Technical Data

wj | **WATKINS-JOHNSON**

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VHF/UHF Receiver Miniceptor WJ-8607

Features

The WJ-8607 is a small, lightweight VHF/UHF receiver designed for limited space applications. Its compact size (105 cubic inches) and flexible capabilities with both remote and handoff interfaces, provide a multitude of independent and systems applications. The WJ-8607 features the high dynamic range, low phase noise, multiple detection modes, and excellent selectivity of larger receivers.

The fully synthesized, low phase noise local oscillators (LO) provide accurate tuning over the basic range of 20 to 512 MHz. The tuning range is extendible to 2000 MHz with a Frequency Extender (FE) option. Although the receiver is designed for VHF/UHF operation, tuning to 2 MHz provides a solution for applications where modest HF performance is acceptable. Three IF bandwidths (IFBW) are standard. Space is provided for two additional bandwidths. A wide selection of IF filters are available ranging from 3.2 kHz to 8 MHz. As an added feature, the IF filters may be bypassed, yielding a bandwidth of approximately 12 MHz. The WJ-8607 demodulates AM, FM, CW, and Pulse type signals. Optional Single Sideband (SSB) detection provides upper or lower sideband demodulation in a 3.2-kHz bandwidth without sacrificing any of the five available IFBW positions. A synchronous detector is used for the AM demodulator, which yields a more linear transfer function than traditional techniques.

❏ *20 to 512 MHz frequency range (2 to 2000 MHz with FE)*

❏ *High dynamic range tracking preselector (20 to 512 MHz with 10% nominal bandwidth)*

❏ *Low phase noise*

❏ *Sweep, Step & Lockout, with channel occupancy*

❏ *Small size: 1.5 x 6.5 x 10.5 in (3.81 x 16.51 x 26.67 cm)*

❏ *Modular construction: 4 circuit boards using SMT*

❏ *Low power: 16 W*

❏ *Light Weight: 5.5 lbs (2.48 kg)*

❏ *High linearity demodulators*

❏ *Self-test of power supply & synthesizer operation*

❏ *Tunable IF output frequency*

HEIGHT 1.5 in (3.81 cm)   **DEPTH** 10.5 in (13.5 with FE) (26.67 cm)
WIDTH 6.5 in (16.51 cm)   **WEIGHT** 5 lbs* (2.26 kg)

*(Additional with FE Option)

The WJ-8607 achieves an outstanding third-order intercept point of +6 dBm, while maintaining a typical noise filter of only 8 dB. A built-in tracking preselector with a nominal bandwidth of 10 percent reduces the interference caused by out-of-band signals.

The receiver is equipped with two IF outputs. The signal monitor output provides nominally 12 dB of gain above the RF input with a 10-MHz bandwidth. An optional wideband output, provides a leveled -30 dBm output. The selected IFBW output provides a sample of the predetected 21.4-MHz IF at a level of -30 dBm.

Two unique features of the WJ-8607 are its translated IF output and switched audio output. The translated IF output allows the operator to translate the 21.4-MHz IF down to an IF output with a maximum center frequency of 2 MHz. When enabled, the translated IF is routed to the video output jack, in lieu of the normal detected video signal. The switched audio output allows multiple audio signals, from similar sources, to be bused together to a common point for selection.

Modes of Control

The WJ-8607 contains two I/O interfaces for control and data analysis operations. The Hewlett-Packard Interface Loop (HPIL) is a low power, interruptible, and addressable serial interface supported by many controlling devices, such as various personal computers. All receiver operations may be controlled or queried via the HPIL. This interface supports control of sweep, step, manual, memory, and data collection operations. The collected queue of signal activity is available on command via the HPIL.

A asynchronous serial interface operates as a dedicated handoff bus or as a full-duplex RS-232 interface. When operated as a handoff bus, the serial interface accepts manual handoff commands, such as frequency, detection mode or bandwidth, from a WJ-8615P Receiver. A single handoff network of up to 30 WJ-8607s and WJ-8615Ps allows multiple

system configurations. The handoff bus can be operated in conjunction with the HPIL to form a highly versatile operating system. With a simple switch change, the serial interface bus is configurable for operation in full-duplex RS-232 mode at a data rate of up to 9600 baud. In this configuration, the RS-232 interface supersedes use of the HPIL. A special cable, supplied with the RS-422A option, converts the RS-232C levels and signals to RS-422A.

Capabilities/Applications

The WJ-8607 uses a Motorola 68HC11 Microcontroller, which controls receiver functions such as AGC, AFC, synthesizer tuning, and remote interface. The receiver provides three basic modes of operation:

- MANUAL (fixed-frequency operation)
- SWEEP (contiguous coverage from start-to-stop frequency)
- STEP (preprogrammed discrete frequencies)

The WJ-8607 is interactive in all of its modes and alerts the host computer of signal activity. While in either the SWEEP or STEP mode of operation, the receiver logs individual signals in the coverage area and reports only changes in signal presence to the host computer. This capability greatly reduces overhead time required by the host computer; since it eliminates the need to sort data from each receiver sweep, and to determine which signals are new and which are repeats. In SWEEP mode, the receiver locks out portions of the RF spectrum, and excludes previously identified portions of the spectrum from the coverage area. Non-volatile memory provides storage of up to 100 SWEEP or STEP setups, and 200 lockout bands.

Application solutions requiring high dynamic range, low power, and portable surveillance subsystems are easily built using the WJ-8607. The small size and low weight are particularly attractive when configuring manportable systems. This receiver is also well-suited for applications where low EMI/RFI emissions are important.

Functional Description

As shown in the Block Diagram, an RF input signal passes through a voltage-tuned tracking preselector that rejects out-of-band signals, thus improving the second-order intercept point of the receiver. The bandwidth of the preselector is nominally 10 percent from 20 to 512 MHz. When the frequency extender is used with the unit, signals in the 512 to 2000 MHz range are filtered with suboctave filters and converted to the VHF range in 10 bands. After the input signal is filtered, it passes through an RF amplifier and low-pass filter before entering the first mixer, where it is mixed with the first LO and upconverted to 691 MHz.

The first LO tunes from 694 to 1204 MHz in 2-MHz steps. The upconverted IF signal at 691 MHz is amplified and filtered before it enters the second mixer. Here it is mixed with the second LO, which tunes from 668.6 to 670.6 MHz in 100-Hz steps. The output from the second mixer is centered at 21.4 MHz, and is filtered and amplified before entering the switchable IFBW filters. A sample of the prefiltered

signal is provided for the signal monitor or optional wideband output.

The WJ-8607 can have up to five IF bandwidths installed. The fifth IF position requires a bandwidth of 250 kHz or greater. An additional feature permits the bypassing of IF filters on command, allowing total determination of the bandwidth by the tracking preselector, first IF filter, and final IF roofing filter. With a simple control command, the tracking preselector is also bypassed. This feature is particularly desirable when relatively wide bandwidths are required at a low-tuned frequency.

After the signal is filtered in the selected IF filter, it passes through several stages of IF amplification and gain control. A sample of the bandlimited IF signal is provided at -30 dBm. Synchronous detectors, which provide highly linear and stable performance, accomplish AM and FM detection. A final conversion to 500 kHz provides SSB detection. The optional SSB detector includes a high-selectivity 3.2-kHz-wide filter for good adjacent channel rejection.
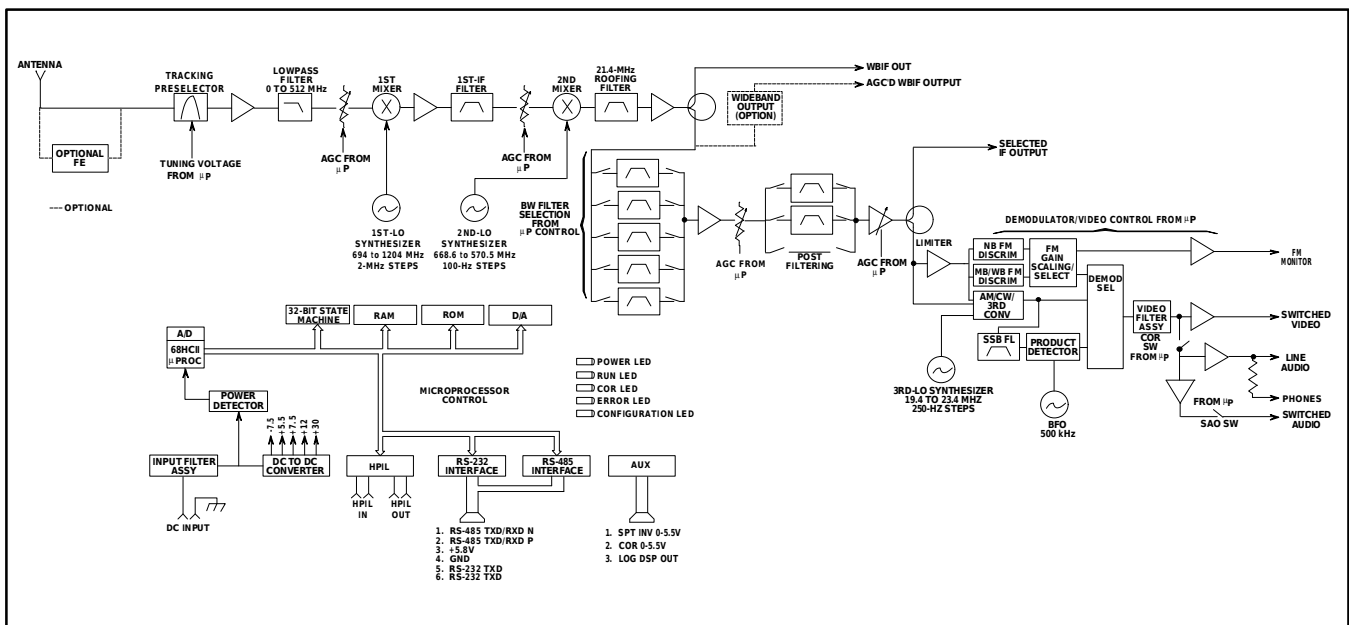
WJ-8607 Receiver Simplified Block Diagram

WJ-8607

Specifications

Frequency Range	20 to 512 MHz (2000 MHz with FE option) Tuning allowed to 2 MHz
Tuning Resolution	100 Hz, synthesized
Internal Reference Accuracy	± 1 part in 10E -6 (0 to 50°C)
External Reference Frequency	Selectable, 1, 5 or 10 MHz; 0-dBm nominal input level
Detection Modes	AM, FM, CW & Pulse standard (SSB optional)
RF Input Impedance	50 ohms, nominal
Preselection	Tracking Preselector, 20 to 512 MHz 10% nominal bandwidth with bypass mode (5 suboctave filters, 12 to 2000 MHz)
Input VSWR	2.0:1, typical 3.0:1, max at the tuned frequency
Noise Figure	12 dB, max (20 to 512 MHz with Preselector on) 8 dB, typical (5 to 512 MHz with Preselector off) 15 dB, max (512 to 2000 MHz with FE)
Intermodulation:	
2nd-order Intercept Point	+45 dBm (20 to 512 MHz with Preselector on) +35 dBm (512 to 2000 MHz)
3rd-order Intercept Point	+6 dBm (20 to 512 MHz with Preselector on) 0 dBm (512 to 2000 MHz) +5 dBm, typical (2 to 20 MHz)
Image Rejection	80 dB, min 90 dB, typical
IF Rejection	
21.4 MHz	90 dB, min above 30 MHz
691 MHz	90 dB, min with Preselector on
FE IF Rejection (Variable)	75 dB, min with FE
LO Phase Noise at 20-kHz Offset	-100 dBc/Hz (20 to 512 MHz) -98 dBc/Hz (512 to 2000 MHz)
Synthesizer Tuning Speed	12 msec, max (from receipt of the last data byte to within 10 kHz of the final frequency)
Signal Monitor Output	Nominally 12 dB above RF input (WBO provides -30 dBm leveled)
Gain Control Modes	Manual, automatic, 100-dB min range
AM Stability	6 dB, max change from AGC threshold to 100 dB above AGC threshold (-5 dBm, max input)
Internally Generated Spurious	<-110 dBm equivalent input (20 to 2000 MHz)
LO Level at RF Input	-100 dBm, typical -90 dBm, max
Switched Video Output	0.5 V peak-to-peak into 50 ohms (30% deviation in FM or 50% AM modulation)
Video Frequency Response	dc to 1/2 the IFBW, -3 dB
Line Audio Output	5 mW, min into 32 ohms
Headphone Output	5 mW, min into 32 ohms
Switched Audio Output	400 mV rms into 600 ohms
Audio Frequency Response	200 Hz to 15 kHz, min

FM Monitor Output	0.5 V peak-to-peak with 30% FM deviation, dc-coupled, 100-kHz max bandwidth, 10K-ohm load
Ultimate FM S+N/N	40 dB, min (in a 50-kHz bandwidth)
Reciprocal Mixing	With an input at rated sensitivity level in 20-kHz bandwidth, an out-of-band signal 350-kHz removed, and 70-dB higher in level will not degrade the S+N/N of the desired signal by more than 3 dB
Selected IF Output	Centered at 21.4 MHz, -30 dBm nominal output level
IFBWs	5 plus bypass mode (3 supplied & 2 optional); See IF Shape Factors for selection
IF Shape Factor	See IF Shape Factors
Translated IF Output	2-MHz, max center frequency Output on the selected video jack Suitable for predetection recording
COR/Squelch	Adjustable for 0 to 55 dB above the noise floor of the selected bandwidth
Power Requirements	12 Vdc (+9 to 16 Vdc)
Power Consumption	16 W, nominal (20 to 512 MHz); add 4 W for FE
Remote Interface	HPIL or RS-232C HPIL & RS-232 are switch-selectable Supports only 1 interface at a time
Handoff Interface	Operates in conjunction with HPIL interface Compatible with WJ-8615P receiver
Maximum RF Input Without Damage	+20 dBm

Environmental Specifications

Receiver Case Temperature	
Operating Temperature Range	-25 to +55°C, see Typical Performance Graphs for typical performance
Full Specification Compliance	+20 to +30°C
Non-operating	-40 to +70°C
Shock	Meets the environmental conditions of MIL-E-5400T, paragraph 3.2.24.6.1 pertaining to equipment shock
Vibration	Meets the environmental conditions of MIL-STD-810D, method 514.3, section I-3.2.4, category 4—propeller aircraft. Figure 514.3-25(a) defines the power spectral density with Li = 0.3 (g2/Hz) and Fi = 68 Hz
Humidity	Meets the environmental conditions of MIL-STD-810D Method 507.2 with optional environmental upgrade

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IF Shape Factors

Bandwidth (kHz)	Shape Factor 60:3 dB BW	Sensitivity (dBm)* 20 to 512 MHz
3.2[3]**	3:1	-107
6.4**	3:1	-105
10**	3:1	-104
20**	3:1	-101
50**	3:1	-97
75**	3:1	-95
100**	3:1	-94
250	4:1	-90
300	4:1	-89
500	4:1	-87
1000	4:1	-84
2000	4:1	-81
4000	4:1	-78
8000	4:1	-75

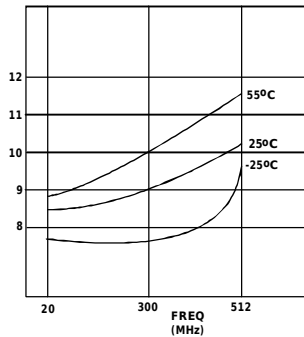*Sensitivity Conditions: Based on 20 to 512 MHz receiver. Add 4 dB for FE.

AM—An input signal AM modulated 50% by a 1-kHz tone produces a minimum video output S+N/N ratio of 10 dB.

FM—An input signal FM modulated at a 1-kHz rate with a peak deviation equal to 30% of the selected IF BW produces a minimum video output S+N/N ratio of 17 dB. (Note: IF bandwidths of 10 kHz or less required a 400-Hz modulation rate.)
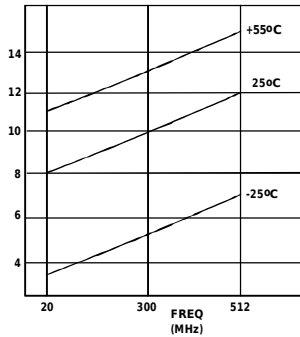
**This IF filter cannot be used in the 5th bandwidth position.

[3]With the 3.2-kHz bandwidth, the audio and video outputs are 6 dB less than published specifications.
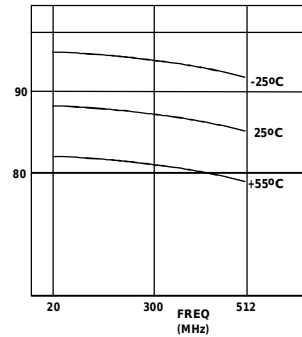
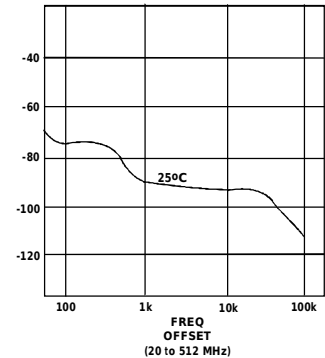TYPICAL NOISE FIGURE (dB)   TYPICAL 3IP (dBm)   TYPICAL GAIN SW IF (dB)   TYPICAL PHASE NOISE (dBc/Hz)

Typical Performance Graphs

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Options

Nomenclature	Function	Physical Characteristics
8607/ENV Environmental	• Meets MIL-STD-810D Method 507.2, Humidity	• Conformally coated
8607/FE Frequency Extender	• Extends UHF tuning range from 512 to 2000 MHz by block-converting 10 bands of the RF spectrum above 512 MHz into the normal tuning range	• Adds 2.85 in (7.23 cm) to length of basic WJ-8607 Receiver • Additional PC assemblies: - 5-band oscillators - RF converter with suboctave preselectors
8607/IFBW IF Bandwidth	• Up to 5 IF Bandwidths	• 3 IFBW standard • Additional 2 BWs optional • 5th IF Filter must be 250 kHz or greater • See IF Shape Factors for available bandwidth choices
8607/SSB Single Sidband	• Converts IF Signal From 21.4 MHz to 500 kHz for Filtering & Demodulation • Allows Demodulation of upper or lower sideband signals	• For Optimum SSB Operation, at least one of the five IF filters should be between 10 & 20 kHz
8607/WBO Wideband Output	• Provides a -30 dBm Output Level at 21.4 MHz (minimum bandwidth of 8 MHz)	• Mounts inside chassis • Eliminates Signal Monitor output
8607/MCS-1 Miniceptor Control Software	• Provides applications software for: - Receiver control/RF Pan display - Mnemonic control - Quick, reset/flush receiver operations - Missions storage/retrieval - Sweep data logging - Sweep data analysis	• MS-DOS*-based application software • Requires as a minimum: - 386/16-MHz PC - EGA, VGA, or SVGA monitor - Com port • Supplied on 5.25-in & 3.5-in disks with manual

*MS-DOS is a trademark of Microsoft Corporation

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Receiver Connectors

I/O	Function	Type
Input	Antenna External Reference Input DC Input	SMA SMB Multipin
Output	Selected Video Output FM Monitor Output Signal Monitor Output of Optional WBO Selected 21.4-MHz IP Output Switched Audio Output Line Audio Output Phone Output	SMB SMB SMB SMB SMB SMB 1/8-in Miniature Stereo Jack
Other	HPIL Input/Output Serial Control Input/Output	Multipin Multipin

Receiver LED Indicators

LED Code	Action Indicated
RUN*	Active microprocessor
COR	Presence of a signal over COR threshold
ERR	Functional error
CFG	Operating in the configuration mode (non-operational mode for downloading IF bandwidth & options configurations into memory
Power	dc power present