PRC1088-MS

PRC1088

TRANSCEIVER

TECHNICAL MANUAL

Datron World Communications Inc.
Manual Part No. PRC1088-MS
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One Year Limited Warranty and Remedies

Datron World Communications Inc. (DWC) warrants that its equipment is free from defects in design, materials and workmanship for a period of 12 months from the date of installation of the equipment, but in no event later than 15 months from the date of shipment. If the equipment does not provide satisfactory service due to defects covered by this warranty, DWC will, at its option, replace or repair the equipment free of charge.

Should it be impractical to return the equipment for repair, DWC will provide replacements for defective parts contained in the equipment for a period of 12 months from the date of installation of the equipment, but in no event later than 15 months from the date of shipment.

This warranty is limited to the original purchaser and is not transferable. Repair service performed by DWC is warranted for the balance of the original warranty or 90 days, whichever is longer.

Exclusive Warranty: There are no other warranties beyond the warranty as contained herein. No agent, employee, or representative of DWC has any authority to bind DWC to any affirmation, representation, or warranty concerning the equipment or its parts that is not in conformity with the warranties contained herein. EXCEPT AS EXPRESSLY SET FORTH ABOVE, NO OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED, ARE MADE WITH RESPECT TO THE EQUIPMENT OR THE PARTS CONTAINED THEREIN, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND DWC EXPRESSLY DISCLAIMS ALL WARRANTIES NOT STATED HEREIN.

Limitations of Warranty: This warranty does not cover:

- Physical damage to the equipment or its parts that does not involve defects in design, material or workmanship, including damage by impact, liquids, temperature, or gases.
- Damage to the equipment or its parts caused by lightning, static discharge, voltage transients, or application of incorrect supply voltages.
- Defects or failures caused by unauthorized attempts to repair or modify the equipment.
- Defects or failures caused by Buyer abuse or misuse.

Return of Equipment - Domestic: To obtain performance of any obligation under this warranty, the equipment must be returned freight prepaid to the Customer Service Department. Datron World Communications Inc., 304 Enterprise Street, Escondido, California 92029. The equipment must be packed securely. DWC shall not be responsible for any damage incurred in transit. A letter containing the following information must be included with the equipment.

a. Model, serial number and date of installation;

b. Name of dealer or supplier of the equipment;

c. Detailed explanation of problem;

d. Return shipping instructions; and

e. Telephone or fax number where buyer may be contacted.

DWC will return the equipment prepaid by United Parcel Service, Parcel Post, or truck. If alternate shipping is specified by Buyer, freight charges will be made collect.

Return of Equipment - International: Contact DWC or your local Representative for specific instructions. Do not return equipment without authorization. It is usually not possible to clear equipment through U.S. Customs without the correct documentation. If equipment is returned without authorization, Buyer is responsible for all taxes, customs duties, clearance charges, and other associated costs.

Parts Replacement: The following instructions for the supply of replacement parts must be followed:

a. Return the parts prepaid to "Parts Replacement" Datron World Communications Inc., 304 Enterprise Street, Escondido, California 92029; and

b. Include a letter with the following information:
   1. part number;
   2. serial number and model of equipment; and
   3. date of installation.

Parts returned without this information will not be replaced. In the event of a dispute over the age of the replacement part, components date-coded over 24 months previously will be considered out of warranty.

Remedies: Buyer's sole remedies and the entire liability of DWC are set forth above. In no event will DWC be liable to buyer or any other person for any damages, including any incidental or consequential damages, expenses, lost profits, lost savings, or other damages arising out of use of or inability to use the equipment. 1/96

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CHAPTER 1
INTRODUCTION AND TECHNICAL SPECIFICATIONS

1.1 GENERAL

This manual provides detailed information on the service and repair of the PRC1088 transceiver. Full technical information is given, including schematic diagrams, circuit descriptions, theory of operation, and test and alignment procedures. The manual also contains detailed parts lists.

1.2 OPERATOR'S MANUAL

The manual should be used in conjunction with the operator's manual TW-PRC1088-TM1. This manual includes full installation and operating instructions and field maintenance instructions.

1.3 TECHNICAL SPECIFICATIONS

Chapter 1 contains the technical specifications in Table 1-1, connection pin assignments in Table 1-2, and the manpack configuration in hop mode (Figure 1-1).

TABLE 1-1.
Technical Specifications.

CHARACTERISTIC	SPECIFICATION
Receiver-transmitter	
Frequency range	30 to 87.975 MHz in 25-kHz steps (2320 channels).
Preset channel selection	9—NO HOP/fixed frequency presets. 9—HOP/frequency hopping presets.
Modes of operation	
NO HOP	Fixed frequency communications with VHF 30- to 87.975-MHz FM-type radios.
HOP	Greater than 100 frequency hops per second on any frequency between 30.000 and 87.975 MHz, on 25-kHz channel spacing. Digital voice and digital data, between two receiver-transmitters, bursted 20-kb/s data, resync every second.
TIME	Fixed frequency automatic time transfer and digital voice between two receiver-transmitters, bursted 20-kb/s data.
NCS	Available in HOP only, Net Control Station (NCS) automatically transmits time update for non-NCS stations to update their internal digital quartz clocks.
SCAN	Available in NO HOP only, compatible with receiver-transmitters with 150-Hz tone squelch, scans preset channel presently selected on display plus three additional preset channels 7, 8, and 9.
COMSEC Mode	Contact factory for detailed information.
ECCM codes	
Net identifier	800 ECCM net identifiers (000 to 799).
Key number	10,000 ECCM key numbers (0000 to 9999).

TABLE 1-1.
Technical Specifications (Continued).

CHARACTERISTIC	SPECIFICATION
Hopping rate	Greater than 100 hops per second.
Receiver	
Sensitivity	0.5 μV for 10-dB sinad.
Audio output	12 mW into 1000 ohms.
IF rejection	100 dB.
Adjacent channel rejection	Greater than 60 dB, 2 channels away.
Squelch	150-Hz tone in FM voice, digital squelch in ECCM mode.
Modulation	NBFM (F3) for data and voice with a deviation of - 7 kHz.
Transmitter	
Power output	Selectable 0.25 W or 5 W @ 12.5 Vdc input.
Primary power	Input voltage between 10 and 15 Vdc. Power consumption at 12.8 Vdc is less than: 2.5 watts—receiver, 11.3 watts—low-power transmit (0.25 W), 28 watts—high-power transmit (5 W).
Harmonic radiation	At least 45 dB below carrier.
Audio bandwidth	Voice: 300 to 3000 Hz, Data: 10 Hz to 10 kHz.
Wide-band noise	At least 117 dB below rated output at - 10% from carrier in a 16-kHz bandwidth (-122 dBm/Hz).
Physical	
Dimensions	Width: 28 cm (11 in.) Height: 10 cm (4 in.) Depth: 28 cm (11 in.).
Weight	4.26 kg (w/out battery).
Environmental	
Temperature	
Operating	-40 °C to + 60 °C.
Humidity	Up to 95%.
Altitude	
Operating	4572 m (15,000 ft.).
Nonoperating	12,192 m (40,000 ft.).
Immersion	1m of water for 2 hours.
Shock	MIL-STD-810E.

TABLE 1-1.
Technical Specifications (Continued).

CHARACTERISTIC	SPECIFICATION
Vibration	MIL-STD-810E.
Drop test	MIL-STD-810E.
Sand and dust	MIL-STD-810E.

TABLE 1-2.
Connector Pin Identification.

CONN	PIN	FUNCTION	I/O	LOGIC OR NOMINAL SIGNAL LEVEL
J1	A	Ground	I/O	Tied to chassis.
	B	NB RCV Audio	O	300 to 3000 Hz, 12 milliwatts into 1000 ohms at full volume.
	C	PTT	I	0 to 1 Vdc or less than 470 Ω = Key, +10 to +30 Vdc or more than 4.7 kΩ = Not Key.
	D	NB XMT Audio	I	150 ohm, compatible with H-250/U Handset.
	E	+12 V RAW	I	+10 to +15 Vdc into RT 2.5 amps max. @ 5 W.
	F	+12 V Battery/Fixed RCV Audio	O	+10 to +15 Vdc battery voltage/10 kΩ source 3.5 V peak to peak.
	H	Remote data in	I	0 to +5 Vdc manchester encoded, "0" = Remote Interrupt.
	J	NB XMT Audio Shield	I	Connected to ground in RT.
	K	Retransmit	O	Less than 50 ohms to ground = Retransmit, Greater than 47 kΩ to ground = Not Retransmit +30 Vdc and 100 mA maximum.
	L	Normal audio inhibit	I	0 to +1 Vdc or less than 1000 Ω to ground = data +10 to +30 Vdc or greater than 47 kΩ to ground = voice.
	M	Remote data out	O	0 to 5 V dc, Manchester encoded data.
	N	+12V	O	+10 to +15 Vdc out of RT (100 mA max).
	P	WB RCV Audio	O	3.5 V peak to peak for ±7 kHz FM deviation, 10 Hz to 10 kHz <3 dB, 1 KHz reference, 300 ohm output.
	R	WB XMT Audio	I	±7 kHz FM deviation for 5 V peak to peak, 10 Hz to 10 kHz <3 dB, 1 kHz reference, 1800 ohm input.
J2		Coax Antenna	I/O	-113 to +37 dBm, 30.000 to 87.975 MHz.
J3, J4	A	Ground	I/O	Tied to chassis.
	B	NB RCV Audio	O	Paralleled with J1-B.
	C	PTT	I	Paralleled with J1-C.
	D	NB XMT Audio	I	Paralleled with J1-D.
	E	Retransmit	O	Paralleled with J1-K.
	F	+12V	O	12V, 1.4A.
J5	A	Ground	O	Tied to chassis.
	B	+12V battery	I	+10 to +15 Vdc battery input.

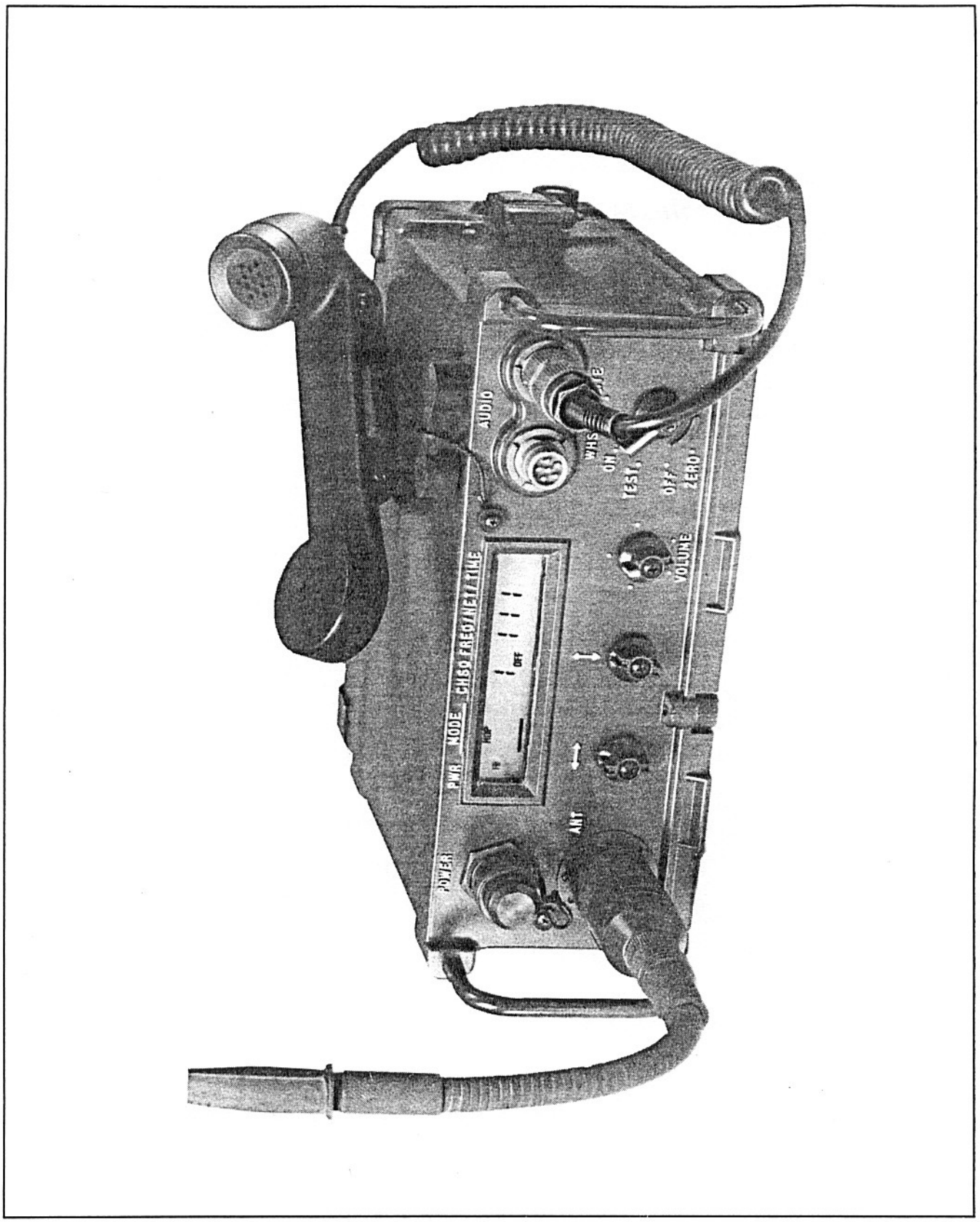

FIGURE 1-1.
PRC1088, Manpack Configuration in Hop Mode.

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j. Should a fault be detected, the LCD will display faults by alternately flashing the word FAULT (refer to Figure 2-3) and the abbreviation corresponding to the fault area, e.g., FAULT, ANT, FAULT.

k. Table 2-3 lists the possible faults which may be displayed as transmit faults if the receiver-transmitter is inoperational.

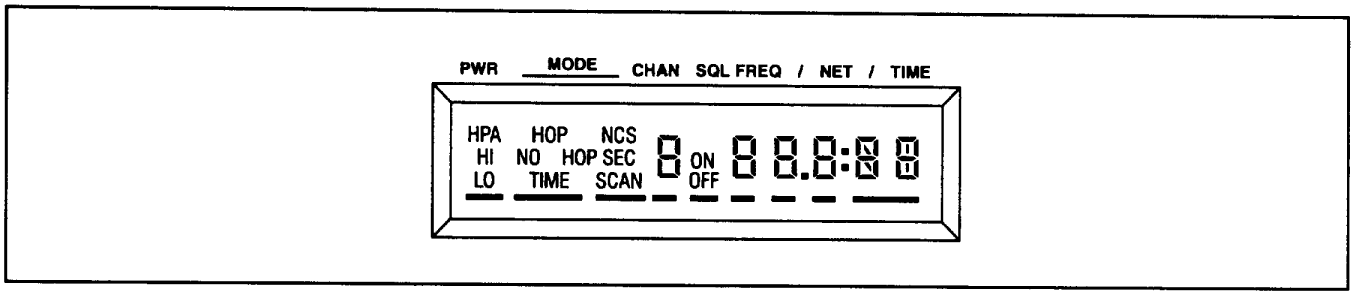

FIGURE 2-1.
Test Display.

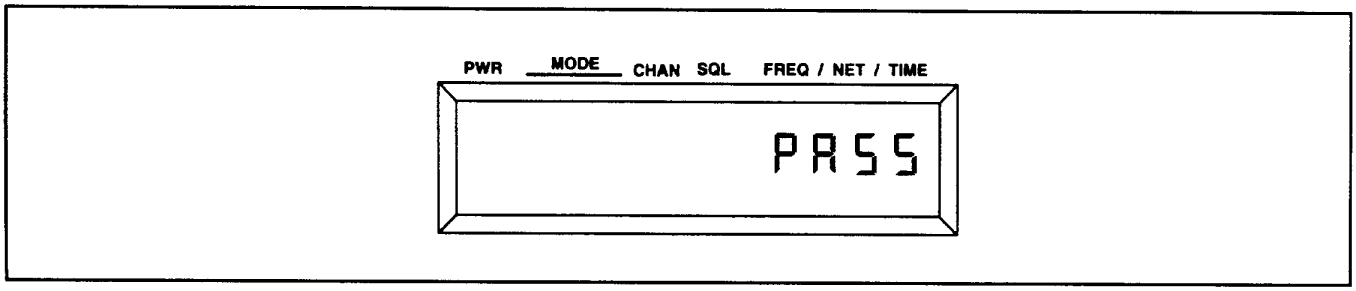

FIGURE 2-2.
Transmit/Receive Pass Display.

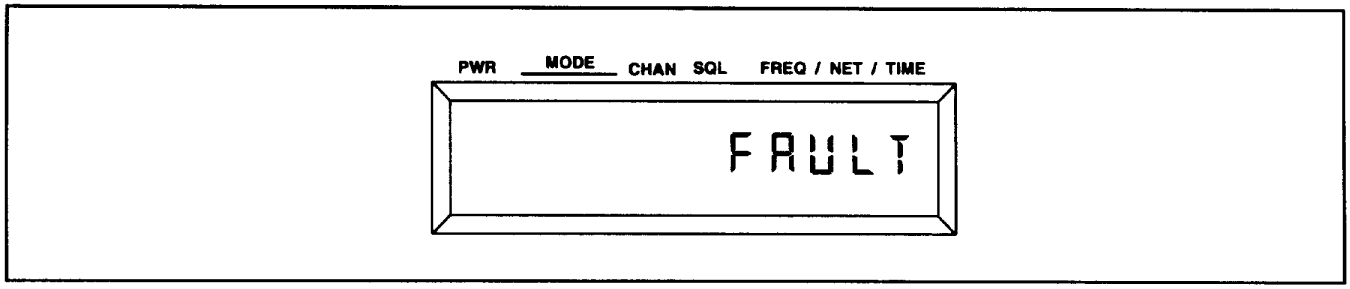

FIGURE 2-3.
Receiver/Transmitter Fault Display.

TABLE 2-2.
Receive Faults.

DISPLAY	FAULT CONDITION	ACTION
BAT	Battery voltage is less than 10 V dc.	Replace battery.
RT FAULT		Set R/T to NO-HOP channel "0" and re-run BITE test to identify faulty module.
A5	Synthesizer has loss-of-lock.	Replace synthesizer, PCB 749002.
A4	Receiver squelched.	Replace receiver, PCB 739001.
A3	Control RAM pattern not read.	Replace control, PCB 739004.

TABLE 2-3.
Transmit Faults.

DISPLAY	FAULT CONDITION	ACTION
BAT	Battery voltage is less than 10 V dc.	Replace battery.
ANT	Antenna VSWR is greater than 3.5 to 1	Check physical condition of antenna. If no damage is observed, replace antenna.
RT FAULT		Set R/T to NO-HOP channel "0" and re-run BITE test to identify faulty module.
A5	Synthesizer has loss-of-lock.	Replace synthesizer, PCB 739002.
A4	Receiver squelched.	Replace receiver, PCB 739001.
A3	Control RAM pattern not read.	Replace control, PCB 739004.
A2	Power amplifier power output is below 1 watt.	Replace power amplifier, PCB 739003.

TABLE 2-4.
Minimum Performance Tests.

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. TEST SET UP	a. Connect test set connector P1 to receiver-transmitter PWR connector J1.		
	b. Connect dc power supply to +12 VDC and GND jacks on rear of test set. Set power supply to +12.5 V dc.	+12.5 ±0.5 V dc.	Adjust power supply.
	c. Set test set PTT KEY down (OFF) and NORMAL AUDIO INHIBIT to VOICE.		
	d. Set receiver-transmitter VOL to midrange and OFF-TEST-ON-LITE switch to ON.		
	e. Using cursor and column switches, input the following information into the receiver-transmitter.		

PWR	MODE	CHAN/ DAY	SQL	FREQ/ NET/TIME
LO	NO HOP	1	OFF	30.000
LO	NO HOP	2	OFF	36.125
LO	NO HOP	3	OFF	39.250
LO	NO HOP	4	OFF	44.375
LO	NO HOP	5	OFF	51.975
LO	NO HOP	6	OFF	52.000
LO	NO HOP	7	OFF	63.725
LO	NO HOP	8	OFF	75.850
LO	NO HOP	9	OFF	87.975
LO	TIME	Current day	OFF	Local time
LO	HOP	1	OFF	111
LO	HOP	2	OFF	222
LO	HOP	3	OFF	333
LO	HOP	4	OFF	444
LO	HOP	5	OFF	555
LO	HOP	6	OFF	666

TABLE 2-4.
Minimum Performance Tests (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	LO HOP 7 OFF 777 LO HOP 8 OFF 888 LO HOP 9 OFF 999 LO HOP 0 OFF 1111 (keynumber)		
	f. Set OFF-TEST-ON-LITE switch to OFF.		
2. Signal noise and distortion	a. Connect signal generator to antenna connector. Set signal generator at 30.0000 MHz with output of 0.5 μ V. Modulate signal with 7-kHz deviation (14 kHz peak-to-peak) at a 1-kHz rate.		
	b. Connect distortion analyzer to NB AUDIO RCV jacks.		
	c. Set OFF-TEST-ON-LITE switch to ON.		
	d. Set MODE display to NO HOP and CHAN/DAY display to 1.		
	e. Measure the signal plus noise plus distortion/noise plus distortion (SINAD) in decibels for channel 1.	NLT 10 dB.	Replace or repair receiver and/or synthesizer card.
	f. Repeat step 2.e for channels 2 through 9, setting signal generator frequency to preset channel frequency.		Same as step 2.e.
	g. Adjust signal generator output for 100 μV and determine reference.		
	h. Turn signal generator modulation off and measure the signal-plus noise/noise (S + N/N) ratio in decibels for channel 1.	NLT 30 dB.	Replace or repair receiver card and/or synthesizer card.
	i. Repeat step 2.h for channels 2 through 9.		Same as step 2.h.
	j. Set OFF-TEST-ON-LITE switch to OFF. Disconnect test equipment.		
3. Wide band audio receive	a. Perform step 2.a. Adjust signal generator output for 100 μV.		
	b. Connect DVM to WB AUDIO RCV jacks.		

TABLE 2-4.
Minimum Performance Tests (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	c. Set OFF-TEST-ON-LITE switch to ON.		
	d. Set MODE display to NO HOP and CHAN/DAY display to 1.		
	e. Measure the dc and ac components at the WB AUDIO RCV jacks. The dc component is measured with modulation removed from the signal generator signal.	AC = 1.17 to 1.3 V rms. DC = 2.7 to 3.1 V dc.	Replace or repair receiver and/or synthesizer cards.
	f. Set OFF-TEST-ON-LITE switch to OFF. Disconnect test equipment.		
4. Narrow band audio receive	a. Perform step 2.a. Adjust signal generator output for 100 μV.		
	b. Connect DVM to NB AUDIO RCV jacks.		
	c. Turn VOL control to fully clockwise position.		
	d. Set OFF-TEST-ON-LIFE switch to ON.		
	e. Set MODE display to NO HOP and CHAN/DAY display to 1.		
	f. Measure RMS audio output at NB AUDIO RCV jacks.	NLT 3.46 V rms.	Replace or repair control, ECCM, and receiver cards.
	g. Measure the audio level at the +12-V BATT jack on the test set.	1.0 to 1.4 V rms.	Check R1, R2, or C6 on chassis.
	h. Set OFF-TEST-ON-LITE switch to OFF. Disconnect test equipment.		
5. Retransmit and squelch	a. Connect signal generator to antenna connector. Set signal generator at 30.000 MHz with output of 0.5 μV. Modulate signal with 2.5-kHz deviation (5.0 kHz peak-to-peak) at 150 ±2-Hz.		
	b. Connect DVM to REXMT.		
	c. Connect handset to AUDIO connector.		

TABLE 2-4.
Minimum Performance Tests (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	d. Set OFF-TEST-ON-LITE switch to ON.		
	e. Set the display as follows: MODE to NO HOP, SQL to ON.		
	f. Measure the dc level at REXMT jack.	0 to 1 V dc and noise in handset.	If the voltage is not in the correct range, replace or repair the control ECCM card. If the voltage is in the correct range but noise is not present in the handset, replace the receiver card.
	g. Reduce signal generator to 0.4 μV and repeat step 5.f.	0 to 1 V dc and noise in handset.	Same as step 5.f.
	h. Reduce signal generator to 0.1 μV and repeat step 5.f.	11.8 to 13.2 V dc and no noise in handset.	If the voltage is not in the correct range and noise is not present in the handset, replace or repair control ECCM card. If the voltage is in the correct range but noise is still present in the handset, replace or repair receiver card.
	i. Disconnect handset.		
	j. Connect DVM to pin E of the AUDIO connector.		
	k. Repeat steps 5.f and 5.g.	0 to 1 V dc.	Check chassis components and associated wiring. Replace or repair power amplifier card.
	l. Repeat step 5.h.	11.8 to 13.2 V dc.	Same as step 5.k.
	m. Set SQL display to OFF.		
	n. Set OFF-TEST-ON-LITE switch to OFF. Disconnect test equipment.		

TABLE 2-4.
Minimum Performance Tests (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
6. Transmit frequency	a. Connect frequency counter, through a 30-dB attenuator, to the antenna connector.		
	b. Set OFF-TEST-ON-LITE switch to ON.		
	c. Set the display as follows: PWR to LO, MODE to NO HOP, CHAN/DAY to 9.		
	d. Set NORMAL AUDIO INHIBIT to DATA. Set PTT KEY to ON.		
	e. Measure the transmit frequency.	87.974850 to 87.975150 MHz.	Replace or repair synthesizer card.
	f. Set OFF-TEST-ON-LITE and PTT KEY switches to OFF. Set NORMAL AUDIO INHIBIT to VOICE. Disconnect test equipment.		
7. Transmit power output	a. Connect power meter, through a 30-dB attenuator, to the antenna connector.		
	b. Set OFF-TEST-ON-LITE switch to ON.		
	c. Set the display as follows: PWR to LO, MODE to NO HOP, CHAN/DAY to 1.		
	d. Set PTT KEY to ON.		
	e. Measure power output.	0.15 to 0.4 W.	Replace or repair power amplifier, synthesizer, and/or receiver card.
	f. Set PTT KEY to OFF and repeat steps 7.d and 7.e for channels 2 through 9.	0.15 to 0.4 W.	Same as step 7.e.
	g. Set PWR display to HI and CHAN/DAY to 1.	4.0 to 6.0 W*.	Same as step 7.e.

TABLE 2-4.
Minimum Performance Tests (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	h. Set PTT KEY to OFF and repeat steps 7.d and 7.e for channels 2 through 9.	4.0 to 6.0 W*. *NOTE Power may be higher if PRC1088 is configured for 10 watt RF output.	Same as step 7.e.
	i. Set PTT KEY to OFF.		
	j. Connect dc power supply to REMOTE DATA IN jacks. Adjust for 24 V dc.		
	k. Set PWR display to HI and CHAN/DAY to 1.		
	l. Set PTT KEY to ON.		
	m. Measure the power output.	2.0 to 3.0 W.	Replace or repair power amplifier card.
	n. Set PTT KEY to OFF and repeat steps 7.l and 7.m for channels 2 through 9.		
	o. Set PTT KEY to OFF and set the display as follows: PWR to LO, CHAN/DAY to 1.		
	p. Set OFF-TEST-ON-LITE switch to OFF. Disconnect test equipment.		
8. Transmit sidetone	a. Connect signal generator through a 30-dB attenuator to the antenna connector. Set signal generator at 30.000 MHz with output of 3.16 mV. Modulate signal with 7-kHz deviation (14 kHz peak-to-peak) at a 1-kHz rate.		
	b. Connect function generator to NB AUDIO XMT jacks. Set function generator for 1.4-mV rms, 1-kHz sine wave.		
	c. Connect distortion analyzer to NB AUDIO RCV jacks.		

TABLE 2-4.
Minimum Performance Tests (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	d. Set OFF-TEST-ON-LITE switch to ON.		
	e. Set the display as follows: PWR to LO, MODE to NO HOP, CHAN/DAY to 1, SQL to ON.		
	f. Set PTT KEY to ON.		
	g. Measure percent of distortion.	12% maximum.	Replace or repair receiver, synthesizer and/or control cards.
	h. Set PTT KEY to OFF.		
	i. Set SQL display to OFF.		
	j. Establish a zero reference on distortion analyzer connect to NB AUDIO RCV jacks.		
	k. Set PTT KEY to ON.		
	l. Measure the signal level (in dB) on the distortion analyzer.	6 ±3.0-dB difference from reference established in step 8j.	Replace or repair control card.
	m. Set OFF-TEST-ON-LITE and PTT KEY to OFF. Disconnect test equipment.		
9. Transmit deviation	a. Connect modulation meter, through a 30-dB attenuator, to the antenna connector.		
	b. Set modulation meter filter to 3000 Hz, low pass.		
	c. Connect distortion analyzer to the audio output of the modulation meter.		
	d. Set OFF-TEST-ON-LITE switch to ON.		
	e. Set PTT KEY to ON.		
	f. Measure the 150-Hz peak-to-peak FM deviation and distortion.	2.5- to 3.5-kHz deviation and 23-dB minimum distortion.	Replace or repair synthesizer and/or control cards.

TABLE 2-4.
Minimum Performance Tests (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	g. Set PTT KEY to OFF.		
	h. Connect function generator to NB AUDIO XMT jacks. Set function generator for 1.4-mV rms, 1-kHz sine wave.		
	i. Set PTT KEY to ON.		
	j. Measure the 150-Hz and 1-kHz composite FM deviation.	6.0 to 8.0 kHz greater than the deviation obtained in step 9.f.	Replace or repair control, power amplifier and/or synthesizer cards.
	k. Set PTT KEY to OFF.		
	l. Disconnect the function generator and reconnect it to WB AUDIO XMT jacks. Set function generator for 0- to +5.2-V peak-to-peak square wave at 1 kHz.		
	m. Set NORMAL AUDIO INHIBIT switch to DATA.		
	n. Set modulation meter filter to 50 kHz, low pass.		
	o. Set PTT KEY to ON.		
	p. Measure the peak-to-peak deviation.	6.0 to 8.0 kHz.	Replace or repair control, ECCM and/or synthesizer cards.
	q. Set OFF-TEST-ON-LITE and PTT KEY switches to OFF. Set NORMAL AUDIO INHIBIT switch to VOICE. Disconnect test equipment.		
10. Memory retention	a. Connect 50-ohm, 10-watt load to the antenna connector.		
	b. Set OFF-TEST-ON-LITE switch to ON.		
	c. Observe the display.		
	d. Set PWR switch to OFF and ON 10 times with 10-second minimum off time.	Display remains the same as in step 10.c.	Replace or repair control card.
	e. Set MODE display to HOP.		

TABLE 2-4.
Minimum Performance Tests (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	f. Repeat steps 10.c and 10.d.	Display remains the same as in step 10.c.	Replace or repair control card.
	g. Set MODE display to NO HOP.		
	h. Set OFF-TEST-ON-LITE switch to OFF. Disconnect test equipment.		
11. Remote lines	a. Connect 50-ohm, 10-watt load to the antenna connector.		
	b. Set OFF-TEST-ON-LITE switch to ON.		
	c. Set PWR display to HPA. Check that CHAN/DAY is 1.		
	d. Using a DVM, measure the dc voltage at REMOTE DATA IN and REMOTE DATA OUT jacks.	4 V minimum at REMOTE DATA IN, 0.2 V maximum at REMOTE DATA OUT.	Replace or repair control card.
	e. Set PTT KEY to ON and repeat step 11.d.	Same as step 11.d.	Same as step 11.d.
	f. Set PTT KEY to OFF.		
	g. Set CHAN/DAY to 9.		
	h. Repeat step 11.d.	4 V minimum at both REMOTE DATA IN and REMOTE DATA OUT.	Same as step 11.d.
	i. Set PTT KEY to ON and repeat step 11.d.	Same as step 11.h.	Same as step 11.d.
	j. Set PTT KEY to OFF, PWR display to LO, and CHAN/DAY to 1.		
	k. Set OFF-TEST-ON-LITE switch to OFF. Disconnect test equipment.		
12. Handset	a. Connect 50-ohm, 10-watt load to the antenna connector.		
	b. Connect the handset to the AUDIO connector.		
	c. Set OFF-TEST-ON-LITE switch to ON.		

TABLE 2-4.
Minimum Performance Tests (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	d. Press Push-To-Talk (PTT) button on handset and hold.		
	e. Vary VOL control from fully counterclockwise to fully clockwise.	Sidetone varies.	Replace R1, R2, C6 on chassis.
	f. Set OFF-TEST-ON-LITE switch to OFF. Disconnect test equipment.		
13. Scanning	a. Connect signal generator, through 30-dB attenuator, to antenna connector. Set signal generator at 30.000 MHz with output of 3.16 mV. Modulate signal with ±2.5-kHz deviation (5.0 kHz peak-to-peak) at a 150-Hz tone.		
	b. Remove signal generator RF output.		
	c. Set OFF-TEST-ON-LITE switch to ON.		
	d. Set MODE display to SCAN.		
	e. Apply RF signal.	CHAN/DAY display indicates 1.	Replace or repair control and/or ECCM cards.
	f. Remove RF signal.	After 3 seconds, resumes scanning.	Same as step 13.e.
	NOTE There is a 3-second delay between when a signal is removed from SCAN channel and when scanning resumes.		
	g. Apply RF signal.	CHAN/DAY display indicates 1.	Same as step 13.e.
	h. Remove RF signal and set PTT KEY switch to ON within 3 seconds.	CHAN/DAY display indication remains at 1.	Same as step 13.e.
	i. Set PTT KEY switch to OFF.	Resumes scanning.	Same as step 13.e.
	j. Set signal generator at 63.725 MHz with output and modulation the same as in step 13.a.		

TABLE 2-4.
Minimum Performance Tests (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	k. Repeat steps 13.e through 13.i.	Same as steps 13.e through 13.i, except CHAN/DAY display indicates 7 rather than 1.	Same as step 13.e.
	l. Set signal generator at 75.850 MHz with output and modulation the same as in step 13.a.		
	m. Repeat steps 13.e through 13.i.	Same as steps 13.e through 13.i, except CHAN/DAY display indicates 8 rather than 1.	Same as step 13.e.
	n. Set signal generator at 87.975 MHz with output and modulation the same as in step 13.a.		
	o. Repeat steps 13.e through 13.i.	Same as steps 13.e through 13.i, except CHAN/DAY display indicates 9 rather than 1.	Same as step 13.e.
	p. Set MODE display to NO HOP.		
	q. Set OFF-TEST-ON-LITE switch to OFF. Disconnect test equipment.		
	NOTE A known-good receiver-transmitter is required to perform this test. Use RG-58 coaxial cables in making interconnections between receiver-transmitters and attenuators as described in steps a, b, and c below.		
14a. Hopping	a. Connect a 60-dB attenuator to the antenna connector on the UUT.		
	b. Connect a second 60-dB attenuator to the ANT connector on the known-good receiver-transmitter.		

TABLE 2-4.
Minimum Performance Tests (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	c. Connect the two 60-dB attenuators together in series through one 10-dB and one 6-dB attenuator. d. Connect one handset to the AUDIO connector on the UUT and a second handset to one of the AUDIO connectors on the receiver-transmitter. e. Set UUT OFF-TEST-ON-LITE switch to ON. f. Set UUT display as follows: PWR to LO, MODE to HOP, CHAN/DAY to 1, SQL to ON, FREQ/NET/TIME to 111. g. Set receiver-transmitter OFF-TEST-ON-LITE switch to ON. h. Set receiver-transmitter display as follows: PWR to LO, MODE to HOP NCS, CHAN/DAY to 1, SQL to ON, FREQ/NET/TIME to 111. **NOTE** The UUT and the receiver-transmitter must be within 10 seconds of each other in time, and must have the same frequency plan. Receiver-transmitters should have the same software partnumber and fill identification number to assume that they have the same frequency plan.		

TABLE 2-4.
Minimum Performance Tests (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	i. Alternately communicate between the UUT and the receiver-transmitter for a total of 20 times.	Initial synchronization will occur at the receiver immediately after the transmitter is keyed. A maximum of 2 late key out of 20 is allowed. Notice that the voice quality over the link is readable.	Perform test 1, 3, 5, 6, and 8. If normal indication was obtained for the tests, replace or repair ECCM card. If normal indication was not obtained for any of the tests, replace or repair power amplifier and/or control cards.
	j. Set receiver-transmitter OFF-TEST-ON-LITE switch to OFF.		
	k. Set UUT display as follows: MODE to NO HOP, SQL to OFF.		
	l. Set UUT OFF-TEST-ON-LITE switch to OFF. Disconnect test equipment.		
14b.COMSEC			Repeat steps in 14a. with "SEC" mode selected on front panel.
15. Page	a. Connect signal generator to antenna connector. Set signal generator at 30.000 MHz with output of 1.0 μV. Modulate signal with 7-kHz deviation (14 kHz peak-to-peak) at 1-kHz rate.		
	b. Remove RF signal.		
	c. Set OFF-TEST-ON-LITE switch to ON.		
	d. Set display as follows: MODE to HOP NCS, CHAN/DAY to 1, SQL to OFF, FREQ/NET/TIME to 111.		
	e. Apply RF signal. *Do not key the handset.*	PAGE flashes on the display.	Replace or repair control card.

TABLE 2-4.
Minimum Performance Tests (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	f. Connect the handset to the AUDIO connector.		
	g. Monitor handset while setting SQL display to ON.	Page tone is heard (beeping tone every 12 seconds).	Replace or repair control card.
	h. Monitor handset while reducing signal generator output of 0.5 μV.	Page tone disappears and normal display is observed.	Replace or repair control card.
	i. Remove the handset.		
	j. Set display as follows: MODE to NO HOP, SQL to OFF.		
	k. Set OFF-TEST-ON-LITE switch to OFF. Disconnect test equipment.		
16. Battery	a. Observe the display while reducing the dc power supply output until display flashes FAULT and BAT. Use DVM to measure the dc power supply output.	9.25 to 9.75 Vdc.	Replace or repair control card.
	b. Set OFF-TEST-ON-LITE switch to OFF. Disconnect test equipment.		

TABLE 2-5.
Input/Output Signal Definitions.

CONN	PIN	SIGNAL NAME	SIGNAL DESCRIPTION	INPUT/OUTPUT
J1	A	Ground	Tied to Chassis.	I/O
	B	NB RCV audio	300 to 3000 Hz, 12 mW into 1000 ohms at full volume.	O
	C	PTT	Key - 0 to 1 V dc or less than 470 Ω Not Key - +10 to +30 V dc or more than 47 kilohms.	I
	D	NB XMT audio	150 ohms, compatible with Handset H-250/U.	I
	E	+12V raw	+10 to +15 V dc into RT, 3.0 A max.	I
	F	+12V battery/ fixed RCV audio	+1- to +15-V dc battery voltage/10-kilohm source, 3.5 V peak-to-peak.	O
	H	Remote data in	0 to +5 dc Manchester encoded, 0 = remote interrupt.	I
	J	NB XMT audio shield	Connected to ground in RT.	I
	K	Retransmit	Retransmit = less than 50 ohms to ground, Not Retransmit = greater than 47 kilohms to ground, +30 V dc and 100 mA max.	O
	L	Normal audio inhibit	DATA = 0 to +1 V dc or less than 1000 ohms to ground. Voice = +10 to +30 V dc or greater than 47 kilohms to ground.	I
	M	Remote data out	0 to 5 V dc, manchester encoded data.	O
	N	+12 V	+1- to +15 V dc out of RT, 100 mA max.	O
	P	WB RCV audio	3.5 V peak-to-peak for ±7-kHz FM deviation, 10 Hz to 10 kHz at less than 3 dB, 1-kHz reference 300-ohm output.	O
	R	WB XMT audio	5 V peak-to-peak for ±7-kHz deviation, 10 Hz to 10 kHz at less than 3 dB, 1-kHz reference, 1800-ohm input.	I
J2		Coax antenna	-113 to +37 dBm, 30 to 87.975 MHz.	I/O
J3, J4	A	Ground	Tied to chassis.	I/O
	B	NB RCV audio	Paralleled with J1-B.	O
	C	PTT	Paralleled with J1-C.	I
	D	NB XMT audio	Paralleled with J1-D.	I
	E	Retransmit	Paralleled with J1-K.	O
	F	+12V	+12V, 1.4 A	O

TABLE 2-5.
Input/Output Signal Definitions (Continued).

CONN	PIN	SIGNAL NAME	SIGNAL DESCRIPTION	INPUT/OUTPUT
J5	A	Ground	Tied to chassis.	O
	B	+12V	+10 to 15 Vdc Battery Input	1
O	B	+12V battery	+1- to +15-V dc battery voltage.	I
	C	NC	Not used.	—

2.3.4 MINIMUM PERFORMANCE TEST

Refer to Table 2-4 for minimum performance test.

NOTE

Should the minimum performance tests identify that there is a fault in the receiver-transmitter, disassembly of the receiver-transmitter may be necessary to identify the faulty circuit card/module. To disassemble the receiver-transmitter, follow the procedures in Section 2.6.1.

If R/T unit is NOT in NO-HOP mode channel "0" when BITE test is run, the display will show:

— RT FAULT,
— ANT FAULT, or
— BAT FAULT only.

To enter diagnostic BITE test, set radio to NO-HOP channel "0," and re-run BITE test. Module fault information will then be displayed.

2.4 SIGNAL DEFINITIONS

Table 2-5 identifies all input and output signals of the receiver-transmitter.

2.5 ADJUSTMENTS

None required.

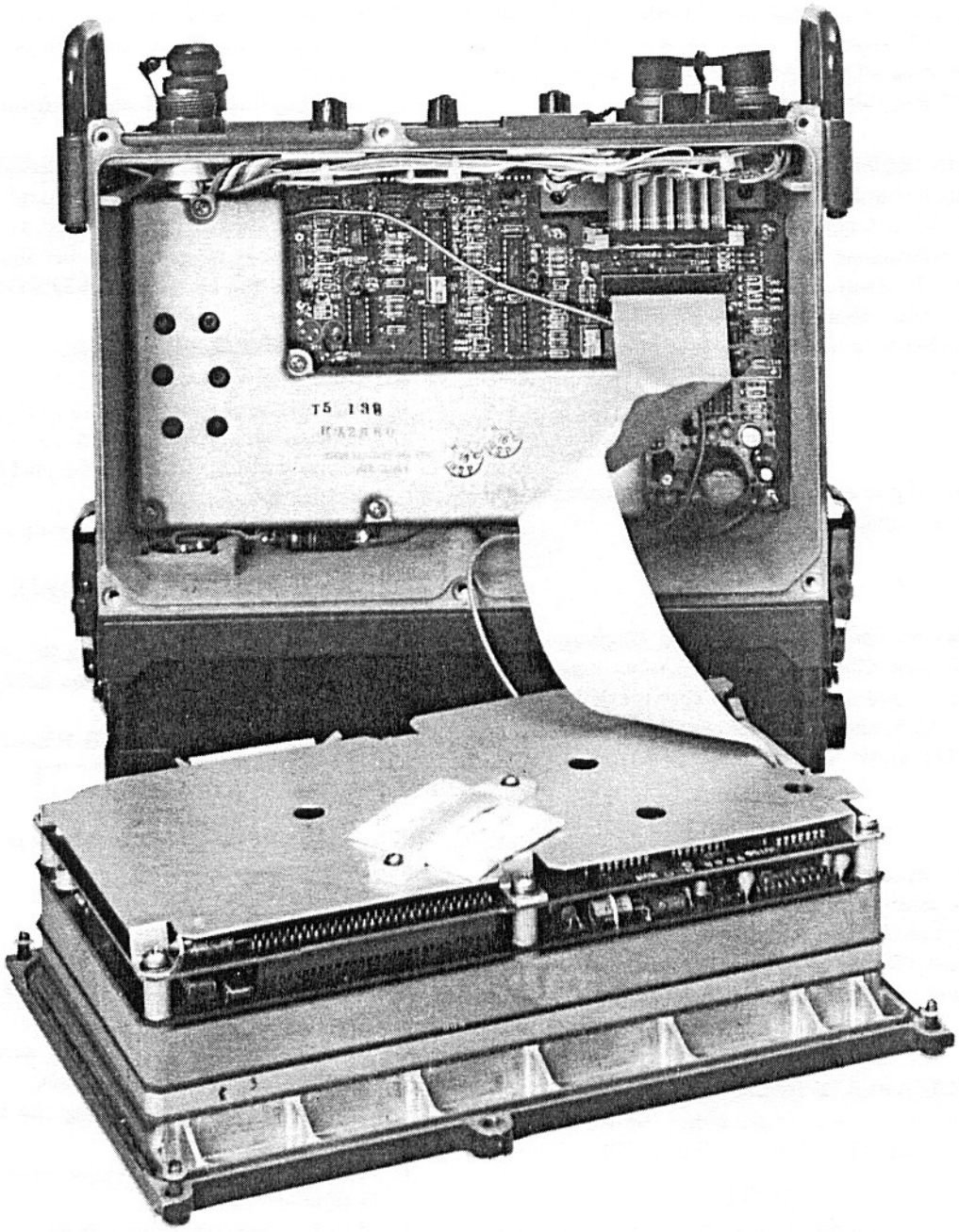

FIGURE 2-4
Receiver-Transmitter With Backplate Removed.

2.6 DISASSEMBLY/ASSEMBLY

The following sections describe the disassembly and assembly procedures for the receiver-transmitter. Disassembly and assembly procedures down to subassembly level have been included to provide access to card-mounted components that are identified and located in the parts list. Standard tools, techniques, and procedures are used to remove and replace components on the chassis and subassemblies.

2.6.1 DISASSEMBLY

Disassembly should be performed only when repair is required. Do not perform the disassembly as a part of routine maintenance. Mark or otherwise identify all disconnected electrical wiring. Make note of color coding, placement of components and method of applying insulation (if any) before unsoldering or removing any electrical parts.

CAUTION

Disconnect all power before attempting disassembly of any portion of the equipment.

CAUTION

This equipment contains Electro-static Discharge Sensitive (ESDS) devices. Care must be taken when handling these components to prevent equipment damage. Follow the procedures in the repair instruction section for handling Electro-Static Discharge Sensitive (ESDS) devices.

CAUTION

This equipment contains desiccant to remove moisture. Whenever the receiver-transmitter is disassembled, the desiccant must be replaced. Since the desiccant may lose one-half of its absorbent life in 15 minutes, the desiccant must be installed within two minutes of resealing the receiver-transmitter.

2.6.1.1 BACKPLATE REMOVAL

a. Situate the receiver-transmitter so that the backplate is accessible. Refer to Figure 2-4.

NOTE

The case is sealed for water tightness. Care must be exercised during removal of backplate to prevent damage to the backplate lip that seals to a rubber gasket.

b. Loosen the six captive Phillips-head hold-down screws.
c. Carefully place the backplate on a flat surface with the circuit cards facing up. Be careful not to exert strain on the ribbon cable and two coaxial cables from the chassis to the circuit cards.

2.6.1.2 ECCM/CONTROL SHIELD REMOVAL

a. Complete procedure 2.6.1.1.
b. Remove the six long Phillips-head screws securing the circuit cards to the backplate.
c. Remove the shield covering the ECCM.
d. Remove connectors A2P1 and A5P1 by pushing outward from the connectors on the connector extractors.
e. Separate the ECCM/control from the backplate.

2.6.1.2.1 ECCM/CONTROL DISASSEMBLY

a. Complete procedures 2.6.1.1 and 2.6.1.2.
b. Remove the two Phillips-head screws securing the ECCM and control to the shield spacer.
c. Separate the ECCM and CONTROL.

2.6.1.3 RECEIVER REMOVAL

a. Complete procedures 2.6.1.2.
b. Remove spacer from the top of the receiver card.
c. Disconnect the four coaxial cables.
d. Remove connector A5P2 by pushing on the connector extractors.
e. Lift the receiver from the backplate.

2.6.1.4 SYNTHESIZER REMOVAL

a. Complete procedure 2.6.1.3.
b. Remove the shield covering the synthesizer.
c. Lift the synthesizer from the backplate.

2.6.1.5 POWER AMPLIFIER REMOVAL

WARNING

Power must not be applied to battery jack J5 during power amplifier removal.

a. Complete procedure 2.6.1.4.
b. Disconnect the ribbon cable from the main chassis.
c. Remove the L-shaped cover over the power amplifier.
d. Remove the three machine screws securing the power amplifier to the chassis.
e. Remove the screws holding the RF power devices to the chassis.
f. Remove the coaxial cable from power amplifier connector A2J2.
g. Lift the power amplifier from the chassis.

2.6.1.6 DISPLAY REMOVAL

a. Complete procedure 2.6.1.1.
b. Remove the two Phillips-head screws holding the display in place.
c. Pull the display far enough from the chassis to expose the connecting wires.
d. Unsolder the wires from terminals E1 through E6.

c. Pull the display far enough from the chassis to expose the connecting wires.
d. Unsolder the wires from terminals E1 through E6.
e. Remove the display.

2.6.1.7 DESICCANT REMOVAL

a. Complete procedure 2.6.1.1.
b. Loosen the two Phillips-head screws just enough to remove the desiccant.
c. Remove the two packs of desiccant, marking their location. The location under the clamp is important.

2.6.2 ASSEMBLY

2.6.2.1 DISPLAY REPLACEMENT

a. Solder wires to the appropriate terminals E1 through E6.
b. Position the display and secure with two Phillips-head screws.
c. Complete procedure 2.6.2.2.

2.6.2.2 POWER AMPLIFIER REPLACEMENT

a. Position the power amplifier in the chassis.
b. Secure Phillips-head screws.
c. Secure RF transistors with screws.
d. Connect ribbon cable from chassis.
e. Connect coaxial cable to connector A2J2.
f. Install L-shaped cover on power amplifier.
g. Complete procedure 2.6.2.3.

2.6.2.3 SYNTHESIZER REPLACEMENT

a. Set synthesizer on backplate.
b. Complete procedure 2.6.2.4.

2.6.2.4 RECEIVER REPLACEMENT

a. Place shield between synthesizer and receiver in place on the backplate.
b. Set receiver on back plate.
c. Connect the four coaxial cables to receiver.
d. Connect ribbon connector from synthesizer to receiver.
e. Complete procedure 2.6.2.5.

2.6.2.5 ECCM/CONTROL ASSEMBLY

a. Connect the CONTROL and ECCM.
b. Complete procedure 2.6.2.6.

2.6.2.6 ECCM/CONTROL/SHIELD REPLACEMENT

a. Set spacer on receiver card.
b. Set ECCM/CONTROL on spacer.
c. Secure ECCM/CONTROL to spacer with two Phillips-head screws.
d. Place shield over ECCM card.
e. Secure the synthesizer, receiver, and control/ECCM to backplate with six long Phillips-head screws.
f. Complete procedure 2.6.2.7.

2.6.2.7 DESICCANT REPLACEMENT

a. Obtain two new packs of desiccant.
b. Install two packs of desiccant under clamp at location marked in 2.6.1.7. (Desiccant may also be adhesive backed.)
c. Tighten the two Phillips-head screws.

CAUTION

Since the desiccant may lose one-half of its absorbent life in 15 minutes, the desiccant must be installed within 2 minutes of resealing the receiver-transmitter.

2.6.2.8. BACKPLATE REPLACEMENT

a. Fold the ribbon cable and two coaxial cables into the chassis.
b. Position the backplate carefully in place.
c. Secure with six Phillips-head screws.

2.6.2.9. LEAK TEST

a. Remove seal screw on side of receiver-transmitter near the latch.
g. Install an appropriate 4-40 adapter in the hole and attach to the appropriate test equipment.
c. Receiver-transmitter shall withstand 2.5 inches of mercury vacuum with 0.009 inch maximum of mercury pressure drop after one minute; or, when pressurized at 1.5 psi and immersed in water, the leak rate shall not exceed three 0.13-inch diameter bubbles in a 10-second period.
d. Remove adapter; reinstall and tighten seal screw.

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CHAPTER 3
THEORY

3.1 GENERAL

This section contains information describing the overall operating principles of Radio Receiver-Transmitter PRC1088 on a functional level. Operating principles of the circuit cards/modules are described only to the level necessary to make the overall description meaningful.

3.2 FUNCTIONAL THEORY

3.2.1 OVERALL UNIT

The receiver-transmitter consists of five 2-sided printed circuit boards and one four-layer printed circuit board. These boards are designated: Display, Power Amplifier, Synthesizer, Receiver, Control, and ECCM. Refer to Figure 3-1, receiver-transmitter simplified block diagram, for the following discussion of the radio set.

The Synthesizer contains a single-loop indirect synthesizer that operates at a frequency 13.5 MHz above the radio set receive or transmit frequency. In the receive mode, this frequency (f_0 + 13.5 MHz) is supplied to the receive mixer to translate the incoming received signal to the 13.5-MHz Intermediate Frequency (IF). In the transmit mode, the output of the 13.5-MHz VCXO (Variable-Control Crystal Oscillator) is mixed with the synthesizer frequency (f_0 + 13.5 MHz) to provide a low level on channel transmit signal. The VCXO is a "pullable" crystal oscillator that is used to provide the required frequency modulation.

The Receiver contains a two-band (30 to 52 MHz and 52 to 88 MHz) voltage-tuned preselector, the receive mixer (where the synthesizer frequency (f_0 + 13.5 MHz) is applied), a 13.5-MHz crystal filter, Intermediate Frequency (IF) amplifiers, descriminator, and squelch circuitry. The preselector serves as a tuned amplifier for both receive and transmit signals. In the transmit mode, the preselector removes the spurious mixing products from the synthesizer output and provides a clean, low-noise transmit signal to the Power Amplifier. In the receive mode, the received signal is supplied to the preselector to remove spurious signals and is then applied to the receive mixer to produce the 13.5-MHz IF. The IF is then filtered, amplified, and applied to the audio circuitry and detected for 150-Hz squelch tone.

The Power Amplifier provides amplification of the transmit signal with ALC (Automatic Level Control) to ensure that power levels of either 0.25 watt or 5 watt (internally adjustable from 5 watt to 10 watt) at the antenna. The Power Amplifier also contains a two-hand low-pass filter to suppress harmonics of the transmit signal.

The Control Module contains the microprocessor circuitry that controls all facets of the radio set operation. This card also contains the audio processing circuitry for the radio set.

The ECCM Module works in conjunction with the microprocessor on the control to provide the signal processing and control functions necessary for frequency hopping Electronic Counter-Counter Measure (ECCM) in transmit and receive. The display is a small printed circuit board containing the Liquid Crystal Display (LCD) and its associated drive circuitry. The display is attached to the back of the front panel.

3.2.2 RECEIVE

Refer to Figure 3-1, block diagram, for the receive signal path.

A signal received at the antenna goes through ANT connector J2 and is applied to the Power Amplifier. The signal is sent through a transmit/receive switch and routed from the Power Amplifier to the receiver.

At the receiver, the signal is applied through a transmit/receive switch to the two-band preselector. The two-band preselector is divided into a 30- to 52-MHz filter and a 52- to 88-MHz filter. The filters consist of a two-pole input and a two-pole output filter with a dual gate MOSFET transistor gain stage in between filters. The filters are varactor tuned. From the preselector the signal is applied through a transmit/receive switch to the receive mixer. At the receive mixer, the receive signal is mixed with a signal from the synthesizer that is 13.5 MHz above the receive frequency. This mixing produces the 13.5-MHz Intermediate Frequency (IF). From the mixer, the 13.5-MHz IF is applied to the 13.5 MHz IF strip where close in selectivty is provided by a crystal filter at 13.5-MHz. Following the 13.5-MHz IF strip is a 462.5-kHz IF strip and FM detector. The 452.5-kHz IF reduces the potential of having internally generated signals on 25-kHz channels. The FM detector provides dc coupled audio and data output to the Control/ECCM Module and to the 150-Hz squelch tone detector on the receiver. The output from the 150-Hz squelch tone detector is used by the voice squelch on the Control/ECCM/COMSEC Module.

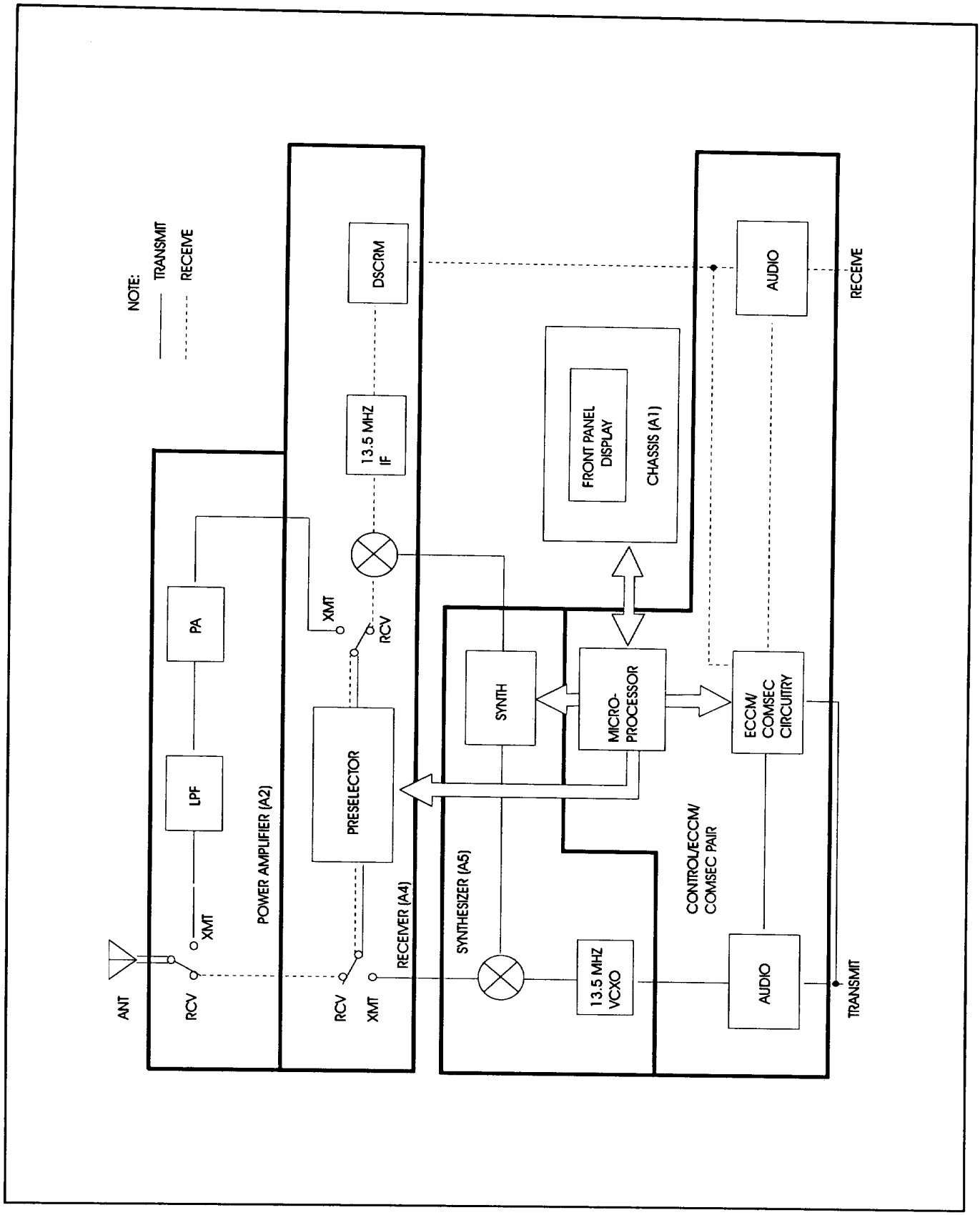


FIGURE 3-1.
PRC 1088 Simplified Block Diagram.

Receive audio entering the Control/ECCM/COMSEC Module originates at the receiver FM detector. When receiving voice, the audio is passed through a 150-Hz notch filter and then a 300-Hz high-pass and a 3000-Hz low-pass filter. A squelch gate mutes the audio when a 150-Hz squelch tone is not detected by the receiver. When receiving audio, the audio is applied through either AUDIO connector J3 or J4 to the handset. Volume level control is on the front panel. When receiving 16-kb/s data, the data is supplied to PWR connector J1 on the front of the receiver-transmitter. When the radio set is in the HOP mode, the receive signal is in the form of data at 20kb/s. This data is applied from the FM detector in the receiver to the switching circuits of the Control/ ECCM/COMSEC. The data (receive ECCM) is then applied through a multiplexer and the BIT sync, a USART (Universal Synchronous Asynchronous Receiver-Transmitter), which converts the 20-kb/s data to 16-kb/s data. The 16-kb/s data is then dedigitzed by passing through the CVSD (Continuously Variable Slope Detector). The dedigitized receive audio or data is then sent back to the switching circuits and applied to either AUDIO connector J3 or J4, or PWR connector J1.

3.2.3 TRANSMIT

Refer to the block diagram in Figure 3-1 for the transmit signal path. The transmit signal path is represented by a heavy solid line.

Transmit audio may orignate at either AUDIO connectors J3 or J4, or PWR connector J1 located on the front panel of the receiver-transmitter. After appropriate gain, clipping, and low-pass filtering, the transmit audio is mixed with 150 Hz from the synthesizer. The transmit audio in the NO HOP mode is then sent to the synthesizer. In the HOP mode transmit audio is digitized by the CVSD at 16 kb/s and is then sent to the USART when, with the aid of the microprocessor, the transmit audio is bursted from 16 kb/s to 20kb/s.

The transmit audio in NO HOP, or the transmit data at 20 kb/s in HOP, mode are now sent to the data filter and modulator in the synthesizer. The data filter limits the spectrum of the transmitted data and provides maximum signal strength in a 25-kHz bandwidth. The ouput of the data filter goes to the modulator (13.5 MHz Voltage-Controlled Crystal Oscillator (VCXO)). The VCXO is turned off in the receive mode since it oscillates on the receiver's first IF frequency and, if left on, would cause unwanted receiver noise. The output of the modulator is fed to the transmit mixer when it is mixed with an output from the phase-locked loop.

The synthesizer transmit mixer output is then sent to the receiver. The signal passes through a transmit/receiver switch and into the two-band tracking preselector for filtering and amplification. The signal then passes through another transmit/receiver switch and is applied to the Power Amplifier.

The RF drive signals (transmit audio) from 30- to 87.975-MHz FM modulated are supplied in the Power Amplifier from the synthesizer at a level of 7.5 dBm. The Power Amplifier has a voltage-controlled pin diode attenuator at its input. This attenuator provides envelope shaping to minimize unwanted AM sidebands while transmitting in the HOP mode. Following the pin diodes is a single ended transistor gain stage and a push-pull bipolar output stage. A pin diode switched two-band, low-pass filter follows the amplifiers. Pin diodes are used to switch between low-pass filters, because at a >100 hops per second rate relays would not have an adequate lifetime. The low-pass filters are designed for 52-MHz and 88-MHz cutoffs. Following the low-pass filter is a directional coupler and a transmit/ receive switch. The two output power levels of 5 watt (or 10 watt) and 0.25 watt are controlled by the ALC in the Power Amplifier.

3.2.4 MICROPROCESSOR

The microprocessor on the control is a NSC800 (refer to Figure 3-1). This microprocessor was chosen because of its low input power requirement (CMOS) and powerful instruction set. The microprocessor provides the control function of the receiver-transmitter. The front panel cursor (√) and column (·) switches are monitored by the microprocessor. The microprocessor also controls the LCD, matching internal reciever-transmitter functions to what is on the LCD. The microprocessor and its associated I/O devices provide parallel frequency and mode information to the remaining modules in the receiver-transmitter.

The ECCM function is handled by a bit synchronizer, USART, and an additional microprocessor. The bit synchronizer synchronizes the receiver clock to the received data during an alternating one-zero pattern. The USART develops character and frame synchronization. The microprocessor handles the resultant data and has an algorithm for generating an exclusive ORing, a processor generated pseudorandom code with data.

The hop rate for ECCM is >100 hops per second. The overhead time between dwells of approximately 1 millisecond is used for synthesizer settling time and Power Amplifier power output rise and fall times. A page frame is inserted into the frequency hopping sequence every 250 milliseconds. This page frequency is operator selectable and programmable for each channel selected. (Refer to the Operation Section for paging).

A quartz clock within the receiver-transmitter provides the course time required for synchronization. The quartz clock in the transmitter and receiver must be

within ±10 seconds of each other to achieve synchronization. In the event that a receiver-transmitter does not have correct time, wrist watch time may be entered on the front panel when the receiver-transmitter is in TIME mode or time can be transferred over the air from station to station in the TIME mode. (Refer to the Operation Section for time setting). Once the quartz clock is set to within 1 second, the worst case net synchronized lifetime is 96 hours.

The quartz clock is a micro power circuit that is kept alive when the receiver-transmitter is off by a lithium Hold-Up Battery (HUB). The HUB also powers a CMOS RAM containing channel presets and display information. This HUB has a worst case life expectancy of five years at which time it must be replaced.

3.2.5 DISPLAY

The display is a small printed circuit board located directly behind the front panel and secured to the chassis. The display consists of the Liquid Crystal Display (LCD), the associated drive circuitry (U2 and U3), and the display lighting (DS1 through DS4). Inputs to the display are through terminals E1 through E6.

CHAPTER 4
POWER AMPLIFIER (ASS 018-00300, PCB 739003)

4.1 DESCRIPTION

Power Amplifier 018-00300 is a two-sided printed circuit card.

The Power Amplifier provides amplification of the transmit signal with ALC (Automatic Level Control) to ensure transmit levels of 0.25 watt or 5.0 watt (10 watt optional) at the antenna. The Power Amplifier also contains a 2-band, low-pass filter to suppress harmonics of the transmit signal.

4.2 PRINCIPLES OF OPERATION

4.2.1 GENERAL

In receive mode, the Power Amplifier switches the receive signal to the receiver card. In transmit mode, the Power Amplifier receives RF drive signals from the synthesizer. The signals are shaped, amplified, and controlled by the Power Amplifier circuits.

4.2.2 FUNCTIONAL THEORY

Remote data in and low/high power from the control card are applied to a dc reference circuit to establish the power level for the Power Amplifier. When operating in low power, a fixed reference signal is generated to hold the power down to approximately 0.25 watt. The output of the dc reference circuit is applied to switch Q7. Another input to Q7 is the blanking pulse from the control card. The blanking signal is applied through switch U1C to pulse generator U5. Pulse generator U5 generates blanking pulses that are used during tune time. The Power Amplifier card does not tune, but it needs time to switch from high to low or low to high band and accomplishes this during tune time.

The output of switch Q7 is applied through low-pass filter U6C to the positive input of ALC comparator U6D. The negative input to the comparator is the sum (U6B) of antenna forward power and antenna reflected power as derived from antenna forward power buffer U3A and antenna reflected power buffer U3B. The output of the comparator is applied to an Automatic Level Control (ALC) attenuator. The ALC attenuator also receives RF drive signals from 30 to 87.975 MHz at a level of 7.5 dBm from the receiver card. The ALC attenuator is a pin diode attenuator that provides envelope shaping to minimize unwanted AM sidebands while transmitting in HOP mode.

The output of the attenuator is applied to Q6, the first of three stages of amplification. From Q6 the signal advances through T1 to the second stage of amplification, driver Q3, then to the push-pull final stage, Q1 and Q2. The RF output is applied to a 2-band, low-pass filter. High or low band is selected by a signal from the control card which passes through a low-pass filter control (P/0 U2) and is applied to a pin diode switch. Pin diodes are used to switch between high and low bands because at >100 hops per second relays would not have an adequate lifetime. The low-pass filters are designed for 52-MHz and 88-MHz cutoffs. Following the 2-band filter is a directional coupler where forward and reflected power are detected and fed to power buffers U3A and U3B. After the coupler is a transmit receive relay. The relay switches + 12-V dc transmit to the card, and 0.25 watt or 5 watt output to the antenna in transmit mode. In receive mode, the received signal is switched from the antenna to the receiver card. PA fault and antenna fault are outputs of power buffers U3A and U3B. Antenna fault will appear in test mode only when antenna VSWR exceeds 3.5 to 1. PA fault occurs when the Power Amplifier has an output of less than approximately 1.0 watts.

Microphone amplifier U10 has a narrow band audio input of 1.4 mV maximum (0.4 mV in "WHISPER" mode) and an output of approximately 1.7 volts of audio to the control card.

The 5.2-V dc switching power supply (Ull, Q10, Q4) receives its input from a + 12-V dc power source. The voltages for the radio are generated by this power supply. Its outputs are + 5.2, + 24, and - 12 V dc. - 12-V dc transmit is a switched voltage.

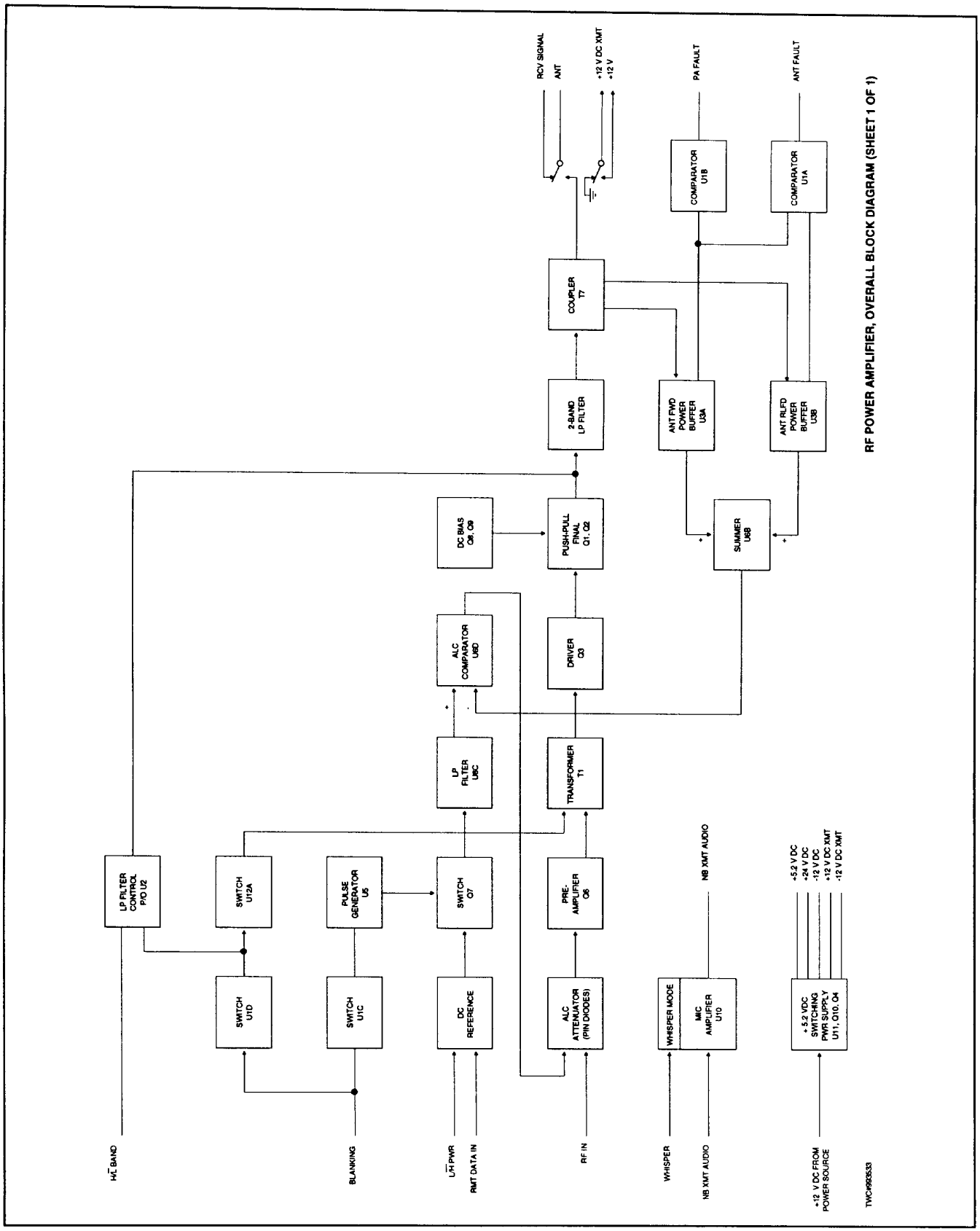


FIGURE 4-1.
Power Amplifier, Overall Block Diagram.

TABLE 4-1.
Test Equipment.

ITEM	MINIMUM SPECIFICATIONS	REPRESENTATIVE TYPE
Signal generator	10 to 12 MIIz, +10 dBm	Hewlett-Packard 8640B/Marconi 2022C
Rf power meter	Up to 10 W	Bird Model 43 with appropriate measuring elements
Function generator	Square wave, up to 500 Hz	Krohn-Hite 5400B, or equivalent
Digital multimeter	0 to 30 V dc, 0 to 2 kΩ	Fluke 8050A, Fluke 77 or equivalent
Power supply	0 to 24 V dc, 3.0 A minimum	
Network analyzer	Dual channel, 5 to 250 MIIz	Hewlett-Packard 8754A or equivalent
Power splitter		Weinschel 9445 or equivalent
Distortion analyzer	10 to 100 kIIz response	Hewlett-Packard 334A or equivalent
Oscilloscope	Bw 60 MIIz, dual trace	Phillips/Fluke PM3070 or equivalent
Test set		Radio Set Test Set
Attenuator	30 dB	Hewlett-Packard 8491A or equivalent
Load	50 Ω, 10 W	Bird 8052 or larger

4.3 TEST EQUIPMENT

Test equipment required to test, troubleshoot, repair, and align the Power Amplifier Card are listed in Table 4-1. Equivalent substitute test equipment may be used.

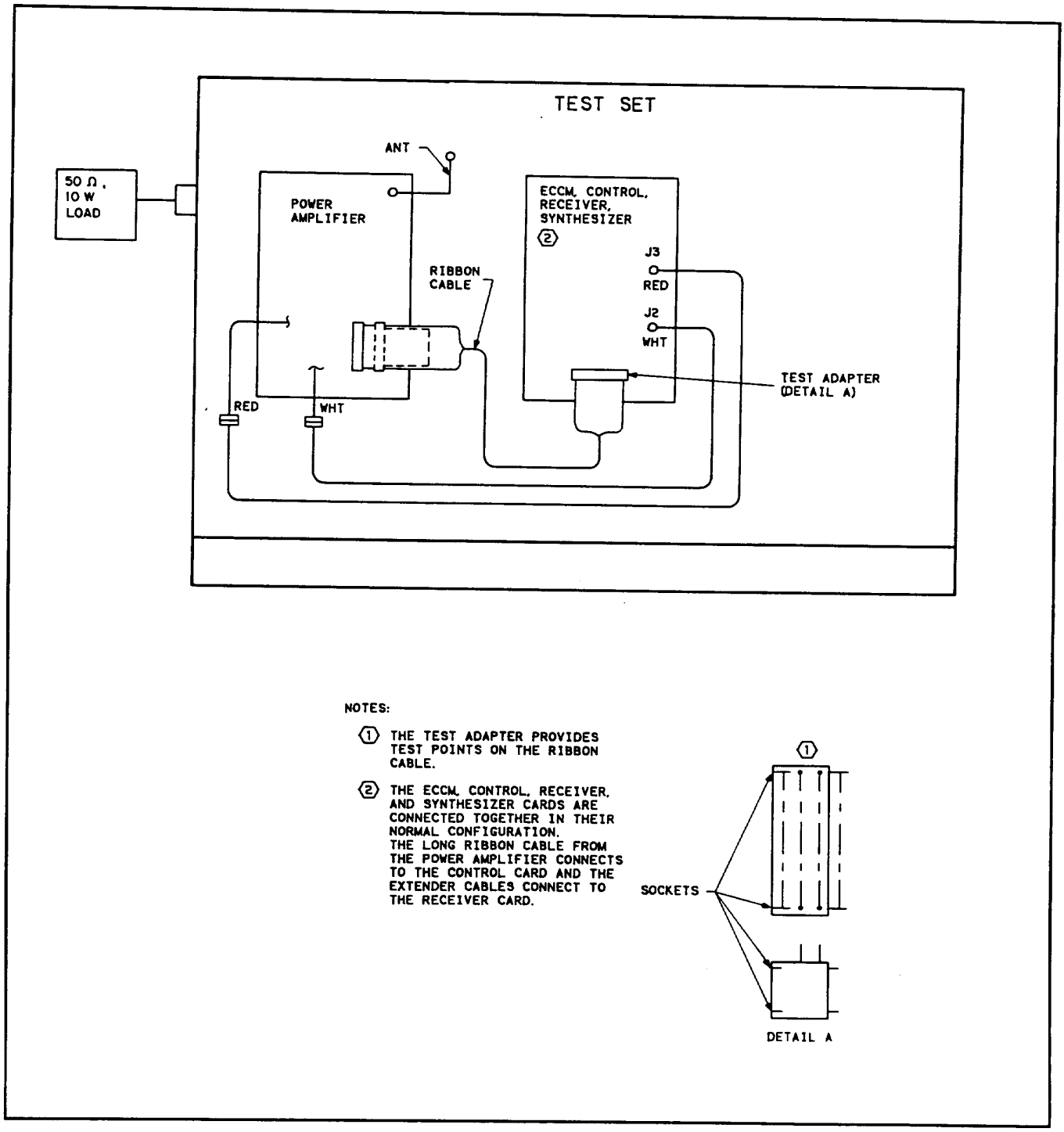


FIGURE 4-2.
Test Setup Diagram.

TABLE 4-2.
Power Amplifier, Testing and Troubleshooting Procedures.

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. Test setup	a. Remove the Power Amplifier Card from the receiver-transmitter. **WARNING** Power must not be applied to battery jack J5 during Power Amplifier removal. b. Remove the test set Power Amplifier Card from the left-hand side of the test set and install the receiver-transmitter power amplifier card in its place. c. Connect the receiver-transmitter Power Amplifier Card to the other test set circuit cards as shown in Figure 4-2. d. Terminate the test set output into a 10-watt, 50-ohm load. e. Set test set controls as follows: Control — Setting PRIMARY PWR — ON UUT PWR — ON NB AUDIO LOAD — OFF (down) WB AUDIO LOAD — OFF (down) REMOTE DATA — NORMAL PTT KEY — OFF NORMAL AUDIO INHIBIT — VOICE OFF-TEST-ON-LITE — ON Display PWR — LO Display MODE — NO HOP Display CHAN/DAY — 1 Display SQL — OFF Display FREQ/NET/TIME — As required VOL — Full CW **NOTE** Unless otherwise indicated, all measurements to ground use the GND jack on the test set as ground. All oscilloscope measurements are made with a x 10 probe.		

TABLE 4-2.
Power Amplifier, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
2. Power supply voltages	a. Perform test 1.		
	b. Using a digital multimeter, measure the power supply voltages at the test adapter pins listed below.		
	Test Adapter		
	Pin 3	+24 to +30 V dc	Check Q10, U11.
	Pin 13	+5.1 to +5.3 V dc	Check U11.
	Pin 25	-11 to -14 V dc	Check Q10, U11.
			If no voltages are present, check L34 and +12-V input power.
	c. Set PTT KEY switch to ON and check the power supply voltages at the test adapter pins listed below.		
	Test Adapter		
	Pin 3	+24 to +30 V dc	Same as test 2.b.
	Pin 13	+5.1 to +5.3 V dc	
	Pin 25	-11 to -14 V dc	
	d. Set PTT KEY switch to OFF.		
3. Power levels	a. Perform test 1.		
	b. Connect an RF signal generator to the Power Amplifier RF in connector P3 (red).		
	c. Connect an RF power meter through a 30-dB attenuator to the test set output.		
	d. Set the signal generator output to +8 dBm.		
	e. Set the test REMOTE DATA switch to TEST, and PWR to HI.		
	f. Set the signal generator and test set frequencies as shown below. Check the power output with the test set PTT KEY switch ON.		

TABLE 4-2.
Power Amplifier, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	Frequency (MHz) 30.000 36.125 39.250 33.275 51.975 52.000 63.725 75.860 87.975	Nominally 5 watts, minimum 4 watts for all frequencies	Check t/r relay. Check blanking circuit. Check RF path.
	g. Set test set PTT KEY switch to OFF.		
	h. Connect an external dc power supply to the test set REMOTE DATA IN jacks and set the power supply to +24 V dc.		
	i. Set test set REMOTE DATA switch to NORMAL.		
	j. Check power output with the signal generator and test set at the frequencies shown below and the test set PTT KEY switch ON.		
	Frequency (MHz) 30.000 36.125 39.250 44.375 51.975 52.000 63.725 75.850 87.975	Nominally 2.5 watts, minimum 2.0 watts at all frequencies	Check ALC circuit.
	k. Set PTT KEY switch to OFF.		
	l. Set PWR to LO.		
	m. Check power output with the signal generator and test set at the frequencies shown below and the test set PTT KEY switch ON.		

TABLE 4-2.
Power Amplifier, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	Frequency (MHz) 30.000 36.125 39.250 44.375 51.975 52.000 63.725 75.850 87.975	Nominally 0.25 watt, minimum 0.1 watt at all frequencies	Check RF path, blanking circuit, and t/r relay.
	n. Set test set PTT KEY and UUT PWR switches to OFF.		
4. Antenna and power faults	a. Perform test 1.		
	b. Connect an RF generator to Power Amplifier Card connector P3 (red).		
	c. Connect an RF power meter and 30-dB attenuator to the test set output.		
	d. Tune the RF generator to a frequency between 42 and 45 MHz and set the power out to +8 dBm.		
	e. On the test set, set the frequency to 43.5 MHz and PWR to HI.		
	f. Set the test set PTT KEY switch to ON and the power level down on the RF generator until the power fault display turns on. Measure the output power.	NMT 2 watts	Check U1B, U3A.
	g. Set the test set PTT KEY switch to OFF.		
	h. Set the RF signal generator output to +8 dBm.		
	i. Disconnect the RF power meter and 30-dB attenuator from the test set output.		
	j. Set the test set UUT PWR switch to OFF.		

TABLE 4-2.
Power Amplifier, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	k. Connect a digital multimeter to test adapter pin 6. Use the test GND jack for the ground connection.		
	l. Set the test set UUT PWR and PTT KEY switches to ON and measure logic level at test adapter pin 6.	Logic level 1	Check U1A, U3B.
	m. Connect the RF power meter and 30-dB attenuator to the test set output.		
	n. Set the test set REMOTE DATA switch to TEST.	Fault display remains off.	Check test set.
	o. Set test set UUT PWR switch to OFF.		
5. Audio amplifier	a. Perform test 1.		
	b. Connect a function generator and distortion analyzer to the test set NB AUDIO XMT jacks. Set the level to 1.40 millivolts at 1-kHz sine wave.		
	c. Set the test set UUT PWR switch to OFF.		
	d. Reconnect the distortion analyzer to test adapter pin 34.		
	e. Set test set UUT PWR switch to ON and measure output level.	1.57 to 1.69 V rms	Check U10.
	f. Set distortion analyzer for 0-dB reference.		
	g. Set distortion analyzer frequency to 300 Hz and measure output level change.	NMT +/-1 dB	Check U10.
	h. Set distortion analyzer frequency to 3000 Hz and measure output level change.	NMT +/-1 dB	Check U10.
	i. Set test set UUT PWR switch to OFF.		
6. Blanking	a. Perform test 1.		

TABLE 4-2.
Power Amplifier, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	b. Connect an RF generator to Power Amplifier Card connector P3 (red).		
	c. Connect a function generator output through a T-connector to test adapter pin 1 (external blanking) and channel A of an oscilloscope. Connect channel B of the oscilloscope through a 30-dB attenuator to the test set output.		
	d. Set the function generator to generate a square wave with 0- to +5-volt transitions at 1000 Hz.		
	e. Set the RF generator output to +8 dBm and frequency between 42 and 45 MHz.		
	f. Set the test set PWR to III and PTT KEY switch to ON. Using external blanking, measure the transition time between no power and 90% of full power.	NMT 25 ms	Check U1, U2.
	g. Trigger the oscilloscope on channel 1. Measure the time delay from the transition point of a falling edge of the 1000-Hz square wave to the 90% of full power output.	20 to 50 ms	Check U1, U2.
	h. Measure the time delay from the 50% transition point of a rising edge of the 1000-Hz square wave to the off or very low power level.	0 to 25 ms	Check U1, U2.
	i. Set test set PTT KEY and UUT PWR switches to OFF.		
7. Transmit/ receive switch	a. Perform test 1.		
	b. Connect a digital multimeter between Power Amplifier connectors P2 (WHT) and J2 (ANT).		
	c. Set the test set PTT KEY switch to ON and measure the resistance.	NLT 100 kΩ	Check K1, U2.
	d Set the test set PTT KEY switch to OFF and measure the resistance.	NMT 1 Ω	Check K1, U2.

4.4 TESTING/TROUBLESHOOTING PROCEDURES

The testing procedures in Table 4-2 check total performance of the Power Amplifier Card. These test procedures permit isolation of a fault to a specific component or circuit when the results are used with the schematic to circuit trace the fault. Refer to Figure 4-2 for the test setup diagram.

The Power Amplifier Card is tested by substitution in a stack of prime equipment subassemblies.

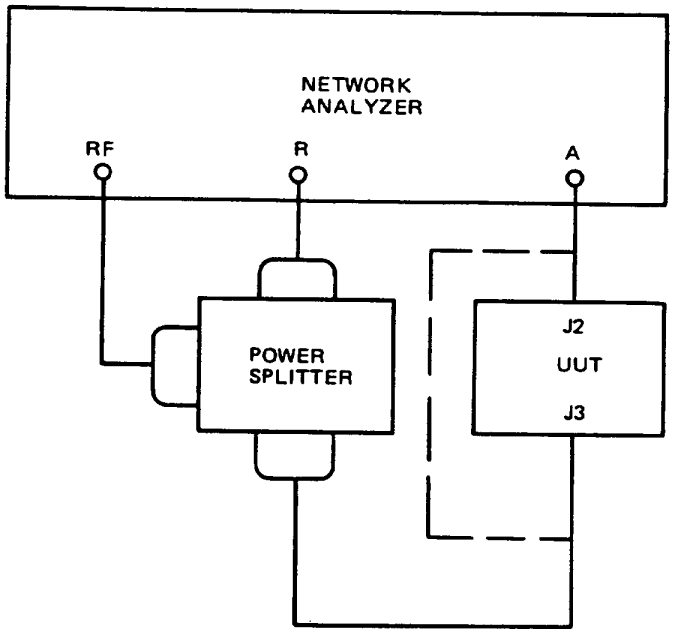


FIGURE 4-3.
Alignment/Adjustment Setup

4.5. ALIGNMENT/ADJUSTMENT (REFER TO FIGURE 4-3)

NOTE

The receiver-transmitter circuit cards must be mounted on the test set as shown in Figure 4-3 for alignment and adjustment.

4.5.1 LOW-BAND FILTER ALIGNMENT

a. Connect the network analyzer RF output to the input of a power splitter.
b. Connect one output of the power splitter to the R input of the network analyzer.
c. Select a sweep width of 50.000 MHz and tune the center frequency to 52.000 MHz.
d. Select channel 1, A/R, and 1 (IB/I) IV range.
e. Connect a lead from the other output of the power splitter to a lead from network analyzer input A.
f. Adjust the trace to the top of the crt using the channel 1 reference switches and offset control.
g. Disconnect the leads that were connected together in step e.
h. Connect the lead from the power splitter to Power Amplifier Card (UUT) J3-1.
i. Connect the lead from network analyzer input A to the UUT antenna jack J2.
j. Disconnect UUT coax connectors P2 and P3 from the receiver card.
k. Set the test set frequency to 30.000 MHz and PTT KEY switch to ON.
l. Measure insertion loss. If the insertion loss is within the following specifications, no adjustment is necessary. If not, perform steps m, n, and o.
    1. Maximum insertion loss at 52.000 MHz of 1.4 dB.
    2. Minimum insertion loss at 60.000 to 65.000 MHz of not less than 30 dB.
    3. Minimum insertion loss at 65.000 to 156.000 MHz of not less than 40 dB.
m. Tune the network analyzer center frequency to 61.000 MHz and adjust coil L2 until a notch is moved to the center of the crt display.
n. Tune the center frequency to 70.000 MHz and adjust coil L3 until a notch is moved to the center of the crt display.
o. Tune the center frequency to 109 MHz and adjust coil L11 until a notch is moved to the center of the crt display.

4.5.2 HIGH-BAND FILTER ALIGNMENT

a. Connect the network analyzer RF output to the input of a power splitter.
b. Connect one output of the power splitter to the R input of the network analyzer.
c. Select a sweep width of 50.000 MHz and tune the center frequency to 88.000 MHz.
d. Select channel 1, A/R, and 1 dB/DIV range.
e. Connect a lead from the other output of the power splitter to a lead from network analyzer input A.
f. Adjust the trace to the top of the CRT using the channel 1 reference switches and offset control.
g. Disconnect the leads that were connected together in step e.
h. Connect the lead from the power splitter to Power Amplifier Card (UUT) J3-1.
i. Connect the lead from network analyzer input A to UUT antenna jack J2.
j. Disconnect the UUT coax connectors P2 and P3 from the receiver card.
k. Set the test set frequency to 60.000 MHz and PTT KEY switch to ON. Measure insertion loss. If the insertion loss is within the following specifications, no adjustment is necessary. If not, perform steps m, n, and o.
    1. Maximum insertion loss at 88 MHz of 1.4 dB.
    2. Minimum insertion loss at 104 to 109 MHz of not less than 30 dB.
    3. Minimum insertion loss at 109 to 264 MHz of not less than 40 dB.
    4. Maximum return loss at 52 to 88 MHz of 12 dB.
m. Tune the network analyzer center frequency to 104 MHz and adjust coil L16 until a notch is moved to the center of the CRT display.
n. Tune the center frequency to 113 MHz and adjust coil L17 until a notch is moved to the center of the crt display.
o. Tune the center frequency to 199 MHz and adjust coil L15 until a notch is moved to the center of the crt display.
p. Repeat steps m, n, and o as required to meet all loss requirements.

4.5.3 POWER AMPLIFIER/AUTOLEVEL CONTROL ADJUSTMENT

NOTE:

This adjustment is only required if Q1 or Q2 have been replaced.

4.5.3.1 Q1/Q2 BIAS ADJUSTMENT

a. Insert a dc ammeter in series with J3. Set current range to approximately 500 mA scale.
b. Disconnect "RF IN" coax connector P3.
c. Key transceiver, check current on the ammeter. Current should be between 60 mA and 100 mA.

d. If current is outside these values, adjust value of resistors R85 A, B, and C to bring current within limits.

CAUTION

Do not key transceiver with R85 A, B, and C removed.

4.5.3.2 AUTO LEVEL CONTROL ALIGNMENT

a. Connect transciever to 50-ohm load, set frequency to 52 MHz. Select the "HI" power position on the transceiver front panel.
b. Adjust R76 to set desired output power (factory setting is 5 watts).
c. Select the "LO" power position on the transceiver front panel.
d. Adjust R65 to set desired output power (factory setting is 250 mW).
e. Apply +24 Vdc to 14 pin connector J1-H. This enables the medium power mode used with the OA-3633 vehicular adapter.
f. Adjust R64 to desired output power (factory setting is 2.5 watts).

4.6 REPAIR

Repair of the assembly is accomplished using the procedures detailed in the Circuit Card Repair instructions.

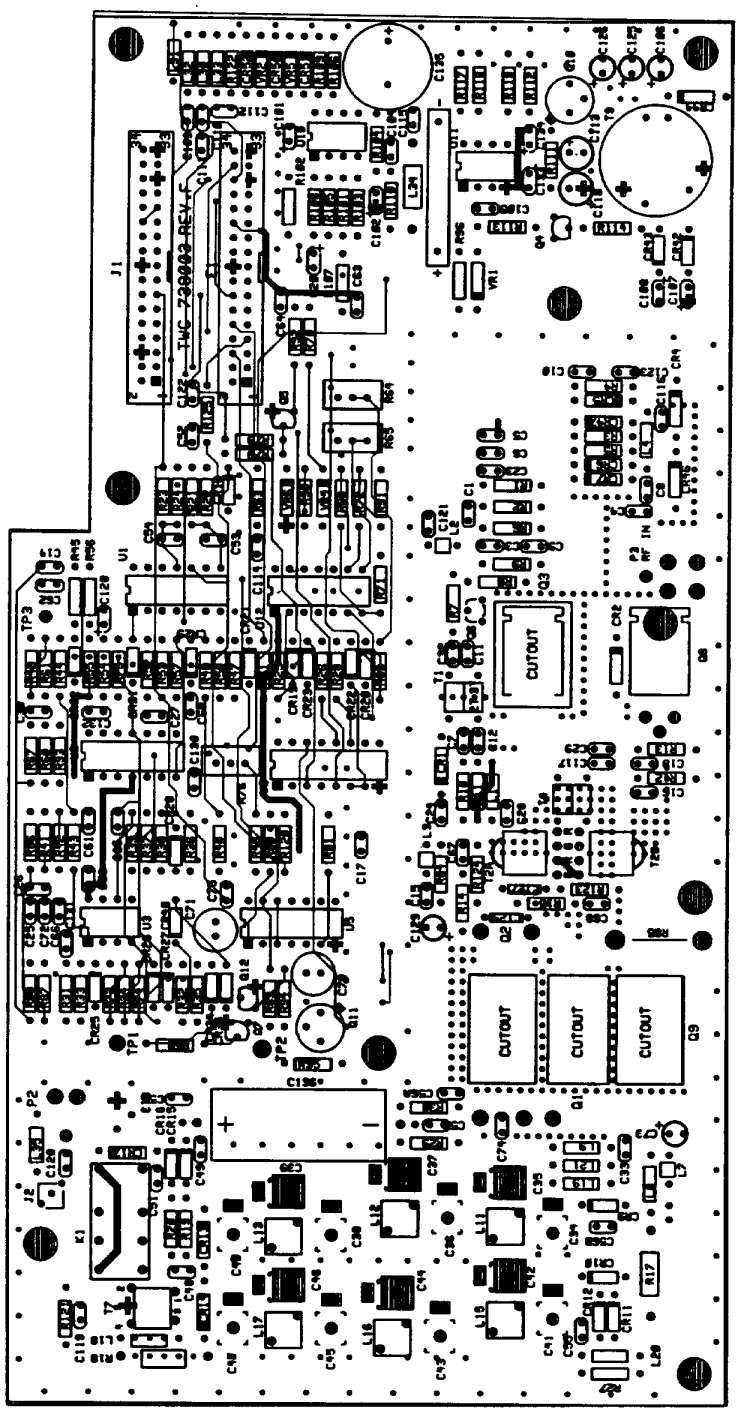
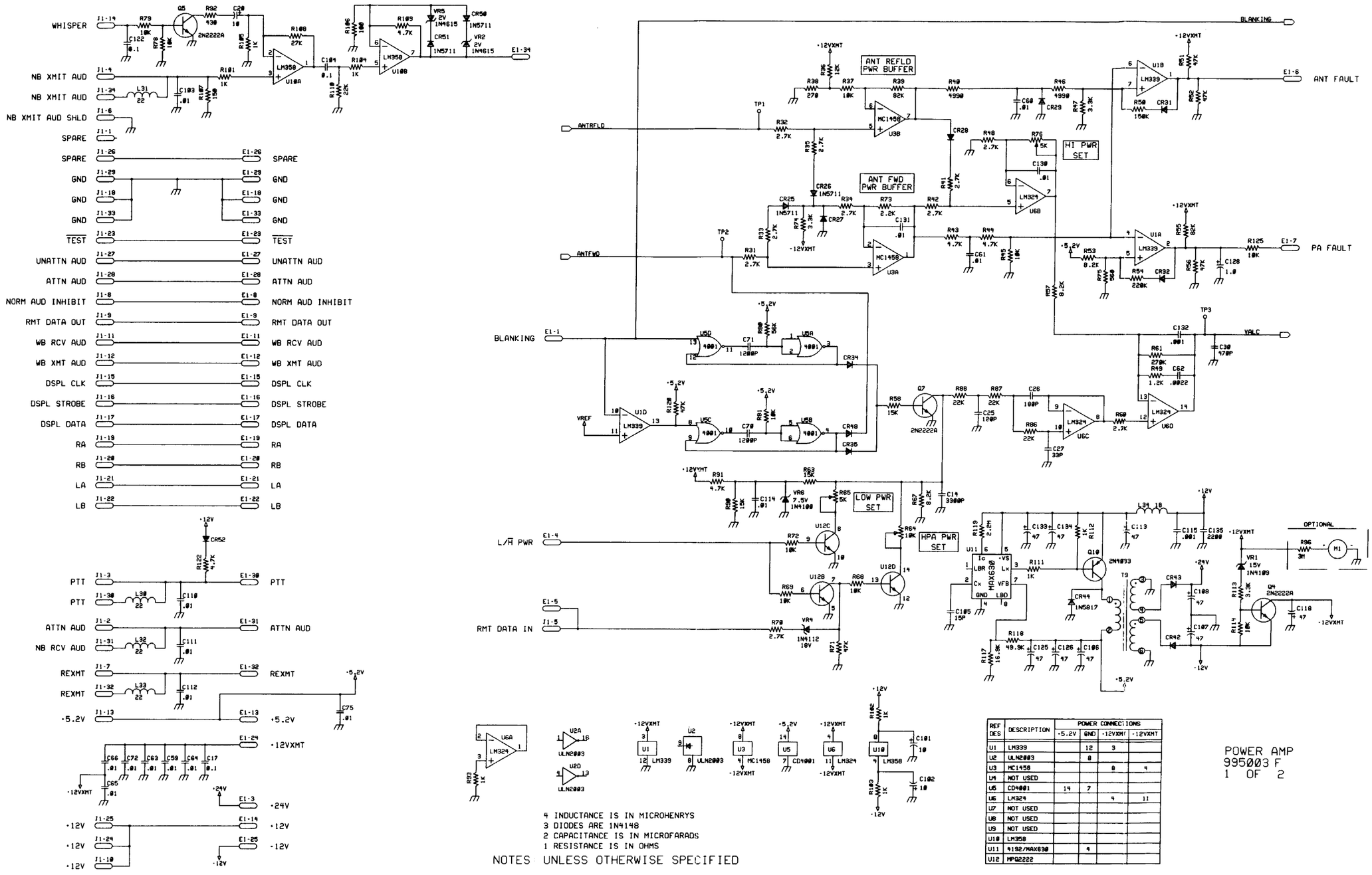


FIGURE 4-4.
Component Locations, Power Amplifier.



REF DES	DESCRIPTION	POWER CONNECTIONS			
		+5.2V	GND	-12VXMT	-12VXMT
U1	LM339		12	3	
U2	ULN2003		8		
U3	MC1458			8	4
U4	NOT USED				
U5	CD4001	14	7		
U6	LM324			4	11
U7	NOT USED				
U8	NOT USED				
U9	NOT USED				
U10	LM358				
U11	4192/MAX630		4		
U12	MPQ2222				

FIGURE 4-5.
Schematic Diagram, Power Amplifier (1 of 2).

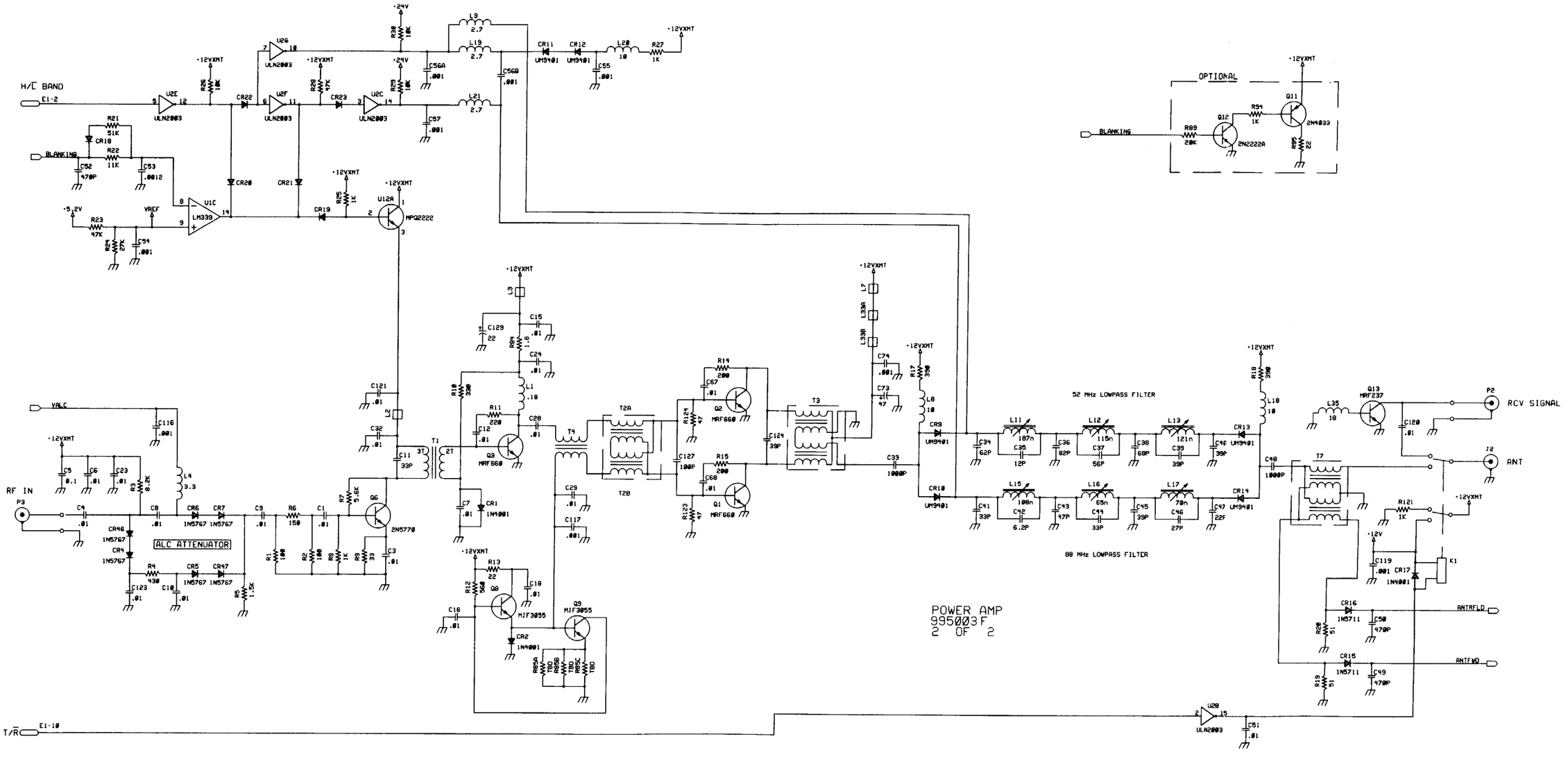


FIGURE 4-5
Schematic Diagram, Power Amplifier (2 of 2).

TABLE 4-3.
Parts List, Power Amplifier.

DESIGNATOR	PART #	DESCRIPTION
C1	214103	CAP, 0.01MF 50V MONO
C3	214103	CAP, 0.01MF 50V MONO
C4	214103	CAP, 0.01MF 50V MONO
C5	275104	CAP, 0.1MF 50V MONOLITHIC
C10	214103	CAP, 0.01MF 50V MONO
C11	275330	CAP, ML NPO 33PF 100V 5% 0.1S
C12	214103	CAP, 0.01MF 50V MONO
C14	275332	CAP, ML 3300PF NPO 10% 50V .2S
C15	214103	CAP, 0.01MF 50V MONO
C16	214103	CAP, 0.01MF 50V MONO
C17	276104	CAP, ML Z5U 0.1UF 50V 0.2SPACE
C18	214103	CAP, 0.01MF 50V MONO
C20	241100	CAP, 10MF DIP TANTALUM
C23	214103	CAP, 0.01MF 50V MONO
C24	214103	CAP, 0.01MF 50V MONO
C25	275121	CAP, ML 120PF NPO 5% 100V 0.1S
C26	275181	CAP, ML 180PF NPO 5% 100V 0.1S
C27	275330	CAP, ML NPO 33PF 100V 5% 0.1S
C28	214103	CAP, 0.01MF 50V MONO
C29	214103	CAP, 0.01MF 50V MONO
C30	276471	CAP, ML NPO 470PF 100V 5% 0.1S
C32	214103	CAP, 0.01MF 50V MONO
C33	275102	CAP, ML NPO .001UF 100V 5% .1S
C34	227620	CAP, 62PF 5% 300V MC MICA MINI
C35	227120	CAP, 12PF 5% 300V MC MICA MINI
C36	227820	CAP, 82PF 5% 300V MC MICA MINI
C37	227560	CAP, 56PF 5% 300V MC MICA MINI
C38	227680	CAP, 68PF 5% 300V MC MICA MINI
C39	227390	CAP, 39PF 5% 300V MC MICA MINI
C40	227390	CAP, 39PF 5% 300V MC MICA MINI

TABLE 4-3.
Parts List, Power Amplifier (Continued).

DESIGNATOR	PART #	DESCRIPTION
C41	227330	CAP, 33PF 5% 300V MC MICA MINI
C42	227062	CAP, 6.2PF 5% 300V MC MICA MINI
C43	227470	CAP, 47PF 5% 300V MC MICA MINI
C44	227330	CAP, 33PF 5% 300V MC MICA MINI
C45	227390	CAP, 39PF 5% 300V MC MICA MINI
C46	227270	CAP, 27PF 5% 300V MC MICA MINI
C47	227220	CAP, 22PF 5% 300V MC MICA MINI
C48	275102	CAP, ML NPO .001UF 100V 5% .1S
C49	276471	CAP, ML NPO 470PF 100V 5% 0.1S
C50	276471	CAP, ML NPO 470PF 100V 5% 0.1S
C51	214103	CAP, 0.01MF 50V MONO
C52	276471	CAP, ML NPO 470PF 100V 5% 0.1S
C53	275122	CAP, ML NPO 1200PF 100V 5% .2S
C54	275102	CAP, ML NPO .001UF 100V 5% .1S
C55	275102	CAP, ML NPO .001UF 100V 5% .1S
C56A	275102	CAP, ML NPO .001UF 100V 5% .1S
C56B	275102	CAP, ML NPO .001UF 100V 5% .1S
C57	275102	CAP, ML NPO .001UF 100V 5% .1S
C59	214103	CAP, 0.01MF 50V MONO
C60	214103	CAP, 0.01MF 50V MONO
C61	214103	CAP, 0.01MF 50V MONO
C62	276222	CAP, ML 2200PF NPO 5% 100V .2S
C63	214103	CAP, 0.01MF 50V MONO
C64	214103	CAP, 0.01MF 50V MONO
C65	214103	CAP, 0.01MF 50V MONO
C66	214103	CAP, 0.01MF 50V MONO
C67	214103	CAP, 0.01MF 50V MONO
C68	214103	CAP, 0.01MF 50V MONO
C70	275122	CAP, ML NPO 1200PF 100V 5% .2S
C71	275122	CAP, ML NPO 1200PF 100V 5% .2S

TABLE 4-3.
Parts List, Power Amplifier (Continued).

DESIGNATOR	PART #	DESCRIPTION
C72	214103	CAP, 0.01MF 50V MONO
C74	275102	CAP, ML NPO .001UF 100V 5% .1S
C75	214103	CAP, 0.01MF 50V MONO
C101	241100	CAP, 10MF DIP TANTALUM
C102	241100	CAP, 10MF DIP TANTALUM
C103	214103	CAP, 0.01MF 50V MONO
C104	275104	CAP, 0.1MF 50V MONOLITHIC
C105	275150	CAP, 15 PF NPO
C106	241476	CAP, 47MF 16V DIP TANT
C107	241100	CAP, 10MF DIP TANTALUM
C108	242047	CAP, 4.7 UF 35V 10% TANT
C110	214103	CAP, 0.01MF 50V MONO
C111	214103	CAP, 0.01MF 50V MONO
C112	214103	CAP, 0.01MF 50V MONO
C113	241476	CAP, 47MF 16V DIP TANT
C114	214103	CAP, 0.01MF 50V MONO
C115	275102	CAP, ML NPO .001UF 100V 5% .1S
C116	275102	CAP, ML NPO .001UF 100V 5% .1S
C117	275102	CAP, ML NPO .001UF 100V 5% .1S
C118	241476	CAP, 47MF 16V DIP TANT
C119	275102	CAP, ML NPO .001UF 100V 5% .1S
C120	276471	CAP, ML NPO 470PF 100V 5% 0.1S
C121	214103	CAP, 0.01MF 50V MONO
C122	275104	CAP, 0.1MF 50V MONOLITHIC
C123	214103	CAP, 0.01MF 50V MONO
C124	277390	CAP, ML 39PF NPO AXIAL 5% 100V
C125	241476	CAP, 47MF 16V DIP TANT
C126	241476	CAP, 47MF 16V DIP TANT
C127	210101	CAP, 100P DISC NPO
C128	241010	CAP, 1.0 MF DIP TANTALUM

TABLE 4-3.
Parts List, Power Amplifier (Continued).

DESIGNATOR	PART #	DESCRIPTION
C129	241226	CAP, 22MF DIP TANTALUM
C130	214103	CAP, 0.01MF 50V MONO
C131	214103	CAP, 0.01MF 50V MONO
C132	275102	CAP, ML NPO .001UF 100V 5% .1S
C133	241476	CAP, 47MF 16V DIP TANT
C134	241476	CAP, 47MF 16V DIP TANT
C135	232222-1	CAP, AL, 222UF, 16, 20%, RA, .3
CR1	320101	DIODE, RECT. SI 1A 600V
CR2	320101	DIODE, RECT. SI 1A 600V
CR4	320431	DIODE, PIN ATTN 5 OHM @ 100MA
CR5	320431	DIODE, PIN ATTN 5 OHM @ 100MA
CR6	320431	DIODE, PIN ATTN 5 OHM @ 100MA
CR7	320431	DIODE, PIN ATTN 5 OHM @ 100MA
CR9	320432	DIODE, PIN, ANT SW, 5.5W, UM9401B
CR10	320432	DIODE, PIN, ANT SW, 5.5W, UM9401B
CR11	320432	DIODE, PIN, ANT SW, 5.5W, UM9401B
CR12	320432	DIODE, PIN, ANT SW, 5.5W, UM9401B
CR13	320432	DIODE, PIN, ANT SW, 5.5W, UM9401B
CR14	320432	DIODE, PIN, ANT SW, 5.5W, UM9401B
CR15	320219	DIODE, 1N5711 HOT CARR SCHOTT
CR16	320219	DIODE, 1N5711 HOT CARR SCHOTT
CR17	320101	DIODE, RECT. SI 1A 600V
CR18	320002	DIODE, SI 100MA 1N4148/1N4150
CR19	320002	DIODE, SI 100MA 1N4148/1N4150
CR20	320002	DIODE, SI 100MA 1N4148/1N4150
CR21	320002	DIODE, SI 100MA 1N4148/1N4150
CR22	320002	DIODE, SI 100MA 1N4148/1N4150
CR23	320002	DIODE, SI 100MA 1N4148/1N4150
CR25	320219	DIODE, 1N5711 HOT CARR SCHOTT
CR26	320219	DIODE, 1N5711 HOT CARR SCHOTT

TABLE 4-3.
Parts List, Power Amplifier (Continued).

DESIGNATOR	PART #	DESCRIPTION
CR27	320002	DIODE, SI 100MA 1N4148/1N4150
CR28	320002	DIODE, SI 100MA 1N4148/1N4150
CR29	320002	DIODE, SI 100MA 1N4148/1N4150
CR31	320002	DIODE, SI 100MA 1N4148/1N4150
CR32	320002	DIODE, SI 100MA 1N4148/1N4150
CR34	320002	DIODE, SI 100MA 1N4148/1N4150
CR35	320002	DIODE, SI 100MA 1N4148/1N4150
CR42	320002	DIODE, SI 100MA 1N4148/1N4150
CR43	320002	DIODE, SI 100MA 1N4148/1N4150
CR44	320429	DIODE, 1N5817 SCHOTKY
CR46	320431	DIODE, PIN ATTN 5 OHM @ 100MA
CR47	320431	DIODE, PIN ATTN 5 OHM @ 100MA
CR48	320002	DIODE, SI 100MA 1N4148/1N4150
CR50	320219	DIODE, 1N5711 HOT CARR SCHOTT
CR51	320219	DIODE, 1N5711 HOT CARR SCHOTT
CR52	320002	DIODE, SI 100MA 1N4148/1N4150
J1	620033	HEADER, 34 PIN PCB SHORT EJECT
J2	614055	CONN, RF VERTICAL
J3	650048	HEADER, 2 PIN .025 SQ
K1	540080	RELAY, DPDT 2 AMP SEALED
L1	430046	INDUCTOR, 0.18 UH MOLDED
L2	490201	BEAD FERRITE SHIELD 73 MAT.
L3	490201	BEAD FERRITE SHIELD 73 MAT.
L4	430027	INDUCTOR FIXED 3.3UH
L7	490201	BEAD FERRITE SHIELD 73 MAT.
L8	430029	INDUCTOR, 10 UH 10% FIXED MOLD
L9	430212	INDUCTOR, 2.7 UH 10% Q35 MOLD

TABLE 4-3.
Parts List, Power Amplifier (Continued).

DESIGNATOR	PART #	DESCRIPTION
L11	490133	INDUCTOR, VARIABLE 6.5 TURNS
L12	490151	IND, VAR 5.5T 0.112UH MINI GRN
L13	490151	IND, VAR 5.5T 0.112UH MINI GRN
L15	490151	IND, VAR 5.5T 0.112UH MINI GRN
L16	490137	INDUCTOR, VARIABLE 3.5 TURNS
L17	490137	INDUCTOR, VARIABLE 3.5 TURNS
L18	430029	INDUCTOR, 10 UH 10% FIXED MOLD
L19	430212	INDUCTOR, 2.7 UH 10% Q35 MOLD
L20	430029	INDUCTOR, 10 UH 10% FIXED MOLD
L21	430212	INDUCTOR, 2.7 UH 10% Q35 MOLD
L30	430021	INDUCTOR FIXED RFC 22UH
L31	430021	INDUCTOR FIXED RFC 22UH
L32	430021	INDUCTOR FIXED RFC 22UH
L33	430021	INDUCTOR FIXED RFC 22UH
L33A	490201	BEAD FERRITE SHIELD 73 MAT.
L33B	490201	BEAD FERRITE SHIELD 73 MAT.
L34	430222	INDUCTOR, 18UH 10% SHIELDED
L35	430221	INDUCTOR, 18 UH FIXED 10%
P2	018-00030	CABLE ASSY, 4260156030 (WHT)
P3	018-00020	CA ASSY, 4260516020 (BLACK)
Q1	310150	XISTOR, MRF660
Q2	310150	XISTOR, MRF660
Q3	310150	XISTOR, MRF660
Q4	310057	XISTOR, NPN, PN2222A, TO92
Q5	310057	XISTOR, NPN, PN2222A, TO92
Q6	310032	XISTOR, NPN, 2N5770, TO92
Q7	310057	XISTOR, NPN, PN2222A, TO92
Q8	310133	XISTOR, NPN MJF3055 TO-220 INS

TABLE 4-3.
Parts List, Power Amplifier (Continued).

DESIGNATOR	PART #	DESCRIPTION
Q9	310133	XISTOR, NPN MJF3055 TO-220 INS
Q10	310142	XISTOR, PNP, 2N4033, TO39, 80V, 1A
Q13	310028	XISTOR, NPN, SD1127/MRF237, TO39
R1	124101	RES, 100 OHM 1/4W 5% CF
R2	124101	RES, 100 OHM 1/4W 5% CF
R3	124822	RES, 8.2K 1/4W 5% CARBON FILM
R4	124431	RES, 430 OHM 1/4W 5%
R5	124152	RES, 1.5K 1/4W 5% CARBON FILM
R6	124151	RES, 150 OHM 1/4W 5% CF
R7	124562	RES, 5.6K 1/4W 5% CARBON FILM
R8	124102	RES, 1K 1/4W 5% CARBON FILM
R9	124330	RES, 33 OHM 1/4W 5% CARBON FILM
R10	134331	RES, 330 OHM 1/2W 5% CF
R11	124221	RES, 220 OHM 1/4W 5% CF
R12	124561	RES, 560 OHM 1/4W 5% CF
R13	124220	RES, 22 OHM 1/4W 5% CARBON FILM
R14	124201	RES, 200 OHM 1/4W 5% CF
R15	124201	RES, 200 OHM 1/4W 5% CF
R17	144391	RES, 390 OHM 1W 5% FILM
R18	144391	RES, 390 OHM 1W 5% FILM
R19	124510	RES, 51 OHM 1/4W 5% CARBON FILM
R20	124510	RES, 51 OHM 1/4W 5% CARBON FILM
R21	124513	RES, 51K 1/4W 5%
R22	124113	RES, 11K 1/4W 5%
R23	124473	RES, 47K 1/4W 5% CARBON FILM
R24	124273	RES, 27K 1/4W 5% CARBON FILM
R25	124102	RES, 1K 1/4W 5% CARBON FILM
R26	124103	RES, 10K 1/4W 5% CARBON FILM
R27	124102	RES, 1K 1/4W 5% CARBON FILM
R28	124473	RES, 47K 1/4W 5% CARBON FILM

TABLE 4-3.
Parts List, Power Amplifier (Continued).

DESIGNATOR	PART #	DESCRIPTION
R29	124103	RES, 10K 1/4W 5% CARBON FILM
R30	124103	RES, 10K 1/4W 5% CARBON FILM
R31	124272	RES, 2.7K 1/4W 5% CARBON FILM
R32	124272	RES, 2.7K 1/4W 5% CARBON FILM
R33	124272	RES, 2.7K 1/4W 5% CARBON FILM
R34	124272	RES, 2.7K 1/4W 5% CARBON FILM
R35	124272	RES, 2.7K 1/4W 5% CARBON FILM
R36	124123	RES, 12K 1/4W 5% CARBON FILM
R37	124103	RES, 10K 1/4W 5% CARBON FILM
R38	124271	RES, 270 OHM 1/4W 5% CF
R39	124823	RES, 82K 1/4W 5% CARBON FILM
R40	1114991	RES, 4.99K 1/8W 1%
R41	124272	RES, 2.7K 1/4W 5% CARBON FILM
R42	124272	RES, 2.7K 1/4W 5% CARBON FILM
R43	124472	RES, 4.7K 1/4W 5% CARBON FILM
R44	124472	RES, 4.7K 1/4W 5% CARBON FILM
R45	124103	RES, 10K 1/4W 5% CARBON FILM
R46	1114991	RES, 4.99K 1/8W 1%
R47	124332	RES, 3.3K 1/4W 5% CARBON FILM
R48	124272	RES, 2.7K 1/4W 5% CARBON FILM
R49	113122	RES, 1.2K 1/8W 5% CARBON FILM
R50	124154	RES, 150K 1/4W 5% CARBON FILM
R51	124473	RES, 47K 1/4W 5% CARBON FILM
R52	124473	RES, 47K 1/4W 5% CARBON FILM
R53	124822	RES, 8.2K 1/4W 5% CARBON FILM
R54	124224	RES, 220K 1/4W 5% CARBON FILM
R55	124823	RES, 82K 1/4W 5% CARBON FILM
R56	124473	RES, 47K 1/4W 5% CARBON FILM
R57	124822	RES, 8.2K 1/4W 5% CARBON FILM
R58	113153	RES, 15K 1/8W 5% CARBON FILM
R60	113272	RES, 2.7K 1/8W 5% CARBON FILM

TABLE 4-3.
Parts List, Power Amplifier (Continued).

DESIGNATOR	PART #	DESCRIPTION
R61	124274	RES, 270K 1/4W 5% CARBON FILM
R63	124103	RES, 10K 1/4W 5% CARBON FILM
R64	170230	RES, 10K TRIMMER
R65	170203	RES, 5K 20T TRIMMER
R67	124822	RES, 8.2K 1/4W 5% CARBON FILM
R68	124103	RES, 10K 1/4W 5% CARBON FILM
R69	124103	RES, 10K 1/4W 5% CARBON FILM
R70	124272	RES, 2.7K 1/4W 5% CARBON FILM
R71	124473	RES, 47K 1/4W 5% CARBON FILM
R72	124103	RES, 10K 1/4W 5% CARBON FILM
R73	113222	RES, 2.2K 1/8W 5% CARBON FILM
R74	124332	RES, 3.3K 1/4W 5% CARBON FILM
R75	124561	RES, 560 OHM 1/4W 5% CF
R76	170203	RES, 5K 20T TRIMMER
R78	124103	RES, 10K 1/4W 5% CARBON FILM
R79	124103	RES, 10K 1/4W 5% CARBON FILM
R80	124563	RES, 56K 1/4W 5% CARBON FILM
R81	124103	RES, 10K 1/4W 5% CARBON FILM
R84	124018	RES, 1.8 OHMS 1/4W 5% FILM
R86	124223	RES, 22K 1/4W 5% CARBON FILM
R87	124223	RES, 22K 1/4W 5% CARBON FILM
R88	124223	RES, 22K 1/4W 5% CARBON FILM
R90	113153	RES, 15K 1/8W 5% CARBON FILM
R91	113472	RES, 4.7K 1/8W 5% CARBON FILM
R92	124431	RES, 430 OHM 1/4W 5%
R93	124102	RES, 1K 1/4W 5% CARBON FILM
R101	124102	RES, 1K 1/4W 5% CARBON FILM
R102	124102	RES, 1K 1/4W 5% CARBON FILM
R103	124102	RES, 1K 1/4W 5% CARBON FILM
R104	124102	RES, 1K 1/4W 5% CARBON FILM
R105	124102	RES, 1K 1/4W 5% CARBON FILM

TABLE 4-3.
Parts List, Power Amplifier (Continued).

DESIGNATOR	PART #	DESCRIPTION
R106	124101	RES, 100 OHM 1/4W 5% CF
R107	124151	RES, 150 OHM 1/4W 5% CF
R108	124273	RES, 27K 1/4W 5% CARBON FILM
R109	124472	RES, 4.7K 1/4W 5% CARBON FILM
R110	124223	RES, 22K 1/4W 5% CARBON FILM
R111	124102	RES, 1K 1/4W 5% CARBON FILM
R112	124102	RES, 1K 1/4W 5% CARBON FILM
R113	124332	RES, 3.3K 1/4W 5% CARBON FILM
R114	124103	RES, 10K 1/4W 5% CARBON FILM
R117	1111692	RES, 16.9K 1/8W 1%
R118	1114992	RES, 49.9K 1/8W, 1% FILM
R119	124225	RES, 2.2M 1/4W 5% CARBON FILM
R120	124473	RES, 47K 1/4W 5% CARBON FILM
R121	124102	RES, 1K 1/4W 5% CARBON FILM
R122	124472	RES, 4.7K 1/4W 5% CARBON FILM
R123	124470	RES, 47 OHM 1/4W 5% CARBON FILM
R124	124470	RES, 47 OHM 1/4W 5% CARBON FILM
R125	124103	RES, 10K 1/4W 5% CARBON FILM
T1	018-00301	XFMR ASSY, PRC1088 T1 3T/2T
T2A	018-00302	XFMR ASSY, PRC1088 T2A, T2B
T2B	018-00302	XFMR ASSY, PRC1088 T2A, T2B
T4	018-00303	XFMR ASSY PA, T4
T7	018-00304	XFMR ASSY, PRC1088 2780511040
T9	459251	XFMR, PRC1088 SWITCHER PA MOD.
U1	330356	IC, LM339N QUAD COMPARATOR
U2	330441	IC, DARL DRIVER ARRAY 7X500MA
U3	330019	IC, MC1458P
U5	330054	IC, DIG, CD4001, DIP14, NOR
U6	330030	IC, LIN, LM324N, DIP14, OP-AMP

TABLE 4-3.
Parts List, Power Amplifier (Continued).

DESIGNATOR	PART #	DESCRIPTION
U10	330081	IC, LIN, LM358N, DIP8, OP-AMP
U11	330439	IC, MAX630/RV4192/RV4191
U12	310101	XISTOR, NPN, MPQ2222A, 14-DIP, IC
VR1	320218	DIODE, 1N4109 ZENER 5% L.NOISE
VR2	320280	DIODE, ZENER 2.0V 5% LOW NOISE
VR4	320217	DIODE, 1N4112 ZENER 5% L.NOISE
VR5	320280	DIODE, ZENER 2.0V 5% LOW NOISE
VR6	320281	DIODE, ZENER 7.5V L.NOISE LO.I
XQ10	830052	NYLON TO-5 XSISTOR MOUNT PAD
XQ13	830052	NYLON TO-5 XSISTOR MOUNT PAD

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CHAPTER 5
CONTROL CARD (ASSY 018-00400, PCB 739004)

5.1 DESCRIPTION

The Control Card consists of a single four-layer printed circuit card. The Control Card (018-00400) is shown in Figure 5-1.

The Control Card contains the microprocessor circuitry that controls all facets of the basic radio set operation. This card also contains much of the audio processing circuitry for the radio set.

5.2 PRINCIPLES OF OPERATION

5.2.1 GENERAL

In receive mode, the switching circuits of the Control and ECCM Modules receive either audio or 16-kb/s data. When the radio is in the HOP mode, the receive signal is in 20-kb/s data. The data is then applied through a multiplexer and the BIT sync to the ECCM Module USART (Universal Synchronous Asynchronous Receiver-Transmitter) which converts the 20-kb/s data to 16-kb/s data. The 16-kb/s data is then dedigitized by passing through the CVSD (Continuously Variable Slope Detector). The dedigitized receive audio or data is sent back to the Control Module switching circuits and then applied to an audio connector or power connector on the front panel.

In transmit mode, the switching circuits of the Control and ECCM Module receive audio from a front panel AUDIO jack or power connector. The audio is amplified, clipped, filtered, and mixed with 150 Hz from the synthesizer. In NO HOP mode, the audio is then sent to the synthesizer. In HOP mode, the audio is digitized by the ECCM Module CVSD and is then sent to the ECCM array where, with the aid of the microprocessor, the transmit audio is bursted from 16 kb/s to 20 kb/s.

5.2.2 CONTROL CARD, FUNCTIONAL THEORY (REFER TO FIGURE 5-3)

Wide band audio is applied to buffer amplifier U27A from the receiver. One output of the buffer amplifier is applied directly to data comparator U26A. The other output of the buffer amplifier goes through dc restorer CR5, CR6, CR8, and CR9 to data comparator U26A. The output of U26A is applied to the USART (Universal Synchronous Asynchronous Receiver-Transmitter) on the ECCM Card, via the programmable gate array, U2.

When operating as the NCS (Net Control Station), page signals or command channel activity (channels 7, 8, and 9) from the receiver are applied to the 3-pole, high-pass filter U27B. After U27B is detector Q8, followed by comparator U26B. The page detect output of U26B is applied to input/ output port U2. U2 is being scanned periodically for page activity in HOP mode or command channel activity in scan mode.

Switch U13A selects either audio from the CVSD (Continuously Variable Slope Detector on the ECCM Card) or wide-band audio data from the receiver. This is the audio path for narrow-band audio. The signal passes through a 150-Hz notch filter (U29B) to squelch gate U13C, U13B. The squelch gate mutes the audio when a 150-Hz squelch tone is not detected by the receiver. After the squelch gate is a 300-Hz high-pass filter (U29A) followed by a 3-kHz, low-pass filter (U29D). Another input to U29A is from fault tone generator U28. The fault tone generator is a multivibrator that is triggered by input/output port U3. The output of low-pass filter U29D is unattenuated audio (narrow-band audio) in receive mode. The unattenuated audio goes to the front panel volume control and from there back to the control board as attenuated audio to audio amplifier U29C, Q9, Q10. This is the final audio amplifier that drives the two audio connectors and the remote connector. When transmitting audio, the gain is reduced by sidetone gain adjust Q7 to a level lower than the received signal to prevent feedback through the handset. Sidetone gain adjust is activated by the TR line in transmit mode.

The two inputs to switch U4B are digital data from the ECCM Card USART in HOP mode or audio from the receiver in NO HOP. Either input can be switched to the front panel remote power connector to run peripheral equipment. The DATA OUT signal may also be processed in the CVSD as audio and returned through switch U13A to the narrow-band audio line.

The front-panel cursor switch (left) and column switch (right) each has two contacts. The outputs of the switches are LA, LB, RA, and RB. These switches feed a binary signal to pulse generator U21, 20B, 20D, 25A, 25D, 20C, and 30D. Each change of a switch changes the signal one bit. This allows the microprocessor to determine the direction of switch rotation. The pulse generator develops a very narrow pulse and feeds it to nonmaskable interrupt RSTA. The front-panel switch inputs are also applied to input/output port U3 where they generate a pulse to tell the microprocessor that a signal is coming in. The microprocessor then monitors the test line and Push-To-Talk (PTT) line as possible

sources for interrupt. The PTT signal from the front panel is applied to Q5 and U3, where it is scanned by the microprocessor. The test signal from the front panel switch is applied to nonmaskable interrupt and I/O port U3 where it is scanned by the microprocessor. Input/output port U3 can have its inputs changed to outputs on each line. If a nonmaskable interrupt input is not a test signal, the microprocessor reprograms the port as an output and drives it low so no pulses will be transmitted from the nonmaskable interrupt.

The 150-Hz signal from the synthesizer passes through a 2-pole, low-pass filter to a summer (U14A). The other input to summer U14A is narrow-band transmit audio from the Power Amplifier Card through a 3-kHz, low-pass filter (U8A, B). The two signals are combined in the summer and pass through switch U5A to the receiver card as modulation. The 150 Hz will produce approximately 3 kHz of modulation. The audio signal will produce about 7 kHz of modulation.

Digital data such as HOP or NO HOP, wide-band transmit audio from the wide-band input, or data from the CVSD (on ECCM Card) is selected by switches U4C and U5B and fed to data integrator U14D. U14D converts a squarewave input to a trapezoidal output. The trapezoidal signal gives maximum power efficiency but takes out the sharp edges that cause ringing and harmonics.

When processing data, the trapezoidal wave will go through switch U5A and will be the modulation output. The 150-Hz modulation signal is not used in wide-band or digital data modes.

Another source of modulation is transmit data from the microprocessor when in HOP mode, or wide-band transmit data from the remote connector in NO HOP mode. Switch U4C is controlled by voice hop and switch U5B is controlled by the hop signal.

Battery fault monitor U14C is set to trip at 9.5 volts and feed a signal to I/O port U3. U3 will generate a tone and a flashing symbol on the front panel. The 3.0-volt, Hold-Up Battery (HUB) supplies power to RAM U15 and the real time clock on the ECCM card through U22. When the radio is turned off, at approximately 7.5 volts, the microprocessor reset circuit (Q1, Q2) is armed and puts the microprocessor in reset.

Input/output port U2 drives the radio. It has the 12 address lines the receiver and synthesizer use to decode the frequency. It has a high-low band signal which determines if the radio will operate above or below 52 MHz. The receive strobe goes to the receiver and synthesizer to notify them that a signal is coming. This causes the receiver to retune. The synthesizer looks for activity on the 0 to 11 frequency address lines and when it detects a change, it will tune to it. The retransmit line is a signal to the front panel. When the radio is used for retransmit, the squelch from the receiver is funneled into the retransmit line and will key a second radio so that the two radios operate as an automatic relay. The PAGE output is a page frame that is inserted into the frequency hopping sequence every 250 milliseconds. The page frequency is operator selectable and programmable for each channel selected.

Input/output port U3 receives all nonmaskable interrupt signals. U3 controls the high or low power level of the Power Amplifier. When a PTT signal is recognized by U9, it activates transmit or receive in the rest of the radio. Display strobe (DSPL ST), display clock (DSPL CLK), and display data (DSPL DATA) are serial strings of data that are displayed on the front panel. Loss of lock is a fault signal from the synthesizer. Antenna fault and PA fault are faults from the Power Amplifier Card.

Microprocessor U1 has several interrupt inputs. One interrupt is Nonmaskable Interrupt (NMI). Reset is essentially an interrupt. During operation, Receive Frame Mark (RCV FRM) and Internal Frame Mark (INT FRM), are inputs to the maskable circuits of the microprocessor and are used in HOP mode. These are data acquisition type signals. They can be programmed on or off depending on the mode of operation. Output Enable (OE) is the read line. During power up, reset Q1 and Q2 generates a pulse that keeps the microprocessor from operating until power is on the line. The reset circuit also has a battery sensing circuit that forces the microprocessor into reset when the battery voltage drops below a certain point. Read (RD) and Write (WR) are outputs of the microprocessor. Address Line Enable (ALE) is a pulse from the microprocessor each time the low order address lines are changed that allows them to be latched by address latch U2. The microprocessor has a 5.12-MHz crystal input which is used to create a 2.56-MHz clock. The 2.56-MHz clock is the master clock for the entire system.

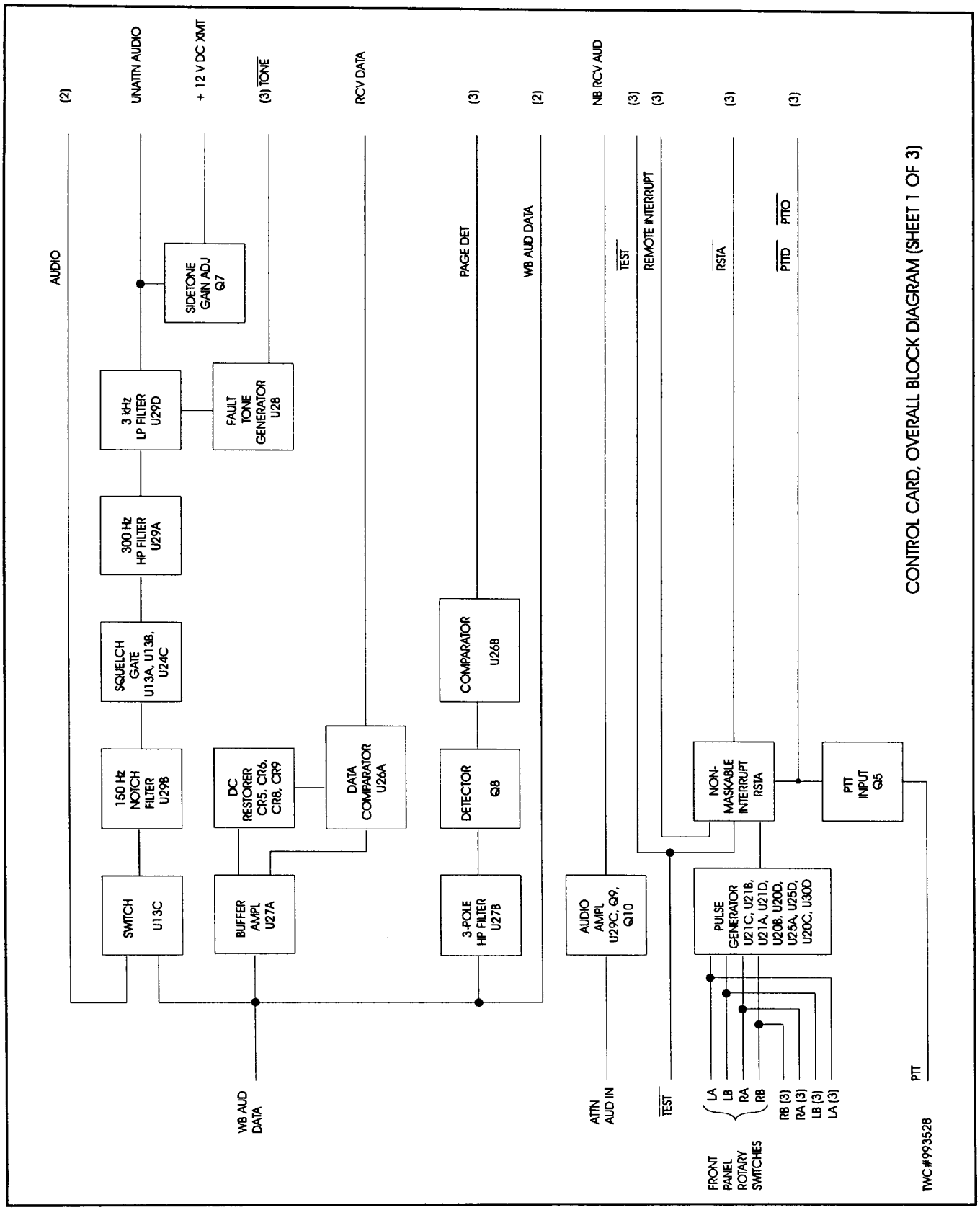


FIGURE 5-1.
Control Card, Overall Block Diagram (Sheet 1).

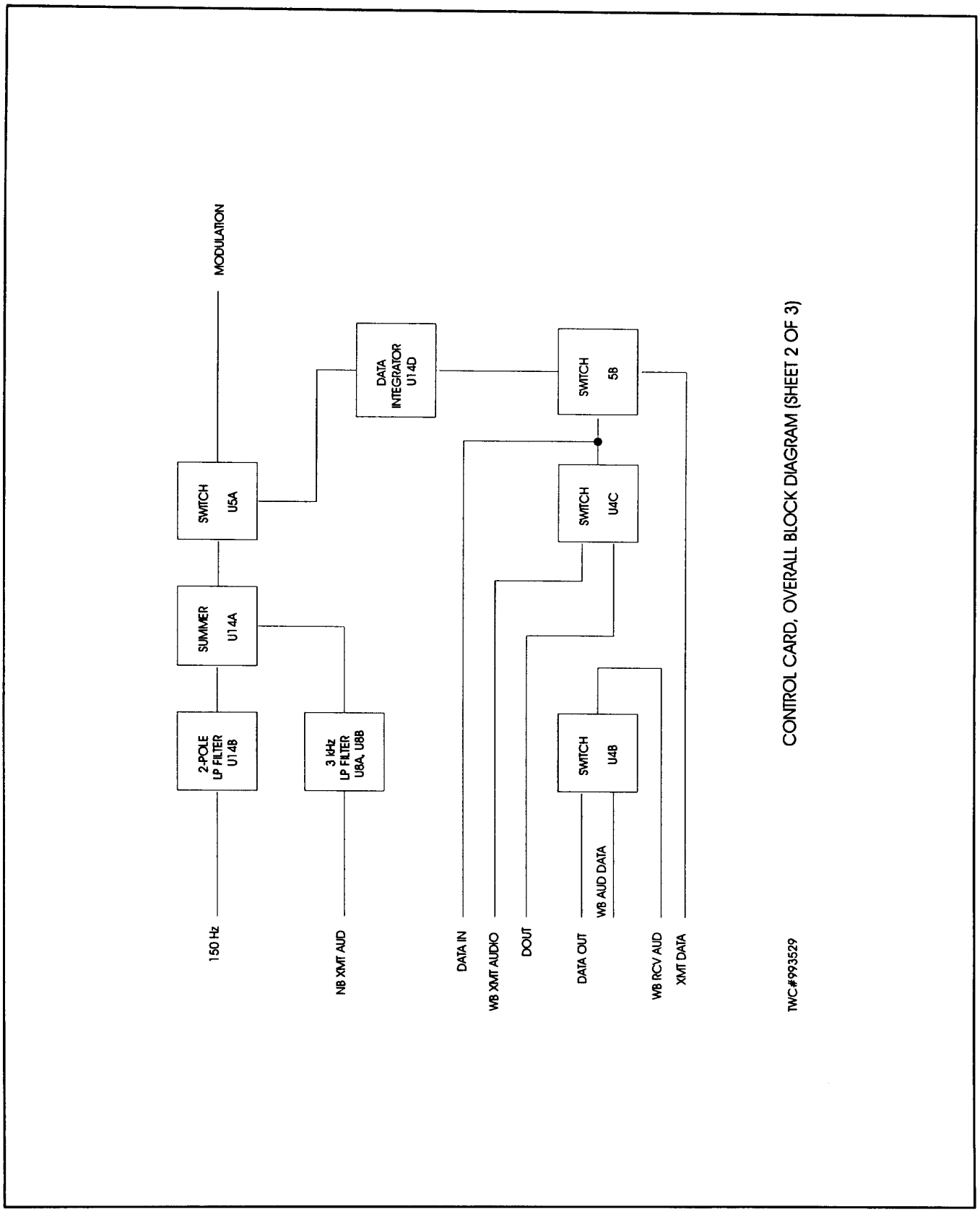


FIGURE 5-1.
Control Card, Overall Block Diagram (Sheet 2).

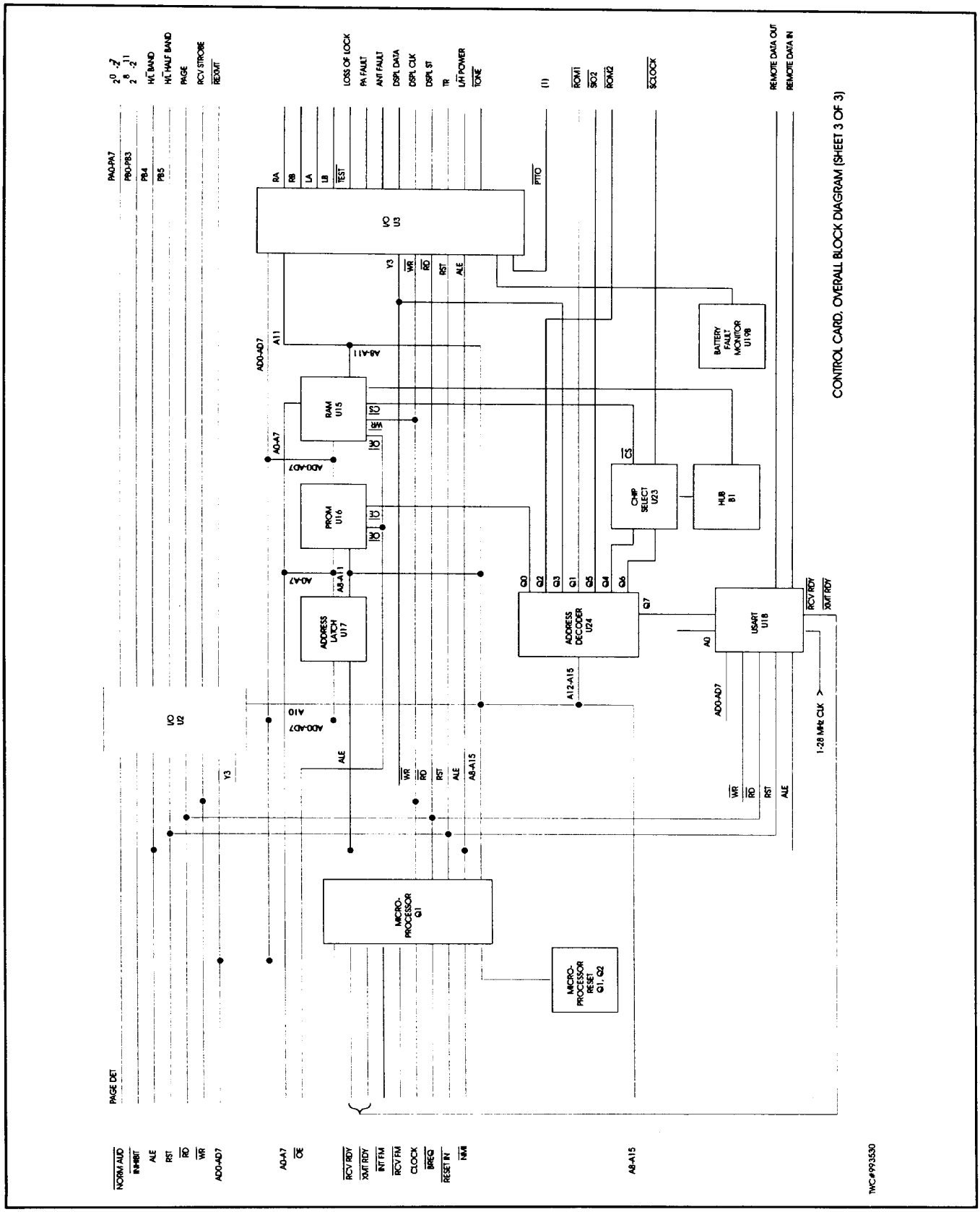


FIGURE 5-1.
Control Card, Overall Block Diagram (Sheet 3).

TABLE 5-1.
Control, Testing and Troubleshooting Procedures.

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. Test setup	a. Remove the control card from the receiver-transmitter. b. Remove the test set ECCM Card and install it upside down on top of the test set Power Amplifier Card cover. c. Remove the test set control card and replace it with the receiver-transmitter control card. d. Connect the receiver-transmitter control card to the test set ECCM, Receiver, Synthesizer, and Power Amplifier Cards. e. Terminate the test set output into a 10-watt, 50-ohm load. f. Set test set controls as follows: Control — Setting PRIMARY PWR — ON UUTPWR — ON NB AUDIO LOAD — OFF (down) WB AUDIO LOAD — OFF (down) REMOTE DATA — NORMAL PTT KEY — OFF NORMAL AUDIO INHIBIT — VOICE OFF-TEST-ON-LITE — ON Display PWR — LO Display MODE — NO HOP Display CHAN/DAY — 1 Display SQL — OFF Display FREQ/NET/TIME — 30.000 MHz VOL — Full CW **NOTE** Unless otherwise indicated, all measurements to ground use the GND jack on the test set as ground. All oscilloscope measurements are made with a x 10 probe.		

TABLE 5-1.
Control, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	NOTE Use the special test adapter to open the lines in the ribbon cable when injecting a signal.		
2. Microprocessor oscillator check	a. Perform test 1.		
	b. Observe display to determine if the unit is operating properly. If the display does not come on and slew switches have no apparent control, turn power off. Troubleshoot to determine the reason for malfunction. Damage to components can occur if the power is left on while the unit is not operating properly.		Check U1, Y1, Q1, Q2.
	c. Connect a frequency counter to control card connector P1-45. The connection should be made on the side of the extender cable connector that mates with P1. Measure oscillator frequency.	2.56 MHz ±10 Hz	Adjust trimmer capacitor C7 to meet specification. Check Y1, U1.
	d. Set test set UUT PWR switch to OFF.		
3. Page detector	a. Perform test 1.		
	b. Set the test set controls as follows: Control — Setting Display MODE — HOP, NCS Display FREQ/NET/TIME — NET 111		
	c. Connect a signal generator to the antenna connector on the test set.		
	d. Set signal generator frequency to 30 MHz, deviation to +/-7 kHz, modulation to 1 kHz, and output to 1.0 microvolt. Observe display.	The word PAGE flashes on and off. No fault tone.	Check U2, U26B, or perform page detector adjustment paragraph 5.1.
	e. Set display SQL to ON.	Page tone is activated.	Check U3.
	f. Set signal generator output to 0.5 microvolt.	PAGE is no longer on.	Check U26, Q8.

TABLE 5-1.
Control, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	g. Set test set UUT PWR switch to OFF.		
4. Slew switches	a. Perform test 1.		
	b. Rotate the left switch and verify that the cursor moves left and right.		Check U3.
	c. Rotate the right switch and verify that the parameter over the cursor is properly displayed.		Check U3.
5. Test mode	a. Perform test 1.		
	b. Set test set OFF-TEST-ON-LITE switch to TEST.		
	c. Observe the test set display.	Display is completely illuminated for 3 seconds and then returns to the original display before entering test mode or displays a fault.	Check U3.
	d. Set OFF-TEST-ON-LITE switch to ON.		
	e. Set test set UUT PWR switch to OFF.		
6. Narrow-band receive audio signal path	a. Perform test 1.		
	b. Disconnect ribbon cable from receiver board connector J1.		
	c. Connect the output of a function generator to the WB AUDIO RCV jacks on the test set.		
	d. Set the function generator for a 1-kHz sine wave at 1.25 V rms on +3.0-V dc offset.		
	e. Connect an oscilloscope to the AUDIO UNATTEN jacks on the test set and observe output.	1-kHz sine wave.	Check Q7, U28A, U29D, U29B, U13A, U13B, U13C.

TABLE 5-1.
Control, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	f. Set test set UUT PWR switch to OFF. g. Connect ribbon cable to receiver board connector ii.		
7. Pass-band gain	a. Perform test 1. b. Disconnect ribbon cable from receiver board connector Jl. c. Connect the output of a function generator to the WB AUDIO RCV jacks on the test set. d. Set the function generator for a 1-kHz sine wave at 1.25 V rms on +3.0-V dc offset. e. Connect a distortion analyzer to the AUDIO 1.0 to 1.4 V rms. Check U13, U24, Q3. UNATTEN jacks on the test set and measure the output voltage. f. Set test set UUT PWR switch to OFF. g. Connect ribbon cable to receiver board connector ii.		
8. Narrow-band receive distortion	a. Perform test 1. b. Disconnect ribbon cable from receiver board connector Jl. c. Connect the output of a function generator to the WB AUDIO RCV jacks on the test set. d. Set the function generator for a 1-kHz sine wave at 1. 25 V rms on + 3.0-V dc offset. e. Set test set NB AUDIO switch to LOAD.		

TABLE 5-1.
Control, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	f. Connect a distortion analyzer to the test set NB NLT 3.46 V rms. Check U13, Q8, Q9. AUDIO RCV jacks and measure output.		
	g. Adjust volume control on function generator for 2.0 V rms at NB AUDIO RCV.		
	h. Measure distortion at the NB AUDIO RCV jacks.	NMT 1%	Check U28A, U29B, U29D, U13A, U13B, U13C, U29C, Q9, Q10.
	i. Set test set UUT PWR switch to OFF.		
	j. Connect ribbon cable to receiver board connector ii.		
	k. Connect an oscilloscope to modulation output J2-1, making the connection at test adapter pin 1.		
9. Narrow-band receive bandwidth	a. Perform test 1.		
	b. Disconnect ribbon cable from receiver board connector Jl.		
	c. Connect the output of a function generator to the WB AUDIO RCV jacks of the test set.		
	d. Set the function generator for a 1-kHz sine wave at 1.25 V rms on +3.0-V dc offset.		
	e. Set the test set NB AUDIO switch to LOAD.		
	f. Connect a distortion analyzer to the test set NB AUDIO RCV jacks and adjust the amplitude control on the function generator for a 2.0-V rms reading at NB AUDIO RCV.		
	g. Set the reference level on the distortion analyzer to 1 kHz.		

TABLE 5-1.
Control, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	h. Measure the decrease in signal level at the NB AUDIO RCV output at 300 Hz relative to the reference.	NMT 3 dB	U28A, U29B, U29D, U13A, U13B, U13C.
	i. Measure the decrease in signal level at the NB AUDIO RCV output at 3000 Hz relative to the reference.	NMT 3 dB	U29C, Q9 Q10.
	j. Set test set UUT PWR switch to OFF.		
	k. Connect ribbon cable to receiver board connector ii.		
10. Side tone level	a. Perform test 1.		
	b. Disconnect ribbon cable from receiver board connector Jl.		
	c. Connect the output of a function generator to the WB AUDIO RCV jacks of the test set.		
	d. Set the function generator for a 1-kHz sine wave at 1.25 V rms with a +3.0-V dc offset.		
	e. Set the test set NB AUDIO switch to LOAD.		
	f. Connect a distortion analyzer to the test set NB AUDIO RCV jacks.		
	g. Set the test set PTT KEY switch to ON and record the output level for reference.		
	h. Set the test set PTT KEY switch to OFF and measure the difference in output level between transmit and receive at NB AUDIO RCV.	5 to 7 dB	Check Q7.
	i. Set test set UUT PWR switch to OFF.		
	j. Connect ribbon cable to receiver board connector J1.		
11. Alarm tone level	a. Perform test 1.		

TABLE 5-1.
Control, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	b. Disconnect ribbon cable from receiver board connector J1.		
	c. Open the loss-of-lock line by opening pin 2 of control card connector J2 with the special test adapter. Connect jumper from + 5-V dc jack on test set through a 10-kohm resistor to J2-2.		
	d. Connect an oscilloscope to the NB AUDIO RCV jacks on the test set.		
	e. Observe the alarm tone burst on the oscilloscope.	0.5 to 1.5 V p-p	Check U3, U28.
	f. Set the test set UUT PWR switch to OFF.		
	g. Close the loss-of-lock line by closing pin 2 of control card connector J2 with the special test adapter.		
	h. Connect the ribbon cable to receiver board connector J1.		
12. Alarm tone frequency	a. Perform test 1.		
	b. Disconnect the ribbon cable from receiver board connector J1.		
	c. Open the loss-of-lock line by opening pin 2 of control card connector J2 with the special test adapter. Connect a jumper from + 5-V dc jack on test set through a 10-kohm resistor to J2-2.		
	d. Connect an oscilloscope to the NB AUDIO RCV jacks on the test set. Measure the period of the signal.	0.4 to 0.66 ms	Check U3, U28, U29D, Q9, Q10.
	e. Set the test set UUT PWR switch to OFF.		
	f. Close the loss-of-lock line by closing pin 2 of control card connector J2 with the special test adapter.		
	g. Connect ribbon cable to receiver board connector J1.		

TABLE 5-1.
Control, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
13. Squelch switch operation	a. Perform test 1.		
	b. Disconnect ribbon cable from receiver board connector J1.		
	c. Connect the output of a function generator to the WB AUDIO RCV jacks of the test set.		
	d. Set the function generator for a 1-kHz sine wave at 1.25 V rms with a +3.0-V dc offset.		
	e. Open pin 20 in the ribbon cable with the special test adapter. Connect jumper from pin 20 of J2 on control card to the GND jack on the test set.		
	f. Set test set SQL to ON.		
	g. Connect an oscilloscope to the test set AUDIO UNATTEN jacks and observe signal.	A signal is present when analog squelch is active (J2-20 grounded).	Check U3, U12C, U13A, U13B.
	h. Move jumper from GND jack on test set to + 5 Vdc jack.	Signal disappears when analog squelch is inactive (+5 V dc on J2-20).	Check U3, U12C, U13A, U13B.
	i. Move jumper from + 5 Vdc jack to GND jack on the test set.		
	j. Connect the oscilloscope probe to the REXMT jack on the test set.	Retransmit is inactive (low) when J2-20 is grounded.	Check U2, Q3.
	k. Move the jumper from the GND jack to the + 5 Vdc jack on the test set.	Retransmit is active (high) when J2-20 is connected to + 5 V dc.	Check U2, Q3.
	l. Connect oscilloscope probe to AUDIO UNATTEN jack.		
	m. Set test set SQL to OFF.		
	n. Observe oscilloscope for signal presence with jumper in GND jack.	Signal is present.	Check U3, U12C, U13A, U13B.
	o. Move jumper to + 5 Vdc jack on test set.	Signal is present.	Check U3, U12C, U13A, U13B.

TABLE 5-1.
Control, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	p. Connect the oscilloscope probe to the REXMT jack on the test set.		
	q. With J2-20 connected to + 5 Vdc jack, observe oscilloscope.	Retransmit is active (high) when J2-20 is connected to + 5 V dc.	Check U2, Q3, U3.
	r. Move jumper from + 5 Vdc jack to GND jack on the test set and observe oscilloscope.	Retransmit is inactive (low) when J2-20 is grounded.	Check U2, Q3, U3.
	s. Set test set UUT PWR switch to OFF.		
	t. Connect ribbon cable to receiver board connector J1.		
14. 150-Hz rejection	a. Perform test 1.		
	b. Disconnect ribbon cable from receiver board connector J1.		
	c. Connect the output of a function generator to the WB AUDIO RCV jacks on the test set.		
	d. Set function generator for a 150-Hz sine wave at 0. 536 V rms with a + 3.0-V dc offset. This signal will be used as a reference.		
	e. Connect a distortion analyzer to the AUDIO UNATTEN jacks on the test set and measure the relative level of the 150 Hz output.	NMT -33 dB	Check U29B, U13C.
	f. Set the test set UUT PWR switch to OFF.		
	g. Connect ribbon cable to receiver board connector ii.		
15. Floating reference operation	a. Perform test 1.		
	b. Disconnect ribbon cable from receiver board connector Jl.		
	c. Connect the output of a function generator to the WB AUDIO RCV jacks on the test set.		

TABLE 5-1.
Control, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	d. Set the function generator for a 10-kHz sine wave at 1.25 V rms with a +3.0-V dc offset.		
	e. Connect an oscilloscope to control card connector P1-38 (receive data output). The connection should be made on the side of the extender cable connector that mates with P1.		
	f. Measure the duty cycle of the square wave at P1-38.	48 to 52%	Check U27A, U26A, U27B, U26B.
	g. Set test set UUT PWR switch to OFF.		
	h. Connect ribbon cable to receiver board connector ii.		
16. Narrow-band transmit audio	a. Perform test 1.		
	b. Disconnect ribbon cable from receiver board connector J1.		
	c. Connect the output of a function generator to narrow-band transmit audio J1-34. The connection should be made to test adapter pin 34.		
	d. Set the function generator for a 1-kHz sine wave at 1.63 V rms.		
	e. Connect a distortion analyzer to the modulation output (J2-1). The connection should be made to pin 1 of the test adapter.		
	f. Set test set PTT KEY to ON and measure the signal level at J2-1.	1.40 to 1.42 V rms	Check U8A, U8B, U14A, U5A, U14B.
	g. Set the test set PTT KEY and UUT PWR switches to OFF.		
	h. Connect ribbon cable to receiver board connector J1.		
17. 150-Hz injection	a. Perform test 1.		
	b. Disconnect ribbon cable from receiver board connector J1.		

TABLE 5-1.
Control, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	c. Open the ribbon cable line at J2-27 with the special switch adapter.		
	d. Connect the output of a function generator to J2-27, making the connection on test adapter pin 27.		
	e. Set the function generator for a 150-Hz sine wave at 2.1 V rms with a 6-V dc offset.		
	f. Connect a distortion analyzer to the modulation output J2-1, making the connection at test adapter pin 1.		
	g. Measure the level of the signal at J2-1.	0.56 to 0.66 V rms	Check U14B, U14A, U5A.
	h. Set the test set UUT PWR switch to OFF.		
	i. Connect ribbon cable to receiver board connector J1.		
18. Premodulation filter performance	a. Perform test 1.		
	b. Disconnect ribbon cable from receiver board connector J1.		
	c. Set the test set MODE to HOP, CHAN to 1, and NET to 111.		
	d. Connect an oscilloscope to modulation output J2-1, making the connection to test adapter pin 1.		
	e. Set the test set PTT KEY switch to ON and measure the level of the triangular or trapezoidal waveform at J2-1.	3.7 to 4.3 V p-p	Check U5A, U14D. Also: U1 ECCM Card.
	f. Set the test set PTT KEY switch and UUT PWR switch to OFF.		
	g. Connect ribbon cable to receiver board connector ii.		
19. Wide-band transmit data	a. Perform test 1.		
	b. Disconnect ribbon cable from receiver board connector Jl.		

TABLE 5-1.
Control, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	c. Set test set NORMAL AUDIO INHIBIT switch to DATA.		
	d. Connect the output of a function generator to the WB AUDIO XMT jacks on the test set.		
	e. Set the function generator for a 10 kHz, 0 to 5-V dc square wave.		
	f. Connect an oscilloscope to modulation output J2-1, making the connection on test adapter pin 1.		
	g. Set the test set PTT KEY switch to ON and measure the level of the triangular waveform at J2-1.	3.7 to 4.3 V p-p	Check U14D, U4C.
	h. Set the test set PTT KEY switch and UUT PWR switch to OFF.		
	i. Connect ribbon cable to receiver board connector J1.		
20. Blanking mode	a. Perform test 1.		
	b. Disconnect ribbon cable from receiver board connector Jl.		
	c. Set the test set MODE to HOP and NET to 111.		
	d. Connect an oscilloscope to modulation output J2-1, making the connection at test adapter pin 1.		
	e. Set the test set PTT KEY switch to ON and measure the voltage level during the time the blanking signal is high.Use the crossing point of the eye pattern as a reference to measure the voltage difference.	NMT 0.5 V	Check U6, Q6, U5, U14.
	f. Set test set PTT KEY switch and UUT PWR switch to OFF.		
	g. Connect ribbon cable to receiver board connector J1.		

TABLE 5-1.
Control, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
21. Low-battery fault	a. Perform test 1.		
	b. Connect an external power supply to the external power jacks on the rear of the test set.		
	c. Set the external power supply to +12 V dc.		
	d. Set test set UUT PWR switch to EXT.		
	e. Slowly reduce the power supply voltage to the point at which the test set display starts displaying a battery fault.	9.25 to 9.75 V dc	Check U14C.
	f. Set test set UUT PWR switch to OFF.		
22. Remote data in	a. Perform test 1.		
	b. Set test set display PWR to HPA, MODE to HOP, and NET to 111.		
	c. Connect an oscilloscope to the REMOTE DATA IN jacks on the test set.		
	d. Set test set PTT KEY switch to ON.		
	e. Observe a blanking signal transitioning at approximately a 100-Hz rate.	Logic 0 < 1 Vdc Logic 1 > 4 V dc	Check U9B, Q4, U6C.
	f. Set test set UUT PWR switch to OFF.		
23. Remote data out	a. Perform test 1.		
	b. Set test set display PWR to HPA and FREQ to 51.000 MHz.		
	c. Connect a digital multimeter to the REMOTE DATA OUT jacks on the test set.		
	d. Set test set PTT KEY switch to ON and measure logic level.	Logic 0 < 1 V dc	Check U18.
	e. Set test set PTT KEY switch to OFF.		
	f. Set test set display FREQ to 52.000 MHz.		

TABLE 5-1.
Control, Testing and Troubleshooting Procedures (Continued).

	g. Set test set PTT KEY switch to ON and measure logic level.	Logic 1 > 4 V dc	Check U18.
	h. Set test set PTT KEY and UUT PWR switches to OFF.		
24. Hold-up battery	a. Perform test 1.		
	b. Set test display CHAN to 2 and FREQ to 40.000 MHz.		
	c. Set test set UUT PWR switch to OFF and leave off for at least 2 seconds.		
	d. Set test set UUT PWR switch to ON.	Test set display comes on and displays channel 2 and 40.000 MHz.	Check B1, CR11, CR12, CR10, U22E, U22F, C50.
	e. Set test set UUT PWR switch to OFF.		
25. Frequency	a. Perform test 1.		
	b. Connect a frequency counter to transmit output J3 on the receiver board.		
	c. Set the following frequencies on the test set and verify frequencies at receiver board J3. Set PTT KEY switch to ON to read frequency and to OFF when changing frequency.		
	30.375 MHz	30.375 MHz +/-25 Hz	Check U3, U21, U25, U20C, U30D.
	54.750 MHz	54.750 MHz +/-25 Hz	
	59.625 MHz	59.625 MHz +/-25 Hz	
	74.250 MHz	74.250 MHz +/25 Hz	
	d. Set test set PTT KEY and UUT PWR switches to OFF.		

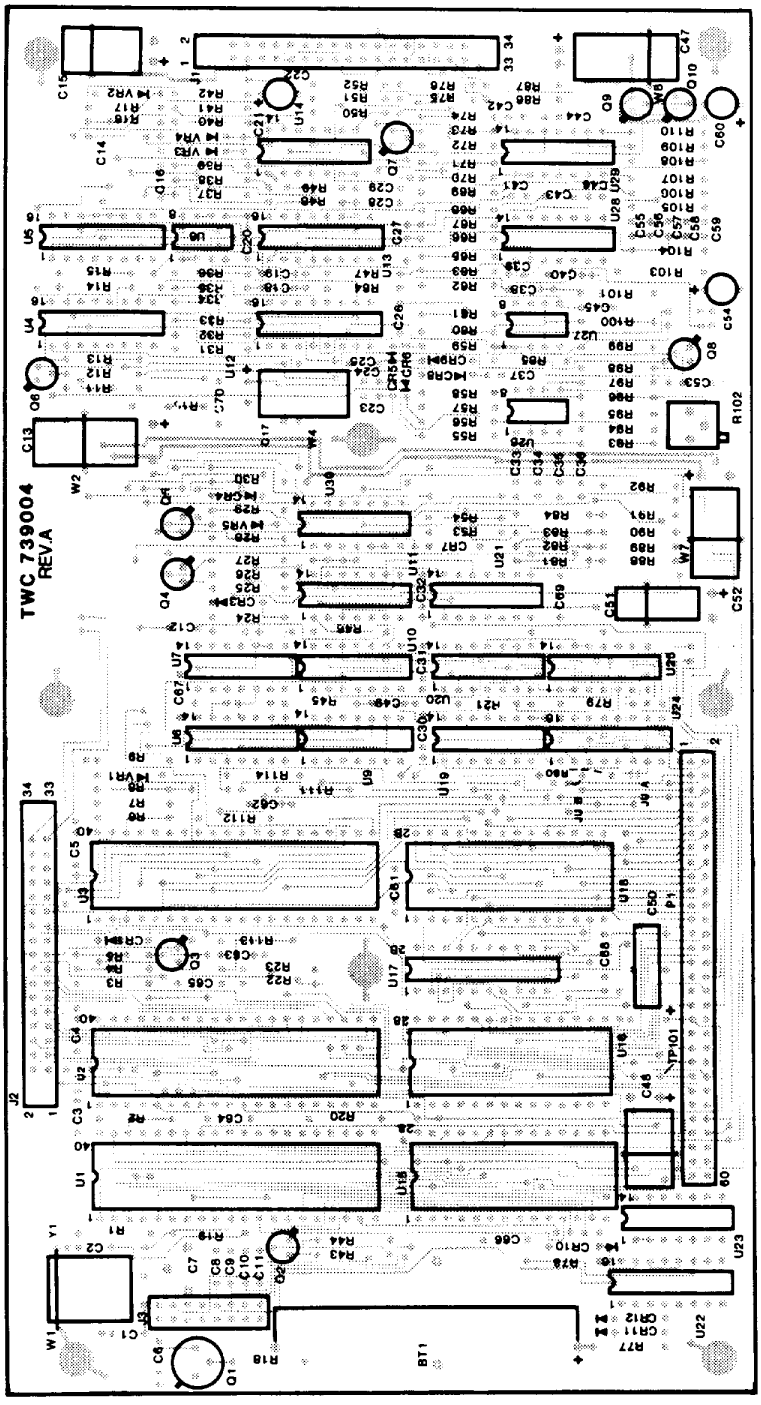
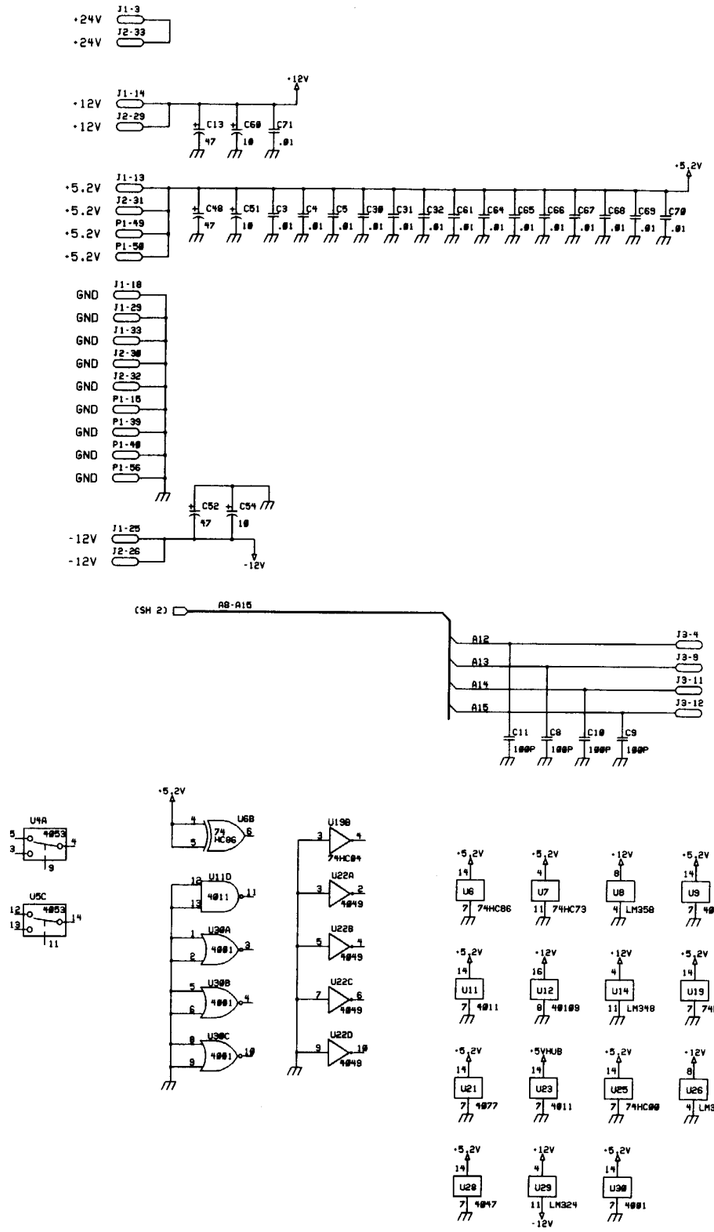


FIGURE 5-2.
Component Locations, Control Card.



REF DES	DESCRIPTION	POWER NODES				
		+5.2V	+5HUB	GND	+12V	-12V
U1	NSC800	40		20		
U2	NSC810	40		20		
U3	NSC810	40		20		
U4	4053			8	16	
U5	4053			8	16	
U6	74HC86	14		7		
U7	74HC73	4		11		
U8	LM358			4	8	
U9	4012	14		7		
U10	4025	14		7		
U11	4011	14		7		
U12	40109			8	16	
U13	4053			8	16	
U14	LM348			11	4	
U15	5565		28	14		
U16	27C512	28		14		
U17	74HC373	20		10		
U18	82C51	26		4		
U19	74HC04	14		7		
U20	4011	14		7		
U21	4077	14		7		
U22	4049			8		
U23	4011		14	7		
U24	74HC139	16		8		
U25	74HC00	14		7		
U26	LM393			4	8	
U27	LM358			4	8	
U28	4047	14		7		
U29	LM324				4	11
U30	4001	14		7		

5 FOR PRC NO HOP: JUA REMOVED, JUB AND JUC ADDED.
FOR ALL OTHERS: JUA ADDED, JUB AND JUC REMOVED.
4 INDUCTANCE IS IN MICROHENRYS
3 DIODES ARE 1N4148
2 CAPACITANCE IS IN MICROFARADS
1 RESISTANCE IS IN OHMS

NOTES: UNLESS OTHERWISE SPECIFIED

VOICE PRIVACY CONTROL BD
PRC1088
995004E
SH 1 OF 4

FIGURE 5-3.
Schematic Diagram, Control Card (1 of 4).

PRC1088
VOICE PRIVACY CONTROL BD
995004E
2 OF 4

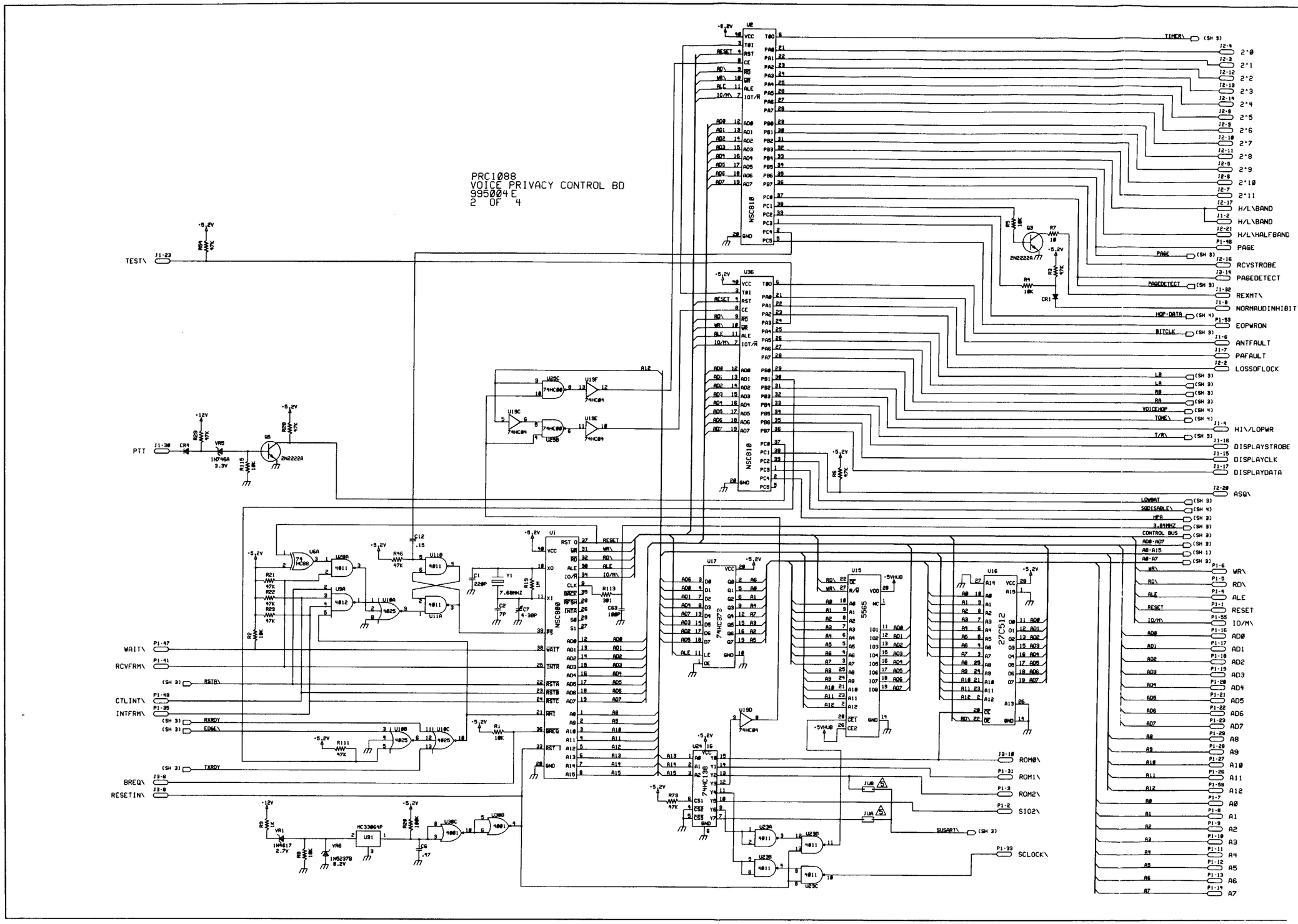


FIGURE 5-3.
Control Card, Schematic Diagram (2 of 4).

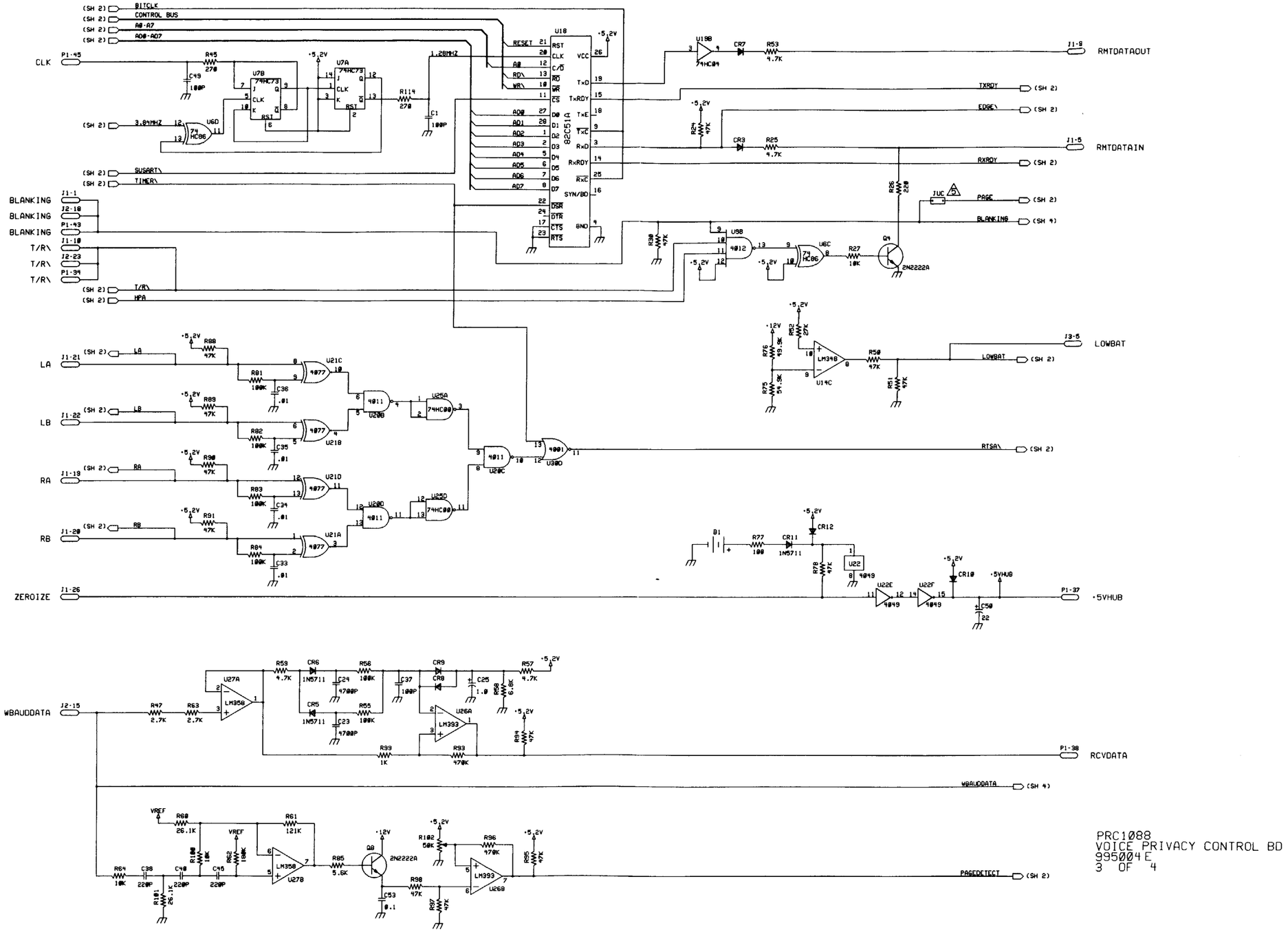


FIGURE 5-3.
Control Card, Schematic Diagram (3 of 4).

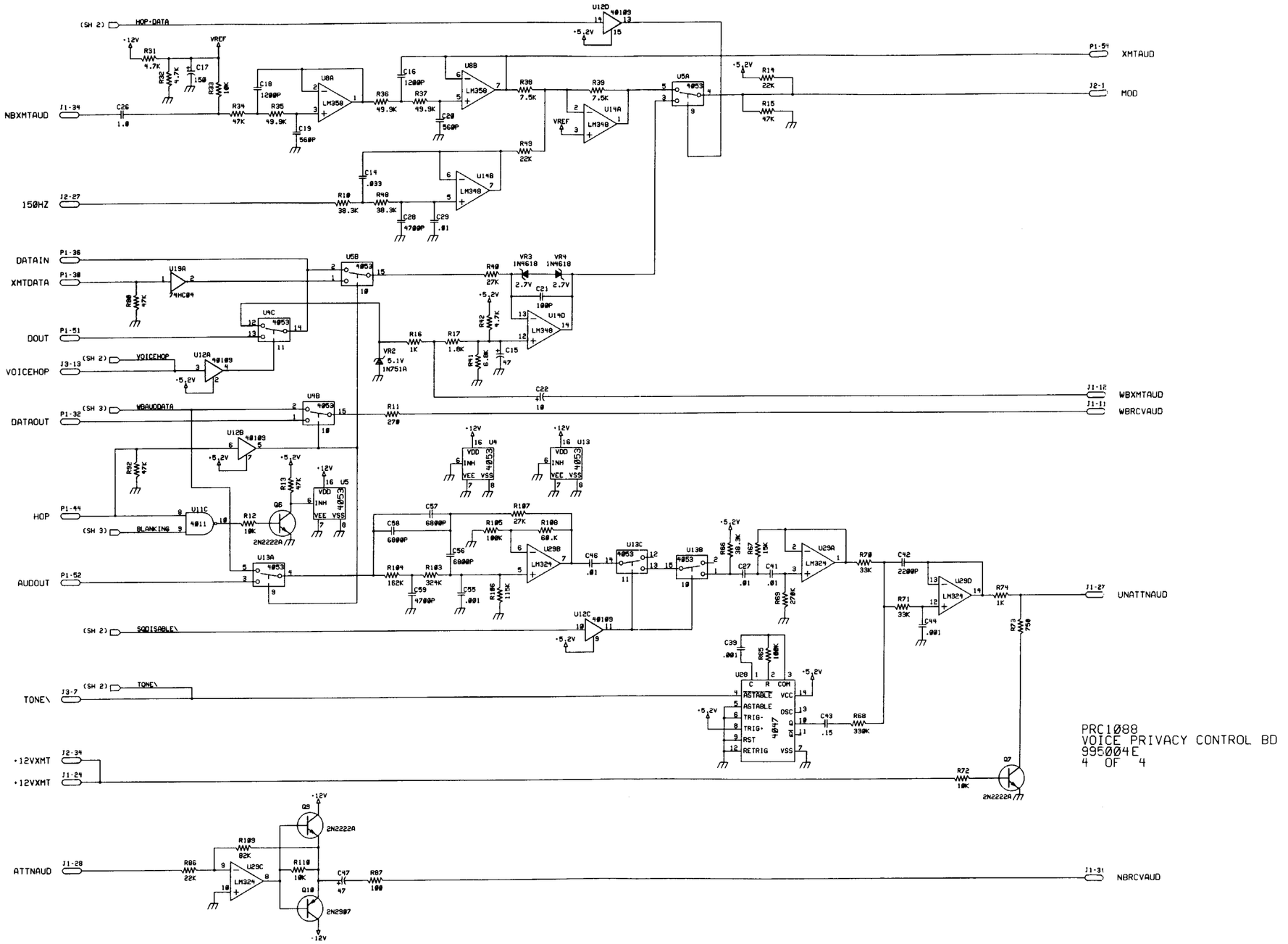


FIGURE 5-3.
Control Card, Schematic Diagram (4 of 4).

TABLE 5-2.
Parts List, Control Card.

018-00400

DESIGNATOR	PART #	DESCRIPTION
BT1	750010	BATTERY, LITHIUM 3V SDX
C1	275221	CAP, ML NPO 220PF 100V 5% 0.2S
C2	210070	CAP, 7 PF DISC NPO
C3	277103A	CAP ML 10KPF NPO AXIAL 5% 50V
C4	277103A	CAP ML 10KPF NPO AXIAL 5% 50V
C5	277103A	CAP ML 10KPF NPO AXIAL 5% 50V
C6	275474	CAP, ML 0.47UF X7R 50V 10% .2S
C7	261610	CAP, 4-30PF TRIMMER Q=300MIN
C8	275101	CAP, ML NPO 100PF 100V 5% 0.2S
C9	275101	CAP, ML NPO 100PF 100V 5% 0.2S
C10	275101	CAP, ML NPO 100PF 100V 5% 0.2S
C11	275101	CAP, ML NPO 100PF 100V 5% 0.2S
C12	275154	CAP, ML 0.15UF Z5U 20% 50V .2S
C13	231500	CAP, 47MF 16V ELECT VRT
C14	275333	CAP, ML NPO .033UF 100V 5% .4S
C15	231500	CAP, 47MF 16V ELECT VRT
C16	275122	CAP, ML NPO 1200PF 100V 5% .2S
C17	232221	CAP, 220 UF 16V VERT ELECTRO
C18	275122	CAP, ML NPO 1200PF 100V 5% .2S
C19	275561	CAP, ML NPO 560PF 100V 5% 0.2S
C20	275561	CAP, ML NPO 560PF 100V 5% 0.2S
C21	276101	CAP, ML NPO 100PF 100V 5% 0.1S
C22	241100	CAP, 10MF DIP TANTALUM
C23	275472	CAP, ML 4700PF X7R 100V 5% .1S
C24	275472	CAP, ML 4700PF X7R 100V 5% .1S
C25	276105	CAP, ML Z5U 1UF 50V 0.2 SPACE
C26	276105	CAP, ML Z5U 1UF 50V 0.2 SPACE
C27	214103	CAP, 0.01MF 50V MONO

TABLE 5-2.
Parts List, Control Card (Continued).

DESIGNATOR	PART #	DESCRIPTION
C28	277472A	CAP ML 4700PF NPO AXIAL 5%50V
C29	277103A	CAP ML 10KPF NPO AXIAL 5% 50V
C30	277103A	CAP ML 10KPF NPO AXIAL 5% 50V
C31	277103A	CAP ML 10KPF NPO AXIAL 5% 50V
C32	277103A	CAP ML 10KPF NPO AXIAL 5% 50V
C33	214103	CAP, 0.01MF 50V MONO
C34	214103	CAP, 0.01MF 50V MONO
C35	214103	CAP, 0.01MF 50V MONO
C36	214103	CAP, 0.01MF 50V MONO
C37	276101	CAP, ML NPO 100PF 100V 5% 0.1S
C38	275221	CAP, ML NPO 220PF 100V 5% 0.2S
C39	275102	CAP, ML NPO .001UF 100V 5% .1S
C40	275221	CAP, ML NPO 220PF 100V 5% 0.2S
C41	214103	CAP, 0.01MF 50V MONO
C42	275222	CAP, ML Z5U 2200PF 50V 20% .1S
C43	275154	CAP, ML 0.15UF Z5U 20% 50V .2S
C44	275102	CAP, ML NPO .001UF 100V 5% .1S
C45	275221	CAP, ML NPO 220PF 100V 5% 0.2S
C46	214103	CAP, 0.01MF 50V MONO
C47	231500	CAP, 47MF 16V ELECT VRT
C48	231500	CAP, 47MF 16V ELECT VRT
C49	275101	CAP, ML NPO 100PF 100V 5% 0.2S
C50	241226	CAP, 22MF DIP TANTALUM
C51	231100	CAP, 10MF 16V ELECT VRT
C52	231500	CAP, 47MF 16V ELECT VRT
C53	276104	CAP, ML Z5U 0.1UF 50V 0.2SPACE
C54	241100	CAP, 10MF DIP TANTALUM
C55	275102	CAP, ML NPO .001UF 100V 5% .1S
C56	275682	CAP, ML 6800PF Z5U 20% 50V .1S
C57	275682	CAP, ML 6800PF Z5U 20% 50V .1S

TABLE 5-2.
Parts List, Control Card (Continued).

DESIGNATOR	PART #	DESCRIPTION
C58	275682	CAP, ML 6800PF Z5U 20% 50V .1S
C59	275472	CAP, ML 4700PF X7R 100V 5% .1S
C60	241100	CAP, 10MF DIP TANTALUM
C61	277103A	CAP ML 10KPF NPO AXIAL 5% 50V
C62	275101	CAP, ML NPO 100PF 100V 5% 0.2S
C63	275101	CAP, ML NPO 100PF 100V 5% 0.2S
C64	277103A	CAP ML 10KPF NPO AXIAL 5% 50V
C65	277103A	CAP ML 10KPF NPO AXIAL 5% 50V
C66	277103A	CAP ML 10KPF NPO AXIAL 5% 50V
C67	277103A	CAP ML 10KPF NPO AXIAL 5% 50V
C68	277103A	CAP ML 10KPF NPO AXIAL 5% 50V
C69	277103A	CAP ML 10KPF NPO AXIAL 5% 50V
C70	277103A	CAP ML 10KPF NPO AXIAL 5% 50V
CR1	320002	DIODE, SI 100MA 1N4148/1N4150
CR3	320002	DIODE, SI 100MA 1N4148/1N4150
CR4	320002	DIODE, SI 100MA 1N4148/1N4150
CR5	320219	DIODE, 1N5711 HOT CARR SCHOTT
CR6	320219	DIODE, 1N5711 HOT CARR SCHOTT
CR7	320002	DIODE, SI 100MA 1N4148/1N4150
CR8	320002	DIODE, SI 100MA 1N4148/1N4150
CR9	320002	DIODE, SI 100MA 1N4148/1N4150
CR10	320002	DIODE, SI 100MA 1N4148/1N4150
CR11	320219	DIODE, 1N5711 HOT CARR SCHOTT
CR12	320002	DIODE, SI 100MA 1N4148/1N4150
E1	650048	HEADER, 2 PIN .025 SQ
HR77	124101	RES, 100 OHM 1/4W 5% CF

TABLE 5-2.
Parts List, Control Card (Continued).

DESIGNATOR	PART #	DESCRIPTION
J1	620033	HEADER, 34 PIN PCB SHORT EJECT
J2	620033	HEADER, 34 PIN PCB SHORT EJECT
J3	620032	HEADER 16 PIN DIL 0.1X0.15P
P1	620031	HEADER 60 PIN DIL 0.1X0.1SP
Q3	310057	XISTOR, NPN, PN2222A, TO92
Q4	310057	XISTOR, NPN, PN2222A, TO92
Q5	310057	XISTOR, NPN, PN2222A, TO92
Q6	310057	XISTOR, NPN, PN2222A, TO92
Q7	310057	XISTOR, NPN, PN2222A, TO92
Q8	310057	XISTOR, NPN, PN2222A, TO92
Q9	310057	XISTOR, NPN, PN2222A, TO92
Q10	310052	XISTOR, PNP, PN2907A, TO92
R1	124103	RES, 10K 1/4W 5% CARBON FILM
R2	124103	RES, 10K 1/4W 5% CARBON FILM
R3	124473	RES, 47K 1/4W 5% CARBON FILM
R4	124103	RES, 10K 1/4W 5% CARBON FILM
R5	124102	RES, 1K 1/4W 5% CARBON FILM
R6	124473	RES, 47K 1/4W 5% CARBON FILM
R7	124100	RES, 10 OHM 1/4W 5% CARBON FILM
R8	124183	RES, 18K 1/4W 5% CARBON FILM
R9	124102	RES, 1K 1/4W 5% CARBON FILM
R11	124271	RES, 270 OHM 1/4W 5% CF
R10	1113832	RES, 38.3K 1/8W 1%
R12	124103	RES, 10K 1/4W 5% CARBON FILM
R13	124473	RES, 47K 1/4W 5% CARBON FILM
R14	124223	RES, 22K 1/4W 5% CARBON FILM
R15	124473	RES, 47K 1/4W 5% CARBON FILM

TABLE 5-2.
Parts List, Control Card (Continued).

DESIGNATOR	PART #	DESCRIPTION
R16	124102	RES, 1K 1/4W 5% CARBON FILM
R17	124182	RES, 1.8K 1/4W 5% CARBON FILM
R19	124105	RES, 1M 1/4W 5% CARBON FILM
R20	124104	RES, 100K 1/4W 5% CARBON FILM
R21	124473	RES, 47K 1/4W 5% CARBON FILM
R22	124473	RES, 47K 1/4W 5% CARBON FILM
R23	124473	RES, 47K 1/4W 5% CARBON FILM
R24	124473	RES, 47K 1/4W 5% CARBON FILM
R25	124472	RES, 4.7K 1/4W 5% CARBON FILM
R26	124221	RES, 220 OHM 1/4W 5% CF
R27	124103	RES, 10K 1/4W 5% CARBON FILM
R28	124473	RES, 47K 1/4W 5% CARBON FILM
R29	124473	RES, 47K 1/4W 5% CARBON FILM
R30	124473	RES, 47K 1/4W 5% CARBON FILM
R31	124472	RES, 4.7K 1/4W 5% CARBON FILM
R32	124472	RES, 4.7K 1/4W 5% CARBON FILM
R33	124103	RES, 10K 1/4W 5% CARBON FILM
R34	1114992	RES, 49.9K 1/8W, 1% FILM
R35	1114992	RES, 49.9K 1/8W, 1% FILM
R36	1114992	RES, 49.9K 1/8W, 1% FILM
R37	1114992	RES, 49.9K 1/8W, 1% FILM
R38	124752	RES, 7.5K 1/4W 5%
R39	124752	RES, 7.5K 1/4W 5%
R40	124273	RES, 27K 1/4W 5% CARBON FILM
R41	124682	RES, 6.8K 1/4W 5% CARBON FILM
R42	124472	RES, 4.7K 1/4W 5% CARBON FILM
R45	124271	RES, 270 OHM 1/4W 5% CF
R46	124473	RES, 47K 1/4W 5% CARBON FILM
R47	124272	RES, 2.7K 1/4W 5% CARBON FILM
R48	1113832	RES, 38.3K 1/8W 1%

TABLE 5-2.
Parts List, Control Card (Continued).

DESIGNATOR	PART #	DESCRIPTION
R49	124223	RES, 22K 1/4W 5% CARBON FILM
R50	124473	RES, 47K 1/4W 5% CARBON FILM
R51	124473	RES, 47K 1/4W 5% CARBON FILM
R52	124273	RES, 27K 1/4W 5% CARBON FILM
R53	124472	RES, 4.7K 1/4W 5% CARBON FILM
R54	124473	RES, 47K 1/4W 5% CARBON FILM
R55	124104	RES, 100K 1/4W 5% CARBON FILM
R56	124104	RES, 100K 1/4W 5% CARBON FILM
R57	124472	RES, 4.7K 1/4W 5% CARBON FILM
R58	124682	RES, 6.8K 1/4W 5% CARBON FILM
R59	124472	RES, 4.7K 1/4W 5% CARBON FILM
R60	112612	RES, 26.1K 1/8W 1%
R61	1111213	RES, 121K OHM 1/8W 1% FILM
R62	124184	RES, 180K 1/4W 5% CARBON FILM
R63	124272	RES, 2.7K 1/4W 5% CARBON FILM
R64	124103	RES, 10K 1/4W 5% CARBON FILM
R65	124104	RES, 100K 1/4W 5% CARBON FILM
R66	1113832	RES, 38.3K 1/8W 1%
R67	124153	RES, 15K 1/4W 5% CARBON FILM
R68	124334	RES, 330K 1/4W 5% CARBON FILM
R69	124274	RES, 270K 1/4W 5% CARBON FILM
R70	124333	RES, 33K 1/4W 5% CARBON FILM
R71	124333	RES, 33K 1/4W 5% CARBON FILM
R72	124103	RES, 10K 1/4W 5% CARBON FILM
R73	124751	RES, 750 OHM 1/4W 5% CF
R74	124102	RES, 1K 1/4W 5% CARBON FILM
R75	1115492	RES, 54.9K 1/8W METAL FILM
R76	1114992	RES, 49.9K 1/8W, 1% FILM
R78	124473	RES, 47K 1/4W 5% CARBON FILM
R79	124473	RES, 47K 1/4W 5% CARBON FILM

TABLE 5-2.
Parts List, Control Card (Continued).

DESIGNATOR	PART #	DESCRIPTION
R80	124473	RES, 47K 1/4W 5% CARBON FILM
R81	124104	RES, 100K 1/4W 5% CARBON FILM
R82	124104	RES, 100K 1/4W 5% CARBON FILM
R83	124104	RES, 100K 1/4W 5% CARBON FILM
R84	124104	RES, 100K 1/4W 5% CARBON FILM
R85	124562	RES, 5.6K 1/4W 5% CARBON FILM
R86	124223	RES, 22K 1/4W 5% CARBON FILM
R87	124101	RES, 100 OHM 1/4W 5% CF
R88	124473	RES, 47K 1/4W 5% CARBON FILM
R89	124473	RES, 47K 1/4W 5% CARBON FILM
R90	124473	RES, 47K 1/4W 5% CARBON FILM
R91	124473	RES, 47K 1/4W 5% CARBON FILM
R92	124473	RES, 47K 1/4W 5% CARBON FILM
R93	124474	RES, 470K 1/4W 5% CARBON FILM
R94	124473	RES, 47K 1/4W 5% CARBON FILM
R95	124473	RES, 47K 1/4W 5% CARBON FILM
R96	124474	RES, 470K 1/4W 5% CARBON FILM
R97	124473	RES, 47K 1/4W 5% CARBON FILM
R98	124473	RES, 47K 1/4W 5% CARBON FILM
R99	124102	RES, 1K 1/4W 5% CARBON FILM
R100	124103	RES, 10K 1/4W 5% CARBON FILM
R101	1112612	RES, 26.1K 1/8W 1%
R102	170325	RES, 50K TRIMMER HORIZ MOUNT
R103	1113243	RES, 324K 1/8W 1%
R104	1111623	RES, 162K 1/8W 1%
R105	124104	RES, 100K 1/4W 5% CARBON FILM
R106	1111153	RES, 115K 1/8W 1%
R107	124273	RES, 27K 1/4W 5% CARBON FILM
R108	1116042	RES, 60.4K 1/8W 1%
R109	124823	RES, 82K 1/4W 5% CARBON FILM

TABLE 5-2.
Parts List, Control Card (Continued).

DESIGNATOR	PART #	DESCRIPTION
R110	124103	RES, 10K 1/4W 5% CARBON FILM
R111	124473	RES, 47K 1/4W 5% CARBON FILM
R112	124472	RES, 4.7K 1/4W 5% CARBON FILM
R113	124271	RES, 270 OHM 1/4W 5% CF
R114	124271	RES, 270 OHM 1/4W 5% CF
R115	113103	RES, 10K 1/8W 5% CARBON FILM
U1	330437	IC, NSC800 MICROPROCESSOR
U2	330436	IC, NSC810 RAM I/O TIMER
U3	330436	IC, NSC810 RAM I/O TIMER
U4	330423	IC, CD4053BE ANALOG MUX/DEMUX
U5	330423	IC, CD4053BE ANALOG MUX/DEMUX
U6	330430	IC, 74HC86N QUAD 2I/P XOR GATE
U7	330431	IC, 74HC73 DUAL JK FF WITH RST
U8	330081	IC, LIN, LM358N, DIP8, OP-AMP
U9	330424	IC, CD4012BE DUAL 4I/P NAND
U10	330376	IC, MC14025BCP
U11	330035	IC, DIG, CD4011, DIP14, NAND
U12	330434	IC, CD40109 QUAD LO TO HI L/S
U13	330423	IC, CD4053BE ANALOG MUX/DEMUX
U14	330450	IC, LM348N QUAD OPAMP
U15	330451	IC, MEMORY RAM 8KX8 100NS
U17	330429	IC, 74HC373N OCTA D TYPE LATCH
U18	330462	IC, USART, 28-PIN DIP, 82C51A
U19	330196	IC 74HC04
U20	330035	IC, DIG, CD4011, DIP14, NAND
U21	330433	IC, CD4077 QUAD XOR NOR GATE
U22	330080	IC, DIG, MC14049UBE, DIP16, BUFFER
U23	330035	IC, DIG, CD4011, DIP14, NAND
U24	330435	IC, 74HC138 1 OF 8 DECODER

TABLE 5-2.
Parts List, Control Card (Continued).

DESIGNATOR	PART #	DESCRIPTION
U25	330307	IC, MC54/74HC00
U26	330185	IC LM393N
U27	330081	IC, LIN, LM358N, DIP8, OP-AMP
U28	330432	IC, CD4047BE MONO/ASTABLE OSC
U29	330030	IC, LIN, LM324N, DIP14, OP-AMP
U30	330054	IC, DIG, CD4001, DIP14, NOR
U31	330397	IC, MC33064 UNDERVOLT SENSING
VR1	320229	DIODE ZENER 2.7V@0.25MA 5%
VR2	320204	DIODE, ZENER 5.1V
VR3	320229	DIODE ZENER 2.7V@0.25MA 5%
VR4	320229	DIODE ZENER 2.7V@0.25MA 5%
VR5	320210	DIODE, ZENER 3.3V 1N746A
VR6	320202	DIODE, ZENER 8.2V T/R
XU1	621001	SOCKET IC 40 PIN
XU2	621001	SOCKET IC 40 PIN
XU3	621001	SOCKET IC 40 PIN
XU15	621009	SOCKET, 28 PIN DIP
XU16	621009	SOCKET, 28 PIN DIP
XU18	621009	SOCKET, 28 PIN DIP
Y1	360072	CRYSTAL, 7.68000 MHz

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CHAPTER 6
ECCM/COMSEC (ASSY 018-00700, PCB 739007)

6.1 DESCRIPTION

The ECCM/COMSEC Card consists of a single two-sided printed circuit card.

The ECCM/COMSEC Card has an 80C31 microprocessor to provide the signal processing and control functions for the COMSEC (COMmunications SECurity) mode, and supervisory control of the ECCM array.

6.2 PRINCIPLES OF OPERATION

6.2.1 ECCM CARD FUNCTIONAL THEORY (Refer to Figure 6-1)

Address lines A0 through A11 on connector J1 from the control card are applied to EPROM U7, U15, real time clock U6, and input/output port U8. Real time clock U6 provides time of day for transfer and display. When the radio is shut down, voltage is supplied to U6 by the control board Hold-Up Battery (HUB). The voltage is 5 volts when operating and 3 volts in HUB mode.

Integrated circuits U7, U15, U6, and U8 are scanned by Read (RD) and Write (WR) lines from the control board microprocessor.

The ECCM/COMSEC Card has its own microprocessor (U10), RAM (U4), EPROM (U3), and input/output port (U9). All components in the ECCM processor are separated from the control processor. All information passed between the control and ECCM processors is passed via input/output port U9. There are no memory elements shared between the ECCM and control microprocessors. The ECCM processor monitors the ECCM array for a sync signal, tests a received USART character, and handles encryption/de-cryption.

6.2.2 PROGRAMMABLE ARRAY FUNCTION

To reduce processing demands on the ECCM microprocessor, much of the initial sync detection is handled by the ECCM array.

A 2.56 MHz clock from the control microprocessor is applied to the array and is the reference for the sync detection, timing correction, and clock divider networks. The clock divider network provides a 2.56-MHz clock for the ECCM USART and a 16-kHz clock for the CVSD (Continuously Variable Slope Detector), U1.

6.2.3 TRANSMIT MODE

In the transmit mode, the clock divider network sends a 20-kHz clock to transmit blanking circuitry where an Internal Frame Mark (INTFM) is created. The INTFM establishes the hop rate and sends it to the ECCM microprocessor. Each new INTFM pulse initiates the selection of a new hop frequency. The INTFM microprocessor sends a Reset Internal Frame Mark (RSITM) for the next frame.

Wideband audio data, or digitized narrow-band audio (INDATA 16 kBPS) is switched internally and synchronized with an internally generated 16 kHz clock. Any timing corrections are fed back as necessary to the clock divider network. The output (RCVDATA) is sent to the USART (U5) where the 16 kBPS is bursted to 20 kBPS. The USART sends a Transmit Ready (TXRDY) signal to the processor to alert it that data will be arriving. The USART then sends the 20-kBPS transmit signal to the processor. If in encryption (COMSEC) mode, the data is encrypted and returned back to the USART.

The transmit blanking circuits send the 20-kHz internal frame mark to a gated transmit clock where it is gated with 20 kHz from the clock divider network. This gated output is sent to the USART where it is used to synchronize the 20-kBPS signal from the microprocessor. The transmit signal from the USART is then sent to the control card for transmission.

6.2.4 RECEIVE MODE

In the receive mode, the received signal data is supplied to the ECCM array and switched internally back out to the USART (U5). This data is sampled in the array by the sync detection and timing correction circuits. The sync detector consists for eight flip flops which scan the incoming data for a one-zero pattern. When detected, a bit sync signal is sent to the processor and bit sync is recognized. After bit sync is detected, a 2.56-MHz internally generated clock is allowed to run. The USART (U5) starts scanning the incoming data for a recognizable character. When detected, the USART sends the microprocessor a Receive Ready Signal (TXRXRDY). The microprocessor sees this interrupt and recognizes character boundaries. The microprocessor will then examine the next eight bits of data to ensure that the character is valid.

The clock divider network sends a constant 20-kHz clock to the receive blanking circuits to create a receive frame mark. This receive frame mark goes to the microprocessor and is the basis for timing in the receive mode. Each receive frame mark initiates a change in radio operating frequency. The microprocessor sends a reset receive frame mark to reset the receive frame mark clock for the next frame.

After the microprocessor validates the receive character, the data is stored in memory and the microprocessor sends a receive ready signal back to synchronize the receive ready signal from the microprocessor with a search start signal from the sync detector and timing circuits. An internally generated blanking signal is used to establish the USART receive clock timing. This signal (blanking) is also sent to the radio to a squelch gate on the Control Card, and to the Receiver, Synthesizer, and Power Amplifier Cards.

The internal clock divider network produces an 80-kHz clock and sends it to a divider in the sync detection and timing correction circuits. The divider output is 20 kHz. The 20 kHz is the constant clock for the receive blanking circuit. The 20 kHz is also gated with the receive blanking pulse and the output of the sync detection circuit. The gated 20 kHz output then goes to the USART (U5).

The 20-kPBS signal is stored in memory and processed by the microprocessor. If necessary, the data is decrypted at this point. The data is then returned to the USART through the address lines. The ECCM array then sends a 16-kHz clock to the USART. The USART then converts the 20-kPBS data to 16-kBPS serial data and feeds it to the CVDS (ECCM Card) or to the external 14 pin power connector.

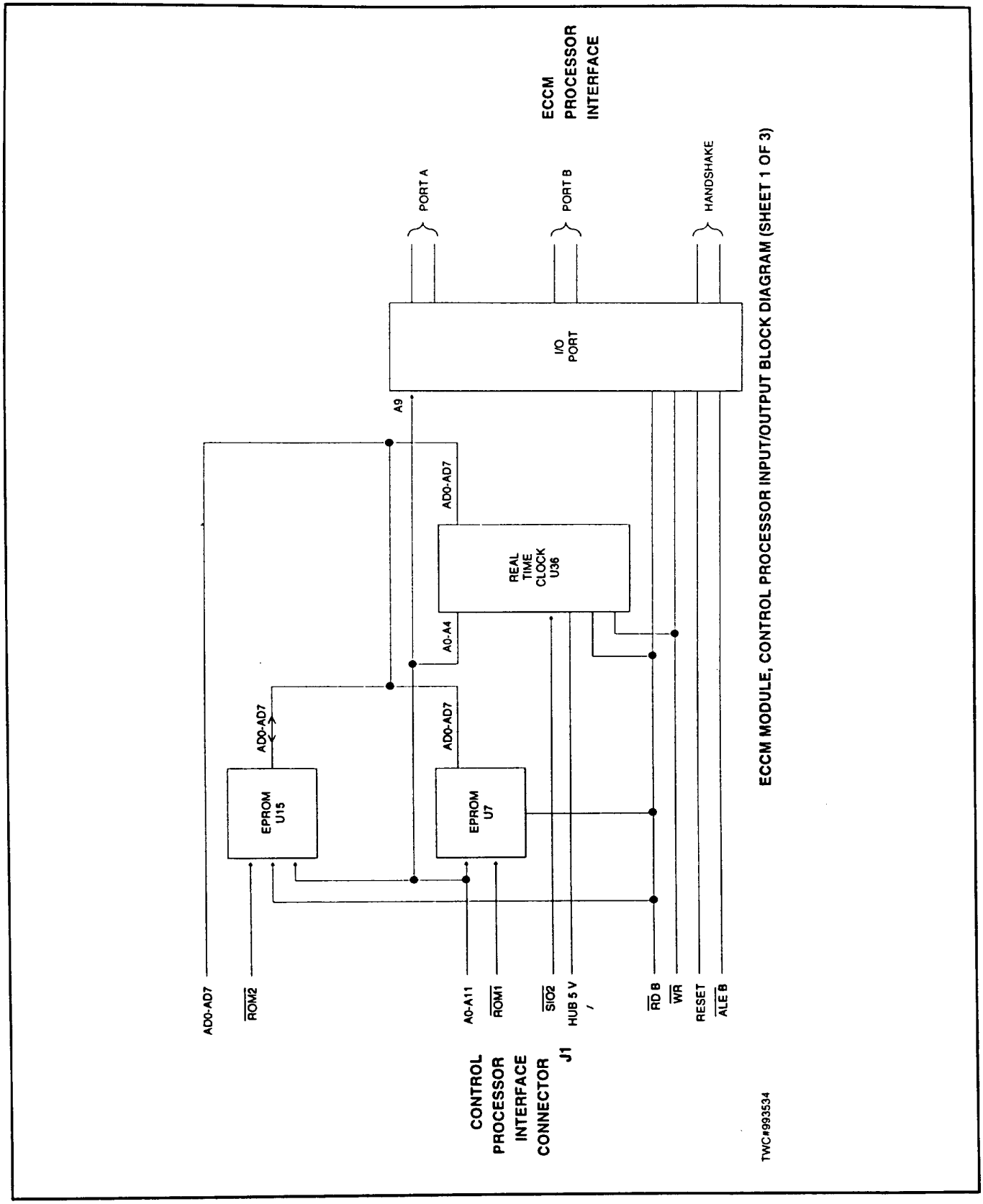

FIGURE 6-1.
ECCM Card, Overall Block Diagram (Sheet 1 of 3).

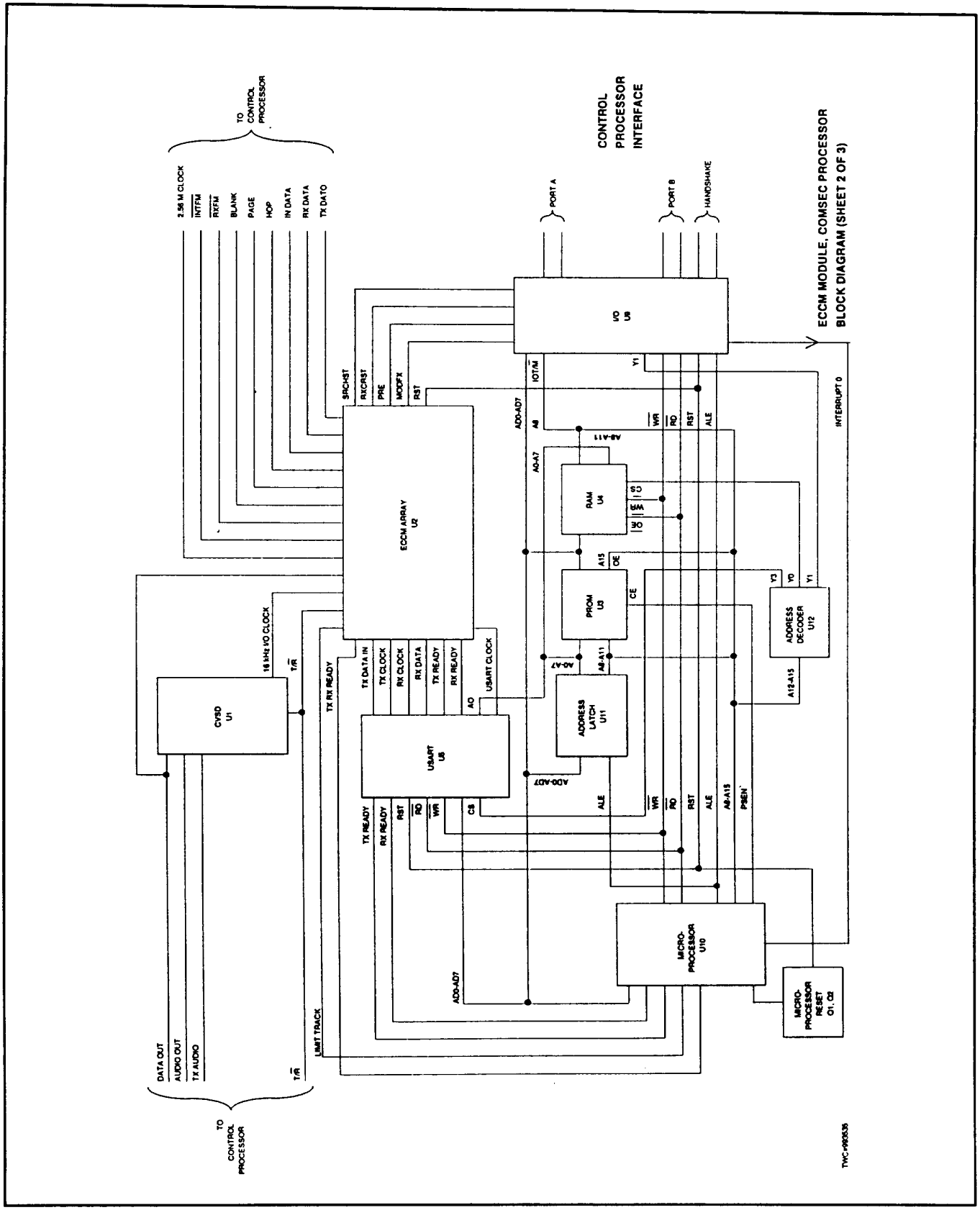

FIGURE 6-1.
ECCM Card, Overall Block Diagram (Sheet 2 of 3).

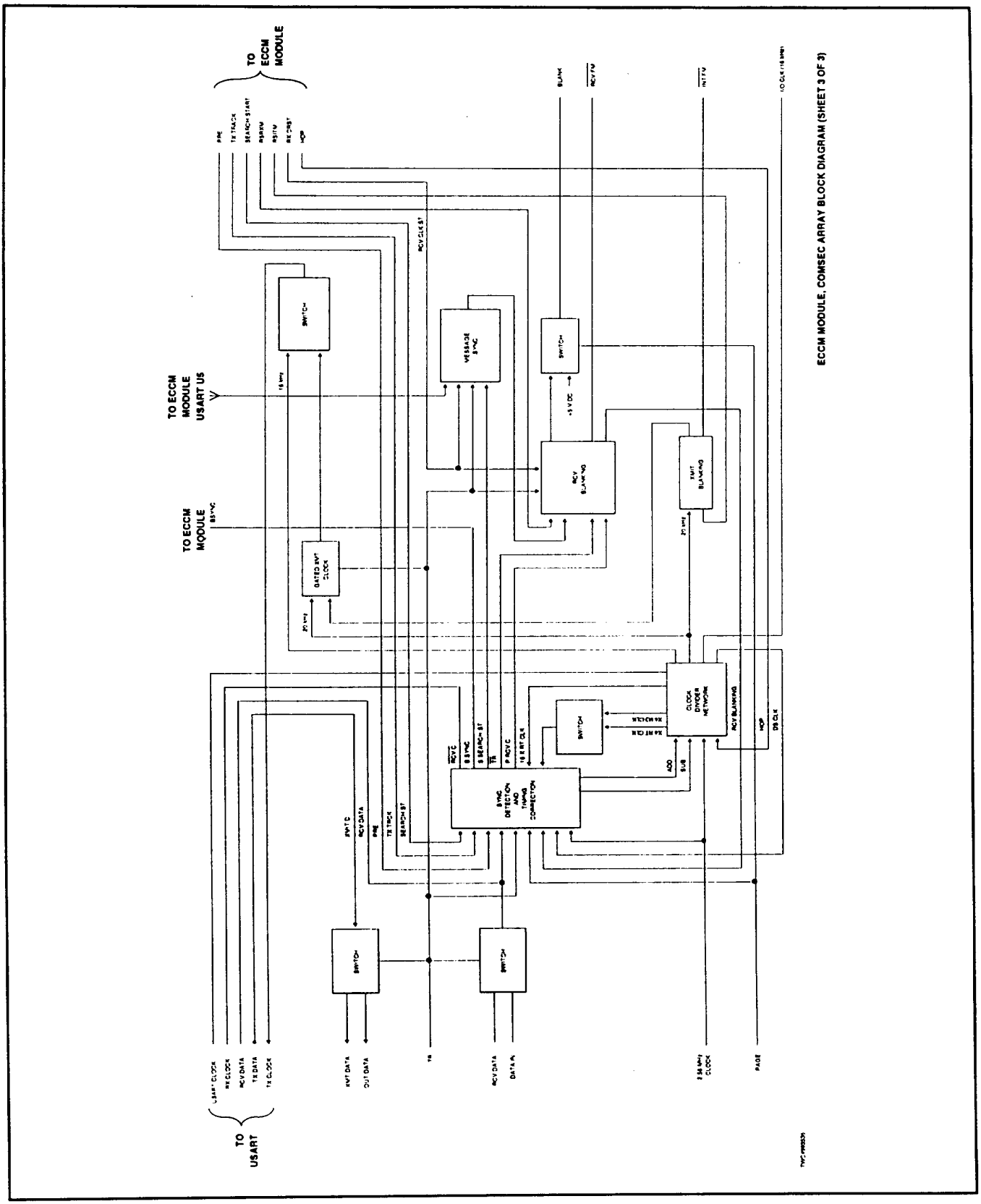

FIGURE 6-1.
ECCM Card, Overall Block Diagram (Sheet 3 of 3).

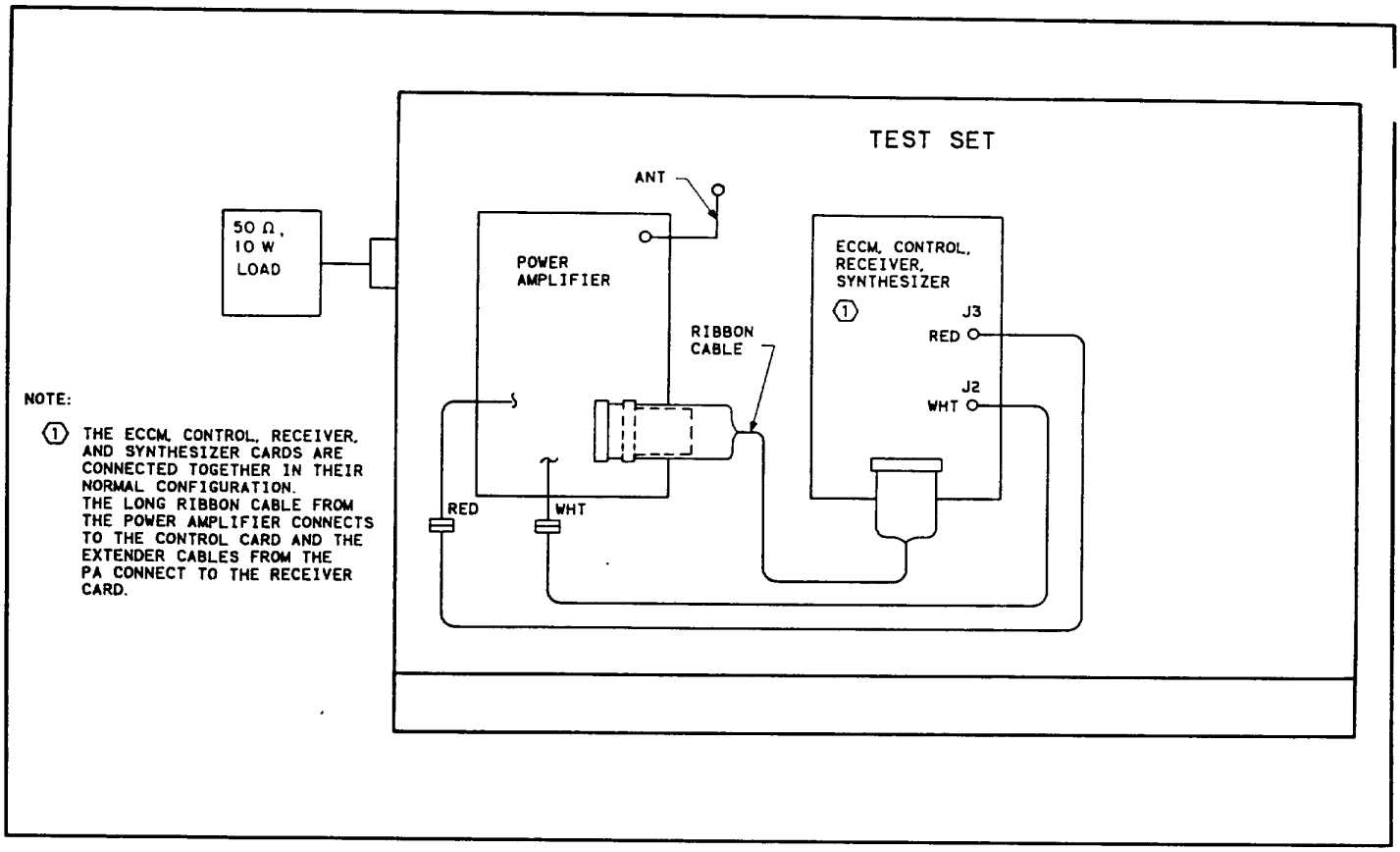

FIGURE 6-2.
ECCM Card, Test Setup Diagram.

TABLE 6-1.
ECCM, Testing and Troubleshooting Procedures.

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. Test setup	a. Remove the ECCM card from the receiver-transmitter. b. Remove the test set ECCM Card and replace it with the receiver-transmitter ECCM Card. c. Connect the receiver-transmitter ECCM card and the test set Control, Receiver, Synthesizer, and Power Amplifier Cards as shown in the test setup diagram, Figure 6-2. d. Terminate the test set output in a 10-watt, 50-ohm load.		

TABLE 6-1.
ECCM, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	e. Set the test set controls as follows: Control — Setting PRIMARY PWR — ON UUT PWR — ON NB AUDIO LOAD — OFF (down) WB Audio Load — OFF (down) Remote Data — NORMAL PTT KEY — OFF NORMAL AUDIO INHIBIT — VOICE OFF-TEST-ON-LITE — ON Display PWR — LO Display MODE — NO HOP Display CHAN/DAY — 1 Display SQL — OFF Display FREQ/NET/TIME — As required VOL — Full CW **NOTE** Unless otherwise indicated, all measurements to ground use the GND jack on the test set as ground. All oscilloscope measurements are made with a x 10 probe.		
2. Real time clock	a. Perform test 1.		
	b. Connect a frequency counter to ECCM Card TP5 (U6) and check frequency.	32 767 +/-0.5 Hz	Adjust trimmer capacitor C21 to meet specification. Check Y1, U6.
	c. Set the test set display MODE to TIME and set the time of day into the real time clock on a minute boundary of a clock.	Real time clock updates on next minute boundary of clock.	Check U6.
	d. Set test set UUT POWER switch to OFF.		
3. Timing chain	a. Perform test 1.		
	b. Set test set display MODE to HOP and NET to 111.		

TABLE 6-1.
ECCM, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	c. Set test set UUT PWR switch to OFF.		
	d. Connect frequency counter to ECCM Card TP9.		
	e. Set test set UUT PWR switch to ON and check frequency.	16 kIIz +/-0.4 IIz	Check U2.
	f. Set test set UUT PWR switch to OFF.		
	g. Connect an oscilloscope to ECCM Card U5-25.		
	h. Set UUT PWR and PTT KEY switches to ON and measure frequency at U5-25.	16 kIIz	Check U5.
	i. Set PTT KEY and UUT PWR switches to OFF.		
	j. Connect oscilloscope to ECCM Card U5-3.		
	k. Set UUT PWR and PTT KEY switches to ON and measure duration signal is on. Speak into handset of UUT and verify that signal varies with voice.	0.1 to 0.16 ms	Check U2.
	l. Set PTT KEY and UUT PWR switches to OFF.		
	m. Connect oscilloscope to ECCM Card U5-19.		
	n. Set UUT PWR and PTT KEY switches to ON and measure frequency and on-off duration of signal. Speak into handset of UUT and verify that signal varies with voice.	About 10 kIIz On = 8 ms Off = 1.6 ms	Check U5.
	o. Set PTT KEY and UUT PWR switches to OFF.		
	p. Connect oscilloscope to ECCM Card U8-43.		
	q. Set UUT PWR and PTT KEY switches to ON and measure spacing of pulses.	Short pulses at 9.6-ms spacing	Check U8.

TABLE 6-1.
ECCM, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	r. Set PTT KEY and UUT PWR switches to OFF.		
	s. Connect oscilloscope to ECCM Card U1-15.		
	t. Set UUT PWR and PTT KEY switches to ON and measure voltage at U1-15.	5 volts (high)	Check control card.
	u. Set PTT KEY and UUT PWR switches to OFF.		
	v. Connect oscilloscope to ECCM Card J1-43.		
	w. Set UUT PWR and PTT KEY switches to ON and measure voltage and on-off duration of signal at J1-43.	On = 0 V, 8 ms Off = 5 V, 1.6 ms	Check U2.
	x. Set PTT KEY and UUT PWR switches to OFF.		
	y. Connect oscilloscope to ECCM Card U1-15.		
	z. Set UUT PWR switch to ON and measure voltage.	0 volt (low)	Check control card.
	aa. Set UUT PWR switch to OFF.		
	ab. Connect oscilloscope to ECCM Card J1-43.		
	ac. Set UUT PWR switch to ON and measure voltage.	5 volts (high)	Check U2.
	ad. Set UUT PWR switch to OFF.		
	ae. Disconnect the ribbon cable from receiver board connector J1.		
	af. Connect oscilloscope to ECCM Card U9-41.		
	ag. Set UUT PWR switch to ON and measure duration between pulses.	240 ms	Check U9.
	ah. Set UUT PWR switch to OFF.		
	ai. Connect oscilloscope to ECCM Card J1-46.		
	aj. Set UUT PWR switch to ON and measure signal.	5-V, 9.6-ms pulses spaced 240 ms apart	Check control card.

TABLE 6-1.
ECCM, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	ak. Set UUT PWR switch to OFF.		
	al. Connect ribbon cable to receiver board connector J1.		
4. Transmit voice	a. With test set PRIMARY POWER switch in OFF, connect a receiver-transmitter to the test set through a 30-dB attenuator.		
	NOTE The UUT and receiver-transmitter must be within 10 seconds of each other in time and have the same frequency plan. The frequency plans are identical if the software part numbers and fill identification numbers are the same. This test proves that the UUT transmits the special synchronizing signals contained in the first and last frames of each message.		
	b. Connect handsets to the UUT and receiver-transmitter.		
	c. Set UUT controls per test 1. Set receiver-transmitter OFF-TEST-ON-LITE switch to ON, PWR to LO, MODE to HOP, CHAN to 1, SQL to ON, and NET to 111.		
	d. Set UUT MODE to HOP NCS and NET to 111.		
	e. With the UUT keyed by setting test set PTT KEY switch to ON, determine if a voice channel is established with the receiver-transmitter.	Voice channel established.	Check U5.
	f. Set receiver-transmitter OFF-TEST-ON-LITE switch to OFF.		
	g. Set test set UUT PWR switch to OFF.		

TABLE 6-1.
ECCM, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
5. Receive voice	a. With the test set PRIMARY POWER switch in OFF, connect a receiver-transmitter to the test set through a 30-dB attenuator. **NOTE** The UUT and receiver-transmitter must be within 10 seconds of each other in time. This test proves that the UUT receives the special synchronizing signals contained in the first and last frames of each message.		
	b. Connect handsets to the UUT and receiver-transmitter.		
	c. Set receiver-transmitter OFF-TEST-ON-LITE switch to ON, PWR to LO, MODE to HOP NCS, CHAN/DAY to 1, SQL to ON, and NET to 111.		
	d. Set test set controls per test 1 except set MODE to HOP, SQL to ON, CHAN/DAY to 1, and NET to 111.		
	e. With receiver-transmitter PTT keyed, determine if a voice channel is established with the UUT.	Voice channel established.	Check U5.
	f. Set test set UUT PWR switch to OFF.		
	g. Connect oscilloscope to ECCM Card U8-2.		
	h. Set UUT PWR switch to ON and measure spacing of pulses.	Pulses at 9.6-ms spacing	Check U8.
	i. Set UUT PWR switch to OFF.		
	j. Connect oscilloscope to ECCM Card U5-3.		
	k. Set UUT PWR switch to ON and observe signal. Speak into UUT handset and verify that signal varies with voice.	On = 8 ms Off = 1.6 ms	Check U2.
	l. Set UUT PWR switch to OFF.		

TABLE 6-1.
ECCM, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	m. Connect oscilloscope to ECCM Card U5-25.TESTPROCE-DURENORMAL IF INDICATION INDICATIONIS ABNORMAL		
	n. Set UUT PWR switch to ON and observe signal.	On = 8ms Off = 1.6 ms	Receive U2.
	o. Set UUT PWR switch to OFF.		
	p. Connect oscilloscope to ECCM Card U5-9.		
	q. Set UUT PWR switch to ON and measure frequency.	About 16 kIIz	Check U2.
	r. Set UUT PWR switch to OFF.		
	v. Connect oscilloseope to ECCM card U5-19.		
	w. Set UUT PWR switch to ON and observe signal. Speak into receiver-transmitter handset and verify that signal varies with voice.	About 8 kIIz	Check U5.

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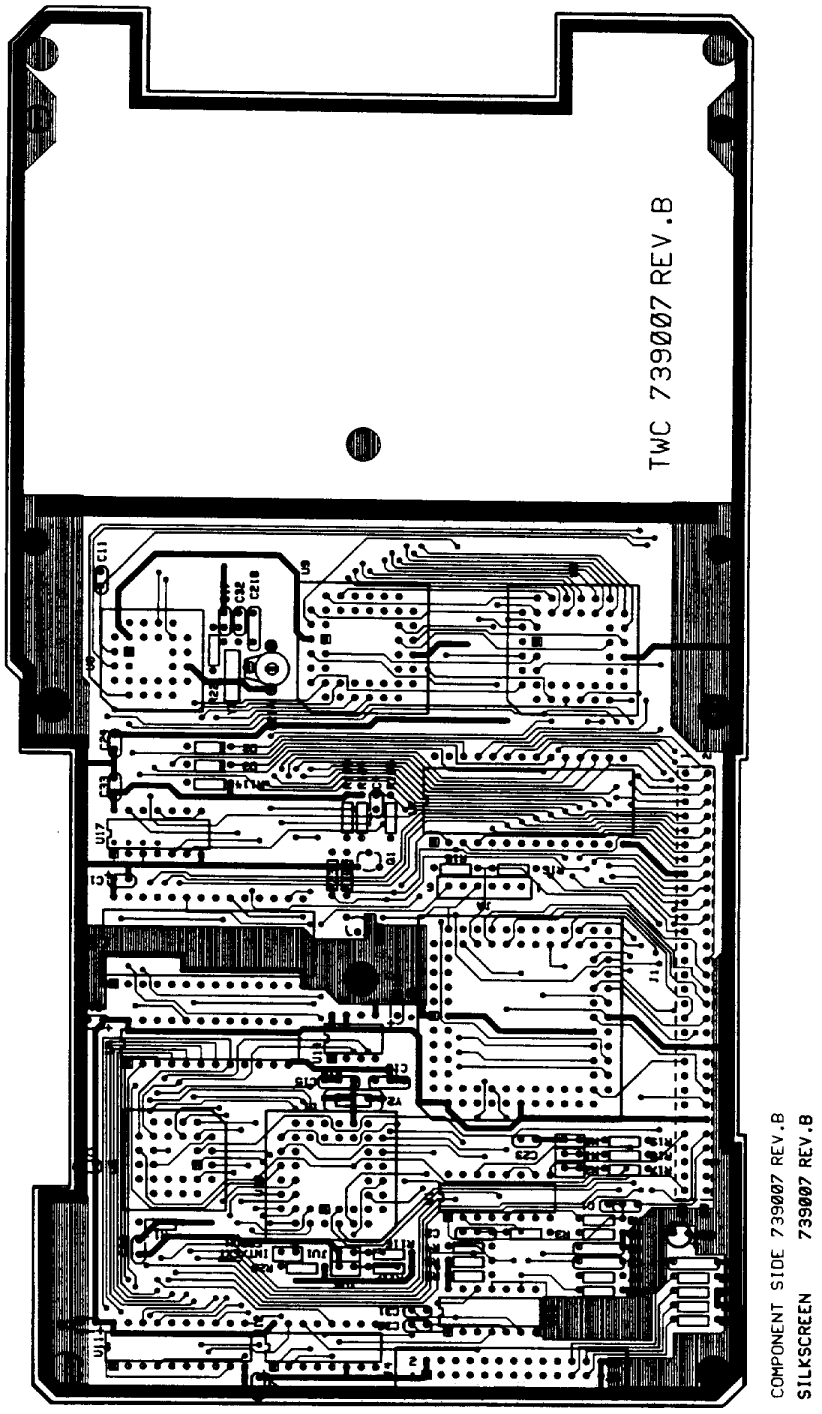
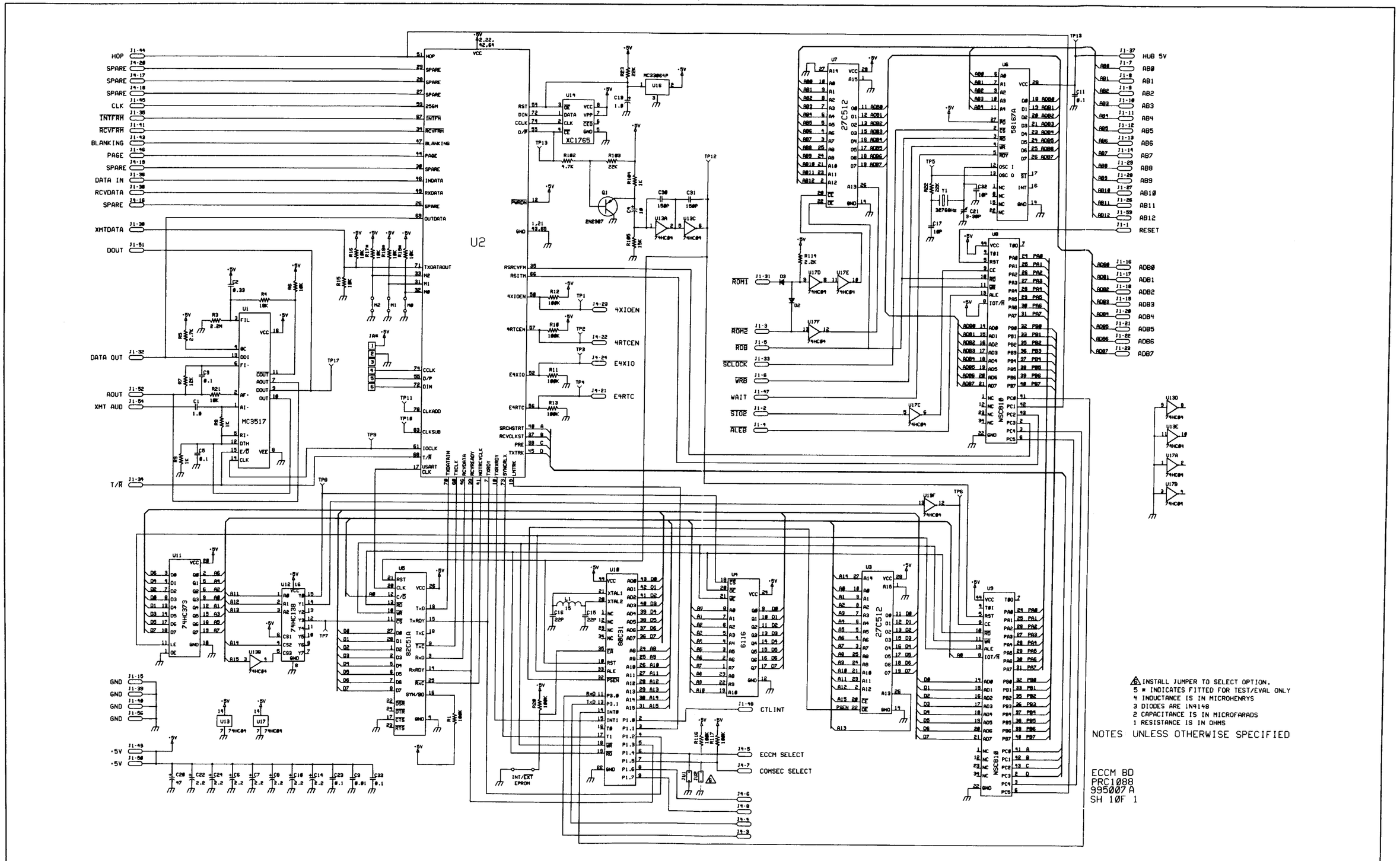


FIGURE 6-3.
Component Locations, ECCM Card.



INSTALL JUMPER TO SELECT OPTION.
5 = INDICATES FITTED FOR TEST/EVAL ONLY
4 INDUCTANCE IS IN MICROHENRYS
3 DIODES ARE 1N4148
2 CAPACITANCE IS IN MICROFARADS
1 RESISTANCE IS IN OHMS

NOTES UNLESS OTHERWISE SPECIFIED

ECCM BD
PRC1088
995007 A
SH 10F 1

FIGURE 6-4.
ECCM Card, Schematic Diagram.

Table 6-2.
Parts List, ECCM Card.

018-00700

DESIGNATOR	PART #	DESCRIPTION
C1	276105	CAP, ML Z5U 1UF 50V 0.2 SPACE
C2	275334	CAP, ML 0.33UF X7R 50V 10% .2S
C3	277104	CAP, ML 0.1UF AXIAL X7R 10%50V
C4	241100	CAP, 10MF DIP TANTALUM
C5	277104	CAP, ML 0.1UF AXIAL X7R 10%50V
C6	241020	CAP, 2.2MF DIP TANTALUM
C7	241020	CAP, 2.2MF DIP TANTALUM
C8	241020	CAP, 2.2MF DIP TANTALUM
C9	210151	CAP, 150 PF 10% DISC
C10	241020	CAP, 2.2MF DIP TANTALUM
C11	275104	CAP, 0.1MF 50V MONOLITHIC
C14	241020	CAP, 2.2MF DIP TANTALUM
C15	275220	CAP, ML 22PF NPO 100V 5% 0.2S
C16	275220	CAP, ML 22PF NPO 100V 5% 0.2S
C17	275100	CAP, ML 10PF NPO 100V 5% 0.1S
C19	241010	CAP, 1.0 MF DIP TANTALUM
C20	241476	CAP, 47MF 16V DIP TANT
C21A	261610	CAP, 4-30PF TRIMMER Q=300MIN
C22	241020	CAP, 2.2MF DIP TANTALUM
C23	275104	CAP, 0.1MF 50V MONOLITHIC
C24	241020	CAP, 2.2MF DIP TANTALUM
C30	210151	CAP, 150 PF 10% DISC
C31	210151	CAP, 150 PF 10% DISC
C32	275100	CAP, ML 10PF NPO 100V 5% 0.1S
C33	275104	CAP, 0.1MF 50V MONOLITHIC
D2	320002	DIODE, SI 100MA 1N4148/1N4150
D3	320002	DIODE, SI 100MA 1N4148/1N4150

Table 6-2.
Parts List, ECCM Card (continued).

J1	613169	CONN, 60 PIN DIL 0.1 X 0.154
L1	430150	INDUCTOR, 15UH 10% MOLDED
Q1	310052	XISTOR, PNP, PN2907A, TO92
R1	113104	RES, 100K 1/8W 5% CARBON FILM
R3	113225	RES, 2.2M OHM 1/8W 5%
R4	113183	RES, 18K 1/8W 5% CARBON FILM
R5	113272	RES, 2.7K 1/8W 5% CARBON FILM
R6	113103	RES, 10K 1/8W 5% CARBON FILM
R7	113123	RES, 12K 1/8W 5% CARBON FILM
R8	113102	RES, 1K 1/8W 5% CARBON FILM
R9	113102	RES, 1K 1/8W 5% CARBON FILM
R10	113104	RES, 100K 1/8W 5% CARBON FILM
R11	113104	RES, 100K 1/8W 5% CARBON FILM
R12	113104	RES, 100K 1/8W 5% CARBON FILM
R15	113103	RES, 10K 1/8W 5% CARBON FILM
R16	113103	RES, 10K 1/8W 5% CARBON FILM
R20	113104	RES, 100K 1/8W 5% CARBON FILM
R21	113103	RES, 10K 1/8W 5% CARBON FILM
R22	113223	RES, 22K 1/8W 5% CARBON FILM
R23	113223	RES, 22K 1/8W 5% CARBON FILM
R102	113472	RES, 4.7K 1/8W 5% CARBON FILM
R103	113223	RES, 22K 1/8W 5% CARBON FILM
R104	113102	RES, 1K 1/8W 5% CARBON FILM
R105	113153	RES, 15K 1/8W 5% CARBON FILM
R114	113222	RES, 2.2K 1/8W 5% CARBON FILM
R117	113104	RES, 100K 1/8W 5% CARBON FILM
R117	124104	RES, 100K 1/4W 5% CARBON FILM
U1	330428	IC, MC3517L DELTA MOD/DEMOD
U2	330454	IC, GATE ARRAY 84P PLCC

Table 6-2.
Parts List, ECCM Card (Continued).

DESIGNATOR	PART #	DESCRIPTION
U1	330428	IC, MC3517L DELTA MOD/DEMOD
U2	330454	IC, GATE ARRAY 84P PLCC
U3	018-00790	SOFTWARE, PRC1088 ECCM U3
U4	330456	IC, STATIC RAM 2KX8 0.3 SPACE
U5	330491	IC, 82C51A PLCC USART
U6	330427	IC, MM58167AV RTC PLCC 28 PIN
U7	018-00791	SOFTWARE, PRC1088 ECCM U7
U8	330455	IC, NSC810 RAM/IO TIMER PLCC
U9	330455	IC, NSC810 RAM/IO TIMER PLCC
U10	033051	IC, SMT 80C31 PLCC-44
U11	330429	IC, 74HC373N OCTA D TYPE LATCH
U12	330435	IC, 74HC138 1 OF 8 DECODER
U13	330196	IC 74HC04
U16	330397	IC, MC33064 UNDERVOLT SENSING
U17	330196	IC 74HC04
XU2	621110	SOCKET, 84 PIN PLCC
XU3	621009	SOCKET, 28 PIN DIP
XU5	621012	SOCKET, 28PIN IC PLCC
XU6	621012	SOCKET, 28PIN IC PLCC
XU7	621009	SOCKET, 28 PIN DIP
XU8	621015	SOCKET 44 PIN PLCC
XU9	621015	SOCKET 44 PIN PLCC
XU10	621015	SOCKET 44 PIN PLCC
XU14	621003	SOCKET IC DIP 8-PIN
Y1	360071	CRYSTAL, 32.7680 KHZ
Y1	761024	WIRE BUSS 24 AWG TC

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CHAPTER 7
RECEIVER (ASSY 018 - 00100, PCB 739001)

7.1 DESCRIPTION

The Receiver Card is a 2-sided printed circuit card. In transmit, the Receiver Card provides a clean, low-noise transmit signal to the Power Amplifier. In receive mode, the received signal is converted to 13.5-MHz IF. The IF is then applied to the audio circuitry and detected for 150-Hz squelch tone.

7.2 PRINCIPLES OF OPERATION

7.2.1 GENERAL

The receiver contains a 2-band (30 to 52 MHz, and 52 to 88 MHz), voltage-tuned preselector, receive mixer, a 13.5-MHz crystal filter, intermediate frequency (IF) amplifiers, discriminator, and squelch circuitry. The preselector serves as a tuned amplifier for both receive and transmit signals.

7.2.2 FUNCTIONAL THEORY (Refer to Figure 7-1)

Parallel frequency lines (2^2 to 2^{11}) from the control card are converted to a dc tuning voltage (4 to 20 volts) in the digital analog converter. The dc voltage then tunes the filter that is selected in the 2-band tracking preselector. The transmit drive signal from the synthesizer or the receive signal from the Power Amplifier is applied to the 2-band tracking preselector through switch CR19, CR20. In the transmit mode, the preselector removes the spurious mixing products from the synthesizer output and provides a clean, low-noise transmit signal to the Power Amplifier. In the receive mode, the received signal is supplied to the preselector to remove spurious signals.

The preselector has two selectable RF amplifier bands. The high-band frequency range is 52 to 87.975 MHz and the low-band range is 30 to 51.975 MHz. High or low band and receive or transmit mode are selected by power switches. The power switches receive their inputs (HI/LO band and T/R) from the control card.

Power switch U14C, Q11, and Q12 provides +12 V dc to turn on the preselector low band. Power switch U14A, U14B, Q9, and Q10 provides +12 V dc to turn on the preselector high band. Power switch U14D, Q13, and Q14 provides +7 V dc to activate the receive mode. Power switch Q15 and Q16 provides +7 V dc to activate the transmit mode.

In transmit mode, the output of the preselector is switched through CR39, CR40 to transmit RF amplifier Q3. The output of Q3 is a +8-dBm filtered transmit drive signal that is applied to the Power Amplifier Card.

In receive mode, the output of the preselector is switched through CR39, CR40 to mixer M1, where it is mixed with the receive injection signal from the synthesizer to produce 13.5-MHz IF. The IF signal is amplified by IF amplifier Q4 and applied to 13.5-MHz crystal filter FL1, where close-in selectivity is provided. From FL1, the IF signal is amplified by IF amplifier Q5 and applied to U1, RF in. Crystal Y1 controls the frequency of an oscillator in U1 to produce a 13.9625-MHz signal which is mixed with the 13.5-MHz RF in signal to produce 462.5-kHz IF. The 462.5-kHz IF reduces the potential of having internally-generated signals on the 25-kHz channels. The 462.5-kHz IF is amplified through limiter amplifiers in U1 and applied to a phase discriminator which detects the phase shift of the incoming signal. Phase shift is provided to the phase shift discriminator by discriminator coil L33. Dc coupled audio and data is then applied to wide-band audio amplifier U2A, U2B, and to a 150-Hz detector in Ul. The output of the amplifier is applied to the control card and the output of the detector is applied to 150-Hz amplifier U2D. From the amplifier, the squelch signal passes through another detector to comparator U2C. U2C compares the 150-Hz dc voltage to a dc voltage from the +7-volt supply. The output of the comparator is applied to the Control/ECCM card where it is used by the voice squelch.

7.3 TEST EQUIPMENT

Test equipment required to test, troubleshoot, repair, and align the receiver card are listed in Table 7-1. Equivalent substitute test equipment may be used.

7.4 TESTING/TROUBLESHOOTING PROCEDURES

The testing procedures in Table 7-2 check the total performance of the receiver card. These test procedures permit isolation of a fault to a specific component or circuit when used with the schematic to circuit trace the fault. Refer to Figure 7-2 for the test setup diagram.

The receiver card is tested by substitution in a stack of prime equipment subassemblies.

7.5 ALIGNMENT/ADJUSTMENT

NOTE

The receiver-transmitter cards must be mounted on the test set.

7.5.1 HIGH-BAND RF AMPLIFIER TRACKING

a. Preset the high-band RF amplifier tunable capacitors C22, C17, C11, and C5 to 50-percent capacity.

NOTE

At 100-percent capacity, the silvered section of the capacitor rotor is symmetrical with respect to the protruding (lower) portion of the stator. Zero percent is 180° from this position. There are two possible positions of the rotor for any capacity value between 0 and 100 percent; either position is acceptable.

b. Preset the high-band RF amplifier tunable coils as follows.

NOTE

Zero turns means the top surface of the slug is flush with the top surface of the coil form.

Coil	Plug Position
L8	1 turn in
L7	4 turns in
L4	2 turns in
L3	1 turn in

c. Connect an RF voltmeter with a 50-ohm load to receiver connector J3 using 50-Ω coax.

d. Connect a signal generator to receiver connector J5 using 50-ohm coax. Set the signal generator mode to CW and output to -23, +1, -0 dBm.

e. With the test set and signal generator set to the frequencies given below, peak the RF signal on the voltmeter. Set the test set PTT KEY switch to ON when peaking components and OFF when changing frequency.

Test Set Frequency (MHz)	Signal Generator Frequency(MHz)	Procedure
87.975	88.000 +/-0.1	Peak C22, C17, C11, C5
52.000	52.000 +/-0.1	Peak L8, L7, L4, L3

f. Repeat step e until highest peaks are obtained.

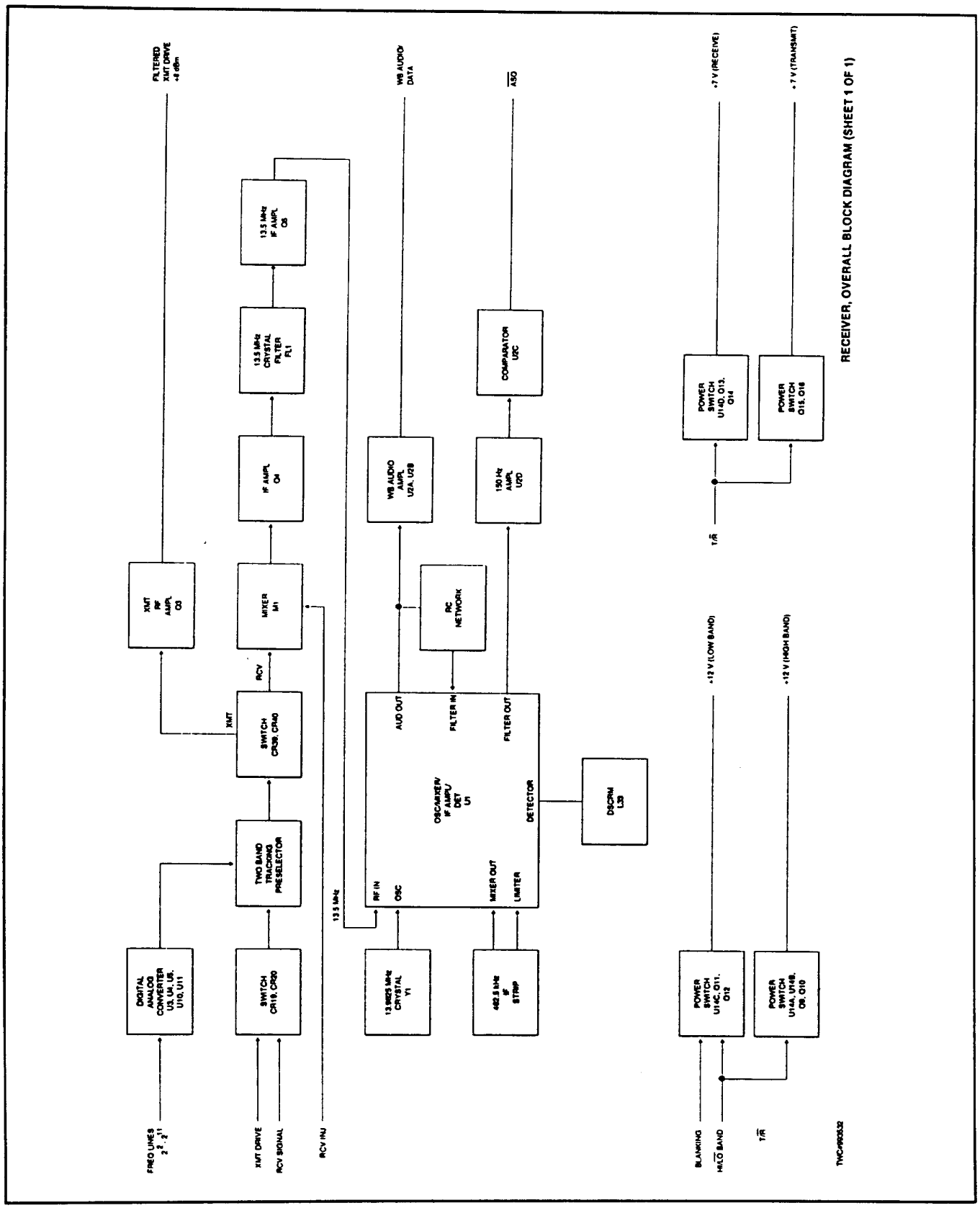


FIGURE 7-1.
Receiver, Overall Block Diagram.

g. Set test set frequency to 70.000 MHz and signal generator frequency to 70 +/-0.1 MHz. The RF level on the voltmeter should be NLT -8 dBm with PTT KEY to ON.
h. Set test set PTT KEY switch to OFF and disconnect test equipment.

7.5.2 LOW-BAND RF AMPLIFIER TRACKING

a. Preset the low-band RF amplifier tunable capacitors as follows.

NOTE

At 100-percent capacity, the silvered section of the capacitor rotor is symmetrical with respect to the protruding (lower) portion of the stator. 0 percent is 180° from this position. There are two possible positions of the rotor for any capacity value between 0 and 100 percent; either position is acceptable.

Capacitor	Position
C52	25% capacity
C47	10% capacity
C42	10% capacity
C36	40% capacity

b. Preset the low-band RF amplifier tunable coils as follows.

NOTE

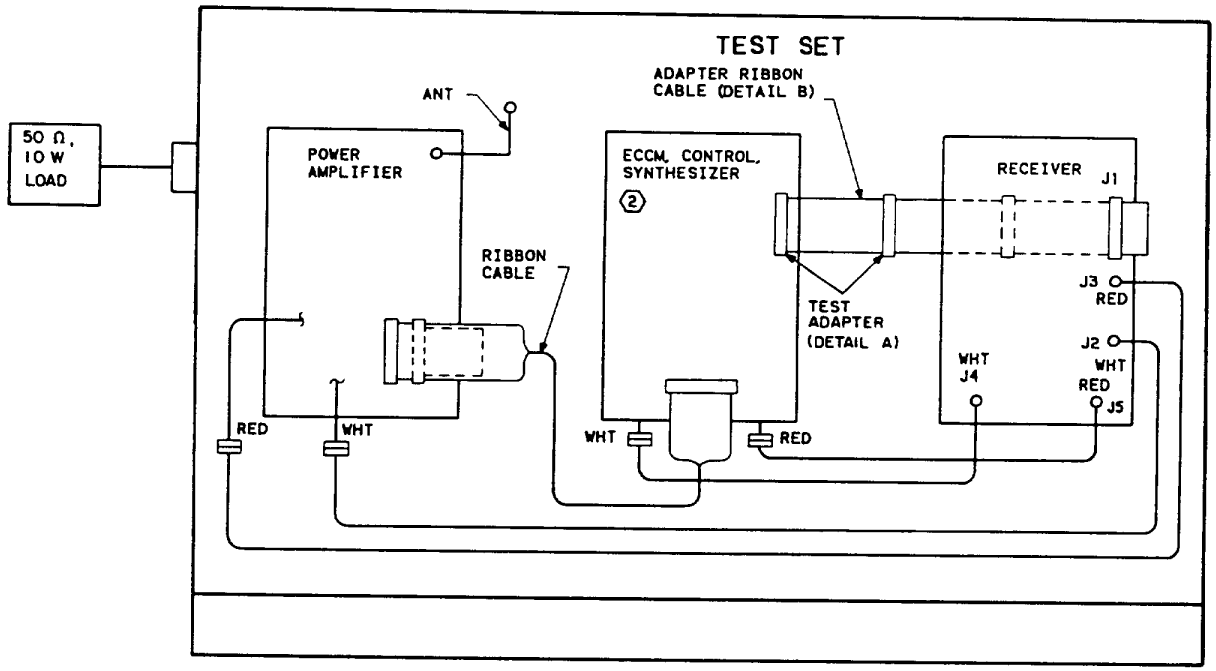
Zero turns means the top surface of the slug is flush with the top surface of the coil form.

Coil	Plug Position
L21	1-1/2 turns in
L20	5 turns in
L17	5 turns in
L16	1-1/2 turns in

c. Connect an RF voltmeter with a 50-ohm load to receiver connector J3 using 50-ohm coax.
d. Connect a signal generator to receiver connector J5 using 50-ohm coax. Set the signal generator mode to CW and output to -23 +1, -0 dBm.
e. With the test set and RF signal generator set to the frequencies given below, peak the RF signal on the voltmeter. Set the test set PTT KEY switch to ON when peaking components and OFF when changing frequency.

TABLE 7-1.
Test Equipment.

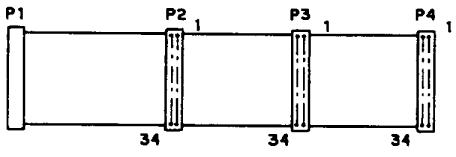
ITEM	MINIMUM SPECIFICATIONS	REPRESENTATIVE TYPE
Signal generator	30 to 88 MHz, -130 to +6 dBm	Marconi 2022 A/B/C, or D
Function generator	10-Hz to 10-kHz sine and square wave	Krohn-Hite 5400B
Frequency counter	10 Hz to 10 kHz, 1-Hz resolution	Fluke 7260A
Oscilloscope	30-MHz bandwidth, 50 mV/DIV	Tektronix 2213
RF voltmeter	88-MHz response, 10 mV full scale	Boonton 92C
Distortion analyzer	10-Hz to 10-kHz response	Hewlett-Packard 334A
Digital multimeter	0 to 25 V dc	Fluke 85
Test set		966X-2 Radio Set Test Set
Load	50 Ω, 10 W	Bird 8052



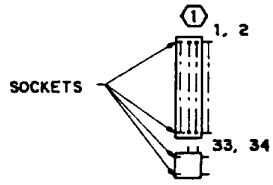
NOTES:

① THE TEST ADAPTER PROVIDES TEST POINTS ON THE RIBBON CABLE.

② THE ECCM CARD IS ON THE TOP, CONTROL CARD IN THE MIDDLE, AND THE SYNTHESIZER IS ON THE BOTTOM. THE LONG RIBBON CABLE FROM THE POWER AMPLIFIER CONNECTS TO THE CONTROL CARD. ALL OTHER EXTENDER CABLES CONNECT TO THE RECEIVER CARD.



DETAIL B



DETAIL A

FIGURE 7-2.
Test Setup Diagram.

TABLE 7-2.
Receiver, Testing and Troubleshooting Procedures.

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. Test setup	a. Remove the Receiver Card from the receiver transmitter. b. Install the Receiver Card on the right side of the test set as shown in Figure 7-2. c. Remove the Receiver Card from the test set stack. d. Connect the receiver-exciter Receiver Card and test set ECCM, Control, Synthesizer, and Power Amplifier Cards as shown in Figure 7-2. e. Terminate the test set output into a 10-watt, 50-ohm load. f. Set test set controls as follows: Control — Setting PRIMARY PWR — ON UUTPWR — ON NB AUDIO LOAD — OFF (down) WB AUDIO LOAD — OFF (down) REMOTE DATA — NORMAL PTT KEY — OFF NORMAL AUDIO INHIBIT — VOICE OFF-TEST-ON-LITE — ON Display PWR — LO Display MODE — NO HOP Display CHAN/DAY — 1 Display SQL — OFF Display FREQ/NET/TIME — As required VOL — Full CW **NOTE** Unless otherwise indicated, all measurements to ground use the GND jack on the test set as ground. All oscilloscope measurements are made with a x 10 probe.		

TABLE 7-2.
Receiver, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
2. Tuning voltage generator operation	a. Perform test 1.		
	b. Connect a digital voltmeter between TP33 and GND.		
	c. Set the test set frequency as shown below and measure the tuning voltage at each frequency.		
	Test Set Frequency (MHz)		
	87.975	19.50 - 20.50 Vdc	Check tuning voltage circuit.
	70.000	8.5 - 9.5 Vdc	
	52.000	3.30 - 4.0 Vdc	
	51.975	21.4 - 22.00 Vdc	
	40.000	7.80 - 8.60 Vdc	
	30.000	3.30 - 4.40 Vdc	
	d. Set test set UUT PWR switch to OFF.		
3. High-band RF amplifier tracking	a. Perform test 1.		
	b. Connect an RF voltmeter (+3 dBm full scale) with 50-ohm load to Receiver Card J3.		
	c. Set the test set frequency to 70.000 MHz.		
	d. Connect a signal generator to Receiver Card J5. Set the signal generator output to -23 +1, -0 dBm, mode to CW, and frequency to 70.0 +/-0.1 MHz.		
	e. Set test set PTT KEY switch to ON and measure RF level.	NLT -8 dBm	Refer to step f if no output. Refer to paragraph 6.5.1 for alignment if out of specification.
	NOTE If indication is normal, proceed to step g.		

TABLE 7-2.
Receiver, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	f. Perform the following fault isolation procedure.		
	(1) Connect a digital voltmeter between TP39 and ground. Measure voltage.	+11 to +13 Vdc	Connect digital voltmeter between TP37 and ground and check for a logic 1. If logic 1 is present, check Q9, Q10. If logic 0 is present, check U14A, U14B.
	(2) Connect a digital voltmeter between TP44 and ground. Measure voltage.	+6 to +8 Vdc	Connect digital voltmeter between TP41 and ground. Voltage should be +6 to + 8 Vdc. If the voltage is correct, check Q15 and Q16. If the voltage at TP41 is not correct, check that the voltage between TP34 and ground is +11 to +13 Vdc. If normal, check U13. If the voltage at TP34 is not correct, check L36.
	g. Set test set PTT KEY switch to OFF.		
4. Low-band RF amplifier tracking	a. Perform test 1.		
	b. Connect an RF voltmeter (+3 dBm full scale) with 50-ohm load to Receiver Card J3.		
	c. Set test set frequency to 40.000 MHz.		
	d. Connect a signal generator to receiver card 15. Set the signal generator output to 22 to 23 dBm, mode to CW, and frequency to 40.000 +/- 0.1 MHz.		

TABLE 7-2.
Receiver, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	e. Set test set PTT KEY switch to ON and measure RF level.	NLT 8 dBm	Refer to step f if no output. Refer to paragraph 5.2 if out of specification.
	NOTE If indication is normal, proceed to step g.		
	f. Perform the following fault isolation procedure.		
	(1) Connect a digital voltmeter between TP40 and ground measure voltage.	+11 to +13 Vdc	Connect digital voltmeter between TP38 and ground, and check for a logic 1. If logic 1 is present, check Q11, Q12. If logic 0 is present, check U14C.
	(2) Connect a digital voltmeter between TP44 and ground. Measure voltage.	+6 to +8 Vdc	Connect digital voltmeter between TP41 and ground. Voltage should be +6 to +8 Vdc. If the voltage is correct, check Q15 and Q16. If the voltage at TP41 is not correct, check the voltage between TP34 and ground. If normal, check U13. If the voltage at TP34 is not correct, check L36.
	(3) Connect an oscilloscope between TP7 and ground.	At 70 MIIz, 100 M Vp-p.	Check Q2.
	(4) Connect an oscilloscope between TP10 and ground.	At 40 MIIz, 100mV p-p.	Check Q3.
	g. Set test set PTT KEY switch to OFF.		
	h. Set test set UUT PWR switch to OFF.		

TABLE 7-2.
Receiver, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
5. Receiver sensitivity	NOTE To ensure proper grounding and shielding, the Receiver Card must be bolted into its normal place in the stack of circuit cards. a. Connect a signal generator to receiver card J2. Set the signal generator output to -115 +/-0.5 dBm (0.4 μV) and mode to FM. Modulate the signal generator with 7-kHz deviation (14 kHz p-p) at a 1-kHz +/-10-Hz rate. b. Connect a distortion analyzer to the test set NB AUDIO RCV jacks. c. Set the test set NORMAL AUDIO INHIBIT switch to VOICE. d. Set the test set and signal generator frequencies as listed below and measure dB level. TEST SET FREQUENCY (MHz) 87.975 70.050 52.000 51.975 40.250 30.000 NOTE If indication is normal, proceed to step f. e. Perform the following fault isolation procedure.	NLT 10 dB for all frequencies.	Remove the Receiver Card from stack and install on test set as shown in Figure 7-2. Repeat test 5. Perform step e or use test data on schematic for fault isolation.

TABLE 7-2.
Receiver, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	(1) Connect a digital voltmeter between TP43 and ground. Measure voltage.	+6 to +8 Vdc	Connect a digital voltmeter between TP42 and ground, and check for a logic 1. If a logic 1 is present, check Q13, Q14. If a logic 0 is present, check U14D.
	(2) If in high band, connect digital voltmeter between TP39 and ground. Measure voltage. If in low band, connect a digital voltmeter between TP40 and ground. Measure voltage.	+11 to +13 Vdc	In high band, connect a digital voltmeter between TP37 and ground, and check for a logic 1. If logic 1 is present, check Q9, Q10. If a logic 0 is present, check U14A, U14B. In low band, connect a digital voltmeter between TP38 and ground and check for a logic 0. If a logic 0 is present, check Q11, Q12. If a logic 1 is present, check U14C.
	f. Set test set UUT PWR switch to OFF.		
6. Audio output	a. Perform test 1.		
	b. Set test set frequency to 30.000 MHz.		
	c. Connect a signal generator to Receiver Card connector J2.		
	d. Set signal generator frequency to 30.000 MHz, output to -93 +/-1 dBm (5 μV), and mode to FM. Modulate generator with 7-kHz deviation (14kHz p-p) at a 1-kHz +/-10-Hz rate.		
	e. Connect a distortion analyzer to the test set WB AUDIO RCV jacks.		

TABLE 7-2.
Receiver, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	f. Set distortion analyzer mode to VOLTMETER and measure audio output.	1.20 to 1.30 V rms	Check receive path.
	g. Set distortion analyzer mode to DISTORTION.	Distortion is NMT 10%.	Check receive path.
	h. Set a 0-dB reference level on the distortion analyzer with 1-kHz modulation.		
	i. Vary modulation rate down to 10 Hz and observe dB change.	NMT +/-1.5 dB	Check receive path.
	j. Set test set UUT PWR switch to OFF.		
	k. Connect a digital voltmeter to test adapter pin 15.		
	l. Turn the signal generator modulation off.		
	m. Set the test set UUT PWR switch to ON and measure audio output voltage.	2.97 to 3.03 V dc	Check U2. Perform alignment procedure in paragraph 7.5.4.
	n. Set test set UUT PWR switch to OFF.		
7. Squelch trip levels	a. Perform test 1.		
	b. Set test set frequency to 52.000 MHz and SQL to ON.		
	c. Connect a signal generator to receiver connector J2.		
	d. Set signal generator frequency to 52. 000 +/- 1.0 MHz, output level at -130 dBm, and modulation to 2.5-kHz peak (5 kHz p-p) at a 150 +/-2-Hz rate.		
	e. Set UUT PWR switch to OFF.		
	f. Connect a dc coupled oscilloscope (1 V/cm) to test adapter pin 20.		
	g. Set UUT PWR switch to ON.		

TABLE 7-2.
Receiver, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	h. Adjust output level of signal generator up from -130 dBm until the ASQ output at pin 20 just trips from high to low.	Signal generator output is -118 to -120 dBm.	Check U2C, U2D. Adjust R73 to meet specifications.
	i. Adjust the output level of the signal generator down until the ASQ output just trips from low to high. **NOTE** If the squelch fails to trip, increase the drive level of the 150-Hz modulating signal.	Signal generator output is less than -121 dBm.	Check U2C, U2D. Adjust R73 to meet specifications.
	j. Set test set UUT PWR switch to OFF.		
8. Transmit RF output	a. Perform test 1.		
	b. Connect an RF voltmeter (+10 dBm full scale) with a 50-ohm load to Receiver Card connector J3 using 50-ohm coax.		
	c. Connect a signal generator to Receiver Card connector J5 using 50-ohm coax.		
	d. Set signal generator output level to 9.0 +/-0.2 dBm and mode to CW.		
	e. Set test set and signal generator to the frequencies listed below. Set the test set PTT KEY switch to ON to measure transmit RF output and OFF when changing frequency.		Perform step f.
	FREQUENCY(MHz)		
	87.975	+9.0 to +12.0 dBm	
	70.025	+8.0 to +12.0 dBm	
	52.000	+8.0 to +11.5 dBm	
	51.975	+9.0 to +12.0 dBm	
	40.050	+8.0 to +12.0 dBm	
	30.000	+8.0 to +11.5 dBm	

TABLE 7-2.
Receiver, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	NOTE If indication is normal, proceed to step g.		
	f. Connect a digital voltmeter between TP44 and ground and measure voltage.	+6 to +8 Vdc	Connect a digital voltmeter between TP41 and ground and measure voltage. Voltage should be +6 to +8 Vdc. If voltage is correct, check Q15, Q16. If voltage at TP41 is not correct, check that the voltage between TP34 and ground is +11 to +13 Vdc. If normal, check U13. If the voltage at TP34 is not correct, check L36.
	NOTE If indication is normal, check Q3.		
	g. Set test set UUT PWR switch to OFF.		
9. Blanking	a. Perform test 1.		
	b. Set test set frequency to 30.000 MHz.		
	c. Connect an oscilloscope input through a 50-ohm load to Receiver Card connector J3.		
	d. Sync the oscilloscope externally from the blanking signal at pin 18 on the test adapter.		
	e. Connect a signal generator to Receiver Card connector J5 using 50-ohm coax.		
	f. Set signal generator output level to 9.0 +/-0.2 dBm, mode to CW, and frequency to 30 MHz.		

TABLE 7-2.
Receiver, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	g. Connect a function generator to test adapter pin 18. Set function generator for 1-kHz square wave with level between 0 and +5 volts.		
	h. Set test set PTT KEY switch to ON.		
	i. Measure the time required for the 30-MHz RF to fall from 90% to 10% of full output (blanking off time).	NMT 300 ms	
	j. Retrigger the oscilloscope and measure the time required for the 30-MHz RF to rise from 10% to 90% of full power (blanking on time).	NMT 25 ms	
	k. Set test set PTT KEY and UUT PWR switch to OFF.		
	1. Remove the oscilloscope connection to J3 and connect a 50-ohm load and RF voltmeter to J3.		
	m. Set test set UUT PWR switch to ON and PTT KEY switch to ON. Measure and record RF output.		
	n. Set test set PTT KEY switch to OFF.		
	o. Apply a logic 1 from + 5-V dc jack on test set to pin 8 of U14.		
	p. Set test set PTT KEY switch to ON and measure the dB change at J3.	NMT -40 dBm	Check U14/+12-volt (low-band) power source.
	q. Set UUT PWR and PTT KEY switches to OFF.		

Test Set Frequency (MHz)	Signal Generator Frequency (MHz)	Procedure
51.975	52.0 +/-0.1	Peak C52, C47, C42, C36
30.000	30.0 +/-0.1	Peak L21, L20, L17, L16

f. Repeat step e until highest peaks are obtained.

g. Set test set frequency to 40.000 MHz and signal generator frequency to 40.0 ± 0.1 MHz. The RF level on the voltmeter should be NLT -8 dBm with PTT KEY switch to ON.

h. Set test set PTT KEY switch to OFF and disconnect test equipment.

7.5.3 IF AMPLIFIER ALIGNMENT

a. Set the test set frequency to 52.000 MHz.

b. Connect a signal generator to receiver board connector J2 using 50-ohm coax. Set signal generator frequency to 52.000 ± 0.0001 MHz, mode to CW, and output level at -85 ± 3 dBm.

c. Connect an oscilloscope probe (50 mV/cm, 1.0 µs/cm) to TP19 to view the 462.5-kHz IF signal. Increase or decrease the level of the signal generator to keep the signal visible at TP19 but not high enough to cause limiting.

d. Carefully peak L31, L30, L29, and L28 for maximum signal level on the oscilloscope. Reduce the level of the signal generator as the circuits tune to keep the IF signal from limiting.

e. Repeat step d until maximum signal level is obtained.

7.5.4 DISCRIMINATOR TUNING AND AUDIO OUTPUT ADJUSTMENTS

a. Set the test set frequency to 52.000 MHz.

b. Connect a signal generator to receiver board connector J2 using 50-ohm coax. Set the signal generator frequency to 52.0000 ± 0.0001 MHz, modulation to 7-kHz peak (14 kHz p-p) at a 1000 ± 10-Hz rate, and output level at -93 ± 1 dBm (5 µV).

c. Provide external sine wave FM with a function generator and monitor the audio frequency with a frequency counter.

d. Set test set NORMAL AUDIO INHIBIT switch to DATA.

e. Connect an oscilloscope, distortion analyzer, and digital voltmeter to the test set WB AUDIO RCV jacks. The oscilloscope should be dc coupled, 1 V/cm vertical sensitivity with ground being the bottom line on the screen; time base of 0.5 ms/cm.

f. Adjust R125 until the dc level of the trace seen on the oscilloscope screen is centered at 3 V dc.

g. Adjust discriminator coil L33 for a peak in the ac output without clipping, as read on the distortion analyzer (voltmeter mode) and oscilloscope. Since peaking the ac component also affects the dc level, re-center the waveform to 3 V dc with R125 as the ac peaking continues.

NOTE

If too much audio is present to avoid clipping at any level of R125 and L33, the audio level may be temporarily reduced with R80, the volume adjust potentiometer.

h. When L33 has been carefully peaked to its final value and no clipping is seen, carefully observe the sine wave for any sharp bends or slope changes which give a nonsinusoidal appearance with distortion. The sine wave audio may be improved with adjustment of L28 and L29, the crystal filter tuning coils.

i. Turn off the modulation of the signal generator.

j. Adjust R125 for a wide-band audio/data output dc level of 3.000 ± 0.030 V dc as read on the digital voltmeter.

k. Turn on the modulation of the signal generator and adjust R125 for an audio output of 1.25 ± 0.05 V rms, as read on the ac voltmeter.

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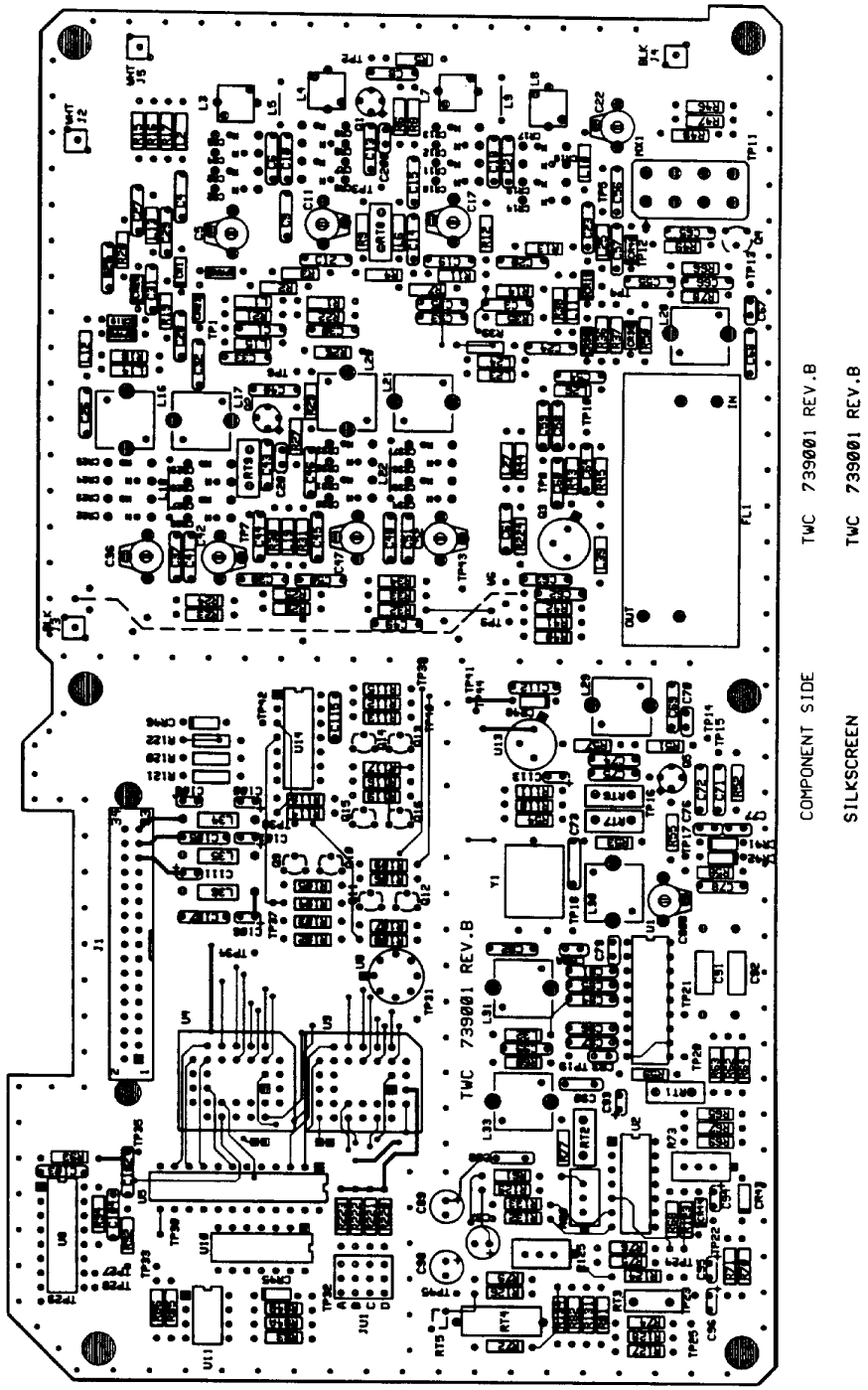


FIGURE 7-3.
Component Locations, Receiver.

VARACTOR GRADE	JUMPER SETTINGS JUA	JUB	JUC	JUD
YELLOW	Ø	Ø	Ø	Ø
BROWN/GREEN	1	Ø	Ø	Ø
WHITE	Ø	1	Ø	Ø
RED	1	1	Ø	Ø
GRAY	Ø	Ø	1	Ø
BLUE	1	Ø	1	Ø
ORANGE	Ø	1	1	Ø
GOLD	1	1	1	Ø
PAGES 9 - 16 SPARE	X	X	X	1

Ø-JUMPER 1-NO JUMPER
X-STEPS 1 - 8 REPEATED

REF DES	TYPE	+7VDC	+12VDC	+24VDC	+5V(A)	+5V(B)			GND
U1	MC3359								17
U2	LM324	4							11
U3	27C128/256				2,32				16
U4	27C128/256				2,32				16
U5	74ACT841					24			12
U6									
U7									
U8	4528				16				8
U9	AD584		8						4
U10	RES ARRAY								
U11	LM358N			8					4
U12									
U13	LM317LZ								
U14	4001				14				7

6 ALL THERMISTORS ARE NTC TYPE.

5 INSTALL JUF & JUG IF U3 & U4 ARE 27C256.
INSTALL JUH & JUJ IF U3 & U4 ARE 27C512.

4 REMOVE FOR ORANGE VARACTORS.

3 JUE REMOVED AND C26 470pF INSTALLED FOR USE AS AN 'R' 80.

2. THIS EQUIPMENT CONTAINS ELECTROSTATIC DISCHARGE SENSITIVE (EDOS) DEVICES. SPECIAL HANDLING METHODS AND MATERIALS MUST BE USED TO PREVENT EQUIPMENT DAMAGE.

1. RESISTANCE VALUES ARE IN OHMS. CAPACITANCE VALUES ARE IN MICROFARADS. INDUCTANCE VALUES ARE IN MICROHENRYS. DIODES CR2-CR17, CR22-CR37 ARE GRADED MV209. DIODES CR1, CR18-CR21, CR39-CR40 ARE TYPE MA47120. DIODES CR41-CR46 ARE TYPE 1N4148.

NOTES: UNLESS OTHERWISE SPECIFIED

J1
1 MODULATION
2 LOSS OF LOCK
3 2^1
4 2^0
5 2^9
6 2^{10}
7 2^{11}
8 2^8
9 2^6
10 2^7
11 2^0
12 2^2
13 2^3
14 2^4
15 WB AUD/DATA
16 RCV STROBE
17 HI/LO BAND
18 BLANKING
19 SPARE
20 ASQ
21 HI/LO HALF BAND
22 SPARE
23 TR
24 SPARE
25 SPARE
26 -12VDC
27 150 Hz
28 SPARE
29 +12VDC
30 GND
31 +5.2VDC
32 GND
33 +24VDC
34 +12VDCXMT

RECEIVER ASSEMBLY
PRC1088
995001 B
SH 1 OF 2

FIGURE 7-4.
Schematic Diagram, Receiver (1 of 2).

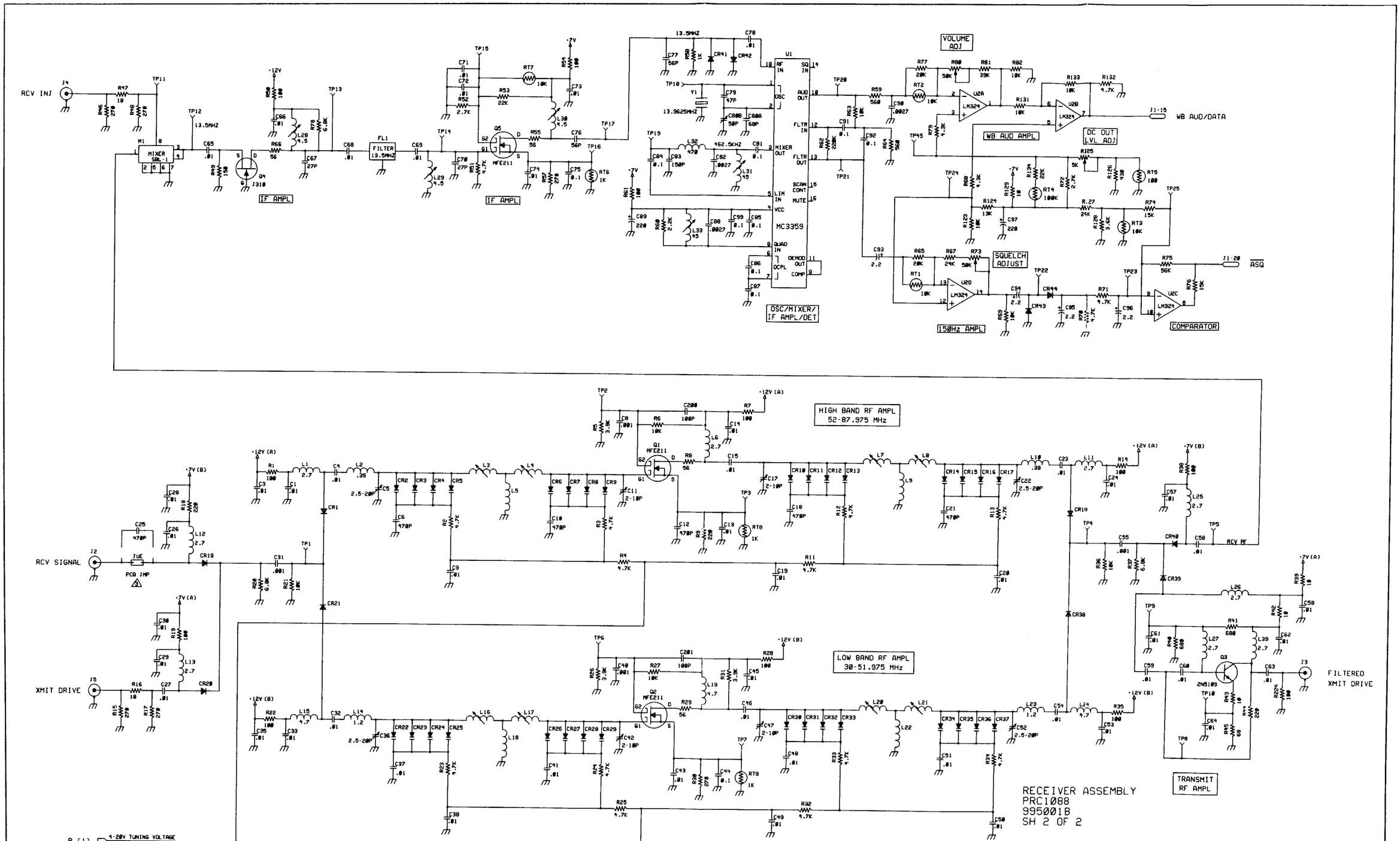


FIGURE 7-4.
Schematic Diagram, Receiver (2 of 2).

Table 7-3.
Parts List, Receiver.

018-00100

DESIGNATOR	PART #	DESCRIPTION
C1	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C3	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C4	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C5	261612	CAP, 2.5-20PF TRIMMER BLUE
C6	277471	CAP, ML 470PF NPO AXIAL 5%100V
C8	277102	CAP, ML 1000PF X7R AXIAL 10%
C9	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C10	277471	CAP, ML 470PF NPO AXIAL 5%100V
C11	261611	CAP, 2-10PF TRIMMER WHITE
C12	277471	CAP, ML 470PF NPO AXIAL 5%100V
C13	277104	CAP, ML 0.1UF AXIAL X7R 10%50V
C14	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C15	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C17	261611	CAP, 2-10PF TRIMMER WHITE
C18	277471	CAP, ML 470PF NPO AXIAL 5%100V
C19	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C20	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C21	277471	CAP, ML 470PF NPO AXIAL 5%100V
C22	261612	CAP, 2.5-20PF TRIMMER BLUE
C23	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C24	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C26	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C27	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C28	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C29	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C30	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C31	277102	CAP, ML 1000PF X7R AXIAL 10%
C32	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C33	277103	CAP, ML 0.01 UF AXIAL X7R 10%

Table 7-3.
Parts List, Receiver (Continued).

DESIGNATOR	PART #	DESCRIPTION
C35	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C36	261612	CAP, 2.5-20PF TRIMMER BLUE
C37	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C38	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C40	277102	CAP, ML 1000PF X7R AXIAL 10%
C41	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C42	261611	CAP, 2-10PF TRIMMER WHITE
C43	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C44	277104	CAP, ML 0.1UF AXIAL X7R 10%50V
C45	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C46	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C47	261611	CAP, 2-10PF TRIMMER WHITE
C48	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C49	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C50	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C51	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C52	261612	CAP, 2.5-20PF TRIMMER BLUE
C53	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C54	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C55	277102	CAP, ML 1000PF X7R AXIAL 10%
C56	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C57	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C58	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C59	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C60	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C61	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C62	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C63	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C64	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C65	277103	CAP, ML 0.01 UF AXIAL X7R 10%

Table 7-3.
Parts List, Receiver (Continued).

DESIGNATOR	PART #	DESCRIPTION
C66	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C67	275270	CAP, 27 PF NPO MONOLITHIC
C68	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C69	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C70	275270	CAP, 27 PF NPO MONOLITHIC
C71	277104	CAP, ML 0.1UF AXIAL X7R 10%50V
C72	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C73	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C74	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C75	277104	CAP, ML 0.1UF AXIAL X7R 10%50V
C76	275560	CAP, ML 56PF NPO 100V 5%
C77	275560	CAP, ML 56PF NPO 100V 5%
C78	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C79	275470	CAP, ML 47PF NPO 5% 100V 0.1SP
C80A	210120	CAP, 12 PF DISC NPO
C80B	261500	CAP, 50PF 5MM TRIMMER GRN
C81	277104	CAP, ML 0.1UF AXIAL X7R 10%50V
C82	275272	CAP, ML 2700PF NPO 5% 100V .2S
C83	275151	CAP, ML 15OPF NPO 100V 5% 0.1S
C84	277104	CAP, ML 0.1UF AXIAL X7R 10%50V
C85	277104	CAP, ML 0.1UF AXIAL X7R 10%50V
C86	277104	CAP, ML 0.1UF AXIAL X7R 10%50V
C87	277104	CAP, ML 0.1UF AXIAL X7R 10%50V
C88	275272	CAP, ML 2700PF NPO 5% 100V .2S
C89	232221	CAP, 220 UF 16V VERT ELECTRO
C90	275272	CAP, ML 2700PF NPO 5% 100V .2S
C91	256104	CAP, 0.1UF 2% POLY 50V AXIAL
C92	256104	CAP, 0.1UF 2% POLY 50V AXIAL
C93	241020	CAP, 2.2MF DIP TANTALUM
C94	241020	CAP, 2.2MF DIP TANTALUM
C95	241020	CAP, 2.2MF DIP TANTALUM

Table 7-3.
Parts List, Receiver (Continued).

DESIGNATOR	PART #	DESCRIPTION
C96	241020	CAP, 2.2MF DIP TANTALUM
C97	232221	CAP, 220 UF 16V VERT ELECTRO
C98	232221	CAP, 220 UF 16V VERT ELECTRO
C99	277104	CAP, ML 0.1UF AXIAL X7R 10%50V
C100	242047	CAP, 4.7 UF 35V 10% TANT
C101	241476	CAP, 47MF 16V DIP TANT
C102	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C103	277102	CAP, ML 1000PF X7R AXIAL 10%
C104	277102	CAP, ML 1000PF X7R AXIAL 10%
C105	277104	CAP, ML 0.1UF AXIAL X7R 10%50V
C106	241100	CAP, 10MF DIP TANTALUM
C107	277104	CAP, ML 0.1UF AXIAL X7R 10%50V
C108	242047	CAP, 4.7 UF 35V 10% TANT
C111	241100	CAP, 10MF DIP TANTALUM
C112	277104	CAP, ML 0.1UF AXIAL X7R 10%50V
C113	241100	CAP, 10MF DIP TANTALUM
C115	277104	CAP, ML 0.1UF AXIAL X7R 10%50V
C200	275101	CAP, ML NPO 100PF 100V 5% 0.2S
C201	275101	CAP, ML NPO 100PF 100V 5% 0.2S
CR1	320290	DIODE, MA47120 35V PIN
CR10	320305B	VARACTOR MV209, ALL 1077
CR11	320305B	VARACTOR MV209, ALL 1077
CR12	320305B	VARACTOR MV209, ALL 1077
CR13	320305B	VARACTOR MV209, ALL 1077
CR14	320305B	VARACTOR MV209, ALL 1077
CR15	320305B	VARACTOR MV209, ALL 1077
CR16	320305B	VARACTOR MV209, ALL 1077
CR17	320305B	VARACTOR MV209, ALL 1077
CR18	320290	DIODE, MA47120 35V PIN
CR19	320290	DIODE, MA47120 35V PIN

Table 7-3.
Parts List, Receiver (Continued).

DESIGNATOR	PART #	DESCRIPTION
CR2	20305B	VARACTOR MV209, ALL 1077
CR20	320290	DIODE, MA47120 35V PIN
CR21	320290	DIODE, MA47120 35V PIN
CR22	320305B	VARACTOR MV209, ALL 1077
CR23	320305B	VARACTOR MV209, ALL 1077
CR24	320305B	VARACTOR MV209, ALL 1077
CR25	320305B	VARACTOR MV209, ALL 1077
CR26	320305B	VARACTOR MV209, ALL 1077
CR27	320305B	VARACTOR MV209, ALL 1077
CR28	320305B	VARACTOR MV209, ALL 1077
CR29	320305B	VARACTOR MV209, ALL 1077
CR3	320305B	VARACTOR MV209, ALL 1077
CR4	320305B	VARACTOR MV209, ALL 1077
CR5	320305B	VARACTOR MV209, ALL 1077
CR6	320305B	VARACTOR MV209, ALL 1077
CR7	320305B	VARACTOR MV209, ALL 1077
CR8	320305B	VARACTOR MV209, ALL 1077
CR9	320305B	VARACTOR MV209, ALL 1077
CR30	320305B	VARACTOR MV209, ALL 1077
CR31	320305B	VARACTOR MV209, ALL 1077
CR32	320305B	VARACTOR MV209, ALL 1077
CR33	320305B	VARACTOR MV209, ALL 1077
CR34	320305B	VARACTOR MV209, ALL 1077
CR35	320305B	VARACTOR MV209, ALL 1077
CR36	320305B	VARACTOR MV209, ALL 1077
CR37	320305B	VARACTOR MV209, ALL 1077
CR38	320290	DIODE, MA47120 35V PIN
CR39	320290	DIODE, MA47120 35V PIN
CR40	320290	DIODE, MA47120 35V PIN
CR41	320002	DIODE, SI 100MA 1N4148/1N4150
CR42	320002	DIODE, SI 100MA 1N4148/1N4150

Table 7-3.
Parts List, Receiver (Continued).

DESIGNATOR	PART #	DESCRIPTION
CR43	320002	DIODE, SI 100MA 1N4148/1N4150
CR44	320002	DIODE, SI 100MA 1N4148/1N4150
CR45	320002	DIODE, SI 100MA 1N4148/1N4150
CR46	320002	DIODE, SI 100MA 1N4148/1N4150
CR48	320101	DIODE, RECT. SI 1A 600V
FL	1370030	XTAL FILTER, 13.5 MHZ PRC1088
J1	613175	CONN, 34P RT ANGLE LOW PROFILE
J2	614055	CONN, RF VERTICAL
J3	614055	CONN, RF VERTICAL
J4	614055	CONN, RF VERTICAL
J5	614055	CONN, RF VERTICAL
JU1A	761022	WIRE BUSS 22 AWG TC
JU1B	761022	WIRE BUSS 22 AWG TC
JU1C	761022	WIRE BUSS 22 AWG TC
JU1D	761022	WIRE BUSS 22 AWG TC
L1	430212	INDUCTOR, 2.7 UH 10% Q35 MOLD
L2	430216	INDUCTOR, 0.39UH 10% Q30 MOLD
L3	490142	IND, VAR 0.12-0.15UH GREEN 7MM
L4	490140	IND, VAR 0.1-0.12UH YELLOW 7MM
L5	761020	WIRE BUSS 20 AWG TC
L6	430212	INDUCTOR, 2.7 UH 10% Q35 MOLD
L7	490140	IND, VAR 0.1-0.12UH YELLOW 7MM
L8	490142	IND, VAR 0.12-0.15UH GREEN 7MM
L9	761020	WIRE BUSS 20 AWG TC
L20	490144	IND, VAR 0.22-0.25UH BLUE 10MM
L21	490143	IND, VAR 0.25-0.29UH PINK 10MM
L22	761020	WIRE BUSS 20 AWG TC

Table 7-3.
Parts List, Receiver (Continued).

DESIGNATOR	PART #	DESCRIPTION
L23	430217	INDUCTOR, 1.2 UH 10% Q25
L24	430028	INDUCTOR, 4.7 UH 10% FIXED
L25	430212	INDUCTOR, 2.7 UH 10% Q35 MOLD
L26	430212	INDUCTOR, 2.7 UH 10% Q35 MOLD
L27	430212	INDUCTOR, 2.7 UH 10% Q35 MOLD
L28	490139	IND, VAR 4.5UH-13.5 MHZ IVORY
L29	490139	IND, VAR 4.5UH-13.5 MHZ IVORY
L30	490139	IND, VAR 4.5UH-13.5 MHZ IVORY
L31	490145	INDUCTOR, VAR 45.O UH-462.5KHZ
L32	430052	INDUCTOR, 470 UH 10% MOLDED
L33	490145	INDUCTOR, VAR 45.O UH-462.5KHZ
L34	490150	INDUCTOR, 1 MH 10% FIXED AXIAL
L35	430040	INDUCTOR 100 UH AXIAL LEAD
L36	430040	INDUCTOR 100 UH AXIAL LEAD
L39	430212	INDUCTOR, 2.7 UH 10% Q35 MOLD
MX1	380020	MIXER, SBL-1 (OR EQUIV)
Q1	310126	XISTOR, MFET, DG, MFE211, TO18
Q2	310126	XISTOR, MFET, DG, MFE211, TO18
Q3	310059	XISTOR, NPN, 2N5109, TO39
Q4	310146	XISTOR, JFET, NCH, U310, DEPL
Q5	310126	XISTOR, MFET, DG, MFE211, TO18
Q9	310052	XISTOR, PNP, PN2907A, TO92
Q10	310057	XISTOR, NPN, PN2222A, TO92
Q11	310052	XISTOR, PNP, PN2907A, TO92
Q12	310057	XISTOR, NPN, PN2222A, TO92
Q13	310052	XISTOR, PNP, PN2907A, TO92
Q14	310057	XISTOR, NPN, PN2222A, TO92
Q15	310052	XISTOR, PNP, PN2907A, TO92
Q16	310057	XISTOR, NPN, PN2222A, TO92

Table 7-3.
Parts List, Receiver (Continued).

DESIGNATOR	PART #	DESCRIPTION
R1	124101	RES, 100 OHM 1/4W 5% CF
R2	124472	RES, 4.7K 1/4W 5% CARBON FILM
R3	124472	RES, 4.7K 1/4W 5% CARBON FILM
R4	124472	RES, 4.7K 1/4W 5% CARBON FILM
R5	124392	RES, 3.9K 1/4W 5% CARBON FILM
R6	124103	RES, 10K 1/4W 5% CARBON FILM
R7	124101	RES, 100 OHM 1/4W 5% CF
R	812456	0RES, 56 OHM 1/4W 5%
R9	124221	RES, 220 OHM 1/4W 5% CF
R11	124472	RES, 4.7K 1/4W 5% CARBON FILM
R134	124223	RES, 22K 1/4W 5% CARBON FILM
R12	124472	RES, 4.7K 1/4W 5% CARBON FILM
R13	124472	RES, 4.7K 1/4W 5% CARBON FILM
R14	124101	RES, 100 OHM 1/4W 5% CF
R15	124271	RES, 270 OHM 1/4W 5% CF
R16	124180	RES, 18 OHM 1/4W 5% CARBON FILM
R17	124271	RES, 270 OHM 1/4W 5% CF
R18	124221	RES, 220 OHM 1/4W 5% CF
R19	124101	RES, 100 OHM 1/4W 5% CF
R20	124682	RES, 6.8K 1/4W 5% CARBON FILM
R21	124103	RES, 10K 1/4W 5% CARBON FILM
R22	124101	RES, 100 OHM 1/4W 5% CF
R23	124472	RES, 4.7K 1/4W 5% CARBON FILM
R24	124472	RES, 4.7K 1/4W 5% CARBON FILM
R25	124472	RES, 4.7K 1/4W 5% CARBON FILM
R26	124392	RES, 3.9K 1/4W 5% CARBON FILM
R27	124103	RES, 10K 1/4W 5% CARBON FILM
R28	124101	RES, 100 OHM 1/4W 5% CF
R29	124560	RES, 56 OHM 1/4W 5%
R30	124271	RES, 270 OHM 1/4W 5% CF
R31	124392	RES, 3.9K 1/4W 5% CARBON FILM

Table 7-3.
Parts List, Receiver (Continued).

DESIGNATOR	PART #	DESCRIPTION
R32	124472	RES, 4.7K 1/4W 5% CARBON FILM
R33	124472	RES, 4.7K 1/4W 5% CARBON FILM
R34	124472	RES, 4.7K 1/4W 5% CARBON FILM
R35	124101	RES, 100 OHM 1/4W 5% CF
R36	124103	RES, 10K 1/4W 5% CARBON FILM
R37	124682	RES, 6.8K 1/4W 5% CARBON FILM
R38	124101	RES, 100 OHM 1/4W 5% CF
R39	124100	RES, 10 OHM 1/4W 5% CARBON FILM
R40	124681	RES, 680 OHM 1/4W 5% CF
R41	124681	RES, 680 OHM 1/4W 5% CF
R42	124100	RES, 10 OHM 1/4W 5% CARBON FILM
R43	124100	RES, 10 OHM 1/4W 5% CARBON FILM
R44	124221	RES, 220 OHM 1/4W 5% CF
R45	124680	RES, 68 OHM 1/4W 5% CARBON FILM
R46	124271	RES, 270 OHM 1/4W 5% CF
R47	124180	RES, 18 OHM 1/4W 5% CARBON FILM
R48	124271	RES, 270 OHM 1/4W 5% CF
R49	124151	RES, 150 OHM 1/4W 5% CF
R50	124101	RES, 100 OHM 1/4W 5% CF
R51	124472	RES, 4.7K 1/4W 5% CARBON FILM
R52	124272	RES, 2.7K 1/4W 5% CARBON FILM
R53	124223	RES, 22K 1/4W 5% CARBON FILM
R54	124101	RES, 100 OHM 1/4W 5% CF
R55	124560	RES, 56 OHM 1/4W 5%
R57	124271	RES, 270 OHM 1/4W 5% CF
R58	124102	RES, 1K 1/4W 5% CARBON FILM
R59	124561	RES, 560 OHM 1/4W 5% CF
R60	124222	RES, 2.2K 1/4W 5% CARBON FILM
R61	124101	RES, 100 OHM 1/4W 5% CF
R62	124224	RES, 220K 1/4W 5% CARBON FILM
R63	124103	RES, 10K 1/4W 5% CARBON FILM

Table 7-3.
Parts List, Receiver (Continued).

DESIGNATOR	PART #	DESCRIPTION
R64	124561	RES, 560 OHM 1/4W 5% CF
R65	124203	RES, 20K 1/4W 5% CARBON FILM
R66	124560	RES, 56 OHM 1/4W 5%
R67	124243	RES, 24K 1/4W 5% CARBON FILM
R68	124432	RES, 4.3K 1/4W 5%
R69	124103	RES, 10K 1/4W 5% CARBON FILM
R70	124472	RES, 4.7K 1/4W 5% CARBON FILM
R71	124472	RES, 4.7K 1/4W 5% CARBON FILM
R72	124272	RES, 2.7K 1/4W 5% CARBON FILM
R73	170310	RES, 50K VERT POT-SIDE ADJUST
R74	124153	RES, 15K 1/4W 5% CARBON FILM
R75	124563	RES, 56K 1/4W 5% CARBON FILM
R76	124153	RES, 15K 1/4W 5% CARBON FILM
R77	124203	RES, 20K 1/4W 5% CARBON FILM
R78	124682	RES, 6.8K 1/4W 5% CARBON FILM
R79	124432	RES, 4.3K 1/4W 5%
R80	170310	RES, 50K VERT POT-SIDE ADJUST
R81	124393	RES, 39K 1/4W 5% CARBON FILM
R82	124103	RES, 10K 1/4W 5% CARBON FILM
R83	1112002	RES, 20K 1/8W 1%
R84A	1118452	RES, 84.5K 1% 0.125W FILM
R84B	1114643	RES, 464K 1% 0.125W FILM
R85	124223	RES, 22K 1/4W 5% CARBON FILM
R86	124470	RES, 47 OHM 1/4W 5% CARBON FILM
R92	124103	RES, 10K 1/4W 5% CARBON FILM
R93	124562	RES, 5.6K 1/4W 5% CARBON FILM
R94	124103	RES, 10K 1/4W 5% CARBON FILM
R102	124102	RES, 1K 1/4W 5% CARBON FILM
R103	124103	RES, 10K 1/4W 5% CARBON FILM
R104	124103	RES, 10K 1/4W 5% CARBON FILM
R105	124100	RES, 10 OHM 1/4W 5% CARBON FILM

Table 7-3.
Parts List, Receiver (Continued).

DESIGNATOR	PART #	DESCRIPTION
R106	124102	RES, 1K 1/4W 5% CARBON FILM
R107	124103	RES, 10K 1/4W 5% CARBON FILM
R108	124103	RES, 10K 1/4W 5% CARBON FILM
R109	124100	RES, 10 OHM 1/4W 5% CARBON FILM
R110	1111301	RES, 1300 OHMS 1/8W 1% FILM
R111	1116041	RES, 6.04K 1/8W 1%
R112	124102	RES, 1K 1/4W 5% CARBON FILM
R113	124472	RES, 4.7K 1/4W 5% CARBON FILM
R114	124103	RES, 10K 1/4W 5% CARBON FILM
R115	124100	RES, 10 OHM 1/4W 5% CARBON FILM
R116	124102	RES, 1K 1/4W 5% CARBON FILM
R117	124472	RES, 4.7K 1/4W 5% CARBON FILM
R118	124103	RES, 10K 1/4W 5% CARBON FILM
R119	124100	RES, 10 OHM 1/4W 5% CARBON FILM
R120	124103	RES, 10K 1/4W 5% CARBON FILM
R121	124103	RES, 10K 1/4W 5% CARBON FILM
R122	124103	RES, 10K 1/4W 5% CARBON FILM
R123	124103	RES, 10K 1/4W 5% CARBON FILM
R124	124133	RES, 13K 1/4W 5%
R125	170311	RES, 5K VERT POT-SIDE ADJUST
R126	124431	RES, 430 OHM 1/4W 5%
R127	124243	RES, 24K 1/4W 5% CARBON FILM
R128	124362	RES, 3.6K 1/4W 5% CARBON FILM
R129	124100	RES, 10 OHM 1/4W 5% CARBON FILM
R131	124103	RES, 10K 1/4W 5% CARBON FILM
R132	124472	RES, 4.7K 1/4W 5% CARBON FILM
R133	124103	RES, 10K 1/4W 5% CARBON FILM
R220	113473	RES, 47K 1/8W 5% CARBON FILM
R221	113473	RES, 47K 1/8W 5% CARBON FILM
R222	113473	RES, 47K 1/8W 5% CARBON FILM
R223	113473	RES, 47K 1/8W 5% CARBON FILM

Table 7-3.
Parts List, Receiver (Continued).

R224	113101	RES, 100 OHM 1/8W 5% CF
RT1	351103	THERMISTOR, 10K 0.5W 10%
RT2	351103	THERMISTOR, 10K 0.5W 10%
RT3	350103	TERMISTOR, 10K 0.5W 10%
RT4	350104	THERMISTOR, 100K 1W 10%
RT5	350101	THERMIST, 100 OHM 0.5W NTC 10%
RT6	351102	THERMISTOR, 1K 0.5W 10%
RT7	351103	THERMISTOR, 10K 0.5W 10%
RT8	351102	THERMISTOR, 1K 0.5W 10%
RT9	351102	THERMISTOR, 1K 0.5W 10%
U1	330445	IC, MC3359P FM IF RECEIVER IC
U2	330030	IC, LIN, LM324N, DIP14, OP-AMP
U5	330475	IC, 74ACT841 10 BIT LATCH
U8	330446	IC, CD4528 DUAL MONOSTABLE
U9	330447	IC, AD584 V REF 2.5, 5, 10 VOLT
U10	182020	RES, R/2R 50K/100K LADDER
U11	330081	IC, LIN, LM358N, DIP8, OP-AMP
U13	330461	LM117H, OLTAGE REG.
U14	330054	IC, DIG, CD4001, DIP14, NOR
Y1	360070	CRYSTAL, 13.9625 MHZ PRC1088

CHAPTER 8
SYNTHESIZER (ASSY 018-00200, PCB 739002)

8.1 DESCRIPTION

The Synthesizer is a 2-sided printed circuit card.

The Synthesizer Card contains a single-loop, indirect synthesizer that operates at a frequency 13.5 MHz above the radio set receive or transmit frequency.

8.2 PRINCIPLES OF OPERATION

8.2.1 GENERAL

In the receive mode, the Synthesizer provides a frequency of 43.5 to 101.475 MHz to the receive mixer to translate the incoming received signal to 13.5-MHz Intermediate Frequency (IF). In the transmit mode, the output of the 13.5-MHz Variable-Control Crystal Oscillator (VCXO) is mixed with the synthesizer frequency (fo - 13.5 MHz) to provide a low-level, on-channel transmit frequency. The VCXO is a "pullable" crystal oscillator that is used to provide the required frequency modulation.

8.2.2 FUNCTIONAL THEORY (REFER TO FIGURE 8-1)

The frequency standard temperature-compensated crystal oscillator U11, U12 (TCXO) provides a 3.2-MHz input into phase-lock loop U1. Also going into Ul are frequency lines (2^0 to 2^{11}) from the Control Card. U10 supplies a 150-Hz square wave. The 150-Hz signal is controlled by enable Q9. This enable is turned on by +12-V dc transmit from the Control Card. The output of U10 is a 0- to 5-V square wave which is filtered by a 4-pole, 200-Hz, low-pass filter (U9A, U9B). The output of the filter is a 150-Hz sine wave which is used for squelch operation.

One phase-lock loop output is a 25-kHz repetition rate pulse which goes to loss-of-lock fault monitor Ql. If U1 loses lock, these pulses get very wide and stay at ground for a long time, causing Q1 to turn on. The Q1 output becomes a logic 1, which indicates a fault.

The gain selectable integrator (U3, U4) has two inputs, band and gain, from the Control Card. The frequency range of band 1 is 65.500 to 101.475 MHz (radio operating frequency of 52.000 to 87.975 MHz). The frequency range of band 2 is 43.500 to 65.475 MHz (radio operating frequency of 30.000 to 51.975 MHz). The gain is selected to provide the proper loop gain for the frequency range selected. The phase-lock loop supplies very narrow phase R and phase V pulses to the integrator. The integrator converts the pulses to a dc voltage of 4 to 18 volts which contains some ripple. The dc voltage then passes through low-pass filter which removes the ripple and tunes the Voltage Controlled Oscillator (VCO). The H/L band control (CR4, Q4, Q5) selects the band in which the VCO will operate. Four volts in low band will put the VCO at 43.5 MHz. Four volts in high band will put the VCO at 65.5 MHz. The voltage will approach 18 volts when the VCO is tuned to the high end of the low band (65.475 MHz) and the high end of the high band (101.475 MHz).

The VCO is coupled through T2 to dual modulas prescaler U2. Phase-lock loop Ul tells the prescaler to divide by either 32 or 33. The divided signal then goes back to Ul. The VCO output is also coupled through T2 to power splitter T3. One output of the power splitter is a +10-dBm, 43.500- to 101.475-MHz receive injection signal which will be supplied to the receiver. The other output from the power splitter goes to mixer Z1.

Audio comes in at MOD IN to the 13.5-MHz Variable-Control Crystal Oscillator (VCXO) and the output of the VCXO becomes the other input into the mixer. The VCXO is turned off during receive mode since it oscillates on the receiver first IF frequency and, if left on, would cause unwanted receiver noise. The mixer output goes to buffer amplifier Q6 and the output of Q6 is a -9 dBm, 30.000- to 87.975-MHz transmit audio signal.

8.3 TEST EQUIPMENT

Test equipment required to test, troubleshoot, repair, and align the Synthesizer Card are listed in Table 8-1. Equivalent substitute test equipment may be used.

8.4 TESTING/TROUBLESHOOTING PROCEDURES

The testing procedures in Table 8-2 check the total performance of the Synthesizer Card. These test procedures permit isolation of a fault to a specific component or circuit when the results are used with the schematic to circuit trace the fault. Refer to Figure 8-3 for the test setup diagram.

The Synthesizer Card is tested by substitution in a stack of prime equipment subassemblies.

8.5 ALIGNMENT/ADJUSTMENT (Refer To Figure 8-3)

NOTE

The Receiver-Transmitter Cards must be mounted on the test set alignment and adjustment.

8.5.1 TEMPERATURE-COMPENSATED CRYSTAL OSCILLATOR (TCXO) ALIGNMENT

This oscillator has been factory aligned. Do not reset output frequency unless the output error is greater than ± 5 ppm.

8.5.2 VOLTAGE-CONTROLLED OSCILLATOR (VCO) ALIGNMENT

a. Connect a digital voltmeter to TP2.
b. Set test set frequency to 87.975 MHz.
c. Adjust C35 for maximum dc voltage.
d. Adjust slug in L2 (yellow) for a voltage of 13.5 V dc.
e. Set test set frequency to 51.975 MHz.
f. Adjust L3 (blue) for a voltage of 14.0 V dc.
g. Set test set frequency to 52.000 MHz.
h. Adjust C35 for a voltage of 4.45 ± 0.05 V dc.

NOTE

Do not adjust C35 if voltage is between 3.70 and 4.45 V dc.

i. Connect a spectrum analyzer to receive output P3 (wht).
j. Set spectrum analyzer controls as follows:

Control	Setting
BANDWIDTH	3 kHz
SCAN WIDTH PER DIVISION	10 kHz/DIV
INPUT ATTEN	20dB
BASE-LINE CLIPPER	As desired
SCAN TIME/DIV	5 seconds
LOG REF LEVEL	+10 dBm
LINEAR SENSITIVITY	As desired
VIDEO FILTER	10 Hz
SCAN MODE	MANUAL
SCAN TRIGGER	AUTO
2 dB LOG/10 dB LOG/LINEAR	10 dB LOG
STORAGE	STD

k. Set test set frequency to 66.500 MHz.
l. Find the 80. 000-MHz receive frequency and adjust the MANUAL SCAN to find the peak 25 kHz away from the fundamental.
m. Adjust R7 for the minimum peak amplitude of the 25-kHz sideband.

8.5.3 MODULATION ALIGNMENT

a. Set test set frequency to 87.975 MHz.
b. Connect a digital voltmeter to TP4.
c. Set test set PTT KEY switch to ON and adjust R58 for 8.00 V dc.
d. Set test set PTT KEY switch to OFF.
e. Connect an RF power meter to Receiver Card J3 (transmit output).
f. Set test set PTT KEY switch to ON and adjust C56 for peak output.
g. Set test set PTT KEY switch to OFF.
h. Connect a frequency counter to Receiver Card J3 (transmit output).
i. Set test set PTT KEY switch to ON and adjust R58 for a frequency of 87.975 MHz ± 20 Hz.
j. Check the voltage at TP4. The voltage should be 8.00 ± 0.5 V dc.

NOTE

Additional frequency adjustment can be made with C56 while maintaining the peak power adjustment.

k. Set test set PTT KEY switch to OFF.
l. Connect a function generator to pin 1 of the test adapter (modulation in) and set to 1 kHz, 1.414 V rms.
m. Set test set frequency to 87.975 MHz.
n. Connect a modulation meter with 3-kHz low-pass filter selected to Receiver Card J3 (transmit output).
o. Set test set PTT KEY switch to ON and adjust R57 for 7-kHz deviation ± 50 Hz.
p. Set test set PTT KEY switch to OFF.

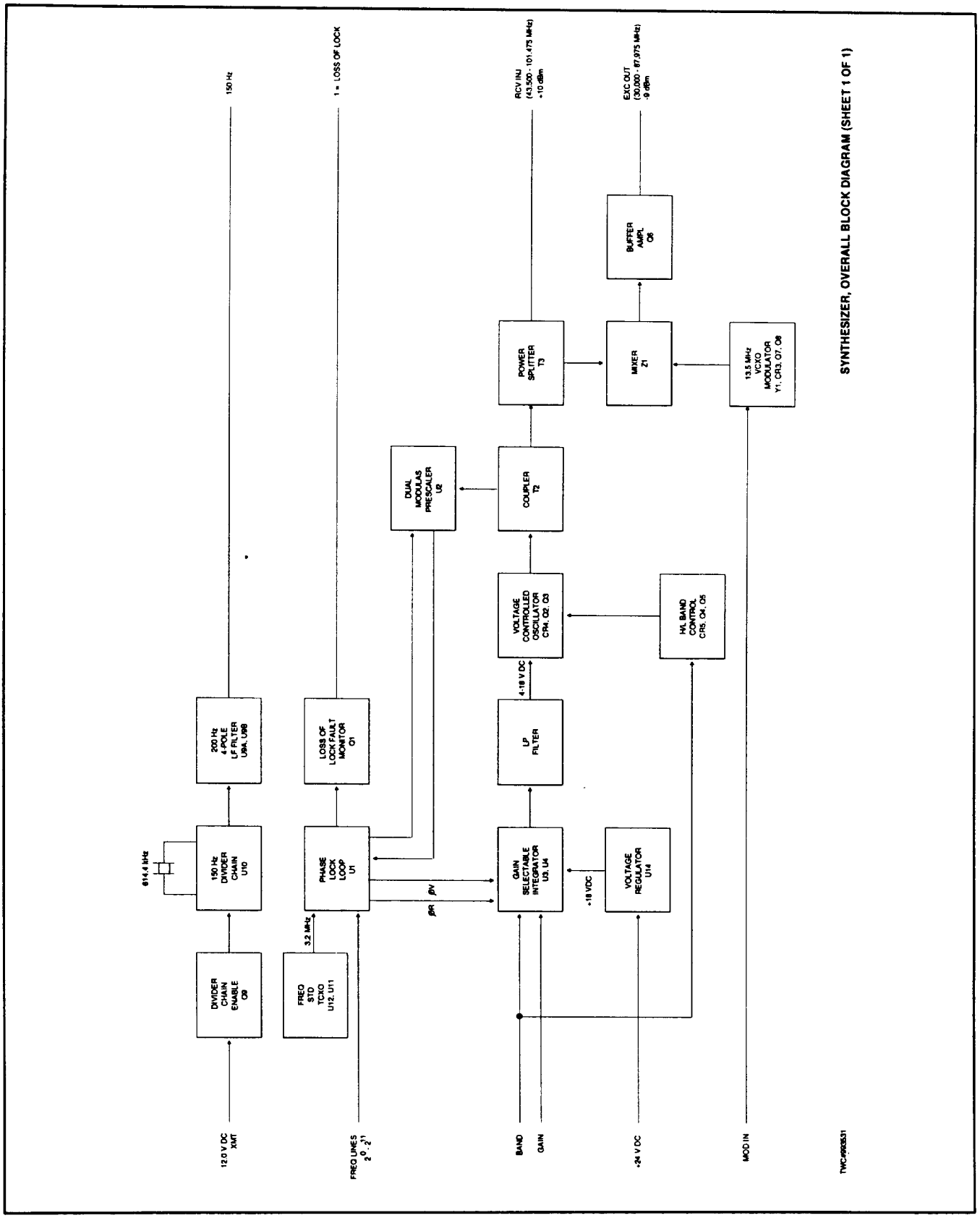
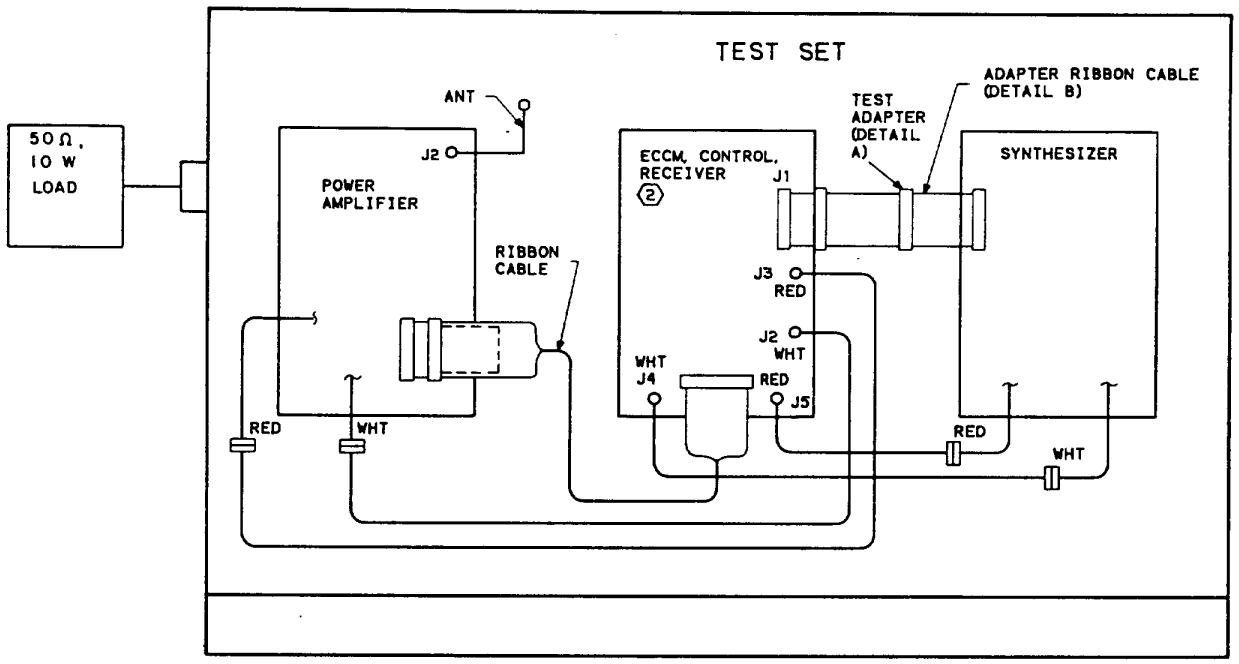


FIGURE 8-1.
Synthesizer, Overall Block Diagram.

q. Change modulation meter filter to 50 kHz and connect audio output of modulation meter to a distortion analyzer.
r. Set test set PTT KEY switch to ON.
s. Set distortion analyzer to a 0-dB reference and tune function generator to 15 Hz and 10 kHz. Verify the deviation is 0 ±1. 2 dB.
t. Set test set PTT KEY switch to OFF.

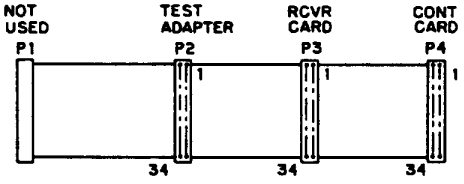
TABLE 8-1.
Test Equipment.

ITEM	MINIMUM SPECIFICATIONS	REPRESENTATIVE TYPE
RF power meter	-11 to +12 dBm	Hewlett-Packard 435/8482
RF attenuator	10 dB	
Frequency counter	0 to 125 MHz	Fluke 7260A
Oscilloscope	BW 100 MHz, dual trace	Tektronix 2213
Digital multimeter	0 to 30 Vdc, 0 to 30 Vac	Fluke 8050A
Spectrum analyzer	20 Hz to 102 MHz	Hewlett-Packard 141T/8552B/8554B
Modulation meter	Deviation 6 to 8 kHz	Boonton 8210
Load	50 Ω, 10 W	Bird 8052
Distortion analyzer	10- to 100-kHz response	Hewlett-Packard 334A
Function generator	15 Hz to 10 kHz, 4 V p-p	Krohn-Hite 5400B
Test set		966X-2 Radio Set Test Set, part number 622-6800-001

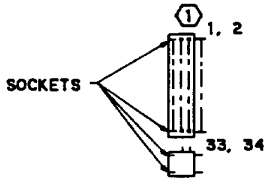


NOTES:

1. THE TEST ADAPTER PROVIDES TEST POINTS ON THE RIBBON CABLE.
2. THE ECCM CARD IS ON THE TOP, CONTROL CARD IN THE MIDDLE, AND RECEIVER CARD ON THE BOTTOM. THE LONG RIBBON CABLE FROM THE POWER AMPLIFIER CONNECTS TO THE CONTROL CARD. ALL COAX EXTENDER CABLES CONNECT TO THE RECEIVER CARD. THE ADAPTER RIBBON CABLE (DETAIL A) IS CONNECTED FROM CONTROL CARD J1 TO THE RECEIVER CARD AND THROUGH A TEST ADAPTER (DETAIL B) TO THE RIBBON CABLE FROM THE SYNTHESIZER CARD.



DETAIL B



DETAIL A

FIGURE 8-2.
Test Setup Diagram.

TABLE 8-2.
Synthesizer, Testing and Troubleshooting Procedures.

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. Test setup	a. Remove the Synthesizer Card from the receiver-transmitter. b. Install the Synthesizer Card on the right side of the test set as shown in Figure 8-2. c. Remove the Synthesizer Card from the test set stack. d. Connect the receiver-transmitter Synthesizer Card and test set ECCM, Control, Receiver, and Power Amplifier Cards as shown in Figure 8-2. e. Terminate the test set output into a 10-watt, 50-ohm load. f. Set test set controls as follows: Control — Setting PRIMARY PWR — ON UUT PWR — ON NB AUDIO LOAD — OFF(down) WB AUDIO LOAD — OFF(down) REMOTE DATA — NORMAL PTT KEY — OFF NORMAL AUDIO INHIBIT — VOICE OFF-TEST-ON-LITE — ON Display PWR — LO Display MODE — NO HOP Display CHAN/DAY — 1 Display SQL — OFF Display FREQ/NET/TIME — As required VOL — Full CW **NOTE** Unless otherwise indicated, all measurements to ground use the GND jack on the test set as ground. All oscilloscope measurements are made with a x 10 probe.		

TABLE 8-2.
Synthesizer, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
2. Frequency selection and lock indicator	a. Perform test 1. **NOTE** Both receive and transmit output should be terminated into 50 ohms at all times. Transmit output is measured at J3 of the Receiver Card and receive output is measured at P3 (wht) of the Synthesizer Card.		
	b. Connect a frequency counter to the receive and transmit outputs alternately and connect an oscilloscope to test adapter pin 2. Set PTT KEY switch to ON when measuring transmit frequency and to OFF when measuring receive frequency.	Voltage at test adapter pin 2 goes from logic 0 to logic 1 each time the test set frequency is changed.	

TABLE 8-2.
Synthesizer, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	Test Set Frequency (MHz) 30.000 46.500 51.975 52.000 66.500 87.975	Transmit 30.000 MHz Receive 43.500 MHz Transmit 46.500 MHz Receive 60.000 MHz Transmit 51.975 MHz Receive 65.475 MHz Transmit 52.000MHz Receive 65.500 MHz Transmit 66.500 MHz Receive 80.000 MHz Transmit 87.975 MHz Receive 101.475 MHz	For loss of lock, check Q1 and associated circuits. For frequency inaccuracy, use data on schematic for fault isolation.
	c. Set test set UUT PWR to OFF.		
3. Frequency accuracy	a. Perform test 1. **NOTE** Both receive and transmit output should be terminated into 50 ohms at all times. Transmit output is measured at J3 of the Receiver Card and receive output is measured at P3 (wht) of the Synthesizer Card.		

TABLE 8-2.
Synthesizer, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	b. Connect a frequency counter to the receive and transmit outputs as required. Set PTT KEY switch to ON when measuring transmit frequency and OFF when measuring receive frequency.		
	Test Set Frequency(MIIz) — Connect to		
	30.000 — Receive output	43.500 MIIz ±20 Hz	Use test data on schematic for fault isolation.
	52.000 — Transmit output	52.000 MIIz ±25 IIz	
	87.975 — Transmit output	87.975 MIIz ±30 IIz	
	c. Set test set UUT PWR to OFF.		
4. Output RF level	a. Perform test 1.		
	NOTE Transmit output is measured at J3 of the Receiver Card and receive output is measured at P3 (wht) of the Synthesizer Card.		
	b. Connect an RF power meter with a 50-ohm load to the receive and transmit outputs as required. Set PTT KEY switch to ON when measuring transmit output and to OFF when measuring receive output.		
	Test Set Frequency (MIIz)		
	30.000 36.500 51.975	Receive RF output level +8 to +13 dBm	For receive, check Q2, Q3.
	52.000 66.500 87.975	Transmit RF output level + 9.5 to + 13.5 dBm	For transmit, check Q6.
5. Second harmonic level	a. Perform test 1.		
	b. Connect a spectrum analyzer to J3 of the Receiver Card (receive output) through a 10-dB attenuator.		

TABLE 8-2.
Synthesizer, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
	c. Observe the synthesizer fundamental frequency and second harmonics of the fundamental for each frequency listed below. Measure the second harmonic dB level down from the fundamental frequency. Waveforms were taken at 30.000 and 87.975 MHz. Test Set Frequency (MHz) 30.000 36.500 51.975 52.000 66.500 87.975	NLT -10 dB at all frequencies.	Use test data on schematic for fault isolation.
	d. Set test set UUT PWR switch to OFF.		
6. Spurious response	a. Perform test 1.		
	b. Connect a spectrum analyzer to J3 of the Receiver Card (receive output) through a 10-dB attenuator.		
	c. Set test set frequency as shown below and verify receiver output frequencies. Measure spurious in dB below the fundamental at and beyond +/-25 kHz. Test Set frequency (MHz) — Output Frequency (MHz) 51.975 — 65.475 66.500 — 80.000 87.975 — 101.475	NLT -40 dB at all frequencies.	Use test data on schematic for fault isolation.
	d. Measure the noise shelf below the fundamental at the above frequencies.	NLT -40 dB at all frequencies.	Use data on schematic for fault isolation.
	e. Set the test set UUT PWR switch to OFF.		

TABLE 8-2.
Synthesizer, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
7. Deviation response	a. Perform test 1.		
	b. Connect a function generator to pin 1 of the test adapter (Synthesizer Card modulation in).		
	c. Set function generator for a 1-kHz sine wave at 1.414 V rms.		
	d. Set test set frequency to 87.975 MHz.		
	e. Connect a modulation meter to the transmit output at Receiver Card J3.		
	f. Set modulation meter filter to LP1 and PEAK to AVG.		
	g. On test set, set PTT KEY switch to ON and measure deviation.	6.950 to 7.050 kHz	Check Q7, Q8. Perform adjustment procedure in paragraph 5.3.
	h. Set test set PTT KEY switch to OFF.		
	i. Connect audio output of the modulation meter to a dB meter.		
	j. Set dB meter to a 0-dB reference and tune function generator to 15 Hz.		
	k. Set test set PTT KEY switch to ON and read dB meter.	+/-1.2 dB	Check modulator circuits.
	l. Set test set PTT KEY switch to OFF.		
	m. Tune function generator to 10 kHz.		
	n. Set test set PTT KEY switch to ON and read dB meter.	+/-1.2 dB	Check modulator circuits.
	o. Set test set PTT KEY switch to OFF.		

TABLE 8-2.
Synthesizer, Testing and Troubleshooting Procedures (Continued).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
8. 150-Hz output	a. Perform test 1. b. Connect a frequency counter to pin 27 of the test adapter. c. Set test set PTT KEY switch to ON and measure output frequency. d . Set test set PTT KEY switch to OFF. e. Disconnect frequency counter and connect a DVM to pin 27 of the test adapter. f. Measure output level. 0 volt (150 Hz off) Check U9. g. Set test set PTT KEY switch to ON and measure 1.98 to 2.22 V rms Check U9. output level.	148.5 to 151.5 Hz	If no output, check Q9, Q1O, U9. If frequency is out of limits, check U10, U11, U 12.

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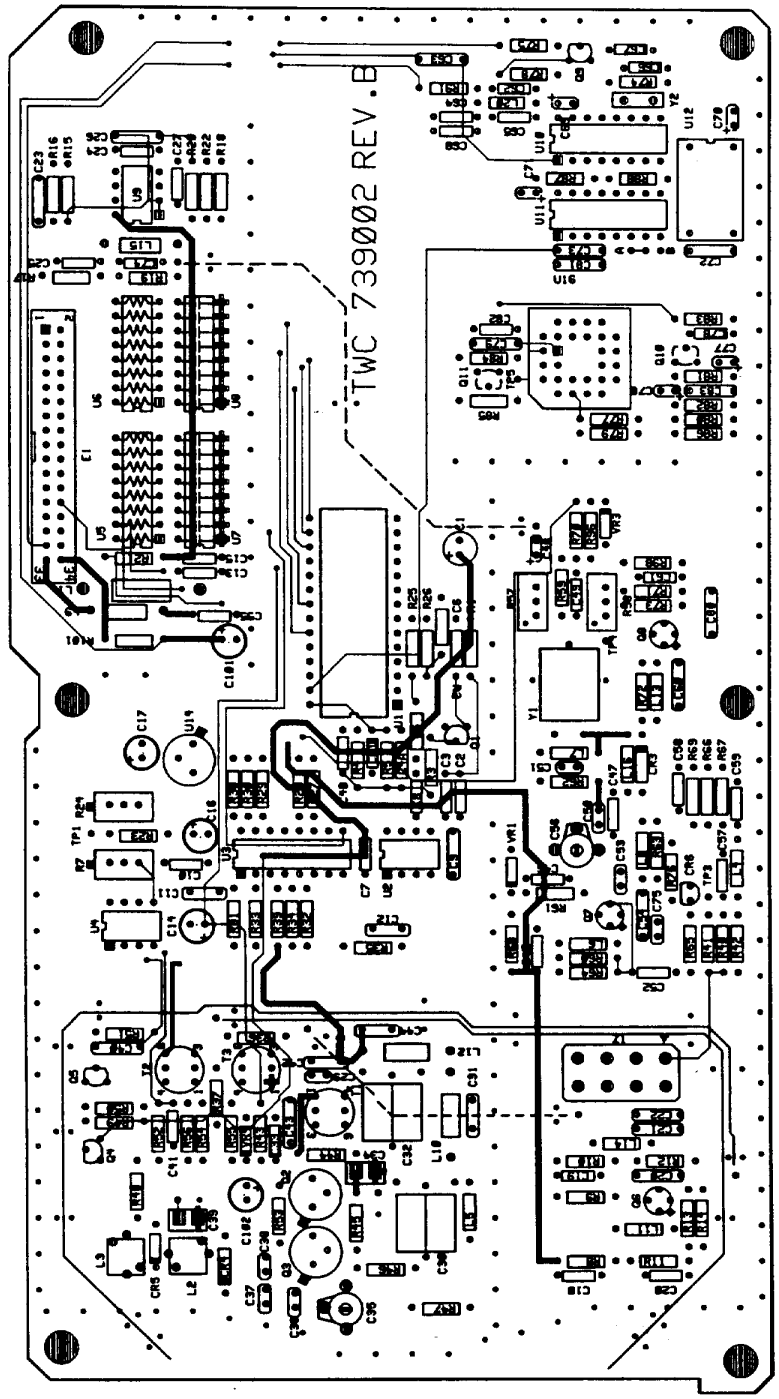
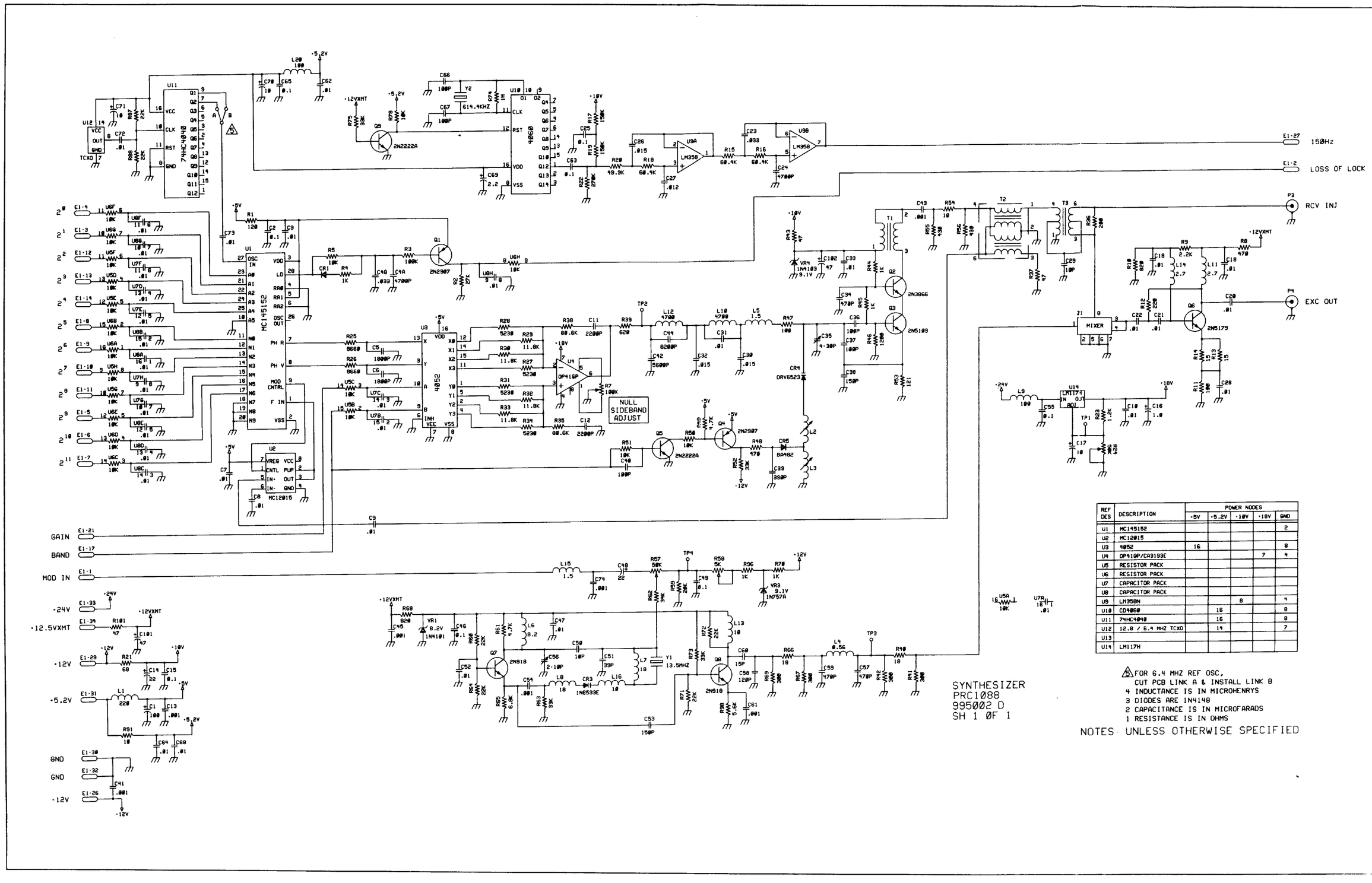


FIGURE 8-3.
Component Locations, Synthesizer.



REF DES	DESCRIPTION	POWER NODES				
		+5V	+5.2V	+10V	+18V	GND
U1	MC145152					2
U2	MC12015					
U3	4052	16				8
U4	OP410P/CA3193E				7	4
U5	RESISTOR PACK					
U6	RESISTOR PACK					
U7	CAPACITOR PACK					
U8	CAPACITOR PACK					
U9	LM358N			8		4
U10	CD4060		16			8
U11	74HC4040		16			8
U12	12.8 / 6.4 MHZ TCXO		14			7
U13						
U14	LM117H					

5 FOR 6.4 MHZ REF OSC, CUT PCB LINK A & INSTALL LINK B
4 INDUCTANCE IS IN MICROHENRYS
3 DIODES ARE 1N4148
2 CAPACITANCE IS IN MICROFARADS
1 RESISTANCE IS IN OHMS

NOTES: UNLESS OTHERWISE SPECIFIED

FIGURE 8-4.
Schematic Diagram, Synthesizer.

TABLE 8-3.
Parts List, Synthesizer (Continued).

DESIGNATOR	PART #	DESCRIPTION
R13	124150	RES, 15 OHM 1/4W 5% CARBON FILM
R14	124150	RES, 15 OHM 1/4W 5% CARBON FILM
R15	1116042	RES, 60.4K 1/8W 1%
R16	1116042	RES, 60.4K 1/8W 1%
R17	124154	RES, 150K 1/4W 5% CARBON FILM
R18	1116042	RES, 60.4K 1/8W 1%
R19	124154	RES, 150K 1/4W 5% CARBON FILM
R20	1114992	RES, 49.9K 1/8W, 1% FILM
R21	124680	RES, 68 OHM 1/4W 5% CARBON FILM
R22	124274	RES, 270K 1/4W 5% CARBON FILM
R23	124122	RES, 1.2K 1/4W 5% CARBON FILM
R24	261614	RES, POT 50K VERT TOP ADJUST
R25	1118661	RES, 8.66K 1/8W, 1% FILM
R26	1118661	RES, 8.66K 1/8W, 1% FILM
R27	1115231	RES, 5.23K 1/8W, 1% FILM
R28	1115231	RES, 5.23K 1/8W, 1% FILM
R29	1111182	RES, 11.8K 1/8W, 1% FILM
R30	1111182	RES, 11.8K 1/8W, 1% FILM
R31	1115231	RES, 5.23K 1/8W, 1% FILM
R32	1111182	RES, 11.8K 1/8W, 1% FILM
R33	1111182	RES, 11.8K 1/8W, 1% FILM
R34	1115231	RES, 5.23K 1/8W, 1% FILM
R35	1118062	RES, 80.6K 1/8W, 1% FILM
R36	113201	RES, 200 OHM 1/8W, 5% CARB FILM
R37	113470	RES, 47 OHM 1/8W 5% CARBON FILM
R38	1118062	RES, 80.6K 1/8W, 1% FILM
R39	124621	RES, 620 OHM 1/4W 5% CF
R40	124180	RES, 18 OHM 1/4W 5% CARBON FILM
R41	124301	RES, 300 OHM 1/4W 5% CARB FILM
R42	124301	RES, 300 OHM 1/4W 5% CARB FILM
R43	113470	RES, 47 OHM 1/8W 5% CARBON FILM

TABLE 8-3.
Parts List, Synthesizer (Continued).

DESIGNATOR	PART #	DESCRIPTION
R44	124102	RES, 1K 1/4W 5% CARBON FILM
R45	124102	RES, 1K 1/4W 5% CARBON FILM
R46	113122	RES, 1.2K 1/8W 5% CARBON FILM
R47	113101	RES, 100 OHM 1/8W 5% CF
R48	113471	RES, 470 OHM 1/8W 5% CF
R49	113472	RES, 4.7K 1/8W 5% CARBON FILM
R50	113103	RES, 10K 1/8W 5% CARBON FILM
R51	113103	RES, 10K 1/8W 5% CARBON FILM
R52	113333	RES, 33K 1/8W 5% CARBON FILM
R53	124121	RES, 120 OHM 1/4W, 5% CARB FILM
R54	124100	RES, 10 OHM 1/4W 5% CARBON FILM
R55	113431	RES, 430 OHM 1/8W, 5% CARB FILM
R56	113431	RES, 430 OHM 1/8W, 5% CARB FILM
R57	261614	RES, POT 50K VERT TOP ADJUST
R58	261613	RES, POT 5K VERT TOP ADJUST
R59	1112002	RES, 20K 1/8W 1%
R60	124223	RES, 22K 1/4W 5% CARBON FILM
R61	124472	RES, 4.7K 1/4W 5% CARBON FILM
R62	1113402	RES, 34K 1/8 1%
R63	124333	RES, 33K 1/4W 5% CARBON FILM
R64	124223	RES, 22K 1/4W 5% CARBON FILM
R66	124180	RES, 18 OHM 1/4W 5% CARBON FILM
R67	124301	RES, 300 OHM 1/4W 5% CARB FILM
R68	124821	RES, 820 OHM 1/4W 5% CF
R69	124301	RES, 300 OHM 1/4W 5% CARB FILM
R70	124102	RES, 1K 1/4W 5% CARBON FILM
R71	124223	RES, 22K 1/4W 5% CARBON FILM
R72	124223	RES, 22K 1/4W 5% CARBON FILM
R73	124333	RES, 33K 1/4W 5% CARBON FILM
R74	113105	RES, 1M 1/8W 5% CARBON FILM
R75	124333	RES, 33K 1/4W 5% CARBON FILM

TABLE 8-3.
Parts List, Synthesizer (Continued).

DESIGNATOR	PART #	DESCRIPTION
R78	124103	RES, 10K 1/4W 5% CARBON FILM
R87	124223	RES, 22K 1/4W 5% CARBON FILM
R88	124223	RES, 22K 1/4W 5% CARBON FILM
R91	124100	RES, 10 OHM 1/4W 5% CARBON FILM
R96	124102	RES, 1K 1/4W 5% CARBON FILM
R98	124562	RES, 5.6K 1/4W 5% CARBON FILM
R101	124470	RES, 47 OHM 1/4W 5% CARBON FILM
T1	459249	XFMR, 3T/3T#34 AWG 1-490316
T2	459248	XFMR, 1T5T5T1T#34 AWG 1-490316
T3	459250	XFMR, 2T/5T/CT/2T/2T 1-490316
U1	330084	IC MC145152P
U1	621009	SOCKET, 28 PIN DIP
U2	330105	IC
U3	330184	IC CD4052BE
U4	330442	IC, OP AMP OP41GP/CA3193E
U5A	113103	RES, 10K 1/8W 5% CARBON FILM
U5B	113103	RES, 10K 1/8W 5% CARBON FILM
U5C	113103	RES, 10K 1/8W 5% CARBON FILM
U5D	113103	RES, 10K 1/8W 5% CARBON FILM
U5E	113103	RES, 10K 1/8W 5% CARBON FILM
U5F	113103	RES, 10K 1/8W 5% CARBON FILM
U5G	113103	RES, 10K 1/8W 5% CARBON FILM
U5H	113103	RES, 10K 1/8W 5% CARBON FILM
U6F	113103	RES, 10K 1/8W 5% CARBON FILM
U6G	113103	RES, 10K 1/8W 5% CARBON FILM
U6H	113103	RES, 10K 1/8W 5% CARBON FILM
U6D	113103	RES, 10K 1/8W 5% CARBON FILM
U7A	277103	CAP, ML 0.01 UF AXIAL X7R 10%
U7B	277103	CAP, ML 0.01 UF AXIAL X7R 10%
U7C	277103	CAP, ML 0.01 UF AXIAL X7R 10%

TABLE 8-3.
Parts List, Synthesizer (Continued).

DESIGNATOR	PART #	DESCRIPTION
U7D	277103	CAP, ML 0.01 UF AXIAL X7R 10%
U7E	277103	CAP, ML 0.01 UF AXIAL X7R 10%
U7F	277103	CAP, ML 0.01 UF AXIAL X7R 10%
U7G	277103	CAP, ML 0.01 UF AXIAL X7R 10%
U7H	277103	CAP, ML 0.01 UF AXIAL X7R 10%
U8A	277103	CAP, ML 0.01 UF AXIAL X7R 10%
U8B	277103	CAP, ML 0.01 UF AXIAL X7R 10%
U8C	277103	CAP, ML 0.01 UF AXIAL X7R 10%
U8D	277103	CAP, ML 0.01 UF AXIAL X7R 10%
U8E	277103	CAP, ML 0.01 UF AXIAL X7R 10%
U8F	277103	CAP, ML 0.01 UF AXIAL X7R 10%
U8G	277103	CAP, ML 0.01 UF AXIAL X7R 10%
U8H	277103	CAP, ML 0.01 UF AXIAL X7R 10%
U10	330037	IC, CD4060BE
U11	330443	IC, 74HC4040 FAST 12BIT BIN CN
U12	361100	OSC, TCXO 12.8MHZ 2.5PPM
U14	330461	LM117H, VOLTAGE REG.
VR1	320258	ZENER 8.2V 5% L.NOISE 1N4101
VR3	320323	DIODE, 1N757A ZENER 9.1V 5%D07
VR4	320259	ZENER 9.1V 5% L.NOISE 1N4103
Y1	360076	CRYSTAL, 13.5 MHZ HC49/18U
Y2	363001	RESONATOR CERAMIC 614.4KHZ
Z1	380020	MIXER, SBL-1 (OR EQUIV)

Chapter 9
DISPLAY CARD (018-00601), CHASSIS CARD (018-00600)

9.1 DISPLAY

The display is a small printed circuit board located directly behind the front panel and secured to the chassis. The display consists of the Liquid Crystal Display (LCD), the associated drive circuitry (U2 and U3), and the display lighting (DS1 through DS4). Inputs to the display are through terminals E1 through E6.

9.2 CHASSIS

The PRC1088 chassis wiring harness assembly is responsible for all signal and power distribution from the front/rear-panel switches and connectors to the PRC1088 chassis.

9.3 POWER DISTRIBUTION

The +12.5 V dc applied through A1J5-B is sent through A1J1-F, through shorting cap A1P3 and back out A1J1-E to function switch S3. With the function switch in the ON position, +12.5V dc is applied through S3 to Power Amplifier A2J1-24 and 25. The following voltages are produced in the Power Amplifier: +12 Vdc XMT, +24 Vdc, -12 Vdc, +12 Vdc, -12 Vdc XMT, and +5.2 Vdc. These voltages, except for the -12Vdc XMT which is used only on the Power Amplifier, are sent through the ribbon cable, A2P1-49 and -50 to the ECCM A3A2. All voltages are also routed through the control to A3A1J2 and are simultaneously sent to the receiver A4 and the synthesizer A5.

The display module is supplied with two voltages. The primary voltage is the +5.2 Vdc from A1P1-15; it provides the voltage necessary for all display functions. The secondary voltage is the +12 V LITE from S3. This voltage is used for illumination of the display, and is applied only when the function switch is in the LITE position.

When in the vehicular applique, power for the receiver-transmitter is applied through A1J1 and is then routed as in the above description.

The +12 Vdc is supplied to A1J1-N for external use should the need arise. It should be noted, though, that A1J1-F and E still require shorting to maintain power to the receiver-transmitter.

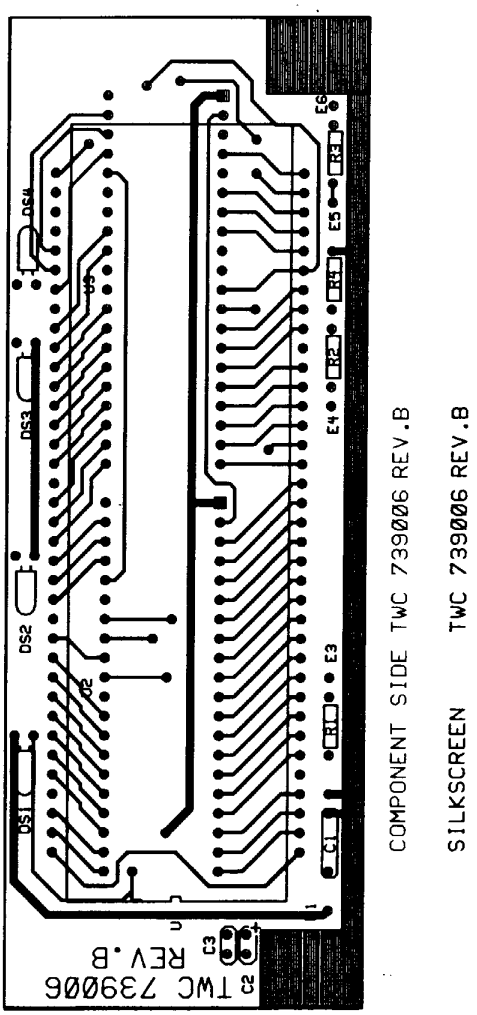


FIGURE 9-1.
Component Locations, Display Card.

TABLE 8-3.
Parts List, Synthesizer.

018-00200

DESIGNATOR	PART #	DESCRIPTION
C1	231101	CAP, 100MF 16V ELECT VRT
C2	277104	CAP, ML 0.1UF AXIAL X7R 10%50V
C3	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C5	277182	CAP, MONO 1800PF NPO AXIAL 5%
C6	277182	CAP, MONO 1800PF NPO AXIAL 5%
C7	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C8	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C9	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C10	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C11	276222	CAP, ML 2200PF NPO 5% 100V .2S
C12	276222	CAP, ML 2200PF NPO 5% 100V .2S
C13	277102	CAP, ML 1000PF X7R AXIAL 10%
C14	241226	CAP, 22MF DIP TANTALUM
C15	277104	CAP, ML 0.1UF AXIAL X7R 10%50V
C16	241010	CAP, 1.0 MF DIP TANTALUM
C17	241100	CAP, 10MF DIP TANTALUM
C18	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C19	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C20	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C21	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C22	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C23	277333	CAP, ML, 33000pF X7R AXIAL 10%
C24	277472	CAP, ML 4700PF X7R AXIAL 10%
C25	277104	CAP, ML 0.1UF AXIAL X7R 10%50V
C26	276153	CAP, ML 15000PF X7R 10% 0.2 SP
C27	277123	CAP, 0.012UF NPO AXIAL
C28	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C29	275100	CAP, ML 10PF NPO 100V 5% 0.1S
C30	275153	CAP, 15000PF NPO

TABLE 8-3.
Parts List, Synthesizer (Continued).

DESIGNATOR	PART #	DESCRIPTION
C31	275103	CAP, ML 0.01UF NPO 5% 100V .2S
C32	275153	CAP, 15000PF NPO
C33	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C34	020471	CAP, 470PF 100V 5% NPO SMT1206
C35	261610	CAP, 4-30PF TRIMMER Q=300MIN
C36	276101	CAP, ML NPO 100PF 100V 5% 0.1S
C37	276101	CAP, ML NPO 100PF 100V 5% 0.1S
C38	276151	CAP ML 150 PF 1% 100V NPO
C39	020391	CAP SMT 390PF NPO 5% 100V 1206
C40	277101	CAP, ML 100PF NPO AXIAL 5%
C41	277102	CAP, ML 1000PF X7R AXIAL 10%
C42	275562	CAP, ML 5600PF NPO 5% 100V .2S
C43	277102	CAP, ML 1000PF X7R AXIAL 10%
C44	275822	CAP, ML 8200PF NPO 5% 100V .2S
C45	277102	CAP, ML 1000PF X7R AXIAL 10%
C46	277104	CAP, ML 0.1UF AXIAL X7R 10%50V
C47	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C48	241226	CAP, 22MF DIP TANTALUM
C49	277104	CAP, ML 0.1UF AXIAL X7R 10%50V
C4A	277472	CAP, ML 4700PF X7R AXIAL 10%
C4B	277333	CAP, ML, 33000pF X7R AXIAL 10%
C50	275100	CAP, ML 10PF NPO 100V 5% 0.1S
C51	275390	CAP, ML 39PF NPO 5% 100V 0.1S
C52	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C53	276151	CAP ML 150 PF 1% 100V NPO
C54	277102	CAP, ML 1000PF X7R AXIAL 10%
C55	277104	CAP, ML 0.1UF AXIAL X7R 10%50V
C56	261611	CAP, 2-10PF TRIMMER WHITE
C57	277471	CAP, ML 470PF NPO AXIAL 5%100V
C58	277121	CAP, ML 120PF NPO AXIAL 5%100V

TABLE 8-3.
Parts List, Synthesizer (Continued).

DESIGNATOR	PART #	DESCRIPTION
C59	277471	CAP, ML 470PF NPO AXIAL 5%100V
C60	277150	CAP, ML 15PF NPO 5% 100V AXIAL
C61	277102	CAP, ML 1000PF X7R AXIAL 10%
C62	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C63	277104	CAP, ML 0.1UF AXIAL X7R 10%50V
C64	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C65	277104	CAP, ML 0.1UF AXIAL X7R 10%50V
C66	277101	CAP, ML 100PF NPO AXIAL 5%
C67	277101	CAP, ML 100PF NPO AXIAL 5%
C68	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C69	241020	CAP, 2.2MF DIP TANTALUM
C70	241100	CAP, 10MF DIP TANTALUM
C71	241100	CAP, 10MF DIP TANTALUM
C72	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C73	277103	CAP, ML 0.01 UF AXIAL X7R 10%
C74	277102	CAP, ML 1000PF X7R AXIAL 10%
C101	241476	CAP, 47MF 16V DIP TANT
C102	241476	CAP, 47MF 16V DIP TANT
CR1	320002	DIODE, SI 100MA 1N4148/1N4150
CR3	320322	DIODE, VARACTOR DKV6533
CR4	320320	DIODE, VARAVTOR HYPER DKV6523
CR5	320005	DIODE PIN BA482
L1	430214	INDUCTOR, 220 UH 5% Q65 MOLD
L2	490140	IND, VAR 0.1-0.12UH YELLOW 7MM
L3	490141	IND, VAR 0.14-0.185UH Q72 7MM
L4	430211	INDUCTOR, 0.56UH 10% Q30 MOLD
L5	430210	INDUCTOR, 1.5 UH 10% Q28 MOLD
L6	430043	INDUCTOR, 8.2 UH MOLDED
L7	430219	INDUCTOR, 18UH, T&R

TABLE 8-3.
Parts List, Synthesizer (Continued).

DESIGNATOR	PART #	DESCRIPTION
L8	430219	INDUCTOR, 18UH, T&R
L9	430040	INDUCTOR 100 UH AXIAL LEAD
L10	430213	INDUCTOR, 4700UH 10% Q45 MOLD
L11	430212	INDUCTOR, 2.7 UH 10% Q35 MOLD
L12	430213	INDUCTOR, 4700UH 10% Q45 MOLD
L13	430218	INDUCTOR, 10UH 10% Q55 MOLD
L14	430212	INDUCTOR, 2.7 UH 10% Q35 MOLD
L15	430210	INDUCTOR, 1.5 UH 10% Q28 MOLD
L16	430218	INDUCTOR, 10UH 10% Q55 MOLD
L20	430040	INDUCTOR 100 UH AXIAL LEAD
Q1	310052	XISTOR, PNP, PN2907A, TO92
Q2	310020	TRANSISTOR, NPN TO39
Q3	310059	XISTOR, NPN, 2N5109, TO39
Q4	310052	XISTOR, PNP, PN2907A, TO92
Q5	310057	XISTOR, NPN, PN2222A, TO92
Q6	310145	XISTOR, NPN, 2N5179, TO72
Q7	310147	XISTOR, NPN, 2N918, TO72
Q8	310147	XISTOR, NPN, 2N918, TO72
Q9	310057	XISTOR, NPN, PN2222A, TO92
R1	124121	RES, 120 OHM 1/4W, 5% CARB FILM
R2	124273	RES, 27K 1/4W 5% CARBON FILM
R3	124104	RES, 100K 1/4W 5% CARBON FILM
R4	124102	RES, 1K 1/4W 5% CARBON FILM
R5	124103	RES, 10K 1/4W 5% CARBON FILM
R8	124471	RES, 470 OHM 1/4W 5% CF
R9	124222	RES, 2.2K 1/4W 5% CARBON FILM
R10	124821	RES, 820 OHM 1/4W 5% CF
R11	124101	RES, 100 OHM 1/4W 5% CF
R12	124221	RES, 220 OHM 1/4W 5% CF

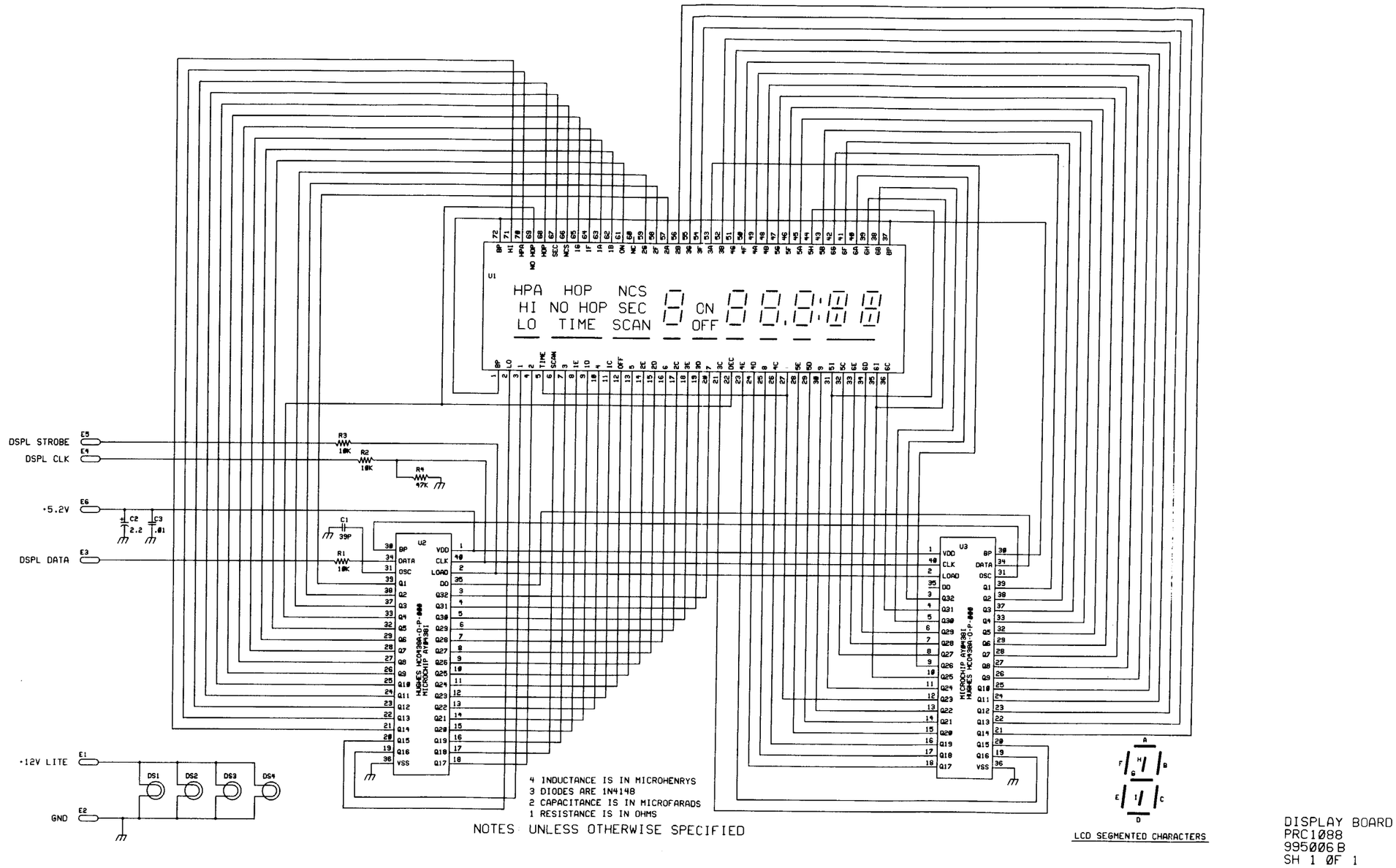


FIGURE 9-2.
Schematic Diagram, Display Card.

Table 9-1
Parts List, Display Card, PRC 1088

DESIGNATOR	PART #	DESCRIPTION
C1	277390	CAP, ML 39PF NPO AXIAL 5% 100V
C2	241020	CAP, 2.2MF DIP TANTALUM
C3	214103	CAP, 0.01MF 50V MONO
DS1	390015	LAMP, 14V 67MA 0.16D X 0.41L
DS2	390015	LAMP, 14V 67MA 0.16D X 0.41L
DS3	390015	LAMP, 14V 67MA 0.16D X 0.41L
DS4	390015	LAMP, 14V 67MA 0.16D X 0.41L
R1	124103	RES, 10K 1/4W 5% CARBON FILM
R2	124103	RES, 10K 1/4W 5% CARBON FILM
R3	124103	RES, 10K 1/4W 5% CARBON FILM
R4	124473	RES, 47K 1/4W 5% CARBON FILM
U1	320805	LCD, PRC1088 CUSTOM
U2	330529	IC, DD, H0438A, 40 PIN, DIP

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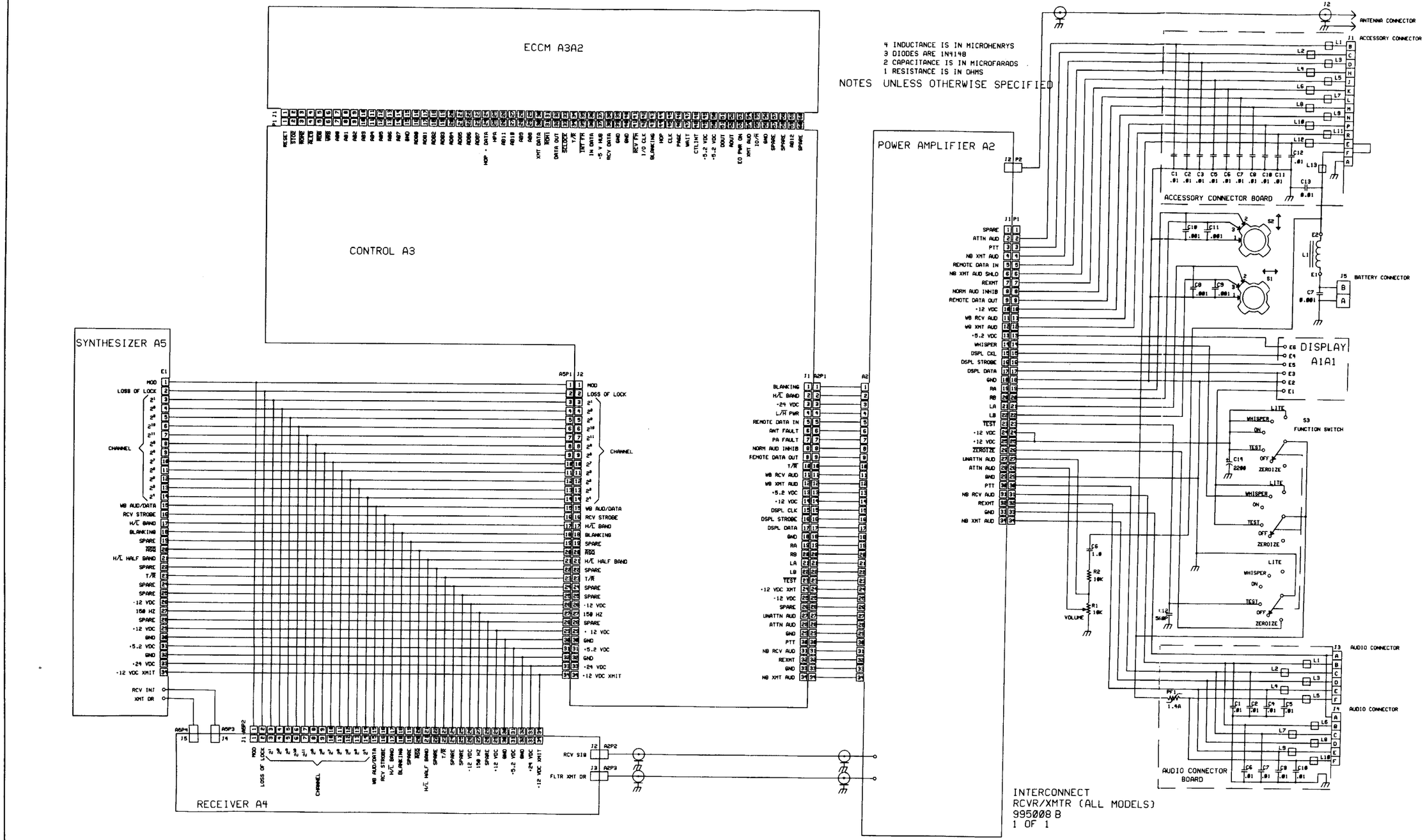

FIGURE 9-3.
Schematic Diagram, PRC1088 Chassis.