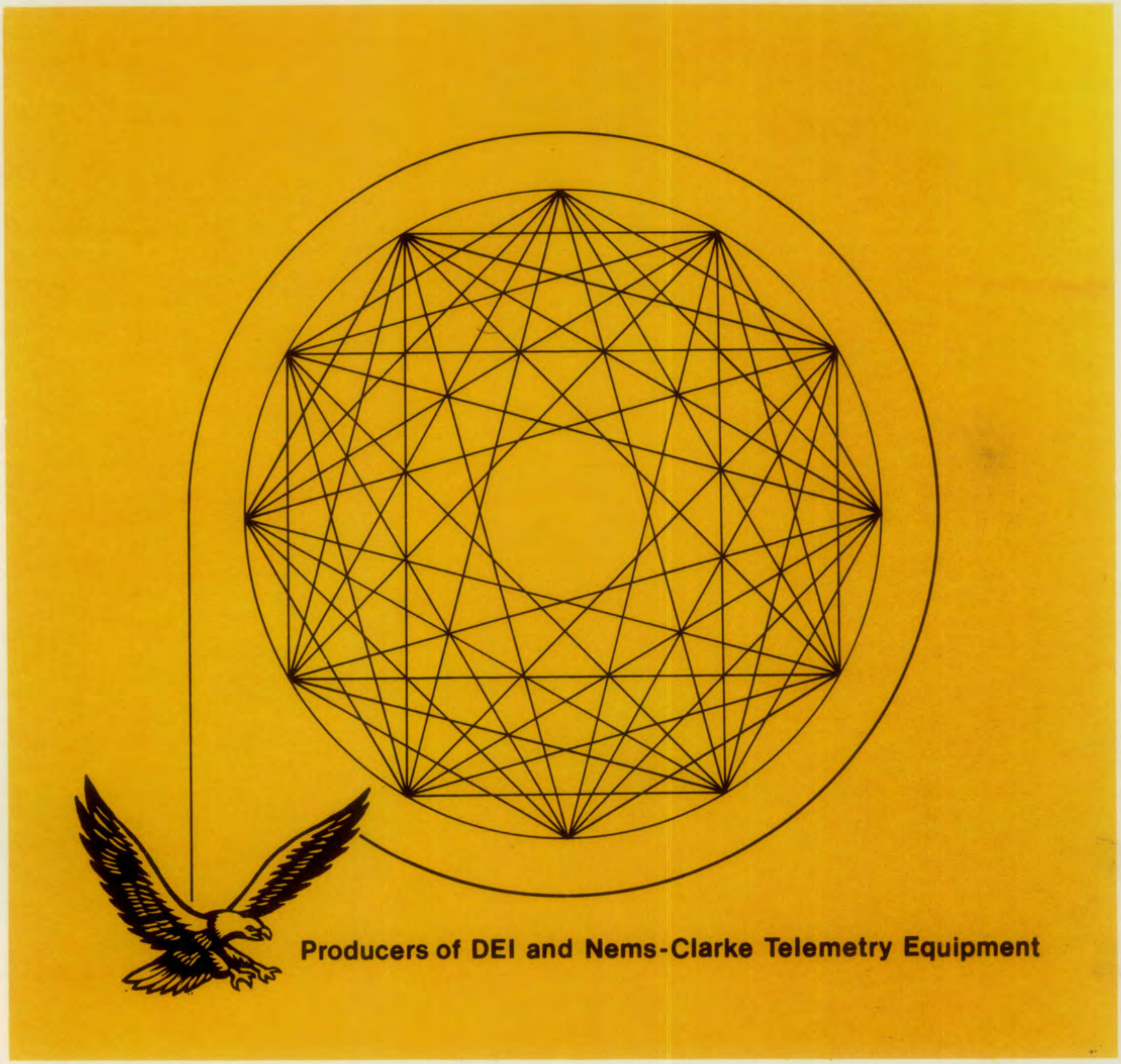

HARTMAN SYSTEMS DIVISION OF A-T-O INC./HUNTINGTON STATION, NEW YORK 11746

TELEMETRY RECEIVER
TMR-74A

Serial # 109

DOC. IDENT	RI FROM	M & S	STOCK NUMBER FSC	NIIN	ADD	UNIT OF ISSUE	QUANTITY	DOCUMENT NUMBER SERV REQUISITIONER	DATE	SERIAL	SUFFIX	SERV	SUPPLEMENTARY ADDRESS	SIGNAL	FUND	DISTRIBUTION	PROJECT	PRIORITY	REQ'D DEL DATE	ADVICE	RI		UNIT PRICE DOLLARS CTS
	HM2		5820	00 LSN		EA	1	H98230	2063	0086									NAN			F	12675,00

SHIPPED FROM	SHIP TO	MARK FOR	PROJECT	TOTAL PRICE DOLLARS CTS
A T/O 9705 Samford Road	B DPDO Aberdeen Proving Ground, MD	C	D L. J. BROWN ACCT 100	E 12675,00

WAREHOUSE LOCATION	TYPE OF CARGO	UNIT PACK	UNIT WEIGHT	UNIT CUBE	U F C	N M F C	FREIGHT RATE		DOCUMENT DATE	MAT. COND	QUANTITY		
F 704-I2	G	H	I	J	K	L	M	N	O	P	Q	R	S

SUBSTITUTE DATA (ITEM ORIGINALLY REQUESTED)	FREIGHT CLASSIFICATION NOMENCLATURE	
T	U	V
W	ITEM NOMENCLATURE X RECEIVER, DEI TMR74, SN H109 W/MANUAL	Y

SHIPPERS USE				RECEIVERS USE		
SELECTED BY AND DATE 1 ID 810260	TYPE OF CONTAINER(S) 2	TOTAL WEIGHT 3		RECEIVED BY AND DATE 7	INSPECTED BY AND DATE 8 2104
PACKED BY AND DATE 4	NO. OF CONTAINERS 5	TOTAL CUBE 6		WAREHOUSED BY AND DATE 9	WAREHOUSE LOCATION 10 [illegible]

REMARKS				
AA AGENCY EXCESS	BB UNCLASSIFIED SANITIZED REQUIRED	CC	DD	EE
FIRST DESTINATION ADDRESS 11	DATE SHIPPED 12		FF	GG
13 TRANSPORTATION CHARGEABLE TO	14 B/LADING, AWB, OR RECEIVER'S SIGNATURE (AND DATE)		15 RECEIVER'S DOCUMENT NUMBER	

DD FORM 1348—1 1 MAR 74 EDITION OF 1 JAN 64 MAY BE USED UNTIL EXHAUSTED DOD SINGLE LINE ITEM RELEASE/RECEIPT DOCUMENT

TIS: 500-035-81, Item 15, 2D256 2C1004N

Jan, 1983

24 May 1979

TMR-74A Installation and Operating Instructions

I. INSTALLATION:

A. The TMR-74A is to be mounted in the place of the TR-711 receiver. Slide rails are provided in the shipping container.

B. The RF input (antenna) is to be connected to J-1.

C. The 10 MHZ output J-8 is to be connected to the input to the Recorder Convertor using the existing cable.

D. Connect the power cable to 110 volts AC.

II. RECEIVER PRESETS:

A. Rear Panel AGC Record Switch: Not used.

B. Front Panel:

RF Tuner:

XTAL: Preferred mode for crystal control operation.

$$Fc = \frac{Fr + 55\ MHZ}{4}$$

Where Fc is the crystal frequency. Fr is the receive frequency in MHZ.

EXT: For external local oscillator using HP Signal Generator patched to J-9 (First local oscillator input). Signal Generator output at -13dbm Signal Generator frequency is:

$$\frac{Fr + 55}{4} = Fsig\ generator.$$

example for 315.0857 receive frequency

$$\frac{315.0857 + 55}{4} = 92.521425\ MHZ$$

VFO: For internal VFO operation. See manual for instructions.

TMR-74A Installation and Operating Instructions (Con't)

MODE SWITCH	:	AM
2nd LO MODE	:	XTAL preferred. For 2nd LO in the VFO or external option see manual for instructions.
AFC TC SEC	:	Not required, no button depressed.
AGC TIME CONSTANT	:	1000 button depressed
IF BANDWIDTH KHZ	:	30 button depressed
VIDEO BANDWIDTH	:	DIR (Direct) button depressed
VIDEO GAIN	:	Not used, full CCW
AUDIO GAIN	:	As desired
FM DEMODULATOR		
BANDWIDTH	:	NAR (Narrow) button depressed
MULTIPLIER	:	Not used. All buttons out
AFC SEARCH	:	Not used. Full CCW
2nd LO TUNING	:	Used only in 2nd LO VFO Mode See manual for instructions. 2nd LO Tuning/VFO Mode should only be used in the event of 2nd LO XTAL failure

III. BALANCE AND TUNING METER ADJUSTMENTS:

A. Allow receiver to warm up for 24 hours.

B. Depress BAL MODE button, wait 1-2 seconds.

C. With small screw driver, adjust the left most balance screw on FM demodulator for ZERO indication on Tuning Meter.

D. Depress CAL MODE button, wait 1-2 seconds.

E. Adjust ZERO screw (beneath right corner of tuning meter) for zero indication on Tuning Meter.

F. Repeat steps B through E.

G. Depress AM MODE to return receiver to normal operation.

NOTE: Above calibration steps allow tuning meter to be used when Trimming crystal frequency. To verify correct set up, install receive crystal in RF tuner oven, activate transmitters to produce spur, tune the RF tuner control for maximum deflection on signal level meter and zero deflection on the Tuning Meter (dial reading should be at approximate receiver frequency), and with VLF receiver input in direct, measure the spur on VLF receiver. The spur should appear at 25 KHZ +/- 1 KHZ, assuming both transmitters are set to exact channel frequency.

IV. VERIFICATION OF PREDECTION RECORDER INPUT LEVEL:

A. The recorder input level from the TMR-74A receiver may be slightly less than from the TR-711 receiver. If so, the recorder input level may require adjustment.

B. Install a TMR-74A receive crystal in the RF Tuner oven. The TR-711 crystals are not useable in the TMR-74A, nor are the TMR-74A crystals useable in the TR-711 receiver.

C. Inject a signal at the receive frequency at the receiver test port 20db attenuator using the HP8640 signal generator. Adjust signal generator for -80dbm output.

D. Adjust the TMR-74A RF Tuner tuning knob for maximum deflection on the signal level meter and zero deflection on the tuning meter.

E. Select the TMR-74A receiver at the station controller and the appropriate playback mode for recorder #1.

F. Activate the recorder

G. The recorder input level should be Ødb on the lower scale with the meter switch on the "IN" position, (recorder amplifier). If the level is Ødb, +/- 1 db, no adjustment to the recorder input level is required when switching between the TR-711 and TMR-74A receivers. If not, adjust the recorder input level to zero db on the lower scale of the recorder amplifier meter.

H. Repeat step G with recorder #2.

V. OPERATION GUIDELINES USING TMR-74A RECEIVER:

A. The preferred mode of operation is XTAL in the first and second LO stages. The second LO crystal is in the chassis and is not channel dependent. The first LO crystal is channel dependent and must be mounted in the crystal oven in the RF Tuner.

B. The above Balance and Tuning Meter adjustments should be checked at least monthly or whenever the Spur is not at 25KHZ.

C. The RF Tuner tuning control actually trims the receive crystal in the first local oscillator. To ensure that the tuning control is at the correct setting, a test signal must be present at the receiver antenna. This test signal can be either the Spur or a signal from the HP8640 Signal Generator using the procedure listed in paragraph IV, C, above. With this test signal, the tuning knob is positioned to approximate frequency on the dial, then the signal level is peaked and the tuning meter adjusted to zero using the tuning knob. The output signal at 10MHZ may be measured for verification of correct operation or the signal can be measured on the VLF receiver at 25KHZ, +/- 1KHZ.

TEST DATA

TMR-74 TELEMETRY RECEIVER

Job No. 9310

Serial No. H109

2.3 Preliminary Test

2.3.1 Mechanical Meter Zero JDC (ok)

2.3.2 Power JDC (ok)

+15 VDC 14.999 -15VDC 14.999 (15 volts ± 300MV)

3.1 Discriminator Balance and Tuning Meter Zero

3.1.3(c) Tuning Meter Zero JDC (ok)

3.1.3(e) Indication of Discriminator Balance JDC (ok)

3.2 Signal Level Meter and Carrier Operated Relay Test

AGC Record Output Adjusted (J4) JDC (ok)

3.2.3(b) AGC on Noise (TP3) +.64 Volts DC .

3.2.3(c) Signal Level Meter Adjustment JDC (ok)

3.2.3(d) AM Det. Lev. TP1 +1.07 (+1.05V ±.1 Volts)

3.2.3(e) COR Adjustment JDC (ok)

3.2.3(f) COR Contacts (J17) JDC (ok)

3.3 Noise Figure Test

3.3.3(a) Maximum Noise Figure VFO 5.5 dB (as specified 2.1.4).

3.3.3(b) Maximum Noise Figure XTAL 5.5 dB

3.3.3(c) Maximum Noise Figure EXT. 5.5 dB

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3.4 **Second LO Test**

3.4.3(a) Second LO Frequency Crystal Controlled 6. 000 MHz (limits 64 -65.003 MHz)

3.4.3(b) Second LO Frequency, VFO

Vernier Tuning Max CCW + 270 MHz (+270 ± 10 kHz)

Vernier Tuning Max CW - 270 MHz (-270 ± 10 kHz)

3.4.3(c) EXT. L.O. Output Level - 7 dB (-7 dBm + 2dB)

3.5 **RF Tuning Unit 1st LO Output**

3.5.3(a) Output Level VFO -3.5 dBm (Limit-7-dB min.) 255 (Dial Freq.)

3.6 **Video Amplifier, Video Filter and Output Meter Test**

3.6.3.1 Video Amplifier Frequency Response

3.6.3.1(d) Unfiltered Video 20 Hz to 2 MHz.

20 Hz to 2 MHz (2 db maximan variation) ________ dB

3.6.3.2 **Video Filter Test**

Filter Frequency		f_1		f_2		Measurement		Limits	
3.125	kHz	312	Hz	3.125	kHz		kHz	2.8125-3.4375	kHz
✓ 6.25	kHz	625	Hz	6.25	kHz		kHz	5.625-6.875	kHz
✓ 12.5	kHz	1.25	kHz	12.5	kHz		kHz	11.3-13.7	kHz
✓ 25	kHz	2.5	kHz	25	kHz		kHz	22.5-27.5	kHz
✓ 50	kHz	5	kHz	50	kHz		kHz	45-55	kHz
✓ 100	kHz	10	kHz	100	kHz		kHz	90-110	kHz
✓ 250	kHz	25	kHz	250	kHz		kHz	225-275	kHz
✓ 500	kHz	50	kHz	500	kHz		kHz	450-550	kHz
750	kHz	75	kHz	750	kHz		kHz	675-825	kHz
✓ 1000	kHz	100	kHz	1000	kHz		kHz	900-1100	kHz
✓ 1500	kHz	150	kHz	1500	kHz		kHz	1300-1650	kHz
• 3000	kHz	300	kHz	3000	kHz		kHz	2700-3300	kHz

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3.6.3.3 Output Meter Test

3.6.3.3(e) Output meter, CAL. JDC (ok)

3.6.3.4 Video Distortion Test

3.6.3.4(d) Video, Distortion .4 % (limit 0.5%)

3.6.3.5(a) Audio Output JDC (ok)

3.7 FM Demodulator and Deviation Meter Test

3.7.3(a) Deviation Meter CAL. (R82 AFC) JDC (ok)

Deviation Meter Range (100 kHz on 300 kHz Range ±10% JDC (ok)

Deviation Meter Range (30 kc on 100 kc Range ±10%) JDC (ok)

3.7.3(b) Rated Video Output with Minimum Deviation
N/A (ok) Wide
N/A (ok) Int.
JDC (ok) Nar.

3.8 IF Filter Test

3.8.3(a) IF Filter Output Level -11 dBm All Positions JDC (ok)

3.8.3(b) A.G.C. JDC (ok)

3.8.3(c) Manual Gain Cont. JDC (ok)

Manual Signal Level Indication JDC (ok)

3.9.3 AFC Test

3.9.3(c) IF Output Frequency (f_1) 10.00003 mc

3.9.3(d) Second LO Frequency 64.9979 mc

3.9.3(f) IF Output Frequency (f_2) 10.00005 mc

(f_2 - f_1) .02 kc (limit .5kHz)

3.9.3(g) Center Frequency Monitor +250 kHz
4.0 VDC AFC
.1 VDC VFO
.1 VDC XTAL

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-250 kHz ____4____ VDC AFC
____.1____ VDC VFO
____.1____ VDC XTAL

3.9.3(s) Search and Lock ____[signature]____ (ok)

3.10 PM Demodulator Test

3.10.3.1 Acquiring a Signal

3.10.3.1(d) Signal Acquired ____N/A____ (ok)

3.10.3.2 Automatic Acquisition

3.10.3.2(c) Automatic Acquisition Loop BW 1000 ____N/A____ (ok)

3.10.3.2(d) Automatic Acquisition Loop BW 300 ____N/A____ (ok)

3.10.3.3 Video Output and Distortion Test

3.10.3.3(e) Video Output (limit 1.41 volt minimum) ____N/A____ volts

3.10.3.3(g) Deviation Meter Indication (typical ±10% of full scale ____N/A____ degrees

3.10.3.3(i) Video Distortion with ±120 degrees of PM ____N/A____ %
(limit 5%)

3.10.3.4 Manual Acquisition Test

3.10.3.4(e) Manual Acquisition ____N/A____ (ok)

3.11 Display Unit Test

3.11.3(c) Sweep width set to 4 MHz using markers ____N/A____ (ok)

3.11.3(e) Full Scale Display with 5 microvolt signal at input to SDU ____N/A____ (ok)

3.11.3(a) Down Converter Output ____N/A____ Freq. ____N/A____ Freq.

3.12 Predetection Down Converter Test -PD-74-R or P-74-R

3.12.3(c) Channel 1

Video Carrier Frequency	Output Voltage
112.5 kc	________ volts (Limit 1.4V RMS Minimum)
225 kc	________ volts
450 kc	________ volts
600 kc	________ volts
800 kc	________ volts
900 kc	________ volts

TEST 22 hs

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3.12.3(e) Video Carrier Output Frequency

Switch Position	Measured Frequency	Limits
112.5 kc	kc	111.5 to 113.5 kc
225 kc	kc	224 to 226 kc
450 kc	kc	449 to 451 kc
600 kc	kc	599 to 601 kc
800 kc	kc	799 to 801 kc
900 kc	kc	899 to 901 kc

3.13 Predetection Playback Test FD-74-P & U-74-P

3.13.3(e) VFO and AFC operation N/A (ok)

3.13.3(c) Predetection Playback Switch Position

✓112.5 kc	(ok)
✓225 kc	(ok)
✓450 kc	(ok)
✓600 kc	(ok)
✓800 kc	(ok)
✓900 kc	(ok)

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3.14.3

IF Filter	S/N	Fu (Upper 3 dB)	Fl (Lower 3 dB)	Bandwidt (3 dB)		Symmetry (10% Max.)
I-74-G10	N/A		N/A		(9-11-kHz)	
I-74-G30	H012	15	15	30	(27-33 kHz)	0
I-74-G50					(45-55 kHz)	
I-74-G100					(90-110 kHz)	
I-74-G300					(270-330 kHz)	
I-74-G500					(450-550 kHz)	
I-74-G750					(675-825 kHz)	
I-74-G1000					(900-1100 kHz)	
I-74-G1500					(1350-1650 kHz)	
I-74-G2000					(1800-2200 kHz)	
I-74-G3300					(2970-3630 kHz)	
I-74-G4000					(3600-4400 kHz)	
I-74-G6000					(5400-6600 kHz)	

Tested By Joseph B. DeCarl Date 2 Aug 79

Approved By ______________________ Date ______________________

TEST 22 hs

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Job ORDER 9310

H 22

TMR-74 SER. NO. LIST

			Rec'd.	S/N
TMR-74-A			1	H109
~~TMR-74-B~~				
TMR-74-C				

Internal Sub-Assemblies

303211-92	AGC Ampl.	A2	1	H058
303212-90	AFC Ampl. → REMOVED: 15-III-88 → (TO: S/N H-024)	A3	1	H056
303213-90	Audio Ampl.	A4	1	H046
303210-90	AM Det/Dist Ampl.	A5	1	H060
203505-90	2nd Local osc.	A6	1	H050
203605-90	2nd I.F. Ampl.	A11	1	H063
303208-90	2nd Mixer	A13	1	H059
203247-90	Pwr Regulator	A15	1	H102

Video & IF BW Filters

V-74-	Video LP Filter	A1-A5	1	H016
V-74-	" " "	A1-A2		
V-74-	" " "	A1-A1		
V-74-	" " "	A1-A3		
V-74-	" " "	A1-A4		
V-74-	" " "	A1-A11		
V-74-	" " "	A1-A8		
V-74-	" " "	A1-A7		
V-74-	" " "	A1-A9		
V-74-	" " "	A1-A10		

I-74-G	IF BW Filter	A12A1	1	H012
I-74-G	" " "	A12A2		
I-74-G	" " "	A12A3		
I-74-G	" " "	A12A4		
I-74-G	" " "	A12A5		
I-74-G	" " "	A12A6		
I-74-G	" " "	A12A7		
I-74-G	" " "	A12A8		
I-74-G	" " "	A12A9		

RF Tuner

TU-74-LA	1435-1540 MHZ RF Tuner		
LB	1540-1660 MHZ RF Tuner		
LC			
PA	105-155 MHZ RF Tuner		
PA	105-155 MHZ RF Tuner		
PB	215-320 MHZ RF Tuner	1	H029
PC			
SA	2200-2300 MHZ RF Tuner		
	RF Tuner		
TU-74-______			

		Req'd.	S/N
	Demodulators		
DP-74-W	Phase Demodulator		
DF-74-H	Freq. Demod. Housing	1	H008
D- 74-N	Narrow BW Demodulator	1	H019
D- 74-I	Intermediate BW Demod.		
D- 74-W	Wide BW Demodulator		
D- 74-EW	Extra Wide BW Demod.		
	Options and Accessories		
U-74-P	SSD Converter		
S-74-A	S5/30 MHZ Down Converter		
P-74-P	Predection Playback		
P-74-R	Predection Record		
PD-74-P	Predet Playback Unit		
PD-74-R	Predet Record Unit		
SD-74-A	Spectrum Display Unit		
MK-74-C	Accessory Tray		
A-74-DF	First IF Filter A1-1		
CO-65	CRYSTAL OVEN	1	H024

TMR-74 TELEMETRY RECEIVER

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continued

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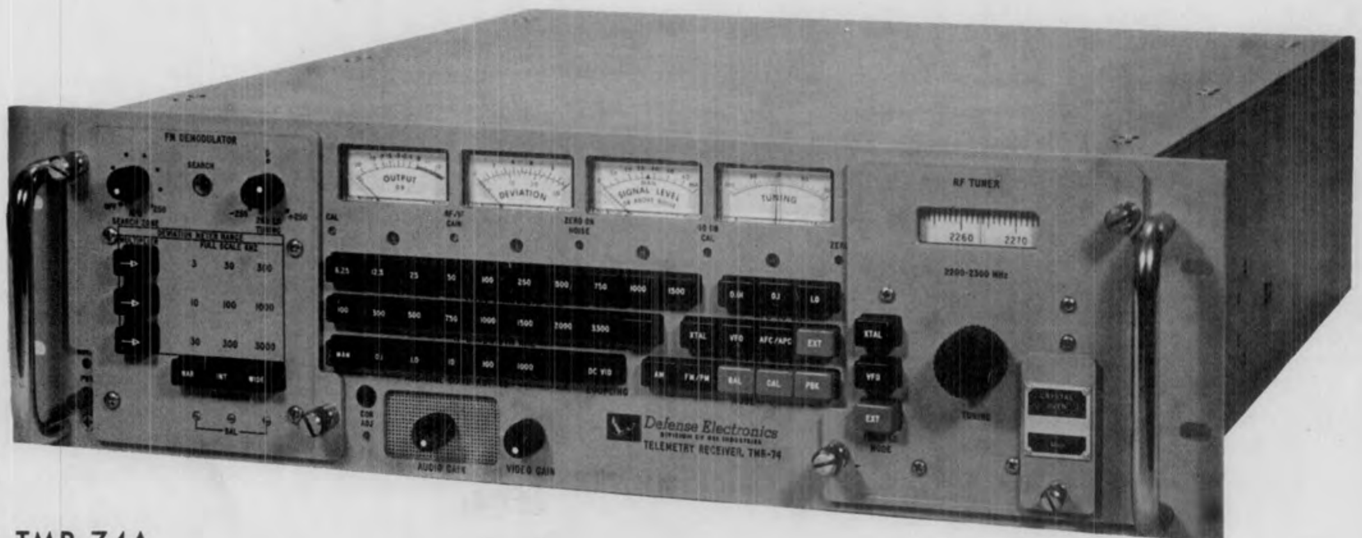
TMR-74B



TMR-74A

Figure 1-1. Model TMR-74 Telemetry Receiver

SECTION I
GENERAL DESCRIPTION

1.1 INTRODUCTION

Completely modular design is used throughout the the Model TMR-74 Telemetry Receiver. For maximum versatility and minimum equipment repair time, all separately identifiable circuit functions are mounted on plug-in printed circuit subassemblies and modules.

The instruction manuals for the TMR-74 are in keeping with the modular design of the receiver. This instruction manual describes in detail the basic receiver circuitry, and discusses the general operating principles of the overall receiver; also included are operating and maintenance instructions as they apply to the overall receiver.

The plug-in subassemblies and modules are described in detail in supplementary instruction booklets and manuals, as appropriate, which should be used in conjunction with this manual.

1.2 DESCRIPTION

The TMR-74 receiver is an entirely new telemetry receiver combining new concepts in operator convenience with unequalled flexibility. The TMR-74 is basically a single-channel, double-superheterodyne receiver which is compatible with all present and projected telemetry formats and is readily adaptable to microwave relay, fm television, tracking, and other applications. The first and second local oscillators have been provided with outputs which enable a pair of receivers to be patched together, thus providing true dual-channel performance if desired, without sacrificing single-channel capability. Front-panel control layouts are the result of many years of experience in providing receivers with human engineering a prime consideration.

Up to nine second i-f bandwidths, ten video bandwidths, and three fm discriminators are pushbutton selectable. The first l-o mode, the second l-o mode, the afc time constant, and the receiver operating mode are also pushbutton selectable. A single phase-demodulator module provides switchable wide-angle or sine-type phase demodulation. Demodulators and rf tuners are front-panel plug-in modules; all other circuitry is contained by internal plug-in subassemblies and modules.

The model TMR-74 is available in two primary configurations, the TMR-74A and the TMR-74B. The basic version, the TMR-74A, has a front-panel height of 5-1/4 inches, and offers the capability of a single video-carrier frequency for predetection recording or playback. However, by adding the MK-74-C adapter chassis, the TMR-74B configuration is achieved and the receiver can be provided with up to six switchable video-carrier frequencies and spectrum-display capability.

The MK-74-C adapter chassis is designed to allow rapid conversion from the "A" configuration to the "B" configuration without extensive and time-consuming electrical or mechanical modification. The MK-74-C consists of an adapter chassis which attaches to the basic receiver chassis, and a seven-inch front panel which replaces the 5-1/4 inch front panel. Both versions are designed for mounting in a standard 19-inch equipment rack, and are secured by four screws inserted through slots in the front panel. The receiver is available with tilt-lock slides to simplify preventive maintenance and servicing.

1.3 PLUG-IN MODULES

Plug-in modules used with the TMR-74 are of two kinds: those which plug in through the front panel of the receiver, and those which plug in internally. Demodulators and rf tuners are front-panel plug-ins, and may be changed without the necessity for removing the receiver from the rack. I-f and video bandwidth filters are internal plug-ins, and can be changed in a matter of seconds after removing the top cover of the receiver. An important feature is that the TMR-74 will accept complements of up to nine i-f bandwidth filters and ten video bandwidth filters simultaneously, with front-panel pushbutton selection of the desired bandwidths.

1.3.1 RF TUNERS

Standard TU-74 rf tuners for the TMR-74 are available for operation in the frequency range of 105 MHz to 2300 MHz. These front-panel plug-in modules are completely solid-state, and offer superior intermodulation characteristics in strong-signal environments. The bandwidth of the TU-74 tuners is sufficiently wide to allow operation with i-f bandwidths as high as 6 MHz without noise-figure degradation or impairment of the ability to handle large in-band signals. Preselection filtering and carefully-controlled early gain are employed to minimize overload in the presence of large out-of-band signals.

The first l-o mode, for example, crystal, vfo, or external, is pushbutton-selectable. If desired, a number of rf tuners may be used in the ATT-74 accessory tray, allowing remotely-controlled selection. The tuning dials of vhf tuners are calibrated in three ranges so that, when employed in L- or S-band applications in conjunction with antenna-mounted down converters, a true indication of the received frequency is immediately available.

1.3.2 DEMODULATORS

a. FM: Complete fm demodulation capability with search-and-lock is provided for the TMR-74 by the front-panel plug-in DF-74-H fm demodulator housing, equipped with a complement of three plug-in D-74 series fm discriminator modules. Selection of deviation meter range and demodulator bandwidth are made through the use of front-panel pushbutton switches. Second l-o vernier tuning and search range controls are also mounted on the demodulator front panel. An extra wide bandwidth discriminator, for use with second i-f bandwidths of 6 MHz, is available. Each D-74 is a compact module which plugs into the demodulator housing. Selection of the desired discriminator is made through the use of pushbutton switches on the front of the housing.

b. Phase: Phase demodulation is provided the TMR-74 by the DP-74-W wide-angle phase demodulator. The demodulator includes automatic search-and-lock with antisideband circuitry for optimum signal acquisition. The DP-74-W also features a synchronous a-m detector and provides both coherent agc and envelope agc outputs. The demodulator responds to signals having phase deviation of up to 4.5 radians. 30° deviation will produce full rated output from the phase detector, and 30% a-m modulation will produce full rated output from the synchronous a-m detector.

c. AM: The TMR-74 includes an integral low distortion a-m detector with a response of up to 3 MHz, or half the i-f bandwidth in use for narrower bandwidths. The a-m output is always available from the receiver.

1.3.3 SECOND IF BANDWIDTH FILTERS

Standard I-74 second i-f bandwidth filters used with the TMR-74 are available for bandwidths of 10 kHz through 6 MHz. Up to nine of these internal plug-in modules may be installed in the receiver simultaneously; selection of the desired bandwidth is made by front-panel pushbutton. Through the incorporation of pushbutton-selected fm discriminators and pushbutton-selected i-f bandwidths, a major operational feature is implemented: when changing i-f bandwidths from, for example, the narrowband range to the wideband range, the proper fm discriminator can also be pushbutton-selected; this precludes the usual necessity for module changes, eliminating the need for extensive module storage and increasing operator convenience.

1.3.4 VIDEO BANDWIDTH FILTERS

Up to ten pushbutton-selectable linear phase video filters, with an asymptotic slope of 24 dB per octave, can be housed simultaneously in the TMR-74. Video bandwidths of 6.25 kHz through 3 MHz and unfiltered (direct) are covered in a range of twelve I-74 series filters. Like the i-f bandwidth filters, the video filters are internal plug-in modules. The facts that a complement of up to ten video filters may be installed at any one time with pushbutton selection, and that i-f filters and demodulators are pushbutton selectable, result in a receiver that is highly adaptable to remote control.

1.4 SUBASSEMBLIES

The basic receiver functions, such as the second l-o, the second i-f amplifier, etc., are physically located on subassemblies which plug into the receiver main chassis. The separation of these functions into discrete subassemblies assures minimum equipment repair time in the unlikely event of failure, and contributes to simplified maintenance and the efficient utilization of chassis space. The circuitry of these subassemblies is located on printed-circuit cards, with shielding provided by modular enclosures where required.

1.5 OPTIONAL MODULES AND ACCESSORIES

Optional modules available for the TMR-74 include subassemblies and modules which provide such functions as first i-f filtering, spectrum display, predetection up and down conversion, and i-f conversion. A notch filter also can be incorporated in receivers intended for conical scan tracking applications.

1.5.1 FIRST IF FILTERS

Optional first i-f filter modules, A-74-F series, are available for applications where enhanced spurious signal and adjacent channel rejection are required. These modules install in the receiver main chassis, and are functionally located between the output of the rf tuner and the input of the second mixer.

1.5.2 SPECTRUM DISPLAY

A plug-in spectrum display unit, the SD-74-A, is available for use with the TMR-74B receiver. The display unit installs at the lower right of the seven-inch front panel with which the TMR-74B is equipped. The SD-74-A provides a visual display of periphal signals present above and below the received signal center frequency. Sweep width is continuously adjustable from 100 kHz to 6 MHz, at a sweep rate of 15 Hz. Resolution is 10 kHz. An internal oscillator provides markers at 500 kHz intervals, for accurate sweep width calibration. In cases where a display unit having an input center frequency of 30 MHz is to be used, the S-74-A 30 MHz to 55 MHz i-f down converter subassembly is available.

1.5.2.1 SDU CONVERTER. The spectrum display unit converter module, model S-74-A, functions to convert the 55 MHz first intermediate frequency of the receiver to 30 MHz to allow spectrum display to be accomplished with display units having center frequencies of 30 MHz. The SDU converter is installed in the receiver main chassis, and may be used with both the TMR-74A and the TMR-74B receivers.

1.5.3 PREDETECTION RECORD AND PLAYBACK

Complete predetection record and playback capability is offered by both the "A" and "B" versions of the TMR-74. Where a single video carrier frequency is required for record or playback, two internal plug-in modules, the P-74-R and the P-74-P, can be made available for operation at the selected frequency.

With these subassemblies the receiver may be held to a front-panel height of 5-1/4 inches (TMR-74A).

If the capability for more than one video carrier frequency is required, two front-panel plug-in modules, the PD-74-R and the PD-74-P, are available. The PD-74 series modules provide or accept up to six switch-selectable video carrier frequencies. These modules are for use with the TMR-74B (seven-inch front-panel height).

In the playback mode, the TMR-74 accepts either a 10 MHz input or a video carrier input, and further translates this to the first intermediate frequency of 55 MHz. Conversion from 10 MHz to 55 MHz is accomplished by the optional internal U-74-P plug-in module. The advantage of this technique is that afc or apc may be applied to the playback data ahead of the second i-f bandwidth filters. This assures that center-frequency uncertainties accumulated during the recording process are eliminated, and permits second i-f bandwidths used during the playback process to be only as wide as the data spectrum dictates. The result is an improved video signal-to-noise ratio.

1.5.4 NOTCH FILTER
Plug-in modular notch filters, the N-74-F series, are available for use with the TMR-74. These filters are used in conical-scan tracking applications, to prevent the a-m and agc circuits of the receiver from responding to signal modulation related to the scanning rate of a conical-scan antenna system.

1.5.5 AUXILIARY TEST KIT
The auxiliary test kit, ATK-74, includes all test fixtures required to facilitate troubleshooting, repair, and other maintenance of the TMR-74, its subassemblies, and modules. The ATK-74 comprises extender cables and extender cards which are specifically designed to simplify maintenance and provide accessibility to all circuits used with the receiver.

1.5.6 AUXILIARY MODULE TRAYS
The Model AAT-74 Auxiliary Accessories Tray and the Model ATT-74 Auxiliary RF Tuner Tray are available for use with the TMR-74 to provide additional storage and operating space for front-panel plug-in modules.

1.5.7 RACK SLIDES
Pull-out slides with tilt locks are available for the TMR-74; these slides facilitate servicing and preventive maintenance of rack-mounted receivers by rendering all areas of the equipment more readily accessible.

1.5.8 OTHER OPTIONS AND ACCESSORIES
Other options and accessories for the TMR-74 include a full range of first local oscillator crystals, and a proportional oven for maximum frequency stability. The frequency to which the receiver is tuned is determined by the crystal when the receiver is in the crystal mode of operation.

Also available upon request is special front-panel paint; the required paint can be supplied either by the customer or by the manufacturer. (Light grey enamel, color 26329, fed. std. 595, MIL-E-14270 is standard.)

For information concerning special applications or requirements not mentioned here, please contact our sales department.

Table 1-1. Specifications

RECEIVER TYPE	Single channel, double superheterodyne.
TUNING RANGE	105 MHz to 6 GHz, determined by plug-in rf tuner.
FIRST IF	55 MHz.
FIRST IF BANDWIDTH	6 MHz.
SECOND IF	10 MHz.
SECOND IF BANDWIDTH	10 kHz to 6 MHz, determined by plug-in i-f bandwidth filter.
FIRST LO MODES	Crystal, vfo, external (switchable); see also applicable rf tuner instruction manual.
SECOND LO CHARACTERISTICS:	
MODES	a. Crystal. b. Vfo with ±250 kHz vernier tuning. c. Afc with ±250 kHz tracking range in addition to vernier tuning range. d. Apc with ±250 kHz control range in addition to vernier tuning range.
STABILITY	a. Crystal: ±0.005% over operating temperature range. b. Vfo: ±0.001%/°C over operating temperature range.
RESIDUAL PHASE JITTER . .	Two degrees rms maximum, when measured with 10 Hz phase locked loop bandwidth.
SECOND MIXER	Double balanced for minimum intermodulation distortion and spurious response characteristics.
ELECTROMAGNETIC CHARACTERISTICS	Certified to MIL-STD-461, which provides for control of spurious signal emission and susceptibility to electromagnetic radiation.
AM DEMODULATOR (Integral to Main Chassis):	
AM DETECTOR RESPONSE . .	Up to 3 MHz or one-half the i-f bandwidth in use. A separate a-m output always available; synchronous a-m available when phase demodulator is in use.

continued

Table 1-1, continued

LOW FREQUENCY RESPONSE	Dependent on agc time constant selected.
AM DETECTOR DISTORTION	Less than 3% total harmonic distortion for 90% a-m modulation at 1 kHz rate.
VIDEO BANDWIDTH	Up to ten switch-selectable linear phase filters with an asymptotic slope of 24 dB/octave provided; the following bandwidths are standard (others available on special order):

6.25 kHz	50 kHz	500 kHz	1500 kHz
12.5 kHz	100 kHz	750 kHz	3000 kHz
25 kHz	250 kHz	1000 kHz	Direct (Unfiltered)

VIDEO AMPLIFIER:

COUPLING	Ac or dc coupling, selected by front-panel pushbutton.
FREQUENCY RESPONSE:	
AC COUPLED	±0.5 dB 100 Hz to 500 kHz; ±1.0 dB 5 Hz to 3 MHz.
DC COUPLED	±0.5 dB dc to 500 kHz; ±1.0 dB dc to 3 MHz.
OUTPUT LOAD	75 ohms.
RATED OUTPUT	4 volts, peak-to-peak.
MAXIMUM OUTPUT	10 volts, peak-to-peak into a 75 ohm load.
DISTORTION	Less than 0.5% at rated output; less than 2.0% at 10 volts peak-to-peak.
AURAL MONITOR	Front-panel speaker with level control is provided.

AFC SYSTEM (With 6 dB S/N Ratio):

TRACKING RANGE	±250 kHz in addition to ±250 kHz vernier tuning range.
AFC DRIFT REDUCTION FACTOR	Greater than 5,000:1.

continued

Table 1-1, continued

AFC SYSTEM, continued	
AFC TIME CONSTANT.	Switch-selectable between 1 Hz and 10 Hz lower 3 dB loop bandwidth. Capable of tracking doppler change of up to 15 kHz per second. (A "special" position is supplied.)
AUTOMATIC SEARCH AND LOCK:	
ACQUISITION RANGE	Up to ±250 kHz sweep plus ±250 kHz vernier tuning range.
AFC SEARCH RNAGE	Adjustable up to ±250 kHz; search zone is approximately symmetrical about the frequency of the second l-o, as set by the vernier tuning control.
AFC SEARCH RATE	Nominally 2 MHz per second.
AGC SYSTEM:	
AGC CURVE	Essentially logarithmic from noise to maximum input; suitable for optimum ratio diversity combining.
AGC CONTROL RANGE	Determined by i-f bandwidth, demodulator and rf tuner noise figure; up to 135 dB.
AGC OUTPUT SENSE	Selectable positive or negative polarity from 0V to 3.5V minimum.
AGC NORMALIZING	a. Signal strength meter and agc outputs are normalized to provide constant dB/volt as control range varies. b. Slope and zero are adjustable with rear panel controls.
AM STABILITY	Less than ±1.5 dB variation in a-m output from 6 dB i-f s/n ratio to -7 dBm input, measured with 30% a-m modulation.
AGC TIME CONSTANTS	Pushbutton switch-selectable time constants of 0.1, 1.0, 10, 100, and 1,000 milliseconds are provided in addition to manual gain and special switch positions.

continued

Table 1-1, continued

AGC SYSTEM, continued

NOTCH FILTER	Provision is made for optionally adding a low frequency notch filter when the receiver is to be used in a conical scan tracking mode. This prevents the agc system from reacting at the scan rate.

INPUT CONNECTORS:

RF INPUT	Type N (see RF Tuner specifications).
PLAYBACK INPUT	50 ohms, BNC; 55 MHz (10 MHz with optional module U-74-P, Video Carrier with optional modules U-74-P and P-74-P).
FIRST LO INPUT	Input for external first l-o signal at frequency corresponding to first l-o monitor output; -13 dBm minimum; 50 ohms, BNC.
SECOND LO INPUT	Input for external second l-o signal; -13 dBm minimum; 50 ohms, BNC.
POWER INPUT	MS3102A10SL-3P (see also "Power Requirements").

OUTPUT CONNECTORS:

COR OUTPUT	Isolated contact closure.
VIDEO OUTPUT	Video signal at 10V peak-to-peak maximum, BNC.
PREDETECTION RECORD OUTPUT	Limited or unlimited (internally selectable) 10 MHz second i-f signal; -13 dBm nominal, 50 ohms, BNC*.
AGC RECORD OUTPUT	0-3.4V minimum into a 1k ohm load, BNC. Sense selectable, slope and zero adjustable, at rear panel. Two agc outputs optionally available for recording and combiner control.
10 MHz LINEAR OUTPUT	Unlimited 10 MHz second i-f signal; -13 dBm nominal, 50 ohms, BNC.

continued

* If plug-in predetection down converter is used (PD-74-R or P-74-R), predetection record output will be a video carrier frequency.

Table 1-1, continued

OUTPUT CONNECTORS, continued	
10 MHz LIMITED OUTPUT . . .	Limited 10 MHz second i-f signal -13 dBm nominal, 50 ohms, BNC.
FIRST LO OUTPUT	Monitors submultiple of first l-o injection frequency; -7 dBm minimum, 50 ohms, BNC.
SECOND LO OUTPUT	Monitors the second mixer injection frequency; -7 dBm minimum, 50 ohms, BNC.
CENTER FREQUENCY MONITOR	Analog voltage derived from afc or discriminator.
FIRST IF/SDU	Low level output at first i-f frequency for spectrum display unit; 50 ohms, BNC. 30 MHz output is available as an option.
AM OUTPUT	Dc coupled output simultaneously available with video output, BNC. May be used in conscan tracking applications when optional notch filter is employed. Also useful for pseudo-monopulse tracking applications. When phase demodulator is employed, synchronous a-m is available at this output.
POWER REQUIREMENTS	115-230V ac ±10%, 50-400 Hz, 35 watts nominal.
ENVIRONMENTAL:	
OPERATING	a. Temperature 0° to +50°C. b. Atmospheric pressure to 10,000 feet above MSL.
STORAGE	a. Temperature from -55° to +65°C. b. Atmospheric pressure to 50,000 feet above MSL.
HUMIDITY	To 95% in accordance with Procedure 1, Condition B, MIL-E-5277-C.

continued

Table 1-1, continued

PHYSICAL CHARACTERISTICS:	
SIZE	a. TMR-74A: panel 5-1/4" by 19"; chassis 19-1/2" deep. b. TMR-74B: panel 7" by 19"; chassis 19-1/2" deep.
WEIGHT	a. TMR-74A; approximately 48 pounds. b. TMR-74B; approximately 55 pounds.
FINISH	Light grey enamel, color 26329 per FED STD 595, MIL-E-14270 (other finishes available upon request).

1.6 MODULE AND SUBASSEMBLY COMPLEMENT

Table 1-2 lists the various standard and optional modules and subassemblies available for use with the TMR-74. Internal subassemblies are indicated by six-digit model numbers, for example 303211; internal modules are indicated by model numbers prefixed with a single letter, for example V-74-G; front-panel modules are indicated by a two-letter prefix, for example DF-74-H. An asterisk indicates modules that are for use with the TMR-74B. The TMR-74 is normally supplied with all internal subassemblies and a complement of ten video bandwidth filters.

Table 1-2. Module/Subassembly Complement

Description	Model/Part Number	Reference Designation
Video Bandwidth Filters	V-74-G Series	A1A1 -- A1A5, A1A7 -- A1A11
(Spare)	--	A1A6 and A1A12
AGC Amplifier	303211	A2
AFC Amplifier	303212	A3
Video/Audio Amplifier	303213	A4
IF Distribution Amplifier/ AM Detector	303210	A5
Second Local Oscillator	203505	A6
Predetection Playback Module (internal)	P-74-P	A7

continued

Table 1-2, continued

Description	Model/Part Number	Reference Designation
Up-Converter, Predetection Playback (10 MHz to 55 MHz)	U-74-P	A8
Predetection Record Module (internal)	P-74-R	A9
Down-Converter, Spectrum Display (55 MHz to 30 MHz)	S-74-A	A10
Second IF Amplifier	203605	A11
Second IF Bandwidth Filters	I-74 Series	A12A1 -- A12A9
Second Mixer	303208	A13
First IF Filter	A-74 Series	A14
Power Supply Regulator	203247	A15
(Spare)	--	A16
RF Tuner	TU-74 Series	--
Demodulator, FM	DF-74-H	--
Narrow BW Demodulator	D-74-N	(A1)
Intermediate BW Demodulator	D-74-I	(A2)
Wide BW Demodulator	D-74-W	(A3)
Demodulator, Phase	DF-74-H	--
Spectrum Display Unit	SD-74-A*	--
Predetection Record Module	PD-74-R*	--
Predetection Playback Module	PD-74-P*	--
Notch Filter	N-74-F	--

SECTION II
PREPARATION FOR USE

2.1 GENERAL

The Model TMR-74 Telemetry Receiver is shipped fully assembled with all internal subassemblies installed and in operating condition. Consequently, installation procedures are reduced essentially to checks of the physical condition of the equipment, and a referenced performance check. Also discussed in this section are mechanical installation data and front-panel plug-in module installation.

2.2 UNPACKING AND INSPECTION

The following checks should be made upon unpacking the receiver and accompanying modules:

a. Check the front panel of the receiver for damage to knobs, pushbuttons, meter windows, and the frequency indicator dial.

b. Operate control knobs, examining them for looseness. Turn tuning controls through their entire range, checking for binding; binding may indicate a damaged system.

c. Remove the top and bottom covers of the receiver main chassis; inspect the subchassis of the receiver for security of subassemblies and loose or disconnected wiring.

d. Check to ensure that the power transformer (T1) is connected according to the available line voltage. (See figure 7-1.) To avoid the possibility of serious damage to the receiver, use only the specified fuse (0.75A).

2.3 INSTALLATION

The model TMR-74 is designed for either bench or standard 19-inch equipment rack mounting. For rack mounting, four screws are inserted through the slots provided in the front panel to secure to receiver in the rack. Rack slides are provided.

Front-panel height of the TMR-74 is 5-1/4 inches for the TMR-74A and seven inches for the TMR-74B. Both versions have a depth of 19-1/2 inches and are 19 inches wide. Detailed outline data are shown in figure 2-1. Because of the low internal power dissipation, no forced-air ventilation is normally required unless the receiver is mounted in close proximity to heat-producing equipment, especially in an enclosed rack, in which case external cooling should be provided to maintain an acceptable ambient temperature (not in excess of 50°C). Also, no more than two receivers should be stack-mounted in the rack unless special cooling is provided.

Power requirements of the TMR-74 are 115/230V ac ±10%, 50-400 Hz, 35 watts nominal. The power input connector is type MS3102-10SL-3P. The input and output connectors (see figure 2-2) are located on the rear panel of the receiver, to facilitate its use in the equipment racks. The cabling to the rear apron connectors depends on the task to be accomplished by the receiver. The information given in table 1-1 and figure 2-2 may be used as a guide in making these connections.

2.4 FRONT-PANEL PLUG-IN MODULES AND INTERNAL SUBASSEMBLIES

The front-panel plug-in modules (rf tuner and demodulator) are installed in the receiver through openings in the front panel. Insert the module in the appropriate slot, making sure the front panel of the module is flush with the front panel of the receiver. The modules are held in place with thumbscrews. Turn these screws to the right to fasten the modules in place.

The receiver is normally shipped with the internal subassemblies installed. For maintenance purposes and to assist in the installation of modules or subassemblies obtained at a later date, a subassembly and module location drawing is shown in Section V, figure 5-1. Location of the demodulator internal modules (D-74 Series) are shown in the subassembly location drawing of the FM Demodulator Housing manual, DF-74-H.

All electrical connections between modules and subassemblies and the receiver are made automatically through mating connectors upon installation; there are no cables to connect or disconnect to install or remove the modules.

When installing new internal plug-in modules that are pushbutton operated the corresponding pushbutton cap should also be replaced with the engraved plastic cap supplied with the new unit. The plastic pushbutton caps are friction fit on the pushbutton plungers; to replace a cap, pull off the old cap and slip on the new cap.

2.5 PERFORMANCE CHECK

Before scheduled operation of the receiver, it is suggested that its performance be checked according to the procedure given in Section V, paragraph 5.3.3.

NOTES:
1. STANDARD SLIDE: CHASSIS-TRACK C-230-D-20, CAPACITY 100 LB.
2. OPTIONAL SLIDES AVAILABLE.

FUSES	
SYMBOL	DESCRIPTION
A	FUSE, .75 AMP SLO-BLO
B	FUSE, SPARES

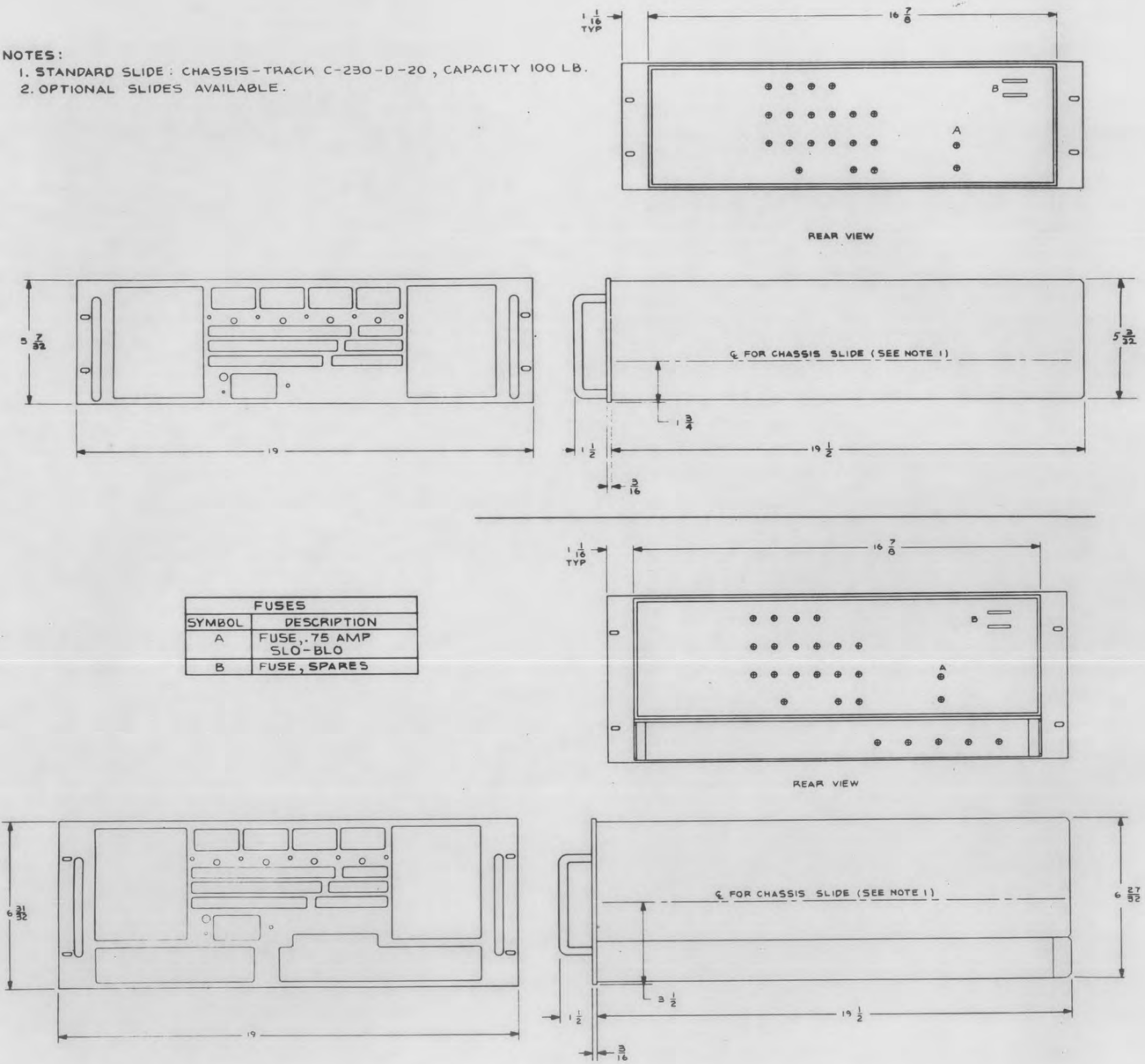


Figure 2-1. Outline Data, TMR-74A (top), and TMR-74B (bottom)

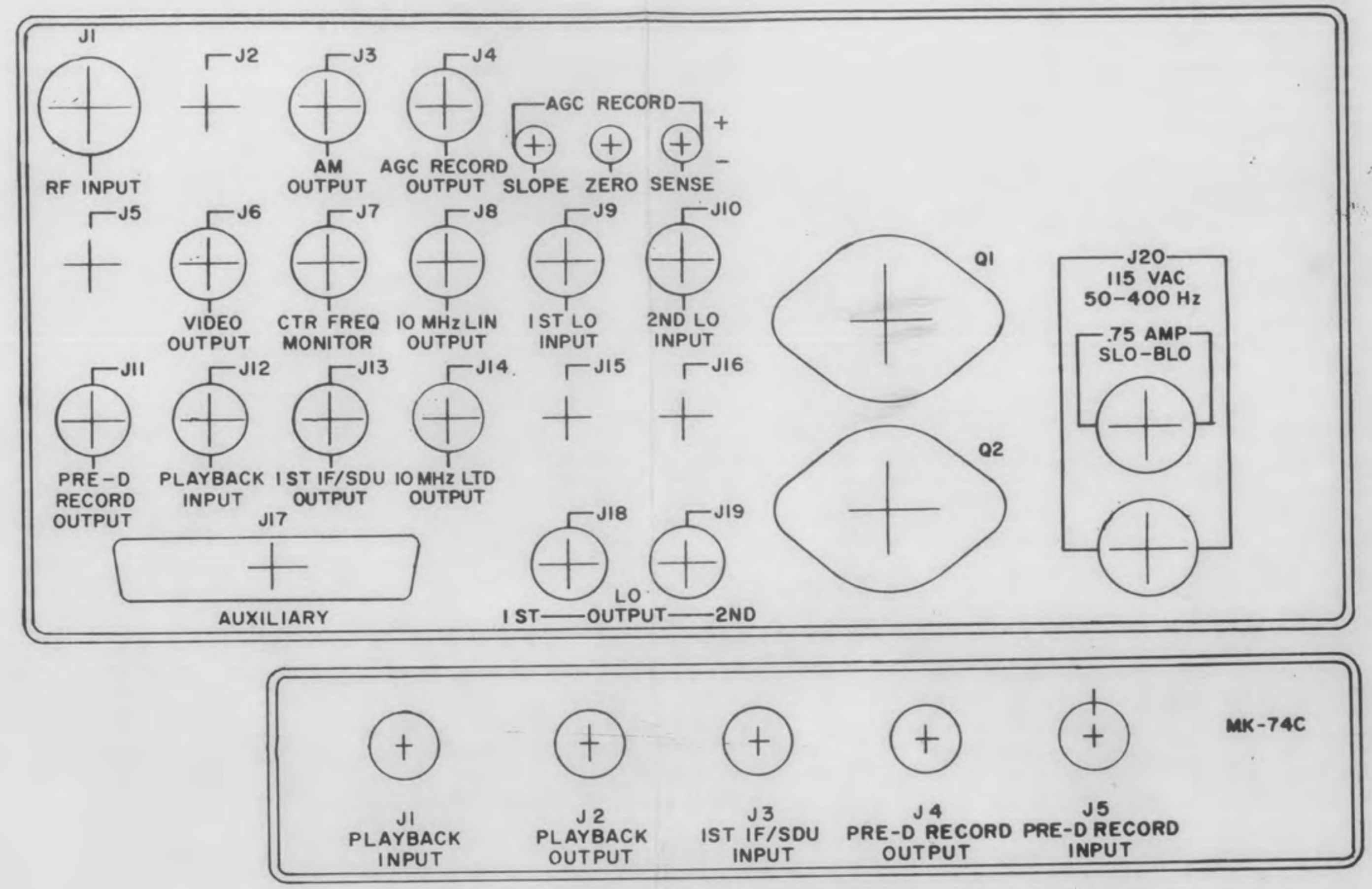


Figure 2-2. Rear Panel Connector Identification, TMR-74A and TMR-74B (top) and TMR-74B (bottom)

Table 2-1. Rear Panel Connectors

Function	Connector Type	Ref. Des.	Function	Connector Type	Ref. Des.
RF Input	N	J1	Auxiliary	DCM-25W3-S	J17
Spare	BNC	J2, J5, J15, J16	1st LO Output	BNC	J18
			2nd LO Output	BNC	J19
AM Output	BNC	J3	115V ac 50-400 Hz	Modified MS3102 A10SL-3P	
AGC Record Output	BNC	J4			
Video Output	BNC	J6	Playback Input	BNC	MK-74C J1
Ctr. Freq. Monitor	BNC	J7			
10 MHz Lin. Output	BNC	J8	Playback Output	BNC	MK-74C J2
1st LO Input	BNC	J9			
2nd LO Input	BNC	J10	1st IF/SDU Input	BNC	MK-74C J3
Pre-D Record Output	BNC	J11			
Playback Input	BNC	J12	Pre-D Record Output	BNC	MK-74C J4
1st IF/SDU Output	BNC	J13			
10 MHz Ltd. Output	BNC	J14	Pre-D Record Input	BNC	MK-74C J5

SECTION III
OPERATION

3.1 GENERAL

The Model TMR-74 Telemetry Receiver employs plug-in modules and features pushbutton selection of all major operating characteristics for maximum versatility and the ultimate in operator convenience. The rf tuners and demodulators plug in through the front panel, and the second i-f and video bandwidth filters plug in internally; selection of the desired filters and demodulator bandwidths is made by front-panel pushbuttons. Complements of up to nine second i-f bandwidths and up to ten video bandwidth filters may be installed in the receiver simultaneously. In the event a receiver is supplied with less than the maximum complement of filters and demodulators, blank pushbuttons are factory installed for each empty module position. The blank pushbuttons contain stoppers to prevent these positions of the ganged switch assembly from being engaged. Later, should one or more modules be added or changed to a different bandwidth, the applicable pushbutton is relabeled with the appropriate plastic cap.

The front-panel controls and indicators of the TMR-74 are to a large extent explained by their labeling; however, as an aid to the operator, controls and indicators for the receiver are listed with a functional description of each, in paragraph 3.3. It is suggested that the operator become familiar with the functions of all operating controls and indicators.

3.2 OPERATING PRECAUTIONS

Prior to any scheduled operation, the cabling to the rear panel connectors should be checked. These connections depend upon the specific system requirements. Connector functions and types are listed in Section II, table 2-1.

The Model TMR-74 employs modular rf tuners, demodulators, and second i-f and video bandwidth filters. These quick-change and switchable modules permit operation over a wide frequency range with a-m, fm, or pm demodulation, and optimum i-f and video bandwidths. Before operating the TMR-74, the specific reception or playback requirements at hand and the method of employing the receiver in the accomplishment of the task must be studied to facilitate the proper selection of plug-in modules and operating characteristics.

The second i-f bandwidth of the receiver is determined by the I-74 series plug-in i-f filter selected. The i-f filter chosen must be compatible with the bandwidth of the demodulator in use. Table 3-1 lists standard demodulators and the compatible i-f filters.

Table 3-1. Demodulator-IF Bandwidth Filter Compatibility

Demodulator		Bandwidth	IF Filter (I-74 Series) Bandwidth in kHz
DF-74-H (FM)	D-74-N	Narrow	10 - 50
	D-74-I	Intermediate	50 - 750
	D-74-W	Wide	750 - 4,000
DP-74-W (Phase/Sync. AM)		-	10 - 6,000

3.3 OPERATING CONTROLS AND INDICATORS

Operating controls and indicators located on the front panel of the TMR-74 are discussed here. For optimum front-panel layout, certain controls which relate directly to main chassis functions are located on the front-panel plug-in rf tuner and demodulator modules; these controls are listed here, together with other rf tuner and demodulator controls. For purposes of clarification, front-panel module controls are keyed to indicate their location.

PWR (Power) . . . . This switch controls the application of primary power to the receiver. A companion indicator lights when power is applied.

MODE . . . . Five pushbutton switches used to select receiver operating mode as follows:

AM - receiver is in AM receive mode only.

FM/PM - receiver is in FM or PM receive mode, as determined by plug-in demodulator.

CAL - the receiver is in "calibrate" mode and is not mission operable.

BAL - the receiver is in "balance" mode and is not mission operable.

PBK - the receiver is in mode for playback of up-translated predetection recorded signals; the receiver accepts a 55 MHz First IF signal so that playback data may be centered in the IF Passband by the afc or apc circuitry. Optional U-74-P converter subassembly provides

– continued –

MODE (continued)	10 MHz playback input capability and optional P-74-P converter subassembly (with U-74-P) allows receiver to accept a video carrier frequency. In the TMR-74B, use of the PD-74-P playback module (with U-74-P) allows receiver to accept one of six switch-selectable video carriers.
AUDIO GAIN	Controls level of audio signal to front-panel speaker.
VIDEO GAIN	Controls video output level from zero to maximum available amplitude.
IF BANDWIDTH kHz	Nine pushbutton switches used to select desired second i-f filter bandwidth.
VIDEO BANDWIDTH kHz. . .	Ten pushbutton switches used to select video filter cutoff frequencies.
2ND LO MODE	Four pushbutton switches used to select XTAL, VFO, AFC/APC, or EXTernal mode of second LO.
AFC TIME CONSTANT mS. .	Three pushbutton switches to select one of three afc time constants, 0.01 sec, 0.1 sec, or 1.0 sec.
AGC TIME CONSTANT mS. .	Seven pushbutton switches used to select one of five time constants or manual gain; includes a "special" position.
COUPLING	Pushbutton switch used to select ac or dc coupling of video output.
ZERO ON NOISE . . . . . (screwdriver adj.)	Provides a means of calibrating the SIGNAL LEVEL meter under no-signal conditions. Range is sufficient to allow zeroing when a 20 dB gain rf preamplifier is used.
60 dB CAL . . . . (screwdriver adj.)	Provides a means of calibrating the SIGNAL LEVEL meter with 60 dB s/n ratio.
ZERO . . . . (screwdriver adj.)	Provides a means of zeroing the TUNING meter when the receiver is in "calibrate" mode.
CAL . . . . (screwdriver adj.)	Provides a means of calibrating the video OUTPUT meter.

– continued –

COR ADJ. . . . . (screwdriver adj.)	Allows setting of the COR threshold. Normally factory-preset to be activated at 6 dB s/n ratio.
TUNING . . . . (meter)	This zero-center meter provides visual indication of the position of the received signal in the i-f passband. The signal is derived from the mean-of-peaks detector to provide correct indication with asymmetrical signals. In the AFC mode, the meter indicates loop stress, allowing the operator to reduce loop stress with the 2ND LO TUNE control.
OUTPUT . . . . (meter)	This meter indicates peak-to-peak video output in dB; zero dB reference is front-panel adjustable.
DEVIATION. . . . . (meter)	This meter indicates peak fm deviation, phase deviation, or % AM modulation, dependent upon demodulator employed.
SIGNAL LEVEL . . . . . . (meter)	This meter indicates signal-level-above-noise up to 60 dB. Zero-on-noise and 60 dB calibrate controls provided.
COR	This indicator lamp indicates that receiver is sensing signal and producing at least 6 dB s/n ratio for other s/n ratio depending on threshold level (COR ADJ.) adjustment.
RF/IF GAIN . . . . (screwdriver adj.)	Allows manual control of receiver gain when receiver is in manual (MAN) agc mode.
TUNING *	Rf tuning is accomplished by adjusting this control and observing the frequency dial and main chassis TUNING meter.
1ST LO MODE *	Pushbutton switches used to select mode of operation for 1st local oscillator.
AFC SEARCH ZONE ** . . .	Controls the zone of afc search up to ±250 kHz. "Off" position is provided.

– continued –

* Located on TU-74 series rf tuner.

** Located on DF-74 series demodulator housing.

2ND LO TUNE ** . . . . . . Provides vernier tuning of ±250 kHz when second l-o is in VFO mode; controls center of afc search zone. May also be used to minimize loop stress when in AFC mode.

BANDWIDTH ** . . . . Three pushbutton switches used to select the desired fm discriminator (NARrow, INTermediate, and WIDE bandwidth).

MULTIPLIER ** . . . . Three pushbutton switches used to select the full-scale sensitivity of the DEVIATION meter; used in conjunction with the BANDWIDTH switches. DEVIATION meter full-scale indication is read from the DEVIATION METER RANGE kHz grid.

BAL ** . . . . Each of these three controls is used to
(screwdriver adj.) adjust for zero output from the fm demodulator module with the selected bandwidth, with zero carrier-deviation.

SEARCH ** . . . . This indicator light glows to indicate that afc is in the search mode.

<u>The Following Controls are Located on the DP-74-W Phase Demodulator:</u>

2ND LO TUNE . . . . Permits vernier tuning of second l-o when in the AFC/APC mode.

LOOP BANDWIDTH . . . . . This switch selects 10, 30, 100, 300, or 1000 kHz loop bandwidths.

LOOP DISABLE . . . . Opens phase-locked loop.

LOSS OF LOCK . . . . This light glows amber when loop is not locked.

VIDEO . . . . Selects synchronous a-m or pm output from demodulator.

ACQUISITION . . . . Selects manual or automatic acquisition mode.

A front view of the TMR-74B, showing operating controls and indications, is provided in figure 3-1. The controls and indicators of the TMR-74A and the TMR-74B are identical except that the TMR-74A does not include front-panel spectrum display and predetection record/playback capability.

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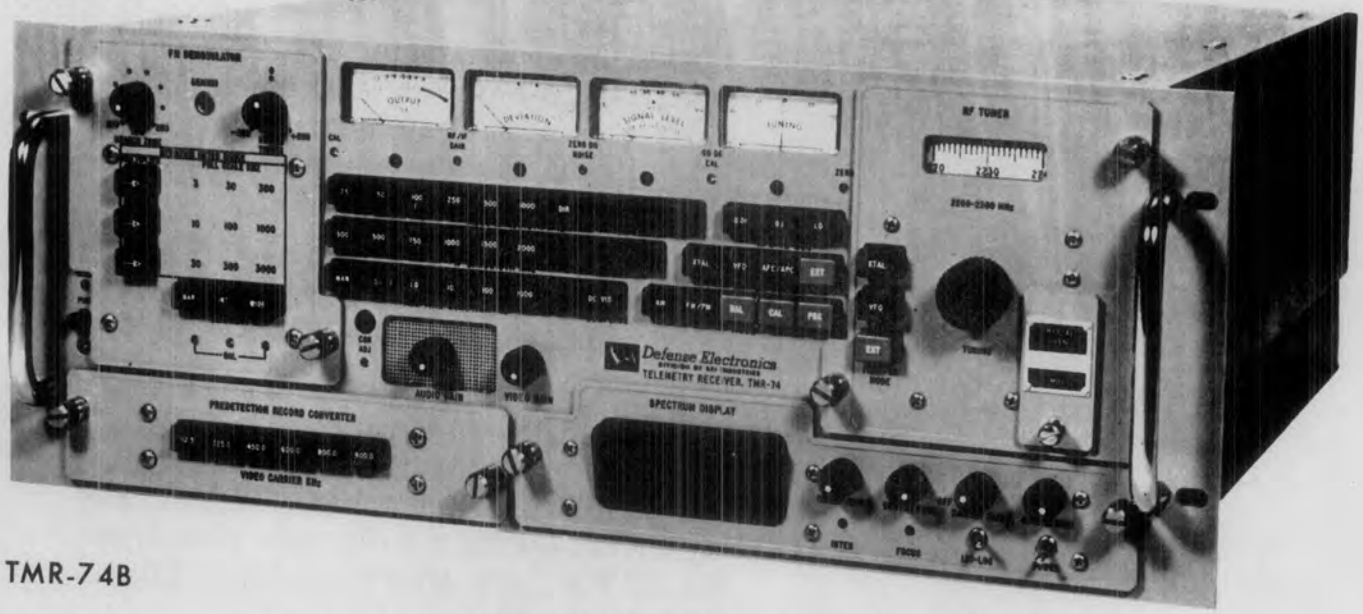
* Located on TU-74 series rf tuner.

** Located on DF-74 series demodulator housing.



TMR-74B

Figure 3-1. Model TMR-74B, Front View showing Operating Controls and Indicators

3.4 PREOPERATIONAL ADJUSTMENTS

The suggested preoperational adjustments for the TMR-74 are discriminator (demodulator) balance, tuning meter calibration, and output meter calibration. The procedures for performing these adjustments are given in Section V, paragraph 5.3.3.

3.5 TYPICAL OPERATING PROCEDURE

The specific settings of the various operating controls of the TMR-74 are dependent upon the signal to be processed, and the preferred receiver mode and characteristics.

The functions of the receiver operating control and indicators are described in paragraph 3.3 of this manual, and, for the plug-in modules, in the appropriate module instruction manuals. A basic understanding of the function of each control and a knowledge of the signal format should enable the operator to select the desired control settings for optimum operation.

The formulas for determining the frequency of the crystals used with the various rf tuners are given in the rf tuner instruction manuals.

3.5.1 AM AND FM SIGNAL RECEPTION

a. Push the PWR switch in, and observe that the power indicator lamp lights; adjust the AUDIO GAIN and VIDEO GAIN controls to midrange.

b. Select the desired mode of operation, AM or FM, by depressing the appropriate MODE switch (AM or FM/PM).

c. Select the desired FIRST LO MODE, and the desired 2ND LO MODE.

d. If the AFC/APC second l-o mode is to be used, select the desired afc time constant by depressing the appropriate AFC TC SEC switch, and set the AFC SEARCH ZONE control to OFF and the 2ND LO TUNE control to 0.

e. If the XTAL first l-o mode is to be used, select the VFO second l-o mode; precise tuning is then accomplished by adjusting the 2ND LO TUNE control and observing the TUNING meter then changing the second l-o mode to AFC/APC, if afc operation is desired.

f. Adjust the TUNING control and the 2ND LO TUNE control, as necessary, for zero (center-scale) on the TUNING meter.

g. Select the desired agc time constant by depressing the appropriate AGC TIME CONSTANT MS switch. Longer time constants are used for a-m operation and shorter time constants for fm operation. The use of the manual (MAN) gain mode is recommended only for system checkout.

h. Select the required i-f and video bandwidths by depressing the appropriate IF BANDWIDTH KHZ and VIDEO BANDWIDTH KHZ switches.

i. Depress the desired demodulator BANDWIDTH and deviation meter MULTIPLIER switches.

j. In the case of the TMR-74B, if the front-panel plug-in PD-74-R predetection record converter is used select the desired video carrier output frequency with the OUTPUT CENTER FREQUENCY KHZ switch. Set the controls of the SD-74-A spectrum display unit, if employed, as desired. (Refer to the instruction manual for the display unit.)

k. If afc search is to be used, set the AFC SEARCH ZONE control to the desired position.

l. Set the VIDEO GAIN control for the desired output level as indicated by the OUTPUT meter, and adjust the AUDIO GAIN control as desired.

3.5.2 PM SIGNAL RECEPTION

The operating procedure in the apc AFC/APC mode is similar to that for the a-m and fm modes with regard to most of the control settings. The exceptions and additional controls are as follows.

a. Set the 1ST LO MODE to XTAL.

b. Set the 2ND LO MODE switch to AFC/APC.

c. Select the desired **LOOP BANDWIDTH**.

d. Select the desired **VIDEO** output (synchronous a-m or pm).

e. Select the desired **ACQUISITION** mode (manual or automatic).

3.5.3 PLAYBACK OPERATION

The operating procedure for the receiver in the playback (**PBK**) mode is similar to the procedures for the receive modes, except that the first local oscillator is disabled when the **PBK** mode is selected, thus the **1ST LO MODE** switch setting may be disregarded.

3.5.4 BALANCE AND CALIBRATE MODES

The balance (BAL) and calibrate (CAL) modes are used only during preoperational setup; the use of these modes is discussed in paragraph 5.3.3.

SECTION IV
PRINCIPLES OF OPERATION

4.1 INTRODUCTION

This section of the manual contains a functional description of the overall TMR-74 receiver, and discusses the interfaces relating to subassemblies, plug-in modules, and main chassis. General functional information is given on the subassemblies and plug-in modules as they relate to receiver operation. Detailed descriptions of the subassemblies are given in the individual instruction booklets which, as applicable, are supplied as a supplement to this manual. The plug-in modules are covered by separate instruction manuals and booklets, in which more detailed information will be found.

4.2 GENERAL INFORMATION

The TMR-74 is a single-channel, double-superheterodyne receiver, designed for use in a wide variety of programs and applications without need for modification. This inherent versatility is a result of the completely modular design of the receiver, in which all major operating characteristics are determined by the selection of plug-in rf tuners and demodulators and pushbutton-switched second i-f and video filters.

The receiver is capable of receiving frequency, phase, or amplitude modulated rf carriers in various bands from 215 MHz to 2300 MHz. Signal bandwidths are provided in the range from 10 kHz to 6 MHz. The receiver features automatic signal search and acquisition for both fm and pm operation. The first i-f frequency is 55 MHz and the second i-f frequency is 10 MHz, for all tuning ranges.

The basic TMR-74A is readily adaptable to include spectrum display and multifrequency predetection record and playback capabilities, through the addition of the MK-74-C modification kit. The addition of the adapter chassis and associated front panel results in the TMR-74B configuration.

All major circuitry is contained by front-panel plug-in modules, internal plug-in modules, and internal subassemblies. The front-panel modules include rf tuners and demodulators, and, in the case of the TMR-74B, spectrum-display units and switchable predetection record and playback modules. Internal modules include the second i-f filters and video filters; the TMR-74 will accept up to nine second i-f filters and up to ten video filters simultaneously, with front-panel pushbutton selection, thus eliminating the need for module changes in establishing the appropriate bandwidths. All other discrete circuit functions are performed by modular subassemblies installed in the main chassis of the receiver.

The overall receiver block diagram shown in figure 4-3 illustrates the module-subassembly configuration of the TMR-74, and distinguishes between front-panel modules, internal modules, and subassemblies. Interfaces between the various available modules and the receiver subassemblies are standardized, to eliminate the necessity for retuning or extensive adjustment when changing modules.

4.3 FUNCTIONAL DESCRIPTION

With a view to providing an overall functional description of an assembled, operational TMR-74, the following discussion is based on the receiver block diagram of figure 4-3, and the schematic diagrams of Section VII. Where necessary, additional block diagrams have been provided to illustrate the interface which exists between a particular subassembly and other receiver circuits.

4.3.1 RF TUNER (TU-74 Series)

The input to the rf tuner is applied through J1, on the receiver rear apron, and W1 to J1 of the tuner. Several rf tuners are available, providing frequency coverage in the 105 MHz to 2300 MHz frequency range.

The purpose of the rf tuner is to accept as its input an rf signal at the desired frequency, mix this signal with the signal from an internal local oscillator, and provide as the tuner output a 55 MHz first i-f signal for further application to receiver circuitry.

The local oscillator, which functions as the first local oscillator of the receiver, operates at a frequency which is 55 MHz higher than the frequency of the received signal. The local oscillator offers three modes of operation, selectable by pushbuttons on the front panel of the tuner; the three modes are as follows:

a. Crystal; in the crystal mode, the frequency at which the local oscillator oscillates (and thus the frequency to which the receiver should be tuned) is determined by the frequency of the selected crystal. The crystal plugs through the front panel of the tuning unit, and is normally housed in an oven for maximum stability.

b. VFO; in the vfo (variable frequency oscillator) mode, the first local oscillator frequency "tracks" the frequency to which the receiver is tuned (by means of the tuning control on the tuner front panel, being at all times 55 MHz higher then the received frequency. Thus the tuning unit may be continuously tuned over its entire frequency range.

c. External; in this mode of operation, the local oscillator signal is obtained from a source external to the receiver in which the tuning unit is installed. The TMR-74 receiver is provided with inputs and outputs for the first and second local oscillators. This feature means that a pair of TMR-74 receivers can be patched together, using the local oscillator signals of one receiver, to provide true dual-channel performance.

The output amplifier of the tuner is gain-controlled by receiver agc circuitry to assure constant receiver gain over a wide range of received signal levels.

Auxiliary outputs from the TU-74 series of rf tuners include a first local oscillator output for use as an indication of the first l-o frequency or to provide the first l-o input to a companion receiver, and an output which may be used to provide the input signal for a spectrum display unit having an input center frequency of 55 MHz. (An optional converter is available for the TMR-74 to convert the 55 MHz signal to 30 MHz, for use with spectrum display units having a 30 MHz input center frequency.)

The 55 MHz first i-f output of the tuner is made available at A1 of J22, and connected through W14 and XA14 to the optional first i-f filter. When the first i-f filter is not used, a coaxial cable is used to connect A1 of XA14 to A5 of XA14, and thus directly to the second mixer subassembly through W6.

4.3.2 SECOND MIXER (A13)

There are two inputs to the second mixer subassembly; one is the 55 MHz first i-f signal which is applied to the subassembly through A3 of XA13, and the other is the 65 MHz second local oscillator signal which is applied through W8 and Q5 of XA13.

The function of the second mixer is to mix the two inputs and provide as its output signal the difference frequency, which is 10 MHz. This 10 MHz signal is the second i-f signal of the receiver, and is made available for further processing at A4 of XA13. The second mixer subassembly also provides as an output a sample of the 65 MHz l-o signal; this output is connected through receiver main chassis wiring to a rear panel connector.

When the receiver is in the predetection playback mode, the second mixer accepts as its input (at A2 of XA13) a 55 MHz signal which is an up-converted video carrier. As in the case of the 55 MHz first i-f input, this signal is mixed with the second local oscillator signal to provide a 10 MHz second i-f signal.

The 10 MHz second i-f signal output of the second mixer subassembly is applied through A4 of XA13 and W13 to the second i-f bandwidth filter of the receiver.

4.3.3 SECOND IF BANDWIDTH FILTERS (I-74 Series, A12A1-A12A9)

The TMR-74 will accept a complement of up to nine second i-f bandwidth filters simultaneously. The desired filter is switched-in electrically, by means of push-button switches (S2A through S2J and S2H) located on the receiver front panel.

The 10 MHz input signal to the filters is applied through pin 1 of A12XA1 through A12XA9. It is the function of the second i-f bandwidth filter to establish the desired overall receiver bandwidth, by providing the required selectivity between the second mixer and the demodulator. Filter bandwidths of 10 kHz through 6 MHz are available as standard equipment, and other bandwidths may be supplied for special applications.

When the desired i-f bandwidth switch is depressed, for example S2A, operating voltage of +15 volts and agc voltage are applied to the corresponding i-f filter, A12A1, at pins 7 and 13 respectively. This turns on, or "enables" the filter, and applies gain control voltage to its output amplifier. The remaining filters are disabled by the application of -15 volts at pin 7, and have no agc voltage applied. Thus the various sections of S2 connect the appropriate filter with a source of -15 volts and with the agc amplifier of the receiver when "on", or depressed, and with a source of -15 volts when "off"; the agc input is also removed from the unused filters by the switches which are "off".

Agc normalizing voltage, from the agc amplifier subassembly, is applied through pin 12 to an agc normalizing resistor in the second i-f bandwidth filter, and returned through pin 13 to the agc amplifier. The purpose of the normalizing circuit is to modify the operation of the agc amplifier, and thus assure constant gain-bandwidth characteristics for the receiver regardless of the second i-f bandwidth selected. Gain control voltage is applied at pin 11, to control the gain of the filter output amplifier.

The "sweep current output", at pin 6, is a voltage which is applied to the afc search circuitry of the receiver to provide the proper sweep bandwidth corresponding to the bandwidth of the selected filter. The sweep current output is removed (turned off) in the case of unused filters, as a result of the negative voltage applied to pin 7 of these filters through S2.

A further function of the second i-f bandwidth filter is to automatically select the appropriate first i-f bandwidth for the receiver to provide optimum matching of first i-f and second i-f bandwidths. This is accomplished by making available, at pin 8, pin 9, or pin 10 (depending upon the bandwidth of the particular second i-f filter selected), an enabling voltage for the appropriate first i-f filter.

The 10 MHz filtered output of the selected second i-f bandwidth filter is made available at pin 15 of A12XA1 through A12XA9 (depending upon the selected filter) and applied through W14 to the second i-f amplifier subassembly.

4.3.4 SECOND IF AMPLIFIER (A11)

The input to the second i-f amplifier subassembly is the 10 MHz filtered output of the selected second i-f filter, and is applied through A1 of XA11.

The primary purpose of the second i-f amplifier is to provide gain-controlled amplification of the receiver second i-f signal, and make this signal available for further application to receiver circuits. Gain control voltage is applied to the subassembly at pin 1.

The subassembly also contains an accurate 10 MHz oscillator which provides a signal at the receiver second i-f center frequency, for use in preoperational setup of the receiver. The 10 MHz calibration oscillator is turned on by the application of -15 volts at pin 8 of XA11 when the receiver mode switch, S4, is in the balance position; its output appears as the second i-f amplifier output.

The 10 MHz output of the second i-f amplifier subassembly, either the amplified signal from the second i-f filter or the signal from the 10 MHz oscillator, as the case may be, is applied through A3 of XA11 and W15 to the i-f distribution amplifier/a-m detector.

4.3.5 IF DISTRIBUTION AMPLIFIER/AM DETECTOR (A5)

The input to the i-f distribution amplifier-a-m detector is the 10 MHz output of the second i-f amplifier; the signal is applied through A5 of XA5.

This subassembly (A5) provides as its outputs three isolated 10 MHz signals for distribution to the optional predetection record subassembly, to the plug-in fm or phase demodulator, and to a rear panel connector, and also provides the envelope a-m (i.e., non-synchronous a-m) detector function for the receiver.

The 10 MHz output to the predetection record subassembly is applied through A3 of XA5 and W18 to XA9, A3. The output to the plug-in demodulator is applied through A2 of XA5 and W17 to J23, A1. The third 10 MHz output is applied through A1 of XA5 and W16 to J8 on the receiver rear panel; J8 provides the linear 10 MHz output from the receiver.

The detected a-m output of the subassembly is made available at A4 of XA5 and applied through W19 to pin 2 of J23 (the demodulator connector). When the receiver is in the a-m mode, the a-m output is also applied through S4A (the a-m section of the receiver mode switch) and S1 (the receiver video bandwidth switch) to the selected video filter. Also, when the receiver is in the a-m mode, R20 is switched into the deviation meter amplifier circuit (a part of the afc amplifier, A3) by S4B. This adjusts the gain of the amplifier to provide a receiver deviation meter full scale indication of 100%. R20 is connected between pins 5 and 7 of XA3.

4.3.6 DEMODULATORS

There are two types of standard demodulators available for use with the TMR-74. These are the DF-74-H, which, when equipped with three internal plug-in demodulator modules, provides complete fm demodulation capability, and the DP-74-W which provides wide-angle phase and synchronous a-m demodulation. Both demodulators are front-panel plug-in modules; more detailed descriptions follow.

4.3.6.1 FM DEMODULATOR (DF-74-H). The basic purpose of the fm demodulator is to provide demodulation of frequency-modulated signals, and supply as its primary output a video signal for further application to receiver circuits.

The DF-74-H housing will accept up to three fm demodulator "subassemblies" (narrow, intermediate, and wideband) which plug into the housing. Selection of the desired fm demodulator module is accomplished through the use of pushbutton switches mounted on the demodulator front panel.

Other operating controls located on the fm demodulator include pushbuttons to select the deviation meter full-scale range, the vernier tuning control for the second local oscillator of the receiver, and the search range control. The search range control is used to adjust the amount by which the second local oscillator deviates above and below center frequency (sweeps) during afc search.

An indicator light, also located on the front panel of the demodulator, lights when the receiver is in the afc search mode. The discriminator balance controls for the individual demodulators are located on the demodulator front panel.

The DF-74-H contains a number of interface circuits which establish proper interface levels between the particular demodulator selected and certain other receiver subassemblies. These circuits perform functions in the afc search, afc, apc, a-m, and tuning meter circuits. Paragraph 4.3.6.3 discusses the functions associated with the demodulator connector, J28.

4.3.6.2 PHASE DEMODULATOR (DP-74-W). The DP-74-W provides wide-angle phase demodulation or synchronous a-m demodulation, selectable by a switch on the demodulator front panel. The demodulator includes automatic search-for-lock over the select-loop bandwidth, and has anti-sideband circuitry to prevent locking on sidebands. Loop bandwidths of 10, 30, 100, 300, and 1000 Hz are selected by a front-panel switch. Either coherent or envelope agc is available from the DP-74-W, as selected by an internal switch.

Front-panel controls include second local oscillator vernier tuning, loop bandwidth, automatic/manual acquisition, loop open/close (a momentary switch), and the synchronous a-m/pm output selector switch. A search indicator light on the front panel lights during search-for-lock.

4.3.6.3 DEMODULATOR CONNECTOR FUNCTIONS. A brief discussion of each major input and output function of the fm or phase demodulator connector is given in the following paragraphs. All referenced connector numbers are a part of J23 unless otherwise specified.

a. A1, 10 MHz IF Signal Input: The 10 MHz second i-f signal from the i-f distribution amplifier/a-m detector (A5) is applied to the demodulator through W17 and A1.

b. A4, 10 MHz Limited Output: Provides a limited 10 MHz signal for recording purposes; this signal is made available at J14, through W20, on the rear panel of the receiver.

c. Pin 2, AM Input and Pin 6, AM Output: In the case of the fm demodulator, the detected a-m signal from subassembly A5 is routed directly from pin 2 to pin 6 of J23; the a-m output at pin 6 is connected through W21 to the a-m section of S3, the receiver mode switch. When the phase demodulator is used, the a-m input from A5 is applied to circuitry in the demodulator which produces as an output, at pin 6 (following acquisition), coherent agc for use by gain-controlled receiver circuits. The coherent agc signal is connected to the agc amplifier (A2) through S4G, which is normally locked in the open position. This signal also appears at rear panel connector J3, as the receiver a-m output.

d. Receiver Lock Indication: This output, produced only when the phase demodulation is installed in the receiver, provides an indication at the receiver rear panel (J17-4) when phase-lock is accomplished.

e. Pin 5, Input from COR (Carrier Operated Relay): This input disables the anti-sideband-lock circuits of the phase demodulator present when the level of the received signal drops below the level established by the setting of the receiver front panel cor adjust control, R6; obtained from subassembly A2, the agc amplifier.

f. Pin 7, -15 VDC 2ND LO Tune; Pin 28, +15 VDC 2ND LO Tune; Pin 26, 2ND LO Tuning Out: These pins, together with the second l-o vernier tuning control on the demodulator front panel, provide the variable voltage which is used to tune the second local oscillator of the receiver over a range of ±250 kHz. Pins 7 and 28, respectively, are connected to sources of +15 volts and -15 volts, external to the demodulator; connected between them is a resistive voltage divider which provides a variable voltage to the second local oscillator subassembly through W10, and pin 13 of XA6.

g. Pin 9, AFC Input Normalizing, and Pin 8, AFC Output Normalizing: Pins 9 and 8 interface with the afc amplifier subassembly (A3); selection of the desired demodulator module connects one of three resistors across these pins, modifying the slope of the sweep waveform generated in the afc amplifier to obtain a sweep slope compatible with the deviation sensitivity of the selected fm demodulator.

h. Pin 12, Deviation Meter Range In, and Pin 10, Deviation Meter Range Out: Pins 12 and 10 interface with the afc amplifier (through S4B, the fm/pm portion of the receiver mode switch) to allow selection of the desired full-scale sensitivity for the receiver deviation meter. When the fm demodulator is employed, switching of the meter sensitivity is accomplished by the use of three pushbutton switches (on the demodulator front panel) which switches any of three resistances contained in the demodulator into the deviation meter amplifier circuit, providing this amplifier with selectable gain. The deviation meter amplifier is located in the afc amplifier subassembly, A3. When the phase demodulator is employed, a single fixed resistor located in the demodulator is connected between pins 12 and 10, adjusting the gain of the deviation meter amplifier to provide a deviation meter full-scale indication of 300 degrees.

i. Pin 13, Input AFC Control, and Pin 16, Output AFC Control: When the fm demodulator is installed, pins 13 and 16 are connected together by a jumper inside the demodulator. This effectively connects together pins D and C of XA3, the afc amplifier connector; pin D is the vco control voltage output, and pin C is the input to the tuning meter peak detector for the afc/apc mode and is also connected to the second local oscillator subassembly (A6) at pin 7, afc/apc control. When the phase demodulator is installed, pin 13 is not connected (in the demodulator), and the output at pin 16 is the apc voltage produced by the phase demodulator; the apc voltage at pin 16 is applied to the tuning meter afc/apc peak detector at pin C of XA3, and to the second local oscillator at pin 7 of XA6.

j. Pin 18, Video Output: The video output from the demodulator, pm or synchronous a-m from the phase demodulator and fm from the fm demodulator, is available at pin 18. Pin 18 is connected through W23 to the fm/pm section of the receiver mode switch (S4B) for application to the video filters when the receiver is in the fm/pm mode.

k. Pin 22, Search Range Input, and Pin 20, Search Range Output: Pins 22 and 20 connect the search range control circuit of the fm demodulator with the sweep/retrace circuit of the afc amplifier subassembly. The search range control, located on the front panel of the fm demodulator, provides a means of varying the amplitude of the afc search sawtooth applied to the second local oscillator of the receiver, thus varying the amount by which the oscillator sweeps during afc search. When the phase demodulator is employed, pins 22 and 20 are not connected.

l. Pin 24, Auxiliary Video Output: The video signal from pin 24 is applied directly to pin S of the afc amplifier, A3, during afc search and when the receiver is in the a-m mode.

m. Pin 29, Search Indicator: When the fm demodulator is installed, signal developed in the afc amplifier and obtained from pin U of XA3 is applied through pin 29 to the search indicator light located on the demodulator, to indicate that afc search is in progress. Not used when the phase demodulator is installed.

n. Pin 30, Search Inhibit: This is one of the logic functions that controls the operation of the afc search circuits in the afc amplifier, A3. Not used when the phase demodulator is installed. When the search range control of the fm demodulator is in the "off" position, zero voltage is present at pin 30, disabling the afc search function; when the search range control is "on", +15 volts is present at pin 30 and the search function is enabled (other search, or sweep control inputs allowing).

o. Pin 31, AFC PM/FM Control: This also is a logic function that controls the afc search circuits of the afc amplifier. When the fm demodulator is installed in the receiver, pin 31 is connected through the demodulator to pin 15, thus is at a potential of -15 volts; this enables the search circuits of the afc amplifier. When the phase demodulator is installed, pin 31 is connected through the demodulator to a source of +15 volts, at pin 1, and the afc amplifier search circuits are disabled.

4.3.7 VIDEO BANDWIDTH FILTERS (V-74-G Series, A1A1-A1A5 and A1A7-A1A11). The TMR-74 accepts a complement of up to ten video bandwidth filters, with selection of the desired filter implemented by pushbuttons on the front panel of the receiver. Each filter provides a 24 dB per octave rolloff at the -1 dB response point for the specified filter cutoff frequency. (The V-74-DIR provides direct coupling of the video signal to the video amplifier subassembly without modifying high-frequency response.)

The signal applied to the video bandwidth switch (S1, on the receiver front panel), and eventually to the filters, is obtained from S4A-3 in the a-m mode and from S4B-3 in the fm/pm mode. The signal applied to the selected filter is obtained from S1A-1 through S1K-1 and coupled through P1 or P2. The selected filter accepts as its input this signal, applied by way of XA1 pin 1 through XA5 pin 1 for filters interfacing with main chassis circuitry through J1, and XA7 pin 1 through XA11 pin 1 for filters interfacing through J2.

The filtered output signal from the selected filter is available at pin 10 of the applicable connector (i.e., XA1-10, XA2-10, etc.), and is coupled through P1 or P2 to S1A-2 through S1K-2. Closure of the desired switch connects the filtered video signal to C3 and S3H, which are both connected through the front panel video gain control (R8) to the video amplifier subassembly, A4. When dc video coupling of the video amplifier input is selected, C3 is bypassed through S3H; when ac coupling is selected, S3H is open, and the signal is coupled through C3.

The video signal at the desired level is taken from R8 and connected through W29 to XA4, the video amplifier subassembly connector.

4.3.8 VIDEO/AUDIO AMPLIFIER (A4)
The video amplifier receives as its inputs an audio signal from R7 (audio gain) and a video signal from R8 (video gain), and supplies as its outputs an amplified audio signal, an amplified video signal, and a signal which is used to drive the receiver output level meter (M2).

The audio signal input is applied through pin 14 of XA4, and the amplified audio output is available at pin 12. The video signal is applied through pin 4 of XA4, and the amplified video output appears at pin 7. The output meter signal is derived from the video input signal, and appears at pin 11. The audio output signal (at pin 12) is applied to the front-panel loudspeaker, LS1; the video output signal (at pin 4) is applied through W30 to the rear panel video output connector, J6; the output meter signal (at pin 11) is applied to R1, the output meter calibrate control, and thus to the output meter. R1 is a part of the output meter envelope detector circuit, which also includes R11, R12, R13, and CR3.

4.3.9 AGC AMPLIFIER (A2)

The agc system of the TMR-74 is the delayed type, with receiver gain such that some agc voltage is developed on receiver noise in the absence of a received signal. Delayed agc to the rf tuner assures optimum tuner operation over the entire dynamic range of the receiver. The agc curve is essentially logarithmic from noise to maximum input, thus is ideally suited to optimum ratio diversity combining. The control range, which is dependent upon the selected i-f bandwidth, the demodulator, and the rf tuner noise figure, extends to 135 dB. Gain control voltages are normalized by normalization networks in the various plug-in modules to provide uniform gain control characteristics with changes in receiver bandwidth.

Controls are provided to allow adjustment of the rear panel agc output slope, zero, and polarity, to suit specific requirements. Five pushbutton selectable time constants of 0.1 through 1000 msec are provided, as well as a manual gain control mode and a "special" switch position. An optional notch filter and a "notch" agc amplifier may be incorporated into the TMR-74 to permit use in conical scan tracking applications.

Gain control voltage for the receiver is developed by the agc amplifier subassembly, A2. The agc amplifier accepts as its primary input an a-m signal (supplied by the a-m detector, part of A5), the level of which is dependent upon the received signal level. The subassembly provides the following outputs (see figure 4-1):

a. A gain control voltage which varies logarithmically with received signal level, and controls the gain of the receiver to accommodate a wide range of signal levels. This gain control voltage is applied to the second i-f amplifier (part of A11) and, when the received signal level exceeds approximately two-thirds of the input signal level range (i.e., two-thirds of the dynamic range of the receiver) is applied to the rf tuner to reduce its gain.

b. An agc output signal to J4, on the rear panel of the receiver. This output may be used for signal strength recording.

c. Signals to operate the carrier operated relay (cor), K1, and to operate the front panel cor indicator light, DS1.

d. A sweep disable signal, which is applied to the afc amplifier subassembly and "turns off" the afc search upon signal acquisition.

e. A signal to operate the receiver signal level meter, M3.

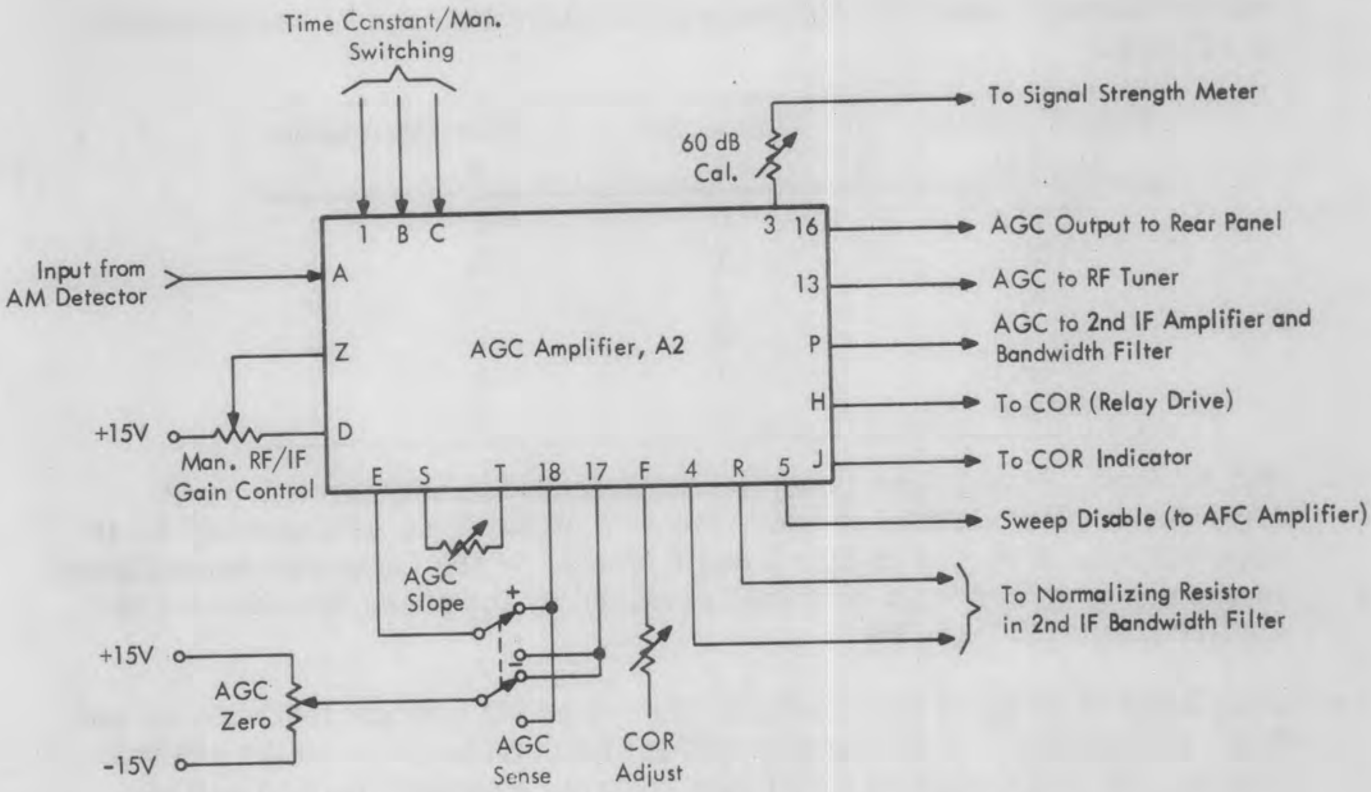


Figure 4-1. Simplified Functional Diagram, AGC Amplifier (A2)

f. The agc amplifier subassembly interconnects with main chassis circuitry to provide the following functions: signal level meter zero control, in conjunction with R3; a means of calibrating the signal level meter for full-scale deflection with a signal-to-noise ratio of 60 dB (60 dB cal., R4); sense (polarity), slope, and zero adjustment of the rear panel agc record output, performed with S8, R9, and R10, respectively; agc normalizing; a means of adjusting the gain of the receiver when in the manual gain control mode, by adjusting R2, the rf/i-f gain control; a means of adjusting the received signal level below which the cor energized and the cor indicator light goes off.

The following paragraphs discuss the major agc amplifier connector functions as they relate to the operation of the overall receiver. All referenced pin numbers are a part of XA2, unless otherwise specified.

a. Pins 1, B, and C, AGC Time Constant: Application of a three-bit code, set up by means of the front-panel agc time constant switch, S3, provides one of five time constants or a manual gain control mode for the receiver agc system. When in the manual gain control mode, gain control of the receiver second i-f amplifier and bandwidth filters and delayed gain control of the rf tuner is accomplished through the use of the rf/i-f gain control, R2. The following chart shows the code for each of the five time constants and the manual mode; "0" corresponds to -15 volts, and "1" corresponds to +15 volts:

Time Constant (msec)	Connector 1	Pin Designation B	C
1000	0	0	1
100	1	0	1
10	0	1	0
1	1	1	0
0.1	1	0	0
Manual	1	1	1

b. Pin A, Input: Video input is applied to the subassembly through pin A. When the fm demodulator is used, the a-m signal from subassembly A5 is applied to pin A by way of pins 2 and 6 of J23. When the phase demodulator is used, a synchronous a-m signal produced by the phase demodulator is applied (from pin 6 of J23).

c. Pins 2 and D, Manual Gain Control: Pins 2 and D interconnect with R2 and R14, respectively, which form a voltage divider connected to the +15 volt source. R2 is the manual rf/i-f gain control, a screwdriver adjustable potentiometer accessible at the receiver front panel.

d. Pin 3, Signal Level 60 dB Calibrate: Interconnected through R5 (60 dB Cal.) to the signal level meter, M3; provides a drive signal for this meter.

e. Pin 4, +8V AGC Normalizing, and Pin R, AGC Normalizing: Pins 2 and R interconnect with the agc normalization network in the second i-f bandwidth filters to provide uniform receiver gain control characteristics with changes in second i-f bandwidth.

f. Pin 5, AFC/COR Control: The agc amplifier provides a signal at pin 5 which is applied to the afc amplifier through pin 14 of XA3 to enable the afc search circuits of that subassembly when the received signal drops below the level established by the front panel cor adjust control (R6).

g. Pins E, 17, and 18, AGC Sense: These pins interconnect with S8, the rear panel agc sense switch, to permit the polarity of the agc output at J4 (agc record output) to be reversed.

h. Pin F, COR Adjust: Interconnects with the front-panel cor adjust potentiometer, R6. (See also paragraph "f".)

i. Pin H, COR Output: A signal appears at pin H to energize the carrier operated relay when the received signal drops below the level determined by the cor adjust control, R6.

j. Pin J, COR Indicator: An output appears at pin J in the absence of output at pin H, to provide a visual front panel indication of signal acquisition by means of the cor indicator, (DS1).

k. Pin K, Signal Level Zero on Noise: Pin K interconnects with the front panel zero-on-noise control, R3, to provide a means of adjusting the signal strength meter to zero with no received signal.

l. Pin 13, RF Tuner AGC, and pin P, IF Bandwidth Filter and Second IF Amplifier AGC: The gain of the rf tuner is controlled by a signal which is a function of the received signal level and appears at pin 13 when the agc signal applied to the second i-f amplifier and bandwidth filters reduces their gain to a minimum. Tuner agc is applied at pin 7 of J22; agc to the i-f circuits is applied at pin 11 of A12XA1-A12XA9, and at pin 1 of XA11.

m. Pins S and T, AGC Slope Adjust: Pins S and T interconnect with the rear panel agc slope control, R9, to allow adjustment of the slope of the agc record output signal at J4.

n. Pin 16, AGC Record Output: The signal at pin 16 is connected through W33 to J4 as the agc record output.

4.3.10 AFC AMPLIFIER (A3)

The basic purpose of the afc amplifier subassembly is to control the frequency of the second local oscillator and thus maintain the frequency of the second i-f signal in the center of the i-f passband.

The subassembly also provides an afc search-and-lock function, to allow automatic signal acquisition. When the receiver is in the fm with afc mode of operation, but no signal is being received, a sweep signal is applied to the second local oscillator from the afc amplifier causing the local oscillator to sweep symmetrically above and below center frequency (65 MHz).

The search range, or the frequency range over which the second local oscillator sweeps, is adjustable up to ±250 kHz by means of the afc search zone control located on the fm demodulator front panel. The afc search zone control also allows the search function to be turned off.

The afc system tracking range is ±250 kHz; however, as the second local oscillator vernier tuning control (also located on the demodulator) allows oscillator center frequency adjustment of ±250 kHz, the effective tracking range of the afc system is actually doubled. The afc search zone is approximately symmetrical about the center frequency of the second local oscillator as set by the vernier tuning control. The afc time constants, which are 0.01 sec, 0.1 sec, and 1.0 sec, are selected by means of the front panel pushbutton afc time constant switch, S6.

The control voltage which is applied to the second local oscillator (when the receiver is in the afc mode of operation) is derived from a video input signal applied to the afc amplifier through either pin T or pin S of XA3. (See figure 4-2.) When the receiver is in the fm mode and afc search is not in progress (i.e., when acquisition has taken place), the video signal utilized is a filtered signal obtained from the video filters (A1A1 etc.) and applied through S3H and pin T. When afc search commences the afc amplifier switches internally to the video signal applied to pin S; this is an unfiltered signal obtained directly from the demodulator at pin 24 of J23. In the a-m mode, the signal applied through pin S is utilized both during search and after acquisition.

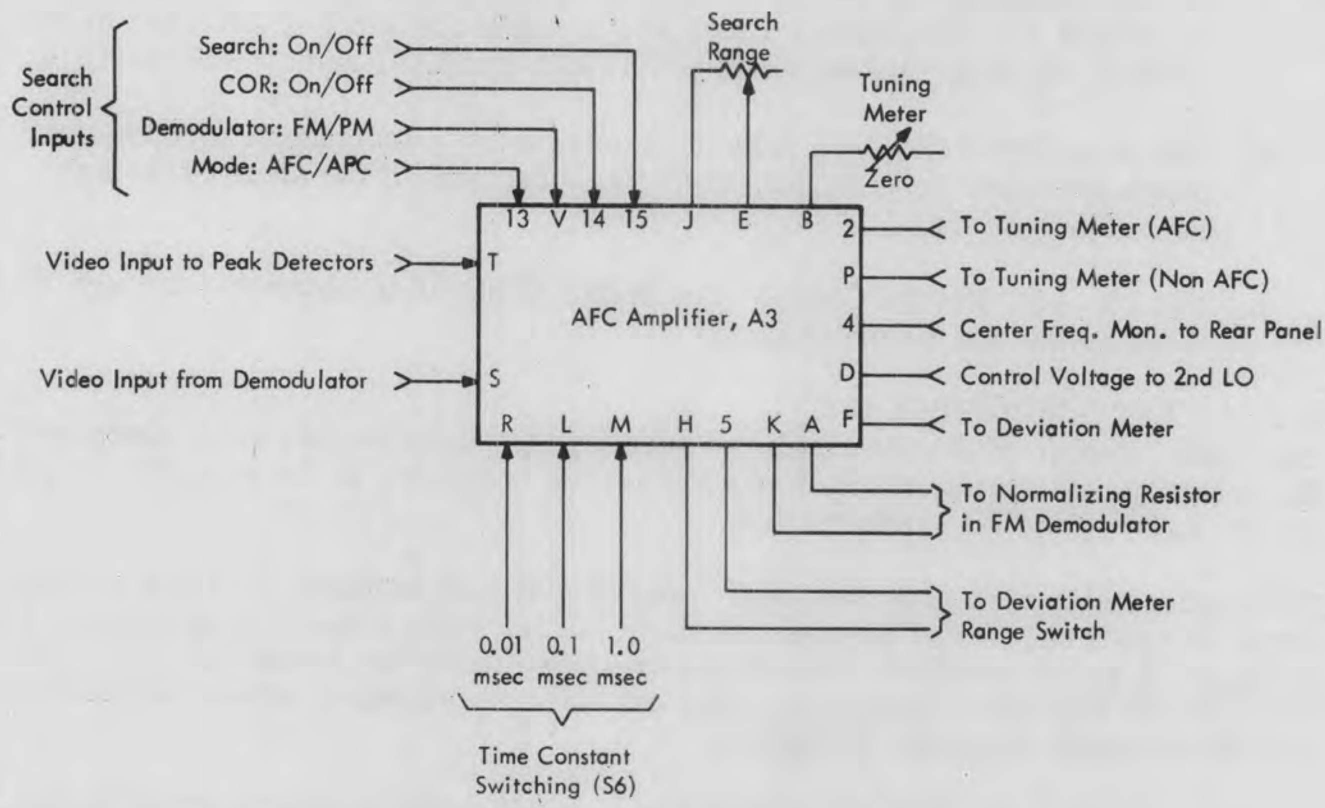


Figure 4-2. Simplified Functional Diagram, AFC Amplifier (A3).

When the receiver is in the fm with afc mode and has acquired a signal, the video signal applied through pin T to the peak detectors within the afc amplifier produces an error voltage when the second i-f signal is not precisely centered within the i-f passband. This error voltage is applied through a buffer to the integrator of the afc amplifier; the output of the integrator appears at pin D and is the control signal which is applied to the second local oscillator. The afc time constant is selected by applying -15 volts to pin R, pin L, or pin M, as determined by the afc time constant switch, S6.

When the receiver is in the a-m with afc mode, the video input at pin S is applied through the buffer to the integrator. An output from the fm demodulator, hence a dc voltage at pin S, is produced when the "average" center frequency of the second i-f signal deviates above or below 10 MHz; this signal, applied through the buffer to the integrator, produces the second local oscillator control voltage output at pin D. Selection of the afc time constant is as in the fm-afc mode.

When afc search is in progress in both the a-m and fm modes, a video signal of sufficient amplitude produced as the second local oscillator (and thus the second i-f signal) sweeps, according to the setting of the search zone control, causes the search to "hold" momentarily, allowing the agc amplifier to develop a carrier operated relay (cor), or "sweep disable" output at pin 5 of XA2. This signal is applied to the afc amplifier at pin 14, disabling the search circuits of the subassembly. Following acquisition, as discussed in the previous paragraphs, the integrator reverts to the signal from the peak detectors (input applied at pin T) for the fm mode, but continues to utilize the signal applied at pin S for the a-m mode.

In addition to the cor, or sweep disable, signal from the agc amplifier, there are three other inputs to the afc amplifier that control the operation of the search circuits. These are the search on/off (search inhibit) input at pin 15, the fm/pm demodulator (apc/fm) input at pin V, and the afc/apc mode (afc/apc) input at pin 13.

The afc amplifier also aupplies signals to operate the receiver tuning and deviation meters, M4 and M2, respectively, and provides a center frequency monitoring output to J7 on the receiver rear panel.

There are two tuning meter clamping circuits in the subassembly, one for the afc/apc mode (output at pin 2) and one for non-afc/apc modes (output at pin P); in the afc/apc mode pin P is grounded through S5, and in other modes pin 2 is grounded through S5. When a phase demodulator is employed, the signal for the tuning meter is obtained from the demodulator (at pin 16 of J23) and applied to the afc/apc clamping circuit, the output of which appears at pin 2.

The gain of the deviation meter amplifier of the afc amplifier subassembly, the output of which drives the deviation meter, may be changed by means of the deviation meter range switch (located on the fm demodulator) to obtain the desired full-scale meter reading. The deviation meter indicates fm peak deviation in kHz, a-m in percent modulation, and phase deviation in degrees. When the phase demodulator is installed, the deviation meter full-scale reading is determined by a fixed resistive network in this demodulator.

The center frequency monitor output provides an analog indication of center frequency when the receiver is not in the afc/apc mode, corresponding to the signal supplied to the tuning meter through pin P.

The following paragraphs discuss the major functions of the afc amplifier connector by pin number, as they relate to the overall functioning of the receiver. All referenced pin numbers are a part of XA3, unless otherwise specified.

a. Pin A, AFC Normalizing Input, and Pin K, AFC Normalizing Output: Pin K interconnects with an afc normalizing resistor located in the fm demodulator and is returned through pin A; the normalizing resistor produces a slope characteristic for the search sweep signal suited to the deviation sensitivity of the selected demodulator.

b. Pin 2, Tuning Meter Output: Provides a drive signal for the receiver tuning meter when the receiver is in the afc mode.

c. Pin B, Tuning Meter Zero: Pin B interconnects the integrator of the afc amplifier with R5, tuning meter zero, to provide a means of adjusting the tuning meter to zero when the receiver is in the calibrate mode.

d. Pin 3, Cal. Gain Override: When the receiver is in the calibrate mode +15 volts is applied to pin 3, through S4D, to switch a high resistance into the integrator feedback circuit; this allows the integrator to become essentially a high-gain amplifier and permits the afc loop to be optimized.

e. Pin C, Loop Stress Input, and Pin D, VCO Control Output: In the afc mode, the second local oscillator control voltage at pin D is coupled through the fm demodulator (in at pin 13, out at pin 16 of J23) to pin C. Pin C is the input of the afc tuning meter clamping circuit and is also connected to pin 7 of XA6, the control voltage input to the second local oscillator subassembly.

f. Pin H, Deviation Meter Range Input, and Pin 5, Deviation Meter Range Output: Pins H and 5 interconnect with any of three resistances in the fm demodulator, selected by the deviation meter range switch on the demodulator, to provide selectable gain for the deviation meter amplifier and thus provide the desired full-scale deviation meter indication.

g. Pin E, Search Range Input, and Pin J, Search Range Output: These pins interconnect with the afc search zone control on the fm demodulator to provide a means of varying the frequency range over which the second local oscillator sweeps during afc search.

h. Pin F, Deviation Meter Output: This is the drive signal for the receiver deviation meter, M2.

i. Pin 10, Sweep Current Input: Pin 10 is connected to a resistor in series with a source of 15 volts in the selected i-f bandwidth filter; the value of the resistor assures the proper characteristics for the sweep sawtooth generated by the search circuits of the afc amplifier for the i-f bandwidths in use.

j. AFC Time Constants, Pin R (0.01 sec), Pin L (0.1 sec), and Pin M (1.0 sec): These pins can be connected through S6A, B, or C, respectively, to a s source of -15 volts, thus applying -15 volts to pin R, pin L, or pin M of the afc amplifier to enable the desired time constant circuit.

k. Pin 11, Tuning Meter Filter: This pin connects the non-afc tuning meter clamping circuit (output at pin P) with C6 and C7, which filter undesired components from the tuning meter signal.

l. Pin N, Average/Means-of-Peak AFC Control: Pin N is connected with S4A in such a way as to apply -15 volts to a transistor switch when in the a-m mode, and +15 volts in other modes. This connects the integrator of the afc amplifier to the video input at pin S (a-m/afc) for all modes except fm (following acquisition); in the fm mode, except when search is in progress, the integrator is connected to the peak detectors, which receive their input at pin T (video input).

m. Pin S, AM/AFC, and Pin T, Video Input: See paragraph l, above.

n. Pin 13, AFC/APC Control: This is one of the search control inputs. A potential of +15 volts is applied to pin 13 through the second local oscillator mode switch (S5) in all modes except afc/apc, to disable the search circuits of the afc amplifier. In the afc/apc mode, -15 volts is applied to pin 13 through S5 to enable the search circuits.

o. Pin 14, COR Control: This is a search control input; pin 14 is connected with pin 5 of XA2, and is supplied with +15 volts when the carrier (received signal) is above threshold, disabling the search circuits, and -15 volts when the carrier is below threshold, enabling the search circuits.

p. Pin 15, Search Inhibit: Pin 15 is connected to the demodulator connector, J23, and is one of the search control inputs. When the afc search is turned off, by means of the afc search zone control on the fm demodulator, pin 15 is in an open circuit condition and the afc search is disabled; when the search zone control is turned on, +15 volts is present at pin 15, enabling the search circuits.

q. Pin U, Search Indicator Output: When the afc search is in progress, an output appears at pin U to operate the search indicator light located on the fm demodulator front panel.

r. Pin 18, Cal., Non-AFC Override: When the receiver is in the calibrate mode, -15 volts is applied to 18, ensuring that a low impedance connected in the integrator feedback circuit during non-afc modes is removed during the calibrate mode. (See also paragraph d, pin 3.) The low impedance is removed by logic circuitry internal to the afc amplifier during the afc mode.

s. Pin V, APC/FM: This is a search control input; pin V interconnects with J23, the demodulator connector. When the fm demodulator is installed, -15 volts is applied to pin V from J23, enabling the search circuits of the afc amplifier. When the phase demodulator is installed, +15 volts is applied to pin V, disabling the afc search circuits. (When the phase demodulator is used, automatic search-and-lock is integral to the demodulator.)

4.3.11 POWER SUPPLY

The power supply circuitry of the TMR-74 provides regulated voltages of +15 volts and -15 volts for use by the various receiver circuits and subassemblies. The power supply consists of two sections: unregulated low dc voltage is developed by the basic power supply, which is located on the main chassis; the regulated dc voltage is produced by the power supply regulator, which works in conjunction with the basic power supply.

The basic power supply includes the line filter (Z1), the power transformer (T1), a full-wave rectifier (CR1), and series regulators Q1 and Q2. The power switch, S7, is a double-pole single-throw. Overload protection is provided by the fuse, F1. Filtering of the unregulated voltages (+20 volts and -20 volts) is accomplished by C1 and C2. The series regulators interconnect with the power supply regulator subassembly through XA15.

The positive and negative sections of the regulator subassembly are similar, thus only the positive section, as it relates to the basic power supply, is discussed. All referenced pin numbers are a part of XA15. Unregulated voltage of +20 volts, from the collectors of the series regulators, Q1, is applied to the regulator through pin 6. Pins 8 and 11 connect with the base and the emitter of Q1. The remote current sensing input is at pin 7, and the regulated output is at pin 10. Additional filtering of the regulated output voltage is performed by C4, for the positive output, and by C5 for the negative output.

When the receiver is to be used with a primary power source of nominally 115 volts ac, the power transformer primary windings are connected in parallel. For primary voltage of nominally 230 volts ac, the primary windings are connected in series.

4.3.12 OPTIONAL MODULES AND ACCESSORIES

There are a number of optional modules available for use with the model TMR-74, to provide such functions as predetection recording and playback capability, spectrum display, adjacent channel and spurious signal rejection, and agc notch filtering for conical scan tracking purposes. Each of these optional modules is fully described by an instruction manual or booklet, as appropriate, thus only a brief description of each is given in the following paragraphs.

4.3.12.1 PREDETECTION RECORD AND PLAYBACK. Two basic types of predetection record and playback modules are available for the TMR-74. The TMR-74A, with its 5-1/4 inch front panel, accepts the P-74-R (record) and P-74-P (playback) series of internal plug-in modules; each of these modules accommodates a single video carrier frequency determined by the frequency of the crystal used for translation. The TMR-74B, which is equipped with a seven-inch front panel, accepts the front panel plug-in PD-74-R and PD-74-P record and playback modules; each of these provides a switch selectable choice of six video carrier frequencies. The TMR-74B also accepts the single-frequency P-74-R and P-74-P internal modules. Brief functional descriptions of the predetection record and playback modules follow.

a. Model P-74-R Predetection Record Module (A9). The model P-74-R accepts as its input a linear 10 MHz second i-f signal and frequency translates this signal to provide as its output a video carrier signal at the desired one of six frequencies, dependent upon the frequency of the crystal installed in the module. The 10 MHz input signal is obtained from subassembly A5, at A3 of XA5, and applied to the module through W18 and A3 of CA9. The video carrier output signal is applied through A1 of XA9 and W37 to rear panel connector J11. A choice of video carrier center frequencies of 112.5, 225, 450, 600, 800, or 900 kHz is available.

b. Model P-74-P Predetection Playback Module (A7). The model P-74-P accepts as its input a video carrier signal at the selected one of six frequencies, and up translates this signal to a frequency of 10 MHz. The 10 MHz signal is then further up-converted to the first i-f signal frequency of 55 MHz by the optional U-74-P up converter, which must be used with the P-74-P, and applied to the second mixer of the receiver. The advantage of this is that afc or apc correction voltage may be applied to the played-back signal ahead of the bandwidth filtering process.

Input signal to the P-74-P is applied through rear panel connector J12 and W38 to A1 of XA7; the 10 MHz output signal is applied through A3 of XA7 and W39 to A3 of XA8, the U-74-P connector. The output of the U-74-P, obtained at A1 of XA8 and at a center frequency of 55 MHz, is then applied to the second mixer subassembly at A2 of XA13, through W12. The choice of video carrier center frequencies for the P-74-P is as specified for the P-74-R.

c. Model PD-74-R Predetection Record Module. The model PD-74-R plugs into the TMR-74B through the front panel and provides a choice of six video carrier output frequencies, selectable by pushbuttons on the module front panel. The available frequencies are as specified for the P-74-R. The PD-74-R plugs into the receiver through the seven-inch front panel which, together with the subchassis that attaches beneath the TMR-74A main chassis, converts the TMR-74A to the TMR-74B configuration.

The 10 MHz input signal for the PD-74-R is obtained from J8 or J14 of the TMR-74A main chassis, and coupled through J5 and W5 of the subchassis to A5 of J6. (See figure 7-2.) The output signal, at the selected video carrier frequency, appears at A1 of J6 and is connected through W4 to J4, at the rear of the subchassis.

d. Model PD-74-P Predetection Playback Module. The model PD-74-P installs in the TMR-74B in a manner similar to the PD-74-R, and will accept any of six video carrier input frequencies as selected by front-panel pushbuttons. Available center frequencies are as for the PD-74-R. The PD-74-P accepts as its input a video carrier signal and translates this signal to a frequency of 30 MHz for playback demodulation. The optional U-74-P further translates this signal to a frequency of 55 MHz.

The playback input signal is applied to J1 of the TMR-74B subchassis and coupled through W1 to A2 of J6. (See figure 7-2.) The up-converted output signal is obtained at A4 of J6 and connected through W2 to J2 of the subchassis. J2 is connected to J12 of the main chassis for application to receiver circuits.

4.3.12.2 SPECTRUM DISPLAY. Spectrum display capability for the TMR-74 can be provided in either of two ways. In the case of the TMR-74B, the Model SD-74-A Spectrum Display Unit can be plugged directly into the front panel to provide integral spectrum display capability. The model SD-74-A provides a visual display of signals occurring above and below the center frequency of the received signal over a bandwidth which is adjustable from 100 kHz to 6 MHz. The sweep rate is nominally 15 Hz, and 500 kHz markers can be switched in to the display. The display area is approximately one inch by three inches.

If it is desired to use an existing display unit having an input center frequency of 30 MHz, the optional S-74-A 55 MHz to 30 MHz converter module may be used; in this case the converter would be required because the center frequency of the spectrum display output is at the first i-f frequency, which is 55 MHz. The S-74-A plugs into the main chassis of the TMR-74, and may be used with both the "A" and "B" versions of the receiver.

Discussions of the module-receiver interconnections for the SD-74-A display unit and the S-74-A converter follow.

a. Model SD-74-A Spectrum Display Unit. The SD-74-A plugs into the TMR-74B through the front panel; connections between the display unit and the receiver are made through J7 of the subchassis. The 55 MHz input signal is obtained from J13 of the main chassis and applied to the SD-74-A through J3 of the subchassis, W3, and A2 of J7.

b. Model S-74-A 55 MHz to 30 MHz Converter Module. The S-74-A plugs into the main chassis of the receiver at XA10. The 55 MHz input to the module is obtained from A2 of J22 and applied through W5 and A1 of XA10. The down-converted output signal, at a frequency of 30 MHz, appears at A3 of XA10 and is connected to main chassis rear panel connector J13 through W40 for application to the external display unit.

4.3.12.3 FIRST IF FILTERS (A-74-F, DF series, A14). First i-f filters are available for use with the TMR-74 to provide enhanced adjacent channel and spurious signal rejection. Available are the A-74-F800, which has an 800 kHz minus 3 dB bandwidth, the A-74-F1800 (1800 kHz bandwidth), and the A-74-DF, which offers a choice of 800 kHz or 1800 kHz bandwidths.

The appropriate filter is automatically switched into the signal path upon selection of the desired second i-f bandwidth filter. For second i-f bandwidths up to 500 kHz, the 800 kHz filter is switched in; for second i-f bandwidths over 500 kHz, the 800 kHz filter is switched out. The 1800 kHz filter is switched in for second i-f bandwidths up to 1500 kHz, and switched out for wider bandwidths. When the A-74-DF filter is installed, switching is automatically accomplished in sequence, as described for the individual filters.

Signal input to the first i-f filter is through A1 of XA14; the signal is obtained from A1 of the rf tuner connector, J22. The filtered (or unfiltered output signal, for second i-f bandwidths over 500 kHz or 1500 kHz, as applicable) output signal is in all cases obtained at A5 of XA14. The output signal is then applied to the second mixer, at A3 of XA13. Enabling voltage from the selected second i-f filter is applied at pins 9, 11, or 12 of XA14, as appropriate.

4.3.12.4 NOTCH FILTER (N-74-F). A notch filter can be made available for use with TMR-74 to adapt the receiver for use in conical scan tracking applications. The purpose of the filter is to prevent the receiver agc circuits from reacting at the scanning rate of a conical scan antenna system. When the N-74-F is employed, the receiver must also be equipped with the "notch" agc amplifier subassembly; this subassembly includes a special notch time-constant circuit.

4.3.12.5 BALANCE MODE. The balance mode of operation, selected with S4C, provides a convenient means of adjusting to zero the discriminator offset of each demodulator module installed in the fm demodulator housing.

In the balance mode, the crystal-controlled 10 MHz oscillator in the second i-f amplifier subassembly (A11) is turned on, and its output is applied through the i-f amplifier to the demodulator as a 10 MHz second i-f signal; the balance control for each demodulator module installed is then adjusted for a zero (center-scale) indication on the tuning meter (M4). The balance controls are located on the front panel of the fm demodulator housing.

The integrator of the afc amplifier subassembly (A3) functions essentially as a low-gain amplifier in the balance mode.

4.3.12.6 CALIBRATE MODE. The calibrate mode of operation, selected with S4D, is provided to enable accurate calibration of the tuning meter circuit for a zero indication when the receiver is correctly tuned to a received signal.

In the calibrate mode, the 10 MHz oscillator located in the second i-f amplifier subassembly (A11) is turned on, as in the balance mode, and its output is applied to the demodulator as a 10 MHz second i-f signal. The tuning meter (M4) is then adjusted for a zero (center-scale) indication, as in the balance mode, by adjusting the front-panel screwdriver adjustable zero control, R5. Tuning meter calibration is carried out after the discriminator balance adjustments have been performed.

The integrator of the afc amplifier subassembly (A3) functions as a high-gain amplifier in the calibrate mode.

4.3.12.7 PLAYBACK MODE. The playback mode of operation, selected with S4E, facilitate use of the receiver as a playback demodulator by enabling or disabling a number of receiver circuits, as appropriate, and connecting the signal level meter to the playback converter for input signal level monitoring purposes.

In the playback mode, four major functions are performed by S4E, as follows:

a. The 55 MHz first i-f input to the second mixer (A13) is disabled, and the playback input to this subassembly is enabled.

b. The predetection record module (P-74-R or PD-74-R) is turned off, and the up converter (U-74-P) and predetection playback module (P-74-P or PD-74-P) are turned on.

c. The first local oscillator, located in the rf tuner, is turned off.

d. The input for the signal level meter is obtained from the predetection playback module (P-74-P or PD-74-P), permitting monitoring of the playback input signal level.

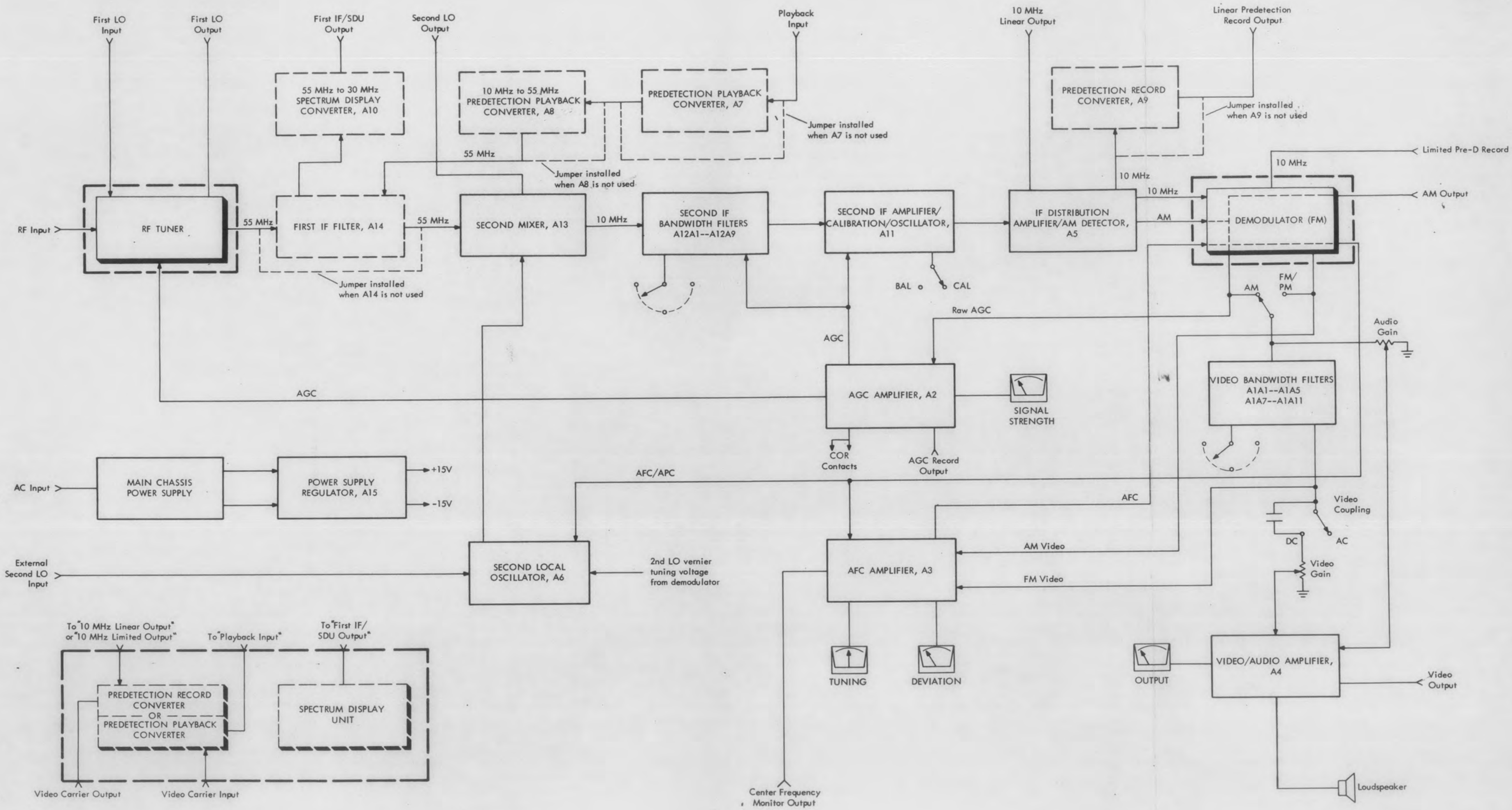


Figure 4-3. Model TMR-74 Telemetry Receiver, Simplified Functional Block Diagram

SECTION V
MAINTENANCE

5.1 GENERAL

The TMR-74 receiver and its associated subassemblies and modules are designed to give long and troublefree operation with a minimum of maintenance. High quality components are used throughout the receiver, with emphasis placed on operation well within specified ratings. All meters and transformers are hermetically sealed to increase reliability.

The receiver should be kept clean, relatively dustfree, and in good mechanical condition. The top cover, bottom cover, and the various modules and subassemblies should be kept in place and firmly secured at all times.

It is recommended that a set of spare subassemblies and modules be kept on hand. Should a malfunction develop, substitution can be made and the receiver returned to operating condition with minimum down-time. The defective subassembly or module can then be repaired and kept on hand as the spare.

Preventive maintenance should be performed at regular intervals to prevent malfunctions and needless interruptions while the unit is in service. The preventive maintenance procedures for the receiver are given in paragraph 5.2. If these checks indicate a malfunction, refer to paragraph 5.3 for corrective maintenance instructions.

5.2 PREVENTIVE MAINTENANCE

Preventive maintenance is work performed on equipment, normally when this equipment is not in use, to keep it in good working order and to prevent a malfunction during operation. Preventive maintenance consists of both physical and electrical checks, which are designed to detect and prevent physical and performance deterioration. These checks are usually conducted at regular intervals.

5.2.1 PHYSICAL CHECKS

The receiver should be checked regularly for evidence of corrosion, and if corrosion is noted, immediate steps should be taken to prevent further deterioration. These steps include cleaning the affected area and applying a light film of oil containing a rust inhibitor. It may be necessary to remove the part to be cleaned to prevent residue or cleaning material from falling into internal parts of the equipment.

To repaint or refinish any area of the front panel, first clean with a clean cloth soaked in any mild degreasing solution such as chlorothene or trichlorethylene. Apply a brush coat of air-drying enamel, which will match as closely as possible the color of the panel, slightly overlapping the undamaged surface, and allow the painted surface to dry in accordance with the instructions of the paint used. The following general instructions should be followed:

a. Use number 0000 sandpaper to remove corrosion. Never use steel wool, emery paper, or crocus cloth.

b. Remove dust and dirt with a clean, dry, lint-free cloth or a dry brush.

c. Dirt lodged in places inaccessible with a brush may be removed carefully with a piece of cloth fastened to a pencil-like stick.

d. Use a clean cloth or brush moistened with solvent for cleaning electrical contacts and terminals. When the item is clean, wipe dry with a clean, dry, lint-free cloth.

e. Surfaces that perform no specific electrical function (e.g., shields, sheet metal, etc.) may be cleaned with a cloth or a brush moistened with a dry-cleaning solvent. Wipe cleaned areas with a clean, dry, lint-free cloth.

f. If available, dry compressed air may be used at line pressure of 60 psi or less to remove dust from inaccessible places. Do not damage parts or disarrange wiring by blasts of high-pressure air.

CAUTION

Always direct the first blasts of compressed air toward the floor to remove condensed moisture from the line.

g. Do not disturb wiring or break small parts by rough or careless handling. Do not overtighten or strip threads on nuts, bolts, or screws. Avoid marring surfaces when removing dust or corrosion.

5.2.1.1 CHASSIS.

a. Examine for dents, cracks, marred painted surfaces, loose or missing screws.

b. Check all visible screws for tightness.

c. Clean the outer surface with a piece of cloth slightly dampened with mild detergent.

5.2.1.2 CABLES, CONNECTORS, AND RECEPTACLES.

a. Inspect for corrosion and loose connections.

b. Inspect for frayed or cut insulation at connecting or support points.

c. Inspect for kinks or strain caused by improper placement.

d. Tighten loose mounting nuts.

e. Resolder loose wires at connecting terminals.

f. Wipe cables free of dust.

g. Clean contact springs of jacks.

h. Blow out receptacles with compressed air, if available.

i. Remove corrosion and dirt from interior of connectors and receptacles with cloth and brush if necessary, and again clear with compressed air.

5.2.1.3 FUSES.

a. Inspect fuse receptacle for evidence of corrosion.

b. Check for loose mountings.

c. Inspect connections.

d. Tighten mounting nuts as required.

e. Clean fuseholders and terminals.

5.2.1.4 SWITCHES.

a. Check mechanical action.

b. Observe wiping action of contacts.

c. Examine contacts and connections for dirt and corrosion.

d. Check for burning or arcing contacts.

e. Tighten loose mounting nuts.

f. Resolder or reconnect loose wires at terminals.

g. Remove dust and dirt from switch contacts with a dry, lint-free cloth or brush.

h. Remove corrosion from switch contacts with a burnishing tool.

5.2.1.5 PRINTED CIRCUIT BOARDS.

a. Inspect the printed circuit wiring for cracks, breaks, and raised foil.

b. Check for loose components and poor solder connections.

c. Check components for breakage or discoloration due to overheating.

d. Remove dust and dirt with a clean, dry, lint-free cloth.

5.2.2 PERFORMANCE CHECK

A procedure for checking the overall performance of the receiver is given in paragraph 5.3.3; it is suggested that the performance check given be carried out for preventive maintenance purposes following each 500 hours of operation.

The performance check of paragraph 5.3.3 is also recommended as a confidence check following installation of the receiver and prior to any major scheduled operation.

5.3 CORRECTIVE MAINTENANCE

Corrective maintenance for the receiver consists of troubleshooting, repair or replacement of defective parts, and adjustment as required. These are discussed in the following paragraphs.

5.3.1 TROUBLESHOOTING

A thorough knowledge of the principles of operation as given in Section IV and familiarity with the main chassis schematic diagram in Section VII are prerequisite for successfully troubleshooting the TMR-74.

In the event of a malfunction, initial checks should be made to ensure that the fuse is not blown, that the correct input and output connections have been made (see tables 1-1, 2-1, and figure 2-2), that all modules and plug-ins are properly installed, and that each subassembly and plug-in module is receiving the proper operating voltages.

If it is determined that the malfunction is not caused by a mechanical or power failure, the problem should first be isolated to a particular subassembly. The block diagram shown in figure 4-3 will help in isolating the malfunction to a subassembly or subassemblies. The procedure given in paragraph 5.3.3 may also assist in determining in which subassembly the malfunction is located. Substitution of the suspect module is recommended as the most conclusive test to determine whether a particular subassembly or module is operational. Once the defective subassembly has been isolated, it can be replaced or repaired as the situation demands.

As an additional aid in fault isolation, a troubleshooting chart is given in table 5-1. When troubleshooting the subassemblies, consult the appropriate instruction booklets for these units. Straightforward troubleshooting techniques such as signal injection, signal tracing, and voltage measurements should be used when attempting to isolate a malfunction to a particular stage or component. It is suggested that the ATK-74 accessory test kit be used to facilitate access to subassembly circuits.

Waveforms are not included in this instruction manual as they would be of little value in troubleshooting the receiver. The waveforms present in the various receiver stages, except for oscillator circuits, depend upon the signal being processed by the receiver.

The following troubleshooting chart, table 5-1, is intended as an aid in isolating the subassembly or module most probably causing the trouble symptoms listed.

As a given defect may cause more than one symptom to appear, possible symptoms are grouped in the "Trouble Symptom" column, and the subassembly or module which should be checked, preferably by substitution, is given in the "Subassembly/Module" column.

Certain basic checks that can be made to further determine the condition of the suspect subassembly or module are also given in the "Trouble Symptom" column.

Table 5-1. Fault Isolation Troubleshooting Chart

Subassembly/Module	Trouble Symptom
RF Tuner	a. Lack of TUNING meter indication. b. Insufficient SIGNAL LEVEL meter indication. c. No 1st i-f/sdu output at J13. d. No 1st l-o output at J18. Check XTAL and VFO 1st l-o modes of operation.
Second Mixer, A13	a. No receiver audio or video output. b. Lack of TUNING meter indication. c. Insufficient SIGNAL LEVEL meter indication. Remove Mixer; inject 10 MHz signal at XA13-A4, -20 dBm level.
Second IF Bandwidth Filters, A12A1--A12A9	a. No receiver audio or video output. b. Lack of TUNING meter indication. c. Lack of SIGNAL LEVEL meter indication. Check all other 2nd i-f bandwidths.

continued

Table 5-1, continued

Subassembly/Module	Trouble Symptom
Second IF Amplifier, A11	a. No receiver audio or video output. b. Lack of proper TUNING meter indication. c. Insufficient SIGNAL LEVEL meter indication. Check calibrate oscillator (CAL) on SIGNAL LEVEL meter, and output at J8; Remove i-f amplifier, A11. Inject 10 MHz signal at XA11-A3, -35 dBm level.
AGC Amplifier, A2	a. SIGNAL LEVEL meter inoperative. b. SIGNAL LEVEL meter maximum above maximum level for lower receiver input levels. c. 10 MHz linear output (J8) level is too high. Check agc time constant selection; Check MANual gain control mode.
IF Distribution Amplifier/ AM Detector, A5	a. FM video output normal but no a-m output at J3. b. 10 MHz linear output (J8) but no limited output J14, or vice versa. c. No a-m or fm video output, J6. d. No 10 MHz linear or limited output. e. No TUNING meter indication. f. Insufficient SIGNAL LEVEL meter indication.
Demodulator	a. No DEVIATION meter indication. b. No fm video output, J6. c. Afc inoperative. d. No OUTPUT meter indication. Check NARrow, INTermediate, and WIDEband demodulators; Check 10 MHz limited output, J14.

continued

Table 5-1, continued

Subassembly/Module	Trouble Symptoms
Video Filter, A1A1--A1A5, A1A7--A1A11	a. No a-m or fm video at J6 with a-m at J3. Check other available video filters bandwidths.
Video Audio Amplifier, A4	a. No output at J6. b. No audio. c. No OUTPUT meter indication. Check AUDIO GAIN and VIDEO GAIN controls; Check other available video filter bandwidths; Check a-m operation; a-m output at J3 and no a-m video at J6.
Second Local Oscillator, A6	a. No TUNING meter indication. b. Insufficient SIGNAL LEVEL meter indication. c. No second l-o output at J19. Check XTAL and VFO operation if AFC mode is inoperative.
AFC Amplifier, A3	a. DEVIATION meter inoperative. b. Afc search inoperative. c. TUNING meter inoperative. Check AFC SEARCH ZONE control; Check second l-o tuning; Check afc time constant selection; Check that receiver operates normally in XTAL and VFO second l-o modes.
Power Regulator Board, A15	a. No power indication (PWR indicator). Check fuse; Check ±15V dc at XA15.

5.3.2 REPAIR AND REPLACEMENT
The TMR-74 is assembled and disassembled in a straightforward manner and should pose no problems for maintenance personnel. Most of the circuitry is located on modular subassemblies. If a fault develops in one of the subassemblies, the subassembly can be replaced in a matter of minutes. All components used in the receiver are considered non-repairable and should be replaced when found to be defective. The subassemblies may be replaced or repaired as the situation warrants.

The top cover of the receiver is held in place by six spring latches that fit into appropriate slots at the top of the main chassis. The cover is removed by sliding it toward the rear, and lifting. The bottom cover of the TMR-74A is secured by 13 machine screws; the underside of the TMR-74B is protected by the subchassis in which the spectrum display unit and the predetection record or playback converters may be installed; the sheet metal bottom cover which is used for the TMR-74A is not installed in the TMR-74B. Access to the circuitry covered by the subchassis is gained by removing the 13 machine screws and the two Phillips head front-panel screws that secure the subchassis to the receiver.

The plastic caps used on the pushbutton switches are friction-fitted to the shaft of the appropriate switches and are removed simply by pulling them away from the switch.

5.3.2.1 FRONT PANEL MOUNTING. Replacement of meters, lamp assemblies, and controls located at the front panel necessitates removal of the front panel. These components are mounted on a keyplate which attaches to the main chassis and is located behind the front panel.

The 5-1/4 inch front panel of the TMR-74A is secured to the main chassis by six Phillips head countersunk machine screws, and to the keyplate by two similar machine screws. It is also necessary to remove the audio gain and video gain control knobs to remove the front panel; each knob is secured to the control shaft by two Allen head screws.

The seven-inch front panel of the TMR-74B is secured in a manner similar to that of the TMR-74A, except that four additional countersunk Phillips head machine screws (one at each side) secure the panel to the subchassis.

The keyplate assembly is secured to the main chassis by four countersunk machine screws at the top sides and four at the bottom sides of the assembly.

5.3.2.2 SUBASSEMBLY REMOVAL AND INSTALLATION. Removal of internal subassemblies and modules is reasonably uncomplicated, but care should be exercised to avoid damaging printed circuit boards and marring subassembly and module enclosures.

Removal of assemblies consisting of printed circuit boards equipped with handles or mounting brackets (specifically assemblies A2, A3, A4, A12A1 through A12A9, and A15), is accomplished by grasping the handle and carefully lifting. Removal of the second i-f filters may necessitate the use of a flat-bladed screwdriver if several filters are installed.

Subassemblies and modules designated A5 through A11 and A13, and A14 are enclosed; the enclosure is equipped with a flange to assist in removal. The use of a flat-bladed screwdriver may be required.

A metal cover is installed over the area of assemblies A12A1 etc., A13, and A14; the cover is secured by two countersunk Phillips head machine screws and must be removed for access to these assemblies.

Removal of the video filters (A1A1, etc.) necessitates removal of subassemblies A2, A3, and A4, and removal of the metal bracket which partially covers the filters and is held in place by a single roundhead Phillips machine screw.

5.3.2.3 PC BOARD COMPONENT REMOVAL AND REPLACEMENT. The suggested procedure for removing components located on the printed circuit boards in the receiver, its subassemblies, and modules, is given below, and requires the use of the following material and equipment:

Liquid soldering flux	1/8 inch, #18 AWG flat braid
Liquid flux remover	Medium wattage soldering iron.

Apply a thin coat of soldering flux to the flat braid. Place and hold the braid over the solder joint. Apply heat to the braid directly over the solder joint; the braid will absorb most of the solder.

CAUTION

Do not heat the solder joint for long periods of time as excess heat may damage the circuit board.

After the major portion of the solder has been absorbed by the braid, apply heat directly to the solder joint and pry the component loose. Clean the affected area using the flux remover. Trim the replacement component leads to the same length as the original component leads. Position the replacement component on the circuit board and solder it in place. Clean the affected area with flux remover. After repairs have been made, the affected unit should be reinstalled in the receiver and the performance of the receiver should be checked following the procedure given in paragraph 5.2.2.

The location of the subassemblies is shown in figure 5-1. To remove the subassemblies, follow the instructions given in paragraph 5.3.2.2.

Point-to-point wiring is used in the case of the basic (main chassis) section of the power supply. In the event that any wires are disconnected in the basic power supply, it is recommended that the wires be coded in some manner before removal, to minimize the possibility of wiring errors.

5.3.3 INITIAL ADJUSTMENTS AND PERFORMANCE CHECK.
Each of the subassemblies is aligned separately and has its own individual alignment procedure. These procedures are given in the subassembly instruction booklets which are included as a supplement to this manual. There are no alignment procedures for the receiver as an assembly other than those given in paragraph 5.3.3. Should realignment of one of the subassemblies be required, the overall performance of the receiver should subsequently be checked according to paragraph 5.3.3.

5.3.3.1 INITIAL ADJUSTMENTS. The adjustments outlined in this paragraph are provided to enable proper adjustment of the demodulator BALance controls, the TUNING meter ZERO control, the SIGNAL LEVEL meter ZERO ON NOISE and 60 DB CALibration controls, and the OUTPUT meter CALibration control.

These adjustments are recommended upon installation of the receiver and may also be carried out prior to scheduled operation. It is also advisable to recheck these adjustments following replacement or repair of any internal subassembly.

a. Demodulator Balance.

(1) Turn on the receiver.

(2) Select the BAL mode. Select the widest-bandwidth demodulator installed (BANDWIDTH).

(3) Adjust the appropriate screwdriver-adjustable demodulator BAL control for a TUNING meter indication of 0 (center-scale).

(4) Repeat steps (2) and (3) for other demodulator bandwidths installed.

b. Tuning Meter Zero.

(1) Turn on the receiver.

(2) Select the CAL mode. Select the demodulator having the narrowest bandwidth.

(3) Adjust the TUNING meter ZERO control for a center-scale indication.

c. Demodulator Balance and Tuning Meter Zero, Alternate Method.

(1) Turn on the receiver.

(2) Select the BAL mode, and the narrowest installed demodulator bandwidth.

(3) Adjust the appropriate demodulator BAL control for a zero-center indication on the TUNING meter.

(4) Switch to the CAL mode, and adjust the TUNING meter zero control for TUNING meter zero; do not readjust the demodulator BAL control.

(5) With the receiver still in the CAL mode, switch to the next wider-bandwidth demodulator, and adjust its BAL control for TUNING meter zero; do not readjust the TUNING meter ZERO control.

(6) Repeat step (5) for any wider-bandwidth demodulator installed, adjusting the appropriate BAL control to obtain TUNING meter zero.

NOTE

Careful adjustment of the balance (BAL) control for the wide-bandwidth demodulator will be required, due to the high sensitivity of the TUNING meter circuit in the CAL mode.

d. Signal Level Meter Calibration. This procedure includes adjustment of the signal level meter zero-on-noise and 60 dB calibration controls.

Recommended Equipment:

Signal Generator	HP 608D
VTVM	HP 412A

(1) Connect the signal generator to J1 and the vtvm to J4, of the receiver. Turn on the receiver.

(2) Select the VFO first l-o mode, the XTAL second l-o mode, and the 10 MS agc time constant. Set the rear panel AGC SENSE switch to (-), and select the 500 KHZ second i-f bandwidth.

(3) Set the output level of the signal generator to -70 dBm and set the generator frequency to the center of the runing range of the rf tuner in use. Tune the receiver to the signal generator frequency using the receiver TUNING control.

(4) Reduce the signal generator output level to minimum. Adjust the ZERO ON NOISE control to obtain a zero indication on the SIGNAL

LEVEL meter. Adjust the AGC ZERO control on the receiver rear panel for zero indication on the HP 412A.

(5) Increase the signal generator output level to 60 dB above noise according to table 5-2. Adjust the 60 DB CAL control to obtain a 60 dB indication on the SIGNAL LEVEL meter. Adjust the AGC SLOPE control for -8V. Switch the AGC SENSE to (+). The vtvm should indicate +8V.

(6) Repeat steps (4) and (5) as required to achieve agc output and SIGNAL LEVEL meter calibration.

(7) COR Adjustment.

(a) Set the signal generator output level to 6 dB above noise according to table 5-2. Adjust the front panel COR (threshold) ADJ until the associated COR indicator just comes on.

(b) Experimentally decrease the output level of the signal generator and then increase it slowly until the COR indicator just comes on. Adjustment is complete when the COR indicator comes on within a fraction of a dB of the 6 dB above noise input level.

e. <u>Output Meter Calibration.</u>

Recommended Equipment:

Signal Generator	HP 651A
RMS VTVM	HP 411A

(1) Connect the signal generator to A4 of XA5, and the rms vtvm to J6, of the receiver. Turn on the receiver.

(2) Select DC VIDEO coupling, set the VIDEO GAIN control to mid-range, and select the AM receiver mode. Select the DIR video bandwidth.

(3) Set the signal generator output level for a meter indication of 0 DB on the 1.0 volt range, at an output frequency of 10 kHz.

(4) Adjust the VIDEO GAIN control for a 1.35 volt indication on the rms voltmeter.

(5) Adjust the receiver OUTPUT meter CAL control to produce a 0 DB indication on the OUTPUT meter (of the receiver).

Table 5-2. S/N Ratio vs. IF Bandwidth

IF Filter Bandwidth	Signal Generator Output Level * +6 dB S/N Ratio	+60 dB S/N Ratio
10 kHz	-118 dBm	-64 dBm
30 kHz	-113 dBm	-59 dBm
50 kHz	-111 dBm	-57 dBm
100 kHz	-108 dBm	-54 dBm
300 kHz	-103 dBm	-49 dBm
500 kHz	-101 dBm	-47 dBm
750 kHz	-99 dBm	-45 dBm
1000 kHz	-98 dBm	-44 dBm
1500 kHz	-96 dBm	-42 dBm
2000 kHz	-95 dBm	-41 dBm
3300 kHz	-93 dBm	-39 dBm
4000 kHz	-92 dBm	-38 dBm
6000 kHz	-90 dBm	-36 dBm

* Signal Generator output level is based on a 10 dB receiver noise figure. For other noise figures, reduce input level by 1 dB for each dB lower noise figure.

5.3.3.2 PERFORMANCE CHECK.

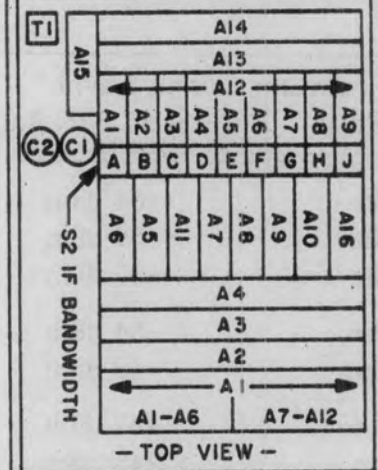
The procedures given in the following paragraphs are intended as "confidence" checks, to provide a means for verifying acceptable overall receiver operation, and to assist in localizing a receiver malfunction.

The procedures given are performed using standard, available modules and subassemblies. Additional tests are given that verify the performance of the receiver when it is equipped with optional modules; these tests should of course be disregarded where a particular optional module has not been supplied.

For convenience, and to assist in locating a particular performance check, the checks included are listed below:

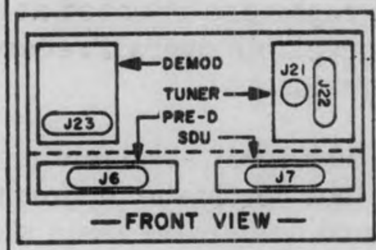
Paragraph	Name of Check
5.3.3.2.1	Power Supply Regulator Adjustment
5.3.3.2.2	Demodulator Balance and Tuning Meter Zero
5.3.3.2.3	Signal Level Meter and COR Adjustment
5.3.3.2.4	Noise Figure Test

continued

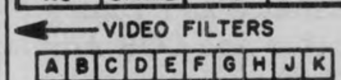


— LEGEND —

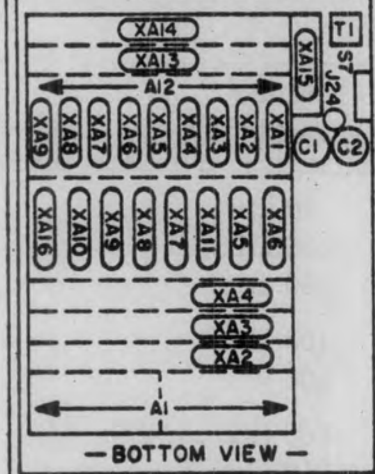
A1	VIDEO FILTERS
A2	AGC AMPLIFIER
A3	AFC AMPLIFIER
A4	VIDEO/AUDIO AMPLIFIER
A5	IF DIST AMPL/AM DET
A6	2ND LOCAL OSC
A7	PRE-DET PLAYBACK
A8	UP-CONV PRE-DET PBK
A9	PRE-DET RECORD
A10	SDU CONVERTER
A11	2ND IF AMPLIFIER
A12	2ND IF FILTERS
A13	2ND MIXER
A14	1ST IF FILTER
A15	POWER REG BOARD
A16	SPARE
T1	POWER TRANSFORMER



DESIG (TOP)	BUTTON	DESIG (TOP)	BUTTON
A1	C	A7	H
A2	B	A8	G
A3	D	A9	J
A4	E	A10	K
A5	A	A11	F
A6	SPARE	A12	SPARE



S1 VIDEO BANDWIDTH
PUSH BUTTON SW



— LEGEND —

A1	VIDEO FILTERS
XA2	AGC AMPLIFIER
XA3	AFC AMPLIFIER
XA4	VIDEO/AUDIO AMPLIFIER
XA5	IF DIST AMPL/AM DET
XA6	2ND LOCAL OSC
XA7	PRE-DET PLAYBACK
XA8	UP-CONV PRE-DET PBK
XA9	PRE-DET RECORD
XA10	SDU CONVERTER
XA11	2ND IF AMPLIFIER
A12	2ND IF FILTERS
XA13	2ND MIXER
XA14	1ST IF FILTER
XA15	POWER REG BOARD
XA16	SPARE
T1	POWER TRANSFORMER
S7	POWER SWITCH

Figure 5-1. Subassembly, Module, and Main Chassis Component Locations

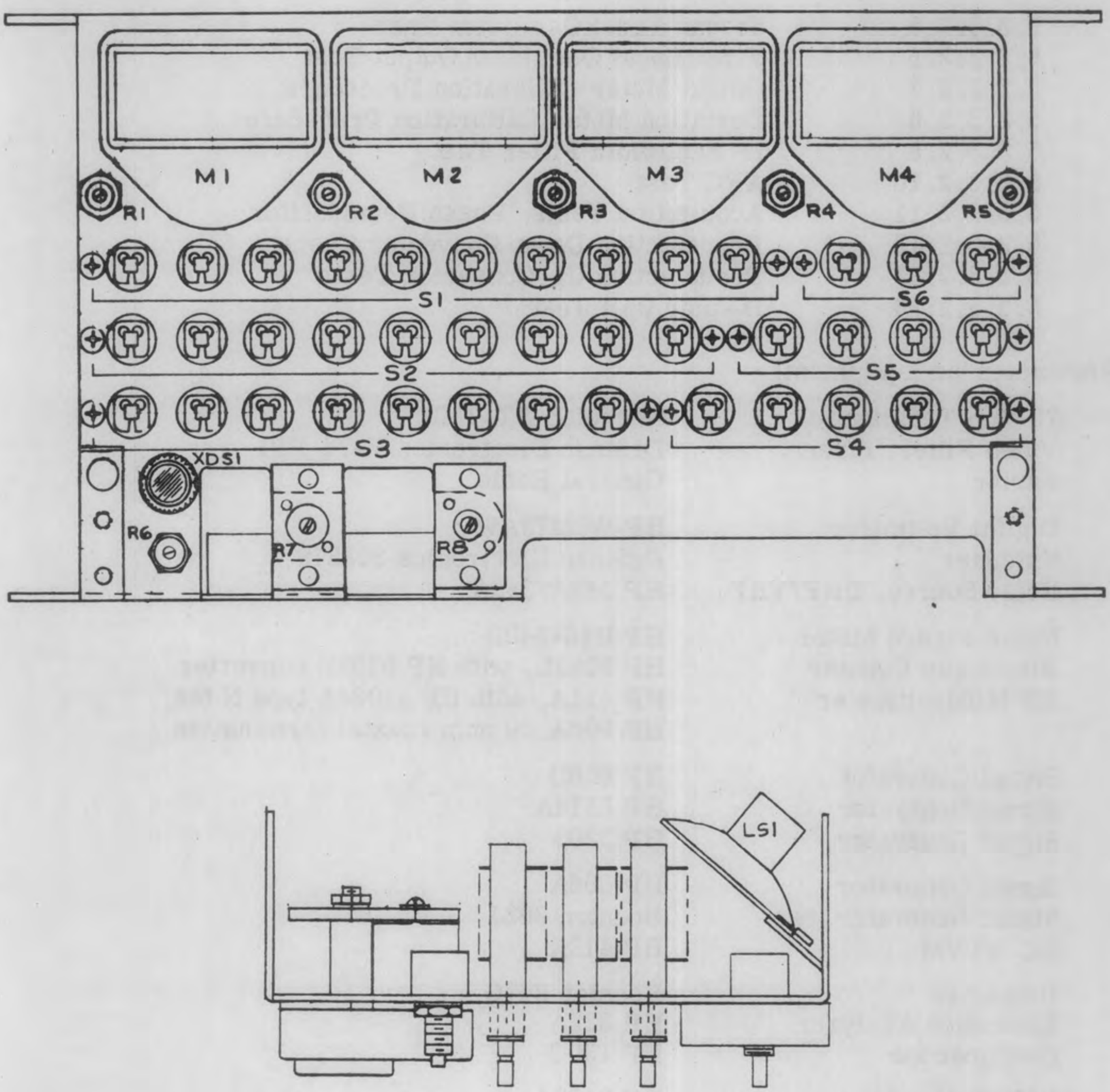


Figure 5-2. Keyplate Assembly, Component Locations

Paragraph (cont)	Name of Check (Cont)
5.3.3.2.5	Second Local Oscillator Test
5.3.3.2.6	First Local Oscillator Output Test
5.3.3.2.7	Output Meter Calibration Procedure
5.3.3.2.8	Deviation Meter Calibration Procedure
5.3.3.2.9	IF Bandwidth Filter Test
5.3.3.2.10	AFC Test
5.3.3.2.11	Acquisition Tests, Phase Demodulator
5.3.3.2.12	Predetection Down-Converter Tests
5.3.3.2.13	Predetection Up-Converter Tests
5.3.3.2.14	Display Unit Test

Recommended Equipment:

75 ohm Termination	Microlab PT-7MB
Video Filter, direct	Defense Electronics V-74-DIR
Variac	General Radio
Digital Voltmeter	HP WSM73AW
Extender	Defense Electronics 303279
Noise Source, UHF/VHF	HP 349A/343A
Noise Figure Meter	HP H18-340B
Electronic Counter	HP 5245L, with HP 5253B converter
RF Millivoltmeter	HP 411A, with HP 11024A type N tee, HP 908A 50 ohm coaxial termination
Signal Generator	HP 608D
Signal Generator	HP 8614A
Signal Generator	HP 3205
Signal Generator	HP 606A
Signal Generator (two)	Boonton 202J
DC VTVM	HP 412A
Univerter	Boonton 207G
Distortion Analyzer	HP 332A
Oscilloscope	HP 130C
RMS Voltmeter	HP 3400A
Test Oscillator	HP 651A
Wide Range Oscillator	HP 200CD

Recommended Test Cables:

The following test cables have been assigned reference designations (e.g., W6) only for convenience in relating the required cable(s) to the test setup drawings.

W1 and W2	Coaxial 50 ohm cable approximately 36 inches long; RG-223/U cable with UG-88C/U connector each end.

W3 and W4	Coaxial 50 ohm cable approximately 48 inches long; RG-223/U cable with UG-88C/U connector each end.
W5	Coaxial 75 ohm cable approximately 48 inches long; RG-59A/U cable with UG-260D/U connector each end.
W6	Coaxial 50 ohm cable approximately 48 inches long; RG-223/U cable with UG-88C/U connector each end.
W7	Coaxial 50 ohm cable approximately 48 inches long; RG-174/U male BNC to Cannon DM52740-1.

Recommended Coaxial Adapters:

a. UG-201A/U N-to-BNC Adapter.
b. UG-274B/U BNC Tee Adapter.
c. 274-QBJ Banana terminals-to-BNC (General Radio Company).

5.3.3.2.1 Power Supply Regulator Adjustment. Connect the receiver to a metered Variac. Turn the receiver on. Set the output voltage of the Variac to 115 VAC. Remove the receiver top cover and connect the digital voltmeter to the ±15V terminals located on the meter mounting board. The voltage should be +15V ±300 mV, and -15V ±300 mV. If the voltage is more or less than specified, turn the receiver off, remove A15 and insert extender board 203279 into XA15. Insert A15 into the extender board with the digital voltmeter connected to the +15V terminal. Adjust R9 on A15. Connect the digital voltmeter to -15V and adjust R18 on A15. Repeat the adjustments until the ±15 voltage is within the tolerance

5.3.3.2.2 Demodulator Balance and Tuning Meter Zero. This procedure demonstrates the use of the calibrate oscillator in the initial adjustment of the demodulator balance and tuning meter zero. The procedure is described in paragraph 5.3.3.1, steps a and b, or step c.

5.3.3.2.3 Signal Level Meter and COR Adjustment. This procedure demonstrates the operational setup and calibration of the signal level meter and the COR threshold adjustment. The procedure is described in paragraph 5.3.3.1, step d.

5.3.3.2.4 Noise Figure Test. This test measures the noise figure for the tuner under test, using the 10 MHz output at J8.

a. Setup. Interconnect the receiver and the test equipment as shown in figure 5-3. Set controls as follows:

POWER switch: ON.	2ND LO MODE: XTAL.
MODE: FM/PM.	2ND IF BANDWIDTH: 750 kHz.
1ST LO MODE: VFO.	AGC TIME CONSTANTS: MAN.

b. Perform the zero-on-noise and 60 dB calibrate procedure referenced in paragraph 5.3.3.2.3 and described in paragraph 5.3.3.1, if not already performed.

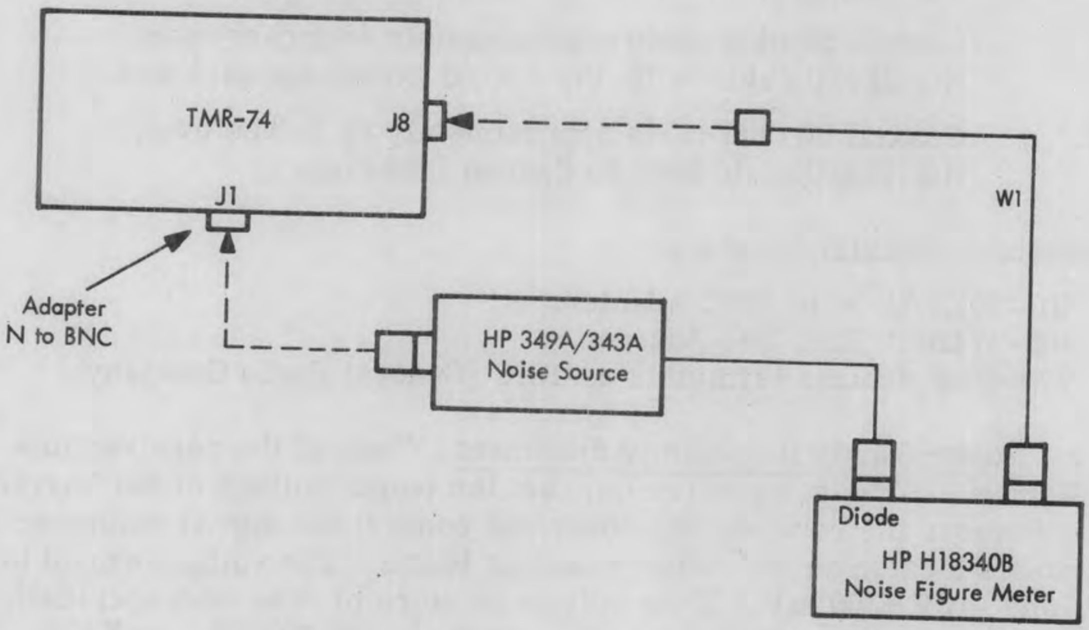


Figure 5-3. Equipment Setup for Noise Figure Test

c. Connect the noise source to J1 of the receiver. Connect J8 to the 10 MHz input of the noise figure meter. With the noise source turned off, adjust the RF/IF GAIN control for a MAN indication on the SIGNAL LEVEL meter.

d. Calibrate the noise figure meter. Slowly tune the receiver over the tuning range, noting the noise figure. Compare the maximum measured noise figure with table 5-3.

e. Repeat (c) and (d) with 1ST LO in XTAL position, with crystals for the center and each end of the band specified in table 5-3 for the tuner under test.

f. Repeat (c) and (d) with 1ST LO in EXT mode. Connect HP 608D to J9. Set the signal generator output level to -10 dBm. Set the frequency for the center and each end of the band specified in table 5-3 for the tuner under test.

NOTE

Remove connection at J9 after completion of test.

Table 5-3. Tuning Unit Specifications

Model No.	Freq. Range	Max. Noise Figure	Xtal Freq.	Ext. LO Input LO Output Range
TU-74-PA	105-155 MHz	6 dB	$F_x = \frac{F_r + 55}{2}$ 80.00000 MHz to 105.00000 MHz	80.00000 MHz to 105.00000 MHz
TU-74-PB	215-320 MHz	6 dB	$F_x = \frac{F_r + 55}{4}$ 67.50000 MHz to 93.75000 MHz	67.50000 MHz to 93.75000 MHz
TU-74-LA	1435-1540 MHz	10 dB	$F_x = \frac{F_r + 55}{32}$ 46.56250 MHz to 49.84375 MHz	93.125 MHz to 99.6875 MHz
TU-74-LB	1540-1660 MHz	10 dB		
TU-74-SA	2200-2300 MHz	10 dB	$F_x = \frac{F_r + 55}{48}$ 46.97917 MHz to 49.06250 MHz	93.95834 MHz to 98.125 MHz

5.3.3.2.5 Second Local Oscillator Test. This test measures the second local oscillator frequency in the XTAL mode, and demonstrates the vernier tuning range of the second local oscillator in the VFO mode. Measurements are made utilizing the 65 MHz second l-o output signal from J19.

a. Connect equipment as shown in figure 5-4. Set controls as follows:

POWER switch: ON.

MODE: FM/PM.

2ND LO MODE: XTAL.

b. Connect the counter to J19. The measured frequency should be between 64.997 MHz and 65.003 MHz.

c. Set the 2ND LO MODE button to VFO. Set the 2ND LO TUNE control fully clockwise; the measured frequency should increase by 270(±10) kHz.

Set the tuning control maximum counterclockwise; the measured frequency should decrease by 270 kHz (from center frequency), ±10 kHz.

NOTE

The ± frequency shifts should be equal. Adjust C6 of A6 (2nd l-o) to equalize the frequency shift.

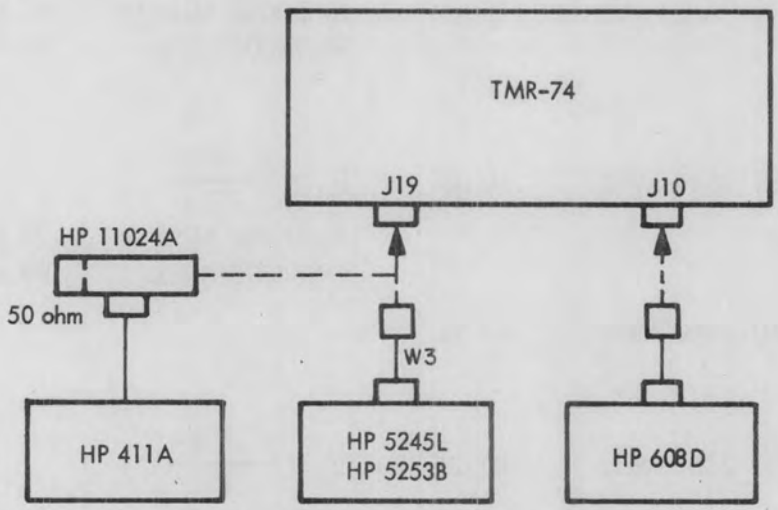


Figure 5-4. Equipment Setup for Second LO Test

d. Set the 2ND LO MODE button to EXT and connect HP-608D to J10. Set the frequency and output level of the HP 608D to 65 MHz and -13 dBm. Connect the HP 411A to J19; the output level should be -7 dBM, ±2 dB.

5.3.3.2.6 <u>First Local Oscillator Output Test.</u>

a. Connect equipment as shown in figure 5-5. Set controls as follows:

POWER: ON.

MODE: FM/PM.

1ST LO: VFO.

b. Adjust the TUNING control of the rf tuner from one extreme to the other. The minimum indication on the HP 411A should be -7 dB.

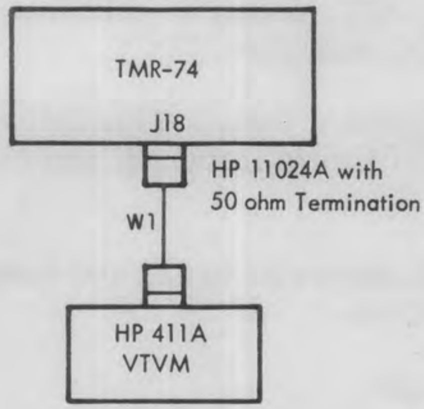


Figure 5-5. Equipment Setup for First LO Output Test

5.3.3.2.7 Output Meter Calibration Procedure. The purpose of this procedure is to demonstrate proper adjustment of the OUTPUT meter circuitry. The procedure is described in paragraph 5.3.3.1, step e.

5.3.3.2.8 Deviation Meter Calibration Procedure. The purpose of this procedure is to demonstrate satisfactory calibration of the DEVIATION meter.

a. Depress the INT BANDWIDTH fm demodulator button and the 500 kHz IF BANDWIDTH button on the receiver. Connect the Boonton 202J to J1 of the receiver. (For L- and S-band rf tuners, an HP 3205 signal generator is recommended.)

b. Set controls as follows:

POWER: ON.

MODE: FM/PM.

2ND LO MODE: XTAL.

AGC TIME CONSTANT: 10.

DEVIATION MULTIPLIER: 100 kHz.

VIDEO FILTER BANDWIDTH: DIR.

c. Balance the demodulator and zero the tuning meter (see paragraph 5.3.3.1). Set the output level of the signal generator for 60 on the TMR-74 SIGNAL LEVEL meter and set the generator to a frequency compatible with the rf tuner installed. Adjust the generator controls to provide fm modulation with 100 kHz (peak) deviation, at a modulating frequency of 1.7 kHz. (Generator deviation should be checked using Bessel null techniques since this affects DEVIATION meter accuracy.)

d. Connect the rms voltmeter to J6. Adjust the VIDEO GAIN control for a 1.41 volt output as indicated by the voltmeter.

e. Adjust R82 on A3, AFC Module to calibrate the deviation meter for a 100 kHz (full-scale) indication.*

5.3.3.2.9 IF Bandwidth Filter Test. This test measures the linear 10 MHz i-f output for all second i-f filters installed, and the agc MAN gain and SIGNAL LEVEL meter action.

a. Connect the signal generator to J1, and connect the HP 411A to J8. Set controls as follows:

POWER: ON.

AGC TIME CONSTANT: 10.

IF BANDWIDTH: 500 kHz.

2ND LO MODE: XTAL.

b. Set the rf millivoltmeter to the -10 dBm range and connect the input cable to J8 on the receiver. Set the signal generator frequency to the center frequency of the tuning unit under test. Set the generator output for a 60 dB indication on the SIGNAL LEVEL meter. The output at J8 should be approximately -13 dBm. Repeat the measurement for all IF BANDWIDTH switch and filter positions, S2A through S2J and A12A1 through A12A9.

c. With the IF BANDWIDTH set to 500 kHz, vary the output level of the signal generator from -7 dBm output to the level at which the COR indicator extinguishes. Note that the output at J8 remains essentially constant. Repeat for all AGC TC positions of S3.

NOTE

The output at J8 may vary when switching to the longer AGC TC positions, but should return to the previously-observed output after a period of time.

d. Set the AGC TC switch to the MAN position. Repeat the signal generator variations of step b and adjust R2, the RF/IF GAIN, and note that the output at J8 can be maintained at the previously-recorded level by the adjustment of R2. Also note that for this adjusted level, the SIGNAL LEVEL meter is at, or near, the MAN indication mark.

5.3.3.2.10 AFC Test. This test demonstrates the afc hold-in range, measures the afc loop gain, and demonstrates the operation of the afc search-and-lock circuitry.

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*R82 is for purpose of compensating deviation meter resistance; if ±10% accuracy is not attained, then the peak detections of afc module and demod output level should be checked.

a. Set receiver controls as follows:

POWER: ON.

MODE: FM/PM.

1ST LO MODE: VFO.

2ND LO MODE: XTAL.

AGC TIME CONSTANT: 10.

2ND IF BANDWIDTH: 500 kHz.

Demodulator BANDWIDTH: INT.

AFC TC: .01.

b. Connect the HP 606A or HP 608D to J22A1. Set the output level of the signal generator to -45 dBm and set the generator frequency to 55 MHz.

c. Set the 2ND LO MODE switch to AFC, and adjust the 2ND LO TUNE control to zero the tuning meter.

d. Connect the HP 412A to J7 and connect the counter to J14, on the receiver. Measure and note the i-f output frequency as F1.

e. Transfer the counter to J19. Measure and note the 2nd l-o frequency (at J19).

f. Adjust the signal generator frequency to obtain a 250 kHz increase in the measured 2nd l-o frequency (J19).

g. Transfer the counter to J14. Measure and note the i-f output frequency (F2). Calculate (F2-F1); the difference should not exceed 0.5 kHz.

h. Set the 2ND LO MODE switch to XTAL. Tune the receiver to the signal generator frequency using the receiver TUNING control.

i. Set the 2ND LO MODE switch to AFC and adjust the 2ND LO TUNE control to zero the TUNING meter.

j. Reduce the signal generator output to minimum. (If the AFC SEARCH ZONE is OFF, the tuning meter will usually go beyond full-scale indication in one direction or the other, not necessarily in the same direction.)

k. Set the AFC SEARCH ZONE control maximum clockwise. Observe that the SEARCH indicator comes on and the tuning meter returns to near zero indicating that the afc search is functioning.

l. Slowly increase the signal generator output to an output level a dB or so above that at which the COR indicator is on and the SEARCH indicator is off. This indicates that the signal is being received and that the afc search has been disabled.

m. Disconnect the rf signal input cable at the signal generator. Observe that the COR indicator is off and that there is a slight delay before the SEARCH indicator comes on and tuning meter indicates near zero. This indicates the afc search is functioning.

n. Reconnect the rf input cable at the signal generator. Observe that the COR indicator comes on and the SEARCH indicator goes out.

o. Adjust the signal generator frequency to obtain approximately half-scale indication upscale on the tuning meter. This indicates that afc loop stress is approximately 175 kHz (i.e., the 2nd l-o frequency has been shifted approximately 175 kHz by afc action to maintain 2nd i-f center frequency).

p. Disconnect the rf signal input cable at the signal generator. Observe that the COR indicator is off, SEARCH is on, that the tuning meter indicates near zero. This indicates that the afc search is functioning.

q. Reconnect the rf input cable at the signal generator. Observe that the COR indicator comes on and that the tuning meter reads approximately half-scale indication upscale as before. This indicates that the afc search has acquired the signal and simulates acquisition of a signal approximately 175 kHz displaced from expected signal frequency.

r. Adjust the 2ND LO TUNE control for zero indication on the TUNING meter. This demonstrates removal of afc loop stress as would be performed by the operator.

5.3.3.2.11 Acquisition Tests, Phase Demodulator. This test demonstrates the operation of the phase demodulator for automatic acquisition, for automatic acquisition with the antisideband lock circuitry enables, and for manual acquisition.

a. Setup.

Set the DP-74-W Phase Demodulator SYNC AGC switch located through top cover of demodulator to NORMAL (center position) and install the PM demodulator in the receiver. Interconnect the receiver and test equipment as shown in figure 5-6, using the cw signal source. Set receiver controls as follows:

POWER: ON.

MODE: FM/PM.

2ND LO MODE: AFC/APC.

AGC TIME CONSTANT: 10.

VIDEO FILTER BANDWIDTH: 100 kHz.

Phase Demodulator BANDWIDTH: 1000.

Phase Demodulator TUNE control: approximately midrange.

Phase Demodulator ACQ switch: AUTO.

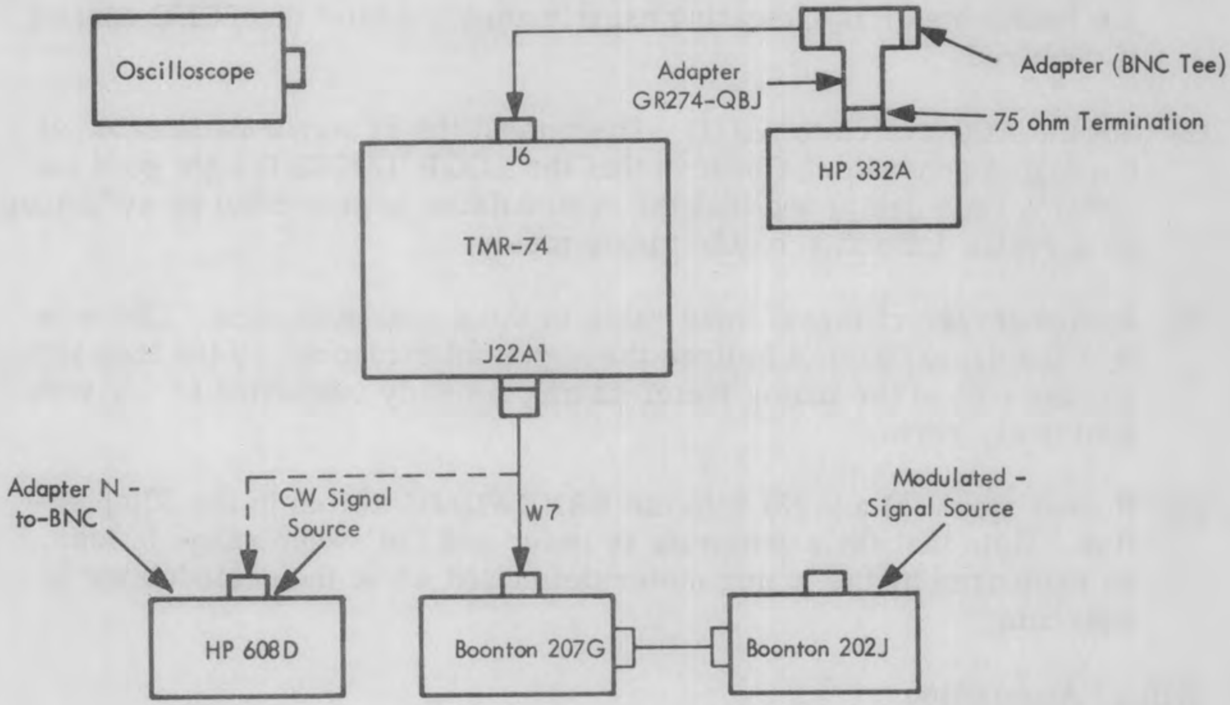


Figure 5-6. Equipment Setup for Phase Demodulator Acquisition Tests

b. Signal Acquisition.

(1) Set the output level of the signal generator (cw signal source) to -40 dBm and set the signal generator frequency to exactly 55 MHz using crystal calibration and earphones.

(Measurements are made at a frequency of 55 MHz. An HP 608D signal generator is used as an accurate frequency source of 55 MHz cw signal, and a Boonton 202J fm signal generator with a Boonton 207G univerter is used to provide a source of angle-modulated signal to simulate a received pm signal. The HP 608D signal generator in a quiet environment is a satisfactory source of cw test signal and the Boonton 202J signal generator in a quiet environment is a satisfactory source of modulated signal, for the purpose of these tests.)

(2) If the LOOP LOCKED lamp on the demodulator is not lighted, set the ACQ switch to AUTO. Adjust the TUNE control for a zero indication on the tuning meter, and set the ACQ switch to MANUAL.

(3) The demodulator is now properly tuned to the incoming signal.

c. Automatic Acquisition Test.

(1) Reduce the signal generator output level to -80 dBm. Observe that the tuning meter is indicating exactly zero. Adjust the TUNE control if required.

(2) Set the ACQ switch to AUTO. Disconnect the rf signal input cable at the signal generator. Observe that the LOOP LOCKED light goes out (after a time delay) and that the demodulator is searching as evidenced by a cyclic deflection on the tuning meter.

(3) Reconnect the rf signal input cable to the signal generator. Observe that the demodulator acquires the signal as evidenced by the loop light coming on and the tuning meter having a steady indication at, or very nearly at, zero.

(4) Repeat steps (2) and (3) with the BANDWIDTH switch in the 300 position. Note that the sweep rate is lower and the sweep range is less, as evidenced by the tuning meter deflection while the demodulator is searching.

d. Manual Acquisition.

(1) Connect the rf input cable to the cw signal source. Set the signal generator (cw signal source) to an output frequency of exactly 55 MHz using the crystal calibrator and earphones. Set the signal generator output level to -40 dBm.

(2) Set the BANDWIDTH switch to the 1000 position. If the LOOP LOCKED lamp is not lighted, set the ACQ switch to AUTO. Adjust the tune control for a zero indication on the TUNING meter and set the ACQ switch to MANUAL.

NOTE

63 kHz deviation with a 30 kHz modulating frequency is an fm signal equivalent to a pm signal with +120 degrees of phase modulation. Under this condition, the loop lock light may go out.

(3) Depress the LOOP OPEN switch and observe the slip-lock video output on the oscilloscope. Adjust the TUNE control to vary the slip-lock frequency on both sides of zero beat. It may be desirable to decrease the sweep rate on the oscilloscope to obtain a more convenient oscilloscope presentation. Adjust the TUNE control for a low-frequency slip-lock (nearly zero beat) and release the LOOP OPEN switch. Observe that the LOOP LOCKED indicator comes on.

(4) Remove the terminated video output cable from the oscilloscope. Repeat step (3), using the speaker and the AUDIO GAIN control to provide an audible indication of slip-lock frequency and zero beat between the 10 MHz reference oscillator in the demodulator and the i-f signal at the second i-f frequency.

(5) Reduce the signal generator output level to -80 dBm. Depress the LOOP OPEN switch. Adjust the TUNE control to vary the audible slip-lock beat. Adjust for a (nearly) zero beat and release the LOOP OPEN switch. Observe that the LOOP LOCKED light comes on indicating that the phase locked loop is locked.

5.3.3.2.12 Predetection Down-Converter Tests. This test demonstrates proper switching of the predetection record video carrier frequency for the PD-74-R, and checks the output level of the PD-74-R and the P-74-R.

a. Connect equipment as shown in figure 4-7. Set controls as follows:

POWER: ON.

MODE: FM/PM.

1ST LO MODE: VFO.

2ND LO MODE: XTAL.

AGC TIME CONSTANT: 10.

b. Set the output level of the signal generator to -45 dBm and set the generator frequency to the center frequency of the tuning unit. Tune the receiver to the signal generator frequency using the receiver TUNING control.

c. For the TMR-74B, equipped with the PD-74-R, set the VIDEO CARRIER FREQ to each position, and observe the measured output voltage; for the TMR-74A, equipped with a P-74-R, measure the single frequency output at J11 of the receiver. In each case, the output should be at least 1.4V rms.

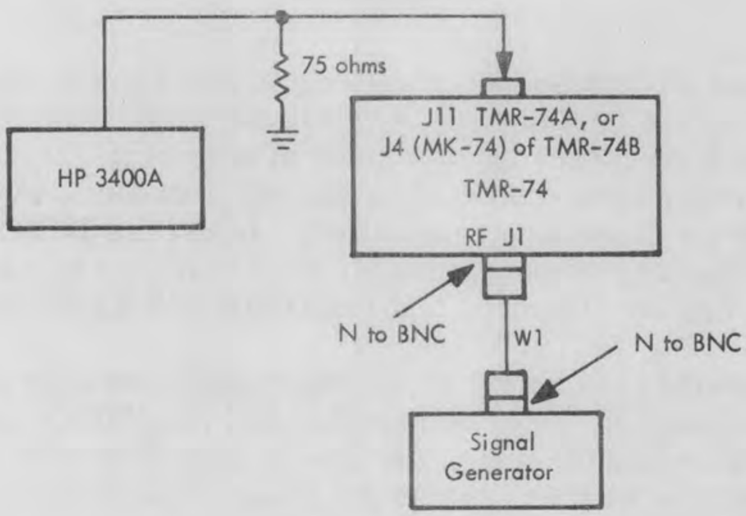


Figure 5-7. Equipment Setup for Predetection Down Converter Tests

5.3.3.2.13 <u>Predetection Up-Converter Tests</u>. This test demonstrates proper operation of the PD-74-P playback module, used with the TMR-74B, and the U-74-P 10-55 MHz up-converter used with both the "A" and "B" versions of the receiver.

a. Connect equipment as shown in figure 5-8. Set controls as follows:

POWER: ON.

MODE: PBK.

2ND LO MODE: XTAL.

AGC TIME CONSTANT: 10.

Demodulator BANDWIDTH: INT.

b. Perform the demodulator balance and tuning meter zero adjustments described in paragraph 5.3.3.1, steps a, b, or c, if not already done.

c. Set the HP 651A generator to 112.5 kHz, and set the output level to 1 volt.

d. Tune the generator for zero TUNING meter indication on the receiver. The frequency on the counter should be approximately 10 MHz.

e. Repeat steps c and d for all frequencies of the predetection playback unit.

f. Switch the 2ND LO MODE switch to VFO. Tune the VFO for zero TUNING meter indication. Note that the counter indicates 10 MHz. Switch to AFC and note that the counter indicates 10 MHz. Vary the frequency of the HP 651A ± about its original setting. Note that the afc action maintains the 10 MHz output.

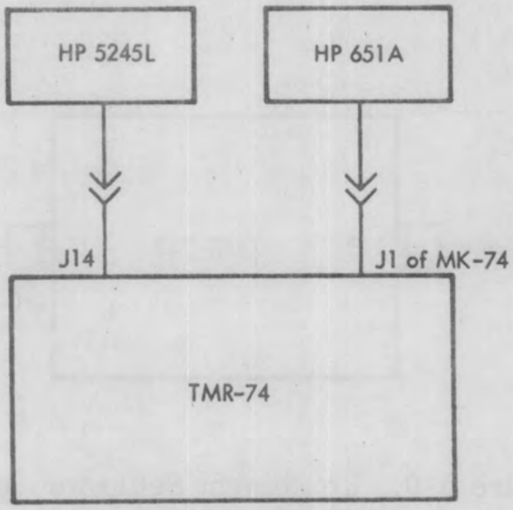


Figure 5-8. Equipment Setup for Predetection Up-Converter Tests

g. For a TMR-74A with the U-74-P installed, connect the HP 651A to J12, set at 10 MHz, and repeat procedure f.

5.3.3.2.14 Display Unit Test. This test demonstrates the operation of the SD-74-A display unit in conjunction with the TMR-74B receiver.

a. Connect equipment as shown in figure 5-9. Set controls as follows:

Receiver:

POWER: ON.

MODE: REC.

1ST LO MODE: VFO.

2ND LO MODE: XTAL.

AGC TIME CONSTANT: 10.

Balance the demodulator and zero the tuning meter as described in paragraph 5.3.3.1, steps a and b, or c, if not already done.

Spectrum Display Unit:

POWER: ON.

MARKER: OFF.

SWEEP WIDTH: midrange.

GAIN: midrange.

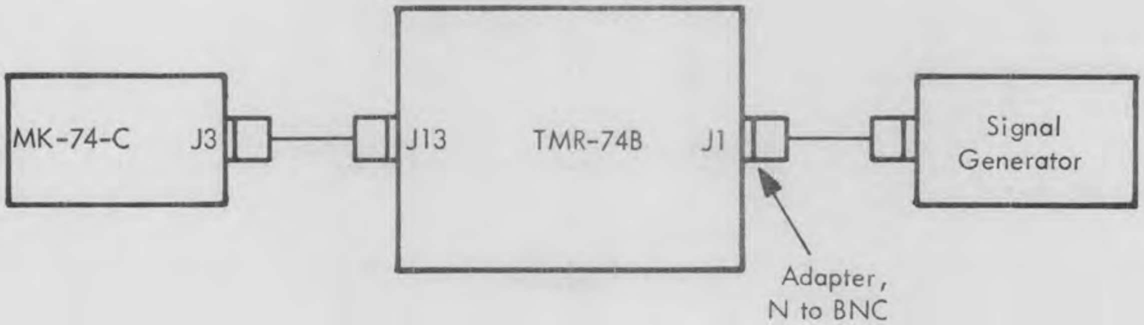


Figure 5-9. Equipment Setup for Spectrum Display Unit Test

b. Set the output level of the signal generator to -70 dBm and set the generator to the center of the band for the rf tuner installed. Tune the receiver to the signal generator frequency using the receiver TUNING control.

c. Set the GAIN control on the display unit to provide an on-scale signal pip on the crt, adjusting the CENTER FREQ control as required to center the displayed signal pip. Adjust the INT and FOCUS controls, if required.

d. Set the MARKER switch on the display unit to ON. Adjust the SWEEP WIDTH, CENTER FREQ, and GAIN controls, as required, to obtain four markers on each side of the center frequency marker, with the center frequency marker properly positioned on the display unit.

e. Reduce sweep width to obtain one marker on each side of the center frequency marker, with the center frequency marker properly positioned on the display unit. Set the MARKER switch to OFF.

f. Set the generator output to 10 μV. Adjust the GAIN control on the display unit to obtain a full-scale deflection of the signal pip on the crt.

g. For a TMR-74A or B with an S-74-A 55-30 MHz down converter installed, locate the appropriate 55 MHz and/or 30 MHz output connectors. Connect the HP 5245L frequency counter to one of these jacks. Increase the output level of the signal generator -10 dBm and observe the frequency of the 55 MHz 1st i-f/sdu output or the 30 MHz down-converted sdu output. Repeat the measurement at the other sdu output if both are provided. (The HP 5261A video amplifier may be required for counting the sdu output.)

SECTION VI
ELECTRICAL PARTS LIST

This section of the manual contains the electrical parts list for the overall receiver and includes a list of the subassemblies and modules. The electrical parts that constitute these subassemblies and modules are listed in the appropriate instruction booklets and manuals which are supplied as a supplement to this manual.

The electrical parts lists for the TMR-74A and the TMR-74B are identical, except for the components that connect the subchassis with the main chassis circuitry. These additional parts are listed on page 6-8.

Reference Designation	Description
A1	Video bandwidth filter assembly, Defense Electronics 203333
A1A1	Video bandwidth filter, 25 kHz, V-74-G25
A1A2	Video bandwidth filter, 12.5 kHz, V-74-G12.5
A1A3	Video bandwidth filter, 50 kHz, V-74-G50
A1A4	Video bandwidth filter, 100 kHz, V-74-G100
A1A5	Video bandwidth filter, 6.25 kHz, V-74-G6.25
A1A6	Spare
A1A7	Video bandwidth filter, 750 kHz, V-74-G750
A1A8	Video bandwidth filter, 500 kHz, V-74-G500
A1A9	Video bandwidth filter, 1000 kHz, V-74-G1000
A1A10	Video bandwidth filter, 1500 kHz, V-74-G1500
A1A11	Video bandwidth filter, 250 kHz, V-74-G250
A1A12	Spare
A1J1	Connector, Elco 02-016-701-3200
A1J2	Connector, Elco 02-016-701-3200
A1P1	Contact set, Elco 02-016-703-5200
A1P2	Contact set, Elco 02-016-703-5200
A1XA1 through A1XA12	Connector, Elco 02-010-701-3200
A2	AGC Amplifier, Defense Electronics 303211
A3	AFC Amplifier, Defense Electronics 303212
A4	Video/Audio Amplifier, Defense Electronics 303213

Reference Designation	Description
A5	IF Distribution Amplifier/AM Detector, Defense Electronics 303210
A6	Second Local Oscillator, Defense Electronics 203505
A7 through A10	Not Assigned
A11	Second IF Amplifier, Defense Electronics 203605
A12	
A12XA1 through A12XA9	Connector, Cinch 252-15-30-241
A13	Second Mixer, Defense Electronics 303208
A14	
A15	Power Supply Regulator, Defense Electronics 203247
C1	Capacitor, electrolytic, 8400 μF, +75-10%, 40V, Sprague 36D842G050BB2A
C2	Capacitor, electrolytic, 8400 μF, +75-10%, 40V, Sprague 36D842G050BB2A
C3	Capacitor, electrolytic, 110 μF ±10%, 10V dc, Sprague 151D117X9010Z2
C4	Capacitor, electrolytic, 100 μF ±20%, 20V, Sprague 150D107X0020S
C5	Capacitor, electrolytic, 100 μF ±20%, 20V, Sprague 150D107X0020S
C6	Capacitor, ceramic, monolythic, 2.2 μF, 25V, Sprague 5C15
C7	Capacitor, ceramic, monolythic, 2.2 μF, 25V, Sprague 5C15
C8	Capacitor, electrolytic, 100 μF ±20%, 20V, Sprague 150D107X0020S
C9	Capacitor, electrolytic, 100 μF ±20%, 20V, Sprague 150D107X0020S
C10	Capacitor, ceramic, disc, 0.01 μF ±20%, 100V, Erie 805-Z5U
C11	Capacitor, mylar, 0.47 μF ±5%, 100V, Elpac ZA474J.
C12 through C14	Capacitor, ceramic, tubular, 33 pF ±5%, 500V, Erie NPO-308-000.

Reference Designation	Description
CR1	Diode, bridge rectifier, Motorola MDA-952-2
CR2	Not assigned
CR3	Diode, 1N914
CR4	Diode, 1N457
DS1	Indicator lamp, green, flat lens, clear, 14V, 17 mA, Dialco 507-3912-0332-600
DS2	Indicator lamp, green, flat lens, clear, 14V, 17 mA, Dialco 507-3912-0332-600
F1	Fuse, SLO-BLO, 0.75A, MDL, Fusetron
J1	Connector, type N, Defense Electronics 105861 (integral part of W1)
J2	Not assigned
J3	Connector, bulkhead, BNC, Dage 2230-7 (integral part of W36)
J4	Connector, bulkhead, BNC, Dage 2230-7 (integral part of W33)
J5	Not assigned
J6 through J14	Connector, bulkhead, BNC, Dage 2230-7 (integral parts of W30, W35, W16, W3, W7, W37, W38, W40, and W20 respectively)
J15	Not assigned
J16	Not assigned
J17	Connector, Cannon DCM-25W3S
J18	Connector, bulkhead, BNC, Dage 2230-7 (integral part of W2)
J19	Connector, bulkhead, BNC, Dage 2230-7 (integral part of W11)
J20	Not assigned
J21	Connector, type N, Defense Electronics B36084 (integral part of W1)
J22	Connector, Cannon DCM-17W5S
J22A1	Coaxial insert, Cannon DM53742-1 (integral part of W4)
J22A2	Coaxial insert, Cannon DM53742-1 (integral part of W5)
J22A3	Not assigned

Reference Designation	Description
J22A4	Coaxial insert, Cannon DM53742-1 (integral part of W3)
J22A5	Coaxial insert, Cannon DM53742-1 (integral part of W2)
J23	Connector, Cannon DDM-36W4S
J23A1	Coaxial insert, Cannon DM53742-1 (integral part of W17)
J23A2	Not assigned
J23A3	Not assigned
J23A4	Coaxial insert, Cannon DM53742-1 (integral part of W20)
J24	Connector, Amphenol 126-221
K1	Relay, dpdt, Defense Electronics 105910
L1	Inductor, fixed, 8.2 μH ±10%, Nytronics WEE-8.2
L2	Inductor, fixed, 8.2 μH ±10%, Nytronics WEE-8.2
LS1	Loudspeaker, Oaktron S-8560
M1	Meter, output, Defense Electronics 203173
M2	Meter, deviation, Defense Electronics 203172
M3	Meter, signal level, Defense Electronics 106199
M4	Meter, tuning, Defense Electronics 203171
Q1	Transistor, npn, 2N4913
Q2	Transistor, pnp, 2N4904
R1	Resistor, variable, 250k ±10%, 1/2W, type W, Allen Bradley WA2L040S254UC
R2	Resistor, variable, 1k ±10%, 1/2W, type W, Allen Bradley WA2L040S102UC
R3 through R5	Resistor, variable, 25k ±10%, 1/2W, type W, Allen Bradley WA2L040S253UC

Reference Designation	Description
R6	Resistor, variable, 50k ±10%, 1/2W, type W, Allen Bradley WA2L040S503UA
R7	Resistor, variable, 2.5k ±10%, 1/2W, type G, Allen Bradley GA2G056S252UA
R8	Resistor, variable, 1k ±10%, 1/2W, Allen Bradley GA2G045S102UA
R9	Resistor, variable, 5k ±10%, 1/2W, type W, Allen Bradley WA2L040S502UC
R10	Resistor, variable, 5k ±10%, 1/2W, type W, Allen Bradley WA2L040S502UC
R11	Resistor, fixed composition, 3.9k ±5%, 1/4W, Allen Bradley CB3925
R12	Resistor, fixed composition, 510k ±5%, 1/4W, Allen Bradley CB5145
R13	Resistor, fixed composition, 7.5k ±5%, 1/4W, Allen Bradley CB7525
R14	Resistor, fixed composition, 510Ω ±5%, 1/4W, Allen Bradley CB5115
R15	Resistor, fixed film, 1.40k ±1%, 1/8W, RN55D1401F
R16	Resistor, fixed composition, 6.2k ±5%, 1/4W, Allen Bradley CB6225
R17	Resistor, fixed composition, 240Ω ±5%, 1/4W, Allen Bradley CB2415
R18	Resistor, fixed composition, 12k ±5%, 1/4W, Allen Bradley CB1235
R19	Resistor, fixed composition, 12k ±5%, 1/4W, Allen Bradley CB1235
R20	Resistor, fixed film, 453Ω ±1%, 1/4W, RN60B4530F
R21	Resistor, fixed composition, 5.1k ±5%, 1/4W, Allen Bradley CB5125
R22	Resistor, fixed composition, 10Ω ±5%, 1/4W, Allen Bradley CB1005
R23	Resistor, fixed composition, 10Ω ±5%, 1/4W, Allen Bradley CB1005
S1	Switch assembly, pushbutton, video bandwidth, Defense Electronics 303361
S2	Switch assembly, pushbutton, i-f filter bandwidth, Defense Electronics 203599
S3	Switch assembly, pushbutton, agc time constant, Defense Electronics 203600
S4	Switch assembly, pushbutton, receiver mode, Defense Electronics 203601
S5	Switch assembly, pushbutton, second 1-o mode, Defense Electronics 203602

Reference Designation	Description
S6	Switch assembly, pushbutton, afc time constant, Defense Electronics 203603
S7	Switch, dpst, Defense Electronics 203241
S8	Switch, dpdt, Alco MST205N
T1	Transformer, power, 115/230V ac, 50-400~, Defense Electronics 303129
W1 through W40	Cable assembly, Defense Electronics 303382
XA1	Not assigned
XA2	Connector, Cinch 251-18-30-221
XA3	Connector, Cinch 251-18-30-221
XA4	Connector, Cinch 250-15-30-201
XA5	Connector, Cannon DCMF-17W5S
XA5A1	Coaxial insert, Cannon DM53743-3 (integral part of W16)
XA5A2	Coaxial insert, Cannon DM53743-3 (integral part of W17)
XA5A3	Coaxial insert, Cannon DM53743-3 (integral part of W18)
XA5A4	Coaxial insert, Cannon DM53743-3 (integral part of W19)
XA5A5	Coaxial insert, Cannon DM53743-3 (integral part of W15)
XA6	Connector, Cannon DBMF-17W2S
XA6A1	Coaxial insert, Cannon DM53743-3 (integral part of W7)
XA6A2	Coaxial insert, Cannon DM53743-3 (integral part of W8)
XA7	Connector, Cannon DBMF-13W3S
XA7A1	Coaxial insert, Cannon DM53743-3 (integral part of W38)
XA7A2	Not assigned
XA7A3	Coaxial insert, Cannon DM53743-3 (integral part of W38)
XA8	Connector, Cannon DBMF-13W3S
XA8A1	Coaxial insert, Cannon DM53743-3 (integral part of W12)

Reference Designation	Description
XA8A2	Not assigned
XA8A3	Coaxial insert, Cannon DM53743-3 (integral part of W39)
XA9	Connector, Cannon DBMF-13W3S
XA9A1	Coaxial insert, Cannon DM53743-3 (integral part of W7)
XA9A2	Not assigned
XA9A3	Coaxial insert, Cannon DM53743-3 (integral part of W18)
XA10	Connector, Cannon DBMF-13W3S
XA10A1	Coaxial insert, Cannon DM53743-3 (integral part of W5)
XA10A2	Not assigned
XA10A3	Coaxial insert, Cannon DM53743-3 (integral part of W40)
XA11	Connector, Cannon DBMF-13W3S
XA11A1	Coaxial insert, Cannon DM53743-3 (integral part of W14)
XA11A2	Not assigned
XA11A3	Coaxial insert, Cannon DM53743-3 (integral part of W15)
XA12	Not assinged
XA13	Connector, Cannon DCMF-17W5S
XA13A1	Coaxial insert, Cannon DM53743-3 (integral part of W11)
XA13A2	Coaxial insert, Cannon DM53743-3 (integral part of W12)
XA13A3	Coaxial insert, Cannon DM53743-3 (integral part of W6)
XA13A4	Coaxial insert, Cannon DM53743-3 (integral part of W13)
XA13A5	Coaxial insert, Cannon DM53743-3 (integral part of W8)
XA14	Connector, Cannon DCMF-17W5S
XA14A1	Coaxial insert, Cannon DM53743-3 (integral part of W4)
XA14A2	Not assigned
XA14A3	Not assigned
XA14A4	Not assigned
XA14A5	Coaxial insert, Cannon DM53743-3 (integral part of W6)
XA15	Connector, Cinch 250-12-30-201
XDS1	Indicator lamp socket, Dialco 250-8738-14-504 (w/o collar)
XDS2	Indicator lamp socket, Dialco 250-8738-14-504 (w/o collar)

Reference Designation	Description
Z1	Line filter assembly, Defense Electronics 203268

The following electrical parts, located in the MK-74-C subchassis, are added to the preceding parts list to form a complete parts list for the TMR-74B:

Reference Designation	Description
J1 through J5	Connector, bulkhead, BNC, Dage 2230-7, (integral parts of W1, W2, W3, W4, and W5 respectively)
J6	Connector, Cannon DCM-17W5S
J6A1	Coaxial insert, Cannon DM53742-1 (integral part of W4)
J6A2	Coaxial insert, Cannon DM53742-1 (integral part of W1)
J6A3	Not assigned
J6A4	Coaxial insert, Cannon DM53742-1 (integral part of W2)
J6A5	Coaxial insert, Cannon DM53742-1 (integral part of W5)
J7	Connector, Cannon DCM-17W5S
J7A1	Not assigned
J7A2	Coaxial insert, Cannon DM53742-1 (integral part of W3)
J7A3 through J7A5	Not assigned
P1	Connector, 9 pin, min. hex, Amphenol 126-220
W1	Cable assembly, Defense Electronics 105906-01
W2	Cable assembly, Defense Electronics 105906-02
W3	Cable assembly, Defense Electronics 105906-03
W4	Cable assembly, Defense Electronics 105906-04
W5	Cable assembly, Defense Electronics 105906-05

SECTION VII
SCHEMATIC DIAGRAMS

This section of the manual contains the schematic diagrams for the Model TMR-74 Telemetry Receiver. The circuits shown in figure 7-1 are common to both the TMR-74A and the TMR-74B; the circuits that are unique to the TMR-74B are shown in figure 7-2.

Schematic diagrams for the subassemblies and modules used with the receiver are included in the instruction manuals and booklets which are supplied as supplements to this manual, as appropriate.

Unless otherwise indicated, the following notes apply to the schematic diagrams included in this section:

a. Resistor values are in ohms.

b. Capacitor values are in microfarads.

c.  indicates clockwise rotation.

d. ⊘ indicates screwdriver adjustable control.

e. ⊙ indicates operating control.

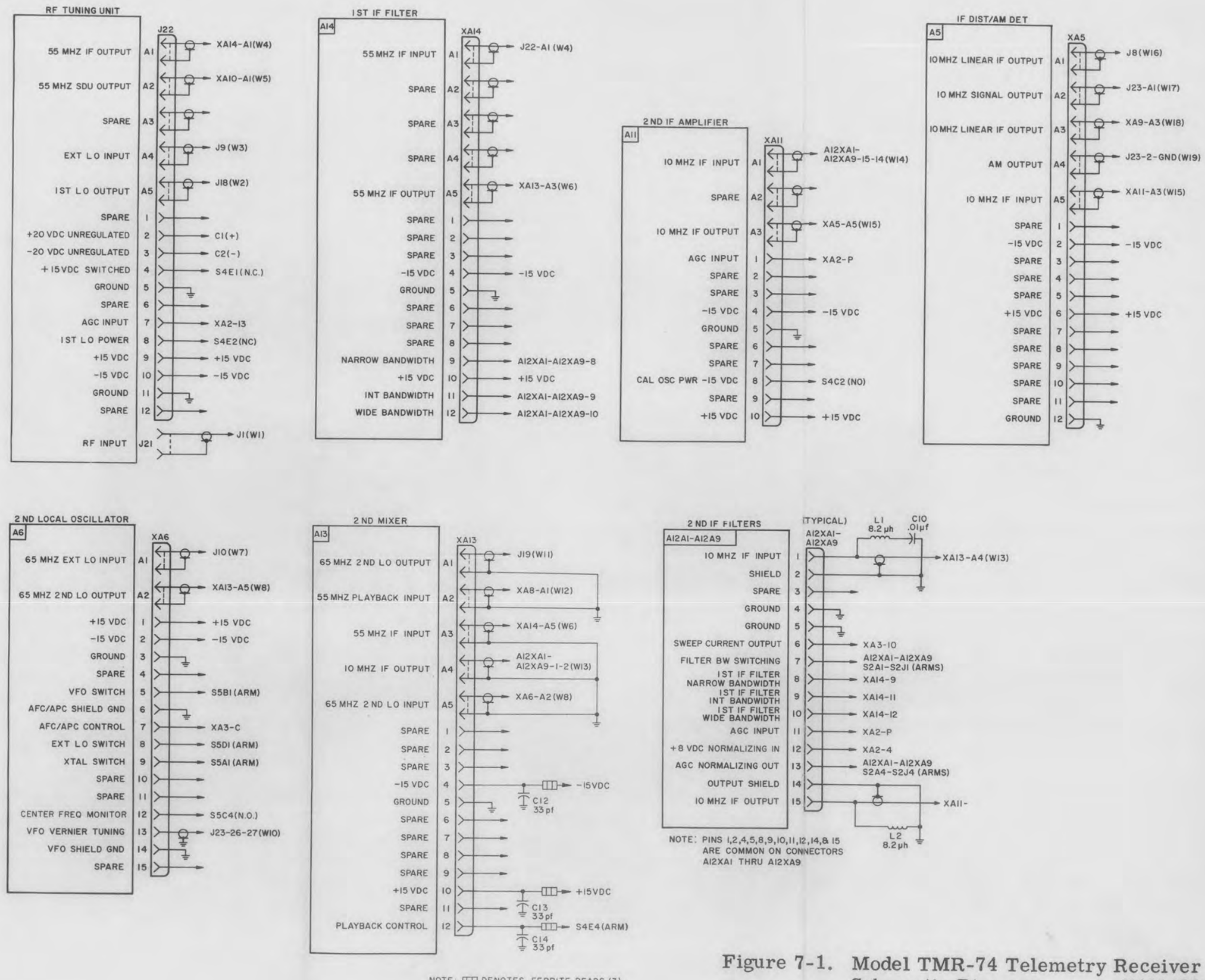


Figure 7-1. Model TMR-74 Telemetry Receiver Schematic Diagram E401632 (Sheet 1 of 5)

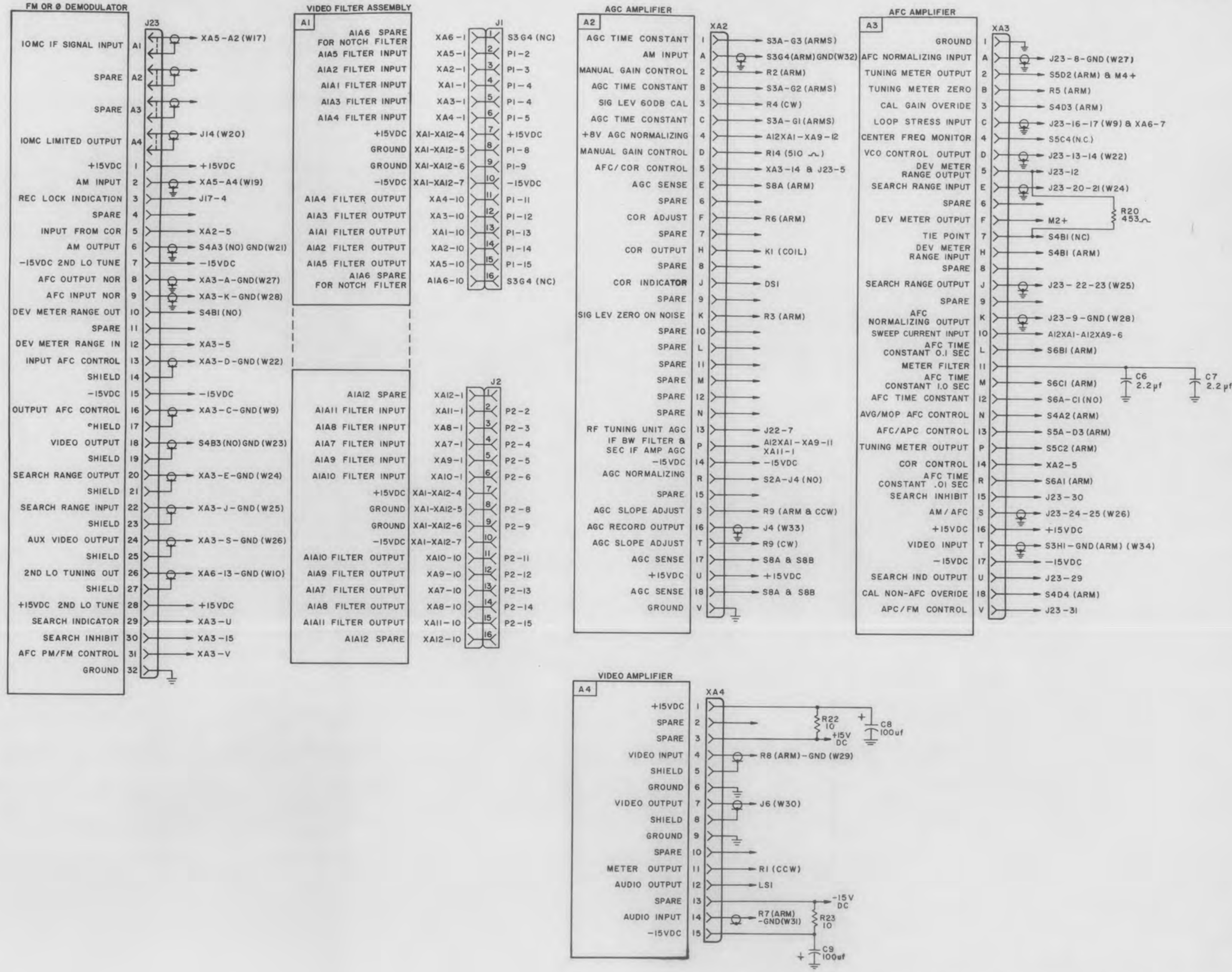


Figure 7-1. Model TMR-74 Telemetry Receiver Schematic Diagram E401632 (Sheet 2 of 5)

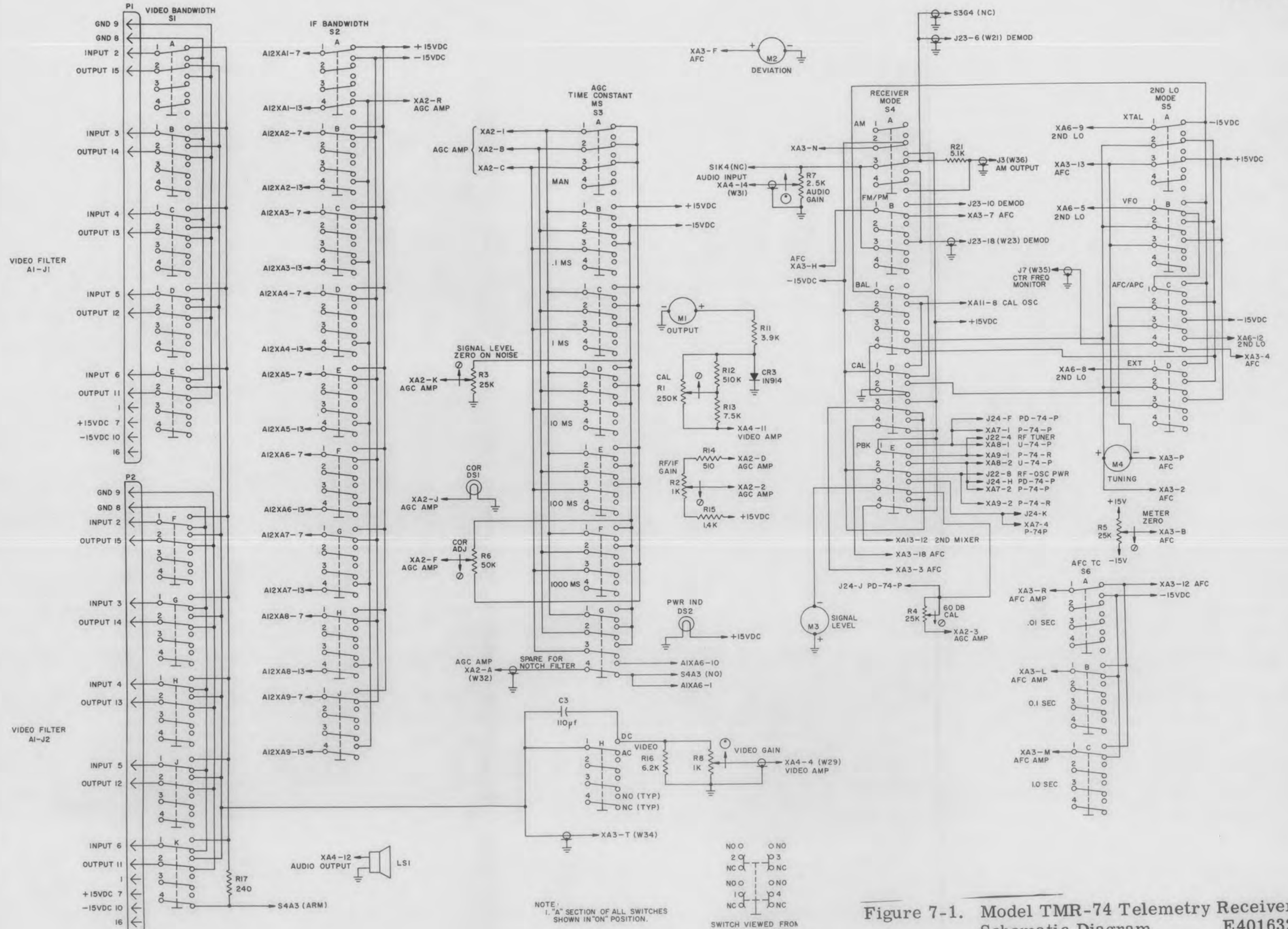


Figure 7-1. Model TMR-74 Telemetry Receiver Schematic Diagram (Sheet 3 of 5) E401632

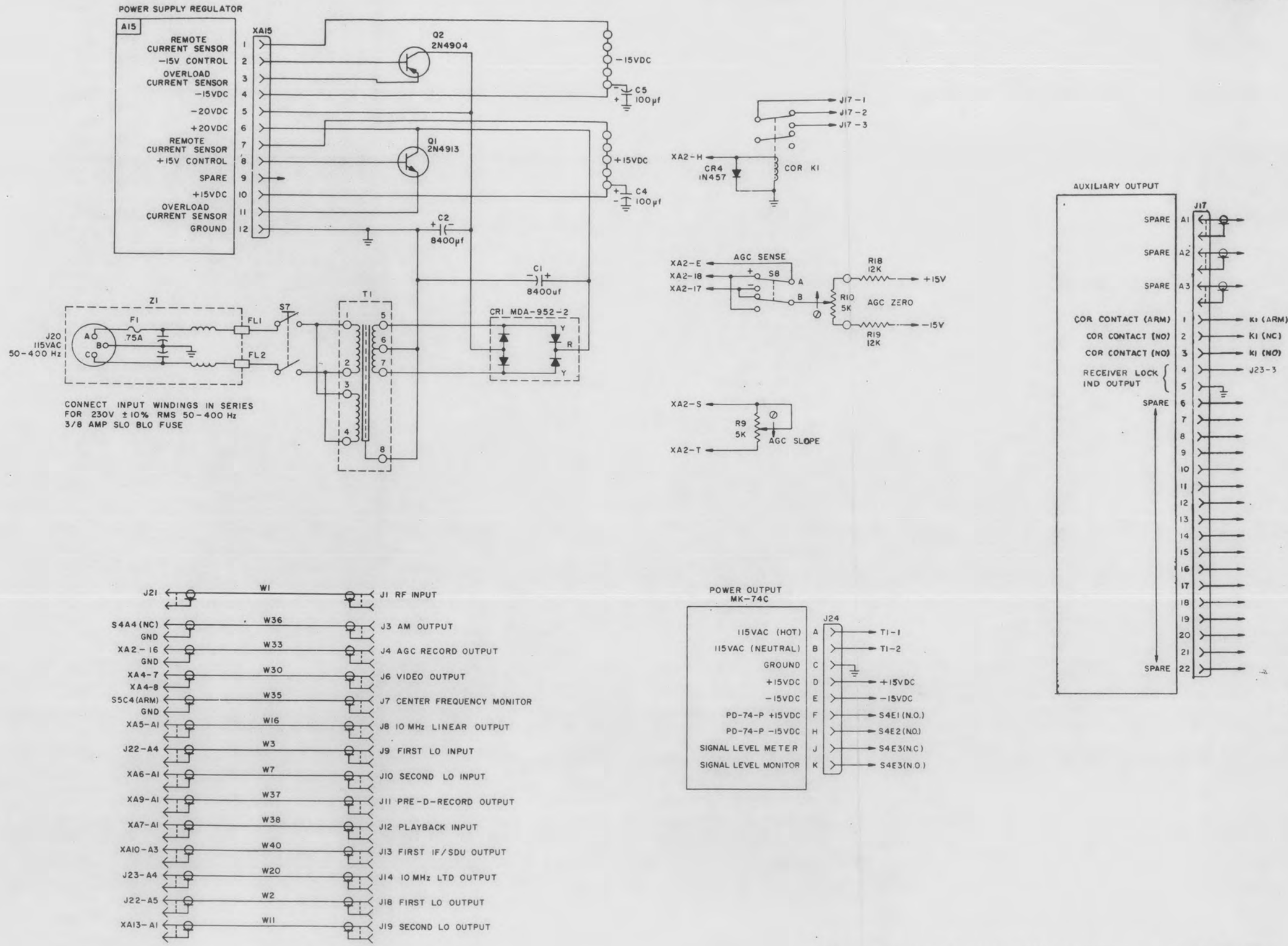


Figure 7-1. Model TMR-74 Telemetry Receiver Schematic Diagram E401632 (Sheet 4 of 5)

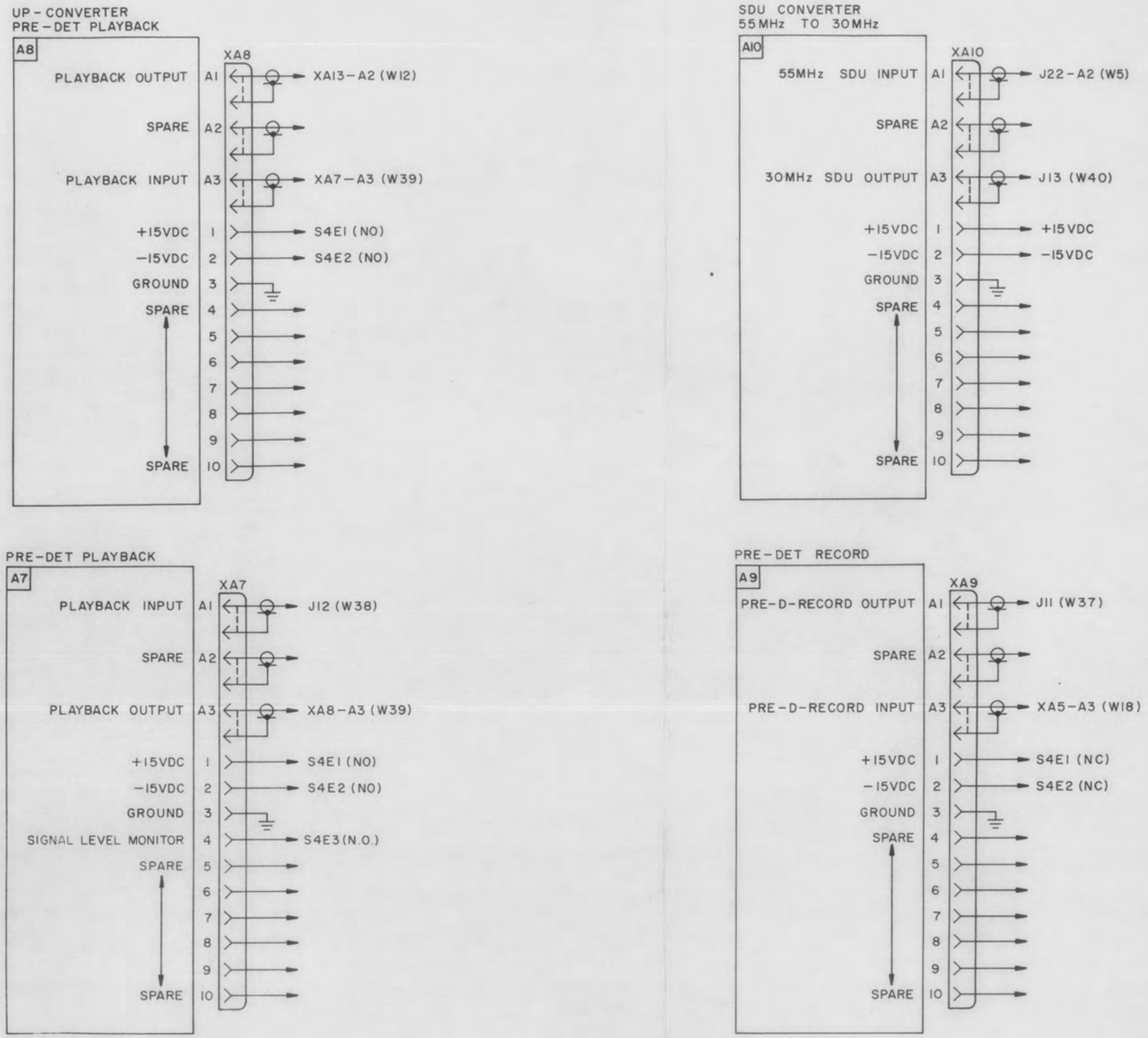


Figure 7-1. Model TMR-74 Telemetry Receiver Schematic Diagram E401632 (Sheet 5 of 5)

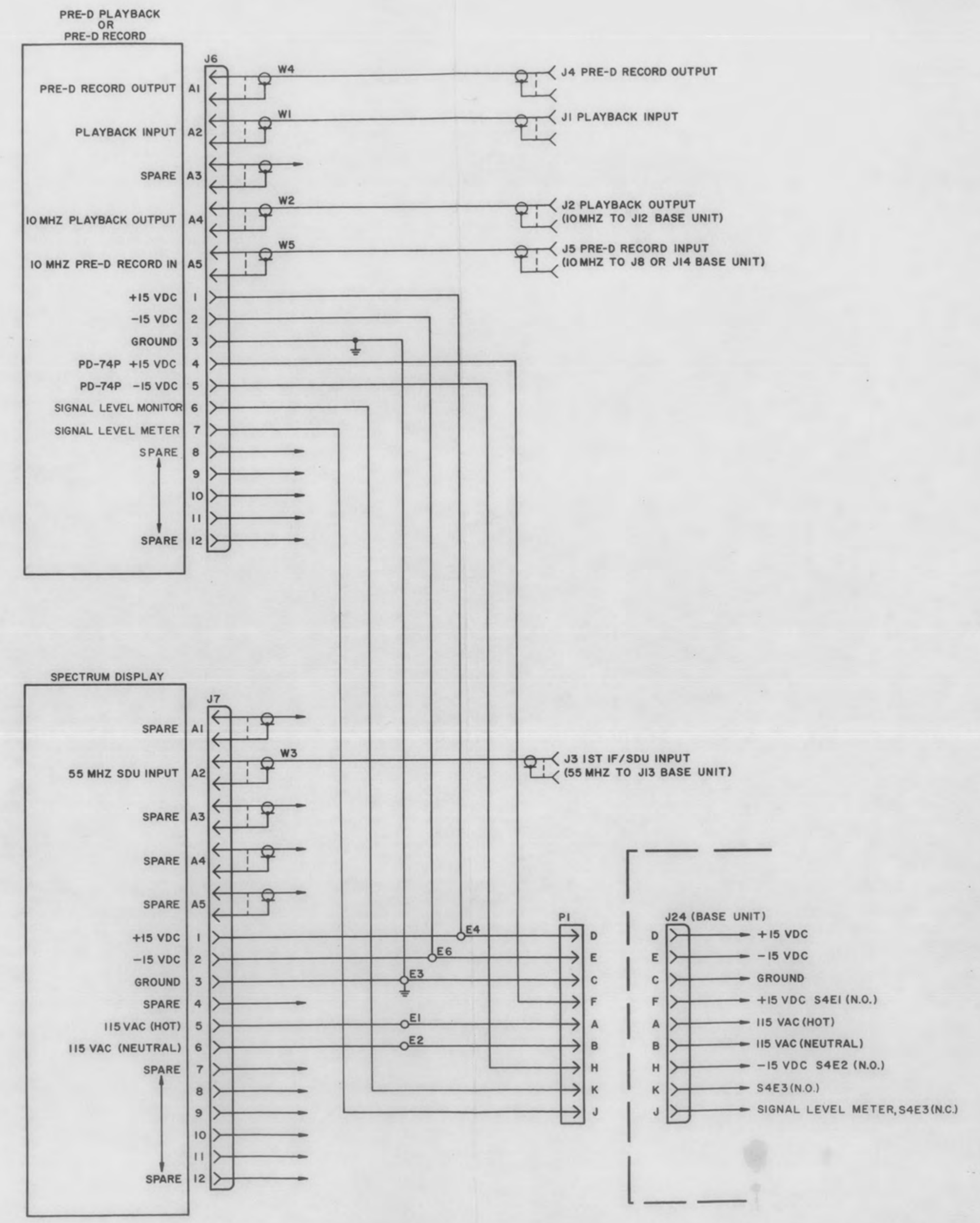


Figure 7-2. TMR-74B Subchassis and Connectors Schematic Diagram E401634 (MK-74)

Revised: August 1970
January 1970

POWER SUPPLY REGULATOR
203247

The power supply regulator is a plug-in subassembly designed for use in Defense Electronics receivers/combiners. Its purpose is to control the series regulators in the base unit and thus provide essentially a constant-voltage output under varying load conditions.

The power supply regulator circuitry is contained on a single plug-in printed circuit board, equipped with a handle and an edgeboard connector, which may be removed from or installed in the base unit in a few seconds after the top cover has been removed.

The subassembly interfaces with the series regulators of the base unit and accepts inputs of plus and minus 20 volts and plus and minus sense, and provides as its outputs plus and minus 15 volts, regulated.

INSTALLATION

No special procedures are necessary to install or remove the regulator. The proper location for the subassembly will be found in the subassembly/module location drawing given in Section V, Maintenance, of the applicable base unit instruction manual. All electrical connections between the main chassis and the subassembly are made automatically upon installation; there are no additional wires or cables to connect or disconnect.

PRINCIPLES OF OPERATION

Since the operation of the plus and minus voltage regulator circuits is similar, only the plus 15 volt regulator is discussed in detail. The error sensing input is applied through pin 7 of the edgeboard connector to a differential amplifier consisting of Q5 and Q6. R9 provides a means of balancing the amplifier and thus adjusting the regulator to supply the required output voltage. CR2 provides a reference voltage at the base of Q5.

The output of the differential amplifier is applied to the base of Q3. The output of Q3 is applied to the base of the series regulator in the receiver, providing the voltage regulation function. Q2 functions as a current source for Q3. Q1, operating as a diode, possesses opposite temperature drift characteristics to Q3, thus increasing regulator stability. CR1 maintains a constant voltage across R3, Q1, and R1, further enhancing overall regulator stability.

Current overload protection is provided by R5 and Q4. Should the current through R5 become excessive, the voltage drop across this resistor causes Q4 to conduct. The effect of this is to bias Q3 in such a way as to limit current flow through the series regulator in the base unit.

Operation of the minus 15 volt regulator is identical, except that to obtain the required reference voltage the base of Q11 (part of differential amplifier Q11-Q12) is returned to ground, and the emitters of Q11 and Q12 are connected to the plus 15 volt sensing input at pin 7.

MAINTENANCE

The design of the power supply regulator limits the need for maintenance. During normal operation, no periodic adjustment is necessary or desirable. Unnecessary adjustments may degrade the performance of the regulator, and therefore should be avoided.

Straightforward troubleshooting methods should be used if a malfunction occurs. The schematic diagram and circuit description given herein should provide the data necessary for qualified maintenance technicians to isolate the malfunction, using effect-to-cause reasoning.

The first check should be of the power supply voltages. The next most likely causes of trouble are the transistors and the diodes. A Simpson 260 multimeter, set up for continuity measurements, is recommended for checking the transistors. The following procedure may be used:

a. Place the test probes between emitter and base; then reverse the position of the probes. One of these positions should indicate forward bias on the meter.

b. Continue checking between base-collector, base-emitter, and emitter-collector.

c. If the meter does not deflect, the junction is probably open.

d. If both positions cause the meter to indicate the same resistance, the junction is probably shorted.

e. If indication is ambiguous, compare the component with the same component in a spare unit, keeping the multimeter set to the same resistance range.

ADDENDUM

The calibration procedures included in the instruction booklet require the use of a test fixture. In most cases, test fixtures are not available in the field. Thus, the following procedures are provided which permit calibration using an extender card, which is part of the accessory test kit for the parent unit.

Equipment Required:

Extender Card	303279
DC VTVM	HP 412A

a. Remove the power supply regulator from the TMR-74 and install the extender card in its place. Install the regulator on the extender card.

b. Apply power to the parent unit.

c. Connect the VTVM between the +15V output (pin 7 of the edge board connector) and ground (12). These points are accessible on the extender card.

d. Adjust R9 on the regulator for exactly a +15V indication on the VTVM.

e. Disconnect the VTVM from the +15V output and reconnect it to the -15V output (Pin 1). Adjust R19 on the regulator board for exactly a -15V indication on the VTVM.

Table 1. Transistor Complement

Reference Designation	Type	Function
Q1	2N4249	Compensation Diode
Q2	2N4249	Current Source
Q3	2N2219	Control Amplifier
Q4	2N3565	Overload Sensor
Q5	2N3565	Differential Amplifier
Q6	2N3565	
Q7	2N3565	Compensation Diode
Q8	2N3565	Current Source
Q9	2N2904	Control Amplifier
Q10	2N4249	Overload Sensor
Q11	2N4249	Differential Amplifier
Q12	2N4249	

Repair and Replacement

All components used in the power supply regulator are considered non-repairable, and should be replaced when found to be defective. A complete electrical parts list is given in this booklet, and a component location drawing is provided.

Care should be exercised when replacing components on the printed circuit board. The following is a suggested procedure for removing components from the board; the procedure requires the following equipment:

Liquid soldering flux	1/8 inch, #18 AWG, flat braid
Flux remover	Medium wattage solder iron

Apply a thin coat of liquid flux to the flat braid. Place and hold the braid over the solder joint. Apply heat to the braid directly over the solder joint; the braid will absorb most of the solder.

CAUTION

Do not heat the joint for long periods of time as excessive heat may damage the circuit board.

After the major portion of the solder has been absorbed by the braid, apply heat directly to the solder joint and carefully pry loose the defective component. Clean the affected area using the flux remover. Trim the replacement component leads to the same length as the original component leads. Position the replacement component on the circuit board and solder it in place. Clean the affected area with flux remover.

If a component is replaced, recalibration may be necessary; in this case, the following procedure is recommended:

Calibration

Recommended Equipment:

DC VTVM	HP 412A
Auto Transformer, with voltmeter	General Radio Variac W5MT3A
Test Set	Defense Electronics 105952

a. Connect the test set to the output of the Variac. Connect the Variac to the ac line and set it for a 120V output. With the test set Power switch Off, insert the power supply regulator.

NOTE

The mechanical and electrical zero of the vtvm should be checked, and if necessary corrected, before adjusting the power supply regulator output voltages.

b. Turn On the test set Power switch. Measuring with the vtvm at the test set +15V output, adjust R9 of the regulator for exactly +15 volts. Measuring at the -15V output, adjust R18 for exactly -15 volts.

This completes calibration of the power supply regulator subassembly.

ELECTRICAL PARTS LIST (See Figure 1)

Reference Designation	Description
C1	Capacitor, dipped, mica, 100 pF, 500V, Elmenco DM15F101J
C2	Capacitor, tantalum, 100 uF 20V, CS13BE107M
C3	Capacitor, dipped, mica, 100 pF, 500V, Elmenco DM15F101J
CR1	Diode, 1N751A
CR2	Diode, 1N937
CR3	Diode, 1N751A
Q1	Transistor, 2N4249
Q2	Transistor, 2N4249
Q3	Transistor, 2N2219
Q4 through Q8	Transistor, 2N3565
Q9	Transistor, 2N2904
Q10 through Q12	Transistor, 2N4249
R1	Resistor, fixed, film, 3.74k ±1%, 1/8W, RN55D3741F
R2	Resistor, composition, fixed, 1.5k ±5%, 1/4W, RC07GF152J
R3	Resistor, fixed, film, 499Ω ±1%, 1/8W, RN55D4990F
R4	Resistor, fixed, film, 499Ω ±1%, 1/8W, RN55D4990F
R5	Resistor, fixed, wirewound, 0.33Ω ±10%, 2W, IRC Type BWH
R6	Resistor, fixed, film, 787Ω ±1%, 1/8W, RN55D7870F
R7	Resistor, fixed, film, 5.49k ±1%, 1/8W, RN55D5491F
R8	Resistor, fixed, film, 1.47k ±1%, 1/8W, RN55D1471F
R9	Resistor, variable, 1k, Beckman Helitrim 62PR1K
R10	Resistor, fixed, film, 2.49k ±1%, 1/8W, RN55D2491F
R11	Resistor, fixed, film, 3.74k ±1%, 1/8W, RN55D3741F

Reference Designation	Description
R12	Resistor, composition, fixed, 1.5k ±5%, 1/4W, RC07GF152J
R13	Resistor, fixed, film, 499Ω ±1%, 1/8W, RN55D4990F
R14	Resistor, fixed, film, 499Ω ±1%, 1/8W, RN55D4990F
R15	Resistor, fixed, wirewound, 0.33Ω ±10%, 2W, IRC Type BWH
R16	Resistor, fixed, film, 9.53k ±1%, 1/8W, RN55D9531F
R17	Resistor, fixed, film, 4.53k ±1%, 1/8W, RN55D4531F
R18	Resistor, variable, 1k, Beckman Helitrim 62PR1K
R19	Resistor, fixed, film, 4.53k ±1%, 1/8W, RN55D4531F
R20	Resistor, composition, fixed, 1.2k ±5%, 1/4W, RC07GF122J

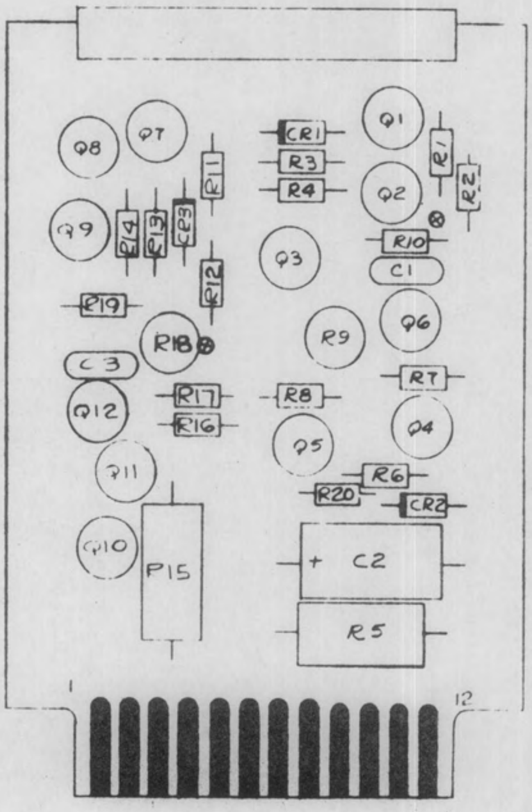
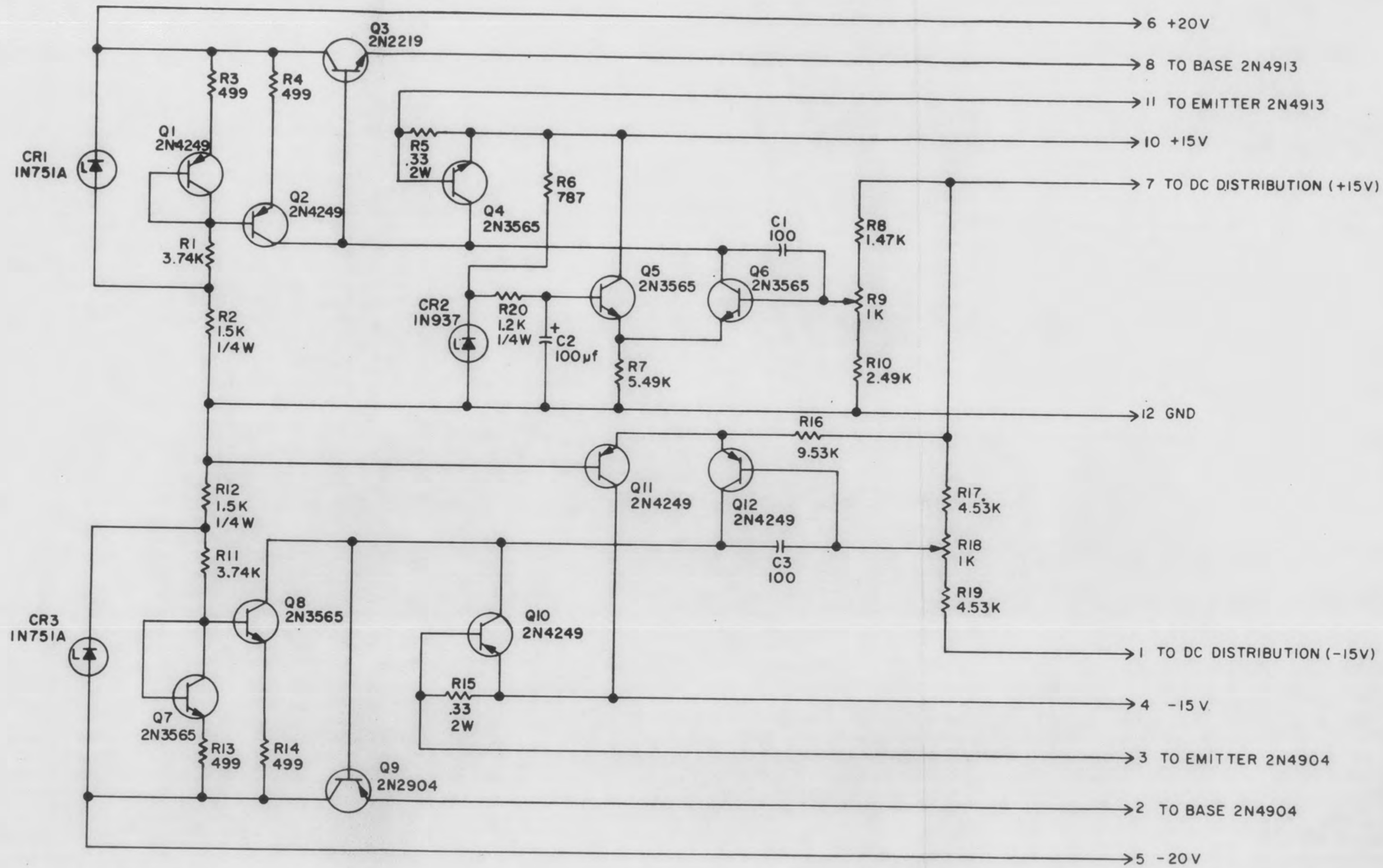


Figure 1. Component Locations
203247



NOTES:

Unless Otherwise Specified:

Resistor values are in ohms;
k=1,000; M=1,000,000.

Capacitor values are in picofarads.

Inductor values are in microhenrys.

* = Selectable value.

Indicates clockwise rotation.

Figure 2. Power Supply Regulator Schematic Diagram 303318

SECOND LOCAL OSCILLATOR
203505

INSTRUCTION BOOKLET

The second local oscillator is a plug-in subassembly designed for use in Defense Electronics telemetry receivers. Its purpose is to supply a 65 MHz 2nd l-o signal to the second mixer in the receiver. The 65 MHz signal may be crystal-controlled, or voltage-controlled by the afc or apc circuits of the receiver.

The second local oscillator is constructed as an enclosed, modular subassembly which may be installed in or removed from the receiver in a matter of seconds after the top cover has been removed. All circuitry is contained on a single printed circuit board, contained within the subassembly, and is interconnected with the receiver through a miniature connector at the bottom of the subassembly.

INSTALLATION

No special procedures are necessary to install or remove the second local oscillator. The proper location for the subassembly will be found in the subassembly/module location drawing in Section V, Maintenance, of the applicable receiver instruction manual.

The physical proximity of the second local oscillator to other subassemblies of the receiver may necessitate the use of a flat-bladed screwdriver or similar instrument to lift the subassembly from the main chassis thus allowing removal. The subassembly is equipped with a flange, at the top, for this purpose.

All electrical connections between the main chassis and the subassembly are made automatically upon installation; there are no additional wires or cables to connect or disconnect.

PRINCIPLES OF OPERATION

The second local oscillator subassembly comprises two independent oscillator circuits, having a common output amplifier. The oscillators are Q1-Q2, the voltage-controlled oscillator (vco) which functions when the afc, apc or vfo mode of operation has been selected, and Q3, the crystal-controlled oscillator which functions when the crystal (XTAL) mode has been selected. The common output amplifier is Q6. Amplifier Q7 allows an external l-o input to be applied to the subassembly, through the receiver main chassis circuitry; the output of Q7 is applied to output amplifier Q6, as are the outputs of the crystal and voltage-controlled oscillators.

The modified Colpitts crystal oscillator, Q3, supplies the crystal controlled 65 MHz signal, with series resonant quartz crystal Y1 as the frequency determining element. Q3 is turned on with the application of -15V at P1-9 when the receiver front panel 2ND LO MODE switch is in the XTAL position. The output of Q3 is applied through buffer amplifier Q5 to output amplifier Q6. The tuned circuit, L2-C29-C30 is common to the output of Q5, to the output of the vco buffer amplifier, Q4, and to the output of Q7.

When the receiver front-panel second l-o mode switch is in the VFO, or AFC/APC position, -15V is applied to the voltage-controlled oscillator, Q1-Q2 through P1-5. The vco is connected in a modified Colpitts configuration; varicaps CR1 and CR2 provide a means of tuning the oscillator through its range.

The vernier tuning control voltage is applied through P1-13 to CR1; R1 and C1 form a hum filter and potentiometer R2 is used for sensitivity adjustment. The afc/apc control voltage (±7.5V for ±250 kHz) is applied through P1-7 to CR2; potentiometers R3 and R20 are used for sensitivity adjustment. Variable capacitor C6 is used to adjust the vco to a center frequency of 65 MHz.

The output of the vco is applied through buffer amplifier Q4 to the output amplifier, Q6. The output of Q6 is applied to P1-A2, as the second l-o output, to the second mixer in the receiver.

In the event that an externally-obtained second l-o signal is to be employed, such as that supplied by a companion receiver, the signal is applied to the subassembly through P1-A1, and to the base of Q7. Q7 is turned on by application of -15V through P1-8 when the receiver 2ND LO MODE switch is placed in the EXT (external) position. The output of Q7 is applied to the tuned circuit consisting of L2, C29, and C30, and thus to the base of output amplifier Q6.

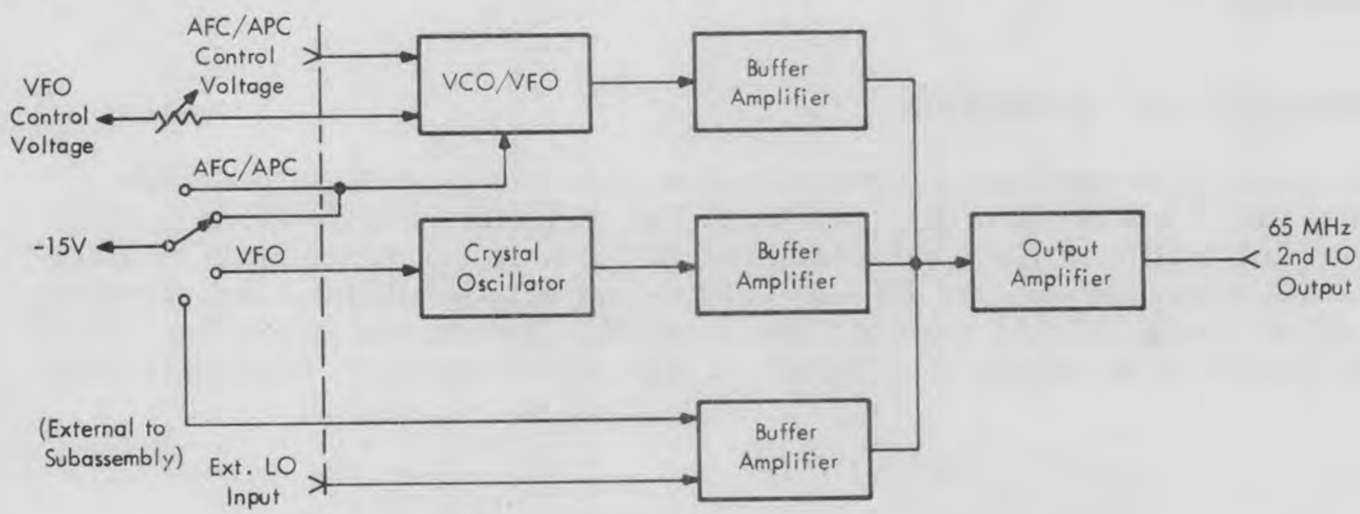


Figure 1. Functional Block Diagram

MAINTENANCE

The design of the second local oscillator subassembly limits the need for maintenance. During normal operation, no periodic adjustment is necessary or desirable. Unnecessary adjustments may degrade the performance of the receiver, and therefore should be avoided.

The subassembly is assembled and disassembled in a straightforward manner and should pose no problem to servicing personnel.

The circuitry is located on a printed circuit board mounted on spacers in a metal chassis. Six machine screws hold the pc board in place. The cover of the chassis, held in place with six machine screws, extends beyond the chassis on both sides, to facilitate plugging the subassembly into the Birtcher clips on the main chassis. A flange is also provided at the top of the subassembly to assist in removal from the receiver chassis.

Straightforward troubleshooting methods should be used if a malfunction occurs. The schematic diagram and circuit description given herein should provide the data necessary for qualified maintenance technicians to isolate the malfunction, using effect-to-cause reasoning.

The first check should be of the power supply voltages. Incorrect power supply voltages can have varying effects on the operation of the subassembly. The next most likely causes of trouble are the transistors and the diodes. A Simpson 260 multimeter, set up for continuity measurements, is recommended for checking the transistors. The following procedure may be used:

a. Place the test probes between emitter and base; then reverse the position of the probes. One of these positions should indicate forward bias on the meter.

b. Continue checking between base-collector, base-emitter, and emitter-collector.

c. If the meter does not deflect, the junction is probably open.

d. If both positions cause the meter to indicate the same resistance, the junction is probably shorted.

e. If indication is ambiguous, compare the component with the same component in a spare unit, keeping the multimeter set to the same resistance range.

Table 1. Transistor Complement

Reference Designation	Type	Function
Q1	2N3478	Voltage Controlled Oscillator (VCO)
Q2	2N3478	
Q3	2N3478	Crystal Oscillator
Q4	2N3478	Buffer Amplifier
Q5	2N3478	Buffer Amplifier
Q6	2N3227	Output Amplifier
Q7	2N3478	Buffer Amplifier

Repair and Replacement

All components used in the second local oscillator are considered non-repairable, and should be replaced when found to be defective. A complete electrical parts list is given in this booklet, and a component location drawing is provided.

Care should be exercised when replacing components on the printed circuit board. The following is a suggested procedure for removing components from the board; the procedure requires the following equipment:

Liquid soldering flux	1/8 inch, #18 AWG, flat braid
Flux remover	Medium wattage solder iron

Apply a thin coat of liquid flux to the flat braid. Place and hold the braid over the solder joint. Apply heat to the braid directly over the solder joint; the braid will absorb most of the solder.

CAUTION

Do not heat the joint for long periods of time as excessive heat may damage the circuit board.

After the major portion of the solder has been absorbed by the braid, apply heat directly to the solder joint and carefully pry loose the defective component. Clean the affected area using the flux remover. Trim the replacement component leads to the same length as the original component leads. Position the replacement component on the circuit board and solder it in place. Clean the affected area with flux remover.

Following replacement of any circuit component, realignment may be necessary; in this case the following procedure is recommended.

Alignment

Recommended Equipment:

Power Supplies (2 required)	Power Designs 4005
Frequency Counter	HP 5245L
Frequency Converter	HP 5253B
Digital Voltmeter	Dymec 2401A
RF Millivoltmeter with tee and 50 ohm termination	HP 411A
Test Set, with Test Cover	Defense Electronics 105953

Initial Setup:

Calibrate the digital voltmeter. Before installing the subassembly in the test set, set the power supply voltages to +15V and -15V, ±0.05V, and the power supply current limiting to 100 mA. Install the test cover on the subassembly and tighten it down securely. The capacity between the cover and the component board is very critical; therefore, the cover must fit tightly, making contact with the module on all sides. Set R2, R3, R20, and R30 to midrange and install the subassembly on the test set.

Procedure:

a. Crystal Oscillator Alignment.

(1) Connect the counter and the rf millivoltmeter to the Osc. Output of the test set using the coaxial tee, removing the termination.

(2) Set the Mode switch to the XTAL position, and adjust L2 and L3 for a peak indication on the rf millivoltmeter.

(3) The counter should indicate 65.000 MHz ±1 kHz. If necessary, adjust L3 slightly to bring the frequency within the ±1 kHz tolerance.

(4) Adjust R30 for a 120 mV indication on the rf millivoltmeter.

b. VFO Alignment.

(1) Set the Mode switch to the VFO position and connect the digital voltmeter to TP1 on the test set. Adjust the VFO control for a -2.0V indication on the digital voltmeter, and adjust C6 for a 65.000 MHz indication on counter.

NOTE

C6 determines the center frequency, and R2 determines the sensitivity (swing) of the VFO for a plus and minus 15V control voltage. The object of the following steps is to adjust R2 for a total swing of 540 kHz, and to adjust C6 for a center frequency indication of 65.000 MHz.

(2) Turn the VFO control fully clockwise. The digital voltmeter should indicate +15V ±50 mV. Note the counter indication. The required frequency is 270 kHz above 65.000 MHz. Determine the difference between the required frequency and that indicated by the counter, and adjust R2 so that the counter frequency changes toward the required frequency. The amount of frequency adjustment should be one-half of the difference between the original counter indication and the required frequency.

(3) Turn the VFO control fully counterclockwise; the voltmeter should indicate -15V ±50 mV. Adjust C6 for a frequency indication of 64.7300 MHz. Turn the control fully clockwise; the frequency indication should be 65.270 MHz ±3 kHz.

(4) Repeat steps (2) and (3) until the fully-clockwise position yields a frequency indication of 65.270 MHz ±3 kHz and the fully-counterclockwise position yields a frequency indication of 64.730 MHz ±3 kHz.

(5) The vfo output is indicated by the rf millivoltmeter, and should be 120 mV ±20 mV. Note this level, and switch the Mode switch to the XTAL position, then adjust R30 for the same level noted in the VFO position.

c. AFC Alignment.

(1) With the Mode switch in the VFO position, adjust the VFO control for a frequency indication of 65.000 MHz ±1 kHz. Set the Model switch to the AFC position and connect the digital voltmeter to TP2 on the test set.

(2) Adjust the AFC control clockwise for an indication of +7.5V ±10 mV, and adjust R3 for a frequency indication of 65.260 MHz.

(3) Adjust the control counterclockwise for an indication of -7.5V ±10 mV and adjust R20 for a frequency indication of 64.740 MHz.

(4) Switch the Mode switch to the VFO position and ensure that the frequency is 65.000 MHz ±1 kHz. Adjust the VFO control, if necessary. Set the switch to the AFC position and repeat steps (2) and (3) until a +7.5V AFC voltage yields a frequency indication of 65.260 MHz ±3 kHz, and -7.5V yields a frequency indication of 64.740 MHz ±3 kHz.

This completes the alignment of the second local oscillator subassembly.

ELECTRICAL PARTS LIST (Refer to figure 2.)

Reference Designation	Description
C1	Capacitor, monolytic, 1.0 uF ±20%, 25V, Sprague 5C023105X0250B3
C2 and C3	Capacitor, ceramic, tubular, 10 pF ±5%, Erie NPO-301
C4	Capacitor, dipped, mica, 1000 pF ±5%, Elmenco DM15F102J
C5	Capacitor, tantalum, 3.3 uF 15V, Sprague 150D335X0015A2
C6	Capacitor, variable, glass piston, 0.8-8.5 pF, JFD VC9GWY
C7	Capacitor, ceramic, tubular, 11 pF ±5%, Erie NPO-301
C8 and C9	Capacitor, ceramic, tubular, 47 pF ±5%, Erie NPO-308
C10	Capacitor, tantalum, 3.3 uF 15V, Sprague 150D335X0015A2
C11	Capacitor, ceramic, disc, 0.001 uF ±10%, Erie HR-809-X5T
C12	Capacitor, dipped, mica, 1000 pF ±5%, Elmenco DM15F102J
C13	Capacitor, ceramic, disc, 0.001 uF ±10%, Erie HR-809-X5T
C14	Capacitor, dipped, mica, 470 pF ±5%, Elmenco DM10F471J
C15	Capacitor, ceramic, disc, 0.001 uF ±10%, Erie HR-809-X5T
C16	Capacitor, tantalum, 3.3 uF 15V, Sprague 150D335X0015A2
C17	Capacitor, tantalum, 3.3 uF 15V, Sprague 150D335X0015A2
C18	Capacitor, ceramic, disc, 0.001 uF ±10%, Erie HR-809-X5T
C19	Capacitor, dipped, mica, 470 pF ±5%, Elmenco DM10F471J
C20	Capacitor, dipped, mica, 330 pF ±5%, Elmenco DM10F331J
C21	Capacitor, ceramic, tubular, 33 pF ±5%, Erie NPO-308
C22	Capacitor, dipped, mica, 68 pF ±5%, Elmenco DM10F680J
C23	Capacitor, ceramic, disc, 0.001 uF ±10%, Erie HR-809-X5T
C24	Not assigned
C25	Capacitor, ceramic, disc, 0.001 uF ±10%, Erie HR-809-X5T
C26	Capacitor, ceramic, tubular, 470 pF ±5%, Elmenco DM10F471J
C27 and C28	Capacitor, ceramic, disc, 0.001 uF ±10%, Erie HR-809-X5T

Reference Designation	Description
C29	Capacitor, ceramic, tubular, 39 pF ±5%, Erie NPO-308
C30	Capacitor, ceramic, tubular, 18 pF ±5%, Erie NPO-301
C31 through C39	Capacitor, ceramic, disc, 0.001 uF ±10%, Erie HR-809-X5T
C40	Capacitor, ceramic, tubular, 33 pF ±5%, Erie NPO-308
C41 and C42	Capacitor, ceramic, disc, 0.001 uF ±10%, Erie HR-809-X5T
C43	Capacitor, ceramic, tubular, 5.1 pF ±0.1 pF, Erie N220-301-000
C44	Capacitor, ceramic, disc, 0.001 uF ±10%, Erie HR-809-X5T
C45	Capacitor, tantalum, 3.3 uF 15V, Sprague 150D335X0015A2
C46 through C48	Capacitor, ceramic, disc, 0.001 uF ±10%, Erie HR-809-X5T
CR1 and CR2	Diode, varicap, 10 pF, TRW PC-115
CR3	Diode, 1N938A
CR4 and CR5	Diode, 1N936
CR6 through CR9	Diode, 1N914
CR10	Diode, 1N4305
L1	Inductor, fixed, 0.2 uH ±5%, JFD LF4W020
L2	Inductor, variable, 0.27 uH ±10%, Nytronics WEE VL-0.27
L3	Inductor, variable, 0.22 uH ±10%, Nytronics WEE VL-0.22
L4 through L7	Inductor, fixed, 5.6 uH ±10%, Nytronics WEE-5.6
L8	Not assigned
L9	Inductor, fixed, 5.6 uH ±10%, Nytronics WEE-5.6

Reference Designation	Description
P1	Connector, Cannon DBM-17W2P, with two coaxial inserts, Cannon DM53740-1
Q1 through Q5	Transistor, RCA 2N3478
Q6	Transistor, 2N3227
Q7	Transistor, RCA 2N3478
R1	Resistor, composition, fixed, 68k ±5%, 1/4W, Allen Bradley CB6835
R2 and R3	Resistor, variable, 50k, Beckman Helitrim 63XR50K
R4 through R6	Resistor, composition, fixed, 22k ±5%, 1/4W, Allen Bradley CB2235
R7 and R8	Resistor, composition, fixed, 390Ω ±5%, 1/4W, Allen Bradley CB3915
R9 and R10	Resistor, composition, fixed, 22k ±5%, 1/4W, Allen Bradley CB2235
R11	Resistor, composition, fixed, 4.7k ±5%, 1/4W, Allen Bradley CB4725
R12	Resistor, composition, fixed, 180Ω ±5%, 1/4W, Allen Bradley CB1815
R13	Resistor, composition, fixed, 7.5k ±5%, 1/4W, Allen Bradley CB7525
R14	Resistor, composition, fixed, 47Ω ±5%, 1/4W, Allen Bradley CB4705
R15	Resistor, composition, fixed, 2.7k ±5%, 1/2W, Allen Bradley EB2725
R16 and R17	Resistor, composition, fixed, 47Ω ±5%, 1/4W, Allen Bradley CB4705

Reference Designation	Description
R18	Resistor, composition, fixed, 10k ±5%, 1/4W, Allen Bradley CB1035
R19	Resistor, composition, fixed, 1.5k ±5%, 1/4W, Allen Bradley CB1525
R20	Resistor, variable, 100k, Beckman Helitrim 62PR100K
R21	Resistor, composition, fixed, 4.7k ±5%, 1/4W, Allen Bradley CB4725
R22	Resistor, composition, fixed, 47Ω ±5%, 1/4W, Allen Bradley CB4705
R23	Resistor, composition, fixed, 130Ω ±5%, 1/4W, Allen Bradley CB1315
R24	Resistor, composition, fixed, 68k ±5%, 1/4W, Allen Bradley CB6835
R25	Resistor, composition, fixed, 33Ω ±5%, 1/4W, Allen Bradley CB3305
R26	Resistor, composition, fixed, 18Ω ±5%, 1/4W, Allen Bradley CB1805
R27	Resistor, composition, fixed, 100Ω ±5%, 1/4W, Allen Bradley CB1015
R28	Resistor, composition, fixed, 47Ω ±5%, 1/4W, Allen Bradley CB4715
R29	Resistor, composition, fixed, 6.8k ±5%, 1/4W, Allen Bradley CB6825
R30	Resistor, variable, 200Ω, Beckman 62PR200
R31	Resistor, composition, fixed, 12k ±5%, 1/4W, Allen Bradley CB1235
R32	Resistor, composition, fixed, 2.2k ±5%, 1/4W, Allen Bradley CB2225
R33 and R34	Resistor, composition, fixed, 18k ±5%, 1/4W, Allen Bradley CB1835
R35	Resistor, composition, fixed, 10Ω ±5%, 1/4W, Allen Bradley CB1005
R36	Resistor, composition, fixed, 150Ω ±5%, 1/4W, Allen Bradley CB1515

Reference Designation	Description
R37	Resistor, composition, fixed, 51Ω ±5%, 1/4W, Allen Bradley CB5105
R38	Resistor, composition, fixed, 56Ω ±5%, 1/4W, Allen Bradley CB5605
R39	Resistor, composition, fixed, 1k ±5%, 1/4W, Allen Bradley CB1025
R40	Resistor, composition, fixed, 51Ω ±5%, 1/4W, Allen Bradley CB5105
R41	Resistor, composition, fixed, 47Ω ±5%, 1/4W, Allen Bradley CB4705
R42	Resistor, composition, fixed, 12k ±5%, 1/4W, Allen Bradley CB1235
R43	Resistor, composition, fixed, 390Ω ±5%, 1/4W, Allen Bradley CB3915
R44	Resistor, composition, fixed, 1.2k ±5%, 1/4W, Allen Bradley CB1225
R45	Resistor, composition, fixed, 3k ±5%, 1/4W, Allen Bradley CB3025
R46	Resistor, composition, fixed, 100k ±5%, 1/4W, Allen Bradley CB1045
R47	Resistor, composition, fixed, 470Ω ±5%, 1/4W, Allen Bradley CB4715
R48	Not assigned
R49	Resistor, composition, fixed, 470Ω ±5%, 1/4W, Allen Bradley CB4715
R50	Resistor, composition, fixed, 18k ±5%, 1/4W, Allen Bradley CB1835
R51 and R52	Resistor, composition, fixed, 10k ±5%, 1/4W, Allen Bradley CB1035
W1	Cable Assembly, Defense Electronics 105810-1
W2	Cable Assembly, Defense Electronics 105810-2
W3	Cable Assembly, Defense Electronics 105810-3
W4	Cable Assembly, Defense Electronics 105810-4
Y1	Crystal, 65.0000 MHz, Piezo 0133035

Reference Designation	Description
Z1 through Z3	Ferrite Bead, Ferrox-Cube K5.001.00/3B

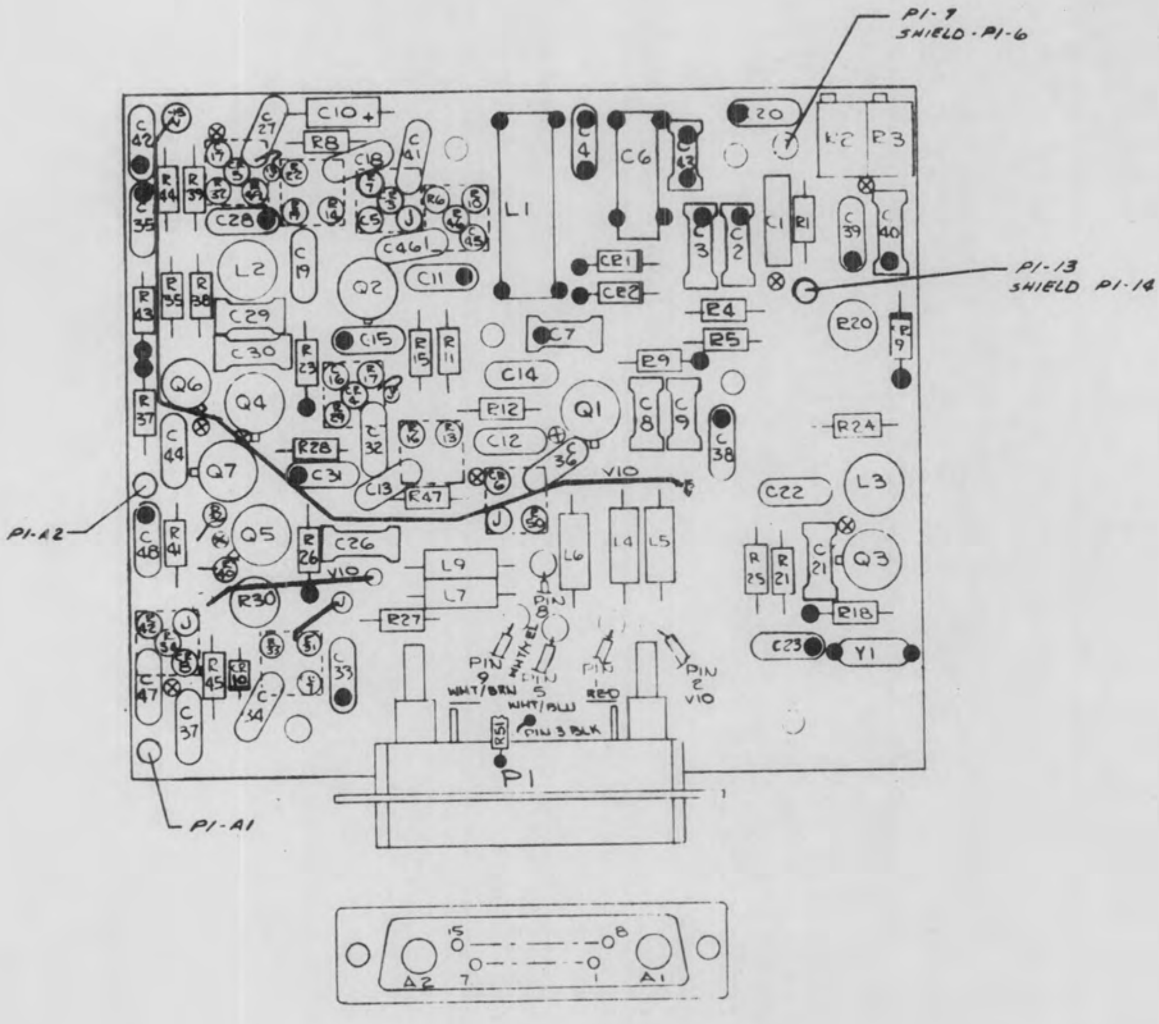
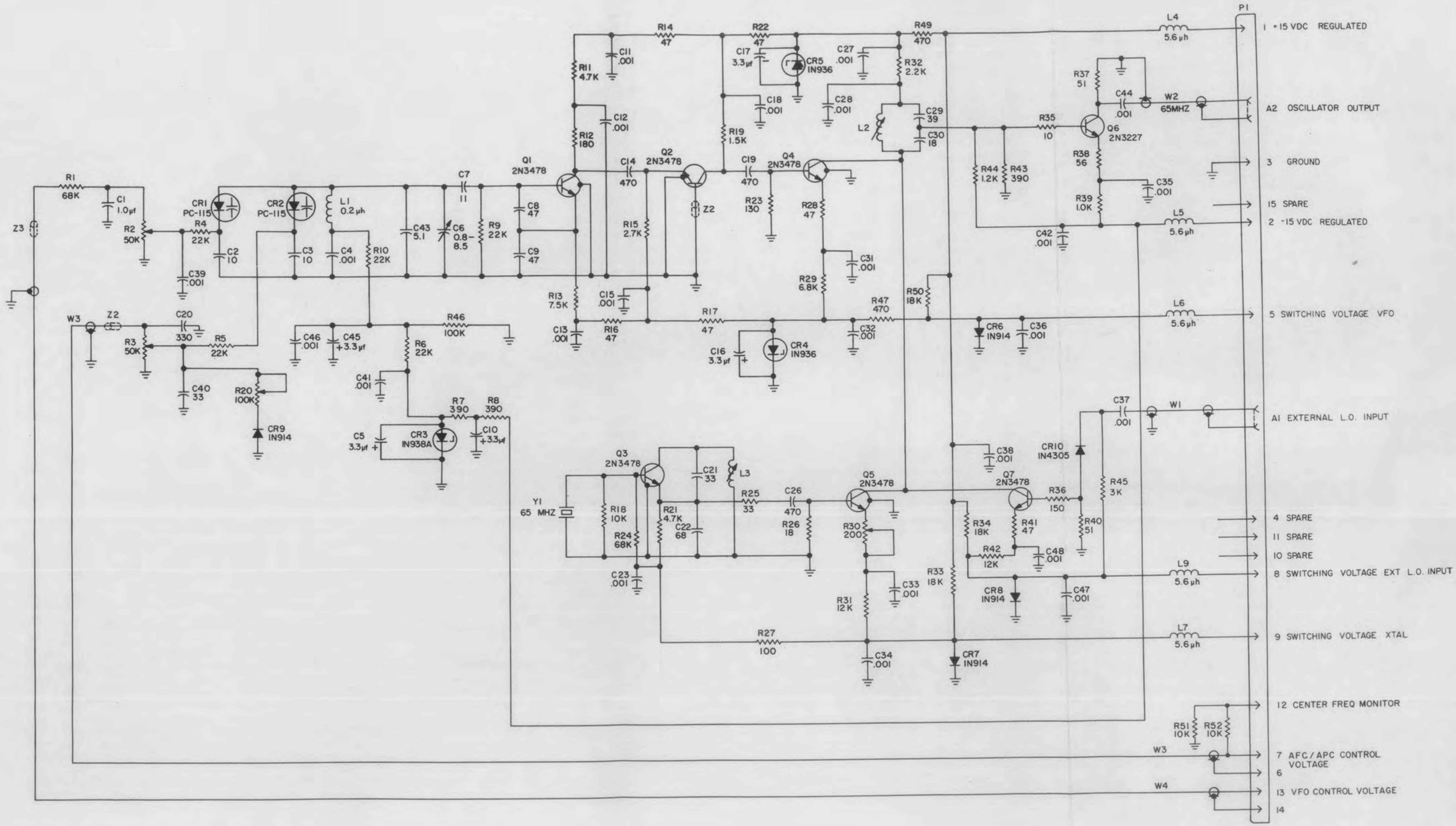


Figure 2. Component Locations
203505



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE IN OHMS
CAPACITOR VALUES LESS THAN ONE ARE IN MICROFARADS
CAPACITOR VALUES GREATER THAN ONE ARE IN PICOFARADS

Figure 3. Second Local Oscillator Schematic Diagram 401623

Revised: August 1970
January 1970

SECOND IF AMPLIFIER
203605

INSTRUCTION BOOKLET

The second i-f amplifier is a plug-in subassembly designed for use in Defense Electronics telemetry receivers. The subassembly functions as the second i-f amplifier of the receiver, and contains an accurate 10 MHz calibration oscillator which may be used for balancing of fm demodulators used with the receivers.

The second i-f amplifier portion of the subassembly accepts as its input a 10 MHz signal and amplifies this signal for further application to receiver circuits. The amplifier provides an output at an essentially-constant average amplitude over a wide dynamic range.

The crystal-controlled calibration oscillator is turned on through the application of -15V, controlled by a switch on the front panel of the receiver.

The second i-f amplifier is constructed as an enclosed, modular subassembly which may be installed in or removed from the receiver in a matter of seconds after the top cover has been removed. All circuitry is contained on a single printed circuit board, contained within the subassembly, and is interconnected with the receiver through a miniature connector at the bottom of the subassembly.

INSTALLATION

No special procedures are necessary to install or remove the subassembly. The proper location for the subassembly will be found in the subassembly/module location drawing given in Section V, Maintenance, of the applicable receiver instruction manual. All electrical connections between the main chassis and the subassembly are made automatically upon installation; there are no additional wires or cables to connect or disconnect.

The physical proximity of the second i-f amplifier to other subassemblies of the receiver may necessitate the use of a flat-bladed screwdriver or similar instrument to lift the subassembly from the main chassis thus allowing removal. The subassembly is equipped with a flange, at the top, for this purpose.

PRINCIPLES OF OPERATION

The second i-f amplifier subassembly performs two discrete functions. One is to amplify the receiver's second i-f signal and provide a means to gain-control this signal over a wide dynamic range, and the other is to generate an accurate 10 MHz calibration signal for use in preoperational setup of the receiver.

The section of the subassembly which forms the 10 MHz amplifier includes Q6 and Q1 through Q5, and associated circuitry. The gain controlled section of the i-f amplifier consists of Q1 through Q4, which are dual-gate metal oxide silicon (mos) field effect transistors (fet's). These dual-gate fet's provide an effective means of logarithmically controlling the gain of the amplifier over a dynamic range of 40 dB under normal signal conditions, with an "over-range" providing an additional 20 dB gain.

Signal input (10 MHz second i-f) is applied to the amplifier through A1 of the edgeboard connector to gate 1 of Q1. Agc voltage is applied through pin 1 to Q6 and thus to gate 2 of broadband amplifier Q1.

Q6 provides a means of minimizing the effect of temperature change on the amplifier gain. The gain of the fet's decreases with increasing temperature; this effect is counteracted by Q6, which increases the voltage applied to gate 2 (effectively reducing the agc voltage) with increasing temperature. The agc trim adjustments are R3 and R6, each used to modify the effect of the agc voltage on the amplifier response. R3 is the "slope" adjustment, and R6 is the gain adjustment.

The varying agc voltage at gate 2 of Q1 serves to control the gain of the amplifier, and thus controls the amplification of the signal applied to gate 1. The output of Q1 is applied to gate 1 of Q2, which functions similarly to Q1; agc voltage is again applied to gate 2. In the output circuit of Q2 is a maximally-flat triple-tuned Butterworth filter (L2, L3, L4, etc.) which has a minus 0.25 dB bandwidth of approximately 6 MHz.

Following Q2 and its associated filter is another broadband amplifier, Q3; again, the second i-f signal is applied to gate 1, and the agc signal is applied to gate 2. The output of Q3 is applied to gate 1 of Q4. As in the case of Q2, Q4 has in its output circuit a triple-tuned filter (L7, L8, L9, etc.) which has a response at the minus 0.25 dB points of 6 MHz. The combination of the two filters results in an overall response for the amplifier of about 6 MHz at the minus 0.5 dB points, and approximately 10 MHz at the minus 3 dB points.

The output buffer is Q5, functioning in a common emitter configuration. The output signal is coupled to A3 of the edgeboard connector through T2 and C1. R39, in the emitter circuit of Q5, provides a means of static gain adjustment.

The 10 MHz calibration oscillator employs a dual-gate fet (Q7) of the same type as those used in the i-f amplifier. Frequency adjustment is provided by C1, and gain adjustment is provided by R14. Crystal Y1 serves a dual purpose; it acts as the frequency-determining element, and serves to remove harmonic distortion from the output of the oscillator. The calibration signal is applied to gate 1 of Q1 through C3, R40, and C7. The calibration oscillator is turned on by the application of minus 15 volts at pin 8 of the edgeboard connector; the oscillator has no effect on the operation of the i-f amplifier when not operating (minus 15 volts not applied to pin 8).

MAINTENANCE

The design of the second i-f amplifier/calibration oscillator limits the need for maintenance. During normal operation, no periodic adjustment is necessary or desirable. Unnecessary adjustments may degrade the performance of the receiver, and therefore should be avoided.

The subassembly is assembled and disassembled in a straightforward manner and should pose no problem to servicing personnel. The circuitry is located on a printed circuit board mounted on spacers in a metal chassis. Four machine screws hold the pc board in place. The cover of the chassis, held in place with six machine screws, extends beyond the chassis on both sides, to facilitate plugging the subassembly into the Birtcher clips on the main chassis. A flange is also provided at the top of the subassembly to assist in removal from the receiver chassis.

Straightforward troubleshooting methods should be used if a malfunction occurs. The schematic diagram and circuit description given herein should provide the data necessary for qualified maintenance technicians to isolate the malfunction, using effect-to-cause reasoning.

The first check should be of the power supply voltages. Incorrect power supply voltages can have varying effects on the operation of the subassembly. The next most likely causes of trouble are the transistors and the diodes. A Simpson 260 multimeter, set up for continuity measurements, is recommended for checking the transistors. The following procedure may be used:

a. Place the test probes between emitter and base; then reverse the position of the probes. One of these positions should indicate forward bias on the meter.

b. Continue checking between base-collector, base-emitter, and emitter-collector.

c. If the meter does not deflect, the junction is probably open.

d. If both positions cause the meter to indicate the same resistance, the junction is probably shorted.

e. If indication is ambiguous, compare the component with the same component in a spare unit, keeping the multimeter set to the same resistance range.

Table 1. Transistor Complement

Reference Designation	Type	Function
Q1	3N140	Amplifier
Q2	3N140	Amplifier
Q3	3N140	Amplifier
Q4	3N140	Amplifier
Q5	2N3904	Output Buffer
Q6	2N3906	Temp. Compensation
Q7	3N140	Oscillator

Repair and Replacement

All components used in the subassembly are considered non-repairable, and should be replaced when found to be defective. A complete electrical parts list is given in this booklet, and a component location drawing is provided.

Care should be exercised when replacing components on the printed circuit board. The following is a suggested procedure for removing components from the board; the procedure requires the following equipment:

Liquid soldering flux	1/8 inch, #18 AWG, flat braid
Flux remover	Medium wattage solder iron

Apply a thin coat of liquid flux to the flat braid. Place and hold the braid over the solder joint. Apply heat to the braid directly over the solder joint; the braid will absorb most of the solder.

CAUTION

Do not heat the joint for long periods of time as excessive heat may damage the circuit board.

After the major portion of the solder has been absorbed by the braid, apply heat directly to the solder joint and carefully pry loose the defective component. Clean the affected area using the flux remover. Trim the replacement component leads to the same length as the original component leads. Position the replacement component on the circuit board and solder it in place. Clean the affected area with flux remover.

If a component is replaced, recalibration may be necessary; in this case, the following procedure is recommended:

Alignment

Recommended Equipment:

RF Millivoltmeter, with tee and 50 ohm termination	HP 411A
Sweep Generator	Jerrold 602
Signal Generators (2 required)	HP 606A
Oscilloscope	HP 130C
Attenuators	HP 355C, HP 355D
50 ohm Detector	Defense Electronics C36877
Test Set	Defense Electronics 105954
Power Supply (2 required)	HP 721A

Initial Setup:

Before installing the subassembly in the test set, adjust the power supply voltages to +15V and -15V, and the short circuit current to 100 mA.

NOTE

Alignment of the subassembly necessitates removal of the jumper wire connecting E1 with E2.

Procedure:

a. Set the CAL switch to OFF, set the AGC switch to INT, set the POWER switch to ON, and adjust the INT AGC control for -4V at TP3 on test set.

b. Adjust R3 and R6 (on the subassembly) for +2V at TP1, adjust R39 maximum counterclockwise then clockwise four turns. Connect equipment as shown in figure 1.

c. Adjust L7, L8, L9, and C28 for the response shown in figure 2.

d. Turn the test set POWER switch to OFF, and remove the subassembly from the test set. Resolder the jumper wire connecting E1 with E2. Remove the BNC tee with 50 ohm load from the sweep input cable, and connect it to J1 of the test set.

e. Adjust L2, L3, and L4 for the response shown in figure 3. The overall response should have less than 0.5 dB ripple and the 7-13 MHz bandwidth should be less than 0.75 dB down.

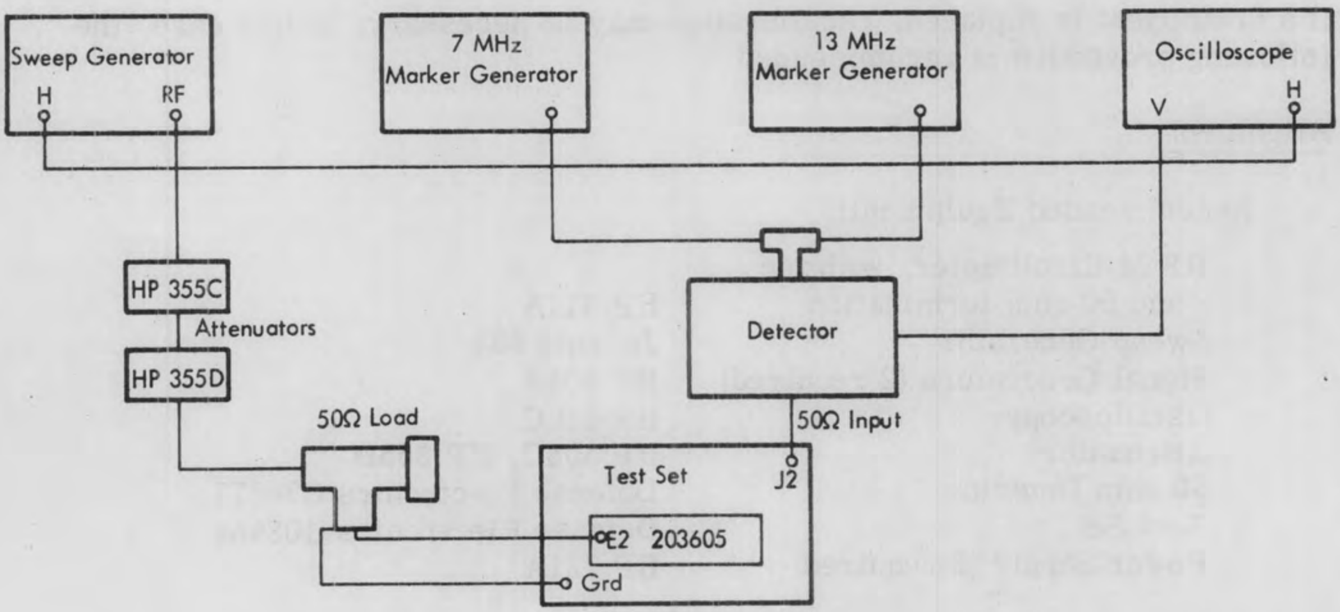


Figure 1. Equipment Setup for Alignment

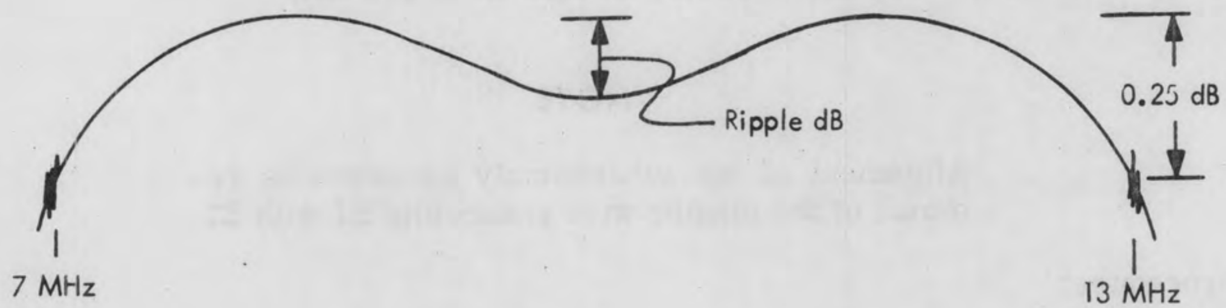


Figure 2. Response no. 1

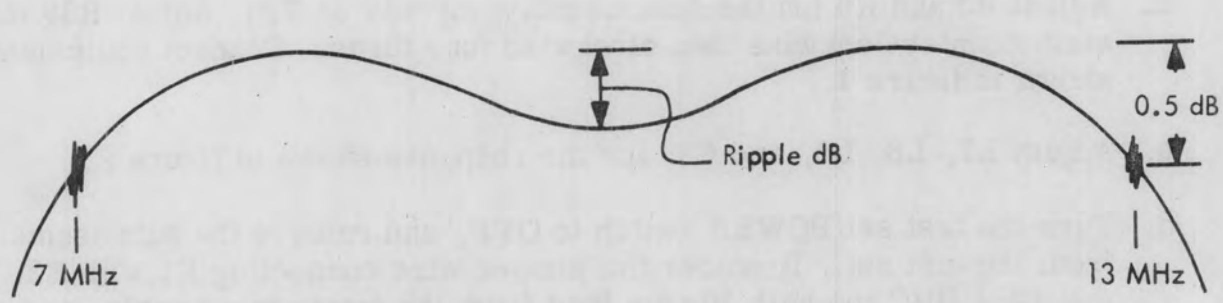


Figure 3. Response no. 2

f. R3, R6, and R39 will be used to set the gain vs. agc as shown in figure 4. Connect the HP 355C and HP 355D attenuators between signal generator and J1 on test set. Set the generator 10 MHz and -25 dBm. Connect rf

millivoltmeter to J2 (amplifier output) with 50 ohm load. Connect dc voltmeter to TP3 on test set. During adjustments, maintain the output level at -25 dBm, and attenuate input as required. The INT AGC control will be used to vary the agc level at TP3.

g. Use R3 at -8V agc and R39 at 0V agc (and R6, if required) to set gain at -8V agc to +1 dB, and 0V agc to +39 dB. Set agc level to +8V and observe gain. If the gain at +8V is greater than +59 dB, R6 must be adjusted to increase the output level. If the gain at +8 dB is less than +57 dB, R6 must be adjusted to decrease the output level. After R6 is adjusted, the above technique should be used until the following gain vs. agc level is achieved:

AGC Level (TP3)	Amplifier Gain at 10 MHz
-8V	+1 dB (output level -25 dBm)
0V	+39 dB (output level -25 dBm)
+8V	+57 dB to +59 dB (output level -25 dBm)

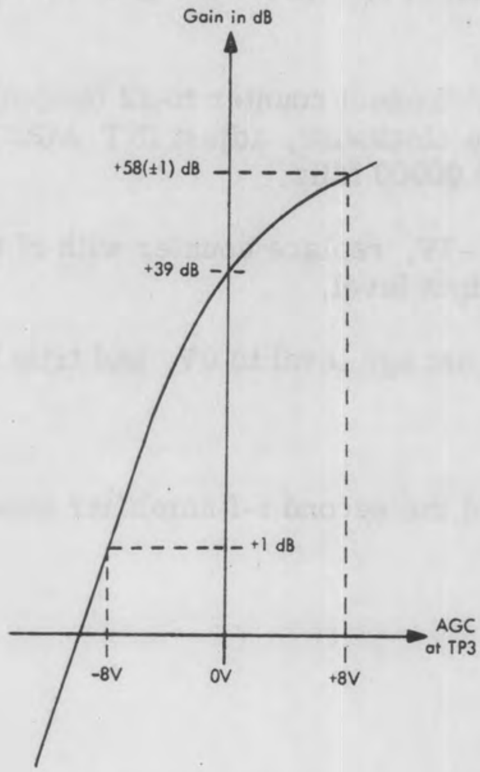


Figure 4. Gain vs. AGC Characteristic

h. Reconnect test equipment as in step e for overall swept frequency response check. Adjust INT AGC control for -4V agc at TP3, and adjust

L7, L8, L9, and C28 as required to achieve the response shown in figure 3.

NOTE

> L2, L3, L4 may be trimmed if required. If the desired overall response cannot be achieved, it will be necessary to remove the jumper between E1 and E2 and repeat steps c, d, and e.

i. Set the INT AGC control for -8V at TP3 and note that the ripple is less than 0.5 dB, and that the 7 MHz and 13 MHz markers are less than 1 dB down from maximum.

j. Set the INT AGC control for 0V at TP3 and note that the ripple is less than 0.5 dB, and that the 7 MHz and 13 MHz markers are less than 1 dB down from maximum.

k. Reconnect equipment as in step f, for gain measurements, and trim R3, R6, and R39 as required to achieve the gain vs. agc response outlined in step f.

l. Disconnect input and connect counter to J2 (output), turn CAL switch ON, adjust R14 maximum clockwise, adjust INT AGC control for 0V at TP3, and adjust C1 for 10.00000 MHz.

m. Reduce agc level to -7V, replace counter with rf millivoltmeter, adjust R14 for -25 dBm output level.

n. Reconnect counter, set agc level to 0V, and trim C1 for 10.00000 MHz.

o. Repeat step m.

This completes alignment of the second i-f amplifier subassembly.

ELECTRICAL PARTS LIST (See figure 5)

Reference Designation	Description
C1	Capacitor, variable, 1.2-16 pF, JFD VC961
C2	Capacitor, dur-mica, 39 pF ±5%, Elmenco DM15F390J
C3	Capacitor, ceramic, disc, 0.01 μF ±20%, 100V, Erie 805-Z5V
C4	Capacitor, ceramic, disc, 0.01 μF ±20%, 100V, Erie 805-Z5V
C5	Capacitor, dur-mica, 120 pF ±5%, Elmenco DM15F121J
C6	Capacitor, dur-mica, 150 pF ±5%, Elmenco DM15F151J
C7	Capacitor, ceramic, disc, 0.01 μF ±20%, 100V, Erie 805-Z5V
C8	Capacitor, ceramic, disc, 0.05 μF +80-20%, 50V, Sprague 55C23A-1
C9	Capacitor, dipped mica, 91 pF ±5%, 500V, Elmenco DM15F910J
C10	Capacitor, ceramic, disc, 0.01 μF ±20%, 100V, Erie 805-Z5V
C11	Capacitor, ceramic, disc, 0.01 μF ±20%, 100V, Erie 805-Z5V
C12	Capacitor, dipped mica, 91 pF ±5%, 500V, Elmenco DM15F910J
C13	Capacitor, ceramic, disc, 0.01 μF ±20%, 100V, Erie 805-Z5V
C14	Capacitor, dipped mica, 91 pF ±5%, 500V, Elmenco DM15F910J
C15	Capacitor, ceramic, disc, 0.01 μF ±20%, 100V, Erie 805-Z5V
C16	Capacitor, ceramic, tubular, 13 pF ±5%, Erie NPO-301-000
C17	Capacitor, ceramic, tubular, 9.1 pF ±5%, Erie NPO-301-000
C18	Capacitor, ceramic, tubular, 10 pF ±5%, Erie NPO-301-000
C19	Capacitor, ceramic, disc, 0.01 μF ±20%, 100V, Erie 805-Z5V
C20	Capacitor, dipped mica, 91 pF ±5%, 500V, Elmenco DM15F910J
C21	Capacitor, ceramic, disc, 0.01 μF ±20%, 100V, Erie 805-Z5V
C22	Capacitor, ceramic, disc, 0.01 μF ±20%, 100V, Erie 805-Z5V
C23	Capacitor, ceramic, disc, 0.05 μF +80-20%, 50V, Sprague 55C23A-1
C24	Capacitor, dipped mica, 91 pF ±5%, 500V, Elmenco DM15F910J
C25	Capacitor, dur-mica, 13 pF ±5%, Erie NPO-301-000
C26	Capacitor, ceramic, disc, 0.01 μF ±20%, 100V, Erie 805-Z5V
C27	Capacitor, ceramic, tubular, 9.1 pF ±5%, Erie NPO-301-000
C28	Capacitor, variable, 3-15 pF, Erie 538-011, D, 3-15

Reference Designation	Description
C29 through C36	Capacitor, ceramic, disc, 0.01 μF ±20%, 100V, Erie 805-Z5V
L1	Inductor, fixed, 8.2 μH ±10%, Nytronics WEE-8.2
L2	Inductor Assembly, fixed, Defense Electronics 203608
L3	Inductor Assembly, fixed, Defense Electronics 203609
L4	Inductor Assembly, fixed, Defense Electronics 203608
L5	Inductor, fixed, 8.2 μH ±10%, Nytronics WEE-8.2
L6	Inductor, fixed, 8.2 μH ±10%, Nytronics WEE-8.2
L7	Inductor Assembly, fixed, Defense Electronics 203608
L8	Inductor Assembly, fixed, Defense Electronics 203609
L9	Inductor Assembly, fixed, Defense Electronics 203608
L10 through L12	Inductor, fixed, 8.2 μH ±10%, Nytronics WEE-8.2
L13	Inductor, fixed, 5.6 μH ±10%, Nytronics WEE-5.6
L14	Inductor, fixed, 5.6 μH ±10%, Nytronics WEE-5.6
P1	Connector, Cannon DBM 13W3P
P1A1	Coaxial insert, Cannon DM53740-5008
P1A2	Coaxial insert, Cannon DM53740-5008
Q1 through Q4	Transistor, Motorola or RCA 3N140
Q5	Transistor, Motorola 2N3904
Q6	Transistor, Motorola 2N3906
Q7	Transistor, Motorola or RCA 3N140

Reference Designation	Description
R1	Resistor, fixed, composition, 1.1k ±5%, 1/4W, RC07GF112J
R2	Resistor, fixed, composition, 6.8k ±5%, 1/4W, RC07GF682J
R3	Resistor, variable, 50k, helitrim, Beckman 78PR50K
R4	Resistor, fixed, composition, 2k ±5%, 1/4W, RC07GF202J
R5	Resistor, fixed, composition, 3.6k ±5%, 1/4W, RC07GF362J
R6	Resistor, variable, 5k, Helitrim, Beckman 78PR5K
R7	Resistor, fixed, composition, 2k ±5%, 1/4W, RC07GF202J
R8	Resistor, fixed, composition, 220Ω ±5%, 1/4W, RC07GF221J
R9	Resistor, fixed, composition, 130k ±5%, 1/4W, RC07GF134J
R10	Resistor, fixed, composition, 9.1k ±5%, 1/4W, RC07GF912J
R11	Resistor, fixed, composition, 130k ±5%, 1/4W, RC07GF134J
R12	Resistor, fixed, composition, 9.1k ±5%, 1/4W, RC07GF912J
R13	Resistor, fixed, composition, 13k ±5%, 1/4W, RC07GF133J
R14	Resistor, variable, 10k, helitrim, Beckman 62PR10K
R15	Resistor, fixed, composition, 300Ω ±5%, 1/4W, RC07GF301J
R16	Resistor, fixed, composition, 1k ±5%, 1/4W, RC07GF102J
R17	Resistor, fixed, composition, 750Ω ±5%, 1/4W, RC07GF751J
R18	Resistor, fixed, composition, 300Ω ±5%, 1/4W, RC07GF301J
R19	Resistor, fixed, composition, 130k ±5%, 1/4W, RC07GF134J
R20	Resistor, fixed, composition, 9.1k ±5%, 1/4W, RC07GF912J
R21	Resistor, fixed, composition, 1k ±5%, 1/4W, RC07GF102J
R22	Resistor, fixed, composition, 1k ±5%, 1/4W, RC07GF102J
R23	Resistor, fixed, composition, 300Ω ±5%, 1/4W, RC07GF301J
R24	Resistor, fixed, composition, 1k ±5%, 1/4W, RC07GF102J
R25	Resistor, fixed, composition, 130k ±5%, 1/4W, RC07GF134J
R26	Resistor, fixed, composition, 9.1k ±5%, 1/4W, RC07GF912J
R27	Resistor, fixed, composition, 1k ±5%, 1/4W, RC07GF102J
R28	Resistor, fixed, composition, 750Ω ±5%, 1/4W, RC07GF751J
R29	Resistor, fixed, composition, 300Ω ±5%, 1/4W, RC07GF102J
R30	Resistor, fixed, composition, 130k ±5%, 1/4W, RC07GF134J

Reference Designation	Description
R31	Resistor, fixed, composition, 9.1k ±5%, 1/4W, RC07GF912J
R32	Resistor, fixed, composition, 1k ±5%, 1/4W, RC07GF102J
R33	Resistor, fixed, composition, 910Ω ±5%, 1/4W, RC07GF911J
R34	Resistor, fixed, composition, 300Ω ±5%, 1/4W, RC07GF301J
R35	Resistor, fixed, composition, 3.6k ±5%, 1/4W, RC07GF362J
R36	Resistor, fixed, composition, 1.8k ±5%, 1/4W, RC07GF182J
R37	Resistor, fixed, composition, 20Ω ±5%, 1/4W, RC07GF200J
R38	Resistor, fixed, composition, 430Ω ±5%, 1/4W, RC07GF431J
R39	Resistor, variable, 1k, helitrim, Beckman 78PR1K
R40	Resistor, fixed, composition, 16k ±5%, 1/4W, RC07GF163J
R41 through R44	Resistor, fixed, composition, 20Ω ±5%, 1/4W, RC07GF200J
R45	Resistor, fixed, composition, 1.1k ±5%, 1/4W, RC07GF112J
T1 through T3	Transformer, assembly, Defense Electronics 203533
TP1	Test Point, white, Amp. Inc. 3-582118-9
W1	Cable Assembly, Defense Electronics 105899-1
W2	Cable Assembly, Defense Electronics 105899-2
Y1	Crystal, 10.00000 MHz, Piezo or McCoy CR-64/U

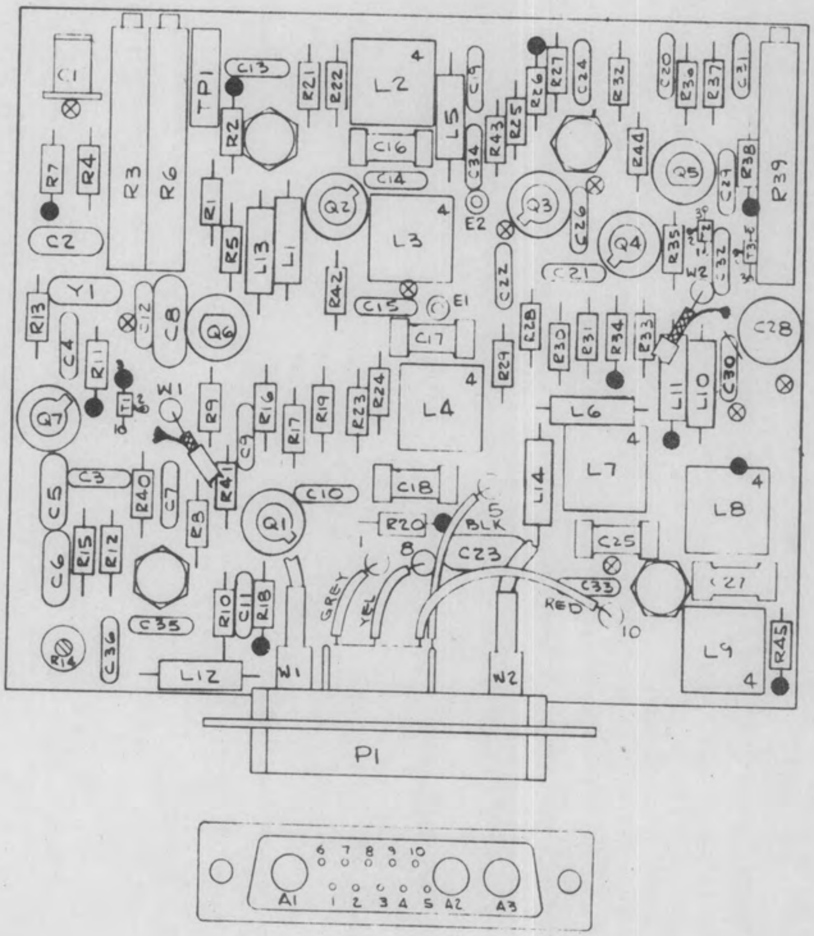
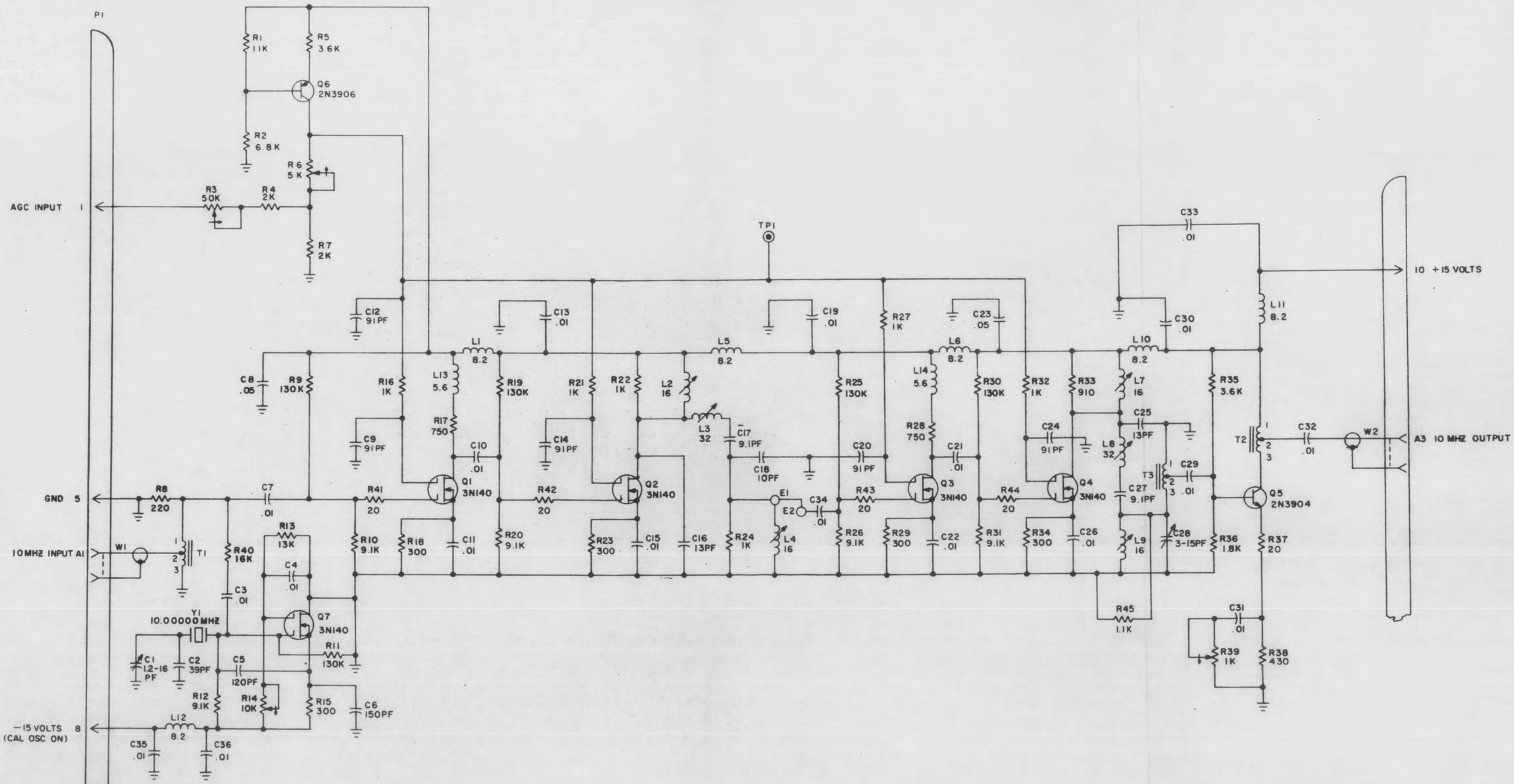


Figure 5. Component Locations
203605



NOTES:

Unless Otherwise Specified:

Resistor values are in ohms;
k=1,000; M=1,000,000.

Capacitor values are in microfarads.

Inductor values are in microhenrys.

* = Selectable value.

Indicates clockwise rotation.

Figure 6. Second IF Amplifier, Schematic Diagram 401628

INSTRUCTION BOOKLET

The second mixer is a plug-in subassembly designed for use in Defense Electronics telemetry receivers. The purpose of the second mixer is to accept as its inputs a 55 MHz first i-f or playback signal and a 65 MHz local oscillator signal, and produce as its output a 10 MHz second i-f signal for further application to receiver circuits. The second mixer has a 3 dB bandwidth which exceeds 6 MHz and is free of spurious and other undesired outputs.

The second mixer is constructed on a single printed circuit board, equipped with a handle and a single connector which mates with the appropriate receptacle on the receiver main chassis. The subassembly may be installed in or removed from the receiver in a matter of seconds after the top cover has been removed.

INSTALLATION

No special procedures are necessary to install or remove the second mixer. The proper location for the subassembly will be found in the subassembly/module location drawing given in Section V, Maintenance, of the applicable receiver instruction manual.

All electrical connections between the main chassis and the subassembly are made automatically upon installation; there are no additional wires or cables to connect or disconnect.

PRINCIPLES OF OPERATION

The 55 MHz first i-f (or playback) signal input is applied through A3 of P1, and applied to a five pole filter consisting, in terms of signal flow (see figure 2), of C20 through C7 and L7 through L3. The essential purpose of the filter is to prevent undesired signals, for example the 75 MHz image signal, from appearing at the input to the mixer (A1). When the receiver in which the subassembly is installed is in a receive mode of operation, the output of the filter is applied through CR3 to the double-balanced diode mixer, A1, at pin A.

When the receiver is in the playback mode, -15 volts is applied to the second mixer at pin 12 of P1, CR3 and CR1 are reverse biased, and CR2 is forward biased. The result of this is that a 55 MHz playback signal applied at A2 of P1 is coupled to the input of the mixer, while the first i-f signal is blocked by CR3. When the receiver is in a receive mode, +15 volts is applied at pin 12 of P1 and the state of the diodes is reversed; CR3 conducts, as does CR1, and CR2 is cut off. Hence, the first i-f signal is applied to the mixer, but any signal present at A2 of P1 (the playback input) will not be present at the input to the mixer.

The diode input-switching arrangement minimizes the risk that undesired signals present at the i-f or playback inputs to the subassembly will adversely affect the performance of the receiver in the selected mode of operation.

The local oscillator input to the subassembly is applied through A5 of P1 to an amplifier consisting of Q3 and Q4, both in a common emitter configuration. T4 and T5, the input and output transformers, provide a constant impedance over the required frequency range of the local oscillator (l-o) signal input. The l-o signal is applied to the mixer at pin W. A second l-o monitor output is obtained at the junction of R30 and R31, and made available at A1 of P1 for application to an external connector on the receiver.

The output of the mixer is obtained at pin B of A1; the mixer output is the 10 MHz difference signal between the 65 MHz and the 55 MHz inputs to the mixer. The 10 MHz signal is applied through T1 to a common base amplifier, Q1. The output of Q1 is applied through T2 to Q2, another common base amplifier. The output of Q2 is obtained from T3 and made available at A4 of P1 for use by the receiver as the second i-f signal.

MAINTENANCE

The design of the second mixer subassembly limits the need for maintenance. During normal operation, no periodic adjustment is necessary or desirable. Unnecessary adjustments may degrade the performance of the receiver, and therefore should be avoided.

Straightforward troubleshooting methods should be used if a malfunction occurs. The schematic diagram and circuit description given herein should provide the data necessary for qualified maintenance technicians to isolate the malfunction, using effect-to-cause reasoning.

The first check should be of the power supply voltages. Incorrect power supply voltages can have varying effects on the operation of the subassembly. The next most likely causes of trouble are the transistors and the diodes. A Simpson 260 multimeter, set up for continuity measurements, is recommended for checking the transistors. The following procedure may be used.

a. Place the test probes between emitter and base; then reverse the position of the probes. One of these positions should indicate forward bias on the meter.

b. Continue checking between base-collector, base-emitter, and emitter-collector.

c. If the meter does not deflect, the junction is probably open.

d. If both positions cause the meter to indicate the same resistance, the junction is probably shorted.

e. If indication is ambiguous, compare the component with the same component in a spare unit, keeping the multimeter set to the same resistance range.

Table 1. Transistor Complement

Reference Designation	Type	Function
Q1	A492	Amplifier
Q2	2N708	Amplifier
Q3	MM1941	Amplifier
Q4	MM1941	Amplifier

Repair and Replacement

All components used in the second mixer are considered non-repairable, and should be replaced when found to be defective. A complete electrical parts list is given in this booklet, and a component location drawing is provided.

Care should be exercised when replacing components on the printed circuit board. The following is a suggested procedure for removing components from the board; the procedure requires the following equipment:

Liquid soldering flux	1/8 inch, #18 AWG, flat braid
Flux remover	Medium wattage solder iron

Apply a thin coat of liquid flux to the flat braid. Place and hold the braid over the solder joint. Apply heat to the braid directly over the solder joint; the braid will absorb most of the solder.

CAUTION

Do not heat the joint for long periods of time as excessive heat may damage the circuit board.

After the major portion of the solder has been absorbed by the braid, apply heat directly to the solder joint and carefully pry loose the defective component. Clean the affected area using the flux remover. Trim the replacement component leads to the same length as the original component leads. Position the replacement component on the circuit board and solder it in place. Clean the affected area with flux remover.

Following replacement of any circuit component, realignment may be necessary; in this case the following procedure is recommended.

Alignment

Recommended Equipment:

Sweep Generator	Jerrold 602
DC Voltmeter	RCA WV-98B
Signal Generators (2 required)	HP 606A
RF Millivoltmeter, with tee and 50 ohm termination	HP 411A
Power Supplies (2 required)	HP 721A
3 dB Pad	Applied Research
6 dB Pad	Applied Research
Oscilloscope	HP 130C
Test Set	Defense Electronics 105955
50 ohm Detector	Defense Electronics TF 109
Test Oscillator	HP 651

Initial Setup:

Connect the power supplies to the test set and adjust for +15V and -15V output voltage. Set the short circuit current to 100 mA. Insert the subassembly into the test set.

Procedure:

a. Alignment of Local Oscillator Amplifier.

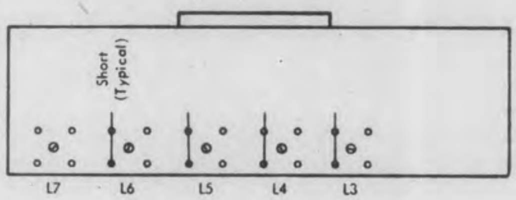
(1) Connect the signal generator to J5 of the test set, and connect the rf millivoltmeter to J1 using the 50 ohm tee. Adjust the signal generator for 65 MHz at a level of 100 mV, and set the rf millivoltmeter to the 0 dBm scale.

(2) Adjust C42 and C35 for maximum response as observed on the rf millivoltmeter.

b. Alignment of 55 MHz Filter.

(1) Connect the dc voltmeter to TP1 of the test set, connect the detector to TP1 of the test set. Connect one signal generator to J5 of the test set, and the other to J3 through the 3 dB and 6 dB pads (in series). Connect the HP 411A to J4. Set the signal generators for 65 MHz at 100 mV at J5, and 55.25 MHz at +3 dBm at J3. Set the rf millivoltmeter to the 0 dBm scale.

(2) Place a short circuit (jumper) across L6 as shown:



(3) Adjust L7 for maximum indication on the dc voltmeter.

(4) Place a short across L5, as shown in step (2). Adjust L6 for minimum dc voltmeter indication.

(5) Place a short across L4, as shown, and adjust L5 for maximum indication.

(6) Place a short across L3, as shown, and adjust L4 for a minimum indication.

(7) Remove the high impedance detector from TP1, and replace the sub-assembly cover.

(8) Adjust L3 for a maximum indication on the rf millivoltmeter.

(9) Replace the signal generator connected to J3 with the sweep generator and replace the rf millivoltmeter with the 50 ohm detector. Connect dc output to oscilloscope vertical input.

(10) Adjust signal generator to 10 MHz and use for external marker for the detector. Use test oscillator for the other external marker.

(11) Increase the output of the sweep generator for approximately 300 mV vertical deflection on the oscilloscope.

(12) The display on the oscilloscope should be symmetrical about 10.0 MHz, ±200 kHz, at the -3 dB points. A slight adjustment of L3 or L7 may be required.

This completes the alignment of the second mixer subassembly.

ELECTRICAL PARTS LIST (See figure 1)

Reference Designation	
A1	Mixer, diode, Defense Electronics 203547
C1 through C5	Capacitor, ceramic, disc, 0.001 uF -20+100%, Erie CK61Y102Z
C6	Capacitor, ceramic, disc, 0.01 uF ±20%, 100V, Sprague 3TG-S102
C7	Capacitor, dipped, mica, 82 pF ±2%, Elmenco DM15F820G
C8	Capacitor, dipped, mica, 62 pF ±2%, Elmenco DM15F620F
C9	Capacitor, dipped, mica, 82 pF ±2%, Elmenco DM15F820G
C10	Capacitor, ceramic, tubular, 13 pF ±5%, Erie NPO-301
C11	Capacitor, dipped, mica, 82 pF ±2%, Elmenco DM15F820G
C12	Capacitor, ceramic, tubular, 16 pF ±5%, Erie NPO-301
C13	Capacitor, dipped, mica, 82 pF ±2%, Elmenco DM15F820G
C14	Capacitor, dipped, mica, 82 pF ±2%, Elmenco DM15F820G
C15	Capacitor, ceramic, tubular, 16 pF ±5%, Erie NPO-301
C16	Capacitor, dipped, mica, 82 pF ±2%, Elmenco DM15F820G
C17	Capacitor, dipped, mica, 82 pF ±2%, Elmenco DM15F820G
C18	Capacitor, ceramic, tubular, 13 pF ±5%, Erie NPO-301
C19	Capacitor, dipped, mica, 62 pF ±2%, Elmenco DM15F620G
C20	Capacitor, dipped, mica, 82 pF ±2%, Elmenco DM15F820G
C21	Capacitor, ceramic, disc, 0.01 uF ±20%, 100V, Sprague 3TG-S102
C22	Capacitor, ceramic, tubular, 9.1 pF ±0.5 pF, NPO-301
C23	Capacitor, ceramic, disc, 0.01 uF ±20%, 100V, Sprague 3TG-S102
C24	Capacitor, ceramic, disc, 0.01 uF ±20%, 100V, Sprague 3TG-S102
C25	Capacitor, ceramic, tubular, 4.7 pF ±0.25 pF, Erie NPO-301
C26	Capacitor, ceramic, disc, 0.01 uF ±20%, 100V, Sprague 3TG-S102
C27	Capacitor, dipped, mica, 270 pF ±2%, Elmenco DM15F271G
C28	Capacitor, dipped, mica, 360 pF ±2%, Elmenco DM15F361G
C29 and C30	Capacitor, ceramic, disc, 0.001 2F -20+100%, Erie CK61Y102Z

Reference Designation	Description
C31	Capacitor, ceramic, disc, 0.01 uF ±20%, 100V, Sprague 3TG-S10
C32 through C34	Capacitor, ceramic, disc, 0.001 uF -20+100%, Erie CK61Y102Z
C35	Capacitor, variable, 2-8 pF, #538-011, A, 2-8 pF
C36 through C40	Capacitor, ceramic, disc, 0.001 uF -20+100%, Erie CK61Y102Z
C41	Capacitor, ceramic, tubular, 36 pF ±5%, Erie NPO-308
C42	Capacitor, variable, 9-35 pF, #538-011, D, 9-35 pF
C43 and C44	Capacitor, ceramic, disc, 0.001 uF -20+100%, Erie CK61Y102Z
CR1 through CR3	Diode, 1N4305
L1 and L2	Inductor, fixed, 6.8 uH ±10%, Nytronics WEE-6.8
L3 through L7	Inductor Assembly, Defense Electronics 203575
L8	Inductor, variable, 1.0 uH ±10%, Nytronics WEE-VL-1.0
L9	Inductor, variable, 0.82 uH ±10%, Nytronics WEE-VL-0.82
L10	Inductor, fixed, 6.8 uH ±10%, Nytronics WEE-6.8
L11	Inductor, fixed, 33 uH ±10%, Nytronics WEE-33
L12	Inductor, fixed, 6.8 uH ±10%, Nytronics WEE-6.8
L13	Inductor, fixed, 33 uH ±10%, Nytronics WEE-33
L14	Inductor, fixed, 1.0 uH ±10%, Nytronics WEE-1.0
L15 and L16	Inductor, fixed, 2.2 uH ±10%, Nytronics WEE-2.2

Reference Designation	Description
L17	Inductor, fixed, 0.56 uH ±10%, Nytronics WEE-0.56
L18	Inductor, fixed, 5.6 uH ±10%, Nytronics WEE-5.6
L19	Inductor, fixed, 0.68 uH ±10%, Nytronics WEE-0.68
P1	Connector, Cannon DCM-17W5P
Q1	Transistor, A492
Q2	Transistor, 2N708
Q3	Transistor, MM1941
Q4	Transistor, MM1941
R1	Resistor, fixed composition, 100Ω ±5%, 1/4W, Allen Bradley CB1015
R2	Resistor, fixed composition, 27Ω ±5%, 1/4W, Allen Bradley CB2705
R3	Resistor, fixed composition, 27Ω ±5%, 1/4W, Allen Bradley CB2705
R4	Resistor, fixed composition, 33Ω ±5%, 1/4W, Allen Bradley CB3305
R5	Resistor, fixed composition, 1.3k ±5%, 1/4W, Allen Bradley CB1325
R6	Resistor, fixed composition, 1.3k ±5%, 1/4W, Allen Bradley CB1325
R7	Resistor, fixed composition, 100Ω ±5%, 1/4W, Allen Bradley CB1015
R8	Resistor, fixed composition, 1.3k ±5%, 1/4W, Allen Bradley CB1325
R9	Resistor, fixed composition, 330Ω ±5%, 1/4W, Allen Bradley CB3315
R10	Resistor, fixed composition, 330Ω ±5%, 1/4W, Allen Bradley CB3315
R11	Resistor, fixed composition, 430Ω ±5%, 1/4W, Allen Bradley CB4315
R12	Resistor, fixed composition, 9.1k ±5%, 1/4W, Allen Bradley CB9125

Reference Designation	Description
R13	Resistor, fixed composition, 3.9k ±5%, 1/4W, Allen Bradley CB3925
R14	Resistor, fixed composition, 560Ω ±5%, 1/4W, Allen Bradley CB5615
R15	Resistor, fixed composition, 9.1k ±5%, 1/4W, Allen Bradley CB9125
R16	Resistor, fixed composition, 6.2k ±5%, 1/4W, Allen Bradley CB6225
R17	Resistor, fixed composition, 62Ω ±5%, 1/4W, Allen Bradley CB6205
R18	Resistor, fixed composition, 910Ω ±5%, 1/4W, Allen Bradley CB9115
R19	Resistor, fixed composition, 180Ω ±5%, 1/4W, Allen Bradley CB1815
R20	Resistor, fixed composition, 47Ω ±5%, 1/4W, Allen Bradley CB4705
R21	Resistor, fixed composition, 56Ω ±5%, 1/4W, Allen Bradley CB5605
R22	Not assigned
R23	Resistor, fixed composition, 5.1k ±5%, 1/4W, Allen Bradley CB5125
R24	Resistor, fixed composition, 10Ω ±5%, 1/4W, Allen Bradley CB1005
R25	Resistor, fixed composition, 1k ±5%, 1/4W, Allen Bradley CB1025
R26	Resistor, fixed composition, 47Ω ±5%, 1/4W, Allen Bradley CB4705
R27	Resistor, fixed composition, 1k ±5%, 1/4W, Allen Bradley CB1025
R28	Resistor, fixed composition, 300Ω ±5%, 1/4W, Allen Bradley CB3015
R29	Resistor, fixed composition, 390Ω ±5%, 1/4W, Allen Bradley CB3915
R30	Resistor, fixed composition, 300Ω ±5%, 1/4W, Allen Bradley CB3015
R31	Resistor, fixed composition, 51Ω ±5%, 1/4W, Allen Bradley CB5105

Reference Designation	Description
R32 through R35	Not assigned
R36	Resistor, fixed composition, 15Ω ±5%, 1/4W, Allen Bradley CB1505
R37	Resistor, fixed composition, 51Ω ±5%, 1/4W, Allen Bradley CB5105
R38	Resistor, fixed composition, 51Ω ±5%, 1/4W, Allen Bradley CB5105
T1	Transformer Assembly, Defense Electronics 203533
T2	Transformer Assembly, Defense Electronics 203576
T3 through T5	Transformer Assembly, Defense Electronics 203533
TP1	Test Point, white, Amp 3-582118-9
W1	Cable Assembly, Defense Electronics 105838-1
W2	Cable Assembly, Defense Electronics 105838-2
W3	Cable Assembly, Defense Electronics 105838-3
W4	Cable Assembly, Defense Electronics 105838-2
W5	Cable Assembly, Defense Electronics 105838-4
Z1 through Z15	Ferrite Bead, Ferroxcube K.5001-00/3B

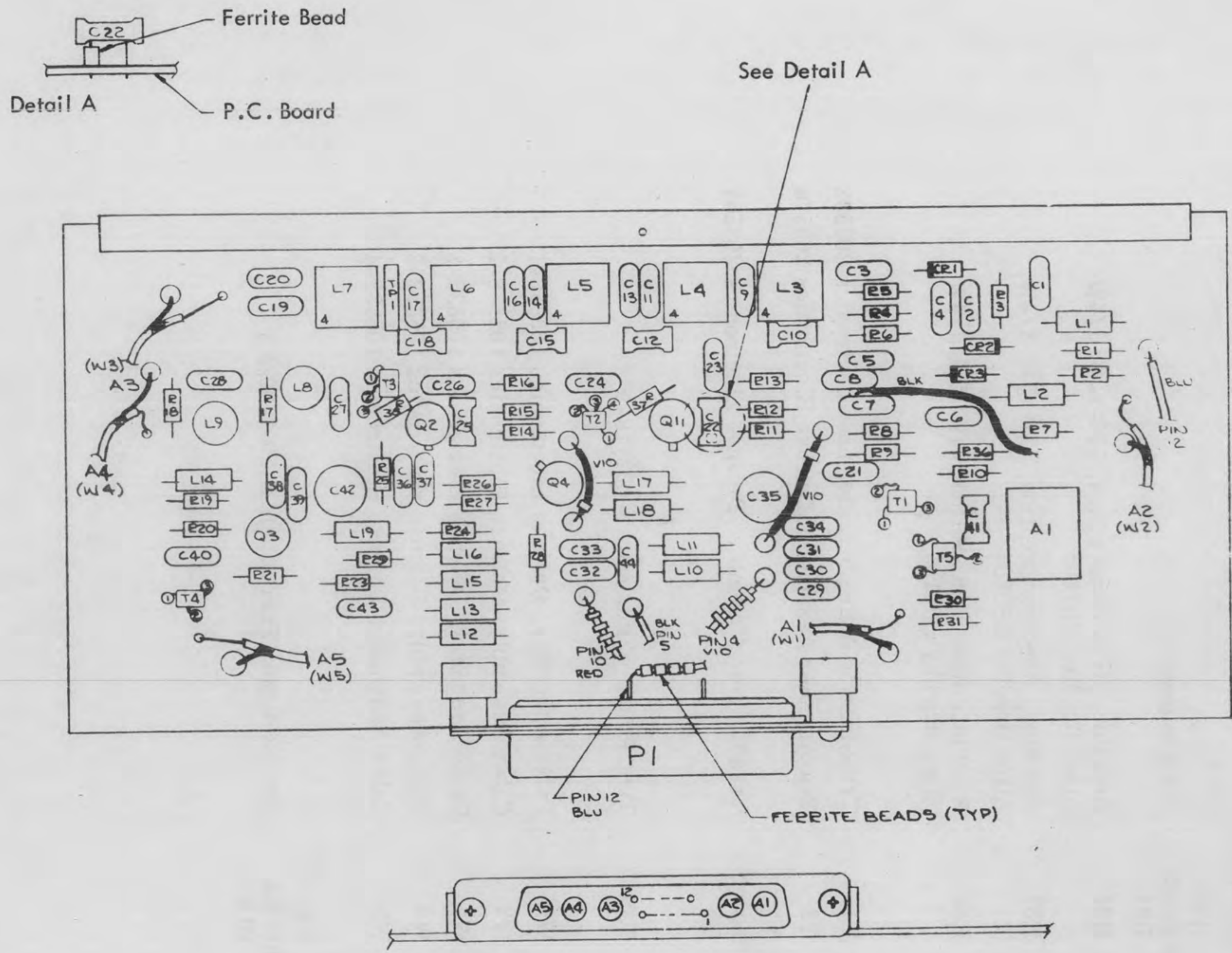
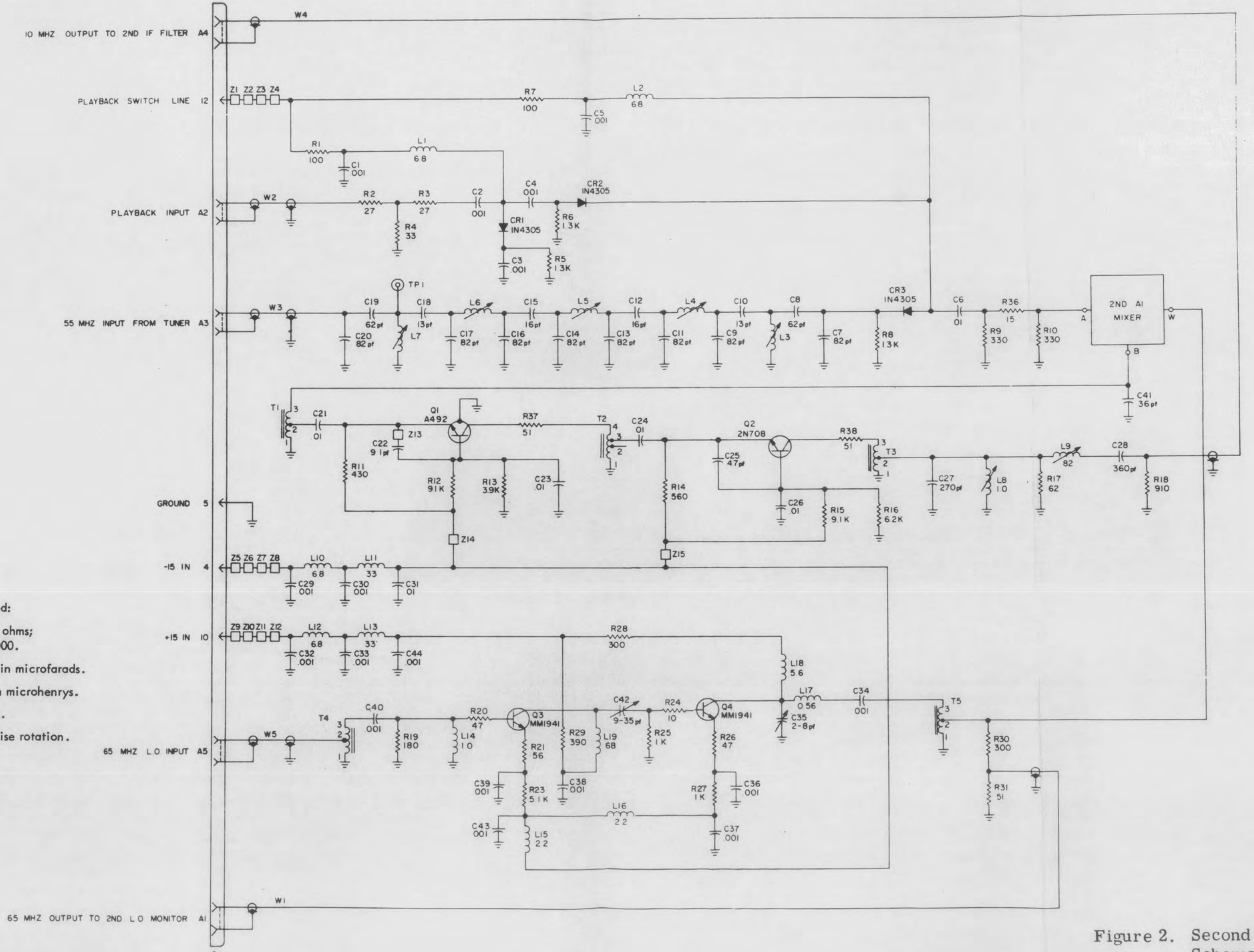


Figure 1. Component Locations
303208



NOTES:

Unless Otherwise Specified:

Resistor values are in ohms; k=1,000; M=1,000,000.

Capacitor values are in microfarads.

Inductor values are in microhenrys.

* = Selectable value.

Indicates clockwise rotation.

Figure 2. Second Mixer, Schematic Diagram 401625

INSTRUCTION BOOKLET

The i-f distribution amplifier/a-m detector is a plug-in subassembly designed for use in Defense Electronics telemetry receivers. Its purposes are to supply three isolated 10 MHz second i-f outputs at the required levels for distribution to points within the receiver, and to provide the a-m detector function for the receiver. The input to the subassembly is a linear (unlimited) 10 MHz second i-f signal.

The i-f distribution amplifier/a-m detector is constructed as an enclosed, modular subassembly which may be installed in or removed from the receiver in a matter of seconds after the top cover has been removed. All circuitry is contained on a single printed circuit board, contained within the subassembly, and is interconnected with the receiver through a miniature connector at the bottom of the subassembly.

INSTALLATION

No special procedures are necessary to install or remove the i-f distribution amplifier/a-m detector. The proper location for the subassembly will be found in the subassembly/module location drawing in Section V, Maintenance, of the applicable receiver instruction manual.

The physical proximity of the i-f distribution amplifier/a-m detector to other subassemblies of the receiver may necessitate the use of a flat-bladed screwdriver or similar instrument to lift the subassembly from the main chassis thus allowing removal. The subassembly is equipped with a flange, at the top, for this purpose.

All electrical connections between the main chassis and the subassembly are made automatically upon installation; there are no additional wires or cables to connect or disconnect.

PRINCIPLES OF OPERATION

The second i-f distribution amplifier/a-m detector subassembly employs two transistor-array integrated circuits for i-f distribution, a full-wave diode detector, and a two-transistor complementary a-m output buffer. To assist in interpreting the Principles of Operation, a block diagram is provided (see figure 1) which depicts the equivalent functional stages of the subassembly. The numerals shown at the input and output of each block, as applicable, indicate the corresponding pin of the associated integrated circuit.

Input to the subassembly is applied through A5 of P1 to pin 6 of integrated circuit A1. The signal is amplified, made available at pin 8, and applied through pin 9 of A1 to a buffer. The output of the buffer appears at pin 2 of A1. The three 10 MHz outputs of the subassembly are obtained by applying the buffer output (at pin 2) to three separate buffers, two a part of A1 and one a part of A2.

The 10 MHz signal to be applied to the demodulator of the receiver is applied through pin 3 of A1 to a buffer, the output of which is obtained at pin 5 and coupled through wideband isolation transformer T3 to A2 of P1.

One of the 10 MHz monitor signals is applied to a buffer (part of A1), then applied from pin 12 of A1 through T2 to A3 of P1. The second 10 MHz monitor signal is applied through R24 to pin 3 of A2, the buffered output being obtained at pin 5 and applied through T1 to A1 of P2.

The input signal for the detector is developed by applying the signal obtained at pin 2 of A1 to a driver, and coupling the amplified signal to a full-wave rectifier (detector) through T4. The driver consists, functionally, of three transistors providing two stages of amplification; the second and third transistors are connected in parallel to provide adequate current for the detector.

The detector input is filtered by the linear-phase lowpass filter consisting of L1-L2 and C2-C5-C6. Filter efficiency is enhanced by the fact that the full-wave detector doubles the frequency of the carrier (i-f) signal. Additionally, the use of a full-wave detector gives wide bandwidth response with low distortion. Gain adjustment is provided by R13, which is used to vary the amount of feedback in the detector driver.

The filtered a-m output of the detector is applied to the base of Q1, which, with Q2, forms the complementary output buffer. R4 provides the means for offset (dc zero) adjustment. The a-m output signal of the subassembly is obtained from the emitter of Q2 and made available at A4 of P1.

Multiple voltage supply-line filtering is used in the second i-f distribution amplifier/ a-m detector subassembly for maximum isolation and excellent circuit stability.

MAINTENANCE

The design of the i-f distribution amplifier/a-m detector subassembly limits the need for maintenance. During normal operation, no periodic adjustment is necessary or desirable. Unnecessary adjustments may degrade the performance of the receiver, and therefore should be avoided.

CHANGE SHEET

ELECTRICAL PARTS LIST, revise as follows:

Page	Reference Designation	Description
7	CR1 and CR2	Diode, Hot Carrier, Hewlett Packard 5082-2804

MAINTENANCE DIAGRAMS, revise as follows:

Page	
13/14	Figure 3, schematic diagram, change part numbers of CR1 and CR2 from 5620 to 5082-2804.

Model:	Date:
303210	10/27/70

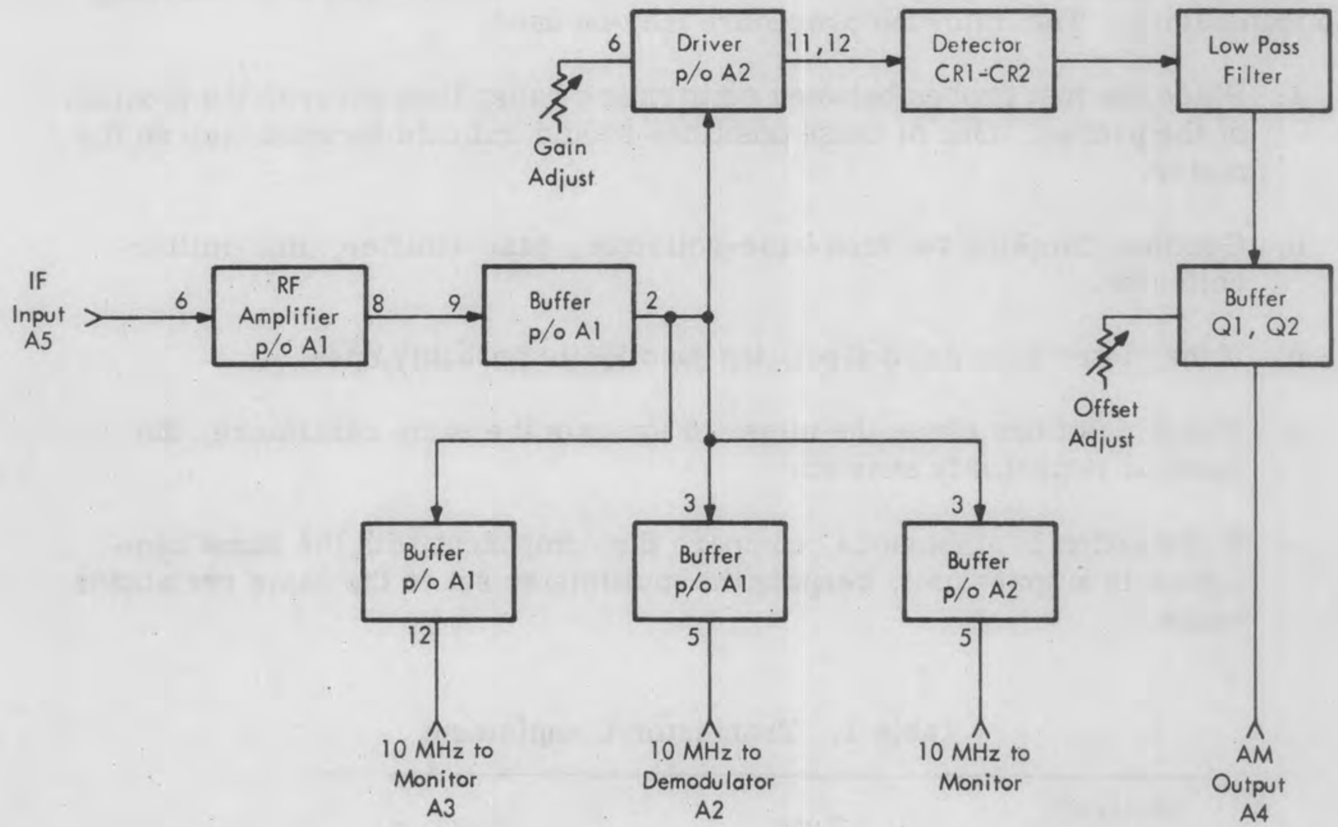


Figure 1. Functional Block Diagram

The subassembly is assembled and disassembled in a straightforward manner and should pose no problem to servicing personnel.

The circuitry is located on a printed circuit board mounted on spacers in a metal chassis. Four machine screws hold the pc board in place. The cover of the chassis, held in place with four machine screws, extends beyond the chassis on one side. This flange and a flange on the chassis are provided to facilitate plugging the chassis into the receiver mounting clips. A flange is also provided at the top of the subassembly to assist in removal from the receiver chassis.

Straightforward troubleshooting methods should be used if a malfunction occurs. The schematic diagram and circuit description given herein should provide the data necessary for qualified maintenance technicians to isolate the malfunction, using effect-to-cause reasoning.

The first check should be of the power supply voltages. Incorrect power supply voltages can have varying effects on the operation of the subassembly. The next most likely causes of trouble are the transistors and the diodes. A Simpson 260 multimeter, set up for continuity measurements, is recommended for checking the transistors. The following procedure may be used:

a. Place the test probes between emitter and base; then reverse the position of the probes. One of these positions should indicate forward bias on the meter.

b. Continue checking between base-collector, base-emitter, and emitter-collector.

c. If the meter does not deflect, the junction is probably open.

d. If both positions cause the meter to indicate the same resistance, the junction is probably shorted.

e. If indication is ambiguous, compare the component with the same component in a spare unit, keeping the multimeter set to the same resistance range.

Table 1. Transistor Complement

Reference Designation	Type	Function
A1	CA3018A	10 MHz Amplifier
A2	CA3018A	10 MHz Amplifier
Q1	2N3904	Emitter Follower
Q2	2N3906	Output Buffer

Repair and Replacement

All components used in the i-f distribution amplifier/a-m detector are considered non-repairable, and should be replaced when found to be defective. A complete electrical parts list is given in this booklet, and a component location drawing is provided.

Care should be exercised when replacing components on the printed circuit board. The following is a suggested procedure for removing components from the board; the procedure requires the following equipment:

Liquid soldering flux	1/8 inch, #18 AWG, flat braid
Flux remover	Medium wattage solder iron.

Apply a thin coat of liquid flux to the flat braid. Place and hold the braid over the solder joint. Apply heat to the braid directly over the solder joint; the braid will absorb most of the solder.

CAUTION

Do not heat the joint for long periods of time as excessive heat may damage the circuit board.

After the major portion of the solder has been absorbed by the braid, apply heat directly to the solder joint and carefully pry loose the defective component. Clean the affected area using the flux remover. Trim the replacement component leads to the same length as the original component leads. Position the replacement component on the circuit board and solder it in place. Clean the affected area with flux remover.

Following replacement of any circuit component, recalibration may be necessary; in this case, the following procedure is recommended.

Calibration

Recommended Equipment:

Signal Generator	HP 606A
DC Voltmeter	HP 412A
Power Supplies	HP 721A
Test Set	Defense Electronics 105956

a. Connect the power supplies to the test set and adjust for +15V and -15V. Set the short circuit current to 100 mA. Plug the subassembly into the test set.

b. Connect the dc voltmeter to J4 of the test set. Adjust R4 of the subassembly for a -1.2V indication on the voltmeter.

c. Connect the signal generator to J5; adjust its output to 10 MHz at a level of -125 dBm. Adjust R13 of the subassembly for a voltmeter indication of 0.0(±0.5)V.

ELECTRICAL PARTS LIST (See Figure 2)

Reference Designation	Description
A1 and A2	Integrated Circuit, RCA CA3018A
C1	Capacitor, ceramic, disc, 0.01 uF ±20%, 100V, Erie 805-Z5V
C2	Capacitor, dipped, mica, 18 pF ±5%, Elmenco DM15F180J
C3	Not assigned
C4	Not assigned
C5	Capacitor, dipped, mica, 62 pF ±5%, Elmenco DM15F620J
C6	Capacitor, dipped, mica, 18 pF ±5%, Elmenco DM15F180J
C7 through C13	Capacitor, ceramic, disc, 0.01 uF ±20%, 100V, Erie 805-Z5V
C14	Capacitor, dipped, mica, 10 pF ±5%, Elmenco DM15F100J
C15 through C19	Capacitor, ceramic, disc, 0.01 uF ±20, Erie 805-Z5V
C20	Capacitor, dipped, mica, 10 pF ±5%, Elmenco DM15F100J
C21 through C25	Capacitor, ceramic, disc, 0.01 uF ±20%, 100V, Erie 805-Z5V
C26	Capacitor, dipped, mica, 10 pF ±5%, Elmenco DM15F100J
C27	Capacitor, ceramic, disc, 0.01 uF ±20%, 100V, Erie 805-Z5V
CR1 and CR2	Diode, Hot Carrier, Summit Eng. Corp. 5620 (matched pair)
L1 and L2	Inductor, fixed, 47 uH ±5%, Nytronics WEE-47
L3	Inductor, fixed, 68 uH ±5%, Nytronics WEE-68
L4 through L8	Inductor, fixed, 180 uH ±5%, Nytronics WEE-180

Reference Designation	Description
P1	Connector, Cannon DCM-17W5P
Q1	Transistor, 2N3904
Q2	Transistor, 2N3906
R1	Resistor, composition, fixed, 2k ±5%, 1/4W, Allen Bradley CB2025
R2	Resistor, composition, fixed, 39Ω ±5%, 1/4W, Allen Bradley CB3905
R3	Resistor, composition, fixed, 240Ω ±5%, 1/4W, Allen Bradley CB2415
R4	Resistor, potentiometer, 500Ω, Beckman 78PR500Ω
R5	Resistor, composition, fixed, 6.2k ±5%, 1/4W, Allen Bradley CB6225
R6	Resistor, composition, fixed, 1k ±5%, 1/4W, Allen Bradley CB1025
R7	Resistor, composition, fixed, 27k ±5%, 1/4W, Allen Bradley CB2735
R8	Resistor, composition, fixed, 160Ω ±5%, 1/4W, Allen Bradley CB1615
R9	Resistor, composition, fixed, 1k ±5%, 1/4W, Allen Bradley CB1025
R10	Not assigned
R11	Resistor, composition, fixed, 1k ±5%, 1/4W, Allen Bradley CB1025
R12	Resistor, composition, fixed, 910Ω ±5%, 1/4W, Allen Bradley CB9115
R13	Resistor, potentiometer, 2k, Beckman 78PR2K
R14	Resistor, composition, fixed, 390Ω ±5%, 1/4W, Allen Bradley CB3915
R15	Resistor, composition, fixed, 39Ω ±5%, 1/4W, Allen Bradley CB3905
R16	Resistor, composition, fixed, 1.3k ±5%, 1/4W, Allen Bradley CB1325

Reference Designation	Description
R17	Resistor, composition, fixed, 62Ω ±5%, 1/4W, Allen Bradley CB6205
R18	Resistor, composition, fixed, 910Ω ±5%, 1/4W, Allen Bradley CB9115
R19	Resistor, composition, fixed, 75Ω ±5%, 1/4W, Allen Bradley CB7505
R20	Resistor, composition, fixed, 1k ±5%, 1/4W, Allen Bradley CB1025
R21	Resistor, composition, fixed, 1.3k ±5%, 1/4W, Allen Bradley CB1325
R22	Resistor, composition, fixed, 51Ω ±5%, 1/4W, Allen Bradley CB5105
R23 and R24	Resistor, composition, fixed, 39Ω ±5%, 1/4W, Allen Bradley CB3905
R25	Resistor, composition, fixed, 200Ω ±5%, 1/4W, Allen Bradley CB2015
R26	Resistor, composition, fixed, 1k ±5%, 1/4W, Allen Bradley CB1025
R27	Resistor, composition, fixed, 51Ω ±5%, 1/4W, Allen Bradley CB5105
R28	Resistor, composition, fixed, 1.3k ±5%, 1/4W, Allen Bradley CB1325
R29	Resistor, composition, fixed, 51Ω ±5%, 1/4W, Allen Bradley CB5105
R30	Not assigned
R31	Resistor, composition, fixed, 1.3k ±5%, 1/4W, Allen Bradley CB1325
R32	Resistor, composition, fixed, 3k ±5%, 1/4W, Allen Bradley CB3025
R33	Resistor, composition, fixed, 4.3k ±5%, 1/4W, Allen Bradley CB4325
R34	Resistor, composition, fixed, 910Ω ±5%, 1/4W, Allen Bradley CB9115
R35	Resistor, composition, fixed, 510Ω ±5%, 1/4W, Allen Bradley CB5115

Reference Designation	Description
R36	Resistor, composition, fixed, 43Ω ±5%, 1/4W, Allen Bradley CB4305
R37	Resistor, composition, fixed, 2.7k ±5%, 1/4W, Allen Bradley CB2725
R38	Resistor, composition, fixed, 12k ±5%, 1/4W, Allen Bradley CB1235
R39	Resistor, composition, fixed, 3.3k ±5%, 1/4W, Allen Bradley CB3325
R40	Resistor, composition, fixed, 51Ω ±5%, 1/4W, Allen Bradley CB5105
R41	Resistor, composition, fixed, 200Ω ±5%, 1/4W, Allen Bradley CB2015
R42	Resistor, composition, fixed, 200Ω ±5%, 1/4W, Allen Bradley CB2015
T1 through T3	Transformer Assembly, Defense Electronics 203533
T4	Transformer Assembly, Defense Electronics 203534
TP1	Test Point, white, Amp 3-582118-9
W1	Cable Assembly, Defense Electronics 105823-1
W2	Cable Assembly, Defense Electronics 105823-2
W3	Cable Assembly, Defense Electronics 105823-1
W4	Cable Assembly, Defense Electronics 105823-3
W5	Cable Assembly, Defense Electronics 105823-4

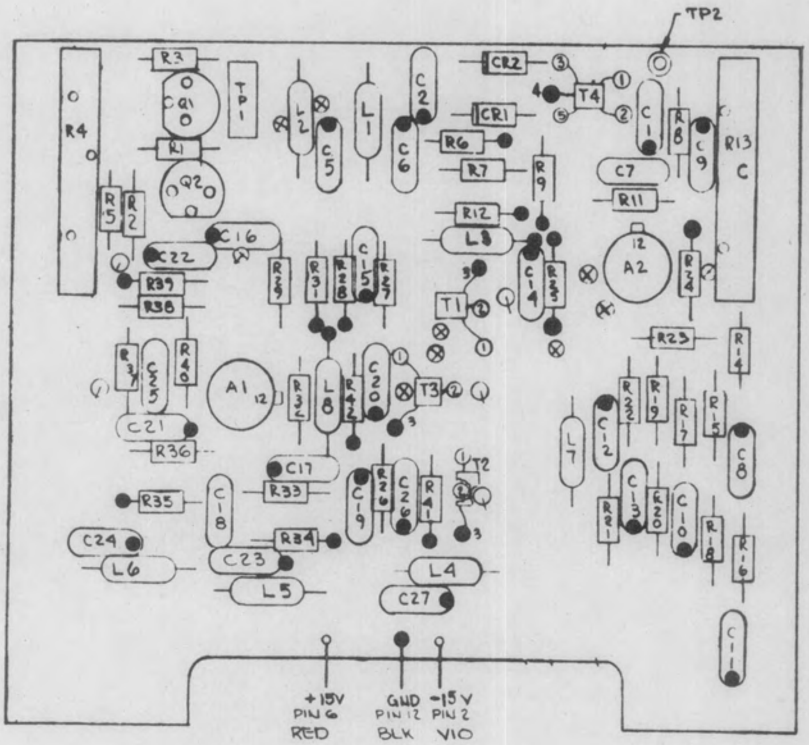
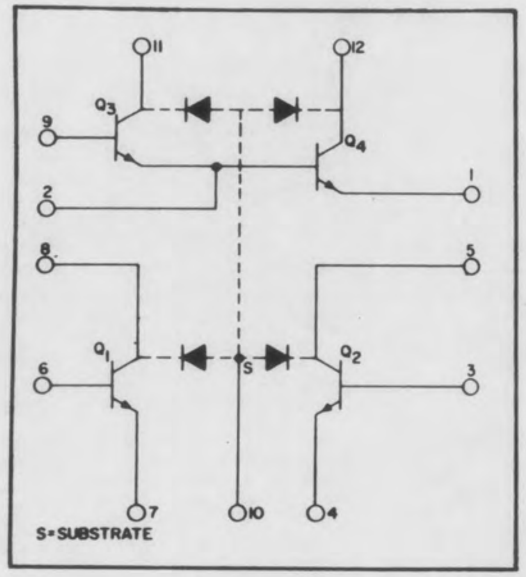


Figure 2. Component Locations
303210



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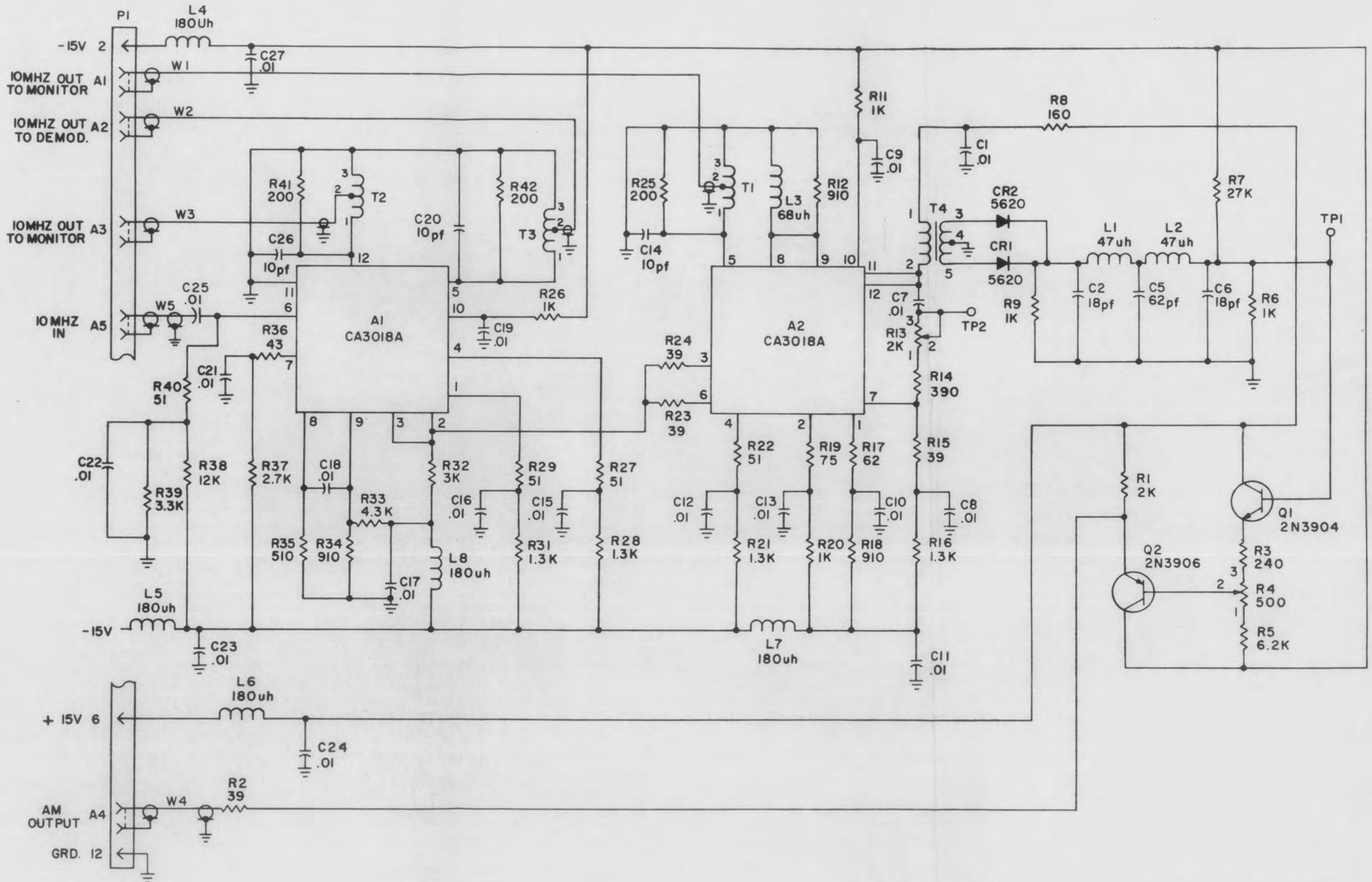


NOTES:

Unless Otherwise Specified:

Resistor values are in ohms;
k=1,000; M=1,000,000.

Capacitor values are in microfarads.

Inductor values are in microhenrys.

* = Selectable value.

Indicates clockwise rotation.

Figure 3. Second IF Distribution Amplifier/AM Detector Schematic Diagram 303249

Revised: August 1970
January 1970

AGC AMPLIFIER
303211-90

INSTRUCTION BOOKLET

The agc amplifier is a plug-in subassembly designed for use in Defense Electronics telemetry receivers. The subassembly accepts as its primary input an a-m signal from the a-m detector of the receiver, which is a function of the received signal level, and provides the following outputs:

a. An agc voltage which may be used to automatically control the gain of the receiver; this signal can appear as one or two outputs from the subassembly, depending upon the level of the received signal. At signal levels corresponding to less than approximately two-thirds of the receiver's dynamic range, the varying gain control voltage which is a function of the received signal level is present only at one point on the subassembly connector, and is used to vary the gain of only the receiver second i-f amplifier and second i-f bandwidth filter. At signal levels above approximately two-thirds of the receiver's dynamic range, at which point the second i-f circuits can no longer be effectively gain-controlled, the agc signal appears at a second point on the output connector, and is applied simultaneously to the rf tuner of the receiver. The result of this is to provide gain control of the receiver in which the subassembly is installed over a very wide dynamic range (i.e., over a wide range of received signal levels). A manual gain control mode is also available.

b. An agc output signal, which is applied through main chassis wiring to a rear apron connector and may be used for such applications as signal strength recording.

c. Carrier-operated relay signal; the agc amplifier provides output signals which are used to operate a carrier-operated relay in the receiver, and to provide visible indication of signal acquisition by causing a lamp to light at the receiver front panel.

d. A sweep disable signal; this signal appears upon signal acquisition and is used when the receiver is in the afc search mode of operation, to cause the afc search function to cease.

e. A signal which is used to operate the receiver signal strength meter, thus providing an indication of received signal level.

f. The agc amplifier also provides, in conjunction with receiver main chassis circuits, signal strength meter zero control, and agc sense (polarity) switching.

The agc amplifier circuitry is contained on a single plug-in printed circuit board, equipped with a handle and an edgeboard connector, which may be removed from or installed in the receiver in a few seconds, after the top cover has been removed.

INSTALLATION

No special procedures are necessary to install or remove the agc amplifier. The proper location for the subassembly will be found in the subassembly/module location drawing given in Section V, Maintenance, of the applicable receiver instruction manual.

All electrical connections between the main chassis and the subassembly are made automatically upon installation; there are no additional wires or cables to connect or disconnect.

PRINCIPLES OF OPERATION

The primary purpose of the agc amplifier is to develop a voltage, derived from an a-m input, that can be used to control the gain of the receiver in which the subassembly is installed. The control-voltage output of the subassembly is applied to the second i-f amplifier and second i-f bandwidth filters of the receiver and, when the received signal exceeds a predetermined level, to the rf tuner.

The agc amplifier also provides signals for the receiver signal strength meter, carrier-operated relay circuits, afc and apc sweep control circuits, and an auxiliary agc output for application to a connector at the rear apron of the receiver.

The agc amplifier can be divided, from a functional viewpoint, into a number of circuits which are as follows (see figure 1):

a. The integrator, A2, plus Q1, Q2, Q5, Q6, Q9 through Q11; the integrator section of the subassembly works in conjunction with diode-transistor input switching logic to provide five selectable agc time constants or a manual gain control mode. The desired mode is selected by applying a three-bit code to the switching logic, the particular combination being selected through the use of front-panel switches on the receiver. The integrator supplies the input signals for all other functions of the subassembly.

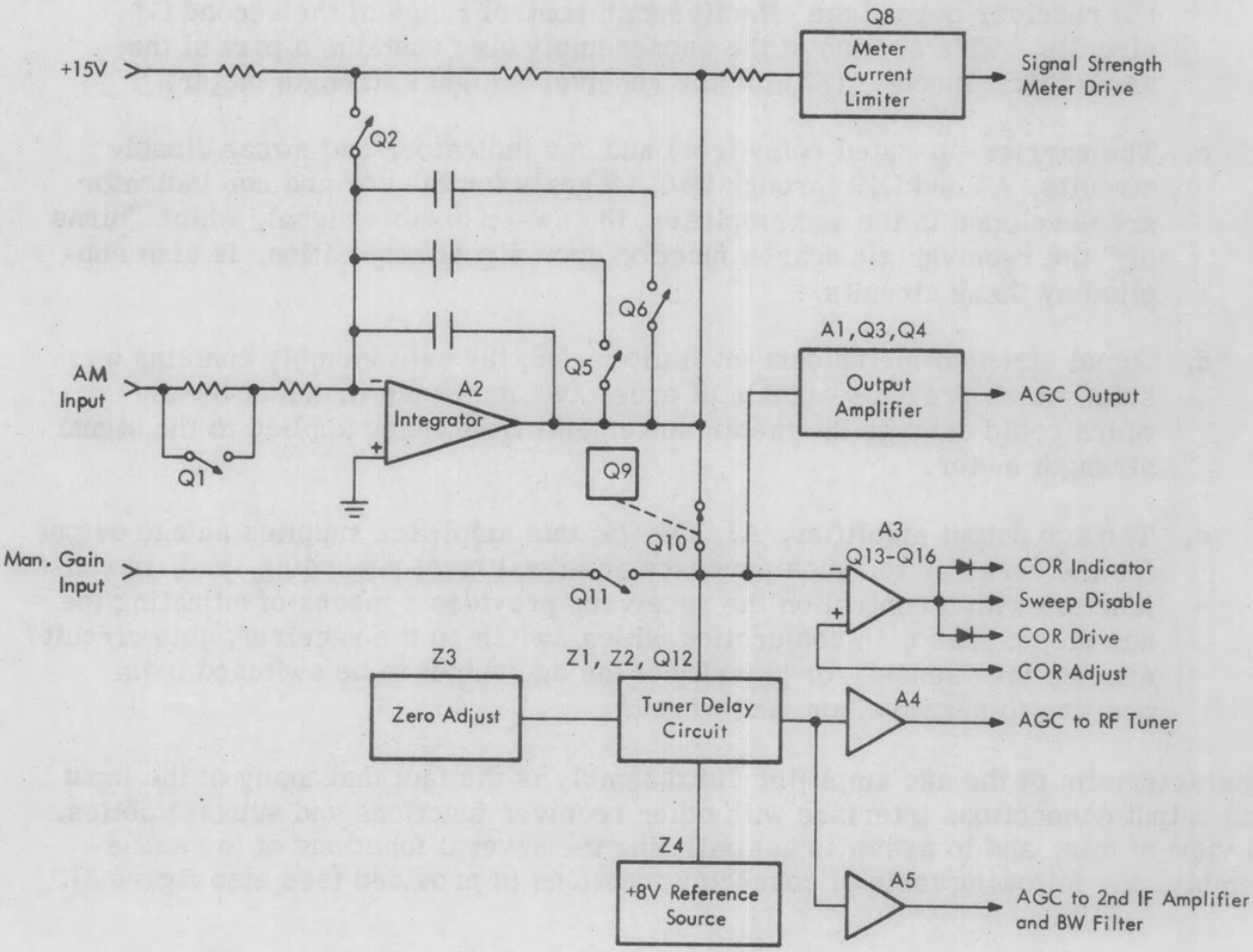


Figure 1. Functional Block Diagram

b. The agc distribution circuits, Z1 through Z4, Q12, A4-A5; it is the purpose of these circuits to apply the conditioned agc signal to the appropriate receiver circuits, dependent upon the strength of the received signal. For received signal levels of low and intermediate strength (specifically those which produce agc voltages corresponding to a maximum of approximately three-fourths of the dynamic range of the receiver), the agc voltage is applied to the receiver second i-f amplifier and second i-f bandwidth filter; for higher received signal levels, the agc voltage is applied also to the rf tuner. The result of this is to extend the gain control range of the receiver beyond the effective gain control range of the second i-f circuits. This section of the subassembly also contains a part of the zero-adjust function (Z3) for the receiver's signal strength meter.

c. The carrier-operated relay (cor) and cor indicator, and sweep disable circuits, A3 and Q13 through Q16. Signals for the cor and cor indicator are developed in the agc amplifier; the sweep disable signal, which "turns off" the receiver afc search function upon signal acquisition, is also supplied by these circuits.

d. Signal strength meter current limiter, Q8; the subassembly contains a stage which prevents signals of excessive amplitude (i.e., at levels which could damage the meter movement) from being applied to the signal strength meter.

e. The agc output amplifier, A1, Q3-Q4; this amplifier supplies an agc output for the receiver for such purposes as signal level recording, and, in conjunction with a control on the receiver, provides a means of adjusting the agc slope. Also, in conjunction with a switch on the receiver, this circuit enables the "sense", or polarity of the agc output to be switched from positive to negative, or vice-versa.

Characteristic of the agc amplifier subassembly is the fact that many of the input and output connections interface with other receiver functions and subassemblies. In view of this, and to assist in assimilating the several functions of the subassembly, the following table of connector functions is provided (see also figure 3).

Table 1. Connector Functions

Pin Designation	Description
16 - AGC Output	Provides agc output signal for application to receiver rear panel connector.
S - Output Slope	Interfaces with rear panel potentiometer to allow adjustment of agc output slope.

continued

Table 1, continued

Pin Designation	Description
17, 18 - Output Sense	Connects to receiver rear panel switch to allow polarity of agc output voltage to be reversed if desired.
3 - Signal Strength Meter Drive . . .	Connected through a potentiometer in the receiver to the receiver signal strength meter; operates this meter.
A - Input	Video input from the detector (a-m with fm demodulator, synchronous a-m with phase demodulator); used to provide basic indication of received signal strength to agc amplifier.
1, B, C - Gain Control Mode	Three-bit two-level code applied to these points establishes time constant for integrator, or allows manual adjustment of receiver gain.
D, 2 - Manual Drive Input	When the agc amplifier is in the manual mode, a variable voltage is applied at this point, the level of which determines the output level of the agc amplifier, and thus the gain of receiver circuits.
E - Sense Output	Interfaces with rear panel agc sense switch to reverse polarity of agc input to A1 of subassembly and thus reverse agc output sense as required.
R, 4 - Normalizer Input, Output . .	Interconnected with normalization network in second i-f bandwidth filters to assure uniform gain control characteristics with changes in i-f bandwidth.
13 - AGC to Tuner.	Gain control voltage output to receiver rf tuner; agc is applied to the tuner only when the control voltage applied to the second i-f amplifier and filter reaches a maximum.
P - AGC to Second IF, Bandpass Filters	Gain control voltage output to receiver second i-f amplifier and bandwidth filter.

continued

Table 1, continued

Pin Designation	Description
K - Signal Strength Zero	Interconnects with potentiometer on receiver to provide signal strength meter zero adjustment.
J - COR Lamp	Provides drive signal to carrier operated relay lamp on receiver; lamp lights when received signal is above preset level.
H - COR (Relay Drive)	Provides closing signal to cor (carrier operated relay) when received signal drops below preset level; output appears when output at pin J is absent.
5 - Sweep Disable	Provides signal to subassembly which disables afc search function upon signal acquisition. This signal enables search function when carrier drops below preset level.
U - +15 VDC Input	+15V dc operating voltage for subassembly circuits; from power supply regulator subassembly.
V - Ground	Connects subassembly ground to receiver main chassis ground.
14 - -15 VDC Input	-15V dc operating voltage for subassembly circuits; from power supply regulator subassembly.
F - COR Adjust	Provides a means of adjusting the carrier level at which the cor lamp and cor relay drive drive signals appear, and the level at which afc search commences.

Integrator

The integrator, A2, is basically an operational amplifier employing capacitive feedback and resistive input, and offering five different electronically-switched time constants. Switching of the time constants (tc) of A1 is performed by Q1, Q5 and Q6. Additionally, a manual gain-control mode may be selected. Thus a total of six possible operating modes exists for the integrator.

The integrator also provides an output that is used to drive the receiver signal strength meter (pin 3 of P1). Q8 functions as a current limiter to prevent meter damage due to excessive current, and provides a logarithmic output characteristic as the signal level reaches a maximum.

Selection of the integrator mode, specifically the desired time constant or the manual mode, is implemented by a switch on the receiver front panel. Switching is electrical, and is accomplished through the use of diode-transistor logic. The switching code is two-level, and consists of three bits. The code for each time constant and the manual mode is as shown below; "0" corresponds to -15 volts, and "1" corresponds to +15 volts:

Time Constant (msec)	Connector Pin Designation		
	1	B	C
1000	0	0	1
100	1	0	1
10	0	1	0
1	1	1	0
0.1	1	0	0
Manual	1	1	1

The circuit components providing the desired time constant for the selected input code are as follows:

a. 1000 msec: R6 (Q1 off); R11; C4 (Q6 on, Q5 off); C6.

b. 100 msec: R11 (Q1 on, bypassing R6); C4 (Q6 on, Q5 off); C6.

c. 10 msec: R6 (Q1 off); R11; C5 (Q5 on, Q6 off); C6.

d. 1 msec: R11 (Q1 on, bypassing R6); C5 (Q5 on, Q6 off); C6.

e. 0.1 msec: R11 (Q1 on); C6 (Q5 and Q6 off).

f. Manual: Q9 and Q11 are on, and Q10 is off; Q2 is on. The feedback loop is through R14 and Q2. A2 functions as an amplifier, driving only the receiver's signal strength meter.

AGC Distribution Circuits

The agc distribution and associated functions are provided by Z1-Z4, Q12, and A4-Q5. The agc switching function, which determines whether the varying gain control voltage derived from the received signal level is applied only to the second i-f amplifier and bandwidth filter or to both the i-f circuits and the rf tuner, is performed by Z1 and Z2, in conjunction with Q12.

Z1, functioning as an operational amplifier, receives its input from Q10 or Q11, through R31. A part of Z2 operates as a differential amplifier; its inputs are a reference voltage (obtained from voltage source Z4 and a voltage divider consisting of R59 and R60), and the output of Z1. CR14 is the reference zener for Z4. Z2, together with Q12, acts as the gate which applies gain control voltage to A4 and thus to the rf tuner, at the point determined by the normalizing network in the second i-f bandwidth filter. Q12 supplies the input to a darlington connected pair (a part of Z2). Gain control voltage to the second i-f amplifier and bandwidth filter is the output of A5, which also receives its input from Z1. The primary purpose of Z3 is to provide a zero adjust function (in conjunction with a receiver front panel control) for the signal strength meter.

COR Amplifier

The cor (carrier-operated relay) amplifier provides cor relay drive and indicator output developed as a function of the agc signal from the integrator. The cor amplifier, A3 and Q13-Q16, also provides a sweep disable output which causes the afc search function of the receiver to cease upon signal acquisition.

The input signal is applied through R33 to A3, an operational amplifier operating essentially open-loop. The state of A3 changes sharply, from positive saturation to negative saturation, as the input signal (a function of the received signal level) increases beyond a preset level. The level at which A3 changes state is determined by the setting of the receiver cor adjust control; adjustment of this control causes a varying voltage to be applied to A3 through pin F of P1.

The output of A3 is applied to complementary amplifiers Q13-Q14 and Q15-Q16. The cor and sweep-disable output signal is applied directly to pin 5 of P1 (sweep disable) and through CR15 and CR16, respectively to pins J (cor indicator) and H (cor-relay) of P1.

Signal Strength Meter Current Limiter

The signal strength meter current limiter functions to prevent meter damage which would otherwise be caused by high level signals. This function is performed by Q8, which also provides a logarithmic meter characteristic as the signal level increases toward maximum. The input to Q8 is from A2.

AGC Output Amplifier

The agc output amplifier consists of A1, Q3, and Q4. A1 is a feedback controlled operational amplifier of which the gain is adjusted by a potentiometer located on the receiver rear panel. The purpose of A1, Q3, and Q4 is to provide a receiver output that may be used for such purposes as signal strength recording; adjustment of the rear panel potentiometer (which interfaces with pins S and T) varies the gain of A1, and thus the gain of the agc output amplifier, providing a means of adjusting the agc slope. Input to the agc output amplifier is obtained from the junction of R31 and R33, through R34 and the agc sense switch on the receiver. The dpdt agc sense switch provides a means reversing the polarity of the agc output signal which is the output of A1, Q3, and Q4. One arm of this switch is in turn connected to a potentiometer which is part of a voltage divider connected between +15 volt and -15 volt sources; this allows adjustment of the dc voltage applied to one input of A1, thus providing an agc zero adjustment.

MAINTENANCE

The design of the agc amplifier limits the need for maintenance. During normal operation, no periodic adjustment is necessary or desirable. Unnecessary adjustments may degrade the performance of the receiver, and therefore should be avoided.

Straightforward troubleshooting methods should be used if a malfunction occurs. The schematic diagram and circuit description given herein should provide the data necessary for qualified maintenance technicians to isolate the malfunction, using effect-to-cause reasoning.

The first check should be of the power supply voltages. Incorrect power supply voltages can have varying effects on the operation of the subassembly. The next most likely causes of trouble are the transistors and the diodes. A Simpson 260 multimeter, set up for continuity measurements, is recommended for checking the transistors. The following procedure may be used:

a. Place the test probes between emitter and base; then reverse the position of the probes. One of these positions should indicate forward bias on the meter.

b. Continue checking between base-collector, base-emitter, and emitter-collector.

c. If the meter does not deflect, the junction is probably open.

d. If both positions cause the meter to indicate the same resistance, the junction is probably shorted.

e. If indication is ambiguous, compare the component with the same component in a spare unit, keeping the multimeter set to the same resistance range.

Table 2. Transistor Complement

Reference Designation	Type	Function
A1	μA 741	Amplifier
A2	LM 301A	Integrator
A3 through A5	μA 741	Amplifier
Q1	2N5555	Switch
Q2	2N5555	Switch
Q3	2N2218	Current Amplifier
Q4	2N2904	Current Amplifier
Q5	2N3904	Switch
Q6	2N3904	Switch
Q7	Not assigned	
Q8	2N5087	Current Limiter
Q9	2N3904	Inverter
Q10	U201	Switch
Q11	U201	Switch
Q12	2N3906	Amplifier
Q13	2N3904	Complementary Symmetry Amplifier
Q14	2N3906	
Q15	2N3906	Complementary Symmetry Amplifier
Q16	2N3904	
Z1 Z2	CA3018	Part of AGC Dist. Circuit
Z3	CA3018A	Part of Sig. Strength Meter Zero Circuit
Z4	CA3018	Voltage Source

Repair and Replacement

All components used in the agc amplifier are considered non-repairable, and should be replaced when found to be defective. A complete electrical parts list is given in this booklet, and a component location drawing is provided.

Care should be exercised when replacing components on the printed circuit board. The following is a suggested procedure for removing components from the board; the procedure requires the following equipment:

Liquid soldering flux	**1/8 inch, #18 AWG, flat braid**
Flux remover	**Medium wattage solder iron**

Apply a thin coat of liquid flux to the flat braid. Place and hold the braid over the solder joint. Apply heat to the braid directly over the solder joint; the braid will absorb most of the solder.

CAUTION

Do not heat the joint for long periods of time as excessive heat may damage the circuit board.

After the major portion of the solder has been absorbed by the braid, apply heat directly to the solder joint and carefully pry loose the defective component. Clean the affected area using the flux remover. Trim the replacement component leads to the same length as the original component leads. Position the replacement component on the circuit board and solder it in place. Clean the affected area with flux remover.

If a component is replaced, recalibration may be necessary; in this case, the following procedure is recommended.

Calibration

Recommended Equipment:

Digital Voltmeter	HP 2401C
AC VTVM	HP 400D
Resistor, fixed	226k ±1%
Test Set	Defense Electronics 105957
Power Supply (2 required)	HP 721A

a. Connect the power supplies to the test set and adjust for +15V and -15V; set the short circuit current to 100 mA.

b. Connect the 226k resistor between TP1 and the junction of C4 and R11. Set the LOOP switch to CLOSED. Set the MODE switch to 10; adjust the STRESS control for 0V ±50 mV at J6. Insert the subassembly into the test set.

c. Connect the digital voltmeter to J5 and adjust R39 on the module for +8V ±5 mV. Remove the 226k resistor from the subassembly.

This completes the calibration of the agc amplifier subassembly.

ELECTRICAL PARTS LIST (See Figure 2)

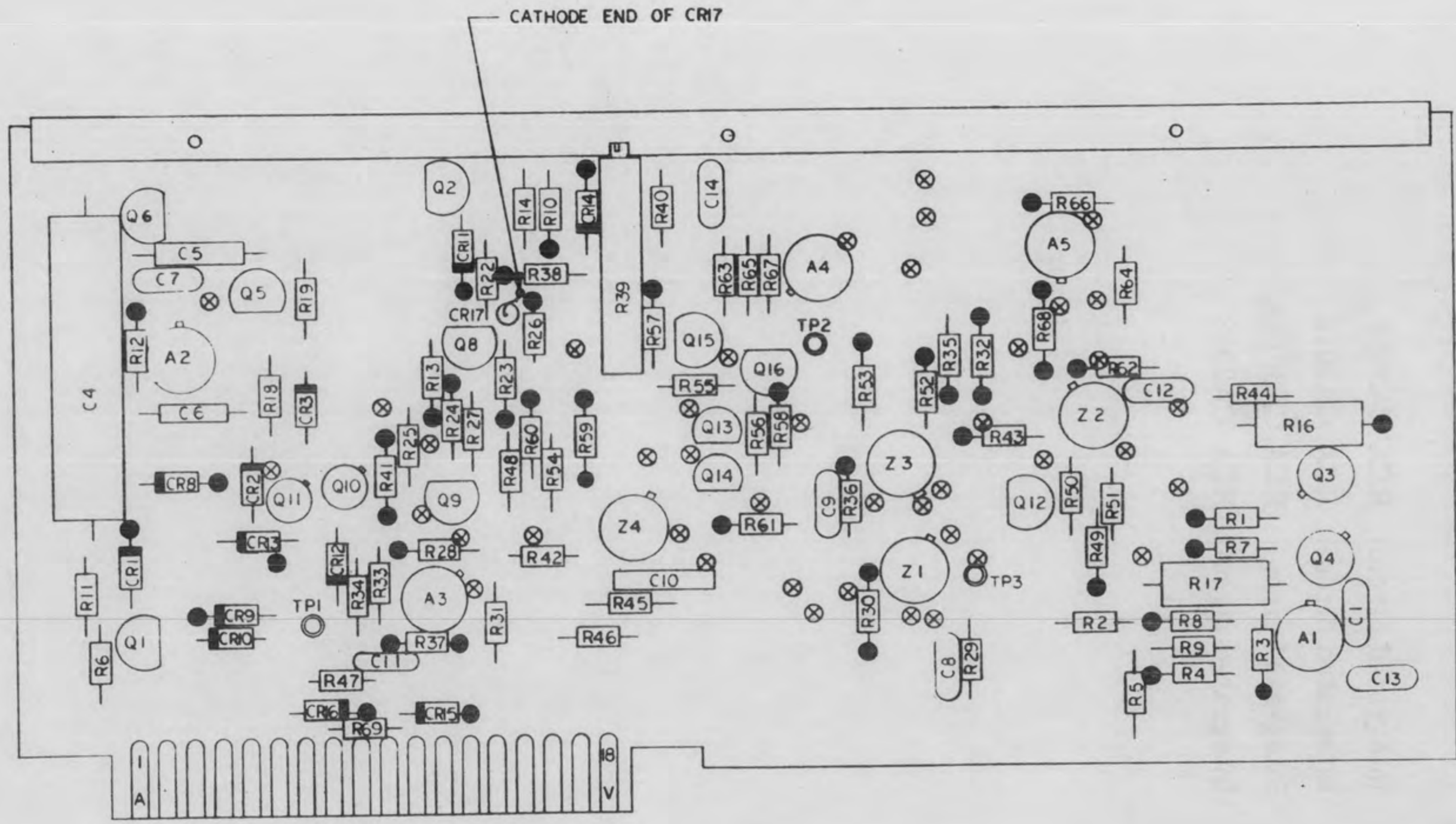
Reference Designation	Description
A1	Integrated circuit, µA 741, Fairchild U5B7741393
A2	Integrated circuit, National Semiconductor LM301A
A3 through A5	Integrated circuit, µA 741, Fairchild U5B7741313
C1	Capacitor, ceramic, disc, 0.01 µF ±20%, Erie 805-Z5V
C2	Not assigned
C3	Not assigned
C4	Capacitor, metalized mylar, 4.0 µF ±5%, Elpac Z1A405J
C5	Capacitor, metalized mylar, 0.036 µF ±5%, Elpac Z1A363J
C6	Capacitor, metalized mylar, 0.0039 µF ±5%, Elpac Z1A392J
C7	Capacitor, ceramic, tubular, 30 pF ±5%, Erie NPO-308
C8	Capacitor, ceramic, disc, 0.01 µF ±20%, Erie 805-Z5V
C9	Capacitor, ceramic, disc, 0.01 µF ±20%, Erie 805-Z5V
C10	Capacitor, ceramic, monolythic, 2.2 µF ±20%, 25V, Sprague 5C15
C11	Capacitor, ceramic, disc, 0.01 µF ±20%, Erie 805-Z5V
C12	Capacitor, dipped mica, 390 pF ±5%, Elmenco DM15F391J
C13	Capacitor, ceramic, disc, 0.01 µF ±20%, Erie 805-Z5V
C14	Capacitor, ceramic, disc, 0.01 µF ±20%, Erie 805-Z5V
CR1	Diode, 1N276
CR2	Diode, 1N457
CR3	Diode, 1N457
CR4 through CR7	Not assigned
CR8 through CR13	Diode, 1N457

Reference Designation	Description
CR14	Diode, 1N936
CR15 through CR17	Diode, 1N457
Q1	Transistor, Siliconix U201
Q2	Transistor, 2N5555
Q3	Transistor, 2N2218
Q4	Transistor, 2N2904
Q5	Transistor, 2N3904
Q6	Transistor, 2N3904
Q7	Not assigned
Q8	Transistor, 2N5087
Q9	Transistor, 2N3904
Q10	Transistor, Siliconix U201
Q11	Transistor, Siliconix U201
Q12	Transistor, 2N3906
Q13	Transistor, 2N3904
Q14	Transistor, 2N3906
Q15	Transistor, 2N3906
Q16	Transistor, 2N3904
R1	Resistor, fixed composition, 10Ω ±5%, 1/4W, RC07GF100J
R2	Resistor, fixed composition, 510Ω ±5%, 1/4W, RC07GF511J
R3	Resistor, fixed film, 110k ±1%, 1/8W, RN55D1103F
R4	Resistor, fixed film, 110k ±1%, 1/8W, RN55D1103F
R5	Resistor, fixed composition, 10k ±5%, 1/4W, RC07GF103J
R6	Resistor, fixed film, 332k ±1%, 1/8W, RN55D3323F
R7 through R9	Resistor, fixed composition, 10k ±5%, 1/4W, RC07GF103J

Reference Designation	Description
R10	Resistor, fixed film, 464k ±1%, 1/8W, RN55D4643F
R11	Resistor, fixed film, 36.5k ±1%, 1/8W, RN55D3652F
R12	Resistor, fixed composition, 220k ±5%, 1/4W, RC07GF224J
R13	Resistor, fixed composition, 62k ±5%, 1/4W, RC07GF623J
R14	Resistor, fixed film, 68.1k ±1%, 1/8W, RN55D6812F
R15	Not assigned
R16	Resistor, fixed composition, 360Ω ±5%, 1W, RC32GF361J
R17	Resistor, fixed composition, 360Ω ±5%, 1W, RC32GF361J
R18	Resistor, fixed composition, 110k ±5%, 1/4W, RC07GF114J
R19	Resistor, fixed composition, 110k ±5%, 1/4W, RC07GF114J
R20	Not assigned
R21	Not assigned
R22	Resistor, fixed film, 15k ±1%, 1/8W, RN55D1502F
R23	Resistor, fixed film, 3.74k ±1%, 1/8W, RN55D3741F
R24	Resistor, fixed composition, 30k ±5%, 1/4W, RC07GF303J
R25	Resistor, fixed film, 12.7k ±1%, 1/8W, RN55D1272F
R26	Resistor, fixed film, 8.45k ±1%, 1/8W, RN55D8451F
R27	Resistor, fixed composition, 270k ±5%, 1/4W, RC07GF274J
R28	Resistor, fixed composition, 30k ±5%, 1/4W, RC07GF303J
R29	Resistor, fixed composition, 43k ±5%, 1/4W, RC07GF433J
R30	Resistor, fixed composition, 22k ±5%, 1/4W, RC07GF223J
R31	Resistor, fixed film, 6.34k ±1%, 1/8W, RN55D6341F
R32	Resistor, fixed composition, 91k ±5%, 1/4W, RC07GF913J
R33	Resistor, fixed composition, 10k ±5%, 1/4W, RC07GF103J
R34	Resistor, fixed composition, 7.5k ±5%, 1/4W, RC07GF752J
R35	Resistor, fixed film, 20.5k ±1%, 1/8W, RN55D2052F
R36	Resistor, fixed composition, 10k ±5%, 1/4W, RC07GF103J
R37	Resistor, fixed composition, 240k ±5%, 1/4W, RC07GF244J
R38	Resistor, fixed composition, 750Ω ±5%, 1/4W, RC07GF751J
R39	Resistor, variable, 2k, Helitrim 78PR2K

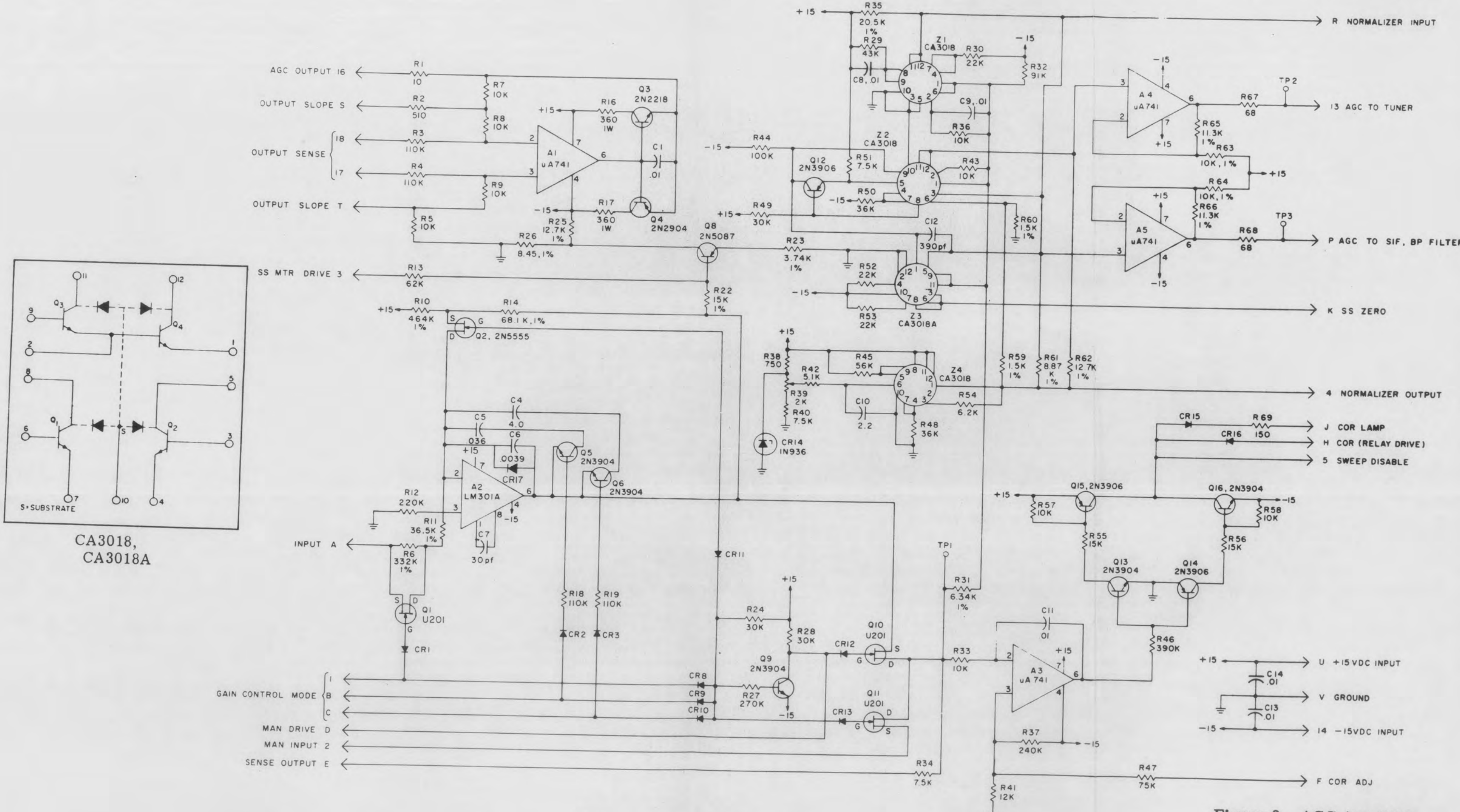
Reference Designation	Description
R40	Resistor, fixed composition, 7.5k ±5%, 1/4W, RC07GF752J
R41	Resistor, fixed composition, 12k ±5%, 1/4W, RC07GF123J
R42	Resistor, fixed composition, 5.1k ±5%, 1/4W, RC07GF512J
R43	Resistor, fixed composition, 10k ±5%, 1/4W, RC07GF103J
R44	Resistor, fixed composition, 100k ±5%, 1/4W, RC07GF104J
R45	Resistor, fixed composition, 56k ±5%, 1/4W, RC07GF563J
R46	Resistor, fixed composition, 390k ±5%, 1/4W, RC07GF394J
R47	Resistor, fixed composition, 75k ±5%, 1/4W, RC07GF753J
R48	Resistor, fixed composition, 36k ±5%, 1/4W, RC20GF363J
R49	Resistor, fixed composition, 30k ±5%, 1/4W, RC07GF303J
R50	Resistor, fixed composition, 36k ±5%, 1/4W, RC20GF363J
R51	Resistor, fixed composition, 7.5k ±5%, 1/4W, RC07GF752J
R52	Resistor, fixed composition, 22k ±5%, 1/4W, RC07GF223J
R53	Resistor, fixed composition, 22k ±5%, 1/4W, RC07GF223J
R54	Resistor, fixed composition, 6.2k ±5%, 1/4W, RC07GF622J
R55	Resistor, fixed composition, 15k ±5%, 1/4W, RC07GF153J
R56	Resistor, fixed composition, 15k ±5%, 1/4W, RC07GF153J
R57	Resistor, fixed composition, 10k ±5%, 1/4W, RC07GF103J
R58	Resistor, fixed composition, 10k ±5%, 1/4W, RC07GF103J
R59	Resistor, fixed film, 1.50k ±1%, 1/8W, RN55D1501F
R60	Resistor, fixed film, 1.50k ±1%, 1/8W, RN55D1501F
R61	Resistor, fixed film, 8.87k ±1%, 1/8W, RN55D8871F
R62	Resistor, fixed film, 12.7k ±1%, 1/8W, RN55D1272F
R63	Resistor, fixed film, 10.0k ±1%, 1/8W, RN55D1002F
R64	Resistor, fixed film, 10.0k ±1%, 1/8W, RN55D1002F
R65	Resistor, fixed film, 11.3k ±1%, 1/8W, RN55D1132F
R66	Resistor, fixed film, 11.3k ±1%, 1/8W, RN55D1132F
R67	Resistor, fixed composition, 68Ω ±5%, 1/4W, RC07GF680J
R68	Resistor, fixed composition, 68Ω ±5%, 1/4W, RC07GF680J
R69	Resistor, fixed composition, 150Ω ±5%, 1/4W, RC07GF151J

Reference Designation	Description
Z1	Integrated circuit, RCA CA3018
Z2	Integrated circuit, RCA CA3018
Z3	Integrated circuit, RCA CA3018A
Z4	Integrated circuit, RCA CA3018



PIN 1 THRU 18 COMPONENT SIDE
PIN A THRU V CIRCUIT SIDE

Figure 2. Component Locations 303211-90



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
RESISTOR VALUES ARE IN OHMS, 1/4W, 5%
CAPACITOR VALUES ARE IN MICROFARADS
DIODES ARE IN457 EXCEPT CR1; IN276

Figure 3. AGC Amplifier, Schematic Diagram