INSTRUCTION MANUAL

FOR

WJ-9518/9518E FDM DEMODULATOR

WATKINS-JOHNSON COMPANY

700 QUINCE ORCHARD ROAD

GAITHERSBURG, MARYLAND 20760

100/ 10-79

WARNING

This equipment employs voltages which are dangerous and may be fatal if contacted. Extreme caution should be exercised in working with the equipment with any of the protective covers removed.

The following changes should be incorporated into the WJ-9518/9518E FDM Demodulator Instruction Manual.

1.0 SECTION I, GENERAL DESCRIPTION

1.1 Table 1-1, Page 1-3: Type WJ-9518/9518E FDM Demodulator, Specifications

1.1.1 Change the Output Level specification: from 1 V rms ±10% into 600 ohms, nominal; to 1 V rms into 600 ohms, nominal.

1.1.2 Add a Bandpass Ripple specification of 1.5 dB, maximum.

2.0 SECTION III, CIRCUIT DESCRIPTION

2.1 Paragraph 3.3.3, Page 3-6: Type 791543 Remote Interface (A3)

2.1.1 Change the first sentence of step 1.

From: .....input lines BR, BE, B11, and BF.....

To: .....input lines BR, BE, B11, B15, and BF.....

2.2 Paragraph 3.3.6.8, Page 3-25: Type 34544 IF Demodulator (A7-A12) A8

2.2.1 The sixth through eighth sentences contain references to adjustable components which are no longer a part of the IF Demodulator design. These sentences should be changed as follows:

From: The impedance matching action of R1, R41, C2, C3, and L1 steps down the 1000 ohms impedance to 50 ohms. This matching network is aligned by adjusting L1 and R41. Test point J1 allows a signal to be inserted to FL1, and R39 and R40 provide a 1000 ohm source for the filter during alignment.

To: The resistive network formed by R1 and R41 matches the output of FL1 to the base of Q1. Test point J1 allows a signal to be inserted to FL1, and R39 and R40 provide a 1000 ohm source for the filter during troubleshooting.

3.0 SECTION IV, MAINTENANCE

3.1 Paragraph 4.5.4, Page 4-9: Output Level Test

3.1.1 Change and expand step 5.

From: .....This level should be 1.0 ±0.1 V rms.

To: .....This level should be 1.0 V rms, nominal.

Adjust (A7-A12) A8R7 and L2 if the output level is not as specified.

3.1.2 Change the last sentence in step 7.

From: .....In each case the output voltage levels shall be 1.0 ±0.1 V rms.

To: .....In each case the output voltage level should be 1.0 V rms, nominal.

3.2 Paragraph 4.6.4.2.5, Page 4-35: IF Demodulator (A7-A12) A8

3.2.1 Eliminate, from step 5, the sentence which reads "L1 should be adjusted for maximum output level."

3.2.2 Eliminate the last two sentences of step 6; these sentences refer to adjustable components which are no longer a part of the IF Demodulator.

3.3 Paragraph 4.6.4.2.11, Page 4-43: Bandpass Filter (A7-A12) A8FL1 Alignment Procedure

3.3.1 The redesign of the IF Demodulator has eliminated the need for this alignment procedure; consider the contents of paragraph 4.6.4.2.11 void.

4.0 SECTION V, REPLACEMENT PARTS LIST

4.1 Paragraph 5.5, Page 5-5: Type WJ-9518/9518E FDM Stepping Demodulator, Main Chassis

		REF. DESIG.	DESCRIPTION	QTY	MFR. PART NO.	MFR. CODE	RECM. VENDOR
4.1.1	CHANGE						
	From :	CR1	Diode	2	FFV250	02763	
	To :	CR1	Diode	2	FFV550	02763	
4.1.2	CHANGE						
	From :	C10	Capacitor, Ceramic, Disc: 0.47 µF, 10%, 100 V	1	8131M100-651-474M	72982	
	To :	C10	Capacitor, Ceramic, Disc: 0.47 µF, 20%, 100 V	1	8131M100-651-474M	72982	
4.1.3	CHANGE						
	From :	C11	Capacitor, Metallized, Polyester: 0.47 µF, 10%, 100 V	1	MMW4P47	09023	
	To :	C11	Capacitor, Metallized, Polyester: 0.47 µF, 20%, 400 V	1	MMW4P47	09023	

4.2 Paragraph 5.5.2.1, Page 5-17: Type 791797 Distribution Amplifier, A2A1

	REF. DESIG.	DESCRIPTION	QTY	MFR. PART NO.	MFR. CODE	RECM. VENDOR
4.2.1 CHANGE						
From :	R31	Resistor, Fixed, Composition: 10 Ω, 5%, 1/4 W	1	RCR07G 100JS	81349	01121
To :	R31	Resistor, Fixed, Composition: 10 Ω, 5%, 1/2 W	1	RCR20G 100JS	81349	01121

4.3 Paragraph 5.5.6, Page 5-27: Type 796023 Digital Control Unit # 1B, A6

	REF. DESIG.	DESCRIPTION	QTY	MFR. PART NO.	MFR. CODE	RECM. VENDOR
4.3.1 CHANGE						
From :	C2	Capacitor, Ceramic, Disc: 0.01 μF, 20%, 200 V	1	8131A200Z5 U103M	72982	
To :	C2	Capacitor, Ceramic, Disc: 0.01 μF, 20%, 200 V	2	8131A200Z5 U103M	72982	
4.3.2 ADD :	C22	Same as C2				

4.4 Paragraph 5.5.7.1, Page 5-33: Type 24577 1st LO Counter, (A7-A12) A1

	REF. DESIG.	DESCRIPTION	QTY	MFR. PART NO.	MFR. CODE	RECM. VENDOR
4.4.1 CHANGE						
From :	U1	Integrated Circuit	1	MC4044P	04713	
To :	U1	Integrated Circuit	1	11C44DC	07263	

4.5 Paragraph 5.5.7.2, Page 5-34: Type 24563 1st LO Voltage Controlled Oscillator, (A7-A12) A2

	REF. DESIG.	DESCRIPTION	QTY	MFR. PART NO.	MFR. CODE	RECM. VENDOR
4.5.1 CHANGE						
From :	Q6	Transistor	1	2N709	80131	02735
To :	Q6	Transistor	1	2N2857	80131	02735

		REF. DESIG.	DESCRIPTION	QTY	MFR. PART NO.	MFR. CODE	RECM. VENDOR
4.5.2	CHANGE						
	From :	R9	Resistor, Fixed, Composition: 1.2 kΩ, 5%, 1/4 W	2	RCR07G 122JS	81349	01121
	To :	R9	Resistor, Fixed, Composition: 1.2 kΩ, 5%, 1/4 W	3	RCR07G 122JS	81349	01121
4.5.3	CHANGE						
	From :	R21	Resistor, Fixed, Composition: 1.2 kΩ, 5%, 1/4 W	1	RCR07G 122JS	81349	01121
	To :	R21	Same as R9				
4.5.4	CHANGE						
	From :	T1	Transformer	1	21428-80	14632	
	To :	T1	Transformer	1	21428-89	14632	

4.6 Paragraph 5.5.7.3, Page 5-38: Type 34531 2nd LO Counter, (A7-A12) A3

		REF. DESIG.	DESCRIPTION	QTY	MFR. PART NO.	MFR. CODE	RECM. VENDOR
4.6.1	CHANGE						
	From :	U4	Integrated Circuit	1	MC4044P	04713	
	To :	U4	Integrated Circuit	1	11C44DC	07263	

4.7 Paragraph 5.5.7.5, Page 5-44: Type 24648 Input Converter, (A7-A12) A5

		REF. DESIG.	DESCRIPTION	QTY	MFR. PART NO.	MFR. CODE	RECM. VENDOR
4.7.1	CHANGE						
	From :	R5	Resistor, Fixed, Composition: 82 Ω, 5%, 1/4 W	1	RCR07G 820JS	81349	01121
	To :	R5	Resistor, Fixed, Composition: 270 Ω, 5%, 1/4 W	3	RCR07G 271JS	81349	01121

		REF. DESIG.	DESCRIPTION	QTY	MFR. PART NO.	MFR. CODE	RECM. VENDOR
4.7.2	CHANGE						
	From :	R12	Resistor, Fixed, Composition: 270 Ω, 5%, 1/4 W	2	RCR07G 271JS	81349	01121
	To :	R12	Same as R5				
4.7.3	CHANGE						
	From :	R14	Same as R12				
	To :	R14	Same as R5				

4.8 Paragraph 5.5.7.7, Page 5-47: Type 24649 2nd Converter (A7-A12) A7

		REF. DESIG.	DESCRIPTION	QTY	MFR. PART NO.	MFR. CODE	RECM. VENDOR
4.8.1	CHANGE						
	From :	C9	Capacitor, Ceramic, Disc: 0.047 μF, 10%, 100 V	5	CK06BX473K	81349	56289
	To :	C9	Capacitor, Ceramic, Disc: 0.047 μF, 10%, 100 V	4	CK06BX473K	81349	56289
4.8.2	CHANGE						
	From :	C13	Same as C9				
	To :	C13	Not Used				
4.8.3	CHANGE						
	From :	R14	Resistor, Fixed, Composition: 1 kΩ, 5%, 1/4 W	1	RCR07G 102JS	81349	01121
	To :	R14	Resistor, Film, Composition: 432 Ω, 1%, 1/4 W	1	RN60D432OF	81349	01121
4.8.4	ADD :	R16	Resistor, Film, Composition: 562 Ω, 1%, 1/4 W	1	RN60D562OF	81349	01121

4.9 Paragraph 5.5.7.8, Page 5-49: Types 34554-3 (796023-1 only), 34554-4 (796023-2 only) IF Demodulator (A7-A12) A8

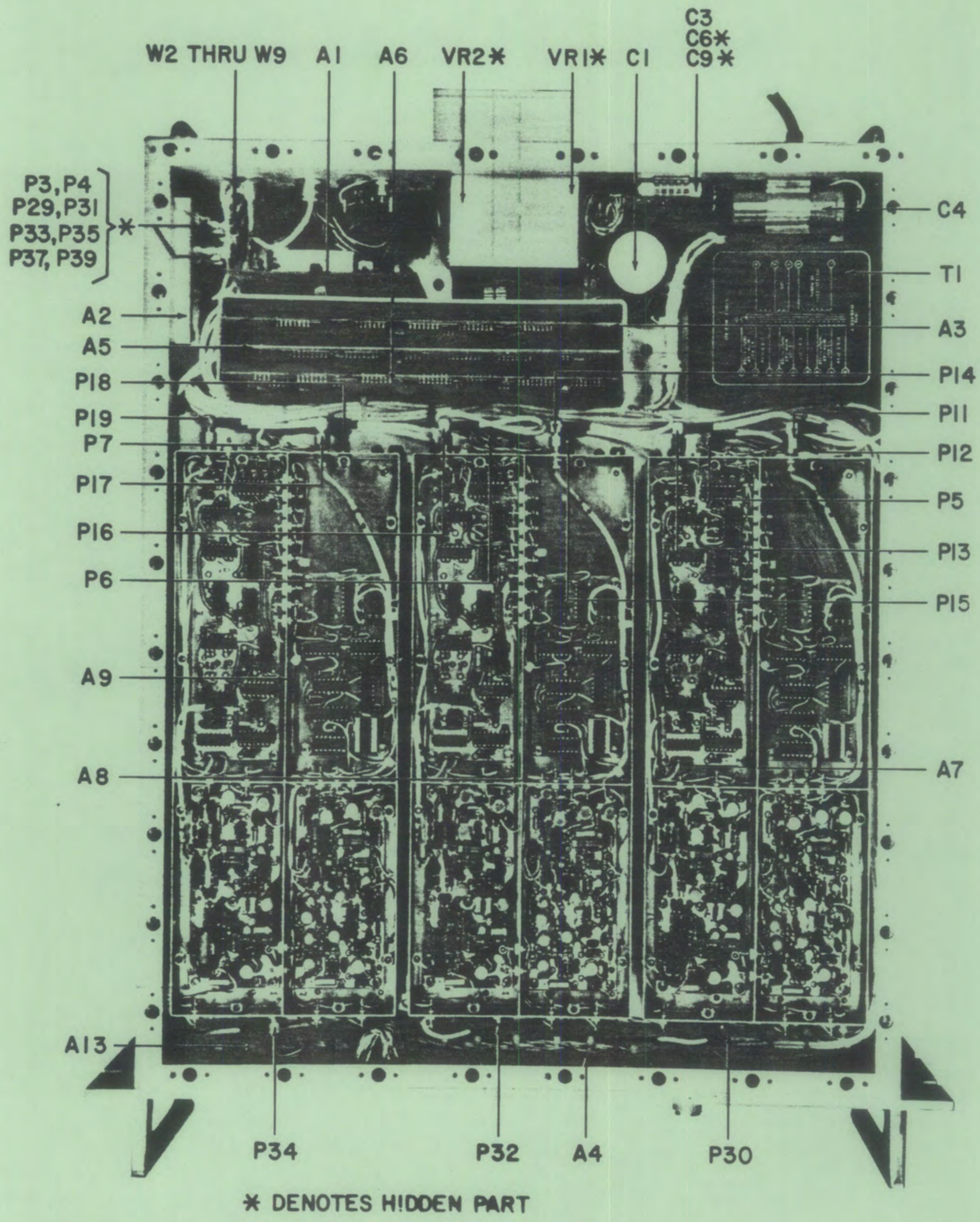
		REF. DESIG.	DESCRIPTION	QTY	MFR. PART NO.	MFR. CODE	RECM. VENDOR
4.9.1	CHANGE						
	From :	C2	Capacitor, Mica, Dipped: 2000 pF, 2%, 500 V	1	CM06FD 202G03	81349	72136
	To :	C2	Not Used				
4.9.2	CHANGE						
	From :	C3	Capacitor, Mica, Dipped: 6800 pF, 5%, 100 V	1	DM19-682J	72136	
	To :	C3	Not Used				
4.9.3	CHANGE						
	From :	C4	Capacitor, Ceramic, Disc: 0.1 µF, 20%, 100 V	8	8131M100-651-104M	72981	
	To :	C4	Capacitor, Ceramic, Disc: 0.1 µF, 20%, 100 V	7	8131M100-651-104M	72981	
4.9.4	ADD :	C5	Capacitor, Electrolytic: 18 µF, 10%, 20 V	1	1960186X 9020-KE3	56289	
4.9.5	CHANGE						
	From :	C5 Thru C8	Same as C4				
	To :	C6 Thru C8	Same as C4				
4.9.6	CHANGE						
	From :	C12	Capacitor, Ceramic, Disc: 2200 pF, 10%, 200 V	1	CK06BX222K	81349	56289
	To :	C12	Capacitor, Mica, Disc: 750 pF, 20%, 500 V	1	CM06FD 751G03	81349	56289

		REF. DESIG.	DESCRIPTION	QTY	MFR. PART NO.	MFR. CODE	RECM. VENDOR
4.9.7	CHANGE						
	From :	C13	Same as C12				
	To :	C13	Not Used				
4.9.8	CHANGE						
	From :	C14	Capacitor, Ceramic, Disc: 3900 pF, 10%, 200 V	1	CK06BX392K	81349	56289
	To :	C14	Capacitor, Ceramic, Disc: 1000 pF, 10%, 100 V	2	CK05BX102K	81349	56289
4.9.9	CHANGE						
	From :	C15	Capacitor, Ceramic, Disc: 1500 pF, 10%, 200 V	1	CK06BX152K	81349	56289
	To :	C15	Not Used				
4.9.10	CHANGE						
	From :	L1	Coil, Variable: 4.23 - 5.17 μH	1	558-7107-21	71279	
	To :	L1	Not Used				
4.9.11	CHANGE						
	From :	R1	Resistor, Fixed, Composition: 56 Ω, 5%, 1/4 W	2	RCR07G 560JS	81349	01121
	To :	R1	Resistor, Fixed, Film: 619 Ω, 1%, 1/4 W	2	RN60D619OF	81349	01121
4.9.12	CHANGE						
	From :	R15	Resistor, Fixed, Composition: 910 Ω, 5%, 1/4 W (34544-3 only)	1	RCR07G 911JS	81349	01121
	To :	R15	Resistor, Fixed, Composition: 2 kΩ, 5%, 1/4 W	1	RCR07G 202JS	81349	01121

		REF. DESIG.	DESCRIPTION	QTY	MFR. PART NO.	MFR. CODE	RECM. VENDOR
4.9.13	CHANGE						
	From :	R17	Resistor, Fixed, Composition: 56 Ω, 5%, 1/4 W	1	RCR07G 560JS	81349	01121
	To :	R17	Resistor, Fixed, Composition: 56 Ω, 5%, 1/4 W	2	RCR07G 560JS	81349	01121
4.9.14	CHANGE						
	From :	R22	Same as R1				
	To :	R22	Same as R17				
4.9.15	CHANGE						
	From :	R41	Resistor, Variable, Film: 100 Ω, 10%, 1/2 W	1	62PR100	73138	
	To :	R41	Same as R1				

4.10 Figure 5-3, Page 5-7: Type WJ-9518E Demodulator, Top View, Location of Components

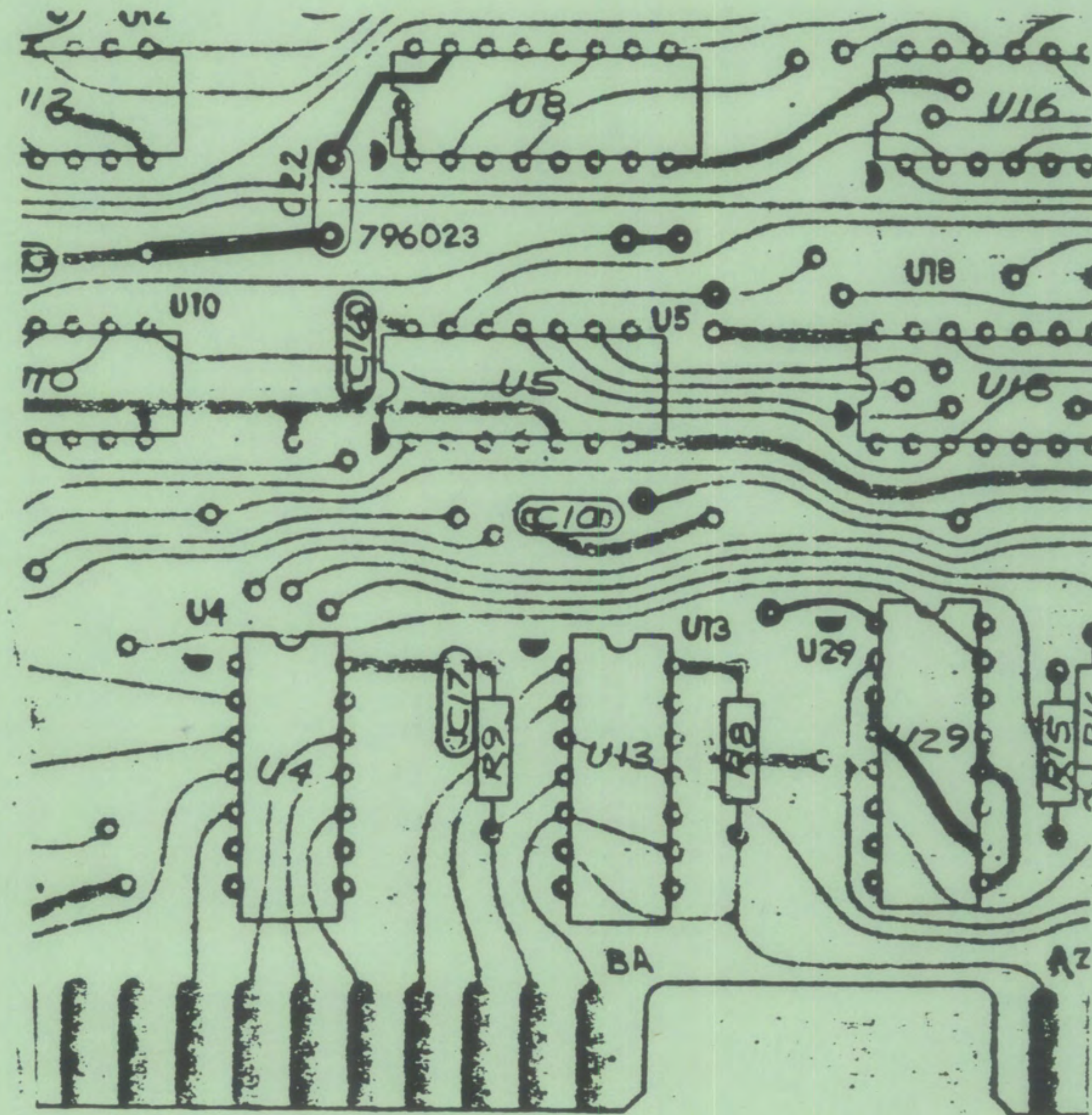
4.10.1 Replace Figure 5-3 with the revised location of components diagram on the following page.



Type WJ-9518/9518E Demodulator, Top View, Location of Components

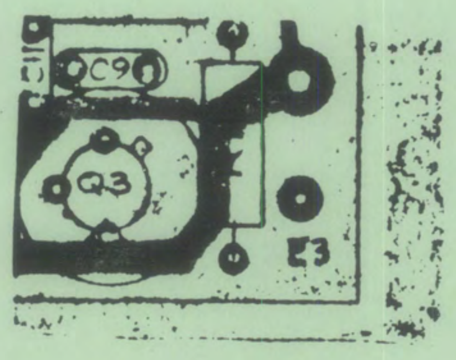
4.11 Figure 5-13, Page 5-28: Type 796023 Digital Control Unit # 1B, Location of Components

4.11.1 Add C22 and reverse pins 1 and 10 of U29 (as illustrated below) to agree with schematic changes described in paragraph 5.2, page 12 of this addendum.



4.12 Figure 5-22, Page 5-48: Type 24649-1 2nd Converter (A7-A12) A7, Location of Components

4.12.1 Delete C13 and add R16 (as illustrated on following page) to agree with schematic changes described in paragraph 5.7 on page 13 of this addendum.



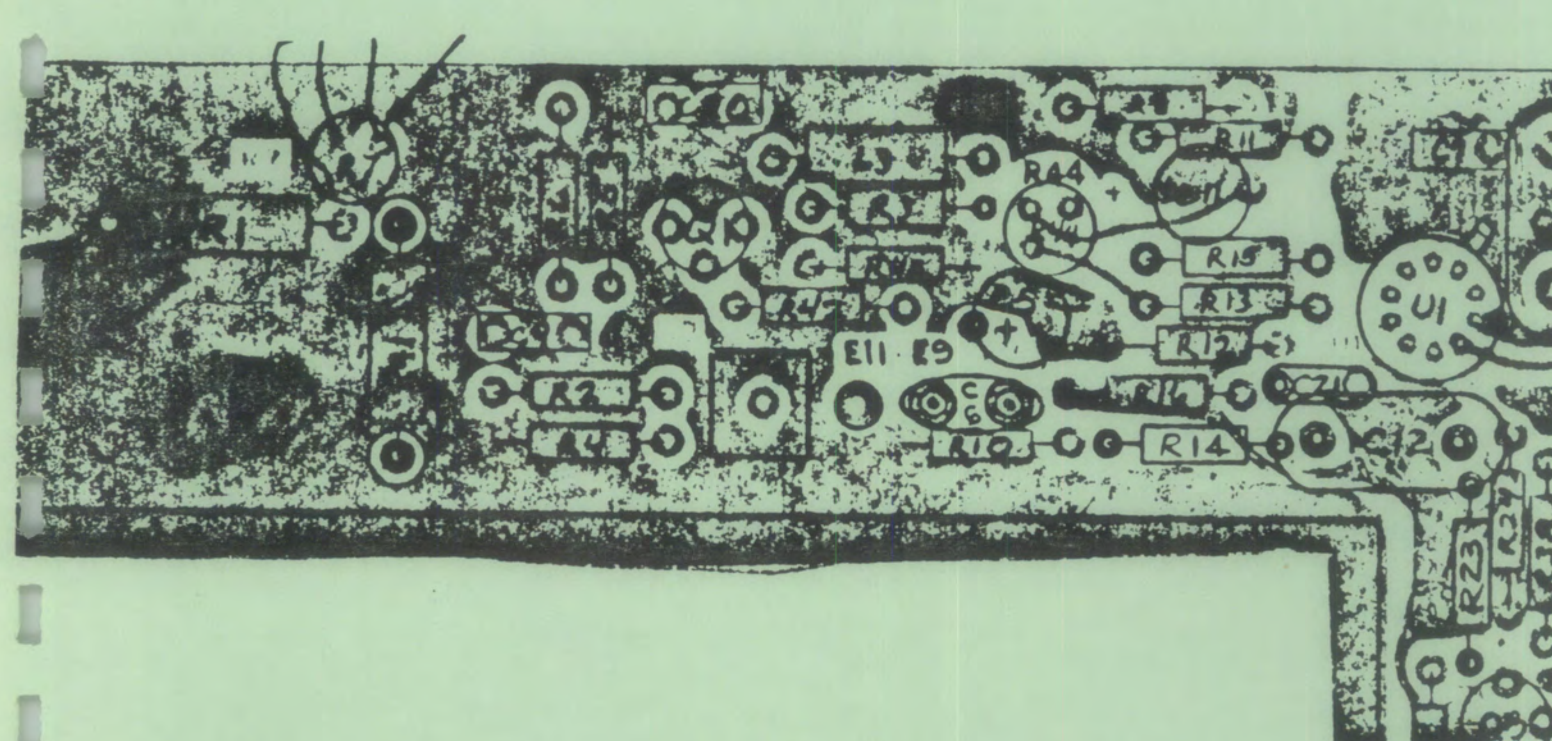
4.13 Figure 5-23, Page 5-50: Type 34544-3, -4 IF Demodulator (A7-A12) A8, Location of Components

4.13.1 Change the location of components diagram (as illustrated below) to reflect the schematic changes described in paragraph 5.8 on page 13 of this addendum. Changes are as follows:

Remove C2, C3, C13, and L1.

Relocate R41 and C12.

Allow additional space for C5 and add + sign.



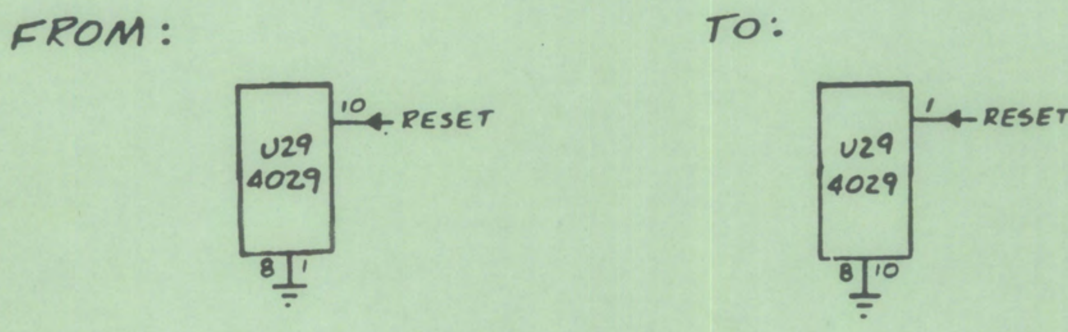
5.0 SECTION VI, SCHEMATIC DIAGRAMS

5.1 Figure 6-2; Page 6-5: Type 791548 Distribution Amplifier (A2)

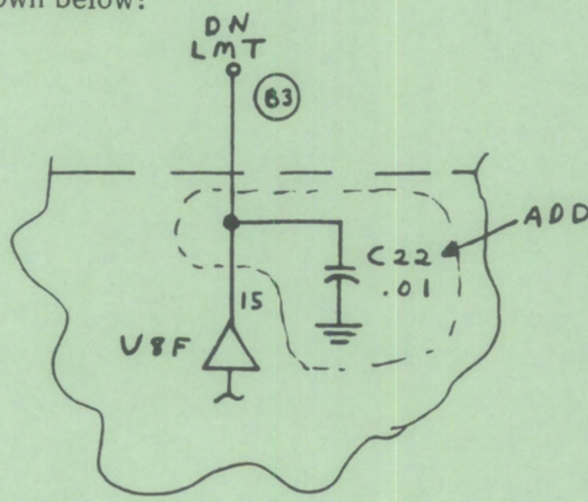
5.1.1 Change the value of R31 from 10 Ω, 1/4 W to 10 Ω, 1/2 W.

5.2 Figure 6-6, Page 6-13: Type 796023 Digital Control Unit # 1B

5.2.1 Reverse pins 1 and 10 of U29, as shown below:



5.2.2 Add C22, as shown below:



5.3 Figure 6-8, Page 6-17: Type 24557 1st LO Counter (A7-A12) A1

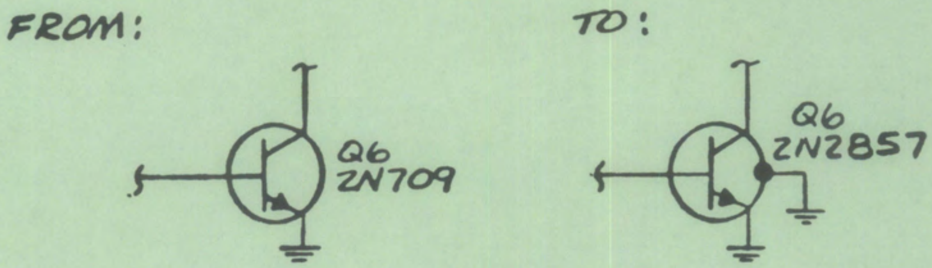
5.3.1 Change the type number of U1 from MC4044 to 11C44DC.

5.4 Figure 6-9, Page 6-19: Type 24563 1st LO VCO (A7-A12) A2

5.4.1 Change the value of R21 from 560 Ω to 1.2 kΩ.

5.4.2 Change the type number of Q6 from 2N709 to 2N2857 and add fourth lead, as shown:

Courtesy of http://BlackRadios.terryo.org



5.5 Figure 6-10, Page 6-21: Type 34531 2nd LO Counter (A7-A12) A13

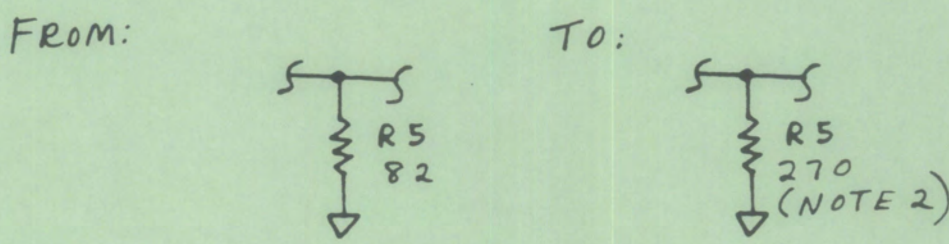
5.5.1 Change the type number of U4 from MC4044 to 11C44DC.

5.6 Figure 6-11, Page 6-23: Type 280039 2nd LO VCO (A7-A12) A4

5.6.1 Change the value of C14 from 2.7 pF to 3.3 pF, to agree with parts list.

5.7 Figure 6-12, Page 6-25: Type 24648 Input Converter (A7-A12) A5

5.7.1 Change R5, as shown:



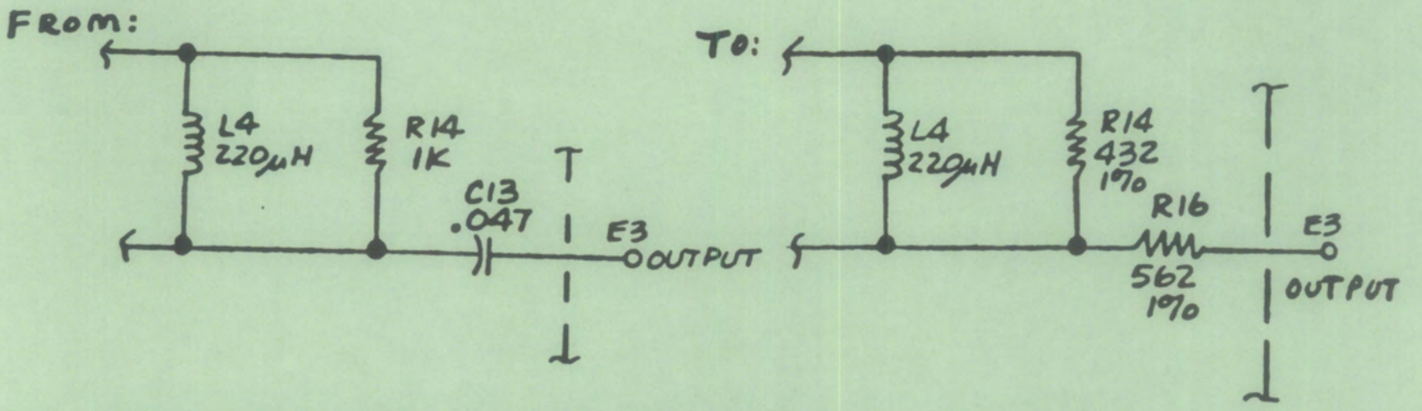
5.7.2 Add note 2 as follows:

2. FINAL VALUE FACTORY SELECT

5.8 Figure 6-14, Page 6-29: Type 24649 2nd Converter (A7-A12) A7

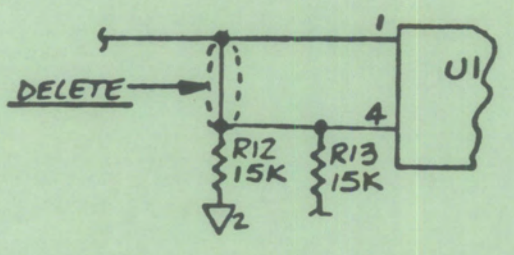
5.8.1 Change the value of R14 from 1 kΩ, 5% to 432 Ω, 1%.

5.8.2 Delete C13 and add R16, as shown:



5.9 Figure 6-15, Page 6-31: Type 34544-3, -4 IF Demodulator (A7-A12) A8

5.9.1 Delete line from R12 to pin 1 of U1, as shown:



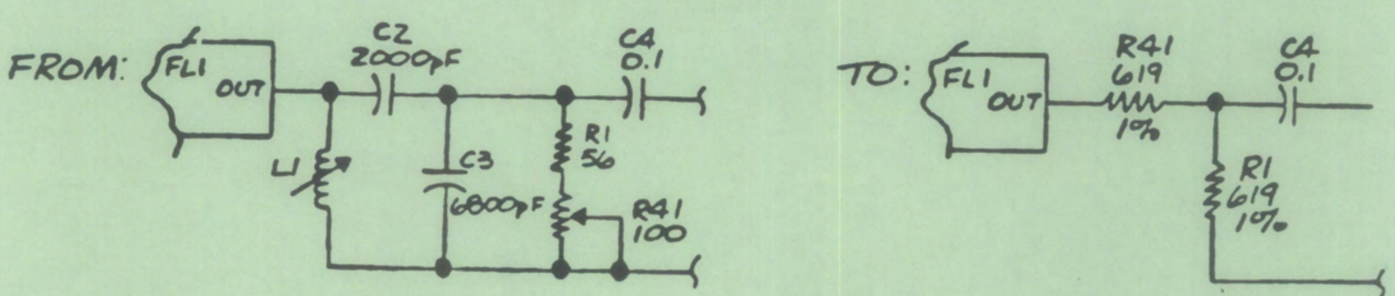
5.9.2 Change the value of C5 from 0.1 µF to 18 µF.

5.9.3 Change the schematic, as shown below, to reflect the following changes:

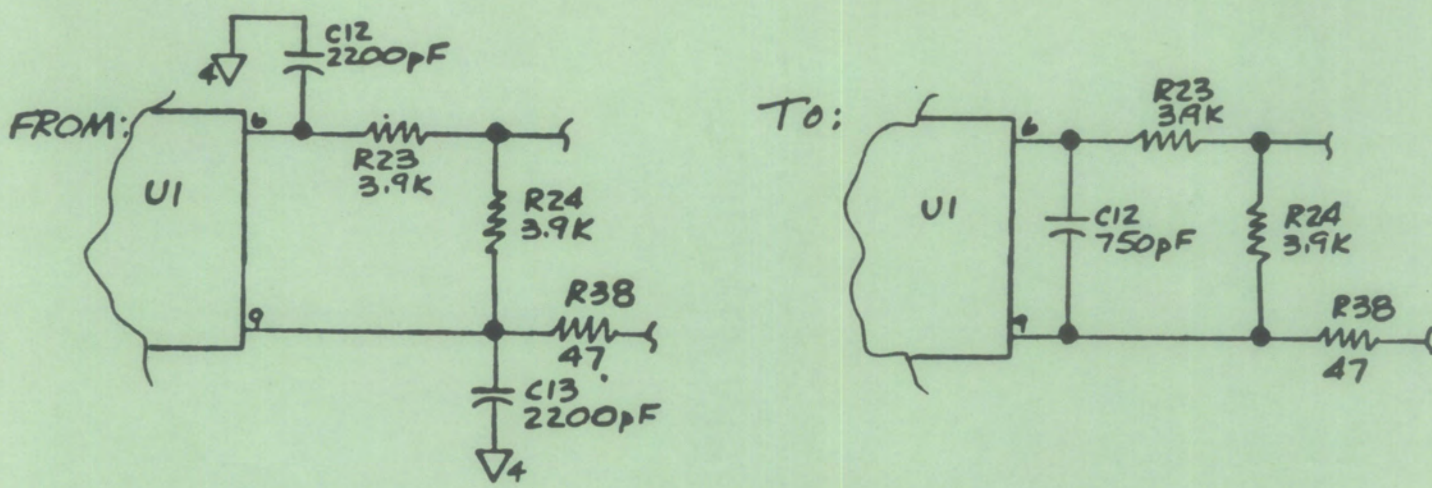
Remove L1, C2, and C3.

Change the value of R1.

Change the value and location of R41.



5.9.4 Delete C13 and change C12, as shown:



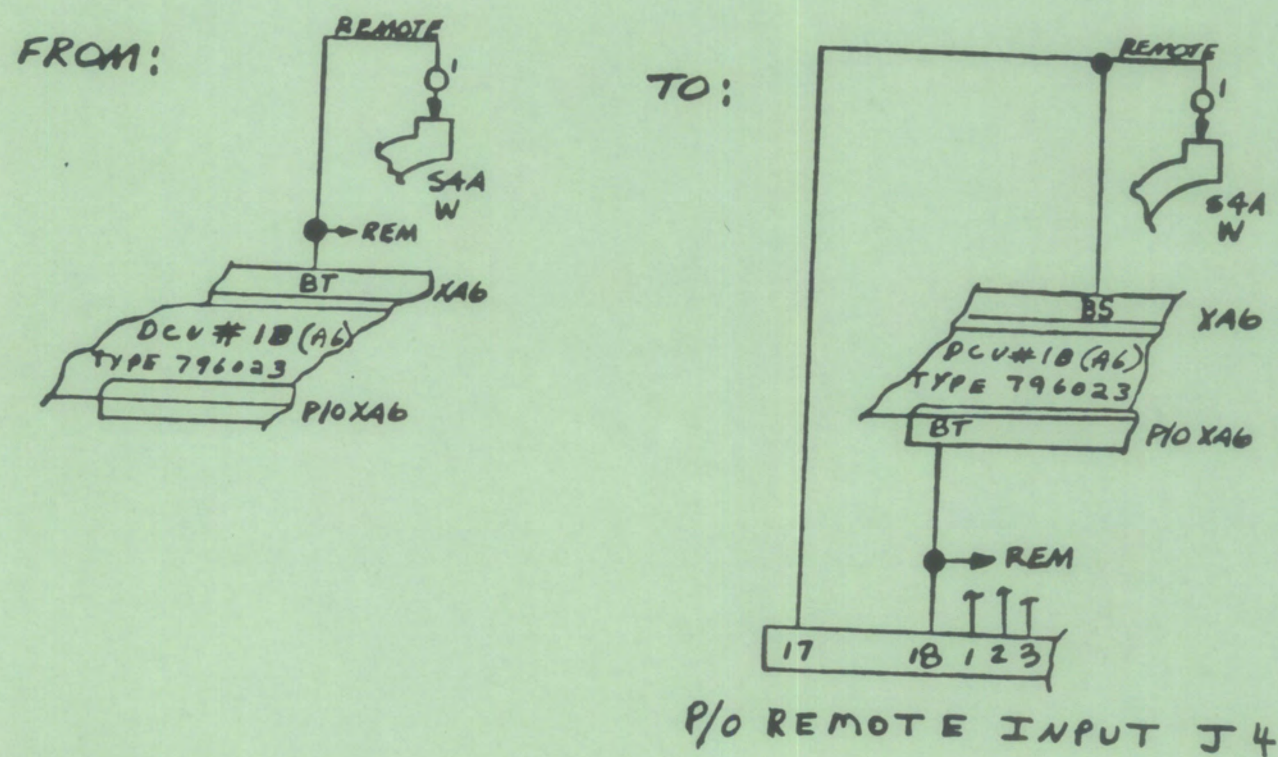
5.9.5 Change the value of C14 from 3900 pF to 1000 pF.

5.9.6 Change the value of C15 from 1500 pF to 1000 pF.

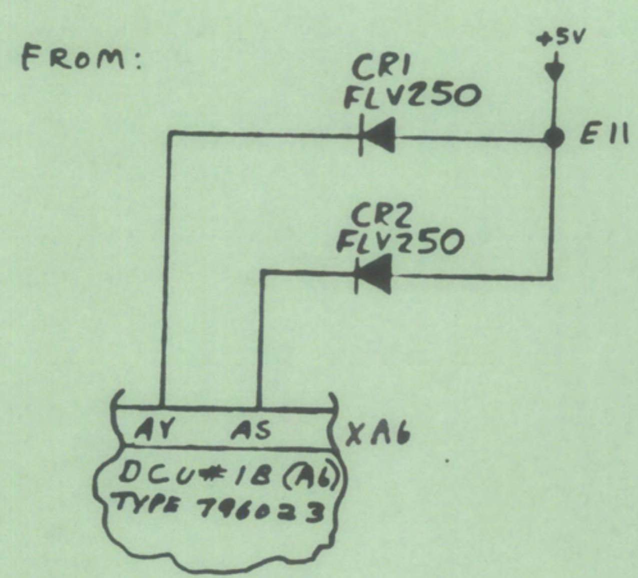
5.9.7 Change the type number of Q1 from 2N2857 to 2N3478.

5.10 Figure 6-17, Page 6-35: WJ-9518/9518E FDM Demodulator

5.10.1 Change Remote Input (J4) connections, as shown:



5.10.2 Change CR1 and CR2, as shown:



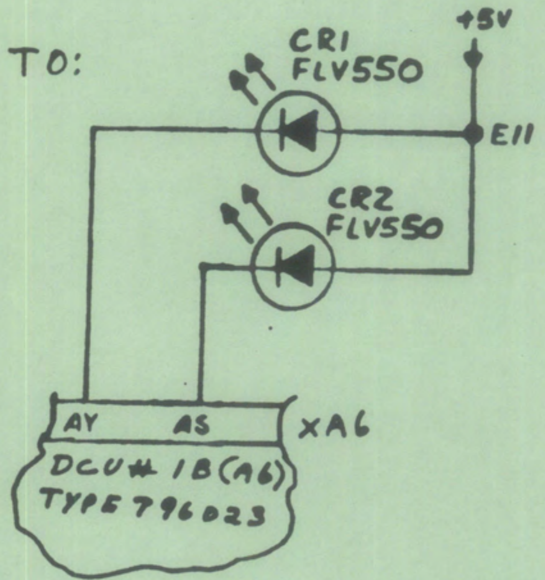


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Figure 1-1. WJ-9518/9518E FDM Demodulator

SECTION I

GENERAL DESCRIPTION

1.1 ELECTRICAL CHARACTERISTICS

The WJ-9518/9518E FDM Demodulator is designed to process signals in the baseband frequency range of 200 Hz to 15 MHz. The unit contains six single sideband demodulator channels, independently tunable across the baseband with an output frequency response of 300 to 3500 Hz. Each of the six channels can be individually tuned via the front panel controls or remotely tuned via the input lines accessible on the rear panel. The unit can be remotely controlled by a PDP-11 computer using a DR11-C interface or equivalent. Additional WJ-9518/9518E units can be parallel connected through an internal baseband buffer amplifier to increase the number of channels as may be required. Remote or local control of the unit is selectable by use of a front panel switch. A channel select switch enables the operator to access any one of the six channels to the front panel display for monitoring, or in local control mode, for tuning the channel. The five-digit LED display indicates the tuned frequency of the channel selected. The readout is in megahertz to a 1 kHz resolution. Two front panel controls provide for upper or lower sideband selection and channel tuning. Channels can be tuned up or down the frequency range in 1 kHz or 4 kHz steps at a variable tuning rate that enables the entire frequency range to be covered in approximately 15 seconds. A phone jack is provided to allow for monitoring the audio output of the selected channel at an output level of 10 mW, 600 ohms.

Phase-lock-loop frequency synthesizers determine the tuned frequency to a resolution of 1 kHz. The frequency to which each of the six channels is tuned, in either the Upper Sideband (USB) or Lower Sideband (LSB), is stored in a Random Access Memory (RAM). The RAM is powered by a battery supply that secures the RAM data in the event of a power failure or when the unit is turned off. In the remote mode, channel tuning data are read into the RAM independently of the Demodulator Select (channel) Switch. The channel select switch is used for monitoring purposes in the remote mode. In the local mode, the data that are read into the RAM are also displayed by the five-digit LED display.

The WJ-9518/9518E is powered by three regulated supplies of +5 Vdc, +15 Vdc, and -15 Vdc. The unit can be used with either a 115 or 220 Vac power source selected by a switch at the back panel. All input and output connections, with the exception of the headphone jack, are made at the rear panel. The baseband input signal is connected through a BNC connector as is the baseband output to additional units. The channel outputs are connected through a multipin bayonet connector. An external reference frequency connection is provided via a BNC connector. A switch next to the connector is used to activate the reference frequency source from internal to external. Two fuse holders are also positioned on the rear panel.

1.2 MECHANICAL CHARACTERISTICS

The WJ-9518/9518E FDM Demodulator mounts in a standard 19-inch equipment rack, uses 5.25 inches of vertical space and extends 21 inches into the rack. Refer to Figures 1-1, 5-5, and 5-6 for views of the demodulator. Critical dimensions appear in Figure 1-2.

All operating controls and indicators are located on the front panel. All input and output connections, with the exception of the phone jack, are made at the rear panel.

The top and bottom covers, right and left side panels, and the main chassis are constructed of aluminum. The demodulator/synthesizer subassemblies are housed in aluminum boxes to allow for easy removal and troubleshooting. The front panel is overlaid with black, with etched main function markings.

Loosening the quarter-turn slotted fasteners around the top and bottom cover permits easy access to the modules and interconnect wiring as well as those circuit boards mounted to the main chassis.

1.3 EQUIPMENT SUPPLIED

The equipment supplied consists of the WJ-9518/9518E FDM Demodulator and a detachable line cord.

1.4 EQUIPMENT REQUIRED BUT NOT SUPPLIED

If the WJ-9518/9518E is to be used in the remote operating mode, a PDP-11 computer and a DR11-C parallel interface (or equivalents) are required. A 600 ohm headphone is required for monitoring.

Table 1-1. Type WJ-9518/9518E FDM Demodulator, Specifications

Number of Inputs	One
Input Range	200 Hz to 15 MHz
Input Impedance	75 ohms, unbalanced
Input Level	-25 dBm,nominal, single tone
Mode	SSB upright or inverted
Output Frequency Response	300 to 3500 Hz, minimum, at -3 dB
Adjacent Channel Rejection	45 dB, minimum
Crosstalk Between Demodulators	Minimum of 60 dB
Residual Noise	Minimum of 60 dB below nominal output
Noise Power Ratio	44 dB, minimum, with input noise level of -7 dBm and noise BW of 2.5 MHz
Harmonic Distortion of Output and Spurious Outputs	50 dB, minimum, below nominal output (Distortion measured at 1 kHz)
Tuning Control	1 kHz or 4 kHz per step, local via front panel, or remote in 1 kHz increments
Frequency Readout	LED, 1 kHz resolution
Output Level	1 Vrms ± 10% into 600 ohms, nominal
Output Impedance	600 ohms, balanced
Headphone Output Level	10 mW, minimum, into 600 ohm load
Video Baseband Output:	
Level	-25 dBm into 75 ohms with -25 dBm at input
Frequency Response	200 Hz to 15 MHz
Impedance	75 ohms
Reference Frequency	1 MHz external, 2 MHz internal
Frequency Stability	± 2 Hz per day, after 15 minute warm-up (internal reference)
Frequency Accuracy	± 5 Hz per year (reference oscillator internally adjusted)
Group Delay at Output:+	
400 Hz to 3400 Hz	200 μsec, maximum
300 Hz to 400 Hz and 3400 Hz to 3500 Hz	500 μsec, maximum
200 Hz to 300 Hz and 3500 Hz to 3600 Hz	1000 μsec,maximum
Operating Temperature Range*	0°C to 50°C
Input Power	115/220 Vac, ±10%, 50 to 400 Hz
Power Consumption	70 watts, approximately
Dimensions	5.25 inches high, 19 inches wide, and 21 inches deep
Weight	50 lbs., approximately (22.7 kilograms)

+ Group Delay on WJ-9518E only.
* Operation within published specification guaranteed at 25°C ± 5°C.

NOTE: The WJ-9518E is identical to the WJ-9518 with the exception that filters (A7-A12) A8FL1 are of a different type. See the parts list in Section V.

SECTION II

INSTALLATION AND OPERATION

2.1 UNPACKING AND INSPECTION

Examine the shipping carton for damage before the equipment is unpacked. If the carton has been damaged, try to have the carrier's agent present when the equipment is unpacked. If not, retain the shipping cartons and padding material for the carrier's inspection if damage to the equipment is evident.

See that the equipment is complete as listed on the packing slip. Contact Watkins-Johnson Company, Gaithersburg, Maryland, or your Watkins-Johnson representative with details of any shortage.

The unit was thoroughly inspected and factory adjusted for optimum performance prior to shipment. It is, therefore, ready for use upon receipt. After uncrating and checking contents against the packing slip, visually inspect all exterior surfaces for dents and scratches. If external damage is visible, remove the protective cover and inspect the internal components for apparent damage. At this point, check the internal cables for loose connections. Check plug-in items such as printed wiring boards, which may have been loosened from their receptacles.

2.2 INSTALLATION

2.2.1 REAR PANEL CONNECTIONS

The rear panel connections are listed below with a brief description. References should be made to Figure 5-2 and the main chassis schematic diagram Figure 6-17.

1. AC Source Voltage Selector - The voltage selector switch position must match the line source voltage, 115 or 220 Vac.

2. Baseband Input J3 - The baseband signal in the frequency range of 200 Hz to 15 MHz is fed at this multipin connector. The input impedance is 75 ohms, unbalanced, with a nominal single tone input level of -25 dBm.

3. Baseband Output J2 - The baseband signal is coupled to the baseband output connector through an internal buffer amplifier. The output impedance at the BNC connector is 75 ohms nominal. The baseband output signal can be fed to additional units if more than six channels are required.

4. Remote Control In J4 - Interface is made with a DR11-C and PDP-11 computer (or equivalent) through the multipin connector. The two 16-bit words of control data are inserted at this connector in a 16-bit-parallel, word-serial format.

5. Remote Control Out J5 - A buffered parallel output of the external control input is made through this connector for interfacing with additional six channel units.

6. Audio Output J6 - The audio output from each channel is fed through a multipin connector. The output level is 1 Vrms ± 10% into 600 ohms. The output impedance is 600 ohms.

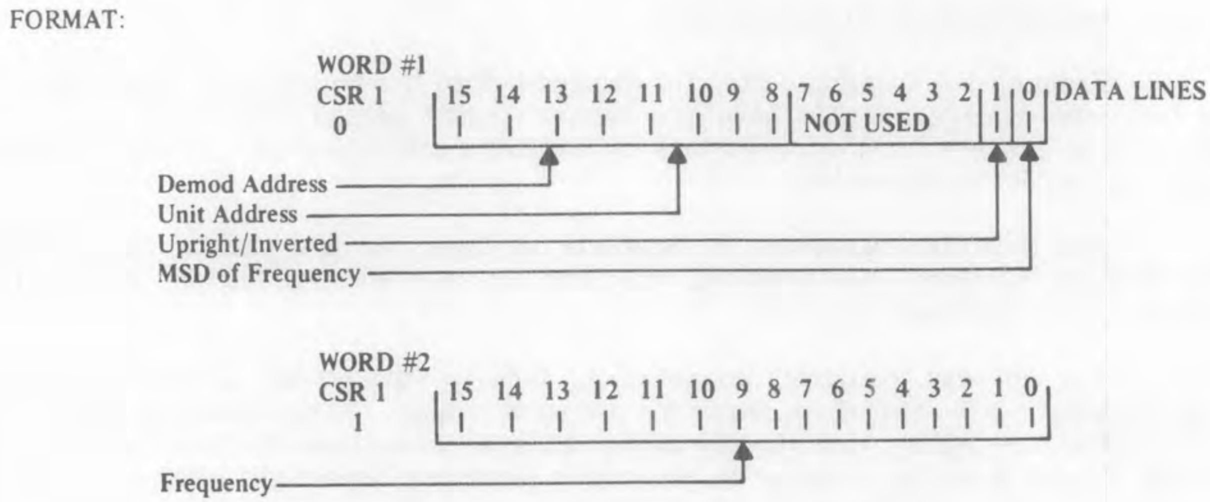


Figure 2-1. Remote Control Data Words.

7. External Reference J8 - The BNC connector accepts an external 1 MHz reference frequency source at a level of 6 dBm, minimum, 50 ohms.

8. External/Internal Switch S1 - This switch selects either the internal 2 MHz reference frequency or an external 1 MHz reference frequency connected to J8.

2.3 OPERATION

The front panel controls are listed below with a brief description of the function of each control. Reference should be made to Figure 5-1.

1. Toggle ON/OFF Power Switch S1 - This switch powers up the equipment or cuts the power.

2. Demodulator Control - This switch selects either the remote or local control condition. In the remote mode, the unit is capable of receiving tuning data from a PDP-11 computer through a DR11-C interface. The tuning data are contained in two 16-bit words (see Figure 2-1). The first word contains the unit address, demodulator (or channel) address, the upper or lower sideband, and the most significant digit of the tuned frequency. The second word contains the other four digits of the tuned frequency. The level of the CSR-1 bit controls the input of the first and then the second word. An internal dip switch A3S1 sets the unit address. The data are read directly into the RAM

for any one of the six channels independently of the Demodulator Select Switch setting and the display. The Demodulator Select Switch and the frequency display serve as channel frequency monitors when the unit is in the remote mode. In the local mode, channels are selected and tuned through the front panel controls.

3. Demodulator Select - This switch selects the channel to be controlled when the unit is in the local condition, or to be monitored when the unit is in the remote condition. The tuned frequency is indicated on the five-digit display.

4. Upright and Inverted Mode Buttons - The Upright button selects the upper sideband (USB). The Inverted button selects the lower sideband (LSB). This information is written into the RAM in the local mode. The buttons are not functional in the remote mode.

5. Upright and Inverted Indicator LED's CR1 and CR2 - These indicator lights display the sideband selected or stored in the RAM for the channel being tuned or monitored.

6. Megahertz Display - The five-digit LED display indicates the tuned frequency of the channel selected, to a 1 kHz resolution.

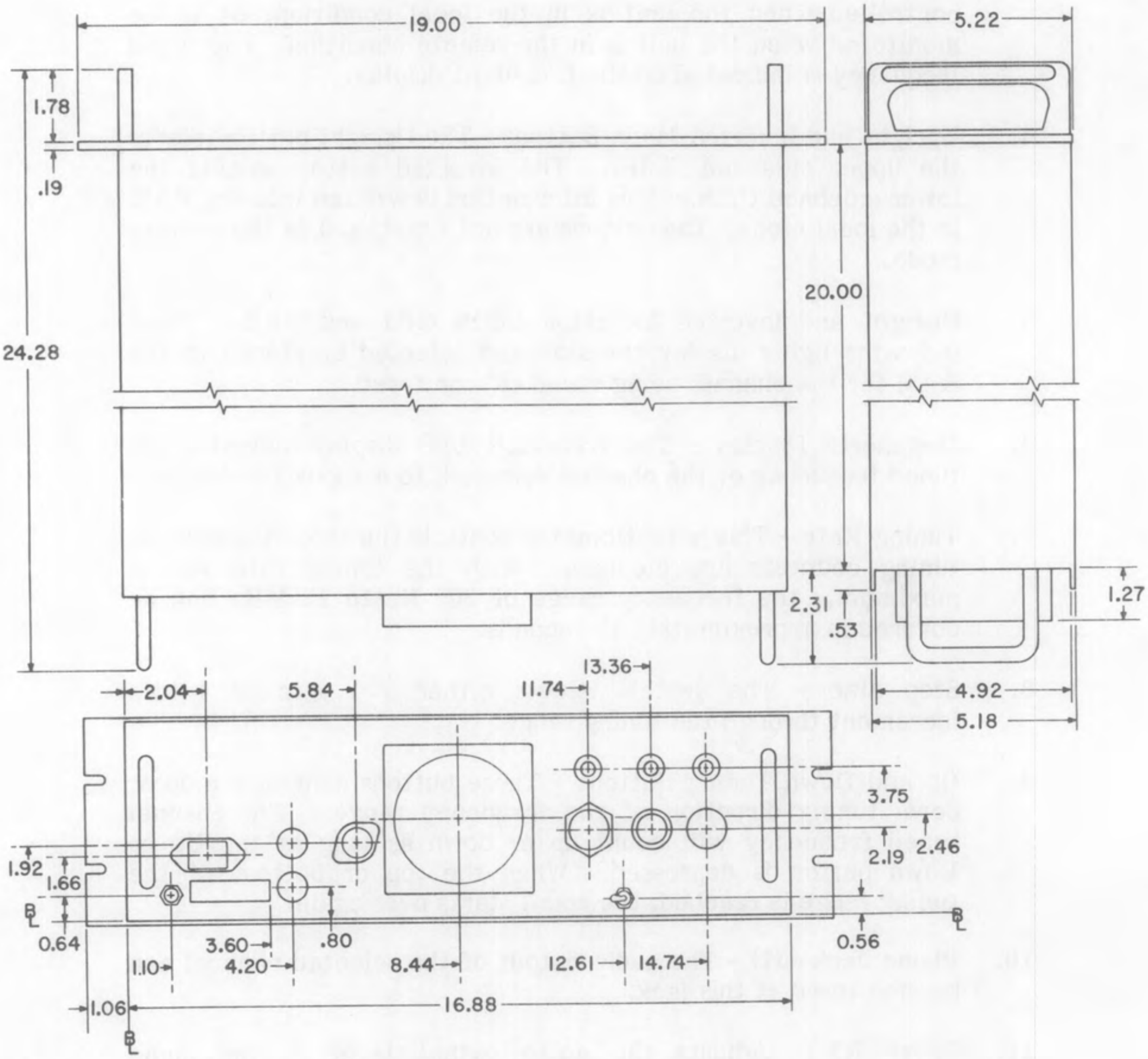
7. Tuning Rate - This potentiometer controls the rate at which the tuning counters are clocked. With the tuning rate set at maximum, the frequency range of 200 Hz to 15 MHz can be covered in approximately 15 seconds.

8. Step Size - The switch selects either a 1 kHz or 4 kHz increment through the tuning range.

9. Up and Down Tuning Buttons - These buttons control the up or down tuning direction of the frequency range. The channel tuned frequency will count up or down as long as the Up or Down button is depressed. When the top or bottom of the tuning range is reached, the count starts over again.

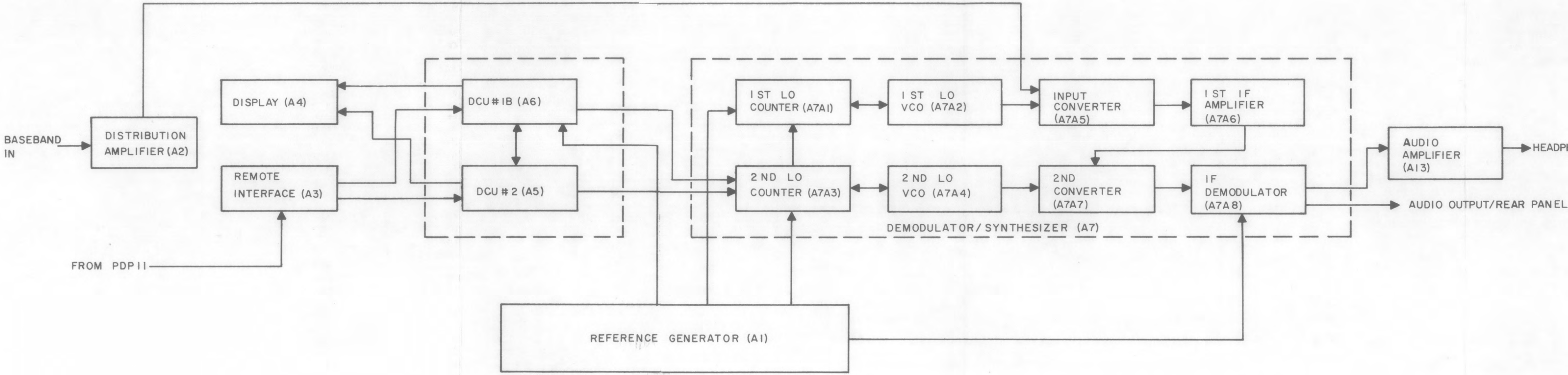
10. Phone Jack (J7) - The audio output of the selected channel can be monitored at this jack.

11. Level R2 - Adjusts the audio output level to the audio monitoring equipment. The output level is 10 mW minimum at 600 ohms for a maximum level setting.



NOTE:
1. DIMENSIONS ARE IN INCHES.

Figure 2-2. WJ-9518/9518E FDM Demodulator, Critical Dimensions



NOTE: SINGLE DEMODULATOR CHANNEL SHOWN: A7 THRU A12 ARE SIX IDENTICAL CHANNELS.

Figure 3-1. Overall Block Diagram

SECTION III
CIRCUIT DESCRIPTION

3.1 GENERAL

The following paragraphs describe the various circuits of the WJ-9518/9518E FDM Demodulator. Schematic descriptions are preceded by an overall functional block diagram description. The block diagram descriptions are written in a functional order, whereas the schematic descriptions are arranged in order of the reference designation.

In this WJ-9518/9518E FDM Demodulator, the unit numbering system is used for identification of electrical components. Each circuit board or assembly part carries a prefix before the usual class letter and item number. For example, the full designation for R1 on the circuit board A9 is A9R1. Prefixes are omitted on illustrations and in the text, except when necessary to avoid confusion.

3.2 FUNCTIONAL DESCRIPTION

The WJ-9518/9518E FDM Demodulator is designed to process signals in the baseband frequency range of 200 Hz to 15 MHz. The unit contains six SSB demodulator channels independently tunable across the baseband with an output frequency response of 300 to 3500 Hz. The functional operation of the unit is divided into six main sections: Distribution Amplifier, Demodulator/Synthesizer, Digital Control, Reference Generator, Headphone Amplifier, and Power Supply. The overall block diagram, Figure 3-1, shows the relationship of all the boards in each section. The following paragraphs will describe the functional operation.

3.2.1 DISTRIBUTION AMPLIFIER

This assembly consists of a level adjustment potentiometer, a common gate amplifier, an amplitude compensation network, and seven emitter followers. The entered signal of 200 to 15 MHz at 75 ohms is amplified by a grounded gate FET used for its low noise figure and large signal handling ability. To set the operating point of the FET, a constant current source and its associated circuitry are used. The signal is distributed to seven direct coupled emitter followers. Six of the resulting seven outputs are processed. The seventh output is sent to a rear panel connector for cascading purposes.

3.2.2 DEMODULATOR/SYNTHESIZER

There are six of these assemblies, one for each of the six channels. Each assembly has eight printed circuit boards. The functions of the Demodulator/Synthesizers are divided into tuning (synthesizer) and signal path (demodulator). The tuning section contains the 1st LO Counter, 1st LO VCO, 2nd LO Counter, and 2nd LO VCO. The signal path section contains the Input Converter, 1st IF Amplifier, 2nd Converter, and IF Demodulator boards.

3.2.2.1 Demodulator Section

This section receives the signal from the Distribution Amplifier and mixes the signal with VCO outputs from the Synthesizer section to produce an audio output.

3.2.2.1.1 Input Converter - In this assembly the 1st intermediate frequency is produced. The signal reaches the mixer through an attenuation pad, a seven-pole elliptic filter, and an impedance matching pad. After 5 dB attenuation, the filter removes any frequencies above 17 MHz from the signal. The 1st LO signal, at 0 dBm in the frequency range from 21.4 to 36.3 MHz, is amplified by a buffer with a compensating network to keep the amplitude response flat. After mixing these two signals, an IF of 21.3 to 21.4 MHz results. Bandpass filtering and transformer coupling remove any unwanted spurious frequencies from the IF signal before it is amplified by the next stage.

3.2.2.1.2 1st IF Amplifier - The signal now passes through a filter with a center frequency of 21.350 MHz and a nominal 1 dB bandwidth of 100 kHz. Frequencies above 25.4 MHz are attenuated 55 dB. An amplifier with equal 50 ohms input and output impedances amplifies the signal with a gain of 15 dB.

3.2.2.1.3 2nd Converter - The 21.3 to 21.4 MHz IF signal goes through a second mixing stage in the 2nd Converter. Frequencies for lower sideband operation in the range of 19.301 to 19.400 MHz and upper sideband operation in the range of 23.300 to 23.399 MHz from the 2nd LO VCO are buffered, transformer coupled, and attenuated 3 dB. The mixing of the USB or LSB frequencies with the 1st IF produces a difference frequency of 2.000 to 2.004 MHz. A three-pole low pass filter prevents any 2nd LO leak-through from affecting the linearity of the grounded gate FET amplifier which next amplifies the signal with a voltage gain of approximately 15 dB.

3.2.2.1.4 IF Demodulator - This assembly provides the final mixing, and outputs an audio signal. Before mixing, the 2nd IF is processed by an output bandwidth determining filter, a transformer impedance matching network, and a common emitter amplifier with a channel gain set potentiometer. The 3rd LO VCO input is a 100 mV p-p square wave, at 2.000 MHz, from the reference generator. This signal is mixed with the IF signal and an audio signal results. Active filtering removes LO harmonic and image frequencies.

Two audio outputs are available from the IF Demodulator board. One output at 600 ohms impedance goes to the headphone amplifier; the other is transformer coupled to 600 ohms impedance and is available at the unit's rear panel connection.

3.2.2.2 Synthesizer Section

The 1st and 2nd LO Counters and VCO subassemblies contained in this section receive the channel frequency tuning data from the Digital Control section and provide signals for the converters in the demodulator section.

3.2.2.2.1 1st LO Counter - This subassembly receives 9 bits of tuning data in parallel from the storage registers on the 2nd LO Counter subassembly. These 9 bits consist of 1 bit for the 10 MHz digit and 4 bits each for the units MHz and hundreds kHz digits. The most significant 4 bits (10 MHz and 2^3, 2^2, 2^1 bits from the units MHz) are applied to a decimal-to-binary translator to produce a 3-bit range word which is used to drive the range switching circuits on the 1st LO VCO. All 9 bits are applied directly to the programmable counter which forms part of the phase lock loop controlling the VCO.

Other components of the phase lock loop are the divide-by-2 prescaler, the counter control logic, the phase/frequency detector, the loop filter, and the VCO proper.

3.2.2.2.2 1st LO VCO - The heart of this assembly is a Colpitts-type oscillator with inductance varied by the octal coded frequency range data from the 1st LO Counter. Stability is obtained by three separate voltage regulators contained on this board. Frequency accuracy is maintained by a phase lock loop containing the VCO. The output that is sent to the demodulator section is buffered for amplitude compensation. A sine wave to TTL converter stage outputs the VCO frequency to the 1st LO Counter for comparison with a reference frequency by the phase detector.

3.2.2.2.3 2nd LO Counter - This assembly receives data, clock, and enable pulses from the Digital Control section. The channel frequency data is serially input to a shift register network that parallel outputs this data to the 1st LO Counter. The functional operation of this counter is similar to the 1st LO Counter. 2nd LO Counter circuitry and the 2nd VCO form a phase lock loop.

3.2.2.2.4 2nd LO VCO - The Colpitts-type, common gate FET oscillator circuitry on this board outputs a sine wave in the USB frequency range of 233 to 233.99 MHz or LSB range of 193.01 to 194 MHz. Range is determined by a high (LSB) or low (USB) level on the base of a common emitter switching transistor, whose collector current is used to control a PIN diode switch used to add (or remove) circuit capacitance causing the required frequency shift in the oscillator. Filter and voltage regulator circuitry contribute to the stability and linearity of the VCO output. This output is divided by 10 and a signal in the frequency range of 19.301 to 19.400 MHz or 23.300 to 23.399 MHz is sent to the demodulator section.

3.2.3 DIGITAL CONTROL

The two Digital Control Boards, DCU #1B and DCU #2, function interdependently to monitor all the conditions of the control switches and, in an automatic sequence of events, activate the logic circuitry necessary to meet the requirements of all these conditions. Together with the Remote Interface and Display boards they perform the digital control functions.

3.2.3.1 Remote Interface

Remote control by a PDP-11 Computer with a DR11-C parallel interface is possible through this assembly. Circuitry consists of data input lines and associated circuitry for insertion of channel address, sideband modes, and channel frequency into the Random Access Memory integrated circuit on DCU #2.

3.2.3.2 Display

This board contains decoder/driver and seven-segment LED display integrated circuits. The Demodulator Select control selects the channel being controlled when the unit is in LOCAL or monitored when the unit is in REMOTE operating mode. This information is processed through DCU #2 to the Display board. An enabling pulse from DCU #1B causes the drivers to put out a decimal coded pulse that causes the proper segments to illuminate and a 5-digit readout results.

3.2.4 REFERENCE GENERATOR

The function of this assembly is to provide four separate square wave pulses to be used as reference frequencies by the digital control clock (1 MHz), the 1st LO Counter (50 kHz), the 2nd LO Counter (10 kHz), and the IF Demodulator (2 MHz). A switch on the unit's rear panel chooses either an external or internal reference. Choice of either switch position activates the Reference Generator circuitry. Full wave doubler action and filtering precede multiplexer circuitry that outputs a 2 MHz square wave. Frequency dividing logic circuitry acts upon this square wave to produce the needed frequency outputs.

3.2.5 HEADPHONE AMPLIFIER

The audio output of the final demodulating stage is amplified prior to reaching the headphone. A potentiometer controls the level of the amplifier input. The integrated circuit amplifier is used in a balanced configuration with feedback to control gain.

3.2.6 POWER SUPPLY

The power supply operates from a line voltage of 115 or 220 Vac. Transformer coupling steps down the voltage levels. Three separate voltages are diode rectified, then filtered and regulated to provide dc outputs of +5 V, +15 V, and -15 V.

+5 V powers the two DCU boards, Remote Interface, Display, Reference Generator, 1st and 2nd LO Counters, and the 2nd LO VCO.

+15 V powers the 1st LO VCO, 2nd LO VCO, Input Converter, 2nd Converter, 1st IF Amplifier, Headphone Amplifier, and the IF Demodulator.

-15 V powers the Distribution Amplifier, 1st LO VCO, 2nd LO VCO, Headphone Amplifier, and the IF Demodulator.

3.3 DETAILED CIRCUIT DESCRIPTION

These descriptions appear in the order of their reference designation prefixes. The applicable schematic diagram for each description is referred to as is required. These circuit descriptions discuss each assembly and circuit board as being separate and distinct from the demodulator itself. Refer to the main chassis schematic, Figure 6-17, to correlate the various circuits. Figure 3-1 is the overall functional block diagram.

3.3.1 TYPE 791540 REFERENCE GENERATOR (A1)

Figure 6-1 is the schematic diagram for this assembly. Figure 3-2 is the simplified block diagram. There are two reference sources: 2 MHz (internal) and 1 MHz (external). The external reference has an input impedance of 50 ohms with a recommended drive of +7 dBm. Reference selection is made via a switch on the back panel. The switch is placed in the position desired and the appropriate circuitry is activated by a positive 5 volt potential. The undesired circuit is grounded or placed at a 0 volt potential.

The external 1 MHz reference signal is doubled by a full-wave frequency doubler made up of T1, R1, R2, R3, CR1, and CR2. CR1 and CR2 are Schottky diodes. Damping resistors R2 and R3 are in series with the two diodes to assure strong doubling action and equal division of current through CR1 and CR2.

Q1 is a common emitter amplifier stage used to provide filtering. L1 and C7 form a tuned tank that resonates at 2 MHz. The output of this stage is a 3 V peak-to-peak sine wave with a frequency of 2 MHz.

The 2 MHz internal reference signal is provided by crystal oscillator U4. The oscillator provides a frequency stability of $\pm 10^{-6}$ for the synthesizers, with $\pm$ 18 Hz the worst possible case of inaccuracy.

TTL gates U3A, U3B, and U3D form a switch selection network. U3C is enabled only with a "low" on either input. This occurs only when both inputs to either U3B or U3D are "high". Selection of the Internal switch position connects +5 volts to crystal oscillator U4 and 0 volts to the doubler and amplifier circuitry. Thus, both inputs to U3D are high and the internal 2 MHz reference is gated to U3C pin 8. Selection of the External switch position connects +5 volts to the doubler and amplifier circuitry and 0 volts to the oscillator. Q1 is activated and U3 pin 5 goes "high". U3C is activated and the doubled external reference frequency is gated to U3C pin 8.

The output of U3C is a 2 MHz square wave which is acted upon by various logic circuits to become the clock pulse for the Digital Control Unit (DCU) and the reference frequencies for the 1st and 2nd LO Counters and the IF Demodulator. Capacitors C10 through C17 provide a driving current of 150 ma for the TTL logic units used.

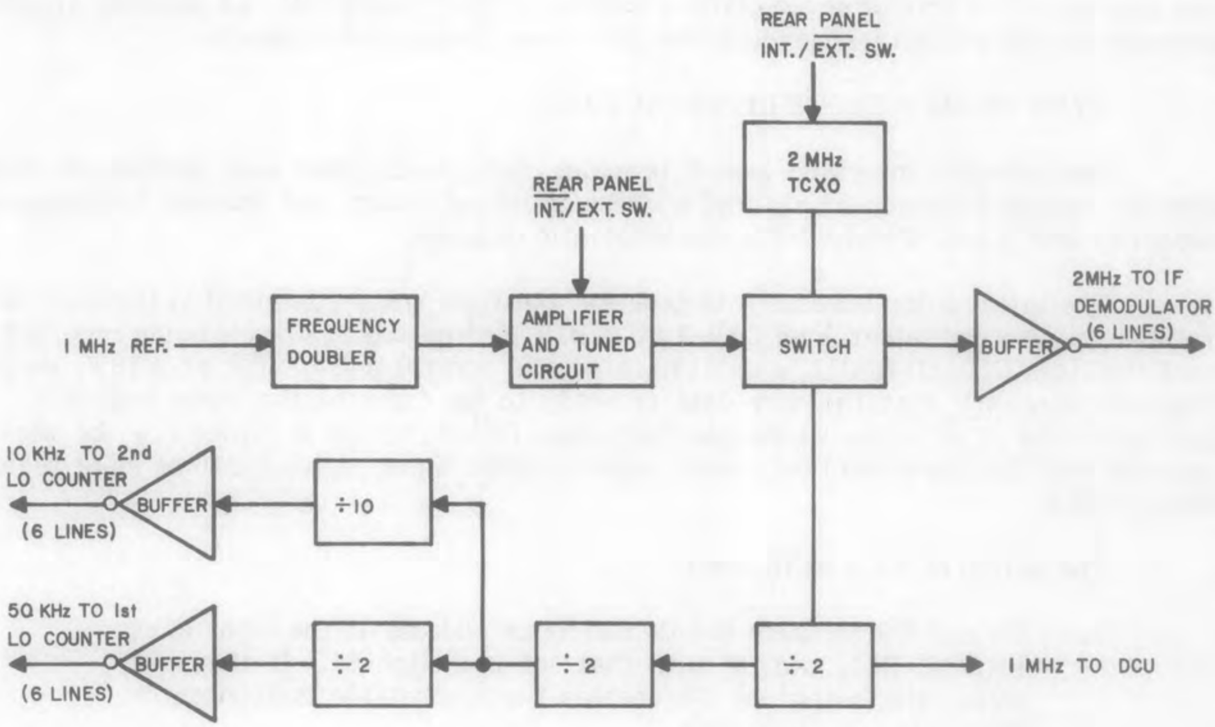


Figure 3-2. Simplified Block Diagram, Reference Generator

U6A and U6B are flip-flops which provide divide-by-2 action. U7 and U8 are decade counters whose outputs are one-tenth their input frequencies. Units 5A through 5F, Units 9A through 9F, and Units 10A through 10F are buffer amplifiers contained in three separate 74LS04 units. The totem-pole outputs of these three units provide the reference frequencies for the 1st and 2nd LO Counters, and the IF Demodulator.

The 2 MHz outputs of buffers U5A through U5F become the virtual carrier reference signals for the IF Demodulators. Resistors R12 through R23 form resistive networks which assure an impedance of approximately 50 ohms at each output and provide a voltage division to 100 mV p-p.

U6A alone acts upon the 2 MHz signal to produce the 1 MHz clock pulse for the DCU.

Successive division by U6A, U7, and U6B provide a total division by 40 to produce a 50 kHz frequency to be used as the reference frequency by the 1st LO Counters.

Successive division by U6A, U7, and U8 provide a total division by 200 to produce a 10 kHz frequency to be used as the reference frequency by the 2nd LO Counters.

3.3.2 TYPE 791548 DISTRIBUTION AMPLIFIER (A2)

Figure 6-2 is the schematic diagram for this assembly. This board has one input (J5) at 75 ohms and seven outputs (J1, J2, J3, J4, J6, J7, and J8) at 75 ohms. Power is derived from a -15 V source. A signal of 200 Hz to 15 MHz is applied to J5. Nominal input single tone level is -25 dBm. Q1 is a constant current source supplying approximately 25 ma to Q2, a common gate amplifier driving seven emitter followers (Q3 through Q9). L1 provides amplitude compensation for Q2 at high frequencies, and R2 is used for gain adjustments.

3.3.3 TYPE 791543 REMOTE INTERFACE (A3)

The remote interface board provides data input lines and associated control circuitry for remote insertion of channel address, sideband mode, and channel frequency into the respective unit RAM. Figure 6-3 is the schematic diagram.

The information necessary to program the WJ-9518 is contained in two data words (see Table 3-1). A word select level CSR-1 at A3B19 controls which word is being received into the input registers U10, U11, U12, and U13. A second control pulse, $\overline{NDR}$ at A3BW, instructs the interface circuitry that the new data is ready to be fed into the input registers. The combination of the $\overline{NDR}$ pulse, which goes high, and CSR-1, which is either low for the first data word or high for the second data word, selects either input register U10 or input registers U11 through U13.

The action of A3 is as follows:

1. U8 and U9 compare the Demodulator address on the input lines BR, BE, B11, and BF with that set in switch S1. If they are equal, the output of U8 enables the monostable multivibrator (U5A) clock through U6A.

2. U5A is triggered by the "low" to "high" transition of $\overline{NDR}$ (not Data Ready) input line when CSR-1 input is in the low state.

3. When the above two conditions are satisfied, data on line B13, B14, B18, BL, and BM are clocked into register U10. The data lines contain the specific Demodulator address (B13, B14, and B18), Upright/Invert (BM), and the 10's-of-MHz bit (BL).

4. Additionally, when the remote control pin, A19, is grounded, (by the front panel local/remote switch) the output of U6B sets flip-flop U7A, enabling the second-word clock of monostable multivibrator U5B.

5. After the $\overline{NDR}$ line has been returned to the "low" state, the data lines B11 through B15, B18, BE, BF, BH, BJ through BN, BP, and BR are changed by the computer and CSR-1 is set to the "high" state, completing the enabling functions for U5B.

6. U5B is triggered by the "low" to "high" transition of the input $\overline{NDR}$ line, which clocks the 16 bits of BCD data into registers U11, U12, and U13 and also resets U7A by clocking a low state into the flip-flop, allowing further receipt of a first word.

Table 3-1. PDP-11 (DR11-C) Interface For WJ-9518

REMOTE CONTROL INPUT OR OUTPUT CONNECTOR PIN NO.	COMPUTER WORD BIT DESIGNATION	FUNCTION WORD #1 CSR-1=0	FUNCTION WORD #2 CSR-1=1
1	b0 (LSB)	MSD OF FREQ. (10MHz DIGIT)	LSD OF FREQUENCY kHz
2	b1	INVERTED/ UPRIGHT	
3	b2	NOT USED	
4	b3		
5	b4		NEXT LSD OF FREQUENCY 10kHz
6	b5		
7	b6		
8	b7		
9	b8	UNIT ADDRESS	100kHz DIGIT
10	b9		
11	b10		
12	b11		
13	b12		MHz DIGIT
14	b13	DEMOD ADDRESS	
15	b14		
16	b15 (MSB)		
35	$\overline{NDR}$ (STROBE)		
36	CSR-1	0	

3.3.4 TYPE 791541 DISPLAY (A4)

Figure 6-4 is the schematic diagram for the display board. U6 through U10 are BCD-to-Seven Segment Decoders. Each decoder circuit provides the functions of a 4-bit storage latch and an 8421 BCD-to-seven segment decoder, and has an output drive capability. The display strobe at E18 enables the decoders and the BCD number appearing at the A, B, C, and D inputs is stored. The decoder converts the number to a seven-bit equivalent and places the information on its a through g outputs.

U1 through U5 are common cathode seven-segment high efficiency LED displays. Pins 2, 3, 4, 5, 8, 9, and 10 are internally connected to the anodes of seven LED's. A high level from the decoder forward biases a diode and its associated display segment illuminates. R1 through R35 are current limiting resistors.

3.3.5 DIGITAL CONTROL UNIT: INTRODUCTION

The digital control circuitry is contained on two boards which function interdependently as shown by Figure 3-3. This circuitry accepts and carries out the commands given by the front panel controls. The paragraphs that follow will first outline the circuitry contained on each board. Then the overall functions will be described incorporating the functions of both boards into one Digital Control Unit.

3.3.5.1 Type 791539 Digital Control Unit #2 (A5)

Figure 6-5 is the schematic diagram for the circuit descriptions that follow:

1. U3 is a digital demultiplexer used to select the clock line to the individual demodulator, thus enabling data transfer to the selected demodulator channels.

2. The demodulator address is selected by U5 and held (for at least one control cycle) by U4. This 3-bit address is applied to U3 and to the most significant address bits of U21.

3. U21 is a 256 x 1-bit Random Access Memory with a battery back-up supply for retention of data on power down. Data for demodulater control are arranged as 8 (6 used) 32-bit words and are stored bit-by-bit during each control cycle. The Demodulator Unit address, as selected by U5 and held by U4, is used as the 3 most significent bits of the address.

4. Address Generator U22 is a CMOS counter/divider chip whose function is to increment the RAM address for each bit. It is reset at the end of each control cycle and starts the addressing over again at the appropriate time during the DCU cycle.

5. Serial-input/parallel-output shift registers U23, U24, and U25 receive the serial output information from the RAM. Their parallel output is sent to the display board (A3) and to the up/down counters on this board (A5).

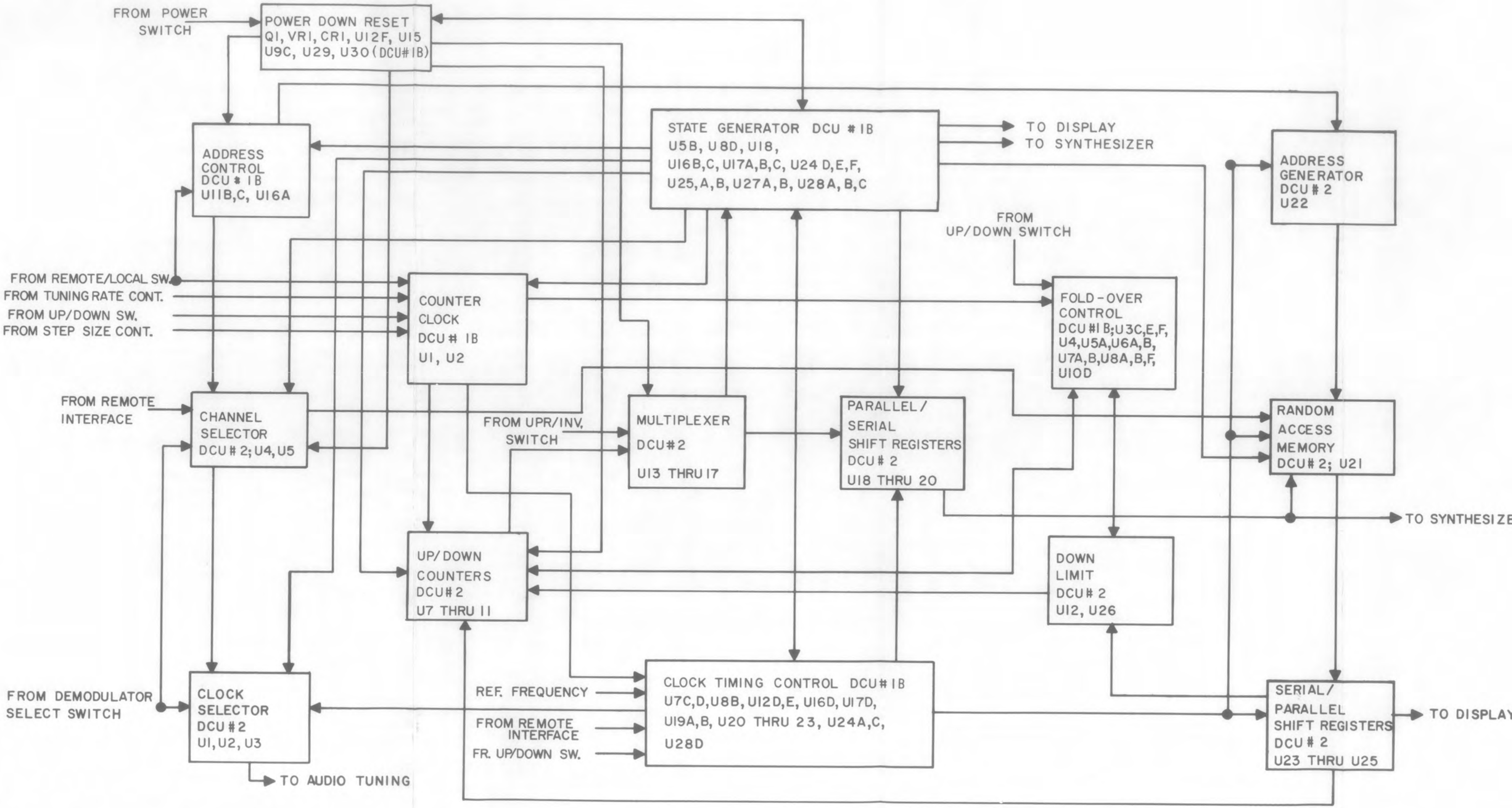


Figure 3-3. Functional Block Diagram, DCU#1 and DCU#2.

6. The up/down counters are U7, U8, U9, U10, and U11. They increment or decrement as dictated by the switch on the front panel.

7. U13, U14, U15, U16, and U17 form a multiplexer unit. They choose either the Local or Remote channel selected data, which are processed through their two channel data selecting action to the proper shift register input lines.

8. U18, U19, and U20 are parallel-load/serial-output shift registers.

3.3.5.2 Type 796023 Digital Control Unit #1 B (A6)

Refer to Figure 6-6, the schematic diagram for the circuit descriptions that follow:

1. Transistor Q1 with associated circuit components, R14, R18, R19, R20, CR1, C21, VR1, U12F, and U15D, E, and F, form a power-down reset network. When power is turned on, this circuitry outputs a reset pulse that starts the State 0 cycle. The reset pulse also causes programmable counter U29 to count from 6 to 0, resetting the addresses in the channel select section of DCU #2 through switch U30. In the event that power is lost during the course of the State Generator operating sequence, U29 and U30 provide assurance that the addresses will be reset to zero when power is restored.

2. U18 is a BCD-to-decimal converter whose output determines the order of the operating cycle of the entire DCU. U18 and its associated circuitry form the State Generator. These states will be fully explained in paragraph 3.3.5.3. Working with U18 are the following logic circuits: OR gates U5B, U16B, C, and D; Set/Reset flip-flops U17A, U17B, and U17C; D flip-flops U25A, U25B, U26A, U26B, and U27A; AND gates U28A, B, and C; Inverting buffers U12E, U24A, D, E, and F; Non-inverting buffer U8D.

3. The clock timing section of this board contains divider chips U19A, U19B, and U20, rate multiplier chips U21 and U22, time delay chip U23, and their associated gates.

4. U1 is a timer and U2 is a rate multiplier chip. These two units provide the clock to the tuning counter chain A5U7-11.

5. D flip-flop U6A and U6B, with their associated gates form a fold over control section that aids in forming the paths for information flow between the two DCU boards.

6. Set/Reset flip-flops U9A, B, C, and D and Data flip-flops U13A and B, with appropriate inverters, OR, and NOR gates (U10A and B, U11A, U12, and U14) accept the control panel decisions for Up or Down tuning, Local or Remote channel selection, and

Upright or Inverted mode. These decisions are then gated to the appropriate lines for execution.

3.3.5.3 State Generator Sequence and DCU Functions

The primary functions of the DCU can be described in two sections. First of all, the circuit action that follows activation of the Toggle ON/OFF Power Switch S1. Activating this switch causes the DCU circuitry to follow automatically a series of steps referred to as "States". During this cycle all the combinations of control positions are monitored.

Because of the extended gating involved, the UP or DOWN tuning control circuitry will be discussed separately.

3.3.5.3.1 State 0

1. Power Switch ON.

2. 1 MHz clock is divided-by-10 by A6 U19B.

3. F-F A6 U17A, U17B, and U17C are all reset.

4. Binary input 000 at ABC (2^0, 2^1, 2^2) inputs of BCD to decimal converter A6 U18 is converted to decimal 0 out and pin 3 goes "high".

5. Q out of F-F A6 U25A is "low".

6. A6 Pin B10, LO MUX, goes "high" through A6 U10C. A5 U5 is enabled, address is selected from either Remote or Local depending on switch position.

7. A6 Pin B21, LATCH, goes "high" and the address is latched into F-F A5 U4.

8. LOCAL line goes "high" and enables A5 U17. Δ MUX line goes "high".

9. Δ MUX line "high" clears F-F A6 U27A, Q out is 0 and U17C is cleared.

10. Positive going transistion of clock pulse causes data on A6 U25A to be transferred to Q, Q goes "high" and sets A6 U17A.

11. A6 U17B does not change states. Binary number 001 enters U18, is converted to decimal 1 and pin 14 goes high. The State Generator advances to State 1.

3.3.5.3.2 State 1

1. Pin 5 of A6 U26A is "high" and will stay that way until INH OUT of A6 U22 goes "high" at the end of 19 pulses.

2. "High" on pin 14 of A6 U18 is ORed by U16D, inverted by U24A and puts "low" on INH/CLR lines of A6 U21 and U22. U21 and

U22 are rate multipliers wired to count 19 pulses. Ø1 and $\overline{\text{Ø1}}$ are the output and inverted outputs of these counters.

3. A6 U23 delays Ø1 5 μsec for outputs Ø2 and $\overline{\text{Ø2}}$. This delay gives the RAM and the SHIFT registers time to process new data.

4. $\overline{\text{Ø1}}$ counts address generator A5 U22 through 19 pulses.

5. Ø2 instructs RAM A5 U21 to READ between each address count. RAM is set up so that the address cannot be changed while it is in the process of shifting through the 19 pulses.

6. $\overline{\text{Ø2}}$ clocks serial/parallel shift registers A5 U23, U24, and U25 whose outputs are sent to the A4 display drivers and to up/down counters A5 U7, U8, U9, U10, and U11.

7. At the end of 19 pulses INH OUT of A6 U22 goes "high", clocks A6 U26A. "High" at D input is transferred to Q out.

8. DISPLAY STROBE line goes "high" and current RAM information is displayed.

9. P-LOAD-1 line goes "high" through U8D and up/down counters A5 U7, U8, U9, U10, and U11 transfer data to Q outputs.

10. Upright or Inverted Switch position sets or resets A6 U13A, resulting MSL or MSL line "highs" are applied to X inputs of A5 U17 and the LOCAL selected USB or LSB is displayed.

11. "High" out of A6 U26A sets F-F A6 U17B. Binary input to U18 is now 011 (2^2, 2^1, 2^0). Decimal 3, output pin 15, goes "high" and the State Generator is advanced to State 3.

3.3.5.3.3 State 3

1. This is the first state that can go into two sets of steps depending on whether LOCAL or REMOTE has been selected.

2. "High" out on A6 U18 pin 15 means U27A pin 5 is "high" and will stay that way until the next clock when State 3 is finished.

3. A6 U19B, U20, and U17D are all reset. Counters A6 U19B and U20 provide a total divide by 10240 of the 100 kHz reference frequency out of A6 U19A. Set/reset F-F A6 U17D puts out a 102.4 Hz positive pulse.

4. If neither UP/DOWN Tuning Switch is depressed, A6 U7D pin 12 is high when pin 13 first goes "high" at the beginning of the timed pulse. Δ LOCAL goes "high".

   (a) In LOCAL, Δ MUX goes "high" through A5 U17. A6 U27A is clocked, Q out goes "high" and sets

U17C. Binary input to A6 U18 is now 111, is converted to decimal 7 out, pin 4 goes "high" and the State Generator is advanced to State 7.

(b) In REMOTE, Δ MUX connects to Δ REM through A5 U17 and ΔMUX will not go "high" again until $\overline{\text{BUSY}}$ (Pin A19 of A6) goes "high" after receiving both words at the input registers in A3.

5. If either UP/DOWN switch is depressed, Δ MUX will not go "high" until after the 9th count of rate multiplier A6 U2. This rate multiplier clocks the UP/DOWN counters. It receives the tuning rate information through the timer A6 U1 from the front panel tuning potentiometer and the step size information from the Step Size Control. U2 changes states after every 10 pulses on pin 9. The ninth pulse is detected at "9" output just before U2 resets. The "high" on this output resets A6 U9A and U9B so that Q's out are "low", are inverted to "high", and "A" goes "high". "A" is "high" only during State 3.

6. If neither UP/DOWN Switch is depressed, A6 U11A pin 4 is "low", pin 6 stays "high" and up/down counters clock A6 U2 is inhibited so that up/down counters do not count.

7. If either UP/DOWN Switch is depressed, A6 U11A pin 4 is "high". In LOCAL, pin 5 is "high". Pin 3 is "high" during 102.4 State 3 pulses, therefore counters are clocked during this time by 1 or 4 counts. Then 9 count ends State 3 through A5 U17 and Δ MUX. In REMOTE A6 U2 is inhibited.

8. When UP Switch is depressed, "high" is on UP line and A5 U5, U8, U9, U10, and U11 counters count up. When DOWN Switch is depressed UP line is "low" and the counters count down.

9. Synchronizer A6 U27A is clocked, U17C is set, and BCD in to U18 is binary 7. The State Generator advances to State 7.

3.3.5.3.4 State 7

1. A6 U18 Pin 4, is "high".

2. "Highs" on data inputs to A6 U25A and U25B, enable OR gate U16A and ADR RST line goes "high", resetting Address Counter A5 U22.

3. If unit is in REMOTE, LATCH Line goes "high" through A5U4. Channel address is at A5 U3 and RAM U21.

4. U17A resets, binary number 110 is at ABC inputs to A6 U18, decimal 6 out, pin 7 goes "high" and the State Generator advances to State 6.

3.3.5.3.5 State 6

1. CLR/INH on A6 U21, U22 is pulled "low", Address Counter Clocks A6 U22 and U23 start counting 19 pulses. Ø1 line goes "high".

2. Ø1 line "high" clocks A5 U18, U19, and U20 and they begin serially clocking data into RAM A5 U21.

3. RESET pulse causes U29 to begin count down from 6 to 0. Switch U30 chooses the 2^2, 2^1, 2^0 digits from the address switch or the "all zeros" condition from U29 and sends this information to the Multiplexer circuitry on DCU #2.

4. $\overline{Ø1}$ sets Address Generator U22 and RAM is addressed for new data.

5. W/RE line goes "high" and Ø2 line goes "high" instructing RAM to write new data.

6. After 19 pulses A6 U22 INH OUT clocks A6 U26B and Q out goes "high". U17B and U17C are reset through U16C. U17A is reset through U16B. Binary input to U18 is 000, the State Generator is advanced to State 0 and the cycle begins again.

3.3.5.3.6 Down Limit Tuning

A6 U5A, U3, U6, and U10D process the signals necessary to cause the down count from 00.001 MHz to 0.000 MHz and then pass directly through the 19.999 MHz count to 14.999. The MSD of the displayed frequency consists of 1 bit and is the only output bit used from A5U17. This is also the LSD of this counter, therefore the output from U17 can only be 1 or 0. The next down count from 00000 would normally be 99999, but since the MSD 9 can only appear as a 1, the number will be 19999. This number is further modified by the DN LMT and PE4 signals from U6B and U10D, respectively. When the 0000 MHz count in the display is reached the 4 C OUT line goes "low". At this point in the sequence A6 U5A pins 2, 3, and 4 are all "low". Normally pin 2 or pin 4 will be "high"; therefore, when all the pins go "low" the D input of U6B goes "high" and the reset clock pulse transfers the "high" to the DN LMT line and the PE4 line. The DN LMT line at board pin B13 of DCU #2 shifts the B input of U12 to the Y outputs and the preset pins of U10. This shifts a BCD 4 to the preset which is latched into U10 by the PE4 pulse. A display of 14.999 MHz results.

3.3.5.3.7 Up Limit Tuning

When the up count reaches 14.999, the next pulse will cause 1, 2, and 3 C OUT lines to go low. Since U10 is at BCD 4, the 2 MSD-4 line will be high, and since U11 is BCD 1, the MSD line A6 U3 B11 will also be high. Therefore, pins 2, 3, 4, 5, 9, 10, 11, and 12 are all low. Pins 5 and 12 are at ground potential. At any other point in the counting sequence one of these lines is "high" and therefore the output of U4 will be "low". When all lines go "low" the output of U4 goes "high" for one clock pulse. The next clock pulse sets the Q output of U6A "high", the UP LOAD line goes "high" and resets A5, U10, and U11 from "1 and 4" to "0 and 0". During this clock pulse the other counters count from 999 to 000. The D F-F A6 U6A is reset on the next clock pulse through U7A and pins 2, 4, 9, 10, and 11 of A6. U4 goes "high" again causing U4 pin 13 to go "low".

3.3.6 TYPE 796024-1-2 DEMODULATOR/SYNTHESIZER (A7-A12)

Refer to Figure 6-7 for the schematic diagram for this assembly. Figure 3-4 is the overall block diagram. These are six Demodulator/Synthesizer assemblies, each containing eight subassembly units. The synthesizer section contains the 1st LO Counter, 2nd LO Counter, 1st LO VCO, and 2nd LO VCO. The demodulator section contains the Input Converter, 1st IF Amplifier, 2nd Converter, and IF Demodulator.

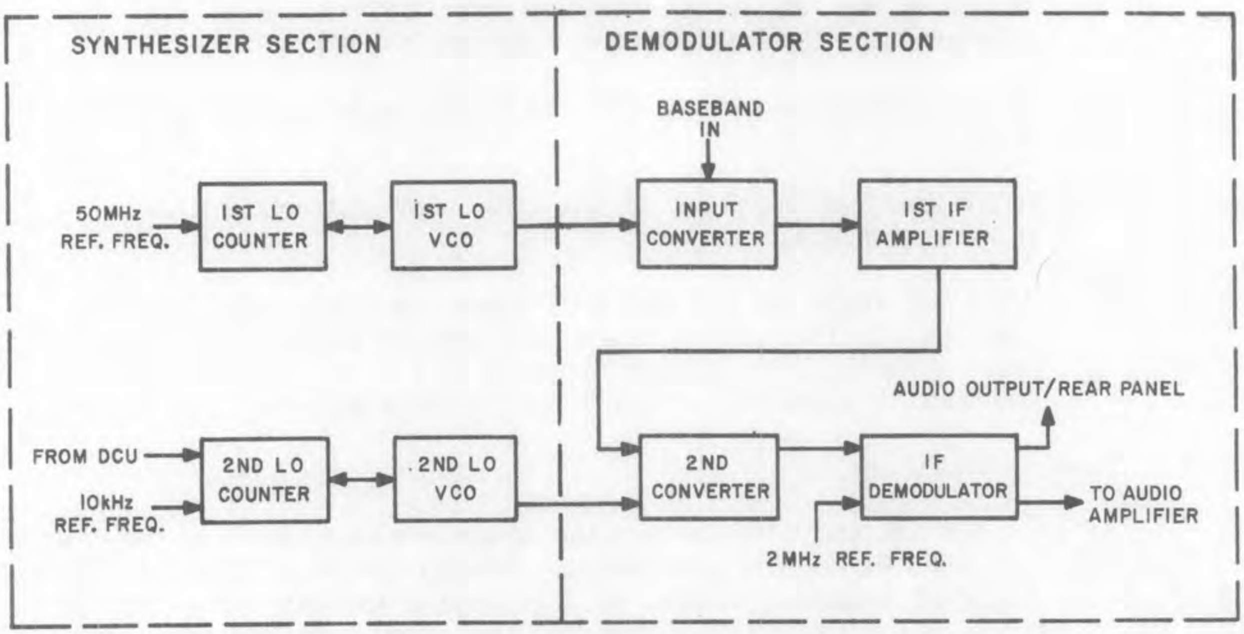


Figure 3-4. Overall Block Diagram, Demodulator/Synthesizer

The synthesizer section of this assembly contains two counters and two oscillator sub-assemblies. The circuits process the USB or LSB frequency ranges from the data supplied by the control units and present them to the converters to be mixed with the baseband signal input.

The 1st and 2nd LO Counters are powered by +5 volts. The Input Converter, 1st IF Amplifier, and 2nd Converter boards are powered by +15 volts. Both LO VCO's and the IF Demodulator board receive + and -15 volts.

The baseband signal, 0 to 15 MHz, enters the Demodulator section at J3. The Input Converter mixes this signal with the 21.4 to 36.3 MHz output of the 1st LO VCO to produce an IF frequency range of 21.3 to 21.4 MHz. The 1st IF Amplifier provides a 15 dB voltage gain for the IF signal. The 2nd LO VCO output is mixed with the signal in the 2nd Converter where upright conversion occurs. The 2nd Converter tunes in 1 kHz steps. The resulting USB, 2.000 to 2.004 MHz, bandwidth is converted to an audio output by the IF Demodulator.

3.3.6.1 Type 24557 1st LO Counter (A7-A12) A1

Figure 6-8 is the schematic diagram for this assembly. Figure 3-5 is the simplified block diagram. The function of the 1st LO Counter is to determine the frequency range in which the first Local Oscillator operates. Its circuitry is part of a phase lock loop shown in Figure 3-6.

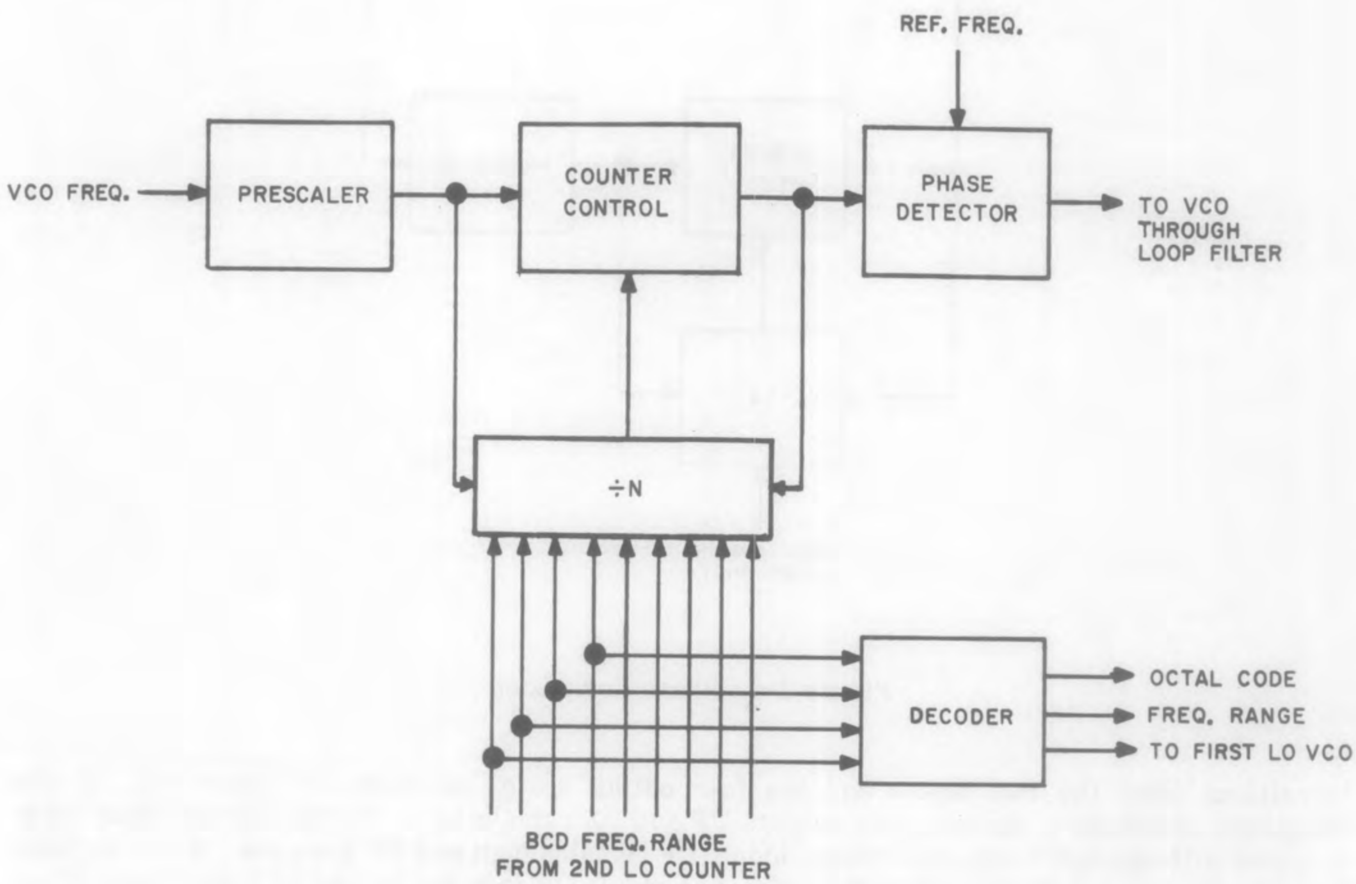


Figure 3-5. Simplified Block Diagram, 1st LO Counter

A pulse of 21.4 to 36.3 MHz (in 100 kHz steps) from the 1st LO enters the counter at E3. U3A is a flip-flop whose divide-by-2 action results in a lower frequency. Integration of this square wave pulse by U2 produces negative pulses with a period of 20 μ sec and a pulse width of 25-50 n sec of variation depending on the frequency. Phase detector U1 compares this pulse to a 50 kHz reference signal to produce an error signal which becomes a correction voltage for the 1st VCO. The phase detector is actually a phase and frequency detector. The IC includes a charge pump and an amplifier, which is not used in this application. Phase detector operation is as follows.

The phase detector receives a fixed reference frequency at input R and a variable frequency at input V from the divider section. The output responds only to negative-going

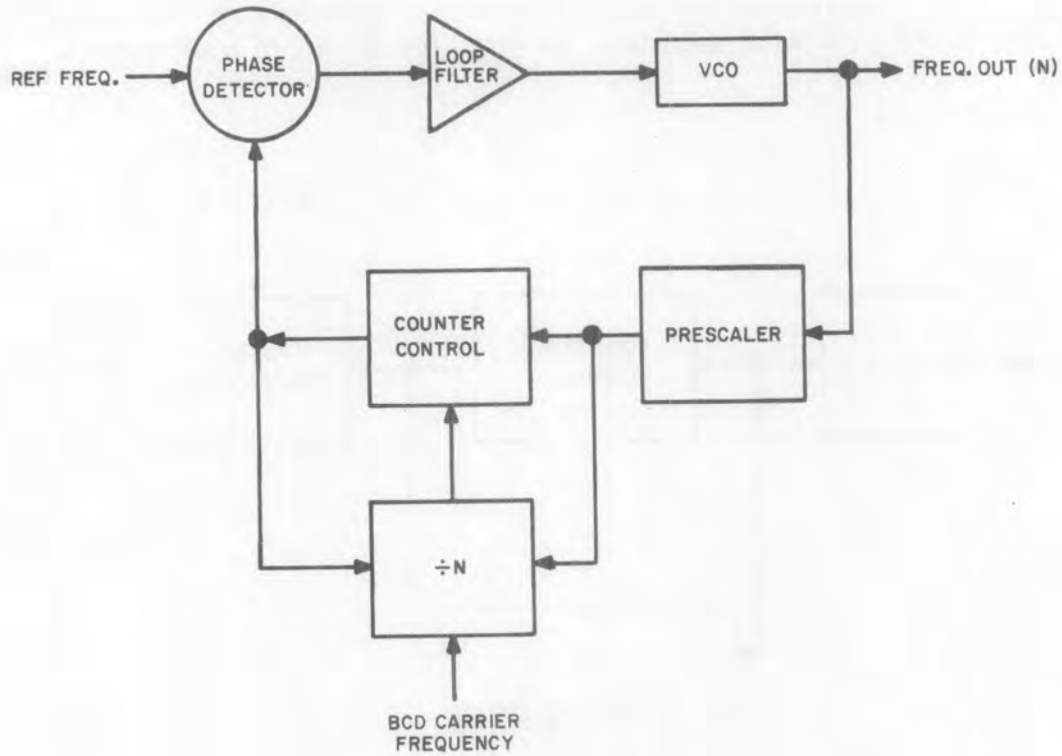


Figure 3-6. Phase Lock Loop

transitions from the two inputs and has four output states as shown in Figure 3-7. If the frequency and phase match exactly, outputs UF and DF remain high. If the variable input leads in phase with respect to the reference input, UF remains high and DF goes low. If the variable input lags in phase with respect to the reference input, DF remains high and UF goes low. When inputs R and V are separated by a frequency difference, the output at pins UF or DF varies high and low at a rate proportional to the difference in frequency of the two inputs.

Under lock conditions, when the input of both R and V are identical in phase and frequency, the output pulses from UF and DF will be extremely narrow and appear on an oscilloscope as spikes. For a large difference between the two input frequencies, as when a new BFO frequency is established, the outputs respond as described above with wide pulses appearing on the proper outputs.

The charge pump accepts both outputs from the phase detector and translates the voltage levels before they are applied to the loop filter. The input to pin 11 appears as an inverted output at pin 10. The input to pin 4 appears as an output at pin 5. There will be a pulsed waveform entering either pin 4 or pin 11 at any given time. When pin 11 is high, the charge pump produces an error signal that raises the VCO frequency; when pin 4 is high, the charge pump produces an error signal that lowers the VCO frequency. The charge pump delivers voltage commands from 2.25 volts on positive swings to 0.75 volts on negative swings, with a mean value of 1.5 volts.

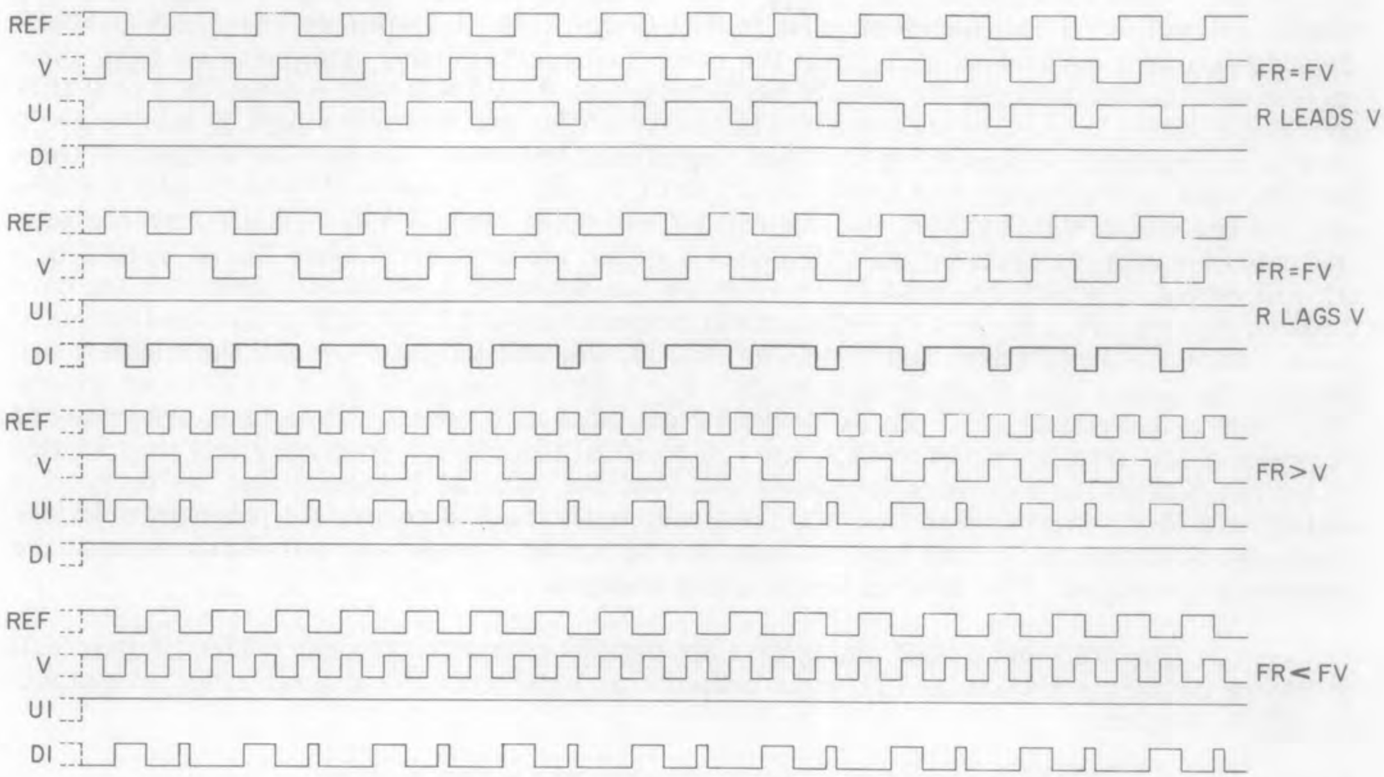


Figure 3-7. Phase Detector Timing Diagram

U5, U6, and U7 are programmable up/down BCD counters. Synchronous operation is provided by having all the flip-flops in the counter chips clocked simultaneously, so that the outputs change coincident with each other, when so instructed by the steering logic of the P and $\overline{P}$ inputs of U2. The U4 units form the synchronous clocking network. The counters U5, U6, and U7 in this application are used as down counter modulo 214 to 363 dividers by modifying the count length with the preset inputs.

For $\overline{F\ out}$ to go low, the P and $\overline{P}$ inputs of U2 must be at the following levels: $P_1 = 1$, $\overline{P}_0 = 0$, $\overline{P}_2 = 0$, $\overline{P}_3 = 0$. U7 detects an 8 at QA and QA and QD = 0 and 1, respectively. U6 detects an 8 at QA and QA and QD = 0 and 1, respectively. U5 detects a 9 at QD = 1. The total count is found by the expression 100 (C+2) + 10(B+1) + (A+2) +2, where A is preset for 3 MSD, B for 2 MSD, and C for MSD. For a tuned frequency of 14.4 xx MHz the number of counts = 358 or 35.8 MHz. 35.8 - 14.4 xx = 21.4 xx MHz IF. The P inputs $\overline{P}_2$, $\overline{P}_3$, $\overline{P}_0$, and P_1 detect a 0001, respectively, and $\overline{F\ out}$ goes low for one clock pulse. The code bits for the MSD and 2 MSD are also used to select one of 8 bands of tuning range in the 1st VCO.

The first three digits of the tuned frequency (i.e., the MSD, 2 MSD and 3 MSD) are fed to the data inputs of counters U5 and U6. The BCD data for the tuned frequency presets the counters to a number from which the counters down-count to zero. The M/M output then goes high for one clock pulse which is inverted through a NAND gate and enables the next counter. The 3 MSD presets half the LO frequency. U7 is a down counter with its data outputs

QA and A0 chosen to detect the "8" count. U7 will count down from its preset to zero at which time it will put out a positive clock pulse to NAND gate U4A. U7 will then count to 9 and back down to zero in a continuous cycle until the other two counters have counted down from their presets and U5 has detected a 9 and U6 has detected an 8. U5 will have a preset of 1 or 0 at A as it is the MSD. D and C of U5 are wired in zero condition and B is wired high so that binary 2 or 3 is determined by presetting the least significant bit only. U5 and U6 will count their presets, then cycle through 0 in a down count until U5 detects 9, since U6 and U7 clock pulses must be present at U4D to clock U5. U6 and U7 will be at zero. U5 and U6 will then continue this count through the cycle but U6 will detect 8 within the first cycle after U5 has detected 9; U7 will detect 8, within the next cycle after U6 has detected 8. When U7 detects 8 the data input on pins $\overline{P}_2$, $\overline{P}_3$, $\overline{P}_0$ and P_1 will be 0001 respectively and $\overline{F\ out}$ will go low on that clock pulse. When $\overline{F\ out}$ goes low, the "load line" on U5, U6, and U7 goes low and the counters are reset to the preset data on their data inputs. For a tuned frequency of 14.4 the count will be 358. That is 358 counts at U7 pin 14 for each $\overline{F\ out}$ pulse at U2 pin 9. If the tuned frequency of the channel has been increased to 14.4, the 358 count will result in a frequency less than 50 kHz at U2 pin 9, thus the reference frequency will lead the variable frequency and the correction voltage out of U1 will increase the VCO frequency until the 358 count rate produces a 50 kHz frequency at U2 pin 9. At this time the loop will be locked in phase and will remain so until the frequency is changed. That is when the preset is changed.

The MSD and 2 MSD tuning data are parallel connected through buffer U8 to a BCD to binary converter U9 whose TTL logic presents an octal coded frequency range at outputs E13, E14, and E15.

3.3.6.2 Type 24563 1st LO Voltage Controlled Oscillator (A7-A12) A2

The schematic diagram for this stage is Figure 6-9. Figure 3-8 is the simplified block diagram. The 1st LO VCO produces the frequency range that is mixed with the baseband signal in the Input Converter. Voltage regulators U1, U3, and U4 provide a regulated voltage of +10 volts for the Colpitts oscillator, -12 volts for the filter circuitry, and +12 volts for the buffer amplifier, respectively.

The values of the MSD and 2 MSD from the 1st LO Counter determine the frequency at which the 1st VCO operates. This frequency is in the range of 21.4 to 36.3 MHz. The binary number present at E6, E7, and E8 causes transistors Q1, Q2, or Q3 to conduct depending on which base lines are high. If, for example, Q1 and Q3 bases are high, both transistors turn on; CR1 and CR3 are forwarded biased and, as a result, L2 and L4 become part of the tuned circuit in the oscillator. Q2, on the other hand, is turned off and C7 charges up to put CR2 in a reverse bias condition blocking L3 from the tuned circuit. The resultant LO frequency will therefore be developed in the tuned circuit comprising the components L2, L3, L4, T1, CR4, C14 through C19, and the common gate FET Q4. C15 and C16 provide capacitive feedback to Q4. C18 provides for alignment adjustment to the oscillator. Varactor CR4 is the phase lock loop fine tuning component.

Q6 is a sine wave to TTL converter whose output at E2 is compared to a reference frequency by the phase detector in the 1st LO Counter to produce the proper correction voltage. The correction voltage is filtered through operational amplifier U2 which integrates the pulse outputs of the phase/frequency detector, producing an integrated voltage level at E9 that varies the reverse bias on CR4. The reference frequency is filtered from this voltage by a notch filter composed of C23, C24, C25, R24, and L7.

Q5 is a buffer amplifier which provides amplitude compensation. E1 is the voltage output from the collector of Q5 which becomes the 1st LO frequency to the Input Converter.

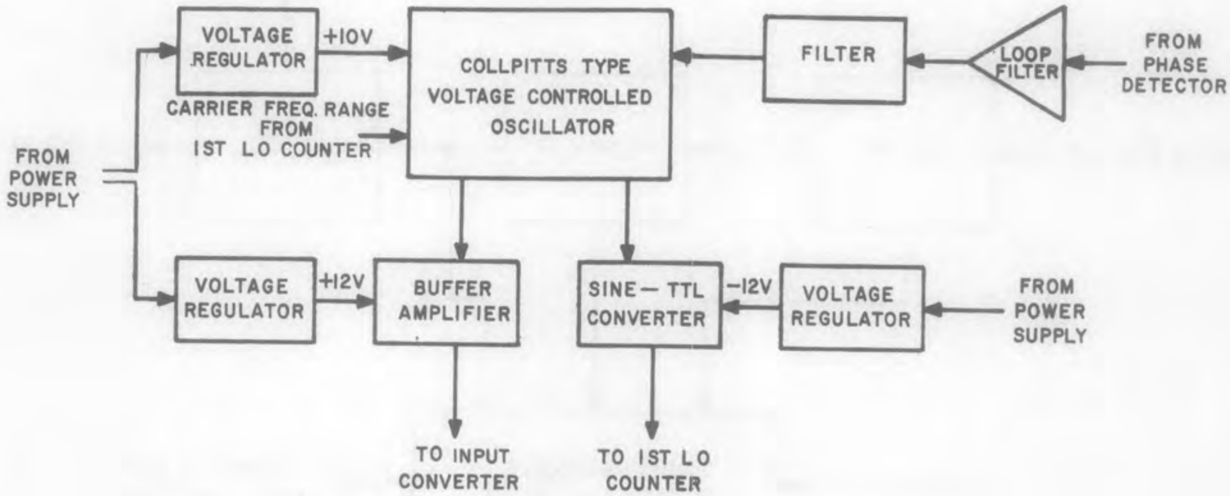


Figure 3-8. Simplified Block Diagram, 1st LO VCO

3.3.6.3 Type 34531 2nd LO Counter (A7-A12) A3

The schematic diagram for this stage is Figure 6-10. The simplified block diagram is Figure 3-9. The 2nd LO Counter receives the tuning data from the Digital Control Units during State 3. Part of the data are shifted to the 1st LO Counter. The 2nd LO Counter also contains a phase detecting network which applies a correction voltage to the 2nd LO VCO.

The tuning data are applied serially along with clock and enable pulses to shift registers U11, U12, and U13. The MSD, 2 MSD, and 3 MSD are fed from U12 and U13 to the 1st LO Counter. The LSD, 2 LSD, USB, and LSB data are fed to the preset data pins on U5, U6, U7, U8, U9, and U10. These presettable counters form part of the synthesizer. The counters are used in the up count mode starting from preset and counting up to 9. The clock pulse to these counters is derived from a sample frequency of approximately 200 MHz from the 2nd VCO. This sample is fed through prescaler U1, which is a 10/11 divider, and flip-flop U2A. Together U1 and U2A produce a clock pulse which is 1/20 and 1/21 of the sample rate.

Phase detector U4 compares this pulse to produce a difference voltage at E3 which becomes the correction voltage for the 2nd VCO. The operation of U4 is exactly the same as U1 of the 1st LO Counter and is discussed in detail in paragraph 3.3.6.1.

U5 and U6 form the lower modulus counter whose preset is the LSD and 2 LSD of the tuned frequency data. These counters will always reach the end of their count prior to the upper modulus counters U7, U8, U9, and U10. During the time the lower modulus is counting up, the clock is at a rate 1/21 of the 200 MHz sample frequency for the remainder of the count

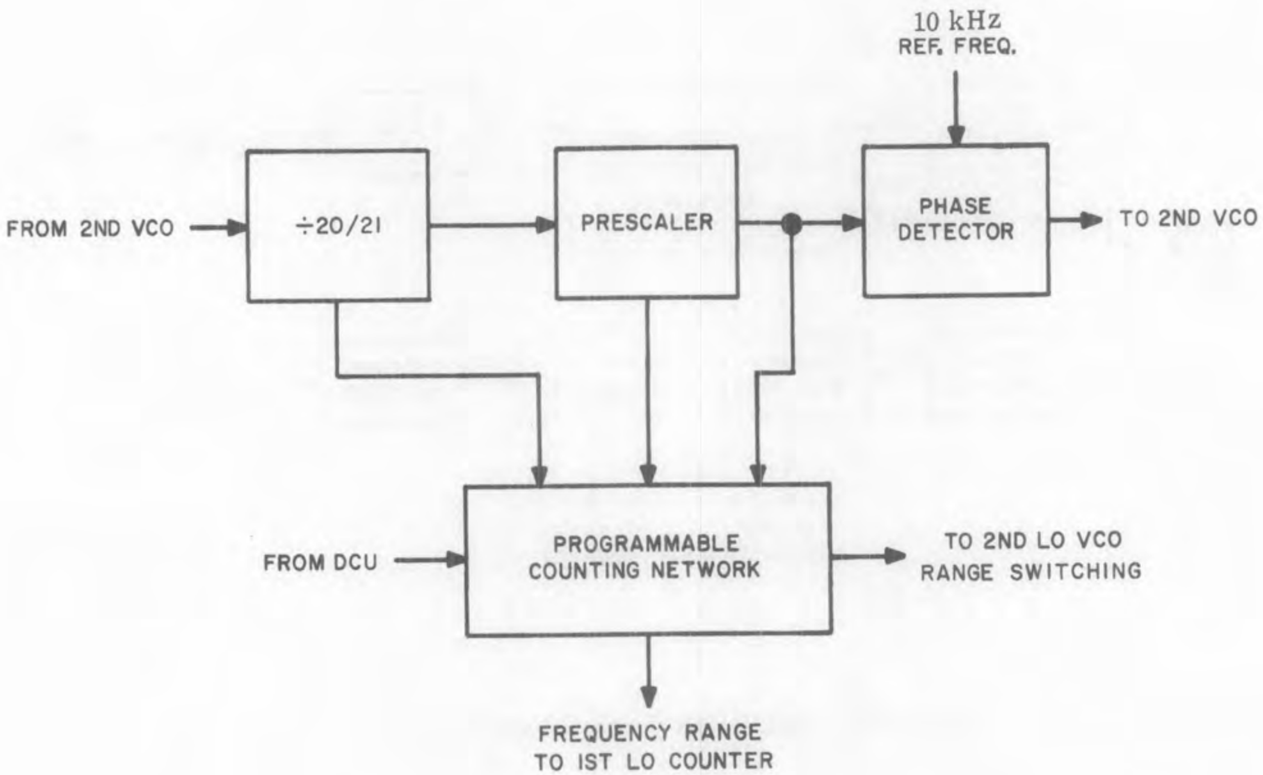


Figure 3-9. Simplified Block Diagram, 2nd LO Counter

in the upper modulus counters. The upper modulus counters are counting at the same rate as the lower modulus counters until the lower modulus counters reach "all nines" condition and then continue to count at a rate of 1/20 of the 200 MHz sample frequency. When the second modulus counter reaches the "all nines" condition, U3 pin 10 and pin 14 go high and $\overline{\text{F out}}$ goes low. The resultant pulse rate at $\overline{\text{F out}}$ is therefore varying at about 10 MHz. When the $\overline{\text{F out}}$ goes low, the load lines on the counters go low, rewriting the preset data to be updated, and the flip-flop U2B is cleared putting pin 9 low. The latch controlling the enable output is reset and the enable lines goes low. This line controls the divide count of the modulus prescaler after the lower modulus reaches the end of its count from 1/21 to 1/20. U2A also controls the divide count of the modulus prescaler to achieve a 1/21 count. The modulus prescaler first counts 11; then when U1 pin 7 goes high, U2A pin 5 changes state to high and the prescaler counts 10 producing a divide by 11+10 = 21 at U2A pin 5. The 10 kHz output is fed to phase detector U4 where comparison to the 10 kHz reference frequency results in a positive or negative voltage relative to the changes in phase between the two signals.

The lower modulus counter counts up to 100 from the preset. The number of clock pulses in for one out is expressed as 100 - X, where X is the preset on the counters equal to the 2 LSD and LSD. The number of counts into the 20/21 divider network for one count out is 21, as the divider starts initially in the 21 condition. The lower modulus counter will reach the end of its count or detection point first.

3.3.6.4 Type 280039 2nd LO Voltage Controlled Oscillator (A7-A12) A4

Figure 6-11 is the schematic diagram for this assembly. Refer to Figure 3-10 for the simplified block diagram. The 2nd LO VCO provides a reference frequency for the 2nd converter stage. Voltage regulators U4 and U5 serve to stabilize the circuit and reduce noise transients on the supply lines. Voltage regulator U1 regulates the dc voltage on the oscillator components to ensure optimum stability in the oscillator.

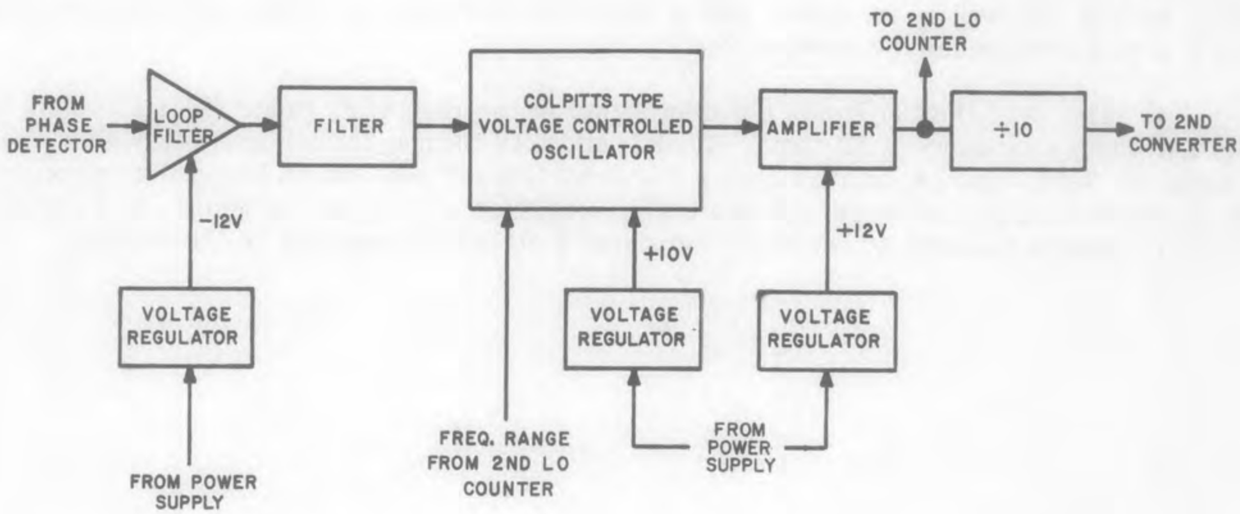


Figure 3-10. Simplified Block Diagram, 2nd LO VCO

The 2nd VCO operates in two ranges: 193.01 to 194 MHz (LSB) and 233 to 233.9 MHz (USB). A "low" on E7 from the 1st LO Counter selects USB and "high" selects LSB.

The phase detector output voltage enters the board at E4 where it is filtered by operational amplifier U3 and its associated circuitry. U3 attenuates the positive pulses and amplifies the negative pulses to produce a voltage presented to the oscillator for frequency correction purposes. C15, C28, C29, L7, L8, and R 21 are a 10 kHz notch filter network.

The Colpitts oscillator is composed of components L2, L4, R17, R20, C6, C8, C13, C14, CR2, and Q1, a common gate FET. Biasing is provided by Q2 and its associated circuitry. Q3 is a loop filter whose output voltage is divided by R9 and R10. Output at E3 is 200 mV rms at approximately 200 MHz which is the sample frequency signal sent to the 2nd LO Counter.

The frequency is divided-by-10 through counter U2, and this frequency in the 20 MHz range becomes the reference frequency for the 2nd Converter.

3.3.6.5 Type 24648 Input Converter (A7-A12) A5

Refer to Figure 6-12 for the schematic diagram for this board and to Figure 3-11 for the simplified block diagram. In this stage the baseband input of 0 to 15 MHz is mixed with the 1st LO VCO output of 21.4 to 36.3 MHz. An output signal of 21.3 to 21.4 MHz is produced and presented to the 1st IF Amplifier.

The input at E1 is a single tone signal with a nominal power level of -25 dBm. Input impedance is 75 ohms. R1, R15, and R16 form a nonadjustable passive network that reduces the power level of the signal by 5 dB. Coils L1, L2, and L3, with capacitors C1 through C6 form a seven-pole elliptic low-pass filter with a cut off frequency of 17 MHz. The filter's two-fold purpose is to pass low frequencies and keep high frequencies out. This filter has a 0.2 dB ripple. R2, R3, and C7 form a passive network with a 50 ohm output impedance. The purpose of this network is to reduce signal power by 5 dB and to effect impedance matching into U1, a double-balanced low-level mixer.

The 1st LO VCO inputs a 0 dBm signal in the frequency range of 21.4 to 36.3 MHz at pin E3. Input impedance is 50 ohms. R5, R7, and C10 form a passive network which reduces the signal by 3 dB. R8, L4, and C11 are a compensation network which keeps the response flat over the desired frequency range. Q1 is a buffer amplifier with a gain of 10 dB. R12, R13, and R14 form a passive network which limits the signal 3 dB before inputting to the mixers.

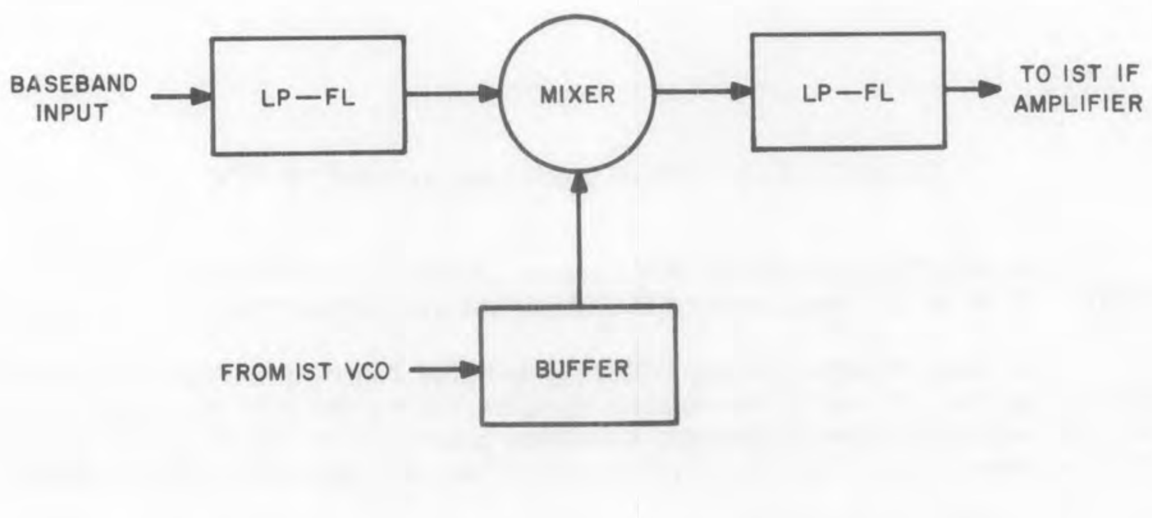


Figure 3-11. Simplified Block Diagram, Input Converter

The 21.3 MHz to 21.4 MHz mixer output is filtered through a balanced low-pass filter (L5, L6, C12, C14, and T2) which keeps high order spurious frequencies out of the 2nd mixer.

3.3.6.6 Type 24650 1st IF Amplifier (A7-A12) A6

The schematic diagram for this board is Figure 6-13. The IF input at E1 is filtered through a bandpass filter (FL1). This filter has a center frequency of 21.350 MHz with a 1 dB bandwidth of 100 kHz. The signal is attenuated 55 dB at 25.4 MHz. U1 amplifies with a gain of 15 dB.

3.3.6.7 Type 24649 2nd Converter (A7-A12) A7

Figure 6-14 is the schematic diagram for this assembly. Figure 3-12 is the simplified block diagram. The IF frequency band enters balanced at E1 and mixes with two frequency ranges from the 2nd LO VCO in a double-balanced low-level mixer (U1). The 2nd LO VCO signal enters at E2. Input impedance is 50 ohms and nominal signal power is 0 dB. Lower sideband frequencies are in the range of 19.301 to 19.400 MHz and upper sideband frequencies are 23.301 to 23.399 MHz. The signal is attenuated 3 dB by passive network R1, R2, and C3. Q1 is a buffer amplifier which needs no compensating circuitry because of its lower frequency range. Another passive network (R8, R9, and R10) attenuates the signal by 3 dB. The 2nd IF frequency range of 2.000 to 2.004 MHz leaves the 2nd mixer and is filtered by a three-pole low-pass filter (capacitors C5 through C8 and coil L2). Q2 is a constant current source driving common gate amplifier Q3 whose voltage gain is approximately 15 dB. Output impedance is 1k ohms.

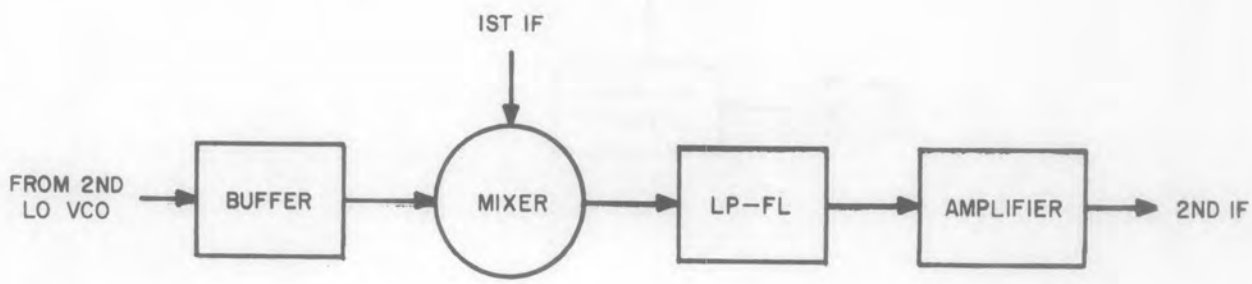


Figure 3-12. Simplified Block Diagram, 2nd Converter

3.3.6.8 Type 34544 IF Demodulator (A7-A12) A8

The IF Demodulator is represented in schematic form by Figure 6-15 and in simplified block diagram form by Figure 3-13. In this stage, final conversion takes place. A

2 MHz 100 mV p-p square wave from the Reference Generator enters the board at pin E2 and is amplified through Q2. The resulting 150 m Vrms is applied to the active mixer U1. The 2.000 to 2.004 MHz signal from the output of the 2nd Converter enters at pin E1 and is filtered by low-pass filter FL1, where the output bandwidth is determined. The impedance matching action of R1, R41, C2, C3, and L1 steps down the 1000 ohms input impedance to 50 ohms. This matching network is aligned by adjusting L1 and R41. Test point J1 allows a signal to be inserted to FL1, and R39 and R40 provide a 1000 ohm source for the filter during alignment. J2 and J3 provide test points that allow the use of a Spectrum Analyzer to sample the signals at the collector of Q1 and the emitter of Q3 respectively. J1, J2, and J3 are coaxial SMC connectors mounted directly on the IF Demodulator board. R7 is a channel gain set potentiometer that controls the gain of amplifier Q1. U1 is the active mixer that receives the two signals described above and outputs an audio signal.

Q3 and Q4, with their associated circuitry, form an active low-pass filter which removes 3rd LO feed-through and rejects image frequencies before U2 amplifies the audio signal. Impedance matching transformer T1 produces 600 ohms output impedance. Audio output is 1 Vrms.

The audio signal at board pin E5 is sent to the headphone amplifier. The signal at board pins E6 and E7 is the audio output at the BNC connector on the rear panel.

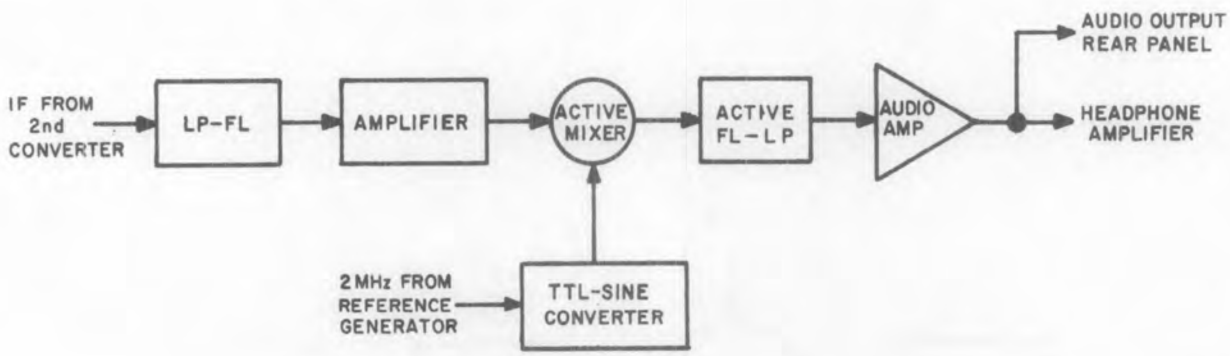


Figure 3-13. Simplified Block Diagram, IF Demodulator

3.3.7 TYPE 791549 HEADPHONE AMPLIFIER (A13)

Figure 6-16 is the schematic diagram for the Headphone Amplifier. The audio signal is amplified by operational amplifier U1. R1 and R3 form a feedback loop which controls the gain of U1. The amplifier is powered by +15 and -15 Vdc.

SECTION IV
MAINTENANCE

4.1 GENERAL

The WJ-9518/9518E FDM Demodulator has been designed to operate for extended periods of time with minimum routine maintenance. Cleaning, inspection, and performance tests should be performed at regular intervals and after troubleshooting, consistent with the facility's normal scheduling. No routine adjustments are required. Should trouble occur, repair time will be minimized if the maintenance technician is familiar with the operating instructions and circuit descriptions provided in Sections II and III, respectively. Reference should also be made to the functional block diagrams in Section III and to the schematic diagrams in Section VI. A complete parts list and illustrations showing parts location can be found in Section V. A complete list of test equipment and accessories required for performance tests and troubleshooting is given in Table 4-1.

4.2 CLEANING AND LUBRICATION

The Demodulator should be kept free of dust, moisture, grease, and foreign matter to ensure trouble-free operation. If available, use low pressure compressed air to blow accumulated dust from the interior and exterior of the Demodulator. A clean dry cloth, a soft bristled brush, or a cloth saturated with cleaning compound may also be used. The WJ-9518/9518E FDM Demodulator does not require lubrication.

4.3 INSPECTION FOR DAMAGE AND WEAR

Many potential or existing troubles can be detected by a visual inspection of the unit. For this reason, a complete visual inspection should be made for indications of mechanical and electrical defects on a periodic basis, or whenever the unit is inoperative. Electronic components that show signs of deterioration such as overheating should be checked and a thorough investigation of the associated circuitry should be made to verify proper operation. Damage to parts due to heat is often the result of other less apparent troubles in the circuit. It is essential that the cause of overheating be determined and corrected before replacing the damaged parts. Plug-in modules should be firmly mounted in their sockets, and connectors on cables should make secure contact. Mechanical parts such as pin connectors, chassis wiring, front panel controls, and switches should be inspected for excessive wear, looseness, misalignment, corrosion, and other signs of deterioration.

4.4 TEST EQUIPMENT REQUIRED

The test equipment listed in Table 4-1, or equivalent, is required to perform the performance tests outlined in paragraph 4.5. "Or equivalent" is defined as an alternate item which will perform, in the stated test, to the degree of accuracy required.

4.5 PERFORMANCE TESTS

The performance test procedures may be used for initial inspection, periodic checks, or to confirm performance specifications after repairs have been made. These tests should be carried out only by skilled technicians using the equipment listed in Table 4-1. If Demodulator problems exist while performing these tests, refer to the Troubleshooting Procedures, paragraph 4.6. When performing these tests, the technician should follow the guidelines below.

Table 4-1. Recommended Test Equipment

Instrument Type	Required Characteristics	Recommended Instrument
AC Voltmeter	0 to 2 MHz capability Sensitivity Voltage range 1 mV to 10 V dB and absolute scale	HP400 EL or HP400 FL
RF Voltmeter	0.5 to 20 MHz capability Sensitivity Voltage range 1 mV to 10 V dB and the absolute scale	Boonton 92B
AC Voltmeter	Must be true rms meter	HP3400A
Noise Generator	Requires the following filters: 12 kHz (high-pass) 14 kHz (notch) 2540 kHz (low-pass) 270 kHz (notch) 2438 kHz (notch)	Marconi TF-2091
Network Analyzer	Digital frequency synthesizer 1 Hz resolution 100 dB dynamic range Group delay measurement and sweep capability	HP3040A
Frequency Counter	10 MHz reference output Accuracy greater than 10^{-9} Hz per day	HP5245L
Variable Auto-transformer	Line voltage ±10% 1.5 ampere minimum	General Radio W5MT3W
Distortion Analyzer	Automatic nulling 30 μ volt sensitivity	HP334A
Frequency Counter	300 Hz to 15 MHz capability High impedance	Fluke 1900A
Oscilloscope	35 MHz bandwidth	Tektronix T935
Digital Voltmeter	DC and AC 0.01 volt resolution	Fluke 8000A
Power Supply	0 to 250 volts DC 1.5 ampere minimum	Elgar 251
Variable Oscillator Plug-In	50 to 400 Hz	Elgar 401-V

Table 4-1. Recommended Test Equipment (Continued)

Instrument Type	Required Characteristics	Recommended Instrument
Signal Generator	±10 resolution 50 kHz to 15 MHz range Output calibrated in voltage and dBm	HP606B
Test Oscillator	±10 Hz resolution Sensitive vernier level control 200 Hz to 10 MHz range	HP651B
Test Oscillator	±10 Hz resolution Sensitive vernier level control 10 MHz to 15 MHz range	HP608
Storage Oscilloscope	100 μV sensitivity Variable persistance Calibrated vertical and horizontal sweep Dual trace	HP1201A
Impedance Matching Network	50 to 75 ohms, 20 dB	
Impedance Matching Network	600 ohms, 10 dB	
Resistive Load	75 ohms, ½ watt resistor	
Resistive Load	600 ohms, ½ watt resistor	
Headphones	Mono, 600 ohm impedance	Telex 820-4

1. Read each paragraph from beginning to end before attempting to perform the test described in the paragraph.

2. All tests shall be performed under the following environmental conditions unless otherwise specified:

Temperature	$+25^{\circ}C \pm 5^{\circ}C$
Altitude	Room Ambient
Humidity	Room Ambient

3. All equipment shall be allowed a warm-up period of at least thirty minutes before the start of any test.

4. All inputs to and outputs from the equipment under test which are not in use during any particular test shall be terminated with their characteristic impedance.

5. All equipment covers shall be in place unless a particular test requires their removal.

4.5.1 TEST SETUP AND OPERATIONAL CHECKS

The purpose of this test is to establish a basic equipment configuration and familiarize the operator with function and placement of the unit controls, establishing in the process that the unit is functional.

1. Connect the equipment as shown in Figure 4-1.

2. Set the WJ-9518 controls and switches as shown in Table 4-2.

3. Set the output frequency of the Signal Generator to 2.001 MHz. Set the input level of the Demodulator to 15.4 mV rms as indicated by AC Voltmeter #1.

4. Set the output of the Autotransformer to 115.0 ± 1.0 V rms as indicated by the Digital Voltmeter.

5. Set the Phone level control for a comfortable output volume.

6. Tune Demodulator channels 2 through 6 to 2.000 MHz, upright, using the Demodulator select, up, down, and tuning rate controls.

7. Ensure that all digits of the frequency display, except the two most significant, change in order from 0 to 9 as the tuned frequency of the Demodulator is increased. Ensure that the two most significant digits change in order from 0 to 14.

8. Set the Step Size switch to 4 kHz and ensure that the Demodulator tunes in 4 kHz steps.

9. Ensure that the UPRIGHT and INVERTED indicator lights operate properly.

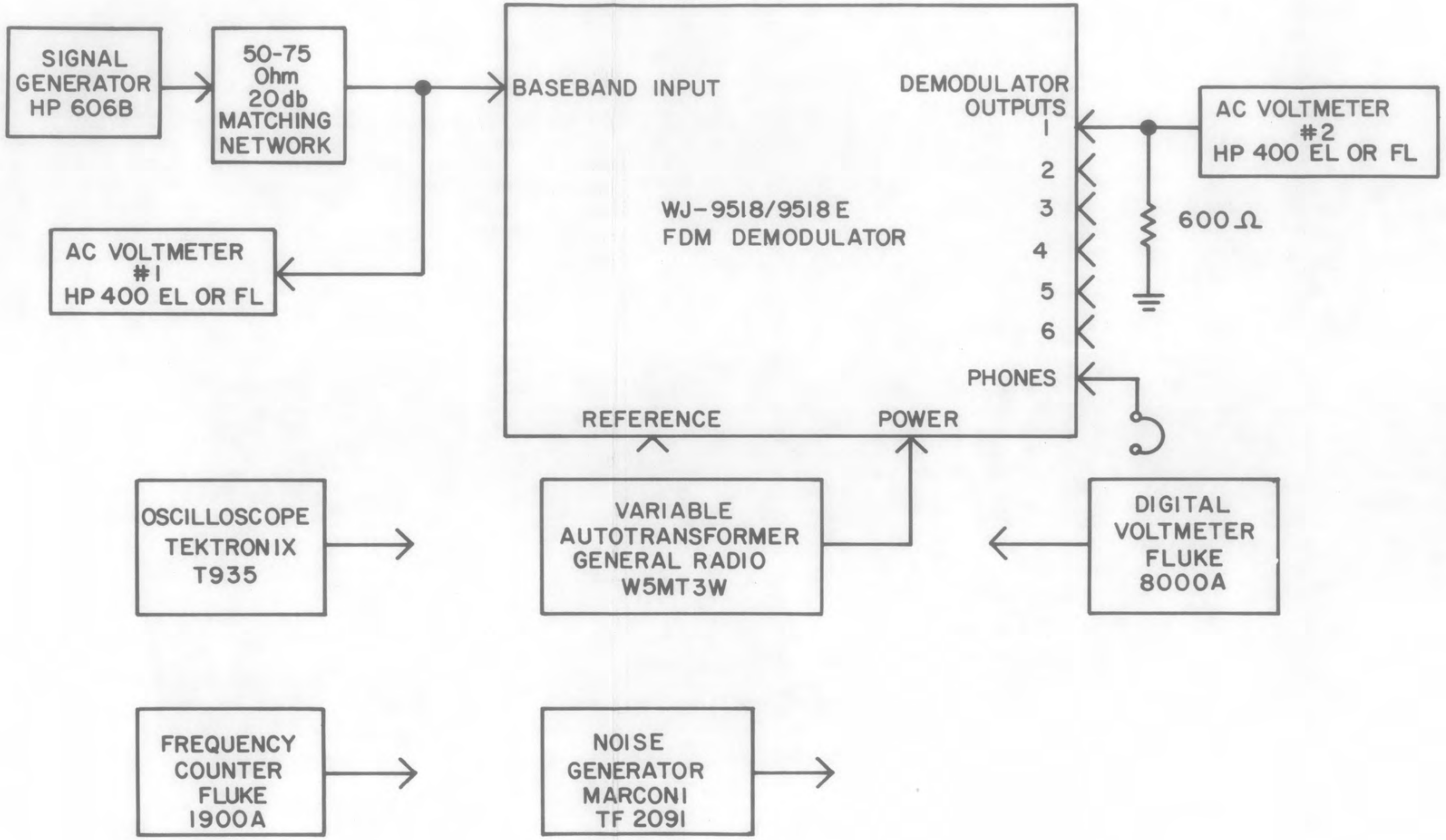


Figure 4-1. General Test Equipment Setup.

Table 4-2. Demodulator Control Test Setup

PANEL	CONTROL	SETTING
FRONT	Phone Level	Midrange
	Demodulator Control	Local
	Demodulator Select	1
	Tuning Rate	Medium
	Mode	Upright
	Step Size	1 kHz
	Power	ON
	Frequency	02.000 MHz
REAR	S9	INT
	S10	115

10. Ensure that the TUNING RATE control operates properly.

4.5.2 POWER SUPPLY OPERATION TEST

The purpose of this test is to confirm that the Demodulator's power consumption is less than the required maximum. The test also verifies the operation of the power supply under limit excursions of input AC voltage, providing the assurance that the unit will remain operational under these conditions.

1. Connect the equipment as shown in Figure 4-1.

2. Set the Demodulator controls as shown in Table 4-2.

3. Read the power consumption as indicated by the Variable Autotransformer. This power shall be no more than 140 W.

4. Using the Digital Voltmeter probe, measure the voltage levels on the +15 V, -15 V, and +5 V bus lines. The voltages should be as follows:

Bus	Voltages
+15 V	+15.0 ± 0.5 Vdc
-15 V	-15.0 ± 0.5 Vdc
+5 V	+5.0 ± 0.2 Vdc

5. Set the output of the Variable Autotransformer to 103.0 ± 1.0 V rms.

6. Using the Digital Voltmeter probe, measure the voltage levels on the +15 V, -15 V, and +5 V bus lines. The voltages should be as follows:

Bus	Voltages
+15 V	+15 V ± 0.1 Vdc
-15 V	-15 V ± 0.1 Vdc
+5 V	+5 V ± 0.05 Vdc

7. Using the Oscilloscope, measure the AC ripple on the +15 V, -15 V, and +15 V bus lines. Maximum ripple should be as follows:

Bus	Ripple
+15 V	7 mV p-p
-15 V	7 mV p-p
+5 V	100 mV p-p

8. Set the output of the Variable Autotransformer to 127.0 ±1.0 V rms.

9. Using the Digital Voltmeter probe, measure the voltage levels on the +15 V, -15 V, and +5 V bus lines. The voltages should be the same as in step 6 above.

10. Replace the Variable Autotransformer with the Elgar 251 Power Supply.

11. Set the Power Supply output to 115.0 ± 1.0 V rms, 400 Hz.

12. Using the Digital Voltmeter probe, measure the voltage levels on the +15 V, -15 V, and +5 V bus lines. The voltages should be the same as in step 6 above.

13. Remove power and set S10, on the Demodulator rear panel, to 220 V.

14. Set the Power Supply output to 220 V rms, 50 Hz.

15. With the Oscilloscope probe monitoring the +15 V bus, decrease the output level of the Power Supply until spikes appear on the Oscilloscope display. Measure the output level of the Power Supply. This level should be no greater than 198.0 V rms.

16. Using the procedure outlined in step 15, measure the Power Supply while monitoring the +5 V, and -15 V bus lines. In each case the output level should be no greater than 198.0 V rms.

4.5.3 SYNTHESIZER OPERATION TEST

The purpose of this test is to measure the VCO control voltages for the 1st LO and 2nd LO oscillators at those frequency points which cause the maximum control excursions, verifying that these excursions are well within the capability of the control circuitry, thus providing the assurance that the unit will remain operational.

1. Connect the equipment as shown in Figure 4-1.

2. Set the WJ-9518 controls and switches as indicated in Table 4-2.

3. Remove top and bottom covers from the unit under test.

4. Connect the probe of the Digital Voltmeter to A7A2TP (E9).

5. Tune the Demodulator to 00.0XX MHz, and note the voltage indicated by the DVM. This voltage should be no less than -8.0 Vdc, and no greater than +8.0 Vdc.

6. Repeat step 5 above with the Demodulator tuned to 07.9XX MHz. The voltage should again be no less than -8.0 Vdc and no greater than +8.0 Vdc.

7. Move the Digital Voltmeter probe to A7A4TP (E10).

8. Tune the Demodulator to XX.X00 MHz upright and note the voltage indicated by the Digital Voltmeter. This voltage should be no less than +3.0 Vdc and no greater than +8.0 Vdc.

9. Repeat the procedure outlined in step 5 (above) with the Demodulator tuned to the frequencies listed below and with the MODE switch set as directed. In each case the voltage indicated by the Digital Voltmeter should be no less than +3.0 Vdc, and no greater than +8.0 Vdc.

Frequency	Mode
XX.X99 MHz	Upright
XX.X99 MHz	Inverted
XX.X00 MHz	Inverted

10. Using the Demodulator Select switch and moving the Digital Voltmeter to demodulator channels 2 through 6 in turn, repeat the procedure outlined in steps 1 through 6 for each demodulator. In each case the voltage should be exactly the same.

11. The Remote Control can be tested by setting the Demodulator Control to Remote and programming the PDP-11 through a DR11-C parallel interface.

4.5.4 OUTPUT LEVEL TEST

The purpose of this test is to verify that the transfer gain of each demodulator channel, i.e., from baseband input to demodulator output, conforms to the specifications for various signal input frequencies.

1. Connect the equipment as shown in Figure 4-1.

2. Set the WJ-9518 controls and switches as shown in Table 4-2.

3. Set the output frequency of the Signal Generator to 00.003 MHz at a level of 15.4 mV rms as indicated by AC Voltmeter #1.

4. Tune the Demodulator to 00.001 MHz.

5. Read the voltage level indicated by AC Voltmeter #2. This level should be 1.0 ± 0.1 V rms.

6. Repeat steps 3, 4, and 5 using the input frequencies, demodulator tuned frequencies and MODE switch settings as listed below and at the top of page 4-10. (Note: Use the RF Voltmeter for input frequencies over 2 MHz.)

Input Frequency	Demodulator Frequency	Mode
00.020 MHz	00.022 MHz	Inverted
00.020 MHz	00.018 MHz	Upright

Input Frequency	Demodulator Frequency	Mode
14.995 MHz	14.997 MHz	Inverted
14.995 MHz	14.993 MHz	Upright

7. Using the Demodulator Select switch, select each demodulator channel 2 through 6 in turn, moving the output connections correspondingly, and on each demodulator, repeat the procedures outlined in steps 1 through 6. In each case the output voltage levels shall be 1.0 ± 0.1 V rms.

4.5.5 PASSBAND RIPPLE TEST

1. Connect the test equipment as shown in Figure 4-1.

2. Set the WJ-9518 controls and switches as indicated in Table 4-2.

3. Tune channel 1 demodulator (A7) to 00.020 MHz upright.

4. Slowly sweep the Signal Generator from 0.020300 to 0.023500 MHz (300 Hz to 3500 Hz audio out), noting maximum and minimum points of inflection within the passband. This ripple should be no greater than 1.0 dB p-p. See Figure 4-2 for examples of acceptable and non-acceptable ripple levels.

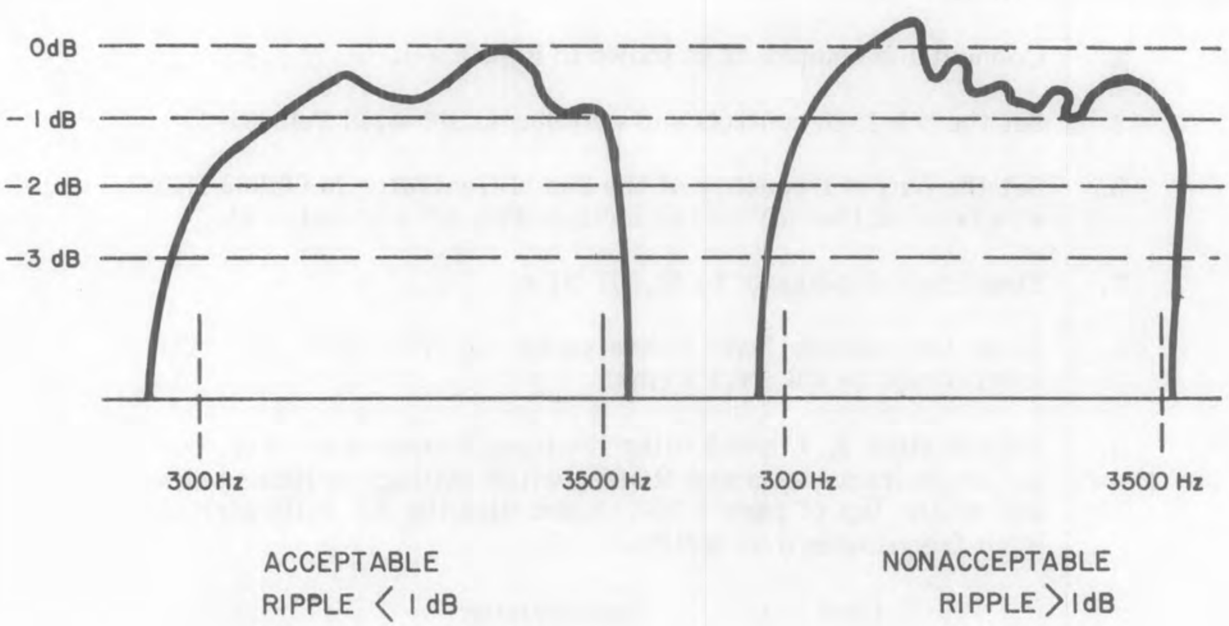


Figure 4-2. Examples of Acceptable and Non-Acceptable Ripple Levels

5. Repeat paragraph 4.5.5, steps 3 and 4, for demodulators A8 through A12 (channels 2 through 6).

4.5.6 OUTPUT 3 dB FREQUENCY RESPONSE/ADJACENT CHANNEL REJECTION TEST

The purpose of this test is to demonstrate compliance with the specified 3 dB bandwidth minimum and with the 45 dB rejection bandwidth maximum. Measurements are made relative to a tuned frequency of 2.000 MHz.

1. Connect the equipment as shown in Figure 4-1. Substitute the HP3040A Network Analyzer for the HP606B Signal Generator.

2. Set the WJ-9518 controls and switches as shown in Table 4-2.

3. Set the output frequency of the Network Analyzer to 02.0010 MHz at a level of 15.4 mV rms as indicated by AC Voltmeter #1.

4. Tune the Demodulator to 2.000 MHz.

5. Slightly adjust the output level of the Network Analyzer for a convenient reference at approximately 1.0 V rms as indicated by AC Voltmeter #2.

6. Increase the output frequency of the Network Analyzer to 02.0035 MHz.

7. Read the total decrease in the output level of the Demodulator as indicated by AC Voltmeter #2. This decrease should be no greater than 3 dB from the reference level.

8. Increase the output frequency of the Network Analyzer to 02.0043 MHz.

9. Read the total decrease in the output level of the Demodulator as indicated by AC Voltmeter #2. This decrease should be no less than 45 dB from the reference level.

10. Decrease the output frequency of the Network Analyzer to 2.0003 MHz.

11. Read the decrease in the output level of the Demodulator as indicated by AC Voltmeter #2. This decrease shall be no greater than 3 dB from the reference level.

12. Decrease the output frequency of the Network Analyzer to 1.9997 MHz.

13. Read the total decrease in the output level of the Demodulator as indicated by AC Voltmeter #2. This decrease shall be no less than 45 dB from the reference level.

14. Using the Demodulator Select switch, select each of the demodulators A8 through A12 (channels 2 through 6) in turn moving the output connections correspondingly, and on each demodulator, repeat the procedures outlined in steps 1 through 13 above. In each case the acceptable limits should be the same.

4.5.7 OUTPUT NOISE LEVEL AND CROSSTALK TEST

The purpose of this test is to verify that the output noise floor for each demodulator, when combined with possible crosstalk from the other five demodulators, complies with the crosstalk and noise specifications. The assumption is made that having five demodulators tuned to the same frequency and the same mode will be nominally the worst case for crosstalk measurements. The measured channel, though tuned to the same frequency, is set to the opposite sideband mode.

1. Connect the equipment as shown in Figure 4-1.

2. Set the WJ-9518 controls and switches as shown in Table 4-2.

3. Using the Demodulator Select and Mode switches, select the UPRIGHT sideband of demodulators 1 through 6. Set the tuned frequency of each demodulator to 02.000 MHz.

4. Set the Input Generator frequency to 2.001 MHz and slightly adjust the output level for a convenient reference of approximately 1.0 V rms as indicated by AC Voltmeter #2.

5. Set channel 1 to Inverted Mode.

6. Read the decrease in the output level of the Demodulator from that set in step 4 above as indicated by AC Voltmeter #2. This decrease should be no less than 60 dB.

7. Repeat the procedure outlined in steps 1 through 6 above using channels 2 through 6 in turn for the Inverted Mode channel in step 3. When testing is completed all the conditions in the following table should have been used. In each case, the acceptable limits should be exactly the same as in the corresponding step above.

Upright Mode Channels	Inverted Mode Channel
2,3,4,5,6	1
1,3,4,5,6	2
1,2,4,5,6	3
1,2,3,5,6	4
1,2,3,4,6	5
1,2,3,4,5	6

4.5.8 NOISE POWER RATIO TEST

The purpose of this test is to verify, by means of the power ratio measurement, the amplitude linearity of the Demodulator signal processing circuitry. The specified noise power ratio is verified with an input noise bandwidth of 2540 kHz and an input noise level of -7 dBm.

1. Connect the test equipment as shown in Figure 4-3.

2. Set the controls and switches of the WJ-9518 as indicated in Table 4-2.

3. Set the 12 kHz highpass filter and the 2540 kHz lowpass filter switches on the Noise Generator to their IN positions. All other filter switches should be set to their OUT positions.

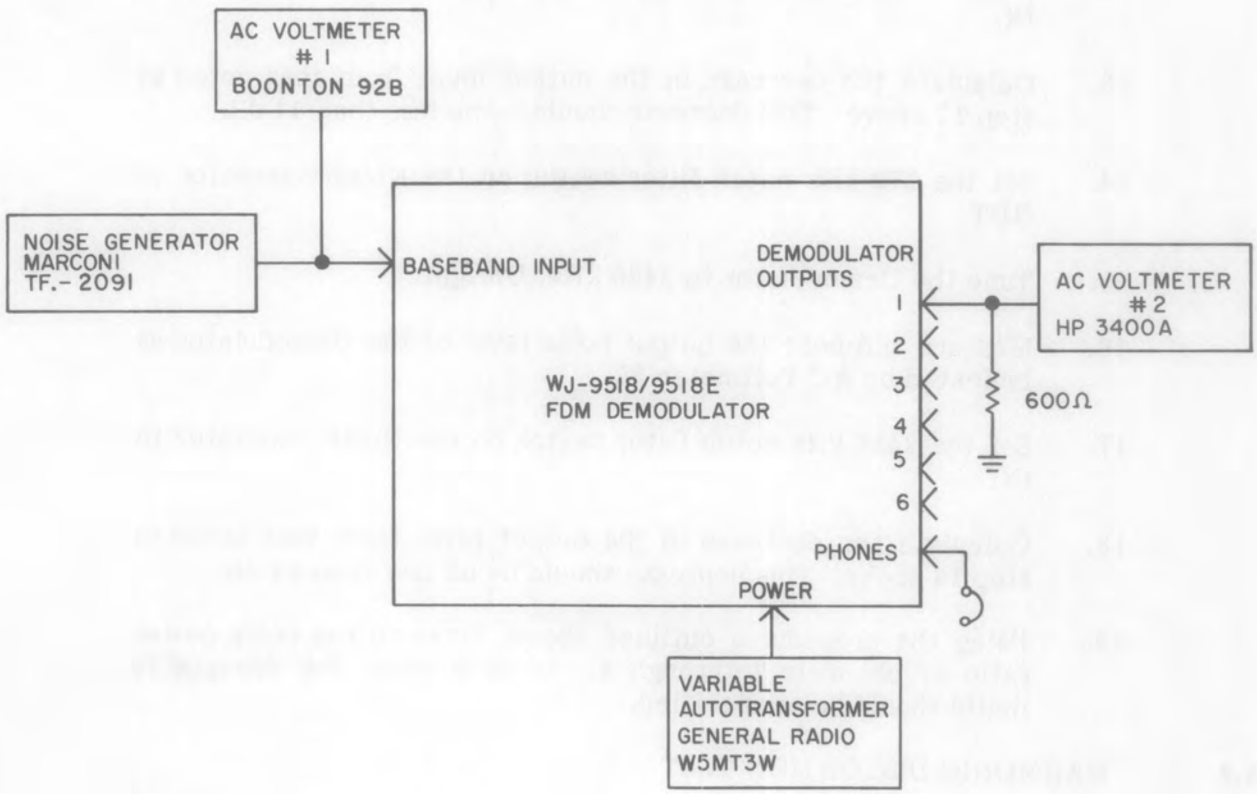


Figure 4-3. Test Equipment Setup for Noise Power Ratio Test

4. Set the output level of the Noise Generator to 122 mV rms as indicated by AC Voltmeter #1 (-7 dBm/75 ohms).

5. Tune the Demodulator to 12 kHz, Upright.

6. Measure and note the output noise level of the Demodulator as indicated by AC Voltmeter #2.

7. Set the 14 kHz notch filter switch on the Noise Generator to IN.

8. Calculate the decrease in the output level from that noted in step 6 above. This decrease should be no less than 44 dB.

9. Set the 14 kHz notch filter switch on the Noise Generator to OUT.

10. Tune the Demodulator to 268 kHz, Upright.

11. Measure and note the noise output level of the Demodulator as indicated by AC Voltmeter #2.

12. Set the 270 kHz notch filter switch on the Noise Generator to IN.

13. Calculate the decrease in the output level from that noted in step 11 above. This decrease should be no less than 44 dB.

14. Set the 270 kHz notch filter switch on the Noise Generator to OUT.

15. Tune the Demodulator to 2436 kHz, Upright.

16. Measure and note the output noise level of the Demodulator as indicated by AC Voltmeter #2.

17. Set the 2438 kHz notch filter switch on the Noise Generator to IN.

18. Calculate the decrease in the output level from that noted in step 16 above. This decrease should be no less than 44 dB.

19. Using the procedures outlined above, measure the noise power ratio of channels 2 through 6. In each case, the acceptable limits should be as specified.

4.5.9 HARMONIC DISTORTION TEST

The purpose of this test is to verify that the Demodulator signal processing circuitry contributes less than the specified maximum total harmonic distortion of a demodulated single tone.

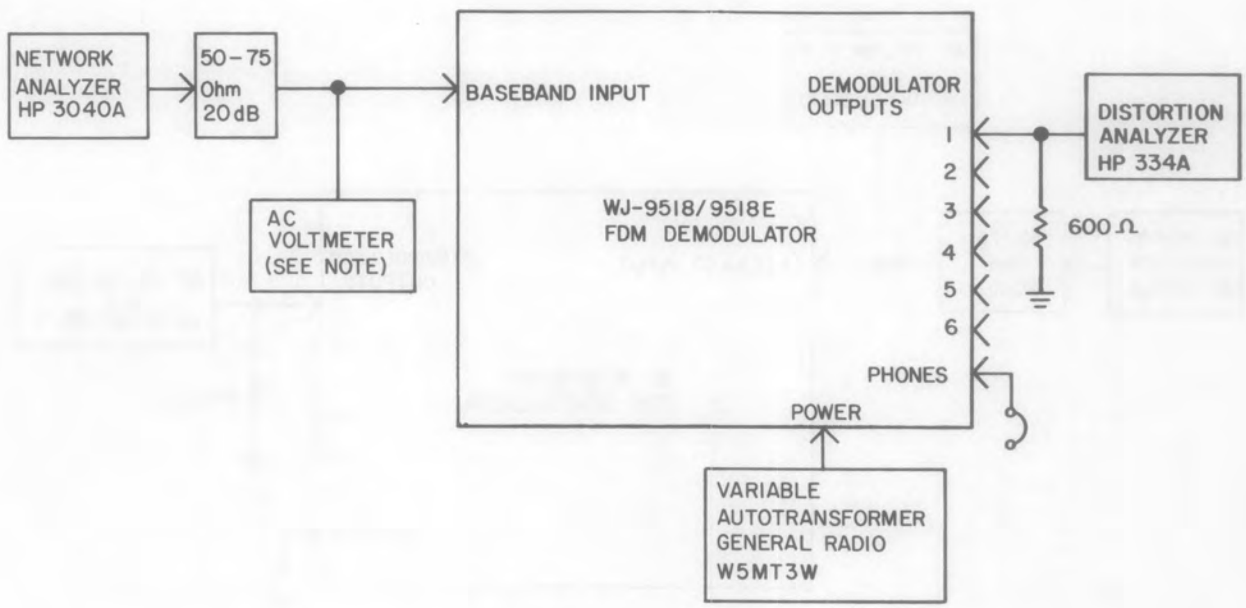
1. Connect the equipment as shown in Figure 4-4.

2. Set the WJ-9518 controls and switches as indicated in Table 4-2.

3. Set the output frequency of the Network Analyzer to 2.001 MHz.

4. Set the Distortion Analyzer function switch to VOLTMETER position. Adjust the Network Analyzer for 1 V rms indication on the Voltmeter (Distortion Analyzer).

5. Set the Distortion Analyzer switch to SET LEVEL. Set the meter range switch to SET LEVEL. Adjust the sensitivity control for 0 dBm reference.



NOTE: AC VOLTMETER IS HP 400 EL OR FL FOR INPUT FREQUENCIES 2MHz OR LESS AND BOONTON 92B FOR FREQUENCIES HIGHER THAN 2MHz.

Figure 4-4. Test Equipment Setup for Harmonic Distortion Test

6. Set the Distortion Analyzer function switch to DISTORTION and null Demodulator output fundamental using Analyzer tuning controls and mode switch. Distortion should be no less than 50 dB below the fundamental output.

7. Using the procedure outlined in steps 1 through 6 above, measure the distortion of the outputs of channels 2 through 6. In each case, the acceptable limits should be identical.

4.5.10 PHASE NOISE TEST

The purpose of this test is to measure the phase noise contribution to the residual noise level. The measurement procedure is that of zero-beating the input signal with the virtual carrier of an FDM channel and observing the noise level in that channel. This is the operational equivalent of the normal oscillator phase noise measurement method of using a double-balanced mixer, and a very stable tunable reference to find the phase noise of each individual oscillator, and gives the noise contribution of both oscillators in the actual demodulated channel band.

1. Connect the test equipment as shown in Figure 4-5.

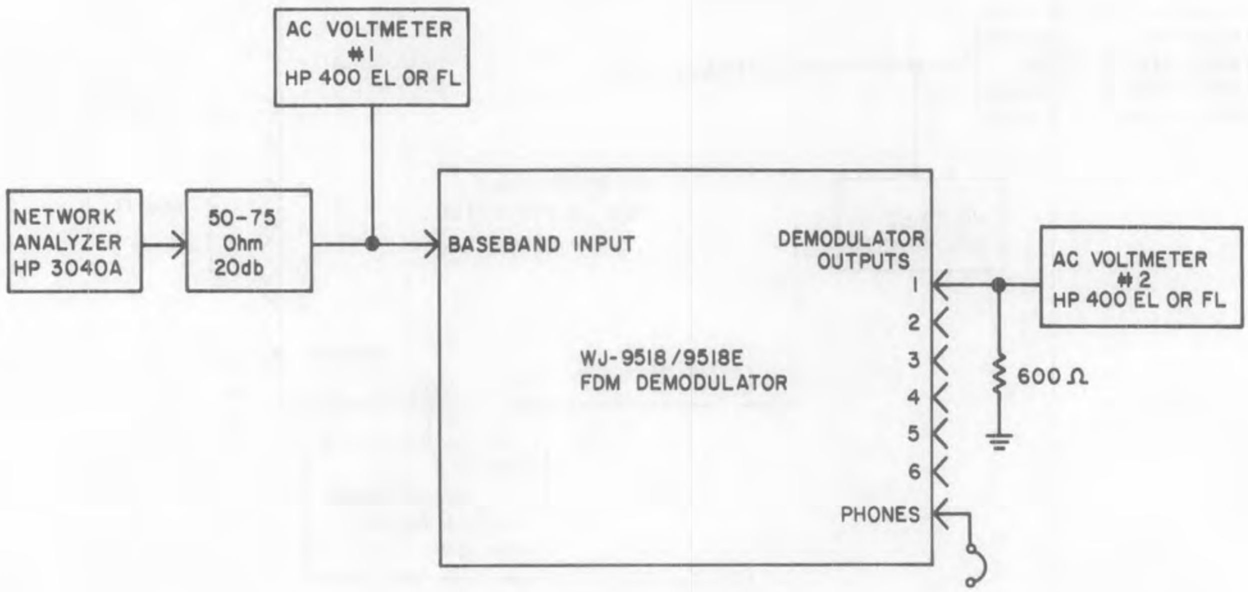


Figure 4-5. Test Equipment Setup for Phase Noise Test

2. Tune the Demodulator to 00.050 MHz, Upright.

3. Set the output frequency of the Network Analyzer to 0.052 MHz. Set the input level of the Demodulator to 15.4 mV rms as indicated by AC Voltmeter #1.

4. Slightly readjust the output level of the Network Analyzer for a convenient reference at approximately 1.0 V rms as indicated by AC Voltmeter #2.

5. Set the output frequency of the Network Analyzer to 0.050000 MHz and measure the decrease in the output level of the Demodulator from that set in step 4 above. This decrease should be no less than 60 dB.

6. Using the procedure outlined in steps 1 through 5 above, measure the phase noise of channels 2 through 6. In each case, the acceptable limits should be identical.

4.5.11 OUTPUT IMPEDANCE MEASUREMENTS

The purpose of this measurement is to verify that the output source impedance is within the specified limits. The measurement technique compares the terminated and unterminated output levels, and the limits are established by the requisite source impedance tolerance.

1. Connect the test equipment as shown in Figure 4-1.

2. Set the Demodulator controls and switches as indicated in Table 4-2.

3. Tune the Demodulator to 2.000 MHz and the Signal Generator to 2.001 MHz.

4. Slightly readjust the output level of the Signal Generator for a convenient reference at approximately 1.0 V rms as indicated by AC Voltmeter #2.

5. Disconnect the 600 ohm load from the output of the Demodulator and note the increase in the Demodulator output level as indicated by AC Voltmeter #2. This increase should be 6.0 ± 1.4 dB.

6. Using the procedure outlined in steps 1 through 5 above, check the output impedance of channels 2 through 6. In each case the acceptable limits should be identical.

4.5.12 INPUT IMPEDANCE MEASUREMENT

The purpose of this measurement is to verify that the Demodulator input load impedance is within the specified limits. The measurement technique compares the input Signal Generator's level when unterminated with the level observed when terminated by the unit under test. The limits are established by the requisite load impedance tolerance.

1. Connect the test equipment as shown in Figure 4-1.

2. Set the WJ-9518 controls and switches as indicated in Table 4-2.

3. Set the output frequency of the Signal Generator to 0.100 MHz, and ensure that the input level of the Demodulator is a convenient reference at approximately 15.4 mV rms as indicated by AC Voltmeter #1.

4. Disconnect the Signal Generator from the Demodulator input port, and note the increase in the Signal Generator output level as indicated by the AC Voltmeter #1. This increase should be 6.0 ± 2.6 dB.

5. Reconnect the Signal Generator to the Demodulator input port.

6. Substitute the Boonton 92B (RF) AC Voltmeter for the HP400EL or FL Voltmeter #1.

7. Set the output frequency of the Signal Generator to 15.000 MHz, and ensure that the input level of the Demodulator is a convenient reference at approximately 15.4 mV rms as indicated by the RF Voltmeter.

8. Disconnect the Signal Generator from the Demodulator input port, and note the increase in the Signal Generator output level as indicated by the RF Voltmeter. This increase should be 6.0 ± 2.6 dB.

4.5.13 VIDEO BASEBAND OUTPUT LEVEL/FREQUENCY RESPONSE TESTS

1. Connect the test equipment as shown in Figure 4-6.

2. Set the output frequency of the Signal Generator to 3.000 MHz.

3. Slightly readjust the output level of the Signal Generator for a convenient reference at approximately 15.4 mV rms as indicated by AC Voltmeter #1.

4. Note the output level change as indicated by AC Voltmeter #2. This change should be no greater than ±0.5 dB from the reference established in step 3 above.

5. Slowly tune the Signal Generator from 3.000 MHz to 15.000 MHz, maintaining a constant Generator output level. At no point should the voltage indicated by AC Voltmeter #2 vary more than ±0.5 dB from the reference level.

6. Substitute the Boonton 92B Voltmeters that are connected to the baseband output and input with the HP400EL or FL Voltmeters.

7. Set the output frequency of the Signal Generator to 3.000 MHz.

8. Adjust the output level of the Signal Generator for a convenient reference output at approximately 15.4 mV rms as indicated by AC Voltmeter #1.

9. Slowly tune the Signal Generator from 3.000 MHz to 5 kHz maintaining a constant Generator output level. At no point should the voltage indicated by AC Voltmeter #2 vary more than ±0.5 dB from the reference level.

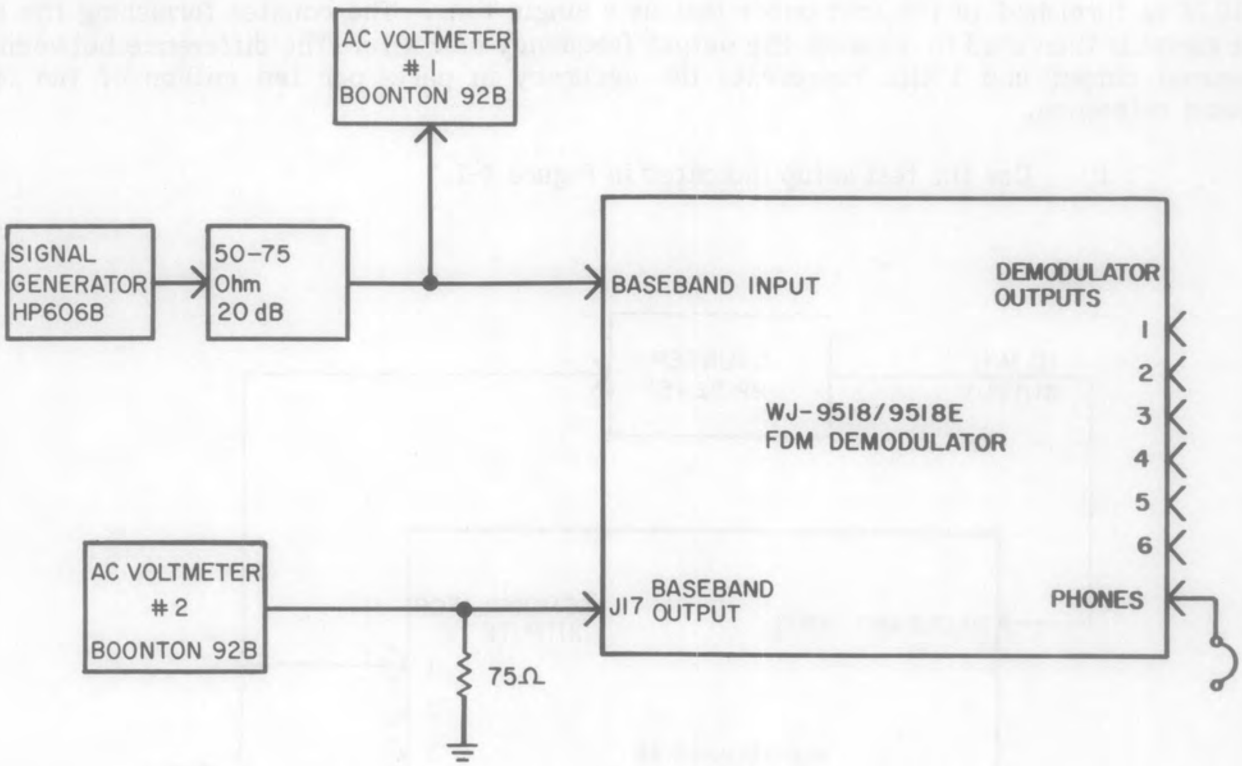


Figure 4-6. Test Equipment Setup for Video Baseband Output Level/ Frequency Response Tests

4.5.14 EXTERNAL REFERENCE TEST

The purpose for this test is to verify that the Demodulator operates properly when using a 1 MHz reference input furnished from an external source at the specified level.

1. Connect the test equipment as shown in Figure 4-1.
2. Set the WJ-9518 controls and switches as indicated in Table 4-2.
3. Set S9, on the Demodulator rear panel, to EXT.
4. Connect a 1 MHz source to J8 (EXT Reference Input). The input level should be +7 dBm, 75 ohms.
5. If the Front Panel Tuning Controls are operative, the external reference control circuitry is satisfactory.

4.5.15 INTERNAL REFERENCE ACCURACY TEST

The internal reference accuracy is measured by demodulating a counter time base at 10 MHz furnished to the unit under test as a single tone. The counter furnishing the time base signal is then used to measure the output frequency of 1 kHz. The difference between the measured output and 1 kHz represents the accuracy in parts per ten million of the unit's internal reference.

1. Use the test setup indicated in Figure 4-7.

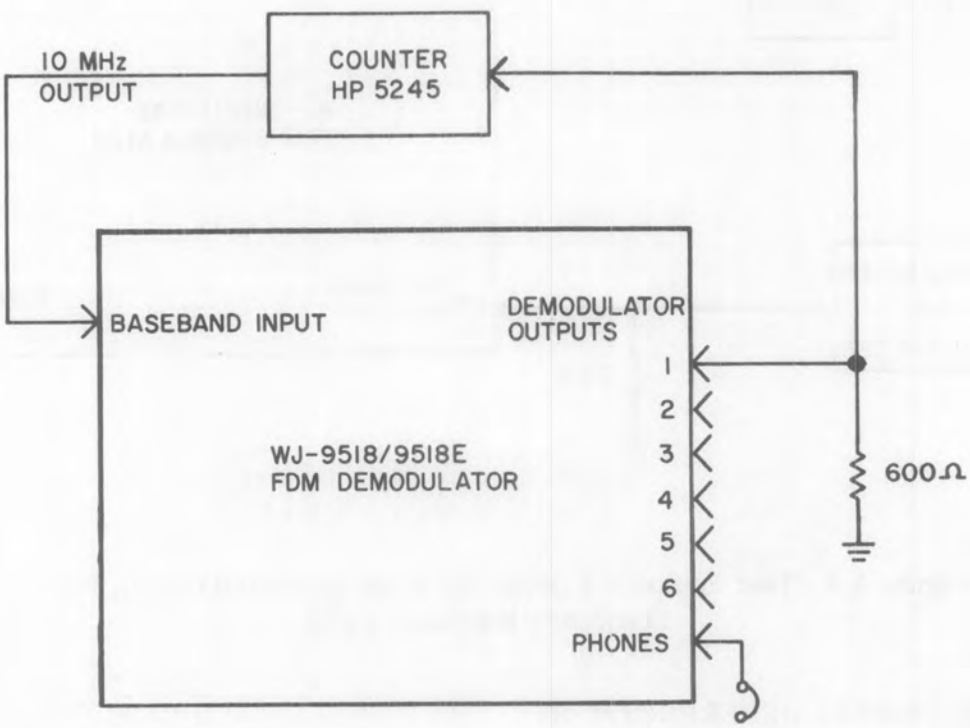


Figure 4-7. Test Equipment Setup for Internal Reference Accuracy Test

2. Tune the Demodulator (channel 1) to 09.999 MHz, Upright.

3. Connect the Counter input to the channel 1 output port of the Demodulator.

4. Read the output frequency of the Demodulator. This frequency should be 1000 ± 3 Hz.

4.5.16 PHONE OUTPUT LEVEL TEST

This test verifies the proper operation of the headphone output of the Demodulator.

1. Connect the test equipment as shown in Figure 4-1, except connect AC Voltmeter #2 to the phones jack with a 600 ohm termination and connect the Oscilloscope parallel to the Voltmeter.

2. Set the WJ-9518 controls and switches as indicated in Table 4-2.

3. Set the output frequency of the Signal Generator to 2.001 MHz, 15 mV rms.

4. Increase the phone output level to the point just before clipping of the phone output occurs as viewed on the Oscilloscope display. It may be necessary to increase the input level until clipping occurs.

5. Read the output level as indicated on AC Voltmeter #2. This level shall be no less than 2.45 V rms.

4.5.17 GROUP DELAY TEST

This test pertains only to the WJ-9518E. The purpose of the test is to verify that the group delay time of the unit under test is within the specifications.

4.5.17.1 Test Equipment Setup

1. Connect the test equipment as indicated in Figure 4-8.

2. Set the controls on the Demodulator as follows:

Mode	Upright
Demodulator Select	1
Frequency	0

3. Set the controls on the Test Synthesizer as follows:

Frequency	2575 Hz
Frequency/Step	50 Hz
Amplitude	-4.7 dBm
Sweep controls:	
Freq/Amp	FREQ
Up/Down	UP
Time/Step	3000 msec
Steps	100

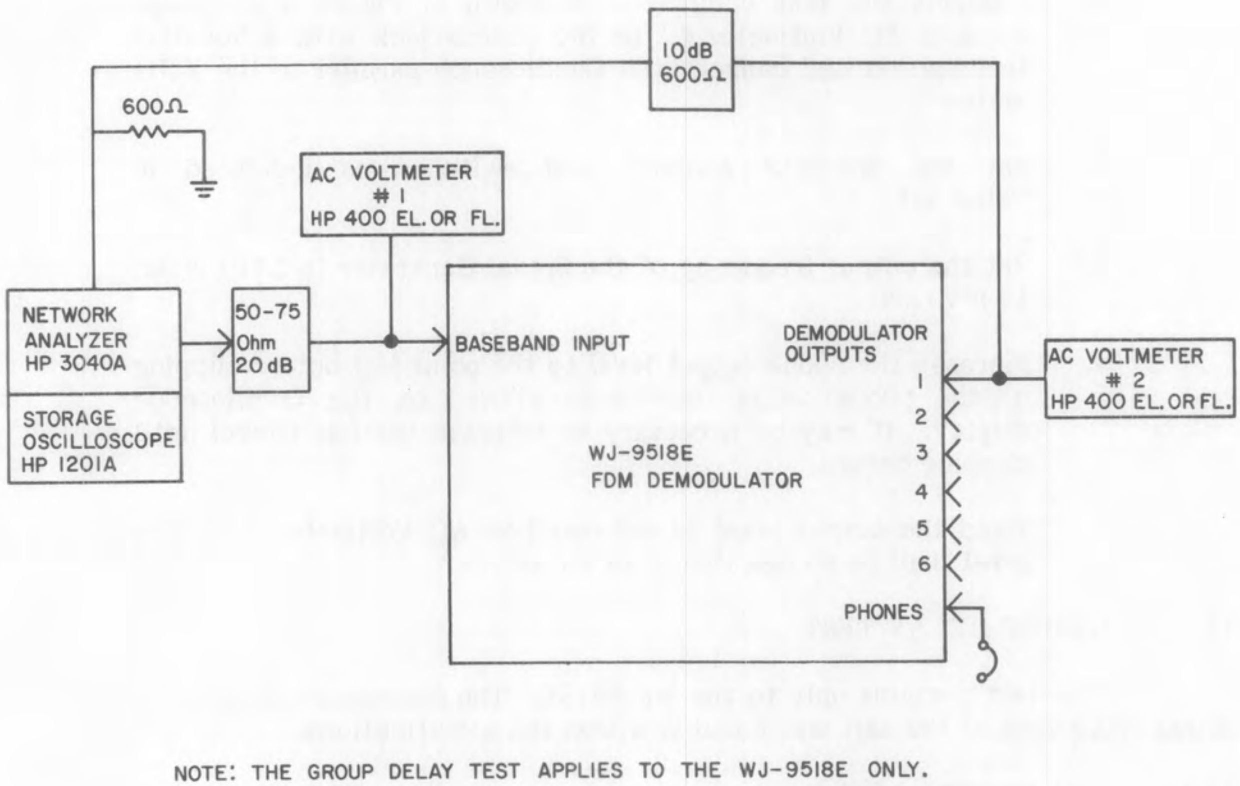


Figure 4-8. Test Equipment Setup for Group Delay Test

4. Set the controls on the Network Analyzer as follows:

Absolute/Relative	Absolute
Amplitude function	B
Max/Ref Input Voltage	0 dBm
Bandwidth	10 Hz
Phase Ref	A
Phase/Delay	Delay
Mode	SWP
Freq Step	5 x 10 Hz
Amp Zero (B)	Set to match Synthesizer amplitude reading with B input and outputs jumpered and terminated.

5. Set the controls on the Storage Oscilloscope as follows:

Channel 1	+ input, dc, 0.1 V/Div, calibrated
Channel 2	-input, dc, 50 mV/Div, uncalibrated
Intensity	Midrange
Persistance	Midrange
Writing speed	STD
Horizontal	Ext Horiz, 0.5 V/Div, uncalibrated
Source	EXT
Vertical Display	CHOP

6. Connect the Oscilloscope channel 1 input to the Delay X-Y recorder output on the rear of the Analyzer. Connect the Oscilloscope channel 2 input to the Amplitude Function output on the rear of the Analyzer.

7. Adjust the Oscilloscope position controls so as to display both A and B traces on the screen.

8. Calibration of Horizontal sweep: three points on the horizontal sweep are calibrated to correspond to the sweep of the synthesizer. These points are:

Far left graticule	75 Hz
Center graticule	2575 Hz
Far right graticule	5075 Hz

Use of the sweep controls on the Synthesizer will facilitate calibration of the Oscilloscope trace. These controls are as follows:

STOP	Places trace at center frequency (2575 Hz)
FIRST POINT	Frequency at the starting point of the sweep (75 Hz)

Using the sweep controls on the Synthesizer and the horizontal position and horizontal calibration controls on the Oscilloscope, calibrate the Oscilloscope to display 400 Hz/Horizontal Division. This may be accomplished by setting the horizontal distance between the FIRST POINT display dot and the STOP display dot to 6¼ horizontal divisions (for the specified frequency settings). Set the Stop display dot to 60% of the screen width. This will then be the horizontal display position for the 2500 Hz measurement made between 2475 Hz and 2525 Hz.

9. Calibration of Vertical Sweep: Stop the Synthesizer sweep (dot at 2575 Hz will be displayed) and place the channel B trace (amplitude) on a horizontal graticule line near the center of the screen. Increment the Synthesizer output by 1 dBm. The trace should move exactly one graticule division. If not, alternately

increment and decrement the Synthesizer output level by 1 dB and adjust the channel B (amplitude) calibration until 1 dB/division is achieved. Delay calibration at the indicated settings is 100 micro sec per Division.

10. Select SWEEP START CONT on the Synthesizer.

11. Adjust the vertical position controls on the Oscilloscope to display both the amplitude and delay traces.

4.5.17.2 Group Delay Measurement

1. Measure and record the group delay variation. The delay should be no greater than the limits listed below:

Frequency (MHz)	Maximum Delay (μ sec)
200 to 300 Hz and 3500 to 3600 Hz	1000
300 to 400 Hz and 3400 to 3500 Hz	500
400 to 3400 Hz	200

2. If the group delay variation is not within the specified limits, variable resistor R1, and variable coil L1 should be adjusted on a sweep basis to minimize the amplitude ripple response. See paragraph 4.6.4.2.11 for the bandpass filter alignment procedure.

4.6 TROUBLESHOOTING PROCEDURES

4.6.1 GENERAL

Troubleshooting tests can be most effectively carried out if the technician first familiarizes himself with the operating instructions and circuit descriptions provided in Sections II and III and with component location diagrams provided in Section V of this manual.

Troubleshooting efforts should first be directed toward eliminating possible external causes of the trouble and ascertaining correct symptoms with the Demodulator properly connected and tested. Occasionally, the main circuit causing the trouble can be pinpointed by noting that the symptom occurs only for operating modes which involve a certain circuit. On the other hand, symptoms which occur for several modes would tend to isolate the trouble to circuitry which is active for all these modes.

4.6.2 COMPONENT LOCATION

Every component in the Demodulator can be located by utilizing the component location diagrams found in Section V. The component location diagrams are listed according to their reference designations, and can be found by using the List of Illustrations in the Table of Contents. For further instructions on reference designations see paragraph 5.1.

4.6.3 REPAIR

4.6.3.1 General

When a trouble has been isolated to a specific circuit board or assembly, the user may decide to make the repair himself or return the board, or assembly to the factory for replacement or repair. Some of the modules can be removed entirely, while in other cases only subassembly boards can be removed.

After a repair has been made, alignment should be carried out, if necessary, and appropriate performance tests should be utilized to verify proper operation.

4.6.3.2 Removing and Replacing Printed Circuit Board Components

When removing components from a printed circuit board for inspection or replacement, be especially careful not to damage the track. The soldering iron power should be no larger than 40 watts, and a solder sipper or wicking procedure should be employed when removing solder. Noncorrosive soldering flux should be used when removing solder by wicking.

In returning components to the board, make sure that the holes are clear and be careful that the leads do not catch the edge of the track and lift it from the board. A good grade of resin core 60/40 solder should be used. Heat no longer than is necessary to achieve a good joint. A heat sink should be used where possible.

4.6.4 BREAKDOWN OF TROUBLESHOOTING PROCEDURES

In troubleshooting the WJ-9518/9518E Demodulator a separate procedure should be considered for each of the six functional areas. These areas are: Distribution Amplifier, Demodulator/Synthesizer, Digital Control, Reference Generator, Headphone Amplifier, and Power Supply. Generally, localizing the trouble to one of these functional areas can be accomplished by observing the results during operation.

The following paragraphs will discuss the troubleshooting procedure for each functional area. The troubleshooter should first study the procedures outlined in the Troubleshooting Trees, Figures 4-9 to 4-11. Starting with the Demodulator Troubleshooting Tree and progressing to the related 1st and 2nd LO VCO Troubleshooting Trees will expedite the isolation of the trouble.

4.6.4.1 Distribution Amplifier (A2) Troubleshooting Procedure

Troubleshooting the Distribution Amplifier should be considered if an audio output is missing from any or all of the six channel outputs at the rear panel connector J6 when the following conditions exist:

1. The baseband signal is applied to J3.

2. The Demodulator is turned on and is properly tuned.

3. Cabling from the Demodulator/Synthesizer assembly has been checked and is found to be satisfactory.

4. Proper operation of the Demodulator/Synthesizer has been verified. (See Figure 4-9, Demodulator/Synthesizer Troubleshooting Tree).

If the above conditions are met, proceed to troubleshoot the Distribution Amplifier using the following procedure as a guide.

1. Refer to the schematic diagram (Figure 6-2), the circuit description (paragraph 3.3.2), and the component location diagrams (Section V).

2. Verify the presence of -15 Vdc at C1, accessible from the outside.

3. Remove the Distribution Amplifier from the Demodulator chassis, without disconnecting the wiring.

4. To access the outputs of the amplifier for voltage measurements, unscrew connectors J1 through J4 and J6 through J8.

5. Apply the baseband signal to input J5.

6. Using a voltmeter probe with a 75 ohm termination, measure the signal level at the outputs. The signal level out should equal the signal level in. Deviation from the expected signal level at one of the six outputs should lead to removing the cover from the board and troubleshooting the circuitry associated with that output as indicated below.

Table 4-3. A2 Component/Output Relationships

Output	Related Components
J1	Q3, R10, R11, C5, C6
J2	Q5, R16, R17, C9, C10
J3	Q7, R22, R23, C13, C14
J4	Q9, R29, R30, C17, C18
J6	Q4, R13, R14, C7, C8
J7	Q6, R19, R20, C11, C12
J8	Q8, R25, R26, C15, C16
All Outputs	Q1, Q2, R1 through R9, R31, C1 through C4, C19, L1, and CR1

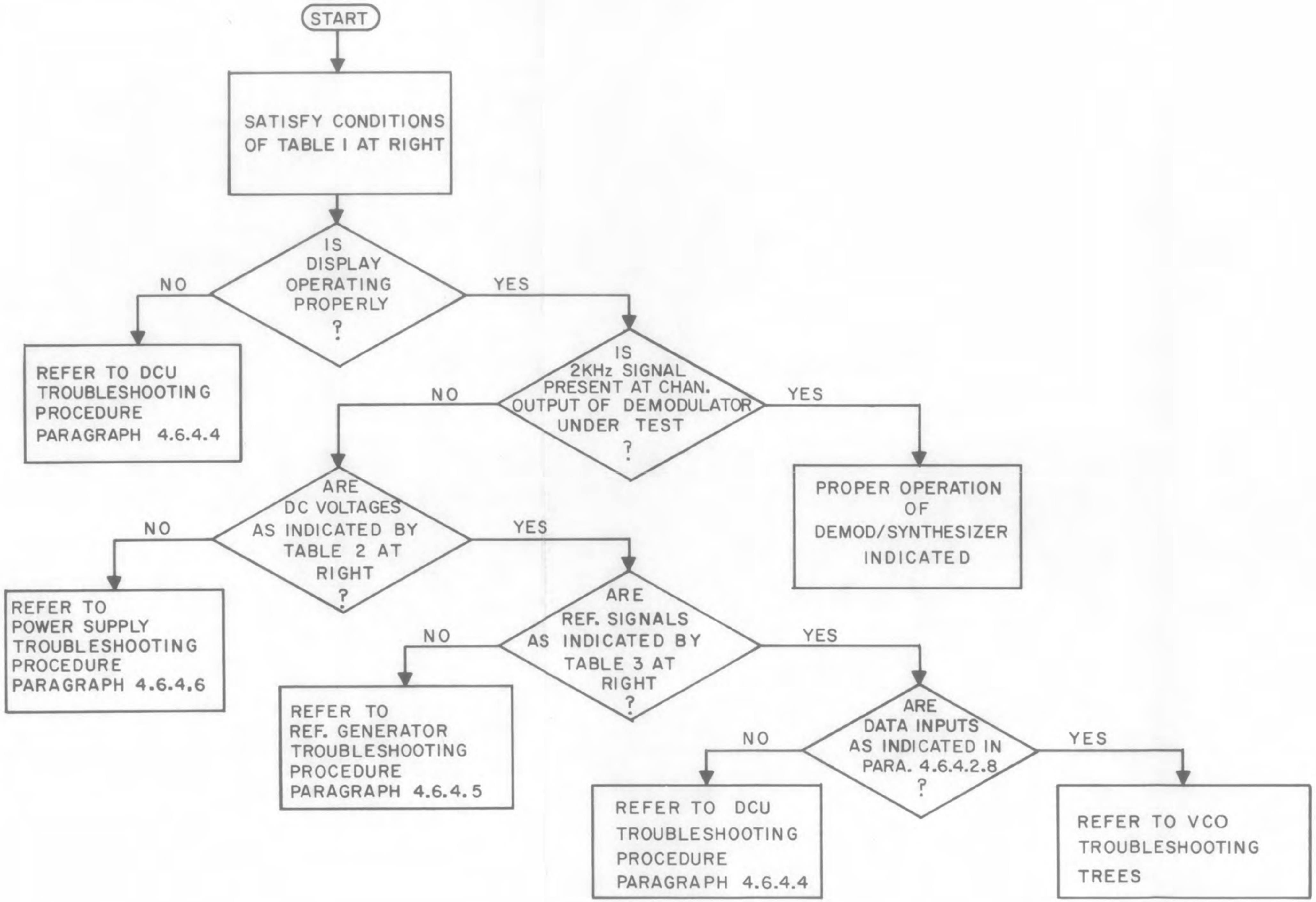


TABLE I

DEMODULATOR CONTROL SETTINGS	
POWER	ON
DEMODULATOR SELECT	CHANNEL UNDER TEST
REMOTE/LOCAL	LOCAL
TUNED FREQUENCY	0.002 MHz
MODE	INVERTED
RF INPUT	NONE

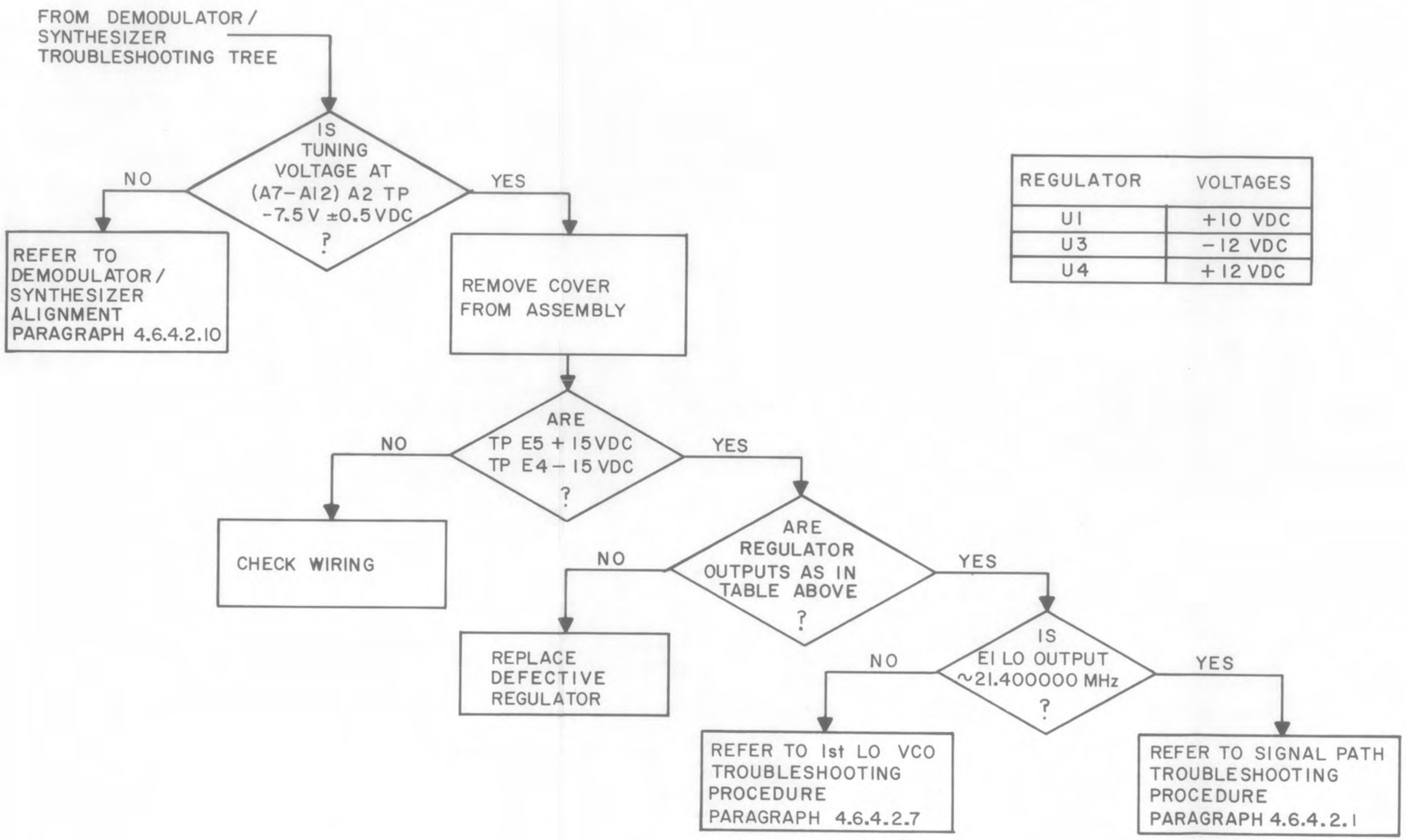
TABLE 2

POWER TERMINALS (A7-A12)	
C1	+5 VDC
C2	+15 VDC
C3	−15 VDC
C4	+5 VDC
C11	+15 VDC
C12	−15 VDC
FL1	+15 VDC

TABLE 3

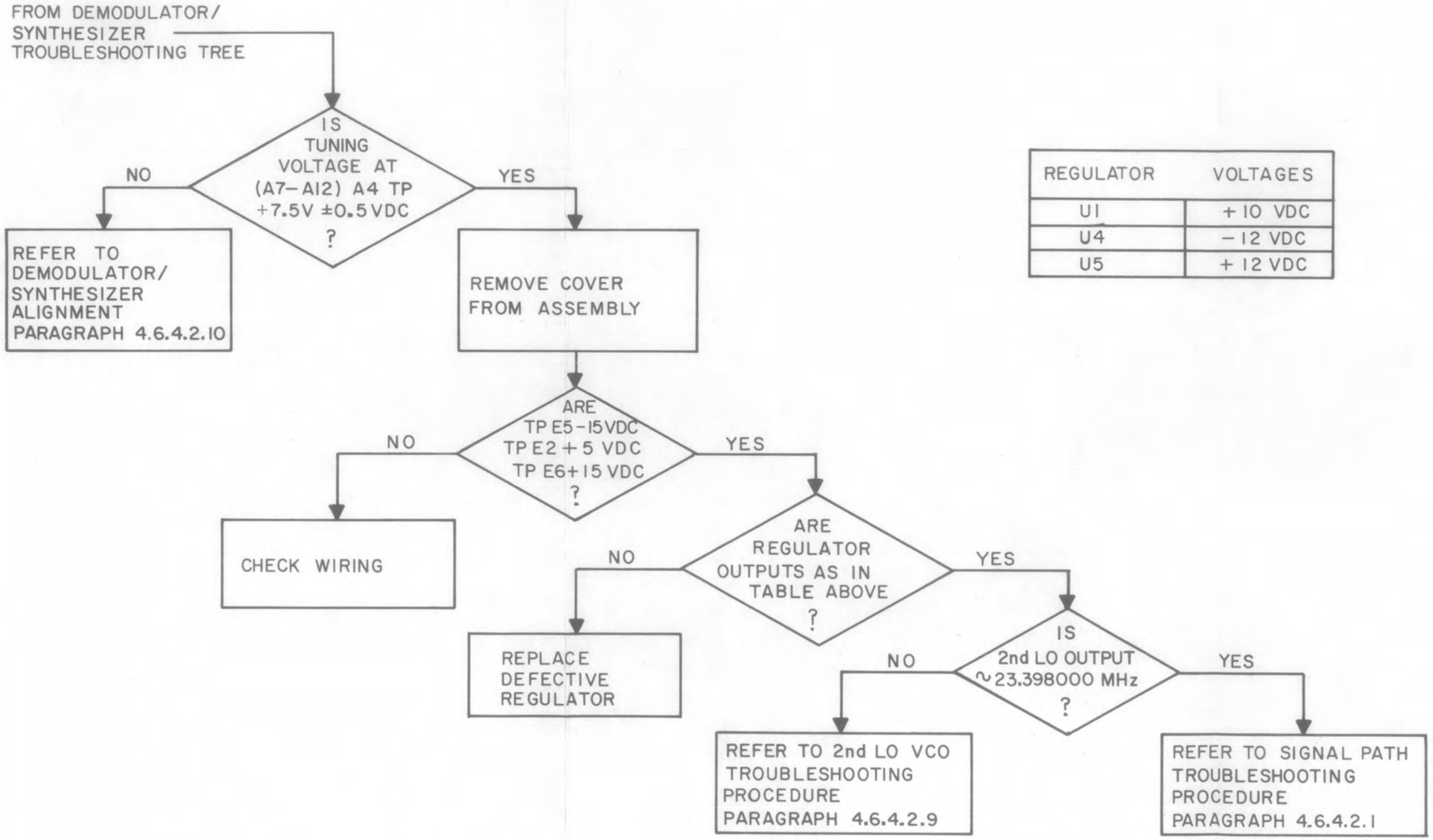
REFERENCE FREQUENCY	CHASSIS CONNECTION
50KHz	J1
10KHz	J2
2MHz	J4

Figure 4-9. Demodulator/Synthesizer Troubleshooting Tree.



REGULATOR	VOLTAGES
U1	+10 VDC
U3	−12 VDC
U4	+12 VDC

Figure 4-10. 1st LO VCO Troubleshooting Tree.



REGULATOR	VOLTAGES
U1	+ 10 VDC
U4	− 12 VDC
U5	+ 12 VDC

Figure 4-11. 2nd LO VCO Troubleshooting Tree.

7. The output frequency response should be flat from 10 kHz to 15 MHz. If all of the outputs show a deviation from this response, alignment may be necessary. R2 is the level adjustment potentiometer for the low (10 kHz) end of the frequency band, and L1 is adjustable for amplitude compensation at the high (15 MHz) end of the frequency band. These two components may be screwdriver adjusted through two openings in the cover of the Distribution Amplifier, labeled R2 and L1.

4.6.4.2 Demodulator/Synthesizer (A7-A12) Troubleshooting Procedures

For circuit descriptions of the Demodulator/Synthesizer assemblies, refer to paragraphs 3.3.6 through 3.3.6.8, and for schematic drawings refer to Figures 6-7 through 6-15. Section V contains component location diagrams. There are six Demodulator/Synthesizer assemblies, A7-A12, each containing eight subassemblies, A1-A8. Each assembly outputs two audio signals, one to the output connector J6, and the other to the phone jack on the front panel of the unit via the Headphone Amplifier. If the unit has been turned on, and properly tuned, and a channel has been selected by the Demodulator Select switch, that channel should output an audio signal when the baseband signal is applied to input J3. If it does not, troubleshooting the Demodulator/Synthesizer assembly associated with the selected channel may be necessary. The Demodulator/Synthesizer Troubleshooting Tree, Figure 4-9, contains the necessary procedure to localize any problem. Figures 4-10 and 4-11, VCO Troubleshooting Trees, are referred to at the appropriate time during the troubleshooting procedure outlined in Figure 4-9. To further aid the troubleshooter, this section contains component level test procedures for (A7-A12) A1 through (A7-A12) A8. Demodulator/Synthesizer alignment procedure is also a part of this section.

4.6.4.2.1 Signal Path Troubleshooting Procedure

If a trouble has been localized to one of the six channels, and proper operation of both LO VCO assemblies has been verified via Figures 4-10 and 4-11, it is necessary to remove the Demodulator/Synthesizer assembly associated with that channel from the chassis of the unit. Use the following procedure to isolate a defective subassembly in the signal path.

Table 4-4. Signal Path Troubleshooting Check Points

Check Point	Correct Signal Level	Correct Signal Frequency	Signal Is Correct	Signal Is Not Correct
Between A5 and A6	Approx. 15 mV p-p	21.4 MHz	Proceed to next check point	Refer to Input Converter Troubleshooting Procedure Paragraph 4.6.4.2.2
Between A6 and A7	Approx. 15 mV p-p	21.4 MHz	Proceed to next check point	Refer to 1st IF Amplifier Troubleshooting Procedure Paragraph 4.6.4.2.3
Between A7 and A8	Approx. 15 mV p-p	2 MHz	Refer to IF Demodulator Troubleshooting Procedure Paragraph 4.6.4.2.5	Refer to 2nd Converter Troubleshooting Procedure Paragraph 4.6.4.2.4

1. Remove the screws that secure the assembly to the chassis and remove the Demodulator/Synthesizer assembly from the unit, being careful to leave the wiring connected.

2. Check the signal levels between the stages with an RF Voltmeter, or preferably, with an oscilloscope with a x10 probe. Proceed as instructed in Table 4-4.

4.6.4.2.2 Input Converter (A7-A12) A5 Troubleshooting Procedure

Troubleshooting the Input Converter subassembly is indicated if, during the signal path troubleshooting procedure, the output at board pin E5 is not 15 mV p-p with a frequency of 21.4 MHz. The following procedure will aid the troubleshooter in isolating the problem.

1. Refer to the schematic diagram (Figure 6-12), circuit descriptions (paragraph 3.3.6.5), and component location diagrams (Section V).

2. Use a DC voltmeter to verify the presence of +15 V at board pin E2.

3. Verify the presence of the signal from the 1st LO VCO at board pin E3.

4. Use an RF voltmeter and check for the presence or absence of signal at the collector of Q1. Signal level at this point should be +17 dBm ± 3 dB. Absence of the proper level signal indicates trouble with Q1 and/or its associated circuitry.

5. Verify the presence of the input signal into the mixer U1. Loss of signal at this point should lead to checking the components in the seven-pole elliptic filter (C2 through C6, L1, L2, and L3) and in the two attenuation/impedance matching networks (R1, R2, R3, R15, and R16).

6. After verifying the proper input signals into mixer U1, check the output of U1. This output frequency should equal the difference between the frequencies of the two signals that entered the mixer. If the signal was lost through U1, replace U1.

7. Loss of signal between the output of U1 and the board output pin E4 indicates a component problem within the output low-pass filter or the coupling transformer.

4.6.4.2.3 1st IF Amplifier (A7-A12) A6 Troubleshooting Procedure

Refer to the schematic diagram (Figure 6-13), circuit description (paragraph 3.3.6.6), and to the component location diagrams (Section V) before troubleshooting this board. Verify the presence of +15 Vdc at board pin E3. R1 should be measured for a change in resistance and capacitors C1, C2, C3, and C14 should be checked for shorted or leaky conditions. Amplifier U1 is an integrated circuit with a gain of 15 dB. If U1 and its associated circuitry appear to be functioning properly, the only component remaining to be checked is FL1. This filter should have a center frequency of 21.350 MHz with a 100 kHz bandwidth.

4.6.4.2.4 2nd Converter (A7-A12) A7 Troubleshooting Procedure

This module should output a signal approximately 15 mV p-p with a frequency equal to the difference between the frequencies of the two signals that enter at board pins E1 and E2. If the output signal deviates from these parameters, use the following procedure as a guide to isolate the defective components.

1. Refer to the schematic diagram (Figure 6-14), the circuit description (paragraph 3.3.6.7), and the component location diagrams (Section V).

2. Verify the presence of +15 Vdc at board pin E4.

3. Verify the 2nd LO input signal at board pin E2.

4. The signal at the collector of Q1 should be 17 dBm $\pm$ 3 dB. If this signal is not as stated, check transistor Q1 and its associated circuitry.

5. If the signal is lost between the collector of Q1 and the input of mixer U1, check the resistors, R8, R9, and R10, and the transformer, T1.

6. The output of mixer U1 should be a signal with a frequency that is the difference between the two signals that enter the mixer. If the output of U1 is not as stated, U1 is defective.

7. If the signal is lost between the output of U1 and the board output E3, trouble most likely exists in Q2 or Q3 and/or their associated circuitry. Voltage and resistance measurements should be made until the defective component is located.

4.6.4.2.5 IF Demodulator (A7-A12) A8

When the use of signal path troubleshooting procedures isolates the IF Demodulator module as the trouble source, the following procedure may prove helpful to the troubleshooter.

1. The schematic diagram for the IF Demodulator is Figure 6-15, the circuit description is in paragraph 3.3.6.8, and the component location diagrams can be found in Section V.

2. Before beginning to troubleshoot this board check to see if the audio output signal is present at board pin E5. Presence of the signal at this point, and absence of the signal at the balanced output, pins E6/E7, indicates a problem exists in the circuitry associated with U2 or T1. If both audio output signals are absent proceed with troubleshooting the IF Demodulator module.

3. Verify the presence of -15 Vdc at board pin E3 and +15 Vdc at board pin E4.

4. Use an oscilloscope to measure the 3rd LO input at board pin E2. This input should be a 2 MHz, 100 mV p-p square wave. Absence of this signal would lead to troubleshooting the Reference Generator circuitry (see paragraph 4.6.4.5).

5. The signal between Q1 and U1 should be approximately 15 mV p-p. L1 should be adjusted for maximum output level. If the 15 mV p-p level cannot be approached, check Q1 and its associated circuitry. Due to the 10-12 dB attenuation across FL1, the voltage level between the filter and Q1 is difficult to measure.

6. FL1 has a center frequency of 2.0019 MHz with a bandwidth of 3.5 kHz. If the filter must be tested, remove the IF input from pin E1, and connect E1 to E8. Apply a convenient reference level signal to the coaxial SMC connector J1. The filter loss is 10-12 dB and, allowing for impedance matching losses, the signal out of FL1 will be approximately 50 dB below the entered reference level. A spectrum analyzer can be attached to test point J2 to display an amplified version of the Q1 collector signal. Before connecting the spectrum analyzer, lift C6 from between E9 and E10, and place it between E9 and E11. L1 and R41 can be adjusted to align the matching network. See paragraph 4.6.4.2.11 for the alignment procedure.

7. Q2 converts the 100 mV p-p square wave input to a 150 mV rms sine wave at pin 7 of U1. Absence of this sine wave at the proper level indicates the possibility of a defective Q2 or a defective component in the circuitry associated with Q2.

8. If the signals into the mixer U1 are verified, the next place that the voltage level can be measured is the emitter of Q3. The output of the emitter followers Q3 and Q4 should be an audio signal. Appropriate voltage measurements should be made to determine if these transistors are operating properly. These measurements will also eliminate or verify the possibility that mixer U1 is defective. Test point J3, a coaxial SMC connector, provides a place for a spectrum analyzer to be attached so that a sample of the Q3 emitter signal can be observed.

4.6.4.2.6 1st LO Counter (A7-A12) A1 Troubleshooting Procedure

Before troubleshooting the 1st LO Counter module, verify the proper operation of the 2nd LO Counter (refer to paragraph 4.6.4.2.8). The 1st LO Counter can operate properly only if the BCD frequency data from the 2nd LO Counter are entered at board pins E4 through E12. Proceed to troubleshoot the 1st LO Counter, if necessary, using the following procedure as a guide.

1. Refer to the schematic diagram (Figure 6-8), the circuit description (paragraph 3.3.6.1), and the component location information (Section V).

2. Verify the presence of a 50 kHz reference signal at board pin E2.

3. Verify the presence of +5 Vdc at board pin E16.

4. The circuit description in paragraph 3.3.6.1 contains a thorough description of the logic circuitry on the 1st LO Counter board. It is suggested that the troubleshooter use that information to isolate a defective logic integrated circuit in the counter section of the board.

5. The expected waveforms within phase detector U1 are illustrated by Figure 3-7. The approximate DC correction voltages out of U1, board pin E1, should be as follows:

Below frequency	+0.5 Vdc
Above frequency	+2.5 Vdc
Locked frequency	+1.3 ± 0.1 Vdc

4.6.4.2.7 1st LO VCO (A7-A12) A2 Troubleshooting Procedure

The Troubleshooting Trees (Figures 4-9 and 4-10) will aid in isolation of a trouble to the 1st LO VCO module. When component level testing is indicated, the following procedure may be helpful.

1. Figure 6-9 is the schematic diagram, paragraph 3.3.6.2 contains the circuit description, and Section V contains the component location information.

2. Verify the presence of +15 Vdc at board pin E5 and -15 Vdc at board pin E4.

3. Avoid voltage measurements across the tuned tank (Q4, CR4, T1, L2, L3, L4, and C14 through C19) because the loading effect of the meter will change the parameters of the tank.

4. Transistors Q1, Q2, and Q3 will be "on" with approximately 2.5 Vdc base voltage, or "off" with approximately 0 Vdc base voltage, depending on the frequency data inputs to board pins E6, E7, and E8.

5. Observe the outputs at board pins E1 and E2. These two signals should track together. If the output signal is absent at pin E1 and present at E2, check Q5 and its associated circuitry. Check Q6 and its associated circuitry, if the output signal is present at pin E1, and absent at pin E2. E2 should output a signal with amplitude sufficient to trigger TTL logic.

6. Observation of the outputs at board pins E1 and E2 could reveal a frequency that is above frequency, below frequency, or locked on frequency. The condition of the frequency should be compatible with the correction voltage at board pin E3 and the control voltage at pin E9. These two voltages should correspond to the following table.

Frequency	E3	E9
Below	+0.5 Vdc	Between -10 and -12 Vdc
Above	+2.5 Vdc	Between +10 and +12 Vdc
Locked	+1.3 Vdc±0.1 V	Between +8 and -8 Vdc

If the frequency does not appear to be responding to the correction voltage at pin E3, check the circuitry between E9 and E3. This circuitry consists of amplifier U2 with its feedback and biasing components, and the notch filter composed of C24, C25, and L7.

7. If the frequency of the signal at board pin E1 will not lock, check to see if it will lock at a different frequency by tuning C18. If lock occurs at a different frequency, troubleshoot the 1st LO Counter.

8. If the problem on the 1st VCO module cannot be isolated to any of the circuitry outside of the tuned tank, check the components within the tank. These components are Q4, CR4, T1, L2, L3, L4, and capacitors C14 through C20.

9. Refer to paragraph 4.6.4.2.10 for alignment procedures.

4.6.4.2.8 2nd LO Counter (A7-A12) A3 Troubleshooting Procedure

Before attempting to troubleshoot the 2nd LO Counter module, it should be determined that the data inputs are present at board pins E14, E15, and E16. These pins correspond to chassis pins E3, E1, and E2, respectively. Figure 4-12 illustrates the waveforms at these three lines with the Demodulator tuned to 2 kHz, inverted. The inputs shown by Figure 4-12 are 1 msec in duration and are repeated every 53 msec. The clock and enable pulses are always of the same form. The data line changes as the tuning information changes. Absence of the proper waveforms on the clock, enable, and data lines will lead the troubleshooter to the Digital Control assemblies. Digital Control Troubleshooting procedure can be found in paragraph 4.6.4.4.

After verifying that the data input lines are proper, proceed to troubleshoot the 2nd LO Counter. The following procedure may be used as a guide.

1. Refer to Figure 6-10 (schematic diagram), paragraph 3.3.6.3 (circuit description), and Section V (component location diagrams).

2. Verify the presence of the 10 kHz signal at board pin E2.

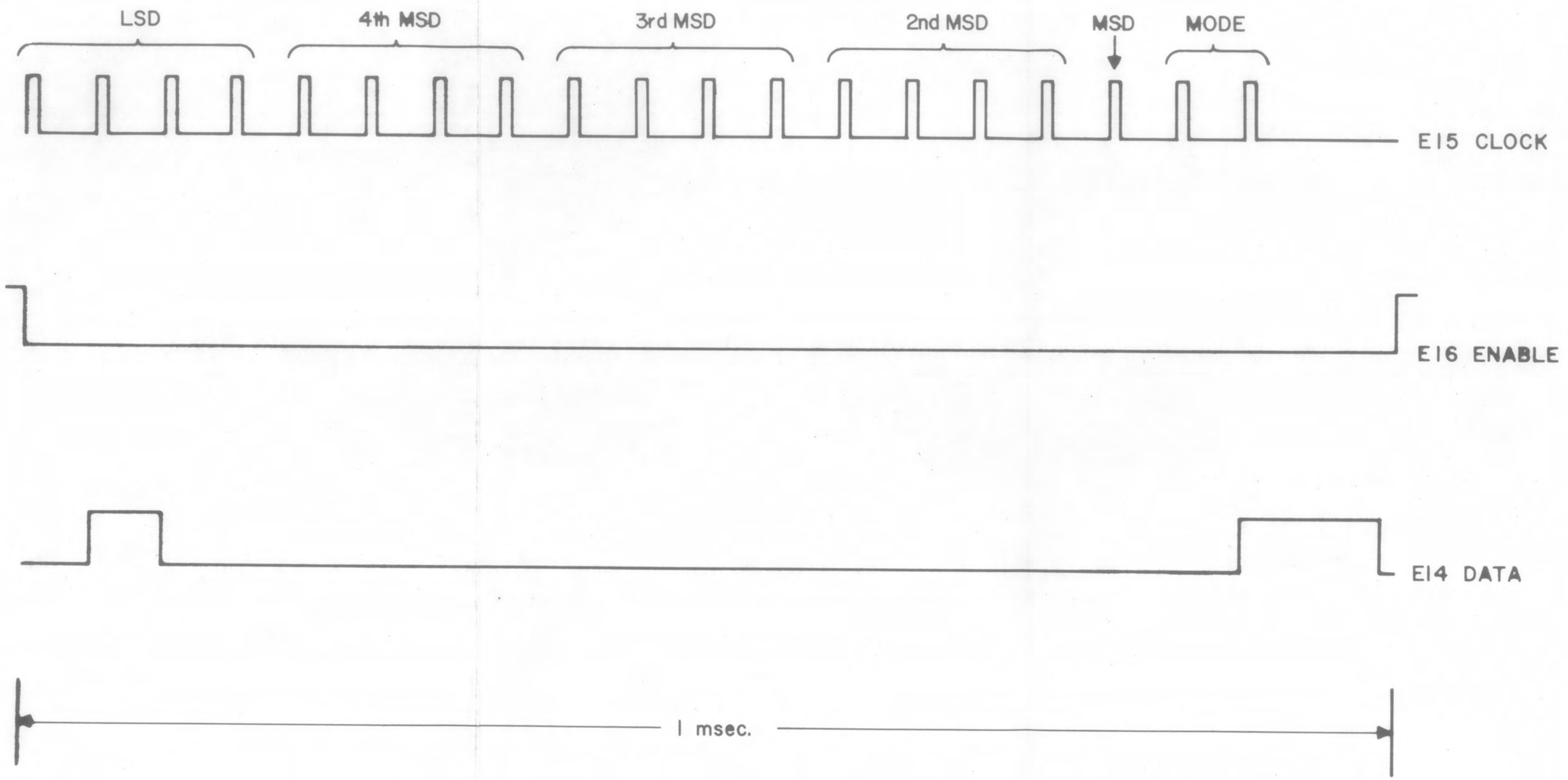


Figure 4-12. 2nd LO Counter Data Input Lines.

3. The circuit description found in paragraph 3.3.6.3 should be used to aid in isolating a defective integrated circuit.

4. The expected waveforms within the phase detector U4 are illustrated by Figure 3-7. The expected DC correction voltages from the phase detector U4 at board pin E3 should be one of those in the following table.

Below frequency	+0.5 Vdc
Above frequency	+2.5 Vdc
Locked frequency	+1.3 ± 0.1 Vdc

4.6.4.2.9 2nd LO VCO (A7-A12) A4 Troubleshooting Procedure

The Troubleshooting Trees (Figures 4-9 and 4-11) will aid in isolation of the 2nd LO VCO as a source of trouble. When component level testing is indicated, the following procedure may be helpful.

1. Refer to the schematic diagram (Figure 6-11), the circuit description (paragraph 3.3.6.4), and to component location diagrams (Section V).

2. Verify the presence of +15 Vdc at board pin E6, -15 Vdc at board pin E5, and +5 Vdc at board pin E2.

3. The voltage level at board pin E7 will be approximately 2.5 Vdc (transistor Q2 "on") or 0 Vdc (transistor Q2 "off"), depending on whether the VCO range is USB or LSB.

4. Avoid voltage measurements across the tuned tank (Q1, L2, L4, R20, C6, C8, C10, C13, C14, and CR2) because the loading effect of the meter will change the parameters of the tank.

5. The Counter output at board pin E3 cannot be measured because the circuit parameters are changed by measurement attempts. The output at board pin E1 can be measured and will be one-tenth the frequency of E3 because of the divide-by-10 action of U2. The signal level at E1 will be approximately 200 mV rms.

5. The correction voltage at board pin E4 should track with the control voltage at E10 as in the table below. If the voltage levels at these two points are not proper, amplifier U3 and the components that comprise the loop filter and the notch filter should be checked (C15, C18, C19, L7, L8, and R21).

Frequency	E4	E10
Below	+0.5 Vdc	Between -10 and -12 Vdc
Above	+2.5 Vdc	Between +10 and +12 Vdc
Locked	+1.3 Vdc ± 0.1 V	Between +8 and -8 Vdc

7. If the frequency of the signal at board pin E1 will not lock, check to see if it will lock at a different frequency by tuning C10 and C13. If lock occurs at a different frequency, troubleshoot the 2nd LO Counter.

8. If the problem cannot be isolated to any of the circuitry outside of the tuned tank, check the components within the tank. These components are Q1, CR2, L2, L4, R20, and capacitors C6, C8, C10, C13, and C14.

9. Refer to paragraph 4.6.4.2.10 for alignment procedures.

4.6.4.2.10 Demodulator/Synthesizer Alignment

4.6.4.2.10.1 1st LO VCO (A2) and Counter (A1)

1. Check A2E5 for +15 Vdc and A2E4 for -15 Vdc.

2. Connect a frequency counter lead to LO output A2E1.

3. Connect a digital voltmeter to test point A2E9.

4. Set the Demodulator controls for 00.0XX frequency.

5. Adjust A2C18 for -7.8 ± 0.02 Vdc. The frequency counter should indicate 21.400 MHz ± 0.

6. Make remaining settings as indicated below:

Unit Control Setting	Counter Frequency (MHz)	DVM	Adjust
02.00XX	23.400±0	-7.8±0.02 Vdc	L2
04.0XX	25.400±0	-7.8±0.02 Vdc	L3
08.0XX	29.400±0	-7.8±0.02 Vdc	L4

NOTE: If C18, L2, L3, or L4 must be set to extremes, check T1.

7. Set the Demodulator controls for 07.9XX frequency. The DVM should read <+8.0 Vdc. Set the Demodulator controls for 13.9XX frequency. The DVM should read <+8.0 Vdc.

8. Recheck at 00.0XX for interaction.

9. Check the VCO output as indicated below:

Unit Control Setting	Counter Frequency (MHz)
00.1XX	21.500 ± 0
00.2XX	21.600 ± 0
00.4XX	21.800 ± 0
00.8XX	22.200 ± 0

4.6.4.2.10.2 2nd LO VCO (A4) and Counter (A3)

1. Check A4E6 (+15 Vdc), A4E5 (-15 Vdc), and A4E2 (+5 Vdc).

2. Connect a frequency counter lead to A4E1.

3. Connect a digital voltmeter to A4E10.

4. Adjust the coil L2 to the extremes of its core.

5. Make adjustments as indicated below:

Unit Control Setting	Counter Frequency (MHz)	DVM	Adjust
XX.X00 Upright	23.400 ± 0	7.5 Vdc (+0 V, -0.5 V)	C13
XX.X00 Inverted	19.400 ± 0	7.5 Vdc (+0 V, -0.5 V)	C10
XX.X99 Upright	23.301 ± 0	> 3.0 Vdc	C13
XX.X99 Inverted	19.301 ± 0	> 3.0 Vdc	C10

NOTE: Check for interaction after each adjustment.

6. Check the VCO output as indicated below:

Unit Control Setting	Counter Frequency (MHz)
XX.X11 Upright	23.389 ± 0
XX.X22 Upright	23.378 ± 0
XX.X44 Upright	23.356 ± 0
XX.X88 Upright	23.312 ± 0

4.6.4.2.11 Bandpass Filter (A7-A12) A8 FL1 Alignment Procedure

The bandpass filter alignment procedure is used to minimize the amplitude ripple response, by aligning the matching network located between the bandpass filter and the mixer on the IF Demodulator subassemblies. This alignment is accomplished by adjusting variable components R41 and L1.

To access R41 and L1, first remove the four screws that secure the Demodulator/Synthesizer assembly to the center partition of the WJ-9518/9518E Demodulator chassis. Drop the assembly from the chassis, without disconnecting the wiring. Remove the assembly cover (on the mounting surface side) to access subassembly A8.

Test equipment setup is as shown in Figure 4-8. The test equipment and Demodulator controls should be set following the Group Delay test procedure outlined in steps 1 through 11 of paragraph 4.5.17.1.

Adjust potentiometer R41 while sweeping the output of the test synthesizer fast enough so that changes in amplitude ripple can be observed on the oscilloscope display, peaking L1 for maximum amplitude response after each R41 adjustment. Alternately adjust R41 and L1 until the amplitude ripple has been minimized.

4.6.4.3 Headphone Amplifier (A13) Troubleshooting Procedure

This assembly is electrically located between the demodulator output and the headphone jack (J7) on the WJ-9518/9518E front panel. A defective component in the Headphone Amplifier circuitry could lead to loss or distortion of the audio signal between the demodulator and phone jack. Before troubleshooting the Headphone Amplifier board, it is advisable to check the level control on the front panel to assure that it is not turned all the way down. Check the Demodulator Select control, also on the front panel. The Select control must be set to the channel under test in order to have a headphone output. Verify that the wiring from the demodulator is proper by checking for a signal at board pin E1. If at this point, trouble is isolated to the Headphone Amplifier module, U1 or a component associated with U1 must be defective. R1 and R3 control the gain of U1. If a distortion problem exists, check to determine if R1 or R3 have changed in resistance values.

4.6.4.4 Digital Control Troubleshooting Procedure

The Digital Control section is comprised of the following modules:

DCU #1B (A6)
DCU #2 (A5)
Display (A4)
Remote Interface (A3)

It is suggested that troubleshooting of the Digital Control section be carried out using a dual or four-trace oscilloscope. The complexity of the circuitry renders it essential that the technician be familiar with the functional and circuit descriptions given in Section III of this manual. Occasionally, the main circuit causing the trouble can be pinpointed by noting that the symptom occurs only for operating modes which involve a certain circuit. On the other hand, symptoms which occur for several operating modes would tend to lead the troubleshooter to circuitry which is active for all these modes. If a specific circuit is not performing correctly, check that it is receiving the proper inputs, and then continue step-by-step with signal and voltage checks, using the circuit descriptions and schematic diagrams as a guide, until the trouble is found.

4.6.4.5 Reference Generator (A1) Troubleshooting Procedure

The Reference Generator supplies four reference signals at four different frequencies: a 1 MHz clock pulse to the Digital Control Unit, and three reference signals to each of the six Demodulator/Synthesizer assemblies. Within the Demodulator/Synthesizers the three signals are applied to the 1st LO Counter (50 kHz), 2nd LO Counter (10 kHz), and IF Demodulator (2 MHz).

If a reference signal is missing from any one of the Demodulator/Synthesizer subassemblies, the wiring from the Reference Generator to the subassembly should be checked. Table 4-5 will aid the troubleshooter in wiring checks. The table lists the Reference Generator pin numbers that connect each of the three reference signals to each subassembly.

Table 4-5. Pin Numbers for Reference Generator Wiring Checks

Demodulator/ Synthesizer	Channel	Reference Generator Pin Numbers 2 MHz	50 kHz	10 kHz
A7	1	9	17	1
A8	2	10	18	2
A9	3	11	19	3
A10	4	12	20	4
A11	5	13	21	5
A12	6	14	22	6

If troubleshooting the Reference Generator components is necessary, Table 4-6 will aid the troubleshooter in localizing the trouble to a component or integrated circuit on the Reference Generator module. Table 4-6 lists each component and the reference frequencies dependent on its operation. Refer to the circuit description in paragraph 3.3.1 for more information.

Table 4-6. Reference Generator Component/Reference/Signal Relationships

Component	Reference Selected	Reference Signal Affected
Q1 and associated circuitry	External Internal	All None
Doubler Circuitry	External Internal	All None
U4	External Internal	None All
U3	External Internal	All All
U6A	External Internal	All All
U7	External Internal	50 kHz, 10 kHz 50 kHz, 10 kHz
U6B	External Internal	50 kHz 50 kHz
U8	External Internal	10 kHz 10 kHz

Table 4-6. Reference Generator Component/Reference/Signal Relationships (Continued)

Component	Reference Selected	Reference Signal Affected
U5	External Internal	2 MHz 2 MHz
U9	External Internal	50 kHz 50 kHz
U10	External Internal	10 kHz 10 kHz

4.6.4.6 Power Supply Troubleshooting Procedure

The power supply section consists of a main assembly and six voltage regulators located on each of the six Demodulator/Synthesizer boards.

The main assembly is centrally located near the rear of the Demodulator chassis. The assembly consists of a transformer, three rectifiers, three filters, and three voltage regulators. Voltage regulators VR1, VR2, and VR3 supply +5 V, +15 V, and -15 V, respectively. VR1 and VR2 are mounted to a heat sink adjacent to the blower located centrally on the rear panel. VR3 is mounted on the rear panel.

There are three voltage regulators located on each 1st LO VCO board. U1 supplies +10 V, U3 supplies -12 V, and U4 supplies +12 V. There are three voltage regulators located on each 2nd LO VCO board. U1 supplies +10 V, U4 supplies -12 V, and U5 supplies +12 V.

Each of the voltage regulators, VR1, VR2, and VR3, has an internal 3 ampere current limiter, so that an overload on an output bus would cause the regulator output level to drop toward zero. In this event an unpowered circuit short circuit check should be made of the regulator output for purposes of isolation of the trouble. If troubleshooting efforts indicate proper operation of all the voltage regulators, the wiring remains to be verified.

There are two slow-blow fuses located on the rear panel to protect the Power Supply circuitry. F1 is a 1.5 ampere fuse and F2 is a 0.75 ampere fuse for the 220 Vac line.

SECTION V

REPLACEMENT PARTS LIST

5.1 UNIT NUMBERING METHOD

The unit numbering method of assigning reference designations (electrical symbol numbers) has been used to identify assemblies, subassemblies (and modules) and parts. An example of the unit method follows:

Subassembly Designation A1	R1 Class and No. of Item
Identify from right to left as:	First (1) resistor (R) of first (1) subassembly (A)

As shown on the main chassis schematic, components which are an integral part of the main chassis have no subassembly designation.

5.2 REFERENCE DESIGNATION PREFIX

Partial reference designation have been used on the equipment and on the illustrations in this manual. The partial reference designations consist of the class letter(s) and identifying item number. The complete reference designations may be obtained by placing the proper prefix before the partial reference designations. Reference Designation Prefixes are provided on drawings and illustrations in parenthesis within the figure titles.

5.3 LIST OF MANUFACTURERS

Mfr. Code	Name and Address	Mfr. Code	Name and Address
01121	Allen-Bradley Company 1201 South 2nd Street Milwaukee, WI 53204	04013	Taurus Corporation 1 Academy Hill Lambertville, NJ 08530
01295	Texas Instruments, Inc. Semiconductor-Components Div. 13500 N. Central Expressway Dallas, Texas 75231	04713	Motorola, Incorporated Semiconductor Products Div 5005 East McDowell Road Phoenix, AZ 80058
02114	Ferroxcube Corp. P.O. Box 359 Mt. Marion Road Saugerties, N. Y. 12477	06978	Aladdin Electronics Div. of Aladdin Ind., Inc. 703 Murfreesboro Road Nashville, TN 37210
02289	Hi-G, Incorporated 580 Spring Street Windsor, CT 06096	07263	Fairchild Camera & Instr, Corp. Semiconductor Division 464 Ellis Street Mountain View, CA 94040
02735	RCA Corporation Solid State Division Route 202 Somerville, NJ 08876	07388	Torotel, Inc. 13402 S. 71 Highway Grandview, MO 64030

Mfr. Code	Name and Address
09023	Cornell-Dubilier Elec. Div Federal Pacific Electric Co. 2562 Dalrymple Street Sanford, NC 27330
11237	CTS Keene, Inc. Paso Robles, CA 93446
12498	Teledyne Crystalonics 147 Sherman Street Cambridge, MA 02140
13103	Thermalloy Company 2021 W. Valley View Lane Dallas, TX 75234
14632	Watkins-Johnson Company 700 Quince Orchard Dr. Gaithersburg, MD 20760
15542	Mini-Circuits Labortary Div. of Scientific Comp. Corp. 2913 Quentin Road Brooklyn, NY 11229
16179	Omni-Sprectra, Inc. 24600 Hallwood Ct. Farmington, MI 48024
17856	Siliconix, Inc. 2201 Laurelwood Rd. Santa Clara, CA 95050
18324	Signetics Corporation 811 E. Arques Avenue Sunnyvale, CA 94086
19505	Applied Engineering Prod. Co. Division of Samarius, Inc 300 Seymour Avenue Derby, CT 06418
21604	The Buckeye Stamping Co. 555 Marion Road Columbus, OH 43207
25088	Siemens America, Inc. 186 Wood Avenue S. Iselin, NJ 08830
26805	Americon Microwave Ind., Inc. 87 Rumford Avenue Waltham, MA 02154
27014	National Semi-Conductor Corp. 2950 San Ysidro Way Santa Clara, CA 95051
27956	Relcom 3333 Hillview Ave, Palo Alto, CA 94304
28480	Hewlett-Packard Co. Corporate Headquarters 1501 Page Mill Road Palo Alto, CA 94304
28875	IMC Magnetics Corp. New Hampshire Division Route 16 Rochester, NH 03867
33095	Spectrum Control, Inc. 152 E. Main Street Fairview, PA 16415

Mfg. Code	Name and Address	Mfr. Code	Name and Address
34156	Semicoa Elctrnc. Components 333 McCormick Avenue Costa Mesa, CA 92626	75042	TRW IRC Fixed Resistors 401 N. Broad Street Philadelphia, PA 19108
37942	P.R. Mallory & Co., Inc. 3029 E. Washington St. Indianapolis, IN 46206	77820	Bendix Corporation The Electrical Comp. Div. Sherman Avenue Sidney, NY 13838
56289	Sprague Electric Co. Marshall Street North Adams, MA 01247	80058	Joint Electronic Type Designation System
71279	Cambridge Thermionic Corp. 445 Concord Avenue Cambridge, MA 02138	80103	Lambda Electronics Corp. Div. of Veeco Instr., Inc. 515 Broad Hollow Rd. Melville, NY 11746
71400	Bussman Manufacturing Division of McGraw-Edison Co. 2536 W. University Street St. Louis, MO 63107	80131	Electronic Industries Assoc. 2001 Eye Street, N.W. Washington, DC 20006
72136	Electro Motive Mfg. Co., Inc. South Park & John Streets Willimantic, CT 06226	81349	Military Specifications
72982	Erie Tech. Products, Inc. 644 West 12th Street Erie, PA 16512	82389	Switchcraft, Inc. 5555 N. Elston Avenue Chicago, IL 60630
73138	Beckman Instr., Inc. Helipot Division 2500 Harbor Blvd. Fullerton, CA 92634	83740	Union Carbide Corporation Consumers Product Div. 270 Park Avenue New York, NY 10017
74868	Bunker Ramo Corp The Amphenol RF Div. 33 East Franklin St. Danbury, CT 06810	91293	Johanson Mfg. Company P.O. Box 329 Boonton, NJ 07005

Mfg. Code	Name and Address	Mfr. Code	Name and Address
91833	Keystone Electronics Corp. 49 Bleeker Street New York, NY 10012	98978	International Electronic Research Corporation 135 West Magnolia Blvd. Burbank, Calif. 91502
93332	Sylvania Electric Pro., Inc Semiconductor Products Div. 100 Sylvan Road Woburn, MA 01801	99800	American Precision Industries Delevan Electronics Division 270 Quaker Road East Aurora, N.Y. 14052

5.4 PARTS LIST

The part list which follows contains all electrical parts used in the equipment and certain mechanical parts which are subject to unusual wear or damage. When ordering replacement parts from Watkins-Johnson Company, specify the type and serial number of the equipment and the reference designation and description of each part ordered. The list of manufacturers provided in paragraph 5.3 and the manufacturer's part number for components are included as a guide to the user of the equipment in the field. These parts may not necessarily agree with the parts installed in the equipment; however, the parts specified in this list will provide satisfactory operation of the equipment. Replacement parts may be obtained from any manufacturer as long as the physical and electrical parameters of the part selected agree with the original indicated part. In the case of components defined by a military or industrial specification, a vendor which can provide the necessary component is suggested as a convenience to the user.

NOTE

As improved semi-conductors become available, it is the policy of Watkins-Johnson to incorporate them in proprietary products. For this reason some transistors, diodes and integrated circuits installed in the equipment may not agree with those specified in the parts list and schematic diagrams of this manual. However, the semi-conductors designated in the manual may be substituted in every case with satisfactory results.

5.5 TYPE WJ-9518/9518E FDM DEMODULATOR, MAIN CHASSIS

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
A1	Reference Generator	1	791540	14632	
A2	Distribution Amplifier	1	791548	14632	
A3	Remote Interface	1	791543	14632	
A4	Display	1	791541	14632	
A5	Digital Control Unit #2	1	791539	14632	
A6	Digital Control Unit #1B	1	796023	14632	
A7	Demodulator/Synthesizer (WJ-9518 only)	6	796024-1	14632	
A7	Demodulator/Synthesizer (WJ-9518E only)	6	796024-2	14632	
A8 Thru A12	Same as A7 *				
A13	Headphones Amplifier	1	791549	14632	
B1	Blower Fan	1	MBC2206F6	28875	
BT1	Battery	1	N4546	83740	
CR1	Diode	2	FLV250	07263	
CR2	Same as CR1				
CR3	Diode	2	1N1614	80131	02735
CR4	Same as CR3				
C1	Capacitor, Electrolytic, Aluminum: 19,500 μF, +100- 10%, 20 V	1	FALM19500-20A3	09023	
C2	Capacitor, Electrolytic, Tantalum: 4.7 μF, 10%, 35 V	3	CS13BF475K	81349	56289
C3	Capacitor, Electrolytic, Aluminum: 600 μF, +75- 10%, 16 V	1	NLW600-16	09023	
C4	Capacitor, Electrolytic, Aluminum: 3000 μF, +150- 10%, 35 V	1	WBR3000-35	09023	
C5	Same as C2				
C6	Capacitor, Electrolytic, Aluminum: 100 μF, +75- 10%, 25 V	1	NLW100-25	09023	
C7	Capacitor, Electrolytic, Aluminum: 1000 μF, +75- 10%, 40 V	1	39D108G040GP4	56289	
C8	Same as C2				
C9	Capacitor, Electrolytic, Aluminum: 50 μF, +75- 10%, 25 V	1	NLW50-25	09023	
C10	Capacitor, Ceramic, Disc: 0.47 μF, 10%, 100 V	1	8131M100-651-474M	72982	
C11	Capacitor, Metallized, Polyester: 0.47 μF, 10%, 100 V	1	MMW4P47	09023	
C12	Capacitor, Mica, Dipped: 1000 pF, 5%, 100 V	2	DM15-102J	72136	
C13	Same as C12				
C14	Capacitor, Ceramic, Disc: 0.1 μF, 20%, 100 V	2	8131M100-651-104M	72982	
C15	Same as C14				
FL1	Filter, Low-Pass	2	51-311-318	33095	
FL2	Same as FL1				
	* Designated by Unit Model Number				

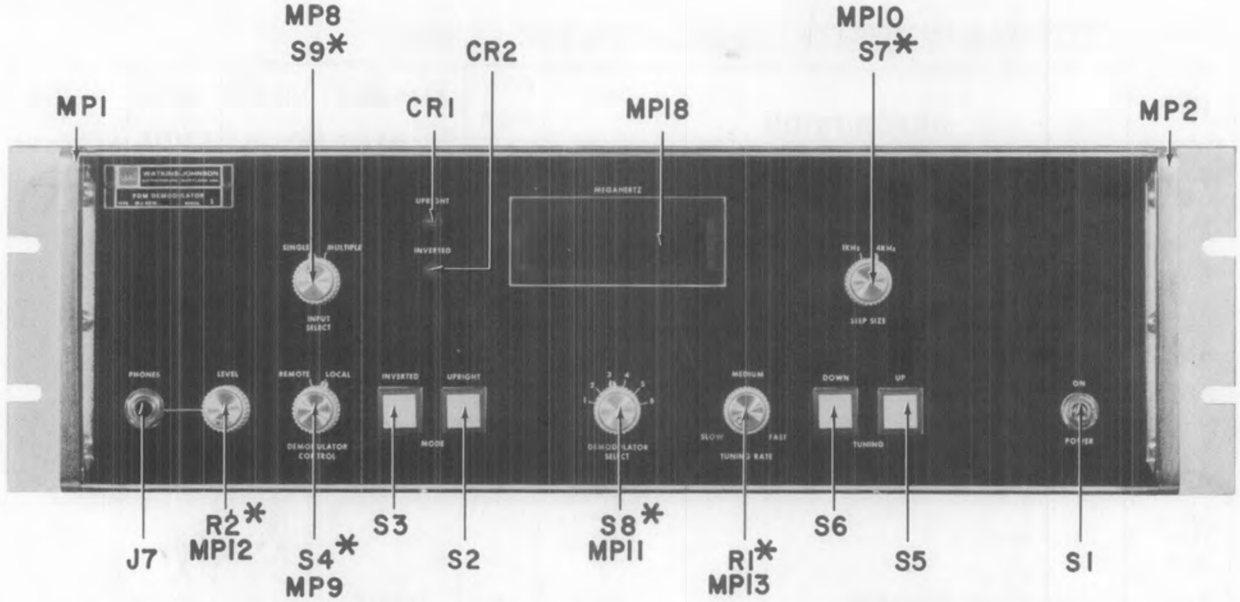


Figure 5-1. Type WJ-9518/9518E FDM Demodulator, Front View, Location of Components

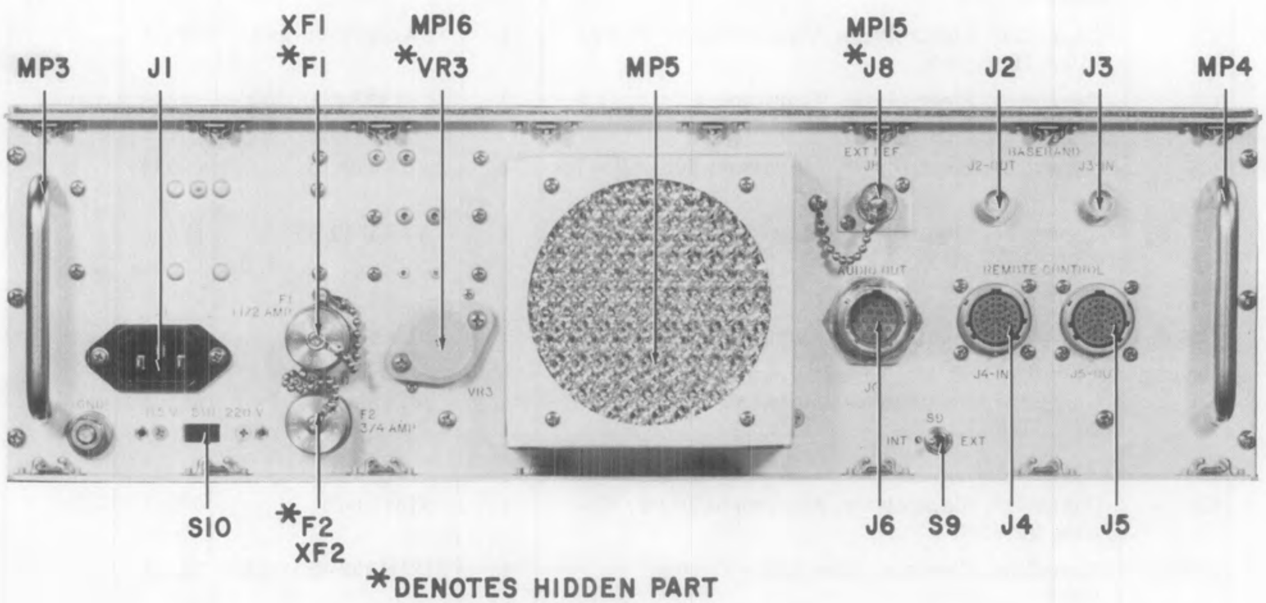


Figure 5-2. Type WJ-9518/9518E FDM Demodulator, Back View, Location of Components

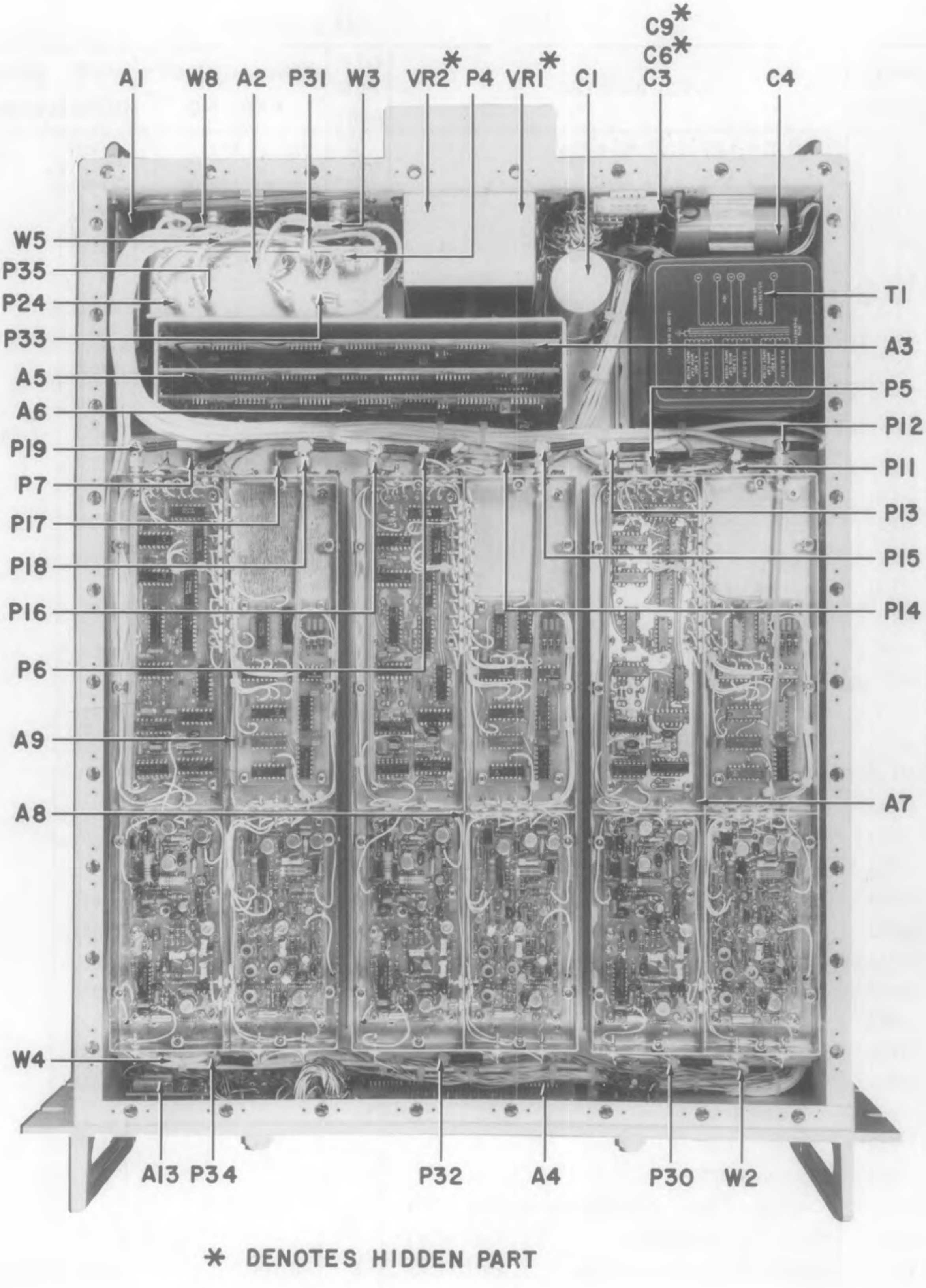


Figure 5-3. Type WJ-9518/9518E Demodulator, Top View, Location of Components

MAIN CHASSIS

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
F1	Fuse: 1.5 AMP, 3AG, Slow-Blow	1	MDX1.5	71400	
F2	Fuse: 3/4 AMP, 3AG, Slow-Blow	1	MDL3/471400	71400	
J1	Connector, Receptacle	1	EAC301	82389	
J2	Connector, Receptacle: BNC Series Part of W9	3	17825-1002	74868	
J3	Same as J2 Part of W8				
J4	Connector, Receptacle, Multipin	2	JTP02RE14-37S	77820	
J5	Same as J4				
J6	Connector, Assembly	1	280006	14632	
J7	Connector, Phone Jack	1	L11	82389	
J8	Connector, Receptacle: BNC Series	1	UG1094/U	80058	74868
L1	Coil, Fixed: 2.7 μH	1	1537-22	99800	
MP1	Handle	2	32306-1	14632	
MP2	Same as MP1				
MP3	Handle	2	415-1250-02-02	71279	
MP4	Same as MP3				
MP5	Cover, Fan	1	280048	14632	
MP6	Cover (Not Shown)	2	51145	14632	
MP7	Same as MP6 (Not Shown)				
MP8	Knob	4	PS70PL2/LG	21604	
MP9	Same as MP8				
MP10	Same as MP8				
MP11	Same as MP8				
MP12	Knob	2	PS70D2/LG	21604	
MP13	Same as MP12				
MP14	PC Handle	1	15689-1	14632	
MP15	Alignment Tool	1	5284	14632	
MP16	Protective Cap: BNC Series	1	31006	14632	
MP17	Cover, Voltage Regulator	1	4632	91833	
MP18	Display Window	1	24018	14632	
MP19	Shroud Assembly	1	34942	14632	
MP20	Heatsink, Bottom	2	34940	14632	
MP21	Same as MP20				
MP22	Heatsink, Top	2	34941	14632	
MP23	Same as MP22				
P1	Connector, Power Plug (Not Shown) Part of W1				
P2	Same as P1 (Not Shown) Part of W1				
P3	Connector, Plug: SMC Series Part of W8	8	UG1466/U	80058	19505
P4	Same as P3 Part of W9				
P5	Connector, Plug: SMA Series	30	521-3	16179	
P6 Thru P28	Same as P5				

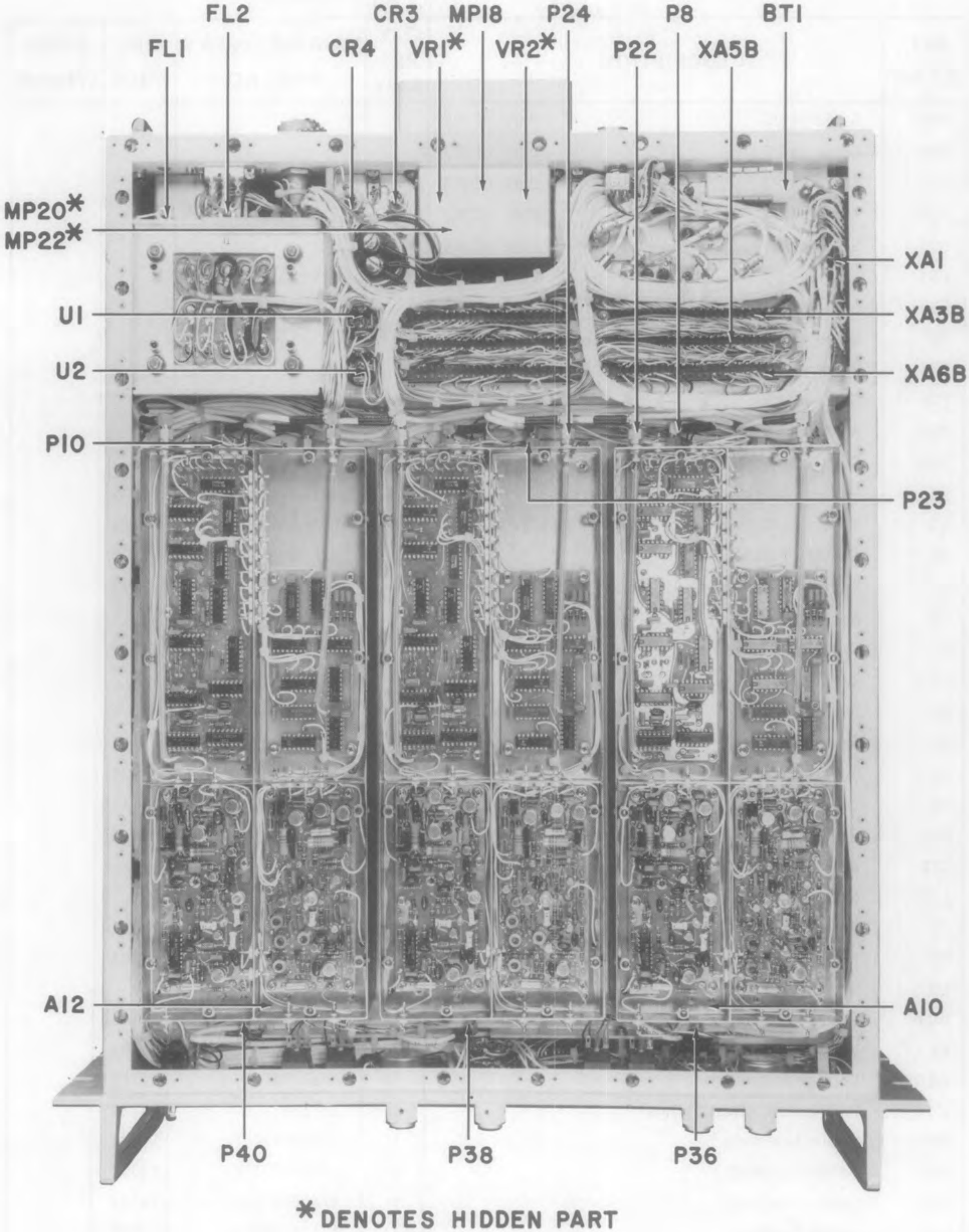


Figure 5-4. Type WJ-9518/9518E, Bottom View, Location of Components

MAIN CHASSIS

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
P29	Same as P3 Part of W2				
P30	Same as P5 Part of W2				
P31	Same as P3 Part of W3				
P32	Same as P5 Part of W3				
P33	Same as P3 Part of W4				
P34	Same as P5 Part of W4				
P35	Same as P3 Part of W5				
P36	Same as P5 Part of W5				
P37	Same as P3 Part of W6				
P38	Same as P5 Part of W6				
P39	Same as P3 Part of W7				
P40	Same as P5 Part of W7				
R1	Potentiometer, Modified: 500 kΩ	1	18712	14632	
R2	Resistor, Variable, Composition: 10 kΩ, 10%, 2 W	1	RV4NAYSD103C	01121	
S1	Switch, Toggle, SPST	1	8280K16	27193	
S2	Switch, Pushbutton: SPDT	4	BXR05-3	82389	
S3	Same as S2				
S4	Switch, Modified	2	1128-22	14632	
S5	Same as S2				
S6	Same as S2				
S7	Same as S4				
S8	Switch, Modified	1	1128-03	14632	
S9	Switch,Toggle: DPDT	1	MTA206N	95146	
S10	Switch, Slide: DPDT	1	11A1211	82389	
S11	Not Used				
S12	Not Used				
T1	Transformer	1	18116	14632	
U1	Full Wave Bridge Rectifier	2	PK20F	83701	
U2	Same as U1				
VR1	Voltage Regulator	1	LAS1905	80103	
VR2	Voltage Regulator	1	LAS1415	80103	
VR3	Voltage Regulator	1	MC7915CK	04713	
W1	Power Cable (Not Shown)	1	17-250	16428	
W2	Cable Assembly	1	17300-161-1	14632	
W3	Cable Assembly	1	17300-161-2	14632	
W4	Cable Assembly	1	17300-161-3	14632	
W5	Cable Assembly	1	17300-161-4	14632	
W6	Cable Assembly	1	17300-161-5	14632	
W7	Cable Assembly	1	17300-161-6	14632	
W8	Cable Assembly	1	17300-161-7	14632	
W9	Cable Assembly	1	17300-161-8	14632	

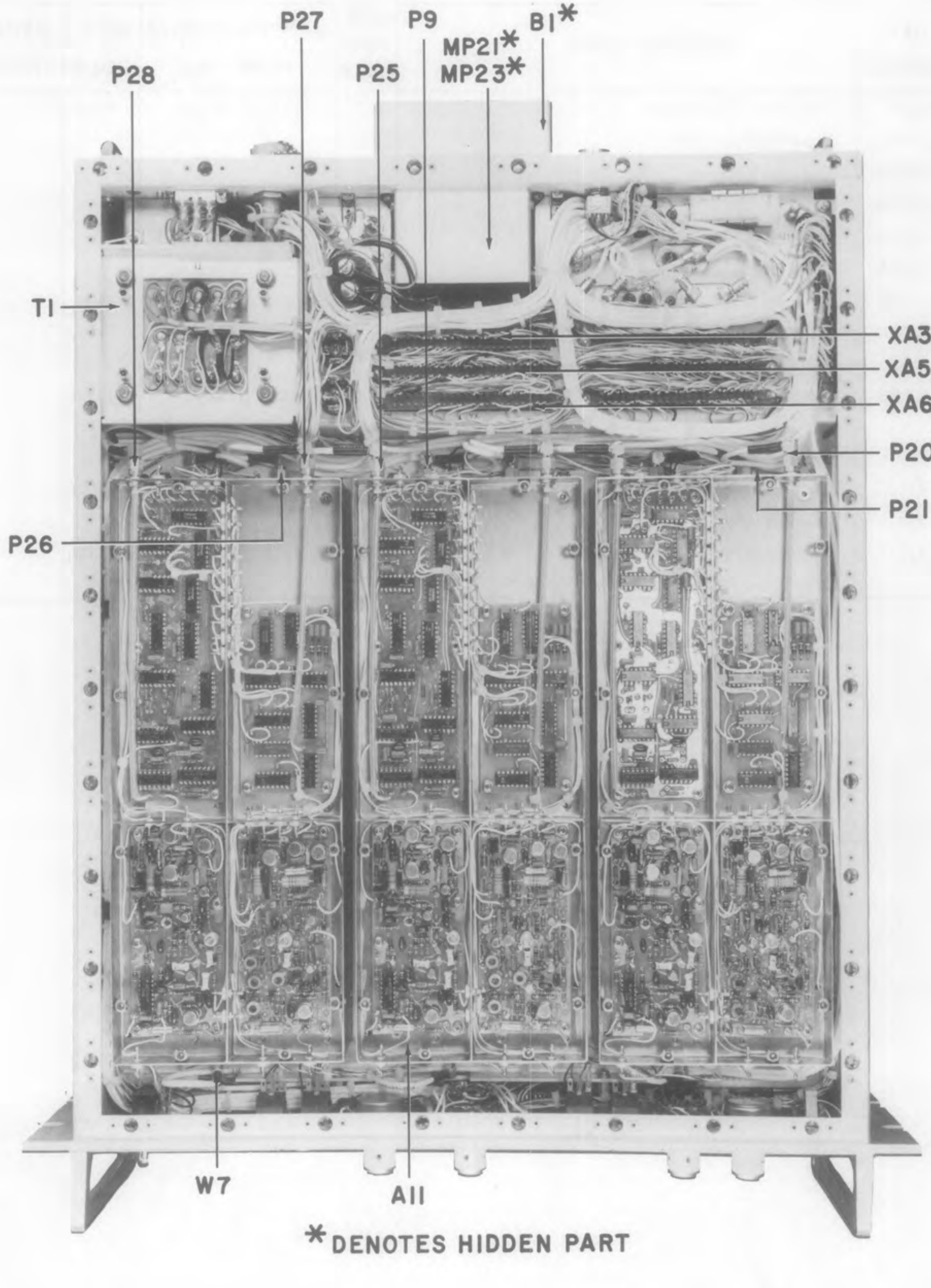


Figure 5-5. Type WJ-9518/9518E Demodulator Bottom View, Location of Components

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REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
XA1	Connector, PC Board	7	251-22-30-160	71785	
XA3A	Same as XA1				
XA3B	Same as XA1				
XA5A	Same as XA1				
XA5B	Same as XA1				
XA6A	Same as XA1				
XA6B	Same as XA1				
XF1	Fuseholder, Shielded	2	340255	75915	
XF2	Same as XF1				
XVR3	Socket, Transistor	1	8080-1G1	91506	
	Accessory Items Furnished With Equipment:				
AI1	Connector, Plug, Multipin	2	JT06RE14-37PSR	77820	
AI2	Same as AI1				
AI3	Connector, Plug, Multipin	1	118-28E14-10S1	03554	

5.5.1 TYPE 791540 REFERENCE GENERATOR REF DESIG PREFIX A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
CR1	Diode	2	5082-2800	28480	
CR2	Same as CR1				
C1	Capacitor, Ceramic, Disc: 0.1 μF, 20%, 100 V	7	8131M100-651-104M	72982	
C2	Capacitor, Electrolytic, Tantalum: 39 μF, 10%, 10 V	2	CS13BC396K	81349	56289
C3	Same as C1				
C4	Same as C1				
C5	Same as C1				
C6	Same as C1				
C7	Capacitor, Mica, Dipped: 1600 pF, 2%, 500 V	1	CM06FD162GO3	81349	72136
C8	Same as C1				
C9	Same as C1				
C10	Capacitor, Ceramic, Disc: 0.47 μF, 20%, 100 V	7	8131M100-651-474M	72982	
C11 Thru C16	Same as C10				
C17	Same as C2				
L1	Coil, Variable	1	558-7107-20	71279	
Q1	Transistor	1	2N2857	80131	02735
R1	Resistor, Fixed, Composition: 75Ω, 5%, 1/4 W	1	RCR07G750JS	81349	01121
R2	Resistor, Fixed, Composition: 10Ω, 5%, 1/4 W	2	RCR07G100JS	81349	01121
R3	Same as R2				
R4	Resistor, Fixed, Composition: 1.5 kΩ, 5%, 1/4 W	1	RCR07G152JS	81349	01121
R5	Resistor, Fixed, Composition: 120 Ω, 5%, 1/4 W	2	RCR07G121JS	81349	01121
R6	Resistor, Fixed, Composition: 3.9 kΩ, 5%, 1/4 W	1	RCR07G392JS	81349	01121
R7	Resistor, Fixed, Composition: 47Ω, 5%, 1/4 W	7	RCR07G470JS	81349	01121
R8	Resistor, Fixed, Composition: 1.8 kΩ, 5%, 1/4 W	1	RCR07G182JS	81349	01121
R9	Resistor, Fixed, Composition: 100Ω , 5%, 1/4 W	1	RCR07G101JS	81349	01121
R10	Same as R5				
R11	Resistor, Fixed, Composition: 33 Ω, 5%, 1/4 W	1	RCR07G330JS	81349	01121
R12	Same as R7				
R13	Resistor, Fixed, Composition: 1 kΩ, 5%, 1/4 W	7	RCR07G102JS	81349	01121
R14	Same as R7				
R15	Same as R13				
R16	Same as R7				
R17	Same as R13				
R18	Same as R7				
R19	Same as R13				
R20	Same as R7				
R21	Same as R13				
R22	Same as R7				

REF DESIG PREFIX A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R23	Same as R13				
R24	Same as R13				
T1	Transformer	1	70-122-02	06978	
U1	Not Used				
U2	Not Used				
U3	Integrated Circuit	1	SN74LS00N	01295	
U4	Temperature-Compensated Crystal Oscillator	1	92063-1	14632	
U5	Integrated Circuit	3	SN74LS04N	14632	
U6	Integrated Circuit	1	SN74LS74N	14632	
U7	Integrated Circuit	2	SN74LS90N	14632	
U8	Same as U7				
U9	Same as U5				
U10	Same as U5				

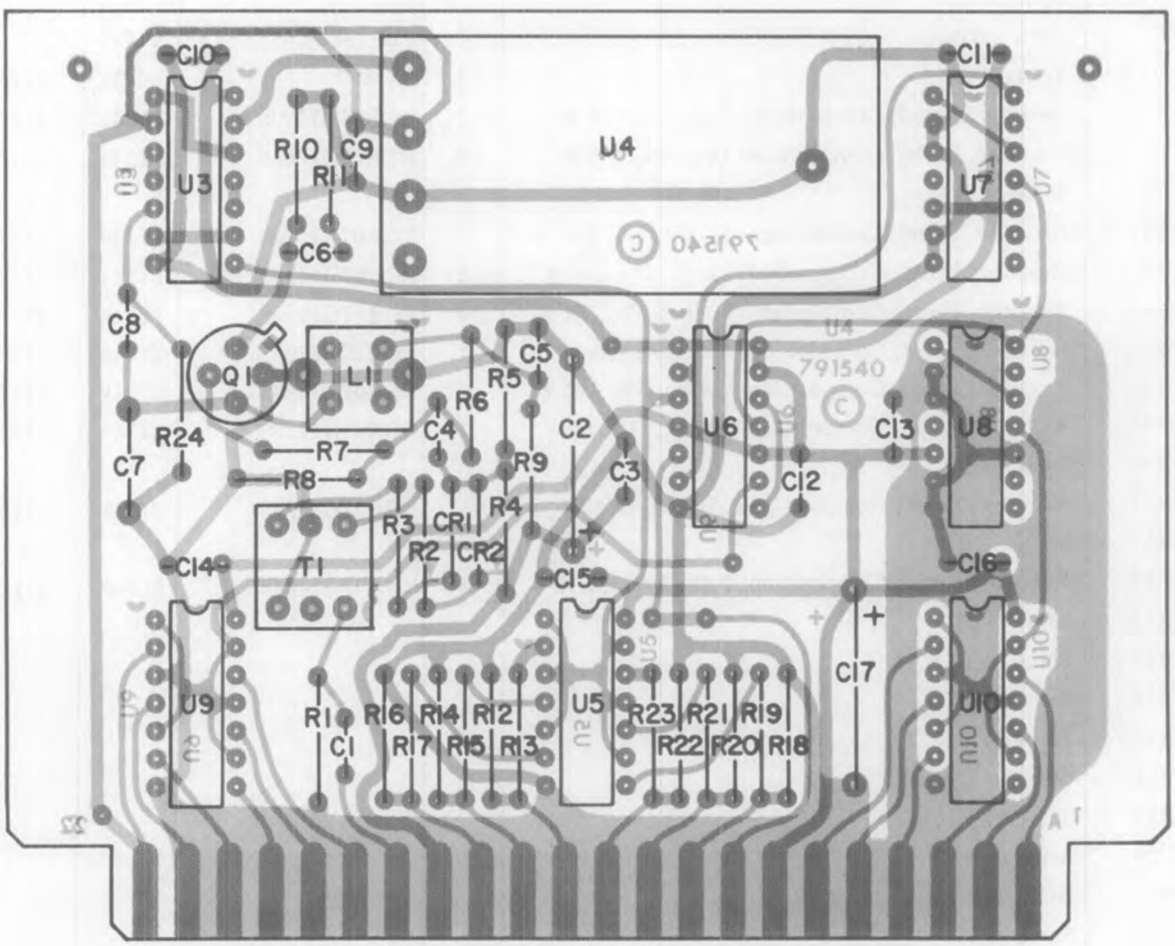


Figure 5-6. Type 791540 Reference Generator (A1), Location of Components

5.5.2 TYPE 791548 DISTRIBUTION AMPLIFIER ASSEMBLY REF DESIG PREFIX A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
A1	Distribution Amplifier	1	791797	14632	
C1	Capacitor, Ceramic, Feedthru: 1000 pF, GMV, 500 V	1	54-794-009-102W	33095	
J1	Connector, Receptacle: SMC Series	8	10-0104-002	19505	
J2	Same as J1				
J3	Same as J1				
J4	Same as J1				
J5	Same as J1				
J6	Same as J1				
J7	Same as J1				
J8	Same as J1				
RA1	Heat Sink	7	TXP0508	98978	
RA2	Same as RA1				
RA3	Same as RA1				
RA4	Same as RA1				
RA5	Same as RA1				
RA6	Same as RA1				
RA7	Same as RA1				

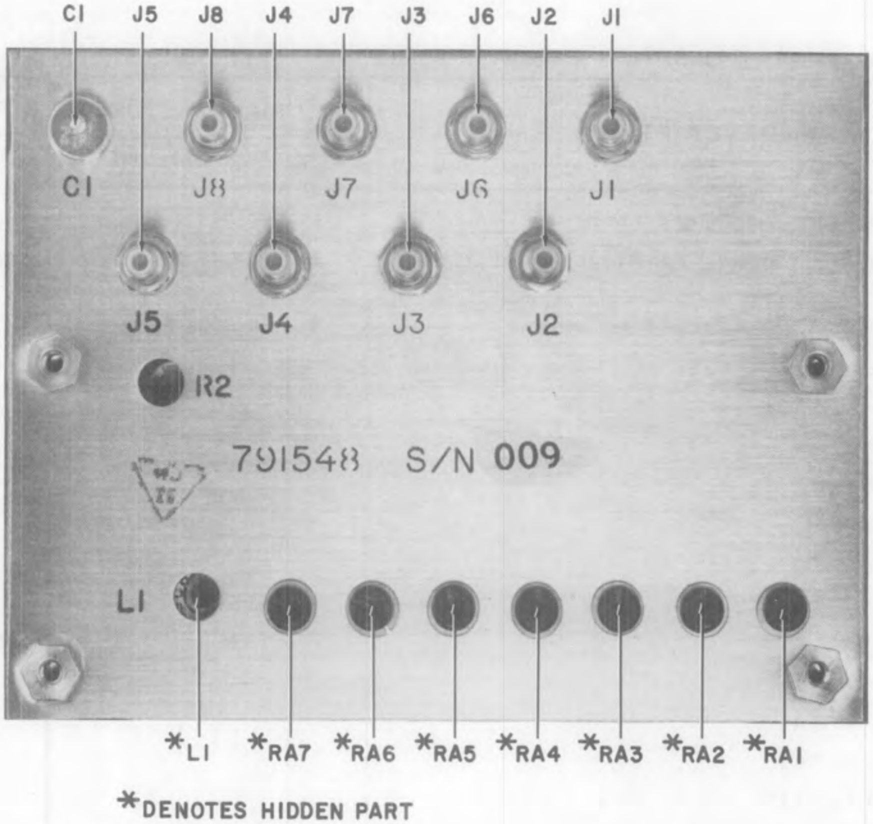


Figure 5-7. Type 791548 Distribution Amplifier Assembly (A2), Front View, Location of Components

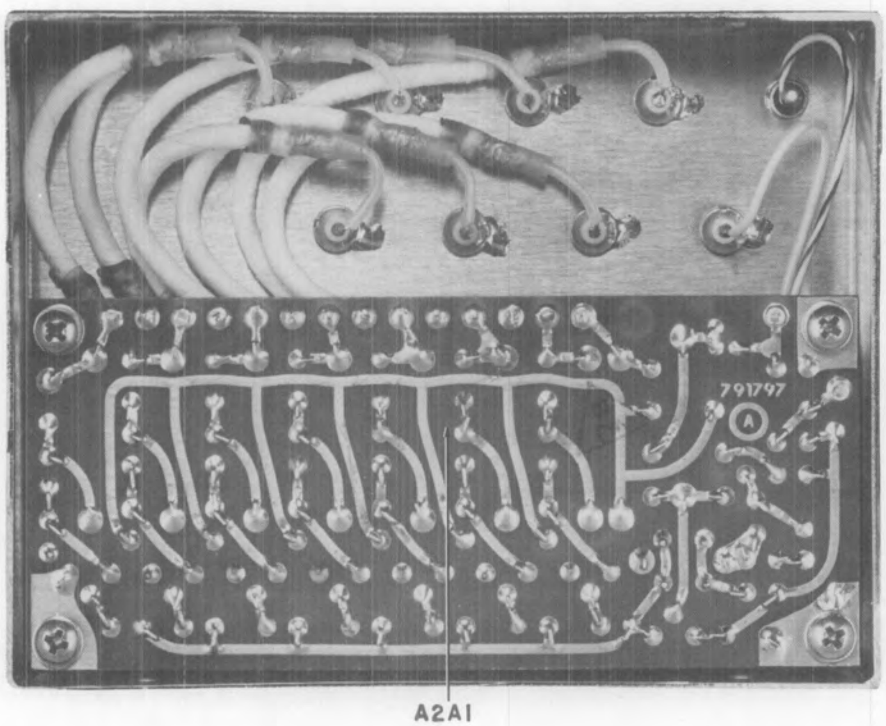


Figure 5-8. Type 791548 Distribution Amplifier Assembly (A2), Back View, Location of Components

5.5.2.1 Type 791797 Distribution Amplifier REF DESIG PREFIX A2A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
CR1	Diode	1	1N4446	80131	93332
C1	Capacitor, Electrolytic, Tantalum: 45 μF, 20% 30 V	10	MTP456M030P1B	37942	
C2	Capacitor, Ceramic, Disc: 0.01 μF, 20%, 200 V	10	8131A200Z5U103M	72982	
C3	Same as C1				
C4	Same as C2				
C5	Same as C2				
C6	Same as C1				
C7	Same as C2				
C8	Same as C1				
C9	Same as C2				
C10	Same as C1				
C11	Same as C2				
C12	Same as C1				
C13	Same as C2				
C14	Same as C1				
C15	Same as C2				
C16	Same as C1				
C17	Same as C2				
C18	Same as C1				
C19	Same as C2				
C20	Same as C1				
E1	Terminal, Forked	16	140-1941-02-01	71279	
E2 Thru E16	Same as E1				
L1	Coil, Variable: 1.98-2.42 μH	1	558-7107-17	71279	
Q1	Transistor	1	2N2222A	80131	04713
Q2	Transistor	1	CP643	12498	
Q3	Transistor	7	2N5109	80131	02735
Q4 Thru Q9	Same as Q3				
R1	Resistor, Fixed, Composition: 200 Ω, 5%, 1/4 W	1	RCR07G201JS	81349	01121
R2	Resistor, Variable, Film: 100 Ω, 10%, 1/2 W	1	62PR100	73138	
R3	Not Used				
R4	Not Used				
R5	Resistor, Fixed, Composition: 47 Ω, 5%, 1/4 W	1	RCR07G470JS	81349	01121
R6	Resistor, Fixed, Composition: 22 Ω, 5%, 1/4 W	1	RCR07G220JS	81349	01121
R7	Resistor, Fixed, Composition: 560 Ω, 5%, 1/4 W	1	RCR07G561JS	81349	01121
R8	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/4 W	1	RCR07G103JS	81349	01121
R9	Resistor, Fixed, Composition: 200 Ω, 5%, 1/4 W	1	RCR07G201JS	81349	01121

REF DESIG PREFIX A2A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R10	Resistor, Fixed, Composition: 22 Ω, 5%, 1/4 W	7	RCR07G220JS	81349	01121
R11	Resistor, Fixed, Composition: 39 Ω, 5%, 1/4 W	7	RCR07G390JS	81349	01121
R12	Resistor, Fixed, Composition: 220 Ω, 5%, 1/4 W	7	RCR07G221JS	81349	01121
R13	Same as R10				
R14	Same as R11				
R15	Same as R12				
R16	Same as R10				
R17	Same as R11				
R18	Same as R12				
R19	Same as R10				
R20	Same as R11				
R21	Same as R12				
R22	Same as R10				
R23	Same as R11				
R24	Same as R12				
R25	Same as R10				
R26	Same as R11				
R27	Same as R12				
R28	Same as R10				
R29	Same as R11				
R30	Same as R12				
R31	Resistor, Fixed, Composition: 10 Ω, 5%, 1/4 W	1	RCR07G100JS	81349	01121

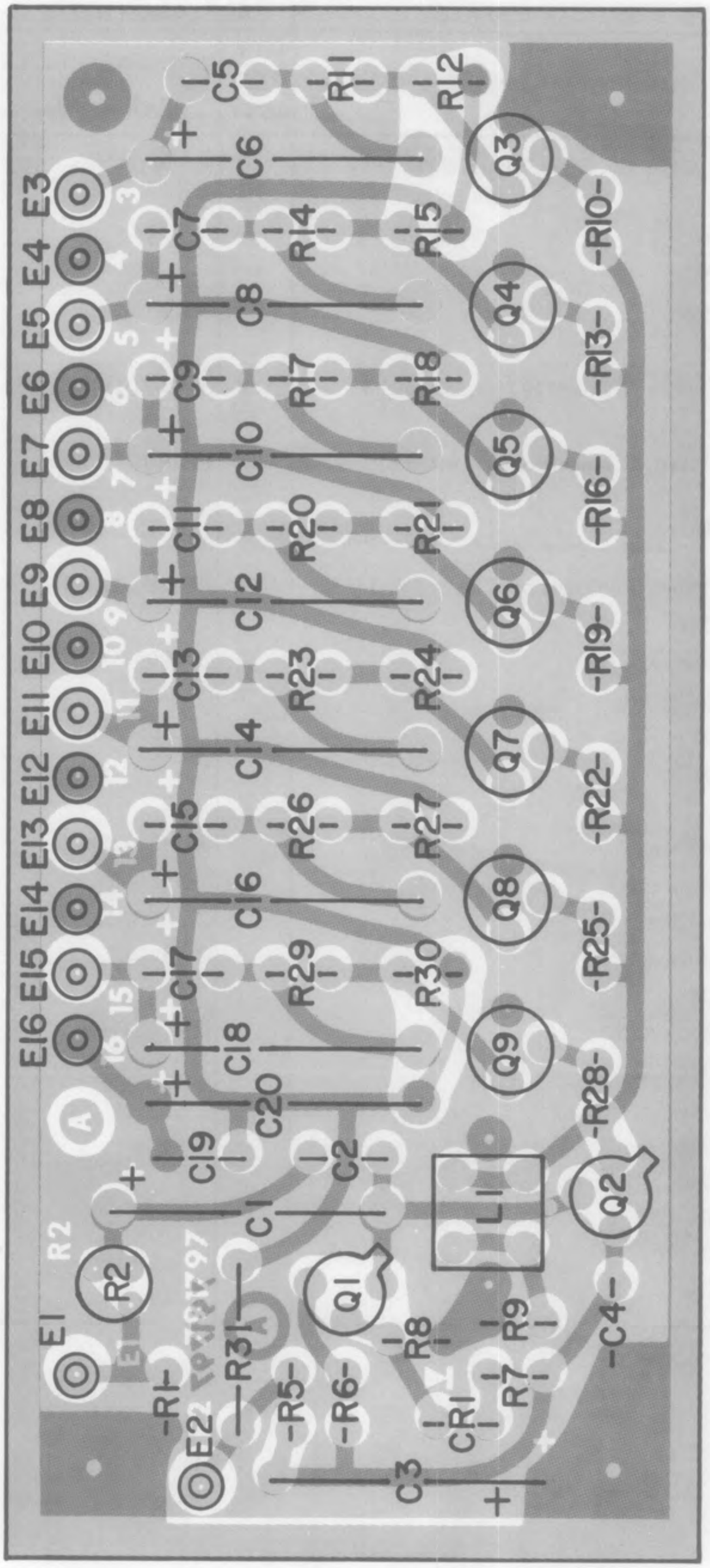


Figure 5-9. Type 791797 Distribution Amplifier (A2A1), Location of Components

5.5.3 TYPE 791543 REMOTE INTERFACE REF DESIG PREFIX A3

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Disc: 0.1 µF, 20%, 100V	6	8131M100-651-104M	72982	
C2	Same as C1				
C3	Same as C1				
C4	Same as C1				
C5	Same as C1				
C6	Same as C1				
C7	Capacitor, Mica, Dipped: 100 pF, 2%, 500 V	2	CM05FD101G03	81349	72136
C8	Same as C7				
R1	Resistor, Fixed, Composition: 4.7 kΩ, 5%, 1/4 W	23	RCR07G472JS	81349	01121
R2 Thru R23	Same as R1				
R24	Resistor, Fixed, Composition: 22 kΩ, 5%, 1/4 W	2	RCR07G223JS	81349	01121
R25	Same as R24				
S1	Switch, Slide: 5 SPDT	1	CTS206-5	11237	
U1	Integrated Circuit	7	CD4050AE	02735	
U2	Same as U1				
U3	Same as U1				
U4	Not Used				
U5	Integrated Circuit	1	SN74LS123N	01295	
U6	Integrated Circuit	1	SN74LS00N	01295	
U7	Integrated Circuit	1	CD4013AE	02735	
U8	Integrated Circuit	2	CD4063BE	02735	
U9	Same as U8				
U10	Integrated Circuit	4	MM74C174N	27014	
U11	Same as U10				
U12	Same as U10				
U13	Same as U10				
U14	Same as U1				
U15	Same as U1				
U16	Same as U1				
U17	Same as U1				

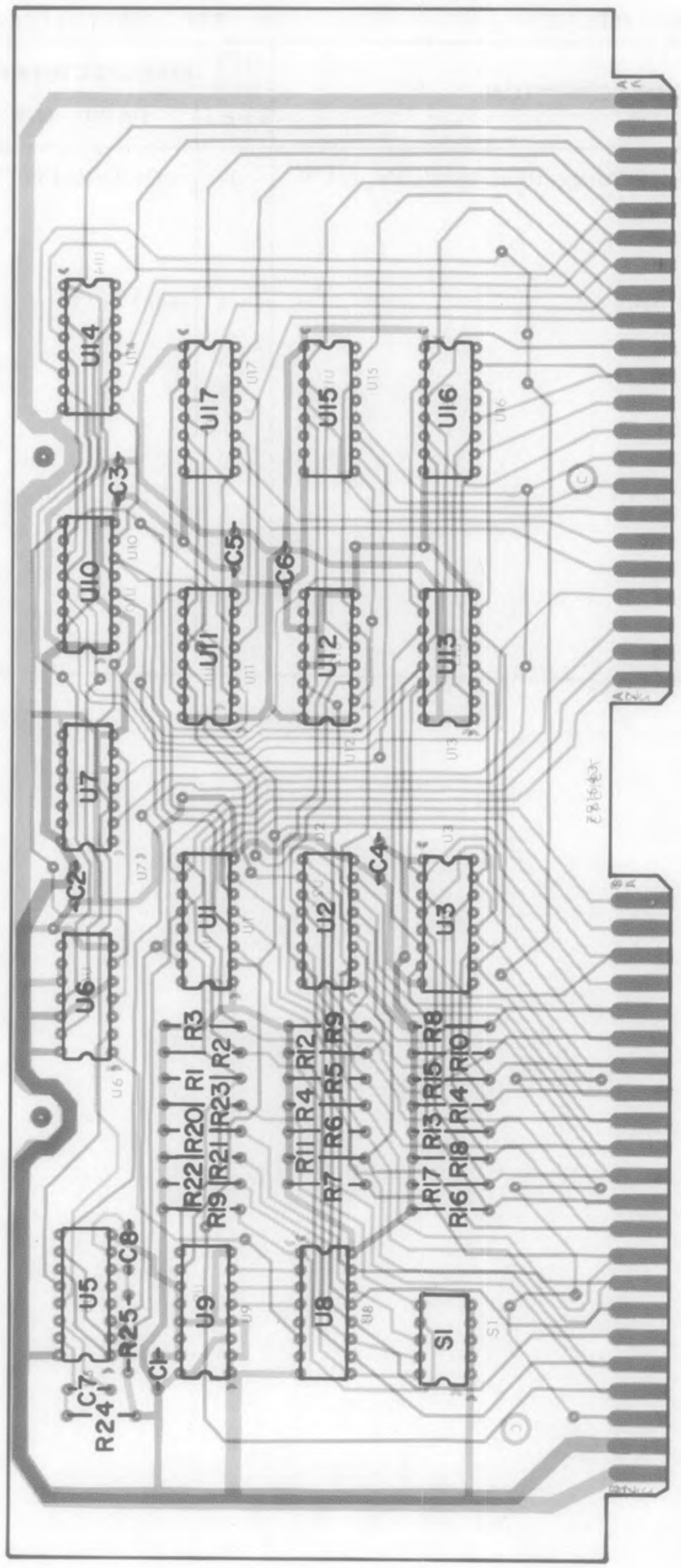


Figure 5-10. Type 791543 Remote Interface (A3), Location of Components

5.5.4 TYPE 791541 DISPLAY REF DESIG PREFIX A4

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R1	Resistor, Fixed, Composition: 680Ω, 5%, 1/4 W	37	RCR07G681JS	81349	01121
R2 Thru R37	Same as R1				
U1	Integrated Circuit	5	5082-7613	28480	
U2	Same as U1				
U3	Same as U1				
U4	Same as U1				
U5	Same as U1				
U6	Integrated Circuit	5	MC14511BCP	04713	
U7	Same as U6				
U8	Same as U6				
U9	Same as U6				
U10	Same as U6				

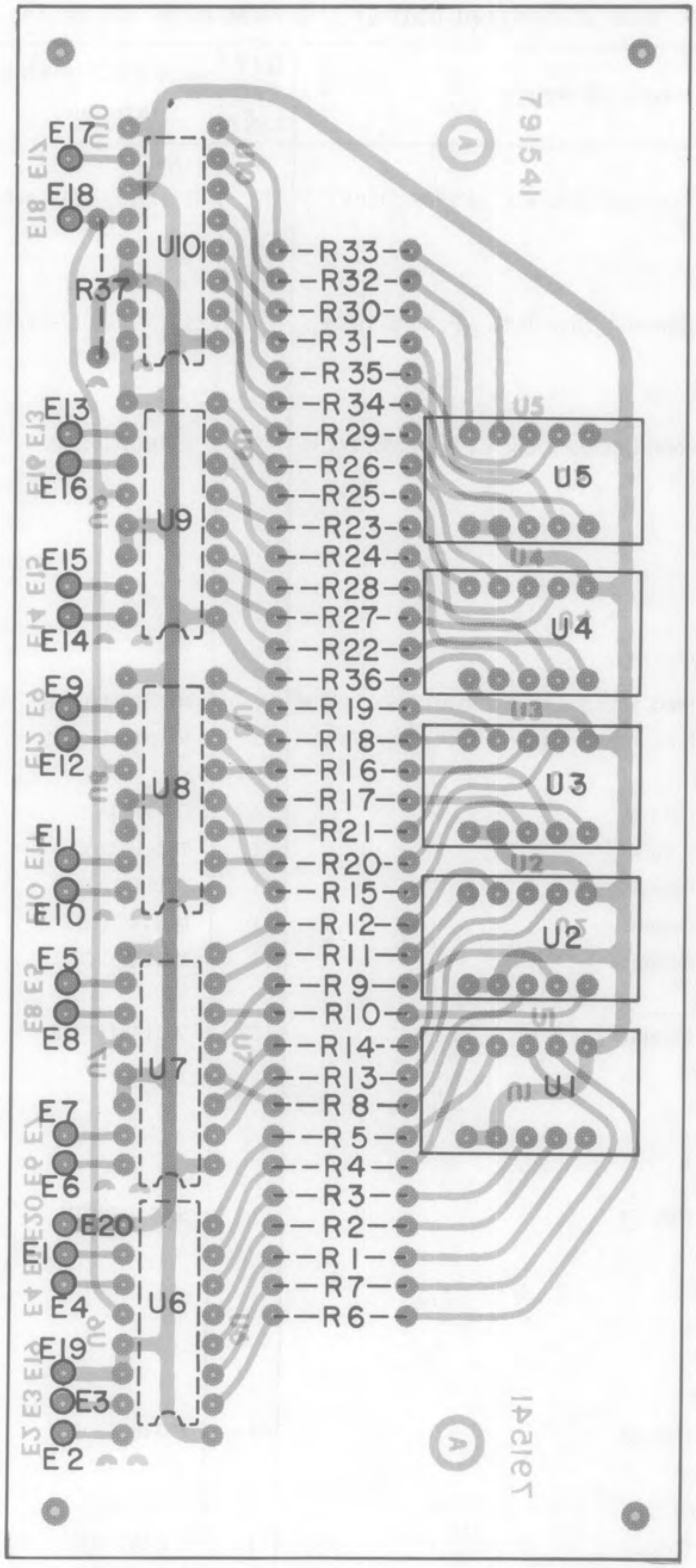


Figure 5-11. Type 791541 Display (A4), Location of Components

5.5.5 TYPE 791539 DIGITAL CONTROL UNIT #2 REF DESIG PREFIX A5

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
CR1	Diode	1	1N4446	80131	93332
C1	Capacitor, Ceramic, Disc: 0.1 μF, 20%, 100V	7	8131M100-651-104M	72982	
C2 Thru C7	Same as C1				
C8	Capacitor, Ceramic, Disc: 0.47 μF, 20%, 100 V	7	8131M100-651-474M	72982	
C9 Thru C14	Same as C8				
R1	Resistor, Fixed, Composition: 4.7 kΩ , 5%, 1/4 W	8	RCR07G472JS	81349	01121
R2	Same as R1				
R3	Same as R1				
R4	Same as R1				
R5	Same as R1				
R6	Same as R1				
R7	Same as R1				
R8	Resistor, Fixed, Composition: 100 kΩ , 5%, 1/4 W	1	RCR07G104JS	81349	01121
R9	Resistor, Fixed, Composition: 180 Ω , 5%, 1/4 W	1	RCR07G181JS	81349	01121
R10	Same as R1				
U1	Integrated Circuit	4	CD4050AE	02735	
U2	Resistor Network	1	784-1R10K	73138	
U3	Integrated Circuit	1	CD4051AE	02735	
U4	Integrated Circuit	1	MM74C175N	27014	
U5	Integrated Circuit	6	MC14519CP	04713	
U6	Same as U1				
U7	Integrated Circuit	5	MC14510BCP	04713	
U8	Same as U7				
U9	Same as U7				
U10	Same as U7				
U11	Same as U7				
U12	Integrated Circuit	1	SN74LS257N	01295	
U13	Same as U5				
U14	Same as U5				
U15	Same as U5				
U16	Same as U5				
U17	Same as U5				
U18	Integrated Circuit	3	CD4021AE	02735	
U19	Same as U18				
U20	Same as U18				
U21	Integrated Circuit	1	CD4061AD	02735	
U22	Integrated Circuit	1	CD4040AE	02735	
U23	Integrated Circuit	3	CD4094BE	02735	

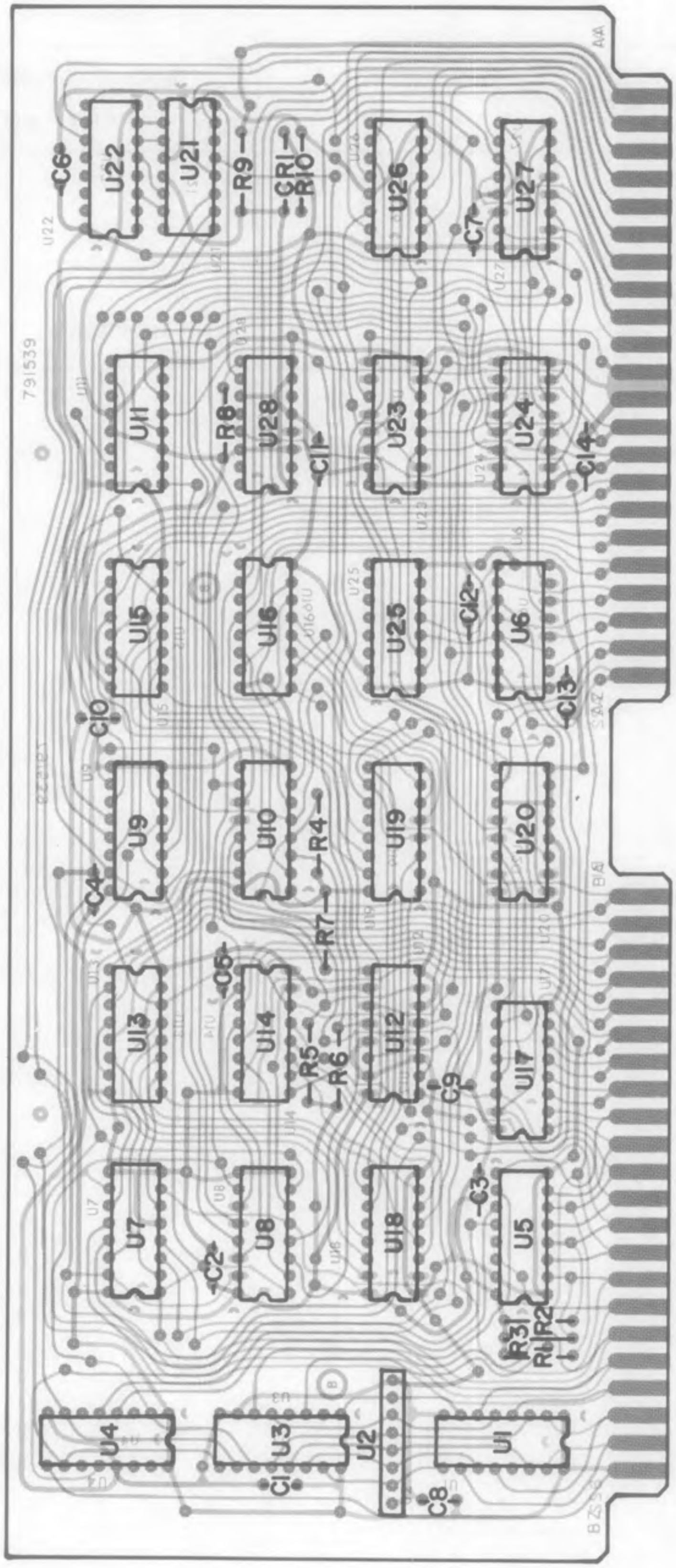


Figure 5-12. Type 791539 Digital Control Unit #2 (A5), Location of Components

REF DESIG PREFIX A5

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
U24	Same as U23				
U25	Same as U23				
U26	Same as U1				
U27	Same as U1				
U28	Integrated Circuit	1	CD4049AE	02735	

5.5.6 796023 DIGITAL CONTROL UNIT # 1B REF DESIG PREFIX A6

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
CR1	Diode	1	1N4446	80131	93332
C1	Capacitor, Ceramic, Disc: 0.1μF, 20%, 100 V	12	8131M100-651-104M	72982	
C2	Capacitor, Ceramic Disc: 0.01 μF, 20 %, 200 V	1	8131A200Z5U103M	72982	
C3 Thru C12	Same as C1				
C13	Capacitor, Ceramic, Disc: 0.47 μF, 20%, 100 V	7	8131M100-651-474M	72982	
C14 Thru C18	Same as C13				
C19	Not Used				
C20	Same as C13				
C21	Same as C1				
Q1	Transistor	1	2N2222	80131	04713
R1	Resistor, Fixed, Composition: 2.7 kΩ, 5%, 1/4 W	2	RCR07G272JS	81349	01121
R2	Same as R1				
R3	Resistor, Fixed, Composition: 4.7 kΩ, 5%, 1/4 W	8	RCR07G472JS	81349	01121
R4 Thru R9	Same as R3				
R10	Resistor, Fixed, Composition: 180Ω, 5%, 1/4 W	2	RCR07G181JS	81349	01121
R11	Same as R10				
R12	Same as R3				
R13	Resistor, Fixed, Composition: 100 kΩ, 5%, 1/4 W	1	RCR07G104JS	81349	01121
R14	Resistor, Fixed, Composition: 1 MΩ, 5%, 1/4 W	1	RCR07G105JS	81349	01121
R15	Resistor, Fixed, Composition: 47 kΩ, 5%, 1/4 W	3	RCR07G473JS	81349	01121
R16	Same as R15				
R17	Same as R15				
R18	Resistor, Fixed, Composition: 1 kΩ, 5%, 1/4 W	2	RCR07G102JS	81349	01121
R19	Resistor, Fixed, Composition: 100Ω, 5%, 1/4 W	1	RCR07G101JS	81349	01121
R20	Same as R18				
U1	Integrated Circuit	1	NE555N	18324	
U2	Integrated Circuit	3	CD4527BE	02735	
U3	Integrated Circuit	2	CD4049AE	02735	
U4	Integrated Circuit	1	CD4078BE	02735	
U5	Integrated Circuit	1	CD4072BE	02735	
U6	Integrated Circuit	5	CD4013AE	02735	
U7	Integrated Circuit	2	CD4081BE	04713	
U8	Integrated Circuit	1	CD4050AE	02735	
U9	Integrated Circuit	2	CD4043AE	02735	
U10	Integrated Circuit	2	CD4071BE	02735	
U11	Integrated Circuit	1	CD4023AE	02735	
U12	Integrated Circuit	1	MM74C14N	27014	

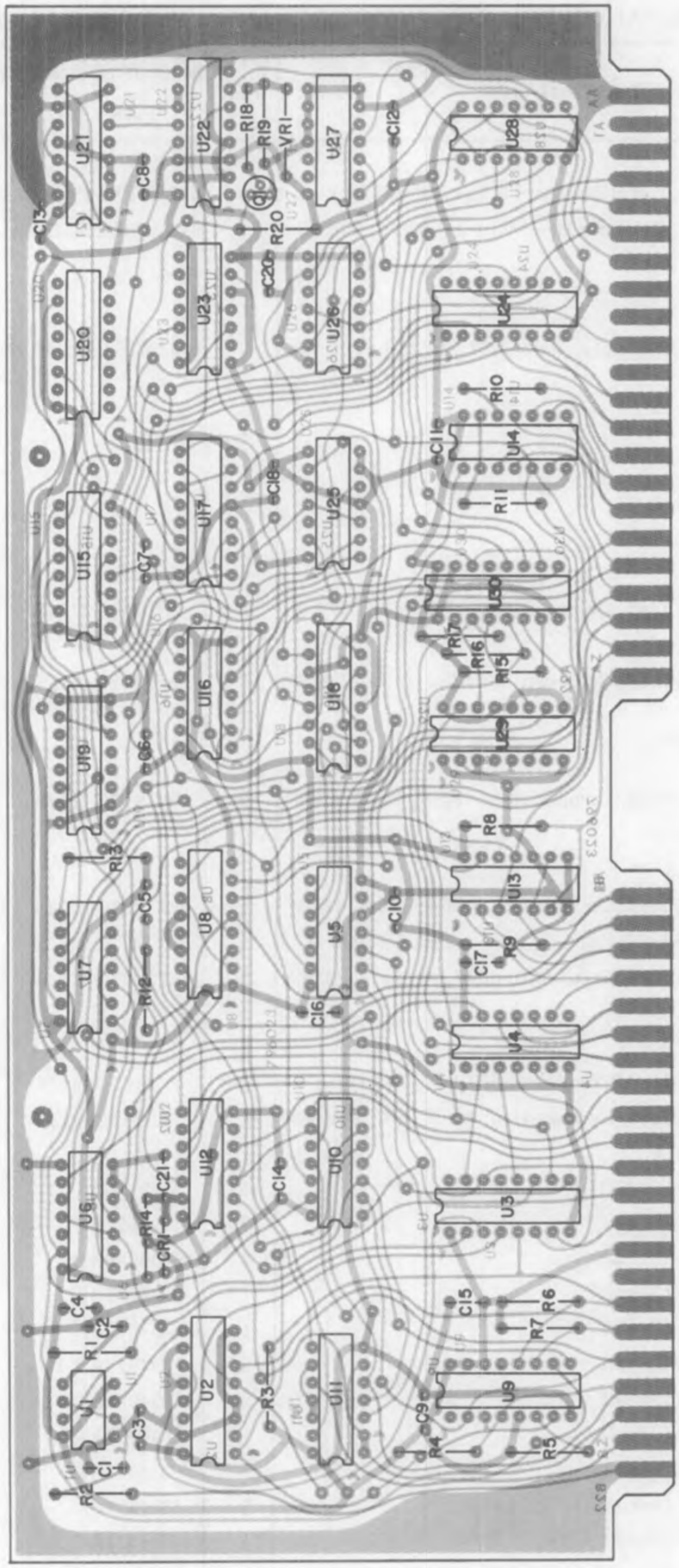


Figure 5-13. Type 796023 Digital Control Unit #1B (A6), Location of Components

REF DESIG PREFIX A6

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
U13	Same as U6				
U14	Integrated Circuit	1	867404	14632	
U15	Integrated Circuit	1	MC14572CP	04713	
U16	Same as U10				
U17	Same as U9				
U18	Integrated Circuit	1	CD4028AE	02735	
U19	Integrated Circuit	1	CD4518BE	02735	
U20	Integrated Circuit	1	CD4040AE	02735	
U21	Same as U2				
U22	Same as U2				
U23	Integrated Circuit	1	CD4006AE	02735	
U24	Same as U3				
U25	Same as U6				
U26	Same as U6				
U27	Same as U6				
U28	Same as U7				
U29	Integrated Circuit	1	CD4029BE	02735	
U30	Integrated Circuit	1	CD4019BE	02735	
VR1	Diode, Zener: 3.3 V	1	1N746A	80131	04713

5.5.7 796024-1 (WJ-9518 only)
TYPE 796024-2 (WJ-8518E only) DEMODULATOR/SYNTHESIZER REF DESIG PREFIX A7 - A12

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
A1	lst LO Counter	1	24557	14632	
A2	1st LO Voltage Controlled Oscillator	1	24563	14632	
A3	2nd LO Counter	1	34531	14632	
A4	2nd LO Voltage Controlled Oscillator	1	280039	14632	
A5	Input Converter	1	24648	14632	
A6	1st IF Amplifier	1	24650	14632	
A7	2nd Converter	1	24649	14632	
A8	IF Demodulator (WJ-9518 only)	1	34544-3	14632	
A8	IF Demodulator (WJ-9518 E only)	1	34544-4	14632	
C1	Capacitor, Ceramic, Feedthru: 470 pF, 20%, 500 V	24	54-794-009-471M	33095	
C2 Thru C7	Same as C1				
C8	Not Used				
C9	Not Used				
C10	Not Used				
C11 Thru C27	Same as C1				
E1	Terminal, Feedthru	6	SFU16Y	04013	
E2 Thru E6	Same as E1				
FL1	Filter, Low-Pass	3	9051-100-0000	72982	
FL2	Same as FL1				
FL3	Same as FL1				
J1	Connector, Receptacle: SMA Series	4	2058-0000	26805	
J2	Same as J1				
J3	Connector, Jack: SMA Series	1	2004-7985	26805	
J4	Same as J1				
J5	Same as J1				
MP1	Cover, Top (Not Shown)	1	43577	14632	
MP2	Cover, Bottom (Not Shown)	1	43578	14632	

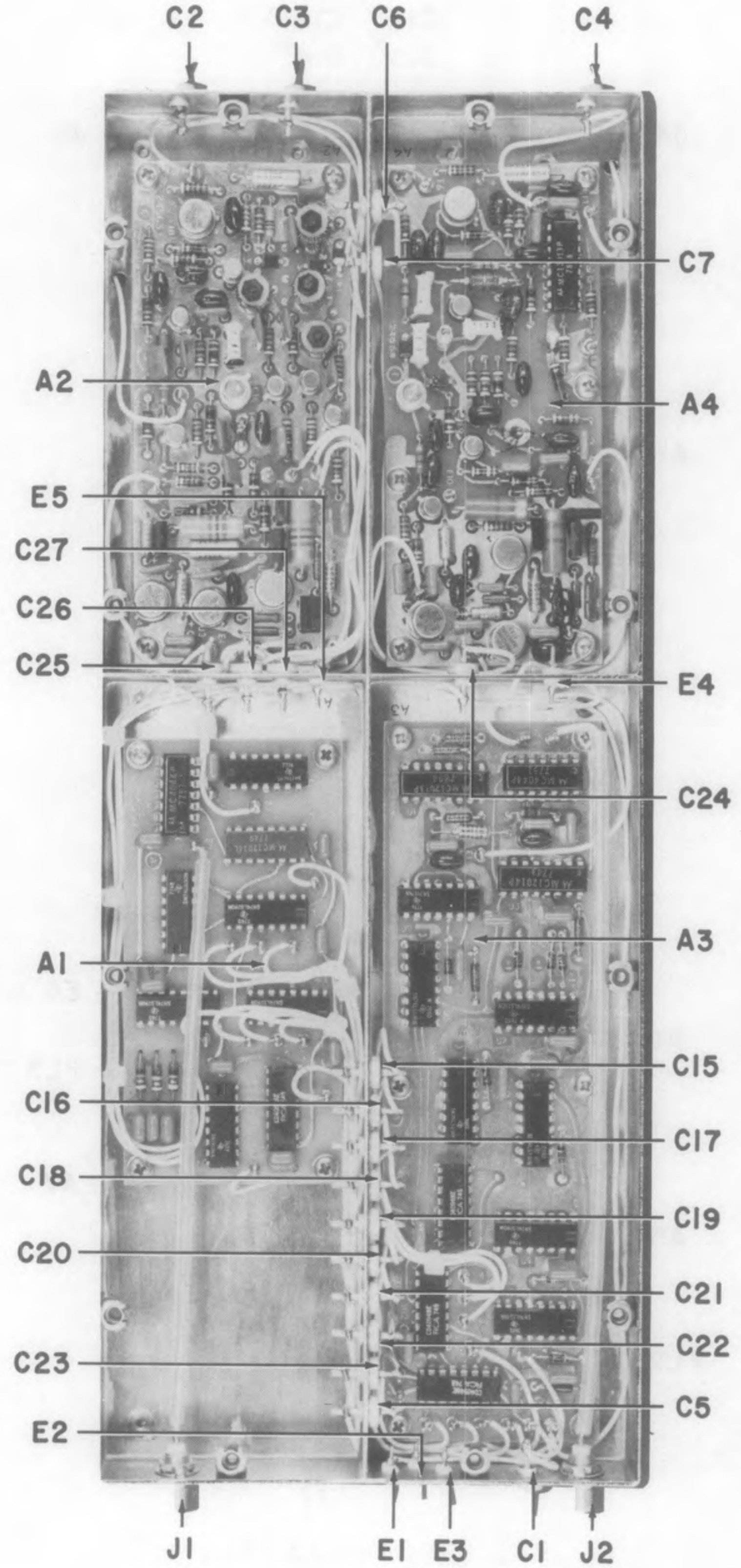


Figure 5-14. Type 796024-1-2 Demodulator/Synthesizer (A7-A12), Top View, Location of Components

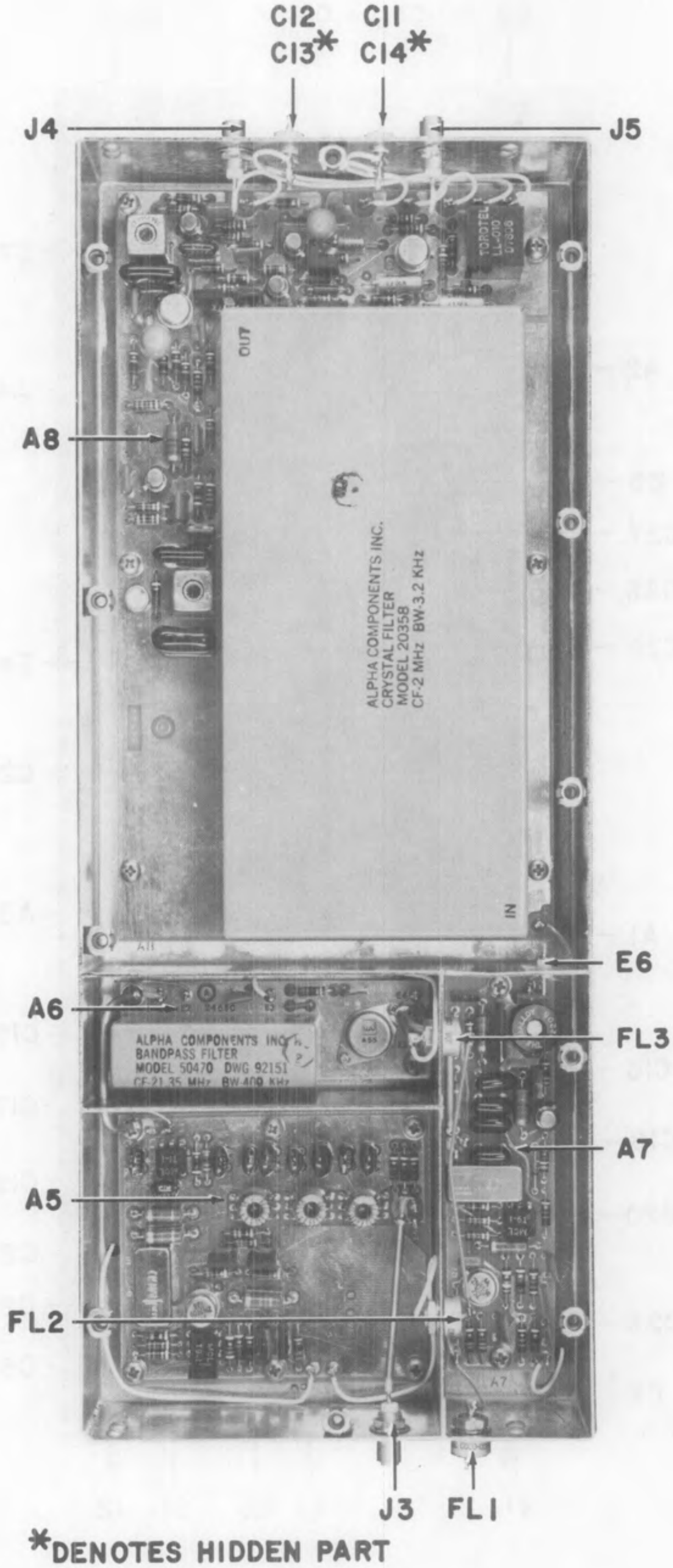


Figure 5-15. Type 796024 Demodulator/Syntheiszer (A7-A12), Bottom View, Location of Components

5.5.7.1 Type 24557 1st LO Counter REF DESIG PREFIX (A7 - A12) A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Disc: 0.47 μF, 20%, 100 V	11	8131M100-651-474M	72982	
C2 Thru C11	Same as C1				
E1	Terminal, Forked	17	140-1941-02-01	71279	
E2 Thru E17	Same as E1				
R1	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/4 W	3	RCR07G103JS	81349	01121
R2	Same as R1				
R3	Same as R1				
U1	Integrated Circuit	1	MC4044P	04713	
U2	Integrated Circuit	1	MC12014P	04713	
U3	Integrated Circuit	1	SN74S74N	01295	
U4	Integrated Circuit	1	SN74LS00N	01295	
U5	Integrated Circuit	3	SN74LS190N	01295	
U6	Same as U5				
U7	Same as U5				
U8	Integrated Circuit	1	CD4050AE	02735	
U9	Integrated Circuit	1	SN74184N	01295	

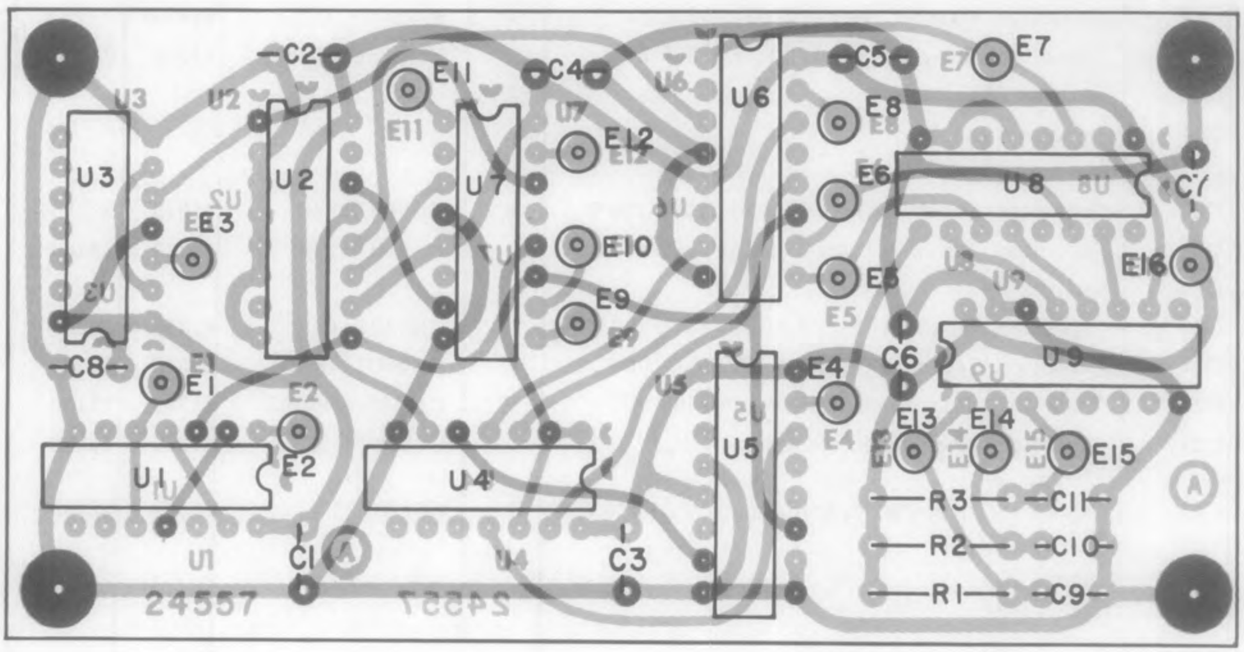


Figure 5-16. Type 24557 1st LO Counter (A7 - A12) A1, Location of Components

5.5.7.2 Type 24563 1st LO Voltage Controlled Oscillator REF DESIG PREFIX (A7 - A12) A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
CR1	Diode	3	MPN3401	81349	56289
CR2	Same as CR1				
CR3	Same as CR1				
CR4	Diode	1	BB109-YELLOW	25088	
C1	Capacitor, Electrolytic, Tantalum: 4.7 μF, 10%, 35 V	1	CS13BF475K	81349	56289
C2	Capacitor, Mica, Dipped: 100 pF, 2%, 500 V	1	CM04FD101G03	81349	72136
C3	Capacitor, Ceramic, Disc: 0.01 μF, 20%, 200 V	13	8131A200Z5U-103M	72982	
C4	Same as C3				
C5	Same as C3				
C6	Capacitor, Ceramic, Disc: 0.47 μF, 20%, 100 V	5	8131M100-651-474M	72982	
C7	Same as C3				
C8	Same as C6				
C9	Same as C3				
C10	Same as C6				
C11	Same as C3				
C12	Same as C3				
C13	Same as C3				
C14	Capacitor, Mica, Dipped: 33 pF, 2%, 500 V	1	CM04ED330G03	81349	72136
C15	Capacitor, Mica, Dipped: 15 pF, 0.5%, 500 V	1	CM04CD150J03	81349	72136
C16	Capacitor, Mica, Dipped: 10 pF, ± 0.5 pF Tol, 500 V	1	CM04CD100D03	81349	72136
C17	Capacitor, Composition, Tubular: 2 pF, ± 0.25 pF Tol, 500 V	1	301-000C0K0-209C	72982	72136
C18	Capacitor, Variable, Air: 1-10 pF, 250 V	1	8052	91293	
C19	Capacitor, Mica, Dipped: 22 pF, 5%, 500 V	1	CM04ED220J03	81349	72136
C20	Same as C3				
C21	Same as C3				
C22	Same as C3				
C23	Capacitor, Ceramic, Disc: 3900 pF, 10%, 200 V	2	CK06BX392K	81349	56289
C24	Capacitor, Ceramic, Disc: 0.022 μF, 10%, 100 V	1	CK06BX223K	81349	56289
C25	Same as C23				
C26	Capacitor, Ceramic, Disc: 0.01 μF, 10%, 200 V	1	CK06BX103K	81349	56289
C27	Capacitor, Ceramic, Disc: 0.1 μF, 10%, 200 V	1	CK06C104K	81349	56289
C28	Capacitor, Mica, Dipped: 30 pF, 2%, 500 V	1	CM04ED300G03	81349	72136
C29	Capacitor, Electrolytic, Tantalum: 4.7 μF, 10%, 10 V	1	CS13BC475K	81349	56289
C30	Capacitor, Electrolytic, Tantalum: 2.2 μF, 10%, 20 V	2	CS13BE225K	81349	56289
C31	Same as C3				
C32	Same as C6				
C33	Same as C30				
C34	Same as C3				

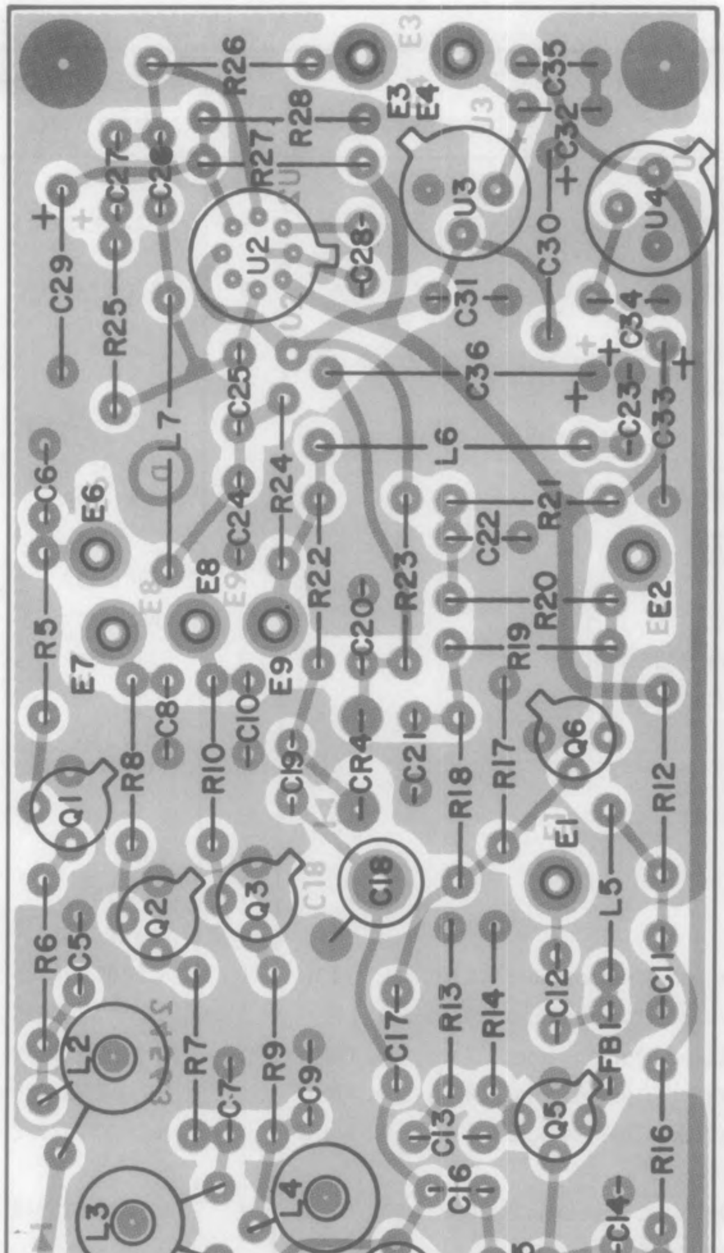


Figure 5-17. Type 24563 1st LO Voltage Controlled Oscillator (A7-A12) A2, Location of Components

REF DESIG PREFIX (A7 - A12) A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C35	Same as C6				
C36	Capacitor, Electrolytic, Tantalum: 15 μF, 10%, 20 V	1	CS13BE156K	81349	56289
E1	Terminal, Forked	9	1941-02-01	71279	
E2 Thru E9	Same as E1				
FB1	Ferrite Bead	1	56-590-65-4A	02114	
L1	Coil, Fixed: 10 μH	1	1025-44	99800	
L2	Coil, Fixed	2	20681-198	14632	
L3	Same as L2				
L4	Coil, Fixed	1	20681-199	14632	
L5	Coil, Fixed: 3.9 μH, 10%	1	1025-34	99800	
L6	Coil, Fixed: 2700 μH, 5%	2	2500-48	99800	
L7	Same as L6				
Q1	Transistor	3	2N2222A	80131	04713
Q2	Same as Q1				
Q3	Same as Q1				
Q4	Transistor	1	U310	17856	
Q5	Transistor	1	2N3478	80131	34156
Q6	Transistor	1	2N709	80131	02735
R1	Resistor, Fixed, Composition: 2.2 kΩ, 5%, 1/4 W	2	RCR07G222JS	81349	01121
R2	Resistor, Fixed, Composition: 10 Ω, 5%, 1/4 W	1	RCR07G100JS	81349	01121
R3	Resistor, Fixed, Composition: 2.7 kΩ, 5%, 1/4 W	1	RCR07G272JS	81349	01121
R4	Resistor, Fixed, Composition: 6.8 kΩ, 5%, 1/4 W	1	RCR07G682JS	81349	01121
R5	Resistor, Fixed, Composition: 3.3 kΩ, 5%, 1/4 W	3	RCR07G332JS	81349	01121
R6	Same as R1				
R7	Resistor, Fixed, Composition: 1.5 kΩ, 5%, 1/4 W	1	RCR07G152JS	81349	01121
R8	Same as R5				
R9	Resistor, Fixed, Composition: 1.2 kΩ, 5%, 1/4 W	2	RCR07G122JS	81349	01121
R10	Same as R5				
R11	Resistor, Fixed, Composition: 470 Ω, 5%, 1/4 W	1	RCR07G471JS	81349	01121
R12	Resistor, Fixed, Composition: 100 Ω, 5%, 1/4 W	1	RCR07G101JS	81349	01121
R13	Resistor, Fixed, Composition: 33 Ω, 5%, 1/4 W	1	RCR07G330JS	81349	01121
R14	Same as R9				
R15	Resistor, Fixed, Composition: 33 kΩ, 5%, 1/4 W	1	RCR07G333JS	81349	01121
R16	Resistor, Fixed, Composition: 5.6 kΩ, 5%, 1/4 W	1	RCR07G562JS	81349	01121
R17	Resistor, Fixed, Composition: 8.2 kΩ, 5%, 1/4 W	1	RCR07G822JS	81349	01121
R18	Resistor, Fixed, Composition: 1 kΩ, 5%, 1/4 W	1	RCR07G102JS	81349	01121
R19	Resistor, Fixed, Composition: 4.7 kΩ, 5%, 1/4 W	1	RCR07G472JS	81349	01121
R20	Resistor, Fixed, Composition: 270 Ω, 5%, 1/4 W	1	RCR07G271JS	81349	01121
R21	Resistor, Fixed, Composition: 1.2 kΩ, 5%, 1/4 W	1	RCR07G122JS	81349	01121

REF DESIG PREFIX (A7 - A12) A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R22	Resistor, Fixed, Composition: 100 kΩ, 5%, 1/4 W	2	RCR07G104JS	81349	01121
R23	Same as R22				
R24	Resistor, Fixed, Composition: 680Ω, 5%, 1/4 W	1	RCR07G681JS	81349	01121
R25	Resistor, Fixed, Film: 4.99 kΩ, 1%, 1/10 W	1	RN55C4991F	81349	75042
R26	Resistor, Fixed, Film: 1.1 kΩ, 1%, 1/10 W	2	RN55C1101F	81349	75042
R27	Resistor, Fixed, Film: 8.66 kΩ, 1%, 1/10 W	1	RN55C8661F	81349	75042
R28	Same as R26				
T1	Transformer	1	21428-80	14632	
U1	Integrated Circuit	1	723HC	07263	
U2	Integrated Circuit	1	LM201AH	27014	
U3	Integrated Circuit	1	79M12HC	07263	
U4	Integrated Circuit	1	78M12HC	07263	

5.5.7.3 Type 34531 2nd LO Counter REF DESIG PREFIX (A7 - A12) A3

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
CR1	Diode	8	5082-2800	28480	
CR2 Thru CR8	Same as CR1				
C1	Capacitor, Mica, Dipped: 100 pF, 2%, 500 V	2	CM04FD101G03	81349	72136
C2	Capacitor, Ceramic, Disc: 0.47 μF, 10%, 100 V	14	8131M100-651474M	72982	
C3 Thru C14	Same as C2				
C15	Capacitor, Electrolytic, Tantalum: 4.7 μF, 10%, 10 V	1	CS13BC475K	81349	56289
C16	Same as C2				
C17	Same as C1				
E1	Terminal	20	140-1941-02-01	71279	
E2 Thru E20	Same as E1				
L1	Coil, Fixed: 1 μH, 10%	1	1025-20	99800	
R1	Resistor, Fixed, Film: 4.75 kΩ, 1%, 1/10 W	3	RN55C4751F	81349	75042
R2	Same as R1				
R3	Same as R1				
R4	Resistor, Fixed, Film: 75Ω, 5%, 1/4 W	1	RCR07G750JS	81349	01121
R5	Resistor, Fixed, Film: 475Ω, 1%, 1/10 W	2	RN55C4750F	81349	75042
R6	Same as R5				
R7	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/4 W	1	RCR07G103JS	81349	01121
U1	Integrated Circuit	1	MC12013P	04713	
U2	Integrated Circuit	1	SN74S74N	01295	
U3	Integrated Circuit	1	MC12014P	04713	
U4	Integrated Circuit	1	MC4044P	04713	
U5	Integrated Circuit	6	SN74LS190N	01295	
U6 Thru U10	Same as U5				
U11	Integrated Circuit	3	CD4094BE	02735	
U12	Same as U11				
U13	Same as U11				

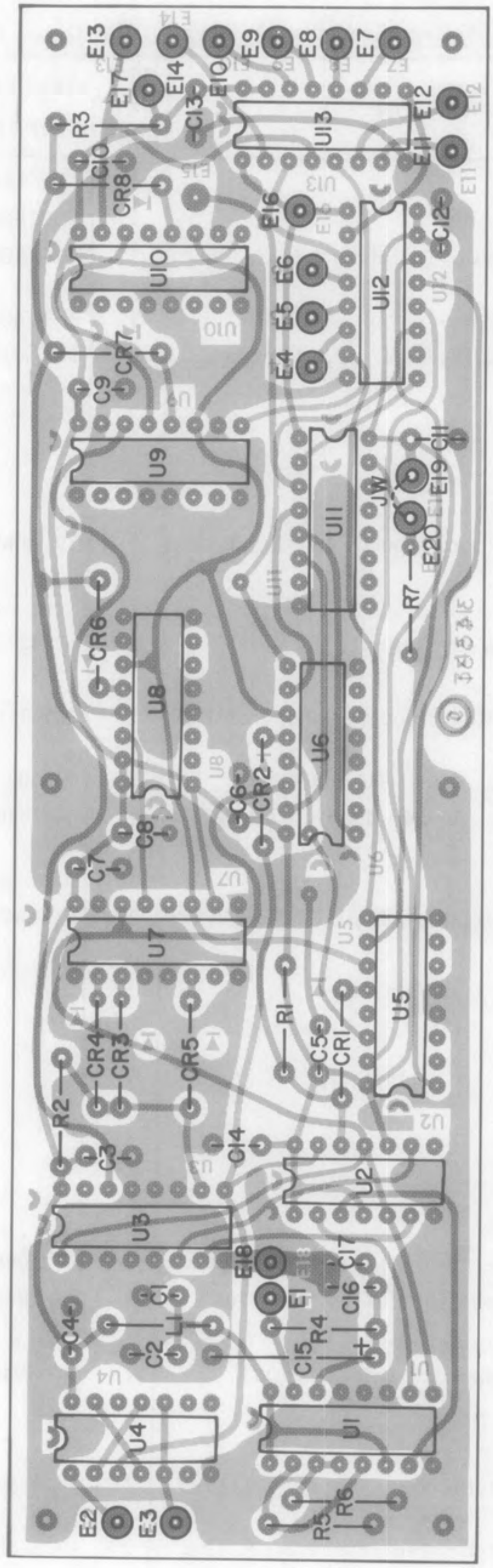


Figure 5-18. Type 34531 2nd LO Counter (A7-A12) A3, Location of Components

5.5.7.4 Type 280039 2nd LO Voltage Controlled Oscillator REF DESIG PREFIX (A7 - A12) A4

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
CR1	Diode	1	MPN3401	04713	
CR2	Diode	1	BB105B	25088	
C1	Capacitor, Electrolytic, Tantalum: 4.7 μF, 10%, 35 V	1	CS13BF475K	81349	56289
C2	Capacitor, Mica, Dipped: 100 pF, 2%, 500 V	17	CM04FD101G03	81349	72136
C3	Capacitor, Ceramic, Disc: 0.47 μF, 20%, 100 V	9	8131M100-651-474M	72982	
C4	Same as C2				
C5	Same as C2				
C6	Same as C2				
C7	Not Used				
C8	Capacitor, Composition, Tubular: 4.7 pF, ±0.25 pF Tol, 500 V	1	301-000-C0H0-479B	72982	
C9	Same as C2				
C10	Capacitor, Variable, Air: 1-10 pF, 250 V	1	8052	91293	
C11	Same as C3				
C12	Capacitor, Composition, Tubular: 0.5 pF, ±0.1 pF Tol, 500 V	1	301-001C0K0-508B	72982	
C13	Capacitor, Variable, Air: 0.5-5 pF, 250 V	1	5853	91293	
C14	Capacitor, Ceramic, Tubular: 3.3 pF, ±0.1 pF Tol, 500 V	1	301-000C0J0-339B	72982	
C15	Same as C2				
C16	Capacitor, Ceramic, Disc: 0.01 μF, 20%, 200 V	1	8131A200Z5U103M	72982	
C17	Same as C2				
C18	Same as C3				
C19	Same as C2				
C20	Same as C3				
C21 Thru C25	Same as C2				
C26	Same as C3				
C27	Same as C2				
C28	Capacitor, Ceramic, Disc: 0.1 μF, 10%, 100 V	3	CK06BX104K	81349	56289
C29	Capacitor, Ceramic, Disc: 0.04 μF, 10%, 100 V	1	CK06BX473K	81349	56289
C30	Same as C28				
C31	Capacitor, Mica, Dipped: 390 pF, 2%, 100 V	1	CM04FD391G03	81349	72136
C32	Same as C28				
C33	Same as C2				
C34	Capacitor, Electrolytic, Tantalum: 4.7 μF, 10%, 10 V	1	CS13BC475K	56289	
C35	Capacitor, Electrolytic, Tantalum: 2.2 μF, 10%, 20 V	2	CS13BE225K	56289	
C36	Same as C3				
C37	Same as C2				

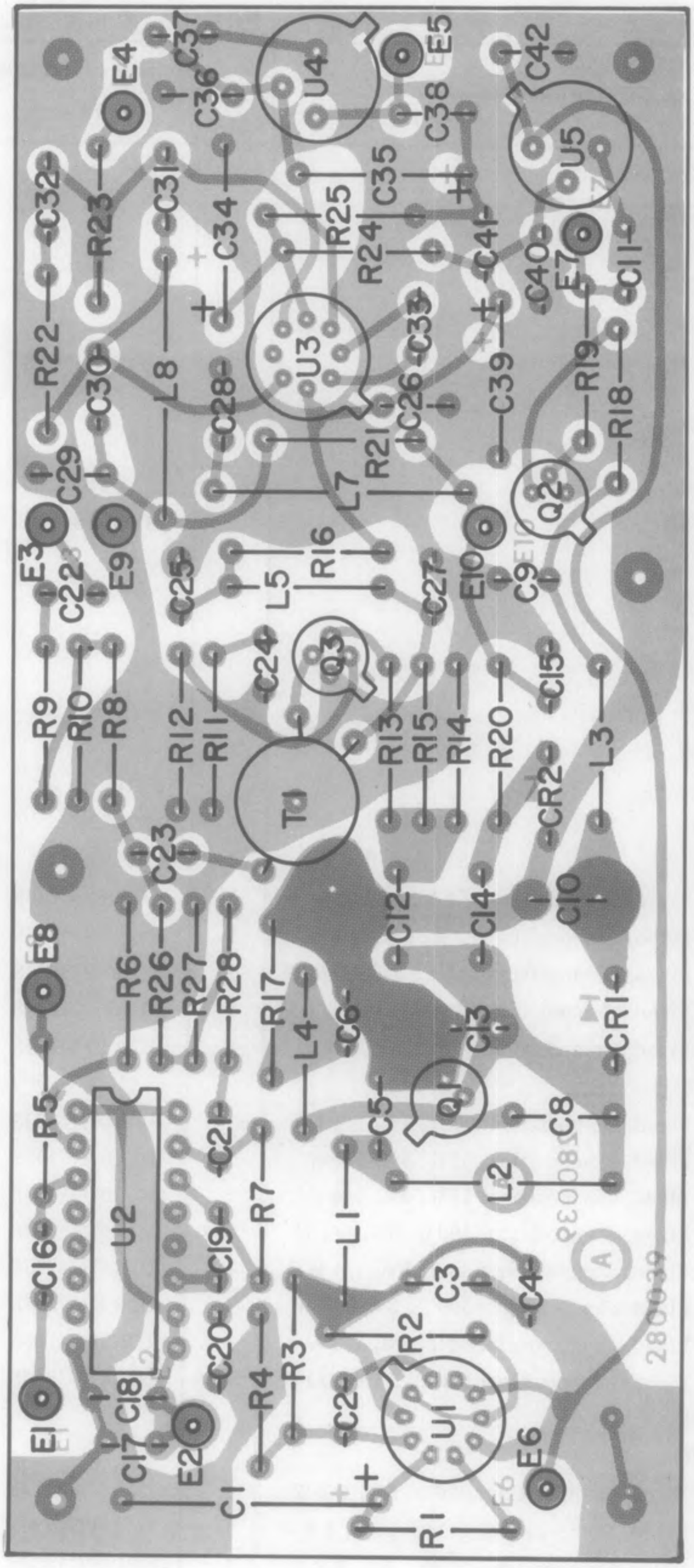


Figure 5-19. Type 280039 2nd LO Voltage Controlled Oscillator (A7-A12) A4, Location of Components

REF DESIG PREFIX (A7 - A12) A4

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C38	Same as C3				
C39	Same as C35				
C40	Same as C3				
C41	Same as C2				
C42	Same as C3				
E1	Terminal	10	140-1941-02-01	71279	
E2 Thru E10	Same as E1				
L1	Coil, Fixed: 1 μH, 10%	4	1025-20	99800	
L2	Coil, Fixed	1	21210-184	14632	
L3	Same as L1				
L4	Same as L1				
L5	Same as L1				
L6	Not Used				
L7	Coil, Fixed: 2700 μH, 5%	2	2500-48	99800	
L8	Same as L7				
Q1	Transistor	1	U310	17856	
Q2	Transistor	1	2N2222A	80131	04713
Q3	Transistor	1	2N2857	80131	04713
R1	Resistor, Fixed, Composition: 2.2 kΩ, 5%, 1/4 W	1	RCR07G222JS	81349	01121
R2	Resistor, Fixed, Composition: 10 Ω, 5%, 1/4 W	1	RCR07G100JS	81349	01121
R3	Resistor, Fixed, Composition: 3.9 kΩ, 5%, 1/4 W	2	RCR07G392JS	81349	01121
R4	Resistor, Fixed, Composition: 6.8 kΩ, 5%, 1/4 W	1	RCR07G682JS	81349	01121
R5	Resistor, Fixed, Composition: 470 Ω, 5%, 1/4 W	2	RCR07G471JS	81349	01121
R6	Same as R5				
R7	Resistor, Fixed, Composition: 75 Ω, 5%, 1/4 W	1	RCR07G750JS	81349	01121
R8	Resistor, Fixed, Composition: 51 Ω, 5%, 1/4 W	2	RCR07G510JS	81349	01121
R9	Resistor, Fixed, Composition: 15 Ω, 5%, 1/4 W	2	RCR07G150JS	81349	01121
R10	Resistor, Fixed, Composition: 100 Ω, 5%, 1/4 W	3	RCR07G101JS	81349	01121
R11	Resistor, Fixed, Composition: 22 Ω, 5%, 1/4 W	1	RCR07G220JS	81349	01121
R12	Resistor, Fixed, Composition: 390 Ω, 5%, 1/4 W	1	RCR07G391JS	81349	01121
R13	Resistor, Fixed, Composition: 47 Ω, 5%, 1/4 W	1	RCR07G470JS	81349	01121
R14	Resistor, Fixed, Composition: 3.3 kΩ, 5%, 1/4 W	1	RCR07G332JS	81349	01121
R15	Same as R3				
R16	Same as R10				
R17	Resistor, Fixed, Composition: 220 Ω, 5%, 1/4 W	1	RCR07G221JS	81349	01121
R18	Resistor, Fixed, Composition: 1.2 kΩ, 5%, 1/4 W	1	RCR07G122JS	81349	01121
R19	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/4 W	1	RCR07G103JS	81349	01121
R20	Resistor, Fixed, Composition: 100 kΩ, 5%, 1/4 W	1	RCR07G104JS	81349	01121
R21	Resistor, Fixed, Composition: 2.7 kΩ, 5%, 1/4 W	1	RCR07G272JS	81349	01121
R22	Resistor, Fixed, Film: 28.7 kΩ, 1%, 1/10 W	1	RN55C2872F	81349	75042

REF DESIG PREFIX (A7 - A12) A4

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R23	Resistor, Fixed, Film: 1.96 kΩ, 1%, 1/10 W	1	RN55C1961F	81349	75042
R24	Resistor, Fixed, Film: 8.66 kΩ, 1%, 1/10 W	1	RN55C8661F	81349	75042
R25	Resistor, Fixed, Film: 1 kΩ, 1%, 1/10 W	1	RN55C1001F	81349	75042
R26	Same as R8				
R27	Same as R10				
R28	Same as R9				
T1	Transformer	1	22294-27	14632	
U1	Integrated Circuit	1	723HC	07263	
U2	Integrated Circuit	1	MC12013P	04713	
U3	Integrated Circuit	1	LM201AH	27014	
U4	Integrated Circuit	1	79M12HC	07263	
U5	Integrated Circuit	1	78M12HC	07263	

5.5.7.5 Type 24648 Input Converter REF DESIG PREFIX (A7 - A12) A5

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Mica, Dipped: 160 pF, 2%, 500 V	1	CM04FD161G03	81349	72136
C2	Capacitor, Mica, Dipped: 15 pF, 5%, 500 V	1	CM04CD150J03	81349	72136
C3	Capacitor, Mica, Dipped: 220 pF, 2%, 500 V	1	CM04FD221G03	81349	72136
C4	Capacitor, Mica, Dipped: 82 pF, 2%, 500 V	1	CM04ED820G03	81349	72136
C5	Capacitor, Mica, Dipped: 200 pF, 2%, 500 V	1	CM04FD201G03	81349	72136
C6	Capacitor, Mica, Dipped: 56 pF, 2%, 500 V	1	CM04ED560G03	81349	72136
C7	Capacitor, Mica, Dipped: 130 pF, 2%, 500 V	1	CM04FD131G03	81349	72136
C8	Capacitor, Ceramic, Disc: 0.01 μF, 10%, 200 V	5	CK06BX103K	81349	56289
C9	Same as C8				
C10	Same as C8				
C11	Same as C8				
C12	Capacitor, Mica, Dipped: 20 pF, 5%, 500 V	2	CM04ED200J03	81349	72136
C13	Same as C8				
C14	Same as C12				
E1	Terminal, Forked	5	140-1941-02-01	71279	
E2 Thru E5	Same as E1				
FB1	Ferrite Bead	3	56-590-64-4A	02114	
FB2	Same as FB1				
FB3	Same as FB1				
L1	Inductor/Transformer Assembly	1	24608-3	14632	
L2	Inductor/Transformer Assembly	2	24608-4	14632	
L3	Same as L2				
L4	Coil, Fixed: 6.8 μH, 5%	1	1537-32	99800	
L5	Coil, Fixed: 2.7 μH, 10%	2	1537-22	99800	
L6	Same as L5				
Q1	Transistor	1	2N5109	80131	02735
R1	Resistor, Fixed, Composition: 100Ω, 5%, 1/4 W	2	RCR07G101JS	81349	01121
R2	Resistor, Fixed, Composition: 43Ω, 5%, 1/4 W	1	RCR07G430JS	81349	01121
R3	Resistor, Fixed, Composition: 91Ω, 5%, 1/4 W	1	RCR07G910JS	81349	01121
R4	Same as R1				
R5	Resistor, Fixed, Composition: 82Ω, 5%, 1/4 W	1	RCR07G820JS	81349	01121
R6	Resistor, Fixed, Composition: 5.6 kΩ, 5%, 1/4 W	1	RCR07G562JS	81349	01121
R7	Resistor, Fixed, Composition: 8.2 kΩ, 5%, 1/4 W	1	RCR07G822JS	81349	01121
R8	Resistor, Fixed, Composition: 1.5 kΩ, 5% 1/4 W	1	RCR07G152JS	81349	01121
R9	Resistor, Fixed, Composition: 4.7 kΩ, 5%, 1/4 W	1	RCR07G472JS	81349	01121
R10	Resistor, Fixed, Composition: 220Ω, 5%, 1/4 W	1	RCR07G221JS	81349	01121
R11	Resistor, Fixed, Composition: 33Ω, 5%, 1/4 W	1	RCR07G330JS	81349	01121
R12	Resistor, Fixed, Composition: 270Ω, 5%, 1/4 W	2	RCR07G271JS	81349	01121
R13	Resistor, Fixed, Composition: 18Ω, 5%, 1/4 W	1	RCR07G180JS	81349	01121
R14	Same as R12				

REF DESIG PREFIX (A7 - A12) A5

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R15	Resistor, Fixed, Composition: 150Ω, 5%, 1/4 W	2	RCR07G151JS	81349	01121
R16	Same as R15				
T1	Transformer	1	T9-1	15542	
T2	Transformer	1	T1-1	15542	
U1	Mixer	1	M6D	27956	

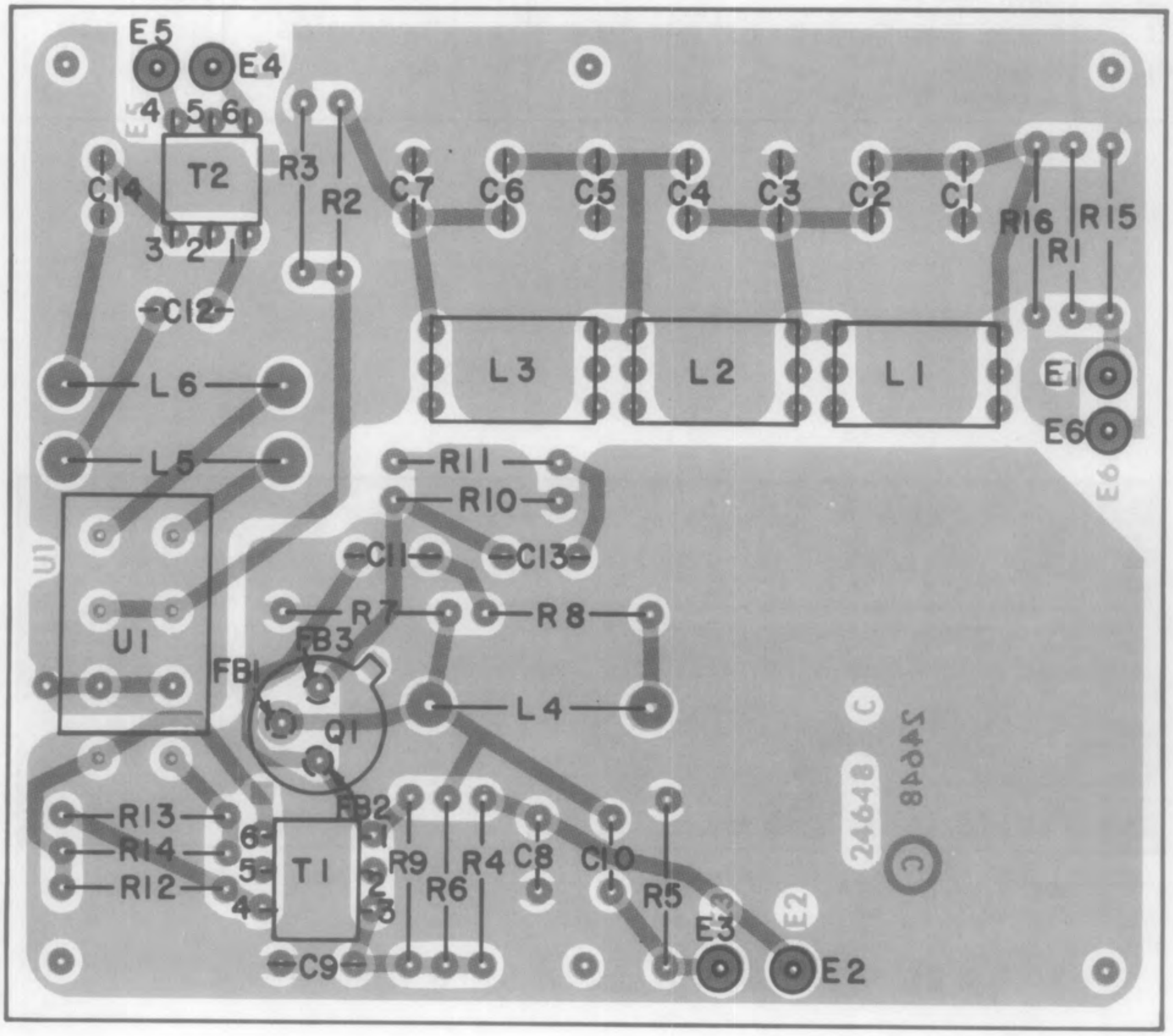


Figure 5-20. Type 24648 Input Converter (A7 - A12) A5, Location of Components

5.5.7.6 Type 24650 1st IF Amplifier REF DESIG PREFIX (A7 - A12) A6

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Disc: 0.01 μF, 20%, 200 V	4	8131A200Z5U-103M	72982	
C2	Same as C1				
C3	Same as C1				
C4	Same as C1				
E1	Terminal, Forked	5	140-1941-02-01	71279	
E2 Thru E5	Same as E1				
FL1	Filter, Bandpass	1	92151	14632	
R1	Resistor, Fixed, Composition: 22 Ω, 5%, 1/4 W	1	RCR07G220JS	81349	01121
U1	Amplifier	1	A55	27956	

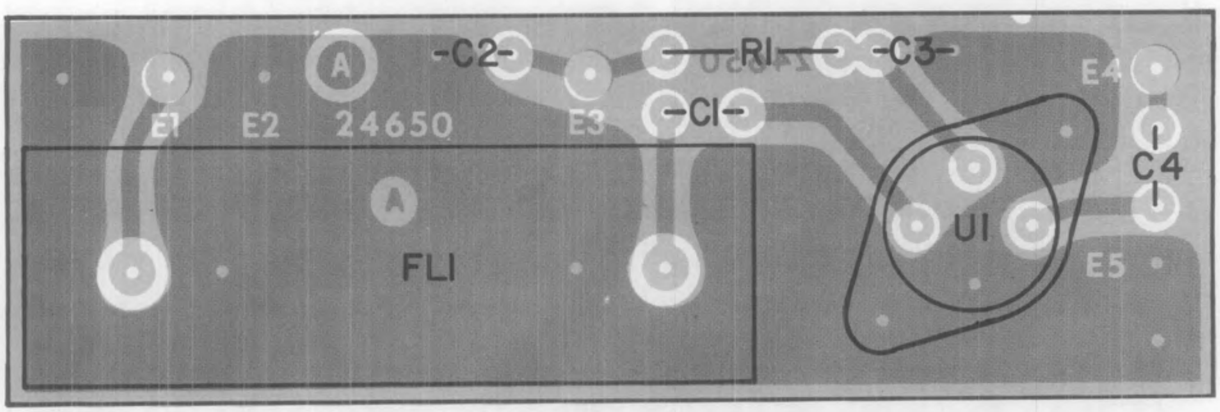


Figure 5-21. Type 24650 1st IF Amplifier (A7 - A12) A6, Location of Components

5.5.7.7 Type 24649 2nd Converter

REF DESIG PREFIX (A7 -A12) A7

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
CR1	Diode	1	1N4446	80131	93332
C1	Capacitor, Ceramic, Disc: 0.01 μF, 20%, 200 V	4	8131A200Z5U-103M	72982	
C2	Same as C1				
C3	Same as C1				
C4	Same as C1				
C5	Capacitor, Mica, Dipped: 680 pF, 2%, 300 V	5	DM15-681G	81349	56289
C6	Same as C5				
C7	Same as C5				
C8	Same as C5				
C9	Capacitor, Ceramic, Disc: 0.047 μF, 10%, 100 V	5	CK06BX473K	81349	56289
C10	Same as C9				
C11	Same as C9				
C12	Same as C9				
C13	Same as C9				
C14	Capacitor, Ceramic, Disc: 0.47 μF, 20%, 100 V	1	8131M100-651-474M	72982	
E1	Terminal, Forked	4	140-1941-02-01	72982	
E2 Thru E4	Same as E1				
FB1	Ferrite Bead	3	56-590-65-4A	02114	
FB2	Same as FB1				
FB3	Same as FB1				
L1	Coil, Fixed: 220 μH, 5%	4	1537-92	99800	
L2	Coil, Fixed: 3.3 μH, 10%	1	1537-24	99800	
L3	Same as L1				
L4	Same as L1				
L5	Same as L1				
Q1	Transistor	1	2N5109	80131	02735
Q2	Transistor	1	2N2222A	80131	04713
Q3	Transistor	1	CP643	12498	
RA1	Radiator	1	2220B	13103	
R1	Resistor, Fixed, Composition: 56 Ω, 5%, 1/4 W	1	RCR07G560JS	81349	01121
R2	Resistor, Fixed, Composition: 6.8 kΩ, 5%, 1/4 W	2	RCR07G682JS	81349	01121
R3	Resistor, Fixed, Composition: 4.7 kΩ, 5%, 1/4 W	1	RCR07G472JS	81349	01121
R4	Resistor, Fixed, Composition: 100 Ω, 5%, 1/4 W	1	RCR07G101JS	81349	01121
R5	Resistor, Fixed, Composition: 3.9 kΩ, 5%, 1/4 W	1	RCR07G392JS	81349	01121
R6	Resistor, Fixed, Composition: 330 Ω, 5%, 1/4 W	1	RCR07G331JS	81349	01121
R7	Resistor, Fixed, Composition: 27 Ω, 5%, 1/4 W	1	RCR07G270JS	81349	01121
R8	Resistor, Fixed, Composition: 270 Ω, 5%, 1/4 W	2	RCR07G271JS	81349	01121
R9	Resistor, Fixed, Composition, 18 Ω, 5%, 1/4 W	1	RCR07G180JS	81349	01121
R10	Same as R8				
R11	Resistor, Fixed, Composition: 33 Ω, 5%, 1/4 W	1	RCR07G330JS	81349	01121

REF DESIG PREFIX (A7 - A12) A7

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R12	Resistor, Fixed, Composition: 390 Ω, 5%, 1/4 W	1	RCR07G391JS	81349	01121
R13	Same as R2				
R14	Resistor, Fixed, Composition: 1 kΩ, 5%, 1/4 W	1	RCR07G102JS	81349	01121
R15	Resistor, Fixed, Composition: 22 Ω, 5%, 1/4 W	1	RCR07G220JS	81349	01121
T1	Transformer	1	T9-1	15542	
U1	Mixer	1	M6D	27956	

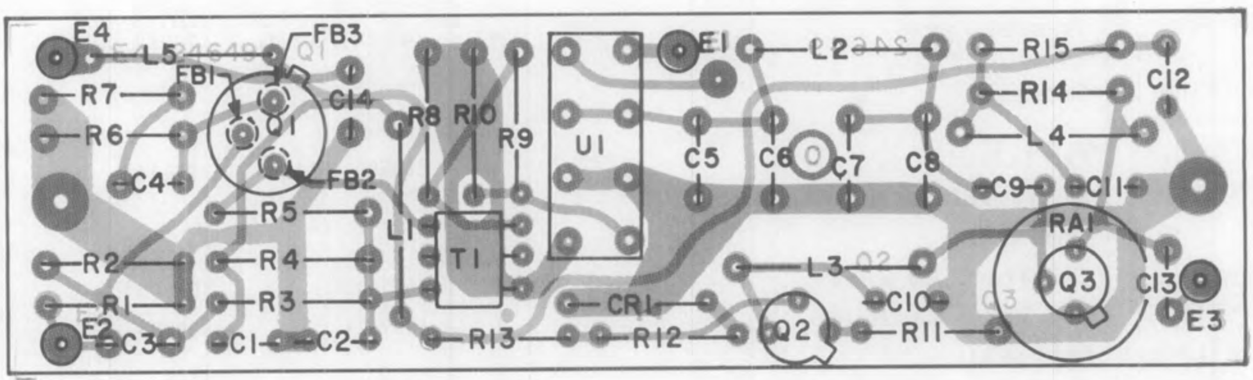


Figure 5-22. Type 24649-1 2nd Converter (A7 - A12) A7, Location of Components

5.5.7.8 Type 34544-3 (796023-1 only) / 34544-4 (796023-2 only) IF Demodulator REF DESIG PREFIX (A7 - A12) A8

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Not Used				
C2	Capacitor, Mica, Dipped: 2000 pF, 2%, 500 V	1	CM06FD202G03	81349	72136
C3	Capacitor, Mica, Dipped: 6800 pF, 5%, 100 V	1	DM19-682J	72136	
C4	Capacitor, Ceramic, Disc: 0.1 μF, 20%, 100 V	8	8131M100-651-104M	72982	
C5 Thru C8	Same as C4				
C9	Capacitor, Mica, Dipped: 2700 pF, 2%, 500 V	1	CM06FD272G03	81349	72136
C10	Capacitor, Mica, Dipped: 150 pF, 2%, 500 V	1	CM05FD151G03	81349	72136
C11	Capacitor, Electrolytic, Tantalum: 100 μF, 20% 20 V	2	196D107X0020TE4	56289	
C12	Capacitor, Ceramic, Disc: 2200 pF, 10%, 200 V	1	CK06BX222K	81349	56289
C13	Same as C12				
C14	Capacitor, Ceramic, Disc: 3900 pF, 10%, 200 V	1	CK06BX392K	81349	56289
C15	Capacitor, Ceramic, Disc: 1500 pF, 10%, 200 V	1	CK06BX152K	81349	56289
C16	Same as C11				
C17	Capacitor, Electrolytic, Tantalum: 1.8 μF, 10% 20 V	1	CS13BE185K	81349	56289
C18	Capacitor, Electrolytic, Tantalum: 15 μF, 10%, 20 V	2	CS13BE156K	81349	56289
C19	Same as C18				
C20	Same as C4				
C21	Same as C4				
C22	Same as C4				
E1	Terminal, Forked	11	140-1941-02-01	71279	
E2 Thru E11	Same as E1				
FL1	Filter (34544-3 only)	1	92093	14632	
FL1	Filter (34544-4 only)	1	92086	14632	
J1	Connector, Receptacle	3	109	19505	
J2	Same as J1				
J3	Same as J1				
L1	Coil, Variable: 4.23 - 5.17 μH	1	558-7107-21	71279	
L2	Coil, Variable: 42.3 - 51.7 μH	1	558-7107-33	71279	
L3	Coil, Fixed: 220 μH, 5%	1	1537-92	99800	
Q1	Transistor	1	2N2857	80131	02735
Q2	Transistor	3	2N2222A	80131	04713
Q3	Same as Q2				
Q4	Same as Q2				
R1	Resistor, Fixed, Composition: 56 Ω, 5%, 1/4 W	2	RCR07G560JS	81349	01121
R2	Resistor, Fixed, Composition: 10Ω, 5%, 1/4 W	3	RCR07G100JS	81349	01121
R3	Resistor, Fixed, Composition: 12 kΩ, 5%, 1/4 W	2	RCR07G123JS	81349	01121

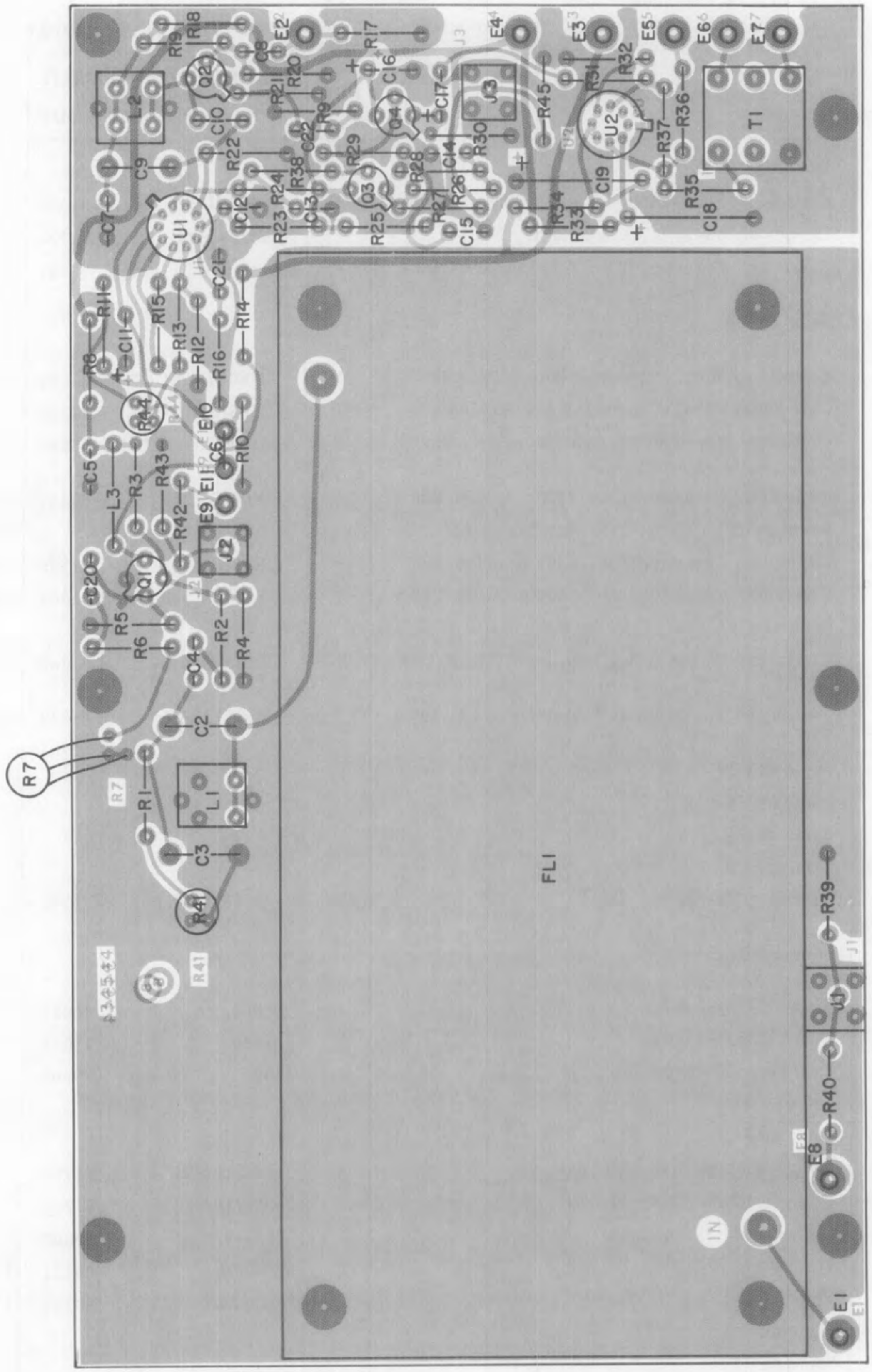


Figure 5-23. Type 34544-3-4 IF Demodulator (A7-A12)A8, Location of Components

REF DESIG PREFIX (A7 - A12) A8

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R4	Resistor, Fixed, Composition: 2.7 kΩ, 5%, 1/4 W	1	RCR07G272JS	81349	01121
R5	Resistor, Fixed, Composition: 680Ω, 5%, 1/4 W	1	RCR07G681JS	81349	01121
R6	Resistor, Fixed, Composition: 33Ω, 5%, 1/4 W	1	RCR07G330JS	81349	01121
R7	Resistor, Variable, Film: 100Ω, 10%, 1/2 W	1	62PR100	73138	
R8	Resistor, Fixed, Composition: 220Ω, 5%, 1/4 W	1	RCR07G221JS	81349	01121
R9	Resistor, Fixed, Composition: 150 Ω, 5%, 1/4 W	1	RCR07G151JS	81349	01121
R10	Resistor, Fixed, Film: 15 kΩ, 1%, 1/4 W	4	CC1502F	01121	
R11	Same as R10				
R12	Same as R10				
R13	Same as R10				
R14	Resistor, Fixed, Composition: 1 kΩ, 5%, 1/4 W	4	RCR07G102JS	81349	01121
R15	Resistor, Fixed, Composition: 910 Ω, 5%, 1/4 W (34544-3 only)	1	RCR07G911JS	81349	01121
R15	Resistor, Fixed, Composition: 750 Ω, 5%, 1/4 W (34544-4 only)	1			
R16	Resistor, Fixed, Composition: 6.8 kΩ, 5%, 1/4 W	4	RCR07G682JS	81349	01121
R17	Resistor, Fixed, Composition: 56Ω, 5%, 1/4 W	1	RCR07G560JS	81349	01121
R18	Resistor, Fixed, Composition: 100Ω, 5%, 1/4 W	3	RCR07G101JS	81349	01121
R19	Resistor, Fixed, Composition: 56 kΩ, 5%, 1/4 W	1	RCR07G563JS	81349	01121
R20	Same as R3				
R21	Same as R14				
R22	Same as R1				
R23	Resistor, Fixed, Composition: 3.9 kΩ, 5%, 1/4 W	2	RCR07G392JS	81349	01121
R24	Same as R23				
R25	Same as R14				
R26	Resistor, Fixed, Film: 4.75 kΩ, 1%, 1/10 W	1	RN55C4751F	81349	75042
R27	Same as R16				
R28	Resistor, Fixed, Film: 2.61 kΩ, 1%, 1/10 W	1	RN55C2611F	81349	75042
R29	Resistor, Fixed, Composition: 47Ω, 5%, 1/4 W	2	RCR07G470JS	81349	01121
R30	Resistor, Fixed, Composition: 3.3 kΩ, 1%, 10 W	1	RCR07G332JS	81349	01121
R31	Same as R16				
R32	Same as R16				
R33	Same as R18				
R34	Same as R18				
R35	Resistor, Fixed, Composition: 560Ω, 1%, 1/10 W	1	RCR07G561JS	81349	01121
R36	Same as R14				
R37	Resistor, Fixed, Composition: 180 kΩ, 1%, 1/10 W	1	RCR07G184JS	81349	01121
R38	Same as R29				
R39	Resistor, Fixed, Film: 51.1Ω, 1%, 1/4 W	2	CC51R1F	01121	
R40	Resistor, Fixed, Film: 976 Ω, 1%, 1/4 W	2	CC9760F	01121	

REF DESIG PREFIX (A7 - A12) A8

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R41	Resistor, Variable, Film: 100 Ω, 10%, 1/2 W	1	62PR100	73138	
R42	Same as R40				
R43	Same as R39				
R44	Resistor, Variable, Film: 500 Ω, 10%, 1/2 W	1	62PR500	73138	
R45	Resitor, Fixed, Composition: 51 Ω, 5%, 1/4 W	1	RCR07G510JS	81349	01121
T1	Transformer	1	LL010	07388	
U1	Integrated Circuit	1	796HC	07263	
U2	Integrated Circuit	1	741HC	07263	

5.5.8 TYPE 791549 HEADPHONE AMPLIFIER REF DESIG PREFIX A13

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Electrolytic, Tantalum: 27 μF, 10% 20 V	2	CS13BE276K	81349	56289
C2	Same as C1				
E1	Terminal, Forked	4	140-1941-02-01	71279	
E2 Thru E4	Same as E1				
R1	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/4 W	1	RCR07G103JS	81349	01121
R2	Resistor, Fixed, Composition: 8.2 kΩ, 5%, 1/4 W	1	RCR07G822JS	81349	01121
R3	Resistor, Fixed, Composition, 33 kΩ, 5%, 1/4 W	1	RCR07G333JS	81349	01121
R4	Resistor, Fixed, Composition, 560 Ω, 5%, 1/4 W	1	RCR07G561JS	81349	01121
R5	Resistor, Fixed, Composition: 22 Ω, 5%, 1/4 W	2	RCR07G220JS	81349	01121
R6	Same as R5				
U1	Integrated Circuit	1	741HC	07263	

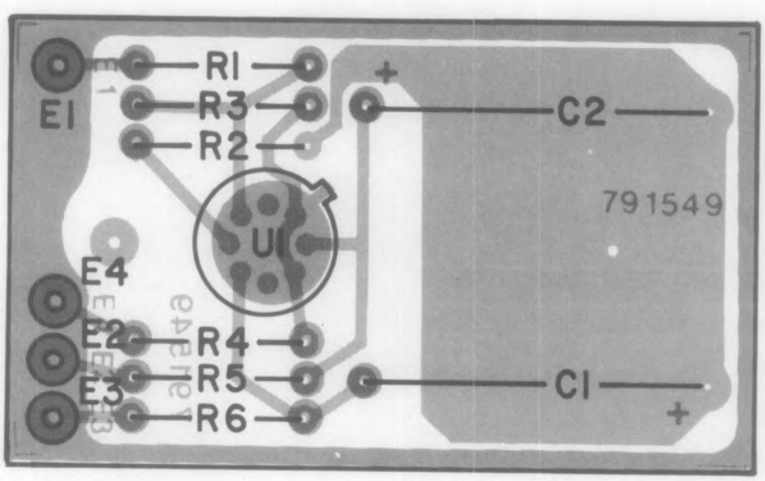
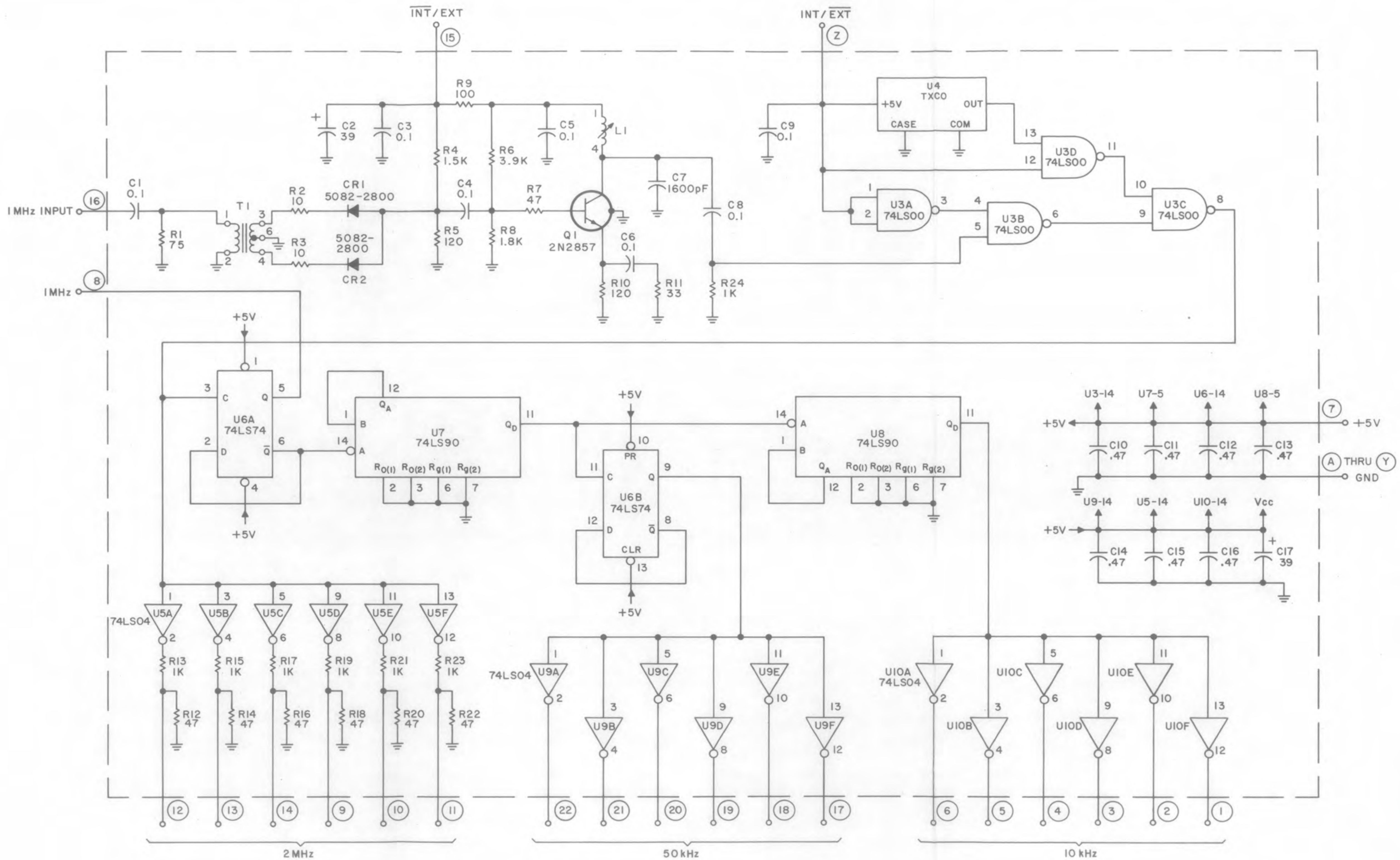


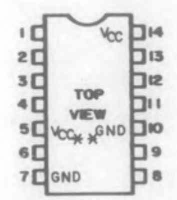
Figure 5-24. Type 791549 Headphone Amplifier (A13), Location of Components

SECTION VI

SCHEMATIC DIAGRAMS

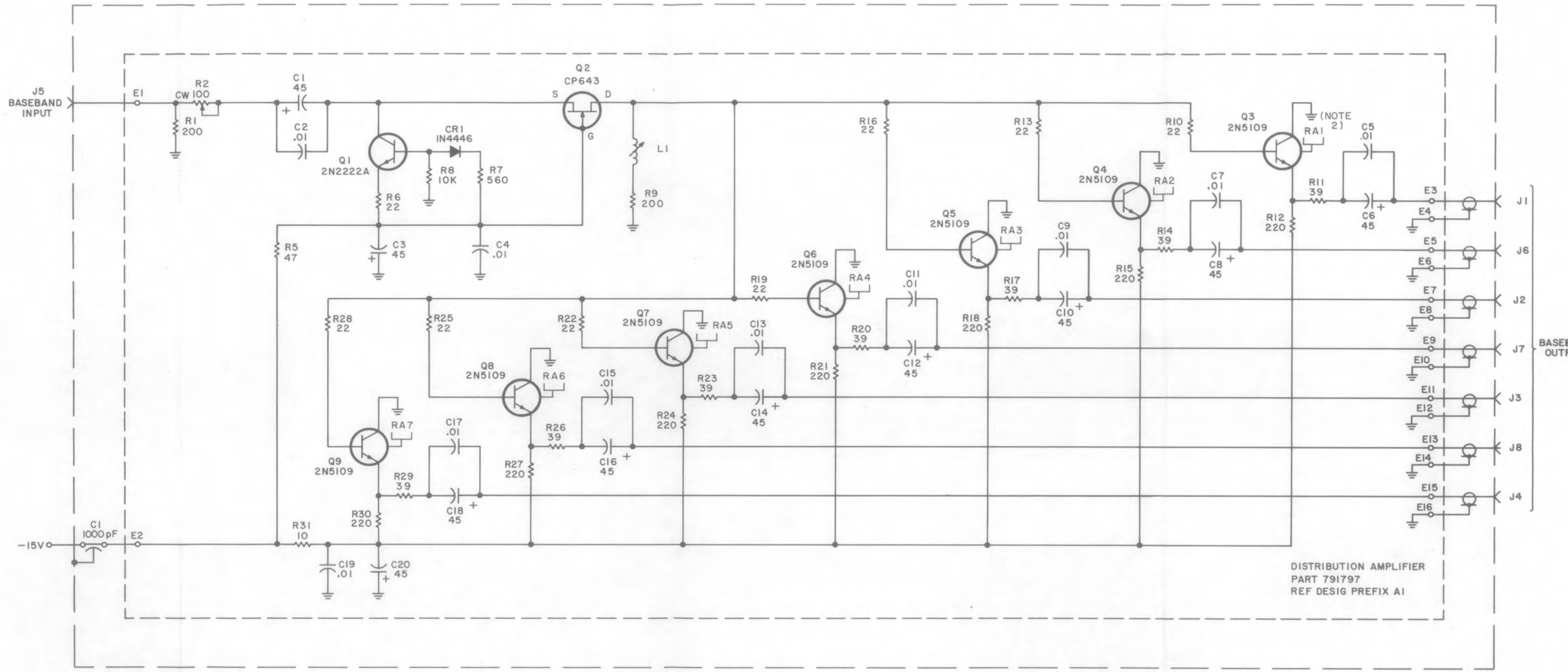


NOTES:
1. UNLESS OTHERWISE SPECIFIED:
a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
b) CAPACITANCE IS IN μF.



74LS00 74LS90* ONLY
74LS04 74LS86
74LS14 74LS74

Figure 6-1. Type 791540 Reference Generator (A1), Schematic Diagram 43087



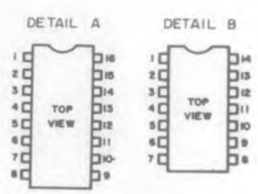
NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
   b) CAPACITANCE IS IN μF.
2. RA1 THRU RA7 ARE PART OF CHASSIS.

Figure 6-2. Type 791548 Distribution Amplifier (A2), Schematic Diagram 43685

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/4 W.
   b) CAPACITANCE IS IN μF.
2. +5V AND GND CONNECTIONS, PIN ARRANGEMENTS, AND SPARE CIRCUITS OF ICs ARE GIVEN IN TABLE I.

IC TYPE	REF DESIGS	+5V PIN	GND PIN	DETAIL	SPARES (PINS TO GND)
CD4050	U1, U2, U3, U14 – U17	1	8	A	U14C (7) U15C (7)
74LS123	U5	16	8	A	
74LS00	U6	14	7	B	
CD4013	U7,	14	7	B	U7B (8,9,10,11)
CD4063	U8, U9	16	8	A	
74C174	U10 – U13	16	8	A	



HIGHEST REF DESIG	REF DESIG NOT USED
C8 R25 S1 U17	

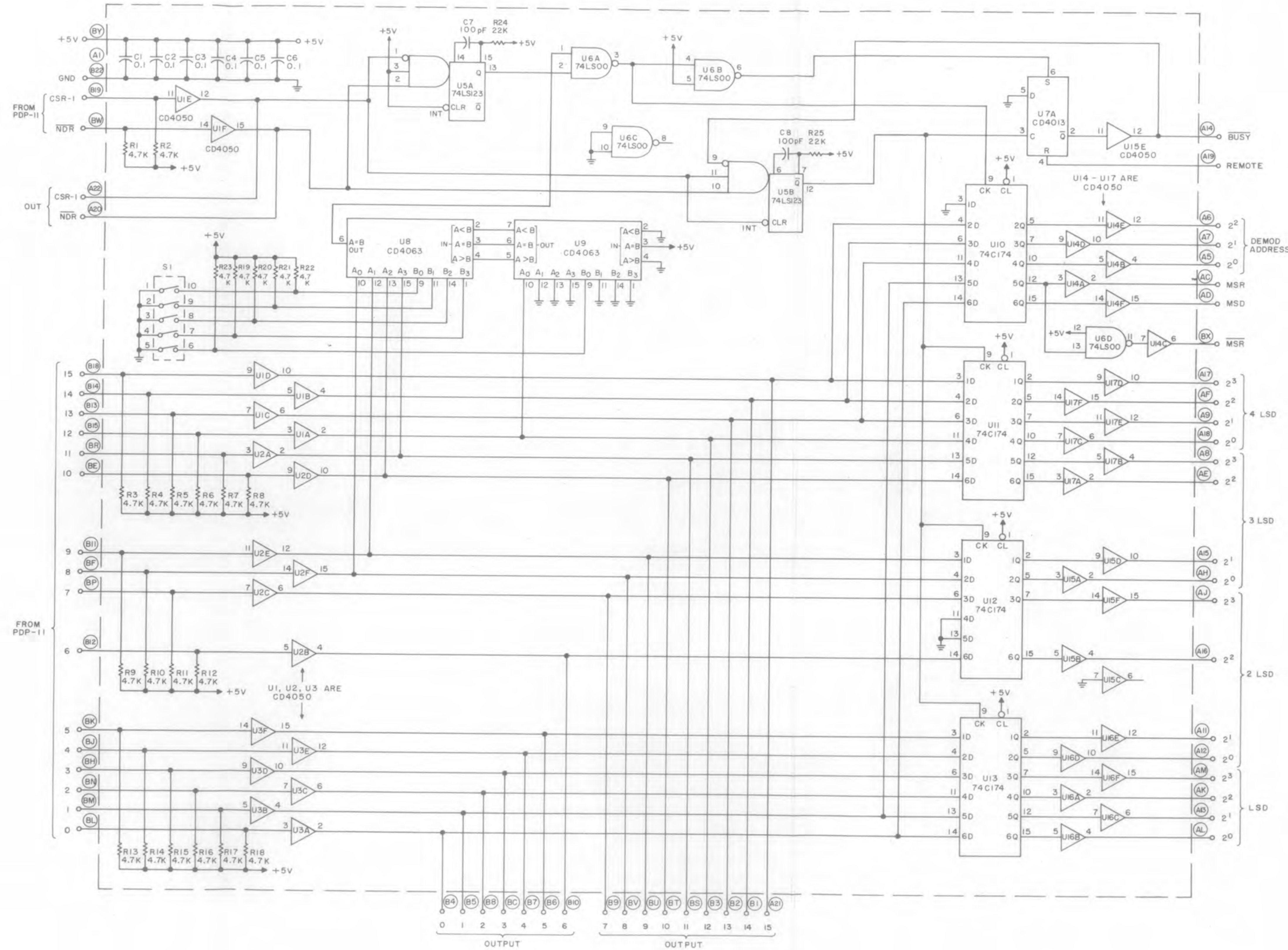
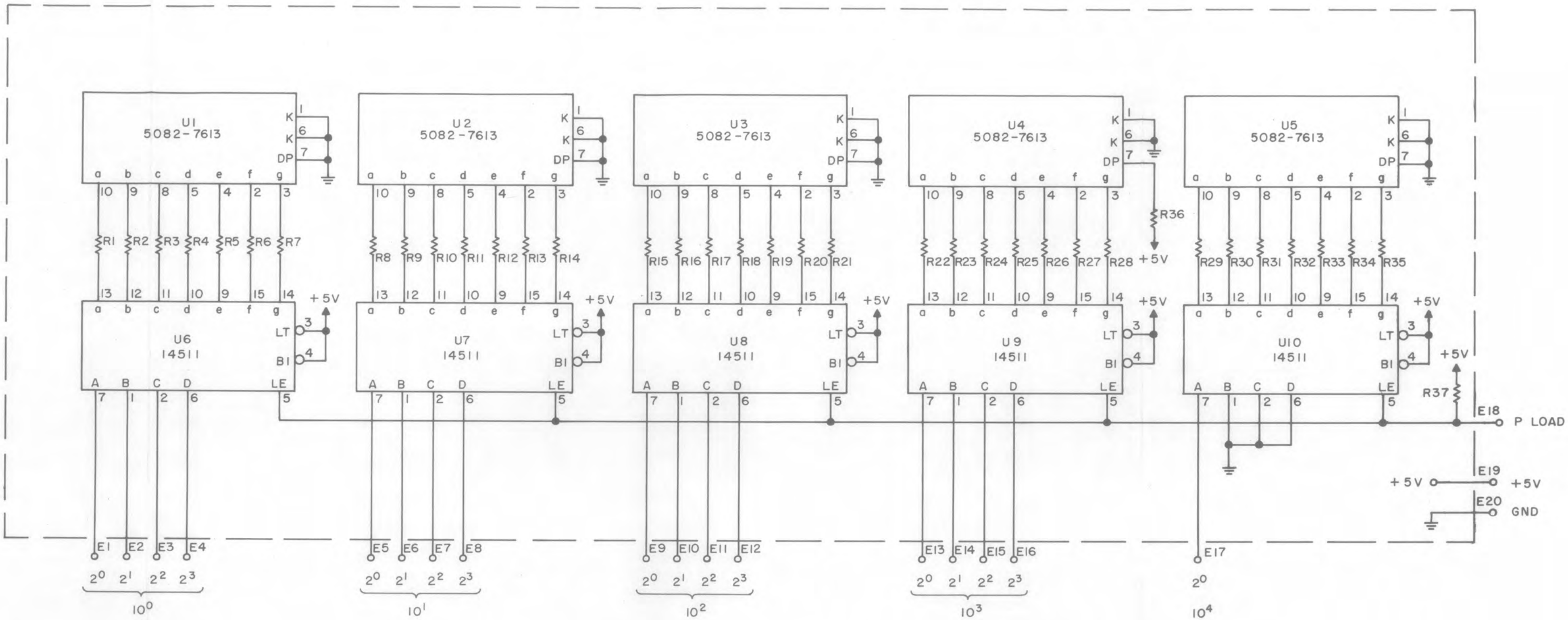


Figure 6-3. Type 791543 Remote Interface (A3), Schematic Diagram 51123



NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTORS ARE 680Ω, ±5%, 1/4W.
2. PIN 8 OF U6-U10 IS GND; PIN 16 IS +5V.
3. PIN ARRANGEMENT FOR U1-U5 IS SHOWN IN DETAIL A; PIN ARRANGEMENT FOR U6-U10 IS SHOWN IN DETAIL B.

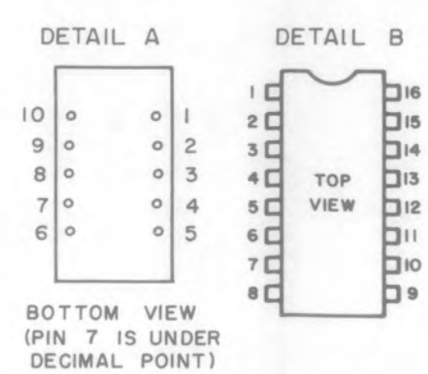
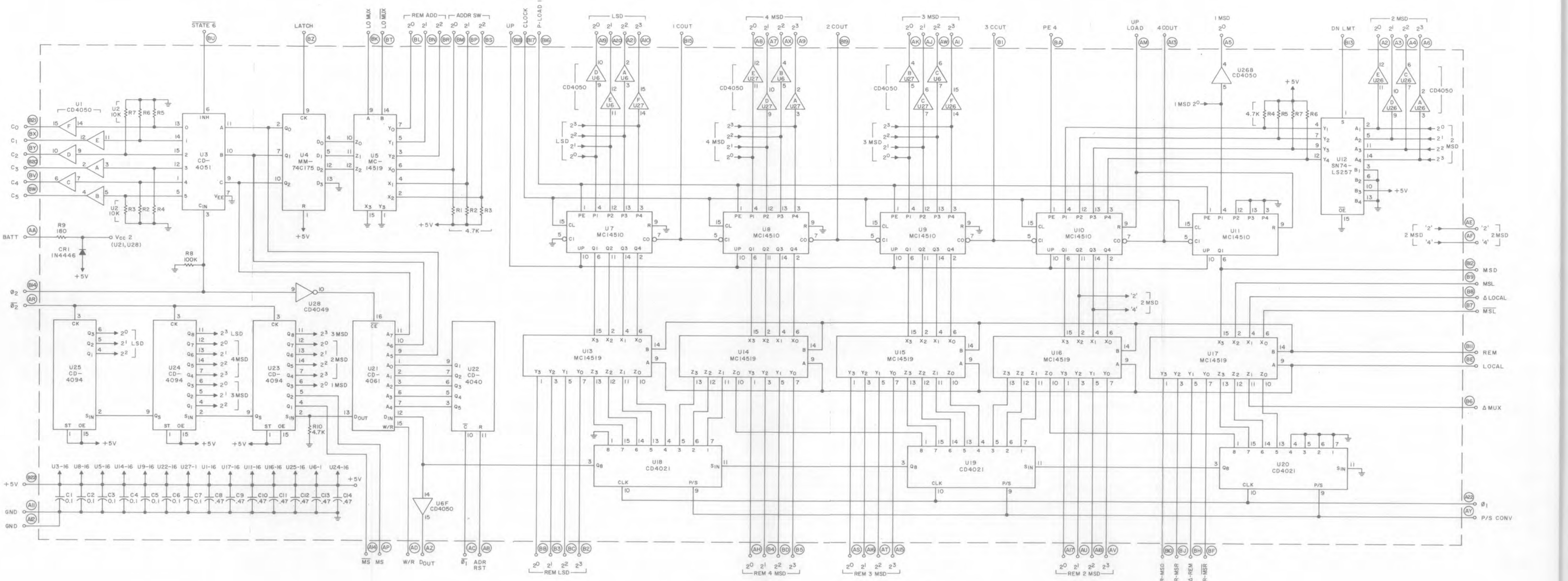


Figure 6-4. Type 791541 Display (A4)
Schematic Diagram 43049



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
   b) CAPACITANCE IS IN μF.
2. ENCIRCLED NUMBERS (LETTERS) ARE MODULE PINS.
3. LEAD ARRANGEMENT, Vcc (Vcc 2) AND GND PINS FOR IC'S ARE LISTED IN TABLE A.

TABLE A

IC	CD4021	CD4040	CD4049	CD4050	CD4051	CD4061	CD4094	MC14510	MC14519	MM74C175	SN74LS257
REF DESIG USED	U18, U19, U20	U22	U28	U1, U6 U26, U27	U3	U21	U23, U24, U25	U7—U11	U5, U13—U17	U4	U12
Vcc (+5V)	16	16	1*	1	16	5*	16	16	16	16	16
GND	8	8	8	8	8	4	8	8	8	8	8
DETAIL	A	A	A	A	A	A	A	A	A	A	A

* Vcc 2 ONLY

DETAIL A

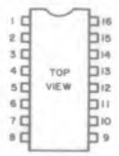
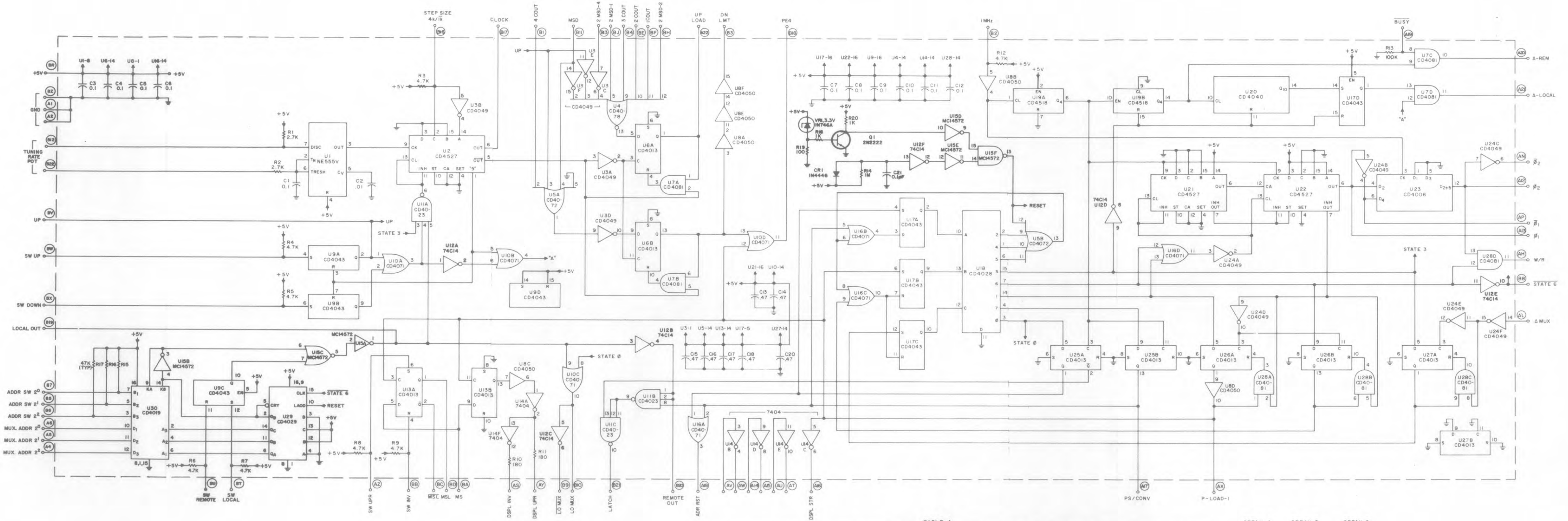


Figure 6-5. Type 791539 Digital Control Unit #2 (A5), Schematic Diagram 61309



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
   b) CAPACITANCE IS IN µF.
2. ENCIRCLED NUMBERS (LETTERS) ARE MODULE PINS.
3. IC'S LEAD ARRANGEMENTS, Vcc & GND PINS ARE LISTED IN TABLE A.

TABLE A

IC	74C14	NE555V	CD4006	CD4013	CD4023	CD4028	CD4040	CD4043	CD4049	CD4050	CD4071	CD4072	CD4078	CD4081	CD4518	CD4527	7404	CD4029	CD4019	MC14572
REF DESIG USED	U12	U1	U23	U6, U13, U25 U26, U27	U11	U18	U20	U9, U17	U3, U24	U8	U10, U16	U5	U4	U7, U28	U19	U2, U21, U22	U14	U29	U30	U15
Vcc (+5V)	14	8	14	14	14	16	16	16	1	1	14	14	14	14	16	16	14	16	16	16
GND	7	1	7	7	7	8	8	8	8	8	7	7	7	7	8	8	7	8	8	8
DETAIL	B	A	B	B	B	C	C	C	C	C	B	B	B	B	C	C	B	C	C	C

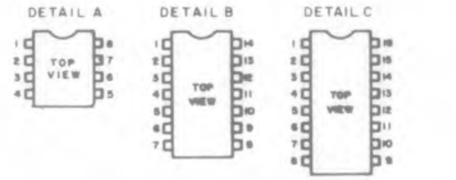


Figure 6-6. Type 796023 Digital Control Unit # 1 B (A6)
Schematic Diagram 61308

CITANCE IS IN pF.
RENCE BETWEEN TYPE 796024-1,-2
TED IN TABLE A.

TABLE A

TYPE	A8 TYPE
96024-1	34544-3
96024-2	34544-4

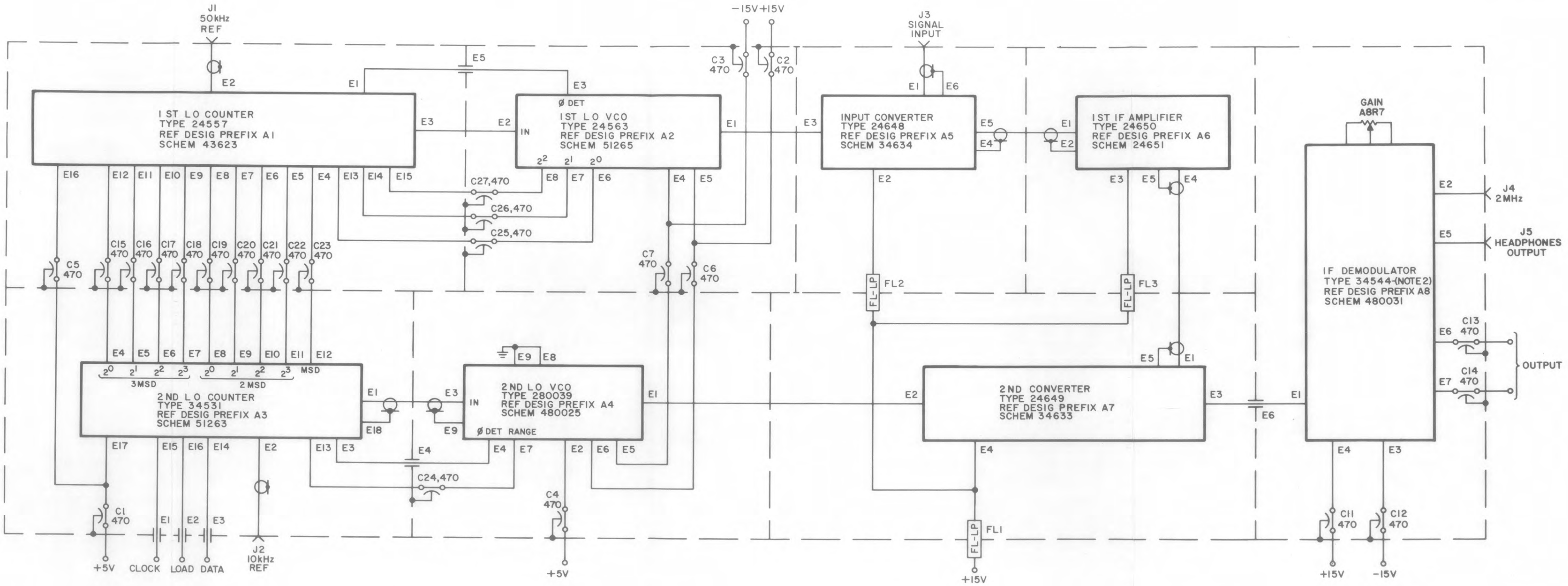


Figure 6-7. Type 796024-1-2 Demodulator/Synthesizer (A7-A12), Schematic Diagram 480028

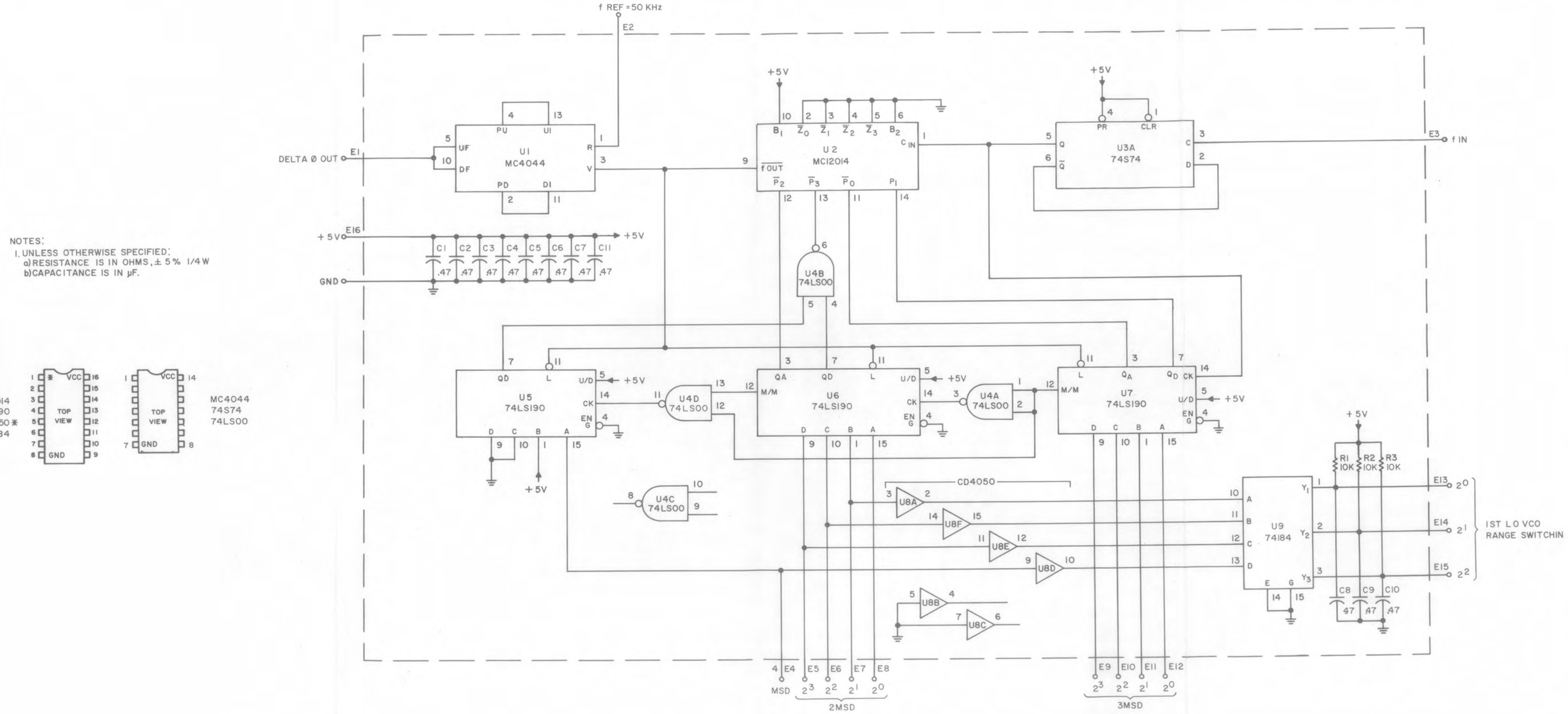
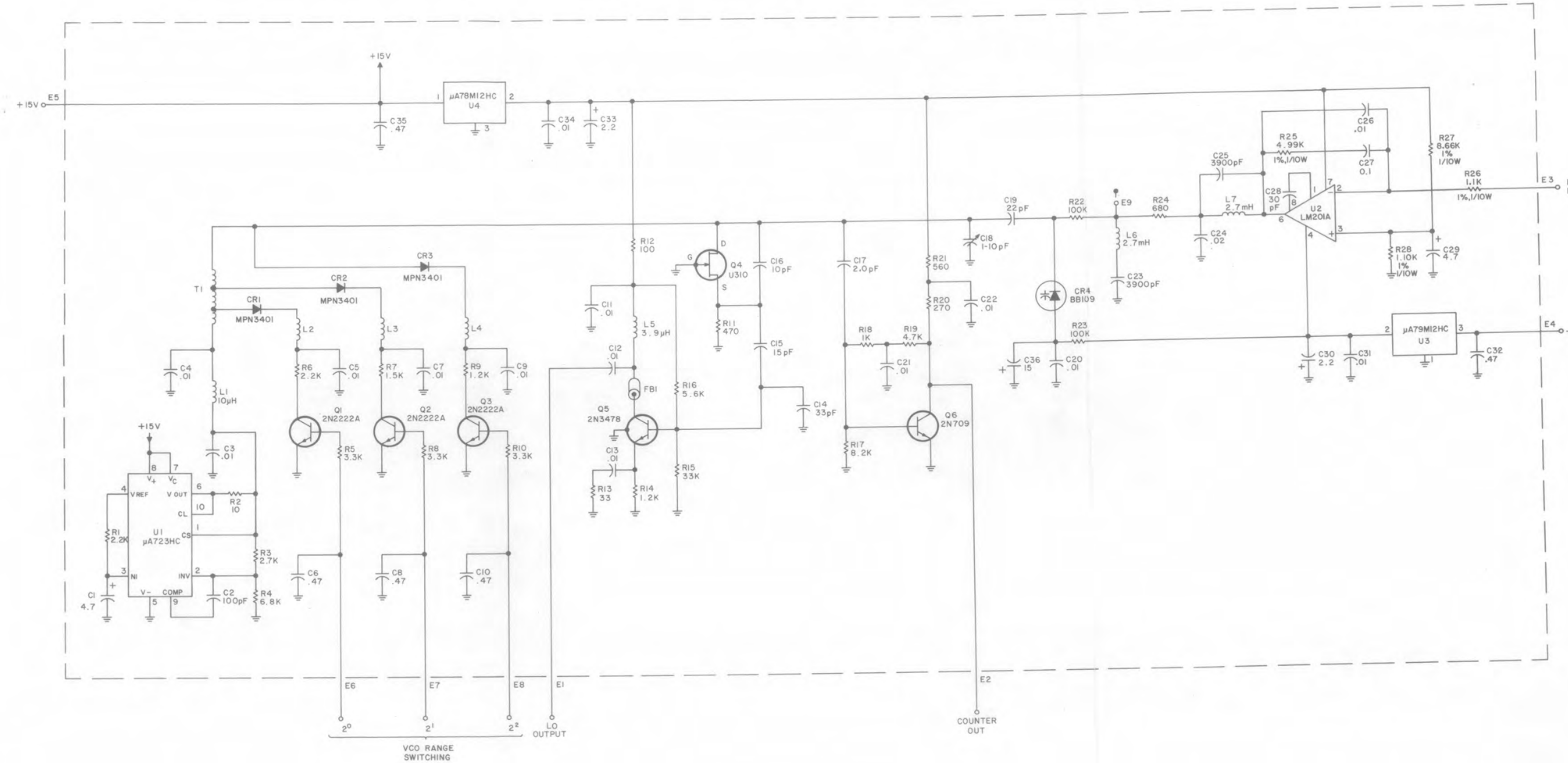


Figure 6-8. Type 24557 1st LO Counter (A7-A12) A1, Schematic Diagram 43623



NOTE:
1. UNLESS OTHERWISE SPECIFIED:
a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
b) CAPACITANCE IS IN µF.

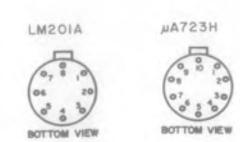
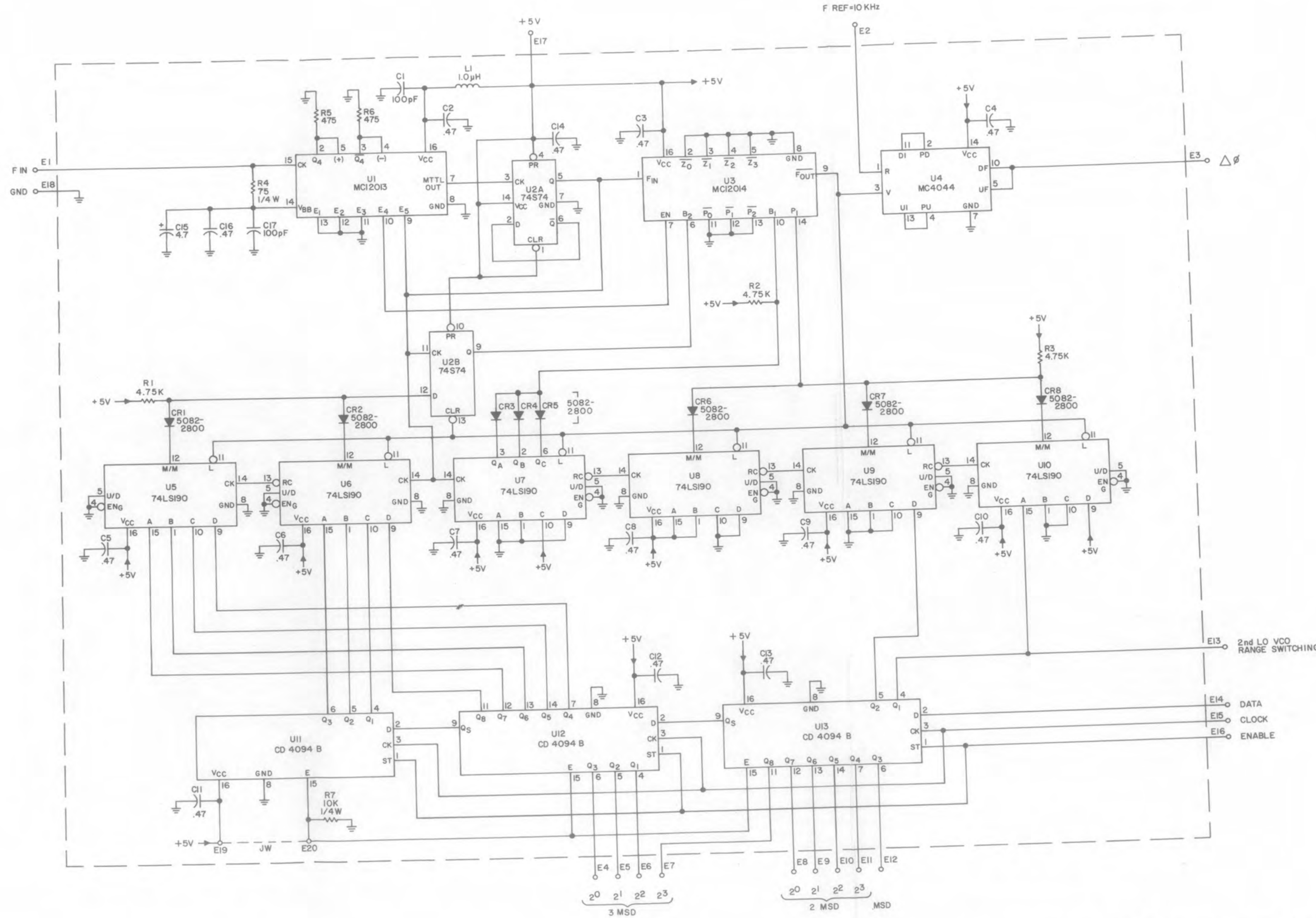
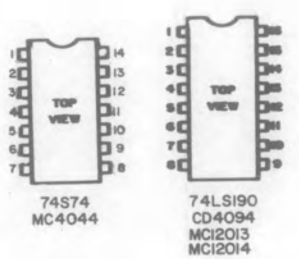


Figure 6-9. Type 24563 1st LO VCO (A7-A12)A2, Schematic Diagram 51265





NOTES:
1. UNLESS OTHERWISE NOTED:
a) RESISTANCE IS IN OHMS, ±1%, 1/10W.
b) CAPACITANCE IS IN µF.

Figure 6-10. Type 34531 2nd LO Counter (A7-A12) A3 Schematic Diagram 51263

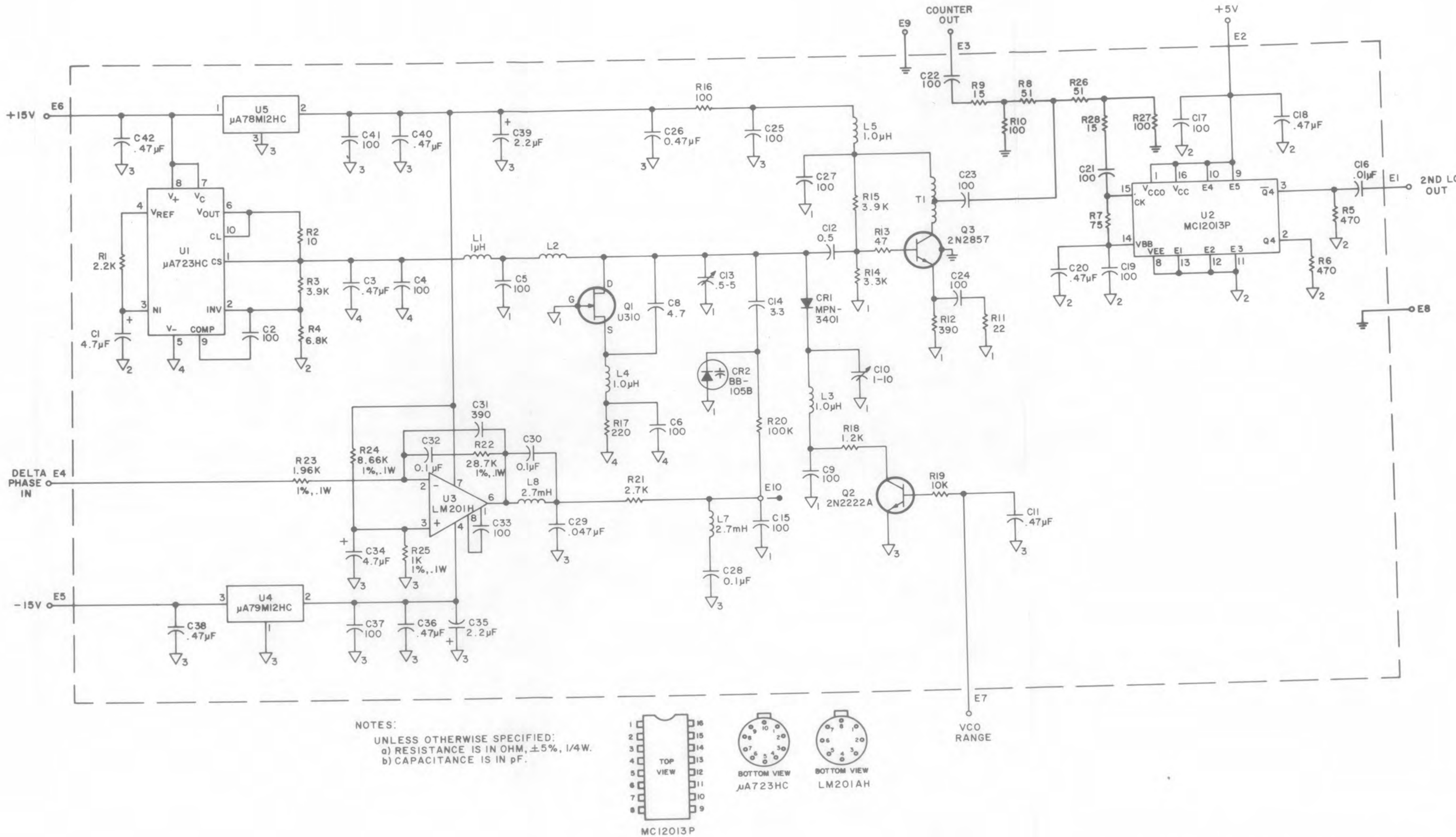
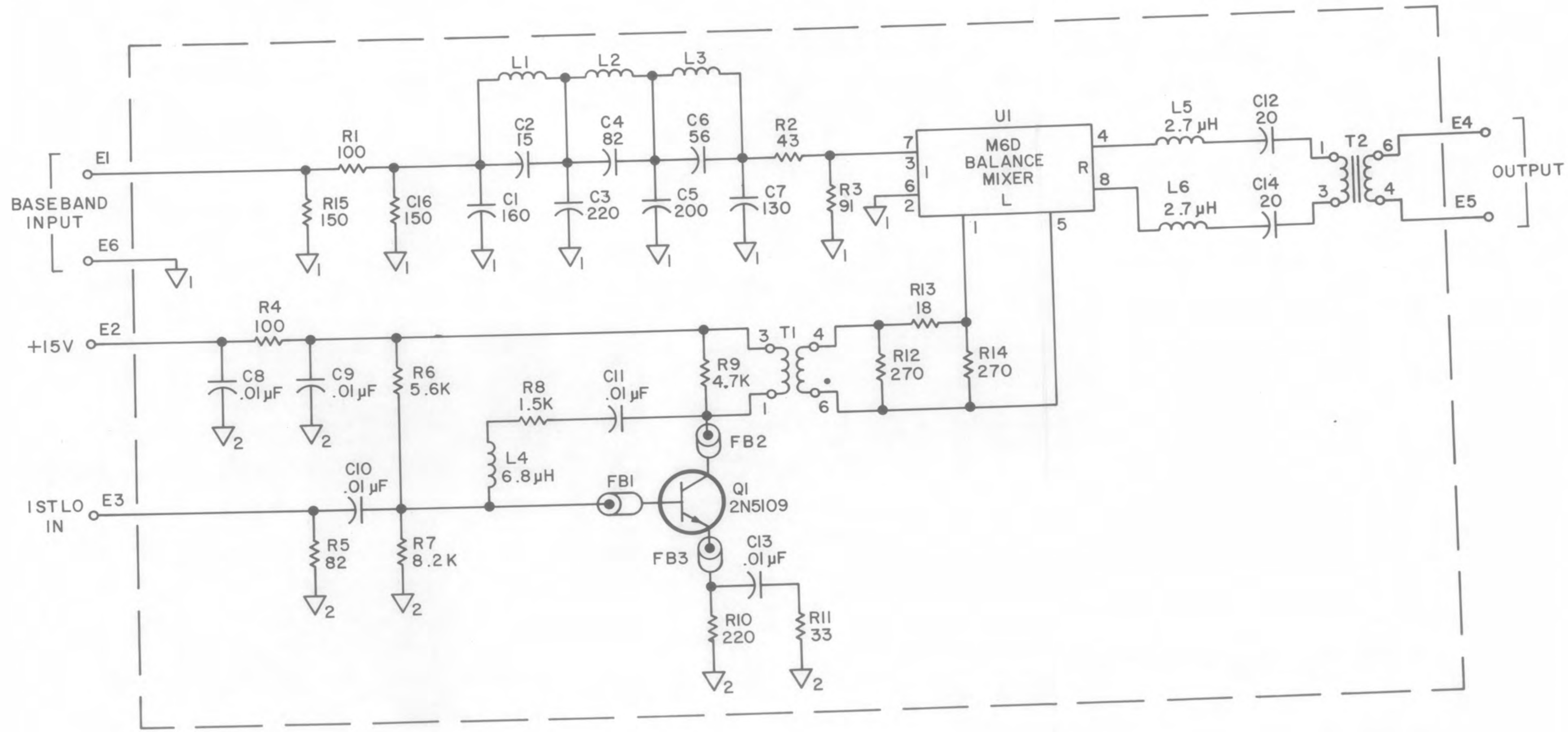


Figure 6-11. Type 280039 2nd LO VCO (A7-A12) A4, Schematic Diagram 480025



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
a) RESISTANCE IS IN OHMS, ± 5%, 1/4W
b) CAPACITANCE IS IN pF.

Figure 6-12. Type 24648 Input Converter (A7-A12)A5, Schematic Diagram 34634

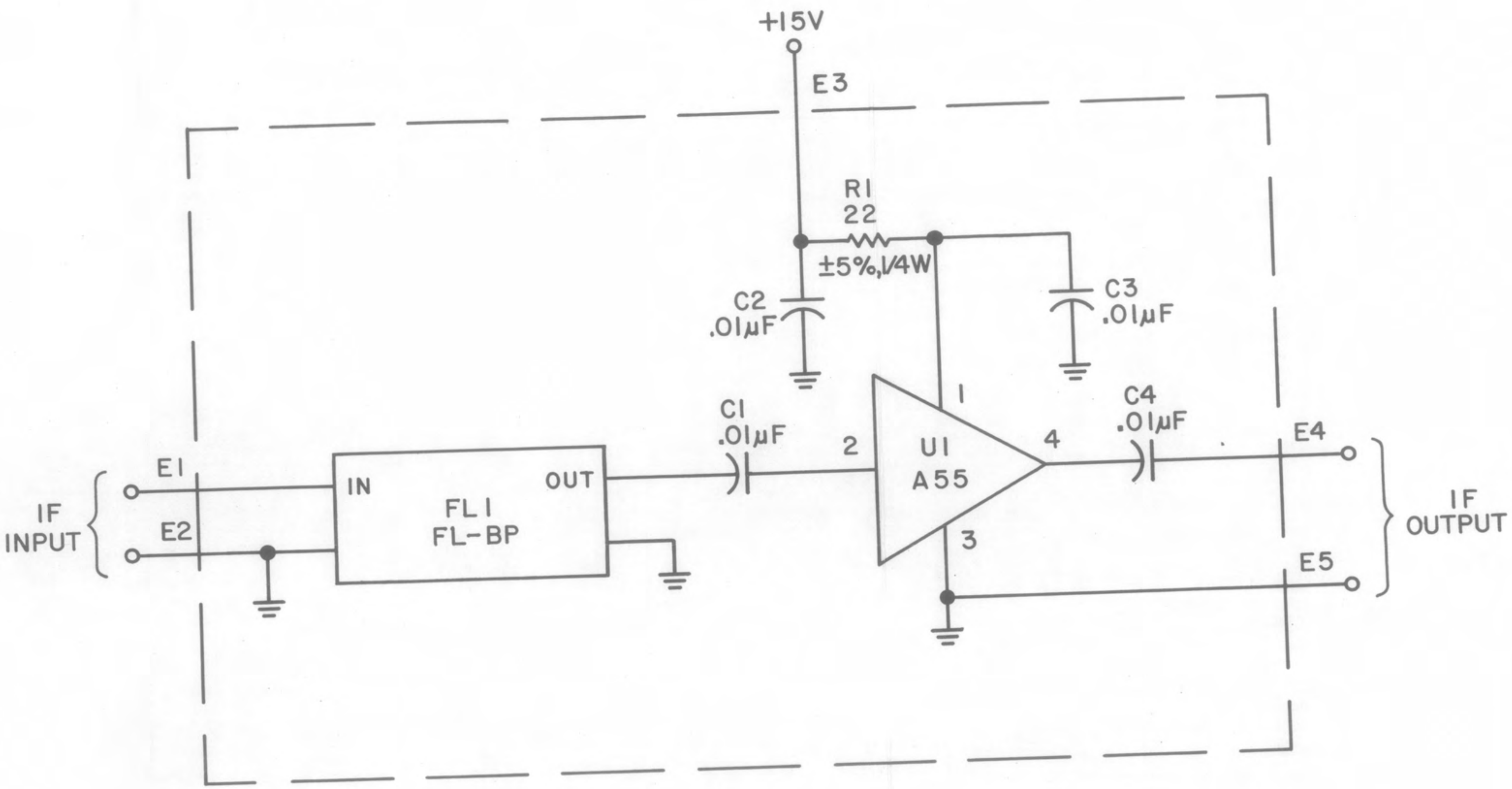
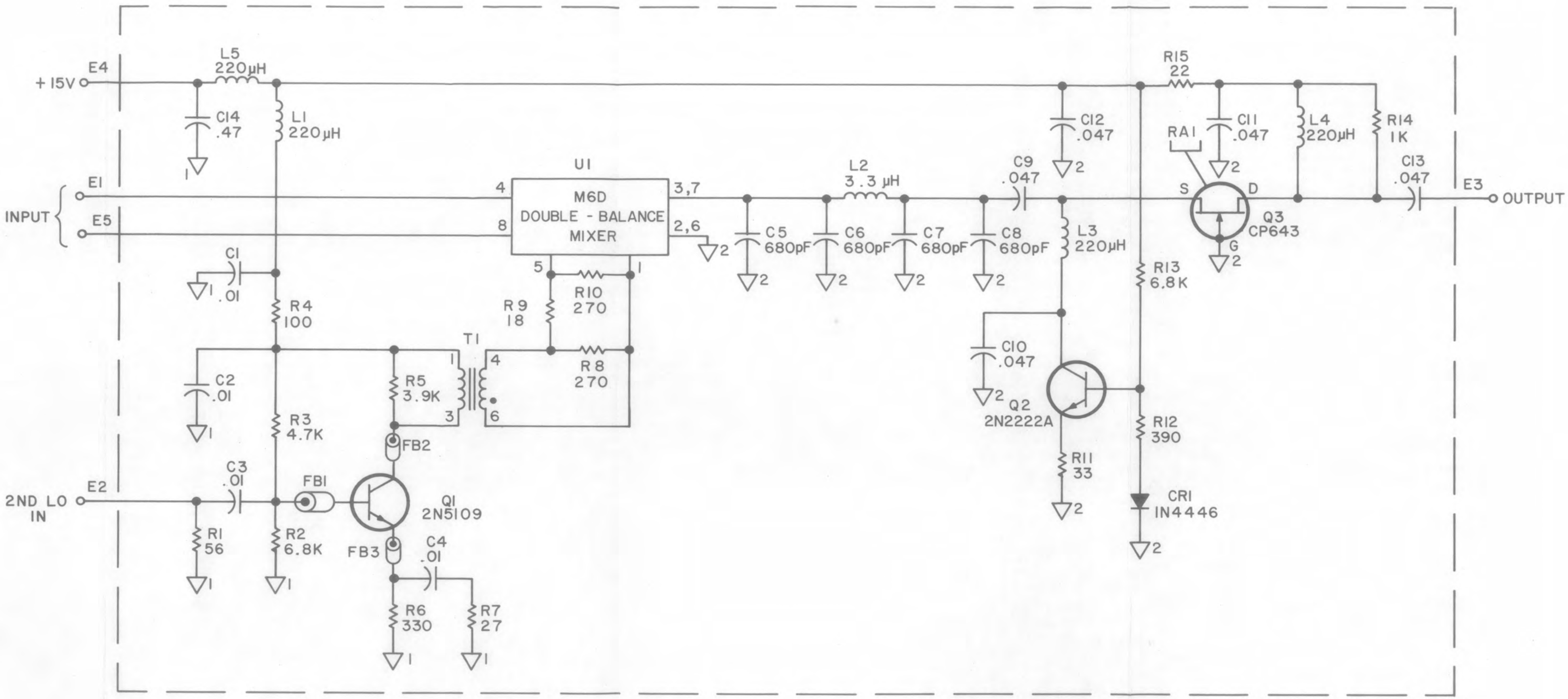
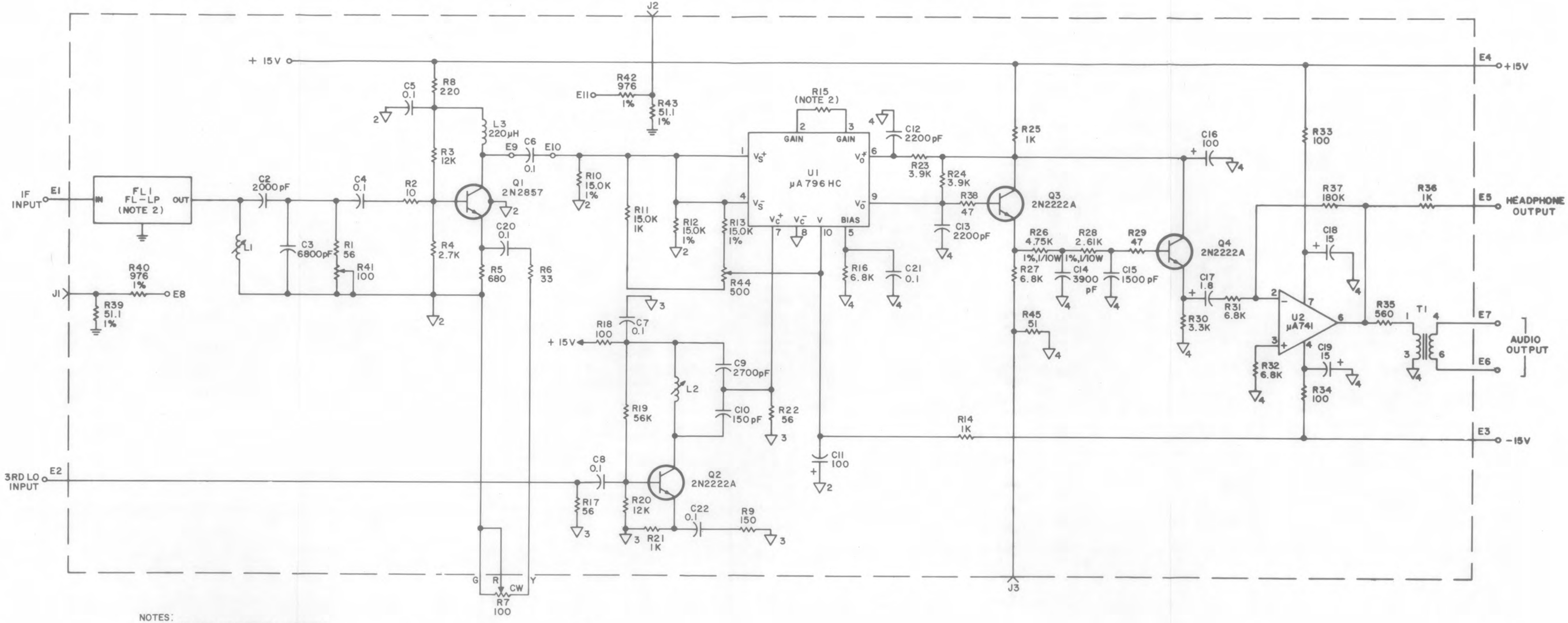


Figure 6-13. Type 24650 1st IF Amplifier (A7-A12)A6, Schematic Diagram 24651



NOTE:
1. UNLESS OTHERWISE SPECIFIED:
a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
b) CAPACITANCE IS IN µF.

Figure 6-14. Type 24649 2nd Converter (A7-A12) A7, Schematic Diagram 34633



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ± 5%, 1/4W.
   b) CAPACITANCE IS IN µF.
2. DIFFERENCE BETWEEN TYPES 34544-3,-4 IS LISTED IN TABLE A.

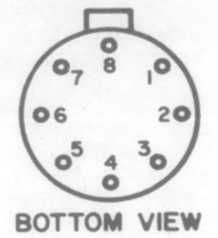
TABLE A

TYPE	FL1	R15
34544-3	92093	910
34544-4	92086	750

Figure 6-15. Type 34544-3-4 IF Demodulator (A7-A12) A8, Schematic Diagram 480031

NOTES:

1. RESISTANCE IS IN OHMS, ±5%, 1/4W.
   CAPACITANCE IS IN µF.
2. LEAD ARRANGEMENT OF U1:



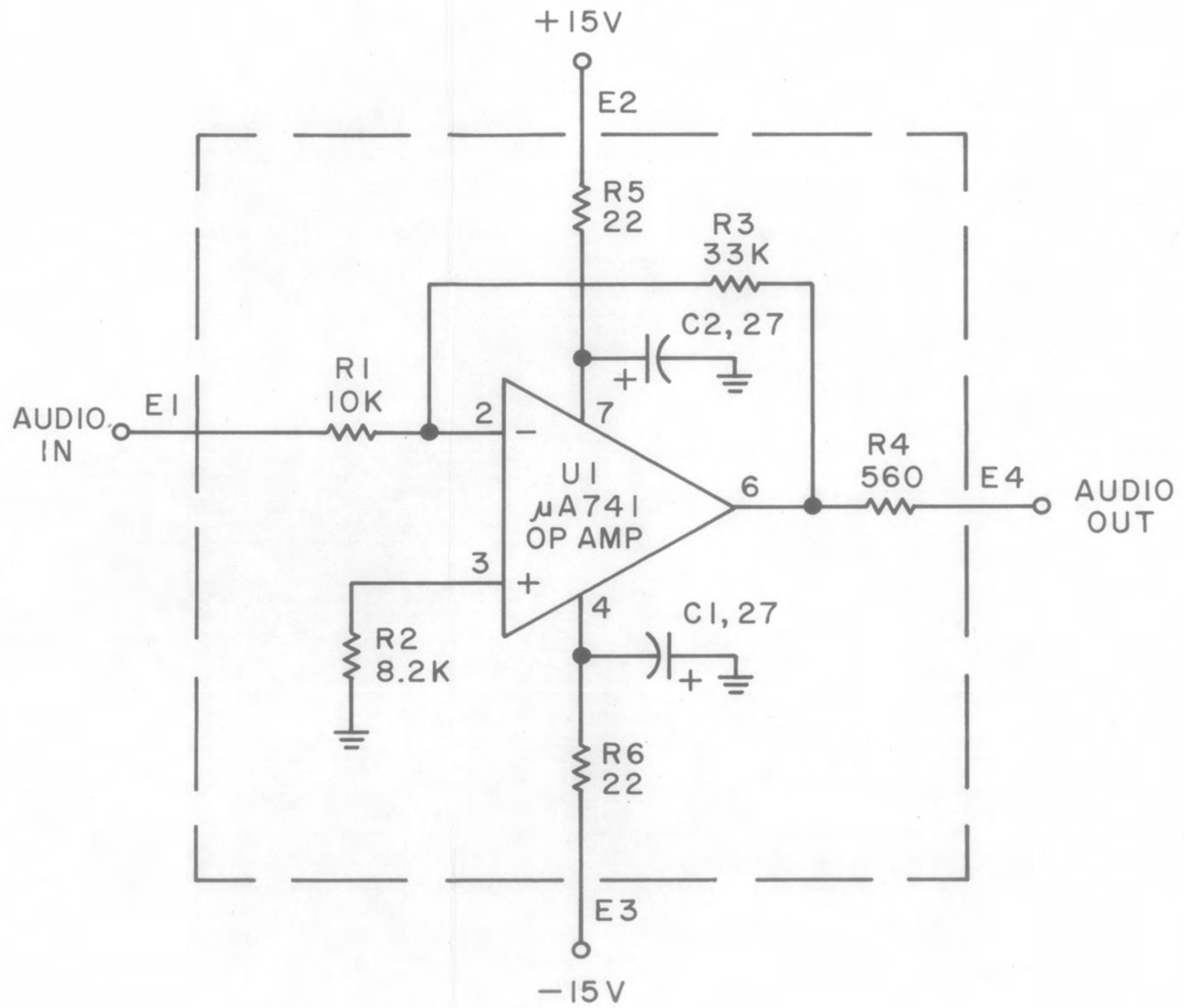
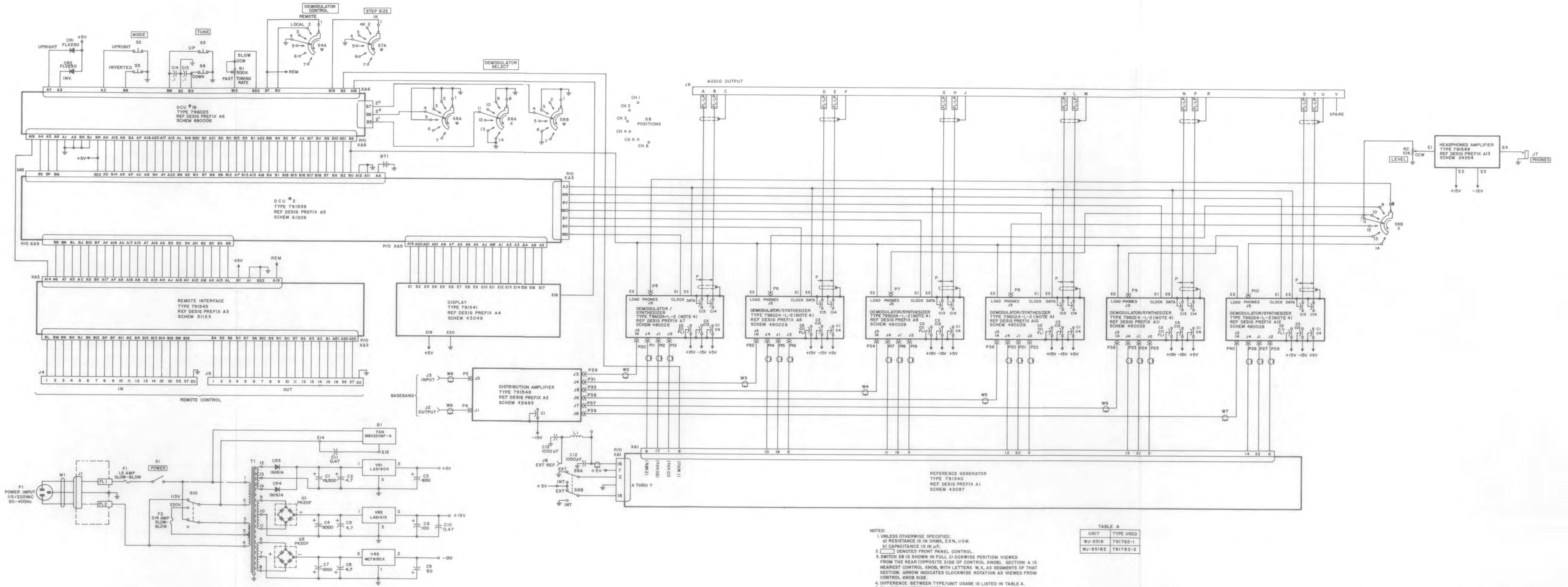


Figure 6-16. Type 791549 Headphone Amplifier (A13), Schematic Diagram 24354



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/2W.
   b) CAPACITANCE IS IN μF.
2. ▭ DENOTES FRONT PANEL CONTROL.
3. SWITCH S8 IS SHOWN IN FULL CLOCKWISE POSITION VIEWED FROM THE REAR (OPPOSITE SIDE OF CONTROL KNOB). SECTION A IS NEAREST CONTROL KNOB, WITH LETTERS W, X, AS SEGMENTS OF THAT SECTION. ARROW INDICATES CLOCKWISE ROTATION AS VIEWED FROM CONTROL KNOB SIDE.
4. DIFFERENCE BETWEEN TYPE/UNIT USAGE IS LISTED IN TABLE A.
5. FL-LP IS AN INTEGRAL PART OF J6.

TABLE A

UNIT	TYPE USED
WJ-9518	791762-1
WJ-9518E	791762-2

Figure 6-17. WJ-9518/WJ-9518E FDM Demodulator Schematic Diagram 61325