
Drive Level: The maximum recommended drive level is +17 dBm.



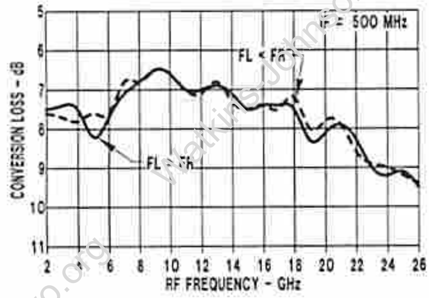


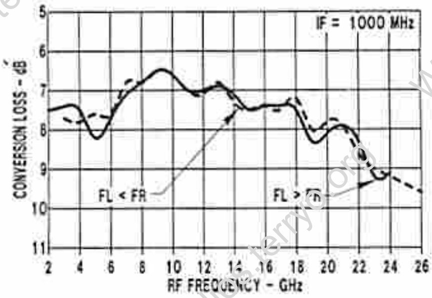


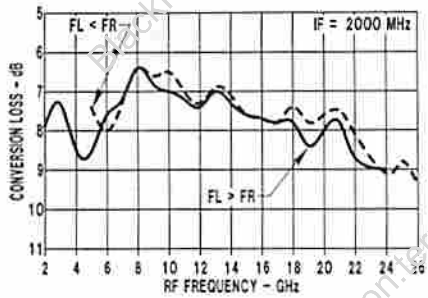
Conversion Loss vs. Frequency

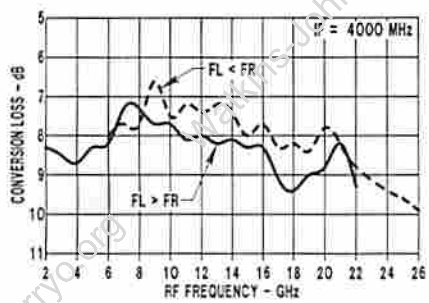


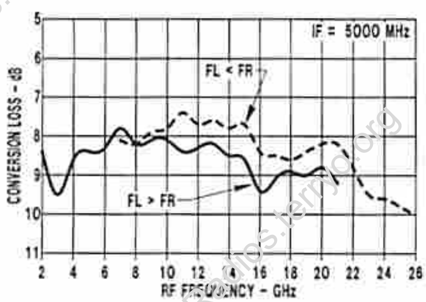
Conversion Loss vs. Frequency



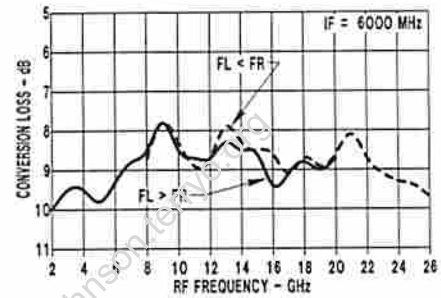




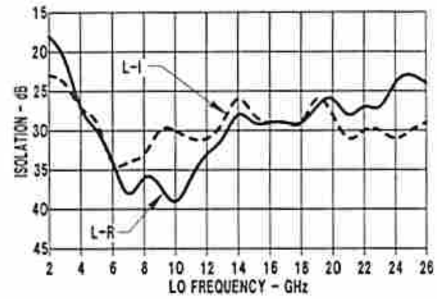


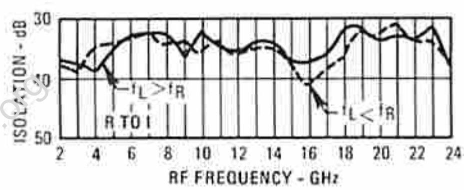


Conversion Loss vs. Frequency

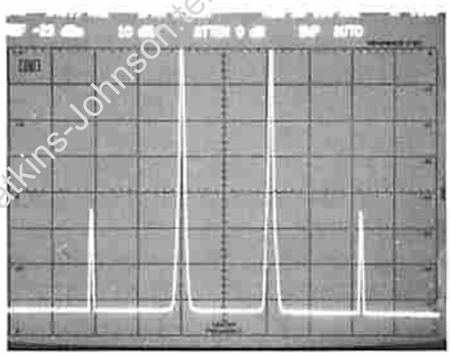


Isolation vs. Frequency





Third-Order Intercept Input



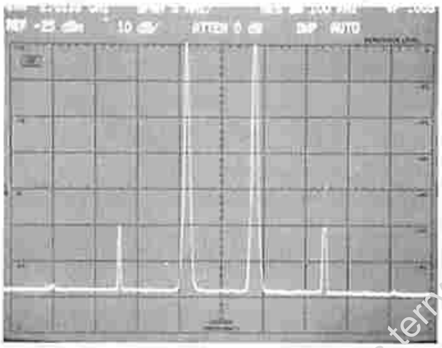
f_R = 3.75, 3.76 at –6 dBm
LO = 4.0 GHz at +10 dBm

6

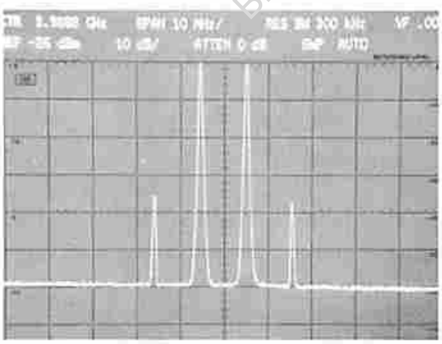
(continued)

Typical Performance at 25°C (Cont.)

Third-Order Intercept Input

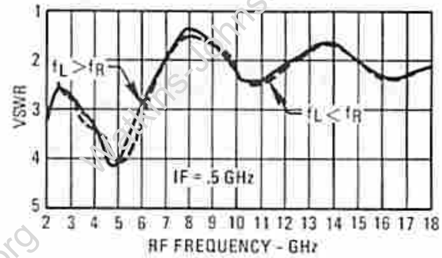


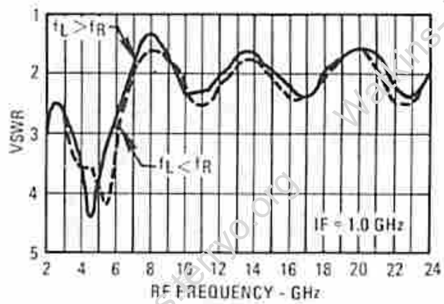
f_R = 13 GHz, 13.01 GHz at -6 dBm
LO = 11.0 GHz at +10 dBm

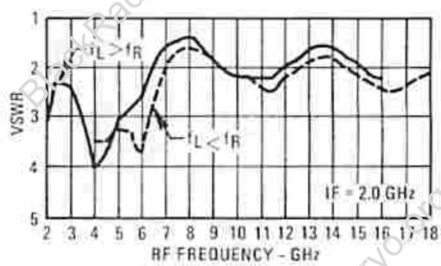


f_R = 20 GHz, 20.01 GHz at -6 dBm
LO = 24 GHz at +10 dBm

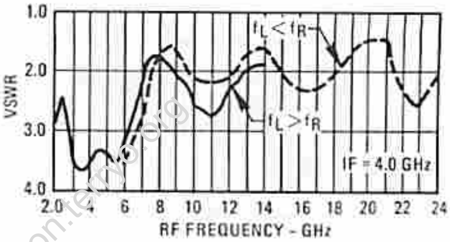
R-Port VSWR



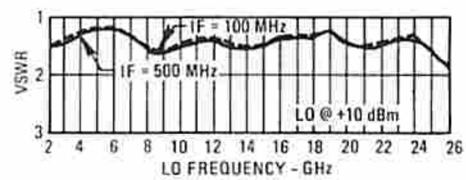


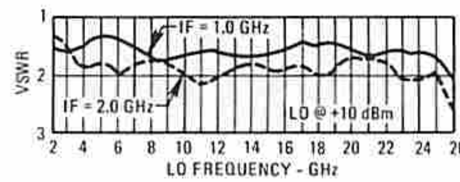


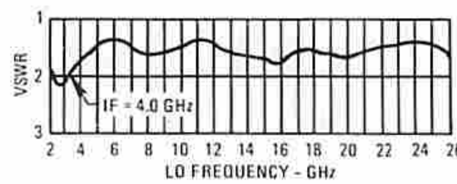
R-Port VSWR



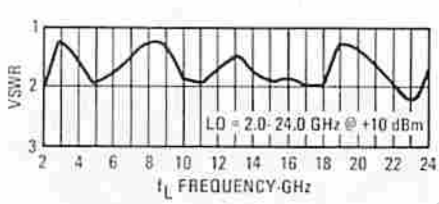
I-Port VSWR



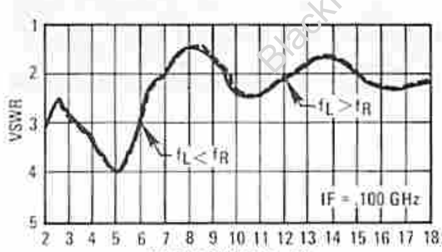




L-Port VSWR



R-Port VSWR



Harmonics of f_L	R - Port	I - Port	Test Conditions
f_L	-8 dBm	-16 dBm	f_L = 2 GHz at +10 dBm
2 f_L	-27 dBm	-18 dBm	
3 f_L	-21 dBm	-34 dBm	
4 f_L	-31 dBm	-27 dBm	
5 f_L	-29 dBm	-41 dBm	
6 f_L	-49 dBm	-38 dBm	
7 f_L	-34 dBm	-46 dBm	
8 f_L	-49 dBm	-61 dBm	
9 f_L	-41 dBm	-53 dBm	
10 f_L	-54 dBm	-58 dBm	
11 f_L	-50 dBm	-58 dBm	
f_L	-24 dBm	-24 dBm	f_L = 6 GHz at +10 dBm
2 f_L	-25 dBm	-30 dBm	
3 f_L	-27 dBm	-32 dBm	
f_L	-23 dBm	-22 dBm	f_L = 11 GHz at +10 dBm
2 f_L	-38 dBm	-41 dBm	

Typical Performance at 25°C (Cont.)

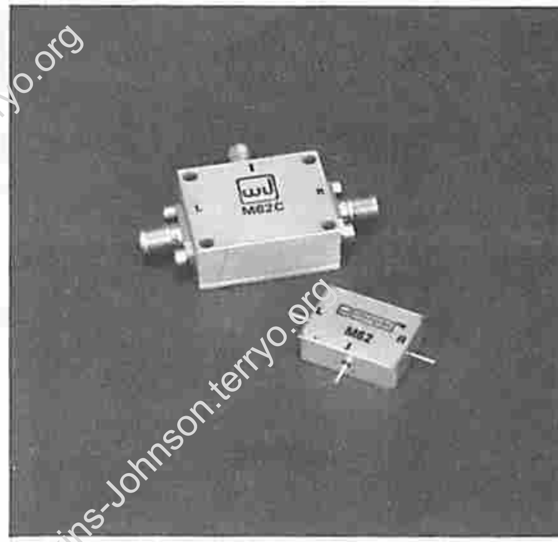
Single Tone Im f_L f_R	Typical Suppression	Test Conditions
f_L f_R		
1 x 1	0 dB	f_L = 2 GHz at +10 dBm
1 x 2	39 dB	f_R = 3.25 GHz at -10 dBm
1 x 3	48 dB	
2 x 1	33 dB	
2 x 2	40 dB	
3 x 1	14 dB	
3 x 2	47 dB	
3 x 3	65 dB	
4 x 1	45 dB	
4 x 2	43 dB	
5 x 1	19 dB	
5 x 3	62 dB	
6 x 2	42 dB	
7 x 3	55 dB	
f_L f_R		
1 x 1	0 dB	f_L = 4.1 GHz at +10 dBm
1 x 2	56 dB	f_R = 6.0 GHz at -10 dBm
2 x 1	31 dB	
2 x 2	48 dB	
3 x 1	16 dB	
3 x 2	51 dB	
3 x 3	57 dB	
4 x 1	43 dB	
4 x 2	44 dB	
5 x 3	54 dB	
7 x 3	67 dB	

6

WJ-M62/M62C

DOUBLE-BALANCED MIXER

LO 2.6 TO 5.35 GHz
RF 3.7 TO 4.2 GHz
IF DC TO 1450 MHz
LO DRIVE +9 dBm (nominal)



- HERMETICALLY SEALED
- LOW VSWR

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		4.9 dB 5.5 dB	6.0 dB 6.5 dB	f_R 3.7 to 4.2 GHz f_I 30 to 1450 MHz $f_L > f_R$ $f_R > f_L$
Isolation f_L at R f_L at I	25 dB 25 dB 20 dB 15 dB	40 dB 30 dB 30 dB 25 dB		f_L 2.6 to 5.35 GHz f_L 4.5 to 5.35 GHz f_L 3.6 to 4.5 GHz f_L 2.6 to 3.6 GHz
Conversion Compression			1.0 dB	f_R Level +3 dBm
VSWR L-Port R-Port I-Port		1.25:1 1.25:1 1.4:1 1.5:1 1.3:1 1.8:1	2.0:1 2.0:1 2.0:1 2.0:1 2.0:1 2.5:1	f_L 2.6 to 5.35 GHz f_R 3.7 to 4.2 GHz $f_L > f_R$ f_R 3.7 to 4.2 GHz $f_L < f_R$ f_I = 100 MHz f_I = 500 MHz f_I = 1450 MHz
Flatness			0.2 dB peak-to-peak	Over any 40 MHz segment of f_R = 3.7 to 4.2 GHz
Third Order Input Intercept		+11 dBm		f_{R1} = 3.98 GHz f_{R2} = 3.96 GHz both at −10 dBm f_L = 2.75 GHz at +9 dBm
Group Time Delay		0.5 ns	0.75 ns	f_R 3.7 to 4.2 GHz

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

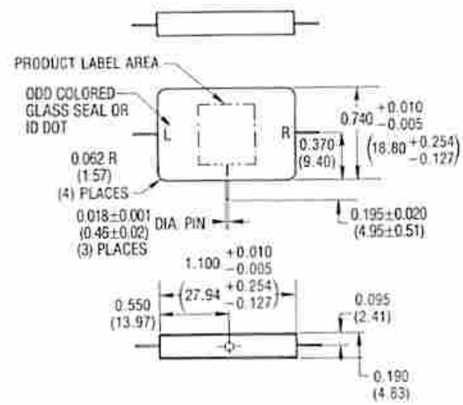
Absolute Maximum Ratings

Operating Temperature. . . . . −54°C to 100°C
Storage Temperature . . . . −65°C to 100°C
Peak Input Power . . . . 23 dBm max. at 25°C, 20 dBm max. at 60°C
Peak Input Current at 25°C. . . . . 50 mA DC

Weight M62: 14 grams (0.5 oz.) max.
M62C: 45 grams (1.6 oz.) max.

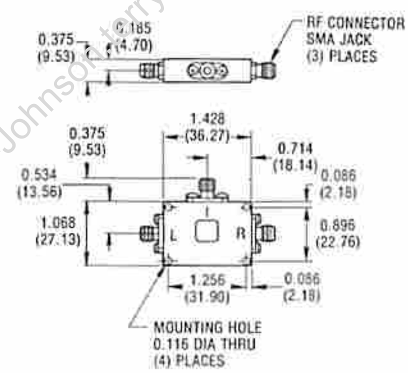
Outline Drawings

M62 (MINPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

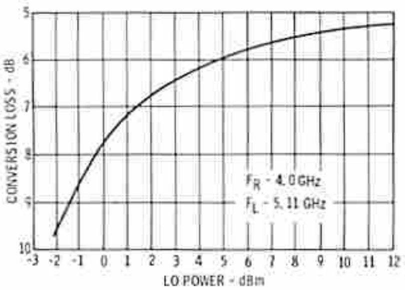
M62C (CONNECTORIZED)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

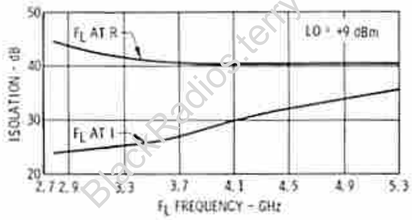
Typical Performance at 25°C

Conversion Loss vs. LO Power

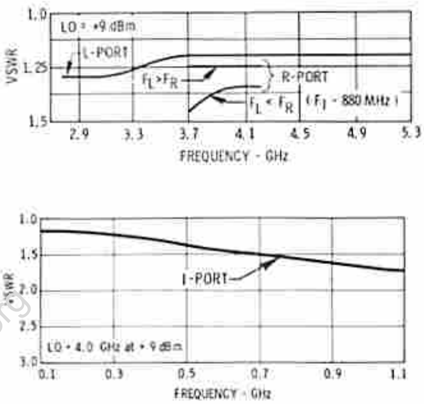


Drive Level: The maximum recommended drive level is +13 dBm.

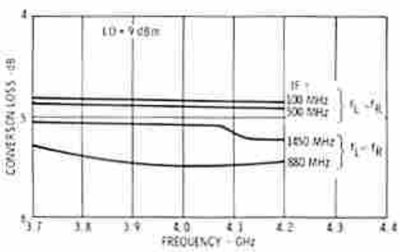
Isolation vs. Frequency



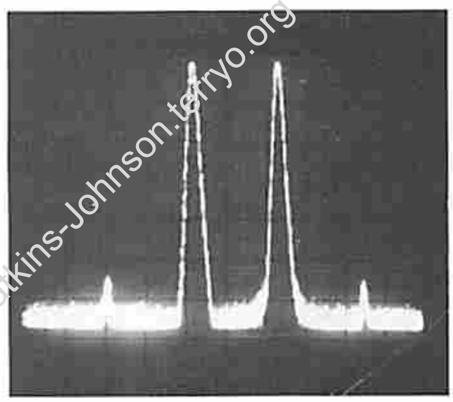
VSWR vs. Frequency



Conversion Loss vs. Frequency



Typical Two-Tone Intermodulation



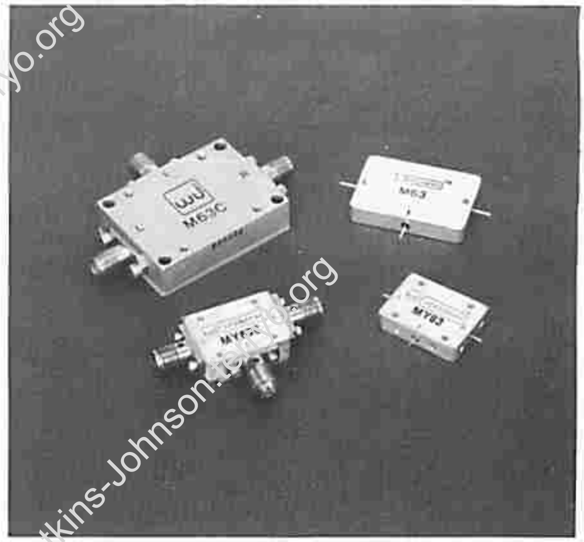
Typical Two-Tone Intermodulation Performance: f_I 550 MHz, f_R = 3.95 GHz ± 1 MHz, f_R @ -10 dBm, $f_L > f_R$ f_L = 4.5 GHz @ +9 dBm. Vertical scale = 10 dB/cm.

6

WJ-M63/M63C
WJ-MY63/MY63C

DOUBLE-BALANCED MIXER

LO 2.5 TO 7.5 GHz
RF 2.5 TO 5.5 GHz
IF DC TO 1.5 GHz
LO DRIVE +9 dBm (nominal)



- HERMETICALLY SEALED
- QPL VERSION AVAILABLE! (See Section 7)

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		5.0 dB	6.0 dB	$f_L > f_R$ f_R 3.0 to 5.0 GHz f_L 3.0 to 5.5 GHz f_I 0.03 to 0.5 GHz
		5.8 dB	7.0 dB	f_R 2.5 to 5.5 GHz f_L 2.5 to 7.0 GHz f_I 0.03 to 1.5 GHz
Isolation f_L at R f_L at I f_L at I	 30 dB 17 dB 20 dB	 40 dB 25 dB 30 dB		 f_L 2.5 to 7.0 GHz f_L 2.5 to 3.5 GHz f_L 3.5 to 7.0 GHz
Conversion Compression			1.0 dB	f_R Level +3 dBm
Third-Order Input Intercept Point		+11 dBm		f_{R1} = 4.0 GHz -10 dBm f_{R2} = 4.01 GHz -10 dBm f_L = 2.8 GHz +9 dBm
VSWR R-Port L-Port L-Port		 1.5:1 1.5:1 2.0:1		

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications. I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

*Typical performance applies to the MINPAC® model and does not necessary reflect the performance of the VERSAPAC® model.

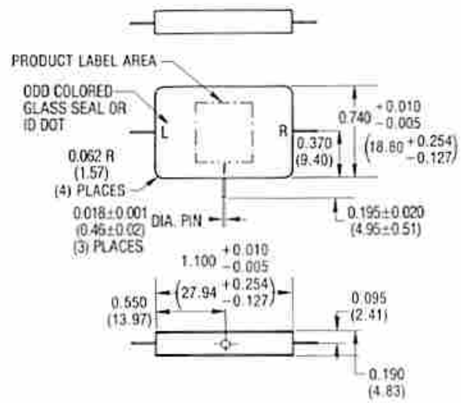
Absolute Maximum Ratings

Operating Temperature. . . . . -54°C to 100°C
Storage Temperature . . . . -65°C to 100°C
Peak Input Power . . . . 23 dBm max. at 25°C
Peak Input Current at 25°C. . . . . 100 mA DC

Weight
M63: 14 grams (0.5 oz.) max
M63C: 45 grams (1.6 oz.) max
MY63: 7.9 grams (0.28 oz.) max
MY63C: 20.0 grams (0.70 oz.) max

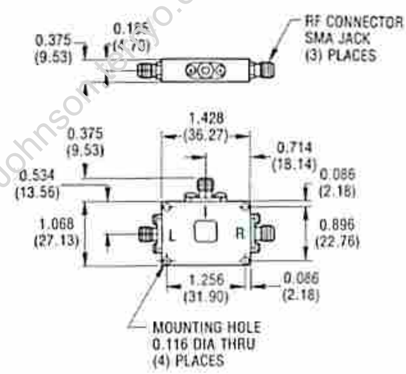
Outline Drawings

M63 (MINPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

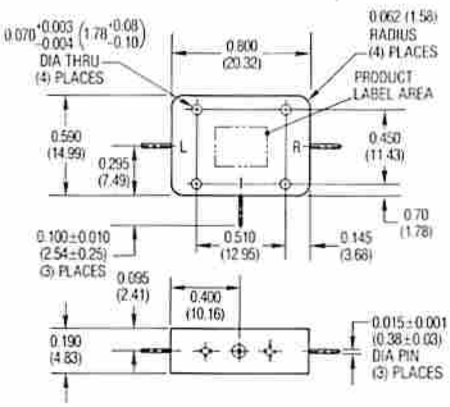
M63C (CONNECTORIZED)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

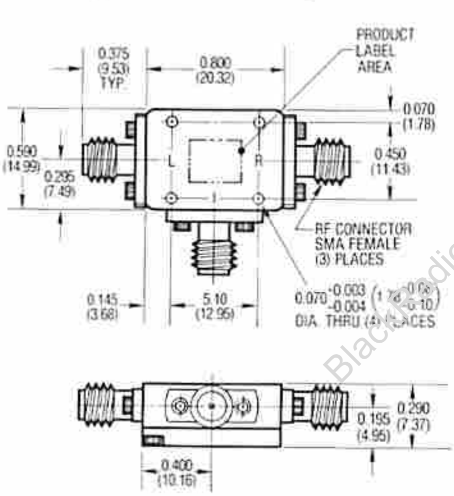
Outline Drawings

MY63 (VERSAPAC)



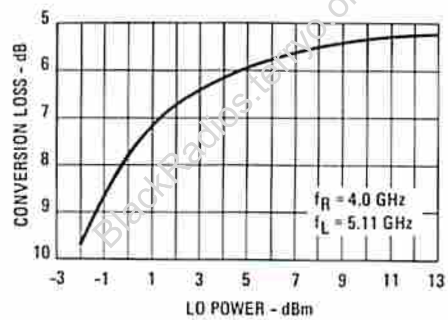
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

MY63C (CONNECTORIZED)



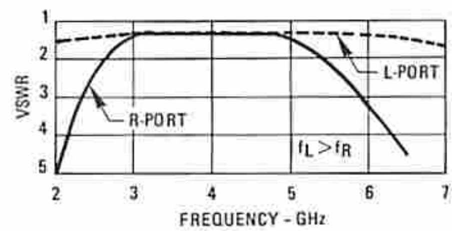
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

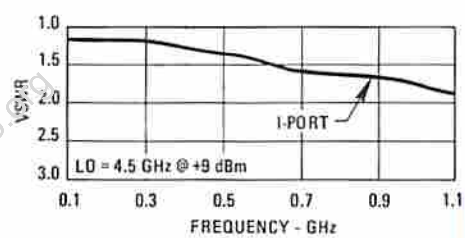
Typical Performance at 25°C*



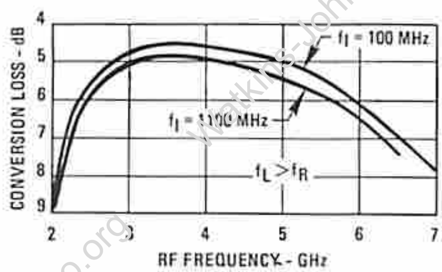
Drive Level: The maximum recommended drive level is +13 dBm.

VSWR

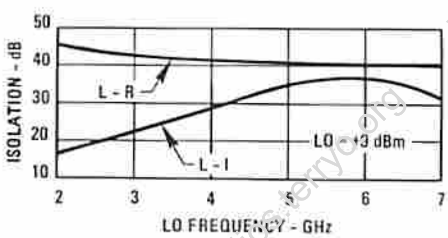




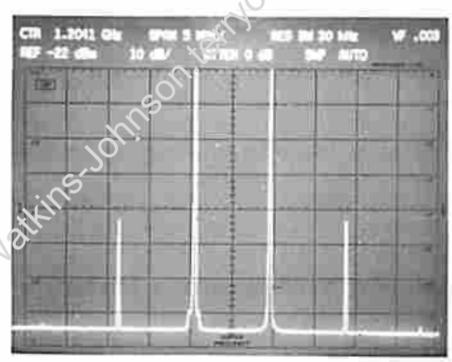
Conversion Loss



Isolation



Typical Two-Tone Intermodulation Performance



Typical Two-Tone Intermodulation Performance: f_I = 1200 MHz, f_R = 3.95 GHz ±10 MHz, f_R @ −10 dBm $f_R > f_L$, f_L = 2.75 GHz @ +9 dBm. Vertical scale = 10 dB/cm.

*Typical performance applies to the MINPAC™ model and does not necessarily reflect the performance of the VERSAPAC® model.

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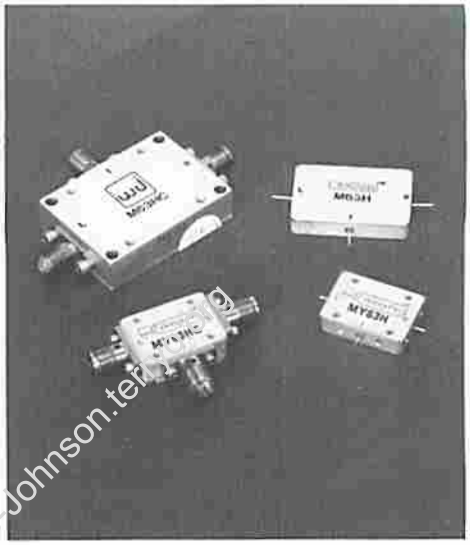
WJ-M63H/M63HC
WJ-MY63H/MY63HC

DOUBLE-BALANCED MIXER

LO 2.5 TO 7.5 GHz
RF 2.5 TO 6.0 GHz
IF DC TO 1.5 GHz
LO DRIVE +20 dBm (nominal)



- HERMETICALLY SEALED

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		5.8 dB	6.5 dB	$f_L > f_R$; f_R 3.0 to 5.0 GHz; f_L 3.0 to 5.5 GHz; f_I 0.03 to 0.5 GHz
		6.0 dB	7.5 dB	f_R 2.5 to 6.0 GHz; f_L 2.5 to 7.5 GHz; f_I 0.03 to 1.5 GHz
Isolation				
f_L at R	30 dB	42 dB		f_L 2.5 to 6.5 GHz
f_L at R	26 dB	32 dB		f_L 6.5 to 7.5 GHz
f_L at I	19 dB	24 dB		f_L 3.0 to 5.5 GHz
f_L at I	13 dB	18 dB		f_L 5.5 to 7.5 GHz
f_L at I	17 dB	21 dB		f_L 2.5 to 3.0 GHz
Conversion Compression			1.0 dB	f_R level +14 dBm
Third Order Input Intercept		+25 dBm		f_{R1} = 4.0 GHz - 0 dBm; f_{R2} = 3.99 GHz - 0 dBm; f_L = 5.0 GHz +20 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

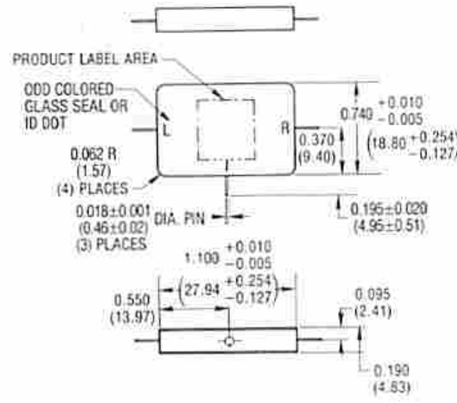
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . 24.7 dBm max. at 25°C, 20.9 dBm max. at 100°C

Weight

M63H:	14 grams (0.5 oz.) max.
M63HC:	45 grams (1.6 oz.) max.
MY63H:	7.9 grams (0.28 oz.) max.
MY63HC:	20.0 grams (0.70 oz.) max.

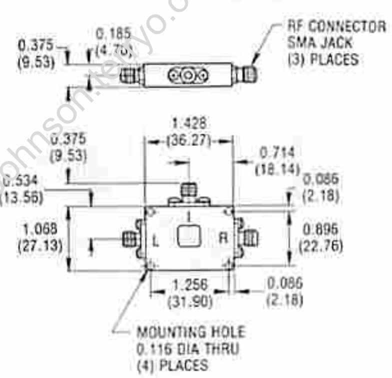
Outline Drawings

M63H (MINPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

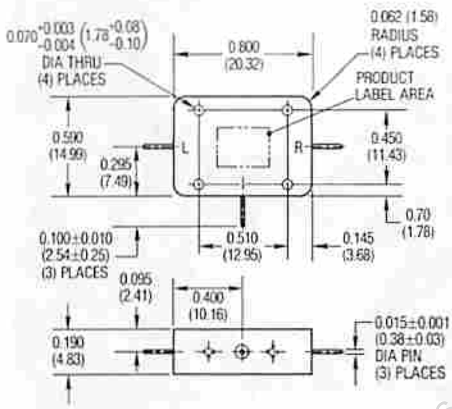
M63HC (CONNECTORIZED)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

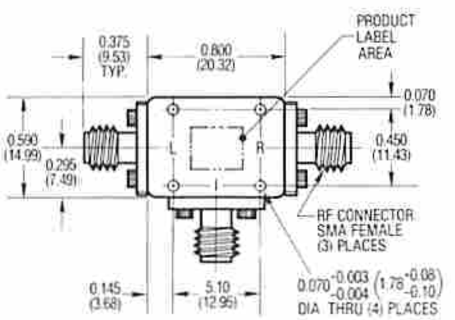
Outline Drawings

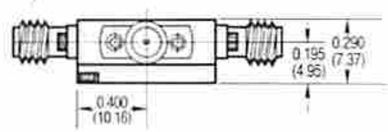
MY63H (VERSAPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

MY63HC (CONNECTORIZED)

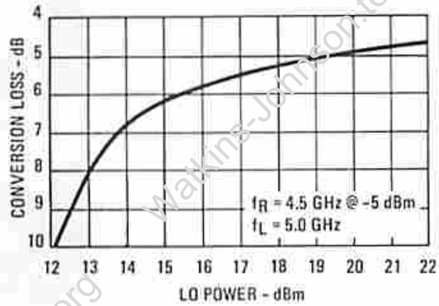




DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

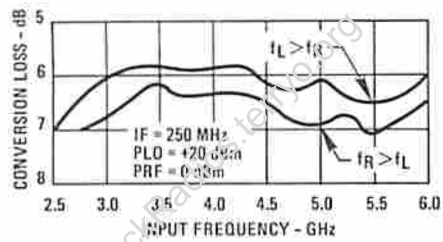
Typical Performance at 25°C*

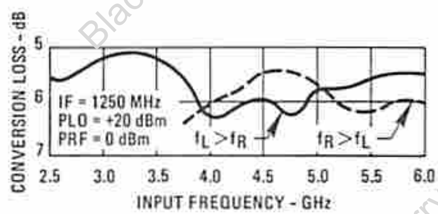
Drive Level



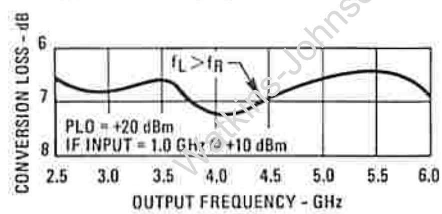
Drive Level: The maximum recommended drive level is +23 dBm.

Conversion Loss

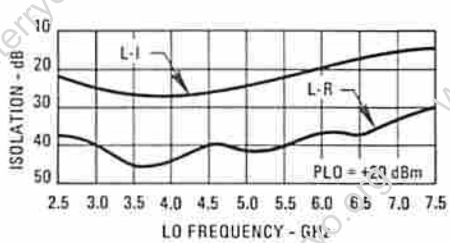


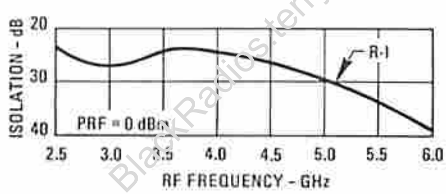


Conversion Loss (Upconversion)

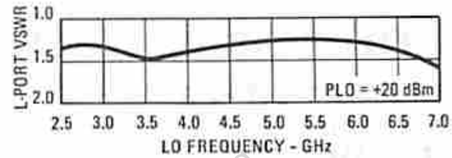


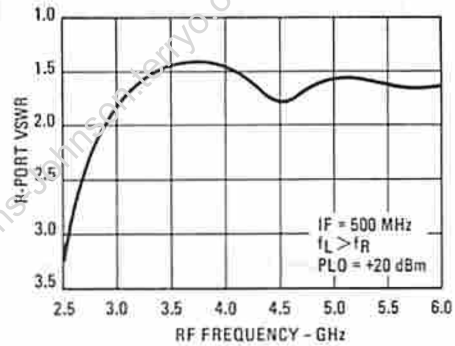
Isolation

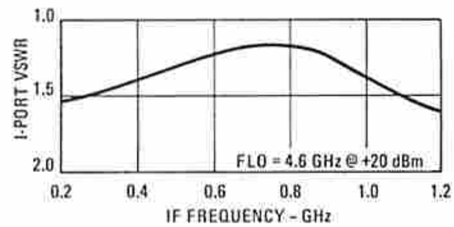




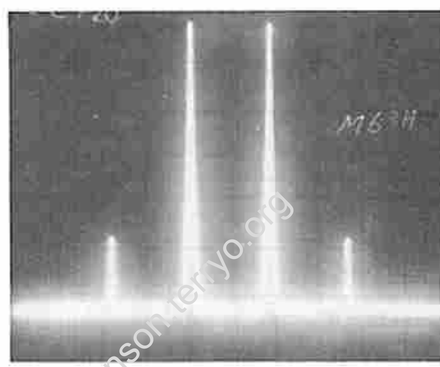
VSWR







Typical Two-Tone Intermodulation Performance



Typical Two-Tone Intermodulation Performance: f_I = 1.0 GHz, $f_L > f_R$, f_L = 5.0 GHz @ +20 dBm, f_R = 3.995 GHz ± 5 MHz @ 0 dBm. Vertical scale = 10 dB/cm.

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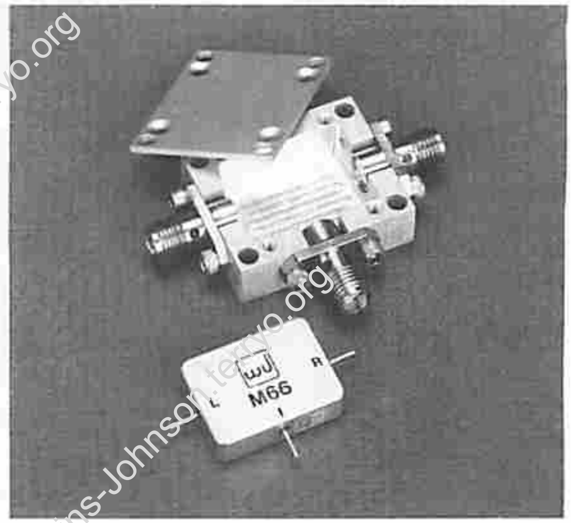
*Typical performance applies to the MINPAC™ model and does not necessarily reflect the performance of the VERSAPAC® model.

WJ-M66/M66C



DOUBLE-BALANCED MIXER

LO 8.95 TO 14.7 GHz
RF 10.95 TO 12.7 GHz
IF DC TO 2.0 GHz
LO DRIVE +10 dBm (nominal)

- HERMETICALLY SEALED

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		5.5 dB 5.5 dB 6.0 dB 6.0 dB	7.0 dB 7.0 dB 8.5 dB 8.5 dB	f_R 10.95-12.7 GHz f_I 3.0-1000 MHz $f_L > f_R$ f_I 3.0-500 MHz $f_L < f_R$ f_I 1000-2000 MHz $f_L > f_R$ f_I 500-2000 MHz $f_L < f_R$
Isolation f_L at R f_L at I	23 dB 20 dB	35 dB 28 dB		f_L 8.95-14.7 GHz
Conversion Compression			1.0 dB	f_R Level 4 dBm
VSWR L-Port R-Port I-Port		1.8:1 1.5:1 1.5:1 1.8:1		f_L 8.95-14.7 GHz f_R 10.95-12.7 GHz & f_L 8.95-14.7 GHz f_I 100-500 MHz f_I >500-2000 MHz & f_L 8.95-14.7 GHz
Third Order Input Intercept Point		+18 dBm		f_{R1} = 11.5 GHz f_{R2} = 11.51 GHz both at -6 dBm f_L = 12.0 GHz
Flatness		0.1 dB p-p	2.0 dB p-p	Over any 50 MHz Segment of f_R = 10.95-12.7 GHz
Group Time Delay		0.35 ns	0.5 ns	f_R = 10.95-12.7 GHz
Single Tone IM Suppression f_L f_R 2 x 2 3 x 3 4 x 4 5 x 5		 50 dB 55 dB >70 dB >70 dB		f_R = 10.95-12.7 GHz at -10 dBm f_L = 8.95-14.7 GHz

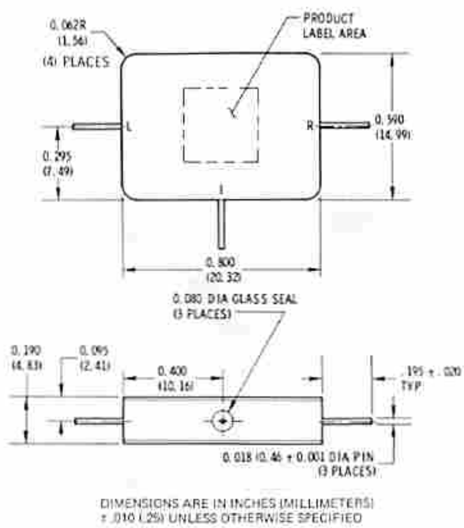
Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

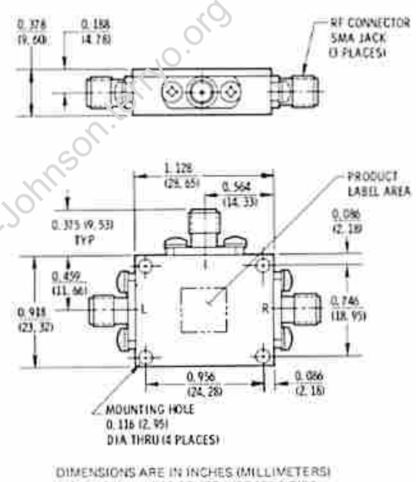
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . 23 dBm at 25°C, 20 dBm at 60°C
Peak Input Current at 25°C . . . . 100 mA DC

Outline Drawings

M66 (MINPAC)



M66C (CONNECTORIZED)

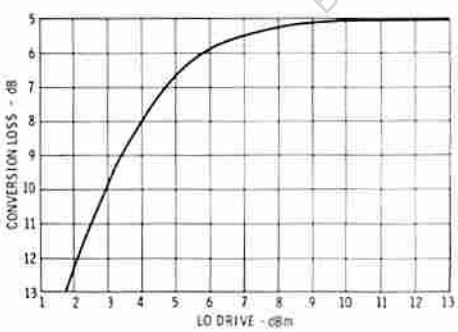


Weight

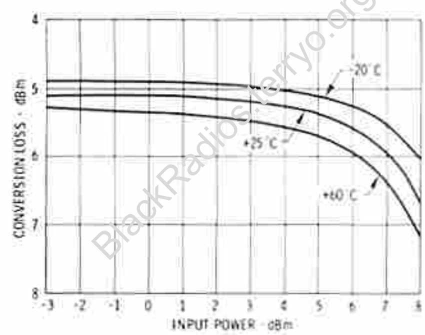
M66: 9 grams (0.32 oz.) max.
M66C: 36 grams (1.27 oz.) max.

Typical Performance at 25°C

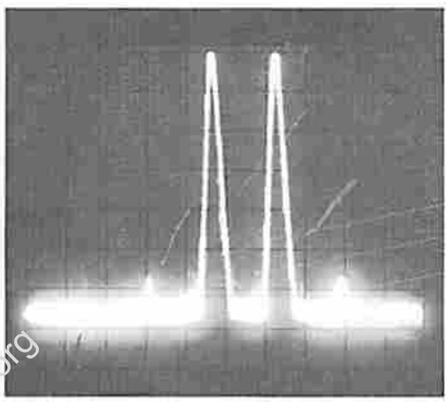
Conversion Loss vs. LO Power



Conversion Loss vs. RF Input Power

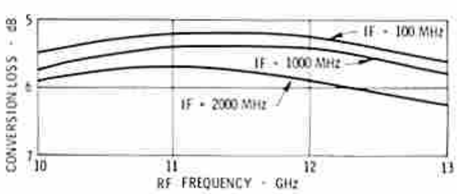


Two-Tone Intermodulation Performance

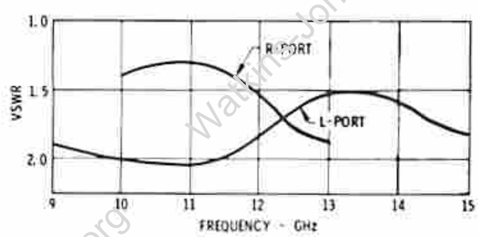


Typical Two-Tone Intermodulation Performance: f_I = 1.0 GHz, f_R = 11.6 GHz ± 1 MHz at -6 dBm, $f_{LO} > f_{RF}$ f_L = 12.6 GHz at +10 dBm. Vertical scale = 10 dB/cm.

Conversion Loss vs. Input Frequency



VSWR vs. Frequency



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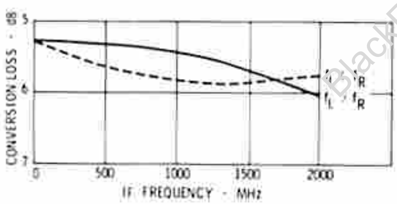
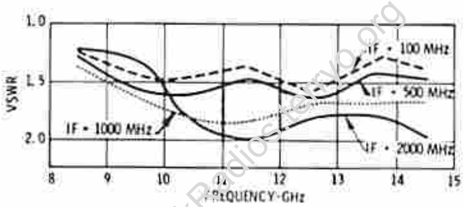
Conversion Loss vs. IF Frequency



I-Port VSWR vs. f_L

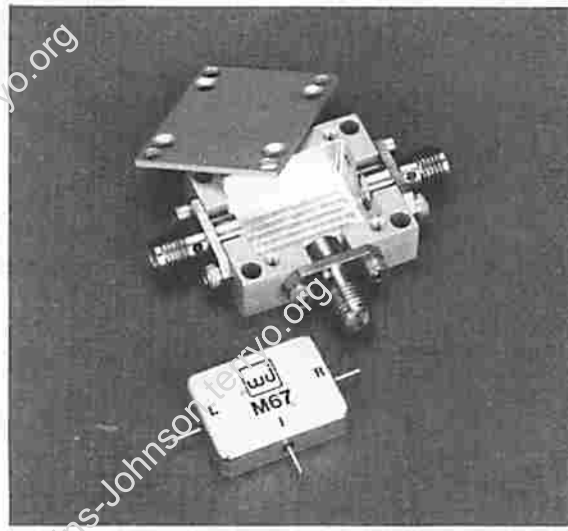


WJ-M67/M67C

DOUBLE-BALANCED MIXER

LO 7.0 TO 17.0 GHz
RF 9.0 TO 15.0 GHz
IF DC TO 2.5 GHz
LO DRIVE +10 dBm (nominal)

- HERMETICALLY SEALED



Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		5.5 dB	7.0 dB	f_R 9.5-13 GHz f_L 9-13.5 GHz f_I 30-500 MHz
		6.5 dB	8.5 dB	f_R 9-15 GHz f_L 8-16 GHz f_I 30-1000 MHz
		6.5 dB	9.0 dB	f_R 9-15 GHz f_L 7-17 GHz f_I 30-2000 MHz
		6.5 dB	9.0 dB	f_R 9.5-13.5 GHz f_L 7-16 GHz f_I 30-2500 MHz
Isolation L to R	22 dB	40 dB		f_L 7-15 GHz
	10 dB	30 dB		f_L 15-17 GHz
L to I	15 dB	25 dB		f_L 7-17 GHz
Conversion Compression			1.0 dB	f_R Level +4 dBm
Third Order Input Intercept Point		+18 dBm		f_{R1} = 11.5 GHz, f_{R2} = 11.51 GHz Both at -6 dBm f_L = 12 GHz
Single Tone IM Suppression				f_R 9-15 GHz at -10 dBm f_L 7-17 GHz
f_L x f_R: 2 x 2		50 dB		
3 x 3		55 dB		
4 x 3		> 70 dB		
4 x 4		> 70 dB		
5 x 4		> 70 dB		
5 x 5		> 70 dB		

1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

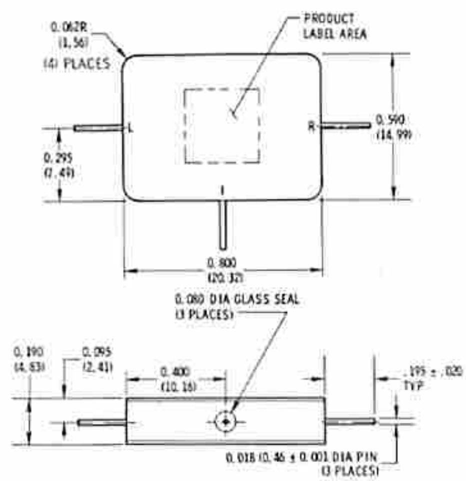
Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . 23 dBm at 25°C, 20 dBm at 100°C
Peak Input Current at 25°C . . . . 100 mA DC

Weight M67: 9 grams (0.32 oz.) max.
M67C: 36 grams (1.27 oz.) max.

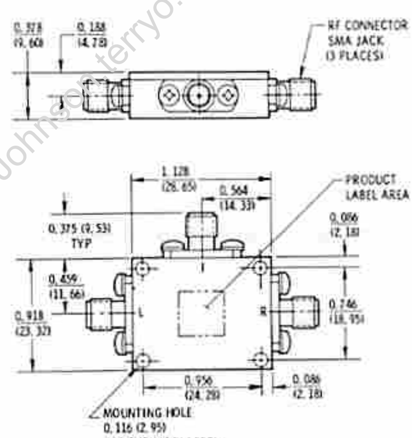
Outline Drawings

M67 (MINPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .010 (.25) UNLESS OTHERWISE SPECIFIED

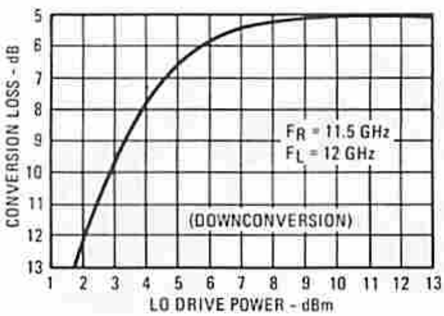
M67C (CONNECTORIZED)



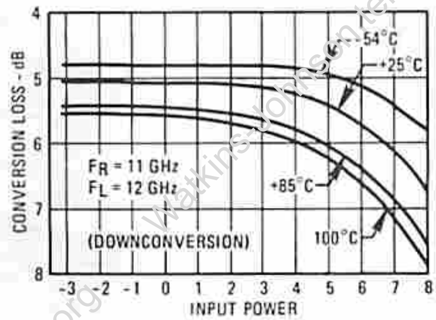
DIMENSIONS ARE IN INCHES (MILLIMETERS)
± 0.015 (0.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C

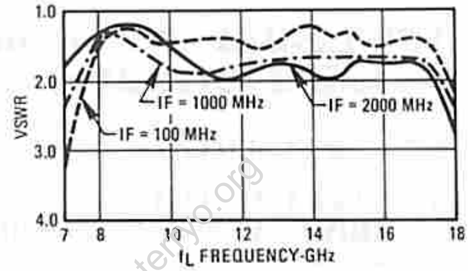
Conversion Loss vs. LO Drive

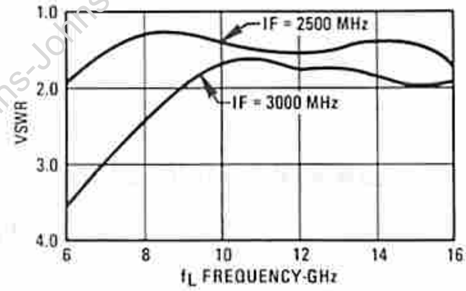


Conversion Loss vs. RF Input Power

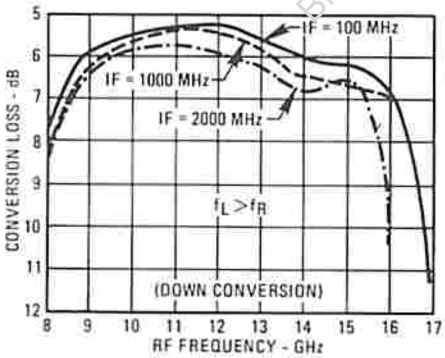


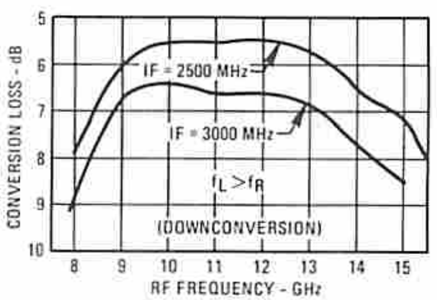
I-Port VSWR vs. f_L



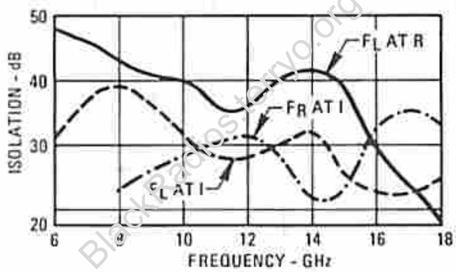


Conversion Loss vs. Frequency

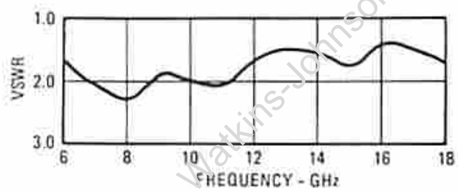




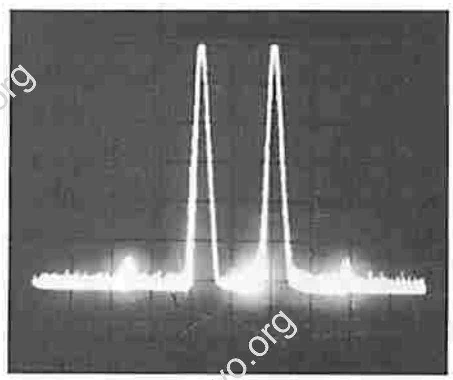
Isolation vs. Frequency



L-Port VSWR vs. Frequency

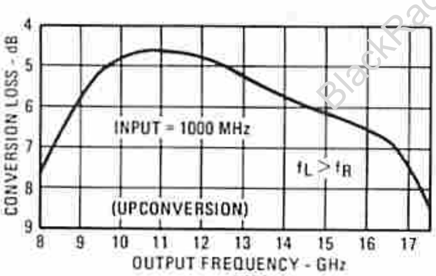


Two-Tone Intermodulation Performance

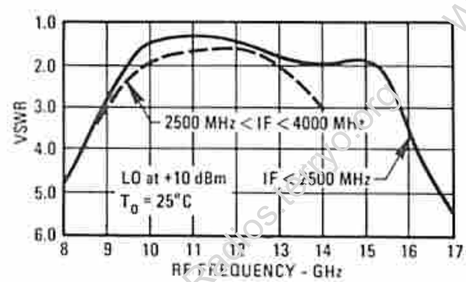


Typical Two-Tone Intermodulation Performance: f_I = 1250 MHz, f_R = 12.0 GHz ± 1 MHz at −10 dBm $f_L > f_R$ f_L = 13.25 GHz at +10 dBm. Vertical scale = 10 dB/cm.

Conversion Loss vs. Output Frequency



R-Port VSWR vs. Frequency

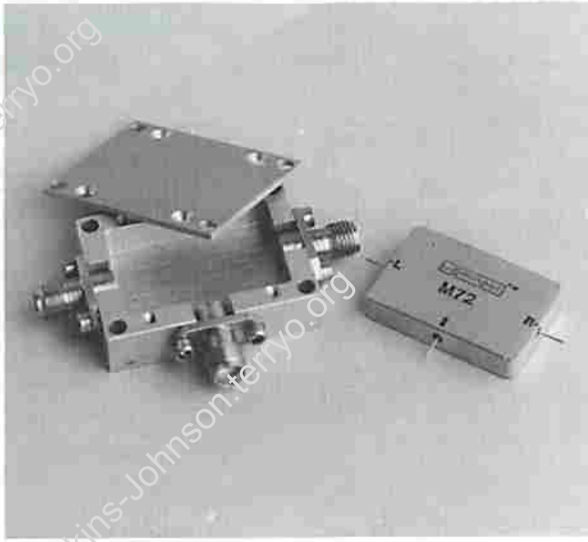


6

WJ-M72/M72C

TRIPLE-BALANCED MIXER (DOUBLE-DOUBLE)

LO }
RF } 2.0 TO 4.0 GHz
IF 0.03 TO 1.0 GHz
LO DRIVE +13 dBm (nominal)



- HERMETICALLY SEALED

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.0 dB	8.0 dB	f_R 2.0 to 4.0 GHz f_L 2.0 to 4.0 GHz f_I 0.03 to 1.0 GHz
Isolation				
f_L at R	17 dB	25 dB		f_L 2.0 to 2.5 GHz
f_L at R	20 dB	30 dB		f_L 2.5 to 4.0 GHz
f_L at I	20 dB	30 dB		f_L 2.0 to 4.0 GHz
Conversion Compression			1.0 dB	f_R Level +10 dBm
Third-Order Input Intercept		+17 dBm		f_{R1} = 3.0 GHz -4 GHz f_{R2} = 3.01 GHz -4 dBm f_L = 3.5 GHz +13 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

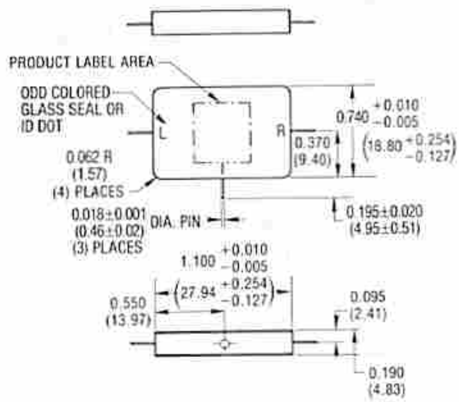
Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . 23 dBm max. at 25°C, 20 dBm max. at 100°C
Peak Input Current at 25°C. . . . . 100 mA DC

Weight M72: 10 grams (0.35 oz.) max.
M72C: 35 grams (1.23 oz.) max.

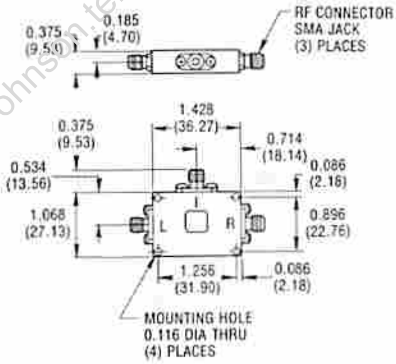
Outline Drawings

M72 (MINPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .010 (.25) UNLESS OTHERWISE SPECIFIED

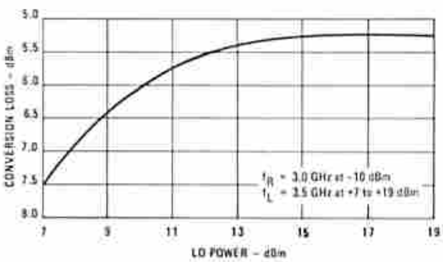
M72C (CONNECTORIZED)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

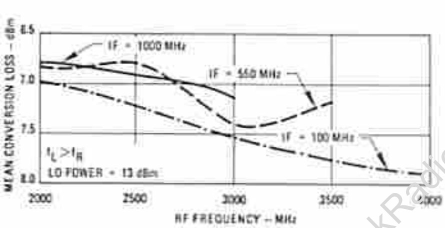
Typical Performance at 25°C

Drive Level

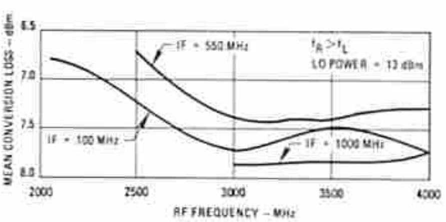


Drive Level: The maximum recommended drive level is +18 dBm. This upper level has been established by the desire to avoid a serious increase in noise figure and a loss of isolation. Operation at +18 dBm is recommended to achieve best two-tone performance and best suppression of the intermodulation products.

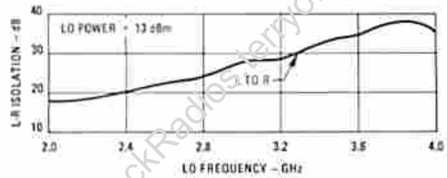
Mean Conversion Loss, High Side LO

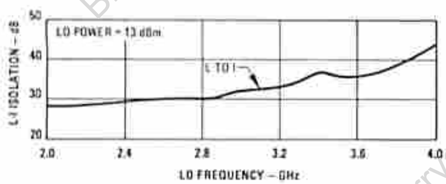


Mean Conversion Loss, Low Side LO

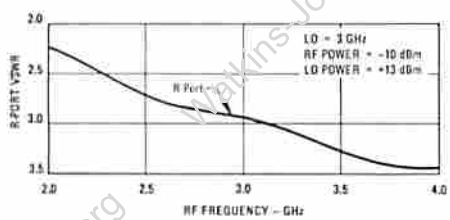


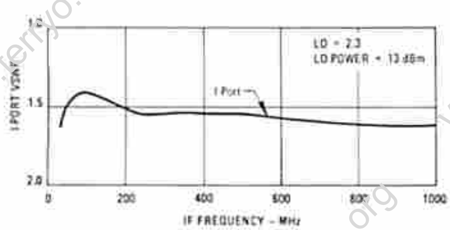
Mean Isolation

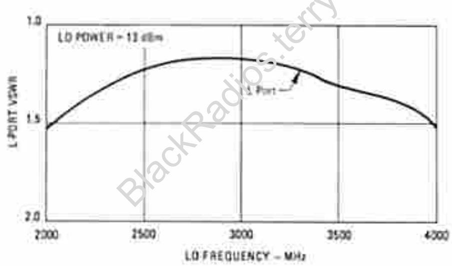




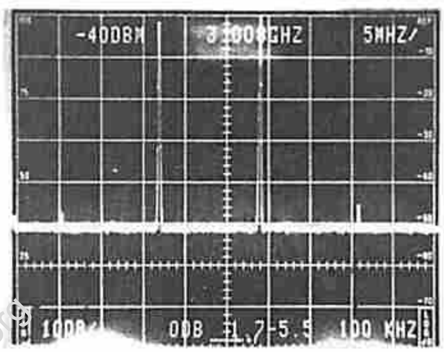
Mean VSWR







Third-Order Intercept Input



f_R = 3.0 ± 0.01 GHz at –4 dBm
f_L = 3.5 GHz at +13 dBm

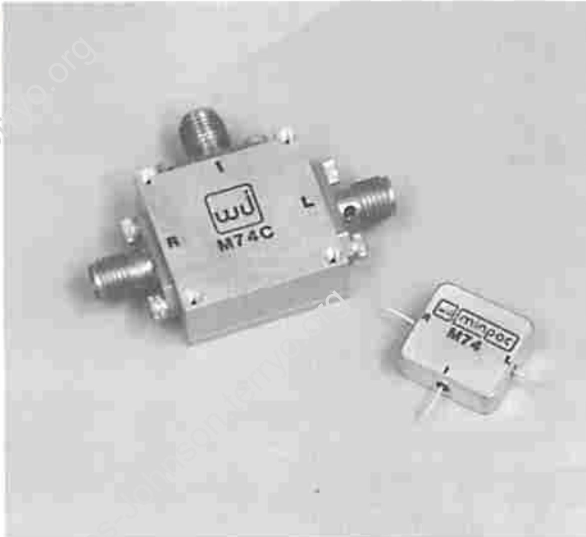
6

WJ-M74/M74C

DOUBLE-BALANCED MIXER

LO 5 TO 18 GHz
RF 7 TO 18 GHz
IF DC TO 3000 MHz
LO DRIVE +10 dBm (nominal)

- HERMETICALLY SEALED



Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		5.7 dB	7.5 dB	f_R 7 to 16 GHz f_L 6 to 17 GHz f_I 30 to 1000 MHz
		6.0 dB	8.0 dB	f_R 7 to 16 GHz f_L 5 to 18 GHz f_I 30 to 2000 MHz f_I 30 to 3000 MHz $f_L > f_R$
		6.2 dB	8.5 dB	f_R 8 to 16 GHz f_L 5 to 16 GHz f_I 30 to 3000 MHz $f_L > f_R$
		7.0 dB	9.0 dB	f_R 16 to 18 GHz f_L 13 to 18 GHz f_I 30 to 3000 MHz
Isolation				
L to R	22 dB	34 dB		f_L 5 to 14 GHz
	15 dB	30 dB		f_L 14 to 18 GHz
L to I	22 dB	34 dB		f_L 8 to 18 GHz
	12 dB	24 dB		f_L 5 to 8 GHz
Conversion Compression			1.0 dB	f_R Level +4 dBm
Third-Order Input Intercept Point		+15 dBm		f_{R1} = 13.00 GHz, f_{R2} = 13.01 GHz both at -5 dBm f_L = 14 GHz
Single Tone IM Suppression				f_R 8 to 13 GHz at -10 dBm
f_L × f_R				
2 × 2		60 dB		
2 × 3		>70 dB		
3 × 2		45 dB		
3 × 3		60 dB		
3 × 4		>70 dB		
4 × 3		>70 dB		
4 × 4		>70 dB		
5 × 5		>70 dB		

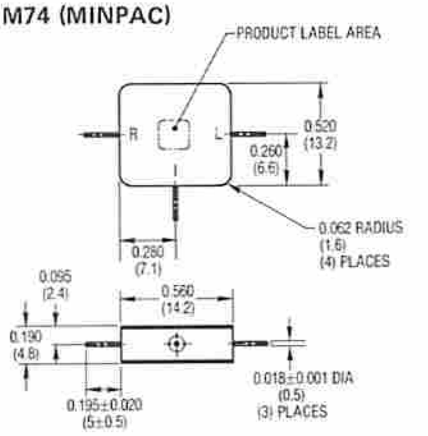
Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . 23 dBm max. at 25°C, 20 dBm max. at 100°C
Peak Input Current at 25°C . . . . 100 mA DC

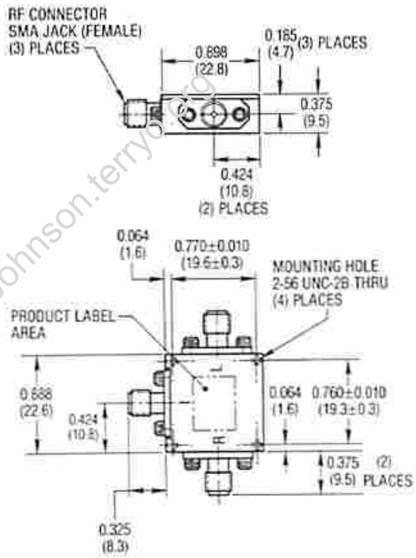
Outline Drawings

M74 (MINPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

M74C (CONNECTORIZED)



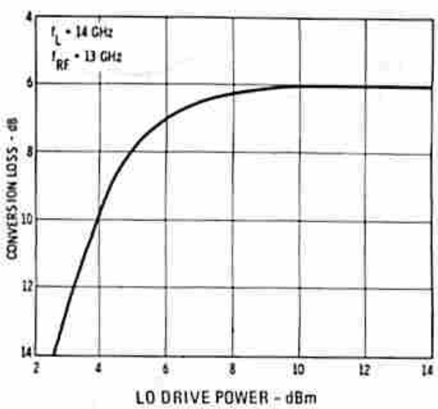
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

Weight

M79: 6 grams (0.21 oz.) max.
M79C: 30 grams (1.06 oz.) max.

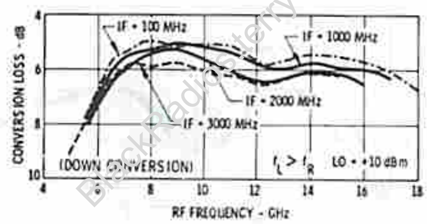
Typical Performance at 25°C

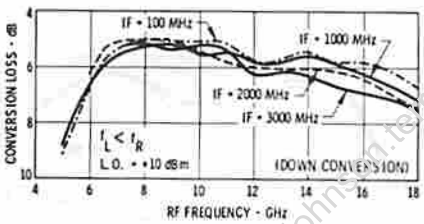
Conversion Loss vs. LO Drive Power

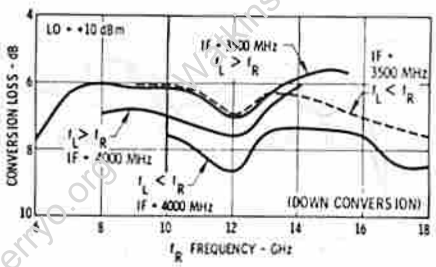


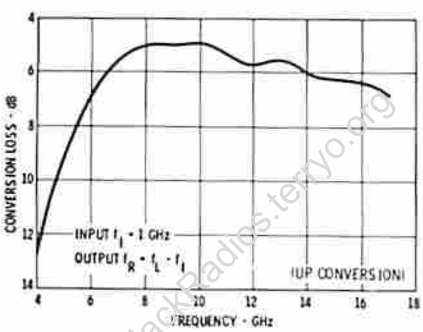
Drive Level: The maximum recommended drive level is +13 dBm. This upper level has been established by the desire to avoid a serious increase in noise figure and a loss of isolation. Operation at +13 dBm is recommended to achieve best two-tone performance and best suppression of the intermodulation products.

Conversion Loss vs. Frequency

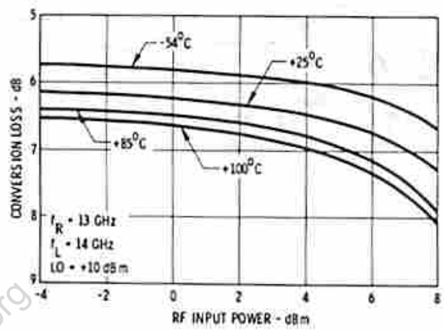




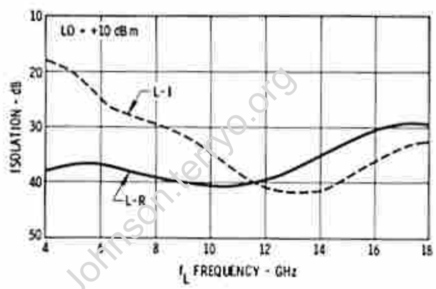


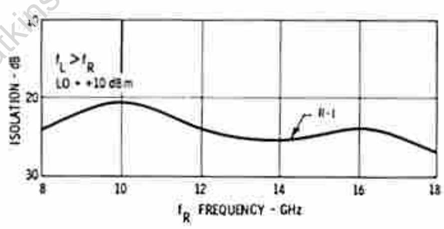


Conversion Loss vs. Input Power and Temperature



Isolation

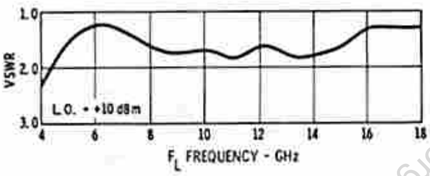




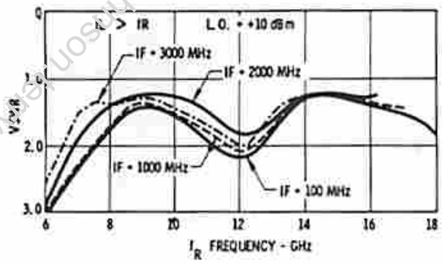
(continued)

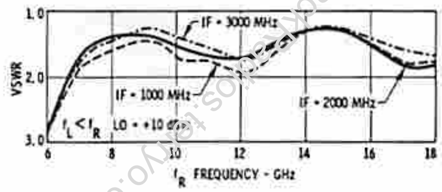
Typical Performance at 25°C

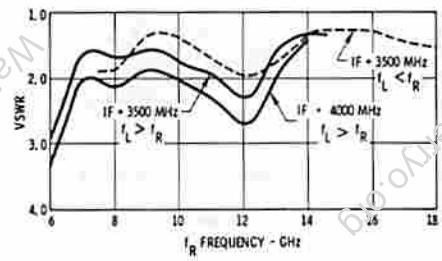
L-Port VSWR



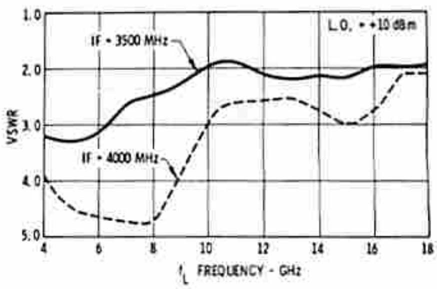
R-Port VSWR

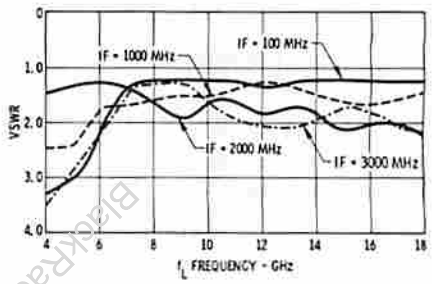




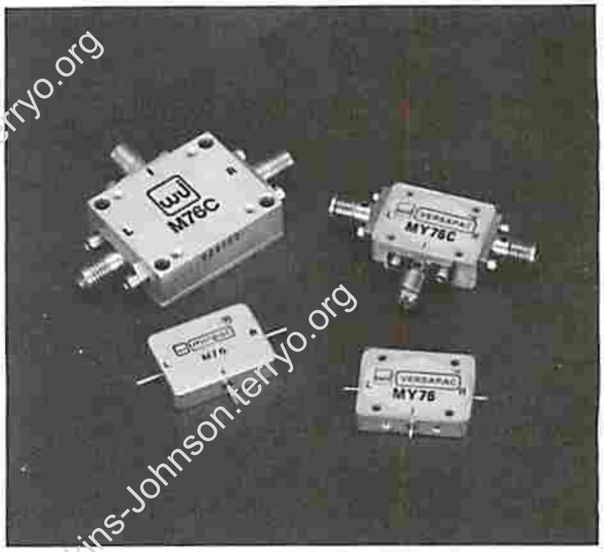


I-Port VSWR





WJ-M76/M76C
WJ-MY76/MY76C



DOUBLE-BALANCED MIXER

LO 2.5 TO 11.5 GHz
RF 4.5 TO 9.5 GHz
IF DC TO 2.0 GHz
LO DRIVE +10 dBm (nominal)

- HERMETICALLY SEALED
- QPL VERSION AVAILABLE (See Section 7)

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		5.5 dB	7.0 dB	f_R 6.0 - 8.0 GHz, f_I 30 - 2000 MHz
		5.5 dB	7.0 dB	f_R 5.0 - 9.0 GHz, f_I 30 - 1000 MHz
		6.0 dB	8.0 dB	f_R 4.5 - 9.5 GHz, f_I 30 - 2000 MHz
Isolation f_L at R	25 dB	40 dB		f_L 2.5 to 9 GHz
	20 dB	30 dB		f_L 9.0 - 11.5 GHz
f_L at I	15 dB	25 dB		f_L 4.0 to 11.5 GHz
	10 dB	20 dB		f_L 2.5 to 4 GHz
Conversion Compression			1.0 dB	f_R level + 3 dBm
Third Order Input Intercept Point		+13 dBm		f_{R1} = 7.00 GHz, f_{R2} = 7.01 GHz, both at −6 dBm, f_L = 8 GHz
Single Tone IM Suppression				f_R 4.5 to 9.5 GHz @ −10 dBm, f_L 2.5 to 11.5 GHz
f_L × f_R: 2 × 2		56 dB		
2 × 3		>70 dB		
3 × 2		37 dB		
3 × 3		50 dB		
3 × 4		>70 dB		
4 × 3		>70 dB		

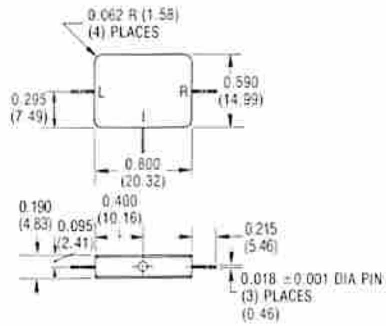
Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

Operating Temperature . . . . −54°C to +100°C
Storage Temperature . . . . −65°C to +100°C
Peak Input Power . . . . 23 dBm max. at 25°C, 20 dBm max. at 100°C
Peak Input Current at 25°C . . . . 100 mA DC

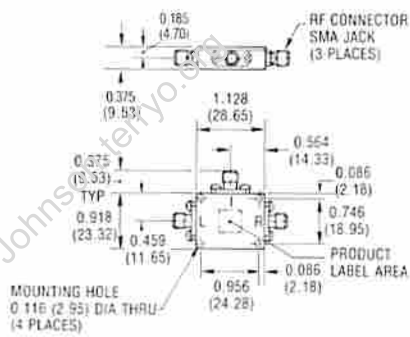
Outline Drawings

M76 (MINPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.010 (.25) UNLESS OTHERWISE SPECIFIED

M76C (CONNECTORIZED)



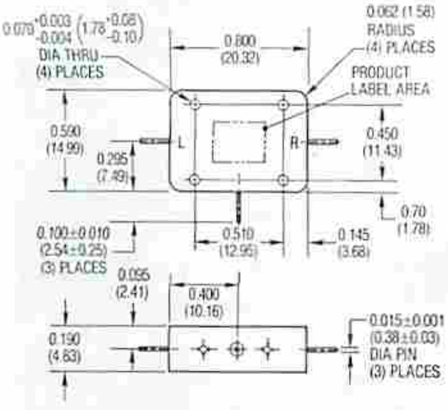
DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

Weight

M76:	9 grams (0.32 oz.) max.
M76C:	36 grams (1.27 oz.) max.
MY76:	7.9 grams (0.28 oz.) max.
MY76C:	20.0 grams (0.70 oz.) max.

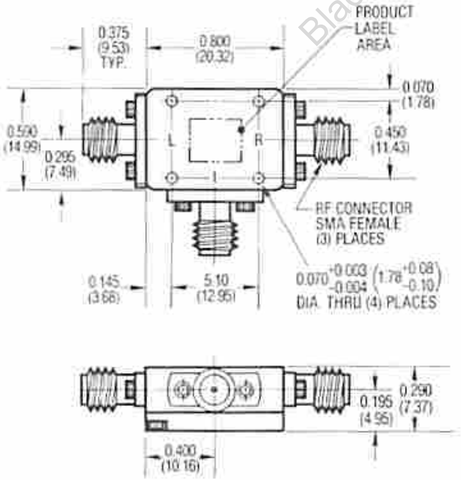
Outline Drawings

MY76 (VERSAPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

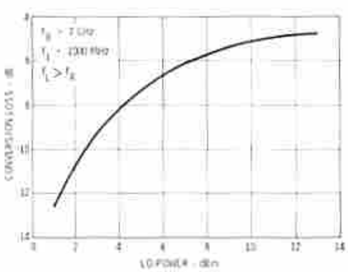
MY76C (CONNECTORIZED)



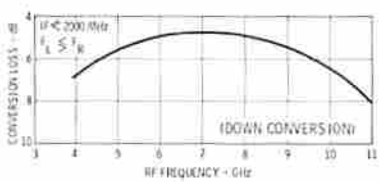
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C*

Conversion Loss Vs. LO Drive

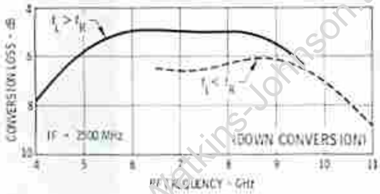


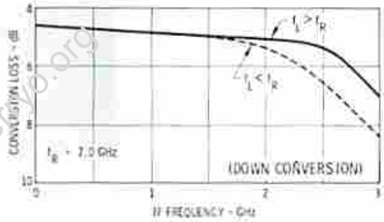
Conversion Loss vs. Frequency



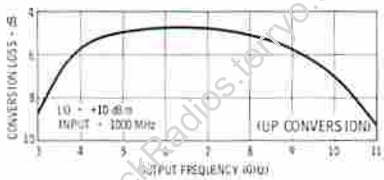
Typical Performance at 25°C*

Conversion Loss vs. Frequency

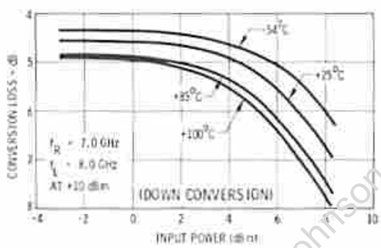




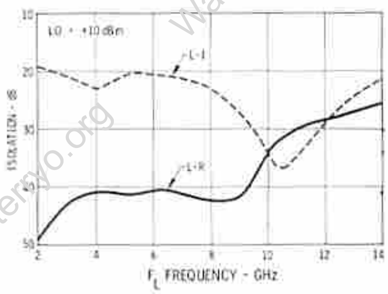
Conversion Loss vs. Output Frequency

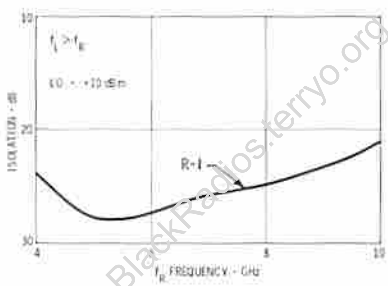


Conversion Loss vs. RF Input Power

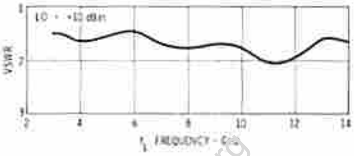


Isolation vs. Frequency

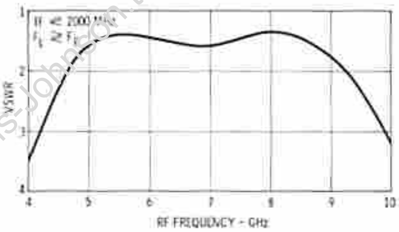




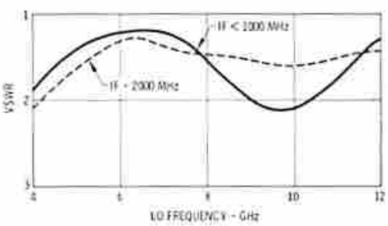
L-Port VSWR vs. Frequency



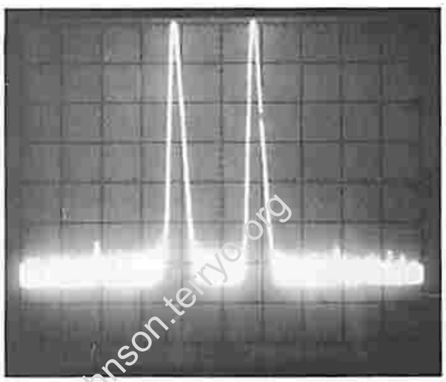
R-Port VSWR vs. Frequency



I-Port VSWR vs. f_L



Typical Two-Tone Performance



Typical Two-Tone Performance: f_I = 1.0 GHz, $f_L > f_R$, f_L = 8.0 GHz @ +10 dBm, f_R 7.0 GHz ± 1 MHz, f_R @ -10 dBm. Vertical scale = 10 dB/cm.

*Typical performance applies to the MINPAC™ model and does not necessarily reflect the performance of the VERSAPAC® model.

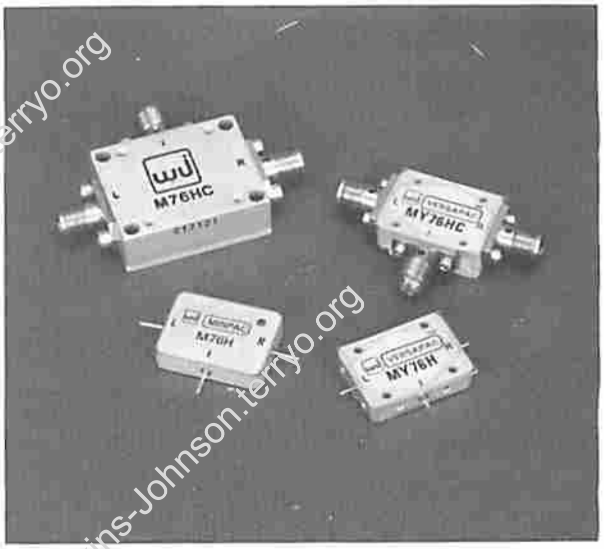
6

WJ-M76H/M76HC
WJ-MY76H/MY76HC

DOUBLE-BALANCED MIXER

LO 2.5 TO 11.5 GHz
RF 4.5 TO 9.5 GHz
IF DC TO 2.0 GHz
LO DRIVE +20 dBm (nominal)

- HERMETICALLY SEALED



Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		5.5 dB	7.0 dB	f_R = 4.5 to 8.0 GHz f_L = 2.5 to 10.0 GHz f_I = 30 to 2000 GHz
		6.5 dB	8.0 dB	f_R = 8.0 to 9.0 GHz f_L = 6.5 to 10.5 GHz f_I = 30 to 1500 MHz
		8.0 dB	9.5 dB	f_R = 8.0 to 9.5 GHz f_L = 6.0 to 11.5 GHz f_I = 30 to 2000 MHz
Isolation L to R L to I	 22 dB 20 dB 15 dB	 35 dB 30 dB 22 dB		 f_L = 2.5 to 11.5 GHz f_L = 6.5 to 11.5 GHz f_L = 2.5 to 6.5 GHz
Conversion Compression			1.0 dB	f_R level +15 dBm
Third Order Input Intercept		+24 dBm		f_{R1} = 6.12 GHz; f_{R2} = 6.18 GHz both at 0 dBm f_L = 7.2 GHz

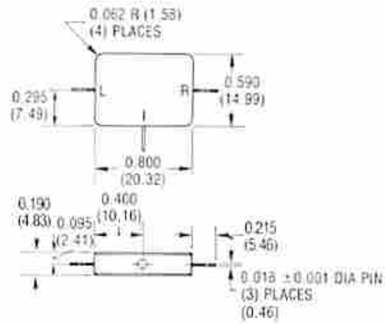
Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

Operating Temperature. . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . 24.7 dBm max. at 25°C
Peak Input Current at 25°C. . . . . 100 mA DC

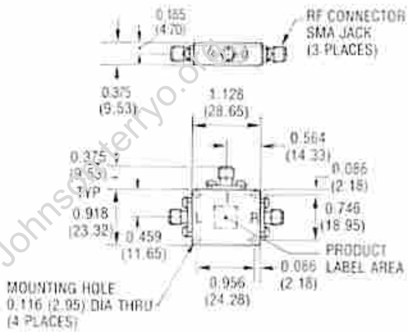
Outline Drawings

M76H (MINPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

M76HC (CONNECTORIZED)



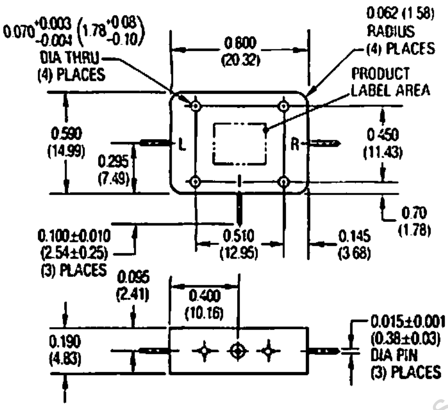
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

Weight

M76H: 9 grams (0.32 oz.) max.
M76HC: 36 grams (1.27 oz.) max.
MY76H: 7.9 grams (0.28 oz.) max.
MY76HC: 20.0 grams (0.70 oz.) max.

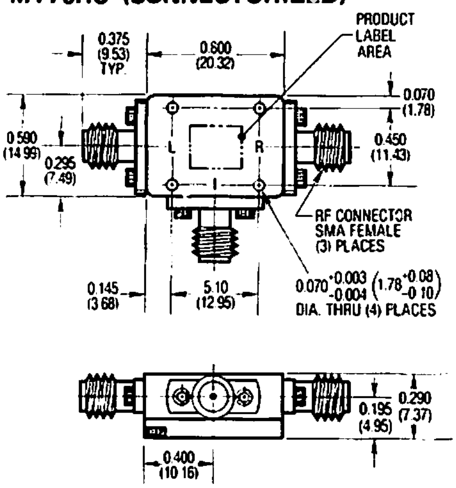
Outline Drawings

MY76H (VERSAPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

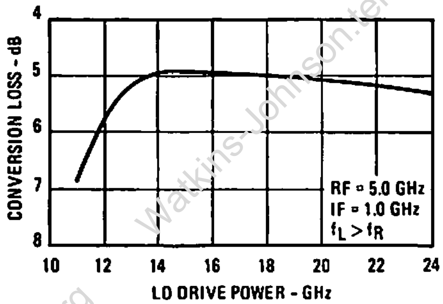
MY76HC (CONNECTORIZED)



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

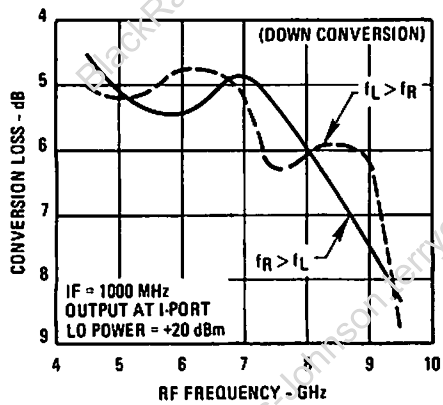
Typical Performance at 25°C *

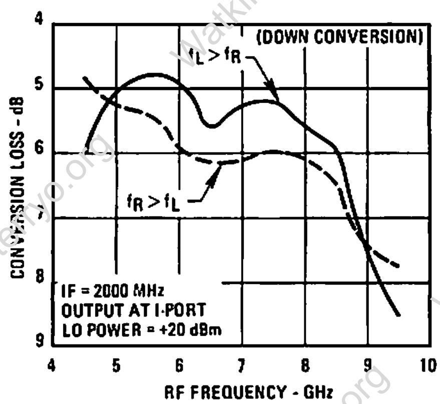
Conversion Loss vs. LO Drive Power



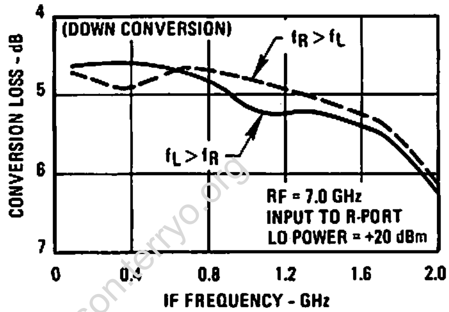
Drive Level: The maximum recommended drive level is +24 dBm. This upper level has been established by the desire to avoid a serious increase in noise figure and a loss of isolation. Operation at +20 dBm is recommended to achieve best two-tone performance and best suppression of the intermodulation products.

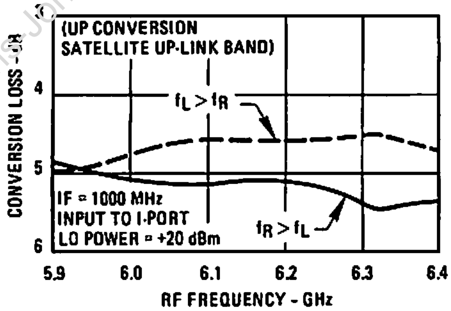
Conversion Loss



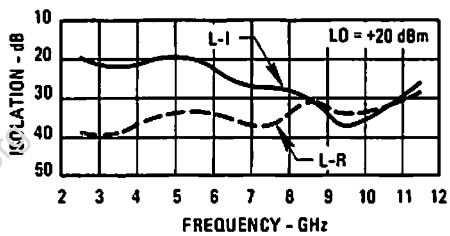


Conversion Loss

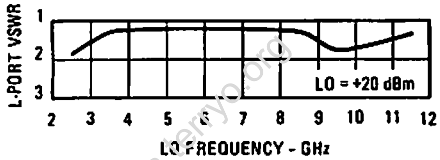


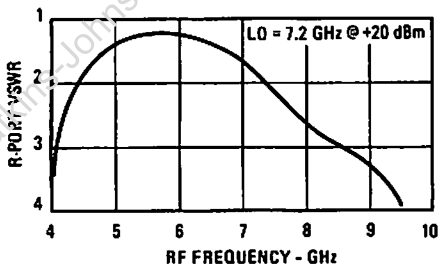


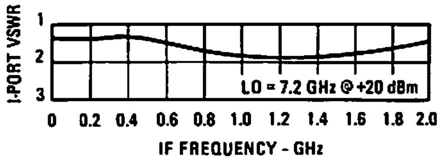
Isolation



VSWR







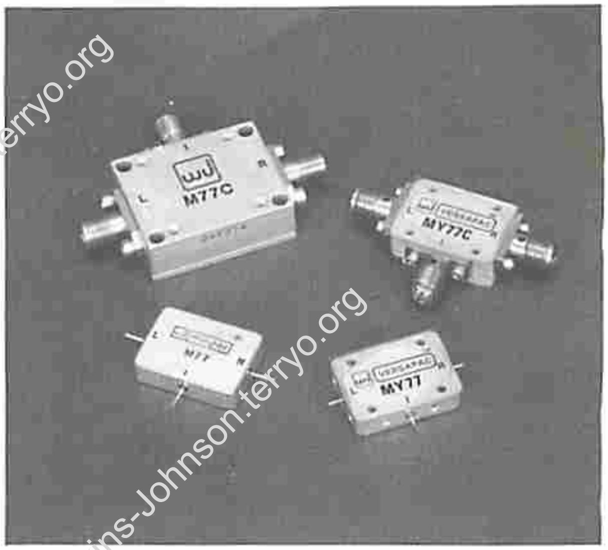
*Typical performance applies to the MINPAC™ model and does not necessarily reflect the performance of the VERSAPAC® model.

6

WJ-M77/M77C
WJ-MY77/MY77C

DOUBLE-BALANCED MIXER

LO 7.0 TO 15.0 GHz
RF 8.0 TO 12.5 GHz
IF DC TO 2500 MHz
LO DRIVE +10 dBm (nominal)



- HERMETICALLY SEALED

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		5.0 dB	7.0 dB	f_R 8 - 12.5 GHz f_L 7 - 13.5 GHz f_I 30 - 1000 MHz
		5.5 dB	7.5 dB	f_R 8 - 12.5 GHz f_L 7 - 14.5 GHz f_I 1000-2000 MHz
		6.0 dB	8.0 dB	f_R 8 - 12.5 GHz f_L 7 - 15.0 GHz f_I 2000 - 2500 MHz
Isolation L to R L to I	20 dB 20 dB 15 dB 10 dB	35 dB 35 dB 30 dB 20 dB		f_L 7 - 15 GHz f_L 8 - 12 GHz f_L 7 - 14 GHz f_L 14 - 15 GHz
Conversion Compression			1.0 dB	f_R level + 4 dBm
Third Order Input Intercept Point		+15 dBm		f_{R1} = 10.00 GHz; f_{R2} = 10.01 GHz both at @ 6 dBm f_L = 11 GHz
Single Tone IM Suppression f_L f_R				f_R 8 to 12.5 GHz @ −10 dBm
2 x 2		60 dB		
2 x 3		70 dB		
3 x 2		37 dB		
3 x 3		59 dB		
3 x 4		> 70 dB		
4 x 3		> 70 dB		
4 x 4		> 70 dB		

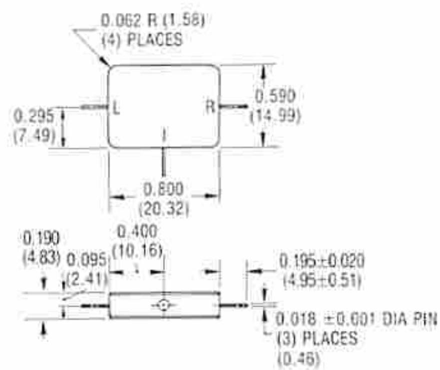
Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . 23 dBm max. at 25°C, 20 dBm max. at 100°C
Peak Input Current at 25°C . . . . 100 mA DC

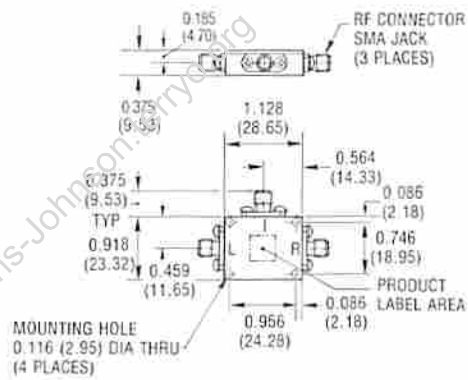
Outline Drawings

M77 (MINPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

M77C (CONNECTORIZED)



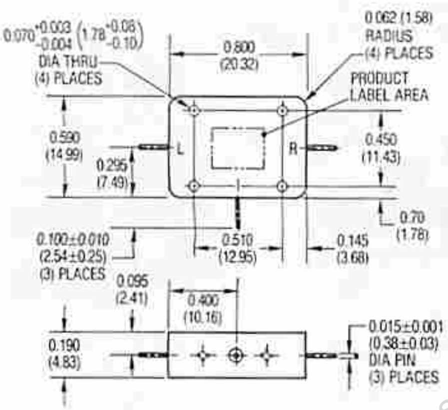
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

Weight

M77:	9 grams (0.32 oz.) max.
M77C:	36 grams (1.2 oz.) max.
MY77:	7.9 grams (0.28 oz.) max.
MY77C:	20.0 grams (0.70 oz.) max.

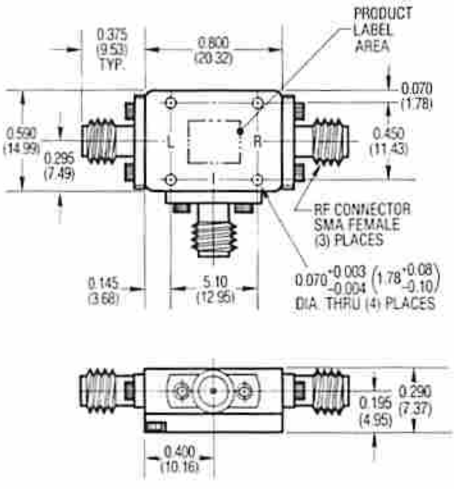
Outline Drawings

MY77 (VERSAPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

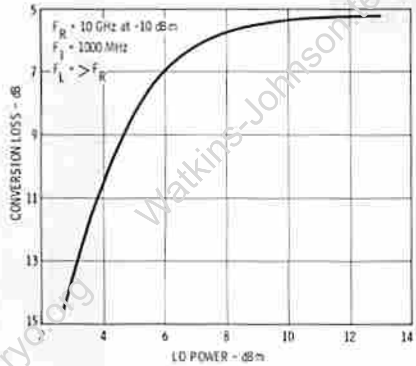
MY77C (CONNECTORIZED)



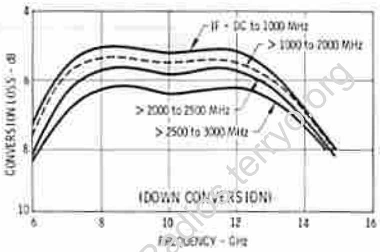
DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C*

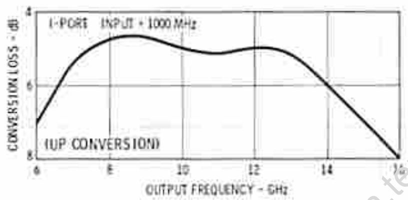
Conversion Loss Vs. LO Drive



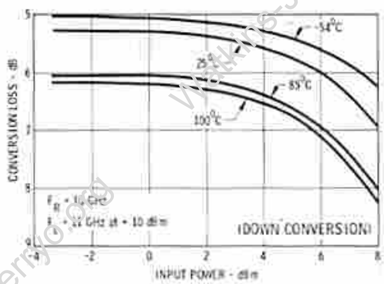
Conversion Loss vs. Frequency



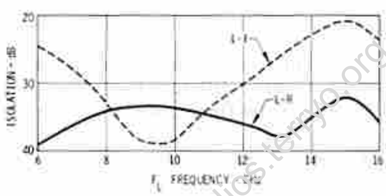
Conversion Loss vs. Output Frequency



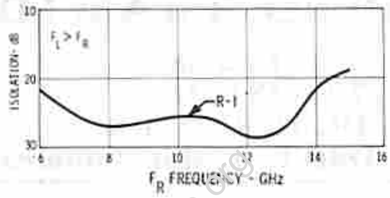
Conversion Loss vs. RF Input Power



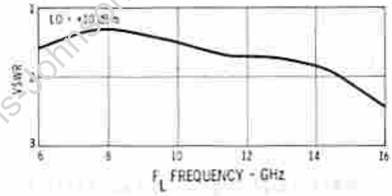
Isolation vs. Frequency



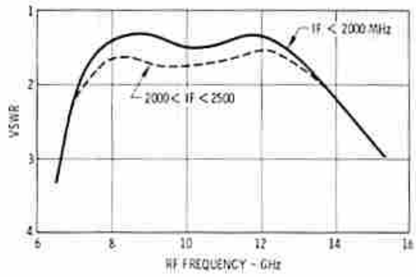
Isolation vs. Frequency



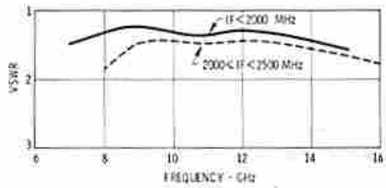
L-Port VSWR vs. Frequency



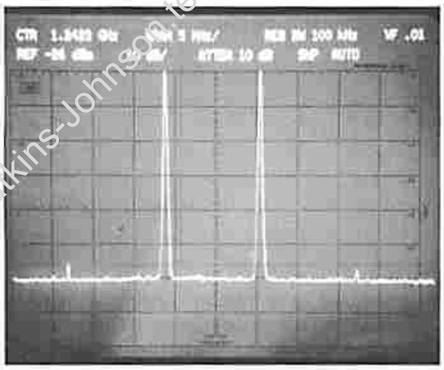
R-Port VSWR vs. Frequency



I-Port VSWR vs. f_L



Typical Two-Tone Performance



Typical Two-Tone Performance: f_I = 1250 MHz, f_R = 10.25 GHz ± 1 MHz f_R @ −10 dBm, $f_L > f_R$, f_L = 11.5 GHz @ +10 dBm. Vertical scale = 10 dB/cm.

*Typical performance applies to the MINPAC™ model and does not necessarily reflect the performance of the VERSAPAC® model.

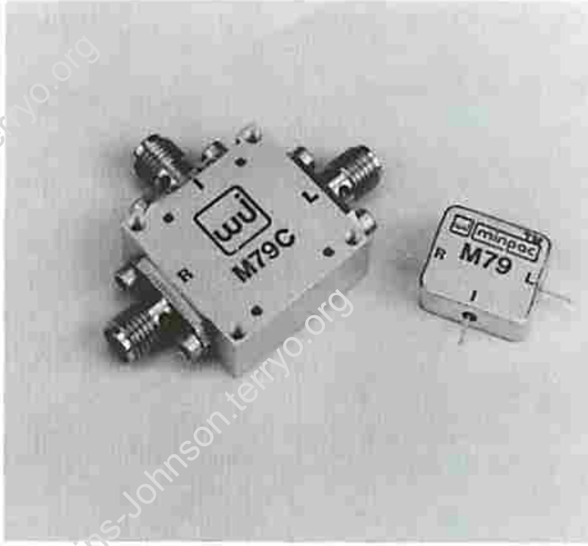
6

WJ-M79/M79C

DOUBLE-BALANCED MIXER

LO 5 TO 18 GHz
RF 7 TO 18 GHz
IF DC TO 3000 MHz
LO DRIVE +10 dBm (nominal)

- HERMETICALLY SEALED
- LOW NOISE
- QPL VERSION AVAILABLE! (See Section 7)



Guaranteed Specifications [1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		5.7 dB	7.5 dB	f_R 7 to 16 GHz f_L 6 to 17 GHz f_I 30 to 1000 MHz
		6.0 dB	8.0 dB	f_R 7 to 16 GHz f_L 5 to 18 GHz f_I 30 to 2000 MHz f_I 30 to 3000 MHz $f_L > f_R$
		6.2 dB	8.5 dB	f_R 8 to 16 GHz f_L 5 to 16 GHz f_I 30 to 3000 MHz $f_L > f_R$
		7.0 dB	9.0 dB	f_R 16 to 18 GHz f_L 13 to 18 GHz f_I 30 to 3000 MHz
Isolation L to R	22 dB	34 dB		f_L 5 to 14 GHz
	15 dB	30 dB		f_L 14 to 18 GHz
L to I	22 dB	34 dB		f_L 8 to 18 GHz
	12 dB	24 dB		f_L 5 to 8 GHz
Conversion Compression			1.0 dB	f_R Level +4 dBm
Third-Order Input Intercept Point		+14 dBm		f_{R1} = 13.00 GHz, f_{R2} = 13.01 GHz both at -6 dBm f_L = 14 GHz
Single Tone IM Suppression f_L f_R				f_R 8 to 13 GHz at -10 dBm
2 x 2		60 dB		
2 x 3		>70 dB		
3 x 2		45 dB		
3 x 3		60 dB		
3 x 4		>70 dB		
4 x 3		>70 dB		
4 x 4		>70 dB		
5 x 5		>70 dB		

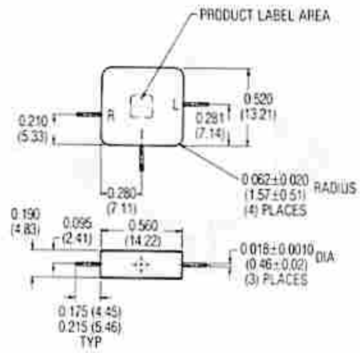
Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

Operating Temperature. . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . 23 dBm max. at 25°C, 20 dBm max. at 100°C
Peak Input Current at 25°C. . . . . 100 mA DC

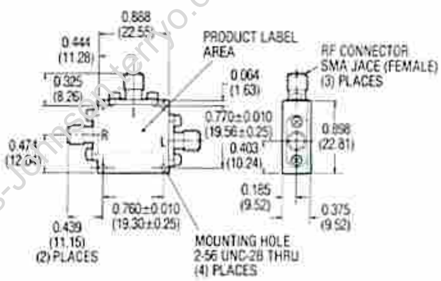
Outline Drawings

M79 (MINPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .010 (.25) UNLESS OTHERWISE SPECIFIED

M79C (CONNECTORIZED)



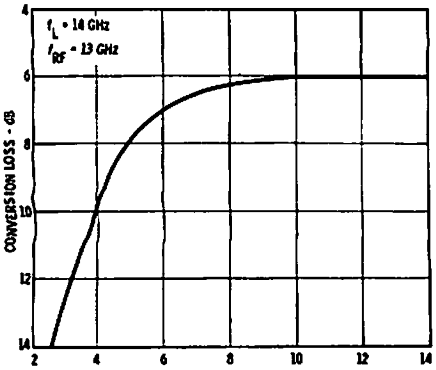
DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

Weight

M79: 6 grams (0.21 oz.) max.
M79C: 30 grams (1.06 oz.) max.

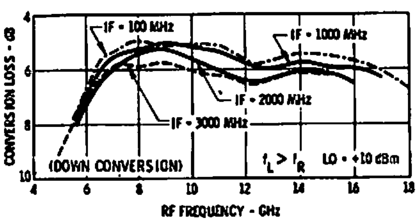
Typical Performance at 25°C

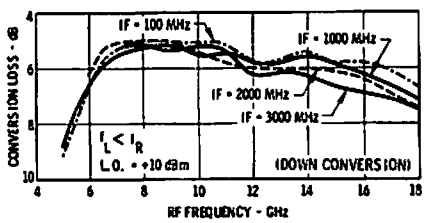
Conversion Loss vs. LO Drive Power.

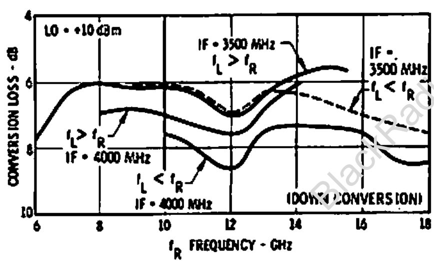


Drive Level: The maximum recommended drive level is +13 dBm. This upper level has been established by the desire to avoid a serious increase in noise figure and a loss of isolation. Operation at +13 dBm is recommended to achieve best two-tone performance and best suppression of the intermodulation products.

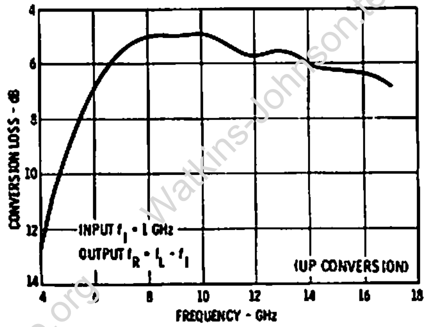
Conversion Loss vs. Frequency.



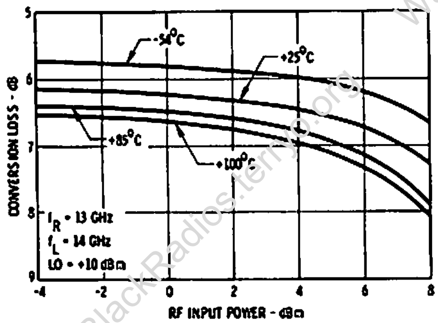




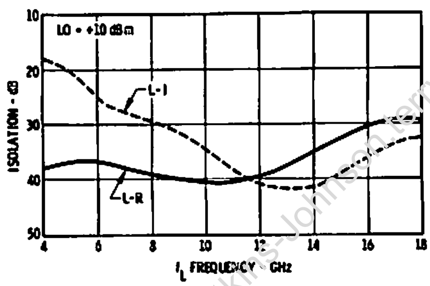
Conversion Loss vs. Frequency

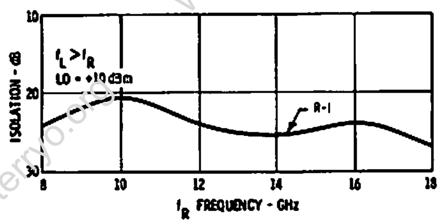


Conversion Loss vs. Input Power and Temperature

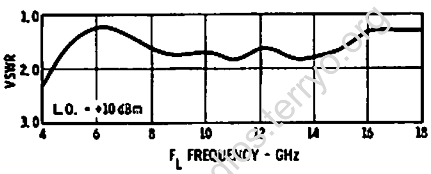


Isolation

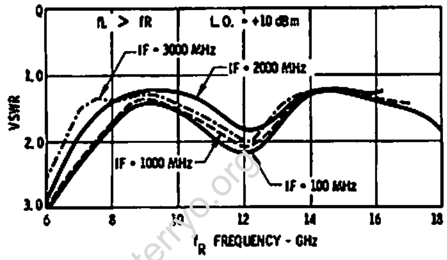


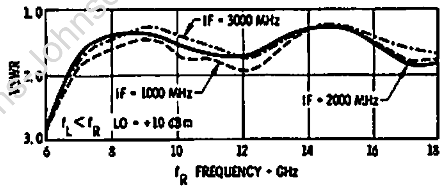


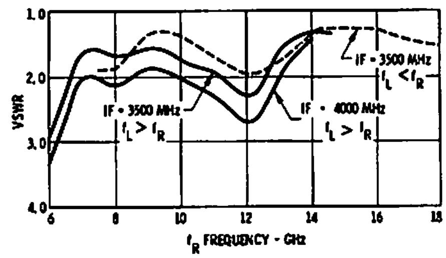
L-Port VSWR



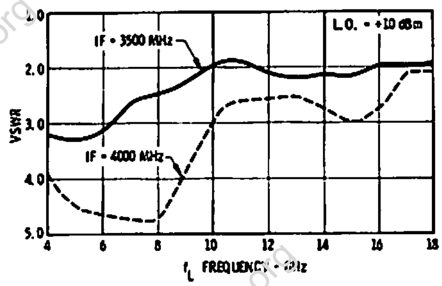
R-Port VSWR

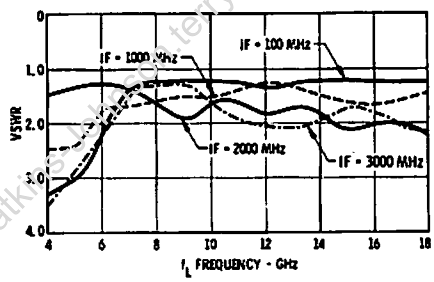






I-Port VSWR





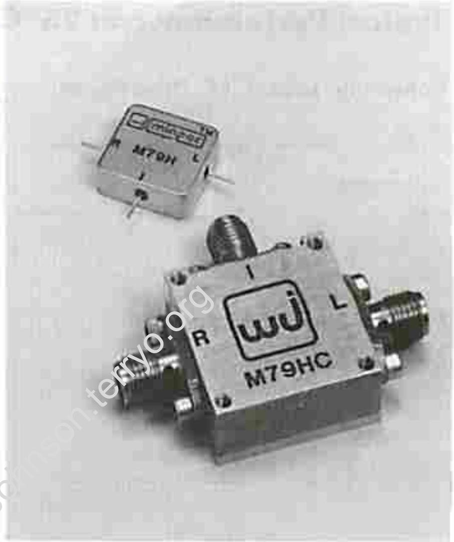
6

WJ-M79H/M79HC

DOUBLE-BALANCED MIXER

LO 5 TO 18 GHz
RF 7 TO 18 GHz
IF DC TO 3000 MHz
LO DRIVE +20 dBm (nominal)

- HERMETICALLY SEALED
- HIGH THIRD-ORDER INTERCEPT POINT
- HIGH LEVEL



Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		6.5 dB	8.0 dB	f_R = 7-15 GHz, f_L = 6-15 GHz, f_I = 30-1000 MHz
		7.0 dB	8.5 dB	f_R = 7-16 GHz, f_L = 5-18 GHz, f_I = 30-2000 MHz
		7.5 dB	9.5 dB	f_R = 7-16 GHz, f_L = 5-18 GHz, f_I = 30-3000 MHz
		8.5 dB	10.0 dB	f_R = 16-18 GHz, f_L = 5-15 GHz, f_I = 30-3000 MHz
Isolation				
L to R	23 dB	35 dB		f_L = 5-14 GHz
	20 dB	30 dB		f_L = 14-18 GHz
L to I	25 dB	35 dB		f_L = 9-18 GHz
	17 dB	27 dB		f_L = 5-9 GHz
Conversion Compression			1.0 dB	P_{RF} = +15 dBm, P_{LO} = +20 dBm
Third-Order Input Intercept Point		+21 dBm		f_{R1} = 13.00 GHz, f_{R2} = 13.01 GHz both at -6 dBm, f_L = 14.0 GHz at +20 dBm
VSWR				
L-Port		1.5:1		f_L = 13-18 GHz
		2.0:1		f_L = 15-18 GHz
R-Port		1.6:1		f_R = 7-18 GHz
I-Port		1.7:1		f_I = 1-3.0 GHz

Notes:

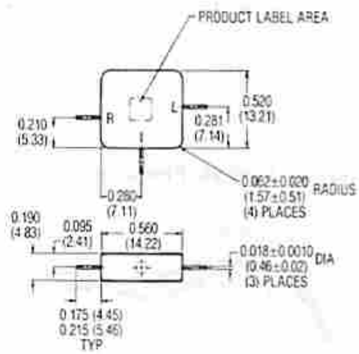
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . 24.7 dBm max. at 25°C, 20.7 dBm max. at 100°C
Peak Input Current at 25°C . . . . .100 mA DC

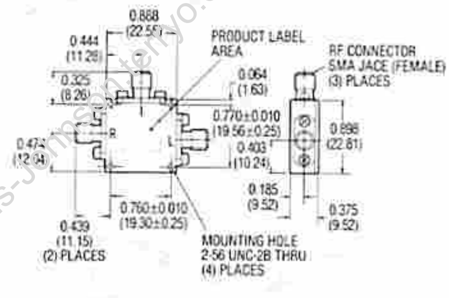
Outline Drawings

M79H (MINPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.010 (.25) UNLESS OTHERWISE SPECIFIED

M79HC (CONNECTORIZED)



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

Weight

M79H: 6 grams (0.21 oz.) max.
M79HC: 30 grams (1.06 oz.) max.

WJ-M80/M80C

DOUBLE-BALANCED MIXER

LO 3.5 TO 18 GHz
RF 6 TO 18 GHz
IF DC TO 3000 MHz
LO DRIVE +7 dBm (nominal)

- HERMETICALLY SEALED

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		6.0 dB	8.0 dB	f_R = 6 to 16 GHz f_L = 5 to 17 GHz f_I = 30 to 1000 MHz
		7.0 dB	9.0 dB	f_R = 16 to 18 GHz f_L = 15 to 18 GHz f_I = 30 to 1000 MHz
		7.0 dB	9.0 dB	f_R = 6 to 18 GHz f_L = 3.5 to 18 GHz f_I = 30 to 3000 GHz
Isolation				
L to R	23 dB	36 dB		f_L = 3.5 to 14 GHz
	18 dB	32 dB		f_L = 14 to 18 GHz
L to I	23 dB	38 dB		f_L = 9 to 18 GHz
	16 dB	28 dB		f_L = 3.5 to 9 GHz
Conversion Compression			1.0 dB	f_R Level +3 dBm
Third-Order Input Intercept		+10 dBm		f_{R1} = 13.00 GHz, f_{R2} = 13.01 GHz both at −10 dBm f_L = 14 GHz

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

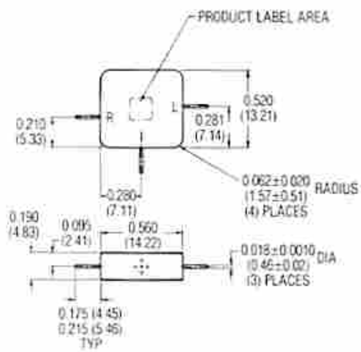
Absolute Maximum Ratings

Operating Temperature. . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +23 dBm max. at 25°C, 20 dBm max. at 100°C
Peak Input Current at 25°C. . . . . 100 mA DC

Weight M80: 6 grams (0.21 oz.) max.
M80C: 30 grams (1.06 oz.) max.

Outline Drawings

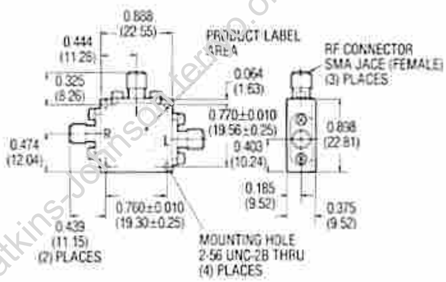
M80 (MINPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

6

M80C (CONNECTORIZED)

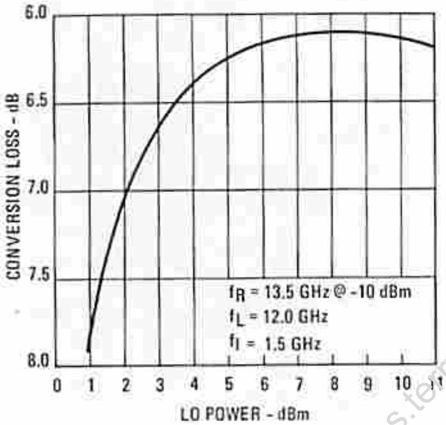


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

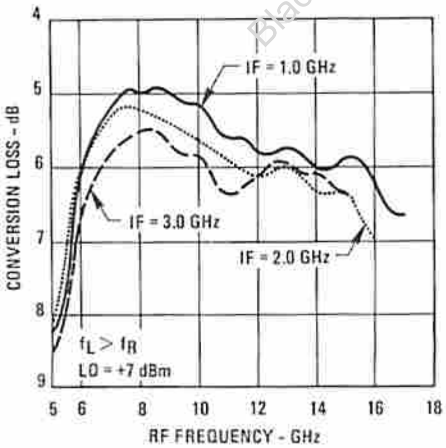
(continued)

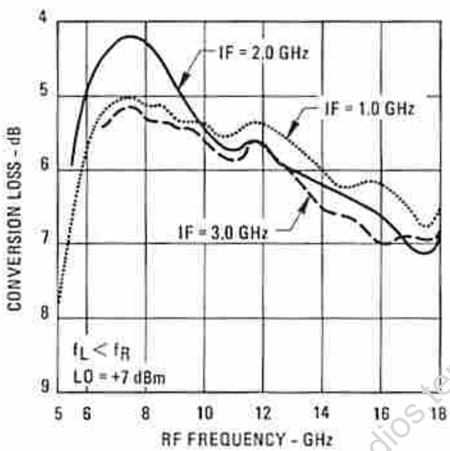
Typical Performance at 25°C

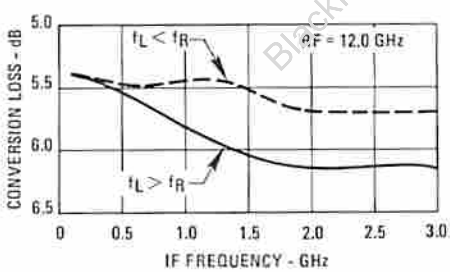
Conversion Loss vs. LO Drive Power



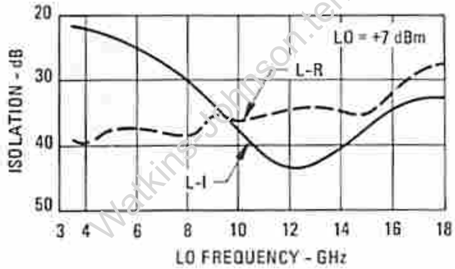
Conversion Loss



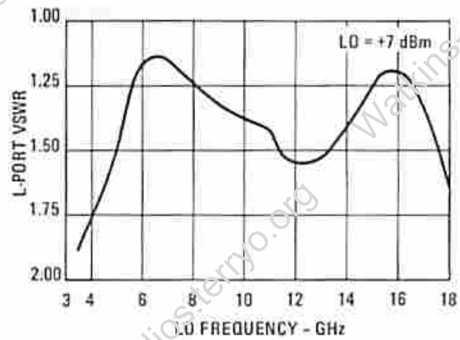


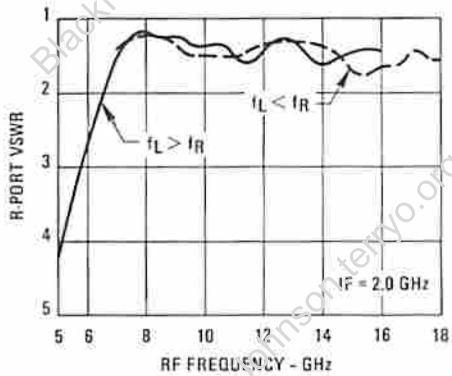


Isolation

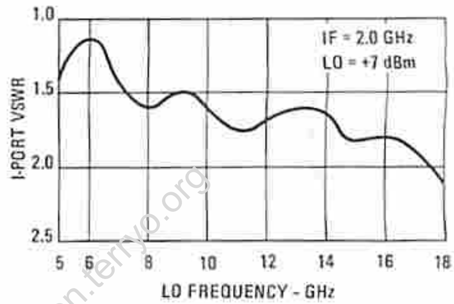


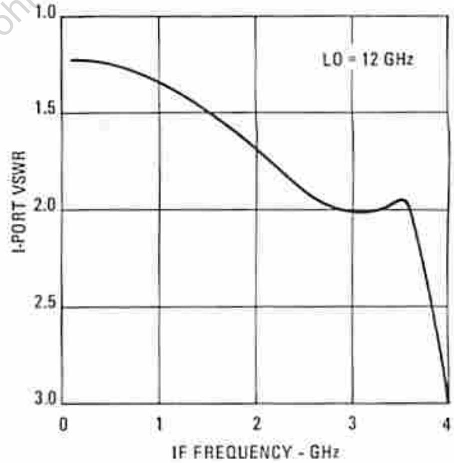
VSWR



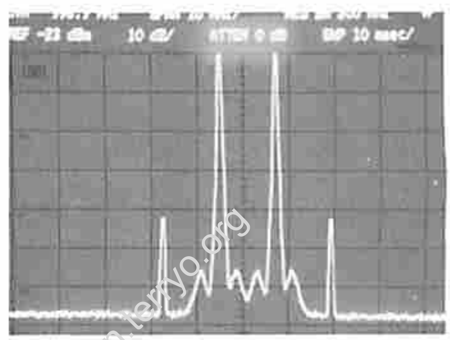


VSWR





Typical Two-Tone Intermodulation Performance



f_I = 1.0 GHz
f_{R1} = 13.00 GHz at -10 dBm
f_{R2} = 13.01 GHz at -10 dBm
f_L = 14 GHz at +7 dBm
Vertical Scale is 10 dB/Div.

WJ-M80L/ M80LC

DOUBLE-BALANCED MIXER

LO 4 TO 18 GHz
RF 7 TO 18 GHz
IF DC TO 3000 MHz
LO DRIVE +0 dBm (nominal)

- STARVED LO - 0 dBm LO POWER
- HERMETICALLY SEALED

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		8.0 dB	10.0 dB	f_R = 7 to 18 GHz, f_L = 6 to 18 GHz, f_I = 30 to 1000 MHz
		9.0 dB	11.0 dB	f_R = 7 to 18 GHz, f_L = 4 to 18 GHz, f_I = 30 to 3000 MHz
Isolation L to R	22 dB	31 dB		f_L = 4 to 15 GHz
	19 dB	27 dB		f_L = 15 to 18 GHz
L to I	26 dB	34 dB		f_L = 9 to 18 GHz
	17 dB	25 dB		f_L = 4 to 9 GHz
Conversion Compression			1.0 dB	f_R Level -2 dBm
Third-Order Input Intercept		+7 dBm		f_{R1} = 13.00 GHz, f_{R2} = 13.01 GHz both at -15 dBm; f_L = 14 GHz at 0 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

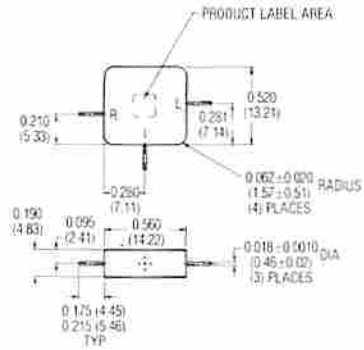
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +20 dBm at 25°C, 17 dBm max. at 100°C
Peak Input Current at 25°C. . . . . 100 mA DC

Weight

M80L: 5.0 grams
M80LC: 20.0 grams

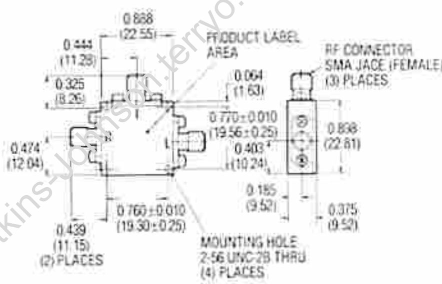
Outline Drawings

M80L (MINPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

M80LC (CONNECTORIZED)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

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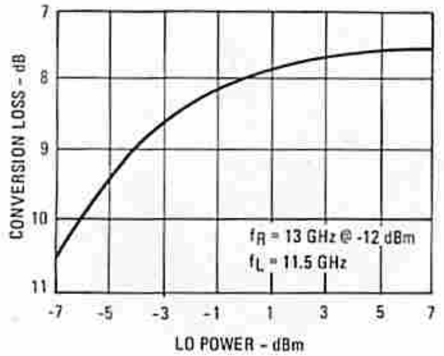
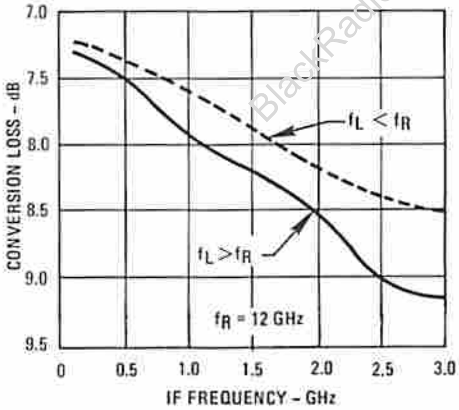
(continued)

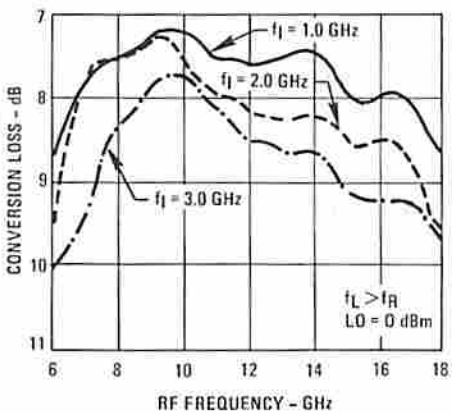
Typical Performance at 25°C

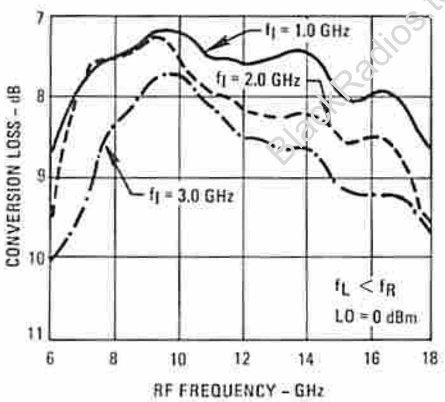
Conversion Loss vs. LO Power



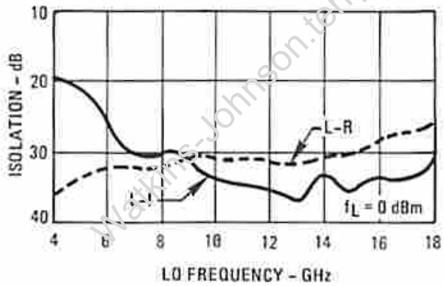
Conversion Loss



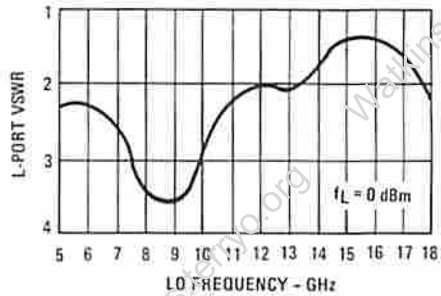


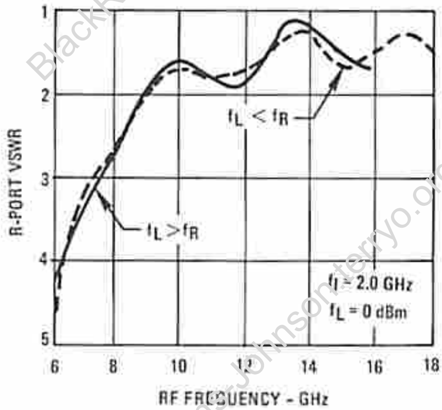


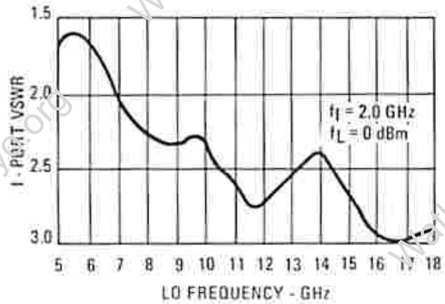
Isolation



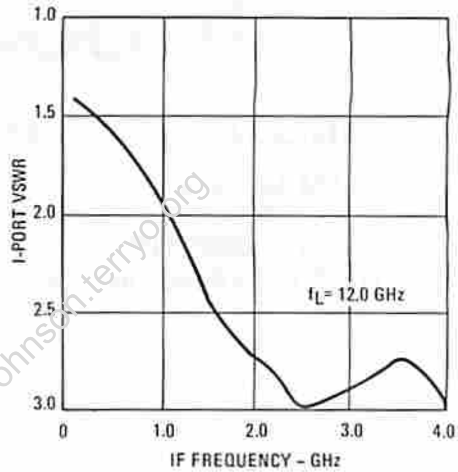
VSWR



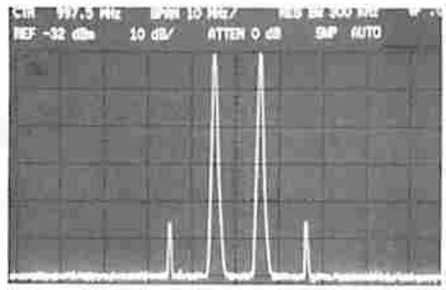




VSWR



Typical Two-Tone Intermodulation Performance



Typical Two-Tone Intermodulation Performance: f_I = 1.0 GHz, f_{R1} = 13.00 GHz at -15 dBm, f_{R2} = 13.01 GHz at -15 dBm. f_L = 14 GHz at 0 dBm. Vertical scale is 10 dB/Div.

WJ-MY82/MY82C

TRIPLE-BALANCED (DOUBLE-DOUBLE) MIXER

LO / RF } 2 TO 18 GHz
IF 0.03 TO 5 GHz
LO DRIVE +13 dBm (nominal)

- HERMETICALLY SEALED

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.5 dB	9.0 dB	f_R = 2 to 18 GHz f_L = 2 to 18 GHz f_I = 0.03 to 2 GHz
		8.0 dB	10.5 dB	f_R = 2 to 18 GHz f_L = 2 to 18 GHz f_I = 2 to 5 GHz
Isolation L to R	16 dB	20 dB		f_L = 2 to 3 GHz
	18 dB	30 dB		f_L = 3 to 18 GHz
L to I	20 dB	30 dB		f_L = 2 to 18 GHz
Conversion Compression			1.0 dB	f_R Level = +6 dBm f_L Level = +13 dBm
Third-Order Input Intercept Point		+18 dBm		f_{R1} = 6.0 GHz, f_{R2} = 6.01 GHz both at -3 dBm f_L = 8 GHz at +13 dBm
		+19 dBm		f_{R1} = 15.0 GHz, f_{R2} = 15.01 GHz both at -3 dBm f_L = 18 GHz at +13 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

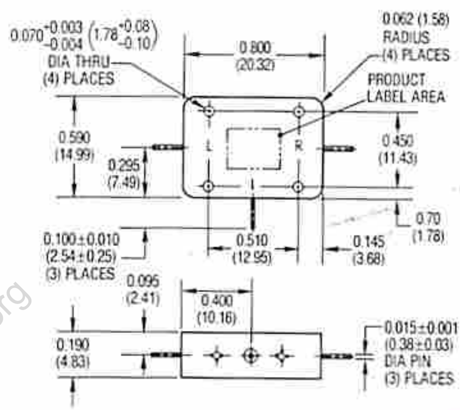
Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . 26 dBm max. at 25°C, 23 dBm max. at 100°C

Weight MY82: 7.9 grams (0.28 oz.) max.
MY82C: 20.0 grams (0.70 oz.) max.

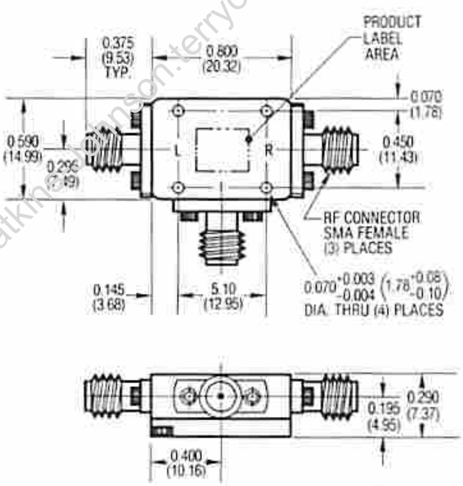
Outline Drawings

MY82 (VERSAPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

MY82C (CONNECTORIZED)



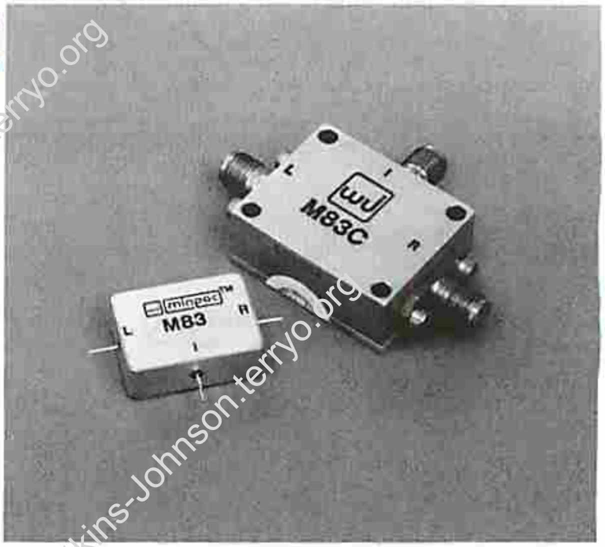
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

6

WJ-M83/M83C

TRIPLE-BALANCED MIXER (DOUBLE-DOUBLE)

LO 2 TO 18 GHz
RF 1 TO 18 GHz
IF 0.03 TO 5 GHz
LO DRIVE +13 dBm (nominal)



- HERMETICALLY SEALED

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		6.5 dB	8.0 dB	f_R = 5 to 13 GHz f_L = 5 to 13 GHz f_I = 0.03 to 2 GHz
		7.5 dB	9.0 dB	f_R = 2 to 16 GHz f_L = 2 to 18 GHz f_I = 0.03 to 4 GHz
		8.5 dB	10.0 dB	f_R = 2 to 18 GHz f_L = 2 to 18 GHz f_I = 0.03 to 5 GHz
				f_R = 1 to 18 GHz f_L = 2 to 18 GHz f_I = 0.03 to 4 GHz
Isolation				
L to R	16 dB	20 dB		f_L = 2 to 3 GHz
	18 dB	30 dB		f_L = 3 to 18 GHz
L to I	20 dB	30 dB		f_L = 2 to 18 GHz
Conversion Compression			1.0 dB	f_R Level +6 dBm f_L Level +13 dBm
Third-Order Input Intercept		+18 dBm		f_{R1} = 6.0 GHz f_{R2} = 6.01 GHz both at -3 dBm f_L = 8 GHz at +13 dBm
		+19 dBm		f_{R1} = 15.0 GHz f_{R2} = 15.01 GHz both at -3 dBm f_L = 18 GHz at +13 dBm

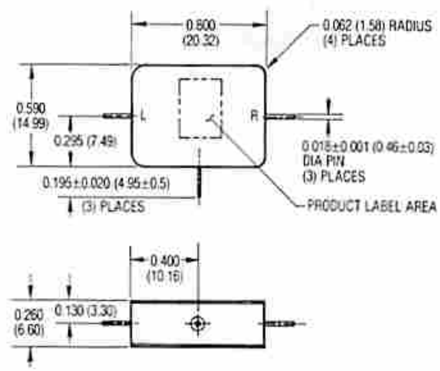
Notes:
1. Measure in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . 26 dBm max. at 25°C, 23 dBm max. at 100°C
Peak Input Current at 25°C . . . . 100 mA DC

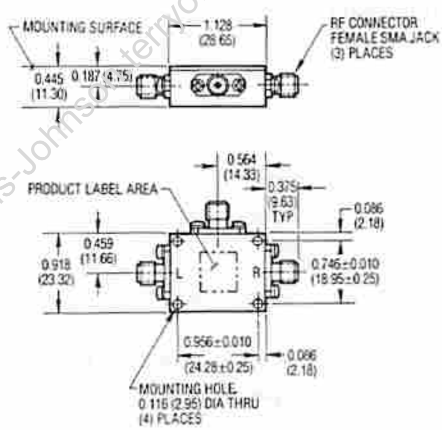
Outline Drawings

M83 (MINPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

M83C (CONNECTORIZED)



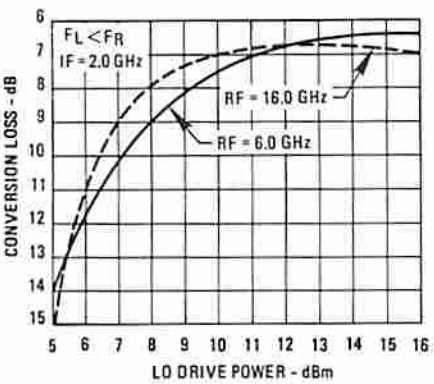
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

Weight

M83: 12 grams (0.42 oz.) max.
M83C: 40 grams (1.41 oz.) max.

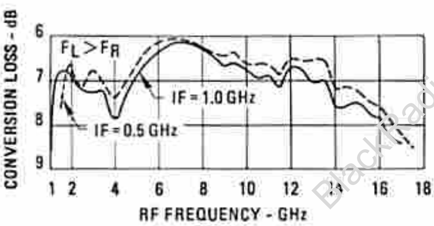
Typical Performance at 25°C

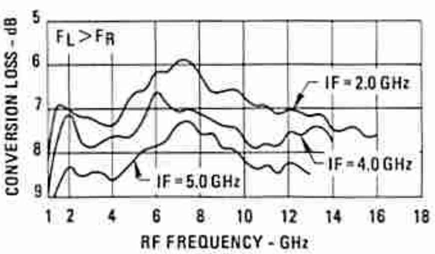
Conversion Loss vs. LO Drive Power



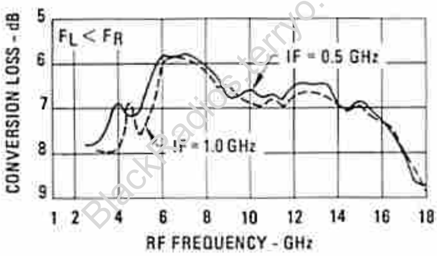
Drive Level: The maximum recommended drive level is +20 dBm. This upper level has been established by the desire to avoid a serious increase in noise figure and a loss of isolation. Operation at +20 dBm is recommended to achieve best two-tone performance and best suppression of the intermodulation products.

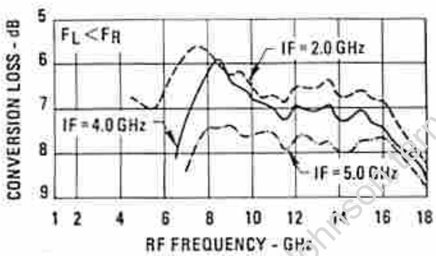
Conversion Loss



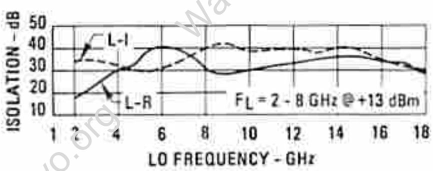


Conversion Loss

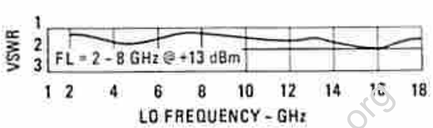




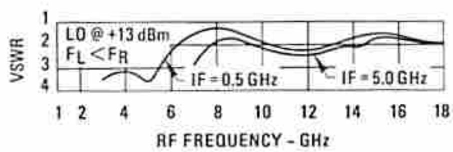
Isolation

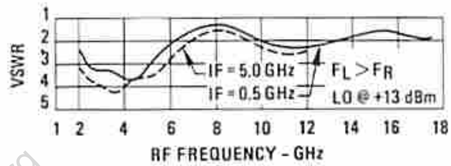


L-Port VSWR

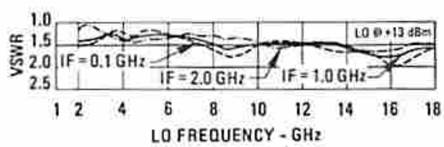


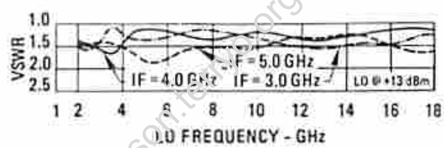
R-Port VSWR





I-Port VSWR





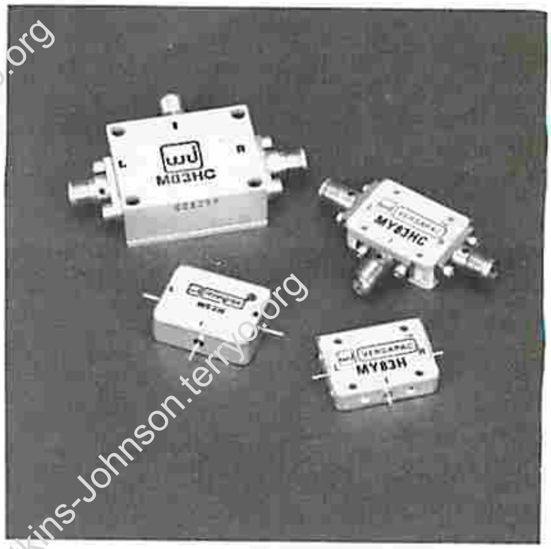
6

WJ-M83H/M83HC
WJ-MY83H/MY83HC

TRIPLE-BALANCED (DOUBLE-DOUBLE) MIXER

LO / RF } 2.0 TO 18.0 GHz
IF 0.03 TO 5.0 GHz
LO DRIVE +20 dBm (nominal)

- MICROSTRIP PACKAGE WITH OPTIONAL CONNECTORS
- HERMETICALLY SEALED



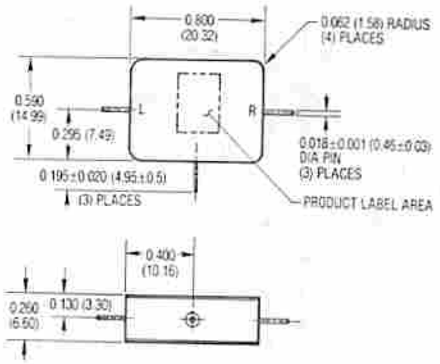
Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		8.5 dB	11.0 dB	f_R =2 to 18 GHz f_L =2 to 18 GHz f_I =0.03 to 5 GHz
Isolation				
L to R	12 dB	16 dB		f_L =2 to 3 GHz
	16 dB	28 dB		f_L =3 to 18 GHz
L to I	20 dB	30 dB		f_L =2 to 18 GHz
Conversion Compression			1.0 dB	f_R level +17 dBm f_L level +20 dBm
Third Order Input Intercept Point		+28 dBm		f_{R1} = 6.0 GHz f_{R2} = 6.01 GHz Both at 0 dBm f_L =8 GHz at +20 dBm
		+25 dBm		f_{R1} = 14.0 GHz f_{R2} = 14.01 GHz Both at 0 dBm f_L = 18 GHz at +20 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

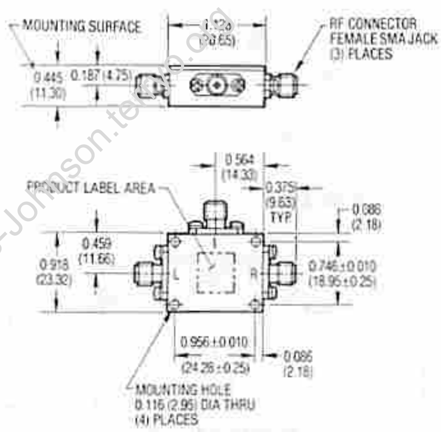
Outline Drawings

M83H (MINPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

M83HC (CONNECTORIZED)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

Absolute Maximum Ratings

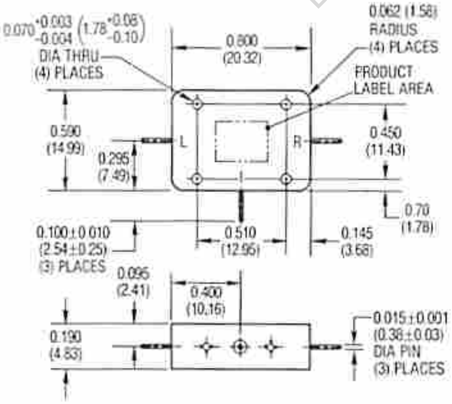
Storage Temperature . . . . -65°C to +100°C
Operating Temperature . . . . -54°C to +100°C
Input Power . . . . 27 dBm max. at 25°C
21 dBm max. at 100°C

Weight

WJ-M83H: 12 grams (0.42 oz.)
WJ-M83HC: 40 grams (1.41 oz.)
WJ-MY83H: 7.9 grams (0.28 oz.) max.
WJ-MY83HC: 20 grams (0.70 oz.) max.

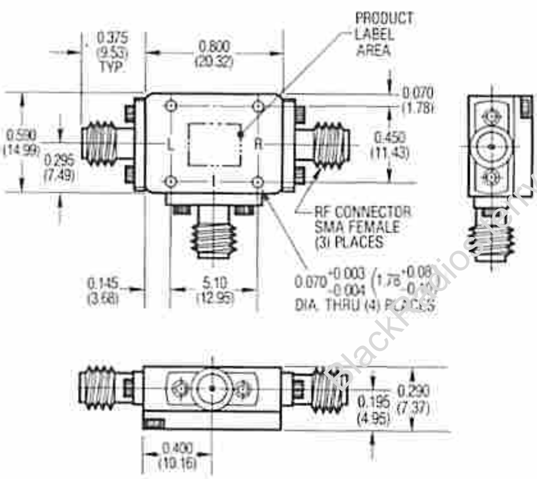
Outline Drawings

MY83H (VERSAPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

MY83HC (CONNECTORIZED)



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

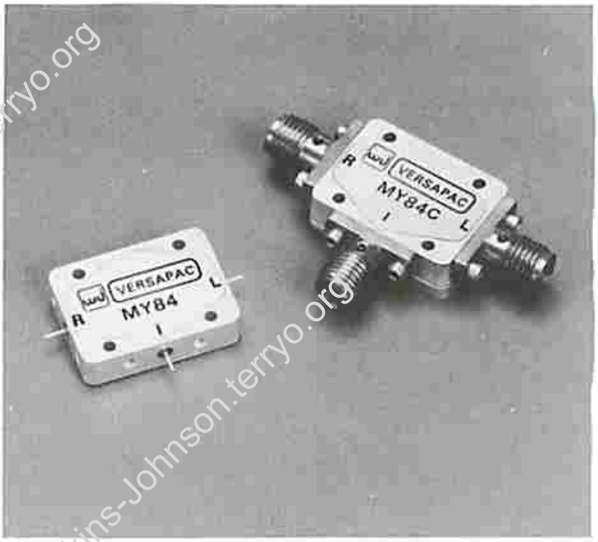
6

WJ-MY84/MY84C

DOUBLE-BALANCED MIXER

LO 1.8 TO 10 GHz
RF 1.8 TO 10 GHz
IF DC TO 1000 MHz
LO DRIVE +9 dBm (nominal)

- HERMETICALLY SEALED



Guaranteed Specifications[1]

Characteristic	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		6.0 dB	7.5 dB	f_R = 1.8-5.5 GHz f_L = 1.8-6.0 GHz f_I = 0.03-0.5 GHz
		6.5 dB	8.5 dB	f_R = 5.5-10.0 GHz f_L = 5.0-10.0 GHz f_I = 0.03-1.0 GHz
Isolation f_L = at R	30 dB	45 dB		f_L = 1.8-6.0 GHz
f_L = at R	20 dB	30 dB		f_L = 6.0-10.0 GHz
f_L = at I	18 dB	30 dB		f_L = 1.8-10.0 GHz
Conversion Compression			1.0 dB	f_R level +4 dBm
Third Order Input Intercept		+11 dBm		f_{R1} = 5.00 GHz -10 dB f_{R2} = 5.01 GHz -10 dB f_L = 5.5 GHz +9 dB

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

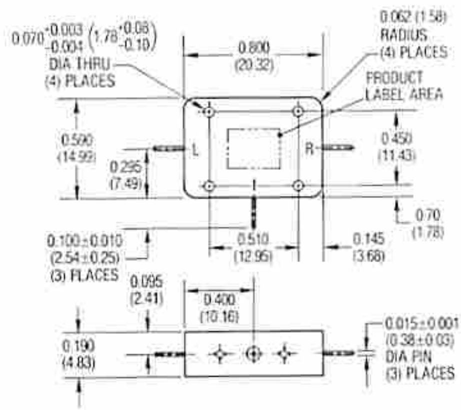
Absolute Maximum Ratings

Operating Temperature . . . . -65°C to +100°C
Storage Temperature . . . . -54°C to +100°C
Peak Input Power . . . . 23 dBm max. at 25°C, 20 dBm max. at 100°C
Peak Input Current at 25°C . . . . 100 mA DC

Weight MY84: 7.9 grams (0.28 oz.) max.
MY84C: 20.0 grams (0.70 oz.) max.

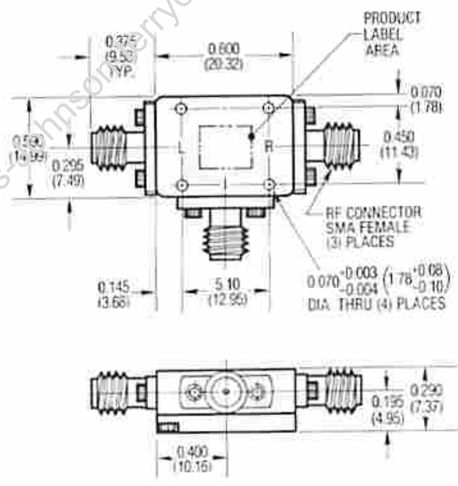
Outline Drawings

MY84 (VERSAPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

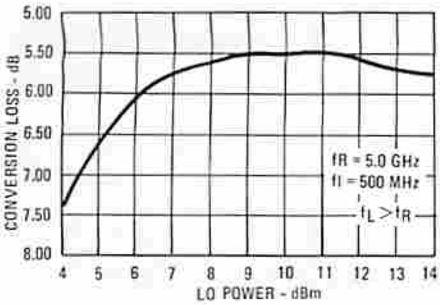
MY84C (CONNECTORIZED)



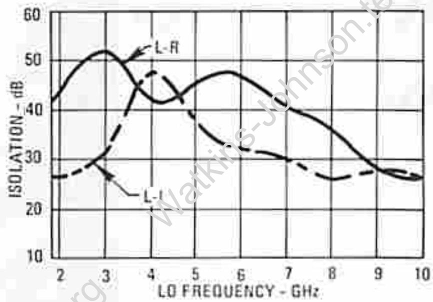
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

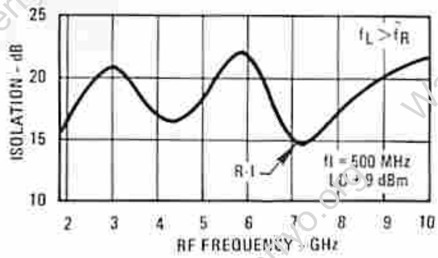
Typical Performance at 25°C

Conversion Loss vs. LO Drive Power

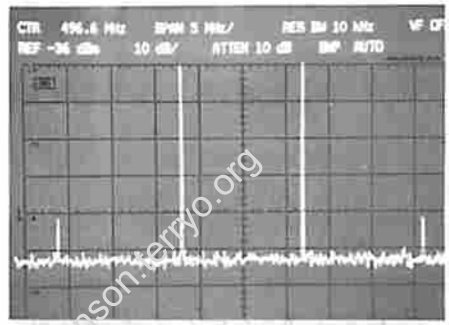


Isolation



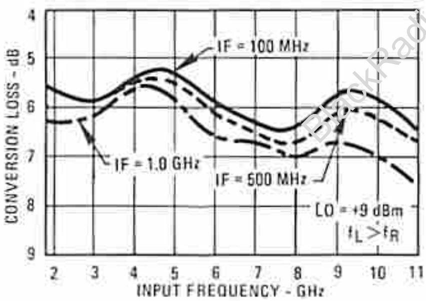


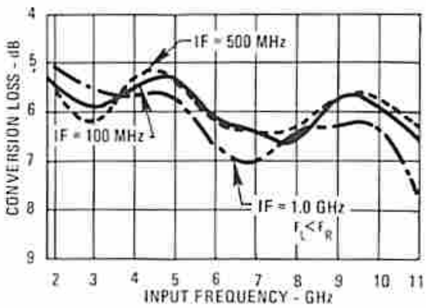
Third-Order Intercept

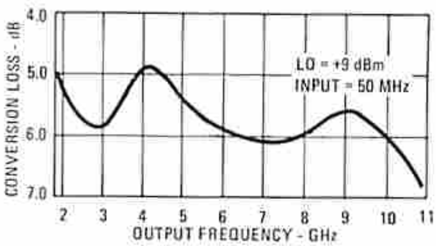


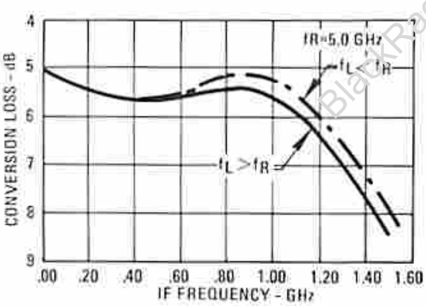
f_R = 5.0 ± 0.01 GHz at –10 dBm
f_L = 5.5 GHz at +9 dBm

Conversion Loss

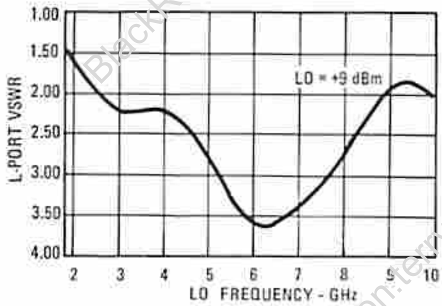


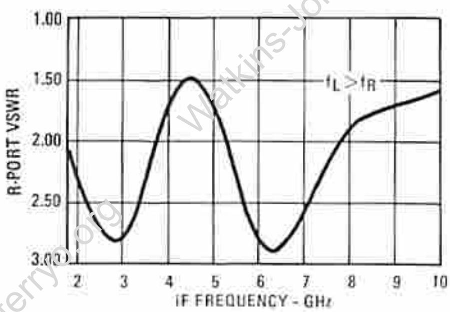


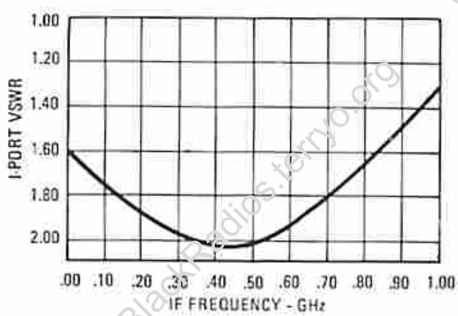




VSWR



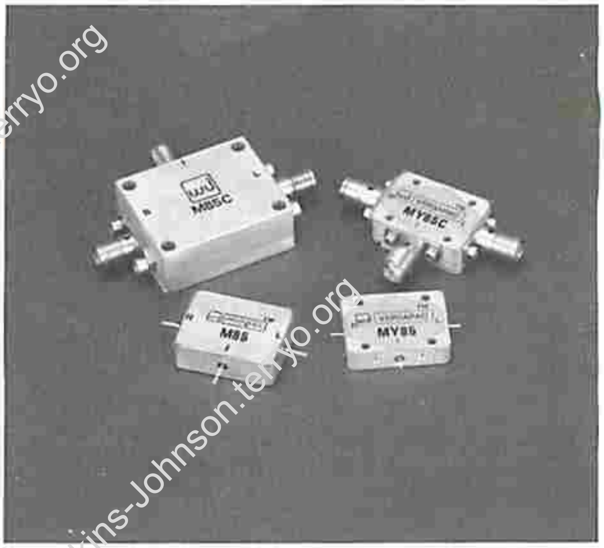




WJ-M85/M85C
WJ-MY85/MY85C

DOUBLE-BALANCED MIXER

LO } 2 TO 18 GHz
RF }
IF DC TO 1000 MHz
LO DRIVE +7 dBm (nominal)



- DC COUPLED I-PORT
- HERMETICALLY SEALED

Guaranteed Specifications [1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.0 dB	9.0 dB	f_L 3 - 15 GHz f_R 4 - 14 GHz f_I DC to 1000 MHz
		8.5 dB	10.5 dB	f_L 2 - 18 GHz f_R 2 - 18 GHz f_I DC to 1000 MHz
Isolation				
L to R	22 dB	30 dB		f_L 2 - 18 GHz
L to I	15 dB	20 dB		f_L 2 - 18 GHz
R to I		20 dB		f_R 2 - 18 GHz
Conversion Compression			1.0 dB	f_I 5.5 GHz f_R 5.0 GHz f_R level +1 dBm
			1.0 dB	f_L 14.5 GHz f_R 15.0 GHz f_R level +3 dBm
Third Order Input Intercept Point		+10 dBm		f_{R1} 5.0 GHz f_{R2} 5.01 GHz Both at -10 dBm f_L 5.5 GHz, +7 dBm
		+10 dBm		f_{R1} 15.0 GHz f_{R2} 15.01 GHz Both at -10 dBm f_L 14.5 GHz, +7 dBm

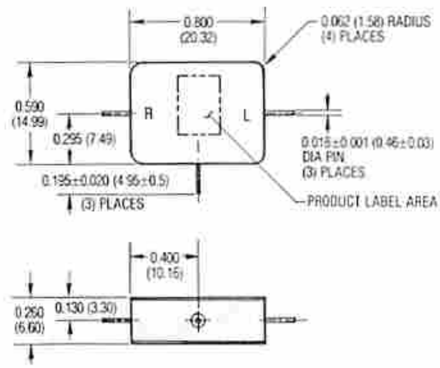
Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . 23 dBm max. at 25°C, 20 dBm max. at 100°C
Peak Input Current at 25°C . . . . 100 mA DC

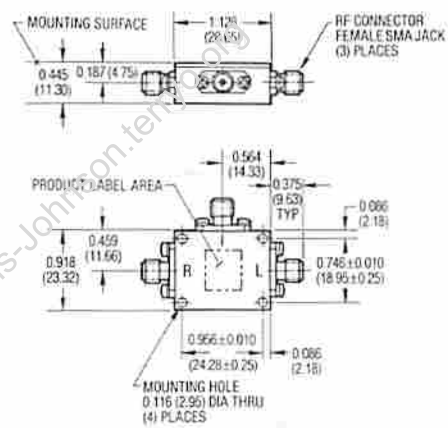
Outline Drawings

M85 (MINPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .010 (.25) UNLESS OTHERWISE SPECIFIED

M85C (CONNECTORIZED)



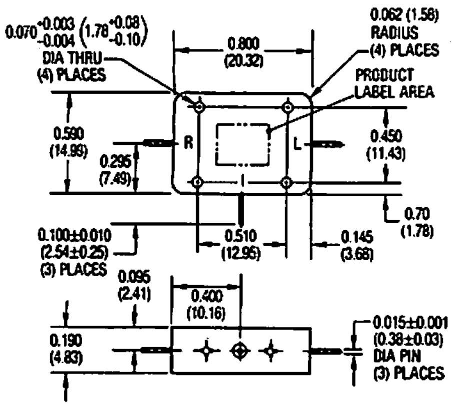
DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

Weight

M85:	12 grams (0.42 oz.) max.
M85C:	40 grams (1.41 oz.) max.
MY85:	7.9 grams (0.28 oz.) max.
MY85C:	20.0 grams (0.70 oz.) max.

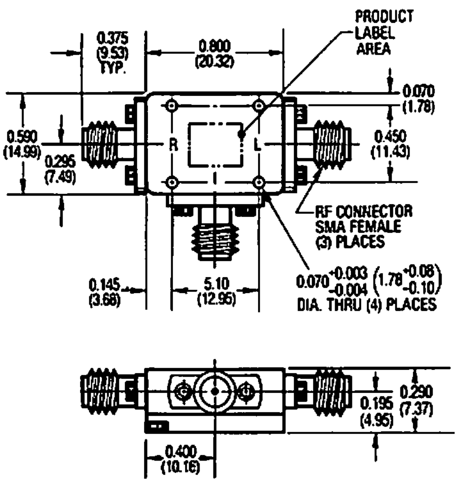
Outline Drawings

MY85 (VERSAPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

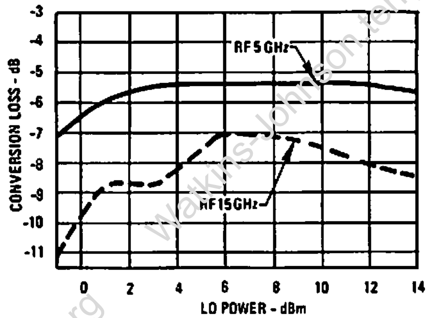
MY85C (CONNECTORIZED)



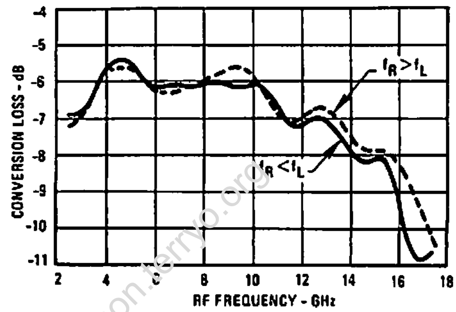
DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C*

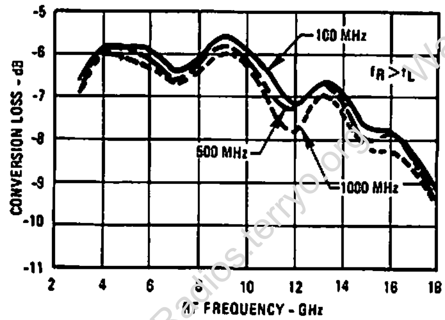
Conversion Loss vs LO Power Level

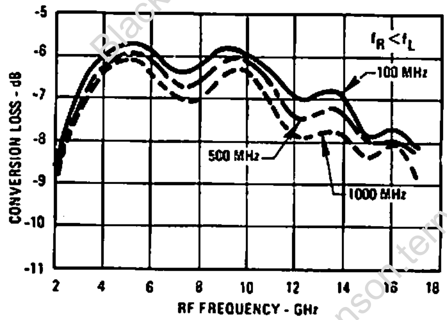


Up Conversion Loss

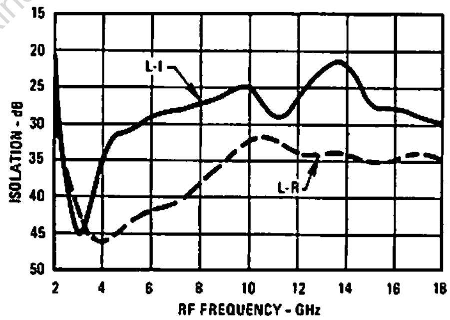


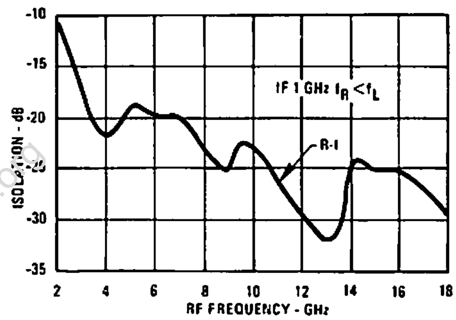
Conversion Loss



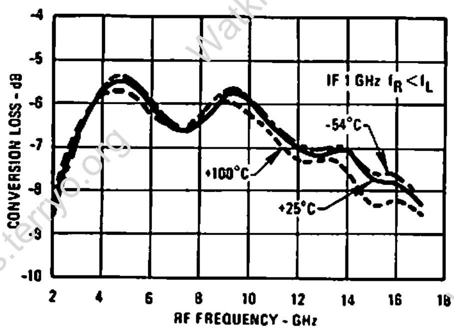


Isolation

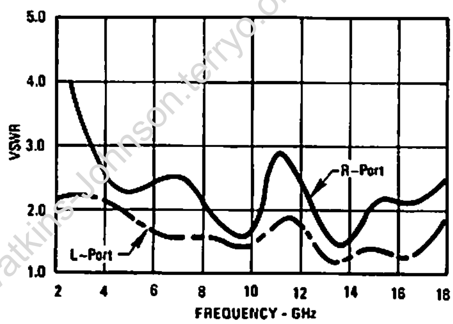


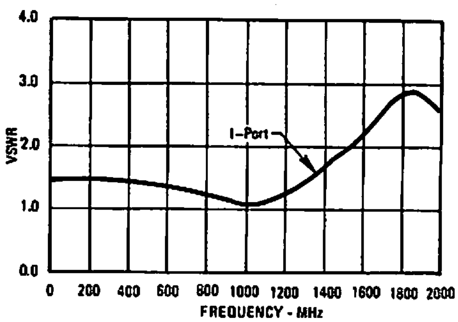


Conversion Loss over Temperature



VSWR



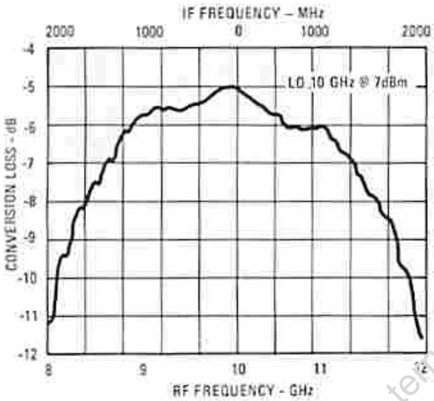


*Typical performance applies to the MINPAC™ model and does not necessarily reflect the performance of the VERSAPAC® model.

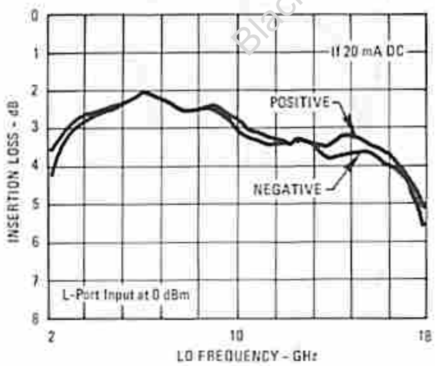
6

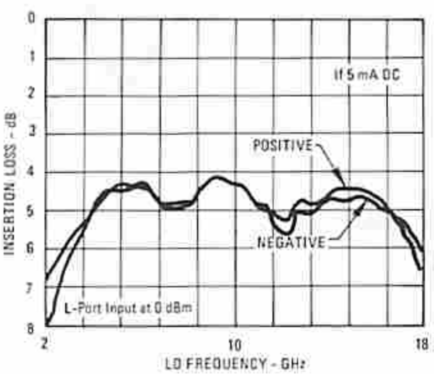
Typical Performance at 25°C* (Cont.)

I Port Bandwidth

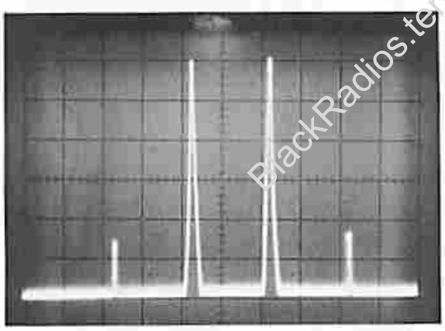


Insertion Loss with DC Driven I-Port





Third-Order Intercept Input



f_{R1} 15.00 GHz at –10 dBm
f_{R2} 15.02 GHz at –10 dBm
LO 14.5 GHz at 7 dBm
Vertical Scale is 10 dB/Div.

Characteristic Single Tone IM	Suppression (dBc) Input 0 dBm	 Input -5 dBm	 Input -10 dBm	Test Condition
f_R f_L				
1 x 1	0	0	0	f_R 2.0 GHz –10 dBm
2 x 1	24	27	31	
2 x 2	41	43	45	f_L 2.6 GHz +7 dBm
3 x 2	38	45	55	
3 x 3	32	41	51	
4 x 3	41	52	>60	
5 x 4	53	>65	>60	
6 x 3	59	>65	>60	
6 x 5	51	>65	>60	
1 x 1	0	0	0	
1 x 2	32	32	31	f_R 2.6 GHz –10 dBm
2 x 2	49	57	>65	
2 x 3	28	28	33	f_L 2.0 GHz +7 dBm
3 x 3	>65	>65	>65	
3 x 4	48	56	>65	
4 x 5	41	52	>65	
4 x 6	53	63	>65	
5 x 6	50	65	>65	

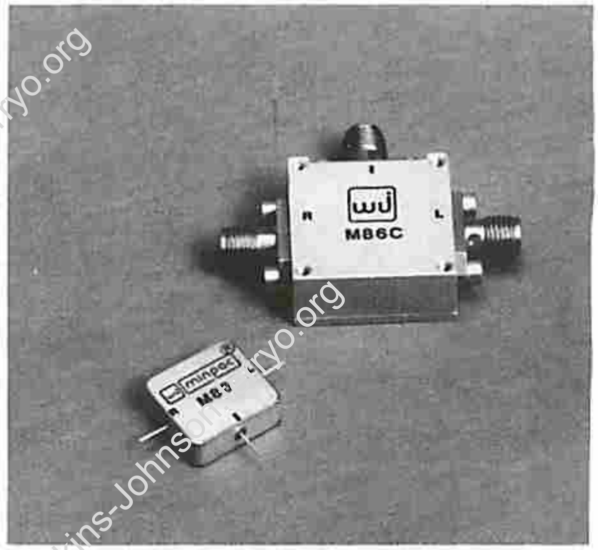
Characteristic Harmonics of f_L	Output Power R-Port	 I-Port	Test Conditions
f_L	– 21 dBm	– 12 dBm	
$2f_L$	-8.5 dBm	– 26 dBm	
$3f_L$	– 45 dBm	<-60 dBm	
$4f_L$	– 24 dBm	– 45 dBm	f_L 2 GHz @ +7 dBm
$5f_L$	– 47 dBm	– 39 dBm	
$6f_L$	– 38 dBm	<-60 dBm	
$7f_L$	<-60 dBm	– 43 dBm	
$8f_L$	– 38 dBm	<-60 dBm	
$9f_L$	<-60 dBm	<-60 dBm	
f_L	– 38 dBm	– 27 dBm	
$2f_L$	– 18 dBm	– 39 dBm	f_L 4 GHz @ +7 dBm
$3f_L$	– 46 dBm	– 29 dBm	
$4f_L$	– 33 dBm	<-60 dBm	
f_L	– 29 dBm	– 20 dBm	
$2f_L$	– 35 dBm	<-60 dBm	f_L 9 GHz @ +7 dBm

*Typical performance applies to the MINPAC™ model and does not necessarily reflect the performance of the VERSAPAC® model.

WJ-M86/M86C

DOUBLE-BALANCED MIXER

LO 3.5 TO 18 GHz
RF 6 TO 18 GHz
IF DC TO 3000 MHz
LO DRIVE +7 dBm (nominal)



- HERMETICALLY SEALED
- DC COUPLED IF

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		6.0 dB	8.0 dB	f_R = 6 to 16 GHz f_L = 5 to 17 GHz f_I = 30 to 1000 MHz
		7.0 dB	9.0 dB	f_R = 16 to 18 GHz f_L = 15 to 18 GHz f_I = 30 to 1000 MHz
		7.0 dB	9.0 dB	f_R = 6 to 18 GHz f_L = 3.5 to 18 GHz f_I = 30 to 3000 MHz
Isolation L to R	23 dB 18 dB	36 dB 32 dB		f_L = 3.5 to 14 GHz f_L = 14 to 18 GHz
L to I	23 dB 16 dB	38 dB 28 dB		f_L = 9 to 18 GHz f_L = 3.5 to 9 GHz
Conversion Compression			1.0 dB	f_R Level +3 dBm
Third-Order Input Intercept		+10 dBm		f_{R1} = 13.00 GHz, f_{R2} = 13.01 GHz both at −10 dBm f_L = 14 GHz

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

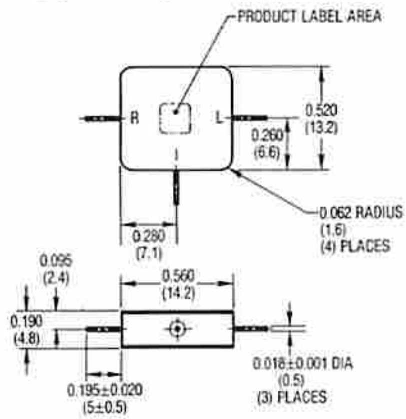
Absolute Maximum Ratings

Operating Temperature . . . . −54°C to +100°C
Storage Temperature . . . . −65°C to +100°C
Peak Input Power . . . . 23 dBm max. at 25°C, 20 dBm max. at 100°C
Peak Input Current at 25°C . . . . 100 mA DC

Weight M86: 6 grams (0.21 oz.) max.
M86C: 30 grams (1.06 oz.) max.

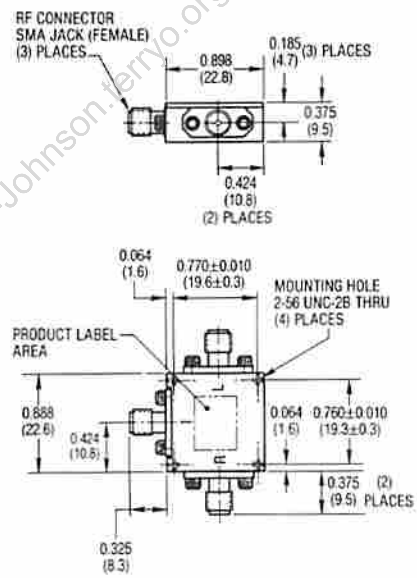
Outline Drawings

M86 (MINPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

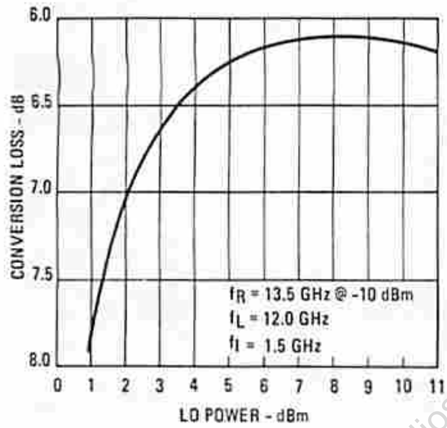
M86C (CONNECTORIZED)

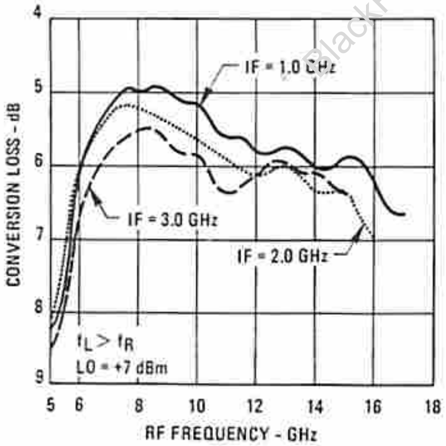


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

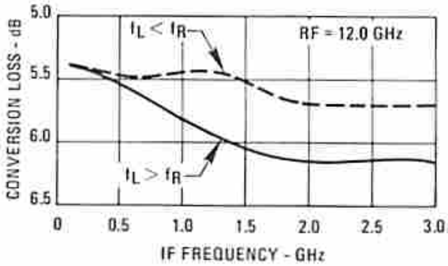
Typical Performance at 25°C

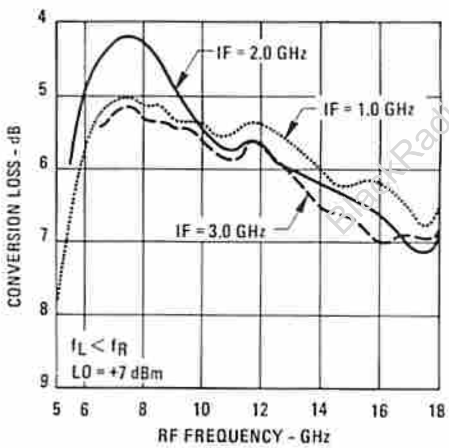
Conversion Loss vs. LO Power



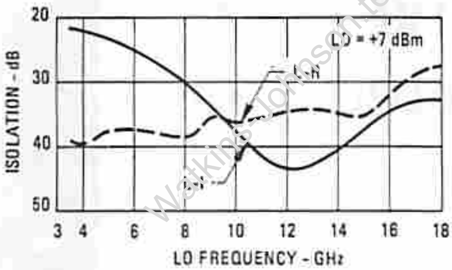


Conversion Loss

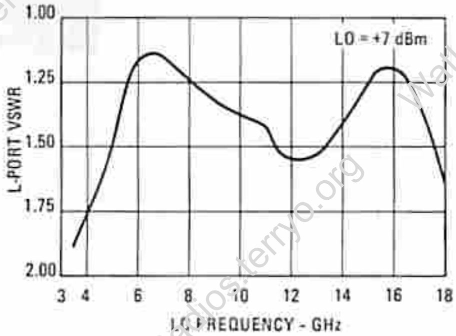


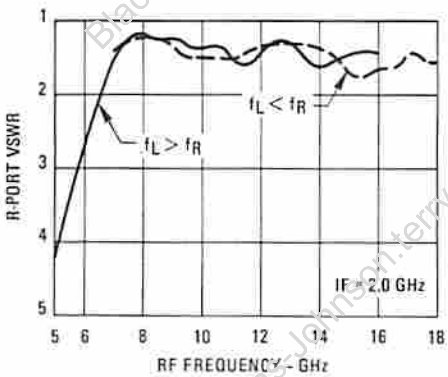


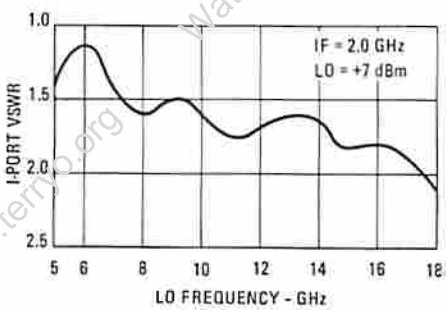
Isolation



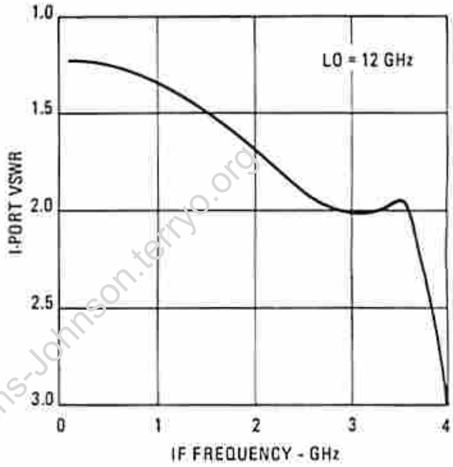
VSWR



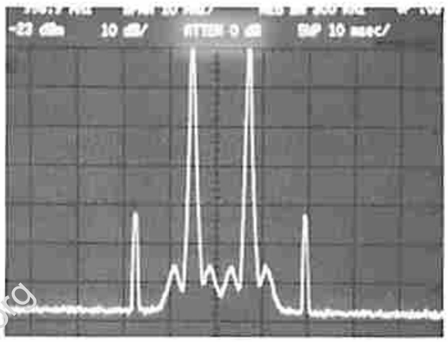




VSWR



Typical Two-Tone Intermodulation Performance



f_I = 1.0 GHz
f_{R1} = 13.00 GHz @ –10 dBm
f_{R2} = 13.01 GHz @ –10 dBm
f_L = 14 GHz @ +7 dBm
Vertical Scale is 10 dB/Div.

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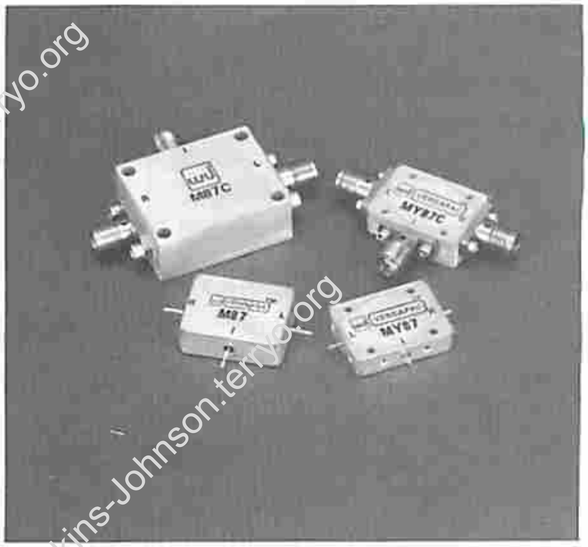
WJ-M87/M87C
WJ-MY87/MY87C

TRIPLE-BALANCED (DOUBLE-DOUBLE) MIXER

LO, RF 0.5 TO 19 GHz
IF 0.03 TO 5.0 GHz
LO DRIVE +13 dBm (nominal)



- HERMETICALLY SEALED

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.5 dB	10.5 dB	f_R 1.0 to 18.0 GHz f_L 0.5 to 18.0 GHz f_I 0.03 to 3.0 GHz
		8.5 dB	11.0 dB	f_R 0.5 to 18.0 GHz f_L 0.5 to 18.0 GHz f_I 0.03 to 4.0 GHz
		10.5 dB	12.0 dB	f_R 0.7 to 19.0 GHz f_L 0.5 to 19.0 GHz f_I 0.03 to 5.0 GHz
Isolation L-R	10.0 dB	17.0 dB		f_L=0.5 to 3.0 GHz
	20.0 dB	30.0 dB		f_L=3.0 to 19.0 GHz
L-I	22.0 dB	32.0 dB		f_L=0.5 to 19.0 GHz
Conversion Compression f_R at 5 GHz			1.0 dB	f_R level +9.0 dBm f_L level +13.0 dBm
f_R at 15 GHz			1.0 dB	f_R level +9.0 dBm f_L level +13.0 dBm
Third-Order Input Intercept Point		+16.5 dBm		f_{R1}=5.0 GHz, f_{R2}=5.01 GHz both at -6.0 dBm f_L=7.0 GHz at +13.0 dBm
		+18.0 dBm		f_{R1}=15.0 GHz, f_{R2}=15.01 GHz both at -6.0 dBm f_L=18.0 GHz at +13.0 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

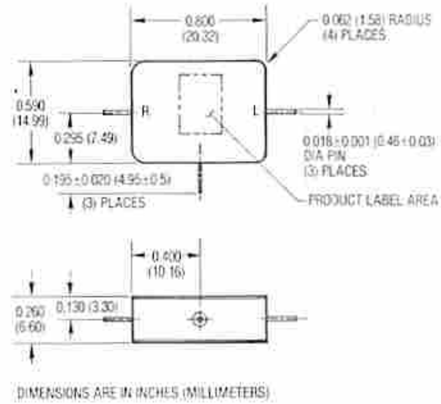
Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . 26 dBm max. at 25°C, 23 dBm max. at 100°C

Weight M87: 12 grams (0.42 oz.) max. MY87: 7.0 grams (0.28 oz.) max.
M87C: 40 grams (1.41 oz.) max. MY87C: 20.0 grams (0.70 oz.) max.

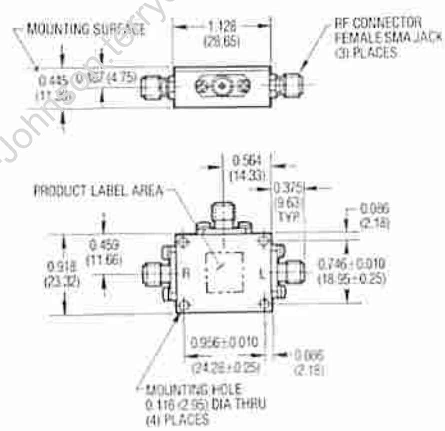
Outline Drawings

M87 (MINPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

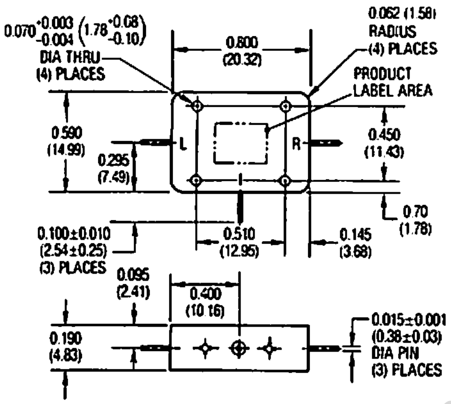
M87C (CONNECTORIZED)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

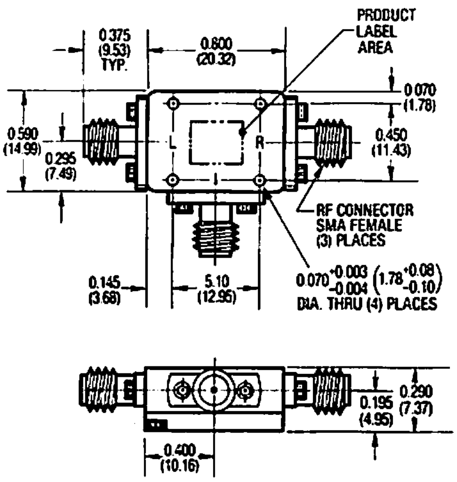
Outline Drawings

MY87 (VERSAPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

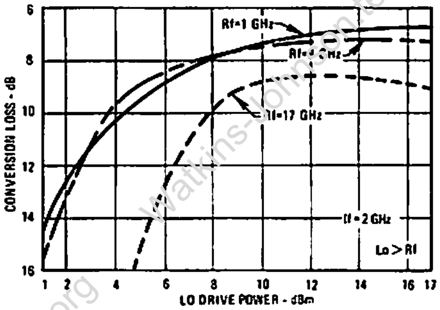
MY87C (CONNECTORIZED)



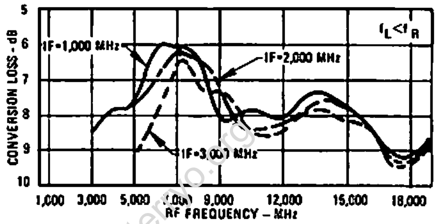
DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

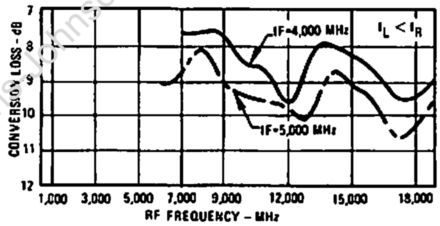
Typical Performance at 25°C*

Conversion Loss vs. LO Drive Power

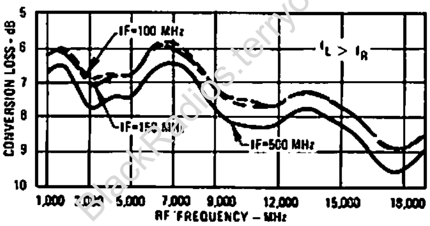


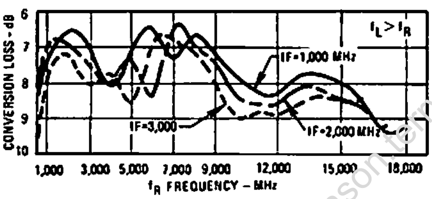
Conversion Loss vs. Frequency LO @ +13 dBm

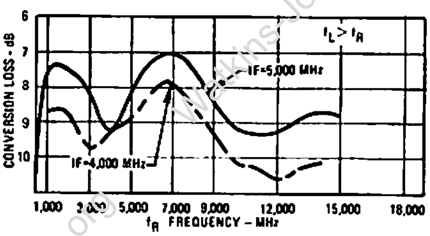


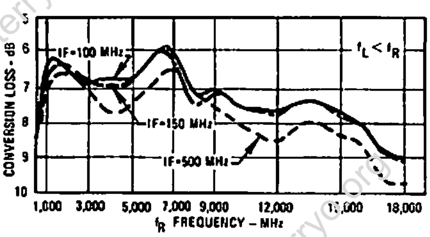


Conversion Loss vs. Frequency LO @ +13 dBm

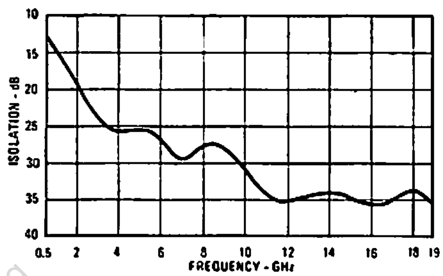




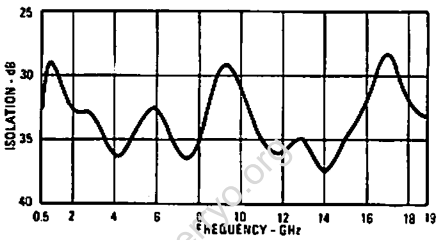




L to R Port Isolation vs. Frequency



L to I Port Isolation vs. Frequency

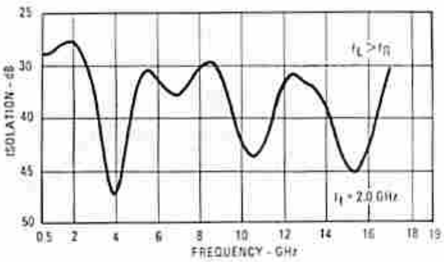


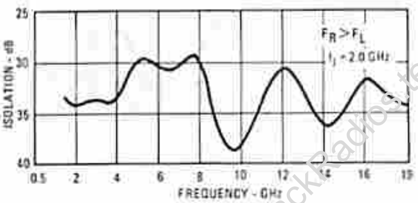
6

*Typical performance applies to the MINPAC™ model and does not necessarily reflect the performance of the VERSAPAC® model.

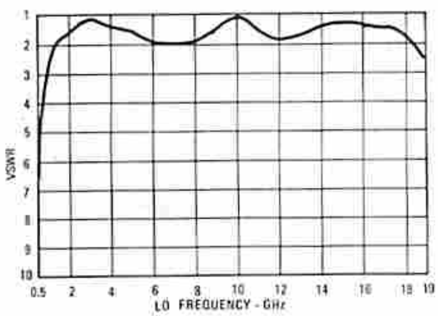
Typical Performance at 25°C* (Cont.)

R to I Port Isolation vs. Frequency

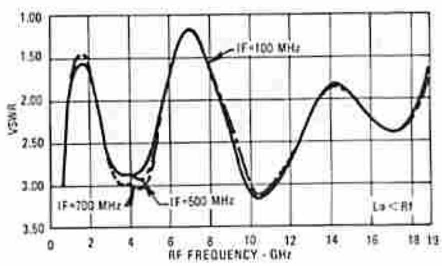


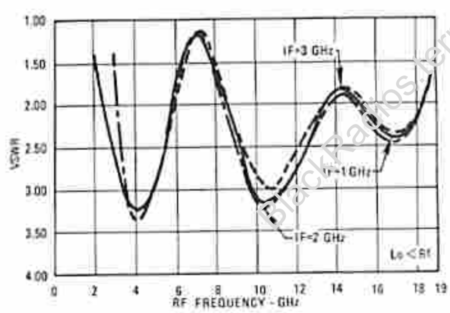


L-PORT VSWR vs. Frequency

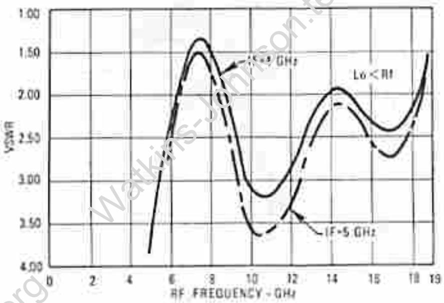


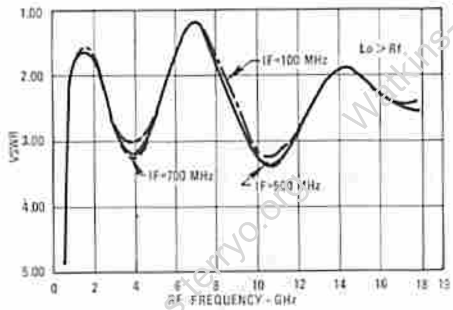
R-Port VSWR vs. Frequency

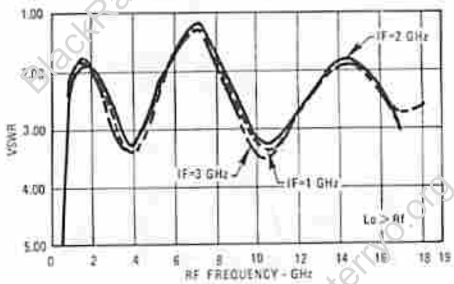


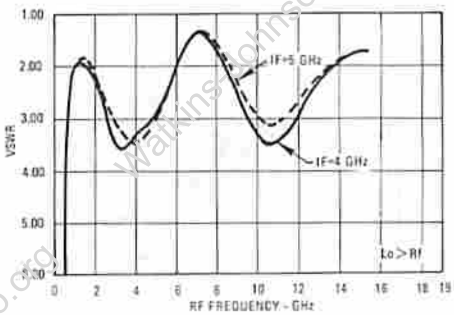


R-Port VSWR vs. Frequency

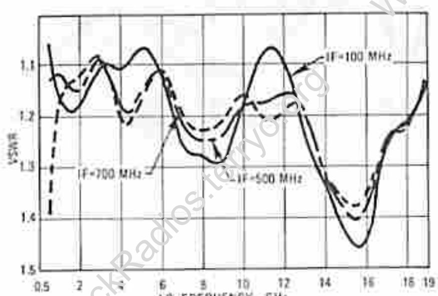




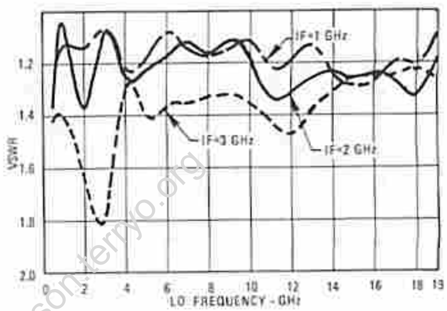


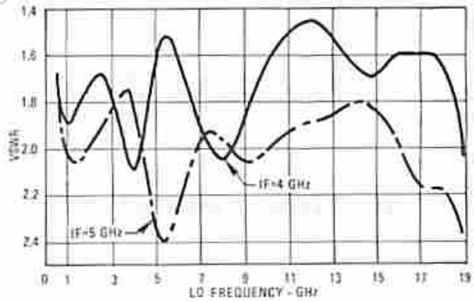


I-Port VSWR vs. Frequency

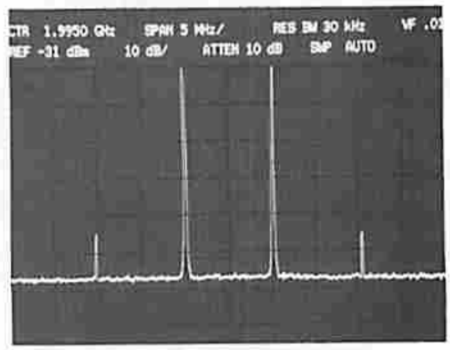


I-Port VSWR vs. Frequency





Typical Two-Tone Intermodulation



Typical Two Tone Intermodulation Performance

f_I = 2.0 GHz
f_R = 5.0 GHz ± 5.0 MHz @ -6.0 dBm
f_L = 7.0 GHz @ +13.0 dBm
Vertical Scale = 10.0 dB/cm

*Typical performance applies to the MINPAC™ model and does not necessarily reflect the performance of the VERSAPAC® model.

Typical Performance at 25°C (Cont.)

Characteristics	Output Power		Test Conditions
Harmonics of f_L	R-Port	I-Port	
f_L	0.0 dBm	-20.0 dBm	f_L = 500 MHz at +13.0 dBm
2 f_L	-34.0 dBm	-15.0 dBm	
3 f_L	-20.0 dBm	-39.0 dBm	
4 f_L	-48.0 dBm	-32.0 dBm	
5 f_L	-43.0 dBm	-47.0 dBm	
f_L	-7.0 dBm	-17.0 dBm	f_L = 2.0 GHz at +13.0 dBm
2 f_L	-25.0 dBm	-13.0 dBm	
3 f_L	-19.0 dBm	–	
4 f_L	-38.0 dBm	–	
5 f_L	-29.0 dBm	–	
f_L	-17.0 dBm	–	f_L = 9.5 GHz at +13.0 dBm
2 f_L	-24.0 dBm	–	

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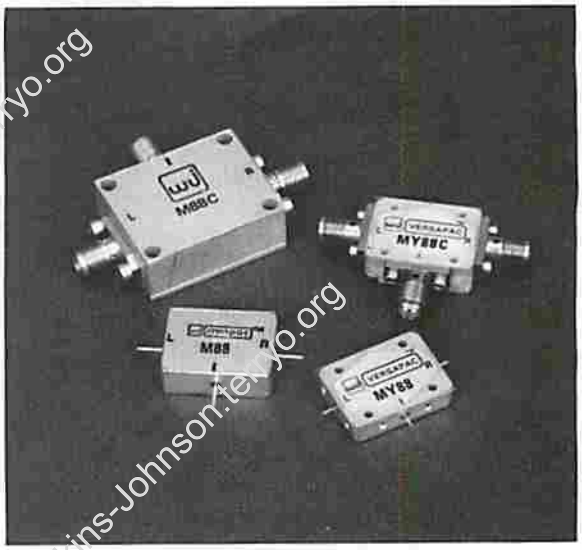
WJ-M88/M88C
WJ-MY88/MY88C

TRIPLE-BALANCED (DOUBLE-DOUBLE) MIXER

LO, RF } 2 TO 18 GHz
IF 1 TO 8 GHz
LO DRIVE +13 dBm (nominal)



- HERMETICALLY SEALED
- WIDEBAND IF 1 TO 8 GHz
- QPL VERSION AVAILABLE! (See Section 7)

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.5 dB	10.0 dB	f_R 2 to 10 GHz f_L 2 to 18 GHz f_I 1 to 8 GHz
		8.0 dB	10.5 dB	f_R 10 to 18 GHz f_L 10 to 18 GHz f_I 2 to 8 GHz
		8.0 dB	11.0 dB	f_R 10 to 18 GHz f_L 2 to 10 GHz f_I 2 to 8 GHz
Isolation L to R L to I	 15 dB 16 dB	 28 dB 32 dB		 f_L 2 to 18 GHz f_L 2 to 18 GHz
Conversion Compression			1.0 dB	f_R level +7 dBm f_L level +13 dBm
Third-Order Input Intercept Point		+18.5 dBm +22 dBm		f_{R1}=6.0 GHz, f_{R2}=6.01 GHz both at -3 dBm f_L = 10 GHz at +13 dBm f_{R1}=15.0 GHz, f_{R2}=15.01 GHz both at -3 dBm f_L = 18 GHz at +13 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

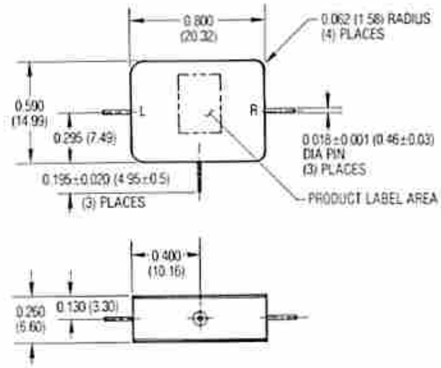
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . 26 dBm max. at 25°C, 23 dBm max. at 100°C

Weight

M88: 12 grams (0.42 oz.) max.
M88C: 40 grams (1.41 oz.) max.
MY88: 7.9 grams (0.28 oz.) max.
MY88C: 20.0 grams (0.70 oz.) max.

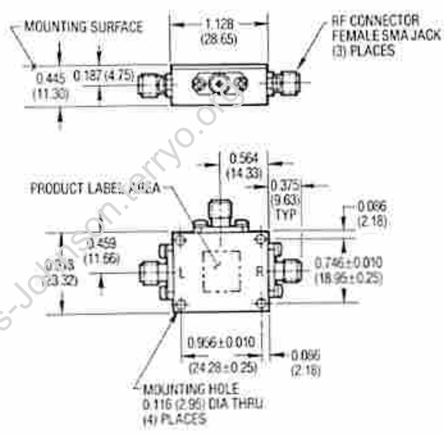
Outline Drawings

M88 (MINPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

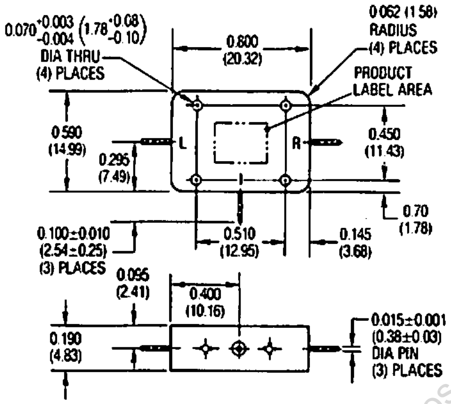
M88C (CONNECTORIZED)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

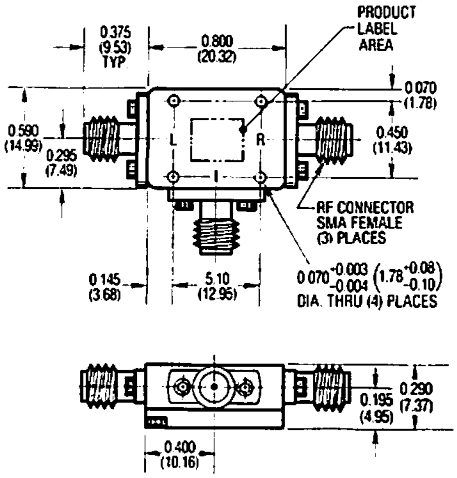
Outline Drawings

MY88 (VERSAPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

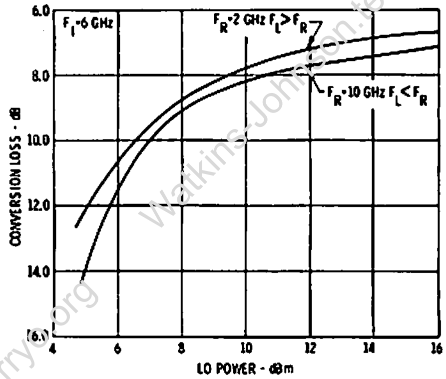
MY88C (CONNECTORIZED)



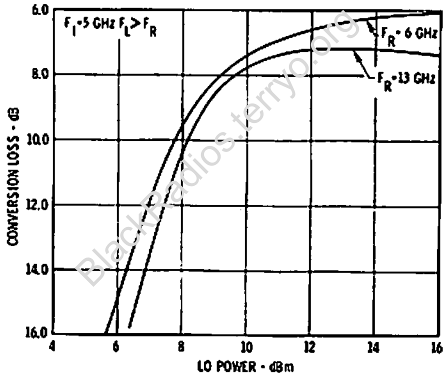
DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

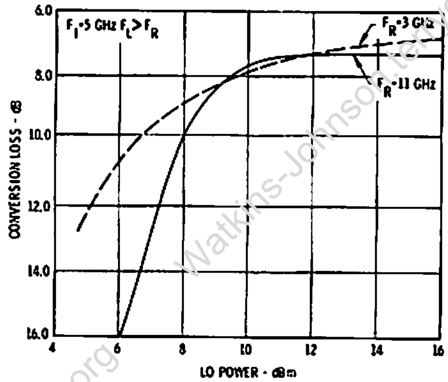
Typical Performance at 25°C* (Cont.)

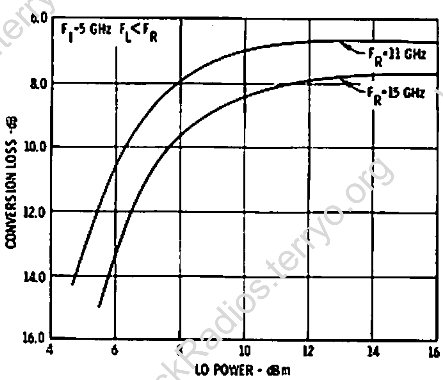
Drive Level



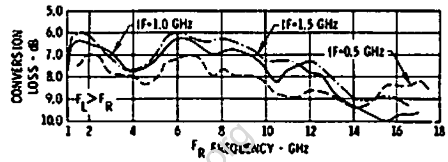
Drive Level: The maximum recommended drive level is +20 dBm.

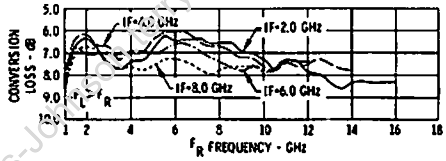


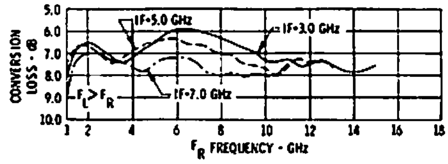


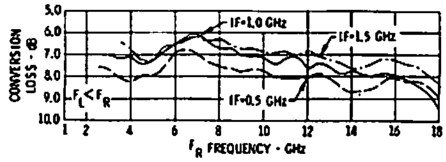


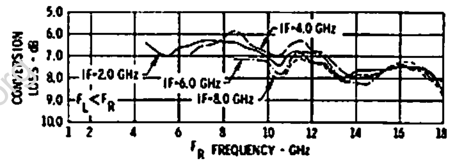
Conversion Loss vs. Frequency, LO @ +13 dBm

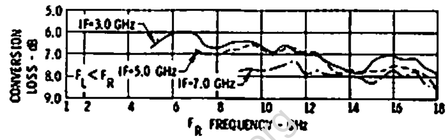




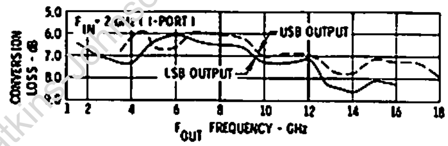




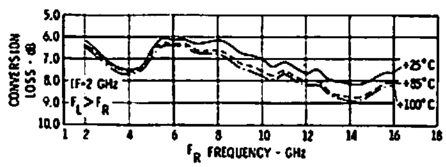




Upconversion (Conversion Loss) LO @ +13 dBm



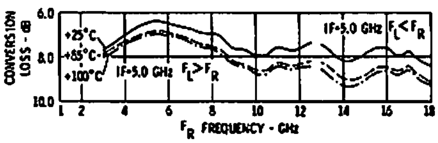
Conversion Loss vs. Freqeuncy & Temperature LO @ +13 dBm



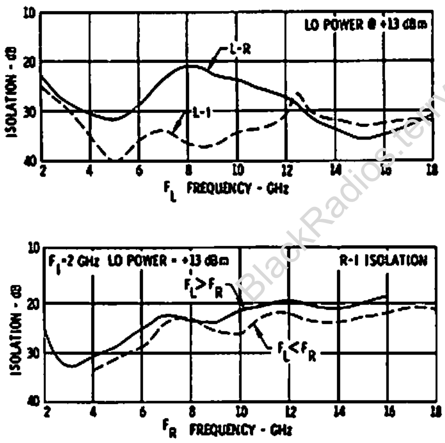
*Typical performance applies to the MINPAC™ model and does not necessarily reflect the performance of the VERSAPAC® model.

Typical Performance at 25°C * (Cont.)

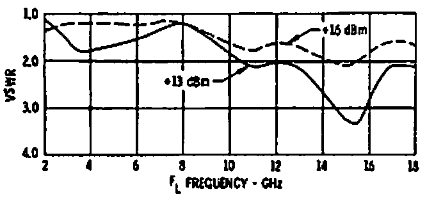
Conversion Loss vs. Freqeuncy & Temperature LO @ +13 dBm



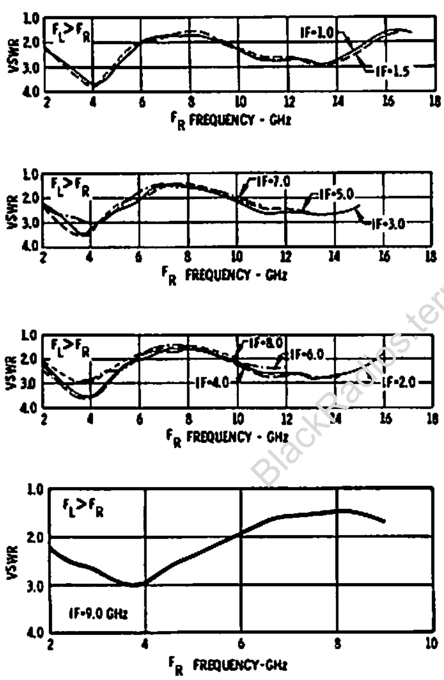
Isolation vs Frequency



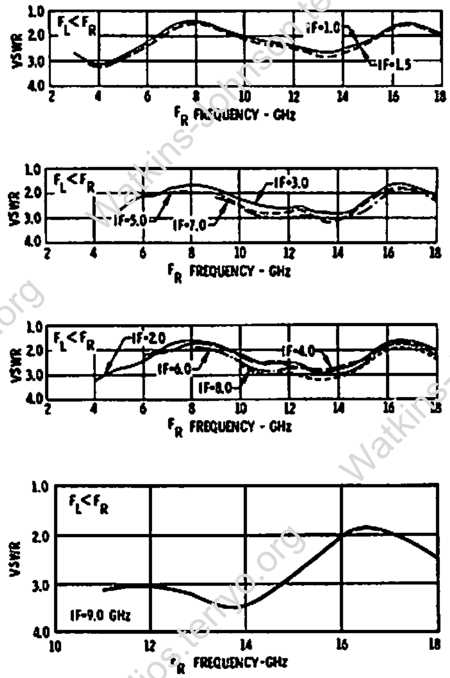
L-Port VSWR



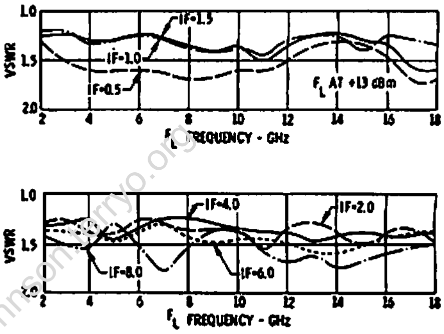
R-Port VSWR LO @ + 13 dBm



R-Port VSWR LO @ +13 dBm



I-Port VSWR vs. Frequency LO @ +13 dBm



Characteristics	Output Power		Test Conditions
Harmonics of f_L	**R-Port**	**I-Port**	
f_L	-10 dBm	-12 dBm	f_L = 2 GHz at +13 dBm
2 f_L	-18 dBm	-15 dBm	
3 f_L	-24 dBm	-21 dBm	
4 f_L	-30 dBm	-31 dBm	
5 f_L	-36 dBm	—	
f_L	-18 dBm		f_L = 4.5 GHz at +13 dBm
2 f_L	-22 dBm		
3 f_L	-34 dBm		
4 f_L	-37 dBm		
f_L	-9 dBm		f_L = 9 GHz at +13 dBm
2 f_L	-29 dBm		
f_L		-21 dBm	f_L = 4 GHz at +13 dBm
2 f_L		-21 dBm	

*Typical performance applies to the MINPAC™ model and does not necessarily reflect the performance of the VERSAPAC® model.

Typical Performance at 25°C

Characteristic	Suppression			Test Conditions (all downconversions)
Single Tone IM	Input 0 dBm	Input -5 dBm	Input -10 dBm	
f_R f_L				
1 x 1	0	0	0	f_R = 2.0 GHz
1 x 2	37 dB	36 dB	36 dB	f_L = 4.1 GHz at +13 dBm
2 x 2	46 dB	50 dB	55 dB	
3 x 2	61 dB	70 dB	>73 dB	
3 x 1	43 dB	54 dB	64 dB	
3 x 3	47 dB	56 dB	>61 dB	
4 x 1	59 dB	69 dB	>69 dB	
4 x 3	62 dB	73 dB	>73 dB	
4 x 4	66 dB	>66 dB	>66 dB	
5 x 1	73 dB	>73 dB	>73 dB	
5 x 2	81 dB	>83 dB	>83 dB	
5 x 3	70 dB	>75 dB	>75 dB	
5 x 4	72 dB	>72 dB	>72 dB	
1 x 1	0	0	0	f_R = 4.1 GHz
1 x 3	17 dB	18 dB	18 dB	f_L = 2.0 GHz at +13 dBm
1 x 4	47 dB	44 dB	43 dB	
1 x 5	44 dB	44 dB	43 dB	
2 x 1	45 dB	49 dB	54 dB	
2 x 2	42 dB	46 dB	51 dB	
2 x 3	44 dB	48 dB	53 dB	
2 x 5	43 dB	47 dB	52 dB	
3 x 2	62 dB	68 dB	>68 dB	
3 x 3	56 dB	63 dB	>64 dB	
3 x 4	59 dB	66 dB	72 dB	
3 x 5	55 dB	62 dB	67 dB	
4 x 4	70 dB	>70 dB	>70 dB	
4 x 5	69 dB	>70 dB	>70 dB	
1 x 1	0	0	0	f_R = 18 GHz
1 x 2	31 dB	30 dB	30 dB	f_L = 10.1 GHz at +13 dBm
2 x 3	56 dB	60 dB	61 dB	
2 x 4	46 dB	51 dB	56 dB	
3 x 5	49 dB	60 dB	67 dB	
1 x 1	0	0	0	f_R = 10.1 GHz
2 x 1	46 dB	52 dB	58 dB	f_L = 18 GHz at +13 dBm
3 x 2	59 dB	69 dB	>70 dB	
4 x 2	72 dB	>75 dB	>75 dB	
5 x 3	80 dB	>80 dB	>80 dB	

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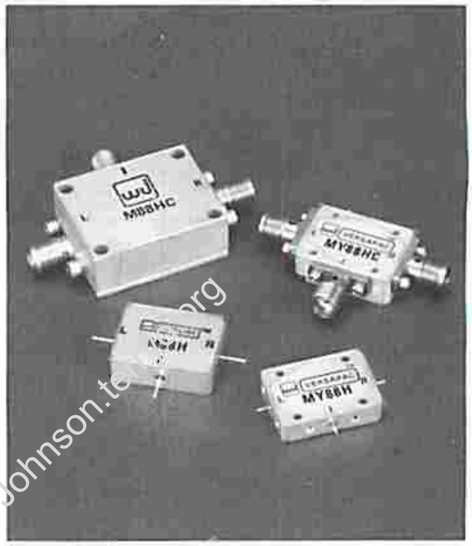
WJ-M88H/M88HC
WJ-MY88H/MY88HC

TRIPLE-BALANCED (DOUBLE-DOUBLE) MIXER

LO } 2 TO 18 GHz
RF }
IF 2 TO 8 GHz
LO DRIVE +21 dBm (nominal)

- HERMETICALLY SEALED
- HIGH COMPRESSION POINT
- QPL VERSION AVAILABLE! (See Section 7)



Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.5 dB	10.0 dB	f_R 2 to 10 GHz f_L 2 to 18 GHz f_I 2 to 8 GHz
		8.0 dB	10.5 dB	f_R 10 to 18 GHz f_L 2 to 18 GHz f_I 2 to 8 GHz
Isolation L to R L to I	 15 dB 17 dB	 28 dB 32 dB		 f_L 2 to 18 GHz f_L 2 to 18 GHz
Conversion Compression			1.0 dB	f_R level dBm +17 (14.0 GHz) f_L level dBm +21 (18.0 GHz)
Third-Order Input Intercept Point		+26 dBm		f_{R1}=6.0 GHz, f_{R2}=6.01 GHz both at 0 dBm f_L = 8 GHz at 20 dBm
		+24 dBm		f_{R1}=14.0 GHz, f_{R2}=14.01 GHz both at 0 dBm f_L = 10 GHz at +20 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

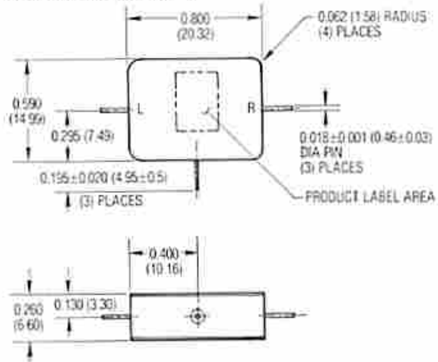
Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . .27 dBm max. at 25°C, 24 dBm max. at 100°C

Weight
M88H: 12 grams (42 oz.) max.
M88HC: 40 grams (1.41 oz.) max.
MY88H: 7.9 grams (0.28 oz.) max.
MY88HC: 20.0 grams (0.70 oz.) max.

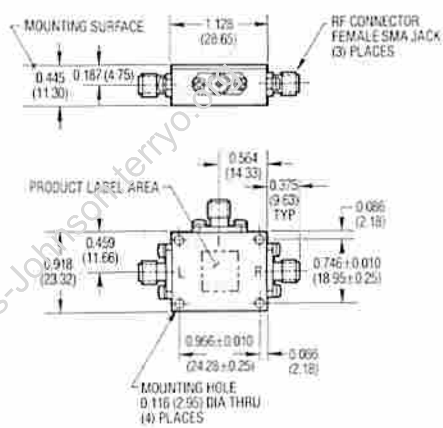
Outline Drawings

M88H (MINPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

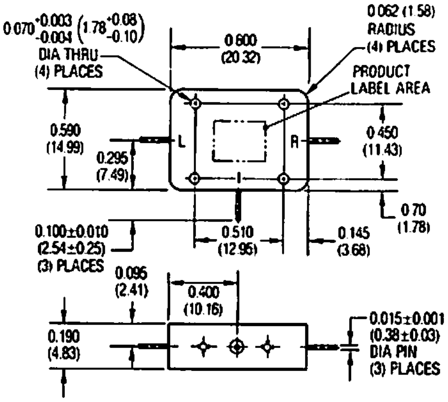
M88HC (CONNECTORIZED)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

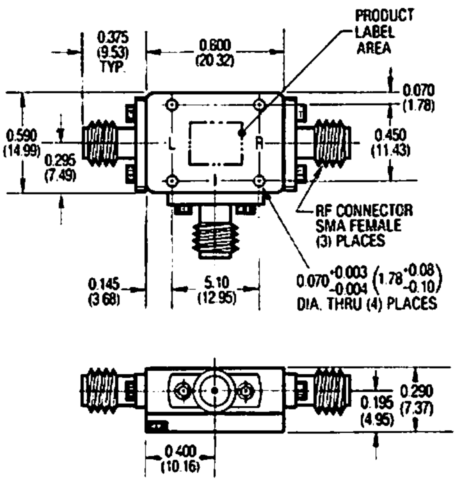
Outline Drawings

MY88H (VERSAPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

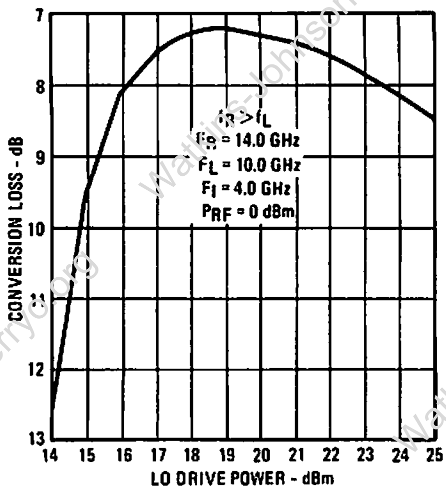
MY88HC (CONNECTORIZED)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

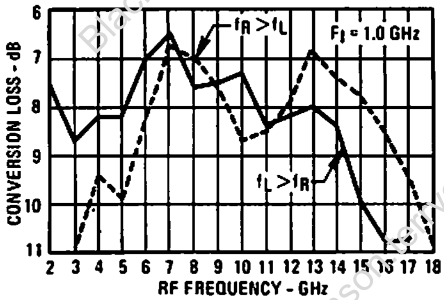
Typical Performance at 25°C*

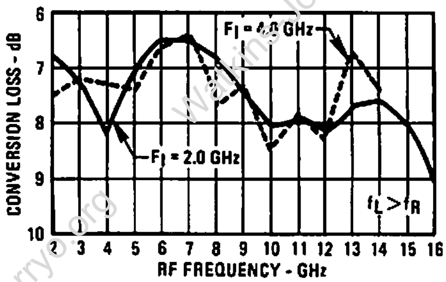
Drive Level

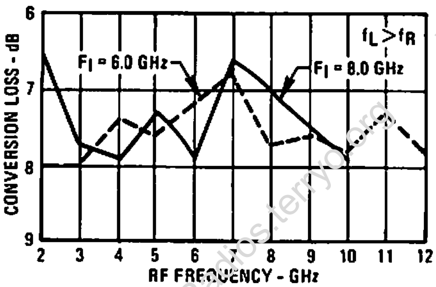


Drive Level: The maximum recommended drive level is +24 dBm.

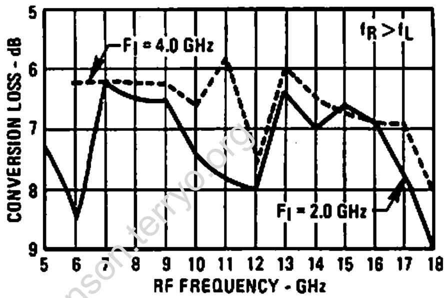
Conversion Loss vs Input Frequency Lo @ + 21 dBm

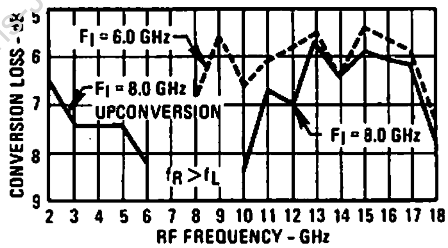


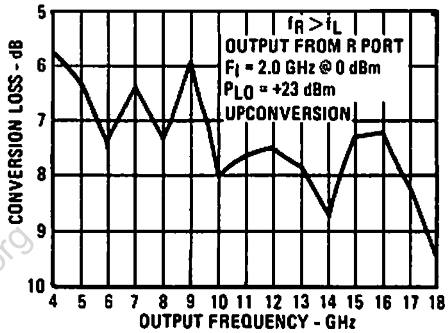




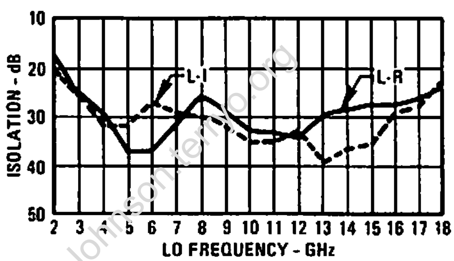
Conversion Loss vs Input Frequency Lo @ + 21 dBm

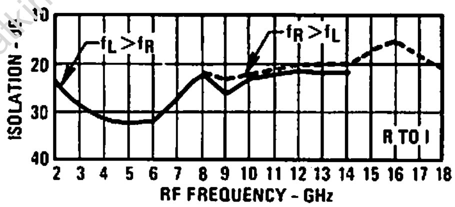






Isolation vs Frequency





*Typical performance applies to the MINPAC™ model and does not necessarily reflect the performance of the VERSAPAC® model.

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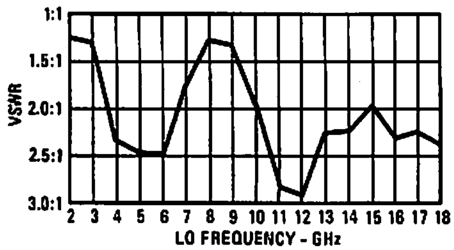
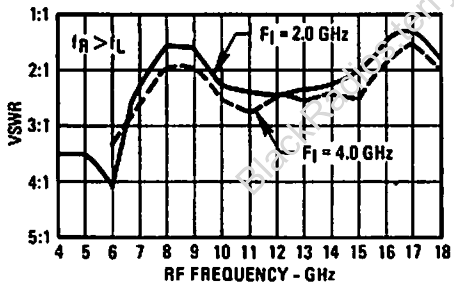
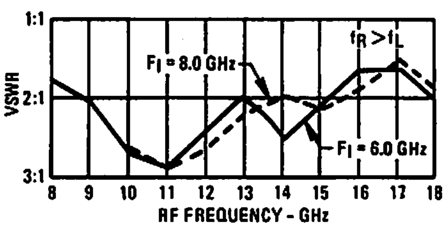
Typical Performance at 25°C* (Cont.)

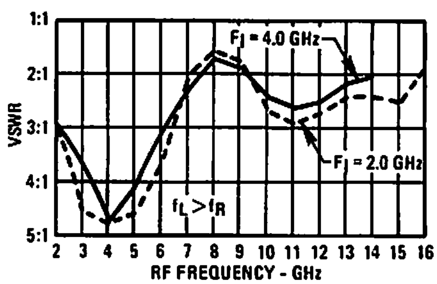
L-Port VSWR @ + 21 dBm

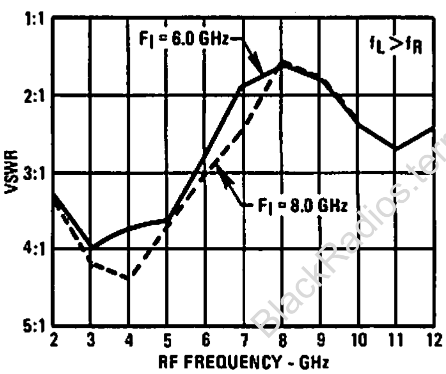


R-Port VSWR Lo @ + 21 dBm

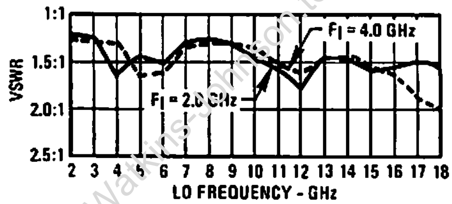


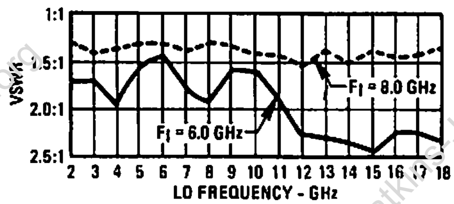






I-PORT VSWR @ +21 dBm





Characteristics	Output Power		Test Conditions
Harmonics of f_L	R-Port	I-Port	
f_L	+.5 dBm	-.7 dBm	f_L = 2 GHz at +20 dBm
2 f_L	-10 dBm	-6.7 dBm	
3 f_L	-11.5 dBm	-12.5 dBm	
4 f_L	-26.7 dBm	-20.5 dBm	
5 f_L	-24.5 dBm	-20 dBm	
f_L	-7.7 dBm	-9.5 dBm	f_L = 4.0 GHz at +20 dBm
2 f_L	-19.5 dBm	-16 dBm	
3 f_L	-15.7 dBm	-20.5 dBm	
4 f_L	-28.5 dBm	-34 dBm	
f_L	-9 dBm	-8.7 dBm	f_L = 8 GHz at +20 dBm
2 f_L	-11.7 dBm	-11.7 dBm	

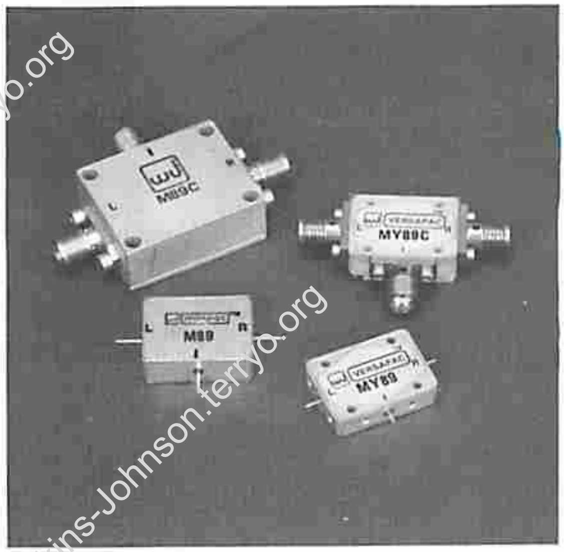
*Typical performance applies to the MINPAC™ model and does not necessarily reflect the performance of the VERSAPAC® model.

WJ-M89/M89C
WJ-MY89/MY89C

TRIPLE-BALANCED (DOUBLE-DOUBLE) MIXER

LO }
RF } 2 TO 8 GHz
IF 1 TO 8 GHz
LO DRIVE +10 dBm (nominal)

- HERMETICALLY SEALED
- WIDEBAND IF 1 TO 8 GHz



Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.5 dB	10.0 dB	f_R 2 to 10 GHz f_L 2 to 18 GHz f_I 1 to 8 GHz
		8.0 dB	10.5 dB	f_R 10 to 18 GHz f_L 2 to 18 GHz f_I 2 to 8 GHz
Isolation				
L to R	15 dB	28 dB		f_L 2 to 18 GHz
L to I	16 dB	32 dB		f_L 2 to 18 GHz
Conversion Compression			1.0 dB	f_R level +4 dBm
Third-Order Input Intercept Point		+14 dBm		f_{R1} = 6.0 GHz, f_{R2} = 6.01 GHz both at −6 dBm f_L = 10 GHz at +10 dBm
		+18.5 dBm		f_{R1} = 15.0 GHz, f_{R2} = 15.01 GHz both at −6 dBm f_L = 18 GHz at +10 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

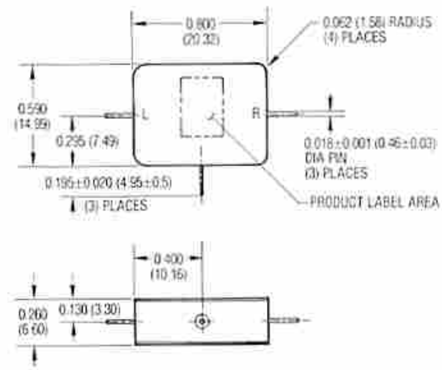
Operating Temperature. . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . .26 dBm max. at 25°C, 23 dBm max. at 100°C

Weight

M89: 12 grams (0.42 oz.) max.
M89C: 40 grams (1.41 oz.) max.
MY89: 7.0 grams (0.28 oz.) max.
MY89C: 20.0 grams (0.70 oz.) max.

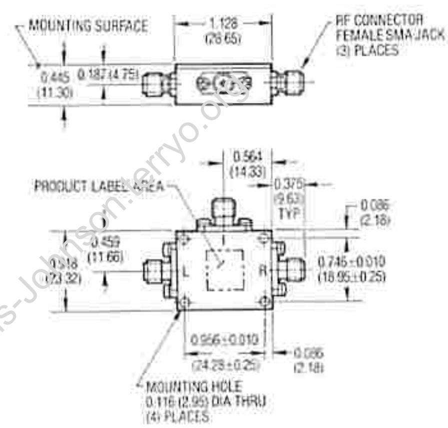
Outline Drawings

M89 (MINPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

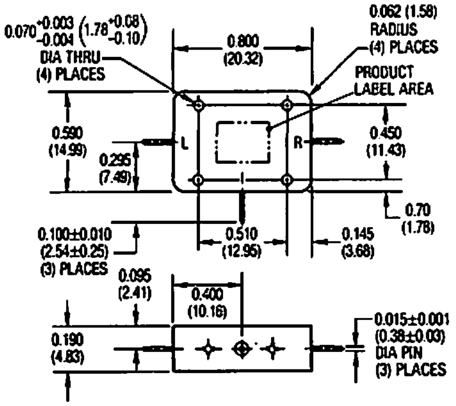
M89C (CONNECTORIZED)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

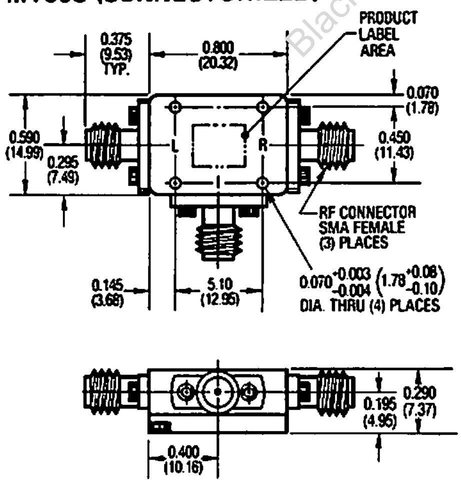
Outline Drawings

MY89 (VERSAPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

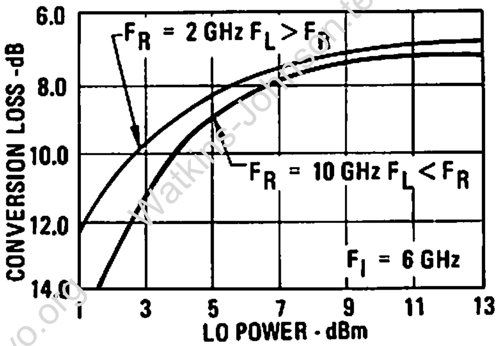
MY89C (CONNECTORIZED)



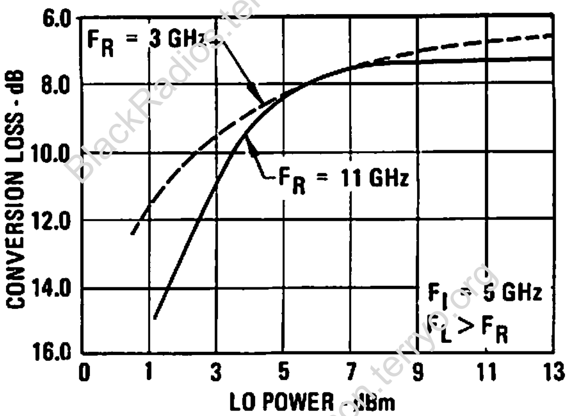
DIMENSIONS ARE IN INCHES (MILLIMETERS)
± .015 (.38) UNLESS OTHERWISE SPECIFIED

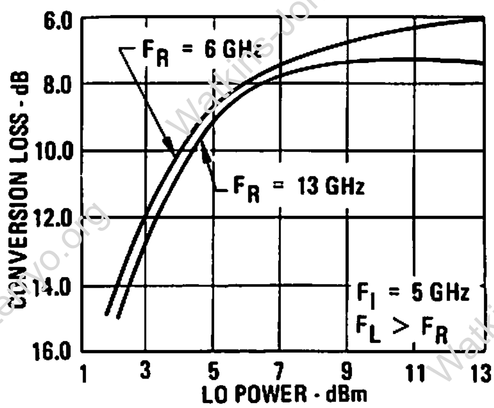
Typical Performance at 25°C*

Conversion Loss vs. LO Drive Power



Drive Level: The maximum recommended drive level is 16 dBm. This upper level has been established by the desire to avoid a serious increase in noise figure and a loss of isolation. Operation at 16 dBm is recommended to achieve best two-tone performance and best suppression of the intermodulation products.



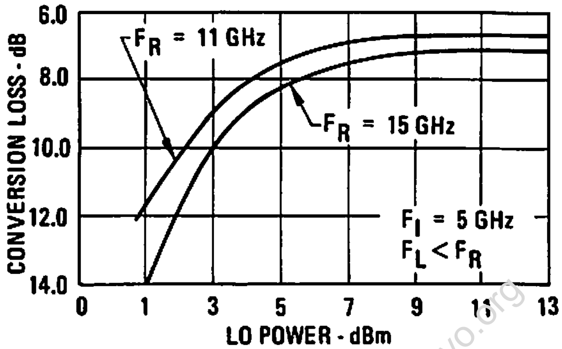


*Typical performance applies to the MINPAC™ model and does not necessarily reflect the performance of the VERSAPAC® model.

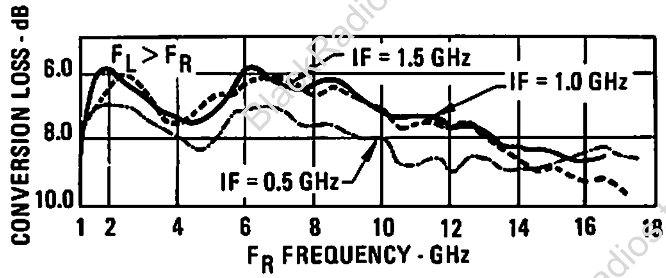
6

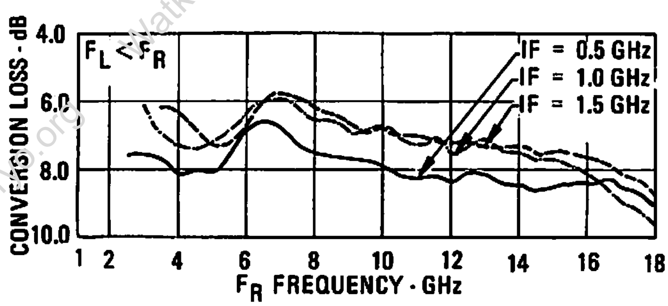
Typical Performance at 25°C* (Cont.)

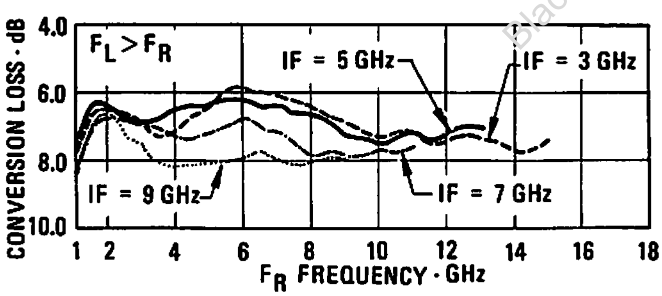
Conversion Loss vs. LO Drive Power

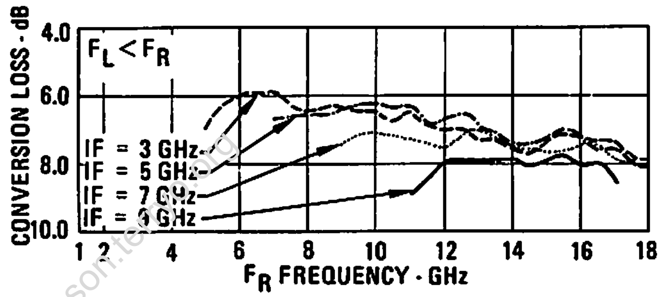


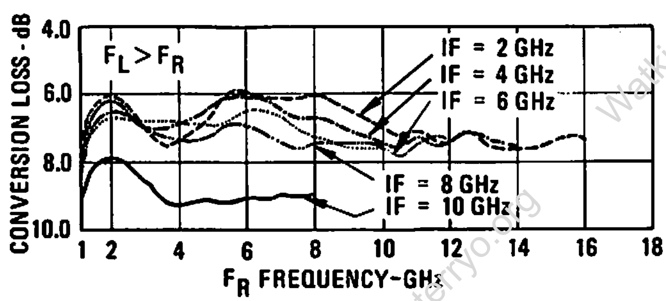
Conversion Loss vs. Frequency, LO Power @ +10 dBm

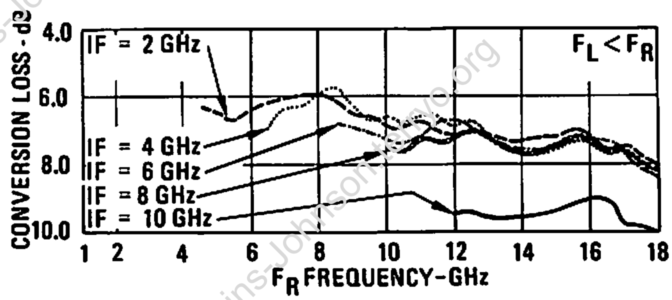




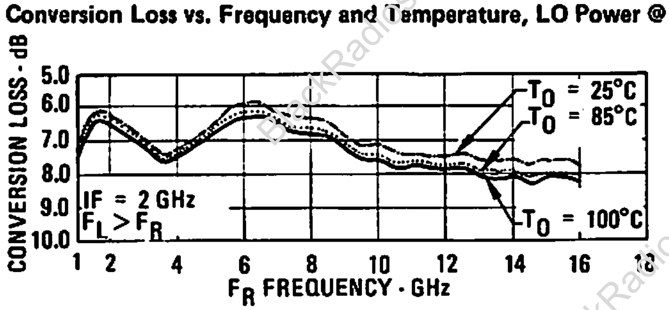


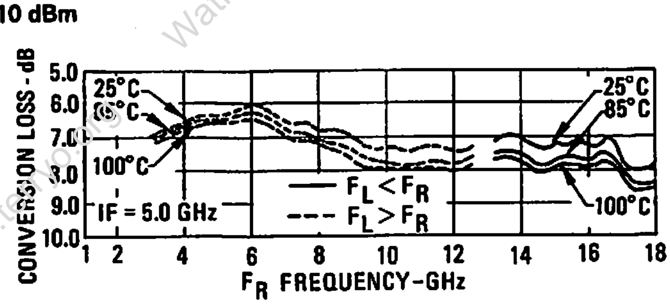






Conversion Loss vs. Frequency and Temperature, LO Power @ +10 dBm

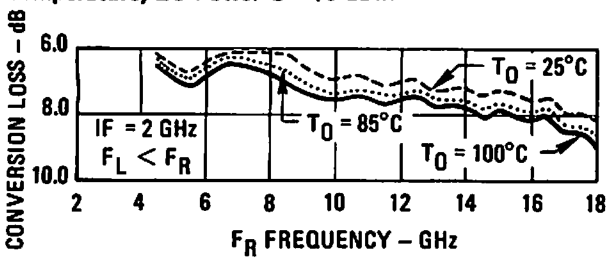




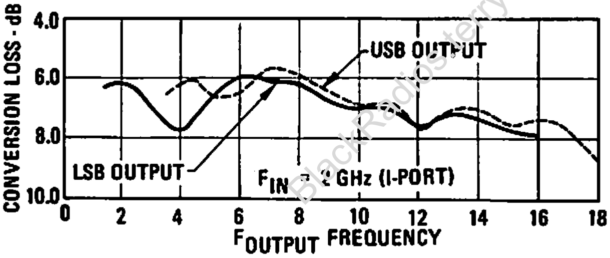
*Typical performance applies to the MINPAC™ model and does not necessarily reflect the performance of the VERSAPAC® model.

Typical Performance at 25°C * (Cont.)

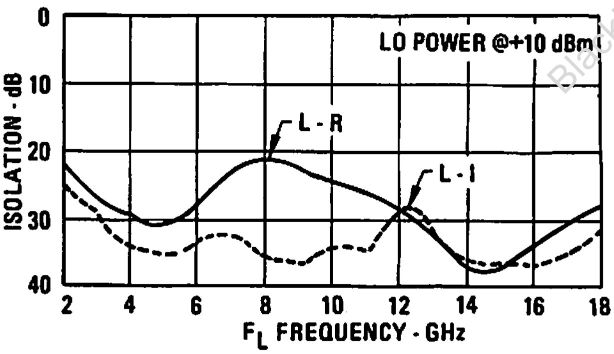
Conversion Loss vs. Frequency and Temperature, LO Power @ +10 dBm

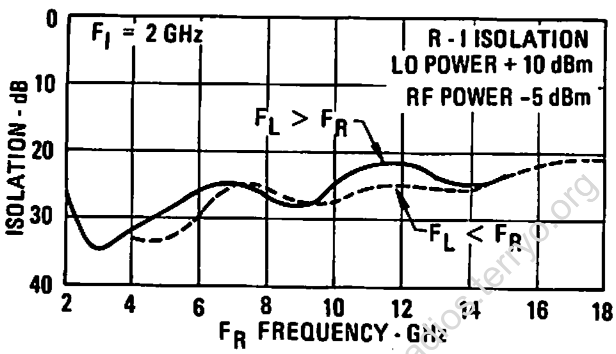


Up Conversion Loss vs. Output Frequency LO Power @+10 dBm

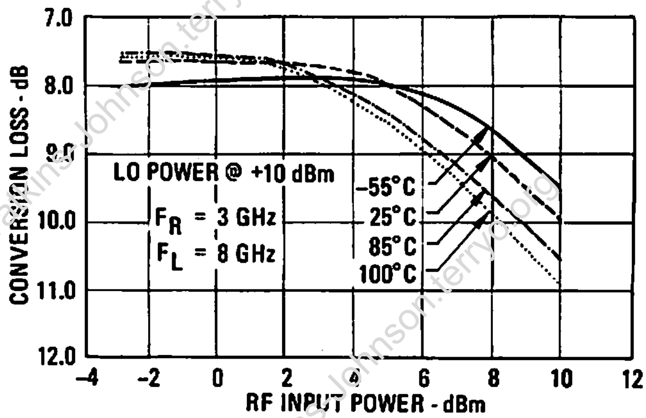


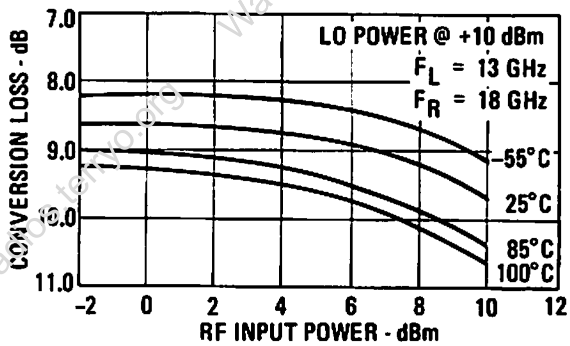
Isolation vs. Frequency

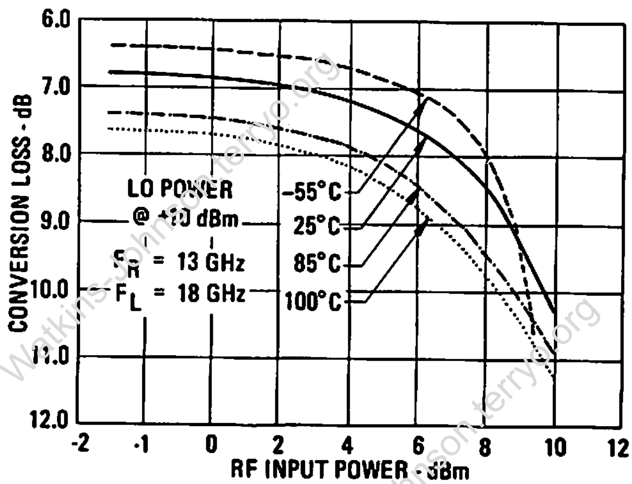


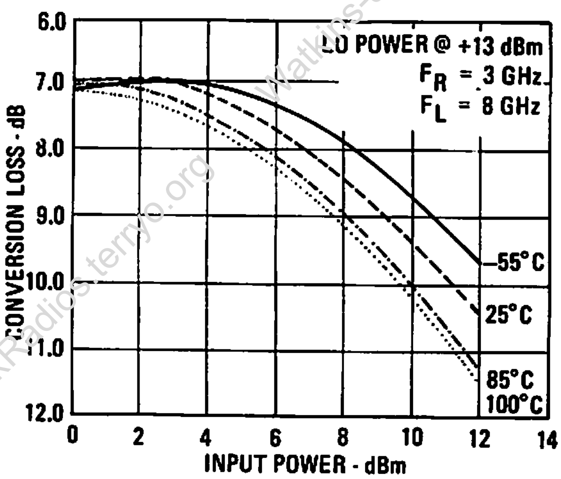


Conversion Loss vs. Input Power and Temperature









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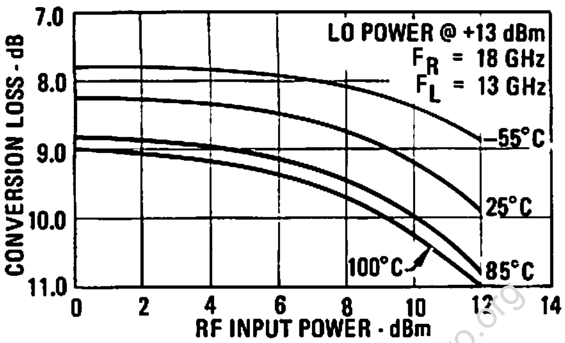
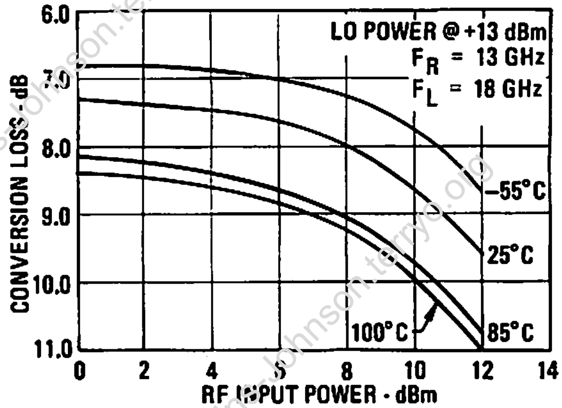
6

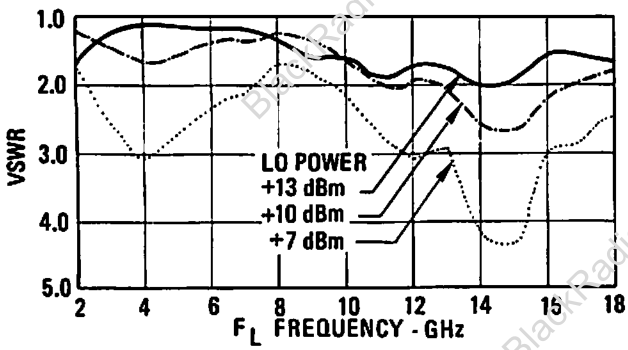
Typical Performance at 25°C * (Cont.)

Conversion Loss vs. Input Power and Temperature (cont.)

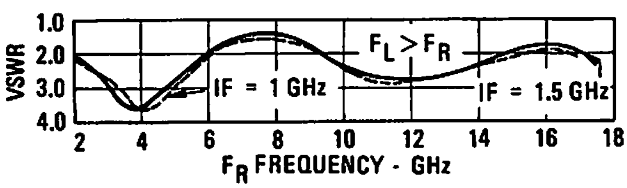


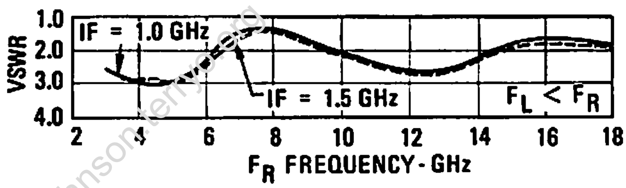


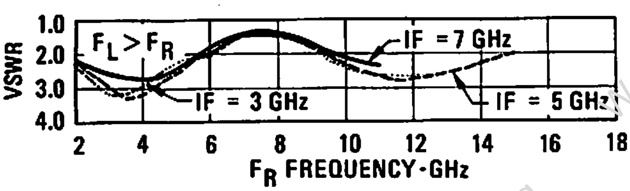
L-Port VSWR vs. Frequency

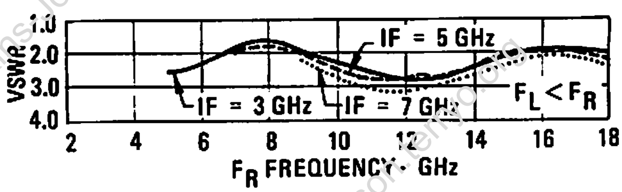


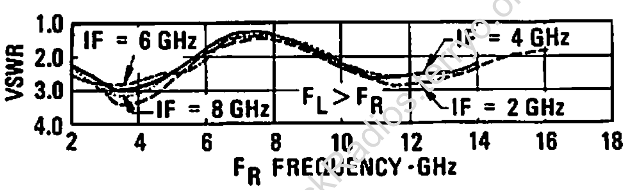
R-Port VSWR vs. Frequency, LO Power @ +10 dBm

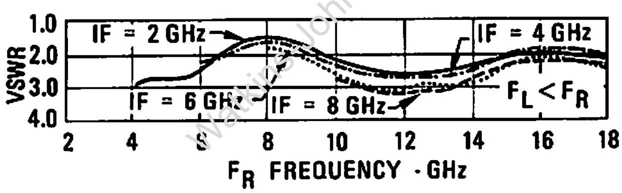


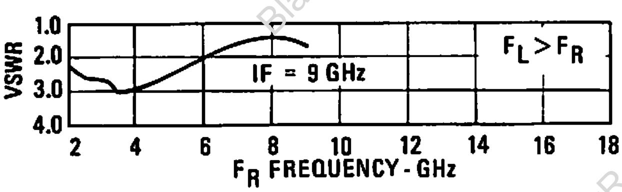


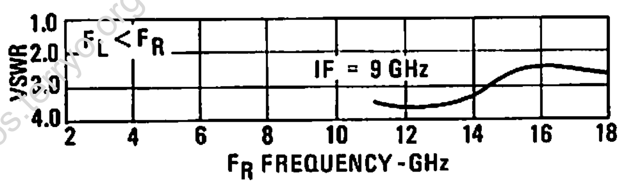








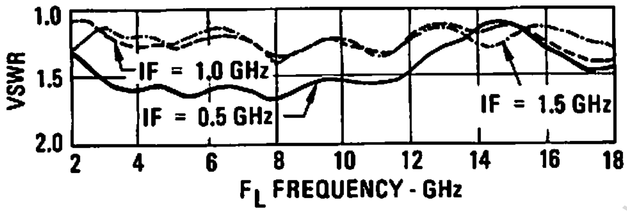


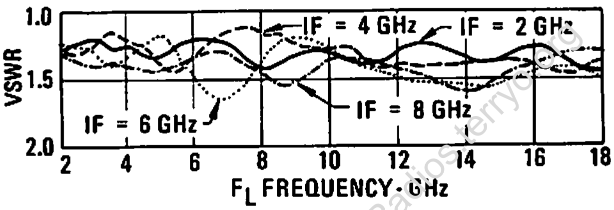


*Typical performance applies to the MINPAC™ model and does not necessarily reflect the performance of the VERSAPAC® model.

Typical Performance at 25°C * (Cont.)

I-Port VSWR vs. Frequency, LO Power @ +10 dBm





Characteristic Single Tone IM			Suppression (dB) Input 0 dBm	Input −5 dBm	Input −10 dBm	Test Conditions
f_R		f_L				
1	X	1	0	0	0	f_R = 2 GHz, f_L = 4.1 GHz at +10 dBm
1	X	2	40.0	42.0	42.0	
2	X	2	42.0	49.0	54.0	
3	X	2	61.0	68.0	>70.0	
3	X	1	42.0	52.0	62.0	
3	X	3	58.0	63.0	68.0	
4	X	1	77.0	>80.0	>80.0	
4	X	3	65.0	79.0	>80.0	
4	X	4	63.0	>68.0	>70.0	
5	X	1	74.0	>77.0	>77.0	
5	X	2	72.0	>76.0	>76.0	
5	X	3	63.0	>75.0	>75.0	
5	X	4	75.0	>75.0	>75.0	
1	X	1	0	0	0	f_R = 4.1 GHz, f_L = 2.0 GHz at +10 dBm
1	X	3	18.0	18.0	18.0	
1	X	4	46.0	46.0	45.0	
1	X	5	35.0	40.0	41.0	
2	X	1	43.0	47.0	52.0	
2	X	2	44.0	46.0	51.0	
2	X	3	42.0	45.0	50.0	
2	X	5	41.0	44.0	44.0	
3	X	2	60.0	>66.0	>68.0	
3	X	3	56.0	67.0	>67.0	
3	X	4	59.0	68.0	>70.0	
3	X	5	57.0	62.0	67.0	
4	X	4	59.0	>67.0	>67.0	
4	X	5	63.0	>69.0	>69.0	
1	X	1	0	0	0	f_R = 18 GHz, f_L = 10.1 GHz at +10 dBm
1	X	2	30.0	30.0	29.0	
2	X	3	55.0	59.0	63.0	
2	X	4	43.0	48.0	52.0	
3	X	5	46.0	55.0	64.0	
1	X	1	0	0	0	f_R = 10.1 GHz, F_L = 18 GHz at +10 dBm
2	X	1	44.0	49.0	55.0	
3	X	2	55.0	65.0	>68.0	
4	X	2	59.0	74.0	>76.0	
5	X	3	73.0	>74.0	>74.0	

Typical Performance at 25° C (continued)

Characteristic Harmonics of f_L	Output Power R-Port	I-Port	Test Conditions
f_L	−12 dBm	−15 dBm	f_L = 2 GHz at +10 dBm
2 f_L	−22 dBm	−18 dBm	
3 f_L	−25 dBm	−24 dBm	
4 f_L	−31 dBm	−31 dBm	
5 f_L	−38 dBm	−31 dBm	
f_L	−22 dBm	−28 dBm	f_L = 4.5 GHz at +10 dBm
2 f_L	−27 dBm	−25 dBm	
3 f_L	−41 dBm		
4 f_L	−37 dBm		
f_L	−12 dBm		f_L = 9 GHz at +10 dBm
2 f_L	−30 dBm		
f_L		−24 dBm	f_L = 4 GHz at +10 dBm
2 f_L		−22 dBm	

*Typical performance applies to the MINPAC™ model and does not necessarily reflect the performance of the VERSAPAC® model.

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Typical Performance at 25°C (Cont.)

LO Power = +10 dBm into L-Port
f_{OUT} = 2 to 18 GHz at R-Port

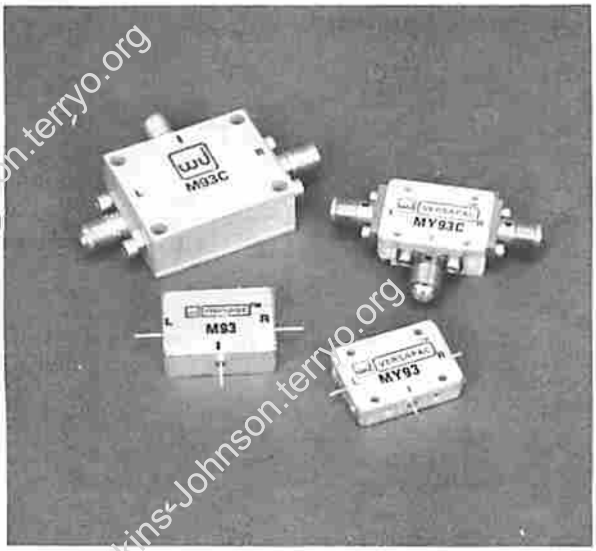
fL (GHz)	I-Port Input (GHz)	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
2.0	LSB	—	—	—	xxx	6.91	xxx	7.29	6.48	7.60	10.02
	USB	6.60	xxx	6.92	6.64	6.40	6.74	7.03	7.95	[illegible]	9.76
2.5	LSB	—	—	—	—	xxx	7.01	7.42	7.25	7.76	8.32
	USB	7.04	6.23	6.31	6.84	6.30	6.65	7.34	7.43	8.78	9.78
3.0	LSB	6.04	—	—	—	6.27	xxx	7.30	7.65	xxx	9.53
	USB	7.09	6.87	xxx	6.33	6.62	6.51	7.39	7.58	7.46	9.90
3.5	LSB	6.21	—	—	—	—	6.51	xxx	7.46	7.98	9.72
	USB	7.48	6.90	5.83	5.96	6.37	7.05	7.12	7.69	7.68	9.58
4.0	LSB	6.77	6.07	—	—	—	6.27	7.65	xxx	8.40	9.55
	USB	7.27	6.31	5.57	xxx	6.43	7.15	7.24	6.88	8.02	9.63
4.5	LSB	7.00	6.35	—	—	—	—	6.64	7.80	xxx	9.65
	USB	6.77	6.33	5.91	5.48	6.47	6.94	7.62	6.96	8.02	9.81
5.0	LSB	7.89	7.69	6.50	—	—	—	6.75	7.87	8.45	xxx
	USB	6.01	5.51	6.02	5.91	xxx	7.35	6.73	7.20	7.76	8.94
5.5	LSB	7.58	8.16	6.43	—	—	—	—	7.05	8.74	9.69
	USB	5.89	5.52	6.20	5.64	6.03	7.19	7.04	7.28	8.21	8.87
6.0	LSB	7.19	7.62	7.76	6.12	—	—	—	6.95	8.68	10.22
	USB	6.39	5.99	6.09	6.61	6.77	xxx	7.29	7.26	7.38	9.45
6.5	LSB	6.68	7.10	7.86	6.67	—	—	—	—	7.72	10.95
	USB	5.87	6.08	6.35	6.63	7.02	6.37	7.16	7.72	7.40	9.35
7.0	LSB	5.97	6.69	7.27	7.81	6.46	—	—	—	7.73	10.64
	USB	6.43	6.22	6.64	6.82	6.20	6.90	xxx	7.00	7.52	9.42
7.5	LSB	6.15	6.08	6.70	7.38	6.79	—	—	—	—	9.32
	USB	6.53	6.97	6.60	6.90	6.54	6.99	7.33	6.29	7.84	9.99
8.0	LSB	6.16	5.75	6.18	6.34	6.61	6.42	—	—	—	9.50
	USB	6.68	6.99	6.95	6.03	6.97	7.18	6.71	xxx	8.42	10.51
8.5	LSB	6.78	6.32	6.11	6.66	6.81	6.43	—	—	—	—
	USB	7.42	6.95	7.40	6.95	7.30	7.89	7.13	7.18	8.58	—
9.0	LSB	6.68	6.19	5.81	6.08	5.67	6.15	6.13	—	—	—
	USB	6.96	7.08	6.34	7.10	7.39	7.01	7.62	7.80	xxx	—
9.5	LSB	6.78	6.33	6.16	6.11	6.54	6.80	6.38	—	—	—
	USB	7.25	7.72	7.12	7.32	7.64	7.08	7.66	8.21	—	—
10.0	LSB	6.62	6.38	6.15	5.94	6.30	5.88	6.34	5.89	—	—
	USB	7.50	6.46	7.22	7.39	6.89	7.56	8.09	8.88	—	—
10.5	LSB	7.29	6.74	6.34	6.05	6.41	6.85	7.15	6.41	—	—
	USB	7.97	7.07	7.59	7.67	7.08	7.45	8.08	—	—	—
11.0	LSB	7.30	6.65	6.66	6.14	6.10	6.57	6.41	6.71	6.48	—
	USB	6.50	7.20	7.36	6.92	7.51	7.84	8.62	—	—	—
11.5	LSB	7.66	7.41	6.89	6.58	6.37	6.64	7.33	7.69	7.13	—
	USB	7.30	7.70	7.81	7.32	7.53	8.13	—	—	—	—
12.0	LSB	7.62	7.25	6.82	6.71	6.26	6.17	6.75	6.43	7.31	7.97
	USB	7.39	7.29	6.94	7.61	7.86	8.66	—	—	—	—
12.5	LSB	7.89	7.28	7.54	7.01	6.64	6.39	6.79	7.38	8.01	8.40
	USB	7.63	7.72	7.34	7.48	8.19	—	—	—	—	—
13.0	LSB	6.69	7.41	7.22	6.81	6.88	6.44	6.45	6.93	7.11	8.90
	USB	7.61	7.04	7.57	7.83	8.51	—	—	—	—	—
13.5	LSB	7.50	7.83	7.32	7.44	7.14	6.96	6.84	6.82	8.01	9.42
	USB	8.18	7.30	7.52	8.10	—	—	—	—	—	—
14.0	LSB	7.90	6.52	7.49	7.30	6.86	6.95	6.91	6.89	7.95	8.60
	USB	7.71	7.57	7.89	8.47	—	—	—	—	—	—
14.5	LSB	8.40	7.40	7.83	7.38	7.68	7.64	7.31	7.39	7.77	9.49
	USB	8.23	7.84	8.05	—	—	—	—	—	—	—
15.0	LSB	8.51	7.42	8.46	7.49	7.34	7.30	7.65	7.46	7.87	9.38
	USB	8.79	8.10	8.49	—	—	—	—	—	—	—
15.5	LSB	8.93	7.84	7.28	7.78	7.54	7.80	7.99	7.39	7.91	9.29
	USB	9.11	8.35	—	—	—	—	—	—	—	—
16.0	LSB	8.27	7.60	7.30	6.47	7.78	7.74	7.82	7.90	7.94	9.66
	USB	9.49	8.80	—	—	—	—	—	—	—	—
16.5	LSB	9.09	7.98	7.71	7.36	7.85	7.74	7.92	7.83	7.77	9.01
	USB	10.18	—	—	—	—	—	—	—	—	—
17.0	LSB	9.19	7.20	7.48	7.48	6.73	7.96	8.06	7.53	8.34	9.13
	USB	—	—	—	—	—	—	—	—	—	—
17.5	LSB	9.63	7.74	8.21	7.77	7.55	7.97	7.82	8.00	8.15	9.13
	USB	—	—	—	—	—	—	—	—	—	—
18.0	LSB	9.62	7.83	7.23	7.59	7.52	6.88	7.93	8.09	8.02	9.78
	USB	—	—	—	—	—	—	—	—	—	—

WJ-M93/M93C
WJ-MY93/MY93C

TRIPLE-BALANCED (DOUBLE-DOUBLE) MIXER

LO, RF: 2 TO 18 GHz
IF 0.03 TO 4 GHz
LO DRIVE +10 dBm (nominal)

- HERMETICALLY SEALED
- QPL VERSION AVAILABLE! (See Section 7)



Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.5 dB	10.0 dB	f_R 2 - 10 GHz f_L 2 - 14 GHz f_I 0.03 - 4 GHz
		8.0 dB	11.0 dB	f_R = 10 - 18 GHz f_L 6 - 18 GHz f_I 0.03 - 4 GHz
Isolation L to R L to I	 15 dB 16 dB	 29 dB 34 dB		 f_L 2 - 18 GHz f_L 2 - 18 GHz
Conversion Compression			1.0 dB	f_R level = +4 dBm f_L level = +10 dBm
Third-Order Input Intercept Point		+14 dBm		f_{R1} = 6.0 GHz f_{R2} = 6.01 GHz both at −6 dBm f_L = 8 GHz at +10 dBm
		+18 dBm		f_{R1} = 15.0 GHz f_{R2} = 15.01 GHz both at −6 dBm f_L = 18 GHz at +10 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

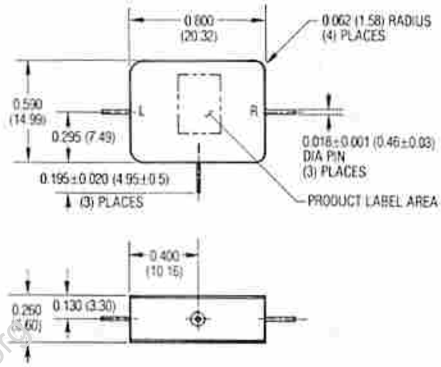
Operating Temperature . . . . −54°C to +100°C
Storage Temperature . . . . −65°C to +100°C
Peak Input Power . . . . 26 dBm max. at 25°C, 23 dBm max. at 100°C

Weight

M93: 12 grams (0.42 oz.) max. MY93: 7.9 grams (0.28 oz.) max.
M93C: 40 grams (1.41 oz.) max. MY93C: 20.0 grams (0.70 oz.) max.

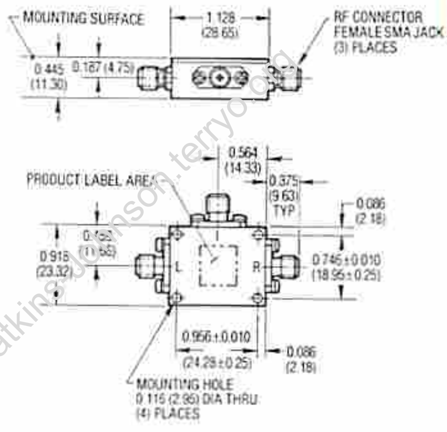
Outline Drawings

M93 (MINPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.25) UNLESS OTHERWISE SPECIFIED

M93C (CONNECTORIZED)

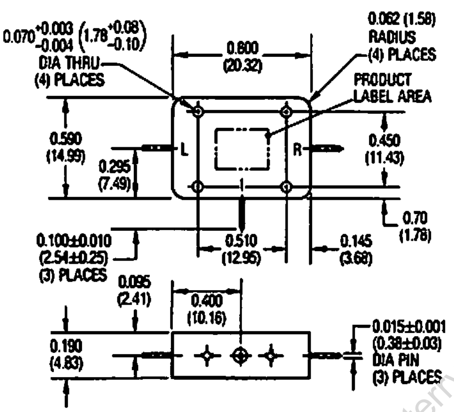


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

6

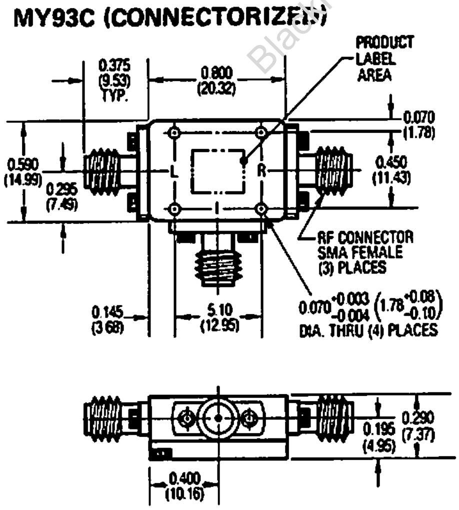
Outline Drawings

MY93 (VERSAPAC)



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

MY93C (CONNECTORIZED)

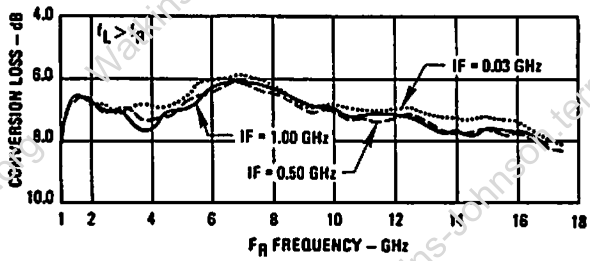


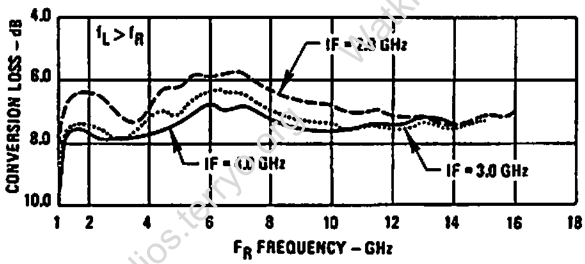
DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

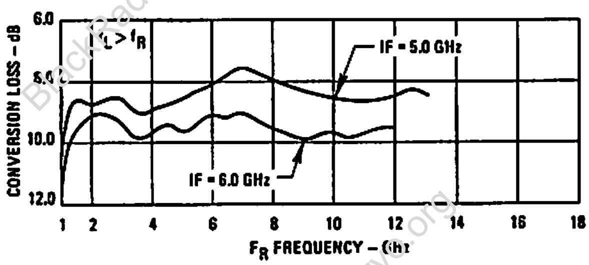
Typical Performance at 25°C*

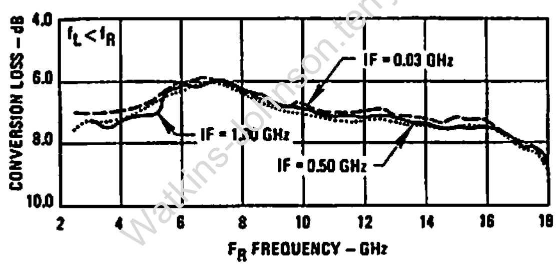
Drive Level: The maximum recommended drive level is 16 dBm. This upper level has been established by the desire to avoid a serious increase in noise figure and a loss of isolation. Operation at 16 dBm is recommended to achieve best two-tone performance and best suppression of the intermodulation products.

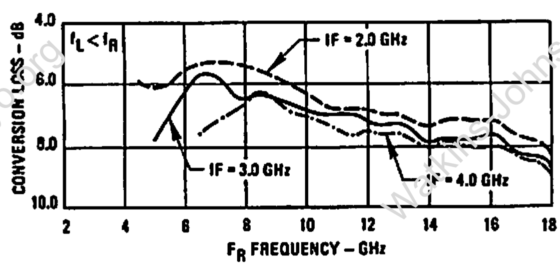
Conversion Loss vs. Frequency, LO Power @ +10 dBm

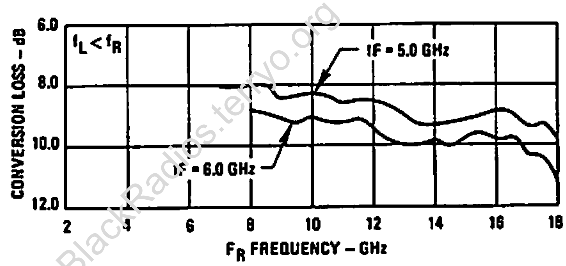








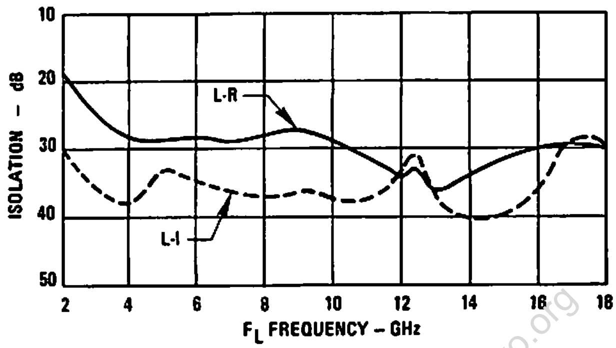




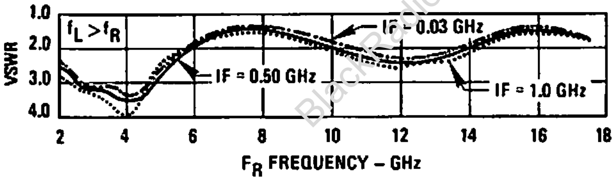
*Typical performance applies to the MINPAC™ model and does not necessarily reflect the performance of the VERSAPAC® model.

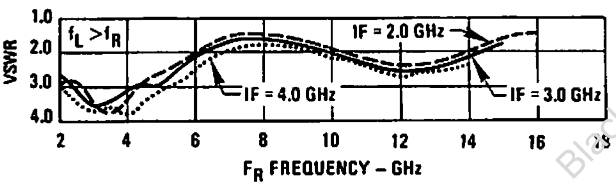
Typical Performance at 25°C

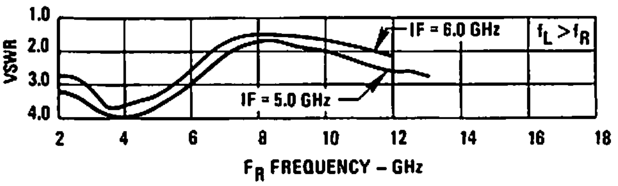
Isolation vs. Frequency, LO Power @ +10 dBm

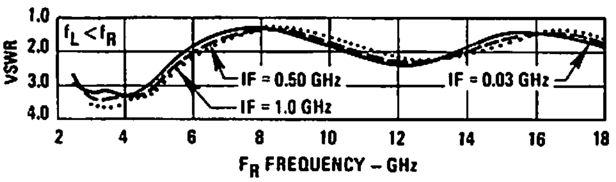


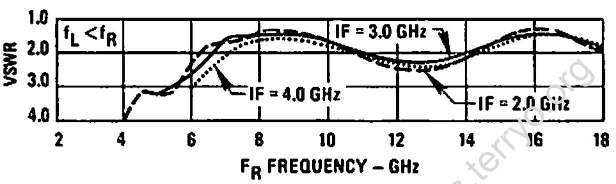
R-Port VSWR vs. Frequency, LO Power @ +10 dBm

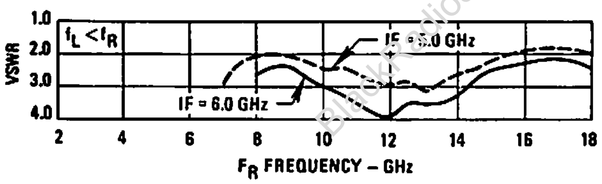




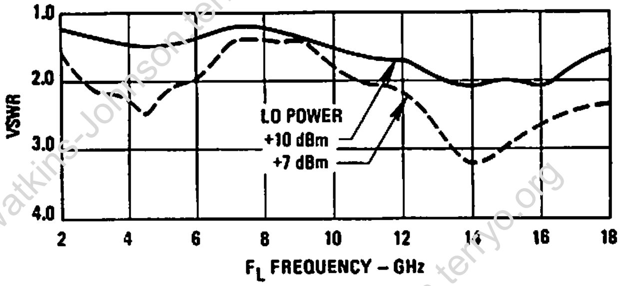




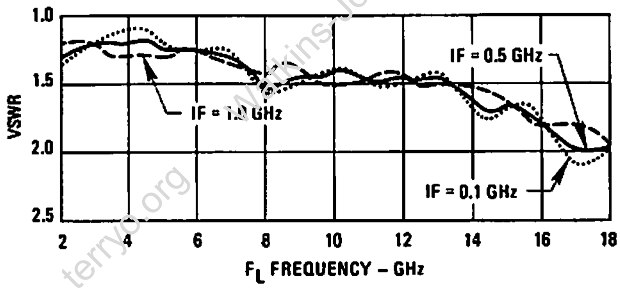


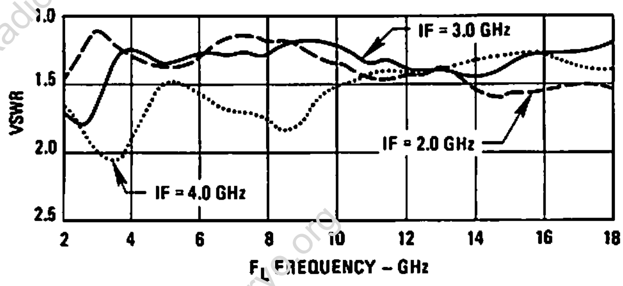


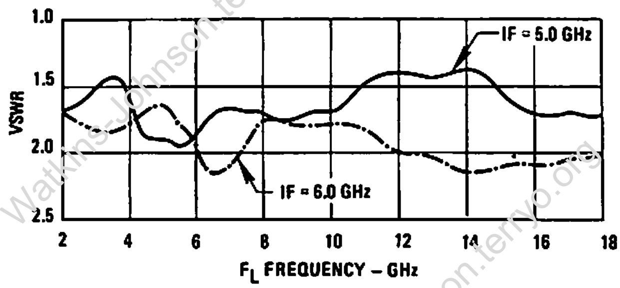
L-Port VSWR vs. Frequency



I-Port VSWR vs. Frequency, LO Power @ +10 dBm







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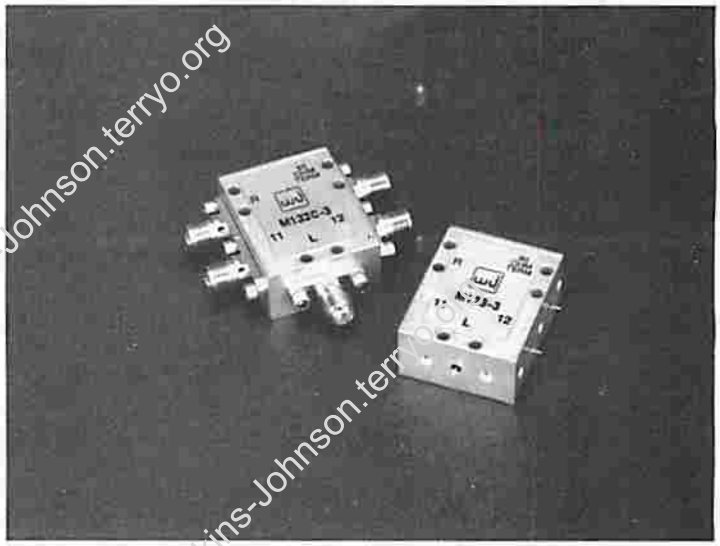
*Typical performance applies to the MINPAC™ model and does not necessarily reflect the performance of the VERSAPAC® model.

WJ-M133-'X'/ M133C-'X'

IMAGE REJECT MIXER

LO / RF } 6.0 TO 18.0 GHz
IF 4 TO 500 MHz
LO DRIVE +10 dBm (nominal)



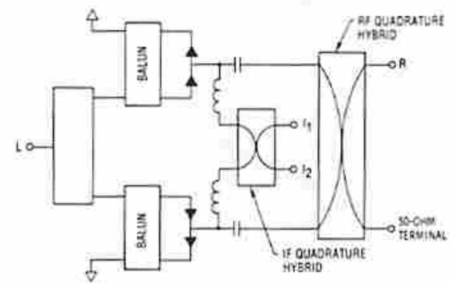
- HERMETICALLY SEALED
- OCTAVE BANDWIDTH IF's[1]
- INTEGRATED MOUNTING HOLES
- AVAILABLE WITH FIELD REPLACEABLE CONNECTORS

Guaranteed Specifications[2]

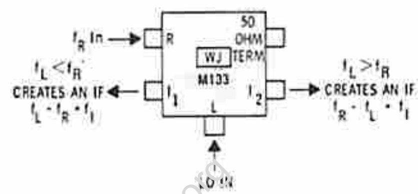
Characteristics	Min.	Typ.[3]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		8.0 dB	9.0 dB	f_R 6 to 15 GHz f_L 6 to 15 GHz f_I 4 to 500 MHz
		8.5 dB	9.5 dB	f_R 6 to 18 GHz f_L 6 to 18 GHz f_I 4 to 500 MHz
Image Rejection[4]	15 dB	20 dB		f_R 6 to 8 GHz f_L 6 to 18 GHz f_I 4 to 500 MHz
Isolation				
L to R	20 dB	30 dB		f_L 6 to 18 GHz
L to I	20 dB	35 dB		f_L 6 to 18 GHz

Notes:
1. Denote frequency band desired by replacing "X" with the appropriate dash number. Options 10-20 (-1), 20-40 (-2), 40-80 (-3), 80-160 (-4), 100-200 (-5), 160-320 (-6) MHz IF's are available. Other wideband IF's are available from 4 to 500 MHz.
2. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
3. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.
4. Greater image rejection may be obtained by selection.
5. The two each 50-ohm terminations are not supplied.

Schematic Diagram



Port Functions



NOTE: THE UNUSED PORTS MUST BE TERMINATED WITH 50 OHM LOADS.[5]

Absolute Maximum Ratings

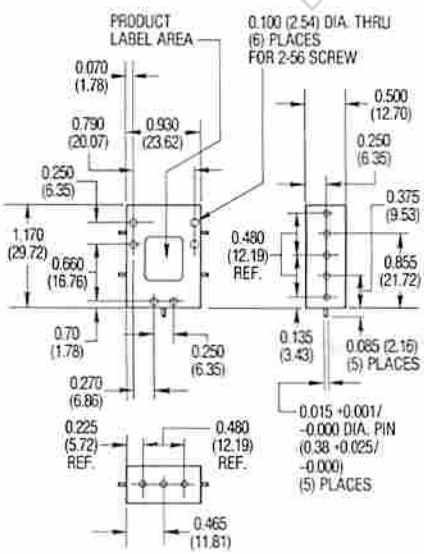
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +17 dBm max.
Peak Input Current at 25°C . . . . 50 mA DC

Weight

M133-"X": 50 grams (1.76 oz.) max.
M133C-"X": 60 grams (2.11 oz.) max.

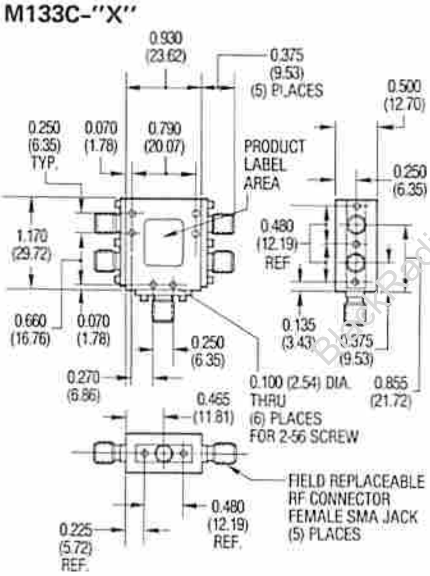
Outline Drawings

M133-"X"



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

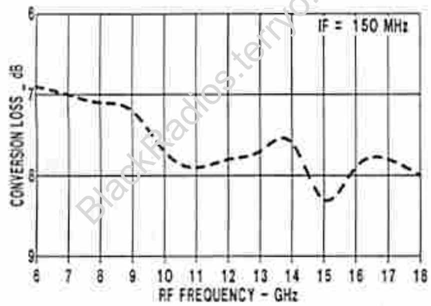
M133C-"X"



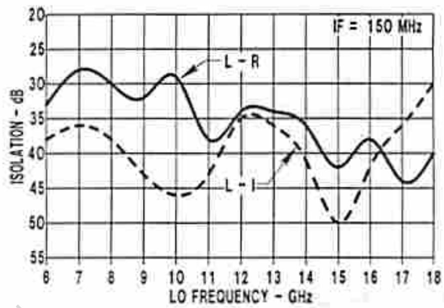
DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

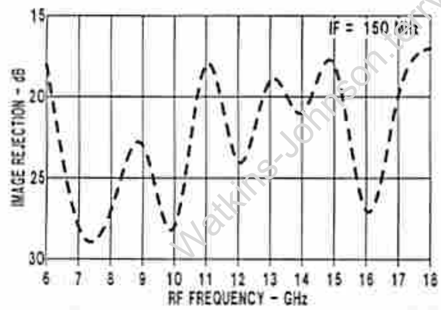
Typical Performance at 25°C

Conversion Loss vs. Frequency



Isolation





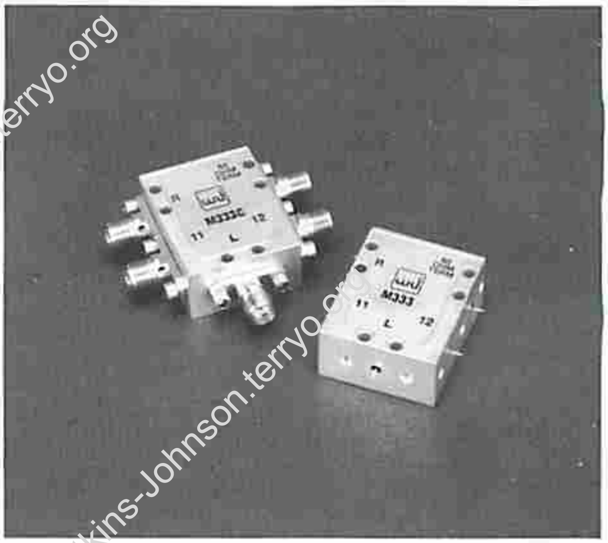
6

WJ-M333/M333C

QUADRATURE IF MIXER

LO } 6.0 TO 18.0 GHz
RF }
IF DC TO 500 MHz
LO DRIVE +10 dBm (nominal)

- HERMETICALLY SEALED
- INTEGRATED MOUNTING HOLES
- AVAILABLE WITH FIELD REPLACEABLE CONNECTORS



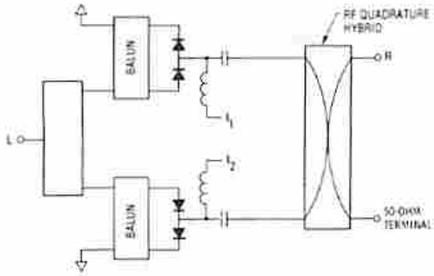
Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		8.0 dB	9.0 dB	f_R 6 to 15 GHz f_L 6 to 15 GHz f_I DC to 500 MHz
		8.5 dB	9.5 dB	f_R 6 to 18 GHz f_L 6 to 18 GHz f_I DC to 500 MHz
Image Rejection	15 dB	20 dB		f_R 6 to 8 GHz f_L 6 to 18 GHz f_I DC to 500 MHz
Isolation				
L to R	20 dB	30 dB		f_L 6 to 18 GHz
L to I	20 dB	35 dB		f_L 6 to 18 GHz

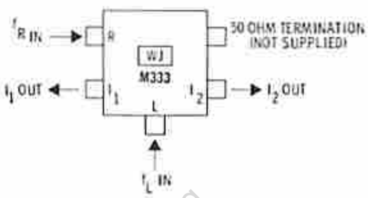
Notes:

1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified. Applies only for IF recombination errors of ±0.4 dB in amplitude match and ±2 dB degrees in quadrature phasing. The I-Port frequency range extends to DC for phase detection pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Schematic Diagram



Port Functions



PHASE RELATIONSHIPS FOR IF OUTPUTS

	I_1	I_2
$f_L < f_R$	0°	-90°
$f_L > f_R$	-90°	0°

Absolute Maximum Ratings

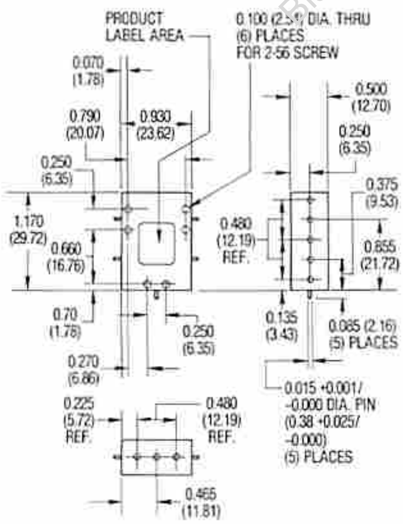
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +17 dBm max.
Peak Input Current at 25°C . . . . 50 mA DC

Weight

M333: 50 grams (1.76 oz.) max.
M333C: 60 grams (2.11 oz.) max.

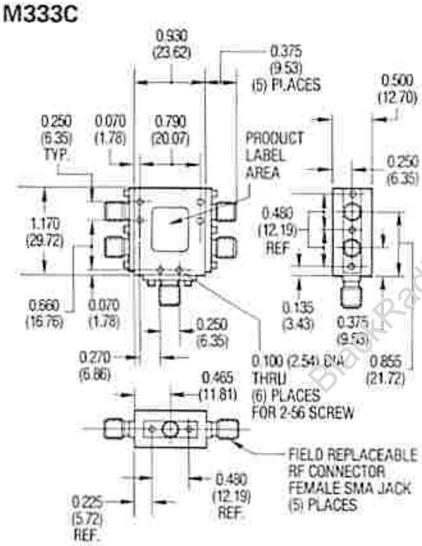
Outline Drawings

M333



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

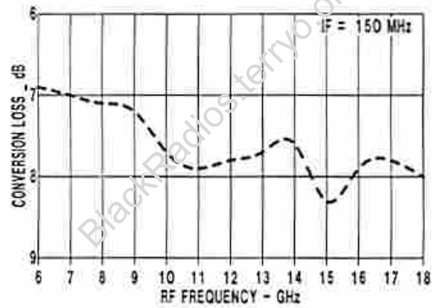
M333C



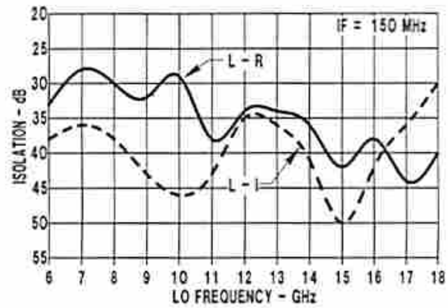
DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

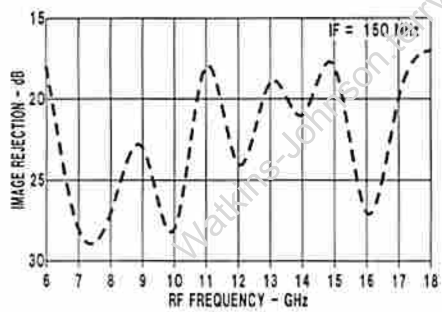
Typical Performance at 25°C

Conversion Loss vs. Frequency



Isolation





6

WJ-MZ5010/ MZ5010C

TRIPLE BALANCED (DOUBLE-DOUBLE) MIXER

LO, RF 2.0 TO 26.0 GHz
IF 1.0 TO 15.0 GHz
LO DRIVE +10 dBm (nominal)

- HERMETICALLY SEALED
- WIDEBAND

Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.5 dB	9.5 dB	f_R 3-18 GHz f_L 3.5-18 GHz f_I 4-12 GHz
		8.5 dB	10.5 dB	f_R 2.5-26 GHz f_L 2.5-24 GHz f_I 4-12 GHz 1-15 $f_L > f_R$
		10.5 dB	13.0 dB	f_R 2-26 GHz f_L 2-26 GHz f_I 1-12 GHz 1-15 $f_L > f_R$
Isolation L – R	18 dB			f_L 4-26 GHz
	15 dB			f_L 2-24 GHz
L – I	17 dB			f_L 4-26 GHz
	12 dB			f_L 2-4 GHz
Conversion Compression			1.0 dB	f_R Level +5 dBm f_L Level +10 dBm
Third-Order Input Intercept		15.0 dBm		

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

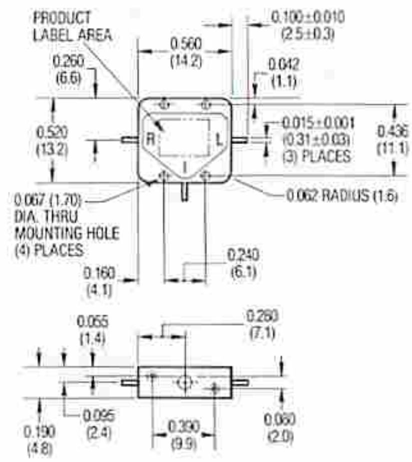
Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +26 dBm max. at 25°C, +22 dBm max. at 100°C

Weight MZ5010: 6 grams (0.22 oz.) max.
MZ5010C: 12 grams (0.43 oz.) max.

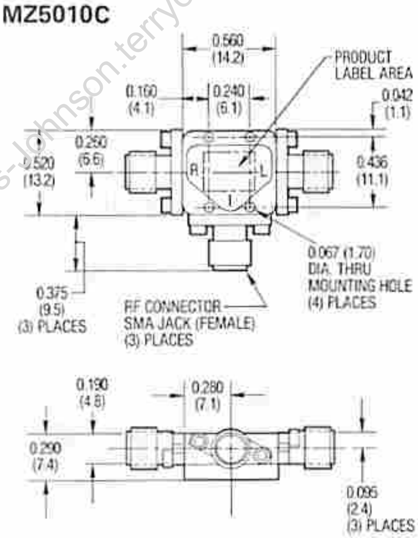
Outline Drawings

MZ5010



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

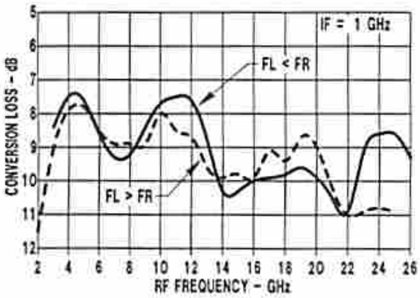
MZ5010C

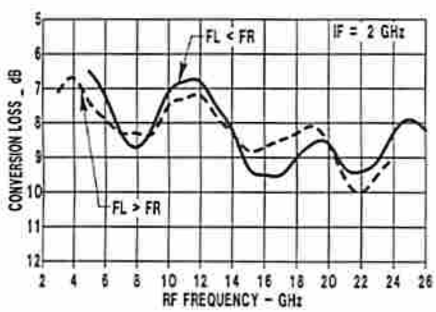


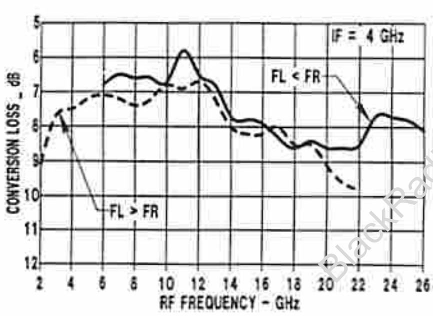
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C

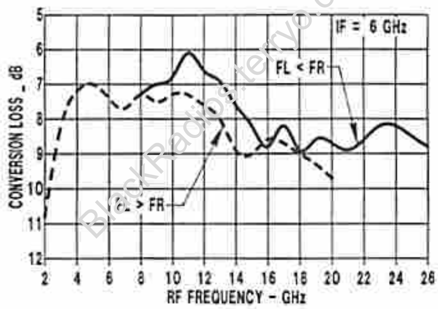
Conversion Loss vs. Frequency

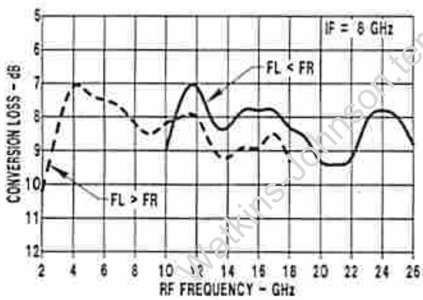


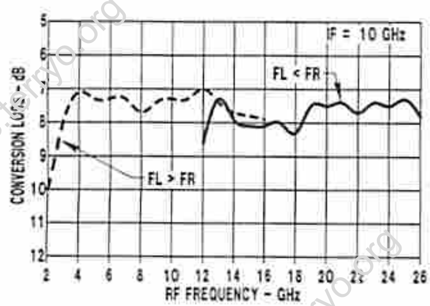




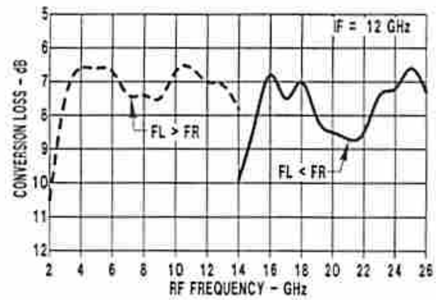
Conversion Loss vs. Frequency

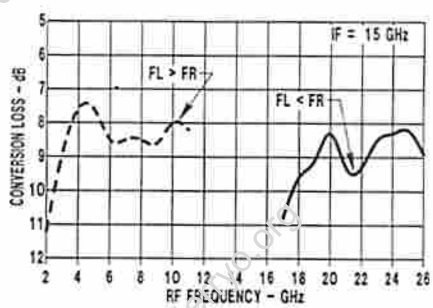




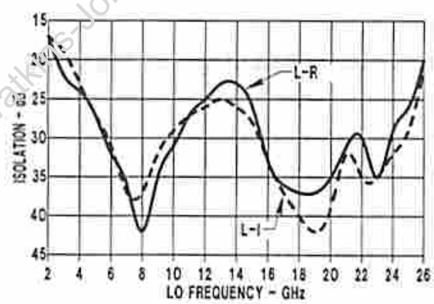


Conversion Loss vs. Frequency





Isolation



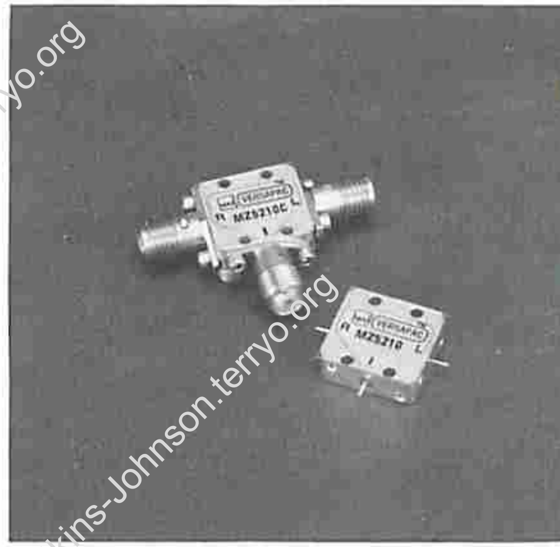
6

WJ-MZ5210/ MZ5210C

TRIPLE-BALANCED (DOUBLE-DOUBLE) MIXER

LO / RF 2.0 TO 24.0 GHz
IF 0.1 TO 5.0 GHz
LO DRIVE +10 dBm (nominal)

- MINIATURE PACKAGE
- HERMETICALLY SEALED
- BROADBAND
- INTEGRATED MOUNTING HOLES
- AVAILABLE WITH FIELD REPLACEABLE CONNECTORS



Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		8.0 dB	10.5 dB	f_R, f_L 3-18 GHz; f_I 0.1-2.0 GHz
		8.5 dB	11.0 dB	f_R, f_L 3-18 GHz; f_I 0.1-5.0 GHz
		10.0 dB	12.0 dB	f_R, f_L 2-24 GHz; f_I 0.1-5.0 GHz
Isolation L – R	12 dB	15 dB		f_L 2-4 GHz
	15 dB	25 dB		f_L 4-24 GHz
L – I	17 dB	25 dB		f_L 2-24 GHz

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

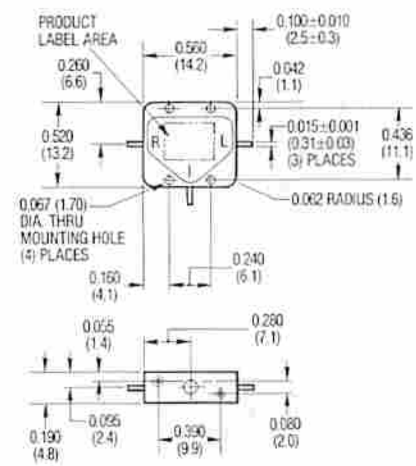
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . +26 dBm max. at 25°C, +22 dBm max. at 100°C

Weight

MZ5210: 6 grams (0.22 oz.) max.
MZ5210C: 12 grams (0.43 oz.) max.

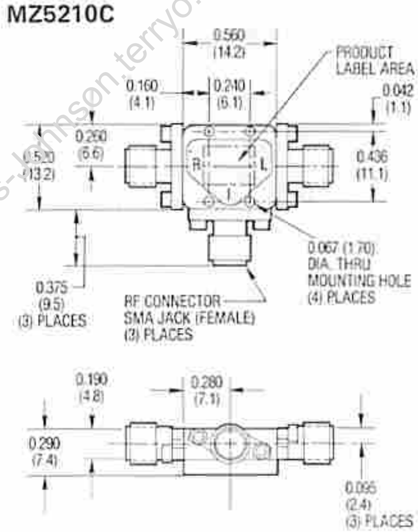
Outline Drawings

MZ5210



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

MZ5210C

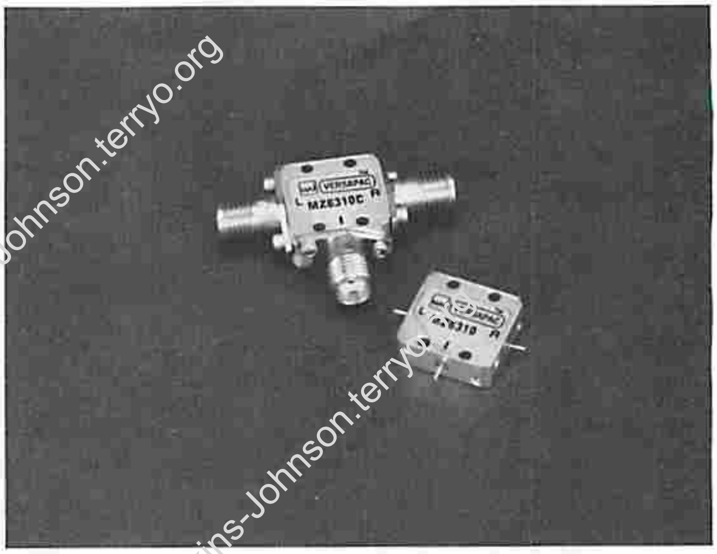


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

WJ-MZ6310/ MZ6310C

DOUBLE-BALANCED MIXER

LO 2.5 TO 7.0 GHz
RF 2.5 TO 5.5 GHz
IF DC TO 1.5 GHz
LO DRIVE +10 dBm (nominal)



- MINIATURE PACKAGE
- INTEGRATED MOUNTING HOLES
- AVAILABLE WITH FIELD REPLACEABLE CONNECTORS
- HERMETICALLY SEALED

Guaranteed Specifications[1]

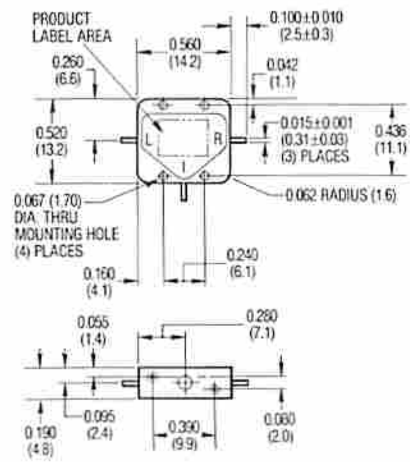
Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		6.0 dB	7.5 dB	f_R 3.0 to 5.5 GHz f_L 2.5 to 7.0 GHz f_I DC to 1.5 GHz
		7.0 dB	9.0 dB	f_R 2.5 to 3.0 GHz f_L 2.5 to 4.5 GHz f_I DC to 1.5 GHz
Isolation				
L – R	20 dB	28 dB		f_L 2.5 to 4.0 GHz
	30 dB	45 dB		f_L 4.0 to 7.0 GHz
L – I	12 dB	18 dB		f_L 2.5 to 3.5 GHz
	22 dB	35 dB		f_L 3.5 to 7.0 GHz
Conversion Compression			1.0 dB	f_R Level +3 dBm
Third-Order Intercept Point		+15 dBm		f_{R1} 4.00 GHz, f_{R2} 4.01 GHz both at –10 dBm f_L 2.8 GHz at +10 dBm

Notes:

1. Measured in a 50-ohm system with nominal LO drive and dowconverter application only unless otherwise specified. The I-Port frequency range extends to DC for phase detection pulse modulation, or attenuator application, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

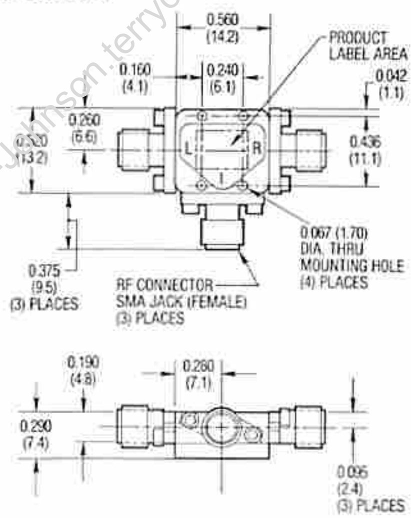
Outline Drawings

MZ6310



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

MZ6310C



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

Absolute Maximum Ratings

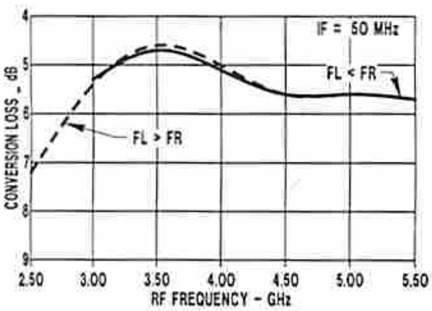
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . 23 dBm max. at 25°C, 20 dBm max. at 25°C

Weight

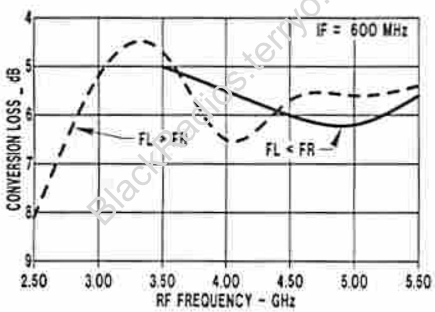
MZ6310:	4.5 grams (0.16 oz.) max.
MZ6310C:	11 grams (0.39 oz.) max.

Typical Performance at 25°C

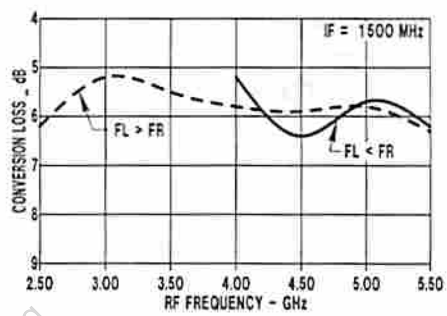
Conversion Loss vs. Frequency

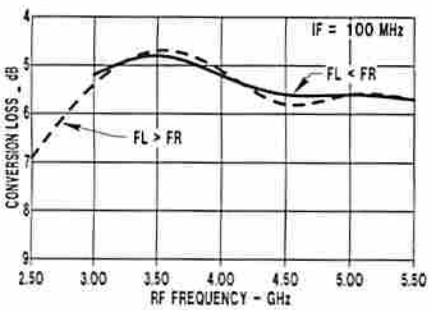


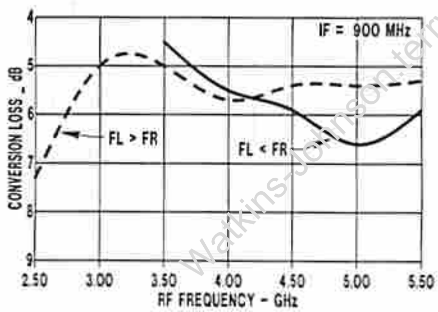
Conversion Loss vs. Frequency



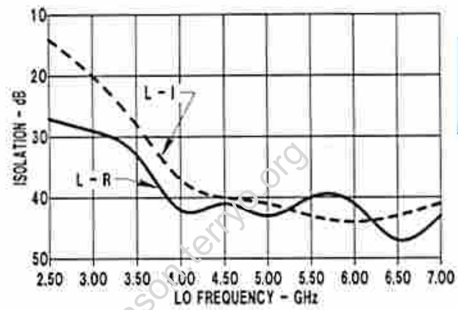
Conversion Loss vs. Frequency

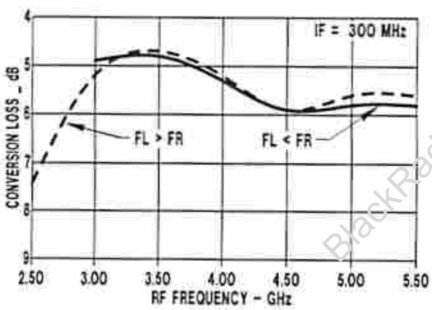


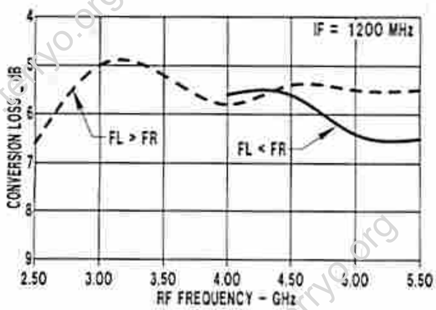




Isolation vs. LO Frequency







6

WJ-MZ7407/MZ7407C

DOUBLE-BALANCED MIXER

LO 4 TO 18 GHz
RF 6 TO 18 GHz
IF DC TO 3000 MHz
LO DRIVE +7 dBm (nominal)

- HERMETICALLY SEALED
- SUPER COMPACT PACKAGE
- AVAILABLE WITH FIELD REPLACEABLE CONNECTORS

Guaranteed Specifications [1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		6.0 dB	8.0 dB	f_R = 7 to 15 GHz f_L = 6 to 13.5 GHz f_I = 30 to 1000 MHz
		7.0 dB	9.0 dB	f_R = 6 to 18 GHz f_L = 4 to 18 GHz f_I = 30 to 3000 MHz
Isolation L to R	23 dB 17 dB	36 dB 32 dB		f_L = 3.5 to 16 GHz f_L = 16 to 18 GHz
L to I	23 dB 15 dB	35 dB 25 dB		f_L = 5 to 15 GHz f_L = 4 to 18 GHz
Conversion Compression			1.0 dB	f_R Level +3 dBm
Third-Order Input Intercept		+10 dBm		f_{R1} = 13.00 GHz f_{R2} = 13.01 GHz both at -10 dBm f_L = 14 GHz

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications. I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

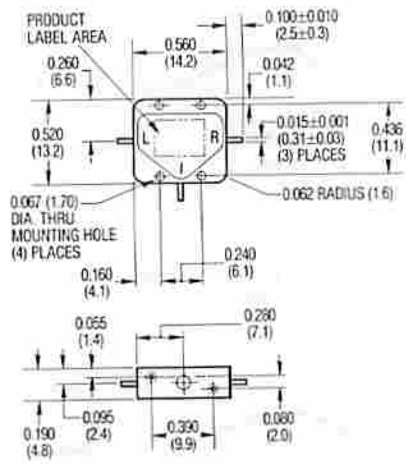
Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . 23 dBm max. at 25°C
Peak Input Current at 25°C. . . . . 100 mA DC

Weight MZ7407: 4.5 grams (0.16 oz.) max.
MZ7407C: 11 grams (0.39 oz.) max.

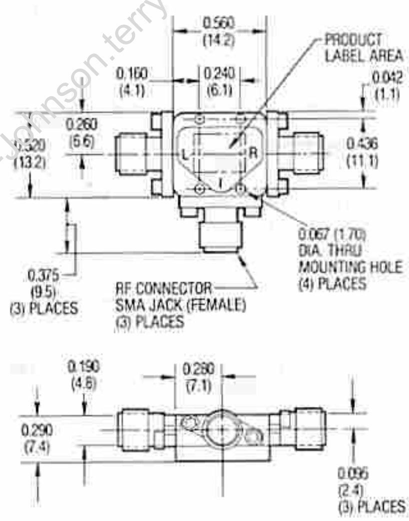
Outline Drawings

MZ7407



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

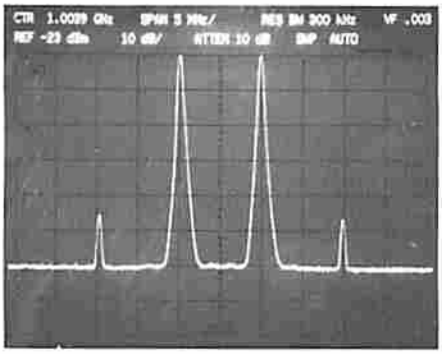
MZ7407C



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C

Typical Two-Tone Intermodulation Performance



Typical Two-Tone Intermodulation Performance:

f_I = 1000 MHz, f_{R1} = 13.00 GHz
f_{R2} = 13.01 GHz, f_R at −10 dBm
f_L = 14 GHz at +10 dBm
Vertical scale = 10 dB/cm

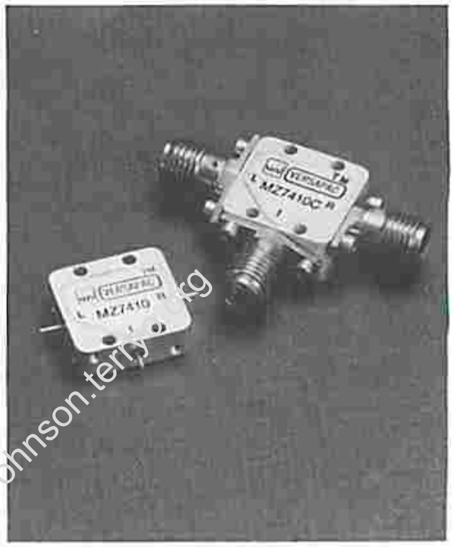
6

WJ-MZ7410/MZ7410C

DOUBLE-BALANCED MIXER

LO 4 TO 18 GHz
RF 6 TO 18 GHz
IF DC TO 3000 MHz
LO DRIVE +10 dBm (nominal)

- HERMETICALLY SEALED
- SUPER COMPACT PACKAGE
- AVAILABLE WITH FIELD REPLACEABLE CONNECTORS



Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		6.0 dB	8.0 dB	f_R = 6 to 15 GHz f_L = 4 to 16 GHz f_I = 30 to 3000 MHz
		7.0 dB	9.0 dB	f_R = 15 to 18 GHz f_L = 16 to 18 GHz f_I = 30 to 3000 MHz
Isolation L to R	23 dB 18 dB	36 dB 32 dB		f_L = 4 to 14 GHz f_L = 14 to 18 GHz
L to I	20 dB	35 dB		f_L = 4 to 18 GHz
Conversion Compression			1.0 dB	f_R Level +4 dBm
Third-Order Input Intercept		+14 dBm		f_{R1} = 13.00 GHz, f_{R2} = 13.01 GHz both at −6 dBm f_L = 14 GHz

Notes:

1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications. I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

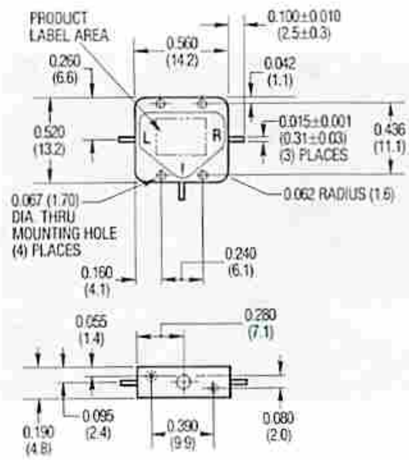
Absolute Maximum Ratings

Operating Temperature . . . . −54°C to +100°C
Storage Temperature . . . . −65°C to +100°C
Peak Input Power . . . . 23 dBm max. at 25°C
Peak Input Current at 25°C . . . . 100 mA DC

Weight WJ-MZ7410: 4.5 grams (0.16 oz.) max.
WJ-MZ7410C: 11 grams (0.39 oz.) max.

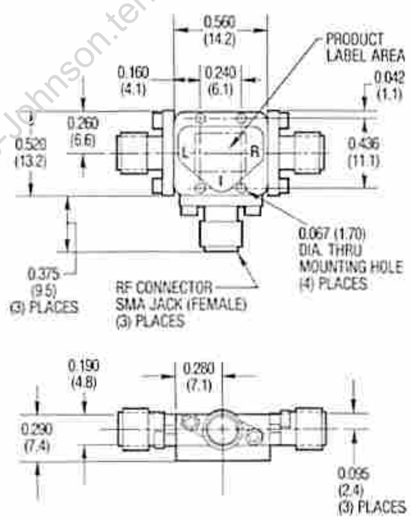
Outline Drawings

MZ7410



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

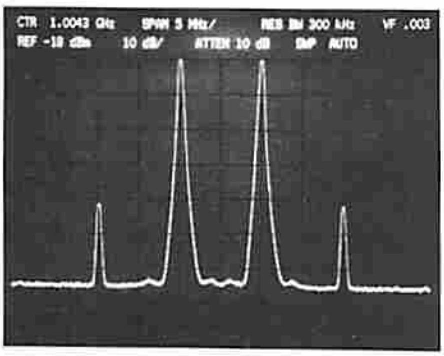
MZ7410C



DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.015 (.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C

Typical Two-Tone Intermodulation Performance



Typical Two-Tone Intermodulation Performance:

f_I = 1000 MHz, f_{R1} = 13.00 GHz
f_{R2} = 13.01 GHz, f_R at -6 dBm
f_L = 14 GHz at +10 dBm
Vertical Scale = 10 dB/cm

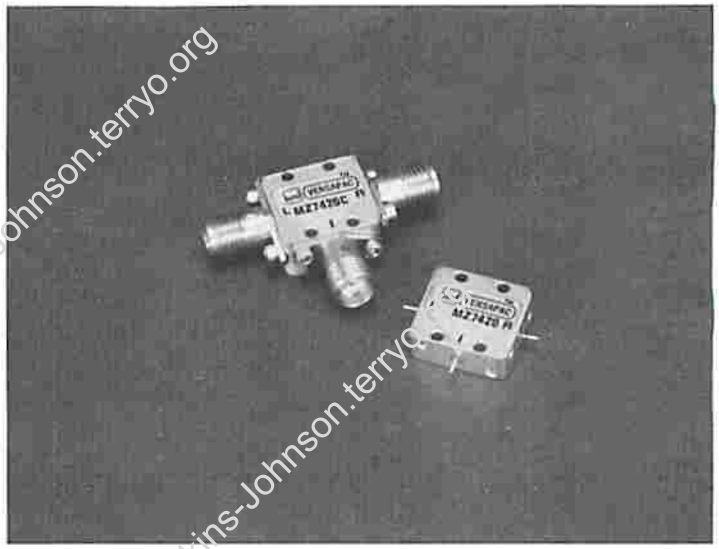
6

WJ-MZ7420/ MZ7420C

DOUBLE-BALANCED MIXER

LO 5 TO 18 GHz
RF 6 TO 18 GHz
IF DC TO 3000 MHz
LO DRIVE +20 dBm (nominal)

- HERMETICALLY SEALED
- SUPER COMPACT PACKAGE
- AVAILABLE WITH FIELD REPLACEABLE CONNECTORS



Guaranteed Specifications [1]

Characteristics	Min.	Typ. [2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		6.5 dB	8.0 dB	f_R = 7-15 GHz f_L = 6-15 GHz f_I = 30-1000 MHz
		7.0 dB	8.5 dB	f_R = 6-16 GHz f_L = 5-18 GHz f_I = 30-2000 MHz
		7.5 dB	9.5 dB	f_R = 6-16 GHz f_L = 5-18 GHz f_I = 30-3000 MHz
		8.5 dB	10.0 dB	f_R = 16-18 GHz f_L = 13-18 GHz f_I = 30-3000 MHz
Isolation				
L – R	23 dB	35 dB		f_L = 5-14 GHz
	18 dB	30 dB		f_L = 14-18 GHz
L – I	23 dB	35 dB		f_L = 9-18 GHz
	17 dB	27 dB		f_L = 5-9 GHz
Conversion Compression			1.0 dB	PRF = +15 dBm; PLO = +20 dBm
Third-Order Input Intercept		+21 dBm		f_{R1} = 13.00 GHz f_{R2} = 13.01 GHz both at -6 dBm f_L = 14.0 GHz at +20 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and dowconverter application only unless otherwise specified. The I-Port frequency range extends to DC for phase detection pulse modulation, or attenuator application, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

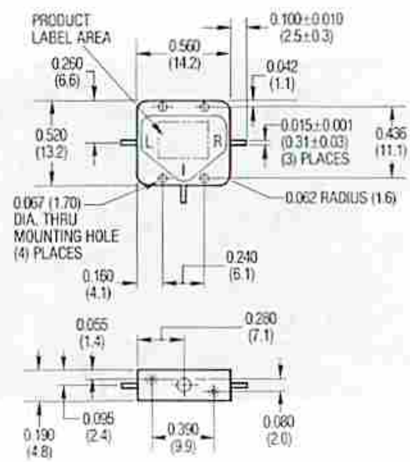
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . 24.7 dBm max. at 25°C, 20.8 dBm max. at 100°C

Weight

MZ7420: 4.5 grams (0.16 oz.) max.
MZ7420C: 11 grams (0.39 oz.) max.

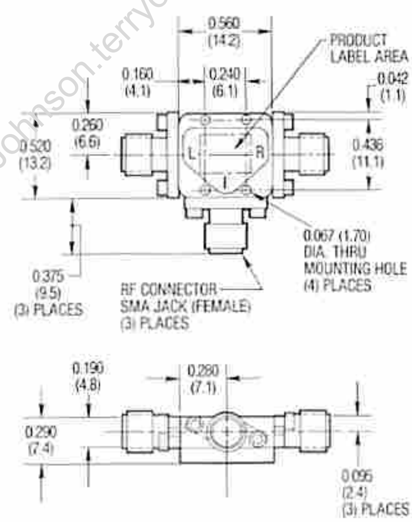
Outline Drawings

MZ7420



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

MZ7420C



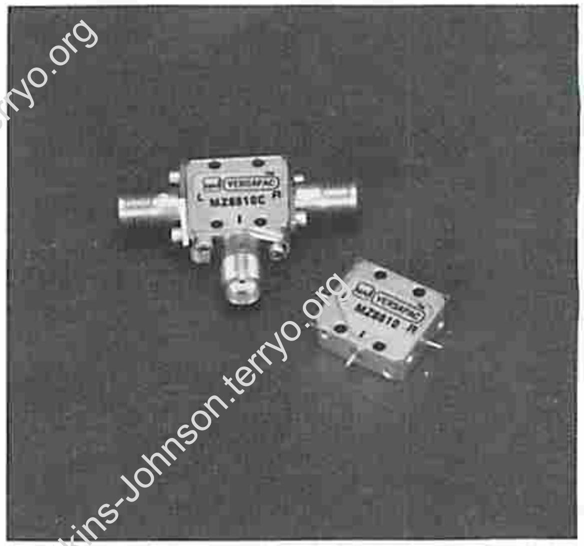
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

WJ-MZ8810/ MZ8810C

TRIPLE-BALANCED (DOUBLE-DOUBLE) MIXER

LO } 2 TO 18 GHz
RF }
IF 1 TO 8 GHz
LO DRIVE +10 dBm (nominal)

- MINIATURE PACKAGE
- INTEGRATED MOUNTING HOLES
- AVAILABLE WITH FIELD REPLACEABLE CONNECTORS
- HERMETICALLY SEALED



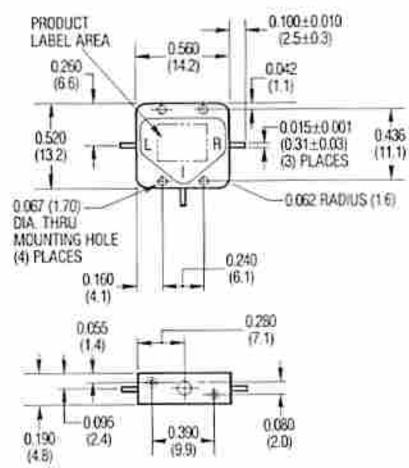
Guaranteed Specifications [1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure			9.0 dB	f_R 3 to 10 GHz f_L 2 to 15 GHz f_I 1 to 5 GHz
		7.5 dB	11.0 dB	f_R 2 to 18 GHz f_L 2 to 18 GHz f_I 1 to 8 GHz
Isolation L – R	15 dB	25 dB		f_L 2 to 18 GHz
L – I	16 dB	28 dB		f_L 2 to 18 GHz
Conversion Compression			1.0 dB	f_R Level +6 dBm
Third-Order Input Intercept		+15 dBm		f_{R1} 3.00 GHz, f_{R2} 3.01 GHz both at –10 dBm f_L 5.0 GHz at +10 dBm
		+13 dBm		f_{R1} 17.99 GHz, f_{R1} 18.00 GHz both at –10 dBm f_L 14 GHz at +10 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

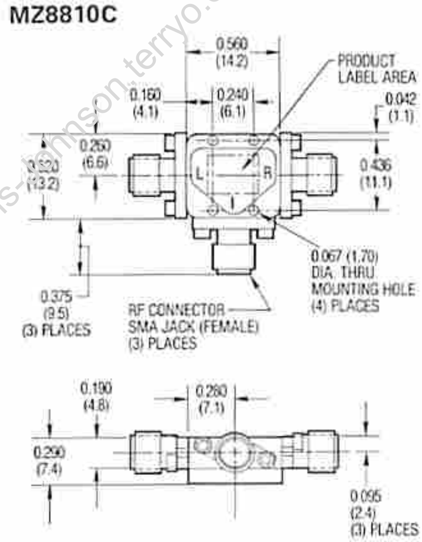
Outline Drawings

MZ8810



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

MZ8810C



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

Absolute Maximum Ratings

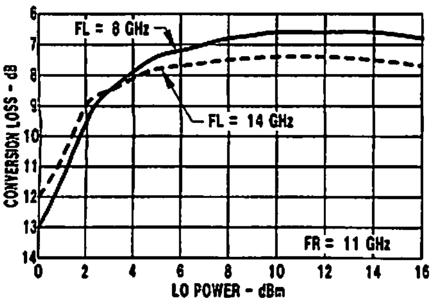
Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . 26 dBm max. at 25°C, 23 dBm max. at 100°C

Weight

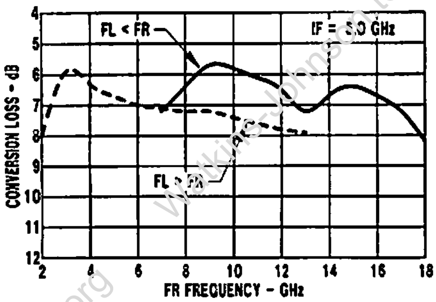
MZ8810: 4.5 grams (0.16 oz.) max.
MZ8810C: 11 grams (0.39 oz.) max.

Typical Performance at 25°C

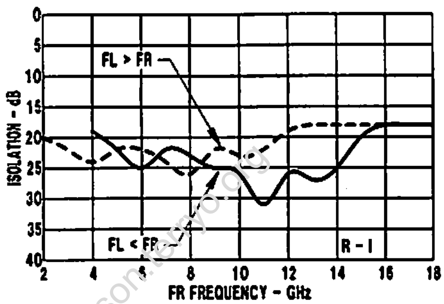
Conversion Loss va. LO Power



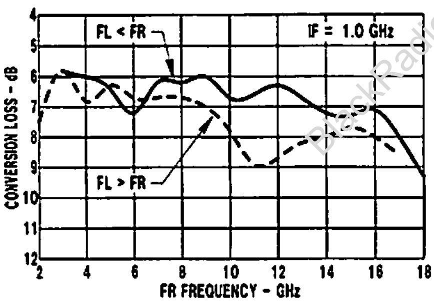
Conversion Loss vs. Frequency

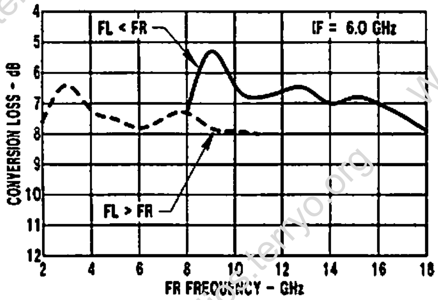


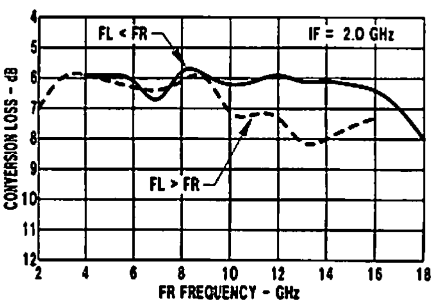
Isolation vs. Frequency

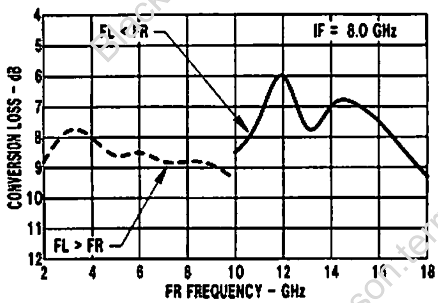


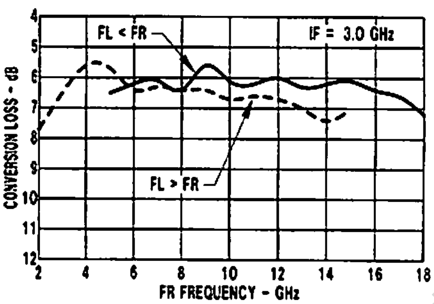
Conversion Loss vs. Frequency



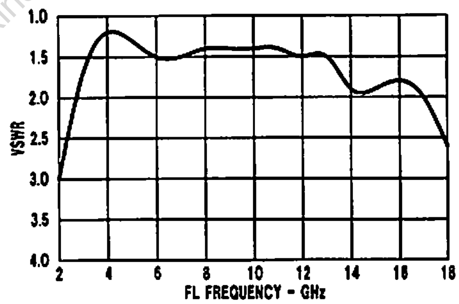




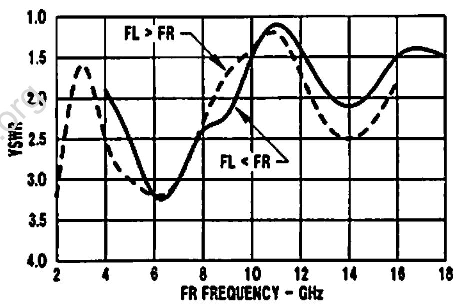




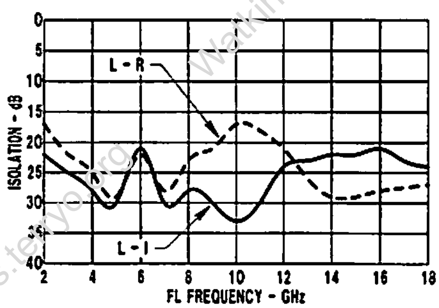
L-Port vs. Frequency VSWR



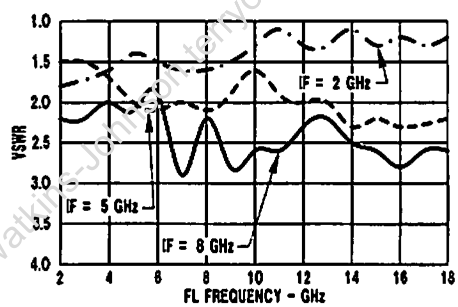
R-Port VSWR vs. Frequency



Isolation vs. Frequency



I-Port VSWR vs. Frequency



6

WJ-MZ8813
MZ8813C

TRIPLE-BALANCED (DOUBLE-DOUBLE) MIXER

LO, RF } 2 TO 18 GHz
IF 1 TO 8 GHz
LO DRIVE +13 dBm (nominal)

- MINIATURE PACKAGE
- INTEGRATED MOUNTING HOLES
- AVAILABLE WITH FIELD REPLACEABLE CONNECTORS
- HERMETICALLY SEALED

Guaranteed Specifications[1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		6.5 dB	9.0 dB	f_R 3 to 10 GHz, f_L 2 to 15 GHz, f_I 1 to 5 GHz
		7.5 dB	11.0 dB	f_R 2 to 18 GHz, f_L 2 to 18 GHz, f_I 1 to 8 GHz
Isolation L – R	15 dB	25 dB		f_L 2 to 18 GHz
L – I	16 dB	28 dB		f_L 2 to 18 GHz
Conversion Compression			1.0 dB	f_R Level +8 dBm
Third-Order Input Intercept		+19 dBm		f_{R1} 3.00 GHz, f_{R2} 3.01 GHz both at –10 dBm; f_L 5.00 GHz at +13 dBm
		+16 dBm		f_{R1} 17.99 GHz, f_{R2} 18 GHz both at –10 dBm; f_L 14 GHz at +13 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

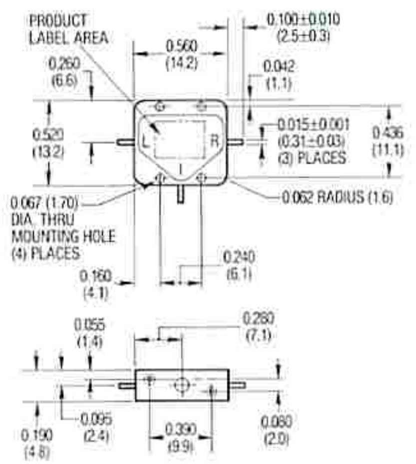
Operating Temperature . . . . –54°C to +100°C
Storage Temperature . . . . –65°C to +100°C
Peak Input Power . . . . 26 dBm max. at 25°C, 23 dBm max. at 100°C

Weight

MZ8813: 4.5 grams (0.16 oz.) max.
MZ8813C: 11 grams (0.39 oz.) max.

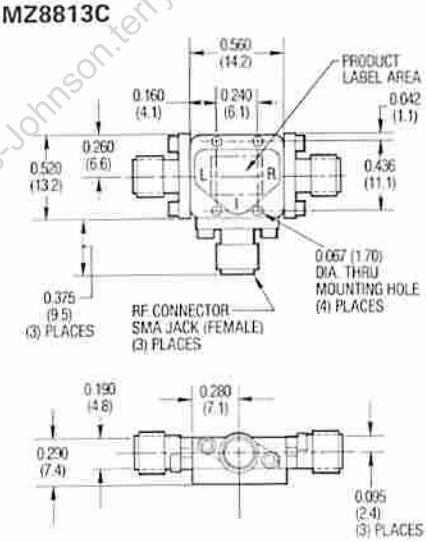
Outline Drawings

MZ8813



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

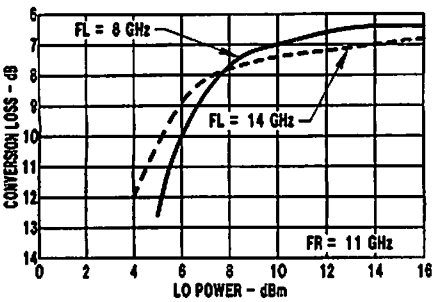
MZ8813C



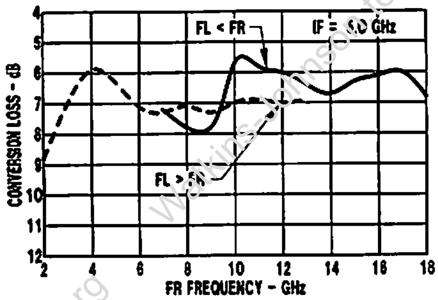
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

Typical Performance at 25°C

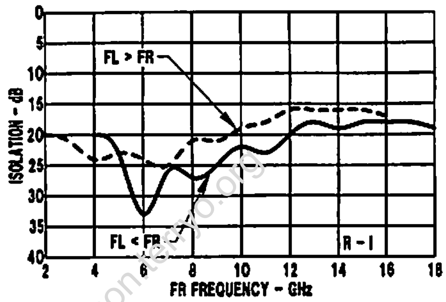
Conversion Loss vs. LO Power



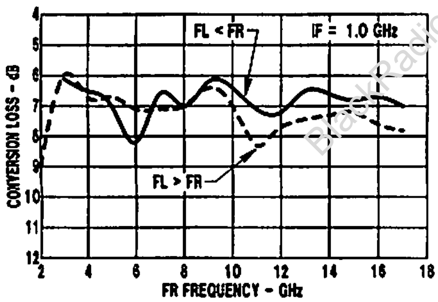
Conversion vs. Frequency

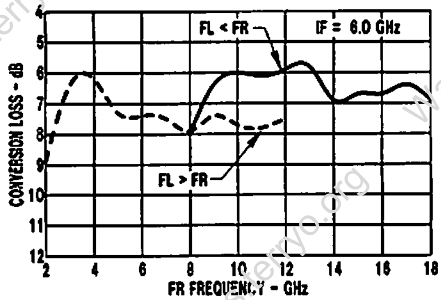


Isolation vs. Frequency

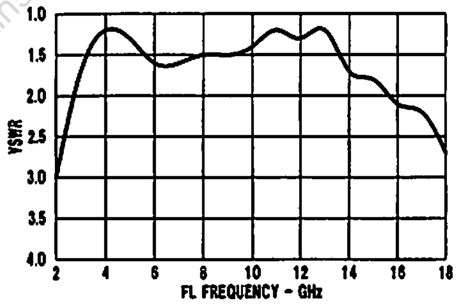


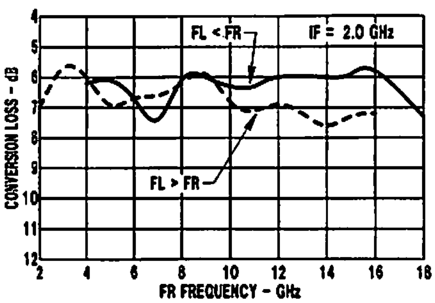
Conversion vs. Frequency

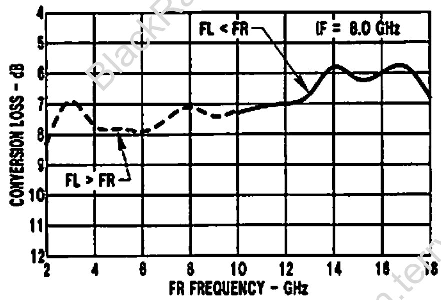




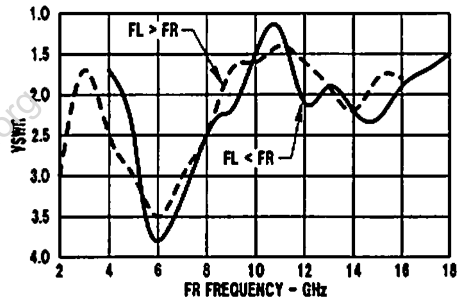
L-Port VSWR vs. Frequency

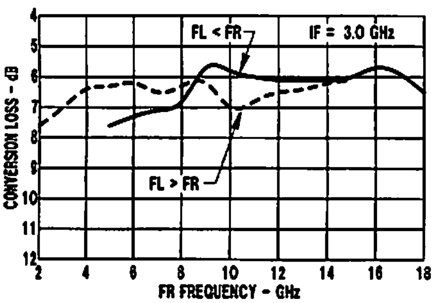




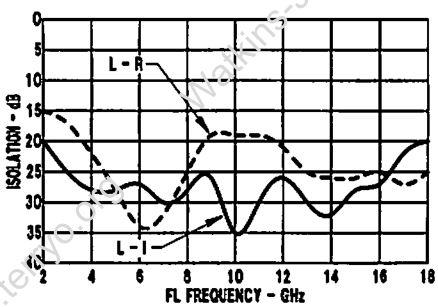


R-Port VSWR vs. Frequency

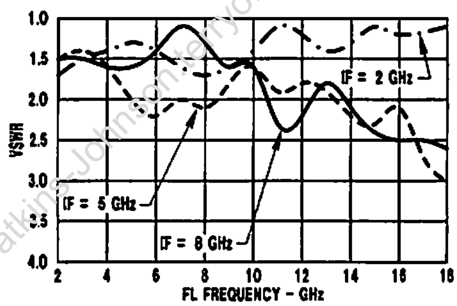




Isolation vs. Frequency



I-Port VSWR vs. Frequency



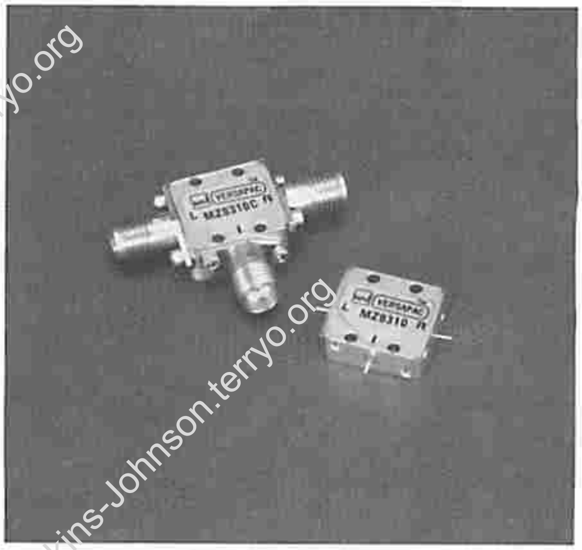
6

WJ-MZ9310/ MZ9310C

TRIPLE-BALANCED (DOUBLE-DOUBLE) MIXER

LO } 2 TO 18 GHz
RF }
IF 0.03 TO 5 GHz
LO DRIVE +10 dBm (nominal)

- MINIATURE PACKAGE
- INTEGRATED MOUNTING HOLES
- AVAILABLE WITH FIELD REPLACEABLE CONVERTORS
- HERMETICALLY SEALED



Guaranteed Specifications[1]

Characteristics	Min.	Typ[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		7.0 dB	8.5 dB	f_R 4 to 18 GHz f_L 4 to 18 GHz f_I 0.03 to 1.0 GHz
		7.5 dB	9.0 dB	f_R 3 to 18 GHz f_L 3 to 18 GHz f_I 0.03 to 2.0 GHz f_I 0.03 to 3.0 GHz $f_L < f_R$
		8.0 dB	10.5 dB	f_R 2 to 18 GHz f_L 2 to 18 GHz f_I 0.03 to 5 GHz
Isolation				
L – R	12 dB	20 dB		f_L 2 to 4 GHz
	16 dB	25 dB		f_L 4 to 18 GHz
L – I	16 dB	30 dB		f_L 2 to 18 GHz
Conversion Compression			1.0 dB	f_R Level +6 dBm
Third-Order Intercept Point		+16 dBm		f_{R1} 3.00 GHz, f_{R2} 3.01 GHz both at -10 dBm f_L 5.0 GHz at +10 dBm
		+13 dBm		f_{R1} 17.99 GHz, f_{R2} 18.00 GHz both at -10 dBm f_L 14 GHz at +10 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

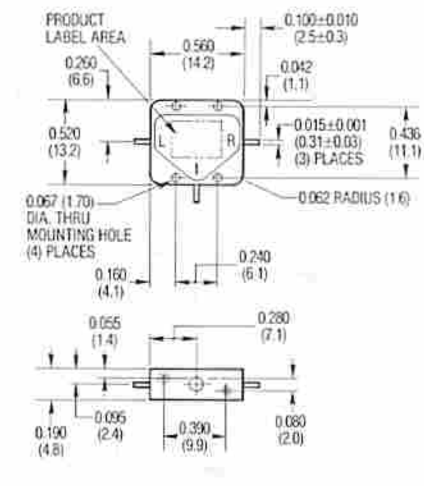
Absolute Maximum Ratings

Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -65°C to +100°C
Peak Input Power . . . . 26 dBm max. at 25°C, 23 dBm max. at 100°C

Weight MZ9310: 4.5 grams (0.16 oz.) max.
MZ9310C: 11 grams (0.39 oz.) max.

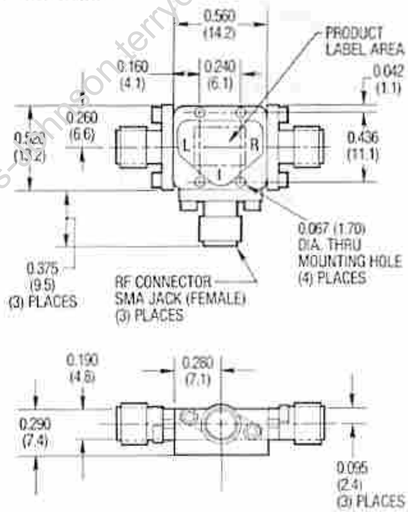
Outline Drawings

MZ9310



DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

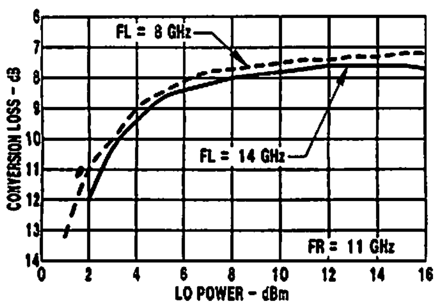
MZ9310C



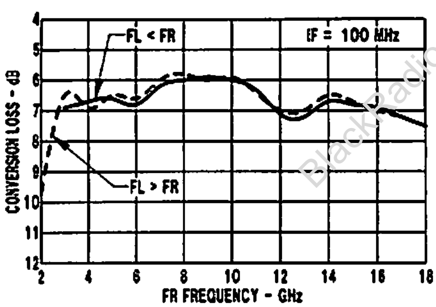
DIMENSIONS ARE IN INCHES (MILLIMETERS) ± .015 (.38) UNLESS OTHERWISE SPECIFIED

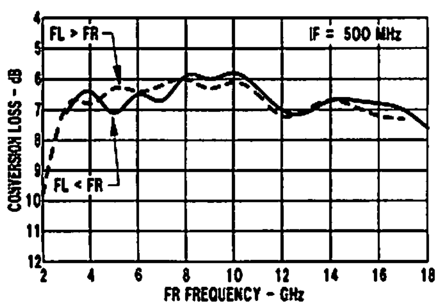
Typical Performance at 25°C

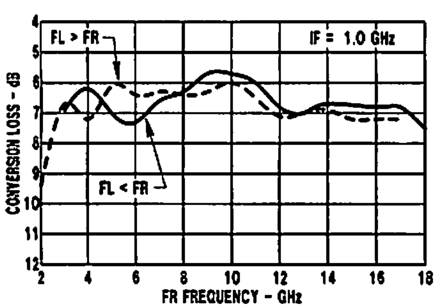
Conversion Loss vs. LO Power



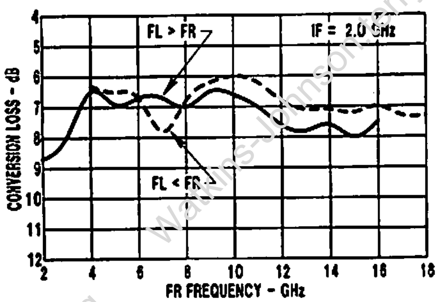
Conversion Loss vs. Frequency

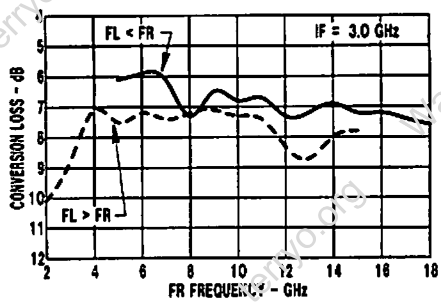


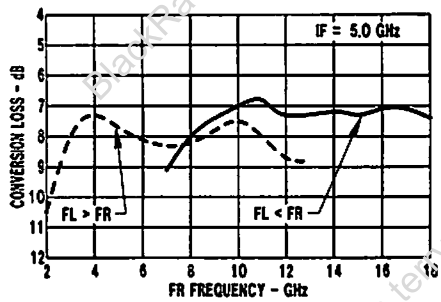




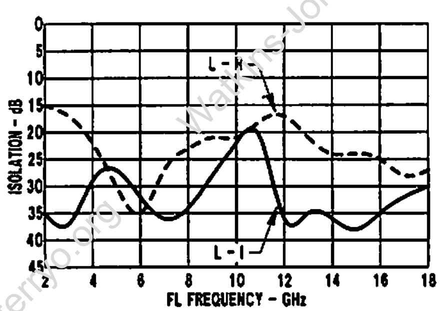
Conversion Loss vs. Frequency



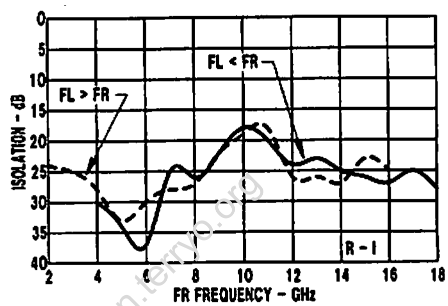




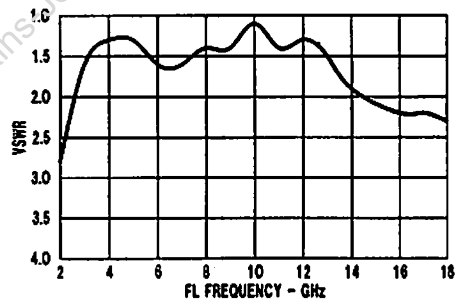
Isolation vs. Frequency



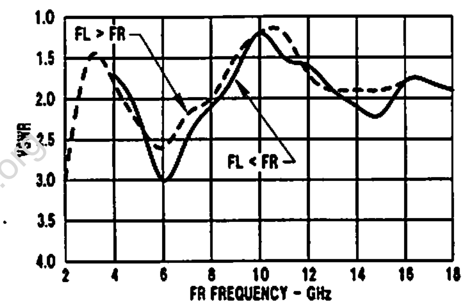
Isolation vs. Frequency



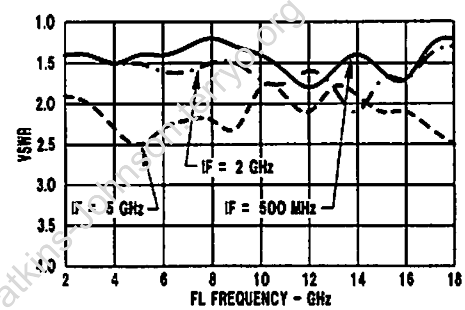
L-Port VSWR vs. Frequency



R-Port VSWR vs. Frequency



I-Port VSWR vs. Frequency



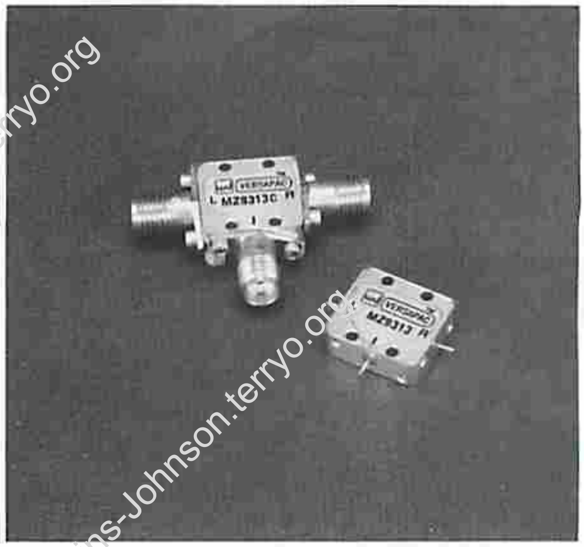
6

WJ-MZ9313
MZ9313C

TRIPLE-BALANCED (DOUBLE-DOUBLE) MIXER

LO / RF } 2 TO 18 GHz
IF 0.03 TO 5 GHz
LO DRIVE +13 dBm (nominal)

- MINIATURE PACKAGE
- INTERGRATED MOUNTING HOLES
- AVAILABLE WITH FIELD REPLACEABLE CONNECTORS
- HERMETICALLY SEALED



Guaranteed Specifications [1]

Characteristics	Min.	Typ.[2]	Max.	Test Conditions
SSB Conversion Loss and SSB Noise Figure		6.5 dB	9.0 dB	f_R 4 to 18 GHz f_L 2 to 18 GHz f_I 0.03 to 3 GHz
		7.5 dB	10.5 dB	f_R 2 to 18 GHz f_L 2 to 18 GHz f_I 0.03 to 5 GHz
Isolation L – R	12 dB	17 dB		f_L 2 to 4 GHz
	15 dB	30 dB		f_L 4 to 18 GHz
L – R	17 dB	30 dB		f_L 2 to 18 GHz
Conversion Compression			1.0 dB	f_R Level +8 dBm
Third-Order Input Intercept		+19 dBm		f_{R1} 3.00 GHz, f_{R2} 3.01 GHz both at −10 dBm f_L 5.0 GHz at +13 dBm
		+15 dBm		f_{R1} 17.99 GHz, f_{R2} 18.00 GHz both at −10 dBm f_L 14.0 GHz at +13 dBm

Notes:
1. Measured in a 50-ohm system with nominal LO drive and downconverter application only unless otherwise specified.
2. Typical values are measured at 25°C and are not guaranteed. They are based on the average value measured at the specified condition.

Absolute Maximum Ratings

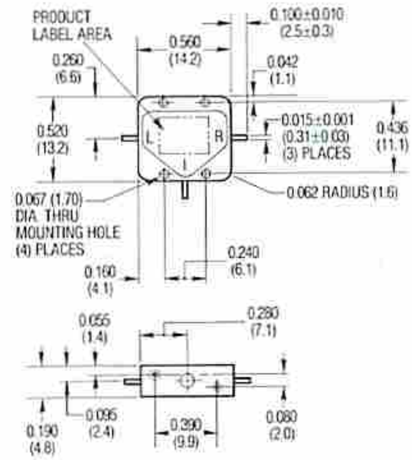
Operating Temperature . . . . −54°C to +100°C
Storage Temperature . . . . −65°C to +100°C
Peak Input Power . . . . 26 dBm max. at 25°C, 23 dBm max. at 100°C

Weight

WJ-MZ9313: 4.5 grams (0.16 oz.) max.
WJ-MZ9313C: 11 grams (0.39 oz.) max.

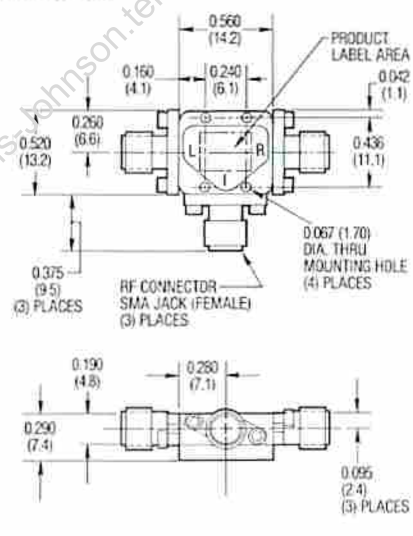
Outline Drawings

MZ9313



DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

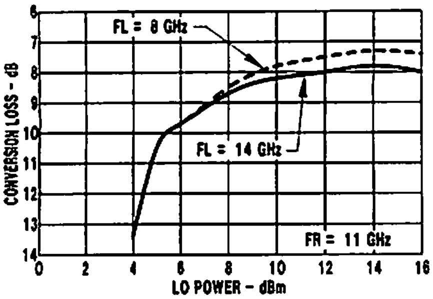
MZ9313C



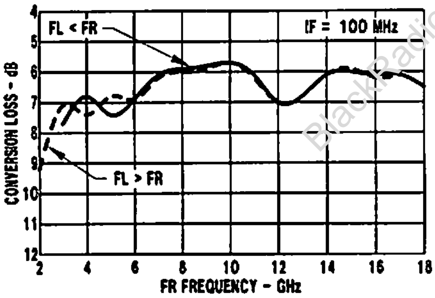
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

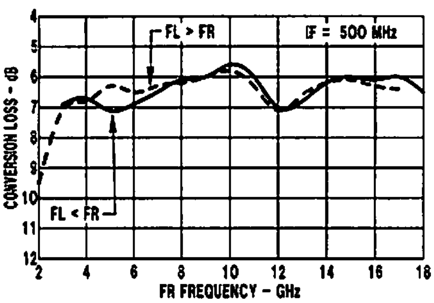
Typical Performance at 25°C

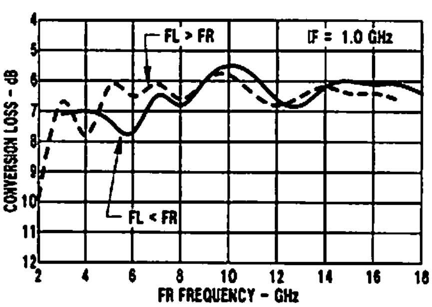
Conversion vs. LO Power



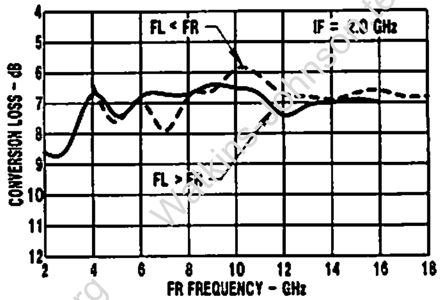
Conversion vs. Frequency

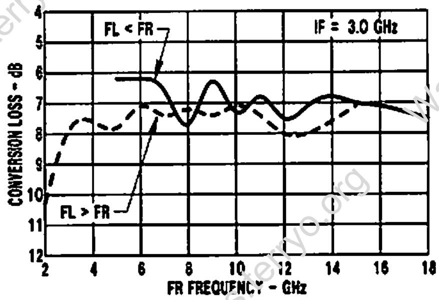


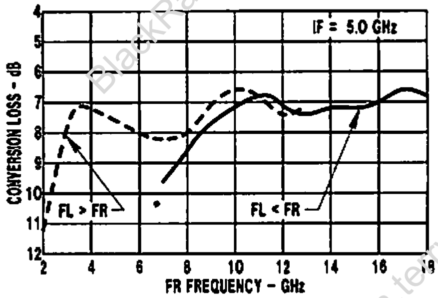




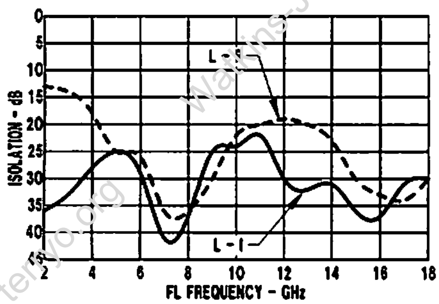
Conversion vs. Frequency



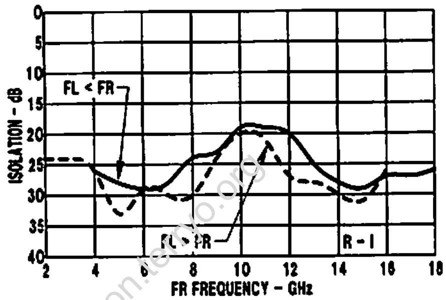




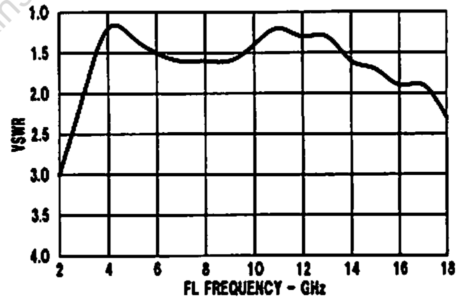
Isolation vs. Frequency



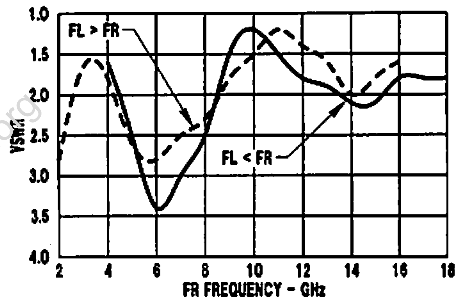
Isolation vs. Frequency



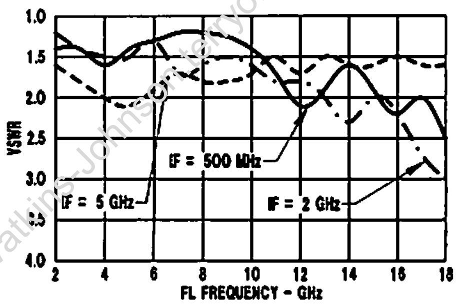
L-Port VSWR vs. Frequency



R-Port VSWR vs. Frequency



I-Port VSWR vs. Frequency



6

Mixer Technical Articles

6

Mixers: Part 1 Characteristics and Performance

Author: Bert C. Henderson

The mixer is a critical component in modern RF systems. Since it is usually the first or second device from the RF input, the performance of the mixer is crucial to the overall operation of the system. Such important mixer parameters as dynamic range, conversion loss, bandwidth, noise figure, interport isolation and VSWR (voltage standing wave ratio) must be optimized to produce the type of device necessary for today's sophisticated RF systems. This article explores the basics of mixer operation, and is intended to give the reader a base on which to build further understanding of today's mixer technology. The systems designer will find portions of this article helpful when integrating various types of mixers into his systems.

Mixer Defined

A mixer converts RF power at one frequency into power at another frequency to make signal processing easier and less expensive. Another, and perhaps more fundamental reason for frequency conversion, is to allow for the practical transmission of audio and other low-frequency information through free space. Audio signals have such long wavelengths that transmitting them directly would require a restrictively large antenna. But, by first converting the audio information up in frequency to center around a higher (carrier) frequency, antennas of practical size can be built to utilize the various channel characteristics of free space, such as ionospheric skip and atmospheric absorption, that depend on the carrier frequency. Receiving the transmitted signal involves capturing part of its electromagnetic energy and reconverting it down to the audio-frequency range to extract the original information. So, both the transmitting and receiving cases require the input signal to be converted; this is done through the mixing process.

Mixing the input signal having the desired information with a local oscillator signal yields upper and lower sidebands, each containing the identical information present in the input frequency. The upper sideband is the sum of the input and the local oscillator frequencies, and the lower sideband is the difference between the input and the local oscillator frequencies. The upper or lower sideband, whichever is selected for use, is called the intermediate frequency (IF). In most receiving systems, the lower sideband (the downconverted product) is used, whereas in transmitting systems the upper sideband (the upconverted product) is used.

Changing the frequency of a signal — without altering the information it carries — is necessary because signal processing components, such as amplifiers, are much less expensive and perform better when designed to operate at lower frequencies.

Since it is much less expensive to amplify a signal in the MHz range than in the GHz range, the incoming microwave signal is first downconverted in frequency and then processed. Likewise, in a transmitter it is less expensive to generate, modulate, and amplify a signal in the MHz range and then upconvert it in frequency into the GHz range.

Figure 1 shows the placement of a mixer in a receiver front end with the schematic symbol most commonly used for mixers. Sometimes X is used instead of I to denote the I-port. For testing purposes, attenuators are placed on all three ports for better matching [1] and to dampen intermodulation products exiting the mixer so that they are minimized in power level before the system reflects them back into the mixer to remix and cause further intermodulation products. When matching and intermodulation products are a problem in a system, isolators are used instead of attenuators on the R- and I-ports so that system sensitivity is not degraded, and on the L-port if LO power is limited.

Since a mixer converts modulated power from one frequency to another, it is sometimes called a frequency converter, but the term *frequency converter* usually implies a mixer/amplifier or mixer/oscillator combination. The term *mixer* more closely describes the mechanism through which frequency conversion occurs. Two inputs are mixed by means of nonlinearities and switching to produce a group of signals having frequencies equal to the sums and differences of the harmonics of the two input signals. Nonlinearities and switching will be discussed at greater length later in this *Tech-notes* series.

The input signal to the mixer that has the desired information modulated onto it is called the received (input RF) signal, or f_R. The other input signal to the mixer, designated as f_L, is called the local oscillator (LO) signal, since it is generated by an oscillator

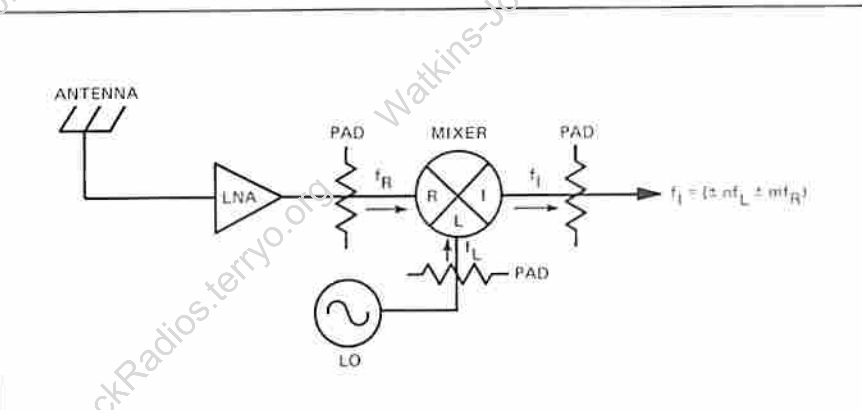


Figure 1. Schematic diagram showing mixer placement in a receiver front end.

physically located near the mixer in the system.

The LO signal is usually much stronger than the received signal; this causes the mixer to have better intermodulation suppression than would be possible if the LO and RF power levels were similar. The LO signal should be, in most cases, at least 20 dB higher in power than the RF input. The mixer output signal is the intermediate frequency and is designated, f_I. The *intermediate frequency* is so termed because it falls between the RF and information frequencies. This is simply stated as:

$$f_I = \pm m\, f_R \pm n\, f_L$$

where,

$$m = 0, 1, 2, 3, \text{etc.}$$
$$n = 0, 1, 2, 3, \text{etc.}$$

The output products most generally desired are the sums and differences of the fundamentals of the received and LO signals. This is the case for which:

$$m = n = 1$$

giving,

$$f_I = \pm f_L \pm f_R$$

While this formula implies that negative frequency products occur, these can be ignored in practical mixer applications in much the same way as incorrect roots can be ignored when calculating quadratic equations. For the case where $f_L > f_R$, which is called high-side LO, $f_I = f_L \pm f_R$. When $f_L < f_R$, which is called low-side LO, $f_I = \pm f_L + f_R$.

Hereafter, in this discussion, the definition of the intermediate frequency products will be restricted to include only the four intermodulation products for which $n = m = 1$.

The higher-order products having $m = 1, 2, 3, 4, \ldots$ and $n = 1, 2, 3, 4, \ldots$ for which m and n are not simultaneously equal to 1, will be referred to as higher-order intermodulation products. Two other possible cases are $m = 1, 2, 3, \ldots, n = 0$ and $m = 0, n = 1, 2, 3, \ldots$. In these cases, the fundamental and harmonics of the received and local oscillator signals, respectively, leak through the mixer to appear at the IF output port. This is caused by finite interport isolation, and occurs to a varying extent in all mixers.

A mixer is a three-port device, having two input ports and one output port. The port through which the received signal enters the mixer is called the *R-port*, and the port through which the local oscillator signal enters the mixer is called the *L-port*. The port through which all the output products exit the mixer is called the *I-port*. A mixer can also be a four-port device if it uses a dc bias for *starved LO* operation, which generally means LO input power is in the range of 0 to +6 dBm. Normal mixers using only the LO power to turn on the diodes require +6 to +20 dBm of LO power.

Most mixers use Schottky barrier diodes, but GaAs diodes are sometimes utilized for operation in the millimeter-wave frequency range. Mixers also use bipolar transistors, J-FETs, and GaAs FETs, all of which require a fourth port for a dc voltage. There are many parameters to consider when choosing a mixer; an introduction to the most important of these follows.

Single Sideband Conversion Loss

Since a mixer converts power from one frequency to another, perhaps the most fundamental parameter is the measure of how efficiently frequency conversion occurs. This parameter is called conversion loss, and is defined as the difference in dB between the received signal power entering the R-port and the output IF power of the desired IF sideband exiting the I-port. Both the up- and down-converted products, or sidebands, exit the I-port. Since normally only one of these products is desired, the other product is filtered out, causing half the down-converted power to be lost. Hence, there is an automatic 3-dB SSB (single sideband) conversion loss minimum. Further power losses during frequency conversion occur because some of the down-converted power is also lost in the form of unwanted higher-order mixing products, heat due to the series resistance of the diodes, and mismatches at the mixer. These all add to cause typical SSB conversion loss to range from 6 to 9 dB. Conversion loss is a strong function of LO power, which radically affects mismatch between the system and mixer.

VSWR

VSWR is the measure of mismatch offered to the system by the mixer, and is usually specified over a given bandwidth as a function of LO power and temperature. It is calculated as follows:

$$\text{VSWR} = \frac{1 + |\rho|}{1 - |\rho|}$$

where

$$\rho = \frac{Z_L - Z_o}{Z_L + Z_o}$$

ρ is the reflection coefficient.

Z_L is the input impedance of the mixer.

Z_o is the characteristic impedance of the system.

Since VSWR does not include the phase of the reflection coefficient, the system designer does not know if the input impedance is above or below the normal 50Ω characteristic impedance. For example, if the L-port VSWR is 2:1, measured in a 50-ohm system, the system designer does not know if the L-port input impedance is 25 ohms or 100 ohms. Actually, the input impedance of a broadband mixer swept over a frequency range of an octave or more, usually rotates through the low and high impedances, roughly producing a circle centered at 50 ohms, as viewed on a Smith Chart. So, a given mixer having L-VSWR of 2:1 over an octave bandwidth will have an input impedance varying from 25 ohms to 100 ohms, passing through an infinite number of complex impedance combinations as the LO frequency changes.

R, L, and I VSWRs are direct functions of LO power, which establishes the operating point of the diodes. Changing the LO power alters the diode operating point, resulting in a different impedance for all mixer ports, causing a corresponding change in VSWR. RF input power, which is at least 20 dB lower than LO input power, does not appreciably alter the diode bias point and, consequently, has little affect on VSWR. When the diode impedance changes, the input impedances of all three ports change. Hence, varying the LO power level will affect the VSWR of all three ports.

One mark of a good mixer design is that its VSWRs are optimized for the LO power that is in the middle of the normal operating power range of the mixer diodes used. This allows for good VSWRs over the maximum range of LO power levels. When designing a mixer, the L-VSWR is first optimized by adjusting the L-port circuit, allowing the LO power to properly bias the diodes and set the R- and I-port VSWRs. Then, the R- and I-port circuits are adjusted to properly match the diodes to the RF input and IF output loads.

Isolation

Interport isolation is the measure of insertion loss between any two mixer ports. It is measured in dB and usually specified over a given bandwidth as a function of LO drive and temperature. Maximizing isolation between ports in mixers is necessary because unwanted signal feedthrough wastes RF power and can obscure the desired IF output, as well as cause electromagnetic interference. Normally, only the isolation between L and R, and L and I ports is specified, because the LO input power, after leaking through the mixer, is comparable to the output IF power, whereas the RF input power usually is not. For instance, if the RF input power is -10 dBm and the R-to-I isolation is 20 dB (both are typical numbers), -30 dBm of RF power leaks out the I-port. If SSB conversion loss is 6 dB, the desired IF signal level is -16 dBm, which is 14 dB higher in power than the undesired RF feedthrough signal, also exiting the I-port. Such a relative power difference is usually sufficient. If LO power is +20 dBm and L-to-I isolation is 30 dB, -10 dBm of LO power leaks out the I-port, which is 6 dB higher in power than the -16 dBm IF product. If the LO frequency falls inside the IF band, this feedthrough can seriously obscure the desired IF output product. Hence, L-to-I isolation is more important to specify than R-to-I isolation. R-to-I isolation is specified only when the relative power level of RF feedthrough and IF output power is critical, and only for mixers having broadband IF outputs, thus allowing the frequency of the RF feedthrough power to fall in the IF band.

If the LO input power is +20 dBm and the L-to-R isolation is 30 dB, -10 dBm of LO power leaks out the R-port to become incident at the amplifier or antenna feeding the R-port. When the R-port has no buffer between it and the receiving antenna, LO feedthrough power can radiate out the receiving antenna. Hence, L-to-R and L-to-I isolations are most important, and normally the only ones specified. Various factors such as diode match and circuit balance influence isolation in mixers, and will be explored in detail later.

Dynamic Range

Dynamic range is measured in dB and is the input RF power range over which the mixer is useful. The lower limit of dynamic range is the noise floor, which depends on the mixer and system. The upper limit of dynamic range is generally taken to be the mixer 1-dB compression point. This is measured in dBm, and is the input RF power level at which conversion loss increases by 1 dB. Other definitions of dynamic range have been specified [2]. Beginning at the low end of the dynamic range, just enough input RF power is fed into the mixer to cause the IF signal to be barely discernable above the noise. Increasing the RF input power causes the IF output power to increase dB-for-dB of input power, continuing until the RF input power increases to a level at which the IF output power no longer increases dB-for-dB, but instead begins to roll off, causing an increase in conversion loss. The input power level at which the conversion loss increases by 1 dB is the 1-dB compression point.

The 1-dB compression point is generally taken to be the top of the dynamic range because the input RF power that is not converted into desired IF output power, is instead converted into heat and higher-order intermodulation products. The intermodulation products that begin to appear when RF power is increased beyond the 1-dB compression point can begin to obscure the desired IF output. Generally, the 1-dB compression point is 5-to-10 dB lower than the LO input power, so a high-level mixer has a higher 1-dB compression point than a low-level mixer and, hence, a wider dynamic range. Table 1 shows the LO power levels generally associated with very high-, high-, medium- and low-level mixers. These power levels apply specifically to mixers using Schottky barrier diodes, but can also be applied in a more general way to mixers using other devices. The type and number of Schottky barrier diodes and resistor elements that may be used determine the level of LO input power.

Level	LO Power Range (dBm)
Very High	+27 to +15
High	+20 to +13
Medium	+13 to +10
Low	+10 to +6

Table 1. Mixer LO power levels.

Intermodulation Products

Intermodulation (IM) products are undesirable mixer-generated output products exiting the mixer from any port. Two types exist: single-tone and multiple-tone. Intermodulation products are composed of a single input RF signal mixing with the LO, and have the following frequencies:

$$f = \pm m\, f_R \pm n\, f_L \qquad (1)$$

where,

$$m = 1, 2, 3, \ldots$$
$$n = 1, 2, 3, \ldots$$

Multiple-tone intermodulation products are composed of two or more input RF signals mixing with the LO, and have the following frequencies:

$$f = (\pm m_1 f_{R_1} \pm m_2 f_{R_2} \pm m_3 f_{R_3} \ldots) \pm n\, f_L \qquad (2)$$

where,

$$m_1, m_2, m_3, \ldots = 0, 1, 2, 3, \ldots$$
$$n = 0, 1, 2, 3, \ldots$$

Multiple-tone intermodulation products for which all but one of the coefficients, m, are zero, resemble single-tone intermodulation products because their frequencies contain harmonics of the LO and harmonics of the one RF input that has the non-zero coefficient, m. Hence, single-tone intermodulation products can be present when multiple-input RF signals are incident at the R-port, because output products can be generated that have frequencies in the form of Equation (1). The level of output power of individual intermodulation products is very much affected by input LO and RF power levels and frequencies.

Charts exist that show trends in intermodulation suppression as a function of input power and frequency. Figure 2 is a single-tone intermodulation chart showing the power level of various intermodulation products relative to the IF output power. Intermodulation charts are not generally tabulated for multiple-tone intermodulation products because each coefficient (m_1, m_2, m_3, ... and n) requires its own axis on the chart, whereas charts for single-tone intermodulation products require only two axes for m and n. Each box in an intermodulation chart represents one of the infinite integral harmonic combinations of f_R and f_L. Each box in this particular chart contains two rows that each have three values of intermodulation signal suppression. In each row, the first value is for a Class 1 mixer (WJ-M1) having +7 dBm of LO drive; the second value is for a Class 2 mixer (WJ-M9BC) having +17 dBm of LO drive; and the third value is for a Class 3 mixer (WJ-M9E) having +27 dBm of LO drive. These classes of mixers are discussed more fully later in this *Tech-notes* series. The top row in each box gives intermodulation suppression for RF input power of 0 dBm; the bottom row gives intermodulation suppression for RF input power of -10 dBm.

Harmonics of f_R	Harmonics of f_L: 0			1			2			3			4			5		
7	79	>99	>99	69	79	>99	80	>99	>99	74	78	>99	83	>99	>99	63	78	>99
	>90	>90	>90	>90	>90	>90	>90	>90	>90	>90	>90	>90	>90	>90	>90	87	>90	>90
6	90	>99	>99	86	>99	>99	91	>99	>99	91	>99	97	90	>99	>99	84	>99	>99
	>90	>90	>90	>90	>90	>90	>90	>90	>90	>90	>90	>90	>90	>90	>90	>90	>90	>90
5	72	93	>99	70	73	96	71	87	>99	52	72	95	77	88	>99	46	66	>99
	>90	>90	>90	80	>90	>90	>90	>90	>90	71	>90	>90	>90	>90	>90	68	>90	>90
4	80	96	83	79	80	91	82	96	>99	77	80	92	82	95	90	76	82	95
	86	>90	>90	>90	>90	>90	86	>90	>90	88	>90	>90	88	>90	>90	85	>90	>90
3	51	63	81	49	58	73	53	65	85	51	60	69	55	65	85	48	55	68
	67	87	>90	64	77	>90	69	87	>90	50	78	>90	77	>90	>90	47	75	>90
2	69	68	64	72	67	71	79	76	62	67	67	70	76	80	63	66	66	70
	73	86	73	73	75	83	74	84	75	70	75	79	71	86	80	64	74	80
1	25	25	24	0	0	0	39	39	35	13	11	11	45	50	42	22	16	19
	24	23	24	0	0	0	35	39	34	13	11	11	40	46	42	24	14	18
0				36	39	29	45	42	20	52	46	32	63	58	24	45	37	29
				26	27	18	35	[illegible]	10	39	36	23	50	47	14	41	36	19

Figure 2. Example of an intermodulation chart showing the power level of various intermodulation products relative to the IF output power.

Notice that the even-by-even intermodulation signals for which both m and n are even, are suppressed more than the odd-by-odd products. This is due to the circuit balance in double-balanced mixers. If diode match and mixer balance were perfect, only the odd-by-odd products would exit the I-port, and all other products would show infinite suppression on the chart. Notice also that the two bottom rows for m = 0 implicitly give L-to-I isolation for various harmonics of f_L, calculated as follows:

L-to-I isolation (dB) =
[LO drive level (dBm)
- RF drive level (dBm)]
+ [SSB conversion loss (dB)]
+ [Suppression from Chart (dBc)]

For example, for the Class 1 mixer with +7 dBm of LO drive, -10 dBm of RF drive and 6 dB of conversion loss, L-to-I isolation is:

$$\text{L-to-I isolation} = (+7 + 10) + 6 + 26 = 49 \text{ dB}$$

L-to-I isolation determined this way takes into account RF input power as well as that of the LO, and so may yield different results than the guaranteed L-to-I isolation specification, which is normally measured without any RF input power.

Intermodulation charts for a particular mixer reveal much about how it handles various input power levels. However, since intermodulation suppression is a function of many parameters, such as diode manufacturer and production lot, and mixer assembly and test, intermodulation charts should only be used to evaluate trends in intermodulation suppression, and not to specify it concretely. A more in-depth discussion of this particular chart is given in the reference literature [3].

Intercept Point

Intercept point, measured in dBm, is a figure of merit for intermodulation product suppression. A high intercept point is desirable. Two types are commonly specified: input and output intercept point (IIP and OIP, respectively). Input intercept point is the level of input RF power at which the output power levels of the undesired intermodulation products and IF products would be equal; that is, intercept each other if the mixer did not compress. This output power level is the output intercept point, and equals the input intercept point minus conversion loss. As input RF power increases, the mixer compresses before the power level of the intermodulation products can increase to equal the IF output power. So, input and output intercept points are theoretical and are calculated by extrapolating the output power of the intermodulation and IF products past the 1-dB compression point until they equal each other. A high intercept point is desirable because it means the mixer can handle more input RF power before causing undesired products to rival the desired IF output product, and essentially means the mixer has a greater dynamic range. Dynamic range, 1-dB compression point, and intercept point are all interrelated, but Cheadle has shown that, in general, no dB-for-dB rule of thumb exists to easily correlate 1-dB compression point with intercept point [3].

The concept of intercept point can be applied to any intermodulation product; however, it normally refers to two-tone, third-order intermodulation products. If two input RF signals are incident at the mixer R-port, they cause the mixer to generate the following two-tone intermodulation products:

$$(\pm m_1 f_{R_1} \pm m_2 f_{R_2}) \pm n f_L$$

where, m_1, m_2, n = 0, 1, 2, 3, . . ., m and n are integers and can assume any value.

Two-tone, third-order intermodulation products have the following frequencies:

$$(\pm 2f_{R_1} \pm f_{R_2}) \pm f_L$$
and
$$(\pm f_{R_1} \pm 2f_{R_2}) \pm f_L$$

They are called third-order products because the coefficients of f_{R_1} and f_{R_2} sum to equal 3. Notice that the order of intermodulation products refers only to coefficients of the RF inputs and does not include that of the LO. The order of the intermodulation product is important because a 1-dB change in the power level of each input RF signal causes the power level of each intermodulation product to change by an amount of dB equal to its order. A 1-dB change in power of each of the two input RF signals causes the power level of each two-tone, third-order product to change by 3 dB.

Input intercept point is normally associated with two-tone, third-order intermodulation products because the third-order product is closest in frequency to the desired IF output product of any two-tone intermodulation product. The even-order, two-tone intermodulation products that exit from double- and single-balanced mixers are suppressed far more than the odd-order products, due to mixer balance. Odd-order intermodulation products containing even-order LO harmonics are suppressed in double-, but not in single-balanced mixers. Third-order two-tone products follow the $(m_1 + m_2)$ dB of output power to 1-dB-of-input-power rule much more closely than the other higher-order, two-tone intermodulation products. Two-tone intermodulation products with orders greater than 7 are rarely a problem unless RF input power comes within a few dB of LO input power.

To illustrate the use and importance of intercept point, consider Figure 3, which shows two input RF signals, two output IF signals, and two output two-tone intermodulation products, given the following input frequencies: f_{R_1} = 410 MHz, f_{R_2} = 400 MHz and f_L = 100 MHz. Assume the desired received signal is f_{R_1}, and that f_{R_2} is an unwanted input signal. Desired signal f_{R_1} mixes with f_L to yield 310 MHz and 510 MHz outputs, and f_{R_2} mixes with f_L to yield 300 and 500 MHz outputs. Signals f_{R_1} and f_{R_2} combine to intermodulate with the LO to produce outputs at 320 MHz, 520 MHz, 290 MHz and 490 MHz. Higher-order single- and multiple-tone intermodulation products are also produced. Changing input power levels of f_{R_1} and f_{R_2} affects the output power levels of the IF and intermodulation products differently. Initially, both f_{R_1} and f_{R_2} have -10 dBm of input power, causing IF products to have -16 dBm of output power, assuming SSB conversion loss for this mixer is 6 dB. This input power level of -10 dBm causes third-order products for this particular mixer to have -62 dBm of power, which is 46 dBc; i.e., 46 dB down from the IF products. As input power for both f_{R_1} and f_{R_2} increases by 20 dB to become +10 dBm, the power level of both IF products increases by 20 dB to become +4 dBm.

The two, third-order intermodulation products, however, have increased by 60 dB to have -2 dBm of power, giving a smaller intermodulation suppression of only 6 dBc, as compared to 46 dBc when RF input powers were both -10 dBm. This highlights a key point: to specify intermodulation suppression, both the suppression (in dBc) and the input RF power levels must be specified because intermodulation suppression varies as a function of input RF power. Further increasing both input power levels by 3 dB brings them up to +13 dBm, causing a 3-dB increase in power for both IF products, bringing them each up to +7 dBm. This 3-dB increase in RF input power causes a 9-dB increase in output power for the intermodulation products, bringing them up to +7 dBm also. The IF and intermodulation power levels are equal here, so +7 dBm is the output intercept point, and +13 dBm is the input intercept point, because this is the power level of both input RF tones that would cause IF and intermodulation products to have the same output power if the mixer did not compress.

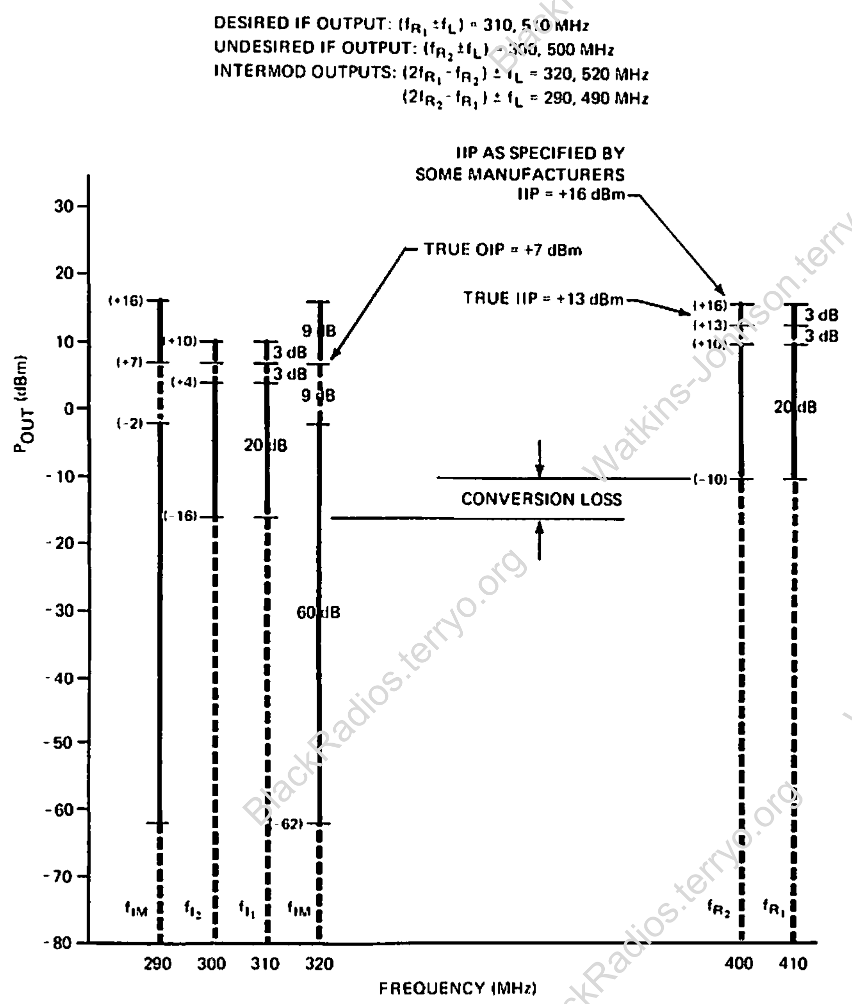


Figure 3. Relative power levels of input RF, output IF, and output intermodulation products as a function of frequency.

Intercept point is normally presented as shown in Figure 4. Input power is plotted along the horizontal axis, and output power is plotted along the vertical axis. Two lines are plotted: one relating IF output power to RF input power, and another relating intermodulation output power to RF input power. Two points on each line are required to plot them. Recall that for -10 dBm of input RF power, the IF output power is -16 dBm, and intermodulation output power is -62 dBm. So, (-10, -16) is the first point for the IF line, and (-10, -62) is the first point for the intermodulation line. Also, recall that +10 dBm of input power causes the IF output power to be +4 dBm and intermodulation output power to be -2 dBm. So, (10, 4) is the second point on the IF line, and (10, -2) is the second point on the intermodulation line. The two lines can now be drawn. The point at which they intersect gives the input and output intercept points for the mixer at a particular set of input frequencies for a given LO power level and temperature.

The reason why so much effort is spent extrapolating out the intercept point instead of simply specifying the desired suppression and input RF power levels is that intercept point assumes intermodulation suppression to be zero dBc. This means that only one piece of information needs to be transferred between system designer and mixer manufacturer; namely, the input RF power level at which intermodulation suppression would be zero dBc, which is the input intercept point. So, instead of needing to specify two numbers, only one is necessary. This is the reason for using the intercept method.

A simple formula exists for calculating input intercept point, given the level of intermodulation suppression, the order of the intermodulation, and the input RF power levels giving rise to this level of suppression.

$$\text{IIP} = \frac{\left[\begin{array}{c}\text{Intermodulation}\\ \text{Suppression (dBc)}\end{array}\right]}{(\text{order} - 1)} + \left[\text{input RF power (dBm)}\right]$$

For example, when each input tone has −10 dBm of power, the third-order, two-tone intermodulation suppression is 46 dBc. This gives:

$$\text{IIP (dBm)} = \frac{46}{3-1} + (-10 \text{ dBm}) = +13 \text{ dBm}$$

This agrees with the +13 dBm IIP determined graphically.

Also, output and input intercept are related by the mixer conversion loss or gain (for active mixers):

$$\text{OIP (dBm)} = \text{IIP (dBm)} \begin{cases} - \text{ mixer conversion loss (dB)} \\ \text{or} \\ + \text{ mixer conversion gain (dB)} \end{cases}$$

Two more details need to be mentioned about intercept point. The first is that when determining intercept point, input RF power for each tone should be no greater than −20 dBm for Class 1 mixers, −10 dBm for Class 2 mixers, and 0 dBm for Class 3 mixers [3].

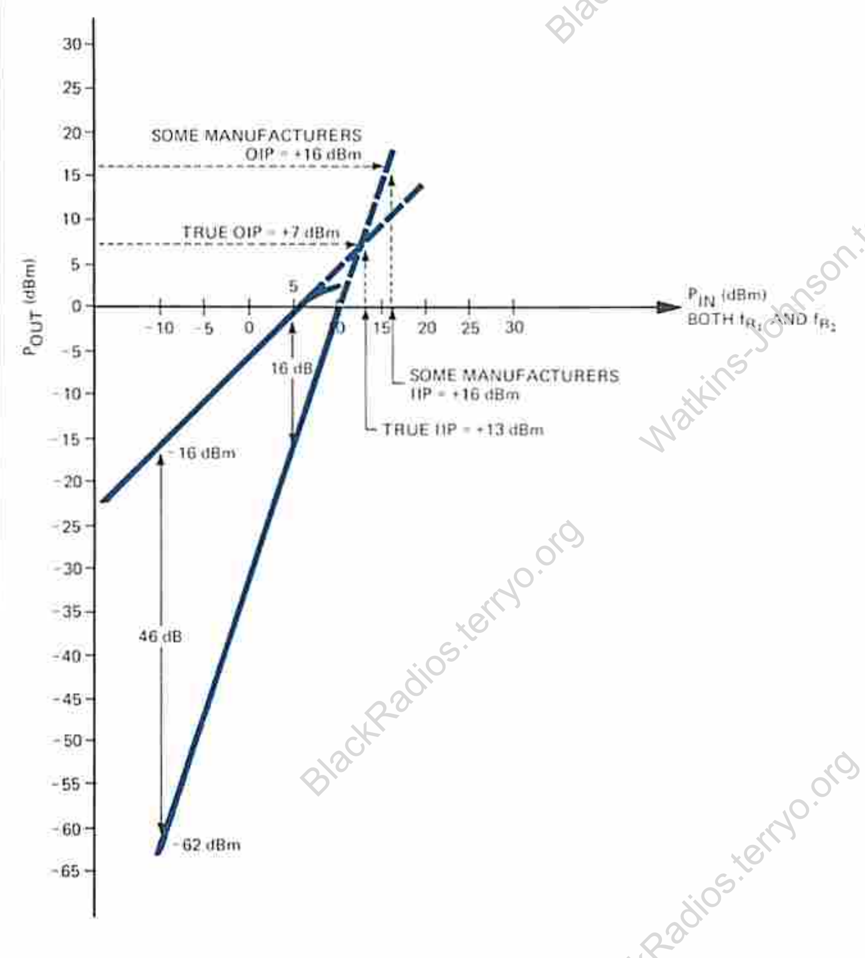


Figure 4. Output power of IF and intermodulation products as a function of input RF power.

If these RF input powers are exceeded, intermodulation output power as a function of input RF power deviates from the $(m_1 + m_2 + \ldots)$ dB output power to 1-dB-input-power rule, causing the wrong intercept point to be extrapolated. Secondly, one confusing aspect connected to intercept point is the way in which it is specified by different manufacturers. While most manufacturers specify intercept point as explained in this discussion, some manufacturers, in order to be able to publish a seemingly high value for the intercept point of their mixers, have a different interpretation. Their technique is to specify input intercept point as the power level at which the input RF and output intermodulation power levels are equal. Figures 3 and 4 show that if the input RF power level is increased from +13 dBm to +16 dBm, the power level of the intermodulation products theoretically increases 9 dB, to become +16 dBm also. Some mixer manufacturers would specify +16 dBm as the input intercept point for this mixer, allowing the customer to think he is buying a better mixer than an identical one specified correctly at +13 dBm. This method generates a value for input intercept point that is higher by half the mixer conversion loss than the true input intercept point. It also generates values for input and output intercept points that are equal.

When specifying intercept point for a mixer, it is advisable to:

1. Distinguish between input and output intercept point.
2. Specify the order of the intermodulation product, and number of input tones it has.
3. When measuring two-tone, third-order intercept point, keep both RF input power levels no greater than:
   (a) −20 dBm for a Class 1 mixer
   (b) −10 dBm for a Class 2 mixer
   (c) 0 dBm for a Class 3 mixer
4. Check that input IP and output IP are not equal; if they are, the input IP value given is misleadingly higher than the correct one by half the mixer conversion loss.
5. Specify individual test frequencies instead of a test bandwidth, and specify all input power levels because intercept point changes as a function of frequency and input power.

SSB Noise Figure

Mixer SSB noise figure is measured in dB, and is the amount of noise added by the mixer to the converted signal plus the SSB conversion loss. Noise figure is the difference in dB between the input RF signal-to-noise ratio and the output IF signal-to-noise ratio (IF power out includes either the up- or down-converted IF product).

$$\text{SSB NF (dB)} = 10 \log \left[\frac{\text{RF PWR In}}{\text{Noise PWR In}}\right] \qquad (3)$$

$$- 10 \log \left[\frac{\text{IF PWR Out}}{\text{Noise PWR Out}}\right]$$

$$= [\text{RF Power In (dBm)} - \text{IF Power Out (dBm)}] + [\text{Noise Power Out (dBm)} - \text{Noise Power In (dBm)}]$$

$$\text{SSB NF (dB)} = [\text{SSB Conversion Loss (dB)}] + [\text{Output-to-Input Noise Ratio (dB)}] \qquad (4)$$

Like SSB conversion loss, SSB noise figure is normally specified instead of DSB (Double Sideband) noise figure, because the mixing process produces both up- and down-converted IF products, and normally only one of these products is desired, so the other product is discarded. This causes half the input power to be lost, making the SSB noise figure 3 dB higher than the DSB noise figure. This is why IF output power in Equation (3) includes either the up- or down-converted IF product, and not both. Simply adding 3 dB to the DSB noise figure assumes that the mixer generates both sidebands with equal conversion loss. This assumption is routinely made in specifying mixer SSB noise figure because DSB noise figure is sometimes easier to measure.

Additive noise has three main components: Johnson (thermal), shot, and flicker noise. Johnson noise is generated by Brownian motion of electrons in the series bulk resistance of the diode, causing random voltage fluctuations to appear across it. As diode temperature increases, the electrons move faster and over a longer distance, increasing the amplitude of the noise power generated. Another source of noise is the shot effect. This noise contribution is generated by random fluctuations in diode current. Both shot and thermal noise are generated randomly, and produce relatively constant noise power (white noise) over a given bandwidth. When calculating the amount of noise added by these two sources, it is important to specify the bandwidth over which the noise power is measured, since the noise power is proportional to bandwidth. Flicker noise is also generated in diodes. Its rms power is proportional to 1/frequency, so it becomes appreciable at lower frequencies. All W-J mixer diodes are normally sorted for noise figure in the GHz frequency range to determine the amount of shot and thermal noise they generate. When diodes are operated at much below 400 kHz, flicker noise may become a problem. Diodes for the WJ-M1K, WJ-M40, and other mixers are sorted for flicker noise. Thermal, shot, and flicker noise are always generated, and combine with SSB conversion loss to yield the overall mixer SSB noise figure. The SSB noise figure is usually about 0.5 dB higher than SSB conversion loss.

This discussion has presented the basics of mixer characteristics and performance. Part 2 of this *Tech-notes* series will go on to discuss mixer theory.

Mixers: Part 2 Theory and Technology

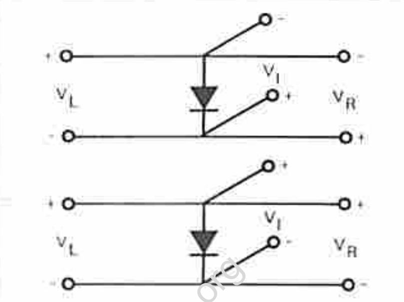


Figure 2. Single-balanced mixer is composed of two single-ended mixers.

Author: Bert C. Henderson

This article presents the practical aspects of mixer theory and technology. It discusses mixer circuits, the mixing process, baluns, diodes, and one W-J mixer design. An understanding of the material in parts 1 and 2 of this *Tech-notes* series will provide the foundation necessary to discuss and specify mixers.

Mixer Circuits

There are basically four types of mixer circuits: single-ended (SE), single-balanced (SB), double-balanced (DB), and double double-balanced (DDB). Each has its own set of performance tradeoffs that must be considered to optimize system performance.

Single-ended mixers are the simplest type, since they use only one diode. Figure 1 shows that the L-, R- and I-ports are electrically the same, being only separated by filters that provide interport isolation. The bandwidths of the filters must not overlap if high isolation is required. Part 1 of this *Tech-notes* series outlined some of the important benefits of having good interport isolation. In addition, good isolation in SE mixers forces the LO and input RF currents into the diode, and the IF current out the I-port. All the possible intermodulation products $f_{I_{m,n}}$ exit the I-port of SE mixers.

$$f_{I_{m,n}} = \pm m f_R \pm n f_L \qquad (1)$$

$$m,n = 0, 1, 2, 3, \ldots$$

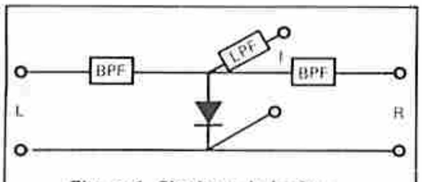


Figure 1. Single-ended mixer.

Coefficients m and n are integers and can assume any value. SE mixers can operate with very low LO power because only one diode is used. This is beneficial in systems that can deliver only a small LO power level. Low LO power, however, also means a small dynamic range because the 1-dB compression point, which is usually taken to be the top of the dynamic range, is typically 5 to 10 dB below the LO power level. If a greater dynamic range is required, two or more diodes can be placed in series to allow for more LO power. Other solutions for allowing more LO power to bias the diode are presented later in the section on Classes of Mixers. If the system is narrow-band and does not require great dynamic range, good IM suppression, and high isolation, an SE mixer may be the best choice, since it can be very inexpensive if the filter arrangements are simple. However, if a more broadband mixer that has better IM suppression is required, a balanced mixer is the better choice.

Single-balanced mixers are composed of two single-ended mixers (see Figure 2). Figure 3 shows two of the forms that SB mixers can take. The L-port balun balances the diodes and interfaces them with the unbalanced LO input. The most important characteristic about a balun is its ability to maintain phase angles with respect to ground, of ±90° at B, ∓90° at D, and 0° at C (if it has a center tap). When these angles are maintained, the balun is said to be well-balanced. Insertion loss, and output-to-input impedance ratios of baluns are also important. Many versions exist, some of which are discussed later.

Single-balanced mixers have good L-to-I and L-to-R isolation due to the balance of the balun and diode match. If the i-v (current-voltage) curves match with each other, and the parasitic reactances of all the diodes match, the diodes form a voltage divider, causing a *virtual ground* to appear at the junction between D1 and D2 in Figure 3. A virtual ground is a node having a 0° phase angle with respect to ground. The effect of the virtual ground is to null out the LO voltage to keep it from appearing at the R- and I-ports, thus isolating the L-port from the R- and I-ports. This is a broadband means of causing isolation, because balun balance and diode match are inherently less susceptible to frequency change than are filters. Actual baluns are never perfectly balanced, and actual diodes are never perfectly matched, so a finite amount of LO power becomes incident at the R- and I-port filters.

RF current in Figure 3 flows from cathode to anode in D2. A forward biased diode can be modeled as a switch that is either open or closed: a closed switch allows current flow in both directions. If the RF current through D2 is much smaller than the LO current biasing it on, D2 will appear to the RF current as a closed switch. The small-signal RF current flowing in D2 cancels a small part of the large-signal LO current, shifting the average operating point of D2 to a lower voltage. Similarly, the RF current flowing in D1 adds to the LO current, causing the average operating point of D1 to have a higher voltage. This is illustrated in Figure 4. If the RF and LO amplitudes are different by less than about 10 dB, alternate cycles of the RF signal cause one diode to almost completely bias off, and the other diode to bias on even harder, causing the mixer to become unbalanced, degrading isolation and IM suppression. Conversion loss degrades as well because the IF and RF current

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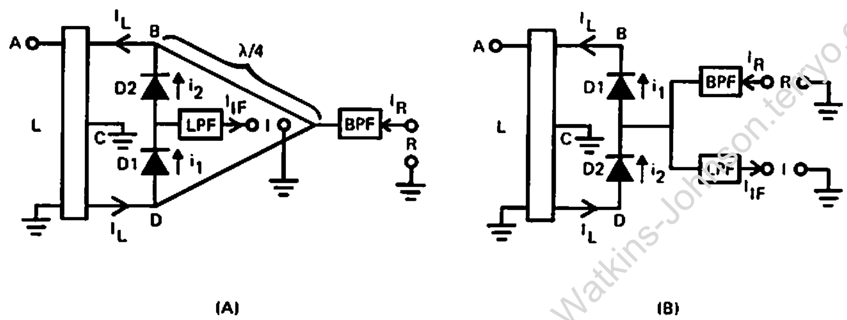

Figure 3. Two versions of a single-balanced mixer.

paths have higher time-averaged impedances due to the diodes biasing off on alternate RF cycles. Also, the diodes are forced to operate in the very nonlinear region of their i-v curve, increasing the potential for two-tone IM products to appear, should a second RF signal be incident at the R-port. R-to-L isolation in SB mixers is caused by the RF currents from D1 and D2 cancelling each other in the L-port balun. Recall that SB mixers also have good L-to-R isolation due to mixer balance. In general, such reciprocity (good L-to-R isolation and good R-to-L isolation) holds for interport isolation caused by mixer balance, but not necessarily for isolation resulting from filters, as R-to-I and I-to-R isolation is in SB mixers. Removal of the R-port filter degrades I-to-R isolation without affecting R-to-I isolation, because the I-port filter keeps RF current from exiting through the I-port.

Besides having better L-to-R and L-to-I isolation than SE mixers, SB mixers have better IM suppression. Half the possible IM products exiting the I-port are suppressed because those with even harmonics of the RF are cancelled due to circuit balance and diode match. Of course, cancellation is never perfect, so IM products with even harmonics of f_R do appear, but they are suppressed.

Single-balanced mixers have twice as many diodes as SE mixers, so they require more LO power. More diodes allow SB mixers to have better IM suppression and isolation than SE mixers with the same amount of input RF power, because the RF voltage is dispersed across two diodes instead of one, thus causing half the deviation from average diode operating point than that of an SE mixer.

If the system requires suppression of IM products with even harmonics of f_R, high L-to-R and L-to-I isolation over a broad bandwidth, and non-overlapping R- and I-port bandwidths, an SB mixer is a better choice than an SE mixer. If the filter arrangements are simple, and the diodes are inexpensive, an SB mixer can be very cost effective.

Double-balanced mixers are composed of two SB mixers. Figures 5 and 6 show that combining two SB mixers results in either a ring or a star (cross) DB mixer, depending on which type of SB mixers are used. DB mixers are so termed because they use two baluns, whereas SB mixers use only one. L-to-R and L-to-I isolation in DB mixers is achieved in the same way as it is in SB mixers, except that the R-port balun causes the LO-generated voltage appearing at the R-port to equal the difference between the small voltages appearing at junctions J_1 and J_2 in Figure 5. Ideally, these small LO-generated voltages are nulled out as virtual grounds, but non-idealities in balun balance and diode match allow them to appear. The LO-generated voltage appearing at the I-port is the sum of the small voltages at J_1 and J_2.

The I-port could be placed at the current return of the L-port balun instead of at the R-port balun (as shown in Figure 5), but L-to-I isolation would degrade for such reasons as: diode match is not used to help isolate the L- and I-ports; the L-port is not balanced as well, due to the loss of its ground return; and the I-port is more susceptible to receiving LO power radiated from the L-port if the two are nearer to each other.

R-to-I isolation in DB mixers is caused by the balance of the R-port balun. In both ring and star DB mixers, the I-port is a virtual ground with respect to the R-port input voltage. This voltage nulling effect is mainly dependent on the balance of the R-port balun in ring mixers, whereas in star mixers, it may also depend on the diode match if the I-port is taken to be the junction of the four diodes (as in Figure 6) and not the center tap of the R-port balun.

Double-balanced mixers theoretically generate only one quarter of the possible IM products; these have odd f_R and odd f_L harmonics. The other IM products are suppressed, the degree of which is a function of balun balance and diode match. Even-by-even IM products which have even f_R and even f_L harmonics are usually suppressed more than even-by-odd, or odd-by-even products.

LO power for DB mixers is typically 3 dB higher than that for SB mixers because DB mixers use twice as many diodes as SB mixers. Hence, the 1-dB compression point of a DB mixer is higher than that of an SB mixer, causing correspondingly greater dynamic range and IM suppression.

Ring DB mixers using soft-dielectric (PTFE) [1] technology (as opposed to thin-film) are generally more popular than star DB mixers using the same technology, because the state-of-the-art with soft-dielectric mixers is to

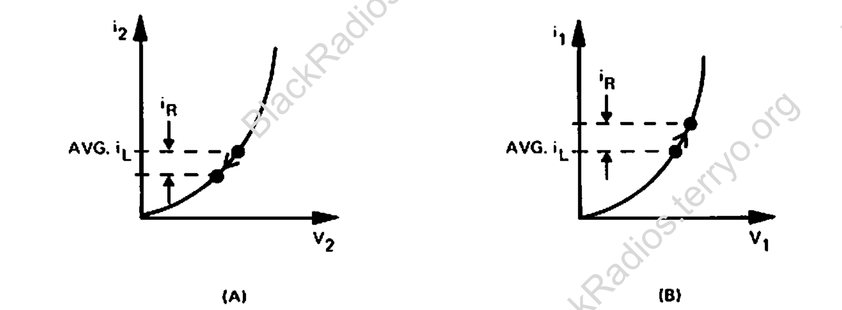

Figure 4. The average operating point of D1 (A) is slightly lowered and of D2 (B) is slightly raised by RF input current i_R.

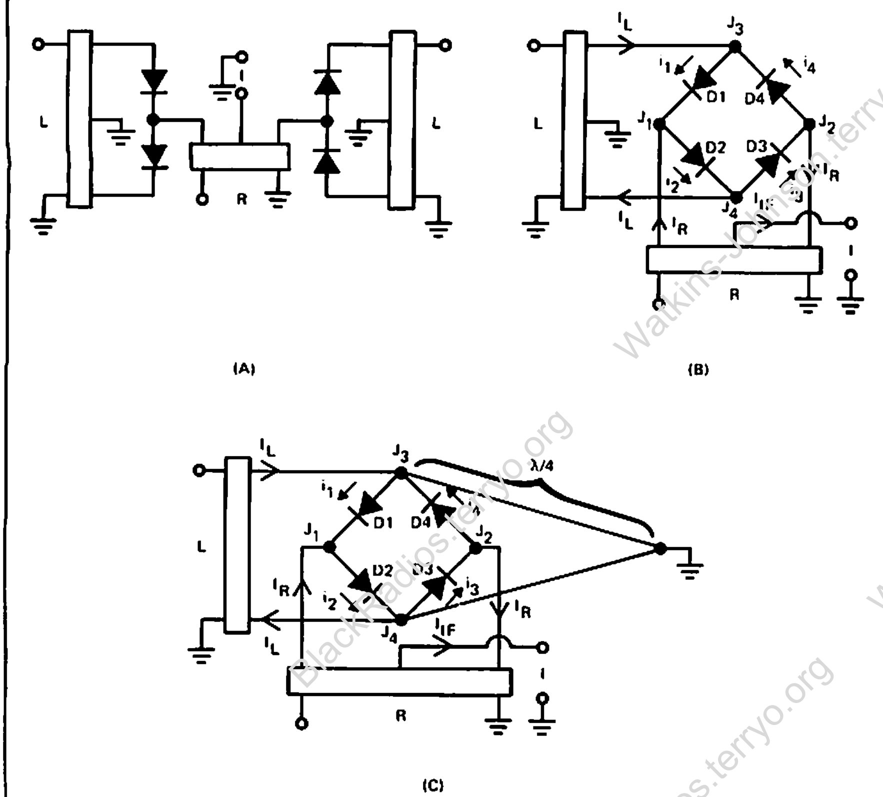

Figure 5. The two versions of a double-balanced mixer in (B) and (C) are formed in (A) by combining the two single-balanced mixers of Figure 3(B).

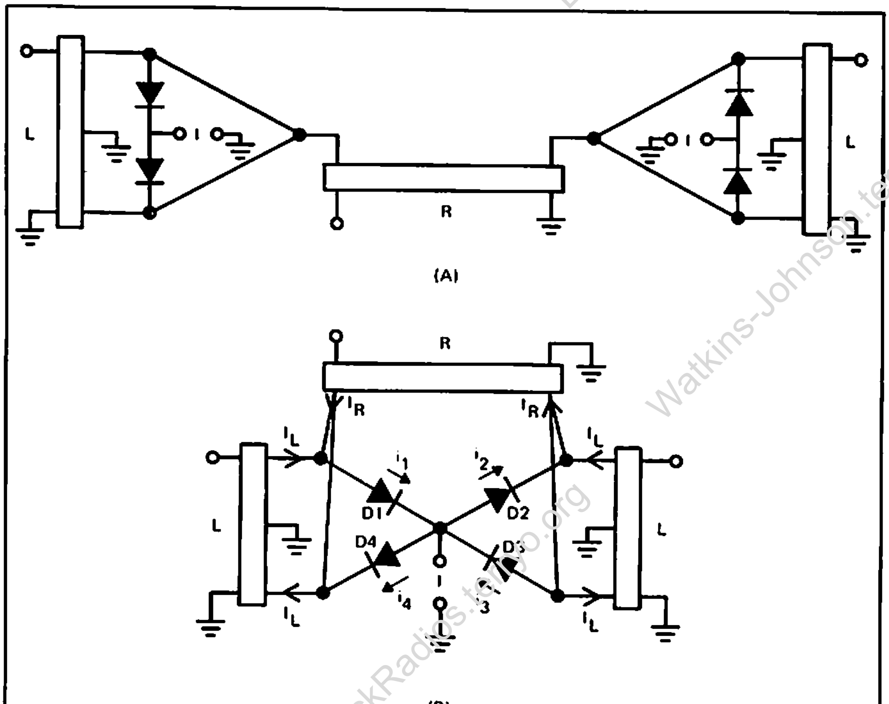

Figure 6. The star double-balanced mixer (B) is formed in (A) by combining the two single-balanced mixers of Figure 3(A).

use a ring quad, which has four Schottky-barrier diodes arranged in a ring. Ring quads have four leads, each of which is bonded to one of the four junctions between diodes. DB star mixers with ring quads use two quads, utilizing only half of each, and, hence, are less cost effective than ring mixers, which fully utilize one quad. Ring quads are quite small, being typically 0.100 to .045 inches square or in diameter [2]. Quads are preferred over individual glass-encapsulated diodes because parasitics in the latter limit the maximum operating frequency to about 5 GHz, whereas ring quads have been successfully operated at frequencies up to 26 GHz at Watkins-Johnson Company, and show promise of going even higher in frequency. Individual beam-lead Schottky-barrier diodes do not have extreme parasitics, as do individual glass-encapsulated diodes.

For most applications, double-balanced mixers, which are the industry standard, are usually by far the best choice over SB and SE mixers. However, an understanding of SB and SE mixers is important because they are the building blocks of which DB mixers are composed. The superior performance of DB mixers over SB mixers almost always far outweighs the minimal increase in price for the two extra diodes and balun. DB mixers have superior IM suppression and dynamic range, as well as low VSWR, low conversion loss, and low noise figure. These characteristics have been achieved over multiple-octave bandwidths.

Ground return paths for RF and IF currents must be present in any mixer. The RF current return in DB mixers exists due to the time-averaged conductance of the diodes, which is mainly controlled by the LO, but also by the input RF if its power level is close to that of the LO. RF current in the mixers of Figure 5 splits: half of it passes through D2 and D3 and half passes through D1 and D4 to complete the RF circuit. The IF currents leave junctions J_3 and J_4 to return to ground through either the L-port balun center tap to ground as in Figure 5B, or through the quarter wave-length lines as in Figure 5C. IF ground return currents usually pass through the mixer case, increasing conversion loss by as much as 1 dB. Triple-balanced mixers, which have a balanced I-port, do not require IF currents to return to ground through the case, eliminating the effect of path losses through the case.

Triple-balanced mixers are so termed because the I-port, as well as the L- and R-ports are balanced as shown in Figure 7. Twice the number of diodes are present in TB mixers as in DB mixers, so more LO power is required, and the RF voltage is dispersed across twice as

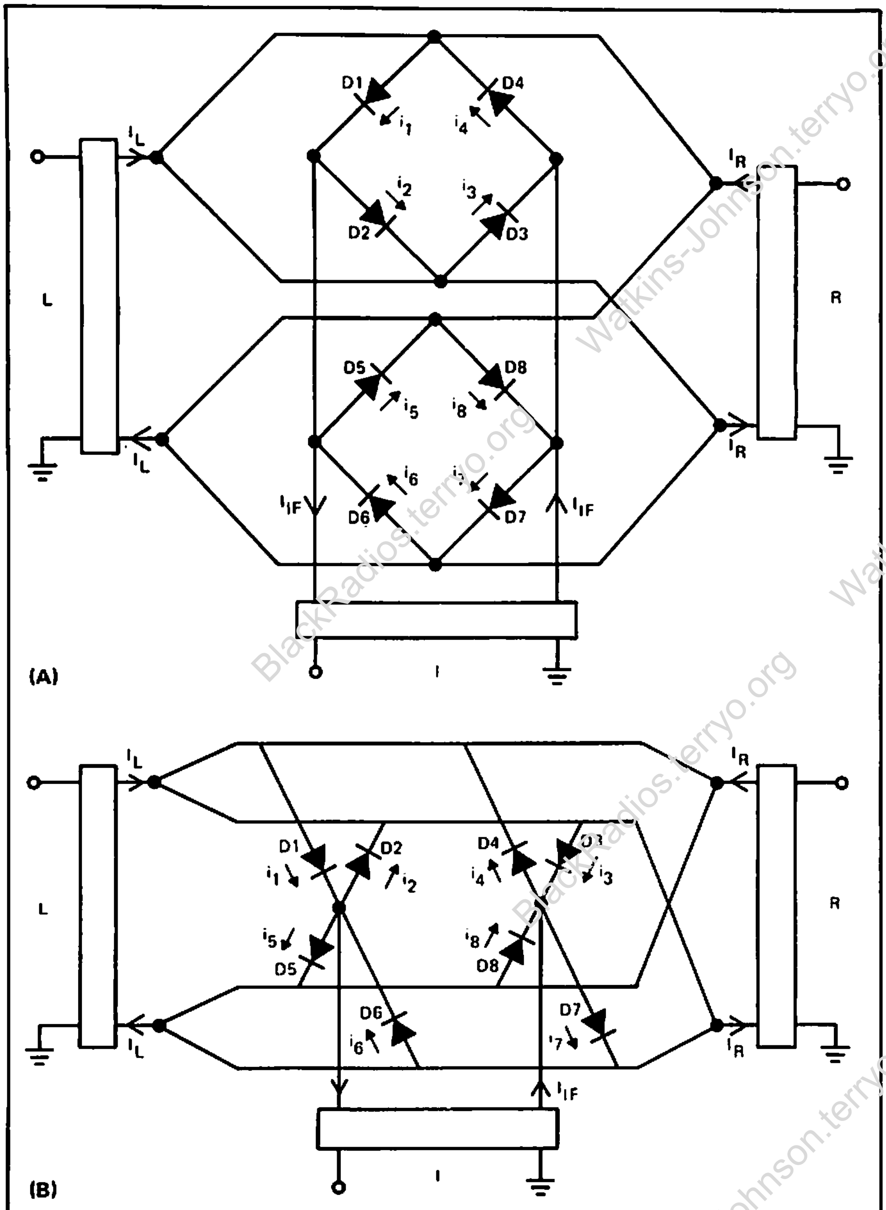

Figure 7. A DDB mixer is formed by combining two ring DB mixers (A) or two star DB mixers (B). (A) and (B) are the same circuit.

many diodes. These factors increase dynamic range and IM suppression. LO power required is typically in the +10 dBm to +13 dBm range for TB mixers with medium-barrier Schottky-barrier diodes, but some TB mixers can handle as much as +24 dBm of LO power, allowing for very high intercept points for both single- and two-tone IM products, much greater dynamic range, and good operation as upconverters because the mixer can handle more input power before compressing. This is significant because amplification is less expensive at the lower frequency before the signal is upconverted.

TB mixers are formed by combining two-star or two-ring DB mixers. A careful study of Figure 7 reveals that these two methods yield identical circuits, suggesting that a duality exists between ring and star DB mixers. They are, in fact, electrically identical.

Triple-balanced mixers usually offer greater dynamic range, better IM suppression and interport isolation, and broader I-port bandwidth than DB mixers. But, the disadvantages are the higher LO power requirement, and greater cost for the extra four diodes and the labor necessary to match eight diodes instead of only four.

Any of the three ports in SB, DB and TB mixers can be the R-, L- or I-port because these mixers are all composed of SE mixers, which have electrically identical L-, R- and I-ports (ignoring filters), which all appear in parallel across the SE diode.

Port selection is largely based on frequency requirements for f_L, f_R and f_I. Essentially, port usage is that which optimizes system performance. This is why even though the R-, L- and I-ports may be designated for a given mixer, the system sometimes performs better with reversed R- and L-ports. Care must be taken, however, when reversing R- and L-ports because L-to-I isolation is typically better than R-to-I isolation in most DB mixers.

The Mixing Process

Mixing can only be caused by devices which have current-voltage relationships that are non-linear or that change as a function of time (time-variant), or both [4]. Switches are time-variant because they form either a short or an open circuit as a function of time. Mixers require very fast switching (at the LO frequency), making mechanical switches impractical. Schottky-barrier diodes are usually used in mixers as switches because of their low noise figure and fast switching speed [5]. Diodes are nonlinear, so both their time-variant and non-linear properties are used to cause mixing.

Because diodes are nonlinear, they cause two or more signals applied simultaneously across them to mix, producing single and multiple-tone IM products. Two voltages applied in series across a diode cause the current through it to contain the IF and higher-order IM products of the two voltage inputs. This is shown by expanding the exponential diode i-v relationship into a power series for a forward biased diode:

$$I_D \cong I_O\, e^{(V_L+V_R)/V_T}$$

$$= I_O \sum_{n=0}^{\infty} \frac{(V_L+V_R)^n}{V_T^n\, n!}$$

where:

V_L and V_R are sinusoidal.

I_O is the reverse bias saturation current.

V_T is the $(q/NKT)^{-1}$ term.

I_D is the diode current.

The n=0 term yields a dc current. The n=1 term yields the fundamentals.

The n=2 term yields the second harmonics of f_L and f_R, plus the up- and down-converted IF products. The n=3 term yields the fundamentals, the third harmonics of f_L and f_R, and the $2f_L \pm f_R$ and $\pm f_L + 2f_R$ intermodulation products. If all n terms were calculated, all the IF and higher-order intermodulation products would show up.

Higher-order intermodulation products are caused by higher values of n, so *they* are severely attenuated by the term,

$$\frac{1}{n!}$$

This agrees with empirical observation, because higher-order IM products are suppressed more than lower-order ones are.

Besides being caused by nonlinear devices, mixing is caused by devices that are time-variant. Switches are time-variant because their two possible states, open or closed, change over time. Figures 8 and 9 illustrate how switching causes LO and RF signals to multiply each other to generate IF and intermodulation products.

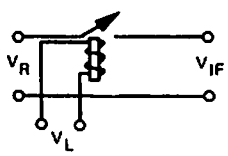

Figure 8. Series switch controlled by V_L, gates V_R to produce V_{IF}.

When V_L is high, V_{IF} equals V_R, and when V_L is low, V_{IF} equals zero. The high and low states of V_L cause the switching waveform of the relay, S_L, to be one and zero, respectively. V_{IF} is the product of S_L and V_R: when V_L is high, $V_{IF} = (1) \cdot (V_R) = V_R$ and when V_L is low, $V_{IF} = (0) \cdot (V_R) = 0$. Since S_L is an odd square wave, it contains the odd harmonics of its base frequency, weighted by their individual Fourier coefficients. V_L and S_L have the same waveform, so their Fourier series are identical; however, their dimensions are different. All the harmonics of f_L in S_L multiply with V_R, generating intermodulation products containing odd harmonics of f_L, as illustrated by the following trigonometric identity:

$$\cos(n\,\omega_L t)\cos(\omega_R t) = \frac{1}{2}[\cos(n\omega_L + \omega_R)t + \cos(n\omega_L - \omega_R)t]$$

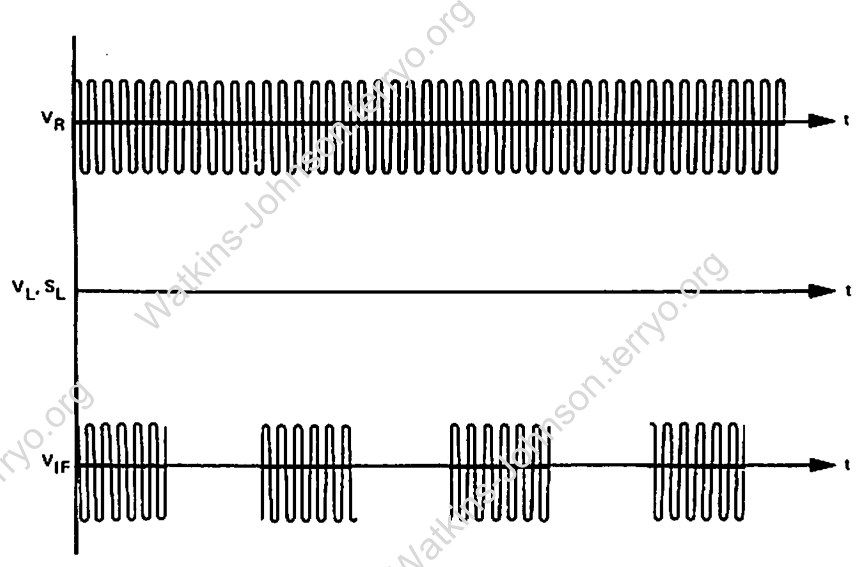

Figure 9. Waveforms of V_R, V_L and V_{IF}.

where,

$$n = 1, 3, 5, 7, \ldots$$

Figure 10 shows a simplified SE mixer, which is the basic building block in balanced mixers. It is identical to Figure 8 in that the large-signal V_L periodically switches the diode on and off to gate V_R, but different in that the diode passes through a very nonlinear conduction region between its fully-on and fully-off states. V_L, which controls diode conductance, G_L (analogous to S_L), causes current I_L to flow through the diode. I_L contains harmonics of f_L due to the diode nonlinearity. G_L equals I_L divided by V_L; hence, G_L also contains harmonics of f_L. These harmonics are especially prevalent in G_L if the level of V_L is high enough to make the

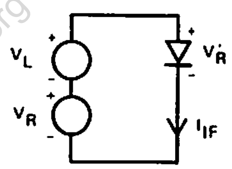

Figure 10. Simplified single-ended mixer.

diode clip, causing I_L to approximate a squarewave. V_R, being a small signal, does not cause the diode to clip; hence, IM products, $\pm mf_R \pm f_L$ are usually suppressed more than $\pm f_R \pm nf_L$, where m and n are integers.

V_R causes current I_R to flow through the diode. I_R contains harmonics of f_R because of diode nonlinearity, and generates V_R' across the diode series bulk and dynamic resistance. Since I_R contains harmonics of f_R, V_R' does also. V_R' and G_L are each expanded into a Fourier series to represent their respective harmonic content, as in equations 2 and 3. Multiplying the two expansions produces a double Fourier series expansion for I_{IF}, as shown in equation 4, that contains all the IM products generated when f_L mixes with f_R [6].

$$G_L = \sum_{n=-\infty}^{\infty} g_n e^{jn\omega_L t} \qquad (2)$$

$$V_R' = \sum_{m=-\infty}^{\infty} v_m e^{jm\omega_R t} \qquad (3)$$

$$I_{IF} = \sum_{n=0}^{\infty} \sum_{m=0}^{\infty} g_n v_m e^{j(\pm n\omega_L \pm m\omega_R)t} \qquad (9)$$

IF power, which is transferred from the mixer to the IF load by current, I_{IF}, contains these IM products.

Multiple-tone IM products result when two or more input RF signals mix with the LO to produce the following frequencies:

$$f_{IM} = (\pm m_1 f_{R_1} \pm m_2 f_{R_2} \pm \ldots) \pm n f_L$$

Coefficients m and n are integers and can assume any value. The IM products, f_{IM}, are generated by two means: diode nonlinearity acting alone, and acting together with the diode-switching property to remix products reflected back into the mixer. The multiple-tone IM products of most interest are the two-tone third-order products, f_{IM_1} and f_{IM_2}. These are generated by the n=4 and n=6 (as well as higher-order) terms of the power series expansion for diode current [7].

$$f_{IM_1} = (\pm 2\, f_{R_1} \pm f_{R_2}) \pm f_L$$

$$f_{IM_2} = (\pm f_{R_1} \pm 2\, f_{R_2}) \pm f_L$$

Two-tone third-order IM products are also generated when the following IM products reflect back into the mixer to remix. This effect can change the intercept-point by as much as 3 dB or so.

Single-Tone

$$f = \pm 2\, f_{R_{1,2}} \pm f_L$$

$$f = \pm f_{R_{1,2}} \pm 2 f_{R_{2,1}}$$

Two-Tone

$$f = \pm f_{R_1} \pm f_{R_2} \pm f_L$$

This method of generating multiple-tone IM products requires poor mismatch at the mixer ports, so its effect can be minimized by properly matching the ports. Operating the diodes in the more linear part of their current-voltage curve by applying relatively high LO power and low input RF power will minimize multiple-tone IM products generated by diode nonlinearity. High-level mixers of the Class-2 and Class-3 variety require more LO power than Class-1 mixers, thus allowing for increased IM suppression.

MIXER CLASS	CIRCUIT	LO POWER FOR DB MIXERS (dBm)
Class 1		+7 to +13
Class 2, Type 1		+13 to +24
Class 2, Type 2		+13 to +24
Class 3, Type 1		+20 to +30
Class 3, Type 2		+20 to +30
Class 3, Type 3		+20 to +30

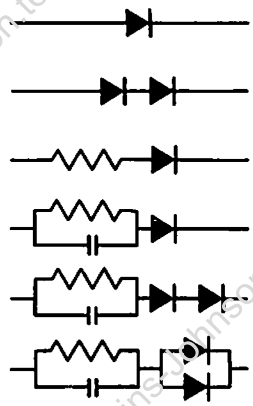

Table 1. The various classes of mixers with their approximate LO power ranges.

Classes of Mixers

Various classes of mixers have been defined that require increased LO power levels and have superior IM suppression [8]. A normal DB mixer which has a single diode in each leg of the ring is a Class 1 mixer. Class 2, type-1 mixers have a second series diode in each leg of the ring, for a total of eight diodes. This type of ring is now available in a small package, similar to ring quads, and is called an octal. Class 2, type-2 mixers have an added series resistor in each leg. Class 3, type-1 mixers have a series diode in series with a shunt RC combination in each leg of the ring. Class 3, type-2 and type-3 mixers are identical to Class 3, type-1 mixers except that they have two series diodes or two shunt diodes, respectively, in place of the single diode in the type-1 mixer. These classes are outlined in Table 1. Class 4 mixers have a network of hybrids that drive two sets of diodes, and two resistors that absorb certain IM products [9].

Adding more elements to the ring allows more input RF power to be applied to the mixer before the average operating points of the diodes in adjacent legs change enough to significantly unbalance the mixer, and also enter the more nonlinear region of the diode i-v curve. Such unbalancing degrades cancellation of IM products with even f_L or f_R harmonics. IM products with odd f_R and odd f_L harmonics theoretically are not affected by mixer balance. When unbalancing occurs, conversion loss increases because power that would otherwise help generate IF products, instead partially contributes to help generate the IM products that begin to appear. This, combined with the higher time-averaged impedance in the IF and RF current paths, and generation of heat, cause conversion compression as input RF power increases.

Class-2 mixers have better IM suppression than Class-1 mixers because input RF voltage is dispersed across twice as many elements. Class-3 mixers, in turn, have better IM suppression than Class-2 mixers because the shunt RC combination self-biases the diode by charging up during the positive LO cycle and discharging slowly enough to keep input RF power from dominating the operating point when LO voltage goes through its zero crossing. Conversion-loss in Class-3 mixers does not significantly increase due to the extra RC combination because the capacitor skirts RF current around the resistor.

Baluns

Balanced mixers are composed of baluns and diodes. The balun balances the diodes and interfaces them with the unbalanced system. It also matches system and diode impedance, and helps provide interport isolation. If the balun is at the L-port, it must provide the IF current return path to ground. Currents in the two balanced leads of a balun are 180° apart in phase and ±90° and ∓90° out of phase with respect to ground.

Baluns are also used for applications other than mixers; in fact, many baluns used in mixers were borrowed from antenna applications [10]. Much has been written about baluns, and many clever versions have been developed [11], [12]. Mixers can be constructed using any type of balun, but certain ones are consistently used in most mixer designs. Most balun circuits can be realized using various technologies such as: waveguide, thin-film and soft-dielectric MIC (microwave integrated circuit), coaxial cable, or bifilar and core. These technologies are generally associated with specific frequency ranges [13]. Generally, MIC and waveguide baluns are used in the 0.5- to 100-GHz frequency range, coaxial and bifilar baluns are used in the dc to 8-GHz frequency range, and bifilar-core baluns are used in the dc to 4-GHz frequency range.

Figure 11 shows a center-tapped transformer which is used in virtually all dc to 4-GHz balanced mixers. Broad-

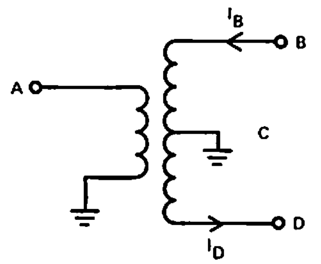

Figure 11. Transformer with a grounded center tap is a balun.

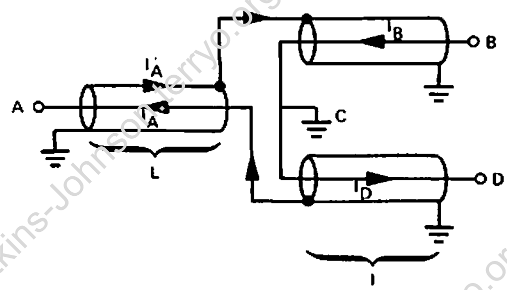

Figure 13. Transmission line balun.

band transformers of this type, having very good balance and various impedance ratios, are realized using bi-, tri- and quad-filar transmission lines wrapped around various shapes and types of ferrite cores [14]. The centertap-to-ground allows for good balance over a fairly broad bandwidth. The frequency dependence of the core permeability limits the bandwidth over which the balun is well balanced because electrical lengths of the windings change as frequency changes, causing a corresponding change in phase. Conversion loss in mixers using these baluns is typically 6.5 dB to 8 dB. Figure 11 is also used to represent baluns, as depicted in most mixer schematics, even though they may be realized completely differently than this figure suggests.

The balun in Figure 12, using a transmission line and quarter-wave line to ground, has been realized using thin-film technology in the so-called coplanar balun of the WJ-M31, and other microwave mixers. When L is a quarter wavelength long, points B and D are ±90° and ∓90°, respectively, out of phase with respect to ground. A fairly broadband balun can be realized by adjusting the lengths of L and the quarter-wave line so that they are a quarter-wave long at different frequencies. The impedance ratio of this balun is 1:1. When this balun is used on the L-port of a DB mixer, the quarter-wave line to ground provides

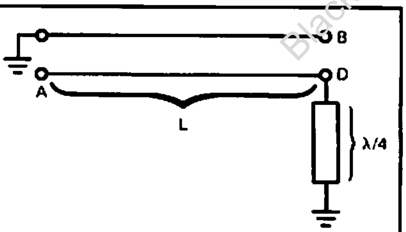

Figure 12. Transmission line with quarter-wave line to ground is a balun.

the ground return path for the IF current.

Another version using transmission lines is shown in Figure 13. It is used in the WJ-M40 and other mixers. Node C is used as the I-port in these mixers.

Figure 14 shows another transmission line balun that uses a *shorting transformer* (l_1 and l_2) to provide the ground return path for IF current. This balun, which is used in the WJ-M1K, and other mixers, is usually realized using two lengths of bifilar: one for L, and one for l_1 and l_2. I_B and I_D do not short to ground through l_1 and l_2 because I_B and I_D force equal currents through l_1 and l_2 that oppose each other if l_1 and l_2 are long, compared to the wavelength in use. When l_1 and l_2 are too short, I_B and I_D *do* short to ground; this limits the low frequency end of the balun bandwidth. The high frequency limit is determined by the series inductance of bifilar L.

Diodes

Almost all mixers currently available use Schottky-barrier diodes to cause mixing. Other devices, such as transistors and FETs, have been used in active mixers [15], [16] that provide conversion gain and high intercept-point; but, these mixers have high NF (noise figure), and are expensive, especially if GaAs FETs are used. Schottky-barrier diodes are relatively inexpensive, have low NF, and can be operated up to millimeter-wave frequencies [3], [5]. They usually require no dc power supply for normal operation because LO power is sufficient to switch them on and off.

The forward-biased properties of Schottky-barrier diodes are controlled by majority carriers, so these diodes can be switched quickly because minority carrier storage effects are not present. When the forward voltage drops to zero, the current stops almost instantly, and the reverse voltage can be established in a few picoseconds [2], [5].

Schottky-barrier quads are made by bonding four diodes arranged in a ring onto a ceramic, fiberglass, or plastic substrate. A monolithic ring quad is preferred over one with individual diodes because the diodes in the monolithic quad match each other and track together over temperature much better than individual diodes. Rings with eight (octal) and twelve (duo-decca) diodes have recently become available for high-level mixer applications.

GaAs Schottky-barrier diodes typically have cutoff frequencies in the 400- to 1000-GHz frequency range, whereas silicon diodes cutoff in the 80- to 200-GHz frequency range. GaAs diodes have higher forward voltage, V_f, resulting in a higher LO power requirement. They are more expensive than silicon diodes and have higher flicker noise. V_f for GaAs diodes with 1 mA of series current is typically .70 volts, compared to .30 volts for a medium-barrier silicon diode.

In order to optimize the noise figure of Schottky-barrier diodes, the following LO power levels should be applied per diode [5]:

Barrier	LO Power Per Diode
High	+3 dBm or more
Medium	−3 dBm to +3 dBm
Low	−3 dBm or less

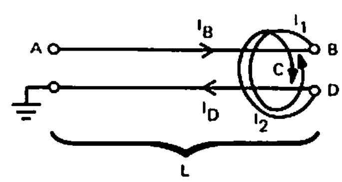

Figure 14. Shorting transformer balun.

The WJ-M1K mixer, which is a field-proven leader with low conversion loss and superior IM suppression, uses the balun in Figure 14 to interface the L-port with the diodes. The R-port balun is the same as that in Figure 13, with the I-port connected to node C. This is a Class 2, type-1 mixer, designed specifically for suppression of IM products.

Analysis of Intermodulation Products

The IM products present in the IF output of an SE mixer are derived by using Equation (4). When SE mixers are combined to form a balanced mixer, some of these IM products are eliminated through cancellation. This is illustrated in the following analyses for SB, DB, and TB mixers. The analysis procedure used assumes diode conductance, G_L, is composed exclusively by harmonics of large-signal V_L; because V_R is a small-signal voltage, its effect on diode conductance can be ignored. It also assumes the diodes are identical, and the baluns are perfectly balanced. Diode currents i_1 and i_2 in the SB mixer of Figure 3A combine to give IF current, I_{IF}.

$$i_1 = \sum_{n=0}^{\infty} \sum_{m=0}^{\infty} v_m g_n e^{j(\pm n \omega_L \pm m \omega_R)t} = K$$

$$i_2 = K e^{\pm jm\pi} = K(-1)^m$$

$$I_{IF} = i_1 - i_2 = K[1-(-1)^m]$$

The $e^{\pm jm\pi}$ term in i_2, which equals $(-1)^m$, is present because I_R opposes i_2.

K represents the double Fourier series, the coefficients of which give the relative amplitudes of the IM products. Since the goal is to determine which IM products exit the I-port and not their relative amplitudes, the double Fourier series is dropped. This allows for quick determination of which IM products will exit the I-port of a given mixer circuit, because the cumbersome Fourier series expansions need not be written.

When m is even (m = 0, 2, 4, . . .), $I_{IF} = 0$; when m is odd (m = 1, 3, 5, . . .), $I_{IF} \neq 0$, showing that IM products containing even harmonics of f_R are suppressed in SB mixers and that all others exit the I-port.

Analysis of the ring DB mixer in Figure 5 is similar. Diode currents i_1, i_2, i_3 and i_4 combine to produce IF current, I_{IF}. Current i_1 has the $(-1)^m$ term because it opposes I_R; i_3 opposes I_L, and i_4 opposes both I_L and I_R.

$$i_1 = K(-1)^m$$
$$i_2 = K$$
$$i_3 = K(-1)^n$$
$$i_4 = K(-1)^{n+m}$$

$$\begin{aligned} I_{IF} &= i_1 - i_2 + i_3 - i_4 \\ &= K[(-1)^m - 1 + (-1)^n - (-1)^{n+m}] \\ &= K[(-1)^n - 1][1 - (-1)^m] \end{aligned}$$

$I_{IF} = 0$ if either n or m are even, so only the IM products with odd f_L and odd f_R harmonics exit the I-port.

The star DB mixer in Figure 6 has the same IF output as the ring DB mixer just analyzed. Its IF output current is calculated as follows:

$$\begin{aligned} I_{IF} &= i_1 - i_2 + i_3 - i_4 \\ &= K[(-1)^n - 1][(-1)^m - 1] \end{aligned}$$

Again, the odd-by-odd IM products are the only ones exiting the I-port.

The two TB mixers in Figure 7 are identical circuits. An analysis of both versions shows that only the odd-by-odd IM products exit the I-port.

$$\begin{aligned} I_{IF} &= i_1 - i_2 + i_6 - i_5 = i_7 - i_8 + i_4 - i_3 \\ &= K[(-1)^n - 1][(-1)^m - 1] \end{aligned}$$

Knowledge of *which* IM products exit the R- and L-ports is often required. Current leaving the R-port of the ring DB mixer in Figure 5 is $I_{R_{out}}$:

$$\begin{aligned} I_{R_{out}} &= i_1 - i_2 \\ &= K[(-1)^m - 1] \end{aligned}$$

IM products with odd f_R and even f_L harmonics exit the R-port. Current $I_{L_{out}}$ contains the IM products exiting the L-port:

$$\begin{aligned} I_{L_{out}} &= i_4 - i_1 \\ &= K(-1)^m[(-1)^n - 1] \end{aligned}$$

IM products with even f_R and odd f_L harmonics exit the L-port. A similar analysis of currents leaving the R- and L-ports of the TB mixer of Figure 7 shows that the odd f_R by even f_L IM products exit the R-port; the even f_R by odd f_L IM products exit the L-port. R- and L-ports must be well-matched to the system in order to keep these products from reflecting back into the mixer to remix and produce further IM products. Attenuators on the mixer ports enhance matching by attenuating unwanted products, thus lessening their effects on adjacent system components.

Harmonic mixers, as shown in Figure 15, use the second harmonic of the LO to generate the desired IF signal.

$$\begin{aligned} I_{IF} &= -i_1 + i_2 - i_3 + i_4 \\ &= K[-(-1)^m + 1 - (-1)^{n+m} + (-1)^n] \\ &= K[1 - (-1)^m][1 + (-1)^n] \end{aligned}$$

IF output occurs for IM products having odd f_R and even f_L harmonics, which include the desired $\pm 2f_L \pm f_R$ products. Harmonic mixing allows the LO to operate with half the normally required frequency. These mixers have higher conversion loss and a more unstable IF output because frequency drift in the LO is doubled.

Conclusion

This *Tech-notes* series has presented the basics of mixer characteristics, performance, theory, and technology: Part 1 discussed SSB conversion loss, VSWR, isolation, dynamic range, IM products, intercept point and SSB noise figure. Part 2 discussed mixer circuits, the mixing process, classes of mixers, baluns, diodes and one example of how baluns and diodes are combined to form a mixer. This foundational material should provide a good basis for the understanding of mixers.

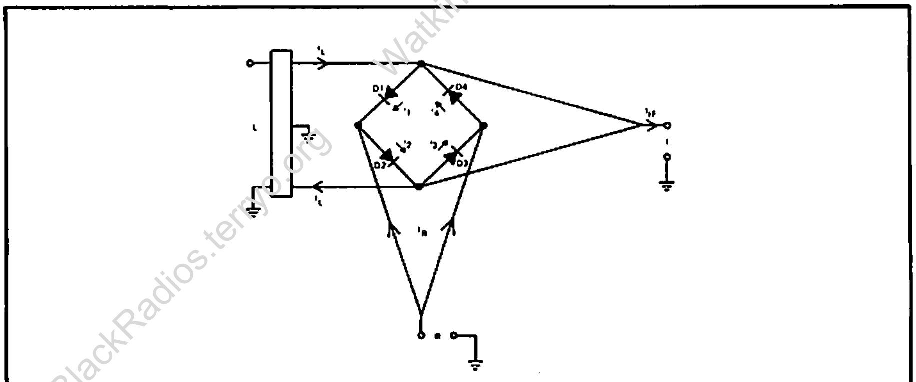

Figure 15. Harmonic mixer.

Selecting Mixers for Best Intermod Performance (Part 1)

Single-tone intermodulation is considered under various input conditions for double-balanced mixers. It's important to select the mixer with the highest isolation over the frequency range of interest.

This is the first of a two-part article that compares the three general classes of double-balanced mixers. Part II, planned for next month, will cover third-order two-tone intermods for various LO drives and rf inputs. The pitfalls in using the intercept method in evaluating intermodulation will also be discussed.

The choice, among the many types of double-balanced mixers, not only depends on cost, size, reliability and dynamic range, but also on an ability to suppress unwanted distortion products resulting from the non-linear characteristics of the mixer diode. Here's a tutorial discussion on the design of mixers and ways to evaluate them. Two types of distortion are considered—single-tone or harmonic intermodulation, and multiple or two-tone intermodulation. Harmonic intermod charts are used as a guide for choosing frequencies and predicting distortion product levels.

Mixer Types and Classes

Mixers are placed into three general classes depending on the mixer's signal-level handling ability. Most commercially-available double-balanced mixers are low-level (Class I) types. Low-level means the total combined input signal power is below −10 dBm. High level mixers are generally above this input threshold.

Class I mixers have 1 dB conversion compression points typically in the region of 0 dBm to +5 dBm with a nominal LO drive level of +7 dBm. Such mixers typically have one diode in each leg of the diode ring, but otherwise are similar in circuit configuration to Class II mixers, Fig. 1.

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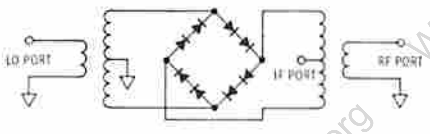
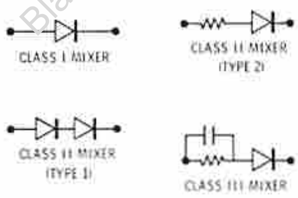


1. **A Class II, Type 1 mixer** has two diodes in each leg. The 1 dB compression point occurs from +8 to +12 dBm with nominal LO drives from +13 to +20 dBm.



2. **The various classes of mixers** have different elements in their legs. A Class II, Type 2 mixer incorporates a precision series resistive element. Class III mixers offer best performance in suppressing higher-order intermods.

High-level Class II mixers have 1-dB compression points at +8 to +12 dBm and nominal LO drive levels from +13 to +20 dBm. They are capable of handling two 0 dBm signals without conversion compression. Of the two Class II type mixers commercially available, Type 1 is least expensive and most common. It uses two diodes in each leg, Fig. 1. This mixer operates with a nominal LO drive of +13 dBm, but will generally give improved single-tone and two-tone IM suppression with a +17 dBm LO drive.

The Class II, Type 2 mixer has a series precision resistor in each leg, Fig. 2, and typically a 0.5 dB greater conversion loss than Type 1. It has a better balanced ring because of the precision resistive elements and, therefore, offers lower dc offset voltage, higher isolation and better suppression of the single-tone IM products—all of which depend on mixer balance. These resistive elements in an intermediate-level mixer serve to hold a larger reverse bias on the pairs of diodes during any non-conducting half cycle. This allows a larger rf signal voltage to be applied before conversion compression occurs. However, more LO power must be supplied to drive the diodes to the low dynamic resistance necessary for minimum conversion loss.

A third mixer class (Class III) is the very high-level class with a 1-dB compression point at +15 dBm or higher and nominal LO drive levels from +20 to +27 dBm. These are the most expensive and the best performing high-level mixers in suppressing higher-order, single-tone, and third-order two-tone intermodulation distortion. The capacitor in parallel with the series resistive element (Fig. 2) will charge to an average dc voltage when the LO drive signal is impressed. This voltage acts to hold a reverse bias on the opposite diodes of the ring so that when the LO voltage passes through its zero voltage transition region, the diodes remain reverse biased. Thus, a larger rf signal must be applied to overcome this reverse bias and turn on the diodes which raise the mixer's conversion compression point. The capacitor also acts as an rf bypass so rf-port signal power is not lost in the resistive elements. The conversion loss of a Class III mixer is a minimum and is typically only about 0.5 dB greater than for a Class I type.

The disadvantage of the Class III mixer is the additional complexity results in increased cost. Also, the thermal noise in the resistive elements can raise the mixer's noise figure above its conversion loss. This thermal noise is worse at frequencies above 200 MHz and is generated principally in the resistive elements as a result of internal dissipation and environmental temperature. The Class III mixer is usually limited to those applications where the maximum operating temperature does not exceed +85°C.

What Constitutes Distortion?

Single-tone (harmonic-intermodulation) distortion results when one signal is present at the r_f port. The desired mixing term is a single-tone intermodulation product resulting from a beating of the local oscillator with the rf input signal. Because the local oscillator and its harmonics mix with the rf input signal and its harmonics, higher-order distortion products also result, Table 1.

Two-tone intermodulation occurs when two signals are applied to the mixer's input port, and results in the mixing between these two signals and the LO, (Part II of this article discusses two-tone distortion in more detail). Often, the single-tone IM products in Table 1 are called "spurious responses". This is correct if one considers only mixer produced products other than the desired sum or difference frequencies. Two-tone or multiple-tone IM distortion would also be correctly labeled "spurious responses" to the system. Confusion occurs when trying to distinguish between the products in Table 1 and two-tone distortion by referring to the former as "spurious responses" and the latter as "IM products", since both can correctly be called by either terminology.

From Table 1 it is evident that for the $3f_R$ row and higher f_R products, the Class III mixer does a superior job of single-tone IM suppression. For the $2f_R$ and f_R row, there is no improvement by using a high-level mixer. The bottom row shows a definite degradation in the suppression for both Class II and Class III mixers. The bottom row represents harmonics of f_L; and because the f_L signal level is higher in the high-level mixer, these harmonics are higher in magnitude.

Theoretically, the nf_R product will decrease (n—1) dB for each dB the f_R level is decreased relative to the desired $f_L \pm f_R$ output level. For example, the $3f_R$ products should decrease (3—1) dB or 2 dB for each dB that f_R is decreased. This means the unshaded $3f_R$ row should show 20 dB greater suppression than the shaded $3f_R$ row since the input level for the unshaded rows is 10 dB less than the shaded rows.

The Class II and Class III mixers show about 20 dB improvement for the −10 dBm input signal, but the Class I mixer is not consistent here. Because the 0 dBm rf input signal is large enough to cause a small amount of conversion compression in the Class I mixer, severe uncancelled odd f_R mixing occurs with odd f_L products. Theoretically, all odd f_R products (mixing with all odd f_L products) are not suppressed because of balance in a double-balanced mixer, but such suppression is dependent on the level produced by the diodes. This is shown in Table I for the Class I mixer, where the $3f_R$ products mixing with the odd f_L products, show about 10 to 20 dB less suppression than the $3f_R$ products mixing with the even-order f_L products. The even f_R products show about the same suppression when mixing with both the even and odd f_L products. If the mixer balance were perfect, these products would be completely cancelled by the double-balanced circuit.

The odd f_R products are the most predictable products in the charts. They typically vary less than ±5 dB from unit to unit of the same model and, unless conversion compression has taken place, they decrease fairly well according to the rule where nf_R will decrease (n-1) dB relative to the desired output for each dB that rf input level is decreased. The even harmonics of f_R vary as much as ±15 dB from unit to unit of the same model; particularly for the $4f_R$ and higher even-order f_R rows.

Select the Right-Class Mixer

Displays of mixer performance for each class, Fig. 3a, b, c, show $3f_R$ and higher order f_R products of the three rf-port input signals mixing with the LO drive signal. The Class II mixer reduces the strongest IM products about 20 dB more than the Class I mixer, and the Class III mixer reduces these products nearly 40 dB more than with the Class I mixer.

Table 1

SINGLE-TONE INTERMODULATION DISTORTION

HARMONICS OF f_R	0	1	2	3	4	5	6	7	8
7	79>99>99	69 79>99	80>99>99	74 78>99	83>99>99	63 78>99	78>99>99	60 81>99	71 99>99
	>90>90>90	>90>90>90	>90>90>90	>90>90>90	>90>90 90	87>90>90	>90>90>90	>90>90>90	>90>90>90
6	90>99>99	86>99>99	91>99>99	91>99 97	90>99>99	84>99>99	93>99>99	84>99>99	88>99 98
	>90>90>90	>90>90>90	>90>90>90	>90>90>90	>90>90>90	>90>90>90	>90>90>90	>90>90>90	>90>90>90
5	72 93>99	70 73 96	71 87>99	52 72 95	77 88>99	46 66>99	75 85>99	[illegible] 64 90	73 82>99
	>90>90>90	60>90>90	>90>90>90	71>90>90	>90>90>90	68>90>90	>90>90>90	65>90>90	88>90>90
4	80 96 88	79 80 91	82 96>99	77 80 92	82 95 90	76 82 95	77 98 [illegible]	72 78 94	77 90 87
	86>90>90	>90>90>90	86>90>90	88>90>90	88>90>90	85>90>90	86>90>90	85>90>90	>90>90>90
3	51 63 81	49 58 73	53 65 85	51 60 69	55 65 85	48 55 68	54 64 85	53 54 64	58 66 87
	67 87>90	64 77>90	69 87>90	50 78>90	77>90>90	47 75>90	74 85>90	44 77 89	74 88>90
2	69 68 64	72 67 71	79 76 62	67 67 70	75 80 63	66 66 70	77 82 61	68 66 62	75 83 64
	73 86 73	73 75 83	74 84 75	70 75 79	71 86 80	64 74 90	69 87 77	64 74 82	69 84 79
1	25 25 24	0 0 0	39 39 35	13 11 11	45 50 42	22 16 19	54 59 50	37 19 39	59 59 49
	24 23 24	0 0 0	35 39 34	13 11 11	40 46 42	24 14 18	45 62 49	28 19 37	49 53 49
0	A B C	36 39 29	45 42 20	52 46 32	63 58 24	45 37 29	60 65 27	71 49 30	64 75 29
		26 27 18	35 31 10	39 36 23	50 47 14	41 36 19	53 51 17	49 37 21	51 63 19

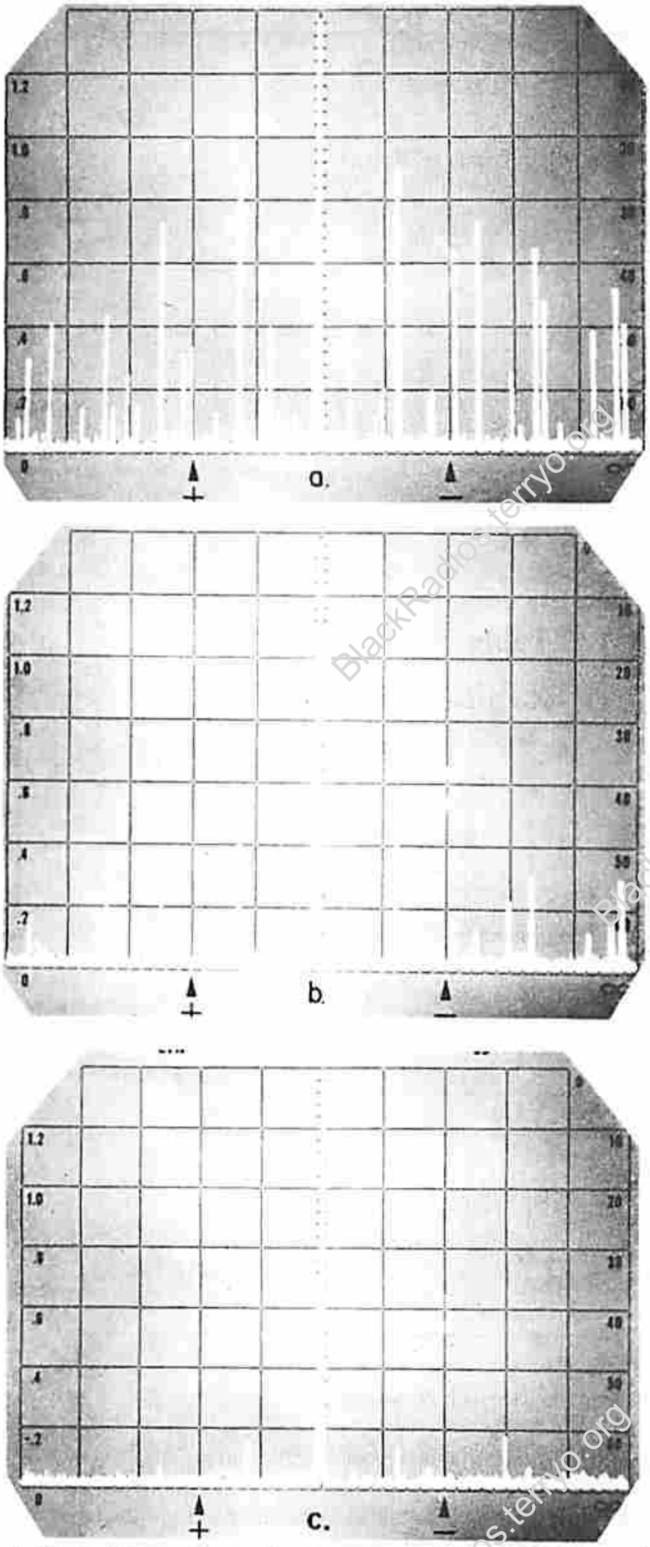
HARMONICS OF f_L

f_R @ 0 dBm (upper cell)
f_R @ −10 dBm (lower cell)
f_R = 49 MHz
f_L = 50 MHz

A: (M1) 0.2 – 500 MHz CLASS I MIXER LO = +7 dBm

B: (M1D/M9BC) 0.5 – 500 MHz CLASS II (TYPE 2) LO = +17 dBm

C: (M1E/M9E) 1.0 - 400 MHz CLASS III LO = +27 dBm



3. **Spectrum analyzer display** shows intermodulation products for (a) Class I mixer, +7 dBm LO drive; (b) Class II mixer, with +17 dBm LO drive; and (c) Class III mixer with +27 dBm LO drive.

SINGLE-TONE INTERMODULATION DISTORTION

Harmonics of f_R	0	1	2	3	4	5	6	7	8
5	>90 >90 >90	83 >90 >90	>90 >90 >90	84 >90 >90	90 >90 >90	79 >90 >90	>90 >90 >90	76 >90 >90	>90 >90 >90
	86 >90 >90	73 >90 >90	87 >90 >90	70 87 >90	84 >90 >90	67 82 >90	>90 >90 >90	67 83 >90	>90 >90 >90
4	88 >90 >90	>90 >90 >90	90 >90 >90	90 >90 >90	88 >90 >90	90 >90 >90	>90 >90 >90	>90 >90 >90	89 >90 >90
	>90 >90 >90	>90 >90 >90	>90 >90 >90	>90 >90 >90	>90 >90 >90	>90 >90 >90	>90 >90 >90	>90 >90 >90	>90 89 >90
3	73 86 >90	64 85 85	69 78 >90	56 67 73	69 76 >90	57 64 80	71 80 >90	55 63 77	69 76 >90
	69 80 90	71 70 77	64 73 89	51 59 68	65 73 90	48 56 79	69 77 90	45 55 73	68 75 88
2	80 66 81	73 82 85	79 67 85	73 78 82	79 65 86	74 79 80	82 67 85	70 74 75	83 71 90
	83 66 74	75 79 81	78 67 82	78 76 78	80 65 85	82 75 80	80 66 87	75 70 75	77 69 90
1	22 22 28	0 0 0	38 38 45	10 11 10	46 46 52	15 17 13	47 47 56	23 25 18	45 45 57
	21 21 29	0 0 0	36 36 44	13 13 15	40 41 52	29 26 14	43 44 57	28 31 19	45 45 60
0	A B C	26 31 23	29 35 23	36 38 38	40 42 38	37 41 40	49 47 47	37 40 38	48 43 50
		35 33 26	37 40 28	40 38 38	62 50 43	44 45 40	49 45 50	52 50 38	51 44 55

HARMONICS OF f_L

LO DRIVE LEVELS +dBm

A	B	C
13	17	20
7	13	17

A: (M1) 0.2–500 MHz CLASS I MIXER
B: (M1B/M9C) 0.2–500 MHz CLASS II (TYPE 1)
C: (M1D/M9BC) 0.5–500 MHz CLASS II (TYPE 2)

f_R = 49 MHz @ -10 dBm FOR ALL CONDITIONS
f_L = 50 MHz

SINGLE-TONE INTERMODULATION DISTORTION

Harmonics of f_R	0	1	2	3	4	5
5	82 >90 >90	80 83 87	78 >90 90	72 78 74	80 >90 >90	67 74 71
	82 >90 >90	80 82 90	80 >90 >90	75 78 82	83 >90 >90	73 75 78
4	89 >90 >90	86 >90 >90	>90 >90 >90	86 >90 >90	95 >90 >90	82 >90 >90
	89 >90 >90	82 >90 >90	90 >90 >90	82 >90 >90	90 >90 >90	80 >90 >90
3	58 65 69	58 62 74	63 68 76	54 54 57	68 72 76	50 53 53
	60 60 72	58 62 76	65 71 78	56 58 61	68 72 78	54 59 59
2	71 76 77	65 78 76	74 80 80	67 75 77	74 85 82	65 75 70
	71 78 80	64 77 78	74 83 82	65 75 78	74 86 82	63 74 71
1	16 24 30	0 0 0	28 40 40	11 13 13	34 43 44	22 28 25
	16 24 30	0 0 0	26 38 40	10 11 11	32 39 44	17 20 20
0	A B C	26 34 32	34 37 36	37 47 44	45 57 60	36 52 51
		24 32 30	30 33 32	37 44 42	40 48 50	34 46 51

HARMONICS OF f_L

(upper box) f_L @ +10 dBm
(lower box, A B C) f_L @ +7 dBm

A: (M6D) 0.05-200 MHz CLASS I MIXER
B: (M6E) 5-500 MHz CLASS I MIXER
C: (M6F) 2-500 MHz CLASS I MIXER WITH BALUNS

f_R = 49 MHz @ -10 dBm
f_L = 50 MHz

If the displays had included products from the bottom three rows of Table 1, there would not have been total improved product suppression for the Class II and Class III mixers. Therefore, before an intelligent choice can be made on the class of mixer required, it is necessary to know what products are present in the output passband.

In many critical applications, where $2f_R$ products occur in the output, the Class II, type 2 mixer is the best choice. If only $3f_R$ and higher products are present, a Class III Mixer will give the maximum suppression. If the output includes still lower order products, then the best answer, if possible, is to change the system frequencies to eliminate these relatively strong products. If this is not possible, then a Class I Mixer with the best isolation should be used.

Table 2 shows the effects of increased LO drive level on single-tone IM suppression for 0.2–500 MHz Class I, Class II, type 1, and Class II type 2 mixers. Note that for many of the $3f_R$ products, the Class II type 2 mixer has about 10 dB improvement over the Class II type 1 mixer. In general, for $3f_R$ and higher f_R products, 0.5 to 2 dB additional suppression can be obtained for each dB increase in LO drive. The $2f_R$ or f_R rows generally show little change with increased LO drive and the bottom two rows typically shows a degradation in suppression.

Choosing the Right Frequency Range

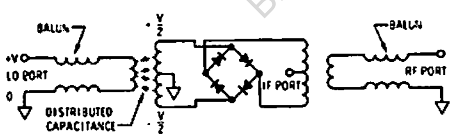
What mixer should one use when the bands overlap significantly? As an example, consider operation near 50 MHz. One has a choice between a 0.05 to 200 MHz mixer and a 5 to 500 MHz mixer. The single-tone IM chart, Table 3, is based on 50 MHz and provides data for three different printed-circuit model Class I mixers. The average suppression for the $3f_R$ row for the 0.05 to 200 MHz unit is 58 dB with a +7 dBm LO drive level. The 5 to 500 MHz unit has an average suppression of 62.3 dB on the $3f_R$ row. This unit has better high frequency isolation due to less distributed capacities in the fewer turns required on the transformers.

The effect of the distributed capacitance has been further reduced in the 2 to 500 MHz mixer. This has been accomplished by using baluns on both the LO and rf ports.

The balun tends to balance the voltage at the input to the transformer, thus causing more nearly equal current to flow in the distributed capacitance. This results in a better balanced output voltage from the transformer to the diode ring. This mixer, with baluns, Fig. 4, gives an average suppression on the $3f_R$ row of 67.5 dB, or 5 dB greater than without the baluns.

Table 4 compares distortion products of a 0.2 to 500 MHz Class I Mixer to those of 3 to 1000 MHz Class I mixers at approximately 300 MHz. Those products, which depend on mixer balance and which exclude only the odd f_R mixing with the odd f_L, have better suppression in the higher frequency mixer because of the higher isolation.

In summary, for the best IM suppression one should select the mixer with highest isolation for the frequency range of interest.



4. **A balun on the LO and rf ports** of a mixer gives a better balanced output voltage from the transformer to the diode ring and results in better IM suppression.

Table 4

SINGLE-TONE INTERMODULATION DISTORTION

(M1) A: 0.2 TO 500 MHz CLASS I MIXER
(M1A) B: 3 TO 1000 MHz CLASS I MIXER

Harmonics of f_R	0 A	0 B	f_L A	f_L B	$2f_L$ A	$2f_L$ B	$3f_L$ A	$3f_L$ B	$4f_L$ A	$4f_L$ B	$5f_L$ A	$5f_L$ B
$5f_R$									90	90	88	89
$4f_R$							83	90	68	95	83	90
$3f_R$					50	67	52	[illegible]	65	73		
$2f_R$			58	63	62	63	56	65				
f_R	23	24	0	0	35	33						
0	A	B	18	18								

HARMONICS OF f_L

$f_L \simeq 300$ MHz @ +7 dBm
$f_R \simeq 300$ MHz @ -10 dBm

Table 5

SINGLE-TONE INTERMODULATION DISTORTION

INPUT FREQUENCIES: upper row of each cell: A B 300 MHz; lower row: A B 50 MHz

Harmonics of f_R	Input freq.	0 A	0 B	f_L A	f_L B	$2f_L$ A	$2f_L$ B	$3f_L$ A	$3f_L$ B	$4f_L$ A	$4f_L$ B	$5f_L$ A	$5f_L$ B
$5f_R$	300 MHz									90	86	92	93
	50 MHz									90	90	74	71
$4f_R$	300 MHz							79	90	84	92	81	90
	50 MHz							90	90	90	90	90	90
$3f_R$	300 MHz					57	68	59	61	59	62		
	50 MHz					68	76	54	57	72	76		
$2f_R$	300 MHz			65	72	61	67	66	69				
	50 MHz			78	76	80	80	75	77				
f_R	300 MHz	23	14	0	0	23	20						
	50 MHz	24	30	0	0	40	40						
0	300 MHz	A	B	20	12								
	50 MHz	A	B	34	32								

HARMONICS OF f_L

FREQUENCY RANGE OF MIXERS
(M6E) A: 5-500 MHz
(M6F) B: 2-500 MHz (with BALUNS

CLASS I MIXERS

Different Input Frequencies and Distortion Products

Table 5 compares distortion products of two higher-frequency Class I mixers (that were included in Table 4) for 50 MHz and 300 MHz input signals. The output signals for 300 MHz input fall between 10 and 50 MHz on the center diagonal and are centered around 300 MHz on the two outside diagonals. Thus, all products are within the i-f port frequency range. The even order f_R products show typically 5-15 dB degradation at 300 MHz on most IM products that depend on mixer balance.

Products that do not depend on mixer balance, ($3f_R$ by $3f_L$ and $5f_R$ by $5f_L$) showed improved suppression at 300 MHz. This is not always the case, but typically such products do not degrade appreciably at the higher frequencies.

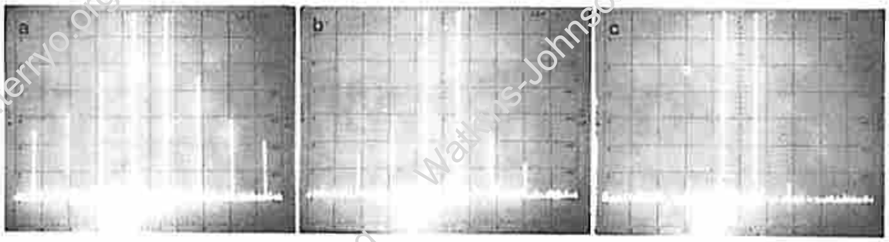
When necessary to specify distortion products, it should be done with reference to broadband 50-ohm systems since any other system is unique and must be exactly duplicated in each test setup right down to the length and type of line between the mixer ports and driving sources and loads (particularly the i-f port). Part II will show how different i-f port filters affect third order two-tone products. Also, it is advisable to specify a definite set of frequencies for each IM product considered, rather than a band of frequencies, so that exact correlation between the manufacturer and customer can be obtained.

Selecting Mixers for Best Intermod Performance

(Part 2)

Third-order two-tone intermodulation is a function of LO drive and rf input levels. In evaluating IM, it's important the mixer is operating in a truly linear region.

This is the second and concluding article on intermodulation products in double balanced mixers. Part I appeared last month.



1. **Spectrum of i-f and IM products** for (a) Class I mixer, 13 dBm LO drive, (b) Class II mixer, 20 dBm LO drive and (c) Class III mixer, 23 dBm LO drive, show the equal spacing in frequency between the unwanted products. Horizontal scale is 0.5 MHz/div. (centered at 30 MHz) and the vertical scale is 10 dB/div.

In many receiver applications, two input signals may enter a mixer and mix with the local oscillator signal to produce unwanted inband intermodulation products.

These third-order two-tone products can be particularly troublesome in a receiver because they are separated from the desired output signals by the same amount as the two input signals. Because of this equally-spaced relationship, it is very difficult to provide adequate filtering to remove the products without affecting the desired outputs.

Two methods that are used to reduce these two-tone products are:

- Increase the LO drive for low input signals so the diodes operate only briefly in the highly non-linear transition region.
- Increase the forward voltage drop in each diode leg. This is accomplished by placing additional diodes or resistive elements in each leg of the mixer ring and increasing the LO drive level.

The Class III mixer gives the best suppression of IM products over wide rf input levels when LO drives of +17 dBm or more are provided. However, the performance for each class of mixer and their relative merits should be carefully weighted before selecting any type. LO levels should also be carefully evaluated for their effect on other parameters.

In addition to third-order two-tone product suppression, the tradeoffs between the 1 dB conversion compression point and the intercept point (where second and third-order IM products occur) in the various mixer types should also be considered. Interestingly enough, achieving a high compression point is no guarantee that maximum two-tone suppression has been achieved in a double-balanced mixer.

Suppressing Third-order Products

Consider the spectrum of the three classes of mixers in Fig. 1. The two rf input signals f_{R1} and f_{R2}, are 0 dBm tones at 220 MHz and 220.5 MHz applied to the rf port of each of the mixers. The LO signal, f_L, set at 250 MHz, is driving each mixer at its maximum recommended LO drive level. The unwanted inband third-order two-tone modulation defined as $(2f_{R2} - f_{R1}) \pm f_L$ and $(2f_{R1} - f_{R2}) \pm f_L$, is shown in decreasing amounts for each mixer class.

Fig. 1 (a) shows the third, fifth, and seventh-order products for a Class I mixer. With 7 dB additional LO power, the Class II mixer, Fig. 1 (b) provides about 20 dB of increased suppression over the Class I mixer on the third order product. And with 10 dB more LO power, the Class III mixer, Fig. 2 (c) provides about 40 dB of increased suppression on the third-order product. This additional suppression on the high level signal can be used to reduce distortion in receivers with large input signal levels and in multi-channel communication equipment. It is also very useful in spectrum analyzer i-f sections where a large dynamic range is required.

Determining the Intercept Point

The intercept point used widely to predict the second and third-order distortion suppression in linear amplifiers is being increasingly applied as a specification for double-balanced mixers. It is defined as the intersection of the desired output curve and the curve of the distortion product of interest. The third-order two-tone curves in Fig. 2 for a Class I and Class III mixer show a 3:1 slope on an absolute log-log scale intersecting the desired output curve which has a 1:1 slope. Their relative slope is then 2:1 which results in the 2 for 1 rule i.e., for each dB the input is reduced, the third order two-tone will be reduced 2 dB relative output.

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For example, if the input level is reduced 10 dB, the additional suppression below the desired output would increase by 20 dB. This rule holds only over the linear region of the third-order slope.

Instead of actually extrapolating the linear portion of the two-tone curve as in Fig. 2, a simpler method is to take the relative suppression (using the test setup of Fig. 3) divide by two and algebraically add the input level to this. For example, using this rule on the −20 dBm inputs for the Class I mixer in Fig. 4 yields 62/2 −20 = +11 dBm as in the input intercept point. This is the true intercept point for this Class I mixer since the −20 dBm inputs is in the linear region. (Note that Fig. 2 verifies this +11 dBm value).

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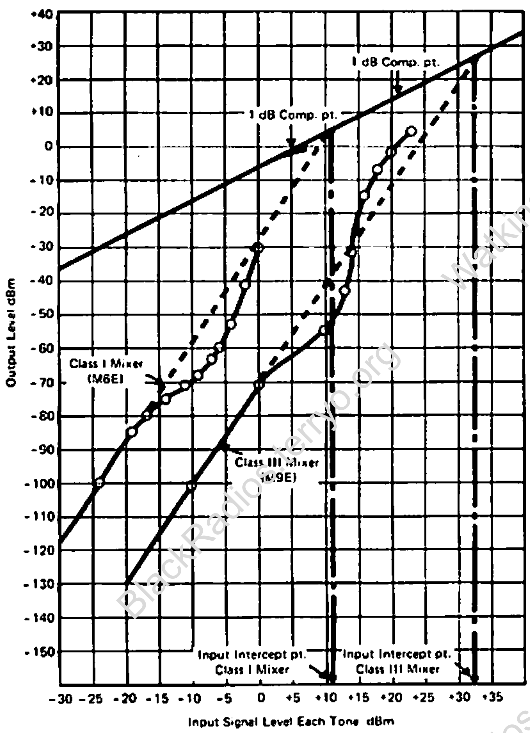
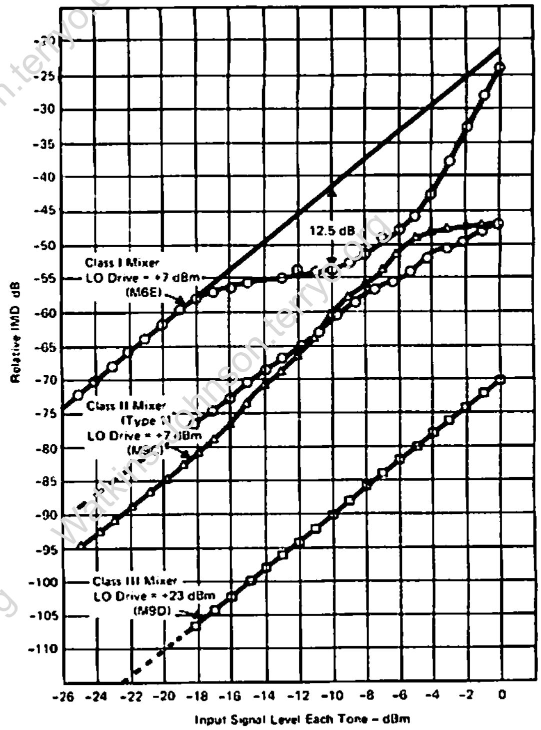


2. **Third-order two-tone modulation** curves may be used to define the intercept point of mixers. It domonstrates the 2 dB for 1 dB rule, that is for each dB the input is reduced, the third-order two-tone will be reduced 2 dB relative to the desired output.



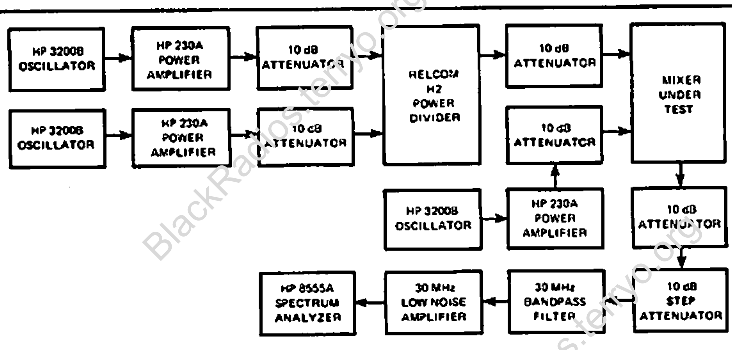
4. **A comparison of relative third-order two-tone intermodulation products** show non-linearities occurring for Class I and II mixers at −18 dBm but not for the Class III mixer even at 0 dBm. The S-band Class II mixer shows a slight non-linearity at the signal levels increase above −16 dBm.

However if the rule is used at the −10 dBm input levels on the Class I mixer, the result is 54/2 −10 = +17 dBm which is 6 dB higher than the true intercept point. The interesting fact here is that −10 dBm is usually the most popular level for measuring two-tone distortion in a mixer. Unfortunately, at this level, the intercept simply is not valid for the Class I mixer. If the purpose of the intercept point is to provide a single specification to predict the IM suppression for a large range of input signal levels then it should be applied only to the linear region. For a Class I mixer, the region is up to about −20 dBm and it is up to about −10 dBm for Class II mixer. For a Class III mixer, the region extends to 0 dBm.

Third-Order IM Cancellations

When two diodes are used for simultaneous mixing in a mixer, cancellation can occur in the third order two-tone products if the diodes are biased at a different level[1]. The different bias levels cause the fourth and sixth order coefficients of the polynomial that represents a diode characteristic curve to be opposite in sign to the fourth and sixth order coefficients of the other diode.

In a double-balanced mixer, which uses a ring quad arrangement, the two diodes are biased on by the LO signal during any half cycle. The rf signal passes through one of these conducting diodes in an opposing direction to the LO signal and in an aiding direction in the other conducting diode. For low level input signals, this rf perturbation is small compared to the average LO bias level. At higher input levels, however, it causes the two diodes to be biased at slightly different levels at any instant in time. A sign reversal on either or both the fourth and sixth order coefficients between the two diodes will cause some degree of cancellation to occur. The extent of canellation is 12.5 dB at −10 dBm input levels for the Class I mixer as shown in Fig. 4. The maximum cancellation using a +7 dBm LO signal occurs with two −8 dBm input signals. As the input levels are increased still further, conversion compression effects occur in the mixer.



3. **Test setup for measuring relative two-tone IM** vs. rf input level shows test instruments used. Comparable manufacturers' test equipment works equally as well. For the test results shown in Fig. 4, LO frequency is 113 MHz and f_{R1} and f_{R2} is 43 and 63 MHz. The S-band mixer tested operates at a f_R of 3.2 GHz and an LO frequency of 3.36 GHz at +17 dBm.

Another type of cancellation in a double-balanced mixer is a relative phase shift between the IM products that are produced in each of the two conducting diodes. The IM distortion currents generated by each diode are summed in the i-f port of the mixer so that any phase shift between these currents will cause some cancellation in the IM distortion. By placing an open ended 50-ohm coaxial line directly in shunt on the i-f port of the mixer and adjusting the line length over several inches as much as 30 dB additional suppression can be provided.

Mixer Compression

The conversion compression in a mixer is unlike the gain compression in an amplifier. An amplifier compresses the signal when clipping of the waveform occurs as a result of the transistors being driven into saturation during one-half cycle or cutoff during the other half cycle or both. In a double-balanced mixer (see Figs. 1, 2; p.48 Nov. 1973 Microwaves,) the local oscillator alternately drives one half of the diode ring on while the other half is reversed biased by the "on" biased diodes. When the magnitude of the rf signal becomes sufficiently large it can also act as an LO signal and turn-on the diodes. When this happens, rf signal energy is lost in these diodes—resulting in conversion compression.

Conversion compression is also caused by the rf signal opposing the LO signal in one of the conducting diodes. This causes a shift in the average operating point towards a higher dynamic impedance. The rf signal then sees a relatively high impedance in one diode and a low dynamic impedance in the other. This effect unbalances the i-f currents through the LO transformer and causes partial loss of common mode cancellation. The rf signal then sees a higher impedance in the LO transformer—further increasing the conversion compression in the mixer. These effects have been found to be less significant than the rf signal acting as an LO source and can be overcome by maintaining a large LO signal to rf signal level ratio.

Effects of LO Drive on IM

Improvements in third-order suppression also occur when the LO drive is optimized. This is seen in the Class I mixer performance in Fig. 5, which shows relative third-order two-tone IM suppression for four LO drive levels. It is not possible to extend the true linear region more than a few dB using increased LO drive. Note that the higher order coefficient cancellation occurring with the +7 and +10 dBm LO drive levels is virtually eliminated with the +13 dBm drive level. The +17 dBm drive level actually produces a reversed effect and degrades at a slightly faster rate than the 2:1 rate. This higher rate of degradation is also evident in the Class II mixer Fig. 5 (dashed lines) when driven at a +20 dBm LO level. In comparing the third-order suppression of the Class I and Class II mixers both driven with +13 dBm LO drive levels, it is seen that there is no apparent advantage for signal levels below −10 dBm in using the Class II mixer to obtain better third-order two-tone suppression. The improvement in third order suppression with increased LO drive for low level input signals is the result of the diodes operating for a shorter period of time in the highly nonlinear transition region.

One trade-off for driving a Class I mixer at a higher than nominal LO drive level can be an increase in noise figure for i-f frequencies below 10 MHz since the diodes are not screened for low 1/f noise at high current levels. This is important in phase detector applications. Also a slight loss of mixer isolation can occur since the diodes are not matched at the higher current levels. Most mixer manufacturers do not recommend that a Class I mixer be driven above +13 dBm on the LO port.

Effects of rf Drive

The type of two-tone degradation occurring for rf input levels above +10 dBm on a Class I mixer demands that changes to the basic mixer circuit be made. This is required to obtain improved performance since increasing the LO has a negligible effect on IM performance. This is one reason that the Class II type 1 high-level mixer was developed. (See Fig. 2, Part I of this article, Nov. '73 p. 48). The extra diode in each leg of the mixer provides

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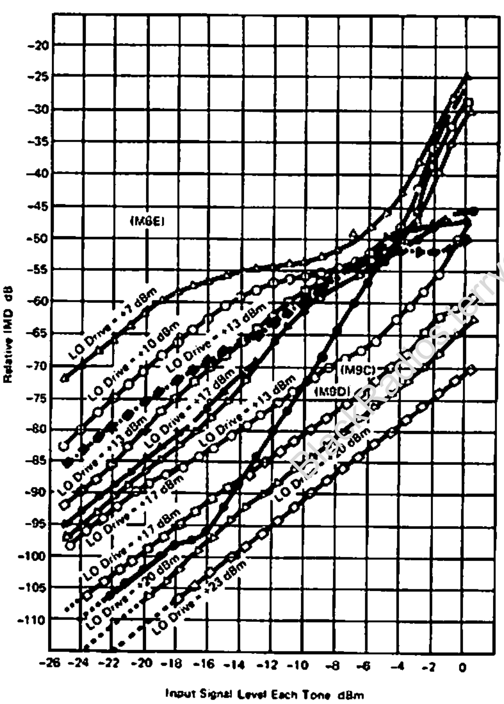
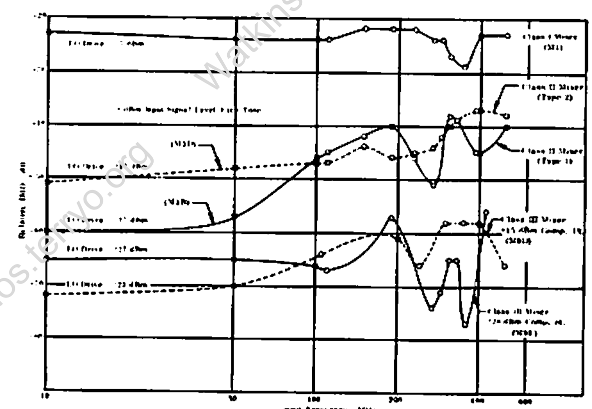
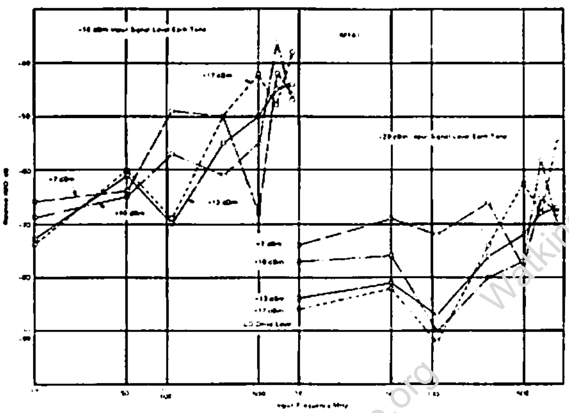


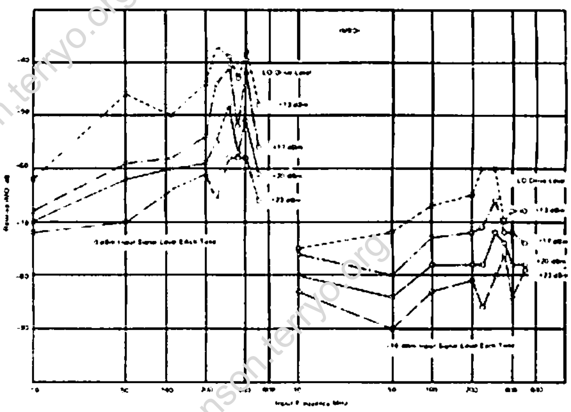
5. **LO drive heavily influences** third-order two-tone IM for a Class I mixer (black). This mixer type does not exhibit any phase cancellation so no cross-overs in suppression occurs. **A Class II mixer** (in dash lines) offers no improvement in third-order IM suppression at a −13 dBm LO drive when signal levels below −10 dBm are used. Class III mixer offers the best IM suppression over wide rf input levels and LO drive levels.



6. **Third-order two-tone suppression** for the three classes of mixer has wide variations at the higher frequencies.



7. **Third-order two-tone suppression for a 3 to 1000 MHz Class I mixer** is not necessarily dependent on the LO drive. Phase cancellation is also a factor.



8. **Class III mixer** offers improved suppression of IM over Class II mixers but is still sensitive to frequency.

additional back bias on the "non-conducting" pair of diodes. The resultant compression effects prevent severe IM degradation on rf input signal levels up to 0 dBm.

For 0 dBm RF inputs, the Class II mixer gives 22 dB greater suppression than the Class I mixer when both mixers are driven at +13 dBm on the LO port. When +17 dBm or greater LO drive levels can be provided, the Class III mixer, Fig. 5, (color tint) will give superior suppression for all rf input levels. This is caused by the capacitive elements in each diode leg in the mixer. Each capacitor holds a reverse bias on each pair of diodes during their non-conducting period even when the LO swings through its zero voltage transistor point. Reasonable linearity is maintained up to 0 dBm for LO drive levels of +17 dBm and higher and up to −3 dBm for a +13 dBm LO drive level.

What's the Effect with Frequency?

Third-order two-tone suppression maintains three distinct levels of suppression for each class of mixer. Across a 500 MHz band, as shown in Fig. 6, there is a 10–15 dB variation in suppression with frequency. The variation is most pronounced at the higher frequencies where a relatively small change in frequency can result in a large change in IM suppression.

The effect over frequency for −10 and −20 dBm input levels and four different LO drive levels is shown in Fig. 7. Notice that increasing the LO drive level does not always result in improved performance. In fact at 500 MHz with −10 dBm rf input levels, the best performance is obtained with +7 dBm drive. The suppression here is nearly 20 dB better than the suppression at 270 MHz and over 25 dB better than the suppression at 700 MHz. Increasing the LO drive level 6 dB, decreases the suppression at 500 MHz by 18 dB. This indicates that phase cancellation effects are responsible for the excessive suppressions at 500 MHz with the +7 dBm LO drive. The suppression improves only by 10 dB with a 10 dB reduction in the rf input levels which is only half the amount predicted using the 2 dB for 1 dB rule. Even with −20 dBm input signals this point measured about 12 dB better than the 270 MHz and 700 MHz readings.

The Class III mixer gives improved performance across the entire frequency band with each increase in the LO drive level, Fig. 8. Because Class I and II mixers are not linear over the common rf input levels used for measurements and are particularly sensitive to phase cancellation, it is recommended that the intercept concept be used on these mixers with extreme caution.

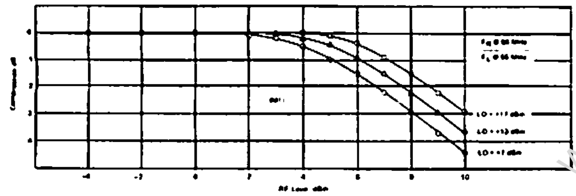
Compression and Intercept Points

The 1 dB conversion compression point is often related erroneously to the intercept point on a one-for-one basis in mixers. Experimental data, however, shows that there is no direct dependence. For input levels below −18 dBm, the Class I mixer gave 25 dB of additional suppression when the LO drive is increased from +7 to +17 dBm, Fig. 5. This is an intercept point increase of 12.5 dB. The 1 dB compression point, however, only increases from +5 dB to +7.2 dB, Fig. 9, because it takes an exponential increase in diode current to obtain a linear increase in diode voltage. Thus, very litional back voltage can be developed to hold both of the "non-conducting" pair of diodes biased off.

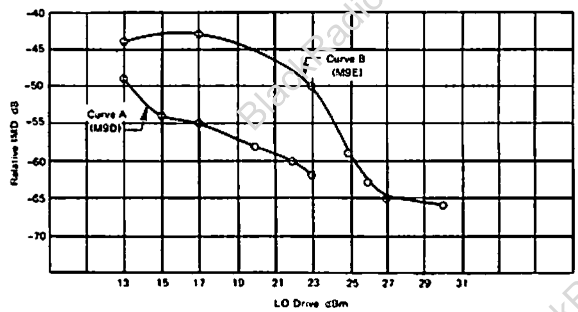
Further evidence that the compression point and intercept point do not track with each other (especially when compression effects have not occurred inside the mixer) are illustrated by the two Class III mixers in Fig. 10. The higher level mixer (B) is designed for a +20 dBm guaranteed 1 dB compression point and maximum third-order, two-tone IM suppression with a nominal LO drive of +27 dBm. The lower level Class III mixer (A) is designed for maximum third-order two-tone IM suppression with a minimum LO drive. (The third-order, two-tone performance of these two mixers is shown in Fig 6). Note that even though the higher level Class III mixer has a 5 dB higher 1 dB conversion compression point and is driven with a +27 dBm LO signal, the lower level unit gives about the same two-tone IM suppression with only +23 dBm LO drive.

Back in the early development of high level double-balanced mixers, a group of special high barrier, hot-carrier diodes were put into a mixer to obtain a higher compression point. The compression point was raised a few dB, but the third-order, two-tone IM suppression—especially for low level signals—was actually several dB worse even when the LO drive was adjusted to give the same average current level in the diodes. (A distortion analysis using numerical techniques on a computer generated sixth order polynominal to represent the diode characteristic curve revealed very large fourth and sixth order components exist as compared to the standard barrier diodes.)

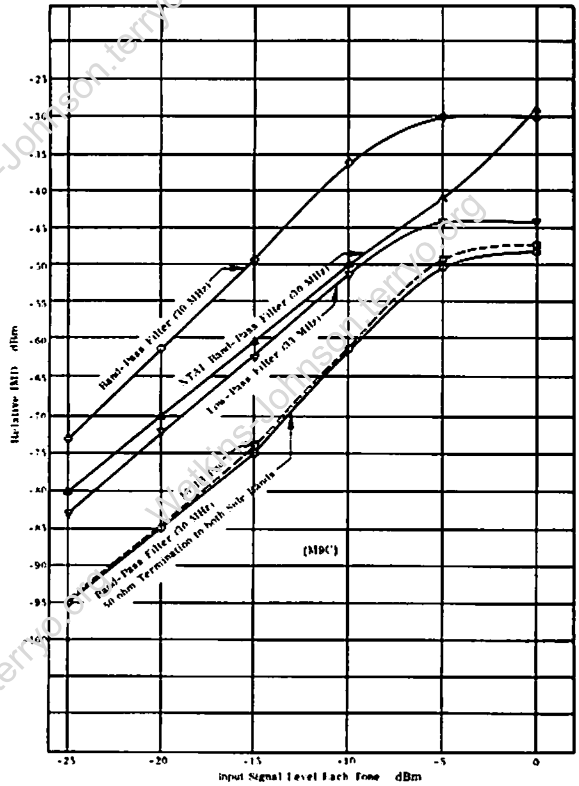
In short, achieving a high compression point is no guarantee that maximum two-tone suppression has been achieved. In fact, there is no direct correspondence between compression point and third-order, two-tone IM suppression, in double-balanced mixers.



9. **An intercept point** is not directly related to the compression point of a mixer.



10. **A higher 1 dB conversion compression point** doesn't necessarily insure better two-tone IM suppression.



11. **It's important to terminate** the i-f port of mixer into 50Ω or IMD increases.

I-f Port Termination Reactive?

The figures presented up to this point are for a 50Ω broadband system. Frequently, however, a limited i-f bandwidth is needed which requires filtering. In a typical down-converting application, this makes the filter look like 50Ω at the lower (or desired sideband) but reactive to the upper sideband. As a result, the upper sideband is reflected back into the i-f port of the mixer, typically degrading the two-tone IM performance. It is necessary that an i-f port termination provide 50Ω to both upper and lower sideband. If not degradation in third-order, two-tone suppression occurs as shown in Fig. 11. The dotted line shows the suppression with a 50Ω broadband termination on the I-port. The bottom solid curve results when using a 30 MHz bandpass filter that provides a 50Ω input impedance at 30 MHz and for frequencies above 45 MHz when terminated in 50Ω. The top curve shows that 25 dB degradation occurs by reversing the input and output ports on this filter with the undesired sidebands reflected back into the I-port of the mixer. The two center curves are obtained using a 30 MHz crystal filter and a 33 MHz low-pass filter connected directly to the I-port. The degradation for these two cases is not as severe as with 30 MHz bandpass filter with reversed input and output ports. The actual amount of degradation is a function of the relative phase of the reflected signal to the phase of the signals present in the mixer.

In some cases, it's possible at any given frequency to obtain good or even better performance (than offered by a broadband 50Ω termination) by using an adjustable line length. Of course, any adjustment for optimum suppression is frequency sensitive and can enhance or degrade the conversion loss by as much as 2 or 3 dB.

Another method for providing a 50Ω termination to both upper and lower sidebands when the frequency separation will permit, is to use a diplexer on the I-Port. A typical application might be to provide a low-pass filter that cuts off above 70 MHz with R-Port frequencies from 225–400 MHz. Diplexers for this have been built which have typically less than 0.2 dB insertion loss.

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Predicting Intermodulation Suppression In Double-Balanced Mixers

Author: Bert C. Henderson

Predicting intermodulation (IM) suppression in double-balanced (DB) mixers continues to be extremely important in the design and operation of microwave and RF systems. IM products generated by the mixer can masquerade as the down-converted IF signal, thereby reducing system effectiveness. Fortunately, the threat of IM products can be avoided if their frequencies and power levels are known. Determination of IM frequencies is fairly simple, but knowledge of the exact power levels of IM products generated by mixers always requires careful measurement, which is time consuming and, thus, expensive. Approximate predictions of IM power levels are sometimes deducible from catalog data showing trends in typical IM suppression for a given mixer; but often, such data is unavailable. Various efforts have been made to mathematically predict IM suppression in single-ended and single-balanced mixers[1,2], but to date no practical formulas for DB mixers have been made available. To help microwave and RF system designers predict single-tone IM suppression, some simple rule-of-thumb formulas that generally agree with measured data are presented in Table 1. The formulas in the right-hand column come from equation 1 (see page 5 and appendix), which is based on the switching characteristics of four ideal diodes. The formulas in Table 1 are unique in that they predict IM suppression, given only ΔP (the difference between RF and LO power levels).

Also included in this article is a practical four-step method to reduce the effect of intermodulation products (intermods) on the system by optimizing mixer usage. With a reliable approximation of suppression for a given IM product, the system designer can better choose the mixer input and output frequencies that minimize the presence of poorly suppressed IM products in the IF output passband. Furthermore, distinguishing a particular IM product from others on a crowded spectrum analyzer display is easier when the approximate level of the desired product is known.

The expressions for IM suppression presented in Table 1 are calculated from equation 1 by using nominal values of balun imbalance, diode mismatch, and V_F (diode turn-on voltage). Equation 1 represents the generalized formula for IM suppression for various values of these parameters. The derivation of the equation is based on the switching characteristic of an ideal diode and, as a result, mixing caused by normal diode nonlinearity is ignored. This approximation has been addressed in the literature[3], and is justified ostensibly by the close agreement between calculated and measured IM suppression, as long as the values of n and m are small, and ΔP is less than about -15 dB. The approximation is made in the analysis that the RF power is much less than the LO power. When n, which is the harmonic of the high-level (LO) input is less than 8, and m, which is the harmonic of the low-level (RF) input is less than 4, predicted results are accurate enough for most system design applications. For larger values of n and m, calculated suppression tends to be better than actual suppression. Evidently, approximations made in the derivation begin to cause inaccuracies for higher values of n and m.

(LO) n	(RF) m	S_{nm} Suppression (dBc)
1	1	0
1	2	ΔP-41
1	3	2ΔP-28
2	1	-35
2	2	ΔP-39
2	3	2ΔP-44
3	1	-10
3	2	ΔP-32
3	3	2ΔP-18
4	1	-35
4	2	ΔP-39
5	1	-14
5	3	2ΔP-14
6	1	-35
6	2	ΔP-39
7	1	-17
7	3	2ΔP-11

Table 1. Formulas approximating suppression of certain IM products. n corresponds to the high-level (LO) input, and m corresponds to the low-level (RF) input. $\Delta P = P_{RF}(dBm) - P_{LO}(dBm)$.

The expressions given in Table 1 are valid whether n and m are positive or negative. The frequencies of IM products in Table 1 are assumed to be within the mixer IF output bandwidth.

Table 1 is used as follows: Suppression of any product listed is approximated by subtracting the LO input power, in dBm, from the RF input power, in dBm, to get ΔP, which is then used to calculate IM suppression. For example, when the LO power is +10 dBm and the RF power is -20 dBm, ΔP = -30 dB, and the $\pm nf_L \pm mf_R$ IM product, when both n and m equal 2, is suppressed by approximately $\{\Delta P - 39\}$dBc, or -69 dBc. The suppression of the 2 x 1 product will be about -35 dBc. In the following paragraphs, $\pm nf_L \pm mf_R$ is abbreviated to n x m (referred to as, "n by m").

The formulas in Table 1 agree with the (m-1) rule[4]; namely, that decreasing RF input power by K dB results in an increase of suppression of any n x m product by K (m-1) dBc. The formulas in Table 1 also imply that the same is true for an increase in LO power because ΔP becomes more negative when LO power is increased, as well as when RF power is decreased. But, in practice, IM suppression is more accurately predicted using the (m-1) rule for changes in RF power than for changes in LO power. As expected, calculated suppression of products with m=1 remains fixed as ΔP varies.

The formulas in Table 1 are based on a double-balanced (DB) mixer with circuit balance and diode match that are generally representative of microwave mixers. Hence, IM suppression calculated using Table 1 is approximate, and may deviate from actual measurement depending on the mixer, the frequencies involved, and load conditions. To get a sense of accuracy of these formulas, measured values of IM suppression for various types of mixers are compared with calculated values.

Comparison With Measured Data

Table 2 indicates that equation 1 and Table 1 are useful in predicting IM suppression because predicted values of suppression generally fall within the variance of measured suppression for the various classes of mixers.

Odd x Odd IM Products

Table 2 shows that predicted suppression for, $\Delta P = -20$ dB, generally agrees with measured data for various classes of mixers, especially for odd x odd and even x even IM products. For example, the 3 x 1 product is predicted to be -10 dBc, which agrees closely with measured values of -10 dBc to -12 dBc for the lower-frequency mixers, including the new Class IV[5] WJ-M4T mixer and the triple-balanced (TB)[6] WJ-M2T mixer. The new WJ-M50A[7] and WJ-M89, whch are microwave TB mixers, have slightly higher suppression of the 3 x 1 product; i.e., -19 dBc and -16 dBc, respectively. These values probably would be closer to predicted values if a higher LO power were applied. Careful study of 3 x 1, 5 x 1, and 7 x 1 IM data, taken with a varying LO power level,[8] shows that these particular products are better suppressed when LO power is slightly lower than that required for optimum conversion-loss, but reducing LO power also degrades suppression of IM products when $m \geq 2$. Hence, odd x odd products, especially with m = 1, should never be allowed inside the IF bandwidth because virtually nothing can be done to improve their suppression without degrading suppression of other products.

The 3 x 3 product is predicted to have suppression of -58 dBc, agreeing with measured values in Table 2, ranging from -65 dBc to -50 dBc. The 5 x 3 product is predicted to have suppression of -54 dBc, which is at least centered among measured values ranging from -47 dBc to -69 dBc.

Even x Even IM Products

Besides odd x odd products, calculated values of even x even IM suppression generally conform to measured data. Calculated suppression of 2 x 2 products for, $\Delta P = -20$ dB, is -59 dBc, which generally agrees with data ranging from -50 dBc to -64 dBc. Suppression of 4 x 2 and 6 x 2 products is predicted to be the same as for 2 x 2 products; i.e., -59 dBc, which also agrees with measured values of -50 dBc to -66 dBc and -52 dBc to -67 dBc, respectively. Data in Table 2 indicates that suppression of even x even IM products in TB and Class IV mixers is generally better than in DB Class I, II and III mixers. This is because all three ports of TB and Class IV mixers are balanced, whereas only two ports, generally the L- and R-ports, are balanced in DB mixers.

IM Product		TB						Class IV		Class I				Class II Type I				Class II Type II		Class III		Predict. Values
n	m	M50A		M89		M2T		M4T		M79		M6V		M9C		M79H		M9BC		M9E		(ΔP=-20)
1	1	0	6	0	7	0	8	0	1	0	5	0	1	0	1	0	5	0	1	0	1	0
1	2	55		51		64		61		60		50		63		63		63		59		61
1	3	>60		>65		64		66		60		60		60		62		65		63		68
2	1	35		30		41		43		42		30		35		40		41		50		35
2	2	60		54		61		64		60		55		50		62		60		51		59
3	1	19		16		10		12		12		11		11		12		10		12		10
3	2	>58		60		60		60		42		49		61		48		58		59		52
3	3	63		62		58		61		>60		58		57		65		50		57		58
4	1	41		40		50		45	2	35		41	2	32		32		36	2	39	2	35
4	2	>62		60		57		66		—		55		57		—		56		50		59
5	1	30		34		30		16		25		18		15		20		15		28		14
5	3	—		64		54		54		>60		53		50		69		54		47		54
6	1	45		—		48		49		—		56		41		—		50		37		35
6	2	62		55		66		67		—		56		59		—		63		52		59
7	1	33		35		18		21	3	24		25	3	19		22		19	3	21	3	17
7	3	>60		>65		55		54	2	—		55	2	54		—		50	2	50	2	51
		P_{LO} = +10 dBm, P_{RF} = -10 dBm												P_L = +20 dBm, P_R = 0 dBm								

Notes	1	2	3	4	5	6	7	8
f_L (MHz)	200	180	125	50	2900 (IF in)	4100	2000	275
f_R (MHz)	180	400	400	49	7100	6000	3250	200

Table 2. Comparison of various IM products and classes of mixers.

The excellent suppression of even x even products by the Class IV WJ-M4T mixer covering 10 to 3500 MHz is due to well-balanced circuitry, and the fact that even x even currents are terminated in two chip resistors before they can exit the mixer. The WJ-M4T has excellent conversion loss, typically 6 dB, which is not degraded by the resistors, because odd x odd currents are phased to skirt around the resistors and exit at the I-port.

Even x Odd and Odd x Even IM Products

Calculated values of even x odd and odd x even suppression generally agree with measured values as well. 1 x 2 and 2 x 1 products are predicted to have -61 dBc and -35 dBc of suppression, respectively, which approximately agree with the measured values of -50 to -64 dBc and -30 to -50 dBc, respectively. Measured suppression of 2 x 1, 4 x 1, 6 x 1, . . ., etc. IM products are similar for a given mixer, as predicted. For example, the 2 x 1, 4 x 1 and 6 x 1 suppression for the M4T is -41 dBc, -45 dBc and -49 dBc, respectively.

Generalized Equation for IM Suppression

The results in Table 1 were calculated using equation 1, which gives IM suppression in dBc for various values of circuit balance, diode match and RF and LO power levels.

Equation 1

$$S_{nm} \triangleq \text{IM Suppression (dBc)} = (|m| - 1)\Delta P + 20 \log(|A_{nm}|) \qquad (1)$$

$$A_{nm} = \frac{1}{B_{IF}\,|m|!}\left[\frac{\Gamma\left(\frac{|n| + |m| - 1}{2}\right)}{\Gamma\left(\frac{|n| - |m| + 3}{2}\right)}\frac{1}{2}\left\{\sin\frac{|n|\pi}{2}\sin\frac{|m|\pi}{2}B_{oo} + \cos\frac{|n|\pi}{2}\cos\frac{|m|\pi}{2}B_{ee}\right\} + \ldots\right.$$

$$\left.\ldots + \frac{\Gamma\left(\frac{|n| + |m|}{2}\right)}{\Gamma\left(\frac{|n| - |m| + 2}{2}\right)}V_f\left\{\sin\frac{|n|\pi}{2}\cos\frac{|m|\pi}{2}B_{oe} + \cos\frac{|n|\pi}{2}\sin\frac{|m|\pi}{2}B_{eo}\right\}\right]$$

$\Gamma(k+1) = k\Gamma(k)$, $\quad V_f = V_F/V_I$

$B_{oo} = 1 + \delta_4 + \alpha(\delta_3 + \delta_2) - |m|\{\delta_4 - \delta_2 + \alpha(\delta_3 + \delta_2) - \beta(\delta_3 + \delta_4)\}$; odd x odd

$B_{ee} = -1 + \delta_4 - \alpha(\delta_3 - \delta_2) - |m|\{\delta_4 - \delta_2 - \alpha(\delta_3 - \delta_2) + \beta(\delta_3 - \delta_4)\}$; even x even

$B_{oe} = |m|\{-\delta_4 - \delta_2 + \alpha(\delta_3 + \delta_2) + \beta(\delta_4 - \delta_3)\}$; odd x even

$B_{eo} = |m|\{\delta_4 + \delta_2 + \alpha(\delta_3 - \delta_2) - \beta(\delta_4 + \delta_3)\}$; even x odd

$B_{IF} = B_{oo}$ with m=1

$\Delta P = P_{RF}\,(\text{dBm}) - P_{LO}\,(\text{dBm})$

$\delta_2 = \frac{V_2}{V_1}$, $\delta_3 = \frac{V_3}{V_1}$, $\delta_4 = \frac{V_4}{V_1}$ (See Figure 2)

L-Balun Isolation = $20 \log(1 - \alpha)$
R-Balun Isolation = $20 \log(1 - \beta)$ (See Figure 1)

6

The parameters alpha and beta in equation 1 are measures of L- and R-port imbalance, respectively. Beta is the ratio of the voltage-to-ground at the two points where the R-port balun ties to the diodes; alpha is the same for the L-port balun. Both alpha and beta ideally equal 1, but parasitics and other nonideal factors can cause alpha and beta to equal values ranging from 0.7 to 0.8, calculated from typical balun isolation of 10 to 15 dB, respectively, as shown in Figure 1 for beta. Results in Table 1 are based on alpha and beta both being equal to 0.7.

Besides balun imbalance, the analysis considers diode voltage mismatch as caused by impedance variations amongst the four diodes. This is due to differences in diode capacitance, C_T, and series resistance, R_T, of each of the four diodes. These voltage differences are approximated by weighting each of the ideal diode voltages, with their respective values of diode impedance normalized with respect to the impedance of diode 1. Diode voltages V_2 through V_4 in Figure 2 are multiplied by δ_2, through δ_4, respectively, which are the ratios of the voltages across diodes 2 through 4, to the voltage across diode 1 (ideally, $\delta_2 = \delta_3 = \delta_4 = 1$). Table 1 is based on $\delta_2 = 0.85$, $\delta_3 = 0.95$ and $\delta_4 = 1.05$.

The formulas in Table 1 are calculated from equation 1 using the approximation that δ_2 through δ_4, and alpha and beta are constant as a function of frequency. This is reasonable because the IM products of most interest are close to the IF output frequency.

V_f, which equals V_F/V_L (V_L is the peak LO voltage), is present in the odd x even and even x odd portions of equation 1, but NOT in the odd x odd and even x even portions. This helps explain why measured values of odd x odd and even x even IM suppression tend to agree with calculated values better than odd x even and even x odd values: V_f is an approximate value because both V_L, and especially, V_F, are approximate values. Table 1 is based on $V_f = 0.1$, assuming $V_F = 0.3$ volts, and $V_L = 3.0$ volts corresponding to +20 dBm of LO power in a 50-ohm system.

V_F affects suppression of all IM products because a higher V_F allows more LO power to be applied to the mixer, increasing $|\Delta P|$, assuming RF power remains constant, and thus increasing suppression of all four types of IM products. Equation 1 indicates that increasing V_F without commensurately increasing LO power will tend to reduce suppression of odd x even and even x odd products, but not affect odd x odd and even x even products. Thus, it is important to consider the interrelationship between LO power, diode forward voltage, and suppression of the various IM products.

To illustrate the use of equation 1, suppression of the 3 x -2 product is calculated:

Example Calculation: 3 x -2

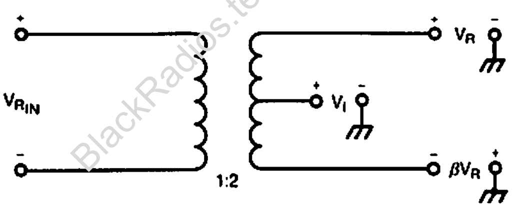
Using $\alpha = \beta = 0.7$, $\delta_2 = 0.85$, $\delta_3 = 0.95$, $\delta_4 = 1.05$, $V_f = 0.1$, $B_{IF} = 3.25$, $B_{oe} = 1.14$

$|A_{nm}| = [1/(3.25)(2)]\,[\Gamma(5/2)/\Gamma(3/2)]\,(0.1)\,(1.14) = 0.026$

$S_{nm} = [\Delta P - 32]$ dBc

Important Rules for IM Suppression

Equation 1 provides significant insight into the suppression of IM products. It agrees with the well-known fact that IM suppression is best when LO power is high and RF power is low i.e., when $|\Delta P|$ is maximum. Also, suppression of products with even harmonics is best when mixer circuitry is well-balanced and diodes are well matched, which is manifested by high interport isolation due to circuit balance.* Also, circuit balance and diode match must be commensurate with each other because IM suppression may not increase if the diode match is improved, while circuit balance remains poor.



ISOLATION $\triangleq 20 \log (V_I/V_R) = 20 \log (1-\beta)$

Figure 1. Balun imbalance as a function of β.

*In many instances, high interport isolation also results from filtering and cross-polarization of LO, RF and IF fields, due to orthogonal MIC baluns.

Equation 1 confirms that even x even products are best suppressed when both L- and R-ports are well balanced and all four diodes are well matched. These same conditions minimize conversion loss (the 1 x 1 product), as well as suppression of odd x odd IM products. Odd x even products are best suppressed when the L-port balun is well balanced ($\alpha = 1$) and the diodes across it are well matched ($\delta_3 = \delta_4$). Even x odd products are best suppressed when the R-port balun is well balanced ($\beta = 1$) and the diodes across it are well matched ($\delta_2 = \delta_3$). The general rule-of-thumb to remember is that best suppression of odd x even and even x odd products is obtained when the LO and RF inputs, respectively, are injected into well-balanced ports. The optimum arrangement is to inject both LO and RF signals into well-balanced ports to best suppress odd x even and even x odd products.

Downconverting and Upconverting

In double-balanced mixers, two of the three ports are balanced at the diodes, and the third port, which is unbalanced, almost always operates at lower frequencies to serve as the IF output. Therefore, injecting the LO and RF signals into the balanced ports generally corresponds to the downconverting case in which the bandwidths of two balanced ports are higher in frequency than the unbalanced IF output port. This explains why IM suppression is usually better when downconverting, as compared to upconverting, where either the RF or LO signal is injected into the unbalanced port. In the upconverting case, a low-frequency signal, injected into the unbalanced I-port is mixed with a second signal that is higher in frequency, and injected into the balanced R- or L-port. These two inputs produce an upconverted signal which exits the mixer via the third port.

Four-Step Optimization Procedure

There are two possible ways to configure a DB mixer as an upconverter: Case 1, where the LO (high-level input) is injected into the mixer at the un-

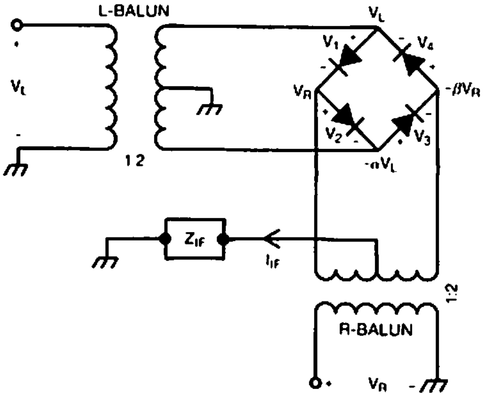


Figure 2. Double-balanced mixer.

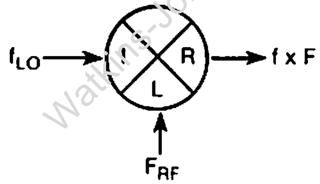
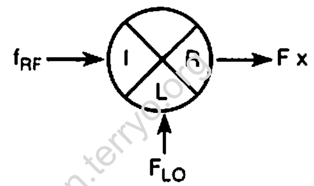
CASE 1 (f x F)				CASE 2 (F x f)			
f		F	Suppression	F		f	Suppression
EVEN	x	ODD	Normal	ODD	x	EVEN	Normal
ODD	x	EVEN	Below Normal	EVEN	x	ODD	Below Normal
DB MIXER 				DB MIXER 			

Table 3. Mixer configurations for upconverting Cases 1 and 2. F is the High Frequency Input, and f is the Low Frequency Input.

balanced I-port; and, Case 2, where the LO is injected at the balanced R- or L-port, as depicted in Table 3. IM suppression for Cases 1 and 2 are different, so the mixer configuration must be chosen carefully to optimize overall IM suppression. A systematic procedure to choose between Cases 1 and 2 follows:

1. Choose the low input frequency, f, and the high input frequency, F.
2. Determine which IM products (n x m) will exist inside the IF-output passband. This is usually done with a computer-generated IM chart.
3. a) Determine suppression for Cases 1 and 2 using n and m from step 2 and Table 1.
   b) Reduce predicted suppression by 10 dB for products having suppression that is below normal, as per Table 3. (The reduction factor of 10 dB causes measured upconversion IM suppression to agree with the predicted values, by taking into account the imbalance at the I-port.)
4. Decide whether Case 1 or Case 2 gives the best overall IM suppression.

Case Study

Upconversion of a WJ-M79H is considered as a case study to illustrate this process. The WJ-M79H, a Class II, Type I DB mixer covering 6 to 18 GHz, is used as an upconverter. IM suppression is measured for Case 1 (the LO injected into the unbalanced I-port at the low frequency) and for Case 2 (the LO injected into the balanced R-port at the high frequency).

The LO level into the WJ-M79H for this measurement is +20 dBm and the RF level is 0 dBm, so, ΔP = -20 dB. The WJ-M79H will operate with LO power up to +23 dBm, with a 1-dB compression level of +20 dBm, and conversion loss of only 7.5 dB.

Step 1

The low frequency is chosen to be f = 2.9 GHz, and the high-frequency range is chosen to be F = 7.1 to 7.6 GHz. The IF output is, therefore, 10.0 to 10.5 GHz.

Step 2

Using an in-house computer program, the IM products shown in Table 4 were found to be near the IF passband.

Step 3

Calculated and measured values of IM suppression for Cases 1 and 2 are given in Table 5. Note that calculated and measured values agree fairly closely.

Step 4

Case 2 is chosen as having the best overall IM suppression because its -F + 6f product is much better suppressed (-60 dBc) than the 6f - F product (-42 dBc) in Class 1. This is important because the output frequency range of these two products is 9.8 to 10.3 GHz, which overlaps the IF bandwidth of 10.0 to 10.5 GHz. If the -F + 6f and 6f - F products did not overlap the IF bandwidth, Case 1 would probably be the best choice because the -f + 2F product in Case 1, close to the IF pass band at 11.3 to 11.5 GHz, is much better suppressed (-50 dBc) than the 2F - f product in Case 2 (-26 dBc). The -4f + 3F and 3F - 4f products are ignored because of their high suppression, even though they overlap the IF bandwidth.

(f) n	(F) m	Output Frequency (GHz)
1	1	10.0-10.5
2	1	12.9-13.4
-1	2	11.3-11.5
-2	2	9.0-9.4
-4	3	9.7-11.2
6	-1	9.8-10.3

Table 4. Listing of IM products in or near the IF band for step 2.

Using this method, the system designer can quickly arrive at the optimum upconverter configuration. He should then confirm these results with measured data, if possible. A similar process can also be used to determine the optimum

Frequency (GHz)	Suppression (dBc)							
	Case 1				Case 2			
	(f) n	(F) m	Calculated	Measured	(F) n	(f) m	Calculated	Measured
10.0-10.5	1	1	0	0	1	1	0	0
11.3-11.5	-1	2	51	50	2	-1	25	26
12.9-13.4	2	1	35	40	1	2	61	63
9.0-9.4	-2	2	59	61	2	-2	59	63
9.7-11.2	-4	3	——	>60	3	-4	——	>60
9.8-10.3	6	-1	35	42	-1	6	——	>60

Table 5. Calculated and measured values of WJ-M79H IM suppression for step 3.

His results for odd x odd products, as interpreted by Tucker[12] agree with Table 1. The input LO and RF signals are both sinusoidal as in equation 6:

$$v_L = V_L \cos(\omega_L t + \theta_L) = V_L \cos x$$
$$v_R = V_R \cos(\omega_R t + \theta_R) = V_R \cos y \qquad (6)$$

Since v_L and v_R are periodic, IF current containing their IM products can be expanded into a double Fourier series in x and y as in equation 7:

$$I_{IF} = \sum_{n=0}^{\infty} \sum_{m=0}^{\infty} [I_{nm} \cos(nx)\cos(my) + Bnm \sin(nx)\sin(my)] \qquad (7)$$

Bnm = 0 because v_L and v_R are even functions of x and y[13]. I_{nm}, the current for the n x m IM product, is solved by integrating I_{IF} over x and y in a double Fourier integral:

$$I_{nm} = \frac{2}{\pi^2} \int_0^{\pi}\int_0^{\pi} I_{IF} \cos(nx)\cos(my)\, dx\, dy \qquad (8)$$

Equations 2, 3 and 4 are combined to yield I_{IF} in equation 9:

$$I_{IF} = \Bigg[(v_L - v_R)\left\{\frac{1}{2} + \frac{1}{\pi}\int_0^{\infty} \frac{\sin(v_L - v_R - V_F)\lambda}{\lambda} d\lambda \right\} - \delta_2(\alpha v_L + v_R)\left\{\frac{1}{2} + \ldots\right.$$

$$\left. \ldots \frac{1}{\pi}\int_0^{\infty} \frac{\sin[(\alpha v_L + v_R)\delta_2 - V_F]\lambda}{\lambda} d\lambda \right\} + \delta_3(\beta v_R - \alpha v_L)\left\{\frac{1}{2} + \ldots\right.$$

$$\left. \ldots \frac{1}{\pi}\int_0^{\infty} \frac{\sin[(\beta v_R - \alpha v_L)\delta_3 - V_F]\lambda}{\lambda} d\lambda \right\} + \delta_4(v_L + \beta v_R)\left\{\frac{1}{2} - \ldots\right.$$

$$\left. \ldots \frac{1}{\pi}\int_0^{\infty} \frac{\sin[(v_L + \beta v_R)\delta_4 + V_F]\lambda}{\lambda} d\lambda \right\}\Bigg] \qquad (9)$$

Equation 9 is inserted into equation 8, the order of integration is interchanged, and the approximation is made that $\alpha = \beta = \delta_2 = \delta_3 = \delta_4 = 1$ in the arguments of the resulting sin terms. α, β, δ_2 through δ_4 remain unchanged elsewhere, however. Integration over x and y is accomplished using modified Bessel integrals[14]. The result is integrated over λ by converting the sin and cosine terms into their Bessel function equivalents as in equation 10, and then using a triple Bessel function definite integral[15] to obtain Inm/V_R.

$$\sin(z) = \sqrt{\frac{\pi z}{2}}\, J_{1/2}(z) \qquad \cos(z) = \sqrt{\frac{\pi z}{2}}\, J_{-1/2}(z) \qquad (10)$$

Hypergeometric functions of two variables[16] result from the integration over λ, but are approximated as equal to unity because both $(V_R/V_L)^2$ and $(V_F/V_L)^2$ are taken to be much less than 1. The ratio of IM-to-IF current at the mixer output is calculated by dividing (I_{nm}/V_R) by (I_{11}/V_R). Intermodulation suppression is equated to the logarithm multiplied by 20, of (I_{nm}/I_{11}), resulting in equation 1. The quantity, ΔP, equals 20 log (V_R/V_L). (V_R/V_L) is present in the current ratio (I_{nm}/I_{11}).

downconverter arrangement, with Step 3b omitted.

TB mixers, such as the WJ-M50A, M89, M88, M87, M83, M93 and M2T can also be used as upconverters. These mixers generally have better even x odd or odd x even suppression than DB mixers because their I-port is balanced, but they tend to be slightly more expensive than DB mixers. The WJ-83H, a new (high-level) Class II DDB 2-to-18 GHz mixer, performs exceptionally well as an upconverter, operating with up to +26 dBm of LO power and about +20 dBm of RF power at the 1-dB compression point; it can deliver +12 dBm of upconverted output power.

Conclusion

An analysis of DB mixers, based on the switching characteristic of an ideal diode, has been presented. The analysis predicts suppression of even x even, odd x even, even x odd, and odd x odd products. The effects of diode turn-on voltage, balun imbalance, diode mismatch, and RF and LO input power levels are considered. The analysis agrees with results already established by measured data; i.e., IM suppression is best when the mixer circuit is well balanced, the diodes are well matched, the LO power is highest, and the RF power is lowest.

Typical values of balun imbalance and diode mismatch are used to establish the simple rule-of-thumb expressions in Table 1 that predict suppression of various IM products, given only the difference between RF and LO power levels. Predicted IM suppression values are within the range of measured IM suppression values for the various classes of mixers, and thus are accurate enough for many system design applications. Their accuracy can be enhanced by more closely tailoring values of circuit imbalance, diode mismatch and V_f to a particular mixer application.

In addition, a four-step procedure to choose the optimum port usage in mixers has been presented.

The analysis presented and the resulting formulas should be helpful to microwave and RF system designers working to avoid the presence of poorly suppressed IM products in their system IF bandwidths. These formulas also lend themselves to usage in computer simulations to approximate system IM performance as input frequencies and power levels to various mixers in the system are varied.

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Appendix

Summary of Derivation of Generalized Equation

The DB mixer in Figure 2 is analyzed by summing diode currents at the I-port[9] as in equation 2. Diode voltages are written in equation 3. When the voltage across a given diode exceeds V_F, the diode is in the "on" state and current flows through it to the IF load. When biased "on," the diode is a short, so the conductance seen by the current is that of the IF load. Diode forward resistance is ignored because it is assumed to be small relative to the IF load impedance. When the diode voltage is less than V_F, the diode is biased "off," so no current flows through it, causing conductance to equal zero. Equation 4 succinctly describes this: when the diode is "on," its conductance G_D is normalized to 1, and when the diode is "off," conductance equals zero. Normalizing the "on" conductance to equal 1 simplifies subsequent algebra, and is valid because conductance cancels later in the derivation, assuming the load impedances at the IM and IF frequencies are equal when the ratio of IM-to-IF current is taken.

$$I_{IF} = i_1 - i_2 + i_3 - i_4 = V_1G_1 - V_2G_2 + V_3G_3 - V_4G_4 \tag{2}$$

$$V_1 = v_L - v_R \qquad V_2 = \delta_2(v_R + \alpha v_L) \qquad V_3 = \delta_3(\beta v_R - \alpha v_L)$$
$$V_4 = -\delta_4(\beta v_R + v_L) \tag{3}$$

$$G_D = \frac{1}{2} + \frac{1}{\pi}\int_0^{\infty} \frac{\sin(V_D - V_F)\lambda}{\lambda}\, d\lambda = \begin{cases} 1\,; & V_D > V_F \\ 0\,; & V_D < V_F \end{cases} \tag{4}$$

Equation 4 is based on equation 5[10], which was used by Bennett[11] to calculate levels of odd x odd IM products in a single-ended mixer assuming $V_F = 0$.

$$\int_0^{\infty} \frac{\sin m\lambda}{\lambda}\, d\lambda = \begin{cases} \pi/2\,; & m > 0 \\ -\pi/2\,; & m < 0 \end{cases} \tag{5}$$

Qualified to MIL-M-28837!

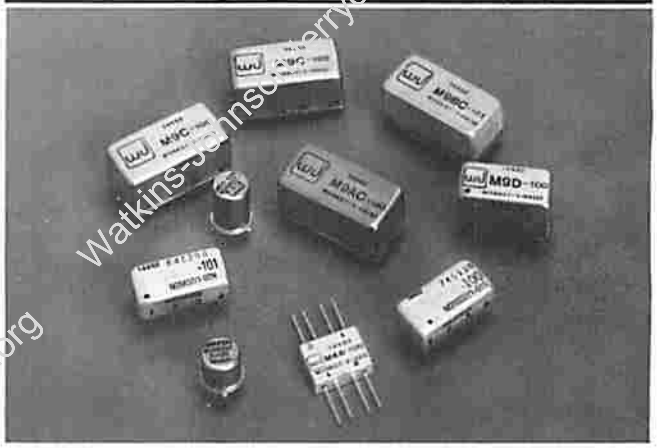
The Advantages In Specifying MIL-Qualified Mixers

- NO ENGINEERING DOCUMENTATION REQUIRED
- NO RFQs
- NO NEED TO REQUEST NONSTANDARD PARTS APPROVAL
- MONITORED BY THE U.S. GOVERNMENT
- ATTRACTIVE PRICE
- STOCK DELIVERIES
- AVAILABLE QUALIFICATION DATA

QPL

The Cost Effective Approach to Hi-Rel Programs

QPL mixers for ground, air and shipboard programs.



Typical Specifications

MIL-M-28837	W-J Model	RF Frequency (MHz)	LO Power Nominal dBm	Conversion Loss (Noise Figure) Typ. dB	IF Frequency (MHz)	f_R Level at 1 dB Compression Point Typ. dBm	Isolation Typ. dB L-R	Isolation Typ. dB L-I	Input Intercept Point Typ. dBm	Package Type	Hermetic Seal	Outline Drawing	Page No.
/1-01S	M6D-100	0.05-200	7	6.5	DC-200	0	45	40	13	PC	Yes	298572	
/1-01N	M6D-101	0.05-200	7	6.5	DC-200	0	45	40	13	PC	Yes	298572	
/1-02S	M6E-100	5-500	7	7.0	DC-500	0	45	40	13	PC	Yes	298572	
/1-02N	M6E-101	5-500	7	7.0	DC-500	0	45	40	13	PC	Yes	298572	
/2-02S	M4A-100	10-1500	7	7.0	DC-1000	0	30	30	13	Flatpack	Yes	296960	
/2-02N	M4A-101	10-1500	7	7.0	DC-1000	0	30	30	13	Flatpack	Yes	296960	
/7-01S	M6T-100	10-500	7	7.0	DC-500	0	40	35	13	TO-5	Yes	298642	
/7-01N	M6T-101	10-500	7	7.0	DC-500	0	40	35	13	TO-5	Yes	298642	
/7-03S	M6V-100	4-500	7	6.5	DC-500	0	45	30	13	TO-5	Yes	298643	
/7-03N	M6V-101	4-500	7	6.5	DC-500	0	45	30	13	TO-5	Yes	298643	
/1-04S	M9D-100	2-400	20	6.5	DC-800	15	40	40	30	PC	Yes	298500	
/1-04N	M9D-101	2-400	20	6.5	DC-800	15	40	40	30	PC	Yes	298500	
/1-05S	M9AC-100	0.05-200	13	7.5	DC-200	10	45	40	23	PC	Yes	298640	
/1-05N	M9AC-101	0.05-200	13	7.5	DC-200	10	45	40	23	PC	Yes	298640	
/1-06S	M9BC-100	0.5-500	17	7.0	DC-500	8	55	45	23	PC	Yes	298640	
/1-06N	M9BC-101	0.5-500	17	7.0	DC-500	8	55	45	23	PC	Yes	298640	
/1-10S	M9C-100	0.4-500	13	7.5	DC-500	10	45	40	23	PC	Yes	298640	
/1-10N	M9C-101	0.4-500	13	7.5	DC-500	10	45	40	23	PC	Yes	298640	
		GHz											
/2-11S/N	M63-100/101	2.5-5.5	9	6.5	DC-1500	3	30	17	11	MINPAC®	Yes	295758	
/5-05S/N	M63C-100/101	2.5-5.5	9	6.5	DC-1500	3	30	17	11	Connectorized	Yes	296010	
/2-12S/N	M76-100/101	4.5-9.5	7	7.5	DC-2000	3	20	10	13	MINPAC	Yes	295813	
/5-06S/N	M76C-100/101	4.5-9.5	7	7.5	DC-2000	3	20	10	13	Connectorized	Yes	295984	
/2-13S/N	M79-100/101	7.0-18.0	10	8.5	DC-3000	4	15	12	15	MINPAC	Yes	295777	
/5-07S/N	M79C-100/101	7.0-18.0	10	8.5	DC-3000	4	15	12	15	Connectorized	Yes	296342	
/2-15S/N	M88-100/101	2.0-18.0	13	10.5	1000-8000	7	15	16	14	MINPAC	Yes	298501	
/5-09S/N	M88C-100/101	2.0-18.0	13	10.5	1000-8000	7	15	16	14	Connectorized	Yes	298502	
/2-16S/N	M93-100/101	2.0-18.0	10	10.5	DC-4000	4	15	16	14	MINPAC	Yes	298501	
/5-10S/N	M93C-100/101	2.0-18.0	10	10.5	DC-4000	4	15	16	14	Connectorized	Yes	298502	

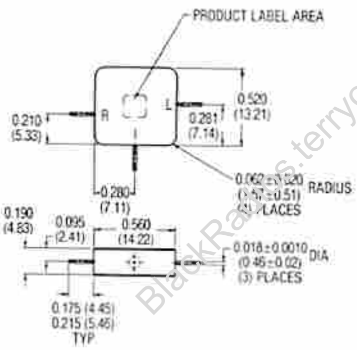
Typical Specifications

Level "N"	Level "S"	Test	MIL-STD-202 Method	Condition	MIL-STD-105 Level II AQL
		Prescreening			
X	X	Preliminary Hermeticity	112	C, IIIA	100%
	X	Bake		24 hrs @ +100°C	100%
	X	Burn-in		96 hrs.	100%
	X	Post Burn-in Electrical Test	(Note 1)		100%
		Subgroup I			
X	X	Visual and Mechanical Inspection		W-J in-house inspection criteria	1.0
X	X	Hermeticity	112	C, IIIA	1.0
X	X	Electrical Test	(Note 1)		1.0
		Subgroup II			
	X	Thermal Shock	107	B	1.0
	X	Vibration	204	D	1.0
	X	Hermeticity	112	C, IIIA	1.0
	X	Final Electrical Test	(Note 1)		1.0
X	X	Final Quality Inspection		W-J in-house inspection criteria	100%

NOTE: 1. Per the applicable MIL-M-28837 Slash Sheet.

Outline Drawings

295777



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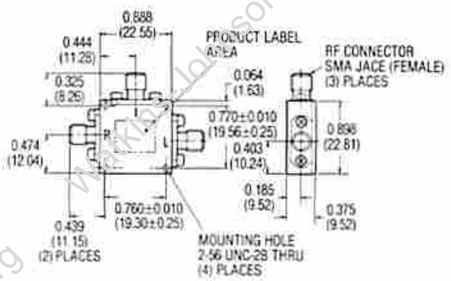
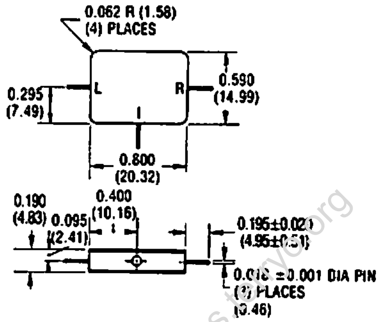


7

Outline Drawings

295813



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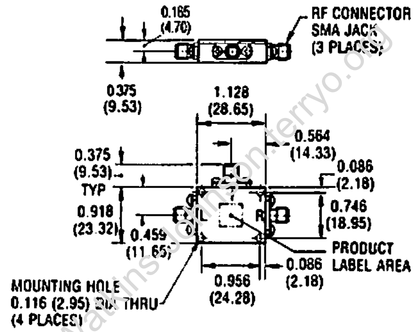

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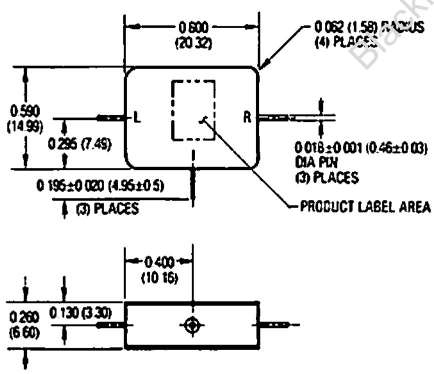

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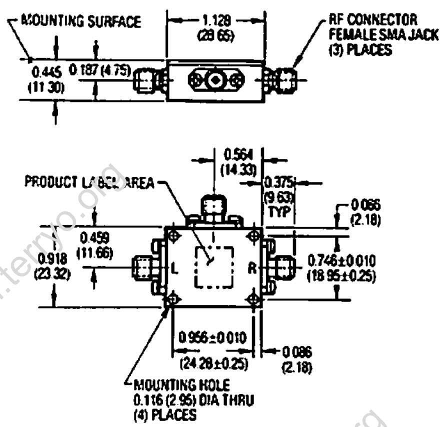

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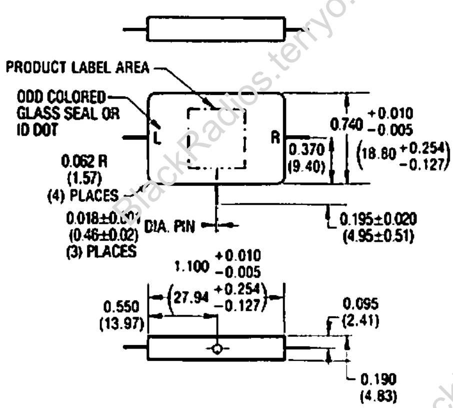

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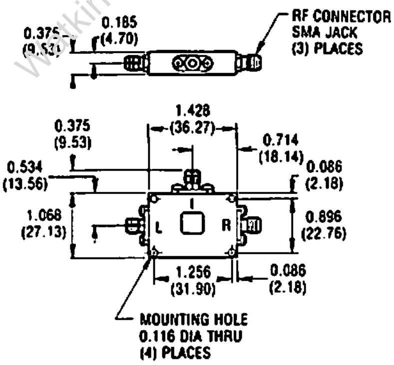

Outline Drawings

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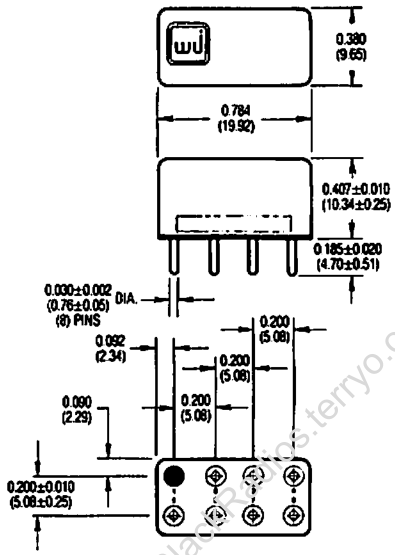

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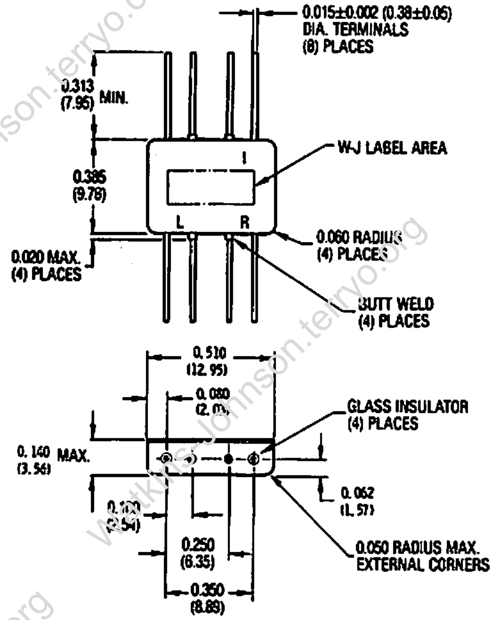

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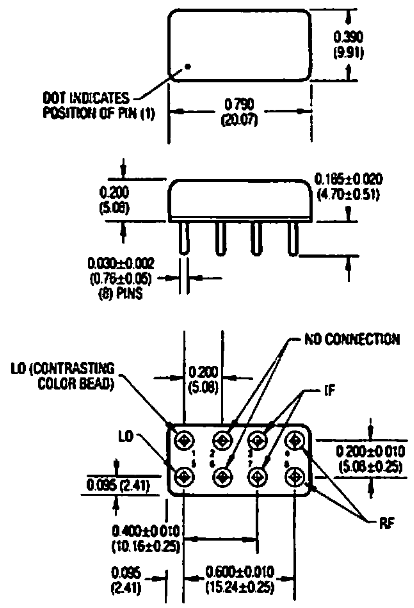

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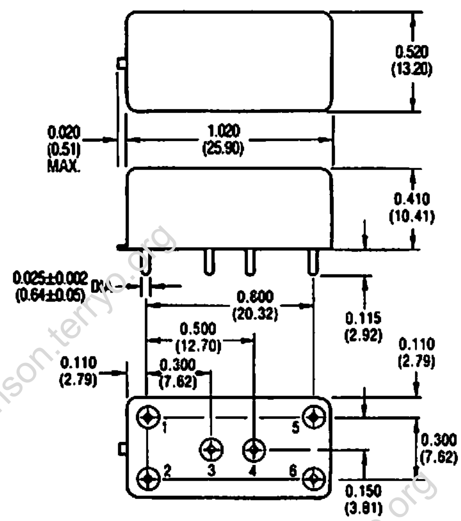

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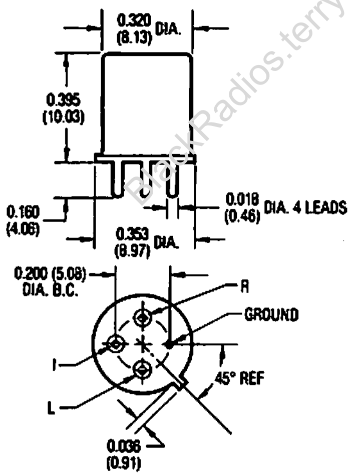

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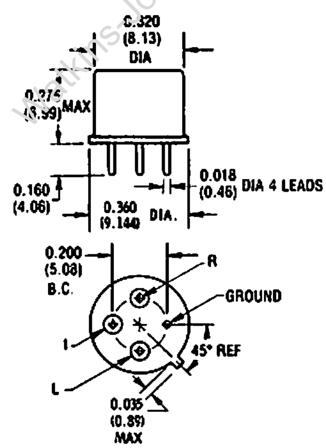


7

MIL-Specification Mixers

Author: Sherrie A. Schindler

Over the last fifteen years there has been a rising awareness of the need for standardization in the military electronics industry. The Defense Electronics Supply Center (DESC), located in Dayton, Ohio, was created in 1962 as a branch of the Defense Logistics Agency (then the Defense Supply Agency) to consolidate military procurement of commonly-used electronic components within a single organization. DESC provides guidance to military system design engineers by encouraging the use of standard parts in new designs. This greatly enhances the maintainability of a new system by ensuring prompt deliveries, reasonable cost, and reliable performance.

A standard part is a component which is defined by a military specification and which is qualified by DESC to the requirements of that specification. MIL-S-19500, General Specification for Semiconductor Devices and MIL-C-39012, General Specification for Radio-Frequency Coaxial Connectors are two widely known examples of military standard parts specifications. In addition to standardization, these specifications are important because they describe appropriate environmental test methods for their respective technologies. This information is useful to the industry at large, even when standard parts are not being used.

MIL-M-28837, General Specification for Radio-Frequency Mixer Stages, was written in 1977. Watkins-Johnson Company, has had mixers qualified to MIL-M-28837 since April of 1981. MIL-M-28837 is important not only as a standardization tool, but also because it applies the test methods of MIL-STD-202 in a comprehensive screening program to mixer technology. Mixers use a variety of assembly techniques that range from lumped element to microstrip to thin-film, making the application of other established screening programs such as MIL-STD-883 Method 5008, and MIL-M-38510 not entirely appropriate.

The Space and Naval Warfare Systems Command is one of the military organizations responsible for generating and maintaining general specifications for standard parts. DESC-ECT (Electronic Component and Tube branch) is the agent that establishes these documents. Information is gathered from interested manufacturers of the subject component and from users of that electronic component before the specification is issued. Manufacturers also provide a detailed description of individual parts, including military usage history, outline, environmental, and electrical data, to DESC-ECT to be included in the detail specification (referred to as a *slash sheet*) associated with the main document. It is only after this data has been incorporated into the slash sheets that a manufacturer may submit an application for approval to begin qualification testing. As part of the application, a Master Equipment List identifying all test equipment, and a copy of the manufacturer's internal documentation for qualification and production must be submitted for review and approval by DESC. DESC also audits manufacturers on a periodic basis — a successful audit is a prerequisite to approval to begin qualification testing. Once a manufacturer has completed qualification testing and is approved by DESC, the qualified part is added to the Qualified Parts List (QPL) attached to the General Specification. There are several rules that qualified suppliers are required to follow. These conditions, listed below, protect the government from changes to parts after qualification and any attempt to use qualification as government endorsement.

Conditions Regarding Qualification Approval

1. Qualified Products List (QPL) listing does not guarantee acceptance of the product in any future purchase.
2. QPL listing does not constitute a waiver of any requirements of the specification or of the provisions of any contract.
3. Advertising of qualification information is permitted. Permission to use such information for advertising or publicity purposes is granted provided that such publicity or advertising does not state or imply that the product is the only product of that type qualified or that the Department of Defense in any way recommends or endorses the manufacturer's product.
4. The listing applies only to products manufactured in the plant(s) specified in the letter of notification.
5. The listing applies to future amendments or revisions of the specification, unless otherwise notified.
6. The listing applies only to products identical to that (those) qualified. The qualifying activity must be advised of any change to the product. Failure to notify the qualifying activity of a change in design is cause for removal from the Qualified Products List, regardless of the extent of the design change.
7. Continued qualification listing is dependent upon the manufacturer's compliance with the retention of qualification, verification of qualification, or periodic requalification requirements, as applicable, in the specification to which the manufacturer's products are qualified. For specifications not containing specific qualification verification or retention requirements, DD Form 1718 must be submitted at intervals to be specified by DESC.

MIL-Specification Mixer Screening

Qualification testing per MIL-M-28837, as described in Table 1, is designed to verify that a specific mixer model meets the physical, environmental and electrical characteristics described in the slash sheets. The screening performed in Groups I and II is nearly identical to that required on each "screened" production lot, stressing the diodes (burn-in) and mechanical construction of the mixer (thermal shock, vibration, mechanical shock, and seal). Group III is a series of tests designed to verify package integrity (solderability, terminal strength, resistance to solvents, and moisture resistance).

Mixer QPL production lots are screened per Group A of MIL-M-28837, as described in Table 2. QPL-qualified parts are produced to two screening levels: screened (level "s") and nonscreened (level "n"). The nonscreened QPL part is a basic commercial mixer which has been verified to meet the electrical and mechanical description contained in the slash sheets. The screened QPL mixer is subjected to a preconditioning bake, 96-hour burn-in, and post burn-in electrical test on a 100% basis. The remaining tests are performed on an AQL of 1.0 per MIL-STD-105.

Qualification maintenance inspection per Group B of MIL-M-28837, as described in Table 3, requires mixers which have successfully completed level "s" screening to be subjected to the same tests described for initial qualification, with the exception of visual mechanical inspection, preconditioning bake, burn-in, and post burn-in electrical test (these screening operations were performed during production testing). To maintain a QPL listing, Group B inspection must be performed once every two years for each qualified part. Any updates to the Master Equipment List must also be submitted with the Group B report. The qualified manufacturer is subject to DESC audits at any time.

If any consumer of QPL-qualified mixers identifies a serious quality problem with a particular part, the consumer may issue an alert or request DESC to issue an alert to the industry, identifying the problem, the model(s) affected, and the manufacturer's corrective action. All sales of the part(s) may be suspended until the alert is resolved. However, the stringent quality requirements placed on QPL-qualified parts are designed to minimize the frequency of alerts.

Test	MIL-STD-202 Method	Condition
Group I (4 Sample Units)		
Visual and Mechanical Inspection		Manufacturer In-House Criteria
Bake		24 hours at +100°C
Burn-In		96 hours at +25°C
Post Burn-In Electrical Test	(Note 1)	
Group II (2 Sample Units)		
Thermal Shock	107	B
Vibration	204	D
Mechanical Shock	213	A
Hermeticity	112	C, IIIA
Electrical Test	(Note 1)	
Group III (2 Sample Units)		
Solderability	208	All Terminals
Resistance to Solvents	215	
Resistance to Soldering Heat	210	B
Electrical Test at Temperature Extremes	(Note 1)	
Terminal Strength	211	A, ½ pound applied
Moisture Resistance	106	
Electrical Test	(Note 1)	

Notes:
1. Per the applicable MIL-M-28837 slash sheet.
2. All operations in this table may be modified by the appropriate slash sheet.

Table 1. MIL-M-28837 qualification inspection[2].

Level "N"	Level "S"	Test	MIL-STD-202 Method	Condition	MIL-STD-105 Level II AQL
		Prescreening			
X	X	Preliminary Hermeticity	112	C, IIIA	100%
	X	Bake		25 hours at +100°C	100%
	X	Burn-In		96 hours at +25°C	100%
	X	Post Burn-In Electrical Test	(Note 1)		100%
		Subgroup I			
X	X	Visual and Mechanical Inspection		Manufacturer In-House Criteria	1.0
X	X	Hermeticity	112	C, IIIA	1.0
X	X	Electrical Test	(Note 1)		1.0
		Subgroup II			
	X	Thermal Shock	107	B	1.0
	X	Vibration	204	D	1.0
	X	Hermeticity	112	C, IIIA	1.0
	X	Final Electrical Test	(Note 1)		1.0
X	X	Final Quality Inspection		Manufacturer In-House Criteria	100%

Notes:
1. Per the applicable MIL-M-28837 slash sheet.
2. All operations in this table may be modified by the appropriate slash sheet.

Table 2. MIL-M-28837 Group A inspection[2].

Advantages and Disadvantages

There are many advantages to procuring a QPL-qualified mixer over a nonqualified mixer. There is no need to create a specification or source control drawing for a QPL-qualified part. Simply buying to the military part number assigned by DESC, provided the mixer model and manufacturer are listed on the latest issue of the Qualified Products List, will secure a standard part all of whose aspects are described and controlled by MIL-M-28837. Another advantage is reduced delivery time, as the manufacturer has the option to build the QPL-listed items for stock, not to custom order. Prices are considerably less than for special Hi-Rel requirements due to the fact that there are many customers for a given QPL mixer, and the manufacturer is thus able to produce in volume. There are also no nonrecurring engineering (NRE) charges or lot charges involved in QPL procurement. Perhaps most important of all, however, is the knowledge that the quality of the part is constantly being monitored by DESC. Qualification data is available for review, as are qualification maintenance reports. QPL-qualified mixers are controlled so as to improve the maintainability of the systems in which they are used. Procuring spares is also an easy task with a QPL-qualified unit.

Disadvantages also exist for potential users of QPL mixers. The largest drawback is that a QPL part must be screened to exactly meet the require-

Test	MIL-STD-202 Method	Condition
Subgroup I (2 Sample Units)		
Thermal Shock	107	B
Vibration	204	D
Mechanical Shock	213	A
Hermeticity	112	C, IIIA
Electrical Test	(Note 1)	
Subgroup II (2 Sample Units)		
Solderability	208	All Terminals
Resistance to Solvents	215	
Resistance to Soldering Heat	210	B
Electrical Test at Temperature Extremes	(Note 1)	
Terminal Strength	211	A, ½ pound applied
Moisture Resistance	106	
Electrical Test	(Note 1)	

Notes:
1. Per the applicable MIL-M-28837 slash sheet.
2. All operations in this table may be modified by the appropriate slash sheet.

Table 3. MIL-M-28837 Group B inspection[2].

ments of MIL-M-28837, no more, no less. If a design engineer requires an electrical test not included in the slash sheets, or desires additional printing on the unit, or any such deviation, no matter how minor, the military part number must be removed from the mixer. This is mainly due to DESC's concern that an item printed with the military part number but having special requirements beyond those of MIL-M-28837 would not be able to be differentiated from a normal QPL part, and that when such a part is repaired or reordered it is probable that a normal QPL will be purchased without the additional screening. Another disadvantage is that the variety of mixers listed on the QPL list, although it is growing constantly, cannot encompass the variety of catalog mixers currently available in the industry. In order to take advantage of QPL-qualified mixers, a system designer may have to redraw a board to accept the package style that is qualified. It should be noted that if a part with the desired electrical performance does not appear on the Qualified Parts List, a qualified manufacturer such as Watkins-Johnson Company can screen any of its mixer models to the QPL *equivalent* level per Group A of MIL-M-28837. (These mixers may *not* be printed with a military part number unless qualification testing is performed on the first article produced for the contract.)

There are disadvantages for the manufacturer of QPL-qualified mixers as well. Any change in design of a currently qualified model must be approved by DESC, and if it is deemed necessary, a new qualification may be required. Even if further testing is not required, written approval may involve a wait of several months. Qualifying a mixer to MIL-M-28837 involves a substantial time, money, and energy investment on the part of the manufacturer. To add a model to the slash sheets, the appropriate data must be gathered and submitted to DESC-ECT. A wait of 9 to 24 months is typical prior to the incorporation of this data into the slash sheets. Another several months is consumed by DESC review of the manufacturer's application to perform qualification testing and the manufacturer's documentation. The actual qualification testing takes approximately two months to complete. Finally, there is another wait of several months for DESC to approve the qualification and add the model to the QPL list. This adds up to a minimum of two years' effort by the manufacturer to add a model to the Qualified Products List.

In spite of the time involved, many motivations exist for a manufacturer to expend the necessary effort to become qualified. The creation of a Hi-Rel "standard" eliminates many small volume programs which each require unique documentation and engineering attention. QPL-listed mixers are produced in volume, leaving the engineer free to concentrate on manufacturing rather than documentation. The qualification also may be used to perform qualification by similarity for unique programs where qualification is required. This allows the qualified manufacturer to avoid duplication of labor-intensive qualification testing. The QPL listing also demonstrates that the manufacturer has a high quality production facility.

Interpreting The Slash Sheets

Having clearly established the benefits of specifying QPL-listed mixers, it is essential to gain a full understanding of the slash sheets. To determine if a

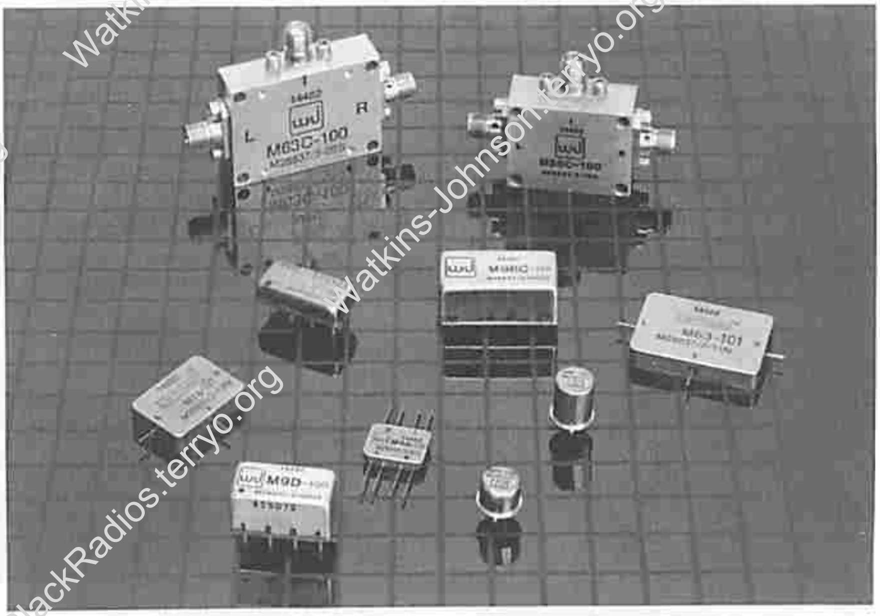


Figure 1. The variety of QPL-qualified package styles.

mixer of a certain package type is described in the slash sheets, a quick scan is necessary. Each slash sheet (there are currently nine) contains a different package style. For example, slash sheet 1 describes plug-in outlines, slash sheet 2 describes packages with solderable leads, slash sheet 5 describes units with SMA female connectors, and slash sheet 7 describes mixers in TO-5 packages. Once an appropriate package style is located, the next task is to review the electrical description in the slash sheets to determine the desired dash number. The "substitutability data" table at the end of each slash sheet will provide a listing of manufacturers' codes for each dash number. This, however, does not mean that the part has been qualified. The Qualified Products List must be reviewed to determine if that part is qualified, and which manufacturer is qualified to produce it. Currently, mixers are qualified on slash sheets 1, 2, 5, and 7. Watkins-Johnson Company has nineteen qualified mixer models covering input frequencies from 0.05 MHz to 18 GHz. Figure 1 illustrates the variety of qualified product styles. The proper method of calling out a military part number is illustrated in Figure 2.

M28837	/1	-01	S
a	b	c	d

a. The general specification for the component type (i.e., mixers, capacitors, etc.)

b. The appropriate slash sheet for the package style (i.e., plug-in, SMA female connectorized, solderable leads, etc.).

c. The specific electrical characteristics as described in the slash sheets.

d. Indicates screened (s) or nonscreened (n) level testing.

Figure 2. How to interpret a military part number.

In 1972, the Department of Defense (DoD) chartered DESC as the first Military Parts Control Advisory Group (MPCAG) responsible for the Parts Control Program in accordance with MIL-STD-965. The program, covered by DoD Instruction 4120.19, became mandatory for all weapon systems procurements in August 1983. This instruction requires that electronic and mechanical parts be reviewed by technical consultants at DESC and the Defense Industrial Supply Center, respectively, prior to procurement and use in the system. These consultants aid designers in selection and application of components using the maximum number of standard parts possible. Under this program, nonstandard part approval requests must be submitted by the system contractor, reviewed by MPCAG, and approved by the military acquisition office for the system. This process is effectively reducing the number of new stock numbers in the Department of Defense, eliminating duplicate documentation, decreasing the cost of military systems, and improving the reliability of equipment. In the fiscal year ending 30 September 1987, the DESC Military Parts Control Advisory Group supported 934 contracts and has supported over 2,850 contracts since 1972.

There are many advantages to specifying QPL-qualified mixers including, reduced cost, shortened delivery time, and improved reliability. The manufacturer of QPL-qualified mixers may concentrate engineering efforts on maintaining a high-quality production line instead of creating documentation for a variety of virtually idential requirements. The systems manufacturer is relieved of the need to create a source or specification control drawing as the mixer is fully specified by its military part number. The creation of MIL-M-28837 has also filled a need in the military electronics industry for a comprehensive screening program applicable to mixer technology. Through the standardization efforts of the Department of Defense, both the systems designer and the components manufacturer reap benefits, thereby simplifying the process of military systems design and parts procurement.

MIXER APPLICATION INFORMATION

The information contained below is applicable to all mixers in general and should be useful to those who might want to more fully understand mixer operation and achieve the most performance possible.

DEFINITIONS

Conversion Loss is the ratio of the output signal level to the low-level input signal level expressed in dB. In a single sideband system, only one sideband is used, therefore, 3 dB of the loss is theoretical. The additional loss is diode and transformer loss. These losses can be minimized by driving the diodes with sufficient current and operating in the best portion of the frequency band.

Conversion loss is specified in a 50-ohm system with an f_L drive level of +7 dBm for low-level mixers. High-level mixers require more drive level power. A short circuit at the output port for the unwanted sideband will usually improve the conversion loss and noise figure by 0.5 dB if operation at the I-port is below 500 MHz.

Noise Figure is the signal-to-noise ratio at the input divided by the signal-to-noise ratio at the output expressed in dB. It does not include the noise figure of an IF amplifier or 1/f flicker noise.

The IF frequency range is normally specified from 400 kHz to the upper frequency range of the device. Appreciable noise contribution from 1/f noise is not noticeable above 10 kHz. Use of specially selected Schottky-Barrier diodes ensures extremely low 1/f noise for phase detection applications. With the recommended drive level the noise figure and conversion loss are essentially identical.

Isolation is the amount of "leakage" or "feedthru" between the mixer ports. The f_L at R isolation is the amount of f_L drive level signal is attenuated when measured at the R-port. The f_L at I isolation is the amount the f_L drive level signal is attenuated when measured at the I-port. Normally, only the f_L isolation is specified since the f_R signal level is much lower than the f_L signal level and is not a problem. The f_I at L and f_R at L isolations are normally the same as the f_L at I and f_L at R isolations. At low frequencies, where diode parameters are matched and circuit parasitics are negligible, isolation greater than 60 dB is possible.

Conversion Compression is the f_R input level above which the f_R input vs. f_I output curve deviates from linearity. Above this level additional increases in input level do not result in equal increases in output level. Conversion compression is not specified for all low-level mixers. However, low-level units normally have the same compression level: i.e., typically 0.3 dB deviation from linearity with an f_R signal level of +2 dBm and a +7 dBm f_L drive level. This f_R level can be raised to +4 dBm if the drive level is increased to +13 dBm.

Conversion compression for high-level mixers is specified since it sometimes provides an indication of the mixer's two-tone performance and it is likely to be important in high-level operation.

Dynamic Range is the amplitude range over which a mixer can operate without degradation of performance. It is dictated by the conversion compression point and the noise figure of the mixer. Since the thermal noise of each mixer is about the same, the conversion compression point normally determines the mixer's dynamic range.

Intercept Point is the point at which the fundamental response and the third-order spurious response curves intercept. It is often used to predict the 2-tone, 3rd-order suppression of a mixer. The higher the intercept point, the better the 3rd-order suppression. Relative to the input, the intercept point is typically 9 to 11 dB higher than the conversion compression point.

Two-Tone, Third-Order Intermodulation Distortion is the amount of 3rd-order distortion caused from a second received signal being present at the R-port. Mathematically, 3rd-order distortion is defined as $(2f_{R2} - f_{R1}) \pm f_L$ where f_{R2} is the second signal. Usually the higher the conversion compression or intercept point of a mixer, the greater the suppression of this product. Typical performance is shown on page 586. Normally this parameter is not specified as it is dependent on the input frequencies and terminating impedances.

Desensitization is the compression of the desired signal caused by a strong second interfacing signal. For a low-level mixer, this compression is typically less than 1.0 dB for an f_{R2} signal level of +1 dBm and less than 10.0 dB for an f_{R2} signal level of +10 dBm. The desensitization level is normally 3 dB below the conversion compression level.

Applications

Harmonic Intermodulation Distortion results from the mixing of mixer-generated harmonics of the input signals. Mathematically, it is expressed as $mf_L \pm nf_R$ where m and n represent the harmonic numbers of the input signals. Typical performance shown on page 587 is not normally specified since the relative level depends on input frequencies, input levels and terminating impedances.

Cross Modulation Distortion is the amount of modulation transferred from a modulated carrier to an unmodulated carrier when both signals are applied to the R-port of the mixer. The higher the conversion compression or intercept point of a mixer, the greater the attenuation of the cross modulation.

General Applications

Mixing: When two signals are fed to the mixer, sum and difference frequencies are produced at the third port. Best isolation is usually achieved by feeding the LO signal to the L port. In downconverters the RF input signal is fed to the R port and the output is taken from the I port. For up converting applications, feed the low frequency input signal to the I port and take the output from the R port.

Drive Level: Examples of recommended drive levels along with minimum and maximum levels are:

Mixer	Recommended Drive Level dBm	Minimum Drive Level dBm	Maximum Drive Level dBm
Low-Level Mixers	+7	+4 to +6	+13
M12/M12A	+13	+10	+17
M9/M9A	+13	+7	+17
M9B	+17	+10	+20
M9D	+20	+10	+23
M1K	+20	+14	+23
M9E	+27	+10	+30
M67	+10	+7	+14
M76H	+20	+14	+23
M80	+7	+4	+12
M83	+13	+10	+17

A minimum drive level is recommended when it is necessary to reduce the level of intermodulation products in the lower two rows of the intermodulation chart or minimize the 1/f output noise. A drive level below the minimum recommended level degrades the conversion loss and noise figure of the mixer over the full temperature and frequency range.

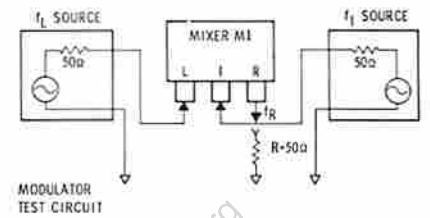
Operation at a high drive level is recommended to achieve best two-tone performance, best suppression of the intermodulation products in the rows above the second row in the intermodulation chart*, and the best flatness of conversion loss as a function of frequency. A drive level above the recommended level will result in an increase in noise figure and an increase in mf_L feedthru.

RF Input Level: With the recommended f_L level, and to avoid deviations from linearity by more than 1 dB, the f_R level should not exceed the following levels:

Mixer Type	f_R Level dBm
Low Level	+1 to +4
High Level	+10 to +14
Ultra High Level (M9E Type)	+21

The f_R signal level should be as low as possible when there is a problem with higher order f_R intermodulation products.

PULSE, AMPLITUDE, AND BI-PHASE MODULATION

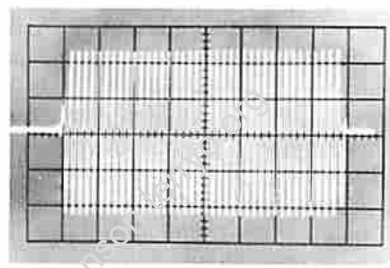


For amplitude modulation, apply a dc current along with the modulating signal at the I-port. The carrier signal is applied at the L-port and the modulated signal appears at the R-port. The dc current at the I-port controls the amount of carrier present in the output.

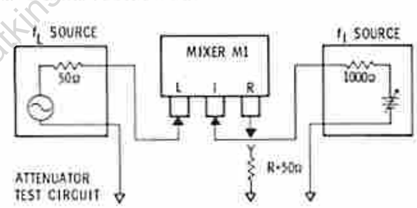
For pulse modulation, feed the unmodulated signal to the L-port and the modulating pulse to the I-port. No dc offset current should be used. Pulse lengths can be of unlimited length since the I-port is direct coupled. A 20 mA level is sufficient to fully turn on the diodes. Rise and fall times less than 1 nsec can be achieved. Zero current turns the diodes off. Either a positive or a negative pulse may be used.

The balanced construction of the mixer allows very little of the switching signal to feed through to the output. To obtain higher "on-off" ratios and improved suppression of the high frequency switching components, refer to pages 716-721.

For bi-phase modulation, reverse the polarity of the switching signal. Upon reversal, the output phase will shift by 180 degrees.



CURRENT-CONTROLLED ATTENUATION



The amount of signal passing through the mixer from the L-port to the R-port is determined by the dc control current present at the I-port. Maximum attenuation is achieved with no dc current and corresponds to the isolation of the mixer. Minimum attenuation is

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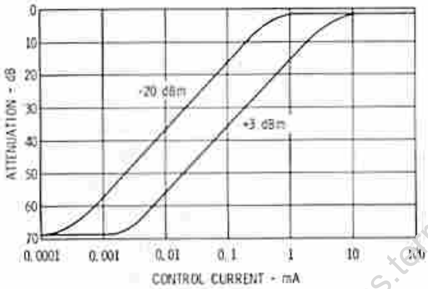
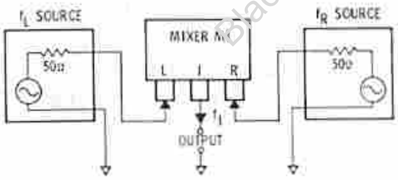
achieved with a dc current of 20 mA or greater.

A plot showing the attenuation characteristics of the M1 is shown below for a 10 MHz signal with signal levels of -20 dBm and +3 dBm. For input signal levels of -20 dBm or less, the attenuation is relatively independent of the signal level.



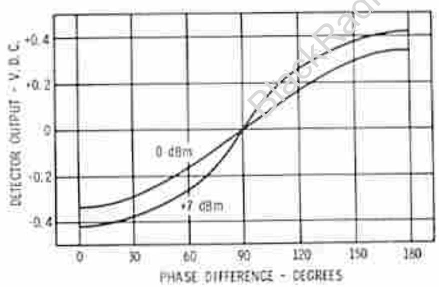
Typical Attenuation vs. Control Current

PHASE DETECTION*



When used as a phase detector, excellent balance of the mixer eliminates null balance adjustments and minimizes interaction between the signal sources. With identical frequencies connected to the R- and L-ports, a dc output related to the phase difference between the two signals will appear at the I-port. The two inputs to the phase detector are normally the same level. The output is usually loaded with 1000 ohms or greater.

The sinusoidal output voltage shown below is from a phase detector in which the inputs are two sinusoidal signals of the same level and the output is loaded with 1000 ohms. The output voltage waveform as a function of phase difference is sinusoidal. With two square wave inputs the output voltage would be linear. Input levels of +7 dBm are recommended for best phase detection. A higher level introduces unbalance and a lower level results in a loss of output level.

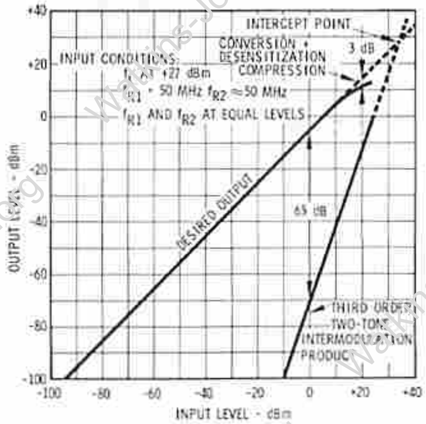


Typical Phase Detector Output vs. Phase Difference

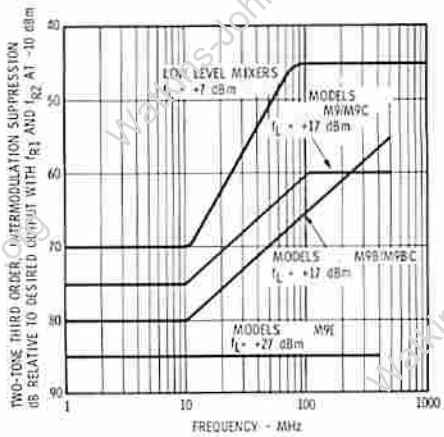
*For more detailed information on Phase Detection see page 605.

TYPICAL TWO-TONE PERFORMANCE AT 25°C

Definition: In a mixer application where the input must be wideband, two signals (f_{R1} and f_{R2}) may mix with the local oscillator signal (f_L) to produce in-band, two-tone third-order intermodulation products ($2 f_{R2} - f_{R1}) \pm f_L$.



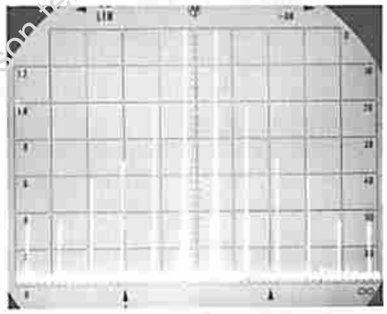
Two-Tone Suppression vs. Input Level: With each dB decrease in f_R input level, the third-order product is decreased an additional 2 dB. As shown above, the M9E will suppress third-order products 65 dB with both input signals as 0 dBm, and 85 dB with both input signals at -10 dBm. Relative to the output, the intercept point for the M9E is +27.5 dBm. Relative to the input, it is +32.5 dBm. This is 17 dB higher than the intercept point for a low-level, double balanced mixer like the M1. The 3 dB compression shown on the graph is a combination of both conversion compression and desensitization.



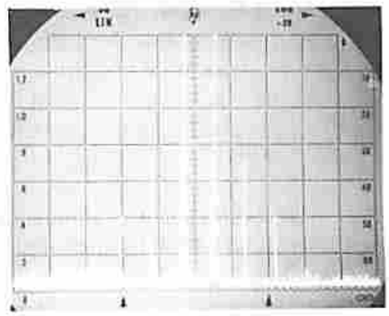
Two-Tone Suppression vs. Input Frequency: The two-tone performance of the M9E is constant across its frequency range. Other mixers, even other high-level mixers (except the M9D), have a degradation in performance above 10 MHz.

Two-Tone Performance of High-Level, Double-Balanced Mixers: In the spectrum analyzer photos, the high-level M9E is compared to the lower-level M9BC and low-level M1 under similar input conditions. The input conditions were as follows:

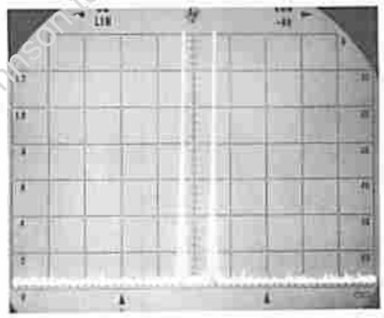
f_L = 352 MHz, f_{R1} = 322 MHz at 0 dBm, f_{R2} = 320 MHz at 0 dBm.
Horizontal Scale: 2.5 MHz/cm, centered at ≈ 31 MHz.
Vertical Scale: 10 dB/cm.



M1: With a +7 dBm f_L drive level, the low-level M1 suppresses many of the two-tone spurs. However, a number of relatively unsuppressed products remain.



M9BC: With a +17 dBm f_L drive level, the M9BC provides an additional 12 dB of suppression of the third-order product.



M9E: With a +27 dBm f_L drive level, the high-level M9E virtually eliminates all two-tone products from the 60 dB spectrum.

Typical Intermodulation Performance at 25°C

M1/M9BC/M9E

Harmonics of f_R	0	1	2	3	4	5	6	7	8
7	79>99>99	69 79>99	80>99>99	74 78>99	83>99>99	63 78>99	78>99>99	60 81>99	71 99>99
	>90>90>90	>90>90>90	>90>90>90	>90>90>90	>90>90>90	87>90>90	>90>90>90	>90>90>90	>90>90>90
6	90>99>99	86>99>99	91>99>99	91>99 97	90>99>99	84>99>99	93>99>99	84>99>99	88>99 98
	>90>90>90	>90>90>90	>90>90>90	>90>90>90	>90>90>90	>90>90>90	>90>90>90	>90>90>90	>90>90>90
5	72 93>99	70 73 96	71 87>99	52 72 95	77 88>99	46 66>99	75 85>99	45 64 90	73 82>99
	>90>90>90	80>90>90	>90>90>90	71>90>90	>90>90>90	68>90>90	>90>90>90	65>90>90	88>90>90
4	80 96 88	79 80 91	82 96>99	77 80 92	82 95 90	76 82 95	[illegible] 98 87	72 78 94	77 90 87
	86>90>90	>90>90>90	86>90>[illegible]	88>90>90	88>90>90	85>90>90	86>90>90	85>90>90	>90>90>90
3	51 63 81	49 58 73	53 65 85	51 60 69	55 65 85	48 55 [illegible]	54 64 85	53 54 64	58 66 87
	67 87>90	64 77>90	69 87>90	50 78>90	77>90>90	47 75>90	74 85>90	44 77 89	74 88>90
2	69 68 64	72 67 71	79 76 62	67 67 70	75 80 63	66 66 70	77 82 61	68 66 62	75 83 64
	73 86 73	73 75 83	74 84 75	70 75 79	71 86 80	64 74 80	69 87 77	64 74 82	69 84 79
1	25 25 24	0 0 0	39 39 35	13 11 11	45 50 42	22 16 19	54 59 50	37 19 39	59 59 49
	24 23 24	0 0 0	35 39 34	13 11 11	40 46 42	24 14 18	45 62 49	28 19 37	49 53 49
0		36 39 29	45 42 20	52 46 32	63 58 24	45 37 29	60 65 27	71 49 30	64 75 29
		26 27 18	35 31 10	39 36 23	50 47 14	41 36 19	53 51 17	49 37 21	

Harmonics of f_L

The performance of M1/M9BC/M9E represents the Class I/Class II Type I/Class III mixer, respectively (see page 623).

Intermodulation signals which result from the mixing of mixer-generated harmonics of the input signals are shown above for the M1, M9BC and M9E. Mixing product suppression is indicated by the number of dB below the $f_L \pm f$ output level. The performance was measured with f_R at 49 MHz, f_L at 50 MHz, and using the following input levels:

M1/M9BC/M9E: f_R at 0 dBm; f_L at +7/+17/+27 dBm respectively for the M1, M9BC and M9E.

M1/M9BC/M9E: f_R at −10 dBm; f_L at +7/+17/+27 dBm respectively for the M1, M9BC and M9E.

Improved performance can be obtained at lower frequencies, and for harmonics of $f_R > 2$, with f_R at a lower level. The suppression figures shown above for the M1 are also applicable for its pc equivalent, M6E. The M1 suppression figures may be used for the M6D/M6A if the input frequencies are assumed to be at 20 MHz rather than 50 MHz. The M1 suppression may also be used for the M1A if the input frequencies are assumed to be 100 MHz rather than 50 MHz.

Mixer-generated intermods are shown for each model under the following conditions: Input signals: f_{R1} − 45.6 MHz at −10 dBm, f_{R2} = 27.8 MHz at −2 dBm, f_{R3} = 26.6 MHz at −2 dBm, f_L = 50 MHz with the levels noted before. Horizontal Scale: 2 MHz/cm, centered at 95.6 MHz. Vertical: 10 dBm/cm.

Mixer-generated harmonic distortion is present in the output spectrum even when a well-balanced low-level mixer such as the M1 is used. By substituting the M9BC high-level mixer, the "worst case" products can be reduced an additional 18 dB. However, these products can be reduced 40 dB, by substituting the M9E very high-level mixer.

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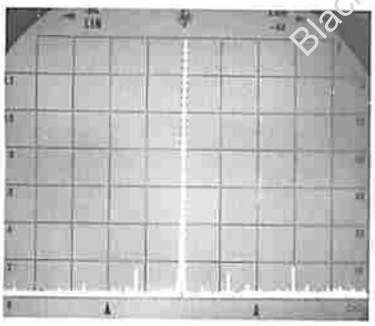
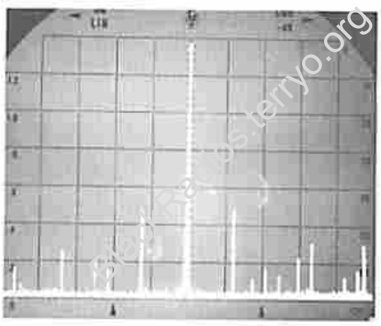
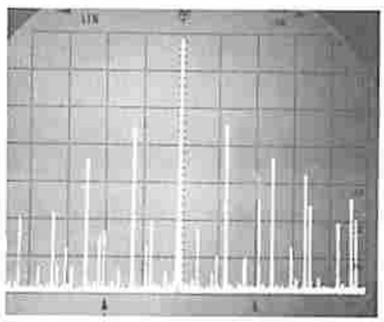






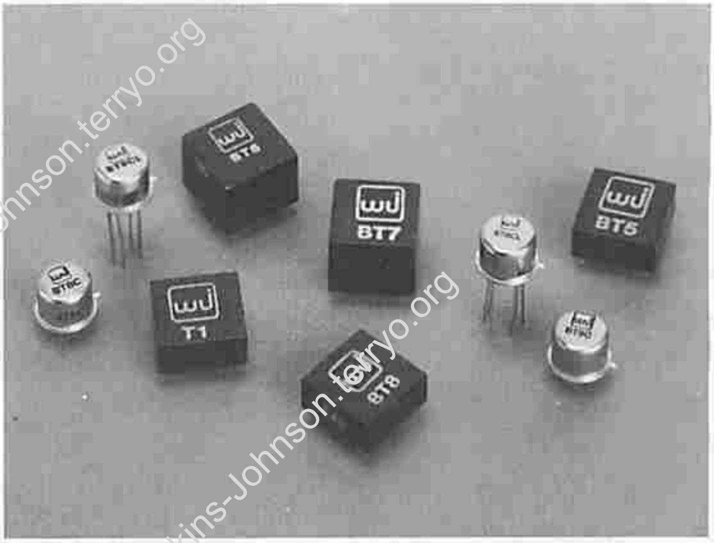
Transformers/Reactive Power Dividers

9

Wide-Band Transformers

- LOW INSERTION LOSS
- WIDEBAND
- SMALL SIZE

Description: Miniature transformers are designed for low-loss operation over a very wide frequency range. They feature an insertion loss typically less than 0.5 dB, a frequency range 0.2 MHz to 700 MHz, and impedance levels from 25 ohms to 800 ohms. The BT series are balanced transformers. The T series are single-ended transformers.



Specifications

Model	Description	Frequency Range MHz	Insertion Loss Max. dB	Amplitude Unbalance Max. dB	Phase Unbalance Max. Degrees	Package Type	Hermetic Seal	Outline Drawing
BT5	50 ohm-50 ohm CT	0.2-500 0.5-50	1.5 0.5	0.25 0.10	——— ———	PC	No	P
BT6	50 ohm-100 ohm CT	0.3-400 1-100	2.0 1.0	0.5 0.1	———	PC	No	Q
BT7	50 ohm-200 ohm CT, DC isolated*	50-400 3-50	2.0 1.5	0.9 0.08	6.0 0.5	PC	No	Q
BT8, BT8C, BT8CL	50 ohm-200 ohm CT, DC isolated*	50-250	1.5	0.9	6.0	PC, TO-5, TO-5	No, Yes, Yes	P, R, S
BT9, BT9C, BT9CL	50-ohm-800 ohm CT, DC isolated*	1-100	3.0	0.4	2.8	PC, TO-5, TO-5	No, Yes, Yes	P, R, S
T1	50 ohm-50 ohm DC isolating reversing or RF common mode isolating	0.6-700	1.5	———	———	PC	No	P
T2	50-ohm-100 ohm	0.4-700 2-300	1.5 0.5	——— ———	——— ———	PC	No	P

*50 volts DC max.

Absolute Maximum Ratings

Storage

Temperature . . . . . . -65°C to +100°C

Weight

Less than 0.2 oz.

Maximum Input Power

1 watt rms

T1 derate to f^2 MHz Wrms below 1 MHz.

T2 derate to $2f^2$ MHz Wrms below 0.7 MHz.

BT5, BT6 derate to $4f^2$ MHz Wrms below 0.5 MHz.

Environmental

All units are guaranteed to meet their specifications over −54°C to +100°C and after exposure to any or all of the following tests per MIL-STD-202E.

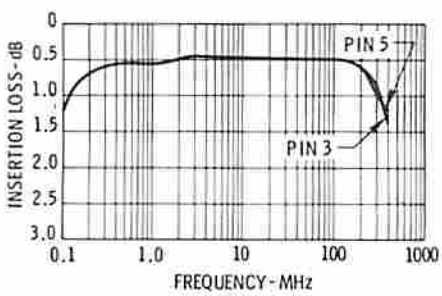
Hermetically sealed units meet the requirements of method 106D of MIL-STD-202E when exposed to humidity.

Exposure	Method	Test Condition
Temperature Cycle	102A	C
Thermal Shock	107D	B
Altitude	105C	G
H.F. Vibration	204C	D
Mechanical Shock	213B	C
Random Vibration (15 minutes per axis)	214	IIF
Solderability	208B	
Terminal Strength	211A	C
Resistance to Soldering Heat	210A	B

Typical Performance of Model BT6 at 25°C

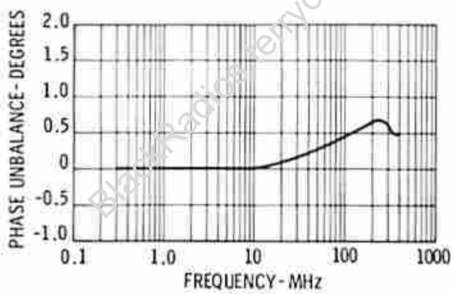
FREQUENCY DOMAIN

Insertion Loss



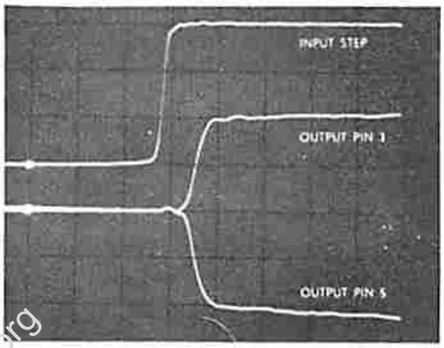
Insertion Loss vs. Frequency: The BT6 has a frequency response which is typically flat to within 0.1 dB over the frequency range 0.3 MHz to 100 MHz. The amplitude balance is represented by the insertion loss difference between pins 3 and 5. For frequencies less than 100 MHz, the amplitude unbalance is typically less than 0.05 dB.

Phase Unbalance (Deviation from 180°)

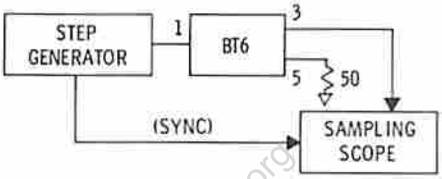


Phase Unbalance vs. Frequency: The phase unbalance of the BT6 is represented by the deviation from a 180 degree phase difference between pins 3 and 5. For frequencies less than 20 MHz the phase unbalance is typically less than 0.1 degree.

TIME DOMAIN

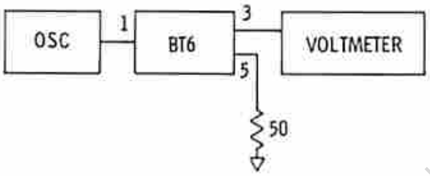


PULSE RESPONSE TEST CIRCUIT

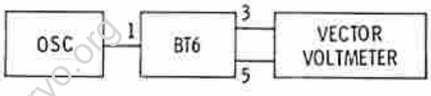


Pulse Response: The similarity between the input and output pulses illustrates the balance and time coherence of the BT6. With a 300 picosecond input pulse, the output pulses have rise times less than 800 picoseconds. Only the vertical position control of the oscilloscope was adjusted in recording the three traces.

INSERTION LOSS TEST CIRCUIT



PHASE UNBALANCE TEST CIRCUIT



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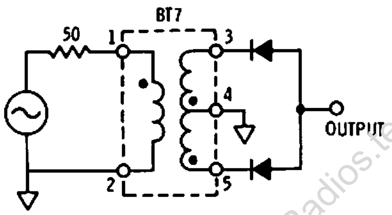
FREQUENCY DOUBLER

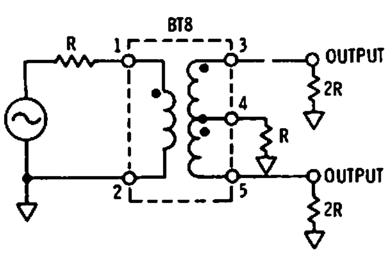
A frequency doubler can be constructed with a BT7 transformer and two matched Schottky barrier diodes. The excellent balance characteristics of the transformer will suppress the 1st and 3rd harmonics of the input 30 dB to 40 MHz and 20 dB to 300 MHz. Input frequency 5 to 300 MHz. Output frequency 10 to 600 MHz.



180° POWER DIVIDER

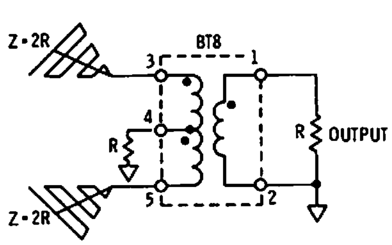
The BT8/BT8C is useful in hybrid junction applications. By applying the input to pins 1 and 2, out-of-phase outputs are available at pins 3 and 5. By applying the input to pin 4, in-phase outputs are available at pins 3 and 5. In both cases the outputs are isolated from each other.

A four-way power divider can be constructed by adding a BT5 balanced transformer to each output.



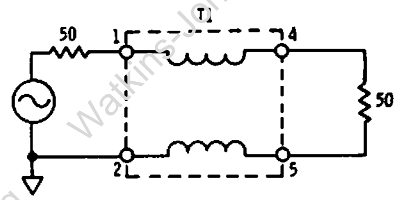
180° POWER COMBINER

The BT8/BT8C can be used as a power combiner. The vector sum of the inputs appears at pin 4 and the vector difference appears between pins 1 and 2. The inputs are isolated from each other.



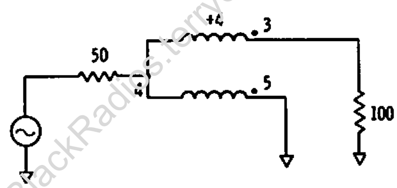
UNBALANCED TO FLOATING DRIVE

The T1 allows an unbalanced source to drive an RF floating load. Phase reversal is optional. It is an efficient way to suppress ground loop problems.



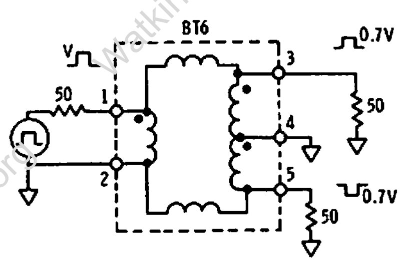
IMPEDANCE TRANSFORMER

The T2 is useful in applications where a broadband 2:1 impedance transformation is needed and dc isolation is not required.



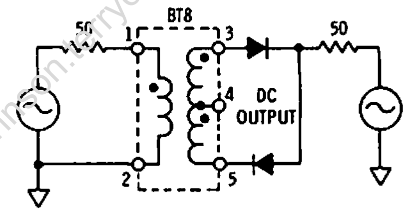
PHASE SPLITTER

The BT6 can provide very closely matched out-of-phase signals. It is recommended in pulse applications where the rise time of the pulse must be as fast as 60 picoseconds. See typical pulse response curves on page 229.



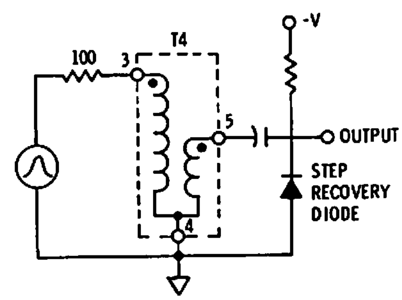
PHASE DETECTOR

A phase detector can be constructed using a Model BT8/BT8C balanced transformer and two matched Schottky barrier diodes. The excellent balance of the transformer prevents crosstalk between the inputs. The dc output is proportional to the phase difference between inputs.



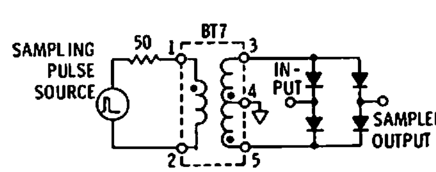
PULSE SHAPER

The risetime of a pulse can be improved with a Model T2 single-ended transformer and a step recovery diode. The wideband characteristics of the transformer allow a 100 ohm to 50 ohm impedance transformation without degradation in phase shape.



SAMPLER

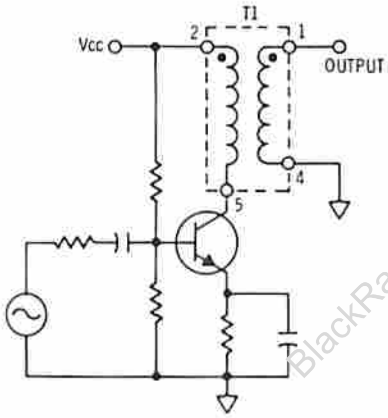
A very high frequency sampler can be constructed with a wideband balanced transformer and four sampling diodes. The Model BT7 is recommended since it has an extremely wide bandwidth and a 50 ohm to 200 ohm impedance transformation.



Schematic Diagrams

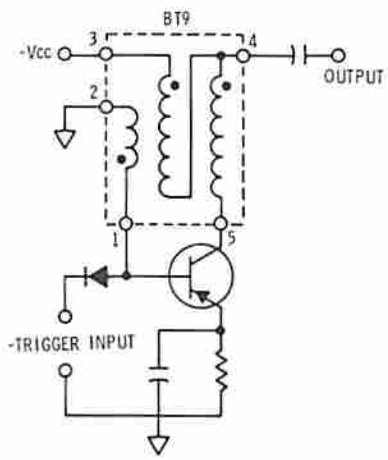
WIDEBAND AMPLIFIER

To ac couple a wideband amplifier, a Model T1 single-ended transformer is recommended. It has dc isolation and a frequency range 0.3 MHz to 700 MHz.

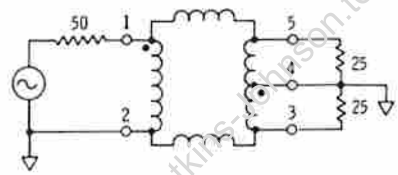


BLOCKING OSCILLATOR

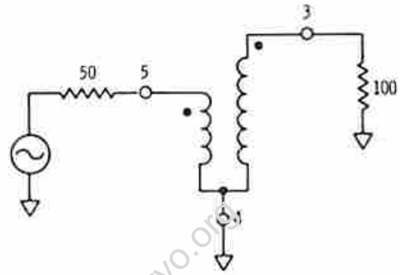
The pulse shape of a blocking oscillator can be improved with a balanced transformer. The high impedance transformation and wide frequency response of the Model BT9/BT9C make it an excellent choice.



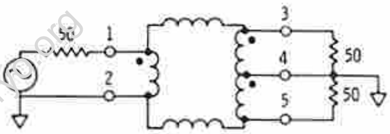
BALANCED



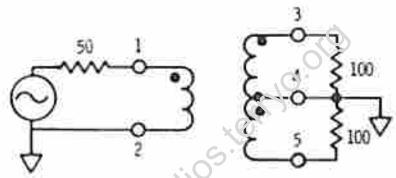
BT5



T2

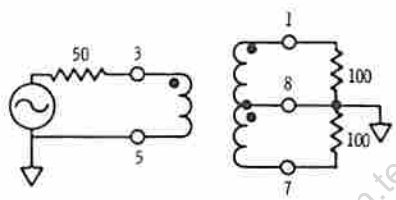


BT6

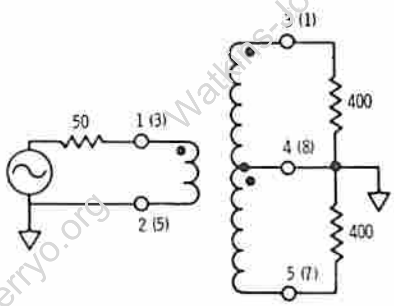


NOTE: PIN 1 AND 5 HAVE SAME POLARITY FOR BT7.

BT7/BT8

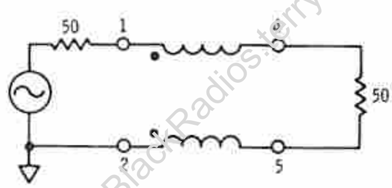


BT8C



BT9 (BT9C)

SINGLE-ENDED



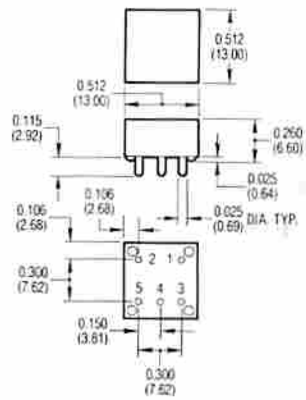
T1

Outline Drawings

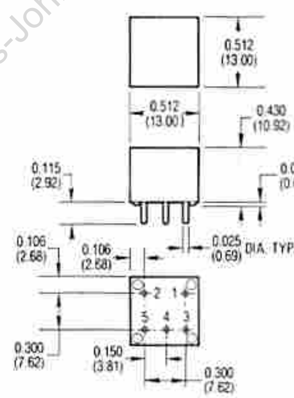
NOTE: DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.010 (.025) UNLESS OTHERWISE SPECIFIED

PIN NUMBERS ARE SHOWN FOR REFERENCE ONLY.

PACKAGE P
BT5/BT8/BT9/T1/T2



PACKAGE Q
BT6/BT7



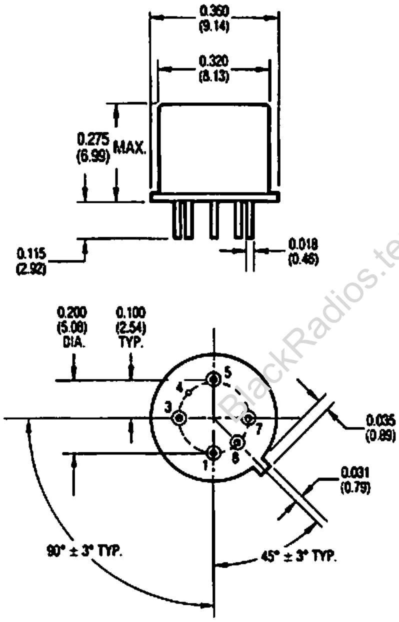
9

Outline Drawings

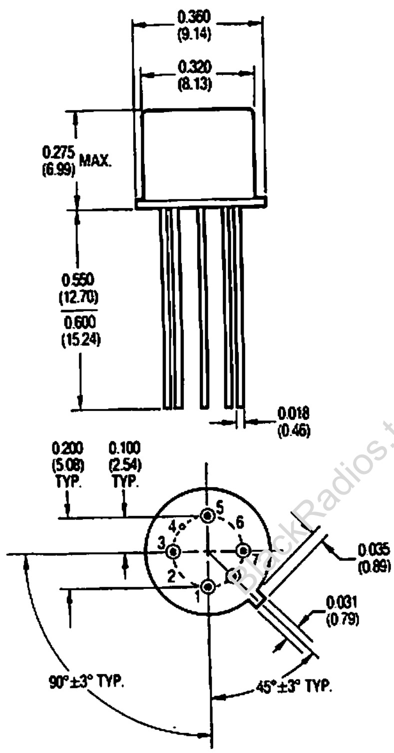
NOTE: DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.010 (.025) UNLESS OTHERWISE SPECIFIED

PIN NUMBERS ARE SHOWN FOR REFERENCE ONLY.

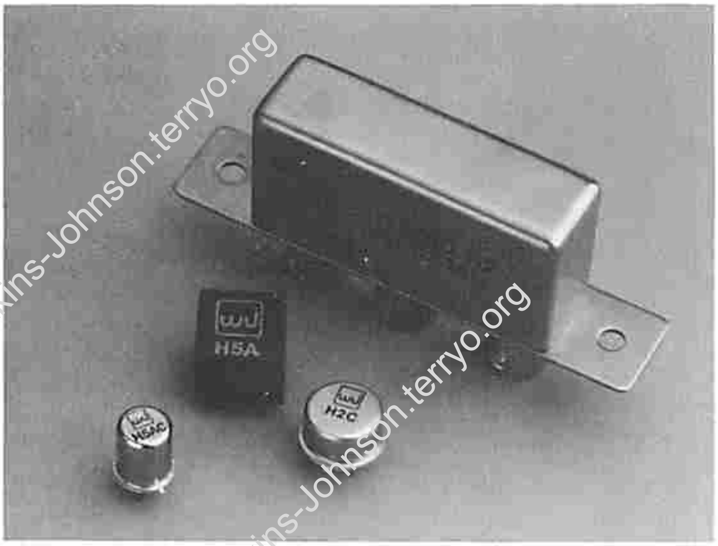
PACKAGE R
BT8C/BT9C



PACKAGE S
BT8CL/BT9CL



Reactive Power Dividers 0.5 to 500 MHz



- HIGH ISOLATION
- LOW INSERTION LOSS
- EXCELLENT PHASE AND AMPLITUDE BALANCE
- BROADBAND
- SMALL SIZE

Typial Specifications

Model	Frequency MHz	Number of Ports	Nominal Phase Difference Between Output Ports	Port C PIN 4	Impedance (ohms) Δ —	A 1	B 2	D 5	E 6	Minimum Isolation dB	Maximum Insertion Loss dB	Maximum Phase Unbalance Degrees	Maximum Amplitude Unbalance dB	Maximum VSWR (all ports)	Maximum Rated Power Splitter[2]/ Combiner (watts)	Package Type	Outline Drawing
H2	0.5-120	3	0°	50	—	50	50	—	—	33 0.5-70 MHz 27 70-120 MHz	0.6	1.5	0.2	1.30	1.00/ 0.25	BNC SMA	A
H5A (H5AC)[1]	0.5-120 (1.0-100)	3	0°	50	—	50	50	—	—	35 (30) 0.5-60 (100) MHz 30 0.5-120 MHz	0.5 (0.6)	1.0	0.1	1.37	1.00 (0.50)/ 0.25 (0.10)	PC Mounted (TO-5)	D (E)
H2C[1]	10-500	3	0°	50	—	50	50	—	—	30 10-100 MHz 25 100-200 MHz 20 200-500 MHz	0.75	1.0	0.1	1.5 Port C 1.4 Port A, B	1.00	TO-8	C

NOTES:
1. Hermetically sealed.
2. See page 802 for power derating as a function of VSWR and ambient temperature.

Description: Watkins-Johnson reactive power dividers have been designed for high performance over a wide frequency range. They feature an insertion loss typically less than 0.2 dB, an isolation typically greater than 40 dB, and a frequency range 0.5 MHz to 500 MHz. Amplitude balance is typically within 0.05 dB; phase balance is typically within 1.0 degrees. All the dividers are extremely linear. With two equal input signals of +10 dBm level, the third and fifth order distortion products are typically suppressed by greater than 100 dB.

Operation: When used as a signal splitter, multiple coherent output signals are provided with a known phase relation of equal amplitude having a power level down from the input level by the "coupling loss." Independent use of one signal by multiple loads is permitted by the high isolation between outputs. Loading effects, feedthru, etc., are minimized. Equal power output ensures balanced feeding for applications such as multi-element antenna arrays. nal sources are isolation from each other and the output is the vector sum of the inputs reduced in amplitude by the "coupling loss." Interaction between inputs is prevented by the hybrids high isolation.

Amplitude unbalance is the amplitude difference in dB between the outputs measured under matched impedance conditions as a signal splitter.

Phase unbalance is the phase difference (from nominal) between the outputs under matched impedance conditions as a signal splitter.

Insertion loss is the power dissipated within the power divider under matched impedance conditions. It does not include the coupling loss.

Coupling loss is the ratio between the power at the input and the power at output for an ideal power splitter under matched impedance conditions. Insertion loss must be added to the coupling loss to determine the exact output level. The coupling is a function of the number of power divider outputs.

Number of Output Ports	Coupling Loss (dB)
2	3.01
3	4.77
4	6.02
5	6.99
6	7.78
7	8.45
8	9.03

9

Isolation is defined as the attenuation of "feedthru" or "cross talk" between the isolated ports under matched impedance conditions. When there is a mismatch at the input port of the power divider, there will be degradation in isolation. Isolation degradation from a resistive mismatch at the common port is shown above the matched isolation values of ∞, 40 dB, 30 dB, and 25 dB. Values are "worst case" decibels, and have been computed on the assumption the internal resistive load is matched to the specified common port impedance. The isolated load impedances are 50 ohms.

VSWR Input	∞	40 dB	30 dB	25 dB
1.00	∞	40.0	30.0	25.0
1.01	52.1	38.1	29.3	24.6
1.03	42.6	35.2	28.2	23.9
1.05	38.2	33.0	27.2	23.3
1.10	32.4	29.4	25.1	21.9
1.15	29.1	26.9	23.5	20.8
1.20	26.8	25.0	22.2	19.8
1.30	23.6	22.4	20.2	18.2
1.50	19.9	19.1	17.5	16.0
1.70	17.6	17.0	15.8	14.6
2.00	15.6	15.0	14.0	13.0

Isolation Between Isolated Ports as a Function of the Resistive Termination at the Common Port — For Matched Isolation Values of ∞, 40 dB, 30 dB, and 25 dB.

Environmental: All units are guaranteed to meet their specifications over -54°C to +100°C, and after exposure to any or all of the following tests per MIL-STD-202E:

Exposure	Method	Test Condition
Temperature Cycle	102A	C
Thermal Shock	107D	B
Altitude	105C	G
H.F. Vibration	204C	D
Mechanical Shock	213B	C
Random Vibration (15 minutes per axis)	214	IIF
Solderability	208B	
Terminal Strength	211A	C
Resistance to Soldering Heat	210A	B

Hermetically sealed units meet the requirements of method 106D of MIL-STD-202E when exposed to humidity.

Absolute Maximum Ratings

Storage Temperature. -65°C to +100°C

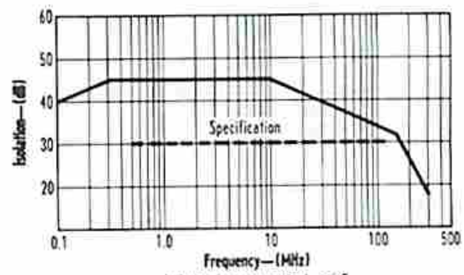
Maximum Splitter Input Power: 3 Port Dividers: Rated power with load VSWRs of 1.50 or less; 0.12 rated power "worst case" with one output shorted and the other open. Applicable over temperature range -54°C to +71°C. Derate linearly to one-half power at +100°C.

Maximum Combiner Input Power: 3 Port Combiners: Rated power with output-load VSWR of 1.50 or less; 0.5 rated power with output shorted. Applicable over temperature range -54°C to +71°C. Derate linearly to 0.8 power at +100°C.

Typical Performance at 25°C

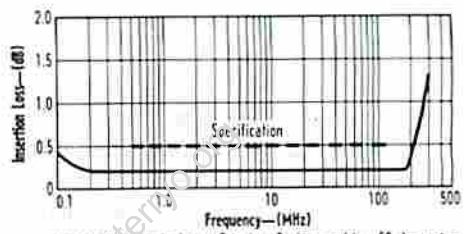
TYPICAL PERFORMANCE OF MODEL H2 AT 25°C

Isolation



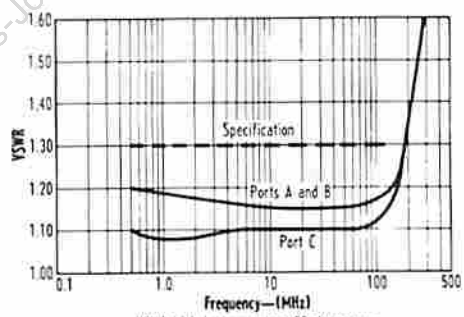
Isolation between ports A and B

Insertion Loss



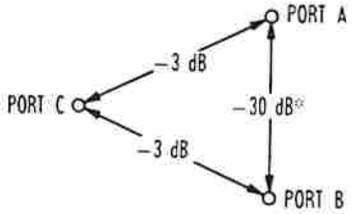
Insertion loss of hybrid, port C to A or B when used in a 50 ohm system

VSWR

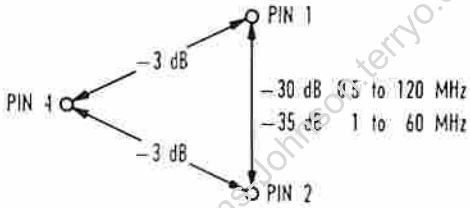


VSWR of hybrid ports in a 50 ohm system

Functional Diagrams



(1) H2/H2C/H5AC



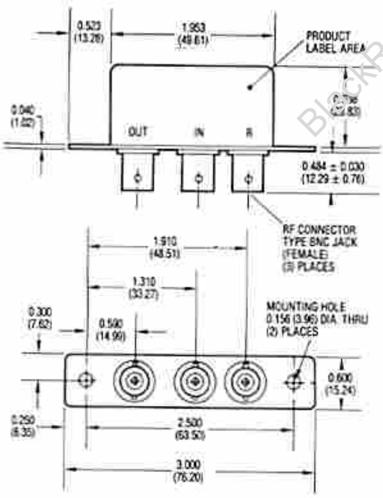
(2) H5A

Pins 3 and 5 are ground pins, and both must be used.

Outline Drawings

Dimensions are in inches (millimeters) ± 0.010 (0.25) unless otherwise specified.

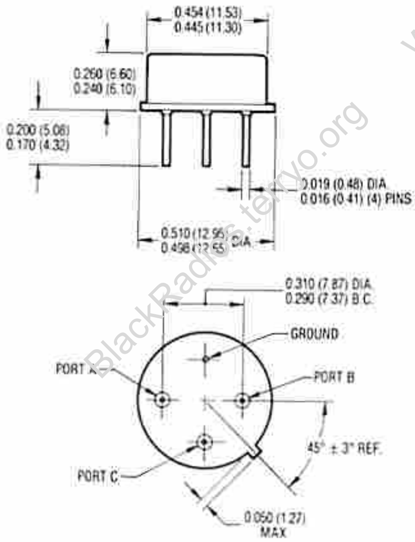
PACKAGE A
H2



NOTES:

1. **Connectors:** BNC Female. SMA connectors available on request.
2. **Weight:** 39.70 grams (1.4 oz.).

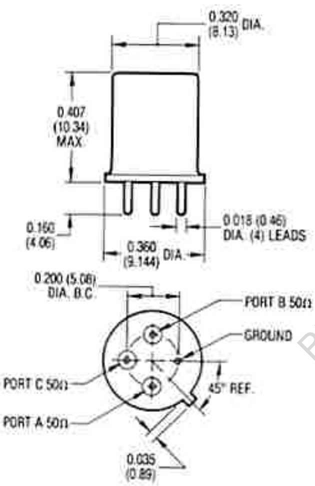
PACKAGE C
H2C



NOTE:

1. **Weight:** 2.0 grams (0.07 oz.).

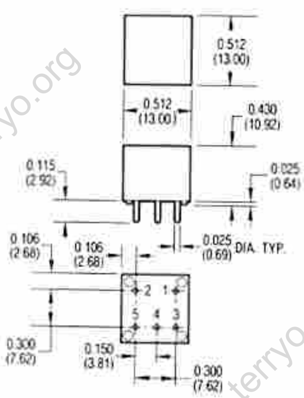
PACKAGE E
H5AC



NOTE:

1. **Weight:** 1.5 grams (0.05 oz.).

PACKAGE D
H5A



NOTES:

1. **Pin Numbers:** Shown for reference only.
2. **Weight:** 2.0 grams (0.07 oz.).

Switches

WJ-PS10

100 TO 1000 MHz THIN FILM SPST POWER SWITCH

- LOW INSERTION LOSS: <1.5 dB (TYP.)
- HIGH CW INPUT POWER CAPABILITY: 2 WATTS
- HIGH ISOLATION: >50 dB (TYP.)
- HIGH 3 Ip SUPPRESSION: 45 dBc (TYP.) @ +20 dBm
- FAST SWITCHING SPEED: <1 μsec.

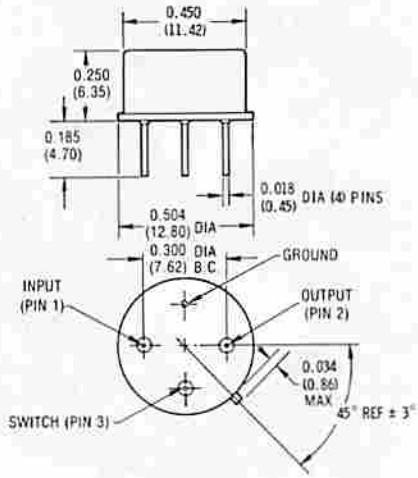
Specifications*

Characteristic	Typ.	Guaranteed 0° - 50°C	-54° - +85°C
Insertion Loss (Max.)			
100-500 MHz	1.8 dB	2.7 dB	3.3 dB
500-1000 MHz	1.5 dB	1.8 dB	2.2 dB
Insertion Flatness (Max.)			
100-500 MHz	±0.5 dB	±0.7 dB	±0.9 dB
500-1000 MHz	±0.2 dB	±0.3 dB	±0.4 dB
Isolation (Min.)			
100-500 MHz	>55 dB	50 dB	45 dB
500-1000 MHz	>45 dB	40 dB	35 dB
VSWR (Max.) Input/Output (ON State)			
100-500 MHz	1.2:1	1.7:1	2.0:1[1]
500-1000 MHz	1.5:1	1.7:1	1.9:1
Switching Speed (10 to 90%)	<1 μsec	2 μsec	2 μsec

*Measured in a 50-ohm system at +20 Vdc Nominal.
Notes:
1. VSWR <200 MHz is 2.2:1.

Outline Drawing

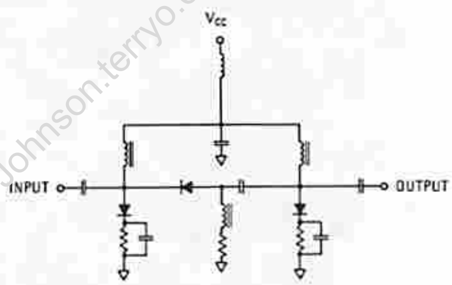
PS10



Absolute Maximum Ratings

Ambient Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . +100°C
Maximum DC Voltage . . . . +22 Volts
Maximum Continuous RF Input Power . . . . 2 Watts
Maximum Short Term RF Input Power . . . . 3 Watts (1 Minute Max.)
Maximum Peak Power (1 Minute Max.) . . . . 10 Watts (3 μsec Max.)
"S" Series Burn-In Temperature . . . . 100°C

Schematic Diagram



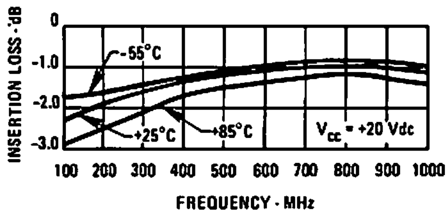
Switching Conditions

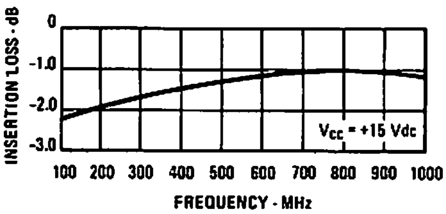
ON	OFF
+55 mA	-55 mA
≈+20 Vdc	≈-20 Vdc
+45 mA	-45 mA
≈+15 Vdc	≈-15 Vdc

Weight approximately 2.0 grams (0.07 oz.)

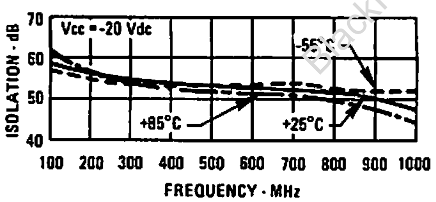
Typical Performance at 25°C

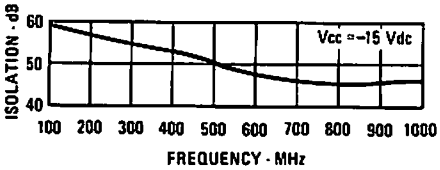
Insertion Loss



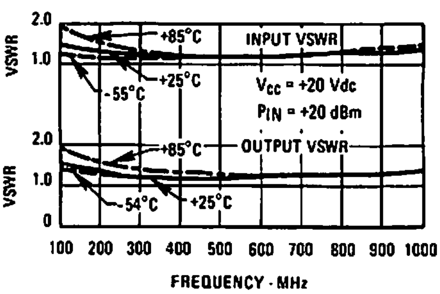


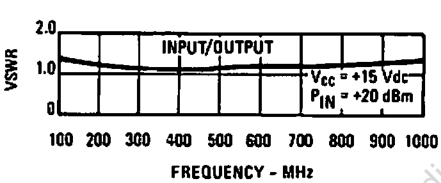
Isolation

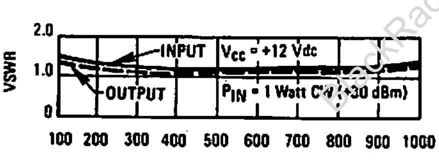


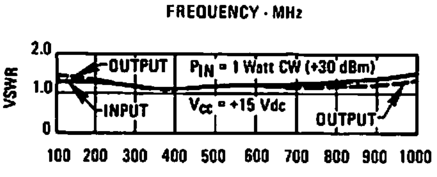


VSWR

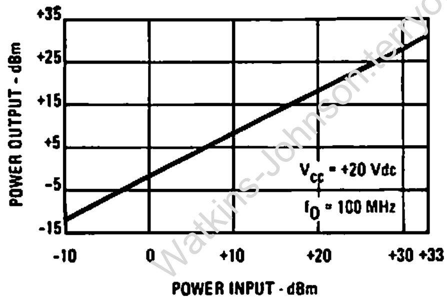


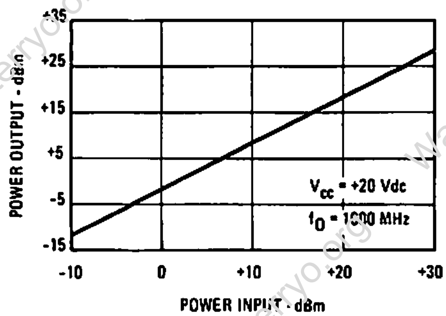




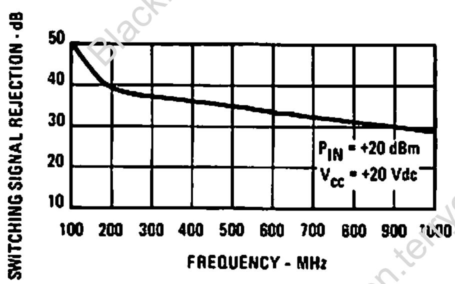


Power Output

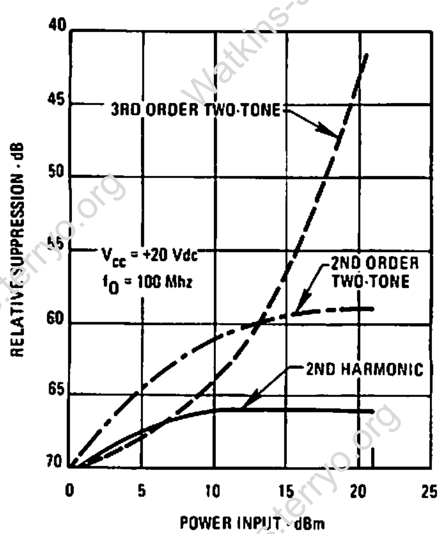




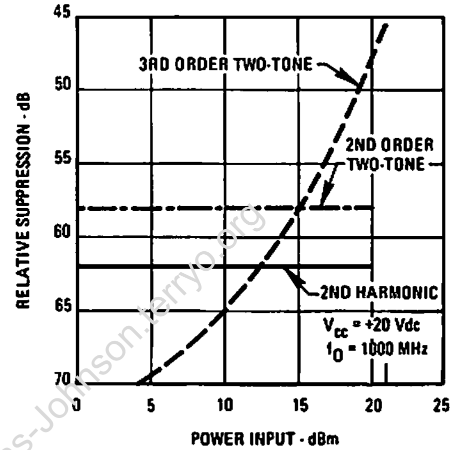
Switching Signal Rejection



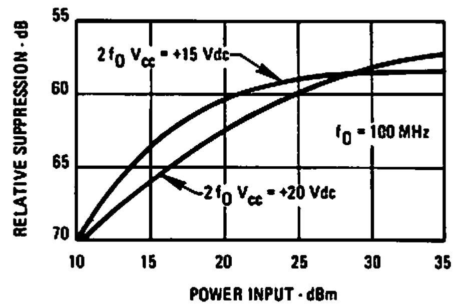
Relative Suppression



Relative Suppression



Harmonic Suppression



Typical Automatic Test Data

V_{cc} = +20 Vdc @ Pin = +20 dBm

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.4	1.4	-2.3
200.	1.3	1.3	-1.9
300.	1.2	1.2	-1.6
400.	1.2	1.2	-1.4
500.	1.1	1.1	-1.3
600.	1.2	1.2	-1.2
700.	1.2	1.2	-1.1
800.	1.3	1.2	-1.0
900.	1.3	1.3	-1.1
1000.	1.4	1.4	-1.2
1100.	1.5	1.4	-1.4
1200.	1.6	1.5	-1.4

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.18	158.0	.76	.6	.77	.4	.18	157.0
200.	.13	149.3	.81	-5.1	.81	-5.4	.14	146.3
300.	.10	150.1	.83	-11.7	.83	-12.1	.10	141.8
400.	.07	162.6	.85	-18.7	.85	-18.9	.07	151.6
500.	.07	-177.6	.86	-25.6	.86	-25.6	.06	172.8
600.	.08	-159.4	.87	-32.[illegible]	.87	-32.9	.07	-172.8
700.	.10	-153.3	.88	-3[illegible].2	.88	-39.2	.09	-164.3
800.	.13	-149.3	.89	-45.3	.89	-45.1	.11	-161.8
900.	.15	-152.2	.88	-51.0	.88	-50.9	.14	-163.3
1000.	.18	-154.9	.87	-56.8	.87	-56.9	.15	-166.5
1100.	.19	-156.1	[illegible]	-63.6	.85	-63.8	.18	-169.8
1200.	.22	-161.5	.85	-70.5	.85	-70.7	.20	-174.3

V_{cc} = +15 Vdc Vdc @ Pin = +20 dBm

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.4	1.4	-2.2
200.	1.3	1.3	-1.8
300.	1.2	1.2	-1.6
400.	1.1	1.1	-1.4
500.	1.1	1.1	-1.3
600.	1.2	1.2	-1.2
700.	1.2	1.2	-1.1
800.	1.3	1.3	-1.0
900.	1.4	1.3	-1.1
1000.	1.4	1.4	-1.2
1100.	1.5	1.4	-1.4
1200.	1.6	1.5	-1.4

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.16	164.2	.78	-1.0	.78	-1.1	.16	162.4
200.	.12	155.2	.81	-6.3	.82	-6.3	.12	151.9
300.	.09	156.4	.83	-12.5	.84	-12.7	.09	147.5
400.	.07	168.9	.85	-19.4	.85	-19.4	.07	157.8
500.	.07	-170.2	.86	-26.5	.86	-26.1	.06	-179.0
600.	.08	-154.0	.87	-33.2	.87	-33.2	.07	-166.5
700.	.10	-149.5	.88	-39.6	.89	-39.5	.09	-159.8
800.	.13	-145.7	.89	-45.5	.89	-45.4	.11	-156.1
900.	.15	-149.8	.88	-51.3	.88	-51.2	.14	-1[illegible].6
1000.	.18	-152.6	.87	-57.0	.87	-57.1	.16	-154.1
1100.	.20	-154.5	.86	-63.9	.86	-64.1	.18	-167.9
1200.	.22	-159.6	.85	-70.8	.85	-70.9	.20	-172.8

WJ-PS30

100 - 2000 MHz
THIN FILM SPST POWER SWITCH

- LOW INSERTION LOSS: < 1.8 dB (TYP.)
- HIGH CW INPUT POWER CAPABILITY: 2 WATTS
- HIGH ISOLATION: > 40 dB (TYP.)
- HIGH 3 I_p SUPPRESSION: 45 dBc (TYP.) @ +20 dBm
- FAST SWITCHING SPEED: < 1 μsec

Specifications*

Characteristic	Typ.	Guaranteed 0° - 50°C	Guaranteed -54° - +85°C
Insertion Loss (Max.)			
100-500 MHz	1.8 dB	2.7 dB	3.3 dB
500-1000 MHz	1.5 dB	1.8 dB	2.2 dB
1000-2000 MHz	1.8 dB	2.5 dB	2.9 dB
Insertion Flatness (Max.)			
100-500 MHz	±0.5 dB	±0.7 dB	±0.9 dB
500-1000 MHz	±0.2 dB	±0.3 dB	±0.4 dB
1000-2000 MHz	±0.4 dB	±0.6 dB	±0.7 dB
Isolation (Min.)			
100-500 MHz	>55 dB	50 dB	45 dB
500-1000 MHz	>45 dB	40 dB	35 dB
1000-1500 MHz	>30 dB	25 dB	20 dB
1500-2000 MHz	>25 dB	15 dB	15 dB
VSWR (Max.) Input/Output (ON State)			
100-1000 MHz	<1.5:1	1.7:1	1.9:1[1]
1000-2000 MHz	<1.7:1	2.0:1[1]	2.0:1[1]
Switching Speed (10 to 90%)	<1 μsec	2 μsec	2 μsec

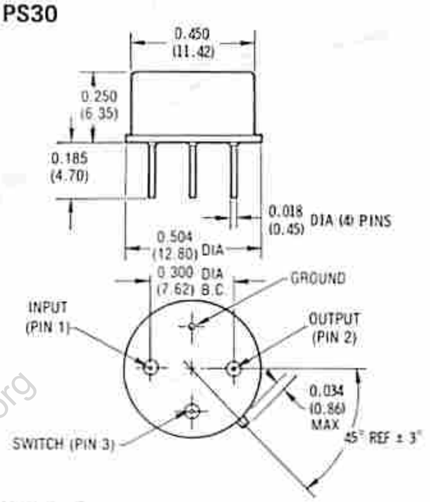
*Measured in a 50-ohm system at +20 Vdc Nominal.
Notes:
1. VSWR <200 MHz >1500 MHz is 2.2:1.

Absolute Maximum Ratings

Ambient Operating Temperature .... -54°C to +100°C
Storage Temperature .... -62°C to +125°C
Maximum Case Temperature .... +100°C
Maximum DC Voltage .... +22 Volts
Maximum Continuous RF Input Power .... 2 Watts
Maximum Short Term RF Input Power .... 3 Watts (1 Minute Max.)
Maximum Peak Power (1 Minute Max.) .... 10 Watts (3 μsec Max.)
"S" Series Burn-In Temperature .... 100°C

Outline Drawings

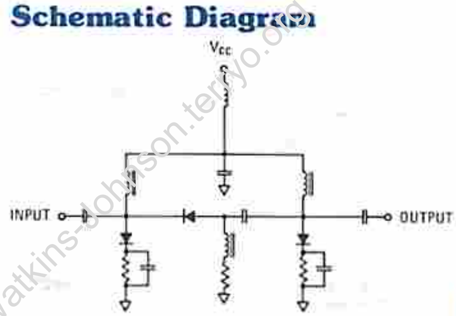
PS30



Weight

approximately 2.0 grams (0.07 oz.)

Schematic Diagram



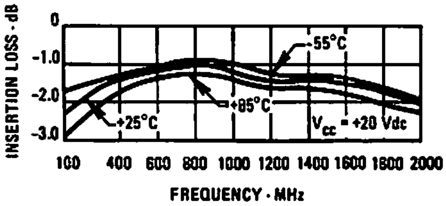
Switching Conditions

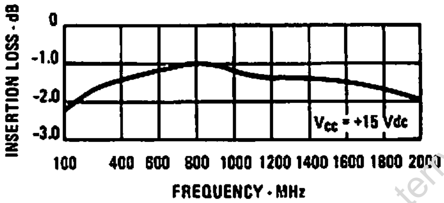
ON	OFF
+55 mA	-55 mA
≈+20 Vdc	≈-20 Vdc
+45 mA	-45 mA
≈+15 Vdc	≈-15 Vdc

10

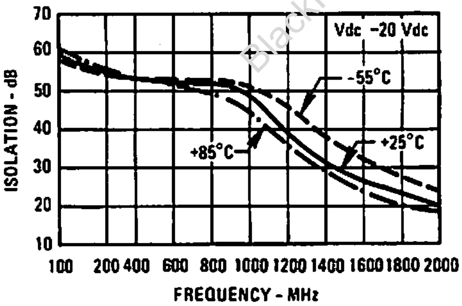
Typical Performance at 25°C

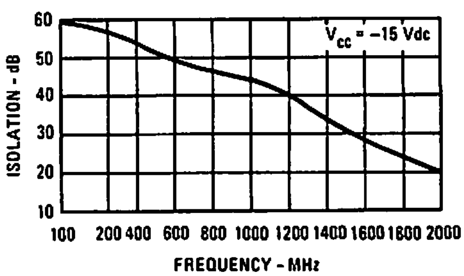
Insertion Loss



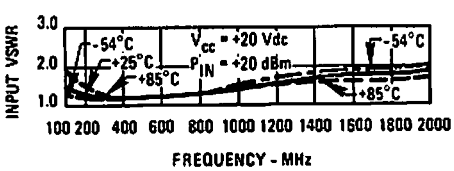


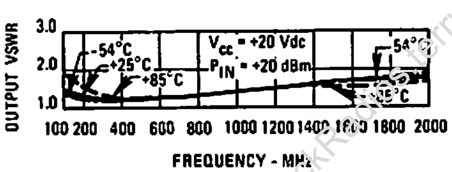
Isolation

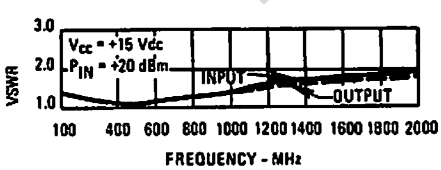


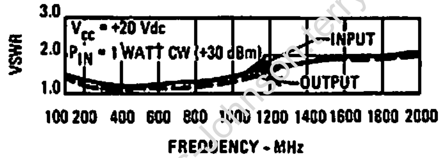


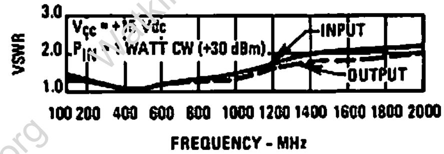
VSWR



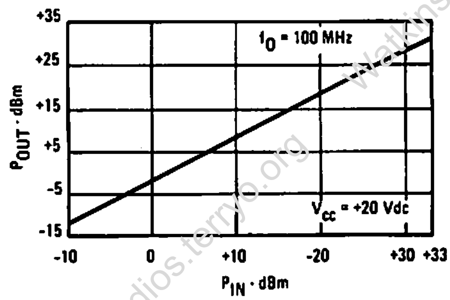


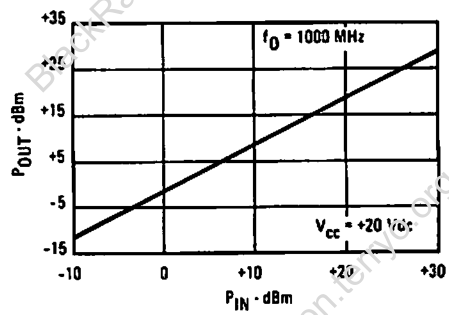


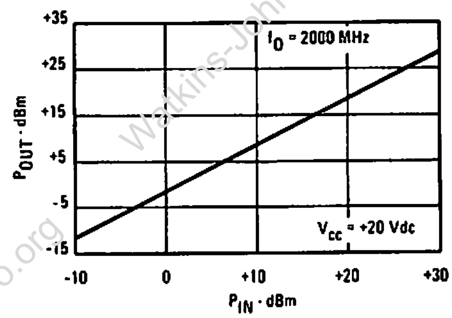




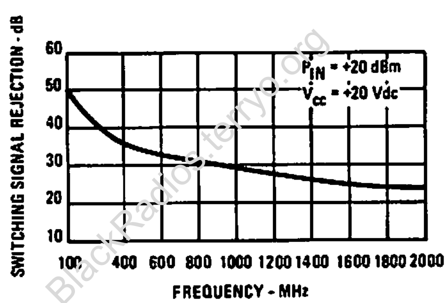
Power Output



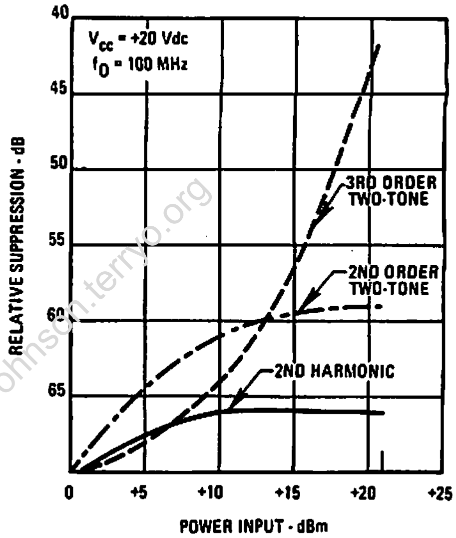


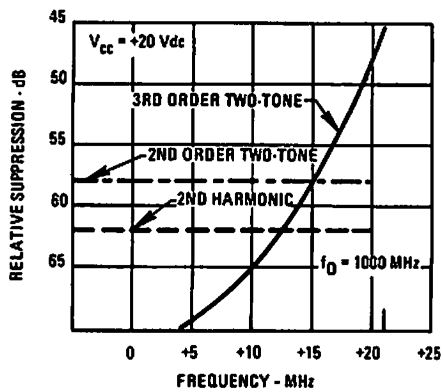


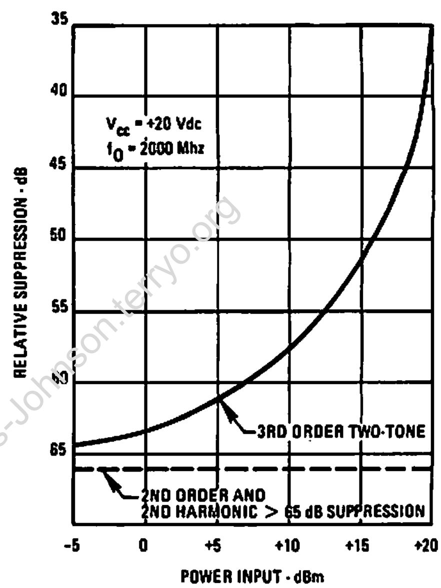
Switching Signal Rejection



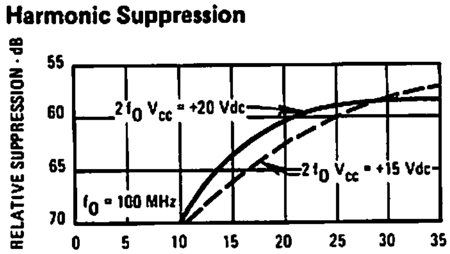
Relative Suppression







Harmonic Suppression



Typical Automatic Test Data

V_{cc} = +20 Vdc @ Pin = +20 dBm

FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.5	1.5	-2.3
200.	1.3	1.3	-1.9
300.	1.2	1.2	-1.6
400.	1.2	1.2	-1.4
500.	1.1	1.1	-1.3
600.	1.2	1.2	-1.2
700.	1.2	1.2	-1.1
800.	1.3	1.2	-1.0
900.	1.3	1.3	-1.1
1000.	1.4	1.4	-1.2
1100.	1.5	1.4	-1.4
1200.	1.6	1.5	-1.4
1300.	1.6	1.5	-1.4
1400.	1.7	1.6	-1.4
1500.	1.7	1.6	-1.5
1600.	1.8	1.7	-1.5
1700.	1.8	1.7	-1.6
1800.	1.8	1.7	-1.7
1900.	1.9	1.8	-1.9
2000.	1.9	1.8	-2.0
2100.	1.9	1.8	-2.1
2200.	1.9	1.8	-2.2

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.18	158.1	.77	.9	.77	.7	.19	157.1
200.	.14	148.8	.81	-5.0	.81	-5.1	.14	145.4
300.	.10	150.2	.83	-11.8	.83	-11.9	.10	141.7
400.	.07	161.1	.85	-18.7	.85	-18.8	.07	151.5
500.	.07	-170.8	.86	-25.5	.86	-25.7	.06	171.4
600.	.08	-160.9	.87	-32.6	.87	-32.6	.07	-173.5
700.	.10	-154.8	.88	-39.0	.88	-39.0	.09	-164.1
800.	.13	-149.0	.89	-45.1	.89	-44.9	.11	-161.2
900.	.15	-153.0	.88	-50.9	.88	-50.7	.14	-163.3
1000.	.18	-154.7	.87	-56.6	.87	-56.7	.15	-166.4
1100.	.19	-156.6	.85	-63.5	.86	-63.6	.18	-169.8
1200.	.22	-161.3	.85	-70.4	.85	-70.5	.20	-174.4
1300.	.23	-164.8	.85	-77.1	.85	-77.0	.21	-179.1
1400.	.25	-170.7	.85	-83.2	.85	-83.0	.22	176.0
1500.	.27	-175.2	.85	-88.7	.85	-88.8	.24	170.6
1600.	.28	179.5	.84	-94.5	.84	-94.5	.25	164.2
1700.	.28	174.2	.83	-100.0	.84	-99.8	.26	158.1
1800.	.29	168.0	.82	-105.4	.82	-105.4	.27	[illegible]
1900.	.30	162.1	.81	-111.6	.81	-111.7	.28	143.4
2000.	.31	157.5	.80	-118.2	.80	-118.4	.28	139.2
2100.	.30	148.2	.78	-125.2	.79	-125.9	.29	133.1
2200.	.30	142.2	.77	-132.5	.78	-133.2	.29	126.2

V_{cc} = +15 Vdc @ Pin = +20 dBm

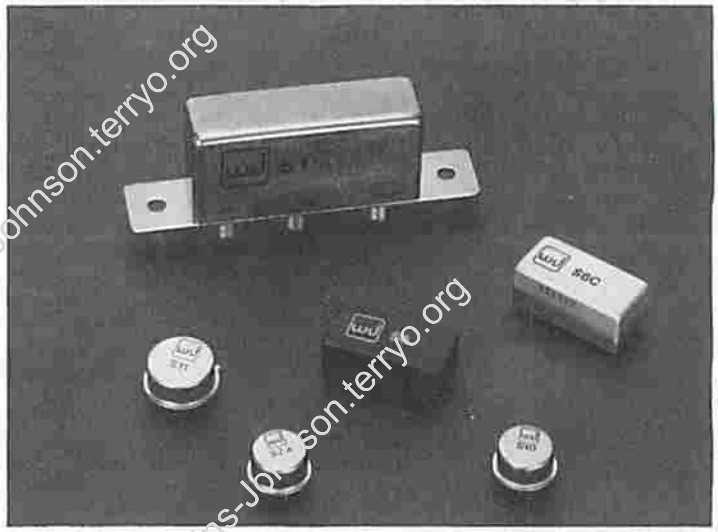
FREQ MHZ	VSWR IN	VSWR OUT	GAIN DB
100.	1.4	1.4	-2.2
200.	1.3	1.3	-1.8
300.	1.2	1.2	-1.6
400.	1.1	1.1	-1.4
500.	1.1	1.1	-1.3
600.	1.2	1.2	-1.2
700.	1.2	1.2	-1.1
800.	1.3	1.3	-1.0
900.	1.4	1.3	-1.1
1000.	1.4	1.4	-1.2
1100.	1.5	1.4	-1.3
1200.	1.6	1.5	-1.4
1300.	1.6	1.5	-1.4
1400.	1.7	1.6	-1.4
1500.	1.7	1.6	-1.4
1600.	1.8	1.7	-1.5
1700.	1.8	1.7	-1.6
1800.	1.8	1.7	-1.7
1900.	1.9	1.8	-1.8
2000.	1.9	1.8	-2.0
2100.	1.9	1.8	-2.1
2200.	1.9	1.8	-2.2

Linear S-Parameters

FREQ	S11		S21		S12		S22	
MHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.	.16	163.6	.78	-.7	.79	-.9	.16	162.4
200.	.12	153.8	.81	-6.2	.82	-6.2	.12	150.5
300.	.09	155.6	.84	-12.3	.84	-12.6	.09	147.5
400.	.07	167.5	.85	-19.2	.85	-19.3	.07	158.4
500.	.07	-170.3	.86	-26.1	.86	-25.9	.06	-180.0
600.	.08	-154.0	.87	-32.8	.87	-32.9	.07	-167.2
700.	.10	-150.1	.88	-39.3	.89	-39.3	.09	-159.5
800.	.13	-145.3	.89	-45.4	.89	-45.2	.11	-157.5
900.	.15	-150.1	.88	-51.1	.88	-51.0	.14	-160.5
1000.	.18	-152.3	.87	-56.8	.87	-56.9	.16	-164.0
1100.	.20	-154.7	.86	-63.7	.86	-63.9	.18	-168.1
1200.	.22	-159.6	.85	-70.7	.85	-70.8	.20	-172.9
1300.	.24	-163.2	.85	-77.4	.86	-77.4	.22	-177.6
1400.	.25	-168.9	.85	-83.5	.85	-83.3	.23	177.3
1500.	.27	-173.6	.85	-89.1	.85	-89.0	.24	171.6
1600.	.28	-178.9	.84	-94.7	.85	-94.5	.25	165.4
1700.	.29	175.6	.83	-100.3	.84	-100.1	.26	158.9
1800.	.30	169.5	.83	-105.8	.83	-105.8	.27	152.4
1900.	.31	163.3	.81	-112.0	.81	-112.0	.28	145.9
2000.	.31	158.7	.80	-118.6	.80	-118.8	.29	139.6
2100.	.31	149.3	.78	-125.7	.79	-126.3	.29	133.4
2200.	.31	143.2	.77	-133.1	.78	-133.7	.29	126.2

10

RF SPST Switches



- HIGH ON-OFF RATIO
- EXCELLENT ISOLATION OF THE SWITCHING SIGNAL
- FAST SWITCHING SPEED

Description: The Watkins-Johnson line of solid-state switches is designed for transient-free operation over a wide frequency range. Utilizing a balanced construction, high frequency components of switching signal are typically suppressed 30 dB or greater. Schottky barrier diodes in the Models S1 and S6 permit switching speeds less than 2 nanoseconds with "on-off" ratios greater than 90 dB.

Typical Specifications

Model	Description	Frequency Range MHz	On-Off Ratio,[2] Min. dB	On-Off Ratio,[2] Min. MHz	Insertion Loss Max. dB	Insertion Loss Max. MHz	Switching Signal Rejection,[3] Min. dB	Switching Signal Rejection,[3] Min. MHz	Switching Speed (nsec) Max.	Switching Condition On	Switching Condition Off	Weight (gms)	Package Type	Hermetic Seal	Outline Drawing
S1	SPST	0.5-500	90 80 70 60	0.5-50 50-100 100-200 200-500	5.0 6.0 7.0	2-100 1-200 0.5-500	30	0.5-500	1.0	+20 mA ≈ +1.5V	−20 mA ≈ −1.0V	45.6	SMA	No	I
S2A	SPST	10-1000	60 50 37 27	10-100 100-200 200-500 500-1000	4.5 5.5 6.6	10-200 200-500 500-1000	30 20 12	10-200 200-400 400-1000	2.0	+20 mA	−20 mA	2.3	PC Mounted (SMA)	Yes (Yes)	J
S6 (S6C)	SPST	0.5-200	70 65 50 45	0.5-20 20-50 50-100 100-200	3.5 4.0	1-50 0.5-200	30	0.5-200	2.0	+20 mA ≈ +1.0V	−20 mA ≈ −1.0V	3.6 (6.8)	PC (PC)	No (Yes)	M N
S10/S11[4]	SPST	10-500	10-100 MHz ≥65 dB 60	 100-300 300-500 MHz ≥ 45 dB	1.7 2.0 2.5	10-100 100-300 300-500	45 30 45	10-100 100-300 300-500	5.0 (S10) 20.0 (S11)	+20 mA ≈ +1.0V	−20 mA ≈ −1.0V	2 2.7	TO-8/ TO-8B	Yes	J P

NOTES:
1. These specifications apply when switch is used in a 50-ohm system with an input signal level of +4 dBm or less and with specified switching currents applied.
2. On-Off ratio is specified between ports A and B. Insertion loss is specified between port C and either port A or B.
3. Sinusoidal switching signal of +17 dBm is applied to switching port and fundamental component of that signal is measured at output port.
4. S11 has an internal TTL driver circuit.

FOR THIN FILM HYBRID POWER SWITCHES, SEE PAGES 806 AND 809

Absolute Maximum Ratings

Storage Temperature

. . . . -65°C to +100°C

Peak Input Current

Model S1 . . . . 70 mA

Models S6, S6C, S10 and S11 . . . . 200 mA

Peak Power

Modesl S1, S6, S6C, S10 and S11 . . . . +30 dBm

Environmental

All units* are guaranteed to meet their specifications over -54°C to +100°C, and after exposure to any or all of the following tests per MIL-STD-202E:

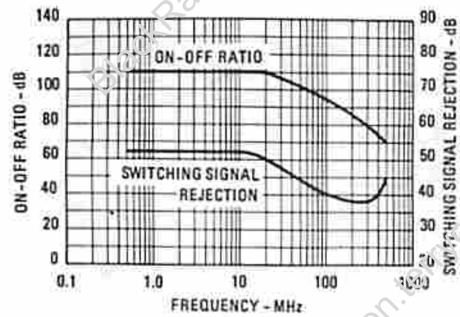
Exposure	Method	Test Condition
Temperature Cycle	102A	C
Thermal Shock	107D	B
Altitude	105C	G
H.F. Vibration	204C	D
Mechanical Shock	213B	C
Random Vibration (15 minutes per axis)	214	IIF
Solderability	208B	
Terminal Strength	211A	C
Resistance to Soldering Heat	210A	B

Hermetically sealed units meet the requirements of method 106D of MIL-STD-202E when exposed to humidity.

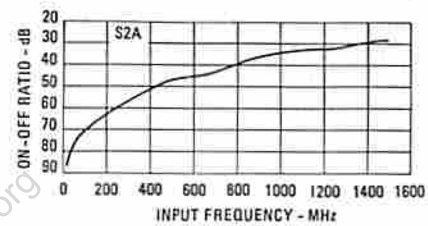
*The temperature range for the Model S1 is -20°C to +100°C for input frequencies below 1 MHz.

Typical Performance at 25°C

On-Off Ratio vs. Frequency: The "on-off" ratio is defined as the ratio of the output voltage when the switch is turned "on" to the output voltage when the switch is turned "off." At lower frequencies, the "on-off" ratio is higher than it is at higher frequencies. The S1 has the best "on-off" ratio.

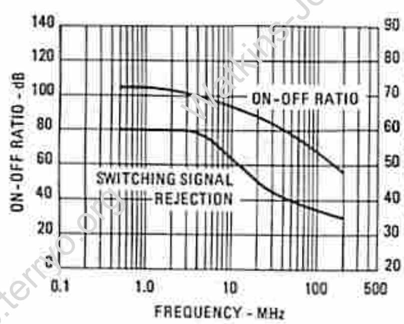


MODEL S1

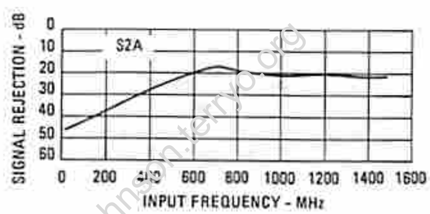


MODEL S2A

Switching Signal Rejection vs. Frequency: The switching signal rejection is defined as the amount of isolation between the switching input port and the output port. It is measured by applying a sinusoidal signal of +17 dBm to the SW port (pins 3 and 4 for pc switches) and measuring the fundamental component of the signal at the output. For transient-free switching, this rejection should be as high as possible.

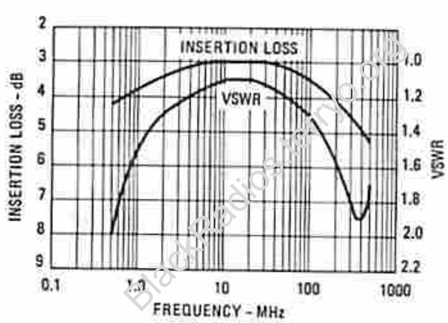


MODEL S6/S6C

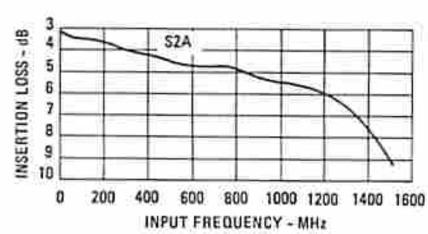


MODEL S2A

Insertion Loss vs. Frequency: The insertion loss is defined as the power loss from the input to the output with the switch turned on by the recommended minimum switching current. With a higher switching current some improvement in performance can be obtained as shown in the insertion loss vs. signal level curves.



MODEL S1

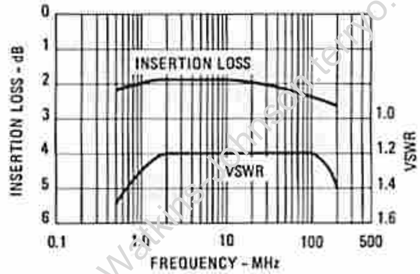


MODEL S2A

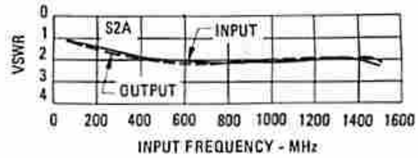
10

Typical Performance at 25°C

VSWR vs. Frequency: The VSWR is defined as the VSWR of either the input or output port when the switch is turned "on" and the other port is terminated in 50 ohms. When the switch is in the "off" mode, the VSWR of the SPST switches is essentially that of an open circuit.

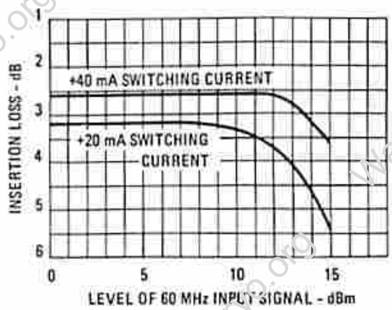


MODEL S6/S6C

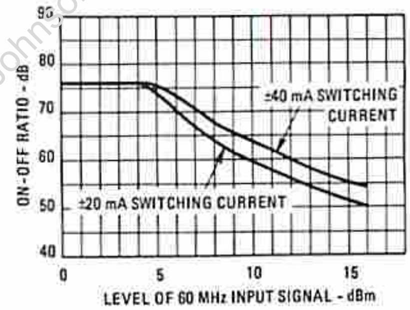


MODEL S2A

Insertion Loss vs. Signal Level: As the input signal level is increased above the maximum specified level of +4 dBm, the input signal starts to control the switch rather than the switching signal. The insertion loss of the switch for various input levels of a 60 MHz signal and switching currents is plotted for each switch.

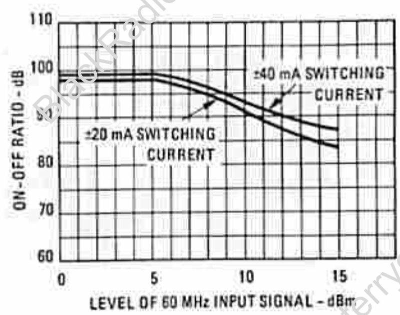


MODEL S1

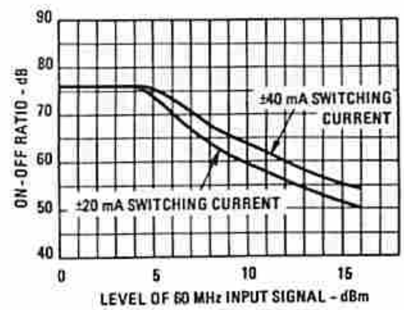


MODEL S6/S6C

On-Off Ratio vs. Signal Level: The loss of "on-off" ratio as a function of input level is plotted for a 60 MHz signal. An increase in the switching current improves the "on-off" ratio.



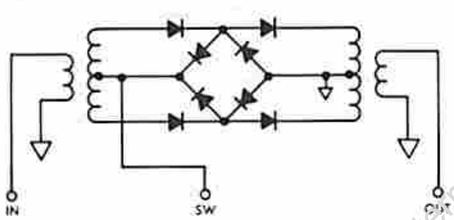
MODEL S1



MODEL S6/S6C

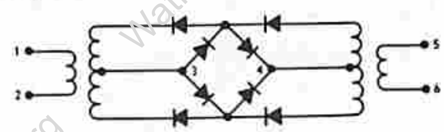
Schematic Diagrams

S1



A biasing current of +20 mA into the SW port gives the on-condition, and −20 mA into the SW port gives the off-condition. The corresponding voltages are approximately +1.5V for the switch "on" and −1.0V for the switch "off."

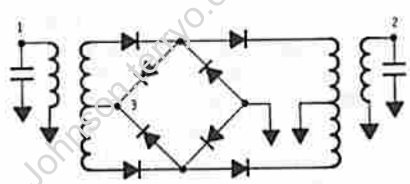
S6/S6C



The input signal is applied at Pins 5 and 6 and the output signal appears at Pins 1 and 2.

Bias is applied to Pins 3 and 4 with Pin 3 at signal ground, if there is a signal ground reference. A bias current of 20 mA into Pin 4 turns the switch "on," and a bias current of 20 mA out of Pin 4 turns the switch "off." for the S6/S6C, the corresponding voltages (Pin 4 to Pin 3) are approximately +1.0V for the switch "on" and −1.0V for the switch "off." Pin 3 is internally grounded to case on Model S6C.

S2A

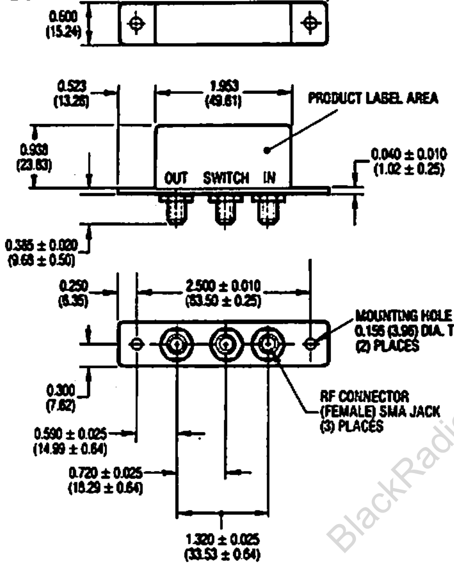


The input signal is applied at Pin 1 and the output signal is taken from Pin 2. The switching bias is applied to Pin 3. A bias current of 20 mA into Pin 3 turns the switch on, and a bias current of 20 mA out of Pin 3 turns the switch off. The corresponding voltages (Pin 3) are approximately +1.0V for the on condition and −1.0V for the off condition.

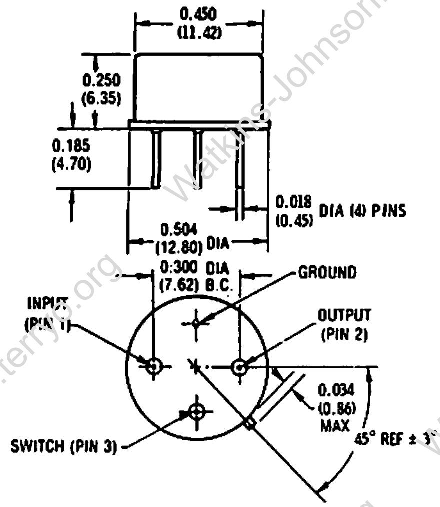
Outline Drawings

NOTE: DIMENSIONS ARE IN INCHES (MILLIMETERS)
±.010 (.025) UNLESS OTHERWISE SPECIFIED

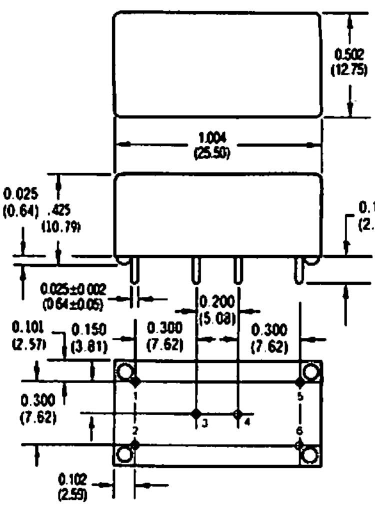
Package I
S1



Package J
S2A/S10

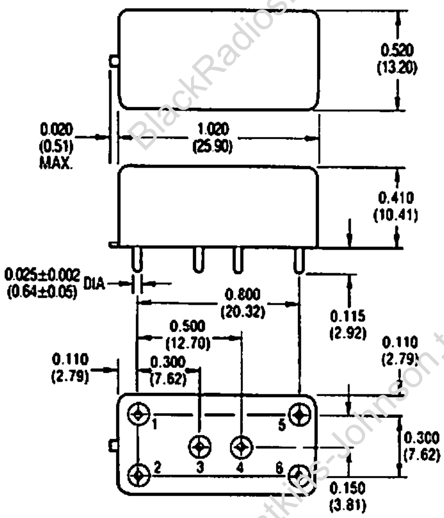


Package M
S6



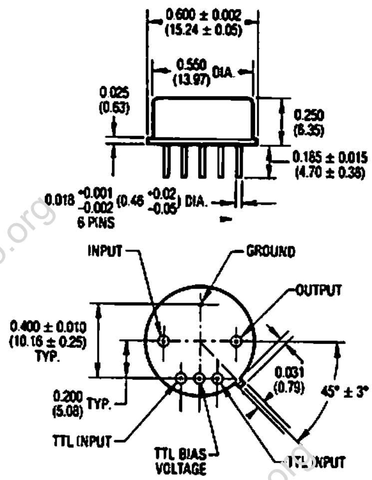
NOTES:
1. Height for S6 is 0.430 (10.92).
2. Pin numbers are molded into header.
3. The W-J logo is over pins 1, 2, and 3.

Package N
S6C



NOTES:
1. Height for S6C is 0.410 (10.41).
2. The WJ logo is over pins 1, 2, and 3.
3. Pin numbers are stamped on the header.

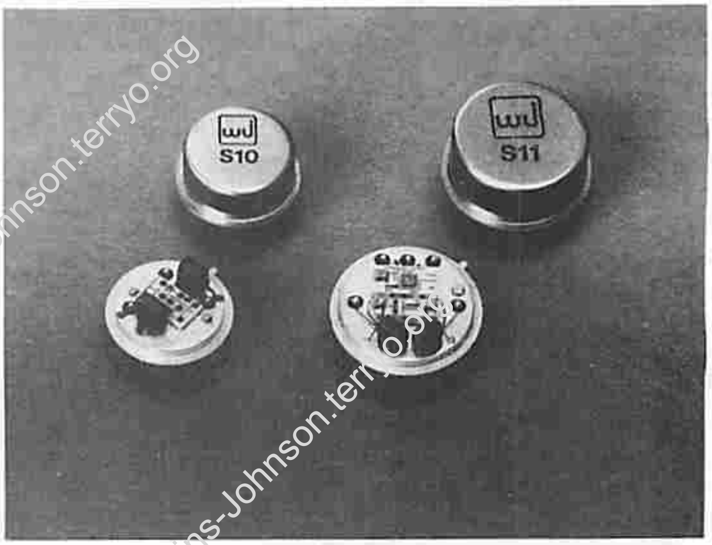
Package P
S11



10

WJ-S10/S11

10 TO 500 MHz THIN FILM SPST SWITCHES



- LOW INSERTION LOSS: <2.0 dB (TYP)
- HIGH ON/OFF RATIO: 60 dB (TYP)
- LOW VSWR: 1.3: TYP
- TTL COMPATIBLE (S11)
- HIGH SPEED SWITCHING: 2 nsec (TYP) S10

Guaranteed Specifications*

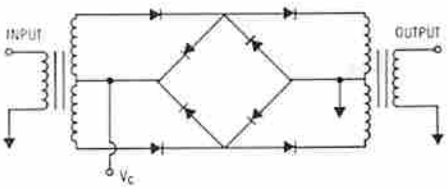
Characteristic	Typical	0°-50°C	-54°-+85°C
Insertion Loss (Max.)			
10-100 MHz	<1.7 dB	2.3 dB	2.7 dB
100-300 MHz	<2.0 dB	2.6 dB	3.0 dB
300-500 MHz	<2.5 dB	4.0 dB	4.5 dB
Isolation			
10-100 MHz	⩾67 dB	54 dB	52 dB
100-300 MHz	⩾62 dB	50 dB	48 dB
300-500 MHz	⩾48 dB	39 dB	36 dB
VSWR (Max.) Input/Output (ON state)			
10-500 MHz	⩽1.9:1	2.4:1	2.6:1
Switching Speed (10 to 90%)			
S10	2 nsec	5 nsec	5 nsec
S11	8 nsec	20 nsec	20 nsec

*Measured in a 50-ohm system.

Absolute Maximum Ratings

Ambient Operating Temperature . . . . -54°C to +100°C
Storage Temperature . . . . -62°C to +125°C
Maximum Case Temperature . . . . +100°C
Maximum DC Voltage . . . . +6 Volts
Maximum Continuous RF Input Power . . . . +10 dBm
Maximum Short Term RF Input Power . . . . 100 Milliwatts
Maximum Peak Power (1 Minute Max.) . . . . 1 Watt (3 μsec Max.)
"S" Series Burn-in Temperature . . . . 100°C

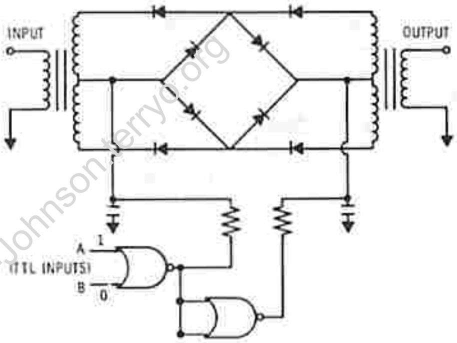
S10 Schematic Diagram



SWITCHING CONDITIONS

ON	OFF
+20 mA	-20 mA
≈+1.0V	≈-1.0V

S11 Schematic Diagram



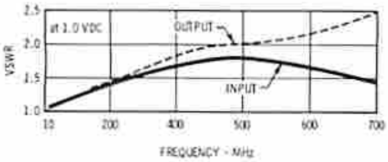
DC volts: 5 ± 1% nominal; DC current 45 mA
TTL logic inputs "0" = 0 volts
"1" = 5 volts nominal
2 volts minimum
6 volts maximum

SWITCHING CONDITIONS

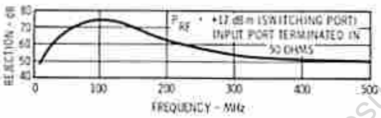
Input Pins	ON State	OFF State		
A	0	1	1	0
B	0	1	0	1

Typical Performance at 25°C

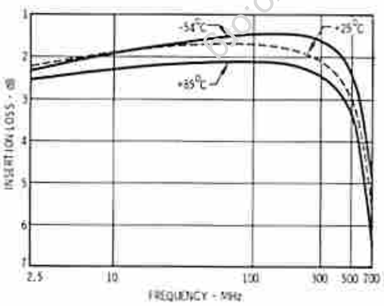
VSWR (ON STATE)



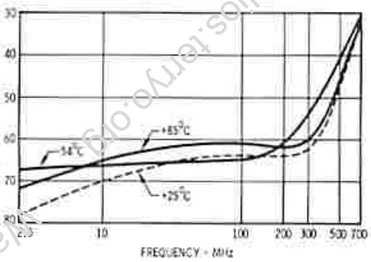
Switching Signal Rejection



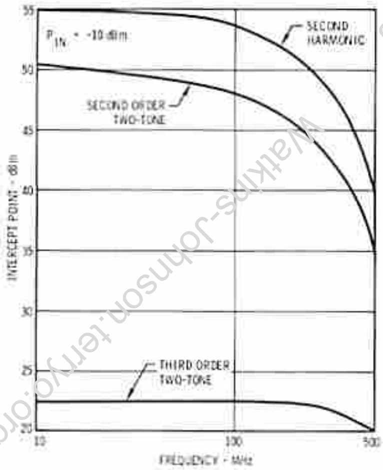
Insertion Loss



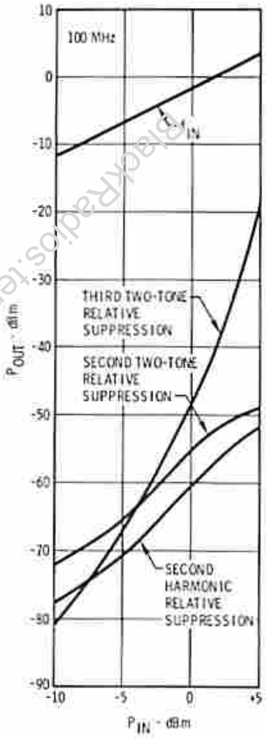
Isolation



Intercept Point



Distortion Products vs. Input Power



Typical Automatic Test Data

OFF STATE

S10

FREQ MHz	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.84	-25.7	.00	127.7	.00	-167.2	.84	-24.9
200.	.83	-52.3	.00	104.7	.00	74.6	.83	-50.7
300.	.81	-80.9	.00	-176.9	.00	-179.2	.81	-80.5
400.	.80	-112.8	.00	-119.6	.00	-117.0	.79	-114.9
500.	.78	-145.3	.00	-109.1	.00	-106.2	.75	-149.3
600.	.76	176.4	.01	-115.0	.01	-116.1	.74	169.8
700.	.74	134.5	.01	-147.3	.01	-146.6	.73	126.1

S11

FREQ MHz	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.82	-22.2	.00	71.4	.00	118.9	.82	-27.2
200.	.81	-45.2	.00	137.4	.00	98.4	.83	-55.0
300.	.80	-70.7	.00	-147.9	.00	-91.4	.82	-85.8
400.	.78	-98.9	.00	-122.5	.00	-119.2	.80	-118.8
500.	.76	-130.0	.00	-120.7	.00	-120.8	.78	-152.2
600.	.75	-166.4	.01	-131.5	.01	-129.7	.79	170.7
700.	.74	151.6	.02	-146.4	.02	-145.0	.79	129.8

ON STATE

S10

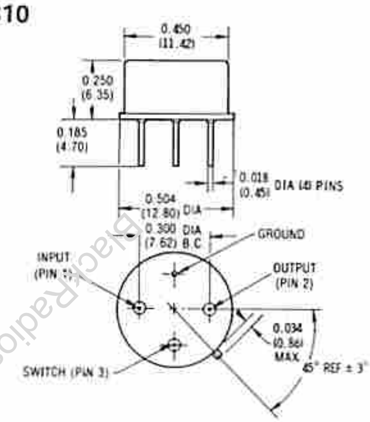
FREQ MHz	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.04	-66.6	.89	.7	.91	.9	.04	-66.6
200.	.09	-122.7	.89	1.7	.79	1.7	.10	-122.2
300.	.16	-154.2	.87	1.4	.87	1.1	[illegible]	-152.1
400.	.25	172.4	.84	-.2	.83	-.5	[illegible]	177.2
500.	.28	140.0	.70	-2.3	.70	-2.0	.27	145.8
600.	.47	106.9	.62	-8.1	.62	-7.2	.40	113.5
700.	.55	71.4	.40	-10.0	.40	-9.0	.55	[illegible]

S11

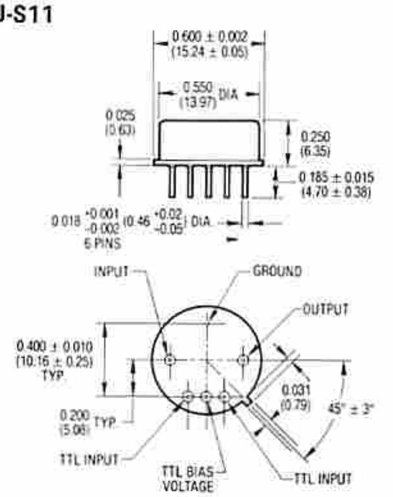
FREQ MHz	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG
100.	.03	-90.6	.91	2.2	.91	2.3	.04	-66.7
200.	.07	-124.5	.89	4.6	.89	4.4	.09	-120.8
300.	.13	-153.1	.78	5.4	.78	5.3	.15	-147.9
400.	.21	176.4	.76	5.1	.75	5.0	.24	-177.0
500.	.32	145.2	.72	3.4	.72	3.9	.35	150.7
600.	.44	114.4	.66	-.5	.66	.4	.47	118.3
700.	.56	81.8	.53	-4.2	.54	-3.7	.50	81.6

Outline Drawings

WJ-S10

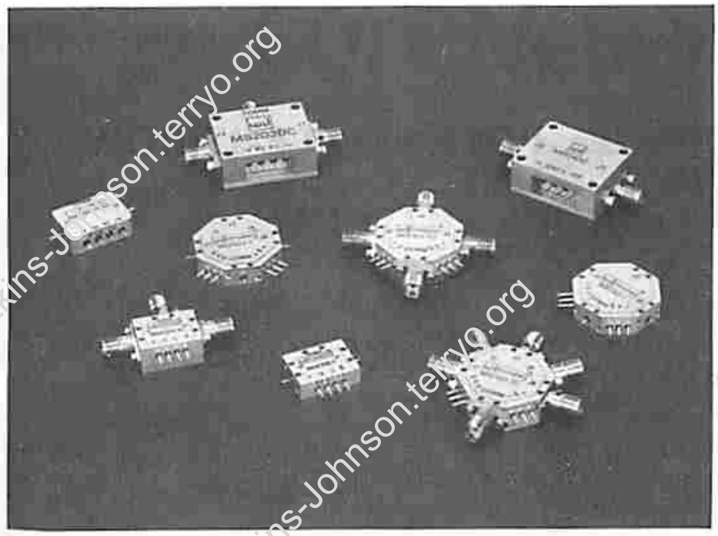


WJ-S11



10

Microwave PIN Diode Switches



- 0.5 TO 18 GHz
- SPST TO SP5T
- MINIATURE HERMETIC PACKAGES
- GUARANTEED PERFORMANCE

Description: Watkins-Johnson's "MS" series of microwave PIN diode switches covers the full 0.5 to 18 GHz frequency range in two primary bands: 0.5 to 4 GHz and 2 to 18 GHz. Within these two bands various models are offered which provide SPST through SP5T functions. For the SPDT series the standard selection increases as both reflective and nonreflective versions are available. All switches are designed to achieve the optimum balance between low insertion loss and high isolation while maintaining the fastest possible switching time performance. Package options include the industry standard MINPAC® for SPST and SPDT models and Watkins-Johnson's new VERSPAC® for SPST through SP5T functions.

Construction: The "MS" series is designed and manufactured for quality and reliability without sacrificing performance. Working in an ESD protected and cleanliness-controlled environment, assembly begins with attaching a low-loss, low-dielectric, soft substrate in a forming gas atmosphere. The soft-substrate, crucial to RF performance, allows for complete channelization of individual arms in the switch. All circuit interconnections are made using gold-gold thermosonic bonding which produces consistent bond strengths typically four times that required by Mil-Standards. The final product is 100% visually inspected before being hermetically sealed with a resistance weld in a dry-nitrogen atmosphere.

Environmental Performance: Rugged designs and manufacturing process control result in a product that performs in the harshest military environments. Typical screening involves S-level environmental testing to the requirements of MIL-STD-883C, Method 5008 including device screening (Table VIII) and Groups A through D.

Guaranteed Specifications[1]
PIN Diode Switches

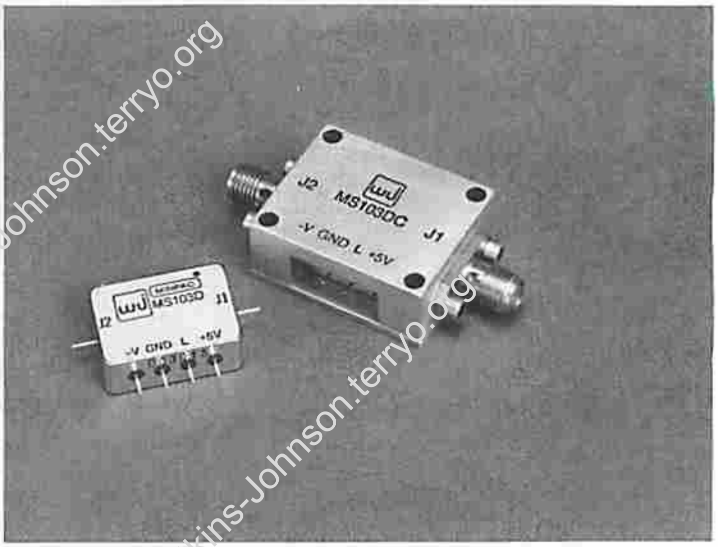
Model	Description	Frequency Range (GHz)	Insertion Loss (dB) Max.	VSWR Max.	Isolation (dB) Min.	Switching Speed (nsec) Max.[2]	Outline Drawing
MS103 (D)(C)	SPST, Reflective	2-18	2.5	1.8:1	70	20	296841/'C' 296927
MS104 (D)(C)	SPST, Reflective	0.5-4	1.0	1.5:1	60	40	296841/'C' 296927
MS203 (D)(C)	SPDT, Reflective	2-18	2.7	2.0:1	55	25	296841/'C' 296840
MSE203 (-1)(C)	SPDT, Reflective	2-18	2.7	2.0:1	55	25	297507
MS205 (D)(C)	SPDT, Reflective	0.5-4	1.3	1.5:1	70	40	296841/'C' 296840
MSE205 (-1)(C)	SPDT, Reflective	0.5-4	1.3	1.5:1	70	40	297507
MSA240	SPDT, Reflective Drop-in Module	2-8	1.3	1.7:1	40	500	296966
MS254 (D)(C)	SPDT, Non-reflective	0.5-4	1.6	1.6:1	60	40	296841/'C' 296840
MSF303 (-1)(C)	SP3T, Reflective	2-18	2.7	2.0:1	55	25	297508
MSF503 (-1)(C)	SP5T, Reflective	2-18	3.1	2.0:1	65	25	297510

NOTES:
1. Applies to switches used in a 50-ohm system and at +25°C case temperature.
2. Switching time is defined as 50% TTL input to 90% RF change including W-J driver delay, except for MSA240 which is defined as 10% RF change to 90% change.

WJ-MS103

SINGLE-POLE SINGLE-THROW REFLECTIVE PIN-DIODE SWITCHES

- 2 TO 18 GHz FREQUENCY COVERAGE
- MINPAC™, HERMETIC PACKAGE
- SMA CONNECTORIZED HOUSING
- LOW INSERTION LOSS
- LOW VSWR
- HIGH ISOLATION
- FAST SWITCHING TIME



Guaranteed Specifications[1]

	Frequency — GHz			
	2-4	4-8	8-12	12-18
Insertion Loss, Maximum	1.0 dB	1.4 dB	2.0 dB	2.4 dB
Input/Output VSWR, Maximum	1.8:1	1.8:1	1.8:1	1.8:1
Isolation, Minimum	80 dB	75 dB	70 dB	70 dB

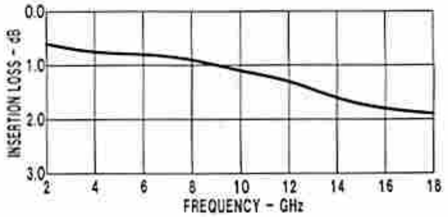
Switching Time[2]: 20 nanoseconds maximum

Notes:
1. Applies to switches used in a 50-ohm system at +25°C case temperature.
2. Switching time is defined as 50% TTL input to 90% RF change including W-J driver delay.
3. Insertion Compression is +30 dBm minimum.
4. Operating Temperature is -54°C to +100°C.

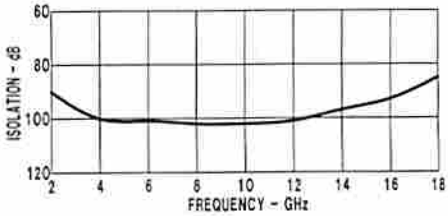
Functional Block Diagram

Typical Performance at 25°C

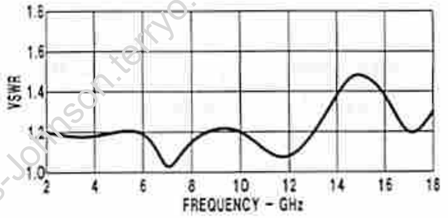
Insertion Loss vs. Frequency



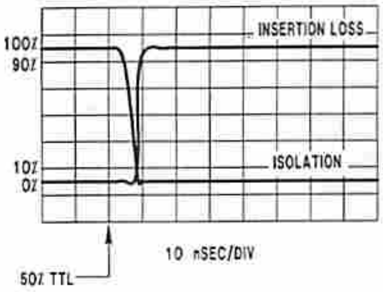
Isolation vs. Frequency



Input/Output VSWR vs. Frequency



Switching Time



Logic Table

	Insertion Loss	Isolation
No Driver	-5 V	+13 mA
Driver*	TTL LO	TTL HI

Driver Bias*: +5.0 ± 0.5 V at 100 mA maximum.
-11 to -15 V at 50 mA maximum.

TTL Logic: TTL LO = 0 to 0.8 at 1.6 mA maximum sink.
TTL HI = 2.0 to 5.0 V at 40 μA maximum source.

*Inverted logic drivers and drivers with alternate bias conditions are available. Consult the factory.

Ordering Information

MS103 D C

1. Designate model number
2. Add "D" if integral driver is desired.
3. Add "C" if connectorized version is desired.

Case Outline

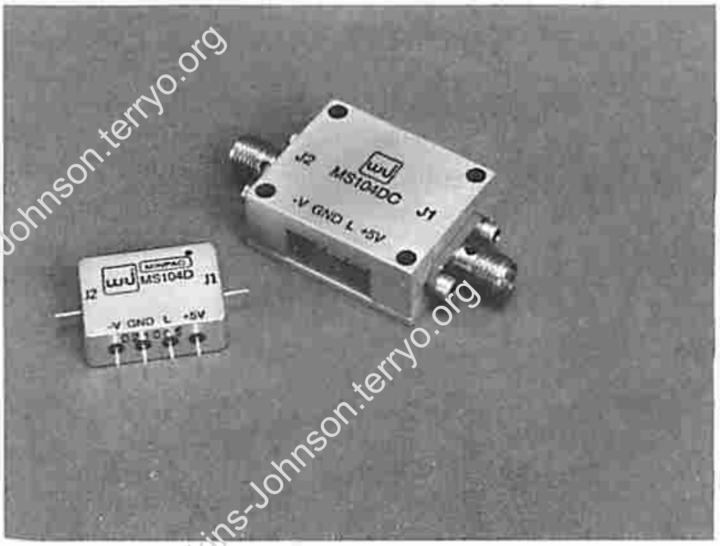
MINPAC™: Drawing Number 296841 (P. 844)

Connectorized Version: Drawing Number 296927 (P. 844)

WJ-MS104

SINGLE-POLE SINGLE-THROW REFLECTIVE PIN-DIODE SWITCHES

- 0.5 TO 4 GHz FREQUENCY COVERAGE
- MINPAC™, HERMETIC PACKAGE
- SMA CONNECTORIZED HOUSING
- LOW INSERTION LOSS
- LOW VSWR
- HIGH ISOLATION
- FAST SWITCHING TIME



Guaranteed Specifications [1]

	Frequency — GHz	
	0.5–2	2–4
Insertion Loss, Maximum	0.8 dB	1.0 dB
Input/Output VSWR, Maximum	1.5:1	1.5:1
Isolation, Minimum	60 dB	75 dB

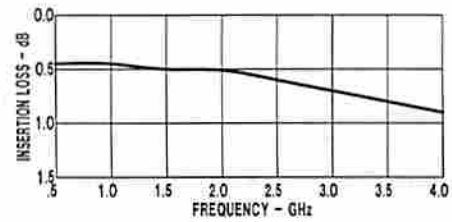
Switching Time[2]: 40 nanoseconds maximum

Notes:
1. Applies to switches used in a 50-ohm system at +25°C case temperature.
2. Switching time is defined as 50% TTL input to 90% RF change including W-J driver delay.
3. Insertion Compression is +30 dBm minimum.
4. Operating Temperature is -54°C to +100°C.

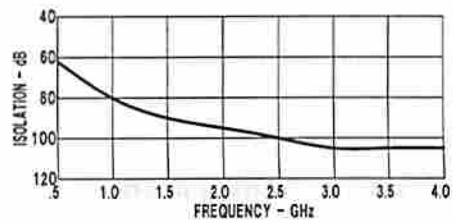
Functional Block Diagram

Typical Performance at 25°C

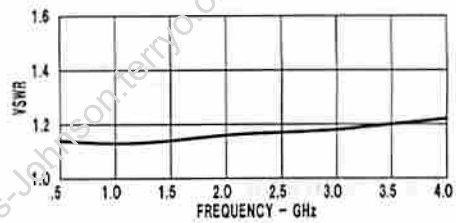
Insertion Loss vs. Frequency



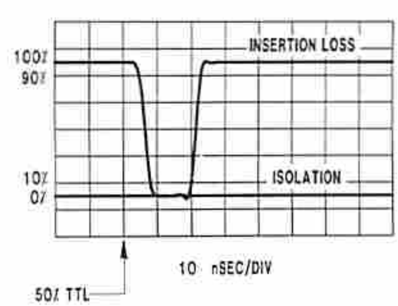
Isolation vs. Frequency



Input/Output VSWR vs. Frequency



Switching Time



Logic Table

	Insertion Loss	Isolation
No Driver	-5 V	+20 mA
Driver*	TTL LO	TTL HI

Driver Bias*: +5.0 ± 0.5 V at 100 mA maximum.
-11 to -15 V at 50 mA maximum.

TTL Logic: TTL LO = 0 to 0.8 at 1.6 mA maximum sink.
TTL HI = 2.0 to 5.0 V at 40 μA maximum source.

*Inverted logic drivers and drivers with alternate bias conditions are available. Consult the factory.

Ordering Information

MS104 D C

1. Designate model number
2. Add "D" if integral driver is desired.
3. Add "C" if connectorized version is desired.

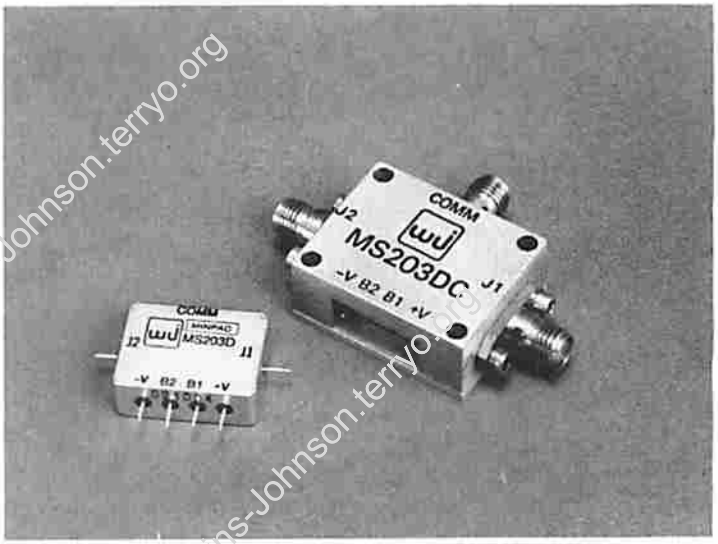
Case Outline

MINPAC™: Drawing Number 296841 (P. 844)
Connectorized Version: Drawing Number 296927 (P. 844)

WJ-MS203

SINGLE-POLE DOUBLE-THROW REFLECTIVE PIN-DIODE SWITCHES

- 2 TO 18 GHz FREQUENCY COVERAGE
- MINPAC™, HERMETIC PACKAGE
- SMA CONNECTORIZED HOUSING
- LOW INSERTION LOSS
- LOW VSWR
- HIGH ISOLATION
- FAST SWITCHING TIME



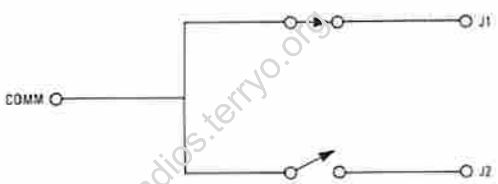
Guaranteed Specifications[1]

	Frequency — GHz			
	2-4	4-8	8-12	12-18
Insertion Loss, Maximum	1.5 dB	1.8 dB	2.2 dB	2.7 dB
Input/Output VSWR, Maximum	2.0:1	2.0:1	2.0:1	2.0:1
Isolation, Minimum	65 dB	60 dB	60 dB	55 dB

Switching Time[2]: 25 nanoseconds maximum

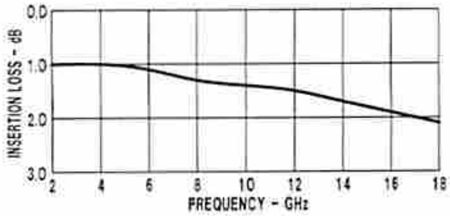
Notes:
1. Applies to switches used in a 50-ohm system at +25°C case temperature.
2. Switching time is defined as 50% TTL input to 90% RF change including W-J driver delay.
3. Insertion Compression is +20 dBm minimum.
4. Operating Temperature is -54°C to +100°C.

Functional Block Diagram

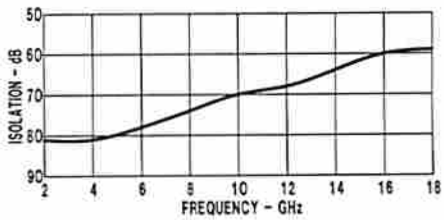


Typical Performance at 25°C

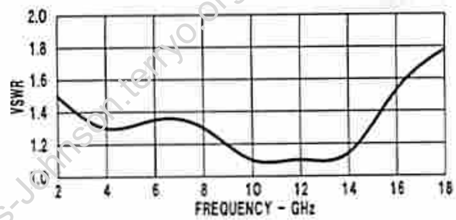
Insertion Loss vs. Frequency



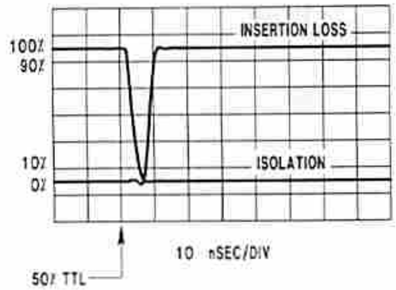
Isolation vs. Frequency



Input/Output VSWR vs. Frequency



Switching Time



Logic Table

	Insertion Loss	Isolation
No Driver	-13 mA	+13 mA
Driver*	TTL LO	TTL HI

Driver Bias*: +5.0 ± 0.5 V at 100 mA maximum.
-11 to -15 V at 50 mA maximum.

TTL Logic: TTL LO = 0 to 0.8 V at 1.6 mA maximum sink.
TTL HI = 2.0 to 5.0 V at 40 μA maximum source.

*Inverted logic drivers, single control input drivers, and drivers with alternate bias conditions are available. Consult the factory.

Ordering Information

MS203 D C

1. Designate model number
2. Add "D" if integral driver is desired.
3. Add "C" if connectorized version is desired.

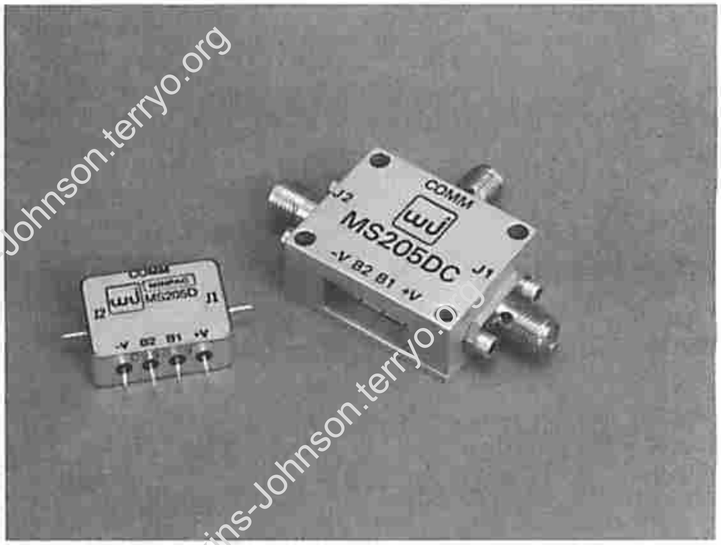
Case Outline

MINPAC^{TM}: Drawing Number 296841 (P. 844)
Connectorized Version: Drawing Number 296840 (P. 844)

WJ-MS205

SINGLE-POLE DOUBLE-THROW REFLECTIVE PIN-DIODE SWITCHES

- 0.5 TO 4 GHz FREQUENCY COVERAGE
- MINPAC™, HERMETIC PACKAGE
- SMA CONNECTORIZED HOUSING
- LOW INSERTION LOSS
- LOW VSWR
- HIGH ISOLATION
- FAST SWITCHING TIME



Guaranteed Specifications [1]

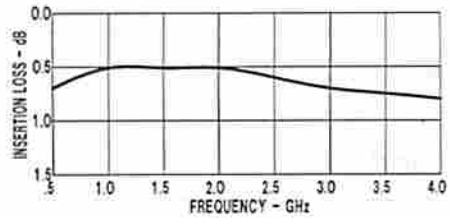
	Frequency — GHz	
	0.5-2	2-4
Insertion Loss, Maximum	1.3 dB	1.3 dB
Input/Output VSWR, Maximum	1.5:1	1.5:1
Isolation, Minimum	70 dB	70 dB

Switching Time[2]: 40 nanoseconds maximum

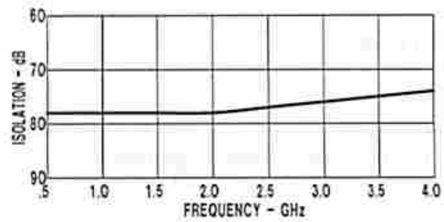
Notes:
1. Applies to switches used in a 50-ohm system at +25°C case temperature.
2. Switching time is defined as 50% TTL input to 90% RF change including W-J driver delay.
3. Insertion Compression is +20 dBm minimum.
4. Operating Temperature is -54°C to +100°C.

Typical Performance at 25°C

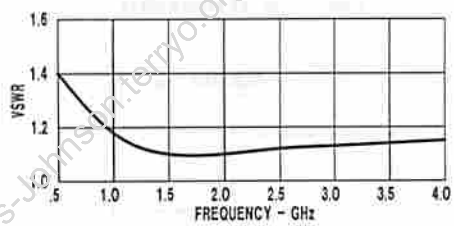
Insertion Loss vs. Frequency



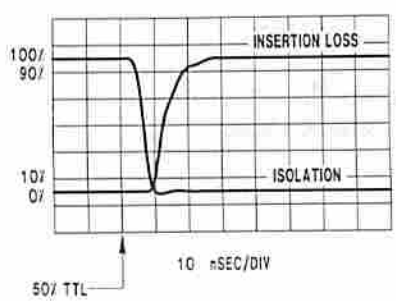
Isolation vs. Frequency



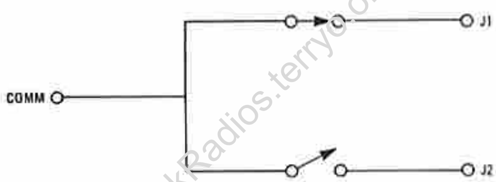
Input/Output VSWR vs. Frequency



Switching Time



Functional Block Diagram



Logic Table

	Insertion Loss	Isolation
No Driver	-20 mA	+20 mA
Driver*	TTL LO	TTL HI

Driver Bias*: +5.0 ± 0.5 V at 100 mA maximum.
-11 to -15 V at 75 mA maximum.

TTL Logic: TTL LO = 0 to 0.8 at 1.6 mA maximum sink.
TTL HI = 2.0 to 5.0 V at 40 μA maximum source.

*Inverted logic drivers, single control input drivers, and drivers with alternate bias conditions are available. Consult the factory.

Ordering Information

MS205 D C

1. Designate model number
2. Add "D" if integral driver is desired.
3. Add "C" if connectorized version is desired.

Case Outline

MINPAC™: Drawing Number 296841 (P. 844)
Connectorized Version: Drawing Number 296840 (P. 844)

10

WJ-MS254

SINGLE-POLE DOUBLE-THROW NON-REFLECTIVE PIN-DIODE SWITCHES

- 0.5 TO 4 GHz FREQUENCY COVERAGE
- MINPAC™, HERMETIC PACKAGE
- SMA CONNECTORIZED HOUSING
- LOW INSERTION LOSS
- LOW VSWR
- HIGH ISOLATION
- FAST SWITCHING TIME

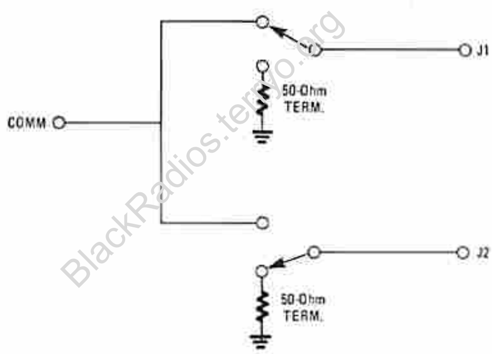
Guaranteed Specifications[1]

	Frequency – GHz	
	0.5-2	2-4
Insertion Loss, Maximum	1.6 dB	1.6 dB
Input/Output VSWR, Maximum	1.6:1	1.6:1
Isolation, Minimum	65 dB	60 dB

Switching Time[2]: 40 nanoseconds maximum

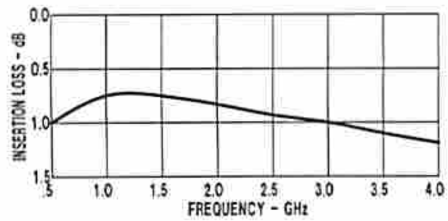
Notes:
1. Applies to switches used in a 50-ohm system at +25°C case temperature.
2. Switching time is defined as 50% TTL input to 90% RF change including W-J driver delay.
3. Insertion Compression is +20 dBm minimum.
4. Operating Temperature is -54°C to +100°C.

Functional Block Diagram

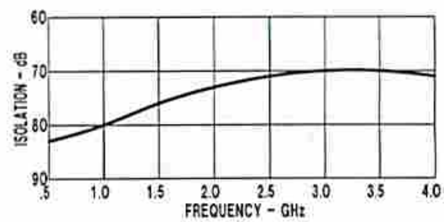


Typical Performance at 25°C

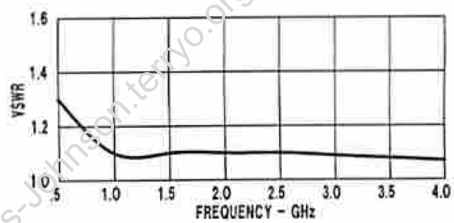
Insertion Loss vs. Frequency



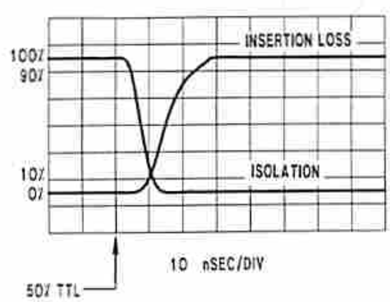
Isolation vs. Frequency



Input/Output VSWR vs. Frequency



Switching Time



Logic Table

	Insertion Loss	Isolation
No Driver	-20 mA	+20 mA
Driver*	TTL LO	TTL HI

Driver Bias*: +5.0 ± 0.5 V at 100 mA maximum.
-11 to -15 V at 75 mA maxiumum.

T TL Logic: TTL LO = 0 to 0.8 at 1.6 mA maximum sink.
TTL HI = 2.0 to 5.0 V at 40 μA maximum source.

*Inverted logic drivers, single control input drivers, and drivers with alternate bias conditions are available. Consult the factory.

Ordering Information

MS254 D C

1. Designate model number
2. Add "D" if integral driver is desired.
3. Add "C" if connectorized version is desired.

Case Outline

MINPAC™: Drawing Number 296841 (P. 844)
Connectorized Version: Drawing Number 296840 (P. 844)

10

WJ-MSA240

SINGLE-POLE DOUBLE-THROW REFLECTIVE PIN-DIODE SWITCH MODULES

- 2 TO 18 GHz FREQUENCY COVERAGE
- HERMETIC DROP-IN PACKAGE
- LOW INSERTION LOSS
- LOW VSWR
- HIGH ISOLATION

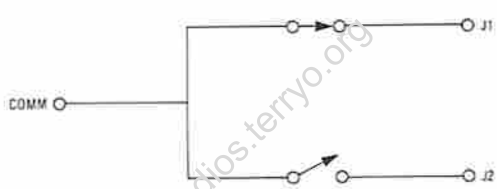
Guaranteed Specifications[1]

	Frequency — GHz
	2 – 8 GHz
Insertion Loss, Maximum	1.3 dB
Input/Output VSWR, Maximum	1.7:1
Isolation, Minimum	40 dB

Switching Time[2]: 500 nanoseconds maximum

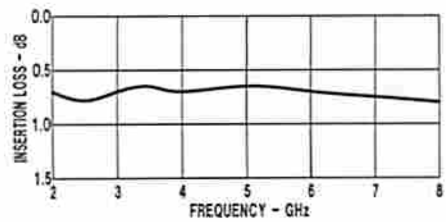
Notes:
1. Applies to switches used in a 50-ohm system at +25°C case temperature.
2. Switching time is defined as 10% RF change to 90% RF change.
3. Insertion Compression is +20 dBm minimum.
4. Operating Temperature is -54°C to +100°C.

Functional Block Diagram

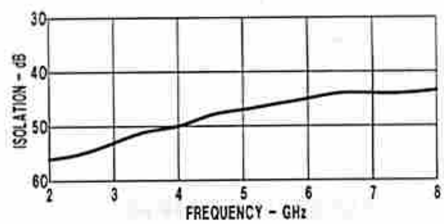


Typical Performance at 25°C

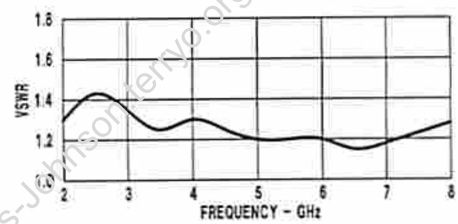
Insertion Loss vs. Frequency



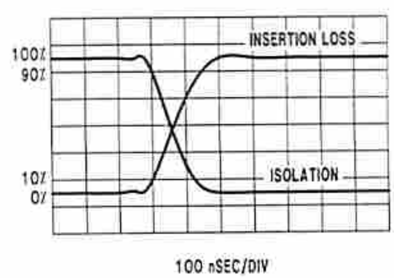
Isolation vs. Frequency



Input/Output VSWR vs. Frequency



Rise/Fall Time



Logic Table

Insertion Loss	Isolation
-35 mA	+5 V

Ordering Information

MSA240

1.

1. Designate model number.

Case Outline

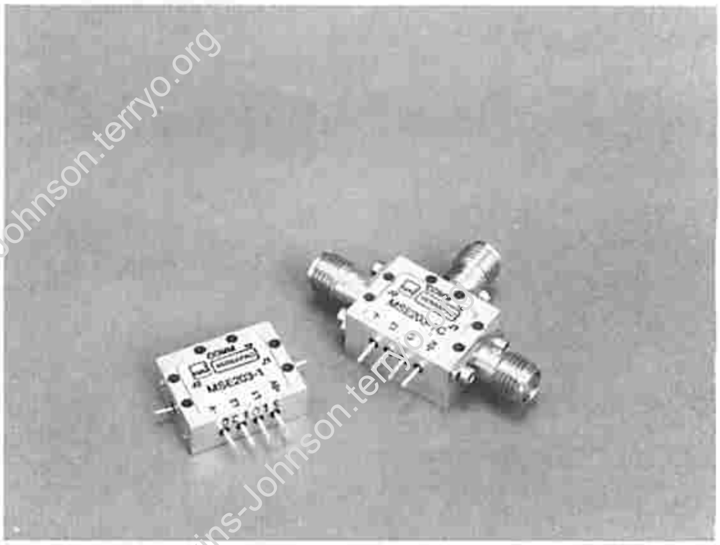
Drawing Number 296966 (P. 844)

10

WJ-MSE203

SINGLE-POLE DOUBLE-THROW REFLECTIVE PIN-DIODE SWITCHES

- 2 TO 18 GHz FREQUENCY COVERAGE
- VERSAPAC™, HERMETIC PACKAGE
- REMOVABLE SMA CONNECTORS
- LOW INSERTION LOSS
- LOW VSWR
- HIGH ISOLATION
- FAST SWITCHING TIME



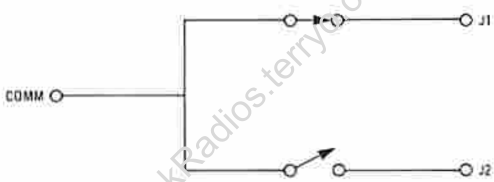
Guaranteed Specifications[1]

	Frequency — GHz			
	2-4	4-8	8-12	12-18
Insertion Loss, Maximum	1.5 dB	1.8 dB	2.2 dB	2.7 dB
Input/Output VSWR, Maximum	2.0:1	2.0:1	2.0:1	2.0:1
Isolation, Minimum	65 dB	60 dB	60 dB	55 dB

Switching Time[2]: 25 nanoseconds maximum

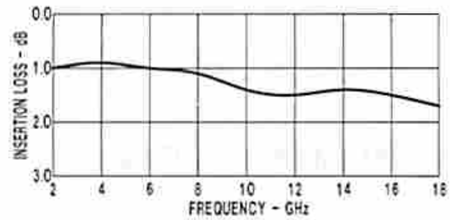
Notes:
1. Applies to switches used in a 50-ohm system at +25°C case temperature.
2. Switching time is defined as 50% TTL input to 90% RF change including W-J driver delay.
3. Insertion Compression is +20 dBm minimum.
4. Operating Temperature is -54°C to +100°C.

Functional Block Diagram

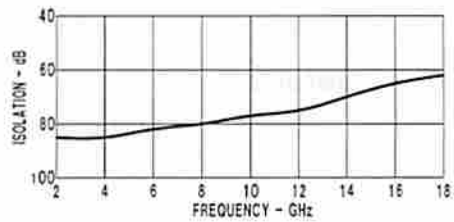


Typical Performance at 25°C

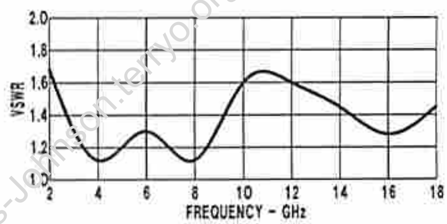
Insertion Loss vs. Frequency



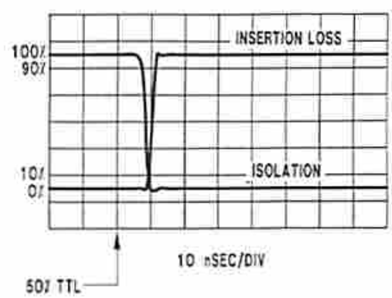
Isolation vs. Frequency



Input/Output VSWR vs. Frequency



Switching Time



Logic Table

DASH NO.	B1	B2	CONTROL INPUT L1	L2	L	COMM-J1	COMM-J2
N/A	−13 mA	+13 mA				I.L.	ISOL.
	+13 mA	−13 mA				ISOL.	I.L.
-1			TTL LO	TTL HI		I.L.	ISOL.
			TTL HI	TTL LO		ISOL.	I.L.
-2			TTL HI	TTL LO		I.L.	ISOL.
			TTL LO	TTL HI		ISOL.	I.L.
-3			TTL LO	TTL LO		I.L.	ISOL.
			TTL HI	TTL HI		ISOL.	I.L.
-4			TTL HI	TTL HI		I.L.	ISOL.
			TTL LO	TTL LO		ISOL.	I.L.
-5					TTL LO	I.L.	ISOL.
					TTL HI	ISOL.	I.L.
-6					TTL HI	I.L.	ISOL.
					TTL LO	ISOL.	I.L.

Driver Bias*: +5.0 ± 0.5 V at 100 mA maximum.
−11 to −15 V at 50 mA maximum

TTL Logic: TTL LO = 0 to 0.8 V at 1.6 mA maximum sink.
TTL HI = 2.0 to 5.0 V at 40 μA maximum source.

*Alternate bias conditions are available. Consult the factory.

Ordering Information

MSE203 -X C

1. Designate model number
2. Driver Option. See Logic Table.
3. Add "C" if connectorized version is desired.

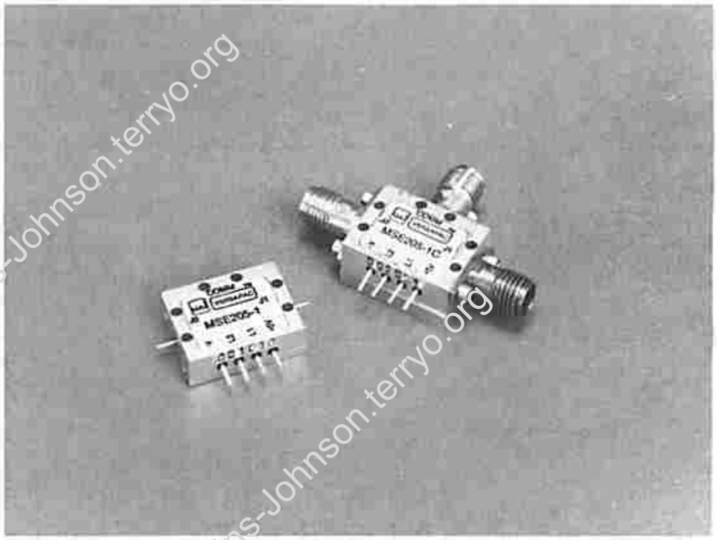
Case Outline

VERSAPAC™: Drawing Number 297507 (P. 854)

Connectorized Version: Drawing Number 297507 (P. 845)

WJ-MSE205

SINGLE-POLE DOUBLE-THROW REFLECTIVE PIN-DIODE SWITCHES



- 0.5 TO 4 GHz FREQUENCY COVERAGE
- VERSAPAC™, HERMETIC PACKAGE
- REMOVABLE SMA CONNECTORS
- LOW INSERTION LOSS
- LOW VSWR
- HIGH ISOLATION
- FAST SWITCHING TIME

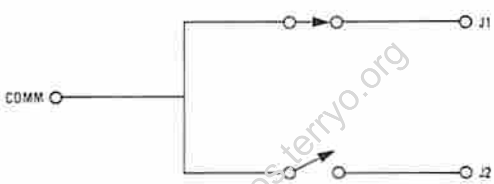
Guaranteed Specifications[1]

	Frequency — GHz	
	0.5-2	2-4
Insertion Loss, Maximum	1.3 dB	1.3 dB
Input/Output VSWR, Maximum	1.5:1	1.5:1
Isolation, Minimum	70 dB	70 dB

Switching Time[2]: 40 nanoseconds maximum

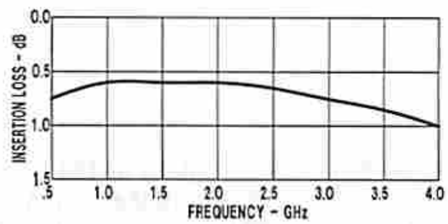
Notes:
1. Applies to switches used in a 50-ohm system at +25°C case temperature.
2. Switching time is defined as 50% TTL input to 90% RF change including W-J driver delay.
3. Insertion Compression is +20 dBm minimum.
4. Operating Temperature is -54°C to +100°C.

Functional Block Diagram

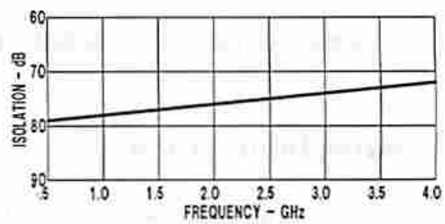


Typical Performance at 25°C

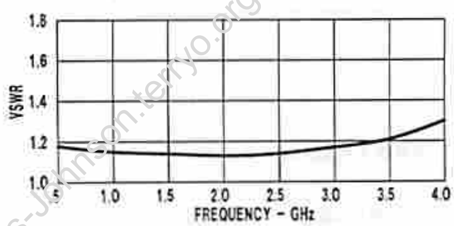
Insertion Loss vs. Frequency



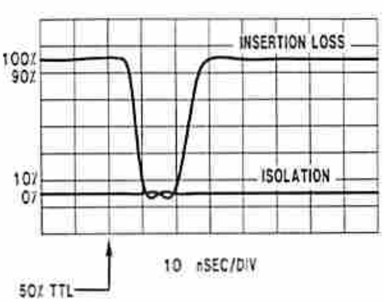
Isolation vs. Frequency



Input/Output VSWR vs. Frequency



Switching Time



Logic Table

DASH NO.	B1	B2	CONTROL INPUT L1	L2	L	COMM-J1	COMM-J2
N/A	-20 mA	+20 mA				I.L.	ISOL.
	+20 mA	-20 mA				ISOL.	I.L.
-1			TTL LO	TTL HI		I.L.	ISOL.
			TTL HI	TTL LO		ISOL.	I.L.
-2			TTL HI	TTL LO		I.L.	ISOL.
			TTL LO	TTL HI		ISOL.	I.L.
-3			TTL LO	TTL LO		I.L.	ISOL.
			TTL HI	TTL HI		ISOL.	I.L.
-4			TTL HI	TTL HI		I.L.	ISOL.
			TTL LO	TTL LO		ISOL.	I.L.
-5					TTL LO	I.L.	ISOL.
					TTL HI	ISOL.	I.L.
-6					TTL HI	I.L.	ISOL.
					TTL LO	ISOL.	I.L.

Driver Bias*: +5.0 ± 0.5 V at 100 mA maximum.
-11 to -15 V at 75 mA maximum

TTL Logic: TTL LO = 0 to 0.8 V at 1.6 mA maximum sink.
TTL HI = 2.0 to 5.0 V at 40 μA maximum source.

*Alternate bias conditions are available. Consult the factory.

Ordering Information

MSE205 -X C

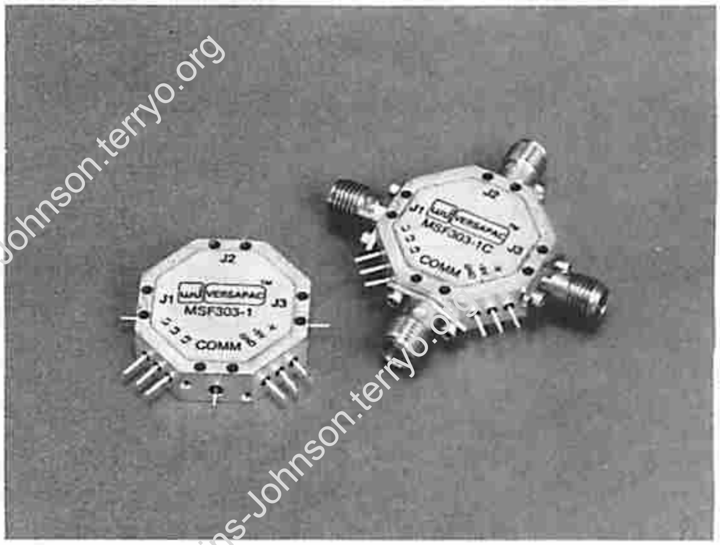
1. Designate model number.
2. Driver Option. See Logic Table.
3. Add "C" if connectorized version is desired.

Case Outline

VERSAPAC™ : Drawing Number 297507 (P. 845)
Connectorized Version: Drawing Number 297507 (P. 845)

WJ-MSF303

SINGLE-POLE THREE-THROW REFLECTIVE PIN-DIODE SWITCHES



- 2 TO 18 GHz FREQUENCY COVERAGE
- VERSAPAC™, HERMETIC PACKAGE
- REMOVABLE SMA CONNECTORS
- LOW INSERTION LOSS
- LOW VSWR
- HIGH ISOLATION
- FAST SWITCHING TIME

Guaranteed Specifications[1]

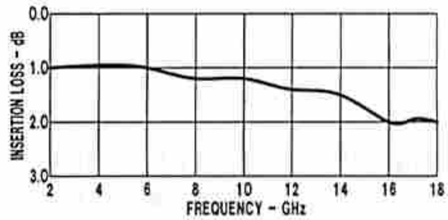
	Frequency – GHz			
	2–4	4–8	8–12	12–18
Insertion Loss, Maximum	1.4 dB	2.0 dB	2.5 dB	2.7 dB
Input/Output VSWR, Maximum	2.0:1	2.0:1	2.0:1	2.0:1
Isolation, Minimum	65 dB	60 dB	60 dB	55 dB

Switching Time[2]: 25 nanoseconds maximum

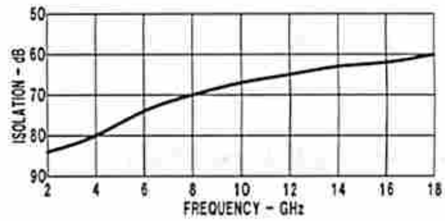
Notes:
1. Applies to switches used in a 50-ohm system at +25°C case temperature.
2. Switching time is defined as 50% TTL input to 90% RF change including W-J driver delay.
3. Insertion Compression is +20 dBm minimum on all switches.
4. Operating Temperature is -54°C to +100°C.

Typical Performance at 25°C

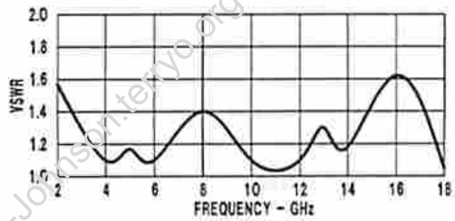
Insertion Loss vs. Frequency



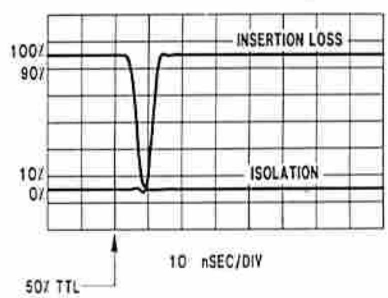
Isolation vs. Frequency



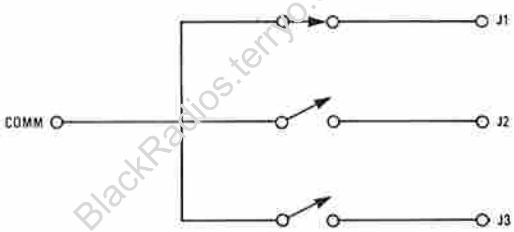
Input/Output VSWR vs. Frequency



Switching Time



Functional Block Diagram



Logic Table

DASH NO.	CONTROL INPUT B1	B2	B3	COMM-J1	COMM-J2	COMM-J3
N/A	-13 mA	+13 mA	+13 mA	I.L.	ISOL.	ISOL.
	+13 mA	-13 mA	+13 mA	ISOL.	I.L.	ISOL.
	+13 mA	+13 mA	-13 mA	ISOL.	ISOL.	I.L.
	L1	L2	L3			
-1	TTL LO	TTL HI	TTL HI	I.L.	ISOL.	ISOL.
	TTL HI	TTL LO	TTL HI	ISOL.	I.L.	ISOL.
	TTL HI	TTL HI	TTL LO	ISOL.	ISOL.	I.L.
-2	TTL HI	TTL LO	TTL LO	I.L.	ISOL.	ISOL.
	TTL LO	TTL HI	TTL LO	ISOL.	I.L.	ISOL.
	TTL LO	TTL LO	TTL HI	ISOL.	ISOL.	I.L.
	A0	A1	E			
-3	TTL HI	TTL LO	TTL HI	I.L.	ISOL.	ISOL.
	TTL LO	TTL HI	TTL HI	ISOL.	I.L.	ISOL.
	TTL HI	TTL HI	TTL HI	ISOL.	ISOL.	I.L.
	X	X	TTL LO	ISOL.	ISOL.	ISOL.

Driver Bias*: +5.0 ± 0.5 V at 175 mA maximum.
-11 to -15 V at 75 mA maximum.

TTL Logic: TTL LO = 0 to 0.8 V at 1.6 mA maximum sink.
TTL HI = 2.0 to 5.0 V at 40 μA maximum source.
X = Don't care (either low or high logic level).

*Alternate bias conditions are available. Consult the factory.

Ordering Information

MSF303 -X C

1. Designate model number.
2. Driver Option. See Logic Table.
3. Add "C" if connectorized version is desired.

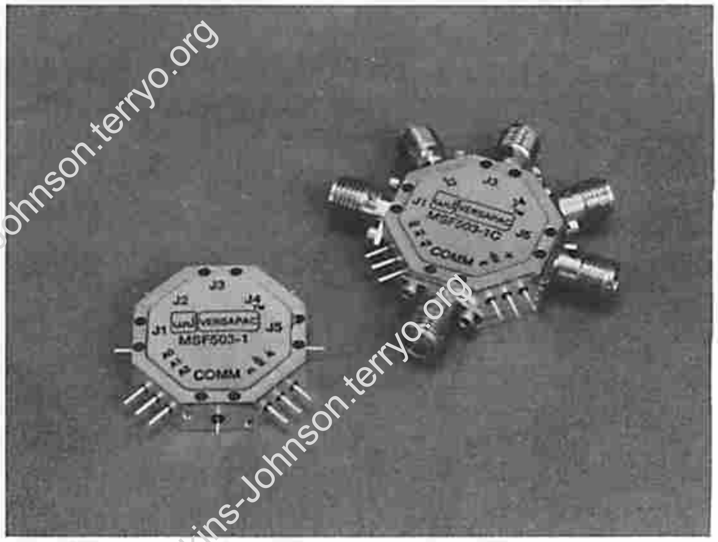
Case Outline

VERSAPAC™: Drawing Number 297508 (P. 845)
Connectorized Version: Drawing Number 297508 (P. 845)

10

WJ-MSF503

SINGLE-POLE FIVE-THROW REFLECTIVE PIN-DIODE SWITCHES



- 2 TO 18 GHz FREQUENCY COVERAGE
- VERSAPAC™, HERMETIC PACKAGE
- REMOVABLE SMA CONNECTORS
- LOW INSERTION LOSS
- LOW VSWR
- HIGH ISOLATION
- FAST SWITCHING TIME

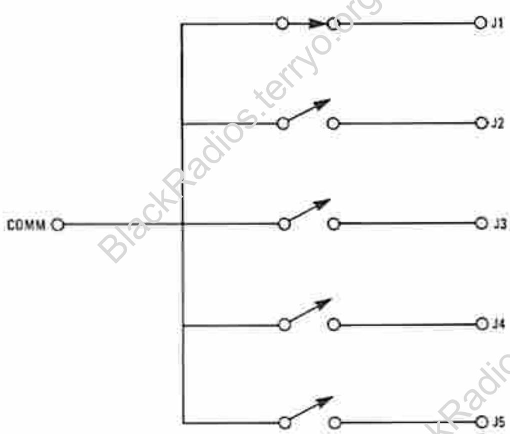
Guaranteed Specifications[1]

	Frequency – GHz			
	2-4	4-8	8-12	12-18
Insertion Loss, Maximum	1.7 dB	2.2 dB	2.7 dB	3.1 dB
Input/Output VSWR, Maximum	2.0:1	2.0:1	2.0:1	2.0:1
Isolation, Minimum	80 dB	70 dB	70 dB	65 dB

Switching Time[2]: 25 nanoseconds maximum

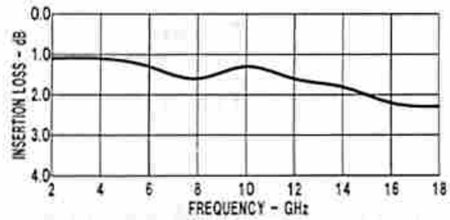
Notes:
1. Applies to switches used in a 50-ohm system at +25°C case temperature.
2. Switching time is defined as 50% TTL input to 90% RF change including W-J driver delay.
3. Insertion Compression is +20 dBm minimum.
4. Operating Temperature is -54°C to +100°C.

Functional Block Diagram

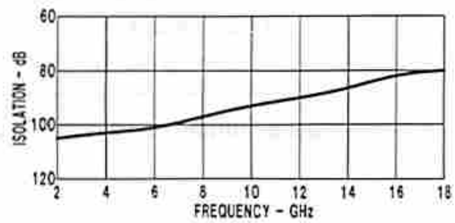


Typical Performance at 25°C

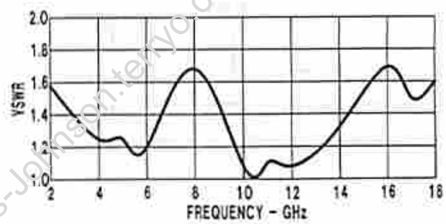
Insertion Loss vs. Frequency



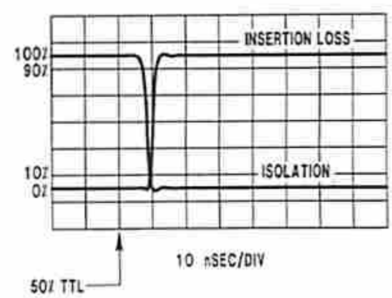
Isolation vs. Frequency



Input/Output VSWR vs. Frequency



Switching Time



Logic Table

DASH NO.	CONTROL INPUT B1	B2	B3	B4	B5	COMM-J1	COMM-J2	COMM-J3	COMM-J4	COMM-J5
N/A	−13 mA	+13 mA	+13 mA	+13 mA	+13 mA	I.L.	ISOL.	ISOL.	ISOL.	ISOL.
	+13 mA	−13 mA	+13 mA	+13 mA	+13 mA	ISOL.	I.L.	ISOL.	ISOL.	ISOL.
	+13 mA	+13 mA	−13 mA	+13 mA	+13 mA	ISOL.	ISOL.	I.L.	ISOL.	ISOL.
	+13 mA	+13 mA	+13 mA	−13 mA	+13 mA	ISOL.	ISOL.	ISOL.	I.L.	ISOL.
	+13 mA	+13 mA	+13 mA	+13 mA	−13 mA	ISOL.	ISOL.	ISOL.	ISOL.	I.L.
	A0	A1	A2	E						
-1	TTL HI	TTL LO	TTL LO	TTL HI		I.L.	ISOL.	ISOL.	ISOL.	ISOL.
	TTL LO	TTL HI	TTL LO	TTL HI		ISOL.	I.L.	ISOL.	ISOL.	ISOL.
	TTL HI	TTL HI	TTL LO	TTL HI		ISOL.	ISOL.	I.L.	ISOL.	ISOL.
	TTL LO	TTL LO	TTL HI	TTL HI		ISOL.	ISOL.	ISOL.	I.L.	ISOL.
	TTL HI	TTL LO	TTL HI	TTL HI		ISOL.	ISOL.	ISOL.	ISOL.	I.L.
	X	X	X	TTL LO		ISOL.	ISOL.	ISOL.	ISOL.	ISOL.

Driver Bias*: +5.0 ± 0.5 V at 240 mA maximum.
−11 to −15 V at 100 mA maximum

TTL Logic: TTL LO = 0 to 0.8 V at 1.6 mA maximum sink.
TTL HI = 2.0 to 5.0 V at 40 μA maximum source.
X = Don't care (either low or high logic level).

*Alternate bias conditions are available. Consult the factory.

Ordering Information

MSF503 -X C

1. Designate model number
2. Driver Option. See Logic Table
3. Add "C" if connectorized version is desired.

Case Outline

VERSAPAC™: Drawing Number 297510 (P. 845)
Connectorized Version: Drawing Number 297510 (P. 845)

10

Microwave GaAs FET MMIC Switch

- DC TO 5 MHz
- SPDT
- MINIATURE HERMETIC PACKAGE
- GUARANTEED PERFORMANCE

Description: Complementing the 0.5 to 18 GHz frequency coverage of our PIN diode switch products, Watkins-Johnson's new MST201 switch provides SPDT switching function over the dc to 5 GHz frequency range. The basic switching element used in the MST201 is a Watkins-Johnson designed and manufactured GaAsFET monolithic microwave integrated circuit (MMIC). In addition to true "dc" signal operation, the GaAsFET technology provides RF performance comparable to PIN diode products with the advantages of low dc current draw, nanosecond switching time and low video transients. The device is supplied in a TO-5 package.

Construction: Working in an ESD protected and cleanliness-controlled environment, assembly begins with substrate attach in a forming gas atmosphere. After attaching the MMIC chip, all circuit interconnections are made using thermosonic gold-gold bonding which produces bond strengths typically four times that required by Mil-Standards. The final product is 100% visually inspected before being hermetically sealed with a resistance weld in a dry-nitrogen atmosphere.

Environmental Performance: Rugged designs and manufacturing process control coupled with the inherent reliability of MMIC technology results in a product that performs in the harshest military environments. Typical screening involves S-level environmental testing of the requirements of MIL-STD-883C, Method 5008, including device screening (Table VIII) and Groups A through B.

Guaranteed Specifications[1]

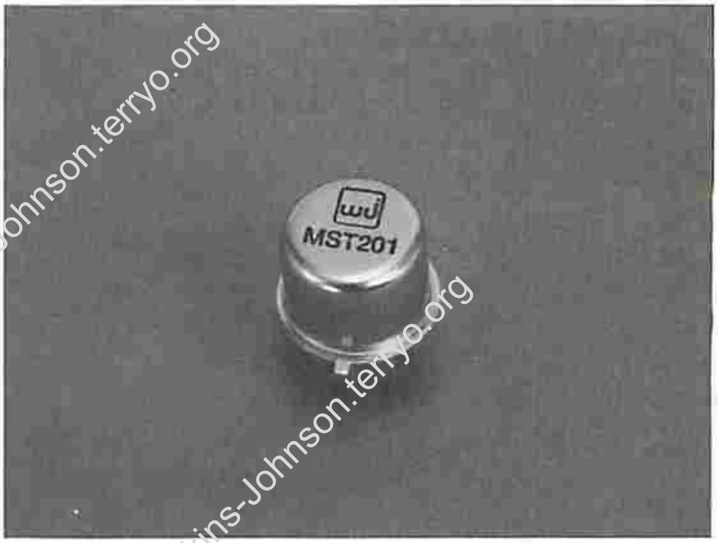
GaAs FET Switches

Model	Description	Frequency Range (GHz)	Insertion Loss (dB) Max.	VSWR Max.	Isolation (dB) Min.	Switching Speed[2] (nsec) Typ.	Outline Drawing
MST201	SPDT, Reflective	DC-5	1.8	1.4:1	30	3	297537

NOTES:
1. Applies to switches used in a 50-ohm system and at +25°C case temperature.
2. Switching time is defined as 10% RF change to 90% RF change.

WJ-MST201

SINGLE-POLE DOUBLE-THROW REFLECTIVE GaAs FET SWITCHES



- DC TO 5 GHz FREQUENCY COVERAGE
- TO-5, HERMETIC PACKAGE
- LOW INSERTION LOSS
- LOW VSWR
- HIGH ISOLATION
- FAST SWITCHING TIME
- LOW VIDEO LEAKAGE[4]

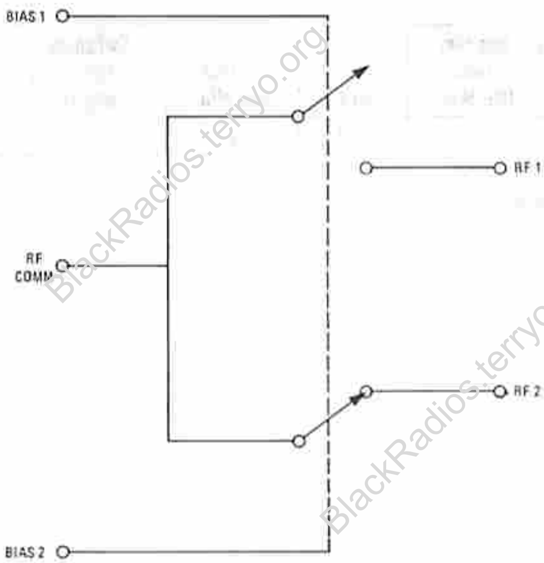
Guaranteed Specifications[1]

	Frequency — GHz	
	DC-2	2-5
Insertion Loss, Maximum	1.3 dB	1.8 dB
Input/Output VSWR, Maximum	1.4:1	1.4:1
Isolation, Minimum	30 dB	30 dB

Switching Time[2]: 3 nanoseconds typical

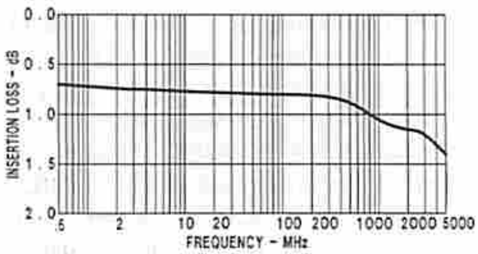
Notes:
1. Applies to switches used in a 50-ohm system at +25°C case temperature.
2. Switching time is defined as 10% RF change to 90% RF change.
3. Insertion Compression (1 dB) is +20 dBm typical at 50 MHz and +30 dBm typical at 5 GHz with control voltages of -8 V and 0 V.
4. Typical video leakage is 10 mV.
5. Operating Temperature is -54°C to +100°C.

Functional Block Diagram

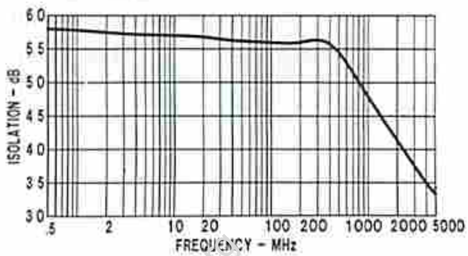


Typical Performance at 25°C

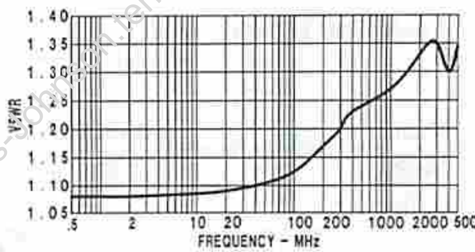
Insertion Loss vs. Frequency



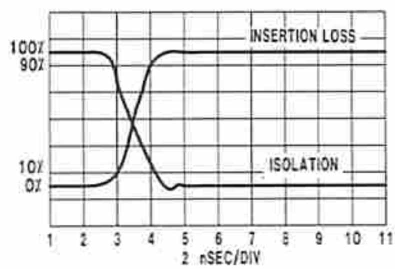
Isolation vs. Frequency



Input/Output VSWR vs. Frequency



Rise/Fall Time



Logic Table

B1	B2	COMM-J1	COMM-J2
-V*	0 V	Insertion Loss	Isolation
0 V	-V*	Isolation	Insertion Loss

Driver Bias: 0 V at 20 μA maximum.
-5 V at 100 μA maximum.
-8 V at 200 μA maximum.

*-V is defined as -5 Vdc to -8 Vdc.

Ordering Information

MST201

1. ____

1. Designate model number

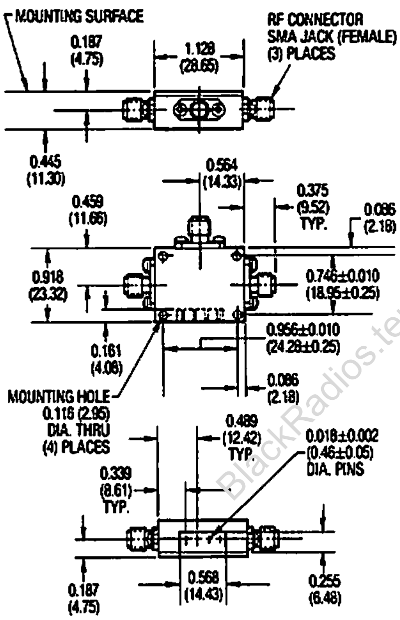
Case Outline

TO-5 Package: Drawing Number 297537 (P. 845)

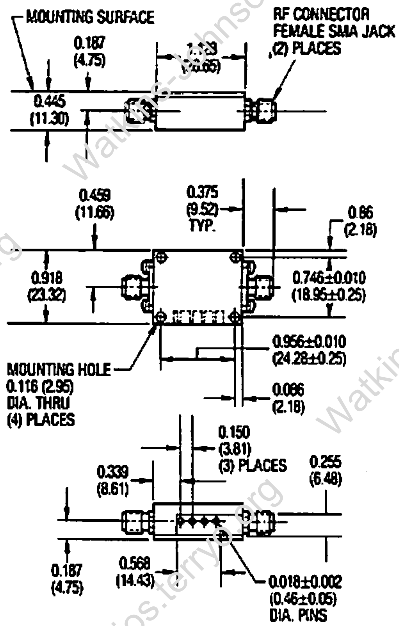
10

Outline Drawings

296840



296927



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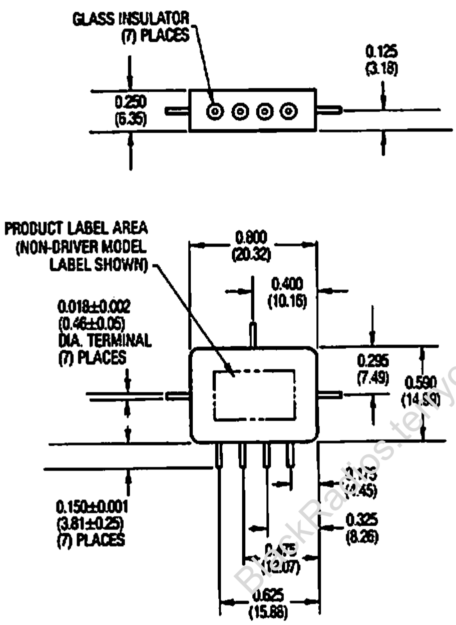
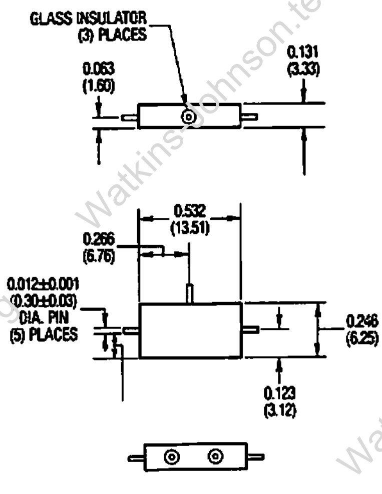
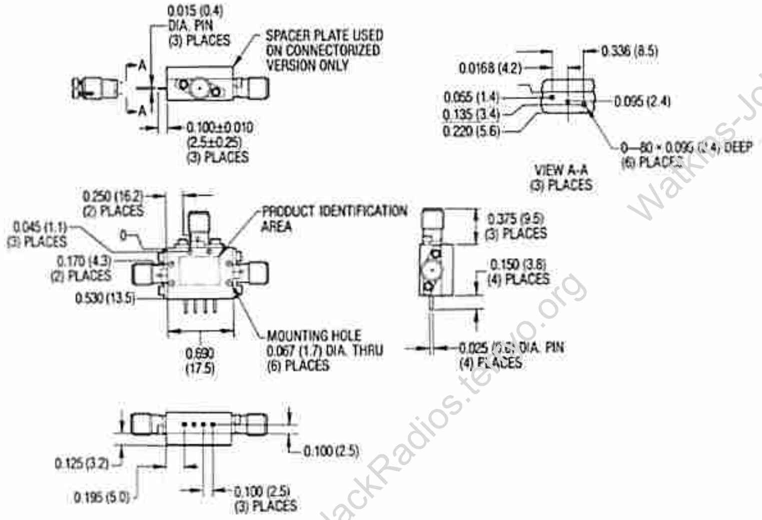


296966

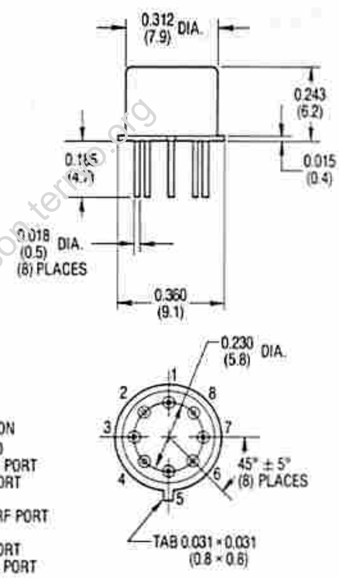


Outline Drawings

297507

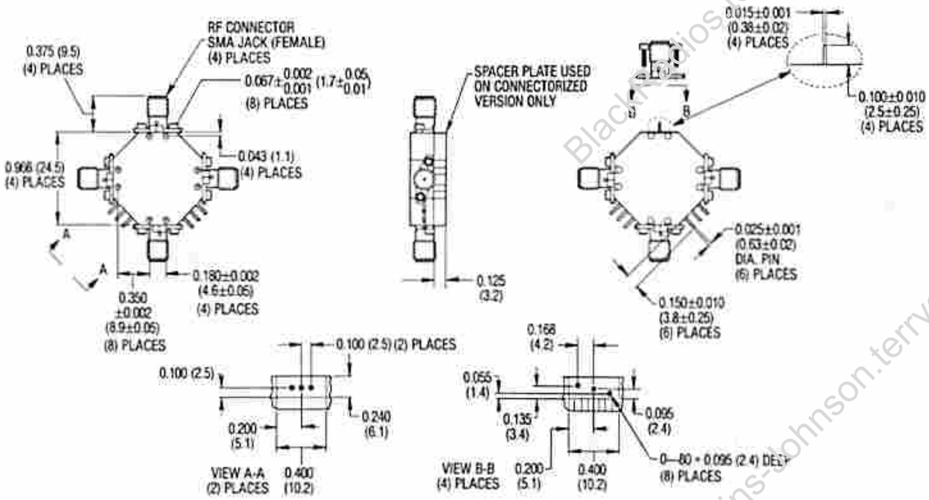


297537

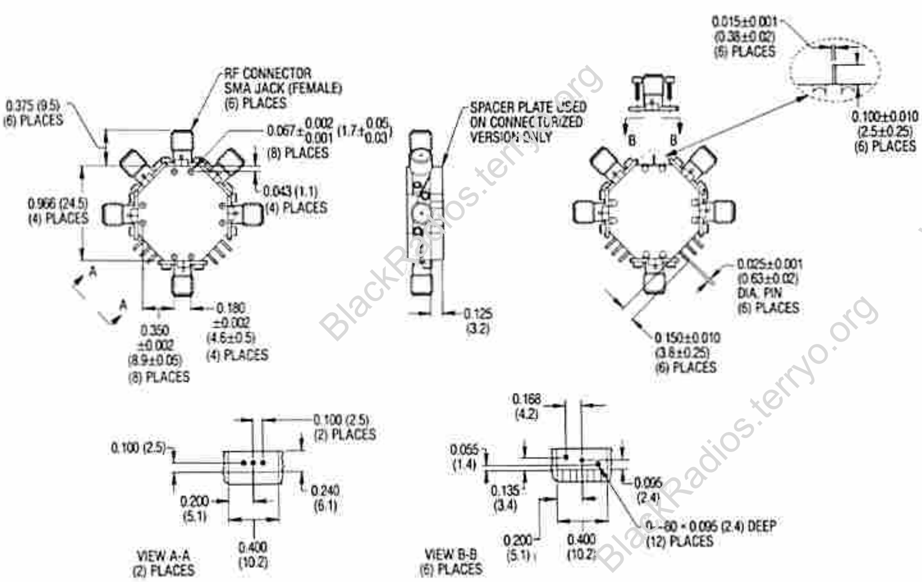


PIN	FUNCTION
1	GROUND
2	B2 BIAS PORT
3	J2 RF PORT
4	N/C
5	COMM RF PORT
6	N/C
7	J1 RF PORT
8	B1 BIAS PORT

297508



297510



10

Microwave Switch Selection Techniques

Authors: Salvatore J. Algeri
Glen R. Hicks

Pin-diode switches provide state-of-the-art switching performance in most present-day microwave systems, such as channelized receivers and electronic warfare systems. Yet, optimum system performance is not always realized, often because exact switching requirements are poorly communicated between the user and designer. Some parameters needed to specify pin-diode switches have several definitions in use within the control-products industry, and the interrelationships between these parameters are not always understood by the system designer. Microwave switches can be optimized for specific applications, but performance tradeoffs inherent in their design require the user to decide what parameters are most important for his needs. The purpose of this article, therefore, is twofold: to clearly define a set of parameters that characterize a pin-diode switch, and to discuss key performance tradeoffs, so as to develop a simple guide that will aid the switch user in selecting pin-diode switches.

Isolation

Although many parameters are used to describe pin-diode switch performance, four are of fundamental importance to the designer because of their strong interdependence: isolation, insertion loss, switching time, and power handling. Isolation is usually the first parameter of interest; the desired isolation determines how many diodes must be used in the switch circuit. Conceptually, isolation is a measure of how effectively a switch is turned off. It is calculated by taking the difference between the power measured at the switch input and the power measured at the switch output, with the switch off.

$$\text{Isolation [dB]} = P_{in}(\text{dBm}) - P_{out_{off}}(\text{dBm})$$

Note that isolation is a measure of the total power lost (reflected and attenuated) through the device when the switch is turned off. Since part of this isolation is due to transmission loss that is present within the device, whether the switch is turned on or off, it is often more meaningful for the switch user to specify isolation relative to the transmission loss. This normalized isolation is more commonly referred to as the *on/off ratio,* which can be calculated by taking the difference between the power measured at the switch output when the device is turned on, and the power measured at the switch output when the device is turned off. As can be seen, on/off ratio is actually the difference between isolation and transmission loss.

$$\begin{aligned} \text{On/Off ratio [dB]} &= P_{out_{on}} - P_{out_{off}} \\ &= (P_{in} - T_{loss}) - P_{out_{off}} \\ &= (P_{in} - P_{out_{off}}) - T_{loss} \\ &= \text{Isolation} - T_{loss} \end{aligned}$$

Insertion Loss

The transmission loss term used in the last equation is measured and calculated in exactly the same manner as isolation, with the exception that the switch is turned on rather than off. A more common term used to denote transmission loss is insertion loss. The insertion loss of a pin-diode switch is often the most critical parameter for the system designer, since this loss may add directly to the noise figure of the system.

Switching Time

Switching time is another parameter of special interest to the solid-state switch user; it is a measure of the time required for the switch to change state (i.e., on to off or off to on), and can range from several microseconds in high-power switches to a few nanoseconds in low-power, high-speed devices. The most common definition of switching time is the time measured from 50% of the input control voltage (usually TTL[1]) to 90% of the final rf power output (see Figure 1).

Notice in Figure 1 that two separate time intervals comprise the total switching time. The first period, from 50% TTL to 10% rf, denoted, t_d, is referred to as *delay time,* and is a function of both the propagation delay of the particular switch driver being used and the charge storage characteristics of the pin diodes in the switch circuit.[2] The second time interval, from 10% rf to 90% rf, denoted, t_r, is called *transition time* (or rise time), and is solely a function of the electrical characteristics of the pin diodes. As shown in Figure 1, delay time is usually the major factor contributing to switching time. Unfortunately, the transition time is frequently given as a device's switching time (which is especially common if the unit is supplied without a driver). Hence, when specifying switching time, a good practice is to preface the switching time specification with the desired interval over which it will be measured (e.g., 50% TTL to 90% rf or 10% rf to 90% rf, etc.) One other important point about switching time is that although

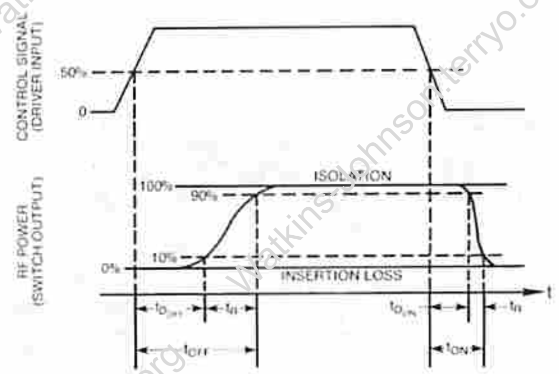


Figure 1. Switching time.

1. Standard TTL logic is defined as follows:

   Logic Low ("0"): $0V \le V_c \le 0.4V$ at 10 mA max.
   Logic High ("1"): $2.4V \le V_c \le 5.5V$ at 250 μA max.

   where V_c is the control voltage.

2. Many commercially available switch drivers employ output current waveshaping ("current spiking") to compensate for the delay due to diode storage charge.

it is defined relative to the rf power, several techniques exist for measuring switching time that detect rf voltage. If rf voltage is used, the equivalent 50% TTL to 90% rf power switching time would be measured from 50% TTL to 95% rf voltage.

Power Handling

Several definitions of the term, power handling, are used in the control-products industry today. One definition is the maximum RF input power that the switch can withstand without *any* degradation in electrical performance. Another definition sometimes used is the rf input power below which no *permanent* degradation in switch performance will occur. The reason for the multiplicity of definitions is simple: Power handling, in a qualitative sense, specifies a limit to the amount of power that a switch can withstand; yet no standard criteria for that limit has ever been established. The confusion is eliminated by redesignating power handling in terms of two different parameters, each of which is consistent with the parameters already used to describe other passive components. The first is, ***maximum rf power,*** which is defined as the maximum rf input power that a switch (or any other device) can withstand with no permanent degradation in electrical performance. The second term is, ***insertion compression point,*** which is defined as the rf input power at which the insertion loss increases by 1 dB above the loss measured with the switch operating in its linear state. As can be seen, insertion compression point is exactly analogous to the 1-dB compression point, which is generally considered to be the upper limit of a device's dynamic range.

A summary of definitions of microwave switch parameters appears in Table 1.

Categorizing Microwave Switches

To understand the basis for the tradeoffs between key switching parameters, such as isolation and power handling, it is helpful to categorize microwave switches according to class, function, and diode configuration. All microwave switches fall into one of two distinct classes: *reflective* and *nonreflective.* Reflective switches reflect incident power back to the source when in the isolated state; nonreflective switches (or "matched switches," as they are sometimes called) are those devices which are designed to terminate any incident power when in the isolated state. Either type of switch will connect a source to a load when in the insertion-loss state.

Both switch categories can be divided into three groups, according to switch function: Single-pole single-throw (SPST), single-pole multithrow (SPMT), and transfer.[3] An SPST switch is a two-port device which either connects the source to the load (in the insertion-loss state) or isolates the source from the load (as shown in Figure 2). An SPMT switch is a multiport device which can connect (or isolate) a source and any one of a number of different loads. Figure 3 shows an SP4T switch connecting a generator, G1, to a load, L2.

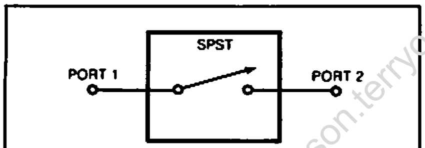


Figure 2. Single-pole, single-throw switch.

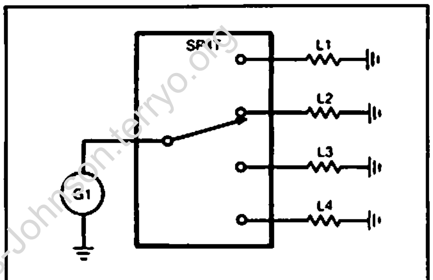
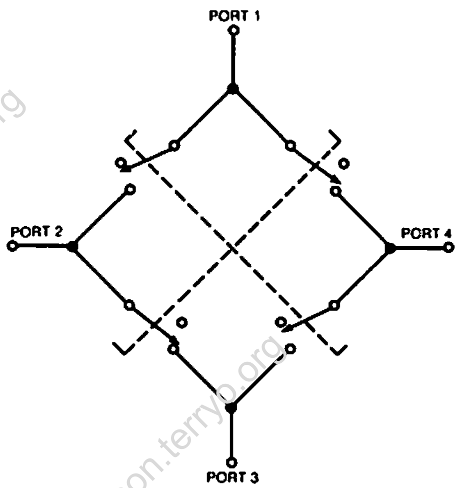


Figure 3. Single-pole, multithrow switch.

Loads L1, L3 and L4 are isolated from each other and the generator. Transfer switches are four-port devices that have two states; the truth table in Figure 4 shows which pair of ports are connected and which are isolated in each state. Note that the insertion-loss port pair in state 1 is "transferred" to the isolated port pair in state 2.



State	Insertion Loss Port Pairs	Isolation Port Pairs
1	1-4 2-3	1-2 3-4
2	1-2 3-4	1-4 2-3

Figure 4. Transfer switch.

There are three principle diode configurations which can produce the SPST, SPMT and transfer functions: All shunt, all series, and series/shunt. Consider the reflective SP2T switch using the all-shunt diode configuration

Term	Definition
Isolation	Total power lost through the switch in the off state.
Insertion Loss	Total power lost through the switch in the on state.
On/Off Ratio	Isolation referenced to (less) the insertion loss.
Switching Time	Total time elapsed from 50% of the input control voltage to 90% of the final rf output power.
Transition Time	Time elapsed from 10% of the final rf output power to 90% of the final rf output power.
Delay Time	Time elapsed from 50% of the input control voltage to 10% of the final rf output power.
Insertion Compression Point	rf input power at which the insertion loss increases by 1 dB.
Maximum rf Power	Maximum rf input power that the switch can withstand with no permanent degradation in electrical performance.

Table 1. Summary of definitions.

3. Other configurations, such as double-pole, double-throw are merely combinations of switches from one or more of these groups.

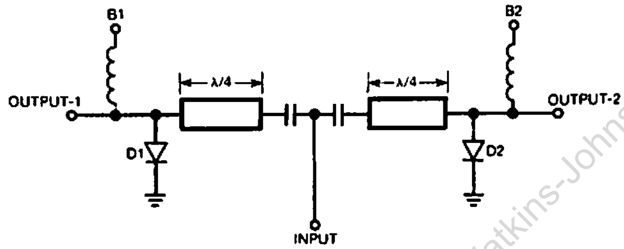


Figure 9. All-shunt diode, reflective SPMT switch.

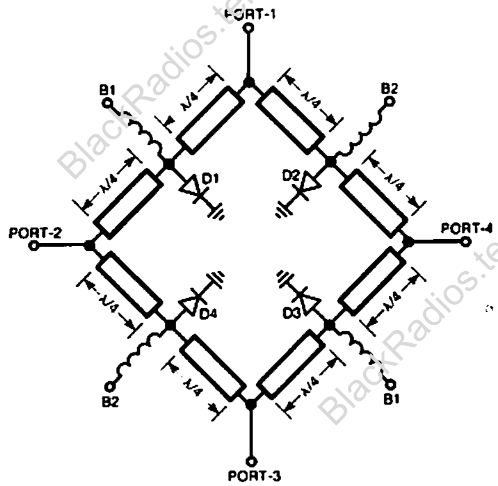


Figure 10. All-shunt diode, transfer switch.

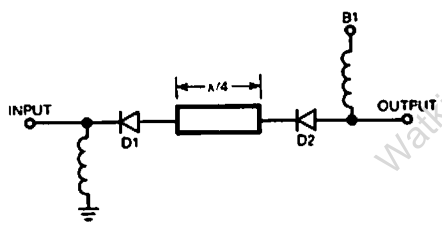


Figure 11. All-series diode, reflective SPST switch.

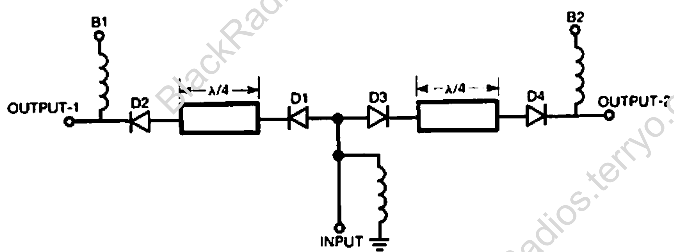


Figure 12. All-series diode, reflective SPMT switch.

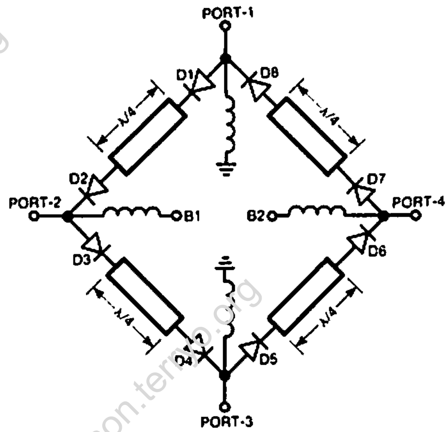


Figure 13. All-series diode, transfer switch.

causing transition time to exceed 200 nanoseconds. A summary of these switching parameter tradeoffs is given in Table 2, along with term definitions in Table 3.

Schematic diagrams of each switch function using the all-series diode configuration are shown in Figures 11, 12 and 13.

Bandwidth for all three functions is multioctave, and the insertion compression point is low. In the insertion-loss state, the diodes are on, and absorb rf energy as it passes through the switch. This absorbed power is the major factor limiting the maximum power capability. Also, due to the physical spacing of the diodes, isolation is frequency dependent. However, this frequency dependence is less severe than with the all-shunt diode configuration. The lowest isolation for the all-series approach usually occurs at the upper limit of the frequency range. Slow transition time is the major drawback of this diode configuration. When two or more diodes are in series, each cannot be connected directly to a low impedance dc source. Hence, for the diodes to be turned off, the stored charge in the I-layer of the pin diodes must recombine through another diode rather than directly through a dc source. This diode-to-diode recombination results in a net transition time that is much longer than that of either diode alone, and generally causes the transition time to fall into the "long" category. Since there is no stored charge in a diode that is turned off, the transition time from isolation (diodes off) to insertion loss (diodes on) can still be short. Once again, a summary of these performance tradeoffs is given in Table 2.

of Figure 5. The input is connected to output 1 when diode D2 is biased into the low-impedance state and diode D1 is biased into the high-impedance state. The low impedance at D2 is transformed to a high impedance at the center junction through the quarter-wavelength transmission line. This transformed impedance is much greater than the impedance between the center junction and output 1. Hence, the signal will flow to output 1, and output 2 will be isolated from the input.

A schematic for an SP2T switch employing the all-series diode configuration is shown in Figure 6. When D1 is biased into the low-impedance state and D2 is biased into the high-impedance state, the input is connected to output 1. Output 2 is isolated from the input because of the high impedance at D2.

The SP2T switch in Figure 7 uses the series/shunt diode configuration. By biasing D1 and D4 into the low-impedance state, and D2 and D3 into the high-impedance state, the input is connected to output 1. The amount of isolation from the input to output 2 is directly proportional to the impedance ratio between D3 and D4. These three diode configurations can each produce any of the three switch functions, but with markedly different electrical performance.

In general, determining the class and function of a pin-diode switch is fairly straightforward. For example, a system may have 4 sources which must be selected and connected to a single output, as in a multioctave sweeper. An SP4T switch would perform this function if the common arm was connected to the output of the sweeper, and each source was connected to one of the other switch arms. The class of the switch needed is determined by the sensitivity of the load and sources to reflection. A reflective switch, such as the WJ-MS403, can be used if the sources can withstand operation into a poor match when they are isolated from the sweeper output. Selecting the diode configuration, however, is considerably more difficult than choosing the class and function, because it involves numerous tradeoffs between isolation, transition time, power handling and bandwidth.[4]

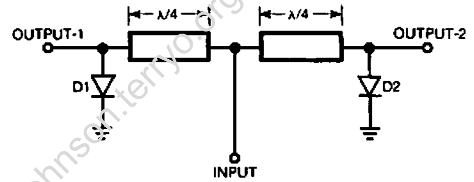


Figure 5. All-shunt diode, SP2T switch.

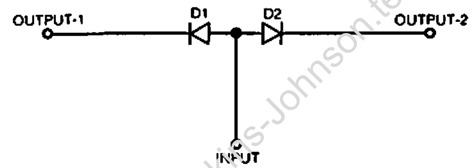


Figure 6. All-series diode, SP2T switch.

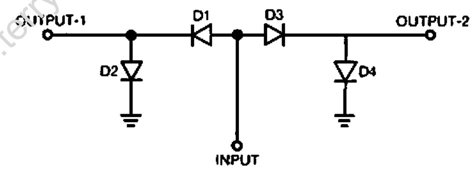


Figure 7. Series/shunt diode, SP2T switch.

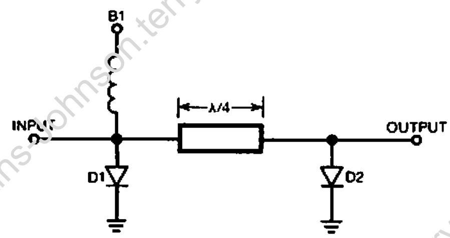


Figure 8. All-shunt diode, reflective SPST switch.

Reflective Switches

Let's consider the all-shunt diode configuration for each of the three switch functions (see Figures 8, 9 and 10). In general, the all-shunt approach limits itself to octave bandwidths in the SPMT and transfer functions, because insertion loss changes drastically with frequency. The SPST function is not characterized by this same drastic change of insertion loss, and is, therefore, multioctave. Isolation in all three functions is high, but due to the electrical spacing between the diodes, it degrades as the frequency moves away from the quarter-wavelength frequency. In the insertion-loss state, a reverse dc voltage can be applied across the diodes that is limited only by their breakdown voltage. Thus, proper diode selection can provide insertion compression points of up to 10 watts, CW. However, a tradeoff exists between insertion compression point and transition time: Short to medium transition times can be realized for insertion compression points up to 2 watts, CW; for compression points up to 10 watts, diode lifetime must be increased,

4. Insertion loss is also dependent on diode configuration, but to a much lesser degree. Generally, the greater the complexity of a solid-state switch (i.e., the number of components) the higher the insertion loss.

Function	Tradeoff Parameters					
	Diode Configuration	Isolation	Transition Time	Insertion Compression Point	Bandwidth	Figure
SPST	All Shunt	High (freq. dependent)	Short	High	Multioctave	8
	All Series	High (freq. dependent)	Long	Low	Multioctave	11
	Series/Shunt	High	Short	Low	Multioctave	14
SPMT	All Shunt	High	Short	High	Octave	9
	All Series	High (freq. dependent)	Long	Low	Multioctave	12
	Series/Shunt	High	Short	Low	Multioctave	15
TRANSFER*	All Shunt	High	Short	High	Octave	10
	All Series	High (freq. dependent)	Long	Low	Multioctave	13
	Series/Shunt	High	Short	Low	Multioctave	16

*Transfer switches are actually nonreflective due to the nature of their function.

Table 2. Tradeoff chart for reflective switches.

Term	Tradeoff Parameters		
	Isolation	Transition Time	Insertion Compression Point
Low (Long)	20 dB to 30 dB	(t ≥ 200 ns)	100 mW max.
Medium	30 dB to 45 dB	50 ns ≤ t < 200 ns	100 mW to 2 Watts
High (Short)	45 dB to 60 dB	(5 ns ≤ t < 50 ns)	2 Watts to 10 Watts

Table 3. Term definition table.

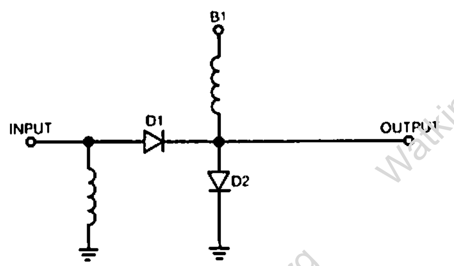


Figure 14. Series/shunt diode, reflective SPST switch.

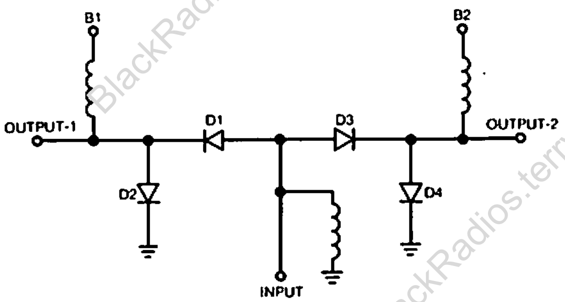


Figure 15. Series/shunt diode, reflective SPMT switch.

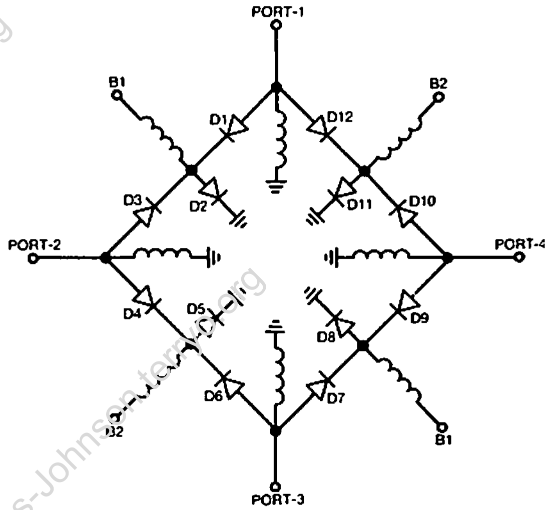


Figure 16. Series/shunt diode, transfer switch.

Table 2 also indicates how the series/shunt diode configuration affects the four tradeoff parameters for each of the three switch functions shown in Figures 14, 15 and 16. This diode configuration, which is used in many high performance W-J switches, such as the 2 to 18 GHz MSE203 provides high isolation and short transition times over multioctave bandwidths. The only real drawback to the series/shunt configuration is its low power-handling capability. In the insertion-loss state, the shunt diodes are exposed to the peak rf voltage, yet the reverse dc voltage across these same diodes is limited, because of the forward voltage of the series diode. This small reverse bias allows the shunt diodes to be forward biased by a much smaller rf voltage than would be possible if the reverse voltage were high, and results in a lower insertion compression point. Despite its lower compression point, the series/shunt configuration provides the best overall performance for a given number of diodes, and is the most commonly used design approach for reflective switches.

Nonreflective Switches

Any SPST[5] or SPMT reflective switch can be made nonreflective by adding a shunt diode in series with a resistor at the input to each arm (compare Figures 8, 9, 11, 12 and 15 with Figures 17, 18, 19, 20 and 21, respectively). This diode-resistor combination is designed to provide a 50-ohm load impedance to the system to absorb the rf energy when the switch is in the isolated state. Although diode configuration affects

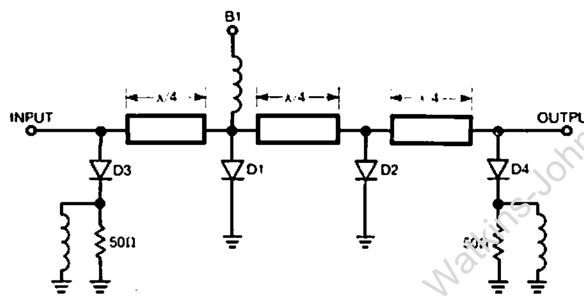


Figure 17. All-shunt diode, nonreflective SPST switch.

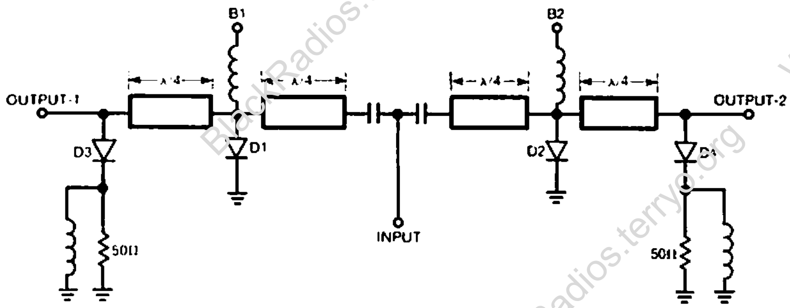


Figure 18. All-shunt diode, nonreflective SPMT switch.

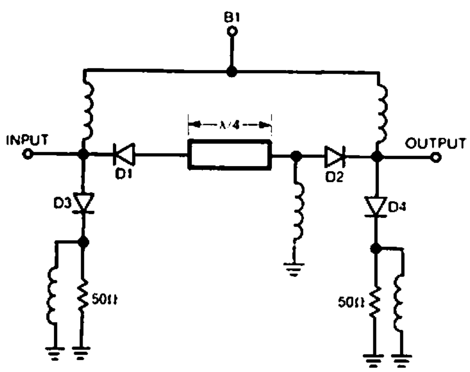


Figure 19. All-series diode, nonreflective SPST switch.

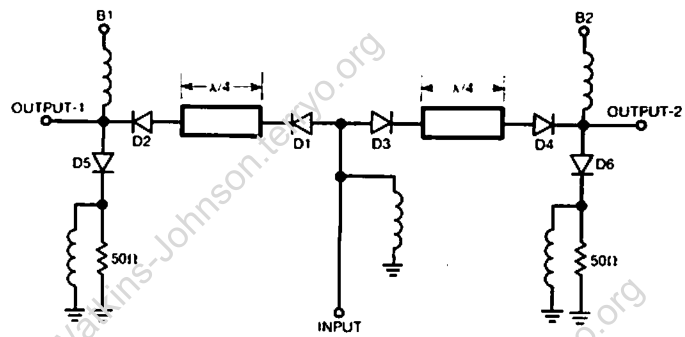


Figure 20. All-series diode, nonreflective SPMT switch.

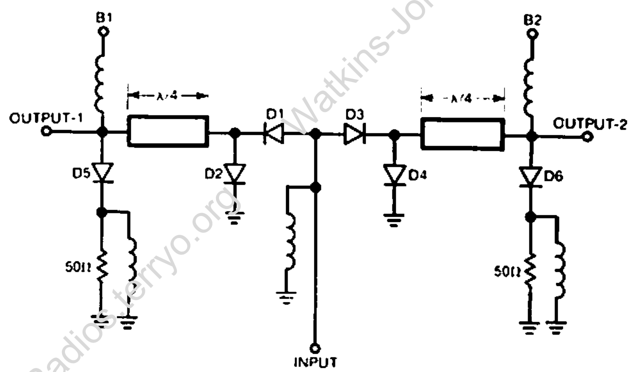


Figure 21. Series/shunt diode, nonreflective SPMT switch.

the four tradeoff parameters in exactly the same way as for reflective switches, the 50-ohm load has an additional effect on power handling and bandwidth. First, for any diode configuration or switch function, maximum rf power is limited to the power dissipation capabilities of the resistor, which usually limits the maximum rf power of the switch to the "medium" category. Second, due to the quarter-wavelength spacing between the diode-resistor pair and any adjacent shunt diode, the bandwidth for both the all-shunt and series/shunt diode configurations will be reduced to an octave. A summary of the tradeoffs between isolation, transition time, insertion compression point, and bandwidth for nonreflective switches is given in Table 4.

Example

The use of the tradeoff charts is best illustrated with an example. Consider a system that has the following switch requirements:

Function:	SP3T
Frequency Range:	2.5 to 10.0 GHz
Isolation:	40 dB (min.)
Insertion Compression Point:	+17 dBm
Maximum rf Power:	+30 dBm
Insertion Loss:	3 dB (max.)
Switching Time:	40 nsec (max.) [50% TTL to 90% rf]
VSWR:	2.0:1 (max.) [Insertion Loss State]

To assess the manufacturability of this switch, the first step is to convert the quantitative electrical specifications for isolation, transition time and insertion compression point to their corre-

5. The SPST series/shunt nonreflective switch cannot be practically realized.

10

Function	Diode Configuration	Isolation	Transition Time	Insertion Compression Point	Bandwidth	Figure
	Tradeoff Parameters					
SPST	All Shunt	High	Short	Medium	Octave	17
	All Series	High	Short	Low	Multioctave	19
	Series/Shunt	(See Note 5)				
SPMT	All Shunt	High	Short	Medium	Octave	18
	All Series	High	Long	Low	Multioctave	20
	Series/Shunt	High	Short	Low	Octave	21

Table 4. Tradeoff chart for nonreflective switches.

sponding qualitative ranges via Table 3. For the switch in this example, the isolation requirement of 40 dB falls into the "medium" range, and the insertion compression point of +17 dBm is in the "low" range. Since the electrical specification calls for a switching time of 40 nsec, clearly, the transition time must be in the "short" category. Once these three numbers have been converted, the next step is to compare the desired switch performance with that of each of the 3 switch types from Table 2 or 4. The switch in our example is a reflective SPMT[6]; therefore, we will compare the specifications of our switch with those of the three SPMT switches in Table 2. The objective of this comparison is to determine if any of these three switches will meet (or exceed) the required performance specifications. If one or more do, it would be fairly certain that the specified switch performance could be readily achieved in practice.

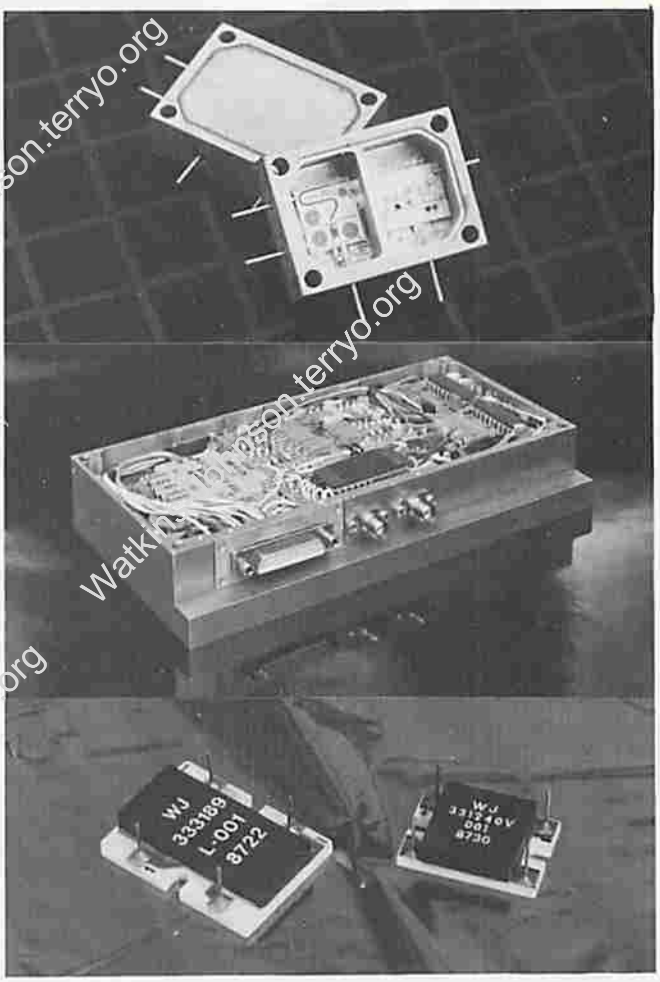
Looking at Table 2, an all-shunt SPMT switch would meet or exceed all electrical specifications, with the exception that this design is effective only over octave bandwidths, and, thus, would not be useful for the 4:1 bandwidth switch in our example. The all-series SPMT switch is multioctave, and meets or exceeds both the isolation and the insertion compression point for our switch requirement. However, Table 2 also indicates that the transition time for this type of SPMT switch is long, which is not compatible with the short switching time needed. Comparing our switch specifications to those of the series/shunt SPMT switch in Table 2, we see that this design will meet or exceed all four switch requirements. Hence, we can conclude that our switch specifications are realizable.

Conclusion

Several switching parameters have been defined with the intent of standardizing the terminology used to describe pin-diode switches. By utilizing terms that are standard throughout the control products industry, the system designer can comfortably specify the pin-diode switch required for the system. Also, four parameters — isolation, transistion time, insertion compression point and bandwidth — were selected as key tradeoff parameters, because of their strong interdependence. The interaction between these four parameters was shown to stem from the particular diode configuration used for the switch circuit, and, ultimately, allowed us to develop charts which qualitatively and quantitatively compared the three switch types for each of the three diode configurations. Finally, an example was given to illustrate how the tradeoff charts could be used by a system designer as an aid in determining the most practical switch for the system.

6. Since no maximum VSWR is specified for the isolation state, we assume that the system is not affected by the VSWR of the isolated arms; therefore, a reflective switch can be used.

VCOs and Heaters



VOLTAGE-CONTROLLED OSCILLATORS AND HEATERS

VOLTAGE-CONTROLLED OSCILLATORS

Watkins-Johnson Company offers a complete line of oscillators products: voltage-controlled oscillators (VCO's), digitally tuned oscillators, fixed-frequency oscillators (including dielectic resonator oscillators, or DRO's), low-noise oscillators, phase-locked oscillators, comb generators/oscillator multipliers, and integrated oscillator subsystems.

These oscillators find application in EW systems, including ECM/ESM receivers and ECM jammers, guidance and fuse systems in missiles, radar systems, and communications systems.

Watkins-Johnson Company's VCO development and production facilities are at the Stewart Division in Scotts Valley, California. Over 60,000 square feet are dedicated to the VCO product line and include extensive computer-controlled test facilities, environmental testing facilities, and MIL-STD-883C screening capability. In addition to maintaining a quality system which meets MIL-I-45208 and MIL-Q-9858, the Stewart Division has supplied hardware in compliance with WS6535 on specific major programs.

CAPABILITIES

For more than a decade Watkins-Johnson Company has maintained a complete product development laboratory and manufacturing facilities for voltage controlled oscillators at its Scotts Valley Plant. To meet the ever advancing technology requirements for VCO's substantial time and resources are continually invested to acquire highly sophisticated equipment and the most knowledgeable technical personnel.

To support oscillator design work and perform final acceptance tests, Watkins-Johnson maintains computer facilities at the Scotts Valley Plant with a variety of design programs and extensive computer controlled test equipment. Such capability is essential to provide the performance improvements and extensive testing required for today's oscillators.

Training courses are conducted periodically to ensure workmanship and soldering in the VCO products are of the highest quality. In addition, for the microwave circuits special workmanship standards have been implemented.

To insure that the VCO products are reliable, Watkins-Johnson maintains environmental test and screening facilities at the Scotts Valley Plant to perform random and sine vibration, thermal shock, temperature cycling, and altitude tests. Additional environment test equipment is available at the Palo Alto Plant.

HEATERS – AC, DC AND TO-8

When your hardware or system has difficulty meeting specifications over a wide operating temperature range, the Watkins-Johnson Company offers a very unique low cost AC or DC heater as the solution. Our AC heater module operates from 100 to 125 volts, 50 to 400 Hz, and the DC heater module operates from 28 volts. By means of an external control resistor, both devices can control their mounting surface at any temperature between +60°C and +100°C, within 10°C. These modules feature an automatic regulator, controller and heater; shutdown at +120°C; and, are designed for operation over the -54°C to +100°C temperature range. These heaters are available screened to MIL-STD-883.

If we can be of any further assistance, please do not hesitate to contact our Voltage Controlled Oscillator Applications Engineering Department at (408) 438-2100 or our Watkins-Johnson Company Field Sales Engineer in your area.

VOLTAGE-CONTROLLED OSCILLATORS

A diverse number of VCO's are available, depending on the application, in the 0.5 to 18 GHz frequency range. Some of the options available include:

Varactor
- Hyperabrupt (0 to 20 Volts)
- Abrupt (0 to 60 Volts)

Active Device
- Bipolar transistor (low noise, low-post-tuning drift)

GaAs FET Buffer Amplifiers

Ferrite Isolators

Voltage Regulators

AC or DC Heaters

Linearizers (DC to 20 MHz)

Filters (Microwave)

Couplers for Multiple Outputs

BIT Outputs

PIN Diode Switches

Units may be optimized for post-tuning drift, modulation-sensitivity variation, and/or phase noise to meet a particular requirement.

DIGITALLY TUNED OSCILLATORS (WJ-2850 SERIES)

Watkins-Johnson Company offers a wide variety of DTO's from 0.5 to 18 GHz. Each unit includes a hyperabrupt varactor-tuned oscillator, followed by GaAs FET amplifiers for load isolation and to increase the power output to the desired level. In addition, voltage regulators are included to reduce frequency pushing and to protect the sensitive microwave-active devices. Heaters are also included to limit the frequency drift over temperature.

A PROM corrected digital input circuit is often included to improve the frequency accuracy (nonlinearity and frequency drift over temperature) to less than ±10 MHz. In addition, a modulation inputs may be provided that have bandwidths out to 40 MHz, including variable-gain amplifiers, which maintain the variation in modulation sensitivity within ±5%.
the post-tuning drift from one microsecond to 100 milliseconds is typically 1-2 MHz.

FIXED-FREQUENCY OSCILLATORS . . . INCLUDING DRO's (WJ-2940 SERIES)

Many different fixed-frequency oscillators are available in the 1 to 20 GHz frequency range, including units with multiple oscillators, PIN diode switches, voltage regulators, and GaAs FET buffer amplifiers. These units are typically capable of operating over the full -55° to +85°C temperature range and maintaining frequency accuracies of ±1 MHz.

PHASE-LOCKED OSCILLATORS (WJ-2910 SERIES)

Watkins-Johnson Company provides phase-locked oscillators operating at frequencies across the 0.5 to 20 GHz range. They are capable of excellent phase-noise characteristics — typically less than -120 dBc/Hz at 100 Hz offset. In addition, these units may include internal crystal oscillators, GaAs FET T buffer amplifiers, and lock indicators.

COMB GENERATORS/OSCILLATOR MULTIPLIERS (WJ-2950 SERIES)

Watkins-Johnson Company also offers comb generators and oscillator/multipliers. The comb generators include a low-frequency crystal oscillator, followed by an amplifier, step-recovery diode, and output filter/matching circuit. These devices are capable of providing outputs every 100 MHz with a minimum of -30 dBm at 18 GHz.

The oscillator/multipliers include an oscillator followed by frequency-selective multiplier circuits to provide outputs at multiple frequencies.

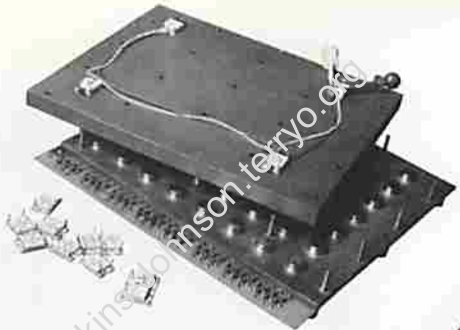
INTEGRATED OSCILLATOR SUBSYSTEMS

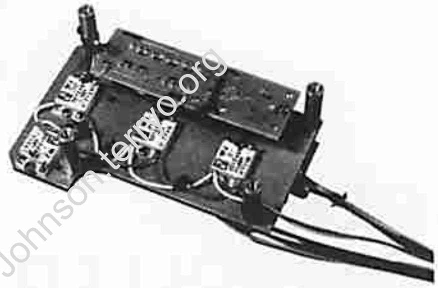
Watkins-Johnson Company is also capable of integrating various oscillator and related components, including oscillators, switches, amplifiers, couplers, filters, and complex input driver circuits. In addition, Watkins-Johnson Company can provide ramp generators, noise modulators, FM modulators, AM modulators, and digital attenuators in the oscillator assembly.

LOW-NOISE OSCILLATORS (WJ-2930 SERIES)

Watkins-Johnson Company offers the WJ-2930 series of miniature, low-noise oscillators. These units operate over the 1.0 to 8.0 GHz frequency range and exhibit very low phase-noise characteristics — typically -110 dBc/Hz at 100 kHz offset.

They are housed in a small 0.25 x 0.59" x 0.8" package and include an oscillator that employs a hyperabrupt varator followed by a three-stage feedback amplifier.





Proportionally Controlled Heaters

D.C.: The WJ-331240-001 is a proportionally controlled integrated heater containing the heater, controller, voltage regulator, and automatic shutdown circuitry. The heater module is a completely self-contained hybrid circuit that can be programmed to control any surface temperature to within 10°C from 60°C to 100°C by means of a single external resistor. These modules operate from unregulated 28 volts (D.C.) power sources and provide up to 28 watts of heat. The operating temperature range for the heater module is from -54°C to +100°C with automatic shutdown at 120°C.

Each heater module is subject to the following reliability screening during manufacture:

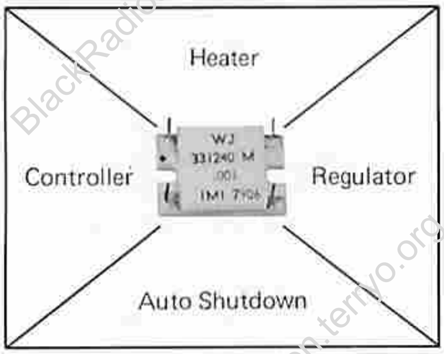
- Precap internal visual per MIL-STD-883, Method 2010, Test Condition B.
- High temperature stabilization bake per MIL-STD-883, Method 1008, Test Condition B, 48 hours.
- Temperature cycling per MIL-STD-883, Method 1010, Test Condition B.
- Constant acceleration per MIL-STD-883, Method 2001, Test Condition B, Y_1 axis only.

The heater circuit is floating so that currents will not affect system ground voltages. The WJ-331240-001 is protected against reverse voltages up to 50 Vdc.

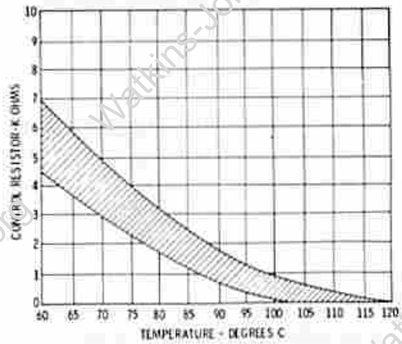
A.C.: The WJ-333189-001 is a proportionally controlled integrated A.C. heater containing all the features and performance characteristics of the D.C. models. The A.C. heater operates from 100 to 125 VAC, 50 to 400 Hz. Voltages from 0 to 150 VAC continuous can be sustained without damage to the unit. Package size for the A.C. heater is .985 x .760 x .180 inches (2.50 x 1.93 x .457 cm).

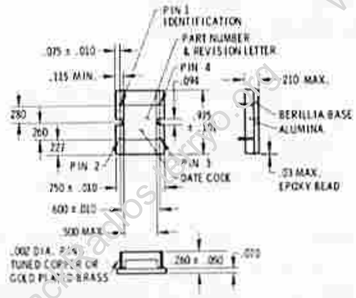
Each heater module is subject to the same reliability screening as are the D.C. heaters.

Self-Contained



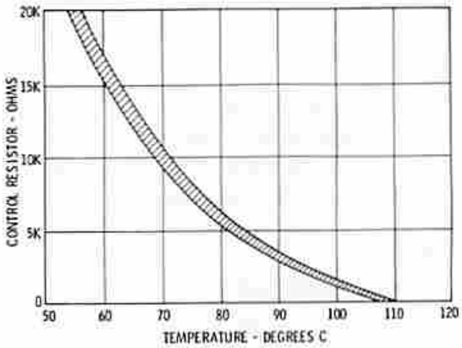
(A.C. WJ-333189-001)

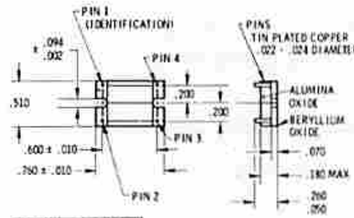




PIN NO	FUNCTION
1	115 VAC
2	115 VAC
3	CONTROL
4	CONTROL RTN

(D.C. WJ-331240-001)





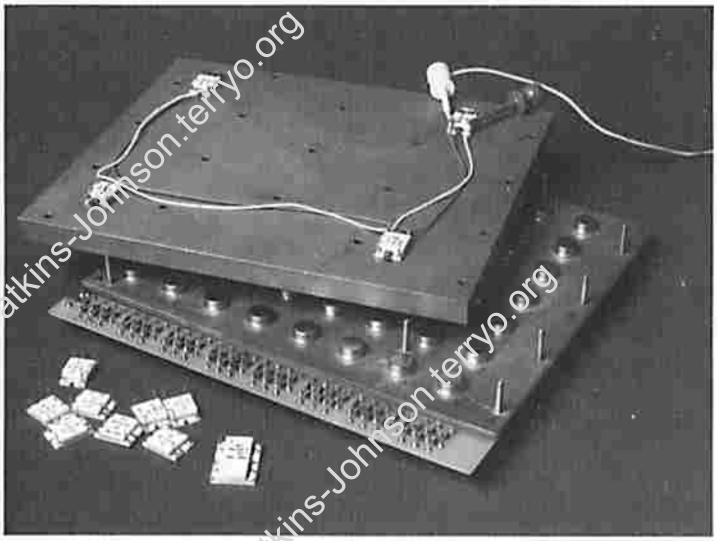
PIN NO	FUNCTION
1	+28 VDC
2	DC RETURN
3	CONTROL
4	CONTROL RTN

Typical 1/8 watt control resistor values required to set heaters to a given temperature are illustrated by the graphs. With the control loads shorted, the unit temperature will not exceed 120°C.

WJ-331240-001*

PROPORTIONALLY CONTROLLED DC HEATER MODULE

*(Hi-Rel version, WJ-331240-000 also available.)



Guaranteed Specifications

Temperature Regulation

Control Range[1]	+60°C to +100°C
Temperature Variation With Load	10°C, Max.
Temperature Variation Over Operating Voltage Range (Constant Load)	2°C, Max.
Automatic Shutdown Temperature (Any Control Resistance, Any Voltage)	120°C, Max.

Electrical Requirements

Operating Voltage Range	24.0 to 28.5 Vdc
Voltage Limits[2]	22.5 Vdc, Min. 34.0 Vdc, Max.
Operating Current, Steady-state	0.015 to 1.00 amps
Turn-on Current Range	0.85 to 1.00 amps

Environment

Temperature	
Operating[3]	−54°C to +100°C
Non-operating	−65°C to +125°C
Altitude	70,000 ft., Max.
Shock	20G, Max.
Vibration	50G at 2,000 Hz, Max.
Humidity[4]	Greater than 95 percent

Reliability Screening

Each heater module is subject to the following reliability screening during manufacture:

1. Precap internal visual per MIL-STD-883, Method 2010, Test Condition B.
2. High temperature stabilization bake per MIL-STD-883, Method 1008, Test Condition B, 48 hours.
3. Temperature cycling per MIL-STD-883, Method 1010, Test Condition B.
4. Constant acceleration per MIL-STD-883, Method 2001, Test Condition B, Y_1 axis only.

Mechanical

Markings	Part Number, Mfg. Date Code, Pin No. 1 (Positive 28 Vdc)
Outline and Mounting Dimensions	Per drawing

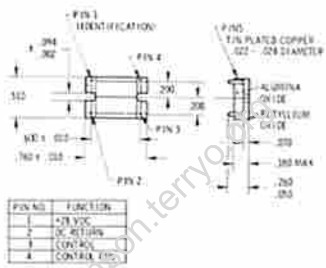
NOTES:

1. The WJ-331240-001 is protected against reverse voltages up to 50 Vdc.
2. Operation is possible over the range +100°C to +120°C, but electrical performance is not guaranteed. Input current decays to 15 mA at +120°C without damage to unit.
3. Heaters are hermetically sealed to meet MIL-STD-883, Method 1014, Test Condition C, Step 1, and Method 1014, Test Condition A or B. Maximum measured leak rate 1 x 10^{-6} atm-cc/sec.
4. Optimum thermal performance is obtained by using a heat sink compound such as Dow Corning 340 on the mounting surface.

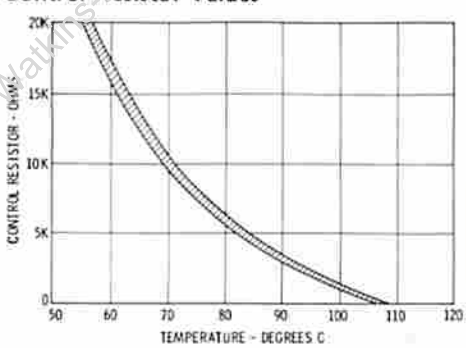
The WJ-331240-001 Heater Module is a self-contained hybrid circuit heater that can be programmed to control to any temperature from 60 to 100 degrees Celsius by means of a single external resistor. These modules operate from unregulated 28 volt (D.C.) power sources and provide up to 28 watts of heat through an electronically insulating ceramic mounting surface. Larger thermal loads may be accommodated by the use of several modules operated in parallel.

Outline Drawing

331240-001



Control Resistor Values



Typical control resistor values required to set the WJ-331240-001 to a given temperature are given by the graph. With the control loads shorted, the unit temperature will not exceed 120°C.

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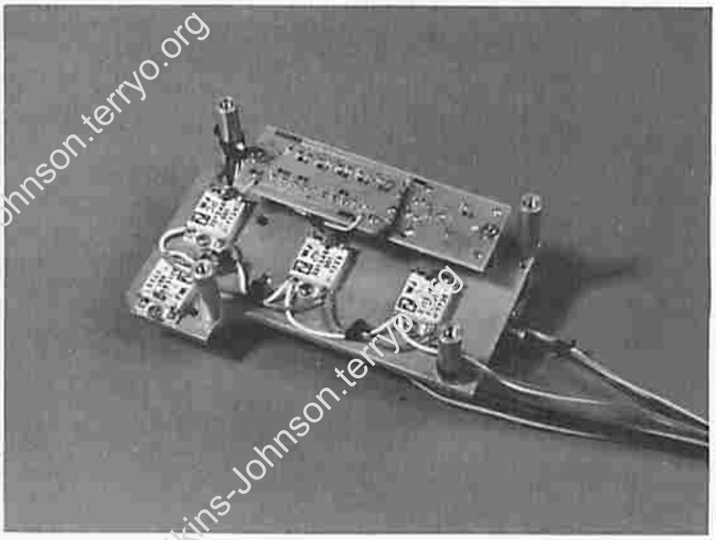
WJ-333189-001*

PROPORTIONALLY CONTROLLED AC HEATER MODULE

*(Hi-Rel version, WJ-333189-000 also available.)



Guaranteed Specifications

Temperature Regulation

Control Range[1]	+60° to +100°C
Temperature Variation With Load[2]	10°C, Max.
Temperature Variation Over Operating Voltage[3]	2°C, Max.

Electrical Requirements

Operating Voltage Range	100 to 125 VAC, 50 Hz to 400 Hz
Voltage Limits[4]	0 to 150 VAC
Operating Current, Steady-state	.015 to .30 Amps
Turn-on Current Range (at 115 VAC)	.25 to .30 Amps

Environment

Temperature	
Operating[5]	−54° to +100°C
Non-operating	−65° to +125°C
Altitude	70,000 ft., Max.
Shock (11 ms half sine wave)	20 G, Max.
Vibration	50G at 2,000 Hz, Max.
Humidity[6]	0 to 90 percent including condensation

Reliability Screening

Each heater module is subjected to the following reliability screening during manufacture:

1. Precap internal visual per MIL-STD-883, Method 2010, Test Condition B.
2. High temperature stabilization bake per MIL-STD-883, Method 1008, Test Condition B, 48 hours.
3. Temperature cycling per MIL-STD-883, Method 1010, Test Condition B.
4. Constant acceleration per MIL-STD-883, Method 2001, Test Condition B, Y axis only.

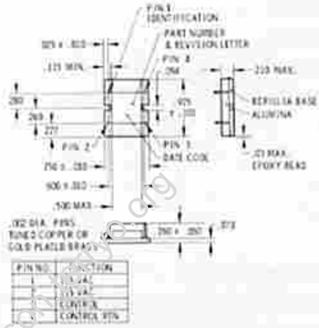
NOTES:

1. Maximum temperature variation for current change from 20 mA to 95 percent of turn-on current at 115 VAC.
2. Maximum temperature variation for a voltage change from 100 to 125 VAC or frequency change from 60 to 400 Hz when the ambient temperature is constant and the current is between 20 mA and 95 percent of turn-on current.
3. Continuous application of voltages within this range will not damage the heater.
4. Operation is possible over the range +100°C to +120°C, but electrical performance is not guaranteed. Input current decays to 20 mA max. at +120°C without damage to unit as long as properly heat sunk.
5. Heaters are hermetically sealed to meet MIL-STD-883, Method 1014, Test Condition C, Step 1, and Method 1014, Test Condition A or B. Maximum measured leak rate 1 x 10^{-6} atm-cc/sec.
6. Optimum thermal performance is obtained by using a heat sink compound such as Dow Corning 340 on the mounting surface.

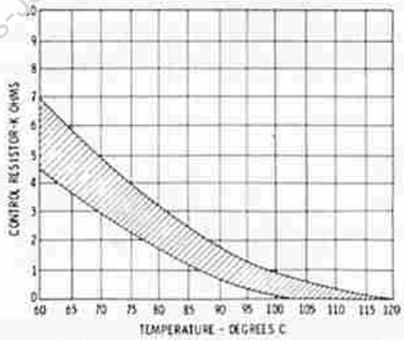
The WJ-333189-001 Heater Module is a self-contained hybrid circuit heater that can be programmed to control to any temperature from 60° to 100°C by means of a single external resistor. These modules operate from an unregulated 115 Volt (A.C.) power source and provide nominally 28 watts of heater power through an electrically insulated ceramic mounting surface. Larger thermal loads may be accommodated by the use of several modules operated in parallel.

Outline Drawings

333189-001



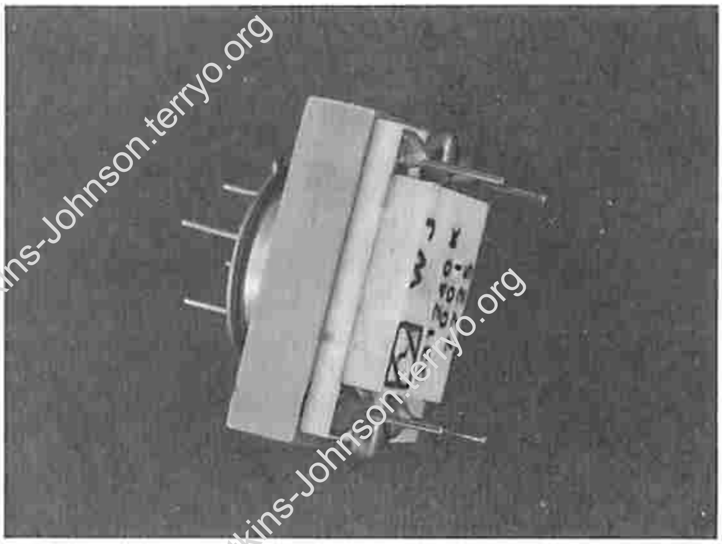
Control Resistor Values



Typical control resistor values required to set the WJ-333189-001 to a given temperature are given by the graph. Minimum power rating of control resistor: 1/8 watt. Precise resistor values should be determined by measuring the mounting surface temperature.

WJ-334334

PROPORTIONALLY CONTROLLED TO-8 HEATER MODULE



Guaranteed Specifications

Temperature Regulation

Control Range[1] . . . . . . +60°C to +100°C
Automatic Shutdown Temperature
(Any Control Resistance, Any Voltage) . . . . . . 120°C

Electrical Requirements

Operating Voltage Range . . . . . . 24.0 to 28.5 VDC
Voltage Limits[2] . . . . . . 22.5 VDC, Min.
34.0 VDC, Max.
Operating Current, Steady-state . . . . . . 0.015 to 1.00 amps
Turn-on Current Range. . . . . . 0.85 to 1.00 amps

Environment

Temperature
Operating[3] . . . . . . −54°C to +100°C
Non-operating. . . . . . −65°C to +125°C
Altitude. . . . . . 70,000 feet, Max.
Shock . . . . . . 20G, Max.
Vibration. . . . . . 50G at 2,000 Hz, Max.
Humidity[4] . . . . . . Greater than 95 percent

Reliability Screening

Each TO-8 heater module is subject to the following reliability screening during manufacture:

1. Precap internal visual per MIL-STD-883, Method 2010, Test Condition B.
2. High temperature stabilization bake per MIL-STD-883, Method 1008, Test Condition B, 48 hours.
3. Temperature cycling per MIL-STD-883, Method 1010, Test Condition B.
4. Constant acceleration per MIL-STD-883, Method 2001, Test Condition B, Y_1 axis only.

Mechanical

Markings . . . . . . Part Number, Mfg. Date Code, Pin No. 1 (Positive 28 VDC)
Outline and Mounting Dimensions . . . . . . Per drawing

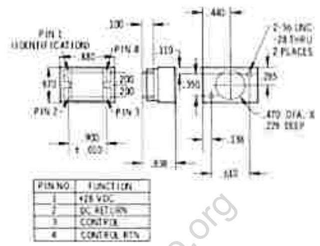
NOTES:

1. The WJ-334334 is protected against reverse voltages up to 50 VDC.
2. Operation is possible over the range +100°C to +120°C, but electrical performance is not guaranteed. Input current decays to 15 mA at +120°C without damage to unit.
3. Heaters are hermetically sealed to meet MIL-STD-883, Method 1014, Test Condition C, Step 1, and Method 1014, Test Condition A or B. Maximum measured leak rate 1 x 10^{-6} atm-cc/sec.
4. Optimum thermal performance is obtained by using a heat sink compound such as Dow Corning 340 on the mounting surface.

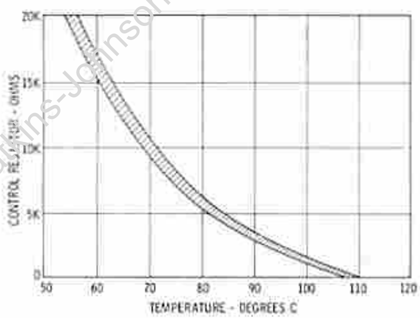
The WJ-334334 TO-8 Heater Module is a self-contained hybrid circuit heater than can be programmed to control to any temperature from 60° to 100° Celsius and mounts directly on top of a TO-8 component. These modules operate from unregulated 28 volt (D.C.) power sources and provide up to 28 watts of heat to control the component's temperature.

Outline Drawings

334334



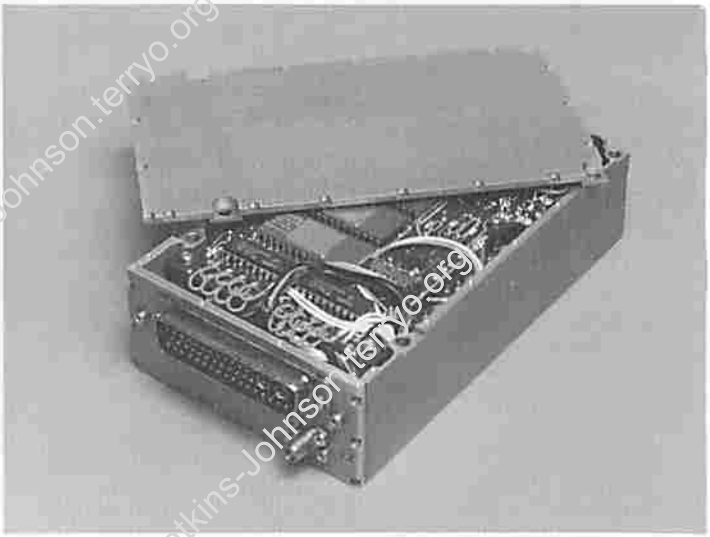
Control Resistor Values



Typical control resistor values required to set the WJ-334334 to a given temperature are given by the graph. With the control leads shorted, the unit temperature will not exceed 120°C.

11

How To Specify And Use A DTO/VCO



Author: Ronald N. Buswell

Modern EW systems require digitally tuned oscillators (DTOs) for use as local oscillators in receivers and in transmitters for jamming. Using PROM correction circuits, DTOs are now capable of excellent frequency accuracies. In addition, buffer amplifiers following the oscillator are capable of providing power levels in excess of 100 mW (+20 dBm), while reducing frequency pulling to typically less than 1 MHz. Also, voltage regulators internal to the DTO reduce pushing effects under 1 MHz/V.

However, DTOs exhibit several subtle characteristics that may affect system performance, including such factors as the set-on accuracy of a receiver, receiver sensitivity, and the power spectral density of a jammer. This article analyzes these factors and explains how and why DTOs affect such performance parameters.

Receiver Applications

ECM receiver systems are often configured using a double conversion technique, as shown in Figure 1. A signal from 2 to 18 GHz is initially downconverted to a common 2-to-6 GHz band, and then a DTO is used to tune across the 2-to-6 GHz band.

The *set-on accuracy* of this system is affected by inaccuracies from the first L.O., which are relatively small, and the DTO. For the DTO, the frequency accuracy is certainly the most significant factor affecting set-on accuracy. Using digital calibration techniques, the frequency accuracy (nonlinearity and drift over temperature) can be virtually eliminated; however, the effects of post-tuning drift and repeatability must still be considered.

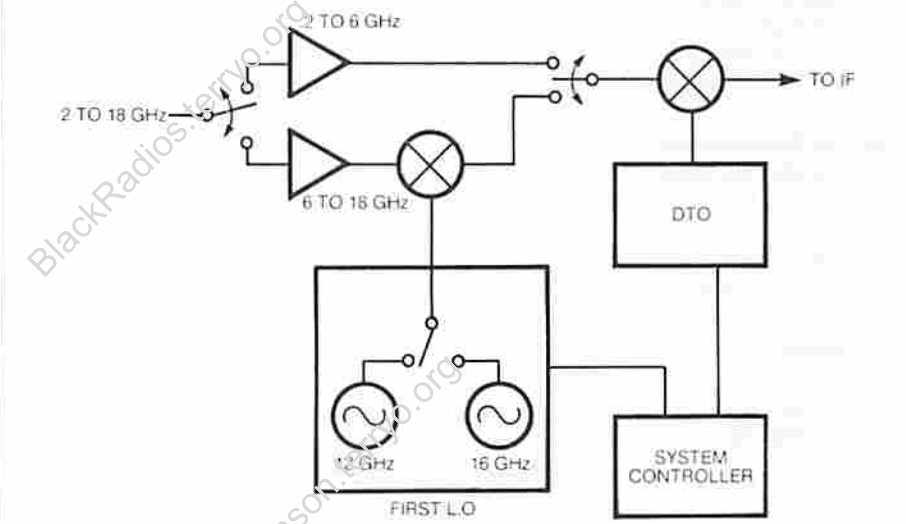


Figure 1. ECM receiver system.

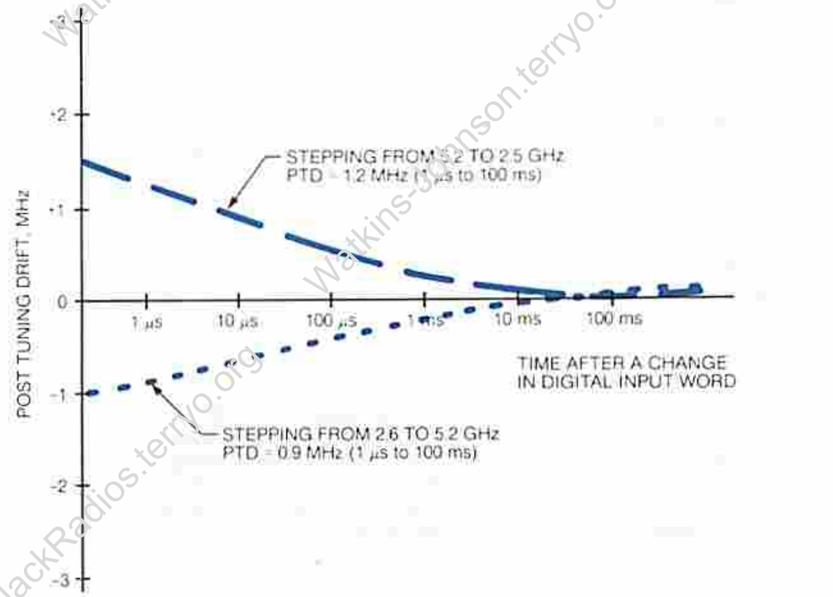


Figure 2. Post tuning drift of a 2.6 to 5.2 GHz DTO.

Post-tuning drift (PTD) for a DTO is defined as the shift in oscillator frequency output, as a function of time, after a change in digital input word, as shown in Figure 2, for a 2.6-to-5.2 GHz unit. The effect that causes this variation in frequency out to a few milliseconds after a step change in frequency is related to the temperature variation of the active devices in the oscillator, especially the varactor, and similar effects in the driver circuit. As the oscillator is tuned across the band, its active devices change their operating points due to variations in rf loading; and, as the temperature changes, the impedance changes, causing shifts in frequency. The rate of change of the frequency is associated with the thermal impedances of the active devices in the circuit. The thermal resistance directly affects the magnitude of the drift, and the thermal capacity affects the rate of change of the impedance and, therefore, the rate of frequency change.

Therefore, lowering the thermal impedances of critical active devices and operating them at bias points at which the junction temperatures remain more constant will reduce the PTD. Also, by using lower-power small-signal devices, such as bipolar junction transistors (compared to Gunn diodes), or by use of silicon transistors (compared to GaAs FETs), the PTD can be reduced. A comparison of typical PTD performance for various types of oscillators is shown in Figure 3.

The thermal effects usually end in a few milliseconds; however, DTOs exhibit other longer-term post-tuning-drift mechanisms. These are primarily associated with an effect called "varactor charging," in which ions on the surface of the varactor migrate across the junction over a period of time in the presence of an electric field that is caused by the reverse bias on the varactor. To reduce varactor charging, a special passivation has been developed that forms molecules with these ions so they will not migrate. A comparison of the PTD of a DTO with and without passivated varactors is shown in Figure 4.

The *repeatability* of a DTO defines how well the DTO will return to the same frequency while being switched to that frequency from many different frequencies, as shown in Figure 5, and includes the effects of post-tuning drift. It is also dependent on how long the DTO rests at either the desired frequency or the other frequencies.

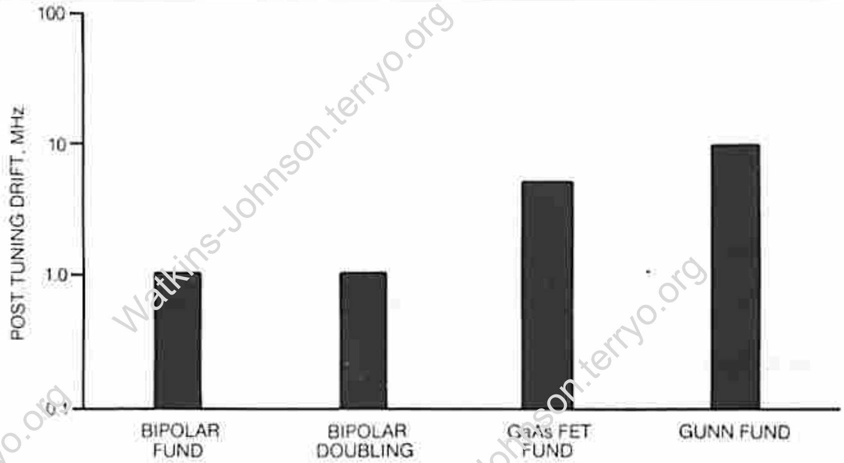


Figure 3. Post tuning drift comparison for various types of oscillator active devices.

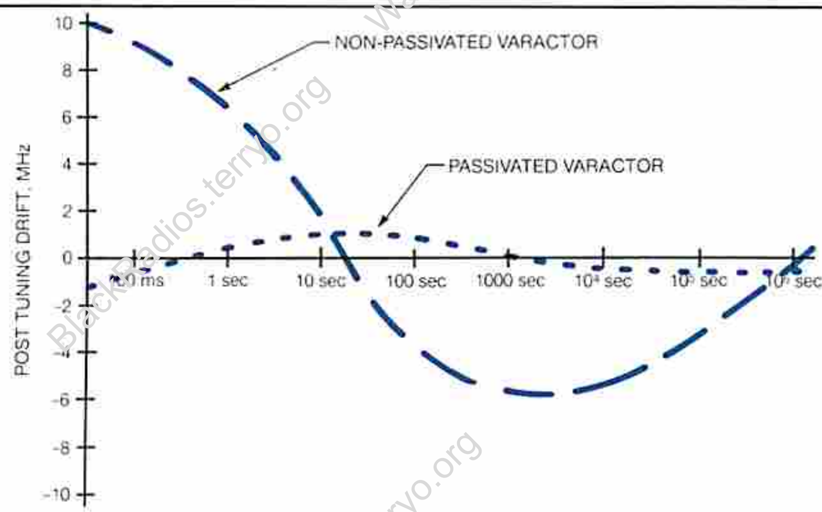


Figure 4. Comparison of PTD with passivated and non-passivated varactors.

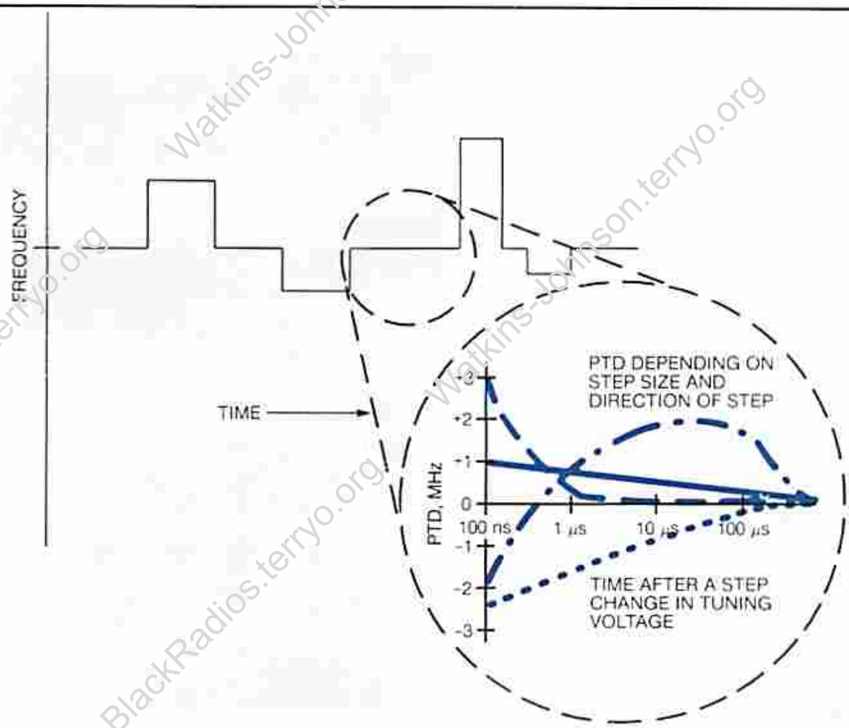


Figure 5. Repeatability.

The short-term repeatability (<10 milliseconds) of a DTO can be improved, as is the case for PTD, by reducing the thermal impedances and operating critical active devices like the oscillator transistors and varactors at constant junction temperatures. Long-term repeatability (>10 milliseconds) can be improved by using the previously mentioned specially passivated varactors.

SYSTEM SENSITIVITY

System sensitivity determines the lowest-level signal that can be received. Certainly, harmonic and spurious signals from the first L.O. and DTO will affect this. However, filtering can normally be used to achieve acceptable results. On the other hand, if the residual fm of the oscillators is too high, it may fill up the receiver IF so signals cannot be detected. The first L.O. residual fm can be made relatively low by using low-noise or phase-locked oscillators. DTOs, however, exhibit greater residual fm, especially when subjected to vibration and bias, and digital line noise.

The *residual fm* of a DTO is defined as the peak-to-peak deviation of the output signal as observed on a spectrum analyzer with a 1-kHz IF bandwidth at -3 dBc. Typically, the residual fm of a DTO using bipolar transistors in the oscillator is less than 100 kHz. This comes from the residual fm of the oscillator itself and the noise from the digital driver that frequency-modulates the oscillator. Gunn diode and FET oscillator DTOs exhibit much worse residual fm, typically 200 to 500 kHz.

Receiver systems normally have a considerable amount of residual fm on the digital and bias lines. It is not uncommon to have 100 mV of noise from power supplies and digital clocks on these lines during normal system operation. This noise causes frequency modulation of the DTO. The normal 100 kHz of residual fm may be degraded to several MHz in the system.

To reduce the effect of digital-line noise, buffers, latches, or other circuits that attenuate the digital-line noise are added to the digital input, as shown in Figure 6. These circuits can affect the tuning speed, so they must be selected with that in mind.

Bias-line noise also affects the residual fm of the DTO. To reduce this, LC filters may be added, as shown in Figure 7; but, in some cases, it is necessary to add a secondary regulator on the bias input

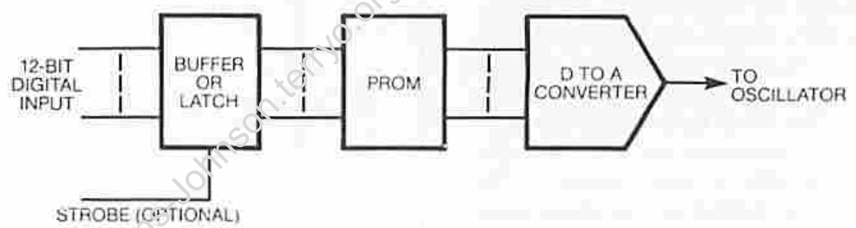


Figure 6. Buffers on digital input.

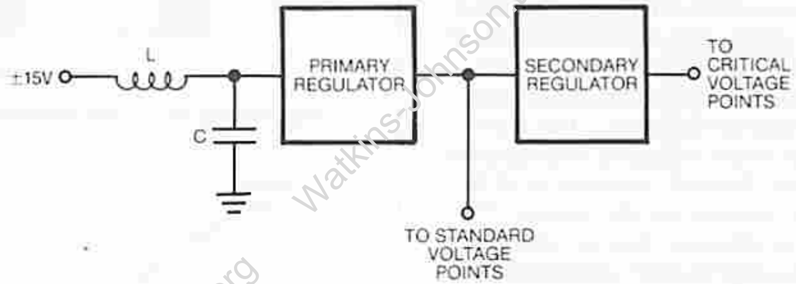


Figure 7. Bias input filter/regulator circuitry.

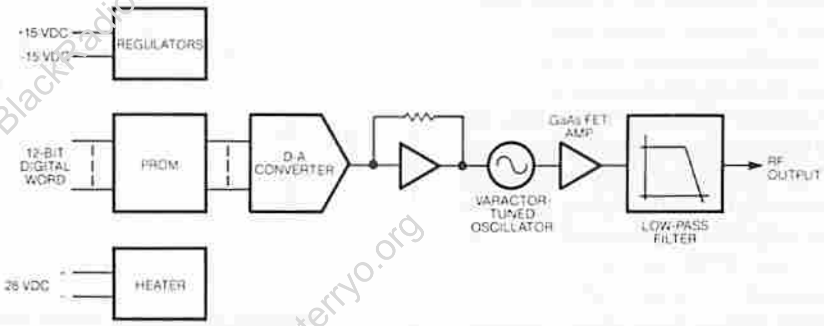


Figure 8. DTO used in a receiver system local oscillator.

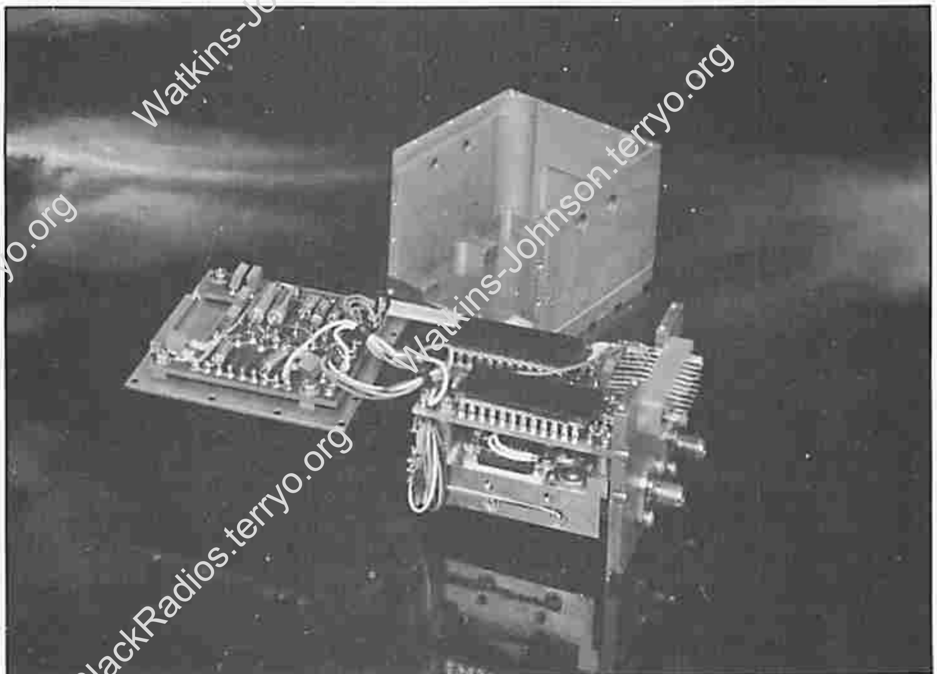


Figure 9. WJ-2854-22 2.6 to 5.2 GHz DTO.

to attenuate low-frequency noise. This has the disadvantage of reducing the voltage available for circuit operation, so the secondary output is used only on the most sensitive bias points. Using digital-line buffering and bias-line filtering, fm levels under 100 kHz can be achieved.

Residual fm in a system during vibration causes parts inside the unit to move. In the oscillator, this causes movement of bond wires and other parts, which results in an increase in the residual fm of the DTO. Careful design of the unit can minimize this effect. For example, the residual fm of a 2.6-to-5.2 GHz DTO exhibits an increase in fm from 100 kHz to 200 kHz, when subjected to 10 g's peak sine vibration from 10-to-2000 Hz.

TYPICAL DTO FOR A RECEIVER APPLICATION

The block diagram of a DTO used in a receiver system is shown in Figure 8. The input to the DTO is driven by a 12-bit digital word to select the desired frequency. Internal to the DTO, a PROM is used to modify the digital address so it exactly matches the oscillator tuning characteristic. Using this technique, frequency accuracies of ±5 MHz can be attained at room temperature, and ±10 MHz can be attained over the -54° to +85° centigrade range. A picture of one of these oscillators covering the 2.6 to 5.2 GHz frequency range is shown in Figure 9, and the performance characteristics of this unit are summarized in Table I.

Jammer Applications

The digitally tuned oscillator used in a transmitter application is often configured with a modulation port, as shown in Figure 10. In the system, the digital lines are used to set the oscillator on the desired frequency, while the modulation port is used to modulate the oscillator for jamming purposes. As such, the bandwidth of the modulation port needs to be as wide as possible. Typical bandwidths today are in excess of 20 MHz. A picture of one of these oscillators covering the 6-to-12 GHz frequency range is shown in Figure 11, and the performance characteristics are summarized in Table II.

The primary purpose of a jammer is to put out the maximum amount of radiated energy over the desired frequency range. In other words, the power-spectral density must be maximized.

RF Characteristics[1,2]	Guaranteed
Frequency Range	2.6 to 5.2 GHz
Power Output, Minimum (J1 and J2 Ports)	+12 dBm
Power Output Variation, Maximum (J1 and J2 Ports)	5 dB
Frequency Drift Over Temperature[3], Maximum	0.25 MHz/°C
Spurious Output Suppression	
Harmonic (nf_o), Minimum	-15 dB
In-band, Non-harmonic, Minimum	-70 dB
Pushing Factor, Maximum	1.5 MHz/V
Pulling Figure (3:1 VSWR), Maximum	1.0 MHz
Isolation Between RF Output Ports (J1 and J2), Minimum	15 dB
Tuning Characteristics	
Tuning Resolution	12-bit TTL Compatible
Digital Tuning Range[5]	0 to 4095
Non-linearity[4], Maximum	±18 MHz
Post Tuning Drift (2.5 μsec to 50 μsec), Maximum	1.8 MHz
Post Tuning Drift, 100 msec to 2 minutes	1.0 MHz
Post Tuning Drift, 30 μsec to 100 msec	1.0 MHz
Input Capacitance, Maximum	150 pF
LSB, Maximum	0.9 MHz
Input Power Requirements	
Oscillator Bias[6]	+15 Volts @ 400 mA, Maximum -15 Volts @ 350 mA, Maximum +5 Volts @ 300 mA, Maximum
Heater Voltage[7]	28 Volts
Heater Current at Turn-on	4.0 Amps, Maximum
Heater Current, Steady-state at -54°C	4.0 Amps, Maximum
Environmental Specifications	
Operating Temperature[3]	-54°C to 85°C
Storage Temperature	-62°C to 95°C
Mechanical Specifications	
Package Dimensions Excluding Connectors and Mounting Flanges (LxWxH)	2.12 x 2.28 x 1.73 inches
Weight, Maximum	9.0 ounces
RF Output Connector (both ports)	SMA Jack
Tuning Input Connector	Multi-pin connector (RFI Protected)
Bias and Heater Connections	Multi-pin connector (RFI Protected)
W-J Outline Drawing Number	337758

Notes:
1. The WJ-2854-22 is an rf oscillator employing varactors, bipolar transistors and field-effect transistors as the active elements. It also contains the following interface elements: isolation amplifier (active isolator), voltage regulator, proportionally controlled internal heater, D/A converter, PROM, and linearizer.
2. Unless otherwise noted, performance is specified for operation into a nominal matched load (VSWR ≤1.2:1) at laboratory ambient temperature.
3. Temperature is measured on the oscillator mounting surface.
4. The tuning non-linearity is the maximum deviation from linear tuning between the specified tuning word extremes and includes the effect of frequency drift over the operating temperature range.
5. The digital tuning range specifies the maximum range required to tune from minimum to maximum frequency.
6. Protective circuitry guards against damage due to overvoltage (up to 10 percent) and transient reverse voltages.
7. The heater is a self-regulating, proportionally controlled unit, isolated from bias and signal grounds.

Table I. WJ-2854-22 digitally tuned oscillator.

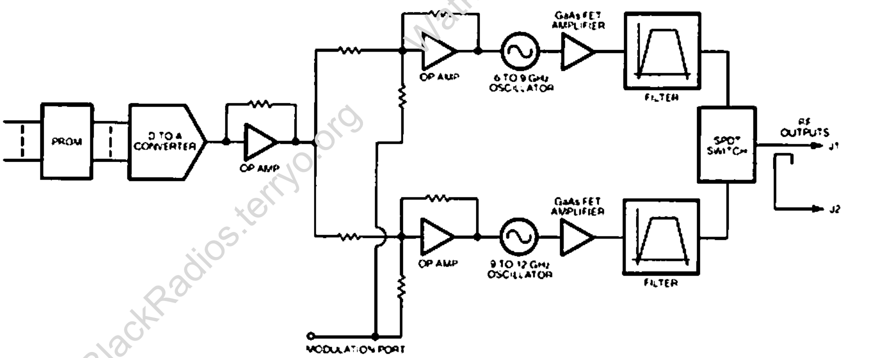


Figure 10. DTO for a jammer application.

Several key specifications for the DTO affect system performance, especially as they relate to power spectral density, including frequency accuracy, modulation-sensitivity variation, and modulation bandwidth.

FREQUENCY ACCURACY

Frequency accuracy for a DTO is defined as the maximum deviation from the ideal frequency at a given digital input, including the effects of frequency change over temperature. The better the frequency accuracy of the DTO, the higher power density that can be achieved, because it is not necessary to modulate the oscillator over as broad a frequency range to ensure that the signal to be jammed is covered. Using PROMs at the digital input to the DTO, accuracies of ±10 MHz can be achieved over the -54° to +85° centigrade range. Other techniques may be used to achieve better accuracies, including the use of synthesizer techniques and calibration routines.

MODULATION SENSITIVITY

The power spectral density is also affected by the variation in modulation sensitivity at the modulation port, as measured in MHz/V. Given a constant amplitude modultion signal, if the modulation port is connected directly to the varactor, as shown in Figure 10, the deviation of the modulated signal and, therefore, the power density, will vary directly with the variation in modulation sensitivity of the oscillator itself. This variation is shown in Figure 12. As the output frequency of the oscillator increases, the modulation sensitivity decreases. Therefore, for a constant modulation signal, the deviation decreases and the power spectral density over the deviated spectrum increases. This effect is undesirable in transmitter applications and, therefore, designs have been developed to correct it.

The most straightforward technique is to place a linearizer circuit between the oscillator and modulation circuit, as shown in Figure 13. This reduces the variation in modulation sensitivity across the band, thereby making the power density and deviation more constant. Overall variations of less than ±15% can be achieved using this technique. The disadvantage of the technique is that circuits having bandwidths greater than 10 MHz are very difficult to achieve.

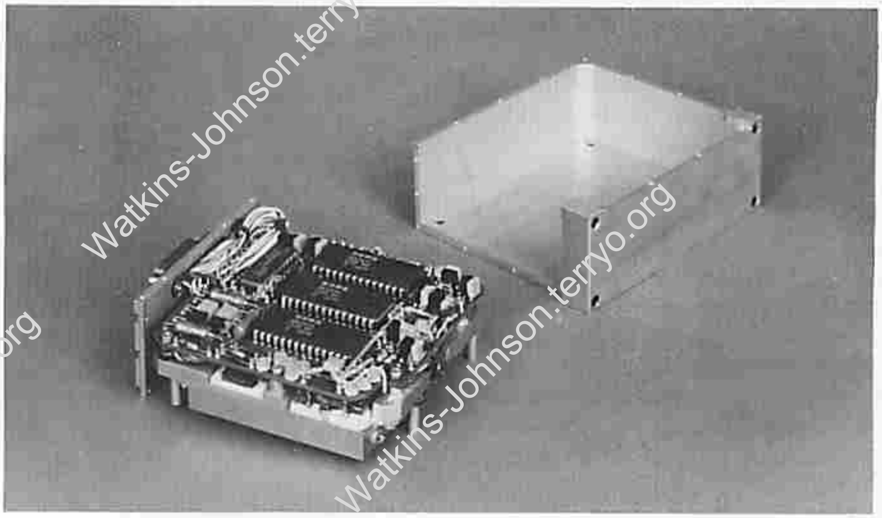


Figure 11. WJ-2855-37 6 to 12 GHz DTO.

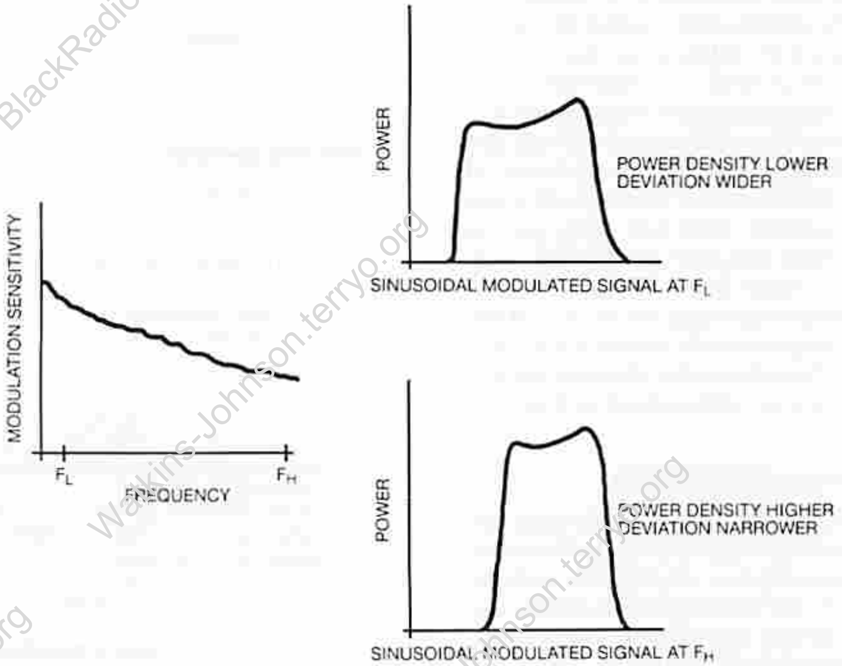


Figure 12. Modulation sensitivity and modulated spectrum characteristics of the modulation port of a DTO.

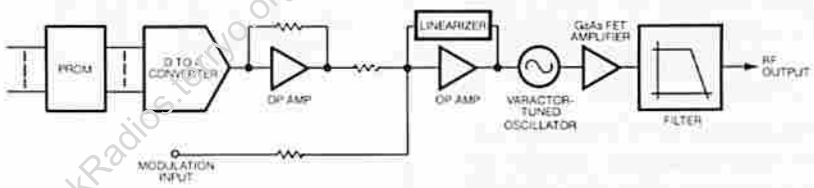


Figure 13. DTO for jammer application with linearizer to reduce variation in modulation sensitivity.

To achieve higher modulation bandwidths, another technique has been developed which uses a variable-gain amplifier, as shown in Figure 14. The gain of the amplifier is controlled by a PROM and D-to-A converter as the unit is tuned across the operating frequency range. Using this technique, the variation in modulation sensitivity and, therefore, variation in power density and deviation are less than ±5%. However, this technique has one basic problem. The gain of the amplifier is set at one frequency, so when modulating the oscillator over frequencies for which the modulation sensitivity of the oscillator itself varies, the power density and deviation will vary. This is especially evident when the deviations become wide, e.g. 100 to 500 MHz. In addition, a fast change in the modulation sensitivity of the oscillator will show up in the modulated spectrum, as illustrated in Figure 15. By controlling the overall variation in modulation sensitivity of the oscillator and aligning out any fine-grain variations, this technique has proven to be superior to the linearizer technique.

One other effect to be considered is *centroid shift*. Due to the nonlinear characteristics of the modulation sensitivity, the center of the modulated spectrum shifts, compared to the location of the unmodulated carrier. The shift necessitates that the system be designed to have slightly larger deviation to cover all threat frequencies. This also results in lower power density than if the modulation sensitivity were constant, as illustrated in Figure 16. This shift can be minimized by aligning the rf oscillator with minimum modulation sensitivity variation. The effect can be virtually eliminated if deviation information can be input to the variable gain amp PROM.

MODULATION BANDWIDTH

The modulation bandwidth of a modulation port is defined as that modulation frequency at which the frequency deviation changes by ±(x)dB from its low-frequency values. Typically, (x) is specified in the range of 1 to 3 dB.

To achieve a certain power spectral density, it is necessary to modulate the oscillator over a broader deviation at low modulation frequencies to ensure the frequencies to be jammed are covered at higher modulation frequencies if the bandwidth decreases. This means that the overall power spectral density will be lower than if the modulation bandwidth were flatter.

RF Characteristics[1,2]	Guaranteed
Frequency Range	6.0 to 12.0 GHz
Power Output, Minimum (J1 Port)	+7.5 dBm
Power Output Variation, Maximum (J1 Port)	4.5 dB
Power Output Variation, Maximum (J2 Port)	-20 to -10 dBm
Frequency Drift Over Temperature[3], Maximum	40 MHz
Spurious Output Suppression	
Harmonic (nf_o), Minimum	23 dB
Harmonic ($nf_o/2$)[4], Minimum	23 dB
In-band, Non-harmonic, Minimum	50 dB
Pushing Factor, Maximum	0.25 MHz/V
Pulling Figure (2.0:1 VSWR), Maximum	2 MHz
Pulling Figure (infinite VSWR), Maximum	5 MHz
Tuning Characteristics	
Tuning Resolution	13-bit
Digital Tuning Range[6]	545 to 7946
Modulation Sensitivity Range, Maximum	100 MHz/V
Modulation Sensitivity Range, Minimum	60 MHz/V
Non-linearity[5], Maximum	±10 MHz
Post Tuning Drift (1.7 µsec to 1.0 msec), Maximum	5.0 MHz
Post Tuning Drift, 1.0 msec to 1 minute, Maximum	3.0 MHz
Modulation Bandwidth (400 MHz deviation)[9], Minimum	8 MHz
Nominal Step Size	1 MHz ±50%
Input Power Requirements	
Oscillator Bias[7]	+15 Volts @ 500 mA, Maximum -15 Volts @ 400 mA, Maximum +5.2 Volts @ 600 mA, Maximum -5.2 Volts @ 100 mA, Maximum
Heater Voltage[8]	115 Volts AC
Heater Current at Turn-on	1.5 Amps, Maximum
Heater Current, Steady-state at -54°C	1.5 Amps, Maximum
Environmental Specifications	
Operating Temperature[3]	-54°C to 85°C
Storage Temperature	-54°C to 125°C
Mechanical Specifications	
Package Dimensions Excluding Connectors and Mounting Flanges (LxWxH)	4.00 x 3.50 x 1.50 inches
Weight, Maximum	20 ounces
RF Output Connector	SMA Jack
Tuning Input Connector	Multi-pin connector (RFI Protected)
Bias and Heater Connections	Multi-pin connector (RFI Protected)
W-J Outline Drawing Number	337758

Notes:
1. The WJ-2855-37 is an rf oscillator employing varactors and bipolar transistors as the active elements. It also contains the following interface elements: isolation amplifier (active isolator), voltage regulator, proportionally controlled internal heater, D/A converter, PROM, and [illegible] switch.
2. Unless otherwise noted, performance is specified for operation into a nominal matched load (VSWR ≤1.2:1) at laboratory ambient temperature.
3. Temperature is measured on the oscillator mounting surface.
4. The output of the WJ-2855-37 is taken from the second harmonic of the oscillation frequency, creating harmonically related ($nf_o/2$) spurious responses.
5. The tuning non-linearity is the maximum deviation from linear tuning between the specified tuning voltage extremes and includes the effect of frequency drift over the operating temperature range.
6. The tuning voltage range specifies the maximum voltage range required to tune from minimum to maximum frequency.
7. Protective circuitry guards against damage due to overvoltage (up to 10 percent) and transient reverse voltages.
8. The heater is a self-regulating, proportionally controlled unit, isolated from bias and signal grounds.
9. With the VCO tuning port modulated sinusoidally by a 50-ohm source, the modulation bandwidth is defined as that modulation frequency at which the frequency deviation decreases to 0.707 of its low frequency value.

Table II. WJ-2855-37 digitally tuned oscillator.

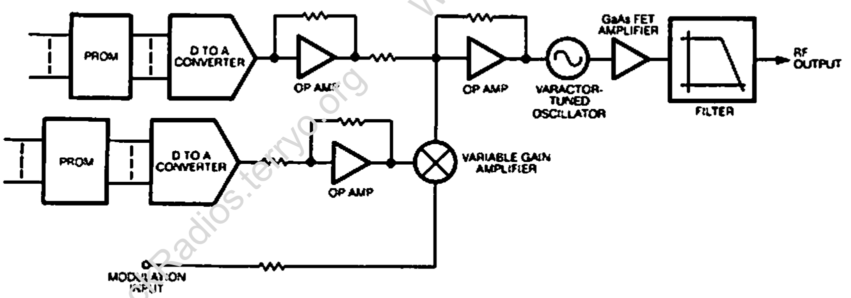


Figure 14. DTO for jammer application with a digitally controlled variable-gain amplifier to reduce variation in modulation sensitivity.

11

The modulation bandwidth also varies as a function of the DTO operating frequency. This, too, affects the power spectral density as the unit is tuned across the operation frequency range, especially at higher modulating frequencies.

Conclusion

Digitally tuned oscillators provide EW systems with capabilities not previously available. Frequency accuracies comparable to YIG oscillators are now available with the tuning-speed advantages of a VCO. In addition, DTOs are capable of being modulated at rates above 20 MHz, with variations in deviation less then ±5% across the entire operating frequency range. Post-tuning drift and repeatability effects have been minimized to be in the range of 1 MHz.

Overall system performance has been significantly improved through the use of modern DTO technology. Power spectral densities are now higher and more constant, and the set-on accuracies have been enhanced.

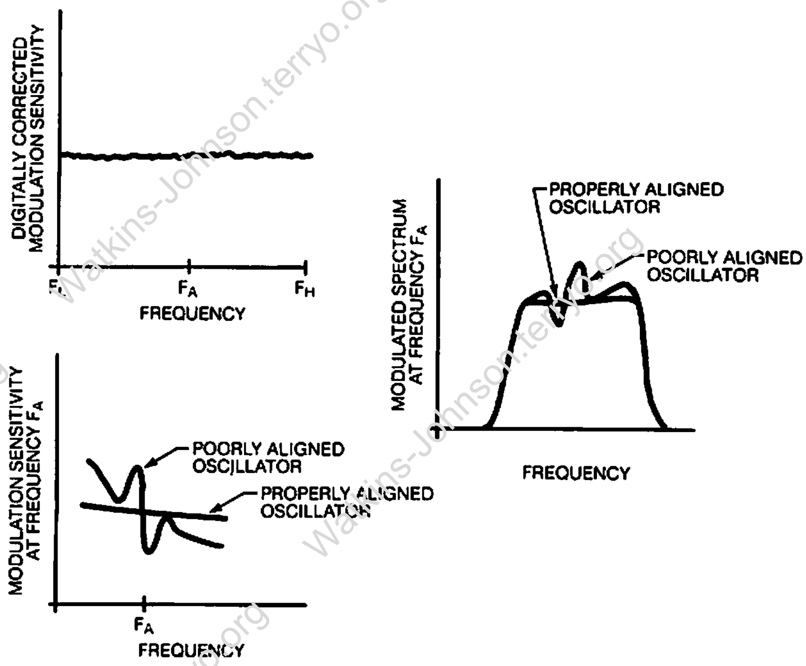


Figure 15. Modulation characteristics of digitally corrected modulation port of a DTO.

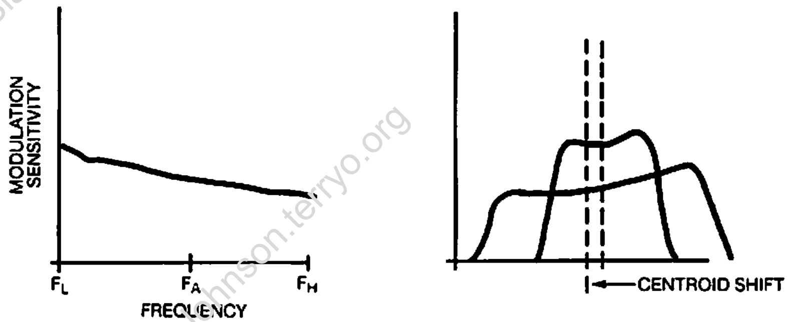


Figure 16. Centroid shift.

TECHNICAL DEFINITIONS

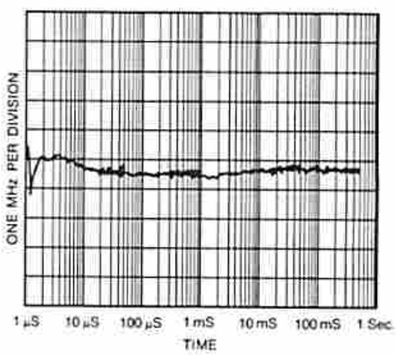
Modulation Sensitivity: The reciprocal of the slope of the tuning voltage vs. frequency graph, as measured in MHz/V.

Frequency Pushing: The change in operating frequency produced by a change in bias voltage (within the specified limits of bias voltage for the unit).

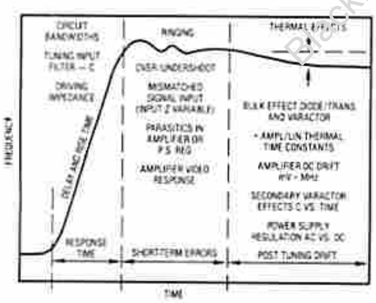
Frequency Pulling: The total frequency excursion observed as a load of the specified VSWR varies over 360 electrical degrees.

Post Tuning Drift
Post tuning drift is the most difficult performance parameter to specify. Post tuning drift is defined as the maximum frequency deviation from the reference frequency in a given time window after a step change in frequency. The reference frequency is defined as the frequency at the time when all transient tuning effects have subsided, typically 500 milliseconds. These effects include driver ringing and settling, thermal transient drift, long-term varactor charging mechanisms and repeatability due to different tuning duty cycles and steps sizes.

A typical post tuning drift specification would read 3 MHz maximum, from 300 nanoseconds to the reference frequency time.



TYPICAL POST TUNING DRIFT



POST TUNING DRIFT

Monotonicity: A unit is monotonic if $V_2 (f_2) > V_1 (f_1)$ for $f_2 > f_1$ where f is frequency and V is voltage. See Figure 12.

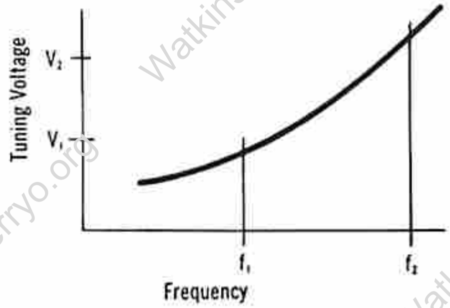


Figure 12

Frequency Accuracy: The maximum deviation from a straight line drawn between two predetermined points on a tuning voltage vs. frequency graph, produced by the combined effects of tuning nonlinearity and frequency drift with temperature.

Frequency Accuracy (DTO's)
Frequency accuracy is defined as the deviation in MHz from the programmed frequency and includes the effects of ambient temperature variation, pushing and pulling. This specification may be combined with post tuning drift to define overall system accuracy.

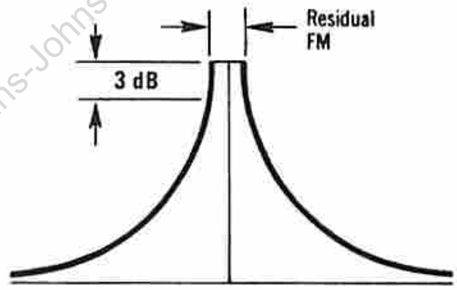
Nonlinearity: The maximum deviation from a straight line drawn between two predetermined points on a tuning voltage vs. frequency graph, expressed as a percentage of the absolute frequency.

Frequency Drift with Temperature: The change in operating frequency produced by a change in operating temperature. The operating temperature is measured on the baseplate.

Harmonic Rejection: The level of harmonically related signals relative to the desired output signal level, measured in dB.

Power Output Variation: The extremes of output power (min. to max.) measured over the entire frequency range as measured into a specified VSWR (all phases). Temperature effects are not included.

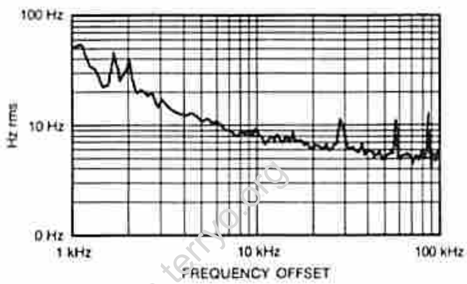
FM Noise
*** Residual FM**
The peak-to-peak deviation of the output signal as observed on a spectrum analyzer with a 1 kHz IF bandwidth at -3 dBc. This includes the effects of frequency pushing modulation due to noise injected on bias or digital lines.



Note: Bias and tuning voltages are to be filtered to eliminate ripple.

Figure 11

*** SSB Phase Noise**
The sideband noise level, a specified distance from the center of the carrier, measured in Hz Rms or dB relative to the carrier in a specified measurement bandwidth.



PHASE NOISE

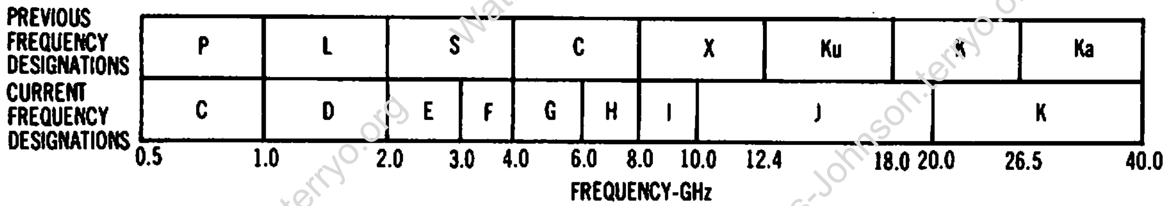
Least Significant Bit Size (DTO's)
The total frequency change for a LSB change in the tuning word any where within the tuning range. Typical specification minimum step size is 0 MHz (i.e., monotonic tuning). The maximum step size is twice the nominal LSB size.

Modulation Bandwidth
Modulation 3 dB bandwidth is defined as the maximum rate at which a VCO may be sinusoidally modulated from a 50 ohm source before its frequency deviation decreases to 0.707 of its low frequency deviation.

11

Conversion Charts

FREQUENCY BAND DESIGNATIONS



JOINT ELECTRONICS TYPE DESIGNATION SYSTEM

1st Ltr. INSTALLATION

A - Airborne
B - Submarine
C - Air transportable
D - Pilotless carrier
F - Fixed
G - Ground
K - Amphibious
M - Ground, mobile
P - Pack or portable
S - Surface craft
T - Ground, transportable
U - General utility
V - Ground, vehicular
W - Water, surface and underwater

2nd Ltr. EQUIPMENT

A - Infrared
B - Pigeon
C - Carrier
D - Radiac
E - Nupac
F - Photographic
G - Telegraph teletype
I - Interphone
J - Electro-mechanical
K - Telemetering
L - Countermeasure
M - Meterological
N - Sound in air
P - Radar
Q - Sonar
R - Radio
S - Special Types
T - Telephone (wire)
V - Visible light
W - Armament
X - Facsimile or TV

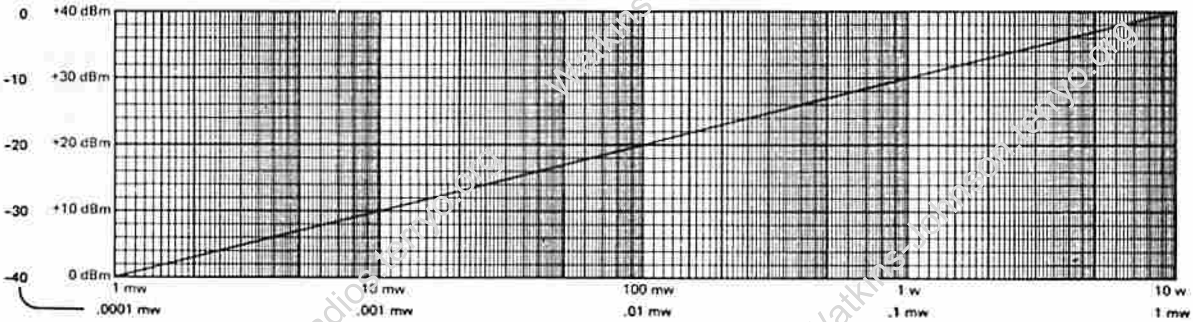
3rd Ltr. PURPOSE

A - Auxiliary
B - Bombing
C - Communications
D - Dir. finding/recon.
E - Ejection/release
F - Fire control
H - Record-reproduce
M - Maintenance/test
N - Navigation aids
Q - Special purposes
R - Receiving
S - Detect/range/bearing
T - Transmitting
W - Control
X - Ident. and recognition

Example: AN/ALR-47

AN/ = Standard Prefix
A = Airborne
L = Countermeasure
R = Receiving
47 = Design Number

POWER RATIO (watts vs. dBm)



CONVERSION OF RETURN LOSS TO EQUIVALENT VSWR

dB	VSWR	dB	VSWR	dB	VSWR	dB	VSWR	dB	VSWR
46	1.01	27	1.09	21.5	1.18	14	1.50	6	3.01
40	1.02	26.4	1.10	20.7	1.20	13	1.58	5	3.57
37	1.03	26	1.11	20	1.22	12	1.67	4	4.42
34	1.04	25	1.12	19	1.25	11	1.78	3	5.85
32	1.05	24	1.13	17.7	1.30	10	1.92	2	8.72
30.4	1.06	23.5	1.14	17	1.33	9	2.10	1	17.40
29	1.07	23	1.15	16	1.38	8	2.32	.5	34.78
28	1.08	22	1.17	15	1.43	7	2.61	0	∞

THE EFFECT OF VSWR ON TRANSMITTED POWER

VSWR	VSWR (dB)	RETURN LOSS (dB)	TRANS. LOSS (dB)	VOLT. REFL. COEFF.	POWER TRANS. (%)	POWER REFL. (%)
1.00	.0	∞	.000	.00	100.0	.0
1.01	.1	46.1	.000	.00	100.0	.0
1.02	.2	40.1	.000	.01	100.0	.0
1.03	.3	36.6	.001	.01	100.0	.0
1.04	.3	34.2	.002	.02	100.0	.0
1.05	.4	32.3	.003	.02	99.9	.1
1.06	.5	30.7	.004	.03	99.9	.1
1.07	.6	29.4	.005	.03	99.9	.1
1.08	.7	28.3	.006	.04	99.9	.1
1.09	.7	27.3	.008	.04	99.8	.2
1.10	.8	26.4	.010	.05	99.8	.2
1.11	.9	25.7	.012	.05	99.7	.3
1.12	1.0	24.9	.014	.06	99.7	.3
1.13	1.1	24.3	.016	.06	99.6	.4
1.14	1.1	23.7	.019	.07	99.6	.4
1.15	1.2	23.1	.021	.07	99.5	.5
1.16	1.3	22.6	.024	.07	99.5	.5
1.17	1.4	22.1	.027	.08	99.4	.6
1.18	1.4	21.7	.030	.08	99.3	.7
1.19	1.5	21.2	.033	.09	99.2	.8
1.20	1.6	20.8	.036	.09	99.2	.8
1.21	1.7	20.4	.039	.10	99.1	.9
1.22	1.7	20.1	.043	.10	99.0	1.0
1.23	1.8	19.7	.046	.10	98.9	1.1
1.24	1.9	19.4	.050	.11	98.9	1.1
1.25	1.9	19.1	.054	.11	98.8	1.2
1.26	2.0	18.8	.058	.12	98.7	1.3
1.27	2.1	18.5	.062	.12	98.6	1.4
1.28	2.1	18.2	.066	.12	98.5	1.5
1.29	2.2	17.9	.070	.13	98.4	1.6
1.30	2.3	17.7	.075	.13	98.3	1.7
1.32	2.4	17.2	.083	.14	98.1	1.9
1.34	2.5	16.8	.093	.15	97.9	2.1
1.36	2.7	16.3	.102	.15	97.7	2.3
1.38	2.8	15.9	.112	.16	97.5	2.5
1.40	2.9	15.6	.122	.17	97.2	2.8
1.42	3.0	15.2	.133	.17	97.0	3.0
1.44	3.2	14.9	.144	.18	96.7	3.3
1.46	3.3	14.6	.155	.19	96.5	3.5
1.48	3.4	14.3	.166	.19	96.3	3.7
1.50	3.5	14.0	.177	.20	96.0	4.0
1.52	3.6	13.7	.189	.21	95.7	4.3
1.54	3.8	13.4	.201	.21	95.5	4.5
1.56	3.9	13.2	.213	.22	95.2	4.8
1.58	4.0	13.0	.225	.22	94.9	5.1
1.60	4.1	12.7	.238	.23	94.7	5.3
1.62	4.2	12.5	.250	.24	94.4	5.6

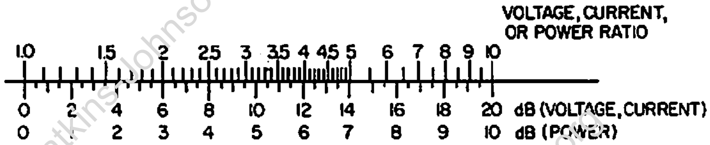
VSWR	VSWR (dB)	RETURN LOSS (dB)	TRANS. LOSS (dB)	VOLT. REFL. COEFF.	POWER TRANS. (%)	POWER REFL. (%)
1.64	4.3	12.3	.263	.24	94.1	5.9
1.66	4.4	12.1	.276	.25	93.8	6.2
1.68	4.5	11.9	.289	.25	93.6	6.4
1.70	4.6	11.7	.302	.26	93.3	6.7
1.72	4.7	11.5	.315	.26	93.0	7.0
1.74	4.8	11.4	.329	.27	92.7	7.3
1.76	4.9	11.2	.342	.28	92.4	7.6
1.78	5.0	11.0	.356	.28	92.1	7.9
1.80	5.1	10.9	.370	.29	91.8	8.2
1.82	5.2	10.7	.384	.29	91.5	8.5
1.84	5.3	10.6	.398	.30	91.3	8.7
1.86	5.4	10.4	.412	.30	91.0	9.0
1.88	5.5	10.3	.426	.31	90.7	9.3
1.90	5.6	10.2	.440	.31	90.4	9.6
1.92	5.7	10.0	.454	.32	90.1	9.9
1.94	5.8	9.9	.468	.32	89.8	10.2
1.96	5.8	9.8	.483	.32	89.5	10.5
1.98	5.9	9.7	.497	.33	89.2	10.8
2.00	6.0	9.5	.512	.33	88.9	11.1
2.50	8.0	7.4	.881	.43	81.6	18.4
3.00	9.5	6.0	1.249	.50	75.0	25.0
3.50	10.9	5.1	1.603	.56	69.1	30.9
4.00	12.0	4.4	1.938	.60	64.0	36.0
4.50	13.1	3.9	2.255	.64	59.5	40.5
5.00	14.0	3.5	2.553	.67	55.6	44.4
5.50	14.8	3.2	2.834	.69	52.1	47.9
6.00	15.6	2.9	3.100	.71	49.0	51.0
6.50	16.3	2.7	3.351	.73	46.2	53.8
7.00	16.9	2.5	3.590	.75	43.7	56.2
7.50	17.5	2.3	3.817	.76	41.5	58.5
8.00	18.1	2.2	4.033	.78	39.5	60.5
8.50	18.6	2.1	4.240	.79	37.7	62.3
9.00	19.1	1.9	4.437	.80	36.0	64.0
9.50	19.6	1.8	4.626	.81	34.5	65.5
10.00	20.0	1.7	4.807	.82	33.1	66.9
11.00	20.8	1.6	5.149	.83	30.6	69.4
12.00	21.6	1.5	5.466	.85	28.4	71.6
13.00	22.3	1.3	5.762	.86	26.5	73.5
14.00	22.9	1.2	6.040	.87	24.9	75.1
15.00	23.5	1.2	6.301	.88	23.4	76.6
16.00	24.1	1.1	6.547	.88	22.1	77.9
17.00	24.6	1.0	6.780	.89	21.0	79.0
18.00	25.1	1.0	7.002	.89	19.9	80.1
19.00	25.6	.9	7.212	.90	19.0	81.0
20.00	26.0	.9	7.413	.90	18.1	81.9
25.00	28.0	.7	8.299	.92	14.8	85.2
30.00	29.5	.6	9.035	.94	12.5	87.5

Conversion of Voltage and Power Ratios to dB

The equation

$$dB = 20 \log \frac{E_1}{E_2} = 10 \log \frac{P_1}{P_2}$$

is frequently used to determine the effects of component and system inter-connections. This nomograph presents the equation in graphical form.



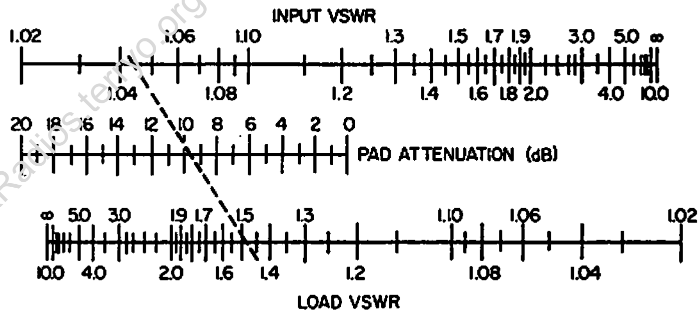
Effect of Attenuating Pads on VSWR

In an electrically "long" transmission line that is not terminated in its characteristic impedance, the VSWR, S, is defined as

$$S = \frac{E_{max}}{E_{min}} = \frac{1 + \rho}{1 - \rho}$$

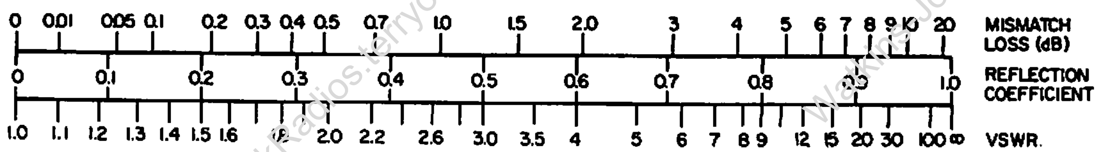
where E is the voltage measured along the line, and ρ is the termination voltage reflection coefficient. Insertion of an attenuator having the same characteristic impedance as that of the line will diminish both the incident wave to the load and the reflected wave returning to the input source, causing the VSWR at the input side to be diminished, as expressed by the equation

$$\frac{1}{S_1} = \tanh \left[\alpha + \tanh^{-1} \frac{1}{S_2}\right]$$



where subscripts 1 and 2 refer to the input and load sides of the pad, respectively, and α is the pad attenuation in nepers. Determination of the attenuation required to reduce the VSWR to a desired value is facilitated by means of this nomograph.

Effect of Impedance Mismatch on VSWR and Transmitted Power Loss



It is often necessary to determine the power-mismatch loss that results when the load impedance is not matched to the line, which can be expressed as

$$\text{mismatch loss (dB)} = 10 \log \frac{P_m}{P}$$

$$= 10 \log \frac{1}{1 - \rho^2} = 10 \log \frac{(S+1)^2}{4S}$$

where P = power delivered to the load, and P_m = power that would be delivered if the impedances were matched for maximum power transfer. These relationships are shown graphically in this nomograph.

DECIBELS — VOLTS — WATTS CONVERSION TABLE 50-OHM SYSTEM TERMINATED

dBm	V	P_o
+53	100.0	200W
+50	70.7	100W
+49	64.0	80W
+48	58.0	64W
+47	50.0	50W
+46	44.5	40W
+45	40.0	32W
+44	32.5	25W
+43	32.0	20W
+42	28.0	16W
+41	26.2	12.5W
+40	22.5	10W
+39	20.0	8W
+38	18.0	6.4W
+37	16.0	5W
+36	14.1	4W
+35	12.5	3.2W
+34	11.5	2.5W
+33	10.0	2W
+32	9.0	1.6W
+31	8.0	1.25W
+30	7.10	1.0W
+29	6.40	800 mW
+28	5.80	640 mW
+27	5.00	500 mW
+26	4.45	400 mW
+25	4.00	320 mW
+24	3.55	250 mW
+23	3.20	200 mW
+22	2.80	160 mW
+21	2.52	125 mW
+20	2.25	100 mW
+19	2.00	80 mW
+18	1.80	64 mW
+17	1.60	50 mW
+16	1.41	40 mW
+15	1.25	32 mW
+14	1.15	25 mW
+13	1.00	20 mW
+12	.90	16 mW
+11	.80	12.5mW
+10	.71	10 mW
+9	.64	8 mW
+8	.58	6.4 mW
+7	.500	5 mW
+6	.445	4 mW
+5	.400	3.2 mW
+4	.355	2.5 mW
+3	.320	2.0 mW
+2	.280	1.6 mW
+1	.252	1.25 mW

dBm	V	P_o
0	.225	1.0 mW
−1	.200	.80 mW
−2	.180	.64 mW
−3	.160	.50 mW
−4	.141	.40 mW
−5	.125	.32 mW
−6	.115	.25 mW
−7	.100	.20 mW
−8	.090	.16 mW
−9	.080	.125 mW
−10	.071	.10mW
−11	.064	
−12	.058	
−13	.050	
−14	.045	
−15	.040	
−16	.0355	
dBm	**mV**	
−17	31.5	
−18	28.5	
−19	25.1	
−20	22.5	.01 mW
−21	20.0	
−22	17.9	
−23	15.9	
−24	14.1	
−25	12.8	
−26	11.5	
−27	10.0	
−28	8.9	
−29	8.0	
−30	7.1	.001 mW
−31	6.25	
−32	5.8	
−33	5.0	
−34	4.5	
−35	4.0	
−36	3.5	
−37	3.2	
−38	2.85	
−39	2.5	
−40	2.25	.1 µW
−41	2.0	
−42	1.8	
−43	1.6	
−44	1.4	
−45	1.25	
−46	1.18	
−47	1.00	
−48	0.90	

dBm	mV	P_o
−49	0.80	
−50	0.71	.01 µW
−51	0.64	
−52	0.57	
−53	0.50	
−54	0.45	
−55	0.40	
−56	0.351	
−57	0.32	
−58	0.286	
−59	0.251	
−60	0.225	.001 µW
−61	0.200	
−62	0.180	
−63	0.160	
−64	0.141	
dBm	**µV**	
−65	128	
−66	115	
−67	100	
−68	90	
−69	80	
−70	71	.1 nW
−71	65	
−72	58	
−73	50	
−74	45	
−75	40	
−76	35	
−77	32	
−78	29	
−79	25	
−80	22.5	.01 nW
−81	20.0	
−82	18.0	
−83	16.0	
−84	11.1	
−85	12.9	
−86	11.5	
−87	10.0	
−88	9.0	
−89	8.0	
−90	7.1	.001 nW
−91	6.1	
−92	5.75	
−93	5.0	
−94	4.5	
−95	4.0	
−96	3.51	

dBm	µV	P_o
−97	3.2	
−98	2.9	
−99	2.51	
−100	2.25	.1 pW
−101	2.0	
−102	1.8	
−103	1.6	
−104	1.41	
−105	1.27	
−106	1.18	
dBm	**nV**	
−107	1000	
−108	900	
−109	800	
−110	710	.01 pW
−111	640	
−112	580	
−113	500	
−114	450	
−115	400	
−116	355	
−117	825	
−118	285	
−119	251	
−120	225	.001 pW
−121	200	
−122	180	
−123	160	
−124	141	
−125	128	
−126	117	
−127	100	
−128	90	
−129	80	.1 fW
−130	71	
−131	61	
−132	58	
−133	50	
−134	45	
−135	40	
−136	35	
−137	33	
−138	29	
−139	25	
−140	23	.01 fW

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