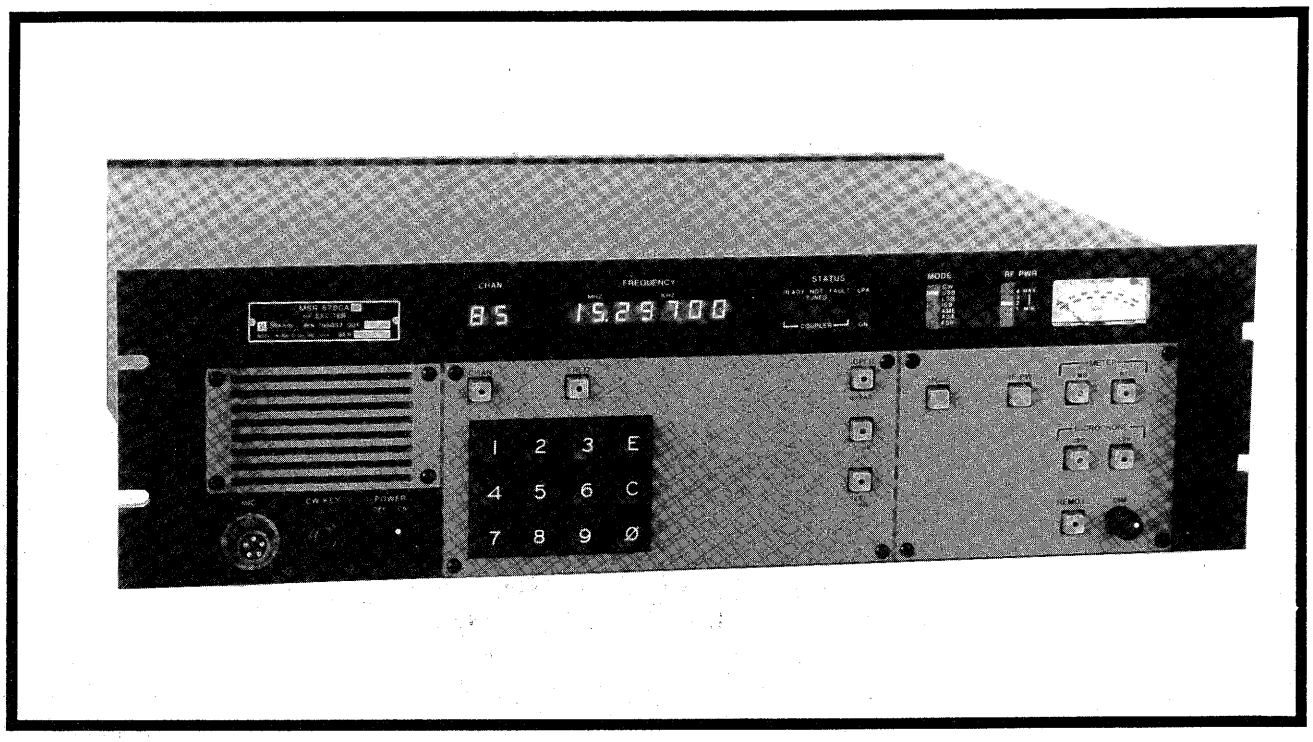

MSR 6700A EXCITER

Issue 1

Publication No. 600305-823-001

NOTICE

MACKAY COMMUNICATIONS INC. reserves the right to make changes to the equipment without notice.

PROPRIETARY STATEMENT

SAFETY NOTICE

This equipment has dangerous RF voltages which can cause BURNS and INJURY. Do not touch the antenna connector, long wire antenna or metal portion of whip antennas when transmitting. When practicable, maintenance should be performed with the equipment de-energized. If power-on maintenance is required, use caution. Do not touch high voltage or RF components.

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GLOSSARY

A	Ampere(s)
A/D	Analog-to-Digital (Converter)
AFSK	Audio frequency shift keying; a baseband modulation scheme in which two audio frequencies are used to represent binary coded data; the frequency is shifted to one frequency to represent a 1 (mark) and to the other to represent a 0 (space).
AGC	Automatic gain control
ALC	Automatic level control
ALE	Address latch enable
AM	Amplitude modulation; a modulation scheme in which the carrier is made to vary in amplitude in accordance with the modulating signal.
AMPL	Amplifier
AME	Amplitude modulation equivalent
ANTIVOX	Prevents false VOX operation; see VOX
BNC	Baby "N" connector
BCD	Binary-coded decimal
BFO	Beat Frequency Oscillator, used in SSB detection circuits
BITE	Built-in Test Equipment
BPF	Bandpass filter
BW	Bandwidth
CPU	Central processing unit
CW	Continuous wave; a wave that does not vary in amplitude or frequency and is turned on and off to carry intelligence, e.g., Morse Code
CCW	Counterclockwise
CMOS	Complementary metal oxide semiconductor
D/A	Digital-to-Analog (Converter)
DAGC	Delayed AGC
dB	Decibel(s)
dBm	Decibel(s) relative to one milliwatt
EMI	Electromagnetic interference
EPROM	Erasable programmable read-only memory
FSK	Frequency shift keying
HF	High frequency; a radio frequency band extending from about 3 MHz to 30 MHz; in this manual, HF includes 1.6 to 30 MHz.
HV	High voltage
IF	Intermediate frequency
IP2	Second order intermodulation intercept point
IP3	Third order intermodulation intercept point
ISB	Independent sideband
IMD	Intermodulation (distortion)
I/O	Input/Output
LED	Light emitting diode

GLOSSARY (Cont.)

LO	Local oscillator
LPA	Linear power amplifier
LPF	Low pass filter
LSB	Lower sideband; a modulation scheme in which the intelligence is carried on the first sideband below the carrier frequency; see SSB
MIC	Microphone
mA	Milliampere(s)
mS	Millisecond(s)
mV	Millivolt(s)
NBFM	Narrow band frequency modulation
OCXO	Oven-controlled crystal oscillator
PEP	Peak envelope power
PCB	Printed circuit board
RAM	Random access memory
RF	Radio frequency
RMS	Root mean square
RX	Receive
RTTY	Radio teletypewriter
SPKR	Speaker
SSB	Single sideband; a modulation scheme in which the intelligence is carried by one of the carrier sidebands, the other sideband and the carrier center frequency being suppressed
TCXO	Temperature-compensated crystal oscillator
TGC	Transmitter gain control
TTL	Transistor/transistor logic
TX	Transmit
uA	Microampere(s)
uP	Microprocessor
uS	Microsecond(s)
USB	Upper sideband; a modulation scheme in which the intelligence is carried on the first sideband above the carrier frequency; see SSB
uV	Microvolt(s)
Vac	Volts, alternating current
VCO	Voltage controlled oscillator
Vdc	Volts, direct current
VSWR	Voltage standing wave ratio; the ratio of the maximum to the minimum voltage of a standing wave on a radio frequency transmission line
W	Watt(s)
XTAL	Crystal element

SECTION 1

INTRODUCTION

1.1 SCOPE

This instruction manual contains information necessary for the installation, operation and maintenance of the exciter.

1.2 DESCRIPTION

1.2.1 GENERAL

The MSR 6700A is a compact, rugged, fully automatic Exciter/Transmitter with modular solid state design. It will provide continuous duty 125 watt PEP and average power over the frequency range of 1.6 to 30 MHz. Features include selectable power levels, 100 programmable channels and synthesized 10Hz steps.

The MSR 6700A Exciter/Transmitter is a microprocessor controlled unit designed to be an exciter for the MSR 1020 1kW Linear Amplifier or to be a stand-alone transmitter. The MSR 6700A comes complete with palm microphone, tech manual and accessory kit including mating connectors, ready to operate into any 50Ω antenna or a variety of antenna tuners. This unit is ideally suited for use in communication systems where full duplex or two-channel ISB operation is a requirement. The Exciter/Transmitter is part of a complete line of communications equipment which includes receivers, transceivers, remote controllers and other equipments.

The standard and optional remote interfaces for the unit allow it to be used in a flexible array of remote control systems. Full serial remote control using an RS-232C/422/423 or MIL-STD-188C interface is standard, while an optional internal tone key/modem board provides two tone FSK remote control through the MSR 6420 remote control unit. A remoted system may contain up to 99 addressable equipments in any combination and be controlled by multiple remote control units or computers.

The MSR 6700A with its data filter option becomes a high speed data radio. The ISB option along with these filters allows the Exciter to operate in full-duplex Tactical Data Information Link (TADIL) systems.

The exciter has been designed and constructed to facilitate quick and easy field service and/or repair. Featuring modular construction, the front panel, rear panel and power amplifier assemblies are removable with only a screwdriver and the PC boards simply unplug from the mother board.

The exciter is composed of 10 major subassemblies. A general description and functionof these assemblies are provided in Sections 1.2.2 through 1.2.11.

1.2.2 CHASSIS/MOTHER BOARD

All subassemblies in the exciter are electrically or mechanically connected to the chassis/mother board. The chassis houses all plug-in PC boards and provides shielding. The mother Board contains all interconnceting wiring in the exciter. All plug-in PC boards connect to the mother board through PC edge connectors. Keys on the connectors discourage plugging PC boards in the wrong slots.

1.2.3 FRONT PANEL ASSEMBLY

The front panel is a rugged aluminum assembly to which all controls are mounted. The LED indicators and associated circuitry are mounted on the front panel board which attaches to the panel. The panel assembly can be removed from the exciter by removing six nuts, two screws and three cable connectors. The front panel is designed so that it can be laid down while still electrically connected and active for ease of troubleshooting and repair.

1.2.4 INTERFACE BOARD

This board interfaces the microprocessor on the Logic board with the front panel control pushbuttons, keypad, and LED displays. This board also includes UART and Baud rate generator circuitry for remote control operation.

1.2.5 LOGIC BOARD

The logic board is the heart of the MSR 6700A digital control system. It contains the microprocessor, program and channel memory, and control logic. CMOS channel memory is maintained by a lithium battery with a 10-year typical life. Logic board signals provide frequency commands to the synthesizer and band and mode information to the exciter modules.

1.2.6 EXCITER SIGNAL PATH

The exciter signal path consists of five PC boards: 1) transmit modulator, 2) IF filter, 3) mixer, 4) high pass filter and 5) half-octave filter.

When transmitting, the exciter takes inputs from the microphone or 600Ω line and the synthesizer, then generates the proper signal to drive the power amplifier.

A double conversion scheme is used, with the first intermediate frequency (IF) at 59.53 MHz and the second IF at 5.00 MHz. Two sets of crystal filters (one set at each IF) determine the exciter bandwidth.

A signal compressor on the transmit modulator board improves the peak-to-average power ratio for more effective communications.

1.2.7 SYNTHESIZER

The synthesizer consists of four PC boards: 1) major loop, 2) translator loop, 3) minor loop and 4) reference board. The synthesizer is a three loop design which provides the exciter with the first local oscillator (LO) from the major loop board, the second LO from the translator loop board and the third LO from the reference board to the exciter. All frequencies are derived from a temperature compensated crystal oscillator (TCXO) on the reference board. The reference board also furnishes the 1 kHz sidetone used for CW. If a fault causes any of the loops to lose lock, the loss-of-lock LED will light on the appropriate board(s) and transmission will be inhibited.

1.2.8 COUPLER INTERFACE BOARD

This board provides control and status interfacing between the MSR 6700A and Mackay MSR 4020/4030/4040 Antenna Couplers. This board also controls the exciter's keying functions, receiving the various keying inputs, and sending out transmit commands to the exciter signal path boards and also to any external equipment in the system.

1.2.9 POWER SUPPLY MODULE

The power supply module furnishes regulated +5 and +26 VDC to the exciter. The power supply is a switching type for good efficiency and operates from either input voltage of 115 or 230 VDC.

1.2.10 REAR PANEL ASSEMBLY

The rear panel assembly is an aluminum assembly which contains the PA assembly and various connectors. It attaches to the exciter chassis with nine screws and is easily removable as a unit. +13 VDC is supplied from the PA assembly and +9 VDC is supplied from a regulator on the rear panel.

1.2.11 POWER AMPLIFIER ASSEMBLY

The power amplifier (PA) is a solid state broadband FET amplifier rated at 125 watts peak envelope power (PEP) and 125 watts average into a 50 ohm load. The unit is cooled by a heatsink and PA fan, mounted on the rear panel.

1.3 TECHNICAL SPECIFICATIONS

Equipment specifications are listed in Table 1.1.

1.4 EQUIPMENT SUPPLIED

This equipment is listed in Table 1.2.

1.5 OPTIONAL EQUIPMENT-NOT SUPPLIED

This equipment is listed in Table 1.3.

Table 1.1

Equipment Specifications

CHARACTERISTIC	SPECIFICATION
Frequency Range	1.60000 MHz to 29.99999 MHz in 10 Hz increments
Frequency Stability	
Standard	+/- 1 x 10^{-6}
Optional	+/- 1 x 10^{-8}
Operating Modes	
Standard	USB, LSB (J3E) USB reduced carrier (R3E) AME (H3E) CW (J1A) FSK (F1B)
Optional	ISB (B9W)
Channel Storage	100 channels store operating frequency, mode, and power level
CW Keying Speed	85 wpm maximum
Standby to Transmit Delay	10 mSec maximum
Transmit to Standby Delay	2 mSec maximum
Channeling Speed	60 mSec maximum
Transmit Duty Cycle	Continuous
Power Requirements	
115VAC Range	98 to 132 VAC, 40 to 410 Hz
230VAC Range	185 to 264 VAC, 40 to 410 Hz
Power Consumption	
115VAC Input	8.0A maximum at 125W RF output 1.3A maximum standby
230VAC Input	4.0A maximum at 125W RF output 0.8A maximum standby

Table 1.1

Equipment Specifications (Cont.)

CHARACTERISTIC	SPECIFICATION
Size	5.2 x 19 x 20.9 inches (H x W x D) 13.2 x 48.3 x 53.3 cm (H x W x D) Includes handles and cooling fan
Weight	40 lbs (18.1 kg)
Enclosure	Designed for installation in standard 19 inch cabinets or racks
Environmental	
Operating Temperature Range	-10 to +55 degrees C
Storage Temperature	-40 to +70 degrees C
Humidity	95% at +50 degrees C for 24 hours
Altitude	To 10,000 feet operating
Shock	Designed to the requirements of MIL-STD-810C, Method 516.2 Procedure V
Vibration	Designed to the requirements of MIL-STD-810C, Method 514.2 Procedure VIII,Figure 514.2-6,Curve V
RF Output Into 50 Ohms	
High Power Output	20 to 30 degrees C: 125W +/- 0.5 dB, PEP and Avg -10 to +55 degrees C: 125W +/- 1 dB, PEP and Avg
Low Power Output	20 to 30 degrees C: 25W +/- 0.5 dB PEP and Avg -10 to +55 degrees C: 25W +/- 1 dB PEP and Avg
AME Carrier Power	20 to 30 degrees C: 35W +/- 0.5 dB -10 to +55 degrees C: 35W +/- 1 dB
IM Distortion (at 125W out)	20 to 30 degrees C: 30 dB below PEP, 33 dB typ. -10 to +55 degrees C: 25 dB below PEP minimum
Carrier Suppression (J3E)	20 to 30 degrees C: 50 dB below PEP -10 to +55 degrees C: 40 dB below PEP

Table 1.1

Equipment Specifications (Cont.)

CHARACTERISTIC	SPECIFICATION
R3E Pilot Carrier	20 to 30 degrees C: 16 dB +/- 2 dB below PEP -10 to +50 degrees C: 16 dB +/- 3 dB below PEP
Hum and Noise	50 dB below PEP
Spurious	40 dB below PEP, 55 dB typical
Transmit Bandwidth (Standard SSB Filter)	300 to 3000 Hz minimum at -6 dB points; 4 dB ripple, maximum
Harmonic Suppression	45 dB below PEP, 50 dB typical
Undesired Sideband	50 dB below PEP at 1 kHz into the undesired sideband
ISB Channel Balance	
USB and LSB Outputs	20 to 30 degrees C: within 2 dB -10 to +55 degrees C: within 3 dB (At 1 kHz audio input, each channel)
Voice Compression	Average power output increases 1 dB or less for 10 dB increase in audio input
Protocol	See Appendix I

Table 1.2 Equipment and Accessories Supplied

QTY.	ITEM	MACKAY PART NUMBER
1	Exciter	795032-000-xxx
1	Accessory Kit (Consisting of the following) Also see * at bottom of page.	795032-017-xxx
1	Microphone, Hand	600352-713-001
1	Cable, Power	600078-102-001
5	Fuse, 8A, Fast-blow	600004-396-018
5	Fuse, 5A, Slow-blow	600006-396-030
1	Extractor PC Board	600268-618-001
1	DB-25 Mating Connector for J42	600292-606-006
1	DB-25 Mating Connector for J44	600292-606-005
4	Connector Shells for J42, J44	600225-233-003
1	PL-259, Mating RF Connector for J46	600244-606-001
1	PL-259 Reducer for J46 Connector	600244-606-002
1	MS3106A 28-21P Mating Connector for J43 **NOTE:** This connector must be used if no antenna coupler or LPA is used with the system. The connector also contains jumpers which must be removed if used to make a cable. See Section 2 for complete instructions.	600450-606-001
1	Cable Clamp for J43 Connector	600376-606-006
1	Remote Control Bypass Connector for J44	700009-608-001
1	Remote Control Bypass Connector for J42	700009-608-101
1	Technical Manual	600305-823-001

* This kit includes microphone, power cord, this manual, spare fuses and p.c. board extractor. Connectors and connector shells which mate to all rear panel connectors are provided to allow the user to build his own cables. Remote control bypass connectors are also included. The connectors may be used to maintain remote control and remote audio when the MSR 6700A is used in a single remote, multi-radio configuration. Their use is explained in Section 6.

Table 1.3 Optional Equipment - Not Supplied

ITEM	MACKAY PART NO.	DESCRIPTION/USE
Rack Mount Kit, 19"	600078-700-001	Slide racks and mounting hardware for installing the MSR 6700A in a standard 19" rack or cabinet.
Microphone, Desk	600367-713-001	
Telegraph Key	600303-616-001	
Handset, type H-250/U	600021-386-001	
Headset, type H-251/U	600036-386-001	
Extender Board Kit	600081-700-001	Plug-in extender boards hold MSR 6700A plug-in PCBs above level of other PCBs to simplify trouble-shooting.
Desk Top Cabinet	600257-704-001	Allows the MSR 6700A to be installed as a free-standing desk top unit. Overall dimensions of the MSR 6700A installed in the cabinet: W-19 3/4" x D-19 1/4" x H 6 3/4". Color: Black.
Spares Kit, PC Board	700008-700-001	This kit includes spares of all plug-in modules to allow simple on-site servicing by replacement of defective modules. Included are all plug-in PCBs, switching power supply module, and LPA module.
Spares Kit, Comprehensive	700010-700-001	This kit includes all items found in the Spare Boards Kit as well as all other items replaceable by a technician with minimal equipment and requiring minimum down-time. Included items are power transistors, integrated circuits installed in sockets, chassis components, fans, knobs and switches, etc. One comprehensive spares kit should support up to five MSR 6700A for two to four years.

Table 1.3 Optional Equipment - Not Supplied (Cont.)

ITEM	MACKAY PART NO.	DESCRIPTION/USE
Spares Kit, Depot	700009-700-001	This kit includes all basic components required to repair defective boards and modules. The Depot Spares Kit complements the Comprehensive Spares Kit and together they should support five MSR 6700As for two to four years. This kit is intended for depot level application by trained technicians.
ISB Option	70006-700-001	Provides additional IF Filter and Transmit Modulator PC boards to configure the MSR 6700A for independent sideband. Factory installed only.
High Stability Reference Option	600402-700-002	Upgrades standard ± 1 in 10^6 frequency stability to ± 1 in 10^8. Factory installable only.
Preselector Option, MSR 6300	700007-700-002	The preselector option consists of an external automatically tracking filter which is electrically inserted in the signal path just before the power amplifier. The preselector reduces broadband PA noise. Included are the external filter and all RF and control signal routing cables, technical manual and 115/230 VAC power supply. Internal components of this kit are factory installable only.
Remote Control Option	700015-700-001 700015-700-002	The MSR 6700A Remote Control Option comes in three basic configurations. The Remote FSK Modem Option and/or the Addressable Audio I/O Option can be added. Table 1.4 shows what features are provided for each configuration. The remote control options are field or factory installable. See Section 6 for complete information.

Table 1.3 Optional Equipment - Not Supplied (Cont.)

ITEM	MACKAY PART NO.	DESCRIPTION/USE
CSW 1000 Control Software	89001-000-001 (English) 89001-000-002 (Spanish)	The CSW 1000 is computer software which allows an IBM compatible computer to control a system of MSR 6700A Exciters and MSR 5050A Receivers. As many as 99 exciters and 99 receivers may be connected in a system and controlled by this software.
Cable Assemblies		See Table 1.5. Cable assemblies are available for all standard system configurations. Cables available are completely wired with necessary mating connectors at each end, or unterminated cable may be ordered for assembly by customer using connectors furnished in Mackay equipment accessory kits. Please specify length desired.
Antenna Assemblies		See Table 1.6. Various antennas and mounting hardware kits are available.

Table 1.4 Remote Control Options

OPTION	REMOTE CONTROL FEATURES
Standard Radio	RS-232C, RS-422, RS-423, MIL-STD-188 Controlled by MSR 6420 remote control unit, a computer, or both. Up to 100 radios can be controlled together in a system.
Remote FSK Modem Option P/N 700015-700-001	Adds: 300 Baud FSK Remote Control (single remote control unit (RCU), single radio or multi-RCU, single radio) Tone keying: High speed remote control of exciter keying using keying tone on standard audio line. Controlled by MSR 6420 or MSR 6420 and a computer.
Addressable Audio I/O Option P/N 700015-700-002	Adds: Switched audio: Multiple exciters can be connected together on an audio bus. Remote control audio is sent only to the selected radio. Controlled by MSR 6420 RCU or MSR 6420 and a computer
Remote FSK Modem and Addressable Audio I/O P/Ns 700015-700-001 & 700015-700-002	Adds: Tone keying Switched audio 300 Baud FSK control in multi-radio configurations of MSR 6700As (or combination of MSR 6700As and 5050A receivers). Can be remote controlled by a single two conductor line "daisy chained" from one radio to the next. Controlled by MSR 6420 RCU or MSR 6420 and a computer.
Data Filter Option P/N 700417-700-001	This option substitutes controlled group delay filters (per TADIL A specs) for the USB, LSB filters in the standard exciter.
Data Filter Option P/N 700417-700-002	Same as -001 but is applied to an exciter with ISB option where USB and LSB filters are separate IF Filter boards.

Table 1.5 Cable Assemblies

MSR 6700A to MSR 4020A Antenna Coupler

Control Cable		Assembled	600686-540-xxx
		Raw Cable	600069-102-009
RF Coaxial Cable	RG-58/U	Assembled	600491-540-xxx
		Raw Cable	600016-102-001
	RG-213/U	Assembled	600492-540-xxx
		Raw Cable	600017-102-001

MSR 6700A to MSR 1020 or MSR 1030 LPA

Control Cable		Assembled	600530-540-xxx
		Raw Cable	600069-102-010
RF Coaxial Cable	RG-58/U	Assembled	600491-540-xxx
		Raw Cable	600016-102-001
	RG-213/U	Assembled	600492-540-xxx
		Raw Cable	600017-102-001

Please specify desired cable length.
Maximum recommended length:

Control Cable	200 feet
RG-58/U Coax	50 feet
RG-213/U Coax	250 feet

MSR 6700A to MSR 4040 Digital Antenna Coupler

Control Cable		Assembled	700034-540-xxx
		Raw Cable	700001-102-001
RF Coaxial Cable	RG-58/U	Assembled	600491-540-xxx
		Raw Cable	600016-102-001
	RG-213/U	Assembled	600492-540-xxx
		Raw Cable	600017-102-001

Please specify desired cable length.
Maximum recommended length:

Control Cable	250 feet
RG-58/U Coax	50 feet
RG-213/U Coax	250 feet

Table 1.6 Antenna Assemblies

150 Ft. Longwire **P/N 600233-817-007**
Includes wire, insulators, eye bolts, rope and instructions

150 Ft. Dipole, MSR 7000 **P/N 600034-398-001**
Pre-assembled antenna with 40 ft., 450 ohm twin lead feed line, no masts.

150 Ft. Dipole, MSR 7001 **P/N 600185-700-001**
Included MSR 7000 150 ft. antenna, 40 ft. mast, guys, hardware, instruction manual and carrying case.

150 Ft. Dipole, MSR 7002 **P/N 600185-700-002**
Same as MSR 7001, but with two masts.

32 Ft. Whip **P/N 600018-398-001**
Rugged, self supported, eight section tapered fiberglass antenna. Requires flange mount base P/N 600018-398-007

Antenna Mounting Base **P/N 600018-398-007**
Flange mounted base for use with 32 foot whip P/N 600018-398-001

SECTION 2

INSTALLATION

2.1 GENERAL

Installation of the MSR 6700A Exciter is fast and simple as the unit is completely wired, calibrated and tested before shipment from the factory. Included in this section are procedures for unpacking, inspection and if necessary, reshipping.

2.2 UNPACKING AND INSPECTION

Unpack the exciter and make certain that all equipment outlined in Section 1.4 is present. Retain the carton and packing material until the contents have been inspected. If there is evidence of damage, do not attempt to use the equipment. Contact the shipper and file a damage claim.

2.3 RESHIPPING

If return of the equipment should become necessary, a Returned Material (RM) number must first be obtained from the Mackay Customer Service Department. This number must be clearly marked on the outside of the shipping carton.

2.4 UNIT INSTALLATION

Thoroughly plan the locations of the exciter and associated equipment and carefully follow all installation considerations. Satisfactory system performance depends upon the care and attention taken prior to and during installation.

The protective connector covers installed on the exciter for shipping should remain over unused connectors.

2.4.1 REAR PANEL

All external connections are made to the exciter rear panel. Mounted on the rear panel are the following connectors:

a) AC POWER - Standard AC power connector.
b) ANTENNA - SO-239 type connector.
c) GND - 1/4 to 20 chassis ground stud.
d) ACCESSORY - 37-pin MS connector for all control signals for connection of external LPA or antenna coupler
e) AUDIO - 25-pin miniature D connector contains all audio inputs, auxiliary 13 and 26 VDC outputs, keying control inputs and transmit mode indicating signal.
f) RS-232/PRESEL - 25-pin miniature D connector contains control signals for RS-232C, RS-422, RS-423 and MIL-STD-188C, and also all signals required for optional preselector.
g) REF IN-OUT - BNC connector for 5 MHz reference. Rear panel switch determines whether signal is an input or an output.
h) PA FAN - 5-pin connector provides supply voltage to PA cooling fan.

2.4.2 INSTALLATION CONSIDERATIONS

2.4.2.1 Antenna Site Location

For optimum characteristics and safety, the antenna should be mounted high enough to clear any surrounding obstructions. The antenna should also be located as far as possible from nearby objects such as power lines, buildings, etc. Figures 2.2 and 2.3 show typical whip and longwire installations.

2.4.2.2 Adequate Ground

Provide the best possible RF ground for the exciter and the coupler. Use a flat copper strap 25 mm wide or number 6 or larger gauge wire. Connect it to the ground terminal at the rear of the exciter and on the coupler ground. Leads to the ground system should be as short as possible.

2.4.2.3 Separation

Provide maximum separation between the coupler output (antenna) and the exciter. The coupler may be mounted up to 61 meters (200 feet) from the exciter when RG-213U cable is used. For runs under 30 meters (100 feet), RG-58A/U cable may be used.

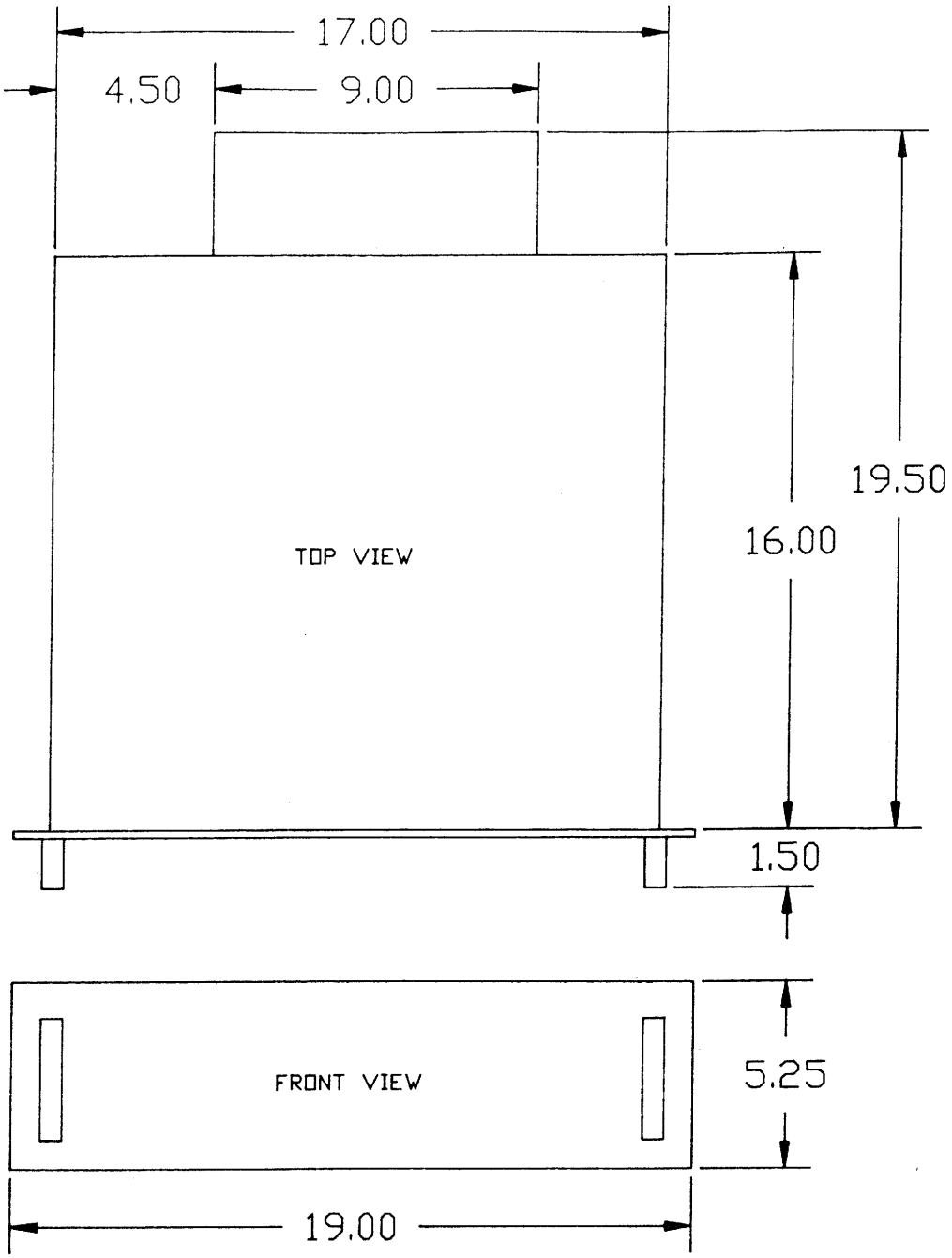


Figure 2.1 Exciter Outline Dimensions

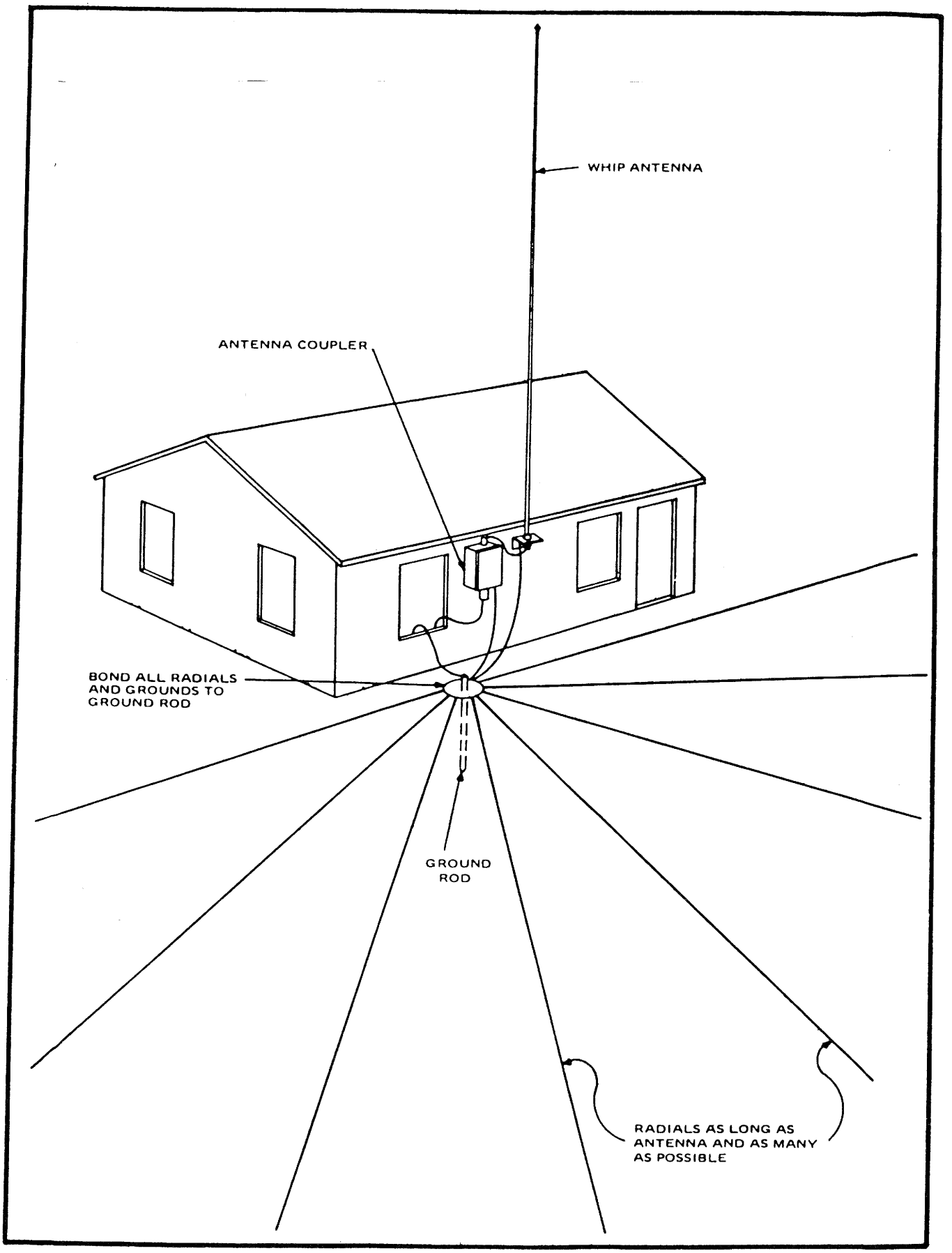


Figure 2.2 Typical Whip Antenna Installation

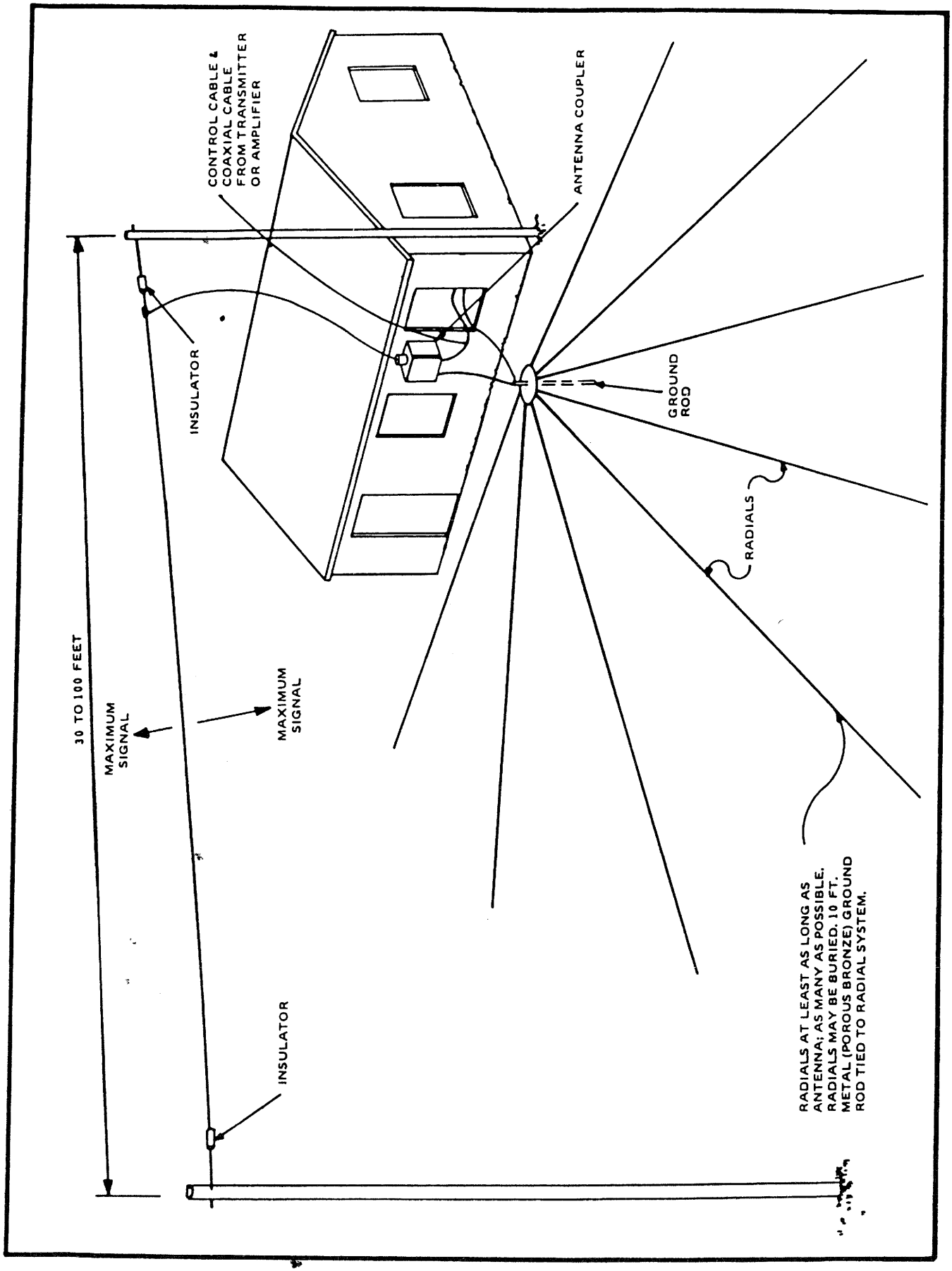


Figure 2.3 Typical Longwire Antenna Installation

NOTE

Transmitters may oscillate if RF power is radiated or conducted into low level stages. Evidence of this condition is erratic or excessive RF output. The cause is the close proximity of the antenna to the trans mitter and/or poor RF grounds.

2.4.2.4 Antenna Lead-In

The lead-in from the coupler to the antenna must be insulated for at least 10 kV potential and should not run parallel to metal objects which are bonded to ground. The coupler should be as close as possible to the antenna and never more than 1 meter away, as this will decrease antenna efficiency.

2.4.3 BASE STATION INSTALLATION

The exciter can be installed in its own (optional) cabinet for table-top mounting or can be installed in a communications console.

2.4.3.1 Rack Mount Installation

The exciter may be conveniently mounted in a standard 19 inch rack by using the exciter rack mount kit (P/N 600078-700-001). This kit includes a pair of rack slides and associated hardware. The exciter in the rack mounted configuration requires a standard panel space of 13.21 cm (5.2 inches).

The front panel is not designed to support the exciter when the unit is installed in an equipment rack. Rack slides should be used to support the exciter when rack mounted.

CAUTION

Do not support the exciter by the chassis bottom in such a way that the air flow will be restricted.

If installation assistance is required, consult the Mackay Customer Service Department.

2.4.4 MARINE INSTALLATIONS

The exciter is not weather, splash and corrosion resistant and should not be installed where it is exposed to salt spray. It should be installed in a well ventilated area away from heat sources, such as heating vents, etc. The location should be as close as possible to the power source and grounding point.

IT IS RECOMMENDED THAT THE EXCITER BE SECURELY GROUNDED, as poor grounding can degrade performance. With a metal hull, the exciter can be grounded directly to the vessel's structure. With a wood or fiberglass hull, a ground/counterpoise system must be constructed. The counterpoise should have as much surface area as possible. About 9.5 square meters (100 square feet) should be provided for 2 MHz operation. A reasonably good ground can be achieved by bonding together large metal objects. Bonded to this ground, should be two or three wide copper straps running as far as possible, together with three or four cross members (ground plates may be effective on lower frequencies but are subject to fouling. Therefore, they are not recommended). Figure 2.4 shows a typical ground/counterpoise system.

2.5 ANTENNAS AND GROUND SYSTEMS

The exciter is designed to drive a 50 ohm resistive antenna system with a 2:1 VSWR maximum.

When used with the companion coupler, the system will drive the following antennas:

CAUTION

The antenna radiates dangerous RF voltage which can cause burns and injury. Do not touch the coupler antenna terminal, long wire or whip antenna while transmitting.

a) WHIP, 5-12 meter (16-35 feet), 1.6 to 30 MHz.

b) LONGWIRE, 15-49 meter (50-150 feet), 1.6 to 30 MHz.

c) DIPOLE, 1.6 to 30 MHz.

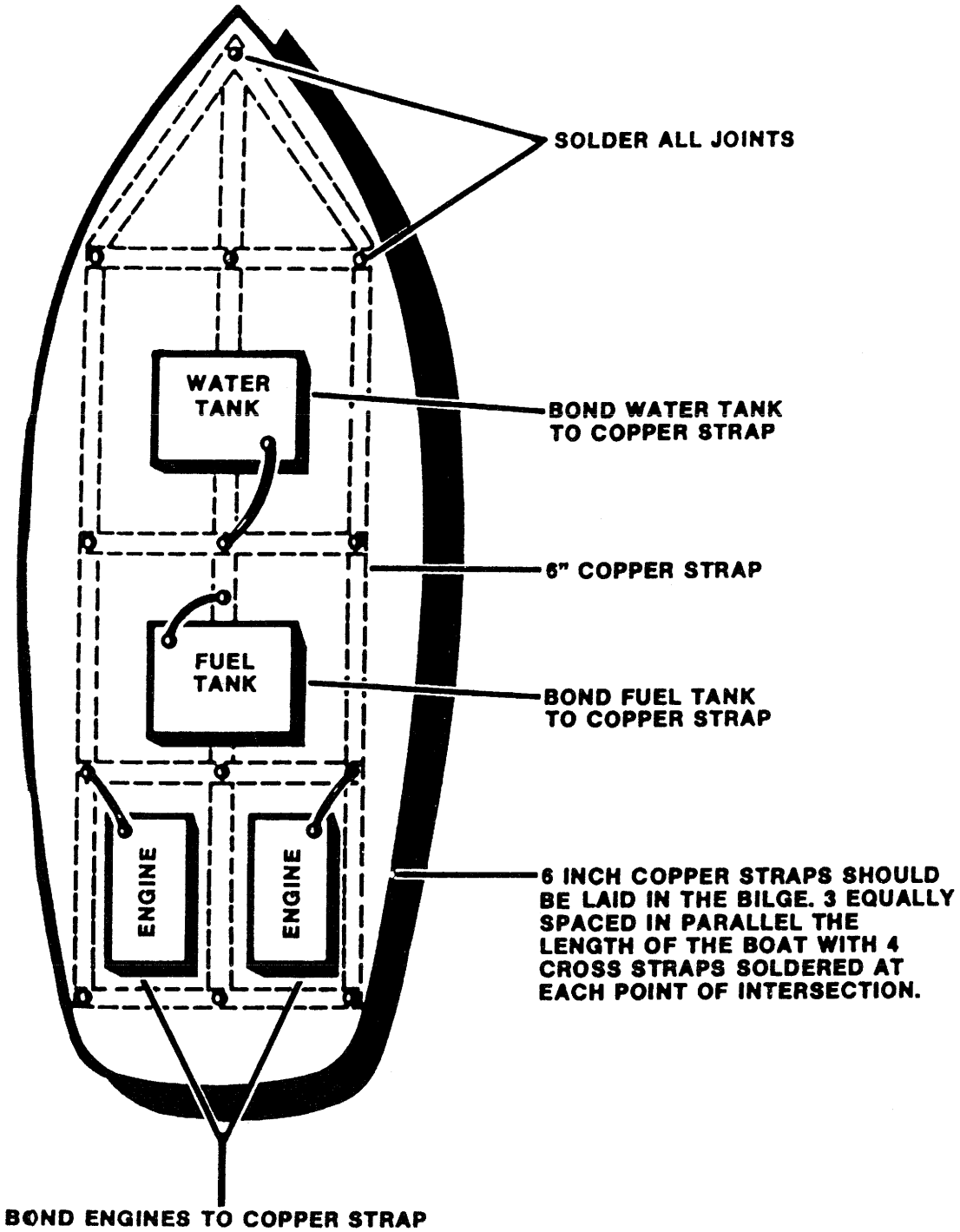


Figure 2.4 Typical Ground/Counterpoise Installation

Some general antenna system guidelines are:

a) Mount the antenna as high as possible.

b) Where possible, use antennas over 1/8 wavelength long at the lowest operating frequency. Short antennas are not efficient radiators.

c) Short antennas are most sensitive to ground loss. When a short antenna is used, the best possible ground system should be obtained. (See Figures 2.2 and 2.3.)

d) On ships with non-metallic hulls, make the ground/counterpoise system cover as large an area as possible. Make maximum use of large metal objects, copper screen, the propellor shaft and properly bonded copper straps.

e) Use the lowest possible inductance ground connections for the antenna coupler.

Table 2.1

Mating Connectors to Exciter and Accessories

DESCRIPTION	DESIGNATOR	MATING PARTS	
		MIL	MACKAY PART NO.
Microphone	A1J1	U-229/U	600388-606-002
CW Key	A1J2	PJ-55B	600015-386-001
Accessory	A3J43	MS-3106A-28-21P	600375-606-002
Antenna	A3J46	PL-259	600244-606-002
PA Fan	A3J40	AMP 126-217	600377-606-001
Audio	A3J42	DB25P	600292-606-006
RS-232/Preselector	A3J44	DB25S	600292-606-005

Table 2.2

Audio Connector (J42) Pin Assignments

PIN DESIGNATION	SIGNAL NAME	DESCRIPTION
1	+13v	+13v from internal regulator. For misc. external use (not to exceed 50mA drain)
2	CNTL STAT C	With pin 3, this is a 600 ohm balanced I/O port for remote FSK operation. This port operational only if remote control options 700015-700-001 (Remote FSK Modem) and 700015-700-002 (Addressable Audio I/O) are installed. If only 700015-700-001 installed, use FSK port at pins 15 and 16. See Sections 1.5 and 5.1 for complete instructions.
3	CNTL STAT D	See pin 2.
4	+26v	+26VDC accessory supply voltage for external use at maximum 1 amp drain.
5	/PWR ON	Pulling this line low will turn on the exciter.
6	MIC	This is an external microphone input, tied in parallel to the front panel input. See Table 2.7.
7	/PTT	This input is tied in parallel with the front panel PTT input. A low state keys the exciter in any mode. See Table 2.7.
8	SW STD A	With pin 9, this is a 600Ω balanced transmit audio input line. Switched standard audio is connected to the standard (#1) transmit modulator board when the unit is addressed via remote control. This port is operational only if remote control option 700015-700-002 is installed. See Sections 1.5 and 5.2.
9	SW STD B	See pin 8.

Table 2.2

Audio Connector (J42) Pin Assignments (Cont.)

PIN DESIGNATION	SIGNAL NAME	DESCRIPTION
10	SW ISB A	With pin 11 switched ISB audio is the same as switched STD Audio (pins 8 and 9) except that it is routed to the ISB (#2) transmit modulator board to produce lower sideband audio when the exciter is in the ISB mode. Two options must be installed for this port to be operational: ISB option and Remote Control option 700015-700-002. See Section 1.5 and 5.2 for complete information.
11	SW ISB B	See pin 10.
12	GND	Connected to radio chassis.
13	GND	Connected to radio chassis.
14	SPARE	No connection.
15	CNTL STAT A	With pin 16, this is a 600Ω balanced I/O port for remote FSK operation. This port operational only if remote control option 700015-700-001 installed. See Section 1.5, 5.1 for complete information.
16	CNTL STAT B	See pin 15.
17	/TX2	This output is low while the exciter is keyed. Will sink 10 mA maximum.
18	/EXT KEY	Pulling this input low will key the exciter in any mode.
19	RECEIVE AUDIO	This input line is connected directly to pin E on the front panel microphone connector. It can be used to bring receiver (or other) audio to the earpiece of a handset or headset.
20	KEY PIN	No signal. Used to key internal cabling to prevent improper connection.

Table 2.2

Audio Connector (J42) Pin Assignments (Cont.)

PIN DESIGNATION	SIGNAL NAME	DESCRIPTION
21	ISB B	See pin 22.
22	ISB A	With pin 21, this is a 600Ω balanced audio input for lower sideband when the exciter is in the ISB mode. Operational only if ISB option is installed. See Section 1.5, 5.2.
23	STD B	See pin 24.
24	STD A	With pin 23, this is a 600Ω balanced audio input for all modes except lower sideband when in ISB mode.
25	/EXT FSK KEY	Pulling this input low will key the exciter only in FSK mode.

Table 2.3

Accessory Connector (J43) Pin Assignments

PIN DESIGNATION	SIGNAL NAME	DESCRIPTION
A	/FAULT	This is a normally high input from the antenna coupler or external LPA. When this line is pulled low, the front panel FAULT INDICATOR will light after a 120 mSec delay.
B	/KEY ENABLE	This is a normally high input from the antenna coupler that is used to key the transmitter (when pulled low) during a tune cycle.
C	/KEY INTERLOCK	This line must be held low to enable keying the transmitter.
D	/SURVEILLANCE TUNE	This line is an output to the antenna coupler. A low state on this line will put the coupler in the surveillance tune mode.
E	/CH1	This output is the least significant bit of an 8 bit BCD number that gives the MSR 4030 Coupler the channel number information required for silent tune mode. The sequence for these lines from least to most significant bit is: CH1, CH2, CH4, CH8, CH10, CH20, CH40, CH80. These outputs are available regardless of tune mode selection or antenna coupler selection.
F	/MED PWR	This is normally high output to the MSR 1020 Power Amplifier. Pressing the RF Level 3 key on the front panel will pull this line low if an MSR 1020 is connected. A low state on this line sets the MSR 1020 to its medium power mode.
G	GND	This GND is the reference for all digital I/O signals and supply voltages available at this connector.
H	/SILENT TUNE	This line is an output to the MSR 4030 Coupler. A low state on this line will put the coupler in the silent tune mode.

Table 2.3

Accessory Connector (J43) Pin Assignments (Cont.)

PIN DESIGNATION	SIGNAL NAME	DESCRIPTION
J	/TUNE	This line is an output to the antenna coupler. Initialization of a tune cycle other than silent tune will cause this line to go low and the coupler to begin a tune cycle.
K	/READY	This line is an input from the antenna coupler. At the completion of a successful tune cycle, the antenna coupler will pull the /READY line low which illuminates the ready indicator on the front panel.
L	/CH4	See pin E in this section.
M	/TUNING	This line is an input from the antenna coupler and the kilowatt amplifier. When the coupler begins a tune cycle, it pulls this line low which causes the not-tuned indicator on the front panel to illuminate until the completion of the tune cycle. Pulling this line low from an external source for at least 20 usec will cause the MSR 6700A to initiate a tune cycle if its VSWR Retune switch in ON.
N	/CH8	See pin E in this section.
P	/CH20	See pin E in this section.
R	EXT REFLECTED PWR	This line is an analog input to the front panel meter which normally carries reflected power voltage from an antenna coupler or amplifier. With the panel meter in the RFL mode, 0 VDC will cause no deflection and 0.5 to 0.7 VDC will cause full scale deflection.
S	/BYPASS	This line is an output to the MSR 4030 coupler. Pressing the Bypass key on the front panel will take this output low enabling the coupler bypass function (if this option is installed in the coupler). This line will go high while the Exciter is keyed.

Table 2.3

Accessory Connector (J43) Pin Assignments (Cont.)

PIN DESIGNATION	SIGNAL NAME	DESCRIPTION
T	/B3	This is one of eight active low outputs which are used by the MSR 1020 Amplifier to select the appropriate harmonic filter. BAND 1 1.6-1.9999 MHz BAND 2 2.0-2.9999 MHz BAND 3 3.0-3.9999 MHz BAND 4 4.0-5.9999 MHz BAND 5 6.0-8.9999 MHz BAND 6 9.0-12.9999 MHz BAND 7 13.0-19.9999 MHz BAND 8 20.0-29.9999 MHz Only one of these lines will be low at a time.
U	/B4	See pin T, this section.
V	/B5	See pin T, this section.
W	/CH80	See pin E, this section.
X	/B6	See pin T, this section.
Z	/CH2	See pin E, this section.
a	/B8	See pin T, this section.
b	/B7	See pin T, this section.
c	ALC GND	This GND is the reference for external ALC and ACC voltages.
d	/B1	See pin T, this section.
e	/B2	See pin T, this section.
f	/LOW POWER	This output is not presently used.
g	/CH10	See pin E, this section.
h	/GROUP SELECT	This pin is grounded. This allows the MSR 4030 to accept channel information from CH 11 to 96.

Table 2.3

Accessory Connector (J43) Pin Assignments (Cont.)

PIN DESIGNATION	SIGNAL NAME	DESCRIPTION
j	ALC	This is an analog input for control of the RF Power output of the Exciter in all modes except AME. It is intended for feedback control of system power when the MSR 1020 Amplifier is used. With 0 VDC at this pin, the exciter will have full RF output as determined by its internal ALC loop. As the input voltage is increased to 4 VDC, the output power will decrease to zero.
k	/COUPLER ENABLE	This input must be held low for the MSR 6700A to be able to initialize any coupler tune mode.
m	ACC	This is an analog input that controls the AM carrier power out from the Exciter. At 0.0 VDC input, the AM carrier power is determined by the internal ACC loop. As the input voltage is increased to 4 VDC, the AM carrier power will go to zero.
n	/CH40	See pin E, this section.
p	/TX2	This output will be low while the Exciter is keyed.
r	+26VDC	Accessory power source, 26 VDC nominal fused for 5A.
s	LPA ON	This output goes high to turn on an MSR 1020 when RF Power buttons 3 or 4 are pressed. The microprocessor will not allow these buttons to light if an MSR 1020 is not connected. Pressing 3 or 4 with pin "s" loaded with 500 to 1000 ohms (or an LPA connected and turned on) will cause it to go high (3 to 6V) and stay high until button 1 or 2 is pressed. With pin "s" loaded with 10k ohms or greater, it will pulse high for about 50 msec when button 3 or 4 is pressed.

Table 2.4

RS-232/Preselector (J44) Pin Assignments

This connector shares control lines for RS-232, RS-422, RS-423, MIL-STD-188 Remote Control and an optional preselector. The preselector lines are operational only when the preselector is installed. For more information on the preselector option (MSR 6300 P/N 700007-700-002) see Sections 1.5 and 5.3. The remote control lines are always operational and are on pins 3, 4, 6, 7, 8, 9, 18.

Remote control pin assignments are not standard. Remote control formats and baud rates are set by dip switches on the Interface Board (see Table 3.1). Preselector control lines are active high, BCD coded to the exciter output frequency. See Table 2.5 for signal specifications.

PIN DESIGNATOR	SIGNAL NAME	DESCRIPTION
1	1M4	BCD "4" bit, 1 MHz DECADE output.
2	GND	Exciter chassis ground.
3	RXB BAL	Return for pin 18, RS-422 only.
4	TXB	Remote control transmit data output, port 2.
5	1M8	BCD "8" bit, 1 MHz decade output.
6	TXB BAL	Return for pin 4, RS-422 ONLY.
7	RXA BAL	Return for pin 9, RS-422 ONLY.
8	TXA BAL	Return for pin 10, RS-422 ONLY.
9	RXA	Remote control receive data input, port 1.
10	TXA	Remote control transmit data output, port 1.
11	100K1	BCD "1" bit, 100 kHz decade output.
12	10K1	BCD "1" bit, 10 kHz decade output.
13	100K2	BCD "2" bit, 100 kHz decade output.
14	1M2	BCD "2" bit, 1 MHz decade output.
15	1M1	BCD "1" bit, 1 MHz decade output.
16	10M2	BCD "2" bit, 10 MHz decade output.

Table 2.4

RS-232/Preselector (J44) Pin Assignments (Cont.)

PIN DESIGNATOR	SIGNAL NAME	DESCRIPTION
17	10M1	BCD "1" bit, 10 MHz decade output.
18	RXB	Remote control receive data input, port 2.
19	SPARE	----------
20	/TX2	This output is low during transmit. It is used to enable the Preselector for transmit operation.
21	10K8	BCD "8" bit, 10 kHz decade output.
22	100K8	BCD "8" bit, 100 kHz decade output.
23	10K4	BCD "4" bit, 10 kHz decade output.
24	100K4	BCD "4" bit, 100 kHz decade output.
25	10K2	BCD "2" bit, 10 kHz decade output.

Table 2.5

Specifications for Remote Control/Preselector (J44)

SIGNAL NAME	SPECIFICATION
Preselector (BCD) Control Voltages - Active High	High Output: +3.5 to 5.5V Low Output: 0 to 0.7V
Remote Control Lines - RS-232, RS-423, MIL-STD-188	Two ports are available, i.e., for daisy chaining (RXA, TXA, and RXB, TXB). A received signal on RXA, e.g., will be processed in the Exciter and also duplicated as an output on RXB. A transmitted control (or status) signal from the Exciter will exit both TXA and TXB.
TXA, B:	
RS-232/RS-423	Logic 1: -4V to -6V/-3.6V to -6V Logic 0: +4V to +6V/+3.6V to +6V Baud Rate: 300 to 9600 Baud
MIL-STD-188C	Logic 1: +4V to +6V Logic 0: -4V to -6V Baud Rate: 300 to 9600 Baud
RXA, B:	
RS-232/RS-423	Logic 1: -3V to -25V/-0.2V to -6V Logic 0: +3V to +25V/+0.2V to +6V Baud Rate: 300 to 9600 Baud
MIL-STD-188C	Logic 1: +0.6V to +7V Logic 0: -0.6V to -7V Baud Rate: 300 to 9600 Baud
Remote Control Lines - RS-422	These lines are returns for RXA, TXA, RXB, TXB to form balanced pairs required for RS-422
TXA/TXA BAL; TXB/TXB BAL (RS-422 TRANSMIT)	Logic 1: -2 to -6V Logic 0: +2 to +6V
RXA/RXA BAL; RXB/RXB BAL (RS-422 RECEIVE)	Logic 1: -0.2 to -6V Logic 0: +0.2 to +6V

Table 2.6

PA Fan Connector (J40) Pin Assignments

PIN DESIGNATION	SIGNAL NAME	DESCRIPTION
A	+26 VCD	Supply voltage for blower fan: 26 VDC at 1A.
D	GND	This is the reference for the fan supply voltage and temperature signal.

Table 2.7

Microphone Connector (J1) Pin Assignments

PIN DESIGNATION	SIGNAL NAME	DESCRIPTION
A	GND	This is the reference for: PTT, microphone audio inputs, and the receive audio output.
B	RECEIVE AUDIO	This line is connected directly to pin 19 of J42. This line is used to provide receive audio to the handset.
C	/PTT	This is an active low input that will key the exciter in any operating mode.
D & E	MIC AUDIO IN	These pins are in parallel. The input characteristics of these lines are determined by the CAR/DYN switch on the Mother board and JP1 on the Transmit Modulator board.
----------	HI-LEVEL DYNAMIC P/N 600352-713-001	With the Mother board switch in the DYN position, 200 mV RMS at 1 kHz will produce rated sideband output power.
----------	LO-LEVEL DYNAMIC P/N 600002-386-001	With the Mother Board switch in the CARBON position and JP1 in 2-3 position, 1 mV RMS at 1 kHz will produce rated sideband output power.
----------	CARBON P/N 600014-386-001	With the Mother board switch in the CARBON position and JP1 in the 1-2 position, 100 mV RMS at 1 kHz will produce rated sideband output power.

Table 2.8

CW Key Jack (J2)

1. Low input keys the Exciter in CW mode only.
2. High input unkeys the Exciter. The Exciter returns to the RECEIVE mode only after the CW hangtime expires.
3. CW hangtime is adjustable from 0.5 to 4 seconds on the coupler interface board.

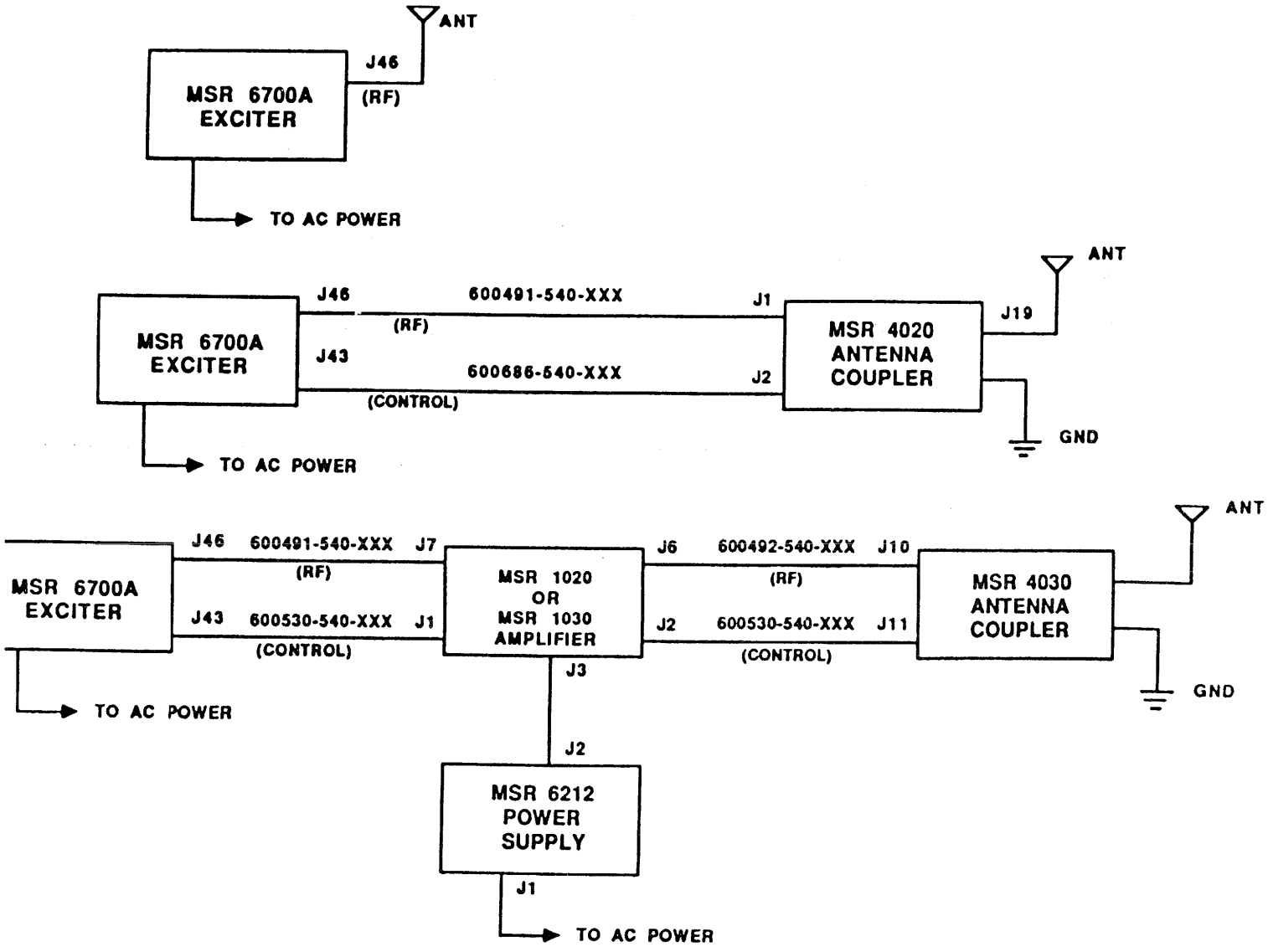


Figure 2.5 Typical System Interconnect Diagram

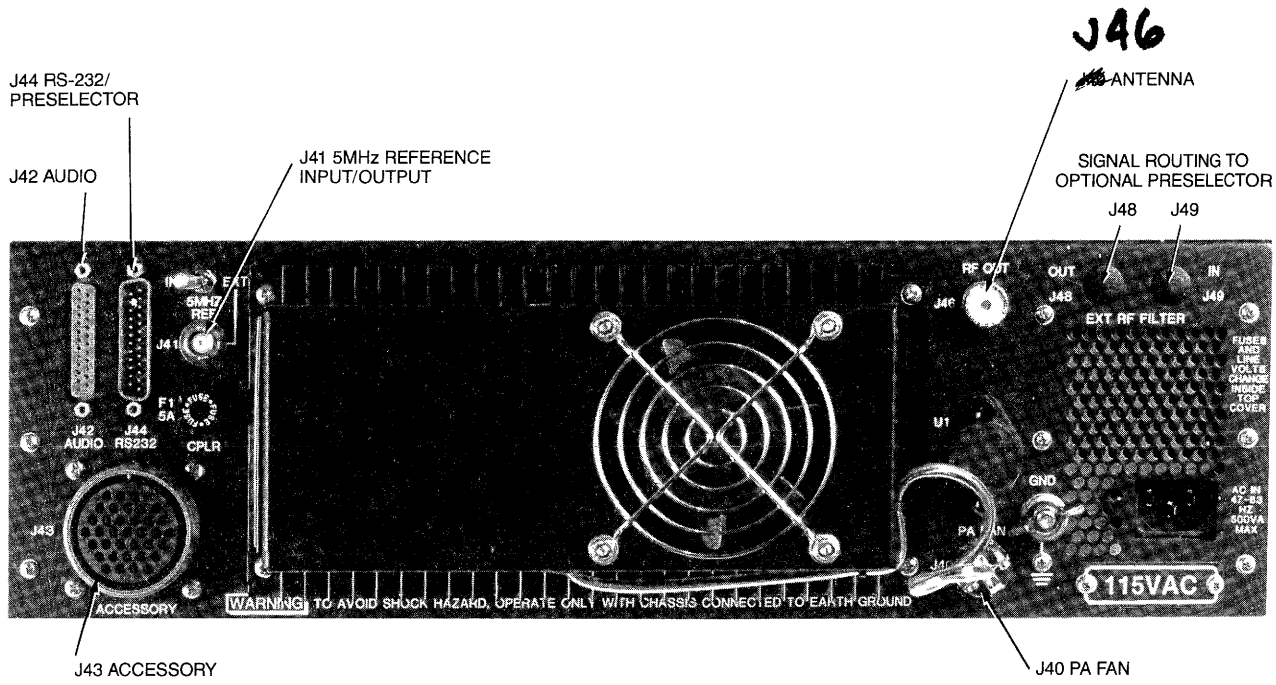


Figure 2.6

MSR 6700A Rear Panel

JAC

SECTION 3

OPERATION

3.1 GENERAL

This section describes the functions of the controls and connectors and explains internal adjustments of the standard MSR 6700A. Complete operating instructions for the standard exciter are provided; operating instructions for non-standard functions are detailed in Section 5.

3.2 FRONT PANEL CONTROLS AND CONNECTORS

Refer to Figure 3.1 for control locations.

NOTE

Some front panel function switches contain LEDs (Light Emitting Diodes) to indicate when a particular function is active. Switches do not mechanically activate the LEDs. The LEDs are turned on by the microprocessor when it selects the various functions.

3.2.1 MICROPHONE CONNECTOR

This connector is for a high or low level dynamic or for a carbon microphone. The exciter is normally configured for the high level dynamic microphone that is shipped with the unit. Refer to paragraph 3.4 to configure the unit for a low level dynamic or carbon microphone.

The exciter may be keyed in any mode using the front panel microphone connector. Keying via the microphone PTT keyline also inhibits rear panel audio signals which are replaced by the microphone audio. When the exciter is in the ISB mode, the user can select which sideband should receive the microphone audio. See Section 3.2.13 for a full explanation.

NOTE

Operation of most MSR 6700A front panel controls is inhibited while the unit is keyed. The exceptions are meter buttons and MIC selector buttons when in ISB mode.

3.2.2 CW KEY JACK

This connector is a standard 1/4 inch phone jack intended for use with a CW key. The unit may be keyed from this jack in the CW mode only.

3.2.3 POWER SWITCH

This two-position rotary switch applies primary power to the unit when in the "ON" position.

3.2.4 CHAN (CHANNEL) BUTTON AND CHANNEL DISPLAY

This button prepares the unit for channel number entry. When pushed, the button indicator lights and dashes appear in the display. The unit expects a two digit channel number entry from the keyboard. Channel entry is terminated by pushing the E (Enter) key in the keypad. See Section 3.5 for complete operating instructions.

3.2.5 FREQ (FREQENCY) BUTTON AND FREQUENCY DISPLAY

This button prepares the unit for frequency entry. When pushed, the button indicator lights and the frequency may be entered starting with the most significant digit. The MSR 6700A operating range is 1.6 to 29.99999 MHz, so any frequencies entered which are out-of-range will be translated back into the exciter's operating range. Low frequencies will be raised to 1.60000 MHz; high frequencies dropped to 29.99999 MHz.

If an error is made in frequency entry, simply press C (Clear) and the incorrect digit is removed. When entering the operating frequency, it is not necessary to enter the full seven digits. The E button may be pushed at any point to terminate the entry. Any unentered digits will be entered as zero when the E button is pushed. Refer to Section 3.5 for complete operating instructions.

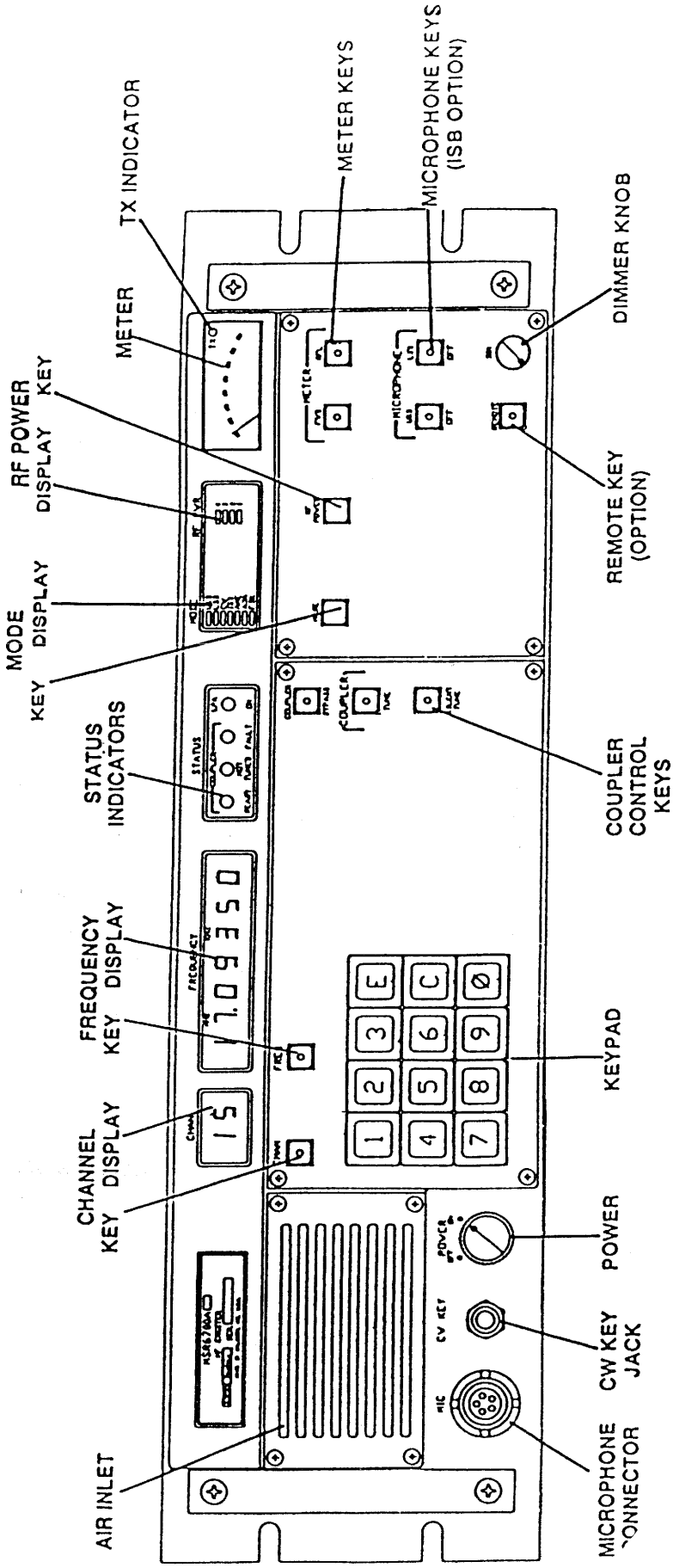


Figure 3.1 Front Panel Controls and Connectors

3.2.6 NUMBER KEYPAD

This 3 x 4 array contains the number keys plus the function keys C (clear) and E (Enter).

The C key may be pushed at any time to terminate the current operation and reset the unit. The E key must be pushed to complete the entry of channel or frequency data.

3.2.7 COUPLER BYPASS

This button activates the bypass option in the MSR 4030 Antenna Coupler. When activated, the antenna RF signal bypasses the antenna coupler tuning elements. This allows improved reception to a receiver sharing the antenna, and operating at a different frequency. The bypass function is over-ridden whenever the exciter is keyed.

The first push on the button activates the bypass function; the button LED lights. Another push disengages the bypass. However, since the MSR 6700A cannot tell if the bypass option is installed, the button LED will come on for MSR 4030 couplers which do not have the bypass option installed.

NOTE

The coupler bypass option should not be activated during ARQ operation. The bypass relay cannot keep up with the fast keying rates required.

3.2.8 COUPLER TUNE AND SILENT TUNE

These buttons initiate either a regular RF tune cycle or a silent tune cycle in the antenna coupler. If no coupler is present in the system, these buttons will not function. If the coupler in use does not have silent tune capability, then the silent tune button will not function.

Silent tune is a feature available with the MSR 4030 Coupler that allows coupler tuning without the presence of RF drive. The coupler accomplishes this by storing the locations of the tuning elements after an initial RF drive tune in a specific channel (channels 01 through 95 may be used).

The coupler recognizes when that channel is subsequently selected, and tunes by returning the tuning elements to the stored locations.

3.2.9 STATUS DISPLAY

The four LED indicators in this display monitor the status of an antenna coupler or LPA connected to the MSR 6700A. The READY, NOT TUNED, and FAULT lights indicate coupler status. The FAULT indicator will also light to show faults within the MSR 6700A. See paragraphs 3.5.6 and 3.5.7 covering coupler operation for more information concerning the coupler status LEDs.

THE LPA "ON" indicator lights when an MSR 1020 1 kW LPA or MSR 1030 400W LPA is connected to the exciter and has been activated by selecting system RF power level 3 or level 4 (see paragraph 3.2.11).

3.2.10 MODE BUTTON AND DISPLAY

This display indicates the current operating mode. The button is used to change modes. Each press switches the mode to the next highest mode listed in the display.

The mode can only be changed when the exciter is in channel "00" (scratchpad mode) or when in the channel or frequency entry mode.

3.2.11 RF POWER BUTTON AND DISPLAY

This button selects the RF output power level of the exciter or exciter/LPA system.
The nominal power levels are as follows:

4	1000W	(with LPA)
3	500W	(with LPA)
2	125W	
1	25W	

The RF PWR button operates in the same way as the MODE button. Each press raises the RF power to the next highest level.

An unavailable RF power level cannot be selected. If there is no LPA in the system, the exciter

will stay in power levels 1 and 2. Because there is no low power setting available when in the AME or A3A mode, the exciter will not allow level one to be selected when in the these modes.

3.2.12 METER AND FWD/RFL BUTTONS

The front panel meter indicates either forward or reflected power as determined by the FWD and RFL buttons. A transmit mode indicating LED in the upper-right corner of the meter is illuminated whenever the exciter is keyed.

The forward power meter reading is an indication of the relative forward power of the MSR 6700A itself. The reflected power reading is indicative of the reflected power seen at the system component nearest the antenna. If the system consists of an exciter connected directly to an antenna, there is no reflected power reading. If there is also an LPA in the system, the reflected power reading comes from the LPA. If the system includes an antenna coupler (with or without an LPA), coupler reflected power will be displayed on the meter.

3.2.13 MICROPHONE BUTTONS

These buttons are used to select and indicate which sideband the microphone audio is to be transmitted on: upper sideband or lower sideband. The microphone buttons are functional only when the exciter is in the ISB mode. The button LEDs, however, are functional in all modes.

In any mode, when the exciter is keyed using the PTT inputs, microphone audio replaces rear panel audio input on the sideband designated by the button LED.

Pressing the MIC USB or MIC LSB buttons when in any mode other than ISB will have no effect. When in the ISB mode, pressing either button shifts the microphone audio to the sideband selected.

3.2.14 REMOTE KEY

Pressing the remote key transfers control of the exciter to a companion MSR 6420 Remote Control Unit or to remote control by a computer. While in the remote mode, all MSR 6700A front panel controls are inhibited and all functions are controlled by the RCU. Front panel keying functions (PTT, CW Key, and rear panel PTT in parallel with front panel MIC PTT) are inhibited. Rear panel keying inputs remain active in the remote mode. To return the MSR 6700A to local control, press the remote key again.

3.2.15 DIMMER KNOB

This knob controls the brightness of the front panel displays and indicator LEDs.

3.3 REAR PANEL CONTROLS AND CONNECTORS

3.3.1 POWER CONNECTOR

Accepts AC power input of 115 or 230 VAC nominal, internally selected in the power supply.

3.3.2 EXTERNAL REFERENCE INPUT, J41

A BNC jack accepts an external refer-ence frequency input or can be used as an output port for the radio's internal 5 MHz reference. See Section 3.3.3.

3.3.3 EXT/INT REFERENCE SWITCH, S1

Used to select the internal reference signal or an externally applied reference at the external reference input, J41.

3.3.4 ACCESSORY CONNECTOR, J43

Used to transfer control signals between the exciter and an LPA or antenna coupler. Refer to Section 2 for detailed control line information. (Mates with standard MS connector MS3106A 28-21P.)

3.3.5 PA FAN CONNECTOR, J40

Used to supply DC power to the PA fan.

Figure 3.2

Front Panel Connectors

3.3.6 RF OUTPUT, J46

Used to connect PA RF output to the antenna or to an antenna coupler or LPA. Mates with PL-259 connector.

3.3.7 AUDIO CONNECTOR, J42

This DB-25S connector accepts the various audio inputs, as well as key commands, and other various inputs and outputs. Refer to Section 2 for a complete list of J42 pin assignments.

3.3.9 RS-232 CONNECTOR, J44

This DB-25P connector accepts control inputs for the various available remote control modes, as well as BCD interface option inputs and outputs. Refer to Section 2 for a complete list of J44 pin assignments.

3.4 INTERNAL CONTROLS AND ADJUSTMENTS

3.4.1 GENERAL

The MSR 6700A is designed to work with a wide variety of external equipment. This section identifies the locations and setting of the various jumpers, switches and potentiometers used by the operator to adapt the exciter to his particular system configuration. This section explains only the adjustments likely to be required by the operator. Other settings are explained in Section 4 of this manual. Adjustments related to optional equipment are described in Section 5. Refer to Figure 3.2 for control locations.

3.4.2 LINE VOLTAGE

Two switches under the power supply top cover configure the power supply to accept AC line voltage of either 115 or 230 VAC. Follow instructions printed on the power supply cover.

3.4.3 MICROPHONE SWITCHES

A switch and a jumper plug are used to configure the exciter for low level dynamic, high level dynamic, or carbon microphone. The switch is located on the mother board (S2). The jumper is on the Transmit Modulator board (JP1).

The switch and jumper should be set as follows:

	CARBON MIC	LOW LVL DYN MIC	HI LVL DYN MIC
S2	CAR	CAR	DYN
JP1	Pins 1-2	Pins 2-3	N/A

See Table 2.7 for microphone specifications.

3.4.4 SPEAKER SIDETONE LEVEL

Potentiometer R6 on the Interface board adjusts the volume level of the CW sidetone heard in the front panel speaker.

It also adjusts antenna coupler tuning beep signal volume.

3.4.5 AUDIO INPUT ADJUST

Potentiometer R1 on the Transmit Modulator board adjusts the level of the rear panel STD and ISB audio input signals.

3.4.6 COUPLER CONTROL SWITCHES
LOGIC BOARD COUPLER SWITCHES

The switches on these boards, S1 on the Coupler Interface board and S1 on the Logic board, are used to select the various coupler functions. If no coupler is connected, it does not matter if these switches are open or closed. See Table 3.2 for an explanation of the coupler functions, and Table 3.3 for switch closure instructions.

3.4.7 CW DELAY

Potentiometer R20 on the coupler interface board is used to adjust transmitter CW unkey delay. The CW delay time may be varied from approximately 0.5 to 4 seconds. Delay time is increased by rotating R20 clockwise.

3.4.8 COMPRESSOR INHIBIT JUMPER

Jumper plug JP9 on the mother board can be used to inhibit the audio compressor(s) whenever the EXT KEY input on the rear panel is used to key the exciter. Refer to paragraph 3.4.10 for jumper location and instructions.

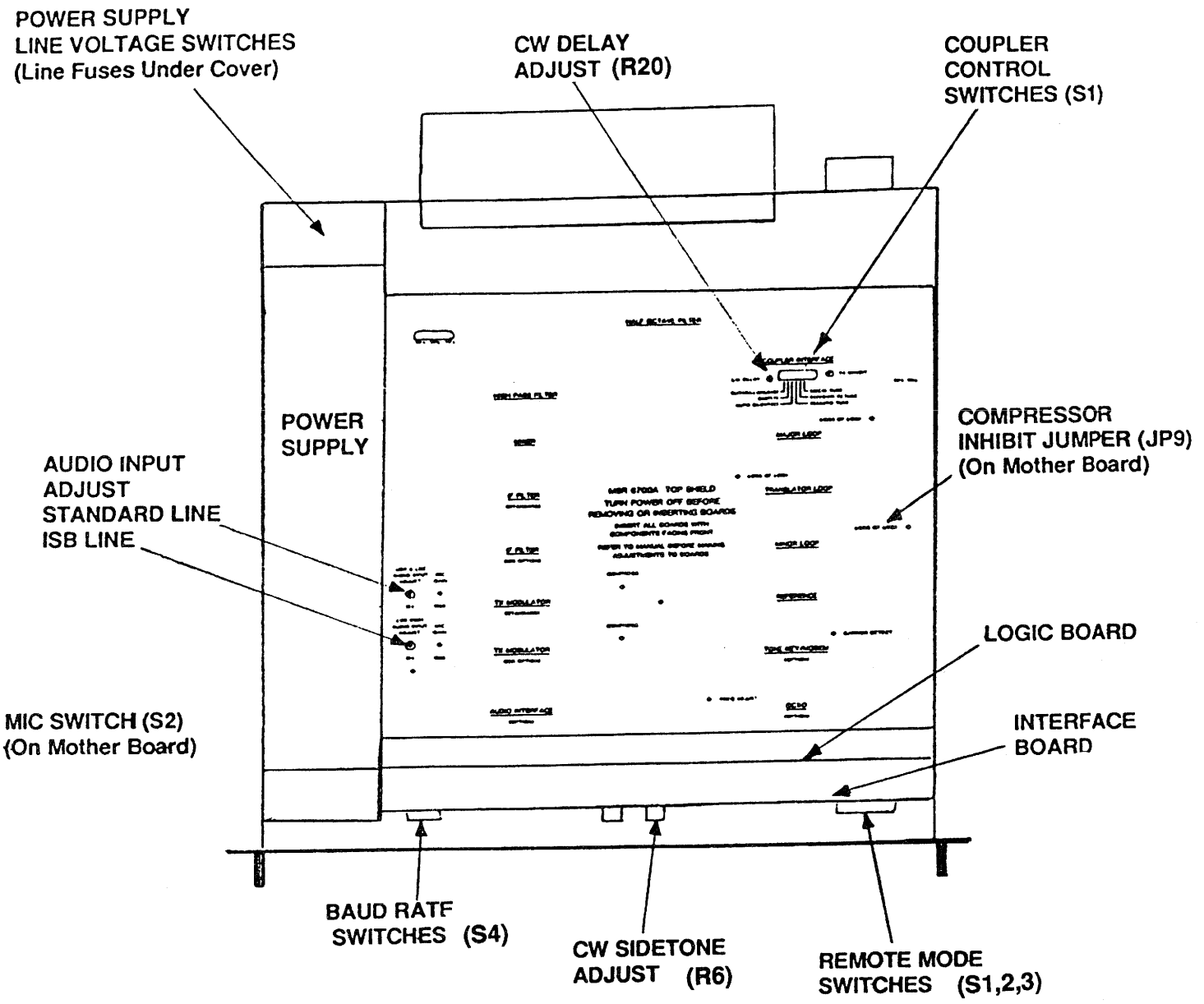


Figure 3.3 Internal Control Locations

3.4.9 BAUD RATE AND REMOTE MODE SWITCHES

These switches on the Interface board are used to configure the exciter for the remote control communication mode desired. Table 3.1 shows switch closures required for the various modes and baud rates. See paragraph 3.5.7 for more information and references.

3.4.10 MOTHER BOARD JUMPERS JP1 - JP10

These three position jumpers are used to configure the MSR 6700A to accept various jumpers or optional functions. Jumpers JP1-JP8 are factory pre-set for the options installed in the exciter and should require no chnages unless the user adds or removes Remote Control Option boards at J7 or J6. JP9 and JP10 positions depend on customer preference. They are normally factory pre-set to the following positions:

JP9: Closed (compressor disabled)
JP10: Open (tone key enabled)

An explanation of each jumper's function follows. Refer to Mother board schematic for exact wiring and Figure 3.3 for jumper locations.

JP1, JP2 - Bypass standard audio around Tone Key/Modem board connector J7

JP3, JP4 - Bypass standard audio around Audio Interface board connector J6.

JP5, JP6 - Connect CNTL/STAT audio (for FSK Modem) to Tone Key/Modem board.

JP7, JP8 - Bypass ISB audio around Audio Interface board.

JP9 - Disables Transmit Modulator board compressors when the exciter is keyed via the EXT KEY input on the rear panel.

Closed (Disabled): Jumper towards rear panel
Open (Not Disabled): Jumper towards front panel

JP10 - JP10 brings the tone keying function under switched audio remote control. When closed, the tone keying circuitry will function only if the RADIO SELECT line is high. For more details, see Section 5 description of remote control option boards.

CONFIGURATION - AUDIO JUMPERS JP1-JP8

a) Standard Exciter. No Tone Key/Modem board (J7). No Audio Interface board (J6).

JP1, JP2 closed - Jumpers away from power supply.
JP3, JP4 closed - Jumpers toward power supply.
JP5, JP6 closed - Jumpers toward power supply.
JP7, JP8 closed - Jumpers toward front panel.

b) Remote Control Option P/N 700015-700-001 Tone Key/Modem board installed in J7. No Audio Interface board.

JP1, JP2 open - Jumpers toward power supply.
JP3, JP4 closed - Jumpers toward power supply.
JP5, JP6 closed - Jumpers toward power supply.
JP7, JP8 closed - Jumpers toward front panel.

c) Remote Control Option P/N 700015-700-002 No Tone Key/Modem board in J7. Audio Interface board installed in J6.

JP1, JP2 closed - Jumpers away from power supply.
JP3, JP4 open - Jumpers away from power supply.
JP5, JP6 open - Jumpers away from power supply.
JP7, JP8 open - Jumpers toward rear panel.

d) Both Remote Control Options installed. Tone Key/Modem board installed in J7/ Audio Interface board installed in J6.

JP1, JP2 open - Jumpers toward power supply.
JP3, JP4 open - Jumpers away from power supply.
JP5, JP6 open - Jumpers away from power supply.
JP7, JP8 open - Jumpers toward rear panel.

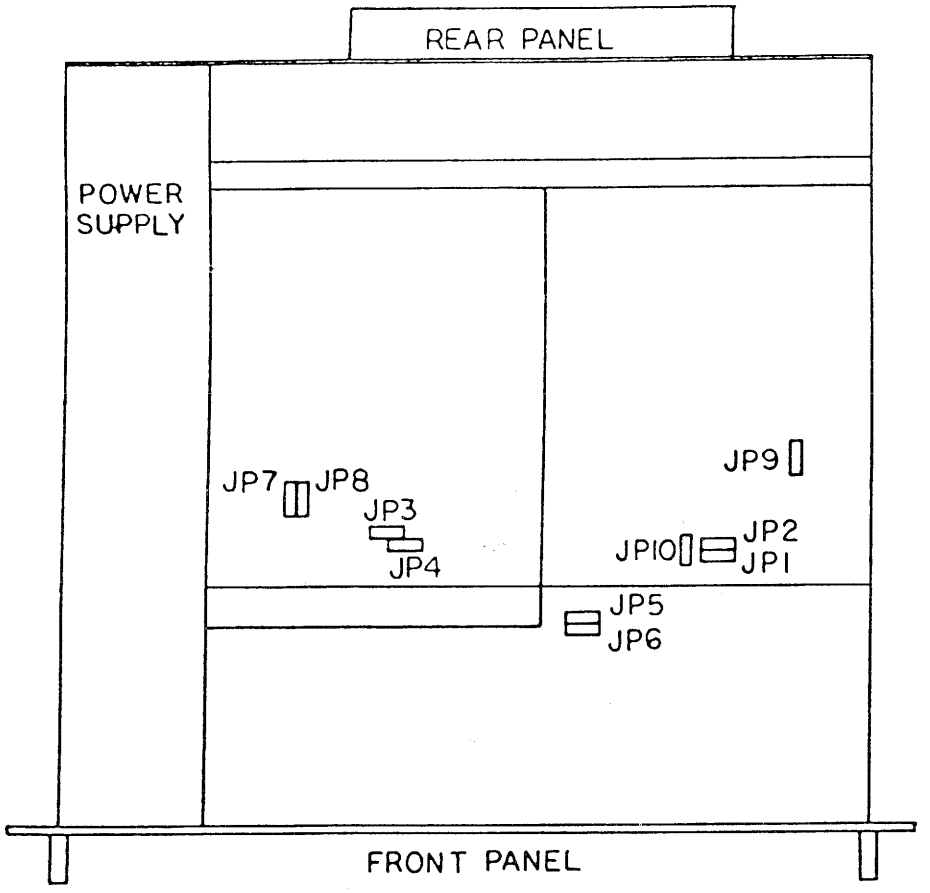


Figure 3.4 Mother Board Jumper Locations

3.5 EXCITER OPERATION

Paragraphs 3.5.1 and 3.5.2 give instructions for programming channel, frequency, emission mode, and power level information at the exciter front panel.

Subsequent paragraphs describe how to use the exciter alone or in a system.

There are two basic modes of exciter operation: Frequency mode and Channel mode. The only real difference is that the frequency mode uses "scratchpad" channel 00 and the frequencies are not stored as a separate channel. Channel mode refers to operation using frequencies and channels previously stored in memory.

3.5.1 CHANNEL MODE - HOW TO STORE FREQUENCIES

a) Press the CHAN button. Dashes will appear in the display, ready for an entry from the keypad.

b) Select the desired channel number (single digit entries are preceeded by 0, as in 02). The frequency previously stored in that channel will be displayed.

c) To change frequencies, press the FREQ button and enter the new operating frequency. Press E (Enter). Select the desired RF power level and mode. Press E again.

d) Repeat the above procedure to program more channels - up to 99.

e) If a mistake is made in frequency entry, press C (Clear) and re-enter the incorrect digit.

f) If an out-of-range frequency is entered, the MSR 6700A will translate the frequency to the closest valid frequency when the "E" button is pushed. Low frequencies below 1.6 MHz will be translated up to 1.6 MHz, and high frequencies will be translated down to 29.99999 MHz.

g) When entering frequency information, it is not necessary to enter the full seven digits. The E button may be pushed at any time to terminate the entry. Any unentered digits will be entered as zeros when the E button is pushed.

3.5.2 FREQUENCY (SCRATCHPAD) MODE OPERATION

a) Select frequency mode operation by pressing the FREQ button. The channel display will indicate the scratchpad channel 00.

b) Enter the desired operating frequency, and press E to enter.

c) While in the scratchpad mode, emission mode and power level may be changed at any time.

3.5.3 SELECTING A STORED CHANNEL

a) Press the CHAN button.

b) Enter number of desired channel.

c) Press E to enter new channel. The exciter is now configured per the previously stored channel information.

3.5.4 OPERATING THE EXCITER WITH A 50Ω ANTENNA/DUMMY LOAD

a) Connnect power connector to correct AC supply voltage. Connect RF OUT to a 50 ohm antenna or 125W dummy load.

NOTE

When the exciter is used without an antenna coupler, the accessory plug which jumpers pin C (key interlock) to pin G (ground) must be installed at J43. The exciter will not transmit without this ground. The accessory plug can be found in the MSR 6700A Accessory Kit.

b) Connect the microphone and turn the power switch to "ON".

c) Select desired channel, frequency, power level, and emission mode.

d) Press the FWD METER button to display forward power.

e) To transmit, press the MIC button and speak at a normal volume level with the microphone held 12 to 50 mm (1/2 to 2 inches) from the mouth. The exciter audio compressor will adjust volume level

Table 3.1 Baud Rate and Remote Mode Switches (Interface Board MSR 5050A, MSR 6700A)

	BAUD RATE SWITCH					
	300	600	1200	2400	4800	9600
1	0	X	0	X	X	X
2	X	0	0	0	X	0
3	0	0	0	X	0	0
4	X	X	X	0	0	0

1) Turn off AC power when setting switches.
2) All switches must be set to one of the configurations listed.
3) S2, S3, Baud Rate Switch:
X=Closed=On 0=Open=Off

* FSK-To-Digital Transitional Radio

	RX B, TX B PORTS				RX A, TX A PORTS				C/S PORTS			
	RS-232C RS-423	RS-422	MIL-188C	NO CONN	RS-232C RS-423	RS-422	MIL-188C	NO CONN	C/S USED, NO DIGITAL	NO C/S CONN	*C/S C,C/S D RX A, TX A	*C/S A,C/S B RX B, TX B
S1 - 1	—	—	—	—	UP	DN	UP	UP	—	—	—	—
2	—	—	—	—	DN	UP	DN	DN	—	—	—	—
3	—	—	—	—	UP	DN	DN	DN	—	—	—	—
4	UP	DN	UP	UP	—	—	—	—	—	—	—	—
5	UP	DN	UP	UP	—	—	—	—	—	—	—	—
S2 - 1	—	—	—	—	—	—	—	—	X	0	X	0
2	—	—	—	—	—	—	—	—	0	0	0	X
3	—	—	—	—	X	X	0	X	—	—	—	—
4	—	—	—	—	0	0	X	0	—	—	—	—
5	—	—	—	—	X	X	0	X	—	—	—	—
6	—	—	—	—	0	0	X	0	—	—	—	—
7	X	X	0	X	—	—	—	—	—	—	—	—
8	0	0	X	0	—	—	—	—	—	—	—	—
9	X	X	0	X	—	—	—	—	—	—	—	—
10	0	0	X	0	—	—	—	—	—	—	—	—
S3 - 1	—	—	—	—	X	X	X	0	—	—	—	—
2	—	—	—	—	0	0	0	0	—	—	—	—
3	—	—	—	—	X	X	X	0	—	—	—	—
4	—	—	—	—	0	0	0	0	—	—	—	—
5	0	0	0	0	—	—	—	—	—	—	—	—
6	X	X	X	0	—	—	—	—	—	—	—	—
7	X	X	X	0	—	—	—	—	—	—	—	—
8	0	0	0	0	—	—	—	—	—	—	—	—
9	—	—	—	—	—	—	—	—	X	0	0	X
10	—	—	—	—	—	—	—	—	0	0	X	0

as necessary.

3.5.5 OPERATING THE EXCITER WITH AN LPA

Operation of the MSR 6700A with the MSR 1020 1 kW LPA or MSR 1030 400W LPA varies little from standard operation. Differences are:

a) Power level desired must be selected as always, but two more power levels are available with the MSR 1020: power level 3 (500W nominal) and power level 4 (1 kW nominal). With the MSR 1030 power levels 3 and 4 both result in nominal 400W.

b) Reflected power meter indication on the front panel will be the reflected power at the LPA. If an antenna coupler is also in the system, the reflected power signal will come from the antenna coupler.

c) Forward power meter indication may not be full scale for full power out. The MSR 1020 or MSR 1030 LPAs require varying amounts of exciter power for full power out at different frequencies and output loads. Check LPA power meter for actual system output power level; exciter forward power meter shows exciter power required to drive the LPA.

d) Fault indications at the MSR 6700A front panel may be signalled by the LPA. Check LPA for faults before assuming that fault originates in the exciter.

3.5.6 OPERATING THE EXCITER WITH THE MSR 4020, MSR 4020A, OR MSR 4030 ANTENNA COUPLER

NOTE

If the MSR 4020 or MSR 4020A coupler is used, it must be a 24V coupler.

NOTE

See Table 3.2 for definitions of the coupler functions mentioned in the following paragraphs.

Basic system operation does not vary with the addition of an antenna coupler. The only changes are the coupler status LEDs on the front panel and the use of the coupler tune buttons.

3.5.6.1 Normal RF Tune Mode

a) Upon initial turn on of the exciter or coupler or after a channel change, the front panel FAULT LED will come on. This is an indication from the coupler that it has not yet been tuned.

b) Press the TUNE button. The front panel FAULT LED should extinguish and the NOT TUNED LED will light, indicating a tune cycle in process.

c) When coupler operation is complete, the NOT TUNED LED will go out and the READY LED will come on. The system is now ready for operation.

d) If the coupler cannot tune (due to a damaged antenna, for example) the front panel FAULT LED will flash to indicate fault at the coupler. The coupler will try to tune for 30 seconds. The exception to this is a fault mode which prevents the coupler from receiving an RF tone signal. In this instance, the coupler will not time out and the NOT TUNED LED will remain lit.

3.5.6.2 Auto RF-Tune

When the exciter is configured for AUTO-RF TUNE, the TUNE button does not need to be pressed to initiate an RF tune. The exciter will command a tune cycle after a channel change.

NOTE

The MSR 6700A is configured for auto-RF tune at the factory. See Table 3.3 for coupler function configuration instructions.

3.5.6.3 Silent Tune

A SILENT TUNE is initiated just like a normal RF TUNE cycle, using the SILENT TUNE pushbutton. It must be remembered that the SILENT TUNE mode can only be used on any channel after an RF TUNE has been performed one time

at that channel. This is because the coupler uses memory locations stored during that initial RF TUNE to determine tuning element locations.

The correct procedure for using SILENT TUNE is as follows:

a) Perform a successful RF TUNE on all programmed channels. (Channels 01 to 96 may be used.)

b) All subsequent tune cycles at those channels can be SILENT TUNES.

c) If the frequency assigned to any channel is changed, or a new channel is stored in memory, perform an RF TUNE at that channel before using the Silent Tune mode.

d) If the system antenna is changed or modified, an RF tune must again be performed at all channels to adapt coupler memory to the new antenna characteristics.

If an attempt is made to perfrom a SILENT TUNE on a channel that has not been previously tuned, the coupler will try to tune for 30 seconds and then time out. The front panel FAULT LED will flash to indicate this.

If the frequency stored in any channel is changed and a silent tune attempted without first performing an RF Tune, the coupler tuning elements will set to tune to the original frequency. A VSWR fault will then occur when the unit is keyed, prompting the user to re-tune the coupler with an RF Tune.

3.5.6.4 Auto-Silent Tune

When the MSR 6700A is configured for the AUTO-SILENT TUNE mode, the coupler will automatically perform a SILENT TUNE cycle each time a different stored channel is selected. The AUTO-SILENT TUNE is performed as soon as the new channel is entered.

All SILENT TUNES use memory information stored during previous RF TUNES, so it is advisable to perform an RF TUNE at all programmed frequencies before configuring the exciter for AUTO-SILENT TUNE. Alternatively, one can wait for the coupler to time out after being unable to SILENT TUNE at a previously untuned frequency, then perform an RF TUNE. Subsequent SILENT TUNES at that channel will be successful.

3.5.6.5 VSWR Retune

When the MSR 6700A is configured for VSWR RETUNE, any VSWR fault experienced by the coupler (or LPA, if connected) will command the coupler to enter an RF TUNE cycle.

3.5.6.6 Recommended Tuning Modes

The MSR 6700A is set in the factory for AUTO-RF TUNE and tuning beep. Do not use AUTO-RF TUNE and AUTO SILENT TUNE simultaneously. See Tables 3.2 and 3.3 for complete information regarding coupler functions, their availability with the various couplers, and switch settings to yield desired functions.

3.5.7 OPERATING THE EXCITER WITH THE MSR 4040 DIGITAL COUPLER

The extremely high speed operation of the MSR 4040 necessitates a different set of operating instructions. See the Technical Manual provided with the MSR 4040 for more complete explanations and instructions.

Upon initial turn of of the MSR 4040 coupler, status LEDs will indicate READY. This varies from the other couplers because of the MSR 4040 memory pre-tune feature.

3.5.7.1 Tuning Procedure

An RF tune cycle may be initiated by pressing the TUNE pushbutton on the exciter front panel. The coupler uses an AM carrier from the exciter to tune, and the tune cycle will be completed in approximately 1/2 second. During the tune cycle, the NOT TUNED LED on the exciter front panel will come on, as soon as the cycle is complete, it will go out, and the READY LED will come back on. The relay positions for this tune are recorded in the coupler memory relative to the selected channel number.

The next time this channel is selected, the coupler pretunes per the recorded data in approximately five (5) milliseconds. The coupler memory can store tuning data for all 100 channels available with the MSR 6700A, including the scratchpad channel 00.

If the frequency stored in a given channel is changed and a manual RF tune not performed, the relay positions stored in the memory will no longer be correct. When the exciter is keyed, a VSWR Fault will occur. It is recommended that the MSR 6700A be configured VSWR RETUNE when the MSR 4040 coupler is used. This will cause the exciter to command an RF TUNE cycle as soon as the fault occurs. The coupler memory will then update for the above channel, and any subsequent selections of this channel will result in correct relay pretuning. This entire process (called "memory pre-tune") will be completed in approximately 1/2 second after keying the exciter.

The MSR 6700A front panel FAULT LED will blink when a fault occurs at the MSR 4040 coupler. The following conditions will cause a fault:

a) The coupler cannot tune a particular antenna within five (5) seconds.

b) No RF energy is sent to the coupler from the exciter within 10 seconds after an RF TUNE is initiated.

c) If the VSWR seen by the coupler exceeds 2:1 (except during an RF TUNE cycle), and VSWR RETUNE is not selected in the exciter or the coupler.

Whenever the coupler is in a fault condition (as indicated by the blinking FAULT LED on the exciter status display) the coupler tuning elements are bypassed and the exciter output is connected directly to the antenna.

3.5.7.2 Recommended Tuning Modes

If the MSR 6700A is used with the MSR 4040 Antenna Coupler, the Exciter should be configured for VSWR RETUNE and TUNING BEEP. AUTO-RF TUNE and AUTO-SILENT TUNE are not necessary because of the memory pre-tune feature of the MSR 4040.

The TUNING BEEP sounds will be heard for exceptionally long tune cycles only.

See Table 3.3 for switch settings for these coupler functions.

3.5.8 REMOTE CONTROL OPERATION

There is a wide variety of remote control configurations available with the MSR 6700A. The exciter can be controlled by the MSR 6420 Remote Control Unit (RCU) or by a computer. Allowable system configurations include multi-radio, single-RCU; single-radio, multi-RCU; and also multi-radio, multi-RCU. Available communication modes are RS-232C, RS-423, RS-422, MIL-STD-188 (all standard) and 300 BAUD FSK Modem (optional). Optional "switched-audio" circuitry allows the audio lines of exciters, receivers and transceivers in a system to be all connected together on a single audio bus; RCU software then controls the audio link between any RCU-radio pair.

Each RCU or radio in a system is identified by its own address code. The address is used by the RCU operator to control or extract status information from one particular radio. The RCU operator selects an address and sends a command signal; the command reaches all radios in the system but is ignored by all except the radio with the selected address.

To verify or change exciter address:

a) Press "E" then "5" on exciter keypad. The present address will appear in the CHAN display.

b) If no change is required, press C to clear out of address entry mode.

c) To change address simply enter new address desired (single digit address must be preceded by a zero, as in 06).

d) Press E to enter the new address into exciter memory.

To put the exciter in the remote control mode, simply press the REM key on the front panel. While the exciter is controlled by the RCU, the front panel controls are non-functional. Also, the exciter cannot be keyed via the front panel (microphone PTT, CW Key), while rear panel keying inputs remain functional. If the MSR 6700A is turned off or if AC power is momentarily lost, the exciter will return to the remote mode when power is restored. To return the exciter to local control, press the REM key a second time. The MSR 6700A may also be put into, or removed from, the remote mode by the RCU.

Please refer to the following sources for complete information regarding the various remote control configurations available, as well as instructions for setting up the MSR 6700A for each configuration.

Table 1.3 - Basic explanation fo available MSR 6700A remote control options and features.

Section 6 - Detailed explanation of remote control options and operation.

Table 3.1 - Baud Rate and Remote Mode Switches

MSR 6420 Technical Manual - Detailed description of MSR 6420 remote control unit. Interconnect wiring instructions included.

CSW 1000 Technical Manual - Detailed description of CSW 1000 software to allow control of radios with IBM compatible computer. Interconnect wiring instruction included.

Table 3.2 Coupler Function Definitions and Availability

FUNCTION	AVAILABLE WITH	DEFINITION
RF TUNE	All couplers	Normal tune mode. During the tune cycle, an AM carrier signal from the exciter is used by the coupler to tune to best RF match.
SILENT TUNE	MSR 4030	Coupler tunes without the presence of an RF signal. After an initial RF tune, the coupler stores the locations of its tuning elements. When that particular channel is again selected and a silent tune initiated, the tuning elements return to the stored locations. Silent tune cycles are therefore generally quicker than RF tunes; typical tune time is less than five seconds.
AUTO RF TUNE	All couplers	An RF Tune is commanded after each channel change.
AUTO-SILENT TUNE	MSR 4030	A Silent Tune is performed whenever the exciter channel is changed.
VSWR RETUNE	MSR 4030 MSR 4020A MSR 4040	A reflected power fault encountered by the coupler or an LPA causes an RF tune.
SURVEILLANCE TUNE	MSR 4030 MSR 4020A	Coupler servo motors are enabled at all times. Recommended for use only in conjunction with Silent Tune or Auto-Silent Tune.
TUNING BEEP	All couplers	An audible BEEP tone is provided at the front panel speaker during any tune cycle.

Table 3.3 Switch Closures for Optional Coupler Functions

FUNCTION	SWITCH CLOSURES (OFF)	
	COUPLER INTERFACE BOARD	LOGIC BOARD
AUTO-RF TUNE	X	S1-2
AUTO-SILENT TUNE	X	S1-1
VSWR RETUNE	S1-2	S1-3
TUNING BEEP	S1-3	X
SURVEILLANCE	S1-4	X

The MSR 6700A is preset by the manufacturer for AUTO RF TUNE and TUNING BEEP with Logic board S1-2 and Coupler Interface board S1-3 closed; all other switches open.

If the MSR 6700A is used with the MSR 4040 digital coupler, VSWR RETUNE and TUNING BEEP are recommended. Logic board S1-3 closed, coupler interface S1-2, S1-3 closed; all other switches open.

SECTION 4

MAINTENANCE

4.1 GENERAL

This section provides information for routine maintenance, repair and evaluation of the overall performance of the exciter. Modular construction of the exciter lends itself to a logical and straight forward troubleshooting procedure. By referring to the overall and individual block diagrams, and using related level and frequency information, a trouble can be quickly localized to a particular assembly. Voltage and signal levels to all assemblies, except the power amplifier, A3A1, and front panel, A1, may be measured on the Mother board, A2, at the appropriate connector or signal point.

After establishing the existence of a trouble in a particular assembly, refer to the servicing information for that assembly located elsewhere in this section of the manual.

4.2 PC BOARD REPAIRS

4.2.1 REMOVAL AND REINSTALLATION

Care should be used when removing PC boards from the exciter. The card extractor, P/N 600268-618-001, should be used if possible. If no card extractor is available, a temporary substitute can be made from a length of solid heavy gauge wire (#10-#12). Form a hook at each end of the wire, and then insert each hook into the holes provided at the top outer edge of each PC board. Apply gentle upward pressure near each hook to free the board(s) from the edge connectors.

NOTE

DO NOT USE PLIERS OR SCREWDRIVERS TO REMOVE THE BOARDS.

When replacing boards into the PC sockets, insure that the board is in its proper position in the card guides at each board edge. Apply light downward pressure to the top edge of the board until it is fully seated into its edge connector.

4.2.2 SOLDERING

To avoid damaging the PC boards during the replacement of components, extreme care should be used in soldering and component removal. A low wattage soldering iron (25-50 watts) with a narrow tip should be used.

A low wattage iron is necessary to prevent the application of excessive heat to the copper foil of the PC board. Excessive heat may cause the foil to separate from the board, rendering the board unrepairable. Only a high quality electronic grade rosin solder should be used in making repairs.

CAUTION

DO NOT USE AN ACID CORE SOLDER.

Due to the circuit density on the boards, solder "bridges" or short circuits between adjacent foil runs are possible, if care is not used during soldering operations. After soldering is completed, the area around the connection should be closely inspected for excess solder or "bridges" between adjacent runs or connections. Any "bridges" or excess solder between connections must be removed before reinstalling the board. Because of the double sided construction used on the PC boards, a component lead may be soldered to printed circuit areas on top and bottom of the board. Consequently, when a component lead is removed, the replacement component should be resoldered top and bottom as applicable.

4.2.3 CMOS DEVICE HANDLING PRECAUTIONS

CMOS devices may be damaged by static voltages, and therefore the following is recommended:

- All MOS devices should be placed on a grounded work bench surface, and the repair operator should be grounded prior to handling MOS devices, since a person can be statically charged with respect to the work bench surface.

- Nylon clothing should not be worn while handling MOS circuit or devices.

- Do not insert or remove MOS devices from sockets while power is applied.

- When soldering MOS devices, insure the soldering iron used is a grounded type.

4.3 LOGIC INTERPRETATION

Several types of digital devices are used in the transceiver. The following descriptions are presented to explain their basic operation and symbolic notation. The digital devices used (gates, flip-flops, inverters, etc.) are binary in nature, that is, the output voltage of each can be only in two permissable states. The two possible states are called logic "1" and logic "0". The assignment of voltage levels to these states is arbitrary. However, in this manual positive logic is standardized, which means we define the logic states as shown below.

LOGIC STATES

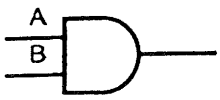
	TTL	CMOS
Logic 1: Normally greater than Logic 0: Normally less than	2.0 Volts 0.8 Volts	7.0 Volts 3.0 Volts

4.3.1 GATES

A gate is a circuit element whose output level depends upon the levels of all of its inputs in a particular pattern.

The AND gate can have two or more inputs. The level of its output is dependent on the state of all input levels. It can be seen from the truth table for the AND gate if any input is 0, the output will be 0. For the output to be 1, all inputs must be 1.

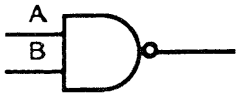
AND GATE



INPUTS		OUTPUTS
A	B	
0	0	0
1	0	0
0	1	0
1	1	1

The outputs of the NAND gate are the opposite of the AND gate. If any input is 0, the output will be 1.

NAND GATE



INPUTS		OUTPUTS
A	B	
0	0	1
1	0	1
0	1	1
1	1	0

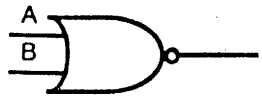
The output of the OR gate is 1 if any input is 1.

OR GATE

INPUTS		OUTPUTS
A	B	
0	0	0
1	0	1
0	1	1
1	1	1

The output of the NOR gate is the opposite of the OR gate. The output is 0 if any input is 1.

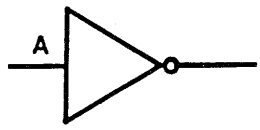
NOR GATE



INPUTS		OUTPUTS
A	B	
0	0	1
1	0	0
0	1	0
1	1	0

4.3.2 INVERTER

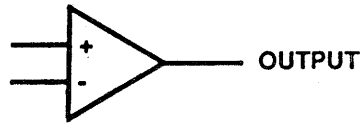
The inverter has a single input. The output level is the opposite of the input level.



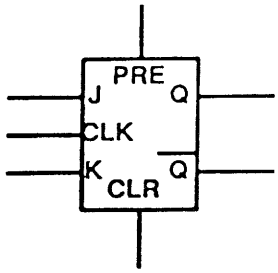
INPUT	OUTPUT
0	1
1	0

4.3.3 VOLTAGE COMPARATOR

The voltage comparator has two inputs, V+ and V-. The V+ input is normally connected to a fixed or reference voltage. The V- input is usually variable. As the V- input becomes more positive and exceeds the V+ input level, the output switches low. If the V- input voltage becomes less positive than the V+ reference input, the output switches to a high level once again.



4.3.4 J-K FLIP-FLOP



The flip-flop is a memory device that stores a logic state. The above symbol is that of a J-K flip-flop. The state of which is referenced to by the level of the Q input. If, for example, the Q output is high, the FF (flip-flop) contains a 1. The $\overline{Q}$ (Q NOT) output is always the opposite of the Q output. The state of the FF can be changed in two ways. It can be changed by means of the clock input, or by the PRESET and CLEAR inputs. The effect of an applied clock pulse on the state of a FF depends upon the J and K inputs. The J input must be high for a clock pulse to cause a 1 output. The K input must be high for a clock pulse to cause a 0 output. If both J and K inputs are high, the FF toggles (changes state) on each applied clock pulse.

The PRESET and CLEAR inputs operate independently of the clock. A high level input to the PRESET line drives the FF to a level 1, while a high input to the CLEAR line drives the FF to a level 0. Some circuits PRESET or CLEAR with a low level input instead of a high level. This is indicated by a "circle" at the appropriate input terminal.

4.3.5 MICROPROCESSOR

The microprocessor is basically a small computer contained within an integrated circuit. This is a device that can store, retrieve, and process data. They are manufactured in many different configurations. The microprocessor, used in this transceiver, contains an 8-bit central processor unit, a 64-byte on chip RAM, 27 input/output lines, and an internal clock. It is configured in a 40-pin dual in-line package.

4.3.6 INPUT/OUTPUT PORT (8-Bit Latch)

The input/output port is an interface device for use with a microprocessor. It contains, within one package, a large number of gates, buffers, and flip-flops. They are manufactured in many different configurations. The in/out port used in this exciter is configured in a 24-pin dual in-line package.

4.3.7 RAM

Random access memories are logic elements that can be reprogrammed many times, and the information stored, can be retrieved by utilizing read/write, and address inputs. A 1024- bit CMOS zero power RAM is used in the exciter memory system. It is configured in a 24-pin dual in line package.

4.3.8 INPUT/OUTPUT EXPANDER

The input/output expander is an interface device for use with a microprocessor. The function of which is to increase the permissable number of inputs and outputs to the microprocessor. It contains within one package, a large number of buffers, latches, decoders, and other logic circuitry. Five I/O expanders are used in the exciter. They are configured in 24-pin dual in-line packages - three on the Logic board, two on the Mother board.

4.4 ASSEMBLY AND SUBASSEMBLY IDENTIFICATION

Schematics for each assembly and module, parts lists, and circuit descriptions are contained in this chapter of the manual. Table 4.4-1 lists major assemblies, while Figure 4.41 displays them.

4.5 COVER REMOVAL

To remove the top and bottom covers from the exciter, rotate the two quick disconnect fasteners located along the front edge of the top cover 1/4 turn counterclockwise. The cover may then be removed by lifting the front edge of the cover and pulling forward to disengage the rear edge of the cover from its retaining lip.

The top inner cover can be removed by first removing the eight (8) mounting screws that secure the inner cover to the chassis. See Figure 4.5-1.

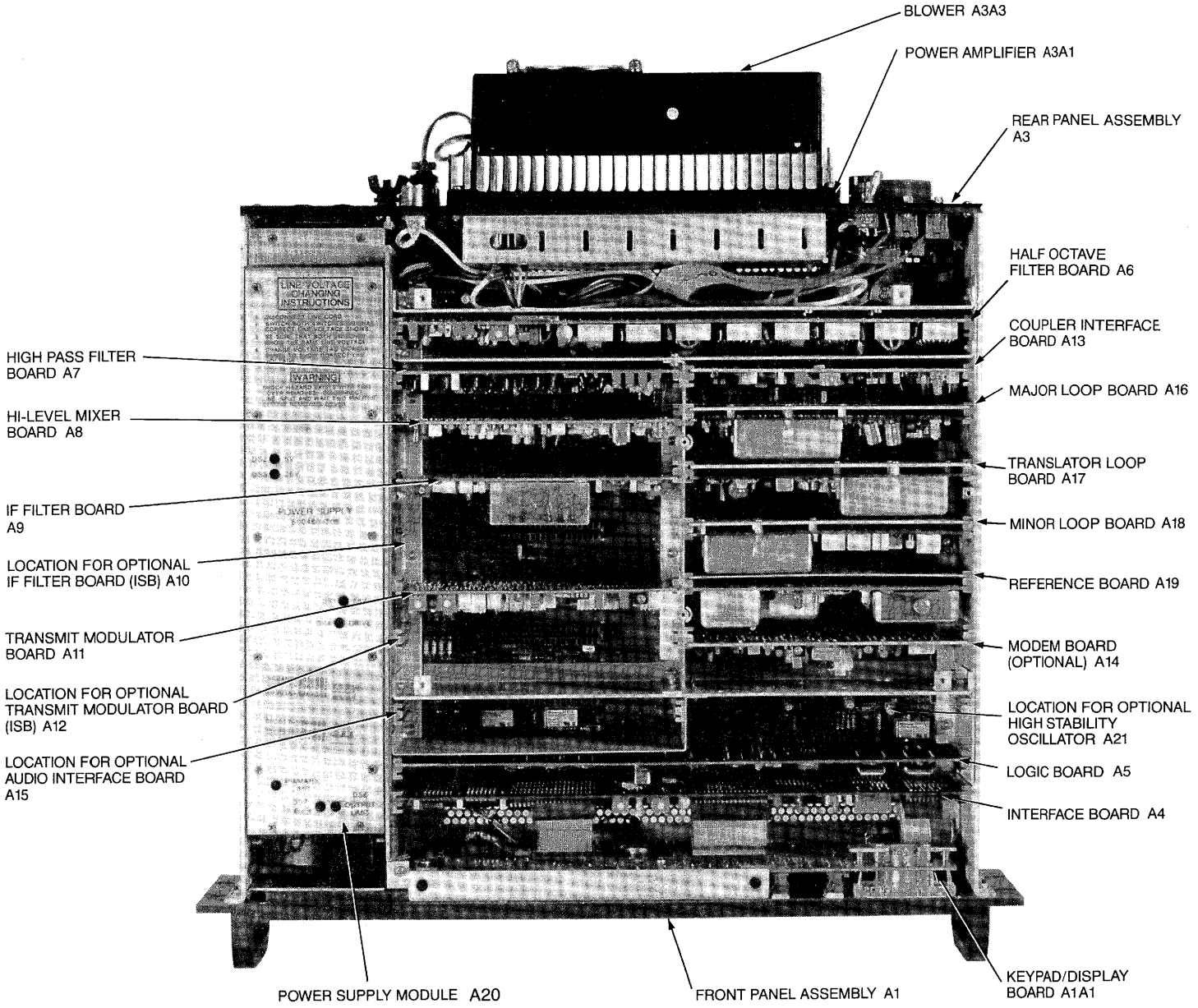


Figure 4.4-1 Exciter Subassembly Locations

Table 4.4-1 Exciter Assemblies

DESIGNATOR ASSEMBLY/SUBASSEMBLY	DESCRIPTION	PART NUMBER
MSR 6700A	Exciter, Grey	795032-000-001
	Exciter, O.D.	795032-000-002
A1	Front Panel Assembly	700003-539-001
A1A1	Keypad/Display	700001-536-002
A2	Mother Board	700005-536-001
A3	Rear Panel Assembly	700202-539-001
A3A1	Power Amplifier Assembly	600407-705-001
A3A1A1	Power Amplifier PC Board Assembly	601192-536-001
A3A2	Accessory Connector Board	601483-536-001
A3A3	Power Amplifier Fan	700023-700-001
A4	Interface Board	700004-536-001
A5	Logic Board	700003-536-001
A5U4	Programmed IC	700002-412-001
A5U15	Programmed IC	700002-412-002
A6	Half Octave Filter	601091-536-002
A7	High Pass Filter	601086-536-003
A8	High Level Mixer	601258-536-002
A9 (STD)	IF Filter Board #1	601076-536-014
A10 (OPT)	IF Filter Board #2 (Part of ISB option 700006-700-001)	601076-536-015
A11 (STD)	Transmit Modulator #1	601078-536-003
A12 (OPT)	Transmit Modulator #2 (Part of ISB option 700006-700-001)	601078-536-003
A13	Coupler Interface Board	601197-536-003
A14 (OPT)	Tone Key/ Modem Board (Part of Remote FSK option 700015-700-001)	602025-536-002
A15 (OPT)	Audio Interface Board (Part of Addressable Audio I/O option 700015-700-002)	700014-536-001
A16	Major Loop Board	601081-536-001
A17	Translator Loop Board	601083-536-001
A18	Minor Loop Board	601214-536-001
A19	Reference Board	601080-536-003
A20	Power Supply Assembly	600460-705-001
A21 (OPT)	OCXO Assembly (Part of High Stability option 700 402-700-002)	600173-378-001
A22 (OPT)	BCD Interface Board (Part of BCD Interface Kit 700021-700-001)	602021-536-002

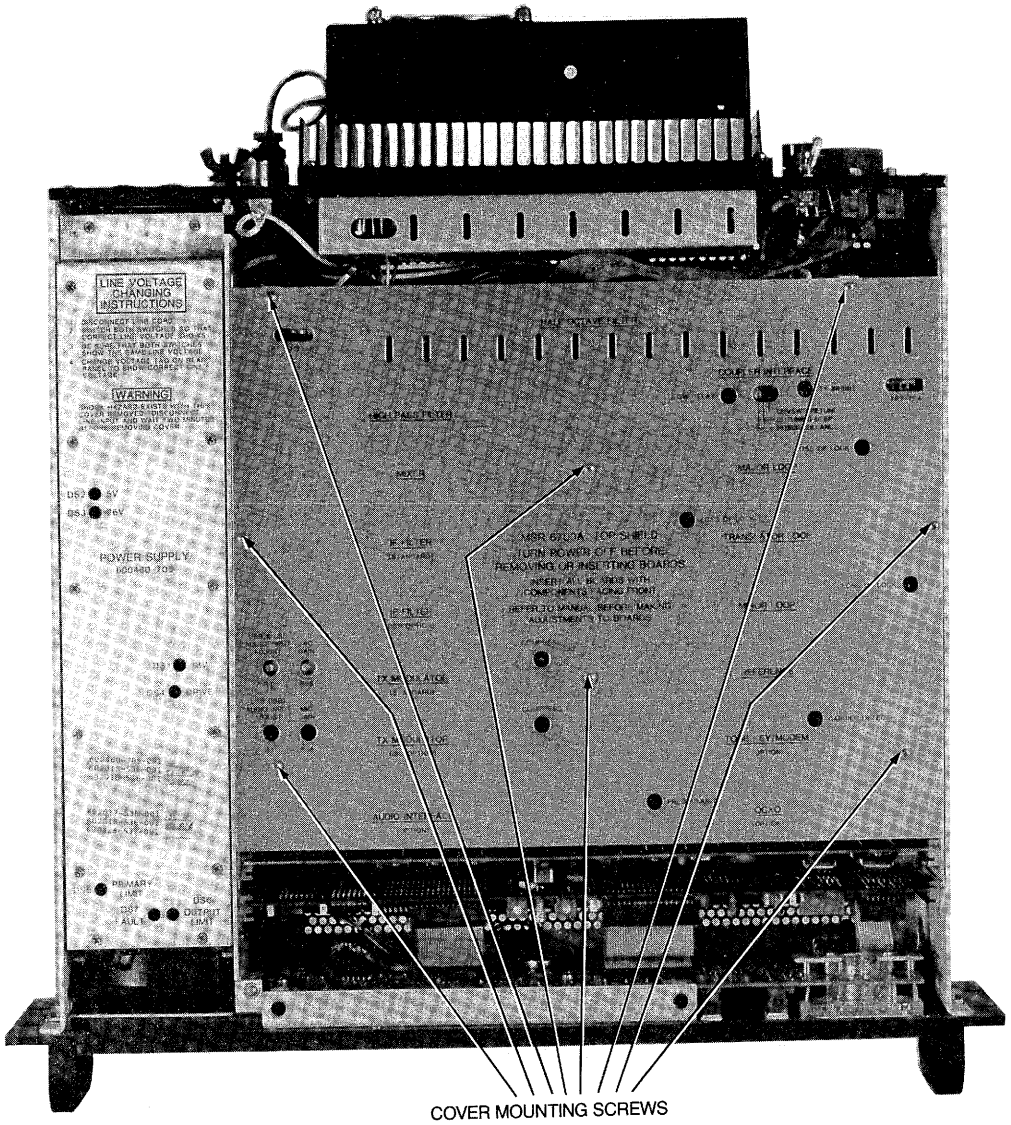


Figure 4.5-1 Inner Cover Mounting Screws

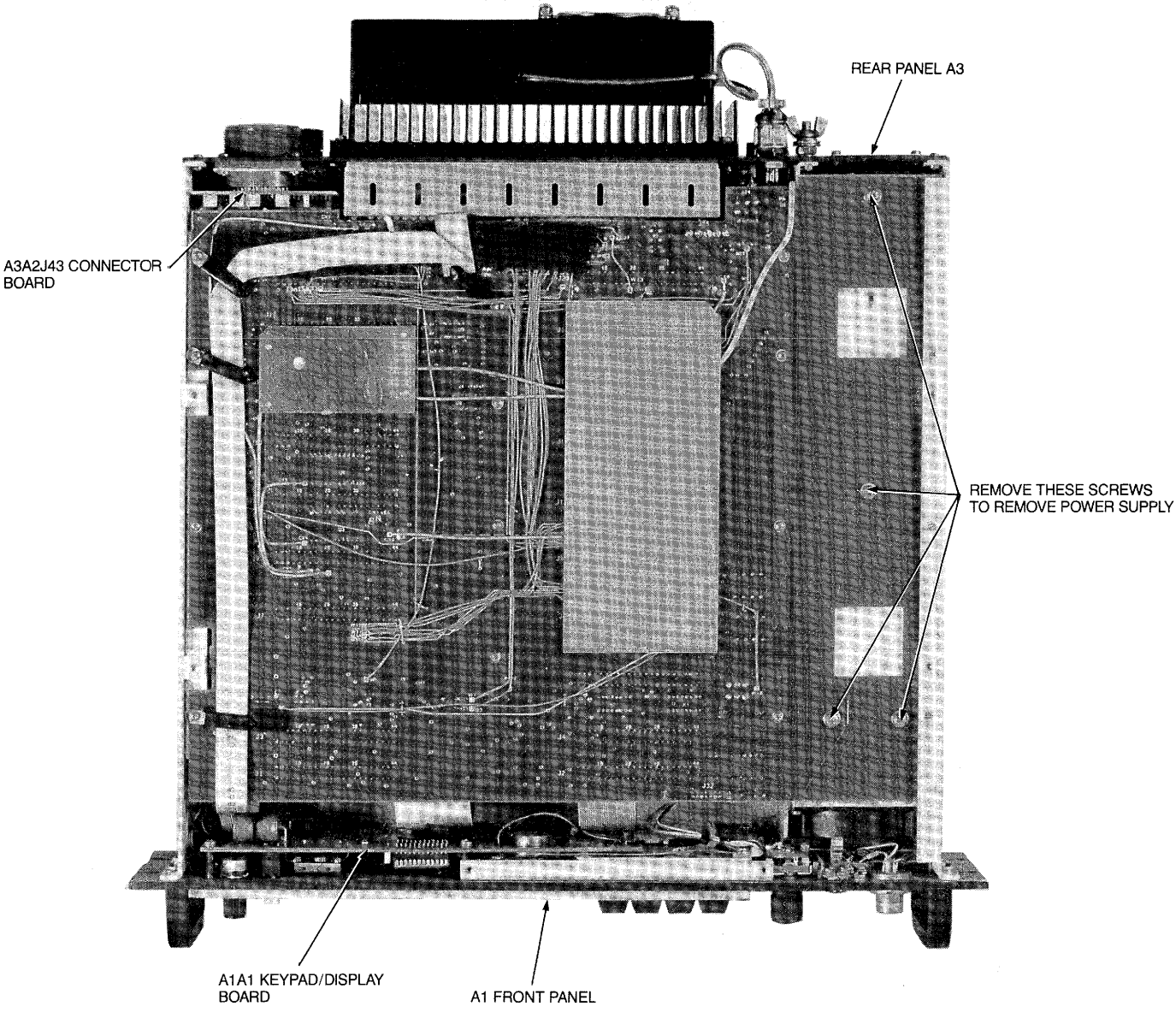


Figure 4.5-2 Bottom View with Cover Removed

4.6 MSR 6700A TRANSMITTER ALIGNMENT/ADJUSTMENTS

As all modules and assemblies of the transceiver are of high reliability, solid state design, adjustments and alignment is seldom, if ever, required. If a module or component replacement or performance indicates the need for adjustments or alignment, the following procedures are provided.

4.6.1 REQUIRED TEST EQUIPMENT

4.6.1.1 For Output Power Adjustments:

a) RF Voltmeter - Boonton Model 92 or 92BD with Model 91-7C 100:1 voltage divider and Model 91-6C unterminated BNC Adapter or equivalent.

b) 2 Dummy Loads - 50 ohm, 125W, Bird Model 465 or equivalent.

c) Oscilloscope - Tektronix Model 465 or equivalent.

d) Digital Multimeter - 3 1/2 digit AD/DC Fluke Model 77 or equivalent.

e) Audio Oscillator - Hewlett-Packard Model 204D or equivalent.

f) Miscellaneous - Audio Combiner and Key Box (user built; see Figure 4.6-1), assorted BNC cables and adapters, PC board extender card (Mackay P/N 601198-536-001).

4.6.1.2 For Comprehensive Transmitter Performance Tests

a) Spectrum Analyzer - Hewlett-Packard 141T System with IF module and 0 to 1.2 GHz head.

b) Dummy Load/Attenuator - 50 ohm, 125W, 30 dB attenuation Bird Termiline Model 8327 or equivalent.

c) Additional Audio Oscillator - Hewlett-Packard Model 204D or equivalent.

4.6.2 TEST SET-UP

(1) Remove the top cover and inside shield of the MSR 6700A.

(2) Connect the Audio Combiner/Key Box to the front panel microphone jack. Be certain that the CARBON/DYNAMIC switch on the MSR 6700A Mother board is placed in the "DYNAMIC" position.

(3) Connect the Audio Oscillator to the Audio Combiner.

(4) Connect the RF voltmeter probe to the rear panel antenna jack (J46) using a TEE connector. Do not connect the voltmeter at the dummy load and do not use any cable between the voltmeter probe and the antenna jack. Connect the dummy load to the TEE connector with a cable. This cable should be a low VSWR 50 ohm cable as short as possible.

5) Since the oscilloscope is for waveform monitoring and absolute calibration is not needed, the scope probe may simply be placed next to the Half Octave Filter board at any convenient point. Capacitive coupling will provide enough signal for monitoring.

CAUTION

Connect the probe ground lead to the chassis so that it does not inadvertently cause a short circuit on the Half Octave board.

4.6.3 BOARD JUMPER SET-UP

Before attempting alignment, check the option jumpers on the Half Octave Filter board and Tx Modulator board as follows: Refer to Figures 4.13-1 and 4.17-1 for jumper locations.

4.6.3.1 Half Octave Filter Board, 1A12

Jumper JP1 should be in upper (normal) position.

4.6.3.2 Tx Modulator Board, A11

(1) Jumper JP1 is not involved with the alignment procedure and may be in either "CAR" or "DYN" position.

(2) Jumper JP2 is not involved with the alignment procedure and may be in either "YES" or "No" position (the "NORMAL" position is "NO" unless 600 ohm center tap keying is in use).

(3) Jumper JP3 should be in "COMPRESSOR IN" position.

(4) Jumper JP4 must be in "NEW HALF OCTAVE BD." position. This is for a group-002 Half Octave Filter board.

4.6.4 OUTPUT POWER ADJUSTMENTS

NOTE

Some adjustments interact. The adjustments should only be made in the order given in this procedure.

4.6.4.1 ALC Threshold Adjustment (A11 Tx Modulator)

Set power level to Level 2. Adjust R83 (ALC threshold adjust) for a DC voltage of 4.00V at TP6.

4.6.4.2 ALC Detector Adjustment (A11 Tx Modulator)

(1) Adjust R51 (output level) fully clockwise.

(2) Adjust R17 (carrier) fully clockwise.

(3) Set radio to 1.6 MHz CW. Key the radio. Adjust A6 Half Octave R11 (ALC CAL) for 79V RF output as read on the RF voltmeter.

(4) Set radio to 29.9 MHz CW. Key the radio and adjust A6 Half Octave C2 (ALC compensation) for 79V out.

(5) Repeat paragraph (3) and (4) as necessary until no change in RF voltage is observed.

4.6.4.3 Low Power Adjust (A11 Tx Modulator)

Set radio to 1.6 MHz CW, Power Level 1. Key the radio and adjust R84 (low power adjust) for 35V RF out.

4.6.4.4 Tx Modulator Board Output Level Adjust

Set radio to 29.9 MHz CW, Power Level 2. Key the radio and adjust Tx Modulator R51 (output level) counterclockwise until the RF output voltage just starts to fall, then adjust clockwise about 1/8 turn.

4.6.5 AME ADJUSTMENTS

(1) Adjust Half Octave R44 (AM modulation) fully counterclockwise.

(2) Set radio to 1.6 MHz AME. Key radio with no modulation and adjust Half Octave R13 (AM carrier) for 42V RF output.

(3) Connect a 30 dB power attenuator to the RF output connector. Connect the spectrum analyzer to the attenuator output.

(4) Set radio to 29.9 MHz AME. Adjust the level of a 1 kHz modulation tone until the compressor LED on the Tx Modulator board comes on. Key the radio and adjust the Tx Modulator R17 (carrier) counterclockwise until the output waveform (as monitored on the spectrum analyzer) shows the sideband 1.5 dB below the carrier. Note that the sideband tone is 1 kHz above the carrier frequency.

(5) Key the radio at 1.60 MHz AME. Adjust Half Octave Filter R44 (AM modulation) clockwise until the RF output meter indicates 79V.

4.6.6 A3A ADJUSTMENTS

(1) Connect a 30 dB power attenuator to the RF output connector. Connect the spectrum analyzer to the attenuator output.

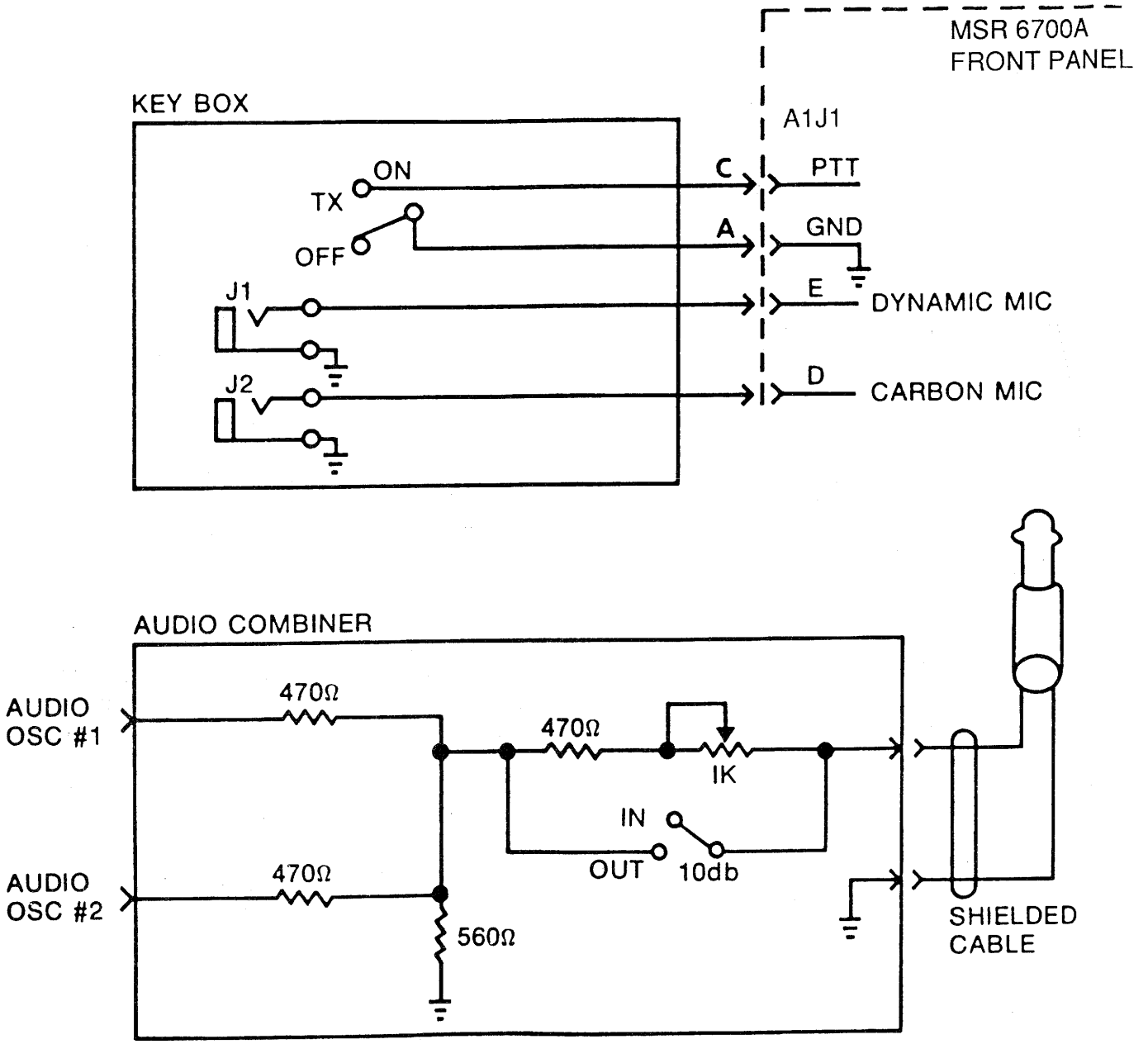


Figure 4.6-1 Audio Combiner and Key Box

CAUTION

Do not connect the spectrum analyzer directly to the transmitter RF output; it would be severely damaged. Adjust the analyzer controls so that a tone 1 kHz away from the sideband output can be seen.

(2) Adjust audio oscillator frequency for a 1 kHz tone and increase the amplitude until the compressor LED on the Tx Modulator board comes on.

(3) Set radio to 1.9 MHz, A3A mode. Key the radio and adjust A7 High Pass Filter R49 so that the carrier is 16 dB below sideband output.

(4) Set radio to 4.0 MHz, A3A mode. Key the radio and adjust A7 High Pass Filter R48 so that the carrier is 16 dB below sideband output.

(5) Set radio to 19 MHz, A3A mode. Key the radio and adjust High Pass Filter R47 so that the carrier is 16 dB below sideband output.

(6) Set radio to 29.0 MHz, A3A mode. Key the radio and adjust High Pass Filter R46 so that the carrier is 16 dB below sideband output.

4.6.7 VSWR AND CURRENT LIMIT ADJUSTMENTS

(1) Set radio to 29.9 MHz, CW mode. Connect the DVM between Half Octave Filter TP2 and ground. Key the radio and adjust Half Octave C30 for a null (minimum voltage).

(2) Connect two dummy loads in parallel to the antenna jack (all cables as short as possible). Set radio to 2.0 MHz, CW mode. Key the radio and adjust Half Octave R35 (current limit) for 45 RF volts output as read on the RF voltmeter.

4.6.8 MICROPHONE SELECTION AND AUDIO INPUT LEVELS

Table 4.6-2 lists four different styles of microphones that can be used with the MSR 6700A.

The Mother board switch (S2), Transmit Modulator board (A11, A12), and jumper plug (JP1) are used to condition the unit for different types of microphones. For use with any carbon microphone, S2 must be set to "CAR" and JP1 must be jumpered 2 to 3 in order to get drive current for the carbon element. For use with dynamic microphones, two options are available. For microphones with 4 to 10 millivolts output (high level), S2 should be switched to DYN and JP-1 can be either 1 to 2 or 2 to 3. For low level dynamic microphones, such as the H-250/U, S2 should be switched to CAR and JP1 must be from 1 to 2. When configured for low level dynamic, the amplifier on the Transmit Modulator board (U2B) has approximately 20 dB more gain than for the high level microphone. R58 on the Transmit Modulator board has been factory adjusted for optimum gain for the three dynamic microphones listed in Table 4.6-2. If another type of dynamic microphone is selected, R58 can be adjusted for more or less gain.

The 600 ohm balanced input is designed to operate from -10 to +10 dBm. R1 on the Transmit Modulator board is factory adjusted for -1 dBm input to the 600 ohm input in order to produce compression in U1B. 600 ohm input levels outside the range of -10 to +10 dBm may require adjustment of R1 to prevent distortion in U1B or too little output at TP1. (The threshold of compression is adjustable from -20 to 0 dBm.) For certain types of digital encoding equipment, audio compressors can create distortion.

Jumper plug JP3 on the Transmit Modulator board can be used to disable the compressor. If JP3 is connected 1 to 2, the compressor will be disabled and the input audio level will have to be adjusted (either externally or by Transmit Modulator R1) to produce 0.23 to 0.27 VPP at TP1.

The compressor is automatically disabled by JP9 on the Mother board when the exciter is keyed from the rear panel EXT KEY input. See Section 3.4.8, 3.4.10.

Table 4.6-2

Audio Input Options

AUDIO INPUT	PART NUMBER	MOTHER BD. S-2	XMIT MOD. JP1	APPROXIMATE LEVEL (VRMS)
Desk Microphone	600352-713-001	DYN	1 to 2	.004 to .010V
Desk Microphone	600367-713-001	DYN	1 to 2	.004 to .010V
H-250/U Handset	600002-386-001	CAR	1 to 2	.0004 to .001V
H-33 Handset	600014-386-001	CAR	2 to 3	0.5 to 7.75V
STD, 600 ohm		N.A.	N.A.	.245 to 2.45V
ISB, 600 ohm		N.A.	N.A.	.245 to 2.45V
FSK (Control/Status), 600 ohm		N.A.	N.A.	.245 to 2.45V

Figure 4.6-2 Transmit Adjustment Locations

4.7 TROUBLESHOOTING

Troubleshooting the radio is accomplished by associating the sympton to one or more modules. Since the majority of the radio consists of easily replaced plug-in modules, the trouble may be narrowed to a single module by substitution of good modules.

Table 4.7-1 lists suspected modules with symptom of malfunctions. Figure 4.7-1 shows the module interconnections.

Troubleshooting within the module may be attempted with the aid of schematics, printouts, assembly layouts, and circuit descriptions in following sections in the manual for each module.

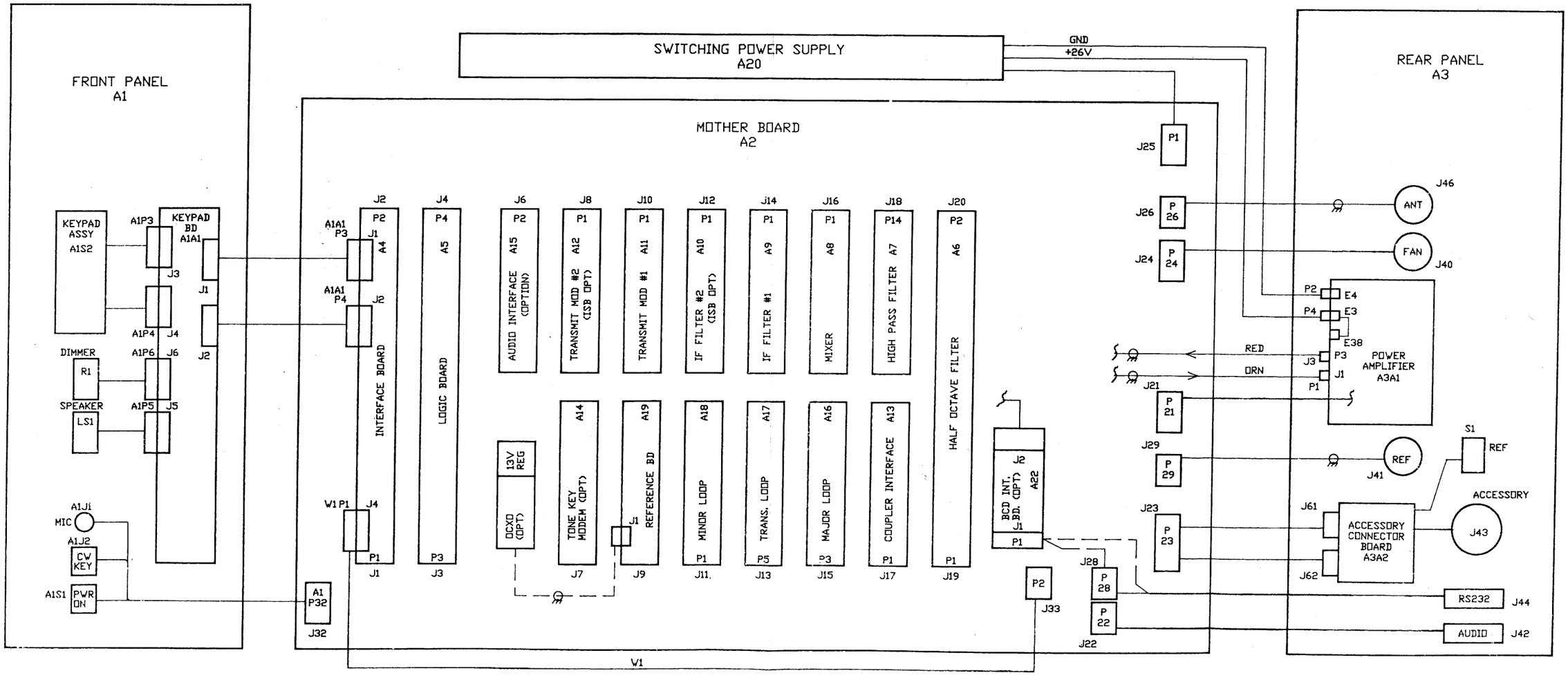


Figure 4.7-1

MSR 6700A Module Interconnection

Table 4.7-1 Troubleshooting Chart

	SYMPTOM	CAUSES
1	Transmitter will not key.	1) Microphone connector improperly attached to front panel microphone input, A1J1. 2) Defective microphone or microphone cord. 3) Key interlock jumper from pin "C" to "G" on accessory connector, A3J43 is open.
2	Transmitter will not key, but transmit indicator is ON when microphone button is depressed. Front panel FAULT light is not on.	1) Defective High Pass Filter board, A7. 2) Inoperative relay, A3A1K2, on PA module.
3	Transmitter will key, but low or no RF output in any mode. FAULT light is "ON".	1) Excessive antenna VSWR. 2) PA overtemperature or overcurrent condition. 3) Defective Half Octave Filter board, A6. 4) Overcurrent adjustment R16 on PA module improperly adjusted. 5) Defective PA module, A3A1.
4	Transmitter will key, but low or no RF output in any mode. FAULT light is "OFF".	1) Defective Transmit Modulator board, A11, A12. 2) Defective IF Filter board, A9, A10. 3) Defective Mixer board, A8. 4) Defective High Pass Filter board, A7. 5) Defective PA module, A3A1. 6) Defective Half Octave Filter board, A6. 7) Defective synthesizer, A16-A19. 8) Defective Audio Interface board, A15 (if installed). 9) Mother board jumpers JP1-JP4, JP7, 8 wrong position. (See Figure 4.10-4.) 10) Defective Tone Key/Modem board, A14 (if installed).
5	Transmitter will not key "ON" and TX INHIBIT light is "ON" on the Coupler Interface board.	1) Check TP1,2,3 or 4 to determine which TP is LOW. a. TP1 - Jumper from G to C on rear panel A3J43. b. TP2 - Power supply fault. c. TP3 - $\overline{\text{TX INHIBIT}}$. Check U4 on Mother board. d. TP4 - LL. Check reference switch on rear panel. Check Synthesizer boards.
6	Transmitter keys "ON" but no microphone audio on USB.	1) Relay K1 or Q1 on Mother board faulty. 2) A1P/J32 not seated properly.
7	In ISB mode, no LSB audio.	1) Q2 or K2 on Mother board is faulty. 2) Transmit Modulator #2 (A12) is faulty.

Table 4.7-1 Troubleshooting Chart (Cont.)

SYMPTOM	CAUSES
8 Transmitter keys "ON" but little or not RF output.	1) Bias relay bad on Power Amplifier, A3A1. 2) High Pass Filter, Q21, Q2 bias transistor bad.
9 Transmitter puts out power but no sidetone heard in handset earpiece.	1) Defective Transmit Modulator board, A11 or A12.
10 Transmitter will not key. Synthesizer is out of lock.	1) Defective U3, U4 on Mother board. 2) Faulty Logic board, A5. 3) Make sure Synthesizer boards A16 through A19 are seated properly. 4) No +13 VDC from rear panel, A3A1. 5) Rear panel S1 in wrong position.
11 Transmitter puts out power but front panel meter does not indicate.	1) Select FWD power on front panel. 2) K3 on the Mother board is faulty. 3) R8 on Half Octave Filter board misadjusted. 4) Faulty circuit on Half Octave Filter board, A6. 5) Faulty circuits on Interface board.
12 Transmitter will not operate; no +9 VDC.	1) Rear Panel assembly A3, U1 is bad. 2) Faulty regulator component on Rear Panel assembly. 3) Mother board A2, R50 not adjusted properly.
13 Transmitter will not operate; no +5 VDC.	1) +5 VDC circuit in power supply, A20, faulty.
14 Transmitter operates satisfactorily on high power but low power function does not operate.	1) Logic board A5, U18 bad. 2) Transmit Modulator R84 misadjusted.
15 Transmitter operates satisfactorily but cannot turn on the MSR 1020.	1) Faulty component on kW "ON" circuit in Mother board (U7A, B, C; Q11)
16 Transmitter okay but kW low power function does not operate.	1) Q7 or Q8 on Mother board faulty. 2) Faulty U8 or U18 on Logic board.
17 Transmitter okay but CPLR BYPASS function does not work.	1) Faulty U8 on Logic board, A5.

Table 4.7-1 Troubleshooting Chart (Cont.)

	SYMPTOM	CAUSES
18	Stored silent tune channels do not operate properly when MSR 6700A is connected to MSR 4030.	1) Faulty S1 or U6 on Logic board. 2) Faulty Logic board, A5. 3) Faulty Interface board, A4.
19	Transmitter okay but antenna coupler STATUS lights do not operate properly.	1) Faulty LEDs or U9 on Keypad/Display board, A1A1. 2) Faulty circuits on Coupler Interface board, A13. 3) Faulty Interface board, A4.
20	Transmitter okay on USB/LSB but no CW power.	1) Faulty 1 kHz circuit on Reference board. 2) Faulty CW circuit on Coupler Interface board. 3) R67 not adjusted properly on Transmit Modulator.
21	Transmitter okay on CW, USB, LSB but no output on LSB in ISB mode.	1) Faulty connection from rear panel J42 to Mother board J22. 2) Mother board jumpers JP7, JP8 in wrong position. 3) Faulty Audio Interface board A15 (if installed).
22	Transmitter okay on USB/LSB/CW but AM power not correct.	1) Transmit Modulator R17 not adjusted properly. 2) Faulty AMT circuit on the Coupler Interface board.
23	Transmitter okay except A3A does not operate.	1) CR6 on Mother board open. 2) High Pass Filter R46, 47, 48 or 49 not adjusted properly. 3) High Pass Filter Q3 defective. 4) Transmit Modulator, A3A circuit defective.

4.8 FRONT PANEL ASSEMBLY, A1

4.8.1 GENERAL

The Front Panel assembly contains control switches and various displays for exciter operation. Almost all front panel circuitry is contained on the Keypad/Display board which mounts directly to the back of the front panel. Components mounted on the front panel and not part of the Keypad/Display board are the microphone connector (J1), CW key jack (J2), power ON/OFF switch (S1) and front panel speaker (LS1). The front panel assembly can easily be removed as a unit by unscrewing six screws located near the handles, top and bottom cover screws (2 each), two side panel screws and one internal screw. Electricial connections are easily removed by unplugging three cables.

4.8.2 FRONT PANEL WIRING

The two ribbon cable assemblies plug directly from the Keypad/Display board to the Interface board. The remaining wire harness connects to the Mother board at J32. This wire harness contains all connections not made through the Keypad/Display board, including microphone audio (pin 11), headphone receiver audio (pins 7 and 8), PTT and CW Key keylines (pins 3 and 1, respectively), and exciter power-on (pin 15). The receiver audio line is connected directly to the receive input port on the rear panel. The Mic and PTT lines have parallel inputs at the rear panel.

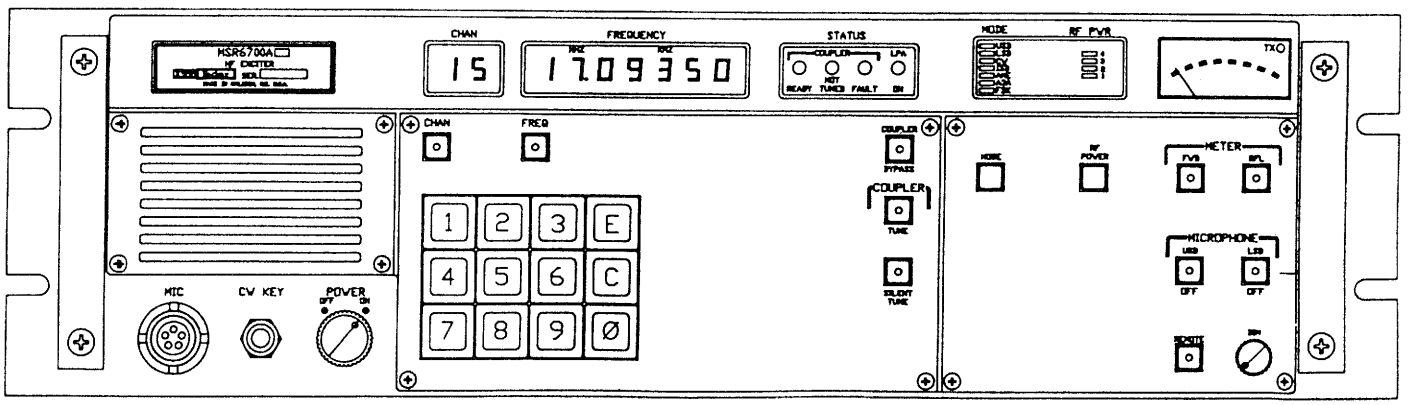


Figure 4.8-1 Front Panel Diagram

Figure 4.8-2 Front Panel Parts List (700003-539-001)

SYMBOL	DESCRIPTION	PART NUMBER
A1	Keypad/Display PCB	700001-536-002
C1	Cap., .1 µf, 50V	600272-314-001
J1	Mic Connector	600388-606-001
J2	Phone Jack	600079-611-002
LS1	Speaker	600013-370-001
P3, 4	Connector, Clinch (Part of S2)	700006-608-001
P32	Conn. Housing, 16 pin	600389-606-002
P5, 6	Conn. Housing, 4 pin	600368-606-033
R1	Res, 500Ω, Dimmer	600111-360-001
S1	Modified Switch	600363-616-001
S2	Keypad	700001-616-001

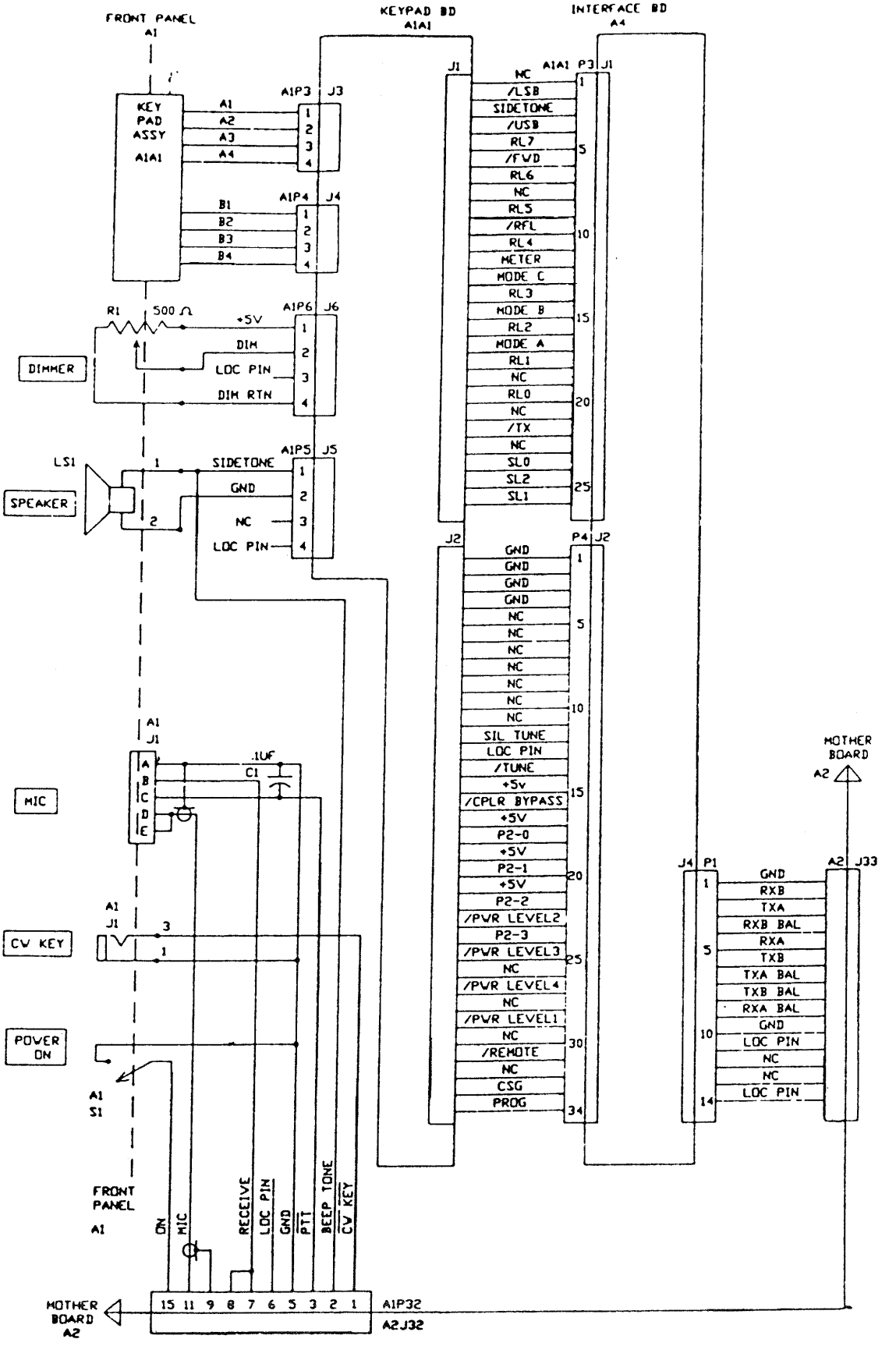


Figure 4.8-3 Front Panel Schematic

4.8.3 KEYPAD/DISPLAY BOARD, A1A1

This board contains a 4 x 4 keypad and 12 pushbutton switches for data and command entering. There are three 4-digit, 7-segment display chips to display channel and frequency and two 10-segment bar graphs for MODE and POWER LEVEL indication. In addition, a dimmer circuit and a meter are included.

4.8.3.1 Keypad Scanning

A 3-bit encoded scan signal, SL0, SL1 and SL2 on J1-24, 26 and 25 are applied to the 3-to-8 decoder U1. Lower four bits of U1 are used as four scan lines for the key matrix. Eight return lines of the matrix, RL0 through RL7, are connected to J1-20, 18, 16, 14, 11, 9, 7 and 5. When a key is pressed, one of the return lines will go low and the keypad chip on the Interface board will convert it into a key code and transfer to the microprocessor chip.

4.8.3.2 Input/Output Expander

U9 is an 8243 I/O expander chip directly tied to the microprocessor through J2-18, 20, 22, 24 and 28. Port 5 of this chip (U9-1, 23, 22 and 21) is used for 7-segment display control. P50 and P51 (U9-1 and 23) are connected to the input of U2, a 2-to-4 decoder 74LS139, to select one of three displays U5, U6 and U7 while P52 is used as a clock input and P53 for data input to these chips in parallel. Port 4 (U9-2, 3, 4 and 5) is used to drive the status indicator DS8 (KW ON), DS7 (FAULT), DS6 (NOT TUNED) and DS5 (READY), respectively. Port 6 (U9-20, 19, 18 and 17) and Port 7 (U9-13, 14, 15 and 16) are used to control lights in CHAN, FREQ, MIC LSB, MIC USB, RFL and FWR pushbutton switches, respectively.

4.8.3.3 7-Segment Display Chip

U5-U8 are 4-digit serial-controlled 7-segment display chips with built-in drivers. Display information is applied to the data input pin (pin 4 of the chip) in serial and is latched by the clock signal in pin 5 when /EN (pin 3) is low. Data received is latched and shown in the display until the chip is selected and data is clocked in again.

4.8.3.4 Bar Graph Display

POWER LEVEL signals are applied to the bar graph display chip U3-16, 17, 18 and 19 through J2-27, 25, 23 and 29. When the signal goes low, the corresponding bar will be turned on. BG1 is connected to the output of decoder chip U3 (74LS145). Input of U3 (U3-15, 14 and 13) is tied to J1-15, 14 and 13 which is a 3-bit encoded MODE input signal (MODE A, B and C). Mode codes are defined as follows:

A	0	1	0	1	0	1	0
B	0	0	1	1	0	0	1
C	0	0	0	0	1	1	1
MODE	CW	USB	LSB	ISB	AM	N/A	FSK

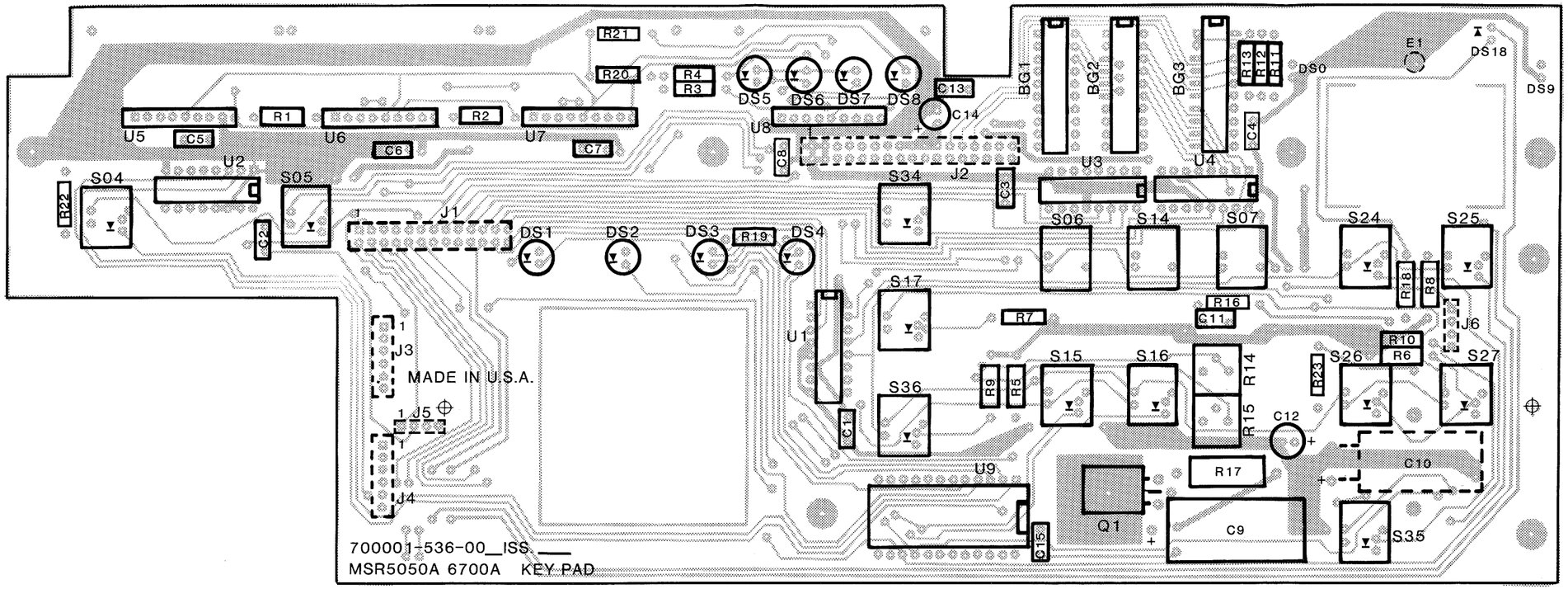
4.8.3.5 Dimmer and Others

Q1 is used to control the DIME +5V supply which is connected to all displays and LEDs. Control voltage is obtained from the dimmer pot in the front panel. The wiper of this pot is tied toJ6-2 which goes through a current limiting resistor R16 to the base of Q1. The ground side of this pot is tied to J6-4 which connects to GND through a 470 ohm resistor R23.

DC voltage on J1-12 is connected to the meter M for FWD and RFL meter indication. DS0 and DS9 will light the meter as long as main power is on.

A signal on J1-22 (/TX) will turn on the TX LED in the meter when the system is keyed.

Sidetone signal in J1-5 is connected to the speaker through J5-1.



Keypad/Display (700001-536-002)

PART NUMBER	DESCRIPTION	SYMBOL
700009-390-001	DIFFUSER LAMP	
700001-390-001	BAR GRAPH, HDSP4830	BG1,3
600302-314-013	CAP. .1UF, MYLAR, 50V	C1-4,11 13,15
600297-314-040	CAP. 2200UF, ALUM, 16V	C10
600297-314-025	CAP. 47UF, ALUM, 25V	C12,14
600302-314-001	CAP. .001UF, MYLAR, 63V	C5-8
600259-314-108	CAP. 1000UF, ALUM, 16V	C9
700010-390-001	LED, RED	DS0,9
700007-390-001	LED, 1.00 LG	DS1-4
700007-390-002	LED .7 LG	DS5-8
600074-390-001	TX LED RED	DS18
600476-540-034	RIBBON CABLE	(J1)
600476-540-012	RIBBON CABLE	(J2)
600423-608-106	CONN. RT/AN HEADER, 6 PIN	J3,4
600423-608-104	CONN. RT/AN HEADER, 4 PIN	J5,6
600034-368-002	METER 0-1 MA	M1
600220-413-001	TRANSISTOR MJE520	Q1
647014-341-075	RES. 4.7K, 1/4W, 5%	R1-3
620004-341-075	RES. 200, 1/4W, 5%	R11,13
612004-341-075	RES. 120, 1/4W, 5%	R16

PART NUMBER	DESCRIPTION	SYMBOL
615084-341-325	RES. 1.5, 1W, 5%	R17
600072-360-014	POT. 100K, 1/2W, CERMET, TOP	R5-10,12 14,15
613004-341-075	RES. 130, 1/4W, 5%	R5-10,18 20-22
647004-341-075	RES. 470, 1/4W, 5%	R23
600365-616-002	SWITCH, PUSH-BUTTON, LIT	S04,05,17 24-27, 34-36
600366-616-002	SWITCH, PUSH-BUTTON, NON-LIT	S06,07
600309-415-001	IC 74LS138, 3 TO 8 LN DEC/MUX	U1
600397-415-001	IC 74LS139, 1 OF 4 DCDR	U2
600528-415-001	IC 74LS145, BCD TO DECI DEC	U3
700116-415-001	DISPLAY, 4 DIGIT, NSM4700A	U5-7
600217-415-101	IC 8243, I/O EXP 24 PIN	U9
600206-419-024	IC SOCKET, 24 PIN	XU9

Figure 4.8-4

Keypad/Display Board Assembly

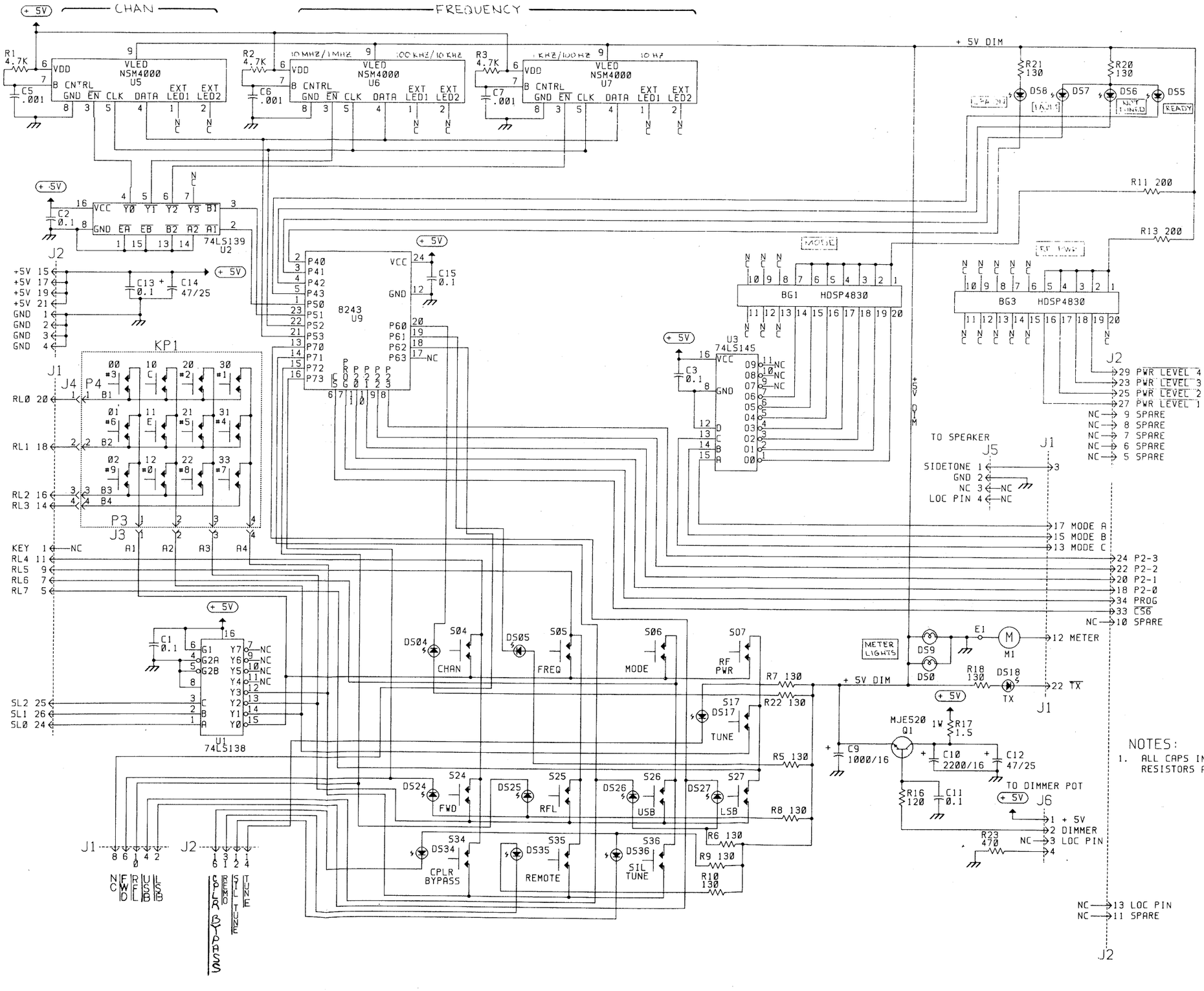


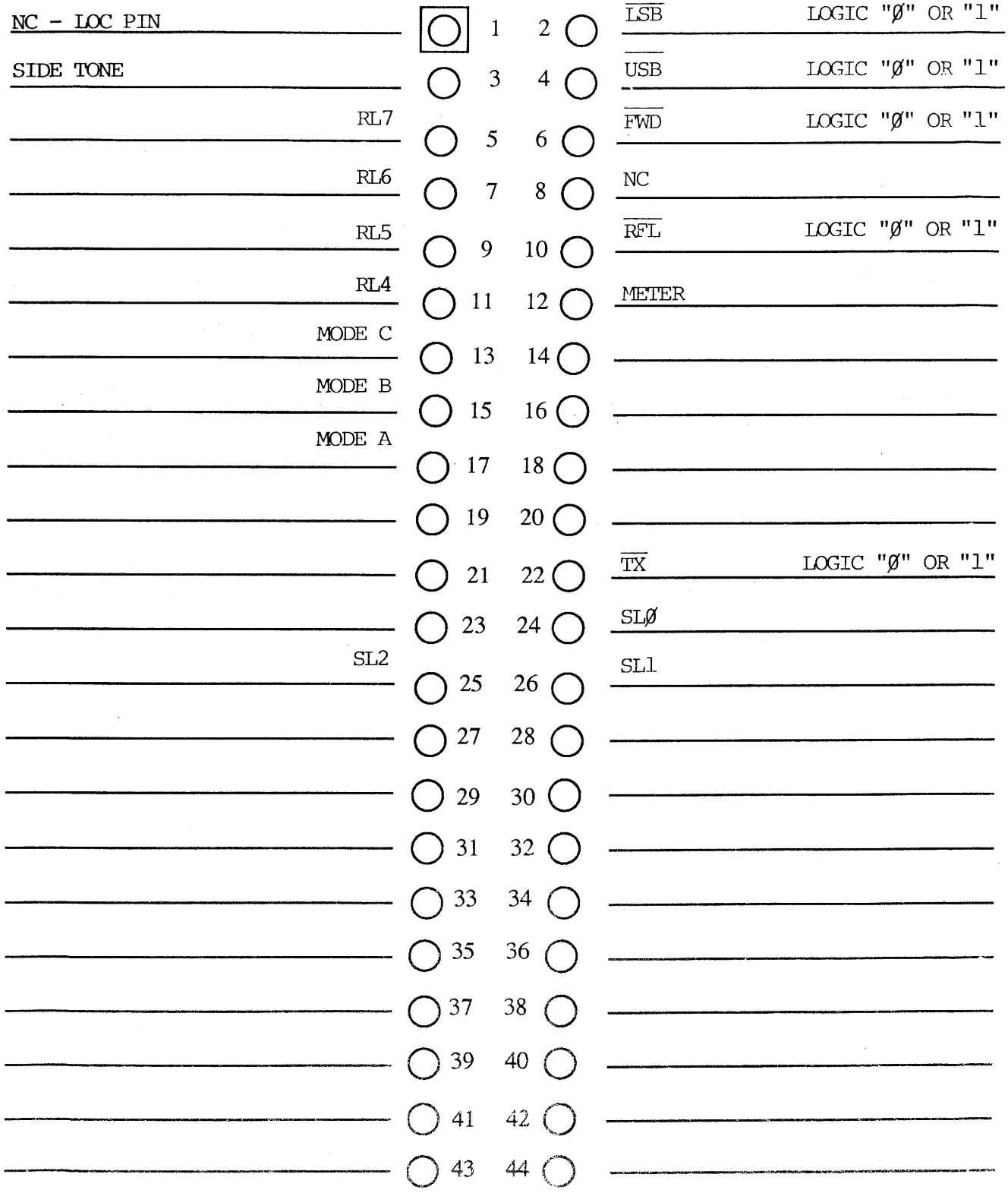
Figure 4.8-5

Keypad/Display Board Schematic

MSR 6700A KEYPAD DISPLAY BD. A1A1

PIN CONNECTIONS AND VOLTAGE READINGS

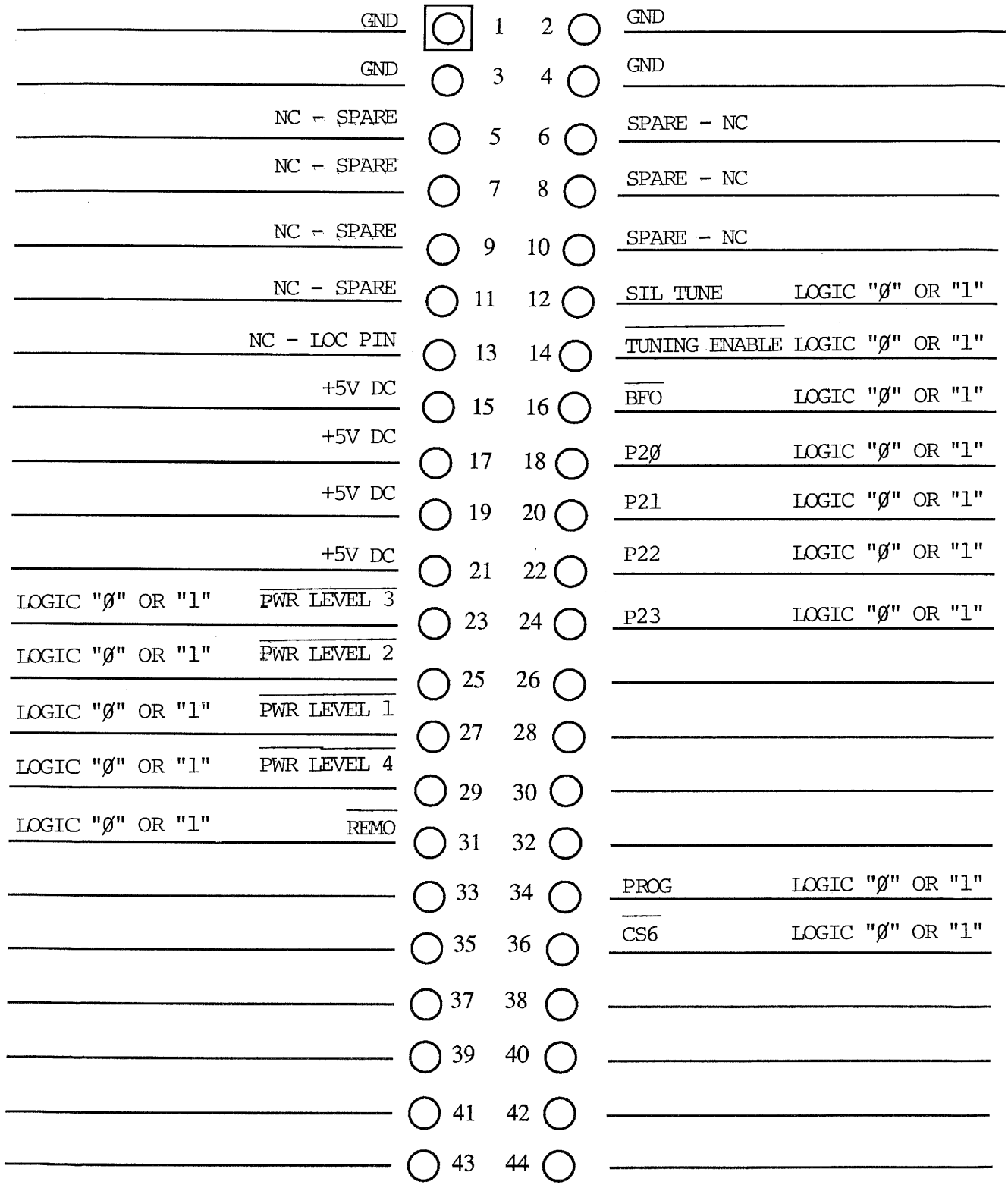
A1A1J1



MSR 6700A KEYPAD DISPLAY BD. A1A1

PIN CONNECTIONS AND VOLTAGE READINGS

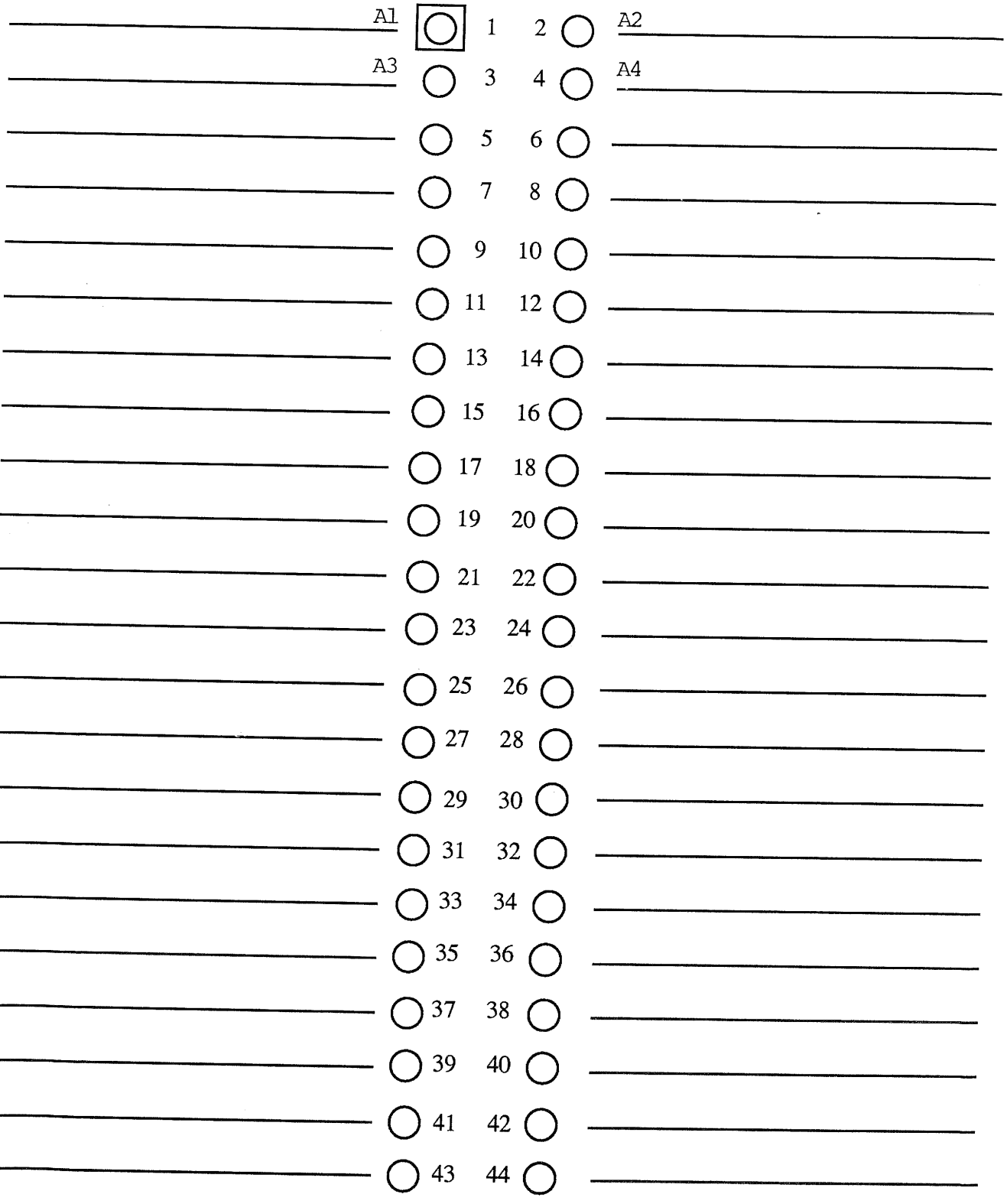
A1A1J2



MSR 6700A KEYPAD BD. A1A1

PIN CONNECTIONS AND VOLTAGE READINGS

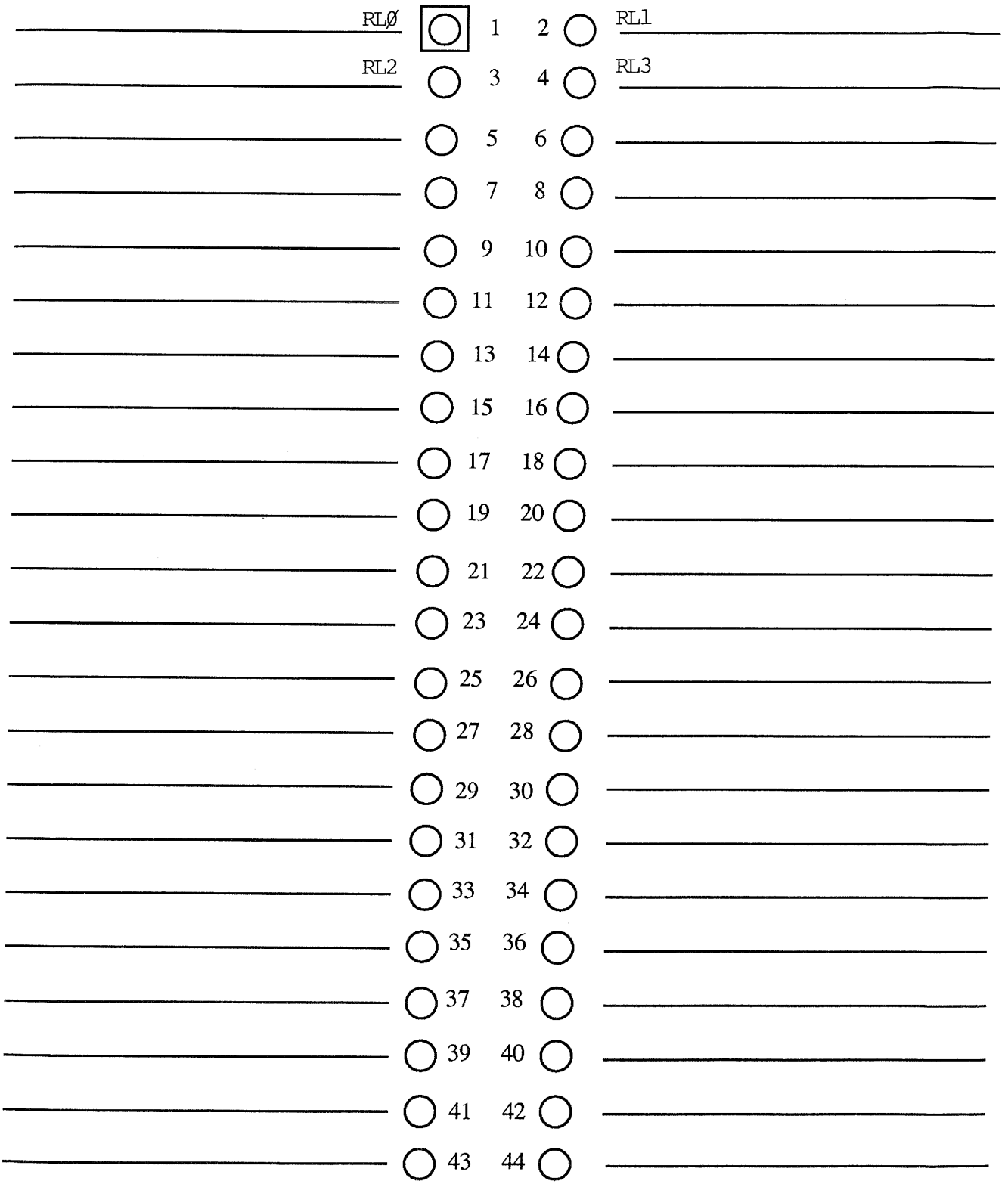
A1A1 J3



MSR 6700A KEYPAD DISPLAY BD. A1A1

PIN CONNECTIONS AND VOLTAGE READINGS

A1A1J4



MSR 6700A KEYPAD DISPLAY BD. A1A1

PIN CONNECTIONS AND VOLTAGE READINGS

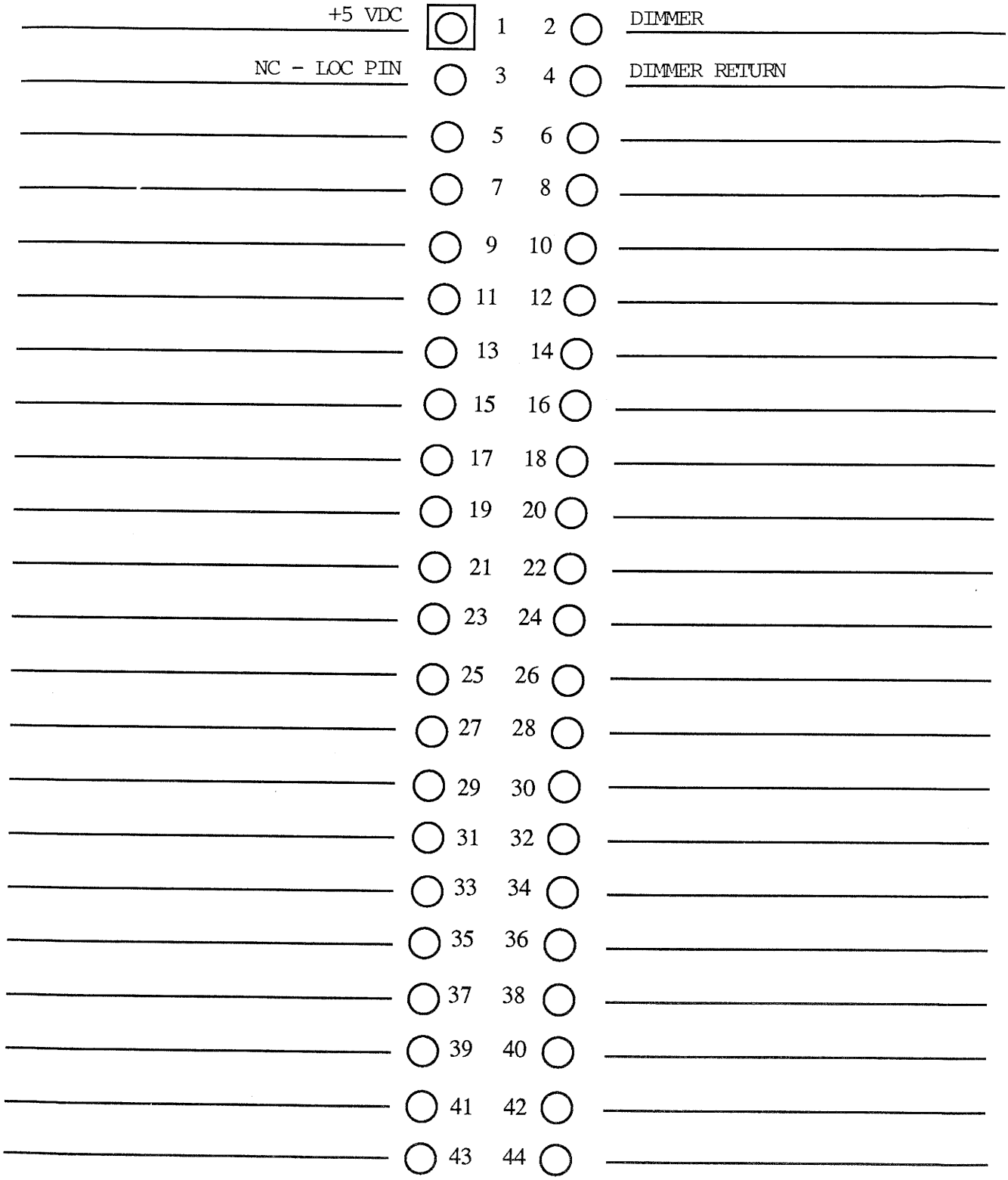
A1A1J5

SIDE TONE	1	2	GND	
NC	3	4	LOC PIN - NC	
	5	6		
	7	8		
	9	10		
	11	12		
	13	14		
	15	16		
	17	18		
	19	20		
	21	22		
	23	24		
	25	26		
	27	28		
	29	30		
	31	32		
	33	34		
	35	36		
	37	38		
	39	40		
	41	42		
	43	44		

MSR 6700A KEYPAD DISPLAY BD. A1A1

PIN CONNECTIONS AND VOLTAGE READINGS

A1A1J6



4.9 REAR PANEL ASSEMBLY, A3

The rear panel assembly contains the 125 watt power amplifier A3A1, accessory connector board A3A2, two 25 pin "D" connectors (with attached ribbon fan cables), 5 MHz reference in/out connector, PA connector, antenna connector and related wiring and parts. Refer to schematic Figure 4.9-4, and Section 2 for more connector/wiring descriptions.

4.9.1 MISCELLANEOUS CONNECTORS/ WIRING

J42 is a 25-pin connector which provides inputs for 600 ohm audio, FSK remote control, and miscellaneous functions. Its integral ribbon cable (P22) connects to the Mother board at J22.

J44 is identical to J42 but carries remote control signals (RS-232, RS-422, RS-423, MIL-STD-188) via its ribbon cable connector P28 to Mother board J28. An optional BCD Interface Kit (Section 5.4) substitutes a connector/cable assembly with an additional parallel connector which connects to a BCD Interface board (A22). This board produces signals on J44 representing the tuned radio frequency which may be used to control an external preselector/postselector such as the MSR 6300.

Two coax cables attached to rear panel J46 and J41 connect to the Mother board (with their miniature SMB connectors P26, P29) at mating connectors J26, J29. Two other miniature coax cables hardwired to the Mother board connect to the PA assembly at J3 and J1.

Power is supplied to the PA by two wires from the power supply with quick-disconnects P2 (26V) and P3 (GND).

P20 is a 14-pin connector from the PA module which connects to Mother board header connector J21.

The 9 volt regulator, LM350 (U1) is mounted in a socket on the rear panel allowing easy replacement. C38,39 and 40 reduce noise in the circuit. P24 connects the circuit to the Mother board where further components allow fine adjustments to the voltage level. P24 also carries the 12V supply from the Mother board to the fan assembly via rear panel J40.

The connector board A3A2 is integral to the 37-pin circular connector J43. The board contains bypass capacitors for all lines and provides discreet wire connections to the 5 MHz external reference control switch S1 and to the 26V coupler line fuse, F1 -- both mounted on the rear panel.

The rear panel is mounted to the chassis by nine screws. Two bottom cover mounting screws must also be removed if installed. The PA assembly may be removed by itself by removing four mounting screws, two coax connectors (SMB), the 14-pin header connector and the two quick-disconnect power leads.

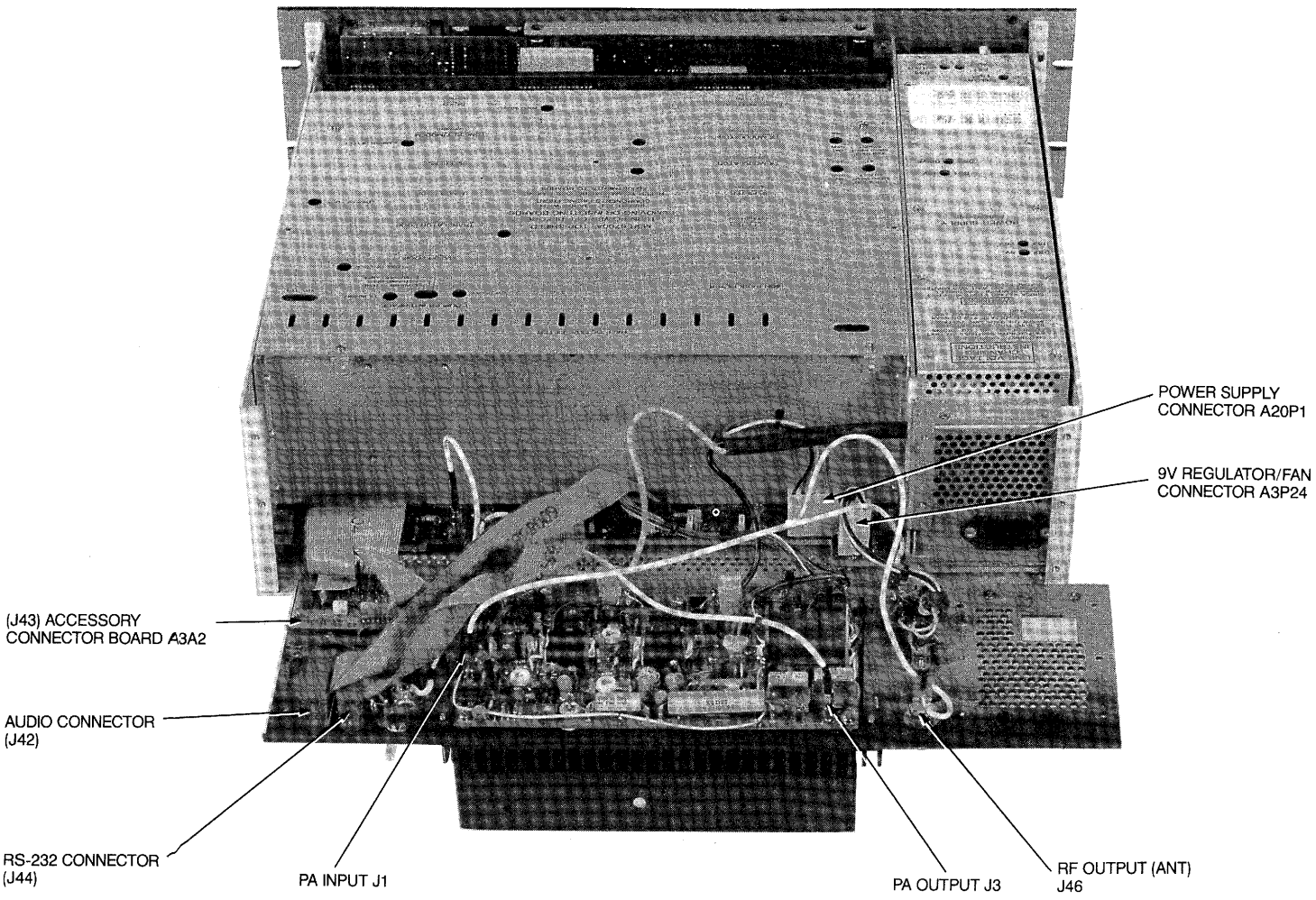


Figure 4.9-1 Rear Panel Assembly/Connections

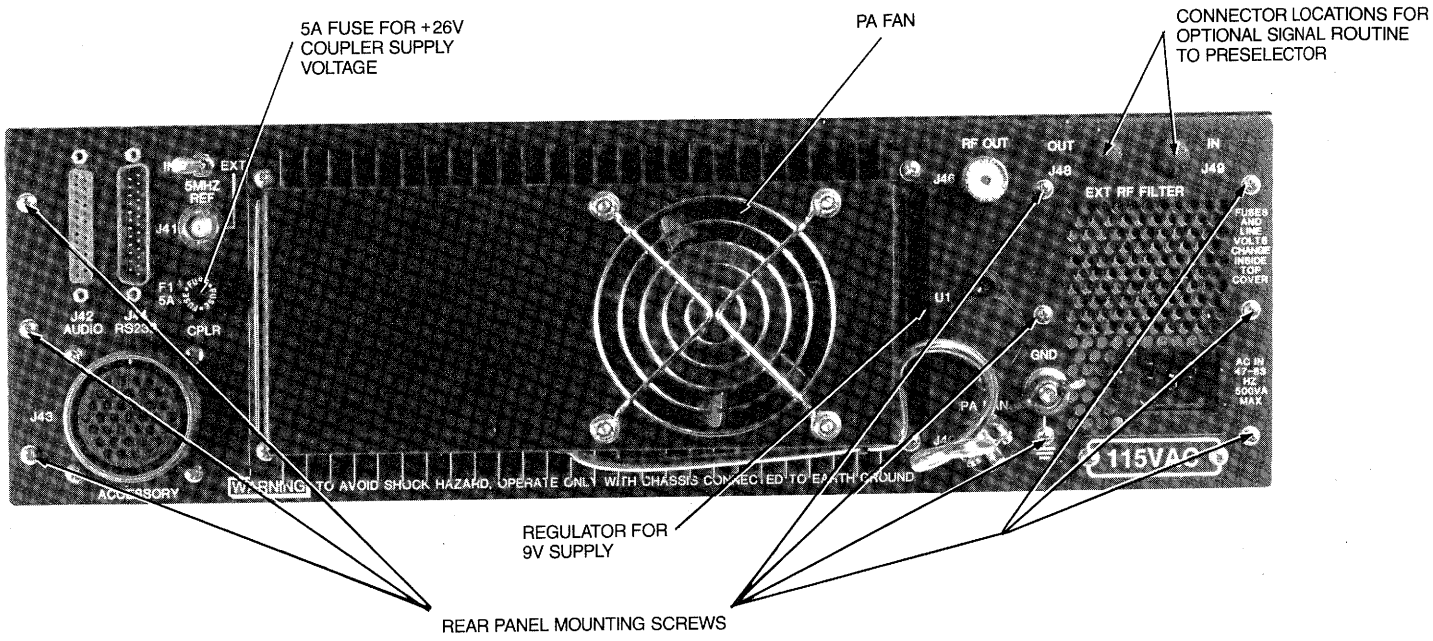


Figure 4.9-2 Rear Panel Assembly, Exterior

SYMBOL	DESCRIPTION	PART NUMBER
A3A1	Power Amplifier Assembly	600407-705-001
A3A2 (J43)	Connector Board Assembly	601483-536-001
A3A3	PA Fan Assembly	700023-700-001
C36,38	Cap., 22 µf, 50V	600297-314-018
C37,40	Cap., 0.1 µf, 50V	600272-314-001
F1	Fuse, 5A, SB	600006-396-030
J42, P22	Cable, Ribbon	600866-540-001
J44, P28	Cable, Ribbon	600866-540-038
J40	Connector, Fan	600377-606-002
J41	Connector, BNC	600162-606-001
J46	Connector, UHF	600373-606-001
(J42, 44)	Mounting Kit	600116-204-001
L1,2,3	Ferrite Bead	600267-622-001
P24	Connector, Molex	600353-606-001
P26	Cable Assembly, Antenna	600440-540-012
P29	Cable Assembly, Reference	600440-540-011
(P24)	Pin, Male	600237-230-001
(P24)	Pin, Female	600223-230-001
S1	Switch, SPDT	600289-616-006
U1	IC, LM350	600817-415-001
(U1)	Cover, Transistor	600288-419-001
(U1)	Insulator, Transistor	600170-419-001
XF1	Fuseholder	600014-613-002
XU1	Socket, Transistor	600250-419-001

Figure 4.9-3 Rear Panel Parts List (700202-539)

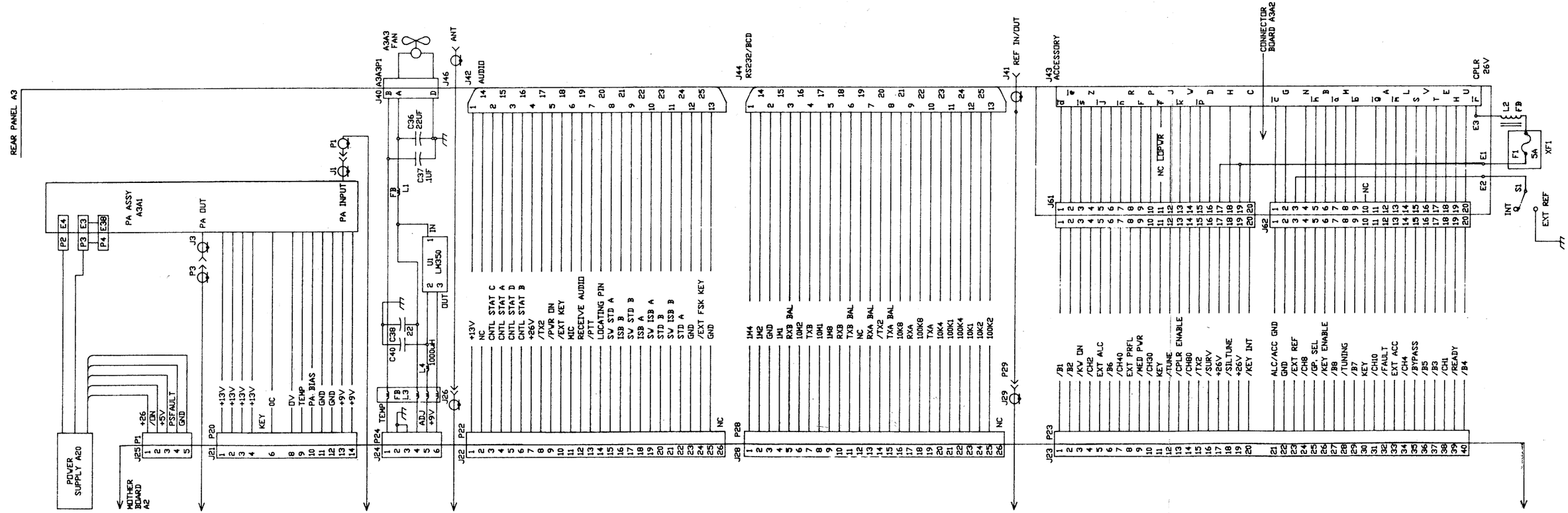


Figure 4.9-4

Rear Panel Schematic

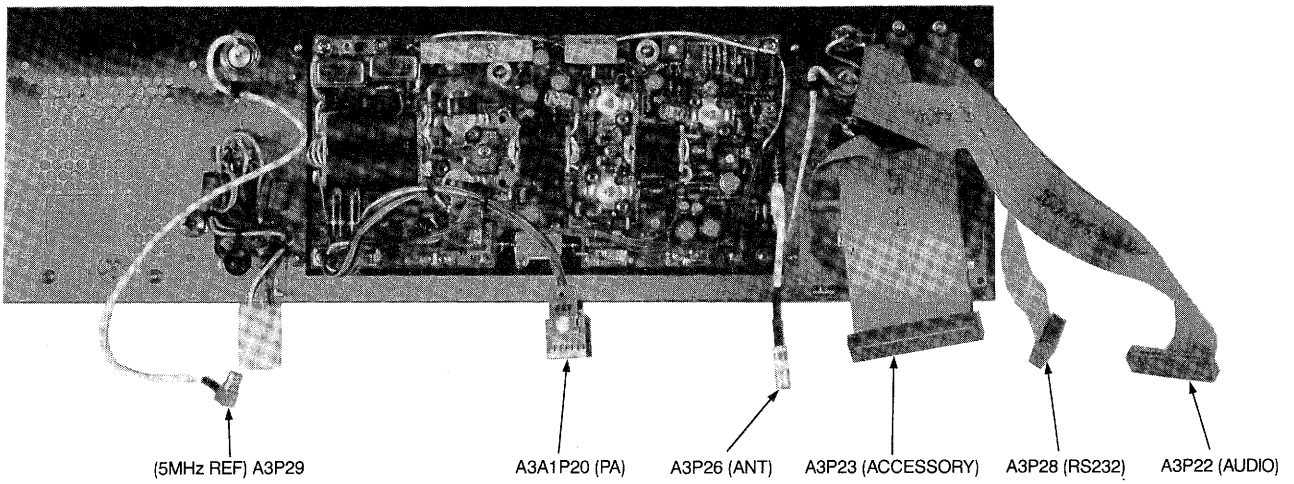


Figure 4.9-5 Rear Panel, Interior

4.9.2 125W POWER AMPLIFIER, A3A1

The solid state power amplifier accepts the +13 dBm RF drive input from the High Pass Filter assembly A7 and provides a nominal 38 dB gain to produce 125 watts output to the antenna (through the low pass filters) in the transmit mode. Also contained on this board are circuits that sense PA overvoltage, overcurrent, and overtemperature. These voltages are fed to the Half Octave Filter board A6 which, via feedback to the Transmit Modulator board, controls overall transmitter gain and power output. Contained also in this module is a +13.2 VDC regulator that supplies regulated +13 VDC radio.

4.9.2.1 Description

The RF signal is fed into P1. R49, R50 and R51 form a 2 dB 50 ohm attenuator. Therefore, input signals are reduced in amplitude before reaching the first amplifier stage. T1, Q5, and T2 serve as a +15 dB power amplifier. Two signals of equal amplitude and phase are taken from T2 to drive a push-pull power amplifier pair, Q6 and Q7. Bias voltage for Q5 is established by the voltage drop across R37 and diode CR3. Output from Q6 and Q7 (the second stage) is taken from T3 to drive the final push-pull output stage, Q8 and Q9, to the 125 watt output level.

Bias voltage for the driver and the power output stage is obtained from 13.2V regulator via R45 and R46 to diodes CR7 and CR9. Pots R44 and R47 provide a means to adjust the operating points of the drive and output stage for best linearity to reduce intermodulation distortion. Diodes CR7 and CR9 are mounted on the heatsink to provide temperature compensation. T4 transforms the low output impedance of Q8 and Q9 to 50 ohms. The secondary winding of T4 contains two windings of 2 1/2 turns each connected in parallel. C49, the capacitor in parallel with the primary of T4 and capacitor C28, compensates for leakage inductance in T4, and provides high frequency compensation. R14, R13 and C33 provide feedback for Q5 and reduce gain at the low frequency end.

Q3 and Q4 form a differential amplifier to provide DC overcurrent protection. The voltage drop across R6 is applied to Q4. When current through R6 reaches a value established by the adjustment of R16, a voltage appears at E5. This voltage, when fed to the Half Octave Filter board, is used to reduce drive to the amplifier.

Q1 and Q2 comprise a 13.2 volt regulator. The output voltage is set by the adjustment of R2. The output current of the voltage regulator is limited to approximately 2.0 amps. When the voltage across R53 begins to exceed 1.4 volts, diodes CR4, CR5 and CR6 begin to conduct, thereby limiting drive to Q2 and thus limiting the 13.2 volts output current.

CR8, C30, R33 and R34 are the overvoltage detectors. Any voltage change on the collector of Q9 is fed to the exciter and when excessive, drive to the amplifier is reduced.

4.9.2.2 PA Adjustment

Normally, adjustments to the solid state power amplifier are not required. If a component replacement or operation indicates a need for adjustments, the following adjustments can be made.

4.9.2.3 Test Set-Up

Terminate the transmit output, A3J46 in a 50 ohm, 125 watt load. Install a thru-line wattmeter (Bird or equivalent) in series with the output for these adjustments. Remove the four screws that attach the amplifier module to the Rear Panel assembly.

Carefully position the PA module in a flat position on the test bench. Insure that all wires and harnesses are attached to the exciter and that no electrical short circuit of the exposed PA circuit board or wiring can occur to the chassis or other metal objects. The exciter Power Amplifier assembly can be safely operated in this position for short periods.

4.9.2.4 13 VDC Regulator Adjust

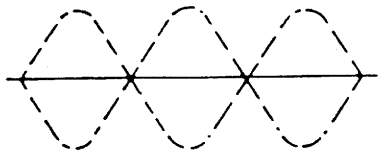
Set the transmit frequency to 5.2 MHz, the mode to USB. Key the radio using the microphone PTT but DO NOT speak into the microphone. Using a DC voltmeter connected between E1 and GND, adjust R2 for +13.2 VDC at E1. Unkey the radio.

4.9.2.5 Output Stage Bias Adjust

Key the radio with no modulation. Adjust R44 (DRIVER BIAS) for .68 VDC measured between the base of Q6 or Q7 and ground. Adjust R47 (FINAL BIAS) for .68 VDC measured between the base of Q8 or Q9 and ground.

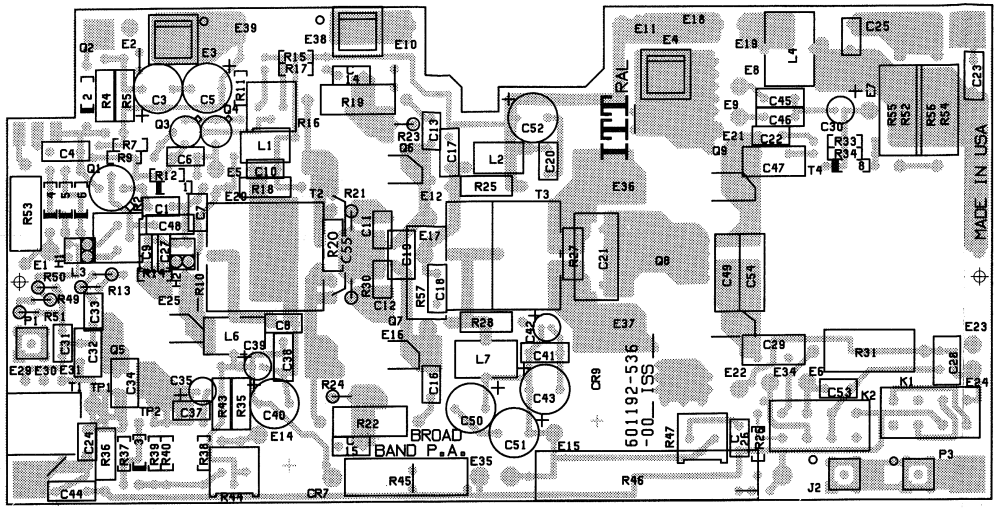
4.9.2.6 Drive Stage Bias Adjust

The exciter settings are the same as 4.9.2.5. Connect an oscilloscope across the 50 ohm load and connect the audio combiner key box Apply two equal audio tones, 700 and 2300 Hz, and key the exciter. The RF output pattern (shown below) on the scope should depict the standard two-tone pattern (similar to an AM modulation pattern with 100% modulation). Adjust R44 until the area between peaks just touches the reference line.



4.9.2.7 Overcurrent Adjustment

Change the transmit frequency to 29.999 MHz, the mode to CW; and key the exciter. 125 watts should be indicated on the wattmeter. Adjust the R16 overcurrent adjust until the output power starts to decrease. Slowly adjust R46 until full power returns. Leave R46 adjusted to this setting. Remove power from the radio. Reinstall the PA module on the Rear Panel assembly.



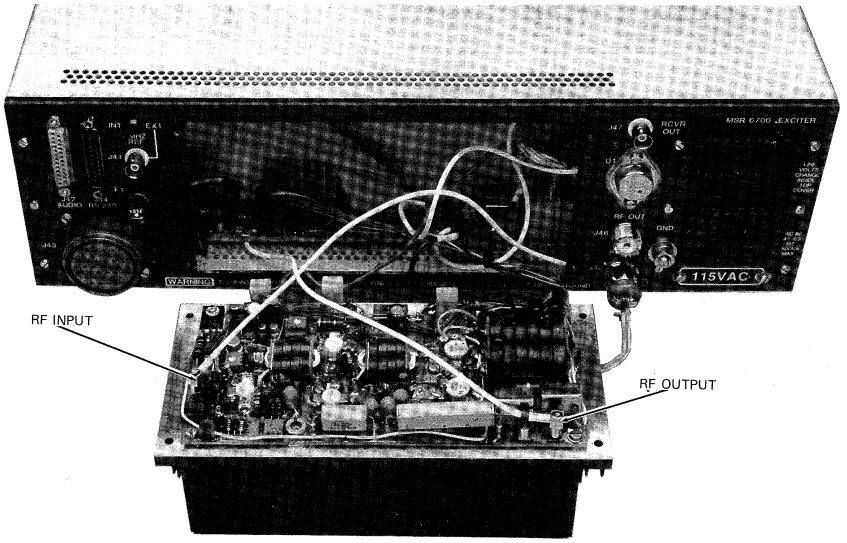
Power Amplifier (601192-536-001)

PART NUMBER	DESCRIPTION	SYMBOL
600226-314-008	CAP. .1UF, CERAMIC, 50V	C1,4,6, 7,8,10-16 20,24,26, 30,31,33 37,53
620093-306-501	CAP. 20PF, 3%, MICA, 500V	C19
600226-314-014	CAP.IUF,50V,CERAMIC	C25
600269-314-044	CAP. 680PF, CERAMIC, 100V	C27
656093-306-501	CAP. 56PF, 3%, MICA, 500V	C28
600297-314-033	CAP 100VF 50V	C3,5,52
627093-306-501	CAP. 27PF, 3%, MICA, 500V	C32
610003-306-501	CAP. 100PF, 3%, MICA, 500V	C34
600297-314-003	CAP. 1UF, ALUM, 50V	C39,42,35
600202-314-052	CAP. 330UF, 6V, TANT.	C40,43, 50,51
600189-314-015	CAP. .01UF, CERAMIC, 100V	C17,18,23, 38,41,44, 45,46,48
600006-411-007	DIODE IN4734A 5.6V	CR1
600006-411-019	DIODE IN4746A 18V	CR2
600011-416-005	DIODE IN4001	CR3,4,5,6
600108-410-001	DIODE IN4152	CR8
600260-230-001	LARGE TURRET TERMINAL	E1,10,11, 12,16,17 34,39,45 TP1, 2, FOR R46
600252-230-002	QUICK CONN. TAB	E3,4,38
600261-230-001	TERMINAL	E5-9, 14,2, 21-24
600064-419-004	2 POSITION VERTICAL MT.	H1,2
600385-606-001	CONN. FEMALE MIN. RF, PC MOUNT	J2
600028-402-006	12VDC RELAY	K1,2
600091-376-001	CHOKE 4.7UH	L1,2
600125-376-009	CHOKE 22UH	L3
600145-513-001	11UH TOROID COIL	L4
600146-513-001	35UH TOROID COIL	L6,7
600198-606-002	**CONN. MALE MIN. RF, PC MOUNT**	**P3,P1**

PART NUMBER	DESCRIPTION	SYMBOL
651192-536-001	PCB	PCB
600082-413-001	TRANSISTOR 2N2219A	Q1
600154-413-001	TRANSISTOR 2N2907A	Q3,4
613014-341-075	RES. 1.3K, 1/4W, 5%	R1,3
691014-341-075	RES. 9.1K, 1/4W, 5%	R11
627024-341-075	RES. 27K, 1/4W, 5%	R12
610014-341-075	RES. 1K, 1/4W, 5%	R13
662004-341-075	RES. 620, 1/4W, 5%	R14
610094-341-205	RES 10 1/2W 5%	R18,25, 28
647004-341-325	RES. 470, 1W, 5%	R19,22
647004-341-075	RES. 470, 1/4W, 5%	R10
600072-360-006	POT. 500, 1/2W, CERMET, TOP	R2,16
610004-341-205	RES. 100, 1/2W, 5%	R20
622084-341-075	RES. 2.2, 1/4W, 5%	R21,23, 24,30
643094-341-205	RES. 43, 1/2W, 5%	R27
651094-341-425	RES. 51, 2W, 5%	R31
610024-341-075	RES. 10K, 1/4W, 5%	R33,50
615004-341-075	RES. 150, 1/4W, 5%	R34
610084-341-205	RES. 1, 1/2W, 5%	R35,43
610014-341-205	RES 1K 1/2W 5%	R36
612004-341-075	RES. 120, 1/4W, 5%	R37
610094-341-075	RES. 10, 1/4W, 5%	R38
612094-341-075	RES. 12, 1/4W, 5%	R39-42
627004-341-205	RES 270 1/2W 5%	R4,5
600072-360-003	POT. 50, 1/2W, CERMET, TOP	R44,47
600096-340-101	RES. 100, 5W, 5%	R45
600097-340-250	RES. 25, 10W, 5%	R46
691094-341-075	RES. 91, 1/4W, 5%	R49
675094-341-075	RES. 75, 1/4W, 5%	R51
610094-341-425	RES 10 2W 5%	R52,54, 55,56
600057-340-005	RES .56, 2W, 10%	R53
636014-341-075	RES. 3.6K, 1/4W, 5%	R7,15
615014-341-075	RES. 1.5K, 1/4W, 5%	R9,17
635105-507-001	TRANSFORMER, BROADBAND INPUT	T1
635106-507-001	TRANSFORMER, DRIVER, 125W PA	T2
635106-507-002	TRANSFORMER, DRIVER, 125W PA	T3
600092-613-001	RELAY SOCKET	XK1,XK2
600025-419-001	TRANSISTOR PAD	

Figure 4.9-6

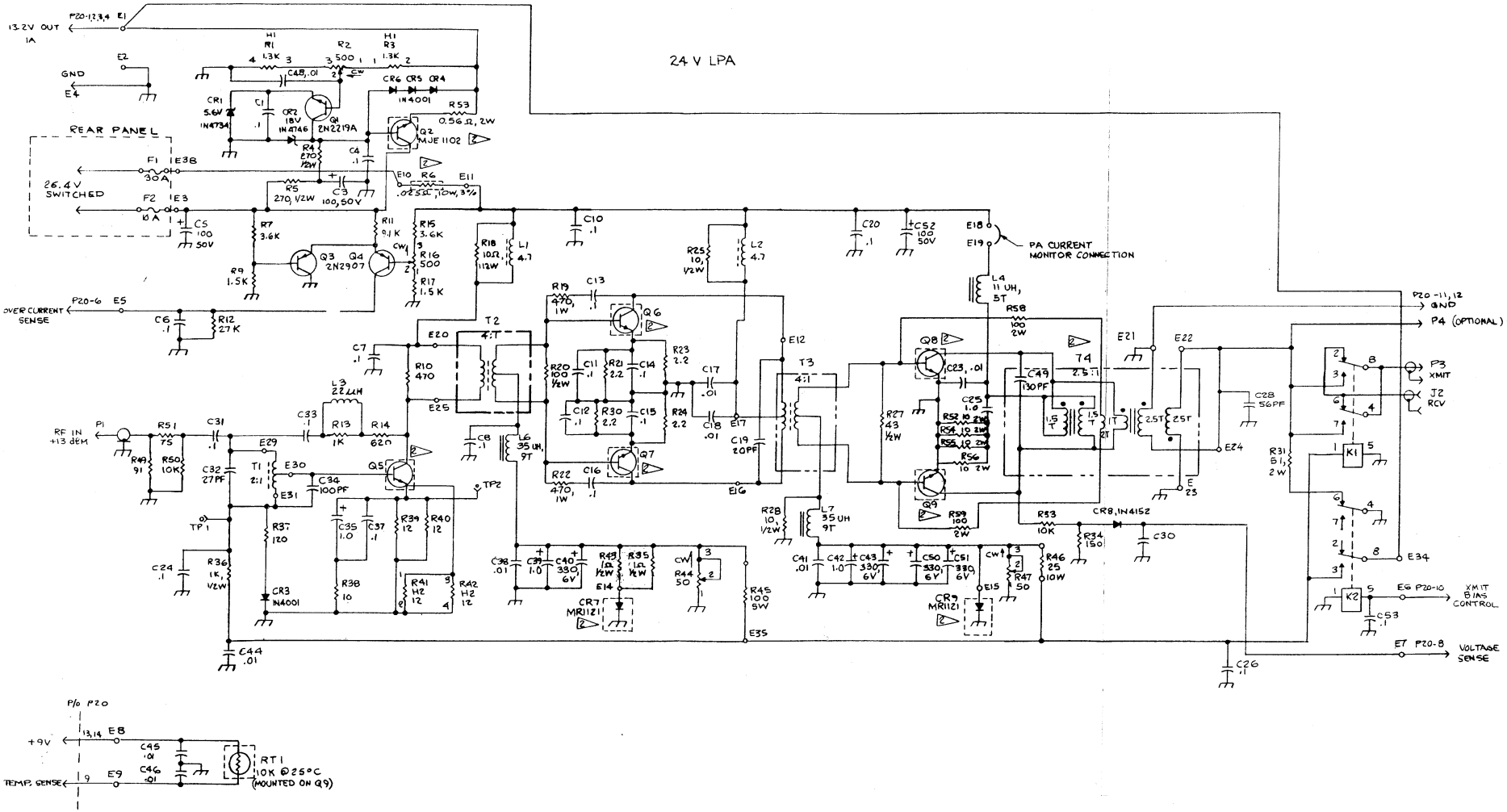
Power Amplifier Board Assembly



125W Power Amplifier (600407-705)

SYMBOL	DESCRIPTION	PART NUMBER
CR7, CR9	Diode, MR1121	600017-416-001
Q2	Transistor, MJE1102	600219-413-001
Q5, 6, 7	Transistor, BLY91CF	600273-413-001
Q8, 9	Transistor, CTC-S100-28	641320-542-009
R6	Resistor, .025Ω, 10W	600009-340-049
T4	Output Transformer	635107-507-001
-------	PC Board Assembly	601192-536-001
-------	Thermistor Assembly	600365-713-001

Figure 4.9-7 Power Amplifier Assembly



NOTES:

1. UNLESS OTHERWISE SPECIFIED: ALL RESISTORS ARE IN OHMS, AND ARE 1/4 W ±5%; ALL CAPACITORS ARE IN MICROFARADS; ALL CHOKES ARE IN MICROHENRIES.

▷ MOUNTED ON HEATSINK.

Figure 4.9-8

125W Power Amplifer Schematic

4.9.3 POWER AMPLIFIER FAN, A3A3

The PA Fan assembly (700023-700-001) is mounted over the PA heatsink on the rear panel. Electrical connections (26 VDC and ground) are made via the fan wiring harness and connector to rear panel J40. The fan uses a d.c. brushless motor to provide 41 CFM air flow.

4.9.3.1 Installation and Operation

The PA Fan Assembly is installed using the same four screws which secure the PA module to the rear panel. Disconnect radio AC power, remove the four screws, mount the fan assembly over the heatsink and replace the screws. Engage the fan plug into connector J41 on the rear panel. Lock into place with the outer locking ring.

Replace the AC power cord and turn the radio on. The fan should come on immediately. No adjustments are required.

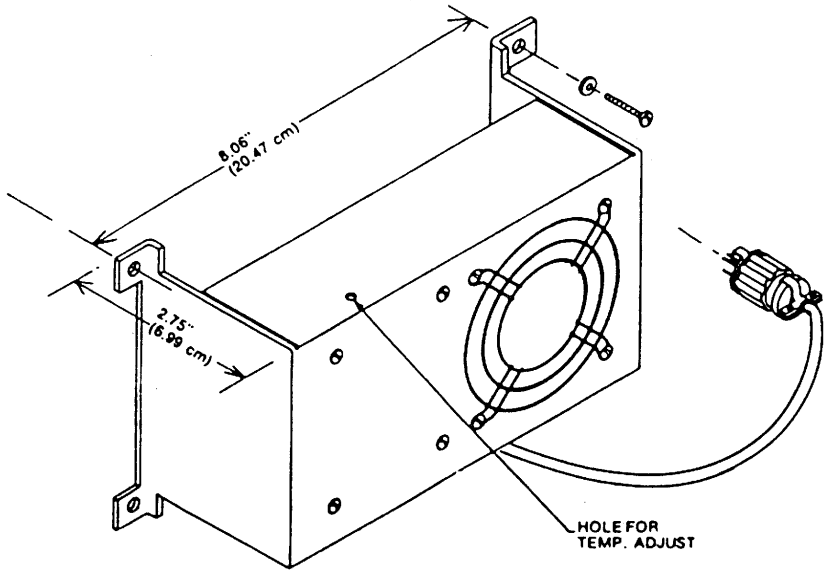
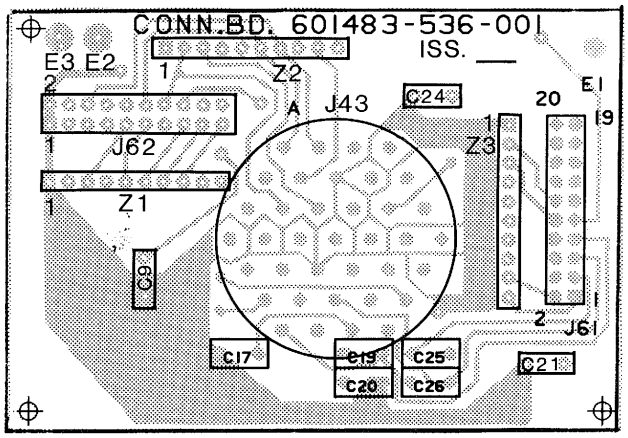


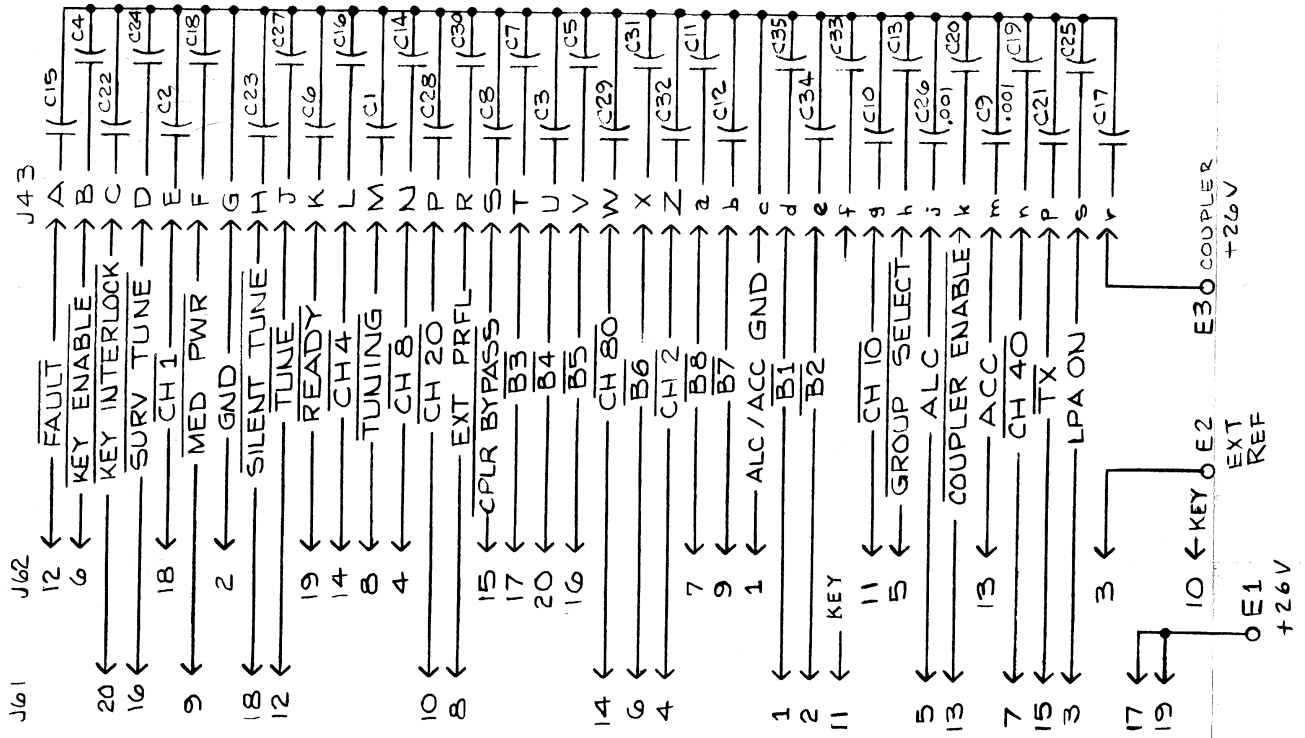
Figure 4.9-9 PA Fan Assembly



Accessory Connector (601483-536-001)

PART NUMBER	DESCRIPTION	SYMBOL
600302-314-013	CAP. .1UF, MYLAR, 50V	C17, 19-21, 24,25
600302-314-001	CAP. .001UF, MYLAR, 63V	C9,26
600472-606-001	CONN. 37 PIN, PC, (MS-28-21S)	J43
600174-608-004	CONN. HEADER, 20 PIN, ST.	J61,62
600380-314-002	CAP SIP .1UF X 9	Z1-3

Figure 4.9-10 Accessory Connector Board Assembly



NOTE:
1) ALL CAP. ARE 0.1μF, EXCEPT C9 AND C26.
2) ALL CAP. ARE PART OF S.I.P. NETWORKS Z1-Z3 EXCEPT C9, 17, 19, 20, 21, 24, 25 AND 26.

Figure 4.9-11

Accessory Connector Board Schematic

4.10 MOTHER BOARD, A2

4.10.1 GENERAL

This board is the electrical main frame of the exciter. All subassemblies are electrically connected to the Mother board as it is mainly used to transfer signals between the various sub-assemblies. All of the chokes and most of the capacitors are used to keep the 125W RF power signal out of the low level control and signal path lines. Two shields plug into the bottom of the board to prevent feedback when the bottom cover is installed. Circuit descriptions are as follows for the active circuitry on the board.

4.10.2 CIRCUIT DESCRIPTIONS

Relays K1 and K2 route audio signals from the microphone inputs to the correct Transmit Modulator board. They also inhibit the rear panel audio signal when the PTT inputs are used to key the exciter. When K1 is energized, microphone audio is routed to the standard Transmit Modulator board, TX Mod #1. At the same time, the PTT line is connected through K1 to the ISB inhibit line of TX Mod#1. When the PTT line is pulled low to key the exciter, the low on the ISB inhibit line causes rear panel audio signals present at TX Mod #1 to be inhibited and replaced by the microphone audio. Similarly, when relay K2 is energized, microphone audio is routed to TX Mod #2. This second Transmit Modulator board is part of the ISB option and is only in place when the ISB option is installed.

Comparator U7D disables the compressor on the Transmit Modulator board(s) when the FSK KEY input is used to key the exciter. When jumper plug JP9 is in the closed position (pins 1 and 2), the compressor is also disabled when the exciter is keyed by the EXT KEY input. LED 1, Resistors R47-R50 and associated components are part of the +9V regulator circuit. The remainder, including an LM 350 regulator IC, is on the exciter rear panel. Potentiometer R50 adjusts the voltage level. LED 1 is illuminated whenever voltage is present on the +9V line.

Relay K3 selects the front panel meter signal. The RFL line, when low, energizes the relay and routes an external reflected power signal to the meter. When the RFL line is high, an internally generated forward power signal is fed to the meter.

Transistors Q7, Q8, and Q10 are simply inverter-drivers.

Comparators U7A, U7B, and U7C, along with Q11 and associated components, are used for LPA verification and power-on. When the operator attempts to turn on the LPA by selecting power level 3 or level 4, a low signal at J3-24 (KWA) forces U7A-1 high. This turns on Q11 if there is a path from the Q11 emitter to ground. If an MSR 1020 or MSR 1030 LPA is in the system, a path to ground is provided through the LPA front panel. If the ground is present, Q11 is turned on, its collector voltage drops and U7B-13 goes high. U7C-14 is then forced low and this low signal at J3-21 (KWB) signals the microprocessor that an LPA is connected. The current through Q11 turns on the LPA. If no LPA is connected, Q11 will not turn on so KWB stays high and the microprocessor informs the operator by not allowing the selection of power levels three or four.

U3 and U4 are Input/Output expanders. They transfer control signals from the microprocessor to the BCD inputs on the Minor Loop and Major Loop boards in the synthesizer to create the correct frequency outputs.

Transistor Q9 turns on to pull in the coupler bypass relay in the antenna coupler (if installed the bypass relay is an option). A high signal on the CPLR BYPASS line, J3-32, turns on Q9. The coupler bypass function is only used when a receiver/exciter system is in the receive mode. The TX3 signal is used to inhibit the bypass function when the exciter is keyed by turning off Q9 via CR17.

U5 and U6 are high voltage QUAD NAND gates. These gates are used as line drivers/inverters for the CH1 to CH80 outputs to the MSR 4030 Antenna Coupler. They provide a BCD output to supply stored channel information used by the coupler when in the silent tune mode.

4.10.3 MOTHER BOARD JUMPERS JP1-JP9
(Refer to Figure 4.10-1 for locations.)

JP1, JP2 - Bypass the STD audio signal around the Tone Key/Modem board connector J7.

JP3, JP4 - Bypass the STD audio signal around the Audio Interface board connector J6.

JP5, JP6 - Connect the CNTL/STAT audio signal to the Tone Key/Modem board.

JP7, JP8 - Bypass the ISB audio signal around the Audio Interface board connector J6.

JP9 - Causes the Transmit Modulator compressors to be disabled when the exciter is keyed via the EXT KEY input.
Closed: Jumper towards rear panel.
Open: Jumper toward front panel.

4.10.3.1 When to Use Audio Jumpers JP1-JP8

a) Standard Exciter. No Tone Key/Modem board (J7). No Audio Interface board (J6).

JP1,JP2 closed -jumpers away from power supply.
JP3, JP4 closed - jumpers toward power supply.
JP5, JP6 closed - jumpers toward power supply.
JP7, JP8 closed - jumpers toward front panel.

b) Remote Control Option #1, single remote, single radio Tone Key/Modem board installed in J7. No Audio Interface board.

JP1, JP2 open - jumpers toward power supply.
JP3, JP4 closed - jumpers toward power supply.
JP5, JP6 closed - jumpers toward power supply.
JP7, JP8 closed - jumpers toward front panel.

c) Remote Control Option #2, single remote, multi-radio, Tone Key/Modem board installed in J7. Audio Interface board installed in J6.

JP1, JP2 open - jumpers toward power supply.
JP3, JP4 open - jumpers away from power supply.
JP5, JP6 open - jumpers away from power supply.
JP7, JP8 open - jumpers toward rear panel.

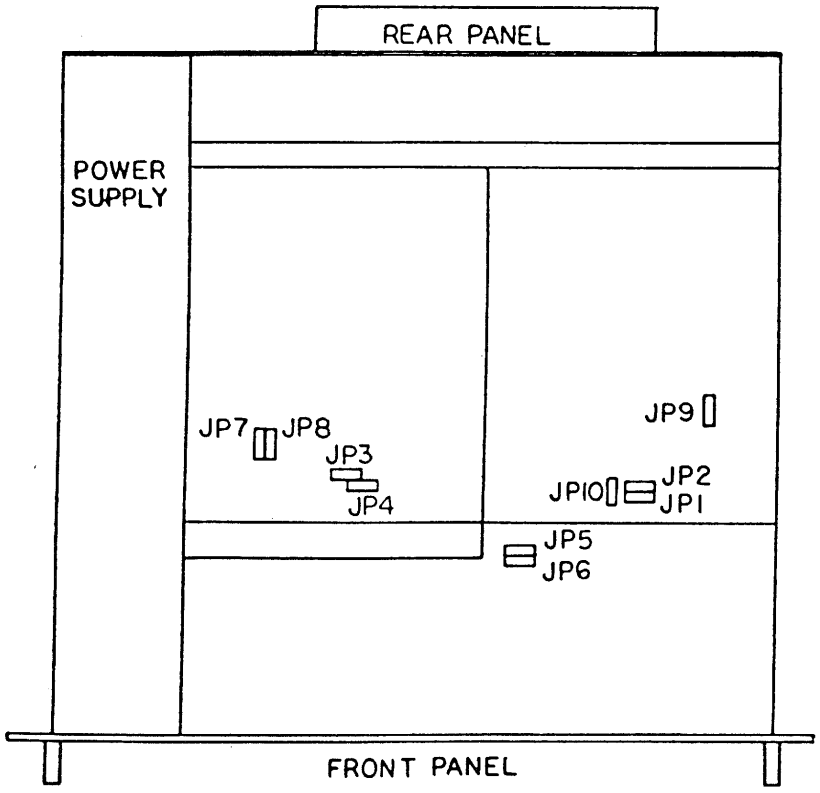


Figure 4.10-1 Mother Board Jumper Locations

PART NUMBER	DESCRIPTION	SYMBOL
600272-314-001	CAP. IUF, CERAMIC, 50V	C1-3,5-8 11-13,16, 18-26, 28-41,43, 46-52,54 57,59-61, 63,64,67 68,70,74; 76-88, 90-94,113
600202-314-018	CAP. 10UF, 25V, TANT.	C105,106
600278-314-007	CAP. .1UF, CERAMIC,100V	C114-116
600302-314-013	CAP. .1UF, MYLAR, 50V	C4,9,10, 53,58,65 66,69 71-73,75, 89,97,104
610045-319-350	CAP. 1UF, 35V, TANT.	C42
600297-314-016	CAP. 22UF, ALUM, 25V	C44
600226-314-014	CAP. 1UF, CERAMIC,50V	C55
600268-314-008	CAP. .01UF, CERAMIC, 50V	C98-103, 107-112
600011-416-002	DIODE IN4004	CR1-3,13, 14,18,19
600052-410-001	DIODE IN270	CR15,17
600109-410-001	DIODE IN4148	CR6-8
600043-390-002	LED, YEL	DS1
600174-608-024	CONN. HEADER, 40 PIN,ST	J23
600147-605-001	CONN. CARD EDGE, 44 PIN, ST.	J1-4,6-20
600237-608-004	CONN. MOLEX, 6 PIN, PC MOUNT	J24
600237-608-003	CONN. MOLEX, 5 PIN, PC MOUNT	J25
600198-606-002	CONN. MALE MIN. RF, PC MOUNT	J26,29
600174-608-025	CONN. HEADER, 16 PIN, ST.	J32
600174-608-021	CONN. HEADER, 14 PIN, ST.	J21,33
600174-608-022	CONN. HEADER, 26 PIN, ST.	J22,88
600190-608-001	CONN, JUMPER, 2 POS.	JP1-10
600279-608-002	CONN. HEADER, 4 PIN, PC MOUNT	JP1-10
600094-403-002	RELAY, DPDT, 24V, 3A CONTACTS	K1-3
600206-419-016	IC SOCKET, 16 PIN	(K1-3)
600125-376-022	CHOKE 180UH	L1,18,19
600125-376-007	CHOKE 33UH	L2,3,8-17 21-23, 25-28
600072-376-025	CHOKE 10UH	L7,20
600221-413-002	TRANSISTOR 2N5308	Q1,2
600154-413-001	TRANSISTOR 2N2907A	Q7
600080-413-001	TRANSISTOR 2N2222A	Q8-11
647024-341-075	RES. 47K, 1/4W, 5%	R1,2
647014-341-075	RES. 4.7K, 1/4W, 5%	R30,31,32
610024-341-075	RES. 10K, 1/4W, 5%	R4,34,36, 43,45,46 51,52,56 57
610004-341-075	RES. 100, 1/4W, 5%	R44
691004-341-075	RES. 910, 1/4W, 5%	R47
647004-341-075	RES. 470, 1/4W, 5%	R48,53
600051-360-007	POT. 1K, 1/2W, CERMET	R50
630024-341-075	RES. 30K, 1/4W, 5%	R54
691024-341-075	RES. 91K, 1/4W, 5%	R55
622014-341-075	RES. 2.2K, 1/4W, 5%	R8,33,35 42,49
600130-616-001	SWITCH, SLIDE, DPDT, PC MOUNT	S2
600217-415-101	IC 8243, I/O EXP	U3,4
600221-415-001	IC 74LS26, NAND, HV, QUAD	U5,6
600324-415-001	IC LM339, COMPARATOR	U7
600206-419-024	IC SOCKET, 24 PIN	XU3,4
600206-419-014	IC SOCKET, 14 PIN	XU5,6,7

Mother Board (700005-536)

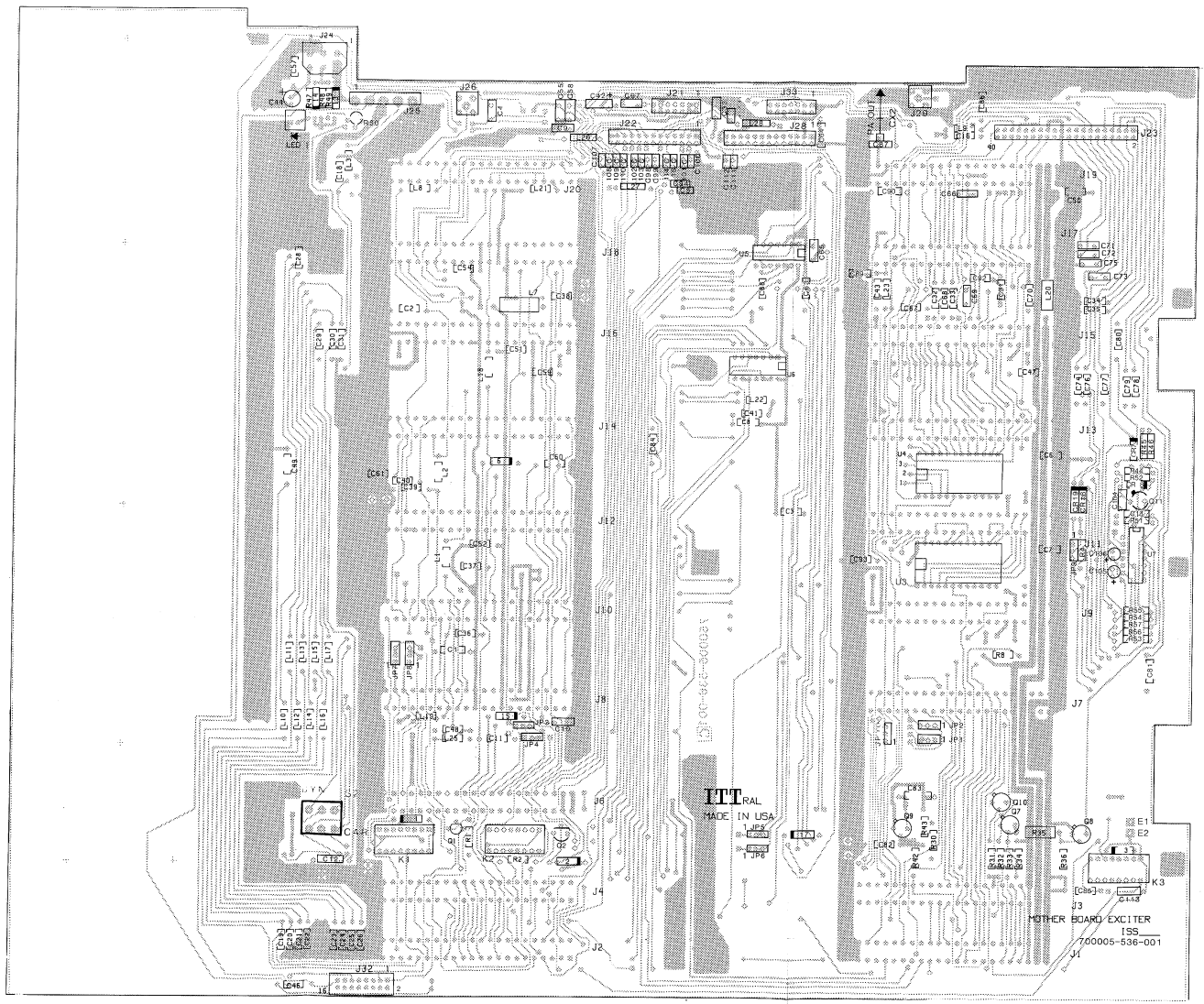


Figure 4.10-2

Mother Board Assembly (Sheet 1 of 2)

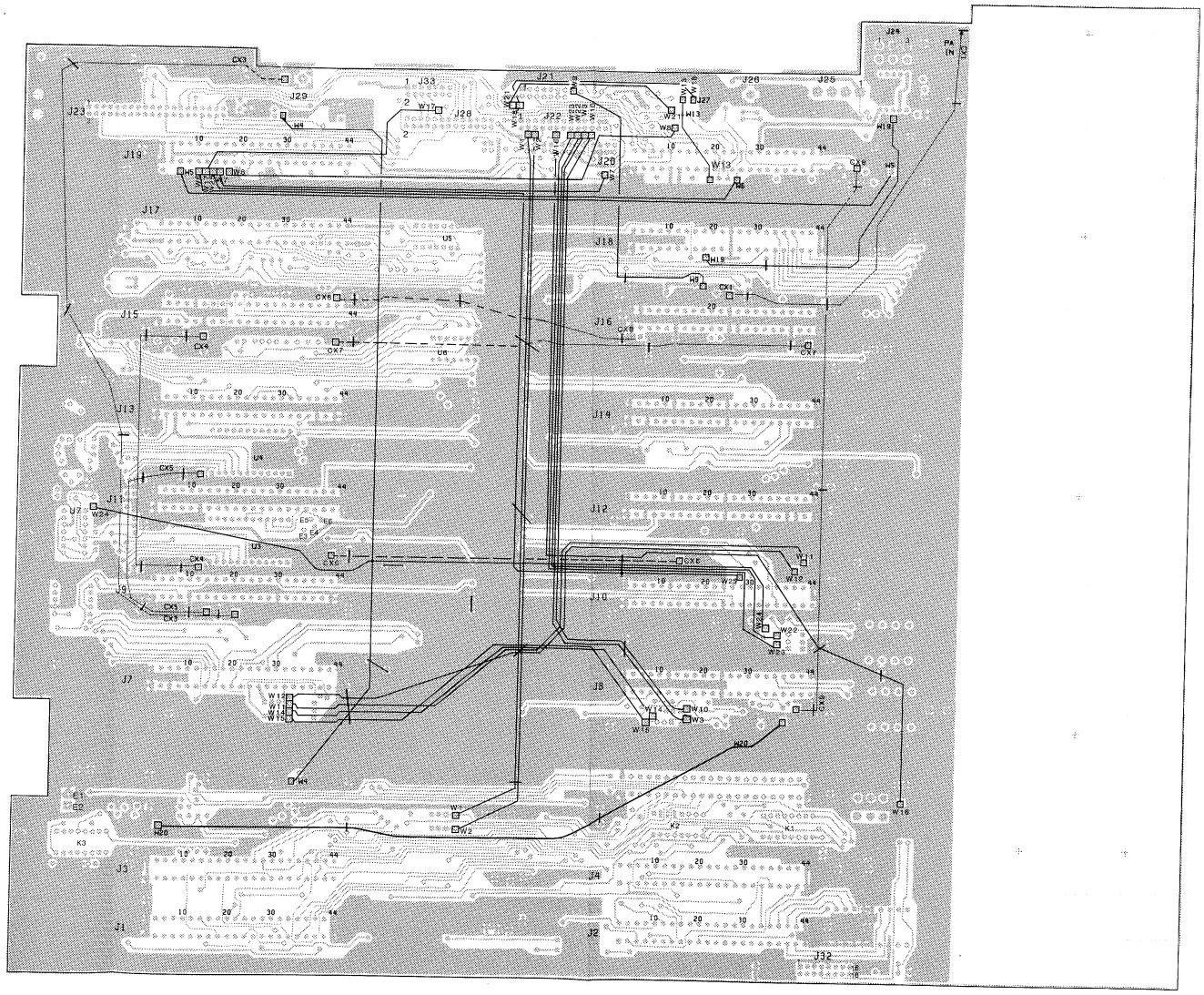


Figure 4.10-2

Mother Board Assembly (Sheet 2 of 2)

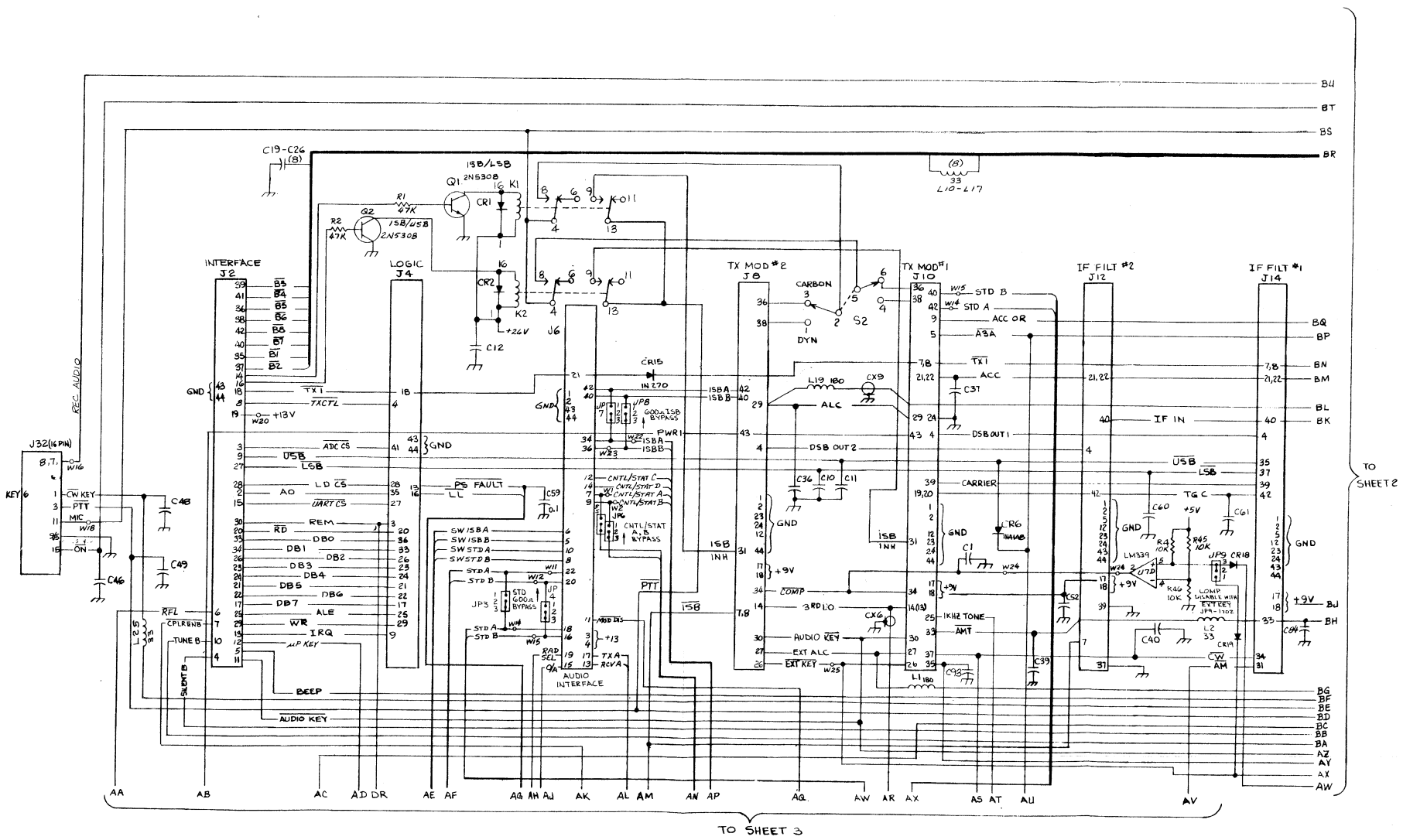


Figure 4.10-3

Mother Board Schematic (Sheet 1 of 4)

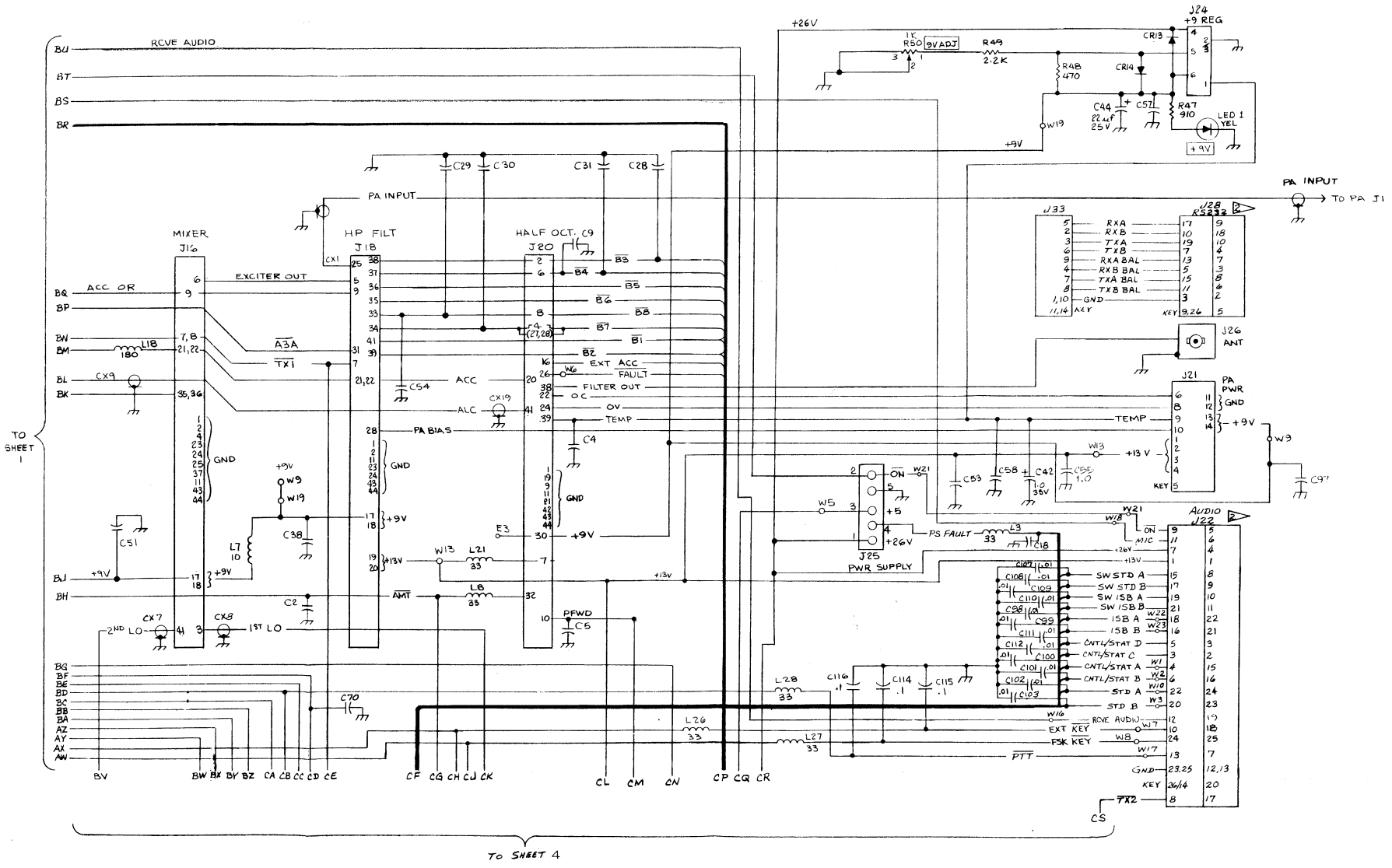


Figure 4.10-3

Mother Board Schematic (Sheet 2 of 4)

PIN NUMBERS IN SECOND COLUMN SHOW SIGNAL LOCATIONS AT MSRG700A REAR PANEL J42 (AUDIO) AND J44 (RS232)

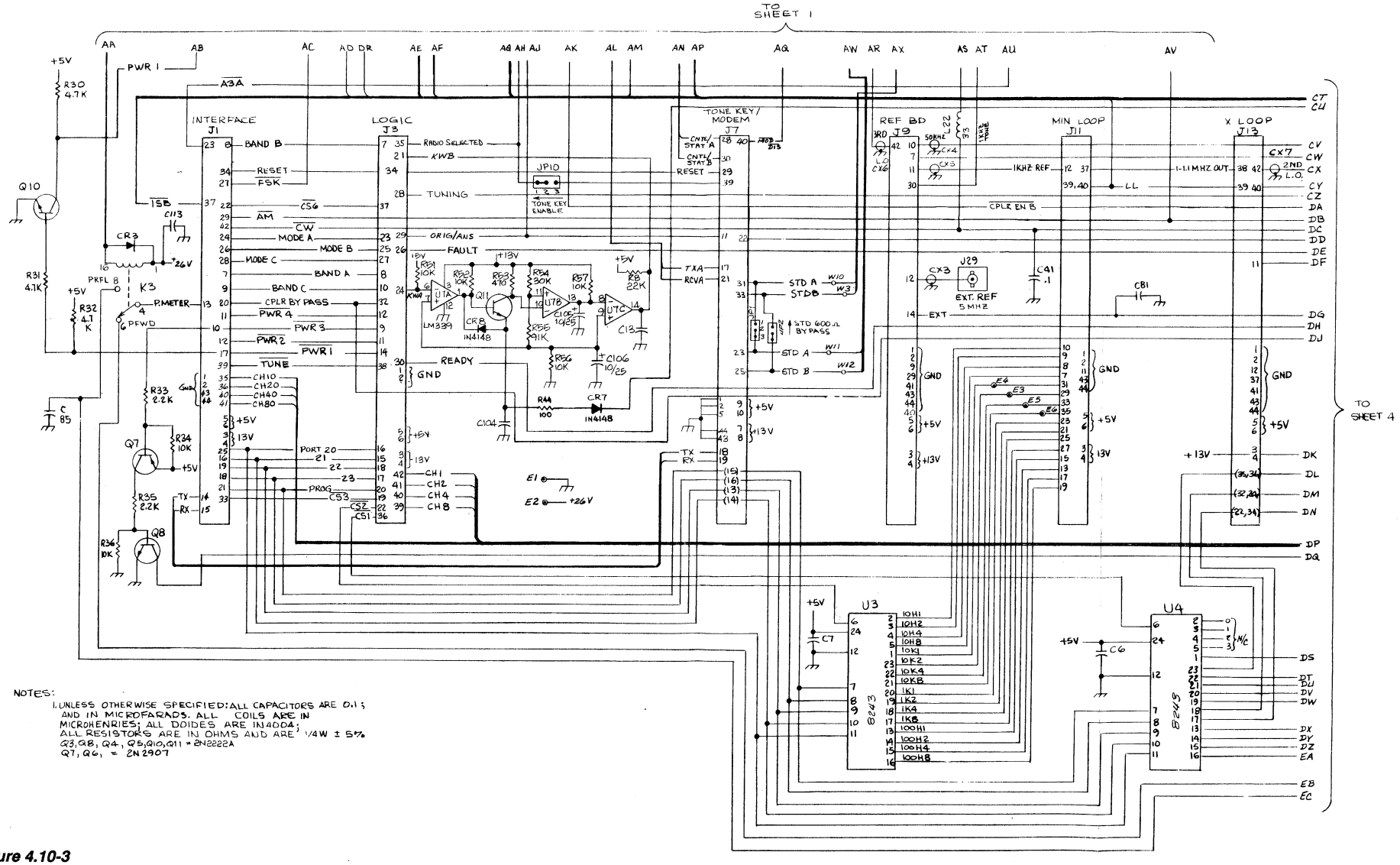


Figure 4.10-3

Mother Board Schematic (Sheet 3 of 4)

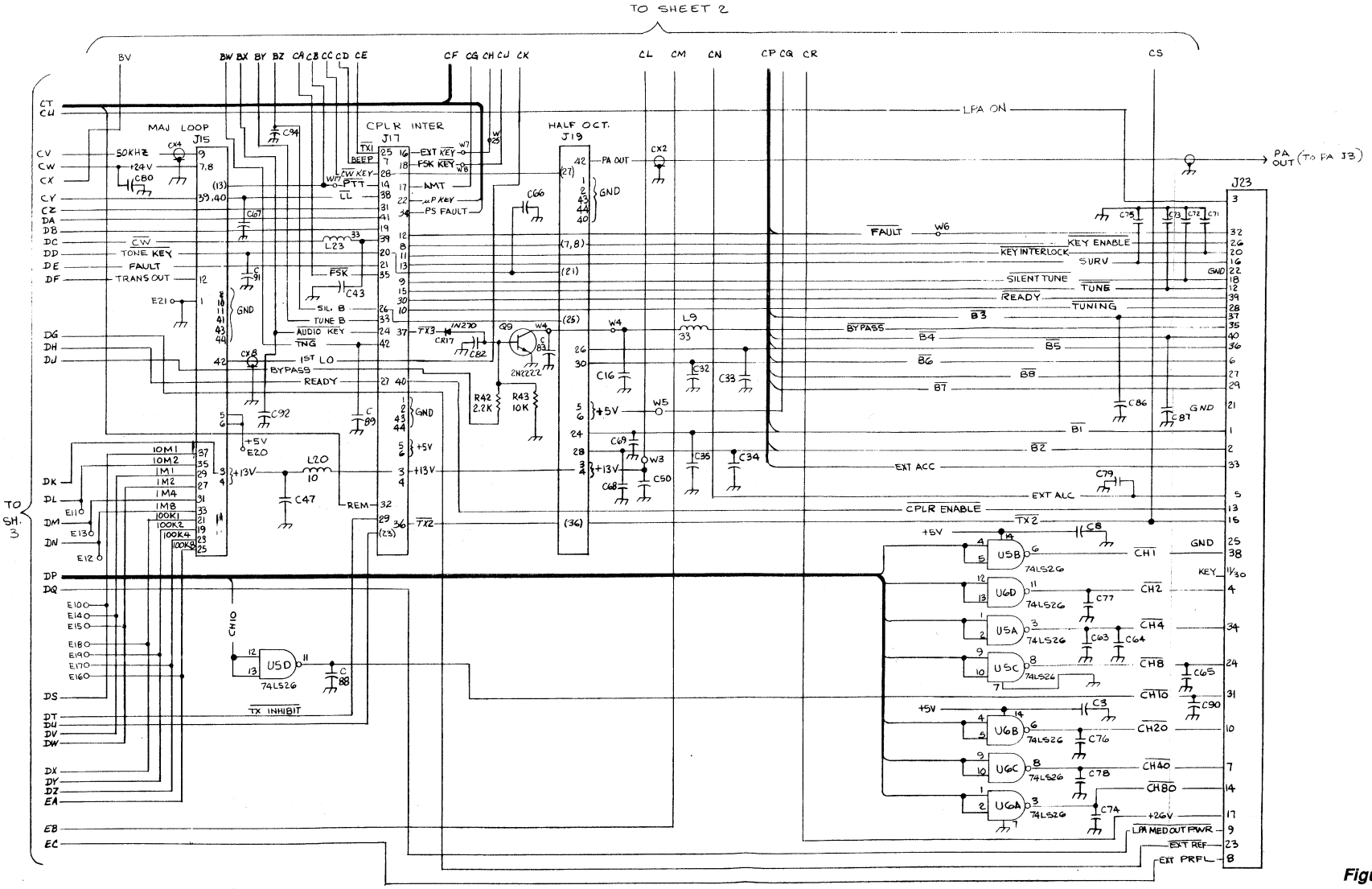


Figure 4.10-3

Mother Board Schematic (Sheet 4 of 4)

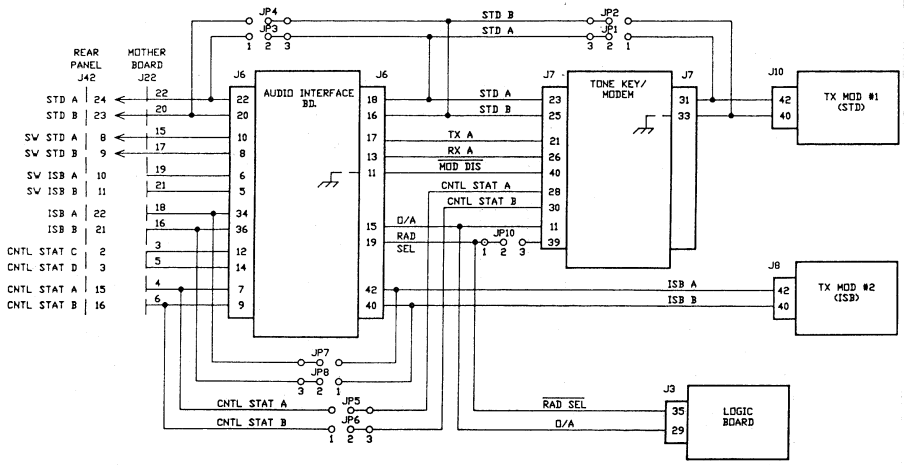


Figure 4.10-4 Signal Path 600 Ohm Audio

4.11 INTERFACE BOARD, A4

4.11.1 GENERAL

The Interface board serves as an interconnection between the Front Panel Keypad/Display board, Logic board and the external Remote Control Unit. Connection is made to the Front Panel via two ribbon cables.

This board contains the following major functions:

Keyboard Display Chip
Analog to Digital Converter (for remote meter)
Mode, Bandline and Filter Selection
Decoders
UARTS (for remote control operation)
Baud Rate Generator (for UART)
I/0 Expander
Sidetone and Beep Generators
Line Drivers
-12V Supply

Each major function is discussed briefly in the folllowing paragraphs.

4.11.2 KEYBOARD DISPLAY CHIP

U1 is the keyboard select chip. The keys on the Front Panel which are mounted on the Keypad/ Display board, are arranged in a matrix configuration. Three scan lines SLO-2 (rows) and eight return lines RLO-7 (columns) define which key was depressed. This information is communicated to the processor on the main data bus DBO-7.

4.11.3 ANALOG TO DIGITAL CONVERTER

U4 is the A to D Converter. The analog signal representing the Front Panel Meter deflection of the 6700A has to be converted to a digital signal so that it can be communicated to the remote control unit. The analog signal enters pin 1, and is converted to a 8 bit digital signal on DBO-7 (the Main Data Bus), which is read by the processor.

4.11.4 MODE/BANDLINE SELECTION DECODERS

U5 and U7 are decoders for Mode and Bandline selection, respectively. These ICs take in the binary coded information on three inputs, and decodes them into eight different decimal equivalent states. The inputs are generated from information processed by the processor, and the outputs are used to pull in the various Modes or Bands in the radio.

4.11.5 UART

UART is short for "Universal Asynchronous Reception and Transmission". The large amount of status and control information that exists on the Main Data Bus is on eight lines. To communicate this information to a remote location over two wires, the information has to be converted from parallel to serial format. This is done by U2. Since this is a bi-directional device, it is connected to the Data Bus in reception mode on RBR1-8, and in the transmission mode on TBR1-8. U21 through 25, dip switches S1-3, and relays K1, K2 interface the UART to the external remote control lines to accommodate RS-232, RS-422, RS-423, and MIL-STD-188C formats. U23A, B are balanced (RS-422) or unbalanced line receivers depending on S1-3 and S1-4 setting. U22A,B are either balanced or unbalanced line drivers depending on S1-5. Two ports A and B are provided so that multiple receivers may be daisy-chained in a remote control network; i.e. on one port are RX A (receive), RX A BAL (return line in an RS-422 format), TX A (transmit out), and TX A BAL (return for TX A in RS-422 format).

Signals coming into RX A are retransmitted out TX B to the next radio in a daisy chain. If the radio power is off, relays K1 and K2 connect ports A, B to maintain communication. In transmit condition, signals are sent out at both TX A and TX B.

Transmit and receive signals are routed to separate buses A and B and ultimately to UART U2 pins 25, 20 (TR0, RR1). Signals are diverted to the appropriate ports by tri-state buffers U24 and U25, controlled by the TX CTL signal from the µP.

When the optimal FSK modem is installed, the FSK signals are reduced to TTL signals RX DATA and TX DATA in the modem and brought to P1 pin 15, 14. The signals are then routed to the same BUS A and BUS B as before.

Switch assignments are shown in Table 3.1.

4.11.6 BAUD RATE GENERATOR

U3 is the baud rate generator. The baud rate is the speed at which data is transferred between UARTs at two locations. (In the MSR 6400 RCU, the UART is built into the 8051 processor chip.)

Dip switch S4 allows setting of the baud rate as follows:

S4				BAUD RATE
1	2	3	4	
0	1	0	1	300
0	1	1	1	1200
1	0	1	0	2400
1	1	0	0	4800
1	1	1	0	9600

U8 is the I/O expander IC. This means that the information from the processor, which exists on pins 8-11, is expanded out on three different ports to get the channel, key and tune information.

4.11.7 SIDETONE AND BEEP GENERATORS

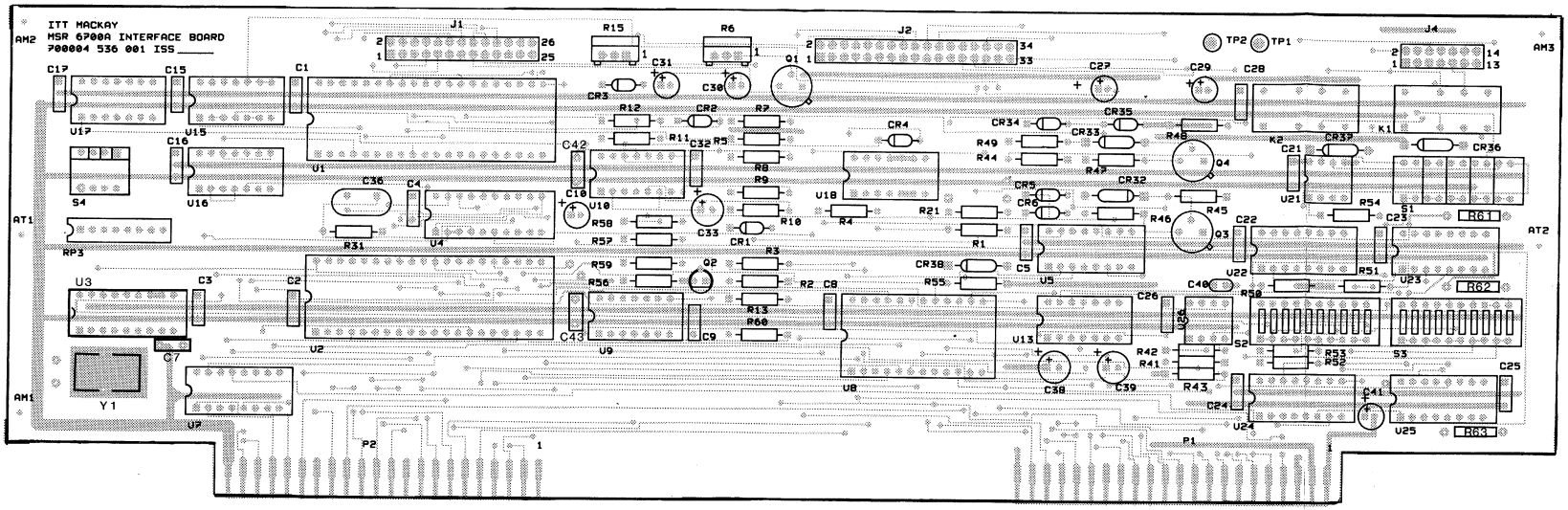
U10B is the sidetone generator and U10A is the beep generator. R6 adjusts the volume of the tone generated by either U10A or U10B. The sidetone is used in the CW mode, and the beep tone is used when the coupler is tuning.

4.11.8 LINE DRIVERS

U21-24 are line drivers that provide two buses for communication of the UART information. This is required for daisy-chaining and remote controlling various exciters.

4.11.9 -12V SUPPLY

U26, Q3 and Q4 provide a -12V supply from 13V input. This -12V is used for the line drivers which convert the TTL signal of the UART to a signal with higher ± excursions. This allows transmission of signals over a greater distance.



Interface (700004-536-001)

PART NUMBER	DESCRIPTION	SYMBOL
600302-314-013	CAP. .1UF, MYLAR, 50V	C1-5,7-9, 15-17, 21-26,28 42,43,
600297-314-016	CAP. 22UF, ALUM, 25V	C10
600297-314-013	CAP. 10UF, ALUM, 50V	C27,29, 30,41
600302-314-013	CAP. .1UF, MYLAR, 50V	C28,42, 43,
600297-314-003	CAP. 1UF, ALUM, 50V	C31
600302-314-007	CAP. .01UF, MYLAR, 63V	C32
600297-314-025	CAP. 47UF, ALUM, 25V	C33,38, 39
615003-306-501	CAP. 150PF, 3%, MICA 500V	C36
600268-314-011	CAP. .015UF, CERAMIC, 50V	C40
600109-410-001	DIODE IN4148	CR1-3,5, 6,34,35,
600006-411-007	DIODE IN4734A 5.6V	CR32,33
600011-416-002	DIODE IN4004	CR36,37
600006-411-012	DIODE IN4739A 9.1V	CR38
600052-410-001	DIODE IN270	CR4
600174-608-005	CONN. HEADER, 26 PIN, ST.	J1
600174-608-006	CONN. HEADER, 34 PIN, ST.	J2
600174-608-021	CONN. HEADER, 14 PIN, ST.	J4
600073-403-003	RELAY, DPDT, 5V	K1,2
600163-413-001	TRANSISTOR 2N2905A	Q1,3
600221-413-002	TRANSISTOR 2N5308	Q2
600082-413-001	TRANSISTOR 2N2219A	Q4
610014-341-075	RES. 1K, 1/4W, 5%	R1,11
620014-341-075	RES. 2K, 1/4W, 5%	R10,56-59
613024-341-075	RES. 13K, 1/4W, 5%	R12
610024-341-075	RES. 10K, 1/4W, 5%	R2,4,13, 31,48, 50-54, 61-63
600000-341-075	RES. 0, 1/4W, 5%	R21
656024-341-075	RES. 56K, 1/4W, 5%	R3
647004-341-075	RES. 470, 1/4W, 5%	R41
643014-341-075	RES. 4.3K, 1/4W, 5%	R42

PART NUMBER	DESCRIPTION	SYMBOL
610094-341-075	RES. 10, 1/4W, 5%	R43
620094-341-075	RES. 20, 1/4W, 5%	R46,47
615094-341-075	RES. 15, 1/4W, 5%	R5
620004-341-075	RES. 200, 1/4W, 5%	R55
600089-360-010	POT. 10K, 1/2W, CERMET, RT/AN	R6,15
647024-341-075	RES. 47K, 1/4W, 5%	R60
622014-341-075	RES. 2.2K, 1/4W, 5%	R7,44, 45,49
610004-341-075	RES. 100, 1/4W, 5%	R8
643024-341-075	RES. 43K, 1/4W, 5%	R9
600106-340-008	RES. NETWORK 8 PIN, 4.7K	RP3
600244-616-005	DIP SWITCH, SPDT X5	S1
600235-616-010	DIP SWITCH, SPST X10	S2,3
600264-616-001	SWITCH, DIP, 4 POS.	S4
600119-419-040	IC SOCKET, 40 POS.	(U1,2)
600119-419-020	IC SOCKET, 20 POS.	(U4)
600119-419-024	IC SOCKET, 24 POS.	(U8)
600507-415-101	IC 8279, KEYBD/DISP	U1
600237-415-001	IC LM556, DUAL TIMER	U10
600271-415-001	IC 74LS08, AND, 2-IN QUAD	U13
600219-415-001	IC 74LS33, NOR, 2-IN, QUAD	U15
600411-415-001	IC 74LS32, OR, 2-IN	U16
600111-415-001	IC 74LS04, HEX INV	U17
600171-415-001	IC LM324, OP AMP, 741 QUAD	U18
600424-415-101	IC 6402, UART, CMOS	U2
600862-415-001	IC 9636A, DRIVER	U21
700107-415-001	IC, MC3487	U22
700105-415-001	IC, MC3486	U23
700103-415-001	IC, 74HC368	U24
700102-415-001	IC, 74HC367	U25
600074-415-001	IC NE555, TIMER	U26
600617-415-001	IC 8116, BAUD RATE GEN	U3
700104-415-001	IC, ADC0804	U4
600528-415-001	IC 74LS145, BCD TO DECI DEC	U5,7
600217-415-001	IC 8243, I/O EXP	U8
600415-415-001	IC 1489, LNRCVR, QUAD	U9
600170-378-001	CRYSTAL, 5.0688 MHZ	Y1

Figure 4.11-1

Interface Board Assembly

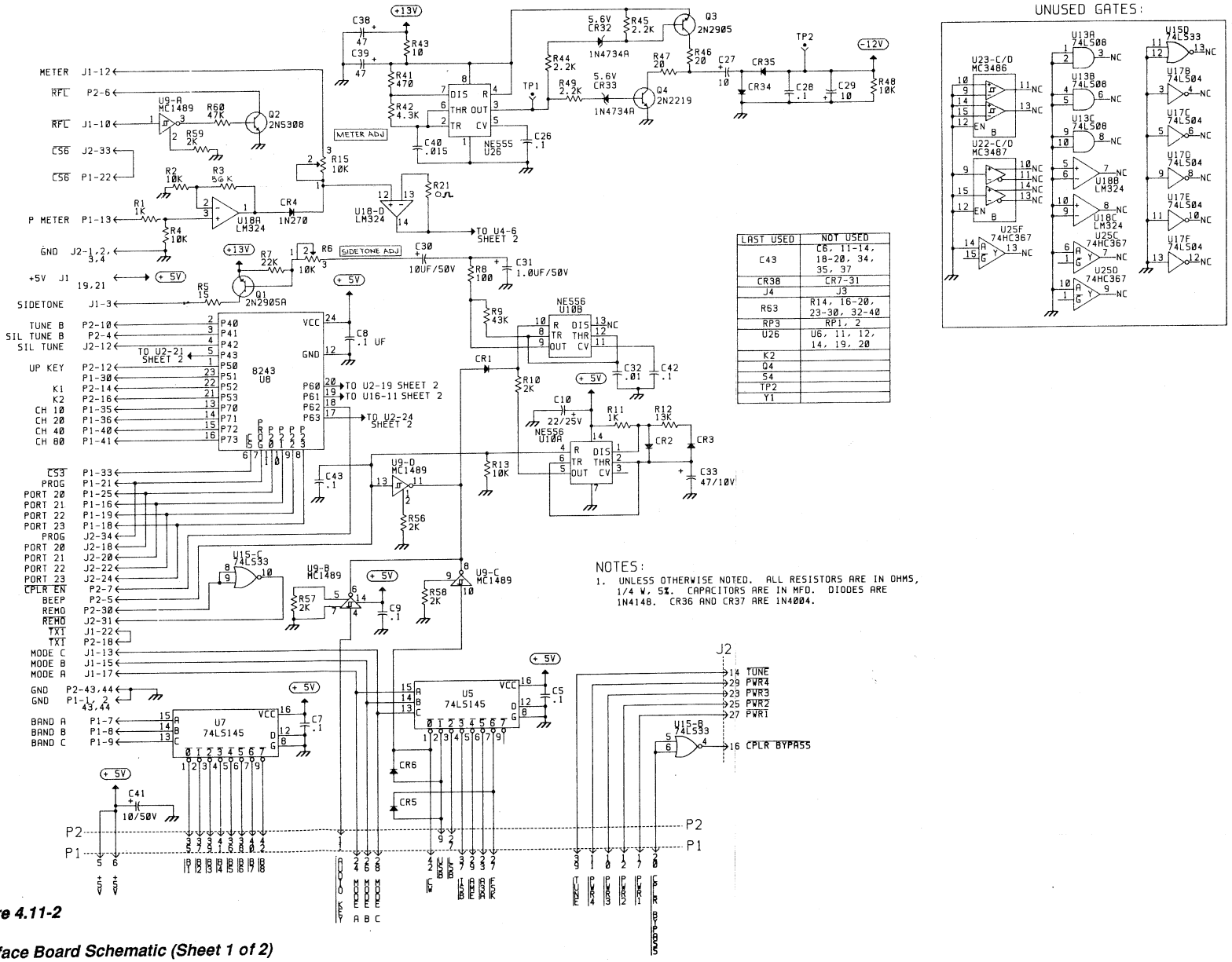


Figure 4.11-2

Interface Board Schematic (Sheet 1 of 2)

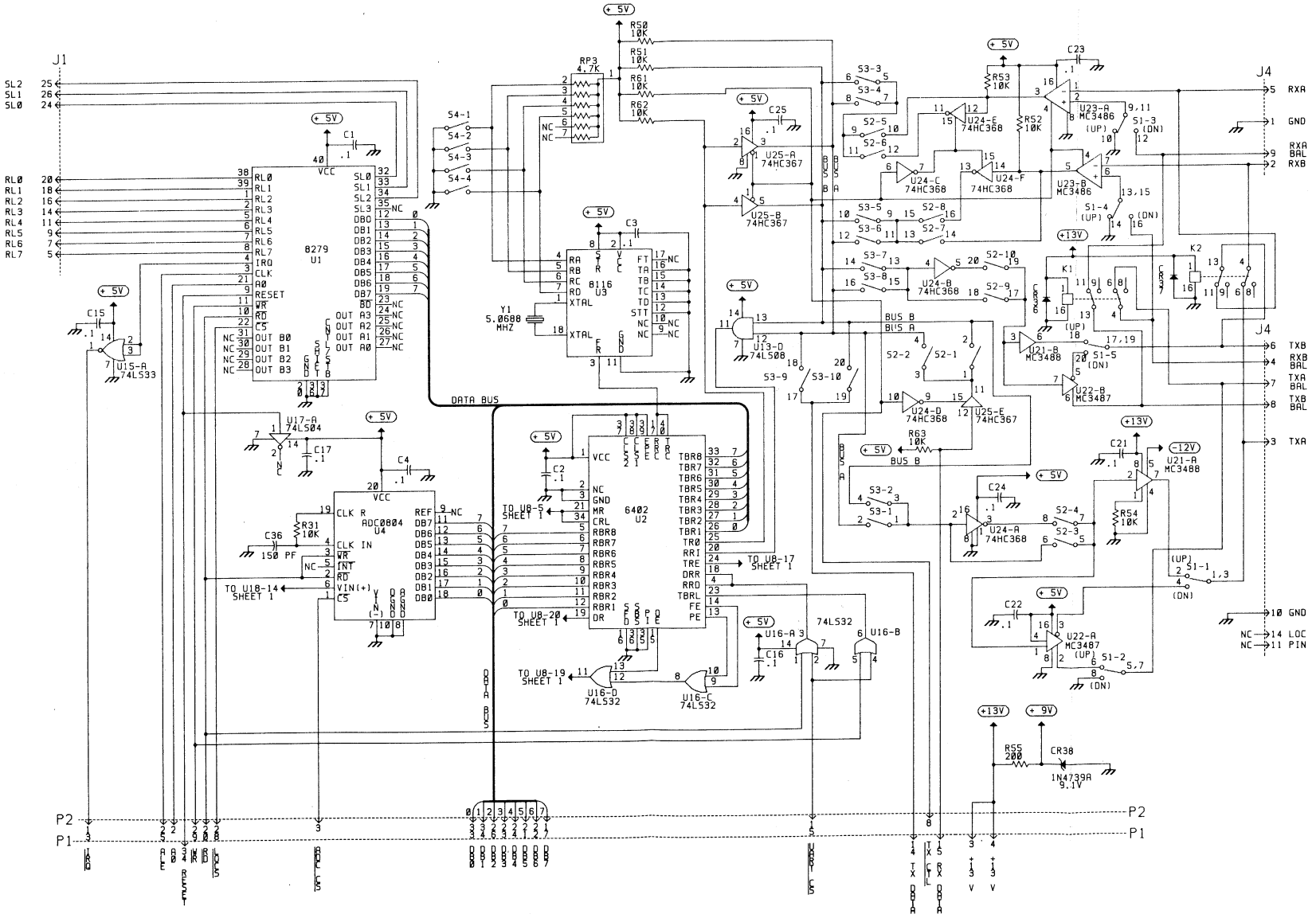


Figure 4.11-2

Interface Board Schematic (Sheet 2 of 2)

PIN CONNECTIONS AND VOLTAGE READINGS

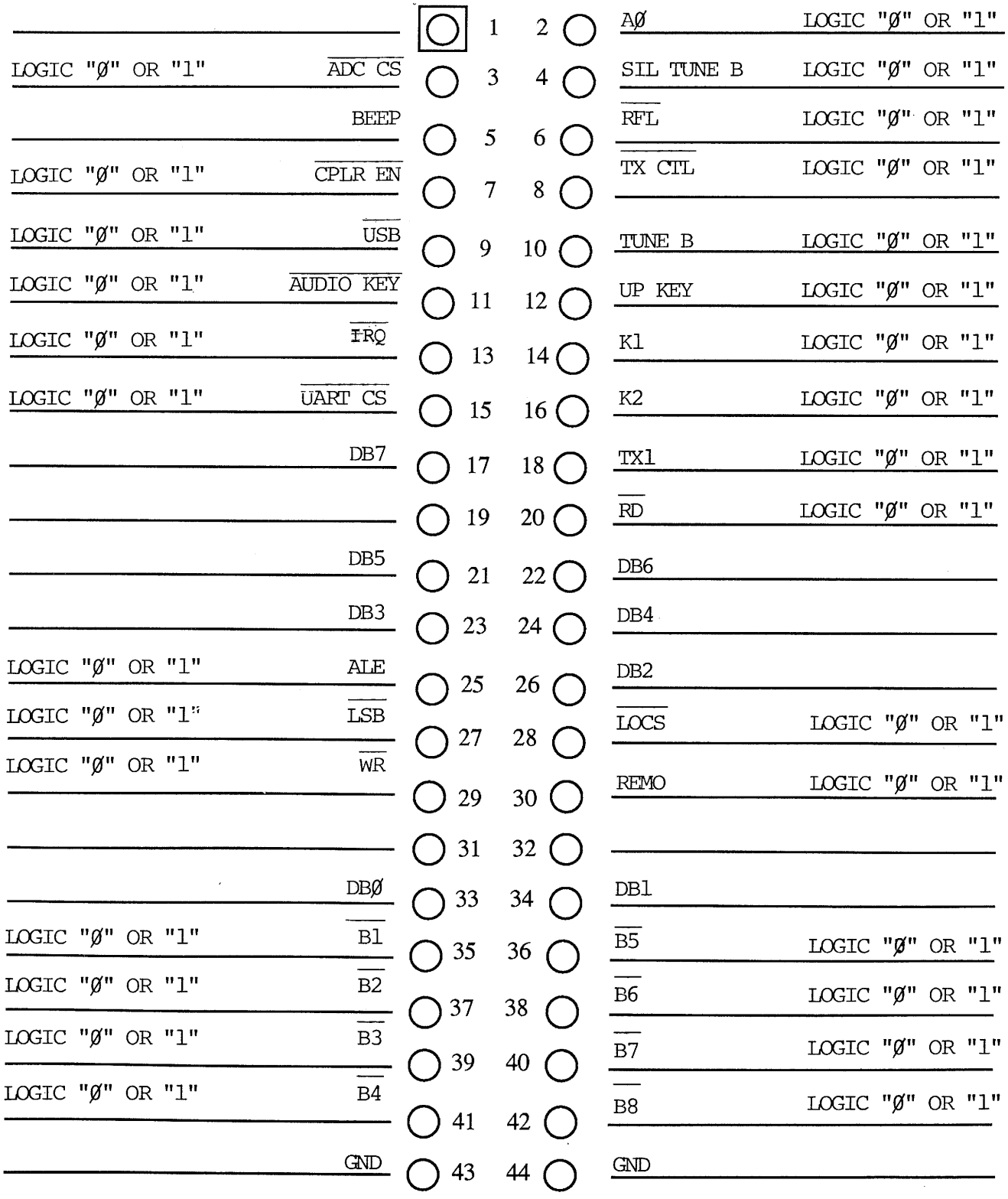
A4P1

	GND	1	2	GND		
	+13 VDC	3	4	+13 VDC		
	+5 VDC	5	6	+5 VDC		
LOGIC "Ø" OR "1"	BAND A	7	8	BAND B	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	BAND C	9	10	$\overline{\text{PWR 3}}$	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	$\overline{\text{PWR 4}}$	11	12	$\overline{\text{PWR 2}}$	LOGIC "Ø" OR "1"	
	P METER	13	14	TX DATA		
	RX DATA	15	16	PORT 21		
LOGIC "Ø" OR "1"	$\overline{\text{PWR 1}}$	17	18	PORT 23		
	PORT 22	19	20	$\overline{\text{CPLR BYPASS}}$	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	PROG	21	22	$\overline{\text{CS6}}$	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	$\overline{\text{A3A}}$	23	24	MODE A		
	PORT 20	25	26	MODE B		
LOGIC "Ø" OR "1"	$\overline{\text{FSK}}$	27	28	MODE C		
LOGIC "Ø" OR "1"	$\overline{\text{AME}}$	29	30			
		31	32			
LOGIC "Ø" OR "1"	$\overline{\text{CS3}}$	33	34	RESET	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	CH 10	35	36	CH 20	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	$\overline{\text{ISB}}$	37	38			
LOGIC "Ø" OR "1"	$\overline{\text{TUNE}}$	39	40	CH 40	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	CH 80	41	42	$\overline{\text{CW}}$	LOGIC "Ø" OR "1"	
	GND	43	44	GND		

MSR 6700 INTERFACE BD. A4

PIN CONNECTIONS AND VOLTAGE READINGS

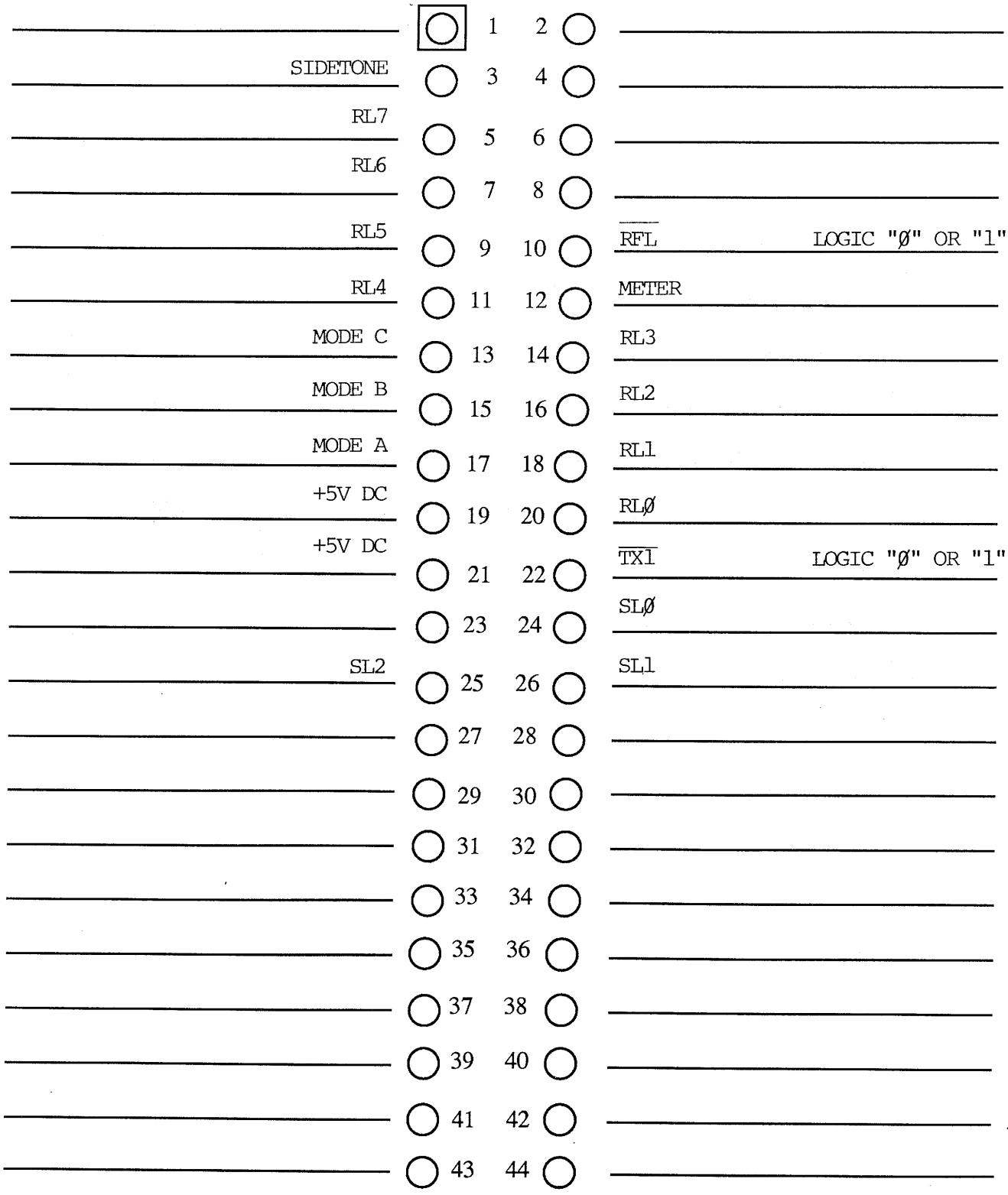
A4P2



MSR 6700A INTERFACE BD. A4

PIN CONNECTIONS AND VOLTAGE READINGS

A4J1



PIN CONNECTIONS AND VOLTAGE READINGS

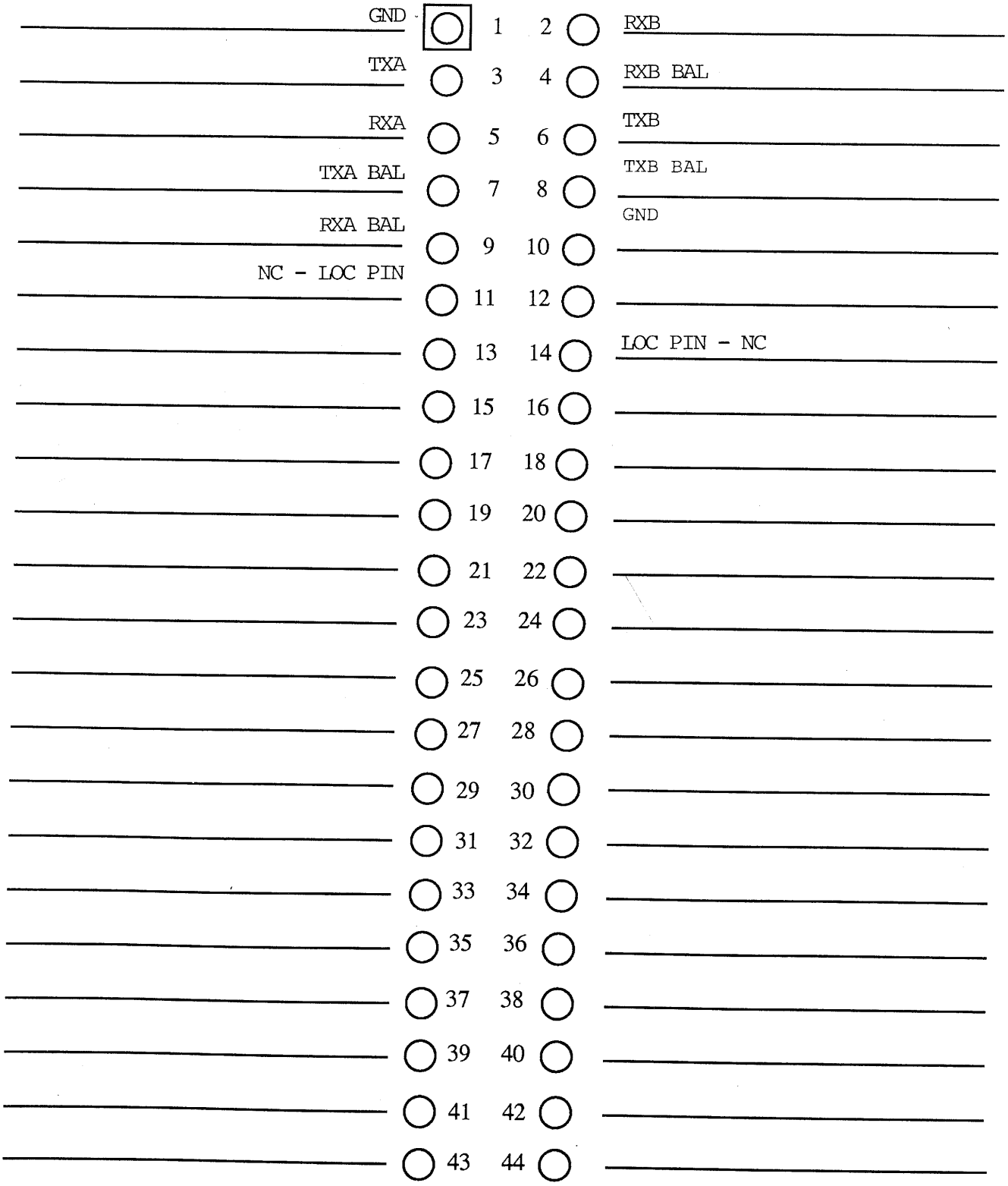
A4J2

	GND	1	2	GND	
	GND	3	4	GND	
		5	6		
		7	8		
		9	10		
		11	12	$\overline{\text{SIL TUNE}}$	LOGIC "Ø" OR "1"
		13	14	TUNE	LOGIC "Ø" OR "1"
		15	16	$\overline{\text{CPLR BYPASS}}$	LOGIC "Ø" OR "1"
		17	18	PORT 20	LOGIC "Ø" OR "1"
		19	20	PORT 21	LOGIC "Ø" OR "1"
		21	22	PORT 22	LOGIC "Ø" OR "1"
LOGIC "Ø" OR "1"	$\overline{\text{PWR 3}}$	23	24	PORT 24	LOGIC "Ø" OR "1"
LOGIC "Ø" OR "1"	$\overline{\text{PWR 2}}$	25	26		
LOGIC "Ø" OR "1"	$\overline{\text{PWR 1}}$	27	28		
LOGIC "Ø" OR "1"	$\overline{\text{PWR 4}}$	29	30		
LOGIC "Ø" OR "1"	$\overline{\text{REMO}}$	31	32		
LOGIC "Ø" OR "1"	$\overline{\text{CS6}}$	33	34	PROG	LOGIC "Ø" OR "1"
		35	36		
		37	38		
		39	40		
		41	42		
		43	44		

MSR 6700A INTERFACE BD. A4

PIN CONNECTIONS AND VOLTAGE READINGS

A4J4



4.12 LOGIC BOARD, A5

This board contains all the circuitry necessary for the control of the MSR 6700A Exciter. An 8035 8-bit microprocessor is used. There are 8k bytes of external ROM for program storage. A 2k byte zero power static RAM is used for data storage. There are six 8243 I/O expander chips in the system to take care of input and output data. However, only two of them are in this board. An 8214 priority interrupt chip is used to handle the system interrupts. A TL7705 Supply Voltage Supervisor chip is used to manage power up and down activity.

4.12.1 MICROPROCESSOR

The 8035 is an 8-bit microprocessor chip that can address up to 4k of external memory directly. Pins 12 thru 19 are DB0 thru DB7 which are the lower 8 bits of address as well as data bus. Port 1, U1-27 thru -30, is a bi-directional port for data input and output. As output port in address mode, the lower 4 bits of port 2, U1-21 thru 24, are upper 4 bits of address bus so that 8035 can address up to 2k of external program memory. A software-controlled internal memory band switch can select either MB0 (lower 2k) or MB1 (upper 2k) to make up 4k of total directly addressable memory. /PSEN controls the fetch of instructions from the external memory chips. In I/O expander control mode, these 4 bits are used in conjunction with PROG U1-25 signal, for data and command transfer between the processor and the I/O expander. Other pins of port 2 (35, 36 and 37) are tied to a 3-to-8 decoder chip (74LS138) to select one of six I/O expander chips in the system. U1-11 ALE is the system clock. It is used to latch the lower 8 bits of address to the 8-bit latch U3 during the high-to-low transition of this signal. The /WR writes data into, while the /RD reads from, external data memory. T0 and T1 are testable input pins and are used for the frequency up and down command in frequency scan mode. T1 is also used to control the channel scan oscillator in channel scan mode. U1-6 is the interrupt input pin. The system will be interrupted and go to an interrupt routine when it goes low. Y1 is a 6 MHz crystal that controls an on-chip oscillator to generate the 400 kHz system clock ALE. U1-4 is the reset input to provide a system reset whenever it goes low.

4.12.2 INTERRUPT INTERFACE

U2 is an 8214 priority interrupt chip that interfaces with the external interrupt inputs. Priority can be assigned by software. A system interrupt will be generated when an interrupt with level higher than the assigned level is arrived. If there are more than one legal interrupts arriving at the same time, the one with the higher level will be processed first. U2-21 is the /IRQ input which will go low when key closure is detected. /IRQ has the highest priority assigned. U2-17 is Loss of Lock Bite input and U2-16 is Power Supply Bite input that will go low when these failures occur.

4.12.3 MEMORY

4.12.3.1 Program Memory

Two 2732A 4k ROMs, (U4 and U15) are used to store instructions for the system control. These two chips are connected in parallel with the processor. A memory chip select signal (U1-31) is provided to select either memory chip 1 (U4) or memory chip 2 (U15). This memory chip-select signal determines whether instruction is fetched from U4 (lower 4k) or U15 (upper 4k).

4.12.3.2 Data Memory

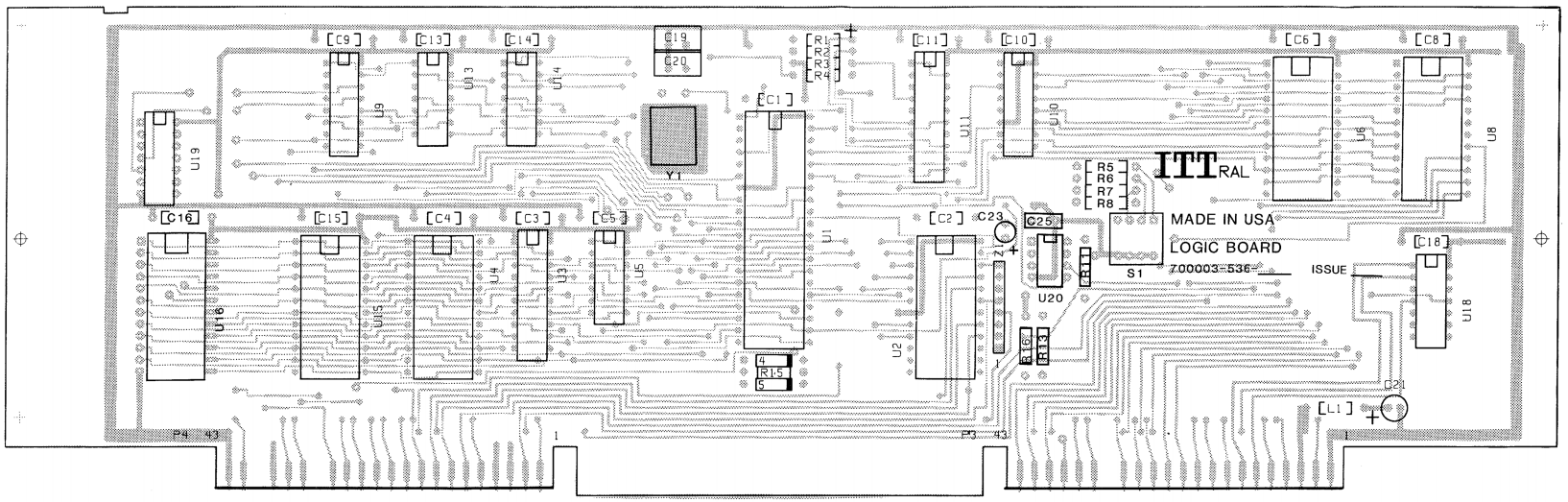
Zero-power static RAM U16 (priority interrupt chip U2) Keypad chip and UART chip (in the Interface board) are considered external data memory chips in this system. Selection of these chips is controlled by U1-27, 28, and 29 that tie to the input of a 3-to-8 decoder chip U9. Output of U9 enables one of these chips. Status of the receiver and channel data are stored in U16. Data stored will be retained, due to the built-in battery inside the MK48Z02 chip, even with VCC removed from this chip. Since 8035 can address only 256 bytes of external RAM, P16 and P17 (U1-33 and 34) are used to select four pages of RAM locations to address up to 1k byte of external RAM. U9-14 provides the MSB of address for the RAM to enable the processor to address up to 2k of external RAM.

4.12.4 I/O EXPANDER

There are six I/O Expander chips (8243) in the system. U6 and U8 are the only two located in this board. Each chip has four 4-bit ports that can be used as input or output port. U6 and U8 (pins 11, 10, 9, 8, and 7) are tied to P20 thru P23 and PROG pin of the processor for command and data transfer. U6 port 4 (U6-2, 3, 4, and 5) is used as an input port for option selection. When the input pin is low, the option is selected. U6 is selected if U10-11 is low. U8 is selected when U10-12 is low. U10-15, 14, 13, and 10 will select I/O chips CS1, CS2, CS3, and CS6 respectively located in other boards.

4.12.5 POWER-ON RESET

A TL7705 (Supply Voltage Supervisor) is used to handle the power up system reset. This chip will hold the /RESET low when supply voltage reaches 3.6 volts and starts a pre-determined delay period after VCC reaches 4.5V for the normal microprocessor reset. The value of C23 is selected so that the period is 130 ms. U20-6 (RESET) is the complement output of U20-5, which will stay high for 130 ms after VCC reaches 4.5V. When the supply voltage drops below 4.5 V, /RESET output will go to logic low and stay low for 130 ms when VCC is recovered back to 4.5V.



Logic (700003-536-951)

PART NUMBER	DESCRIPTION	SYMBOL
600119-419-040	IC SOCKET, 40 POS.	(U1)
600272-314-001	CAP. .1UF, CERAMIC, 50V	C1-6, 8-11, 13-16, 18
620094-306-501	CAP. 20PF, 5%, MICA, 500V	C19,20
600297-314-016	CAP. 22UF, ALUM, 25V	C21
600202-314-018	CAP. 10UF, 25V, TANT.	C23
600302-314-013	CAP. .1UF, MYLAR, 50V	C25
600052-410-001	DIODE IN270	CR4,5
600125-376-001	CHOKE .33UH	L1
647014-341-075	RES. 4.7K, 1/4W, 5%	R1-8, 15,16
622014-341-075	RES. 2.2K, 1/4W, 5%	R11
610014-341-075	RES. 1K, 1/4W, 5%	R13
600264-616-001	SWITCH, DIP, 4 POS.	S1
600218-415-002	IC 8035, UP, 8-BIT	U1
600311-415-001	IC 74LS241, BUF/LN DR	U11
600411-415-001	IC 74LS32, OR, 2-IN	U13
600114-415-001	IC 74LS00, NAND, QUAD 2-IN	U14,U19
600990-415-001	IC MK 48Z02-25, RAM	U16
600016-415-001	IC 7406, HEX INV. ,O/C	U18
600519-415-001	IC 8214, PRIR INT CNTL	U2
600119-419-024	IC SOCKET, 24 POS.	(U2,4, 6,8 15,16)
700123-415-001	I.C. TL7705A	U20
600277-415-002	IC 74LS273 SIG, FF W/CLR	U3
600111-415-001	IC 74LS04, HEX INV	U5
600217-415-101	IC 8243, I/O EXP	U6,8
600309-415-001	IC 74LS138, 3 TO 8 LN DEC/MUX	U9,10
600105-378-001	CRYSTAL, 6.00 MHZ	Y1
600201-537-001	RES NETWORK 4.7K X 7	Z1

PROGRAM CHIPS

U4	PROG IC	700002-412-001
U15	PROG IC	700002-412-002

Figure 4.12-1

Logic Board Assembly

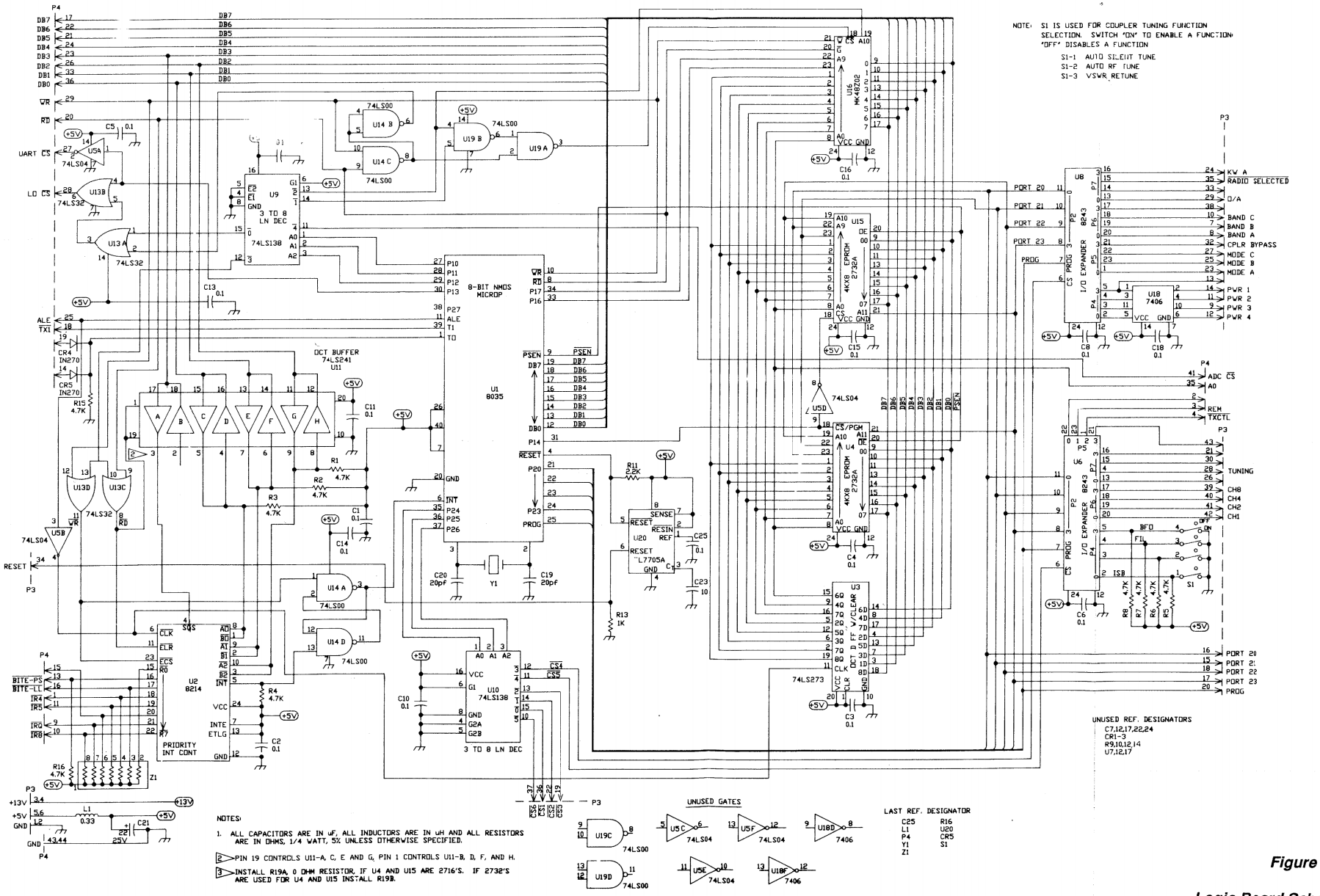


Figure 4.12-2

Logic Board Schematic

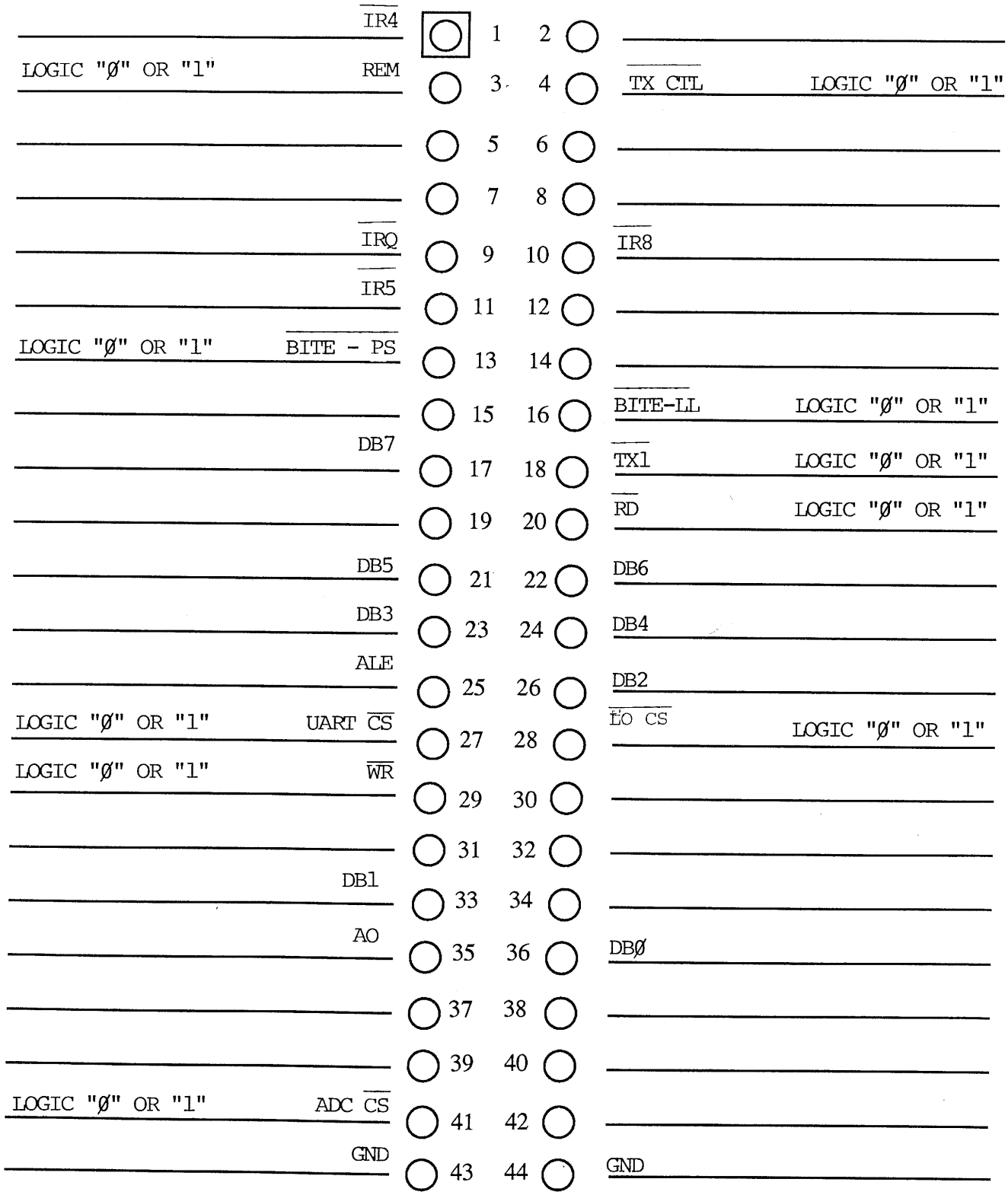
PIN CONNECTIONS AND VOLTAGE READINGS

A5P3

		GND	1	2	GND		
		+13 VDC	3	4	+13 VDC		
		+5 VDC	5	6	+5 VDC		
LOGIC "Ø" OR "1"	BAND B		7	8	BAND A	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	PWR 3		9	10	BAND C	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	PWR 2		11	12	PWR 4	LOGIC "Ø" OR "1"	
			13	14	PWR 1	LOGIC "Ø" OR "1"	
		PORT 21	15	16	PORT 20		
		PORT 23	17	18	PORT 22		
LOGIC "Ø" OR "1"	$\overline{CS3}$		19	20	PROG		
			21	22	$\overline{CS2}$	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	MODE A		23	24	KW A	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	MODE B		25	26			
LOGIC "Ø" OR "1"	MODE C		27	28	TUNING	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	O/A		29	30			
			31	32	CPLR BYPASS	LOGIC "Ø" OR "1"	
			33	34	RESET	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	$\overline{\text{RADIO SELECTED}}$		35	36	$\overline{CS1}$	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	$\overline{CS6}$		37	38			
		CH8	39	40	CH4	LOGIC "Ø" OR "1"	
		CH2	41	42	CH1	LOGIC "Ø" OR "1"	
			43	44			

PIN CONNECTIONS AND VOLTAGE READINGS

A5P4



4.13 HALF OCTAVE FILTER BOARD, A6

4.13.1 GENERAL

This board contains the harmonic filters for the transmit output, the Automatic Level Control (ALC) detector, the Automatic Carrier Control (ACC) circuit for control of the transmit output level in AME mode, a current detector for monitoring and control of Power Amplifier (PA) output current, a reflected power detector to light the Fault indicator to warn the operator of excessive antenna VSWR, and a circuit for protection of the PA under overtemperature conditions.

4.13.2 HARMONIC FILTERS

The purpose of the harmonic filters is to reduce the harmonics generated by the PA to at least -45 dBc. The filters are divided into eight bands, each of which is used for a specific output frequency range as shown below.

1.60000	to	1.99999 MHz	Band 1
2.00000	to	2.99999 MHz	Band 2
3.00000	to	3.99999 MHz	Band 3
4.00000	to	5.99999 MHz	Band 4
6.00000	to	8.99999 MHz	Band 5
9.00000	to	12.99999 MHz	Band 6
13.00000	to	19.99999 MHz	Band 7
20.00000	to	29.99999 MHz	Band 8

The filters are elliptic function filters which are optimized for rejection of the second and third harmonics and for constant in-band impedance. The proper filter is selected by a command on one of the Band lines, /B1 through /B8. And the filter selection circuit operates identically on each band, i.e. a low placed on K16 connects the Band 1 filter in the RF line between P1-42 and P2-38. Note that the relays are connected to short out unused filters. Diode CR25 protects Q9 from the voltage spike generated when the relays are turned off. Diode CR33 protects Q9 from damage in the event that the board is plugged or unplugged from the radio with DC power applied.

4.13.3 ALC DETECTOR

The purpose of the ALC detector is to provide the ALC circuit on the Tx Modulator board with a DC voltage which is proportional to peak RF voltage at the filter outputs.

A resistive divider composed of R1 and the parallel combination of R2 through R5, generates a sample of the RF voltage and applies it to rectifier CR1. Capacitors C17 and C2 compensate the detector at 29.9 MHz. The compensation is adjusted via C2 so that the detector output at 29.9 MHz is exactly the same as at 1.6 MHz. Components L8 and R43 flatten the detector output by compensating for rectification inefficiencies at high frequencies. Components L7 and C34 provide RF decoupling for amplifiers U1A and U1C. Amplifier U1A is a peak-detecting voltage follower designed to store the peak ALC voltage in C3. Resistor R27 in series with C3 is necessary for system stability. The peak ALC voltage out is applied to U1B-10, a variable gain amplifier. The gain of U1B is adjusted via R11 to provide exactly 6.0V out at P2-41 for 79V of RF.

4.13.4 ACC CIRCUIT

The ACC circuit is responsible for keeping the RF output constant in AME mode. A sample of the ALC voltage is amplified by U1C.

The output at U1C-7 is a voltage which follows the modulation envelope. This voltage is applied to the ALC threshold amplifier U1D-13 through R16 and R17. The ACC threshold voltage is applied to U1D from AM carrier adjust R13. The output of the ACC amplifier, U1D-14 is connected to the ACC line, P2-20, through diodes CR6 and CR8.

The ACC line is routed to the ACC input on the Tx Modulator board, where a reduction in voltage causes a gain cut in the transmit signal path. With no ACC action this line sits at about +6.5V. When the ACC circuit is controlling the output, the voltage on this line will stabilize at some value between +6V and +1V, depending on the gain cut needed to maintain the proper output level.

When the radio is keyed in AME mode, the /AMT command will be low, causing U3A-7 to go high. This cuts off CR5 and CR7, allowing the ACC amplifier U1D and the external ACC amplifier U2A to operate. When the voltage applied to R17 exceeds the threshold voltage at U1D-12, the

voltage at U1D-14 fails to lower the transmit output as described above. The AME modulation level is determine by an adjustable clipper provided by R14, R45 and CR3. This circuit clips the top portion of the modulation envelope voltage appearing at R17, which makes the average value of the waveform equal to that of the unmodulated carrier so that the same threshold voltage can be used to establish the output level.

The dominant pole in the ACC feedback loop is R17 x C5 with a zero at R15 x C5 for good transient response. Capacitor C32 prevents carrier overshoot when the circuit is initially keyed on.

4.13.5 EXTERNAL ACC

The external ACC voltage is applied to P2-16, which is connected to input resistor, R30 of the external ACC amplifier, U2A. U2A is biased so that with no voltage on P2-16, U2A-14 is high so that CR9 is cut off and out of the circuit. As the voltage increases on the external ACC line, the voltage at U2A-14 goes lower. This lowers the voltage on the TGC line causing more gain cut in the transmit signal path. The gain of U2A is such that it takes about +3V on P2-16 to cause full gain cut in the radio.

4.13.6 PA PROTECTION CIRCUITS

The protection circuits monitor RF output current and PA temperature and cause an output power cutback to protect the PA in the event that preset limits are exceeded. There is also a reflected power detector which pulls the /FAULT line low (to light the Fault indicator) when the load VSWR exceeds approximately 2:1. Comparators U2B and U2D are used to monitor the current and temperature, respectively, with their outputs OR'd together with CR11 and CR13 so that either comparator output can pull the ACC line low to cut the transmitter output. Comparator U2B monitors the reflected power detector output and activates the fault comparator U3B. U2D-8 is OR'd to the fault comparator input with diode CR10. When U3B-2 falls below +5V, U3B-1 goes high, allowing Q1 to turn on with base current supplied by R28.

4.13.6.1 Current and Reflected Power Detector

A current and reflected power detector is made up of T1 and associated components. Capacitor C30 is used to null the reflected power detector output at 29.9 MHz into 50 ohms.

A voltage is produced at TP2 which is proportional to the reflected power seen by the PA. When this voltage exceeds the +1.5V at U2C-6, the voltage at U2C-7 drops, pulling U3B-2 the + 1.5V through CR12. This pulls the /Fault line low.

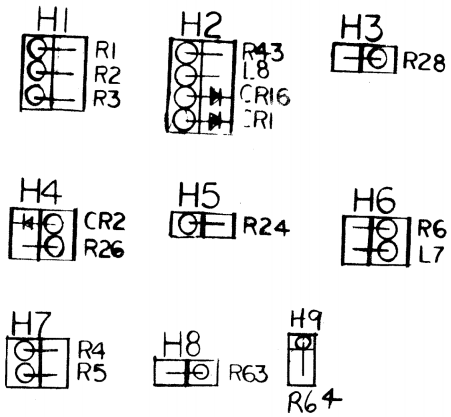
A DC voltage which is proportional to the RF output current appears at TP1. When this voltage exceeds +1.5V at U2B-2, the voltage at U2B-1 drops, cutting the RF output via the ACC line. Since this is a feedback loop, the RF output will stabilize at a current which causes the voltage at TP1 to be +1.5V. This current is adjustable via R35 and is normally set to 1.8A.

4.13.6.2 Overtemperature

The PA contains a thermistor which is wired between +9V and P2-39 and is physically connected to an output transistor flange to sense its temperature. The thermistor circuit is completed by resistors R21 and R22. (Jumper JP1 is in 1-2 position for use with PA assemblies having a thermistor temperature sensor. Later model PAs may have a solid-state temperature sensor which will use the 2-3 position of JP1.) The temperature voltage is sensed by R20 and is compared with an adjustable threshold voltage at U2D-10. This voltage is normally set at about +3V, corresponding to a thermistor voltage of +6V. When this voltage is exceeded, U2D-8 falls causing the output power to decrease. Since the thermal time constant of the PA is long, an overtemperature condition will cause the RF output voltage to oscillate at slow rate.

4.13.7 INTERNAL POWER SUPPLY

Regulator U4 provides on-board regulated +5V for stable threshold voltages. The board's digital thresholds are held at approximately +1.5V with a voltage divider made up of R33 and R34 from +5V.



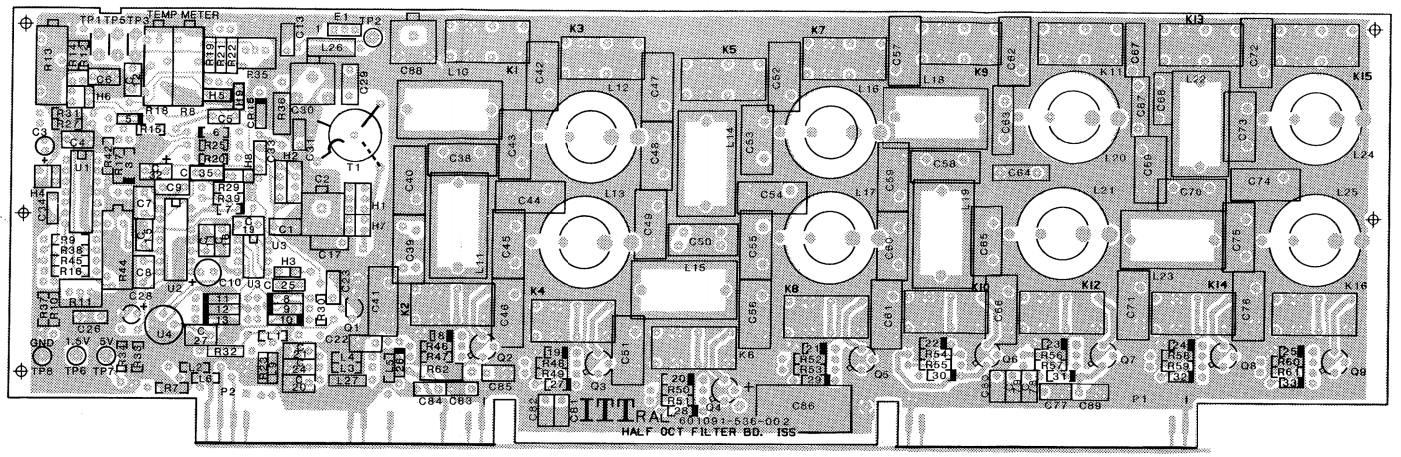


Figure 4.13-1

Half Octave Filter Board Assembly

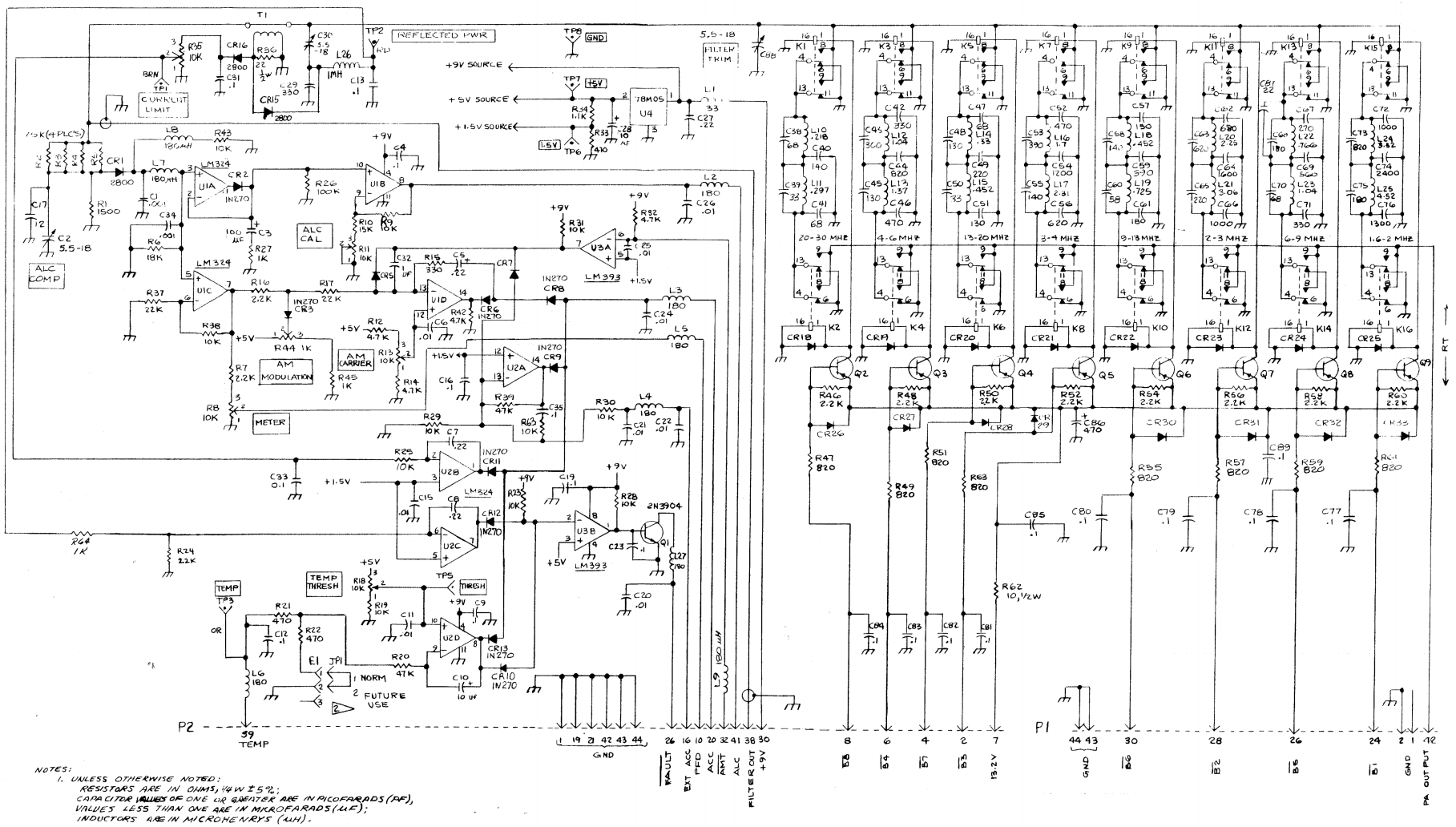
Half Octave Filter (601091-536-002)

PART NUMBER	DESCRIPTION	SYMBOL
600302-314-001	CAP. .001UF, MYLAR,63V	C1,34
600202-314-018	CAP. 10UF, 25V, TANT.	C10,28
600269-314-010	CAP. 12PF, CERAMIC, 500V	C17
600018-317-014	TRIMMER CAP, 5.5-18PF, 175VDC	C2,30,88
633003-306-501	CAP. 330PF, 3%, MICA, 500V	C29
600297-314-031	CAP. 100UF, ALUM, 10V	C3
600226-314-014	CAP. 1UF, CERAMIC, 50V	C32
600287-314-056	CAP. 68PF, DM19, MICA, 500V	C38,41 47,70
600308-314-013	CAP. 33PF, CERAMIC, 2.5KV	C39,50 77-85,89
600302-314-013	CAP. .1UF, MYLAR, 50V	C4,9, 12-13, 16,19,23 31,33,35
600287-314-045	CAP. 140PF, DM19, MICA, 500V	C40, 55,58
600287-314-051	CAP. 330PF, DM19, MICA, 500V	C42,71
600287-314-054	CAP. 300PF, DM19, MICA, 500V	C43
682002-306-501	CAP. 820PF, 2%, MICA, 500V	C44,73
600287-314-044	CAP. 130PF, DM19, MICA, 500V	C45,48 51
600287-314-058	CAP. 470PF, DM19, MICA, 500V	C46,52
600287-314-048	CAP. 220PF, DM19, MICA, 500V	C49,65
600302-314-015	CAP. .22UF, MYLAR, 50V	C5,7,8,27
600287-314-052	CAP. 390PF, DM19, MICA, 500V	C53,59

PART NUMBER	DESCRIPTION	SYMBOL
612011-306-501	CAP. 1200PF, 1%, MICA, 500V	C54
662001-306-501	CAP. 620PF, 1%, MICA, 500V	C56,63
600287-314-055	CAP. 150PF, DM19, MICA, 500V	C57
600302-314-007	CAP. .01UF, MYLAR, 63V	C6,11,15 20,21,22 24,26
600287-314-040	CAP. 58PF, DM19, MICA, 500V	C60
600287-314-047	CAP. 180PF, DM19, MICA, 500V	C61,68 75
668002-306-501	CAP. 680PF, 2%, MICA, 500V	C62
616012-306-501	CAP. 1600PF, 2%, MICA, 500V	C64
610011-306-501	CAP. 1000PF, 1%, MICA,	C66,72
600287-314-050	CAP. 270PF, DM19, MICA, 500V	C67
656002-306-501	CAP. 560PF, 2%, MICA, 500V	C69
624011-306-501	CAP. 2400PF, 1%, MICA, 500V	C74
613012-306-501	CAP. 1300PF, 2%, MICA, 500V	C76
600259-314-103	CAP. 470UF, ALUM, 25V, AXIAL	C86
600308-314-011	CAP. 22PF, CERAMIC, 2.5KV	C87
600118-410-002	DIODE, HOT CARRIER, HP2800	CR1,15, 16
600052-410-001	DIODE IN270	CR2,3,6, 8-13
600109-410-001	DIODE IN4148	CR5,7, 18-33

PART NUMBER	DESCRIPTION	SYMBOL
600198-608-005	CONN. HEADER, 3 PIN, TIN	E1
600064-419-003	3 POSITION VERTICAL MT	H1
600064-419-001	4 POSITION VERTICAL MT	H2
600064-419-005	1 POSITION VERTICAL MT	H3,5,8
600064-419-004	2 POSITION VERTICAL MT.	H4,6,7
600190-608-001	CONN, JUMPER, 2 POS.	JP1
600094-403-003	RELAY, DPDT, 12V, 3A CONTACTS	K1-16
600125-376-007	CHOKE 33UH	L1
670119-513-001	INDUCTOR .218UH	L10
670119-513-002	INDUCTOR .297UH	L11
670123-513-010	COIL, TOROID, 1.04 UH	L12
670123-513-009	COIL, TOROID 1.37UH	L13
670119-513-003	INDUCTOR .330UH	L14
670119-513-004	INDUCTOR .452UH	L15,18
670123-513-006	INDUCTOR 1.70UH	L16
670123-513-005	INDUCTOR 2.31UH	L17
670119-513-006	INDUCTOR .725UH	L19
600125-376-022	CHOKE 180UH	L2-9,27
670123-513-004	INDUCTOR 2.25UH	L20
670123-513-003	INDUCTOR 3.06UH	L21
670119-513-007	INDUCTOR .766UH	L22
670119-513-008	INDUCTOR 1.043UH	L23
670123-513-002	INDUCTOR 3.32UH	L24
670123-513-001	INDUCTOR 4.52UH	L25
600034-376-001	CHOKE 1000UH	L26
600229-413-003	TRANSISTOR 2N3904 TO-92	Q1
600154-413-001	TRANSISTOR 2N2907A	Q2-9
615014-341-075	RES. 1.5K, 1/4W, 5%	R1
615024-341-075	RES. 15K, 1/4W, 5%	R10
600089-360-010	POT. 10K, 1/2W, CERMET, RT/AN	R11,35
647014-341-075	RES. 4.7K, 1/4W, 5%	R12,14, 32,42

PART NUMBER	DESCRIPTION	SYMBOL
633004-341-075	RES. 330, 1/4W, 5%	R15
622024-341-075	RES. 22K, 1/4W, 5%	R17,37
675024-341-075	RES. 75K, 1/4W, 5%	R2-5
647024-341-075	RES. 47K, 1/4W, 5%	R20,39
647004-341-075	RES. 470, 1/4W, 5%	R22,21, 33
610034-341-075	RES. 100K, 1/4W, 5%	R26
610014-341-075	RES. 1K, 1/4W, 5%	R27,45, 64
611014-341-075	RES. 1.1K, 1/4W, 5%	R34
622094-341-205	RES. 22, 1/2W, 5%	R36
600063-360-007	POT. 1K, 15 TURN	R44
682004-341-075	RES. 820, 1/4W, 5%	R47,49, 51,53,55 57,59,61
618024-341-075	RES. 18K, 1/4W, 5%	R6
610094-341-205	RES 10 1/2W 5%	R62
622014-341-075	RES. 2.2K, 1/4W, 5%	R7,16,24 46,48,50 52,54,56 58,60
600063-360-010	POT. 10K, 15 TURN	R8,13,18
610024-341-075	RES. 10K, 1/4W, 5%	R9,19,23, 25,28-30 31,38,43 63
600138-512-001	DETECTOR TOROID	T1
600114-611-001	BROWN TEST POINT	TP1
600114-611-003	ORANGE TEST POINT	TP3
600114-611-005	JACK	TP5
600171-415-001	IC LM324, OP AMP, 741 QUAD	U1,2
600486-415-001	IC LM393, DUAL VOL COMP	U3
600017-419-001	TRANSISTOR PAD	(U4)
600331-415-001	IC 78M05, 5V REG	U4



NOTES:

1. UNLESS OTHERWISE NOTED:
   RESISTORS ARE IN OHMS, 1/4 W ±5%;
   CAPACITOR VALUES OF ONE OR GREATER ARE IN PICOFARADS (PF),
   VALUES LESS THAN ONE ARE IN MICROFARADS (UF);
   INDUCTORS ARE IN MICROHENRYS (UH).

Q2 THRU Q9 COLLECTOR +(11-13VDC) WHEN BAND IS ENERGIZED.

POSITION 1 IS THE NORMAL POSITION FOR JP1. POSITION 2 IS FOR FUTURE USE WITH LATER VERSION PA ASSEMBLIES.

ALL UNMARKED DIODES ARE IN4148

Q2 - Q9 ——— = 2N2907A
Q1 ——— = 2N3904

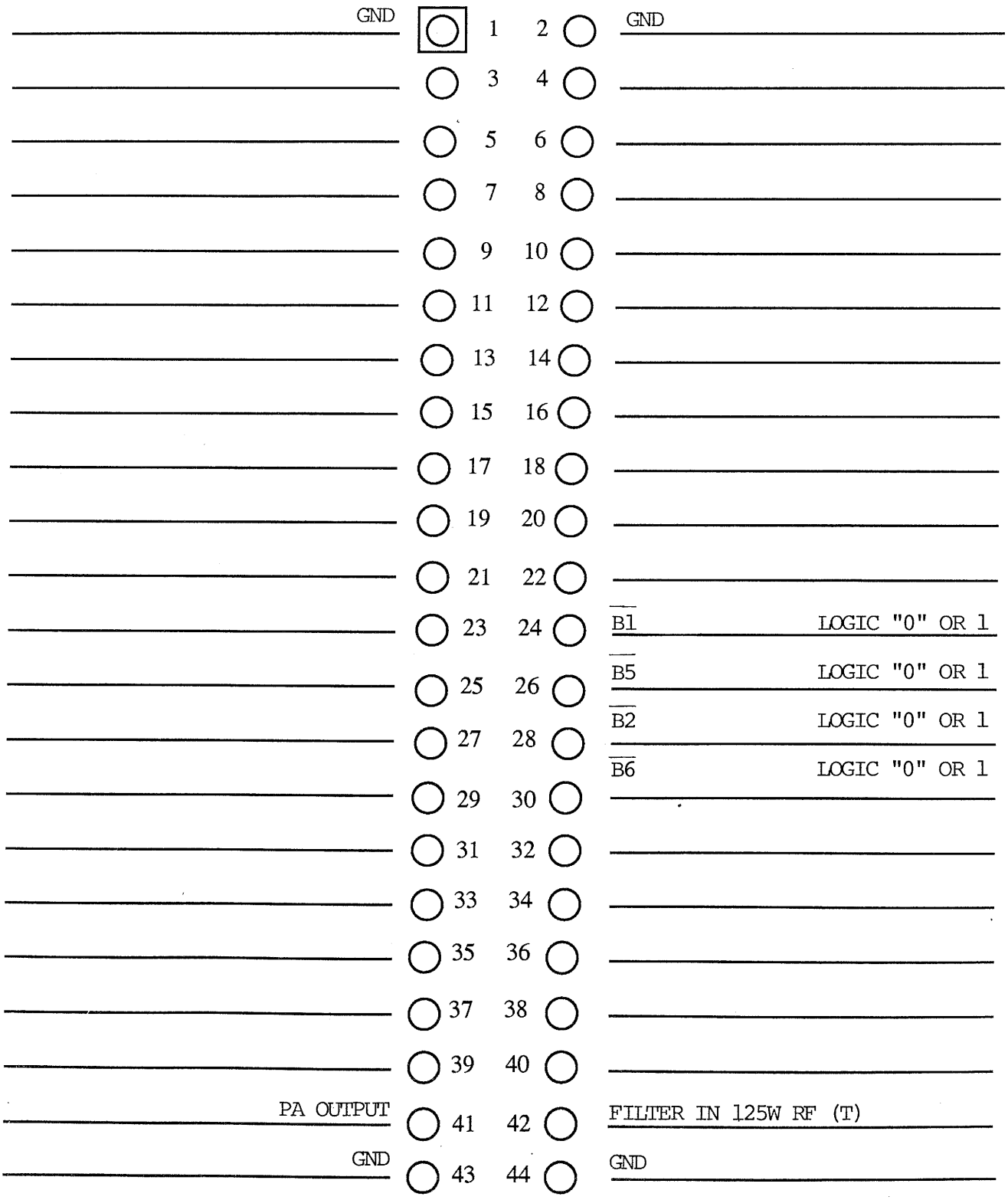
LAST DESIG. USED
Q1, L14, C89, R62, CR33, L27
NOT USED
C14, C18, R45, 40, 41, C36, C37, TP4, L8, L9, CR4, CR14, CR17

Figure 4.13-2

Half Octave Filter Schematic

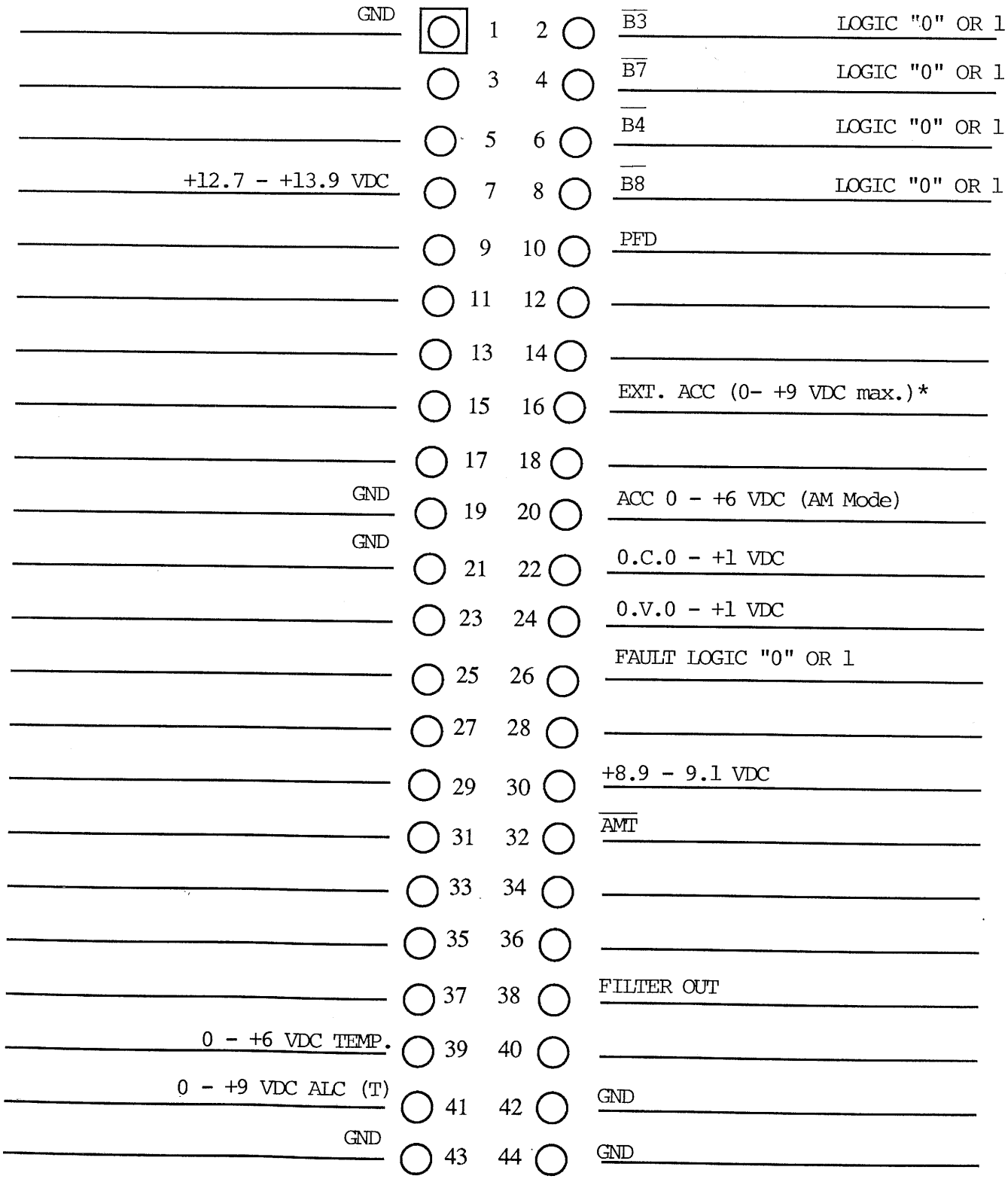
PIN CONNECTIONS AND VOLTAGE READINGS

A6P1



PIN CONNECTIONS AND VOLTAGE READINGS

A6P2



* This voltage not present unless external high power amplifier is used.

4.14 HIGH PASS FILTER BOARD, A7

The High Pass Filter board contains eight 1/2 octave high pass filters (elliptic design). The cut-off frequencies are approximately 1.6, 2, 3, 4, 6, 9, 13 and 20 MHz. The stop band attenuation of these filters is 35 dB. The filters are switched with diodes and transistors. The board also contains a broadcast filter and an RF amplifier, used in the receive mode. The board is also used in transmitter applications in the MSR 6700A, MSR 8050 and MSR 8050A. Four potentiometers are used to provide a band switch analog voltage for A3A operation (used in transmit only). A transmit/receive relay (K1) is used to bypass the broadcast filter and RF amplifier in the transmit mode. A filter bypass relay (K2) is used to bypass all High Pass Filter board functions in receive modes below 1.6 MHz when used in the MSR 8050, 8050A.

4.14.1 HIGH PASS FILTERS

Band 1 (B1) is switched by CR1 and CR2. When a logic 0 (ground) is placed on pin 41, Q6 is saturated and 9V appears on the collector of Q6. This voltage causes current to flow through L19, L20, CR1, L18, R50, CR2, L15 and R20. CR1 and CR2 conduct, and all the other band switching diodes (CR3 and 4, CR5 and 6, etc.) are back biased. If band 1 is selected in receive, the signal flow is as follows: Input on pin 42 through K2 (pins 11 and 13), K1 (pins 4 and 6), C106, CR1, C44, C45, C46, CR2 and K1 (pins 11 and 13), and through C27 to the broadcast filter. The RF amplifier provides about 4 dB of gain (1.6 to 30 MHz). The output is taken from T1 through K2 (pins 4 and 6) to pin 11 of P14. Operation of any other band is similar. During the transmit mode, K1 is energized and the signal flow is as follows: Input on pin 5 through K1 (pins 9 and 13), through the band selected, through K1 (pins 4 and 8), and out on pin 21. The maximum receive level is 2V RMS and the transmit level is 3 volts peak to peak.

4.14.2 RF AMPLIFIER

The RF amplifier consists of Q4 and Q5. Q4 and A5 are high level FETs used in the grounded gate configuration for best intermodulation performance.

4.14.3 TRANSMIT SWITCH

Q2 is a switch used to pull in K1 when in the transmit mode. When a ground (logic 0) is placed on pins 7 and 8, the collector of Q2 pulls in K1. Q2's collector voltage is also connected to the solid-state PA to switch the PA biases on during transmit.

4.14.4 A3A CONTROL VOLTAGE

When the A3A transmit mode is desired, a band switched analog voltage is required. The A3A control voltage consists of R8, R9, Q3 and R49. When A3A is desired, a ground is placed on pin 31. This cuts off Q3, allowing the voltage on R10 to appear on pin 9. Pin 9 is connected to the Transmit Modulator board and allows some carrier (-16 to -18 dB) to be inserted in the A3A mode. If band 1 or 2 is selected, CR33 or CR34 conducts, causing 9V to be applied across R49. R49 is adjusted to provide the proper amount of carrier for 1.6 to 3 MHz (bands 1 and 2). In a similar manner, R48 is adjusted for three to nine MHz (bands 3 to 6), R47 is adjusted for 13 to 20 MHz (band 7), and R46 is adjusted for 20 to 30 MHz (band 8).

4.14 5 OVERALL GAIN OR LOSS

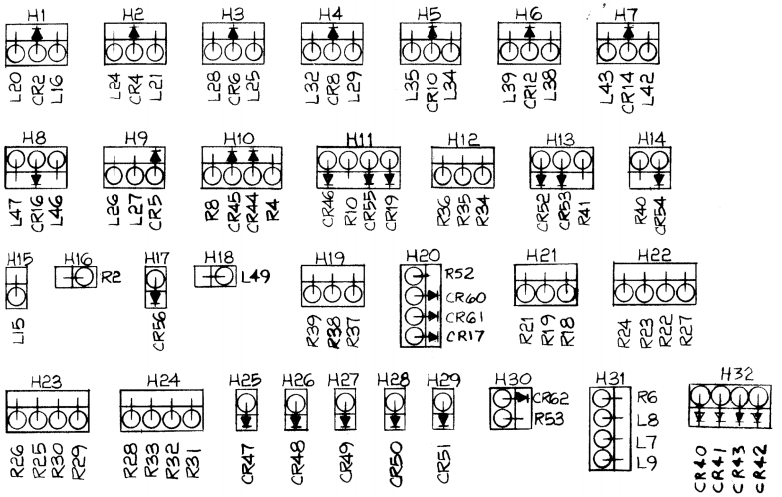
In the receive mode, the overall gain is +4 dB to +8 dB, depending on the band selected. In transmit modes, the loss is -1 dB to -2 dB.

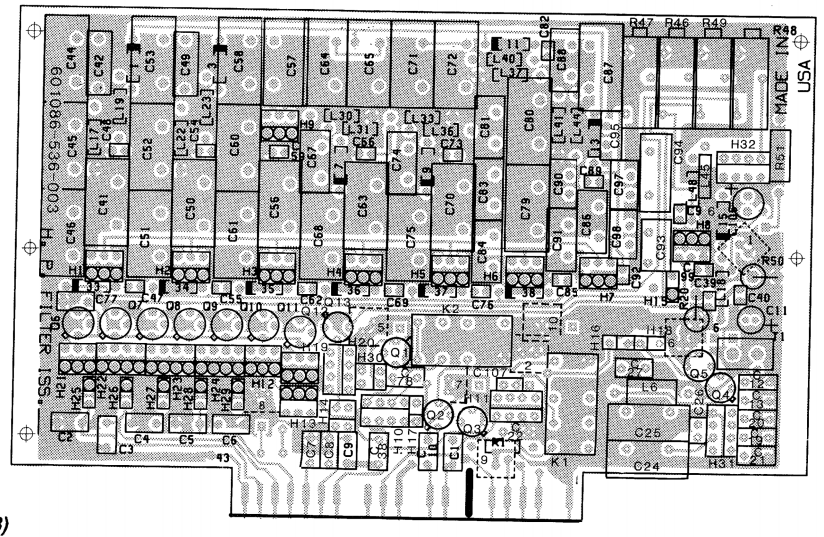
4.14.6 BROADCAST FILTER

The broadcast filter is used only in receive modes at frequencies above 1.6 MHz and provides approximately 35 dB additional attenuation to the broadcast band. The overall rejection of the broadcast band is approximately 70 dB (6 dB cutoff frequency approximately 1.4 kHz).

4.14.7 HP FILTER BYPASS

The high pass filter bypass mode is used to route receive signals directly through the board, bypassing all filter circuitry. This is required for the reception of signals below 1.6 MHz. When in receive mode and below 1.6 MHz, a low (ground) on pin 40 turns on Q1, which switches in K2. The signal path is now: Input on pins 42 through K2 (pins 13 and 9), then through the other half of K2 (pins 8 and 4), then out on P14 (pin 11).



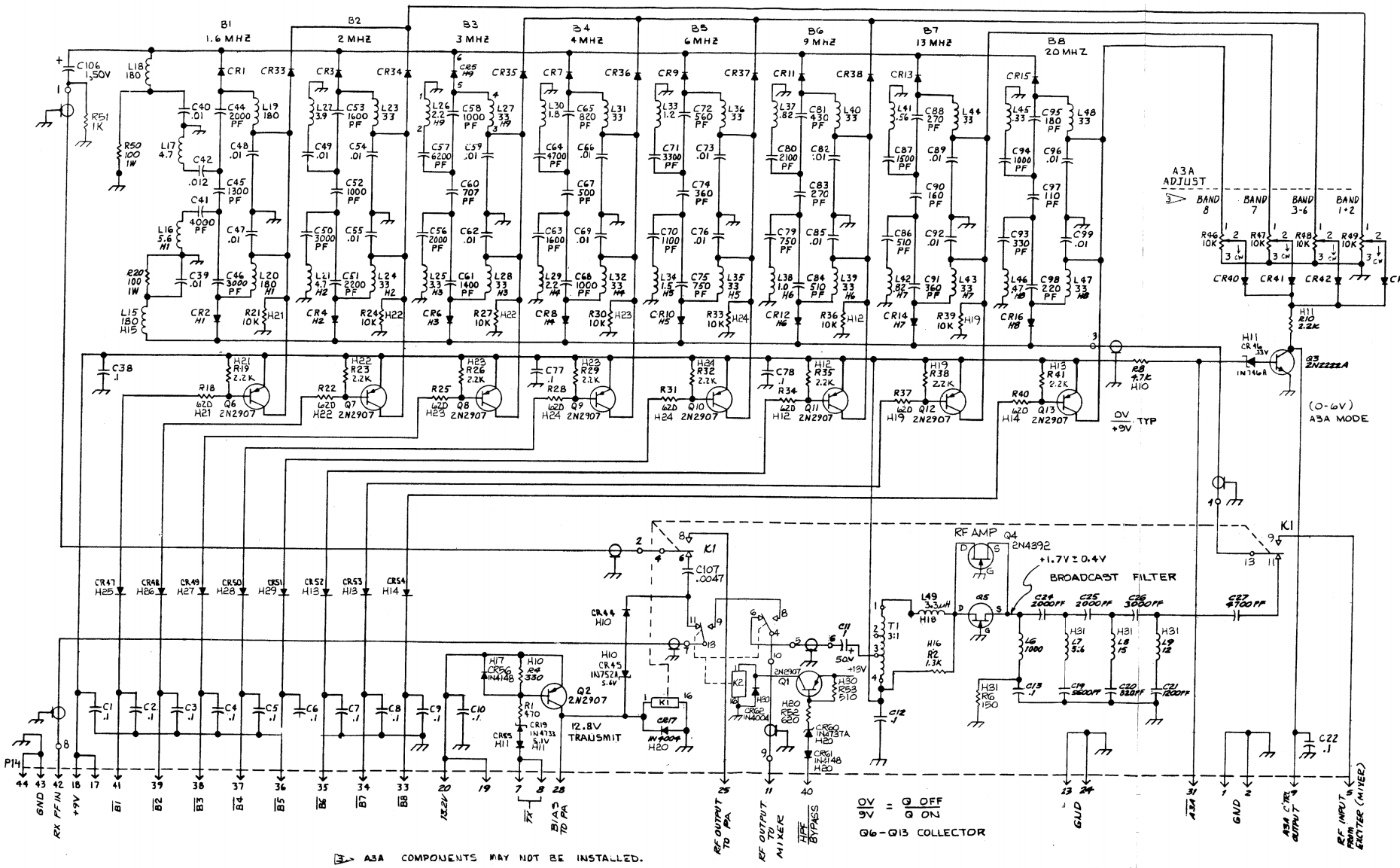


High Pass Filter (601086-536-003)

PART NUMBER	DESCRIPTION	SYMBOL
600226-314-008	CAP. .1UF, CERAMIC, 50V	C1-10,12 13,22,38 77
600268-314-007	CAP. .0047UF, CERAMIC, 50V	C107
600297-314-003	CAP. 1UF, ALUM, 50V	C11,106
600369-314-562	CAP. 5600PF, CERAMIC, 100V	C19
600369-314-821	CAP. 820PF, CERAMIC, 100V	C20
600369-314-122	CAP. 1200PF, CERAMIC, 100V	C21
620013-306-501	CAP. 2000PF, 3%, MICA, 500V	C24,55 44,46
600265-314-026	CAP. 3000PF, CERAMIC, 100V	C26
600369-314-472	CAP. 4700PF, CERAMIC, 100V	C27
600268-314-008	CAP. .01UF, CERAMIC, 50V	C39,40 47,48 54,55
640011-306-501	CAP. 4000PF, 1%, MICA, 500V	C41
600204-314-022	CAP. .012UF, MYLAR, 400V	C42
613014-306-501	CAP. 1300PF, 5%, MICA, 500V	C45
630014-306-501	CAP. 3000PF, 5%, MICA, 500V	C46,50
600204-314-001	CAP. .01UF, MYLAR, 400V	C49
622014-306-501	CAP. 2200PF, 5%, MICA, 500V	C51
610013-306-501	CAP. 1000PF, 3%, MICA, 500V	C52,58 68,94
616013-306-501	CAP. 1600PF, 3%, MICA, 500V	C53,63
622014-306-501	CAP. 2200PF, 5%, MICA, 500V	C57
600268-314-008	CAP. .01UF, CERAMIC, 50V	C59,62 66,69 73,76
670703-306-501	CAP. 707PF, 3%, MICA, 500V	C60
614013-306-501	CAP. 1400PF, 3%, MICA, 500V	C61
647014-306-501	CAP. 4700PF, 5%, MICA, 500V	C64
682003-306-501	CAP. 820PF, 3%, MICA, 500V	C65
650001-306-501	CAP. 500PF, 1%, MICA, 500V	C67
611013-306-501	CAP. 1100PF, 3%, MICA, 500V	C70
633014-306-501	CAP. 3300PF, 5%, MICA, 500V	C71
656003-306-501	CAP. 560PF, 3%, MICA, 500V	C72
636003-306-501	CAP. 360PF, 3%, MICA, 500V	C74,91
675003-306-501	CAP. 750PF, 3%, MICA, 500V	C75,79
600226-314-008	CAP. .1UF, CERAMIC, 50V	C78
621011-306-501	CAP. 2100PF, 1%, MICA, 500V	C80
643003-306-501	CAP. 430PF, 3%, MICA, 500V	C81
600268-314-008	CAP. .01UF, CERAMIC, 50V	C82,85 89,92, 96,99
627003-306-501	CAP. 270PF, 3%, MICA, 500V	C83,88
651003-306-501	CAP. 510PF, 3%, MICA, 500V	C84,86
615013-306-501	CAP. 1500PF, 3%, MICA, 500V C87	C87
616003-306-501	CAP. 160PF, 3%, MICA, 500V	C90
633003-306-501	CAP. 330PF, 3%, MICA, 500V	C93
618004-306-501	CAP. 180PF, 5%, MICA, 500V	C95
611004-306-501	CAP. 110PF, 5%, MICA, 500V	C97
622003-306-501	CAP. 220PF, 3%, MICA, 500V	C98
600144-410-001	DIODE HP3188	CR1-16
600011-416-002	DIODE IN4004	CR17,62
600006-411-006	DIODE, ZE	CR19
600109-410-001	DIODE IN4148	CR33-38, 40-44, 47-56,
600002-411-007	DIODE, ZENER, IN752A 5.6V	CR45
600002-411-001	DIODE, ZENER, 1N746A	CR46
600006-411-010	DIODE, ZENER, IN4737A, 7.5V	CR60
600109-410-001	DIODE IN4148	CR61
600064-419-003	3 POSITION VERTICAL MT	H1-9,12, 13,19,21
600064-419-001	4 POSITION VERTICAL MT	H10,11, 20,22-24, 31
600064-419-004	2 POSITION VERTICAL MT	H14,30
600064-419-005	1 POSITION VERTICAL MT	H15-18,
600094-403-003	RELAY, DPDT, 12V, 3A CONTACTS	K1,2
600125-376-022	CHOKE 180UH	L15,18-20
600125-376-030	CHOKE 4.7UH	L17,21
600125-376-018	CHOKE 3.9UH	L22
600125-376-007	CHOKE 33UH	L23,24, 27,28, 31,32,
600125-376-006	CHOKE 3.3UH	L25,L49
600125-376-016	CHOKE 2.2UH	L26,29
600125-376-017	CHOKE 1.8UH	L30
600125-376-041	CHOKE 1.2UH	L33
600125-376-033	CHOKE 1.5 UH	L34
600125-376-007	CHOKE 33UH	L35,36, 39,40, 43,44,
600125-376-039	CHOKE .82UH	L37,42
600125-376-040	CHOKE 1.0UH	L38
600125-376-005	CHOKE .56UH	L41
600125-376-001	CHOKE .33UH	L45
600125-376-027	CHOKE .47UH	L46
600125-376-007	CHOKE 33UH	L47,48
600034-376-001	CHOKE 1000UH	L6
600125-376-043	CHOKE 5.6UH	L7,16
600125-376-013	CHOKE 15UH	L8
600125-376-020	CHOKE 12UH	L9
600154-413-001	TRANSISTOR 2N2907A	Q1,2,6-13
600080-413-001	TRANSISTOR 2N2222A	Q3
600396-413-001	TRANSISTOR 2N4392	Q4,5
647004-341-075	RES. 470, 1/4W, 5%	R1
622014-341-075	RES. 1.3K, 1/4W, 5%	R10,19, 23,26, 29,32,
662004-341-075	RES. 620, 1/4W, 5%	R18,22, 25,28, 31,34,
613014-341-075	RES. 1.3K, 1/4W, 5%	R2
610004-341-325	RES. 100, 1W, 5%	R20,50
610024-341-075	RES. 10K, 1/4W, 5%	R21,24, 27,30, 33,36,
622014-341-075	RES. 2.2K, 1/4W, 5%	R35,38,41
662004-341-075	RES. 620, 1/4W, 5%	R37,40,52
610024-341-075	RES. 10K, 1/4W, 5%	R39,42
633004-341-075	RES. 330, 1/4W, 5%	R4
600063-360-010	POT. 10K, 15 TURN	R46,49
610014-341-075	RES. 1K, 1/4W, 5%	R51
651004-341-075	RES. 510, 1/4, 5%	R53
615004-341-075	RES. 150, 1/4W, 5%	R6
647014-341-075	RES. 4.7K, 1/4W, 5%	R8
600148-512-001	TRANSFORMER, 3:1, TOROID	T1

Figure 4.14-1

High Pass Filter Board Assembly



NOTES:

1. UNLESS OTHERWISE NOTED :
   RESISTORS ARE IN OHMS, 1/4W, 5%
   CAPACITORS ARE IN MFD
   INDUCTORS ARE IN MHY.
2. DIODE CR17 IS IN4004, CR1-16 ARE HP3188, CR19 IN4728, ALL OTHERS ARE IN4148

LAST DESIG. USED
R53 C106, CR62, Q13 L48, K2
DELETED
C19-18, 23, 28-37, 43, C100-105. R47, 48, 7. R11-17, 43-45. L1-5, 10-15. CR28-32, 37. Q1.

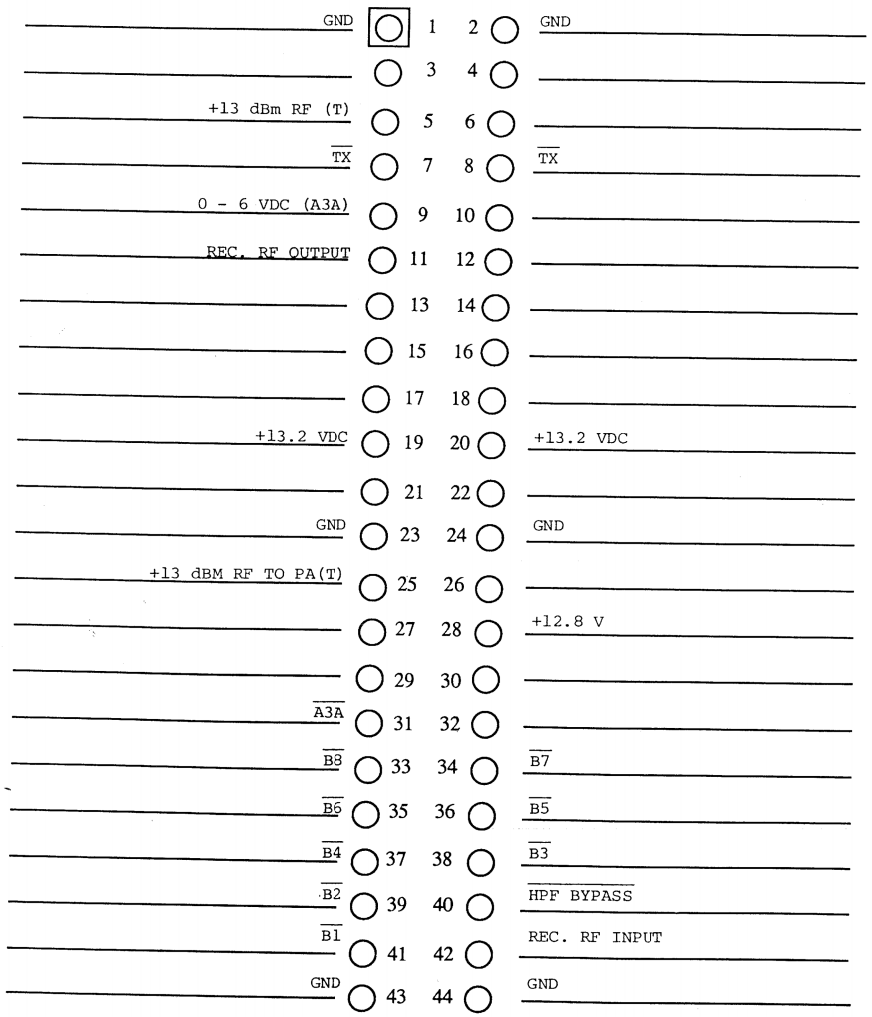
Figure 4.14-2

High Pass Filter Board Schematic

HIGH PASS FILTER BOARD, A7

PIN CONNECTIONS AND VOLTAGE READINGS

A7P14



4.15 HIGH LEVEL MIXER BOARD, A8

The High Level Mixer board is a bi-directional board, i.e. signal gain in both directions. In receive mode, it converts a 0 to 30 MHz RF input to a 1st IF of 59.53 MHz and subsequently a 2nd IF of 5 MHz. In transmit mode, it converts a 5 MHz input to 59.53 MHz and then to RF outputs of 1.6 to 30 MHz. All circuit interfaces are at 50 ohm impedance levels.

In receive mode, inputs on the RX input are selected by the RF switch and filtered by the 30 MHz LP filter. The 1st mixer, with amplified LO input of +21 dBm, 59.53 MHz to 89.53 MHz, converts the RF signals to a 59.53 MHz IF. The mixer is provided a broadband IF termination by a lossless constant resistance network and a non-reflective crystal filter network. A bilateral amplifier provides 18 dB gain which is controllable by a delayed AGC input of 0 to 9 volts. A second crystal filter at 59.53 MHz controls spurious responses due to the second mixer and complements the selectivity of the first filter and the system information filter for a total of 120 dB ultimate selectivity. The second mixer, with an amplified LO of +10 dBm, converts the 59.53 MHz signals to a 5 MHz IF. The second LO amplifier may be gated off by 9V pulses to accomplish noise blanking.

In transmit, the signal path is reversed with inputs at the 5 MHz IF, converted to a 59.53 MHz IF and amplified by the reversed bilateral amplifier. The RF switch directs the 1.6 to 30 MHz outputs from the 1st mixer to the TX amplifier to produce outputs to +15 dBm.

4.15.1 RX CONTROL

With a TTL low at pins 15 and 16, Q8 saturates putting +9 volts on all RX functions.

4.15.2 RF SWITCH

CR1 is biased to conduction by the current through R1, with L1 and L2 providing a high impedance to the signal path for RF signals. The resulting voltage across R1 biases CR2 off, isolating transmit circuits from the signal path. The input signals are thus conducted through C1, CR1 and C3 to the Low Pass Filter.

4.15.3 LOW PASS FILTER

The low pass filter is a 7-element elliptical design (C4 through C8 and L3 and L4) with a cut-off frequency of 31 MHz. This filter attenuates out-of-band spurious signals in both receive and transmit.

4.15.4 FIRST MIXER

Signals from the low pass filter are applied to pin 1 of the first mixer, MX1, a high level double balanced diode mixer. These signals (0-30 MHz) are modulated with +21 dBm LO signals (59.53 to 89.53 MHz) applied to pin 8 to produce a first IF of 59.53 MHz at pins 3 and 4.

4.15.5 CONSTANT RESISTANCE NETWORK

The constant resistance network provides a 50 ohm load to signals from the mixer at frequencies much greater than the IF frequency. R17 provides the 50 ohm load at high frequencies when C30 is a short, and at low frequencies when L14 is a short. C29 and L1 are series resonant at 59.53 MHz to couple the signal to the 90° hybrid network, maintaining a 50 ohm load at frequencies near 59.53 MHz IF.

4.15.6 90° HYBRID/FILTER NETWORK

This circuit maintains a 50 ohm input impedance by phasing equal mismatches from the two identical crystal filters FL1 and FL2, so that they cancel at the circuit input and add across R18 at an isolated port. T3 with C31 and C32, form a quadrature hybrid tuned broadly to 59.53 MHz at a 50 ohm impedance.

This circuit splits inputs from L13 to equal outputs at L15 and L16 phased 90° apart. L15 and C33 match the 2.3k ohm filter impedance of FL1. L16 and C34 perform the same function for FL2. Matching back down to 50 ohms is accomplished by L19, C35 and L20, C36. L17 and L18 are used to tune the residual capacitance across the filters to increase the ultimate rejection. A second 90° hybrid (T4, C37, C38) adds the signals from each filter. The total loss through the whole hybrid/filter network is typically 3.0 dB.

4.15.7 BILATERAL AMPLIFIER

The Bilateral Amplifier consists of receive (Q9) and transmit (Q10) amplifiers activated by a 9V RX or 9V TX control signal. These amplifiers switched into the signal path by CR5, CR9 or CR10, CR7 allow reverse signal flow in transmit applications since all other circuits are inherently bilateral.

The amplifiers are feedback controlled to maintain a 50 ohm input/output impedance with gain controlled by feedback resistor impedance and the relatively low broad band collector output impedance of 600 ohms.

In receive, the signal flows through C38, CR5 (biased on through L23) and C44 to Q9. Q9 is biased by R21 and R22 with R21 also serving as a feedback resistor. The gain is set to 18 dB by the ratio of the collector load of 600 ohms and the emitter resistor R23. L25 and C45 match the 600 ohm output to 50 ohms with the output routed through pin diode CR9. The bias through switches CR5 and CR9 produces an 8V drop across L21, R20 at the input and L30, R30 at the output, which reverse biases transmit path pin diode switches CR7 and CR10.

The maximum signal level for strong signals is limited by a delayed AGC (DAGC) signal from pins 39 and 40. The DAGC input (0 to 9 volts) biases shunt pin diodes CR4 and CR8, which attenuate the signal at Q9 input and output for a total of 40 dB at 0 volts DAGC. Bias current is limited by resistors R31 and R29. CR11 delays the output attenuation for optimum linearity. The DAGC circuit is necessary to maintain inband intermodulation rejection of 40 dB at high input signals. The DAGC attenuation varies from 1 dB at 8.3 volts to 40 dB at 0 volts.

In transmit, the circuit of Q10 is connected through CR7, CR10 by the bias produced through L24, L29 by the 9V TX signal. The circuit is identical to that of Q9.

4.15.8 CRYSTAL FILTER

A second crystal filter, FL3 at 59.53 MHz is required to reject spurious responses due to the second conversion - especially the second IF image at 49.53 MHz. This filter, identical to FL1 and FL2, is matched to 50 ohms input and output by L31, L33 and C55, C56 with ultimate rejection improved by L32.

4.15.9 SECOND MIXER AND 5 MHZ FILTER

The 59.53 MHz first IF signal is converted to a second IF of 5 MHz by a second double-balanced diode mixer, MX2. The 5 MHz output signal is filtered by a 5 MHz low pass filter C62, C63, L36 to reject the 59.53 MHz IF feedthrough, the 54.53 MHz second LO, and other undesired mixer outputs.

4.15.10 FIRST LO AMPLIFIER

The first LO amplifier produces a +21dBm signal at MX1 (pin 8) from 0 dBm board inputs from 59.53 to 89.53 MHz at pin 3. Q5 and Q6 are common gate FETs paralleled for a 50 ohm broadband input with a transconductance to produce a 6 dB gain into the 50 ohm load produced by T2. The FETs are self-biased to 10 mA by R16. L8, L9 and C20 form a 40 MHz high pass filter to reduce low frequency noise.

Q4 is a grounded emitter amplifier with 15 dB gain which produces the +21 dBm LO signal required by MX1. Q3 is a bias regulator which maintains the voltage drop across R14 (due to the current of Q4) constant by controlling the base current of Q4 through R15. L12 and C28 broadly tune the output for a relatively flat response from 59.53 to 89.53 MHz. Biased at 100 mA, the amplifier can produce a linear output of 250 milliwatts.

4.15.11 SECOND LO AMPLIFIER

Q11 and Q12 are paralleled JFETs which produce a +10 dBm output at MX2, pin 8 from a 0 dBm, 54.53 MHz second LO input at board pin 41. The FETs are self-biased by R32 to 10 mA. L35 and C12 match the 50 ohm level of MX2 to a 1.2k ohms at the FET drain to produce a 10 dB gain. With a 9V input at board pin 37, Q13 produces an 8V bias across R32, which cuts the LO amplifier off (cutoff voltage of Q11, Q12 is 6.5V maximum) which in turn cuts the mixer off and thus breaks the signal path. This is used as a noise blanker

gate in the MSR 8000 and may be used as a transmit inhibit gate in transmit applications.

4.15.12 TRANSMIT AMPLIFIER

Q1 and Q2 are feedback controlled amplifiers which increase the level of signals from the first mixer, MX1 to +17 dBm outputs, 1.6 to 30 MHz at board pin 6. Signals from the mixer, MX1 are routed through the low pass filter (C4-C8, etc.), C3, CR2, C14 and C15 to the base of Q2. Q2 is biased for 2.9 volts at the base by R9, R10 and R11. R7 and R8 produce 30 mA bias current with R7 setting the gain and R9 controlling the input/ output impedance of 50 ohms. C18, as well as L7, compensate the high frequency roll off. Q1 is the identical circuit with values changed to produce a capability of 160 milliwatts linear output. In addition, the base bias is changed to add CR3, which compensates for bias changes with temperature.

4.15.13 DC CONTROL

+13 VDC is supplied through L30 to the first LO amplifier circuit. For installations where 13 volts is not connected to the board, CR6 allows the 9 volts to operate the LO circuit at a slightly reduced level. Grounds on pins 7, 8, or 15, 16 saturate the 9 volt TX or 9 volt RX transistor switches (Q7 or Q8) to supply 9 volts to the appropriate circuits.

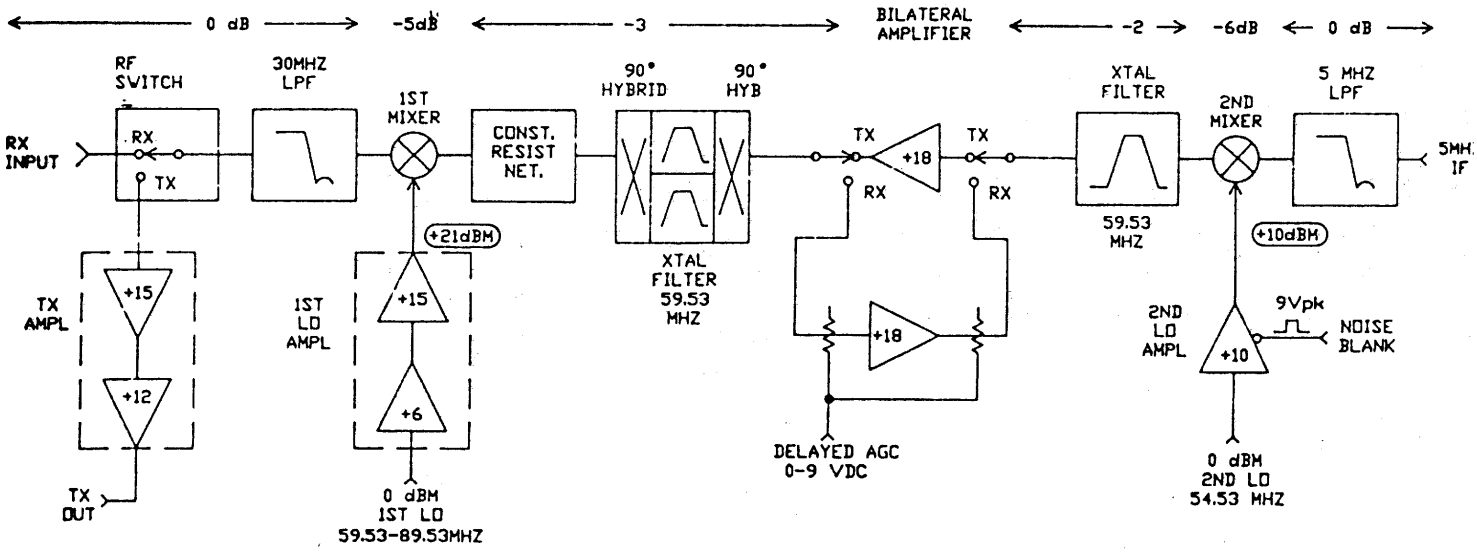
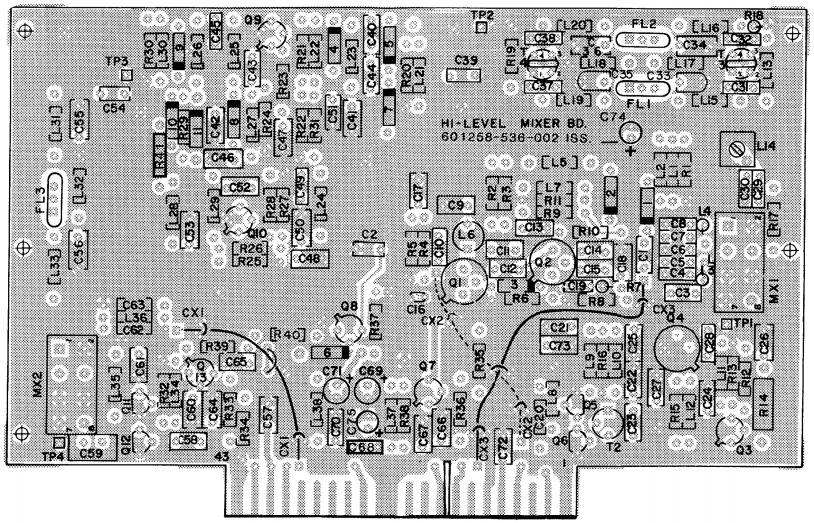


Figure 4.15-1 Block Diagram, High Level Mixer Board



High Level Mixer (601258-536-002)

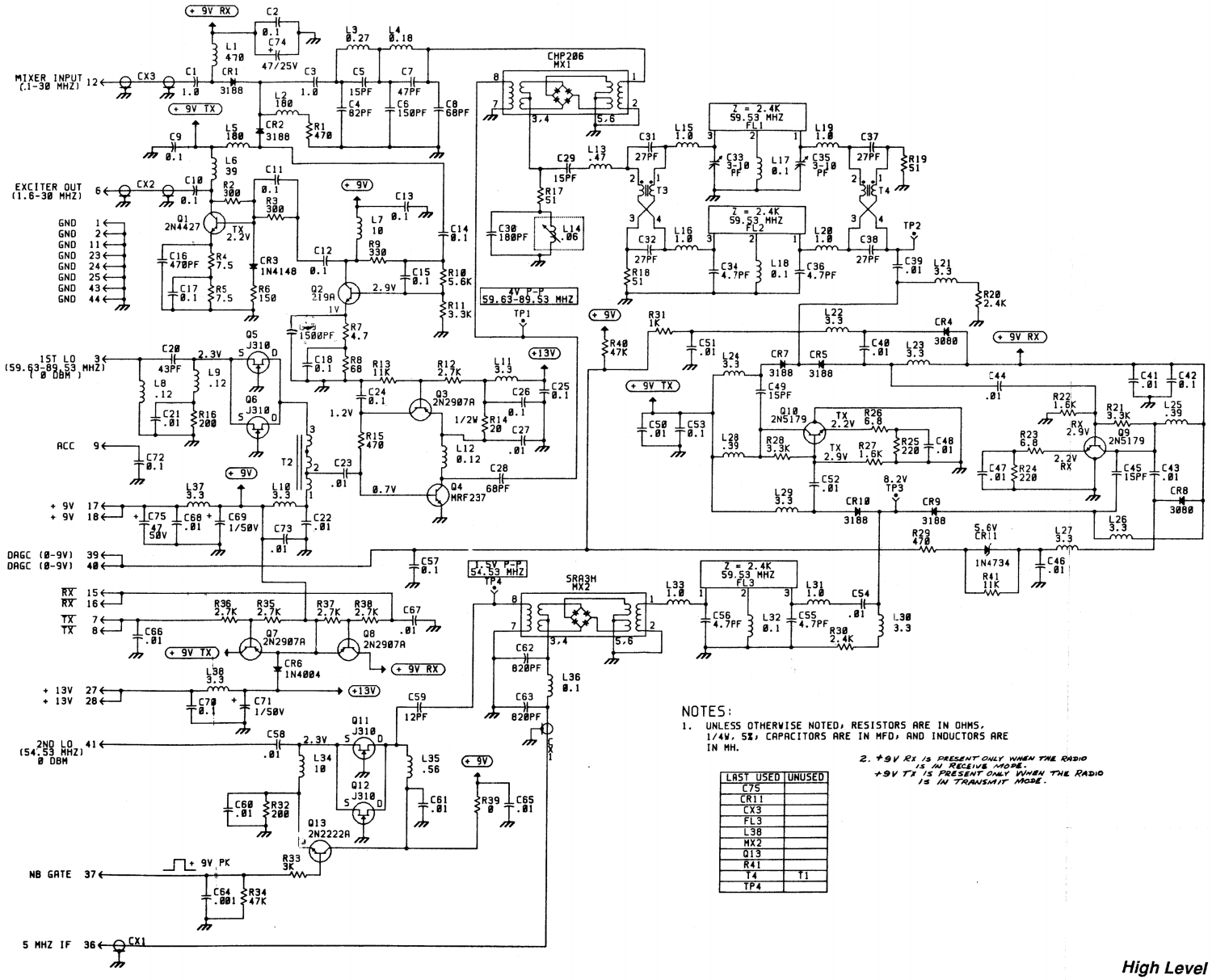
PART NUMBER	DESCRIPTION	SYMBOL
600226-314-014	CAP. 1UF, CERAMIC, 50V	C1,3
600226-314-008	CAP. .1UF, CERAMIC, 50V	C14,15
600210-314-040	CAP. 470PF, CERAMIC, 100V	C16
600210-314-037	CAP. 1500PF, CERAMIC, 100V	C19
600302-314-013	CAP. .1UF, MYLAR, 50V	C2,9-13, 17,18, 24-26,42, 53,57, 70,72
600293-314-430	CAP. 43PF, CERAMIC, 50V	C20
600369-314-181	CAP. 180PF, CERAMIC, 100V	C30
600369-314-270	CAP. 27PF, CERAMIC, 100V	C31,32, 37,38
600052-317-001	CAP. VAR, 3-10PF	C33,35
600269-314-005	CAP. 4.7PF, CERAMIC, 500V	C34,36 55,56
600369-314-820	CAP. 82PF, CERAMIC, 100V	C4
600369-314-150	CAP. 15PF, CERAMIC, 100V	C5,29,45, 49
600302-314-007	CAP. .01UF, MYLAR, 63V	C58,60, 61,65-68, 73,44, 46-48, 50-52,54, 21-23,27, 39-41,43,
600369-314-120	CAP. 12PF, CERAMIC, 100V	C59
600369-314-151	CAP. 150PF, CERAMIC, 100V	C6
600293-314-821	CAP. 820PF, CERAMIC, 50V	C62,63

PART NUMBER	DESCRIPTION	SYMBOL
600302-314-001	CAP. .001UF, MYLAR, 63V	C64
600297-314-003	CAP. 1UF, ALUM, 50V	C69,71
600369-314-470	CAP. 47PF, CERAMIC, 100V	C7
600297-314-025	CAP. 47UF, ALUM, 25V	C74,75
600369-314-680	CAP. 68PF, CERAMIC, 100V	C8,28
600144-410-001	DIODE HP3188	CR1,2,5, 7,9,10
600006-411-007	DIODE IN4734A 5.6V	CR11
600109-410-001	DIODE IN4148	CR3
600156-410-001	DIODE HP3080	CR4,8
600011-416-002	DIODE IN4004	CR6
600060-529-004	FILTER, 59.53 MHZ	FL1-3
600125-376-015	CHOKE 470UH	L1
600125-376-027	CHOKE .47UH	L13
600243-376-008	COIL, VAR, .06uH	L14
600125-376-040	CHOKE 1.0UH	L15,16, 19,20, 31,33
600125-376-028	CHOKE .1UH	L17,18,32
600125-376-022	CHOKE 180UH	L2,5
600125-376-004	CHOKE .39UH	L25,28
600125-376-037	CHOKE .27UH	L3
600125-376-006	CHOKE 3.3UH	L30,37, 38,29,10, 11,21-24, 26,27
600125-376-005	CHOKE .56UH	L35
600125-376-016	CHOKE 2.2UH	L36
600125-376-031	CHOKE .18UH	L4
600072-376-032	CHOKE 39UH	L6
600125-376-032	CHOKE 10UH	L7,34
600125-376-036	CHOKE .12UH	L8,9,12
600018-455-001	MIXER CNP206	MX1
600007-455-001	MIXER SRA 3H	MX2

PART NUMBER	DESCRIPTION	SYMBOL
600222-413-001	TRANSISTOR 2N4427	Q1
600080-413-001	TRANSISTOR 2N2222A	Q13
600082-413-001	TRANSISTOR 2N2219A	Q2
600154-413-001	TRANSISTOR 2N2907A	Q3,7,8
600399-413-001	TRANSISTOR MRF237	Q4
600259-413-001	TRANSISTOR J310	Q5,6, 11,12
600177-413-001	TRANSISTOR 2N5179	Q9,10
600170-419-008	THERMAL WASHER	(Q1)
600017-419-001	TRANSISTOR PAD	(Q2)
600025-419-001	TRANSISTOR PAD	(Q3,7-10 13,T1-3)
647004-341-075	RES. 470, 1/4W, 5%	R1,15,29
656014-341-075	RES. 5.6K, 1/4W, 5%	R10
633014-341-075	RES. 3.3K, 1/4W, 5%	R11,21,28
627014-341-075	RES. 2.7K, 1/4W, 5%	R12,35-38
611024-341-075	RES. 11K, 1/4W, 5%	R13,41
620094-341-205	RES. 20, 1/2W, 5%	R14
620004-341-075	RES. 200, 1/4W, 5%	R16,32
651094-341-075	RES. 51, 1/4W, 5%	R17-19
630004-341-075	RES. 300, 1/4W, 5%	R2,3
624014-341-075	RES. 2.4K, 1/4W, 5%	R20,30
616014-341-075	RES. 1.6K, 1/4W, 5%	R22,27
668084-341-075	RES. 6.8, 1/4W, 5%	R23,26
622004-341-075	RES. 220, 1/4W, 5%	R24,25
610014-341-075	RES. 1K, 1/4W, 5%	R31
630014-341-075	RES. 3K, 1/4W, 5%	R33
647024-341-075	RES. 47K, 1/4W, 5%	R34,40
600000-341-075	RES. 0, 1/4W, 5%	R39
675084-341-075	RES. 7.5, 1/4W, 5%	R4,5
615004-341-075	RES. 150, 1/4W, 5%	R6
647084-341-075	RES. 4.7, 1/4W, 5%	R7
668094-341-075	RES. 68, 1/4W, 5%	R8
633004-341-075	RES. 330, 1/4W, 5%	R9
600094-512-001	TRANSFORMER, 3:1, BALUN	T2
600164-513-001	TRANSFORMER	T3,4

Figure 4.15-2

High Level Mixer Board Assembly



NOTES:

1. UNLESS OTHERWISE NOTED, RESISTORS ARE IN OHMS, 1/4W, 5%, CAPACITORS ARE IN MFD, AND INDUCTORS ARE IN MH.
2. +9V RX IS PRESENT ONLY WHEN THE RADIO IS IN RECEIVE MODE. +9V TX IS PRESENT ONLY WHEN THE RADIO IS IN TRANSMIT MODE.

LAST USED	UNUSED
C75	
CR11	
CX3	
FL3	
L38	
MX2	
Q13	
R41	
T4	T1
TP4	

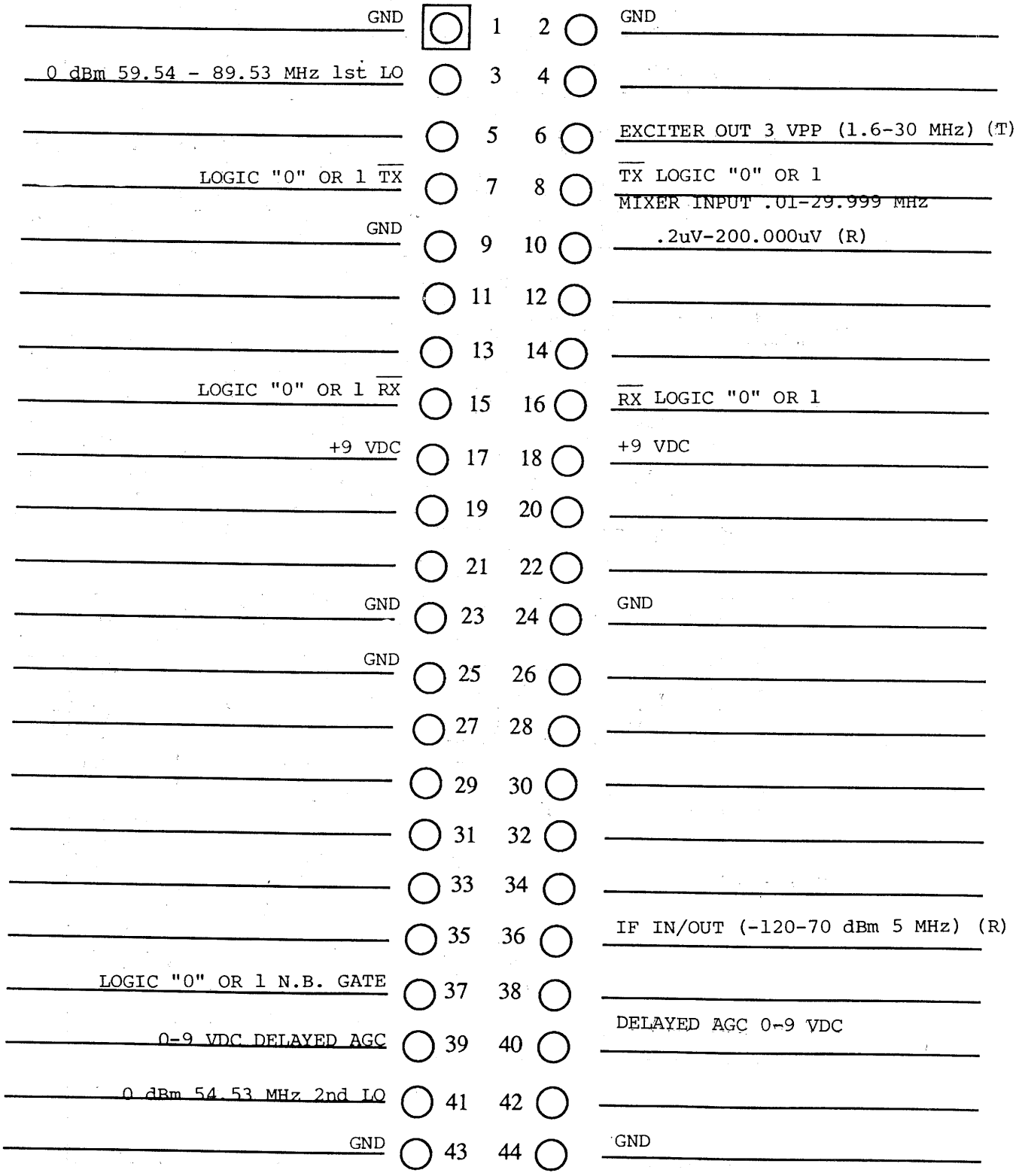
Figure 4.15-3

High Level Mixer Board Schematic

HIGH LEVEL MIXER BOARD, A8

PIN CONNECTIONS AND VOLTAGE READINGS

A8



4.16 IF FILTER BOARD, A9, A10

The IF Filter board contains up to three selectable 5 MHz crystal filters with amplifiers and circuits to perform in both transmit and receive operations. The transmit circuits, although described, are not used in the MSR 5050A.

The same board (with different filters) is used as A9 in Mother board J14 (IF Filter #1) and as A10 in J12 (IF Filter #2). A10 is installed as part of the receiver IF Filter option to offer more selectable filter bandwidths. As part of the ISB options in both receiver and exciter, it provides an independent LSB signal path simultaneously with a USB path in A9.

The filters in A9 for the standard radio are:

FL1 - USB operation, also used as a medium bandwidth filter for CW, AM and FSK. In transmit it is used for USB, CW, FSK, AME and A3A.

FL2 - LSB operation in both receive and transmit.

FL3 - AM operation in receive only.

Since the frequency is inverted in the Mixer board, the USB pass band is actually on the lower side of 5 MHz.

The appropriate filter is selected by diode steering via mode information from the Interface board. During the receive mode, a 5 MHz IF signal from the High Level Mixer board is passed through the appropriate IF filter and further amplified in three stages. The gain is adjustable by jumpers to produce a 7 μV AGC threshold (for voice reception) or 1 μV threshold (for data reception). An AGC voltage from the Audio Squelch board controls the gain of the amplifiers to maintain a constant IF output over a large range of input levels.

In transmit operation, a 5 MHz double-sideband signal from the Transmit Modulator board is applied. The appropriate filter (FL1 or FL2) removes the unwanted sideband. A hybrid combiner adds a controlled level of 5 MHz carrier to the signal in AME and A3A transmit modes. The signal is then routed to the output through an amplifier with gain controlled by a TGC (Transmit Gain Control) voltage from the Transmit Modulator board.

4.16.1 DETAILED DESCRIPTION

4.16.1.1 Filter Selection

The filters are selected by placing a ground (logic 0) on certain pins on the board connector. When USB is selected, a ground is placed on pin 35 of P1. This action causes AC current flow from the +9V bus through R11, CR2, L7, and CR11. The resulting low resistance of pin diode CR2 creates a signal path from L13 to FL1 input. The high impedance of R11 and L7 prevent loading the signal. The other filter selector diodes, CR5 and CR7 are back-biased by the 9 volts supplied through pull-up resistors R23 and R24, and the near-zero volts at their anodes caused by pulling in CR2.

The filter output is similarly selected by CR3 with current from +9V through R30, CR3 and L8, to the same ground at pin 35. FL1 is also selected by the same action with grounds on pin 29 (FSK) through CR21, pin 34 (CW) through CR12, pin 33 (AMT) through CR13.

FL2 (LSB) is selected by a similar process with a ground on pin 37, causing current flow from +9V through R11, CR5, L9, and CR14, to connect the input; and current flow through R30, CR4, L10 and C14, to connect the outputs.

FL3 is selected for receive AM operation by a ground on pin 31, which biases Q5 on (the base being pulled to +9 VDC through R26), causing current flow through the input and output selector diodes CR7 and CR6. FL3 is prevented from being selected in AMT (transmit AM operation) by the ground at pin 33 with biases Q5 off through CR15.

4.16.1.2 Receive Path

The 5 MHz receive input from the Mixer board is on pin 36. Q3 provides 22 dB gain with a 50 ohm input and output impedance.

The 50 ohm input is controlled by the series/shunt feedback of R17/R14. L6 and C12 match the 400 ohm collector impedance to 50 ohms. The gain is controlled by the ratio of the collector load to R17. Q3 is biased for 6 mA collector current by R19 for an output third order IM intercept point of +19 dBm, allowing less than -40 dB inband IM distortion at IF inputs up to -28 dBm.

The amplified signal from Q3 passes through CR9 and C13 to the selected filter. CR9 is biased "ON" by the current through R16 and L5 from the "+9R" voltage bus, which is activated in the receive mode by Q9. The voltage developed across R16 back-biases CR8 preventive loading from the transmit circuitry.

The output of the filter is similarly routed through C28 and CR19 with CR19 biased on by current through L14, L15, and C31 from the "+9R" buss. CR20 is biased off by the voltage developed across R31. C30 and C31 couple the 5 MHz signal to Q6 which provides 31 dB voltage gain into a typical 300 ohm load (17 dB power gain). The 56 ohm R33 shunts the high input impedance of Q6, providing an accurate 50 ohm load for the filters. A variable resistor, R3, in the Q6 emitter, adjusts the gain of Q6 to overcome tolerances in the receive signal path and establishes a fixed end-to-end board gain. This adjustment directly effects the AGC threshold for the receiver. Jumper JP2 (and JP3 for Q7) shunts a 22 ohm resistor across the emitter resistor R35 (R40 for Q7) increasing the stage gain by about 6 dB, which reduces the receiver AGC threshold from -90 to -104 dBm. Q6 gain is proportional to the ratio of the load impedance of about 300 ohms (determined mainly by the parallel impedance of R37, R38, R39, the input impedance of Q7 and the off resistance of CR16) to the unbypassed emitter resistance.The gain is reduced by 30 dB in response to an AGC voltage from pin 12, by current through pin diode CR16 which reduces the load resistance of Q6. The response of Q6 is broadly tuned to 5 MHz (loaded Q of 2 by L17 and C33).

The signal is further amplified by Q7 in a nearly identical circuit with 17 dB gain. The output is sharply tuned (loaded Q of 50) by C40 and variable inductor L20 to reduce the broadband noise in the signal path.

The collector load is 500 ohms for this stage. Q8 is an emitter follower which produces a low inpedance output to the following Audio Squelch board through pin 5. A 20 ohm emitter resistor R53, limits the current gain for low impedance output loads which may compromise stability.

U1 is a voltage follower which passes inputs at pin 12 to a 0-6 volt output to pin diode (CR16, CR17) bias resistors (R37, R42), producing up to 6 mA current in each diode. This provides AGC gain cuts of 30 dB for each diode. U1 input in offset by R60.

The overall gain is 55 dB in voice mode, which produces a 7 μV AGC threshold in the radio with a -30 dBm Audio Squelch board AGC input threshold and 67 dB gain in data mode (JP2 and JP3 positioned E2, pin 1-2 and E3, pin 1-2), producing a 1.4 μV AGC threshold- adjustable in both cases by R35.

The AGC gain cut is 60 dB with an AGC input voltage of 8 VDC. The in-band IM rejection is greater than 40 dB at inputs up to -31 dBm. The noise figure is about 4 dB.

4.16.1.3 Transmit Path

The double sideband input to the IF Filter board on pin 4 from the Transmit Modulator is attenuated 3 dB by R27, R28, R29 and applied to the selected filter through C29 and CR20. CR20 is biased "ON" by current through L21, L15, and R31 from the "+9T" buss which is activated by Q10 in transmit mode. The USB or LSB signal emerging from the filter is passed through C13 and CR8 (by bias current from "+9T" through L2, L3, L4, and R16) to a 3 dB combiner circuit tuned at 5 MHz. The combiner, which adds a carrier (pin 39) to the SSB signal in AME or A3A mode, is formed by L3, L4, C9, C10, and R12.

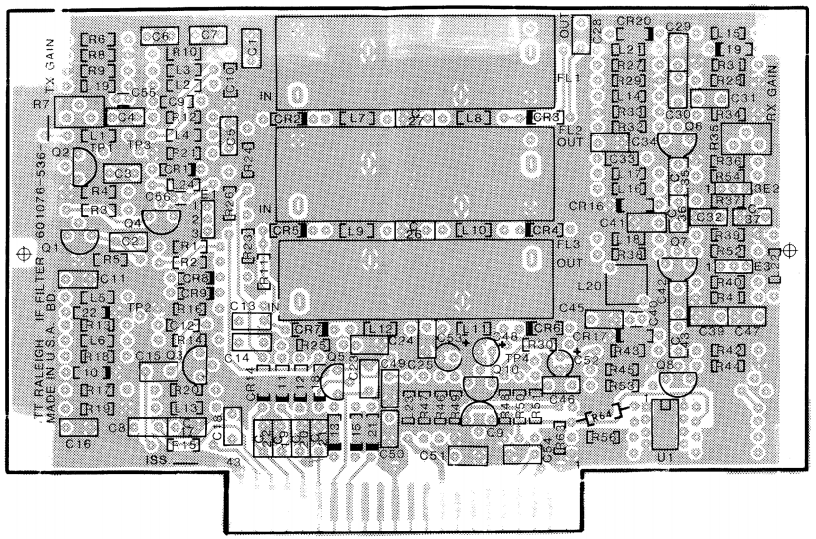
The output of the combiner goes through C7 and C6 to the base of Q2 with R10 imposing a 56 ohm termination to the combiner and consequently, to the filters. Q2 is configured as a common emitter amplifier with maximum gain determined by the ratio of the collector load of 1k (R3/R4 in parallel) and the unbypassed emitter resistor R9, which is adjustable to maintain a precise transmit gain.

The gain is varied by the resistance of pin diode CR1 in the emitter circuit in series with R9 in response to TGC voltage from 2 to 6 VDC at pin 42.

Parallel traps L19/C55 and L24/C56 are tuned to 5 MHz to remove parasitic loading in the emitter circuit to maximize the TGC gain cut to greater than 32 dB. R13 and R20, in conjunction with the diode junction voltages of CR1, Q4 vs. CR21, delay the TGC action until approximately 2 VDC.

Q1 is an emitter follower producing a 50 ohm output impedance at pin 38 (and pin 40). When used in the MSR 6700A in ISB, two IF Filter boards are paralleled at pin 40.

With a +5.5 VDC TGC input at pin 42, the overall SSB transmit gain from pin 4 to pin 38 or pin 40 is +6 dB and carrier gain from pin 39 to pin 38 or 40 is +13 dB. Both gains are reduced by 32 dB by a TGC input at pin 42 from +5.5 to 2 VDC. Third order IM products are down greater than 40 dB with DSB inputs as high as -10 dBm.



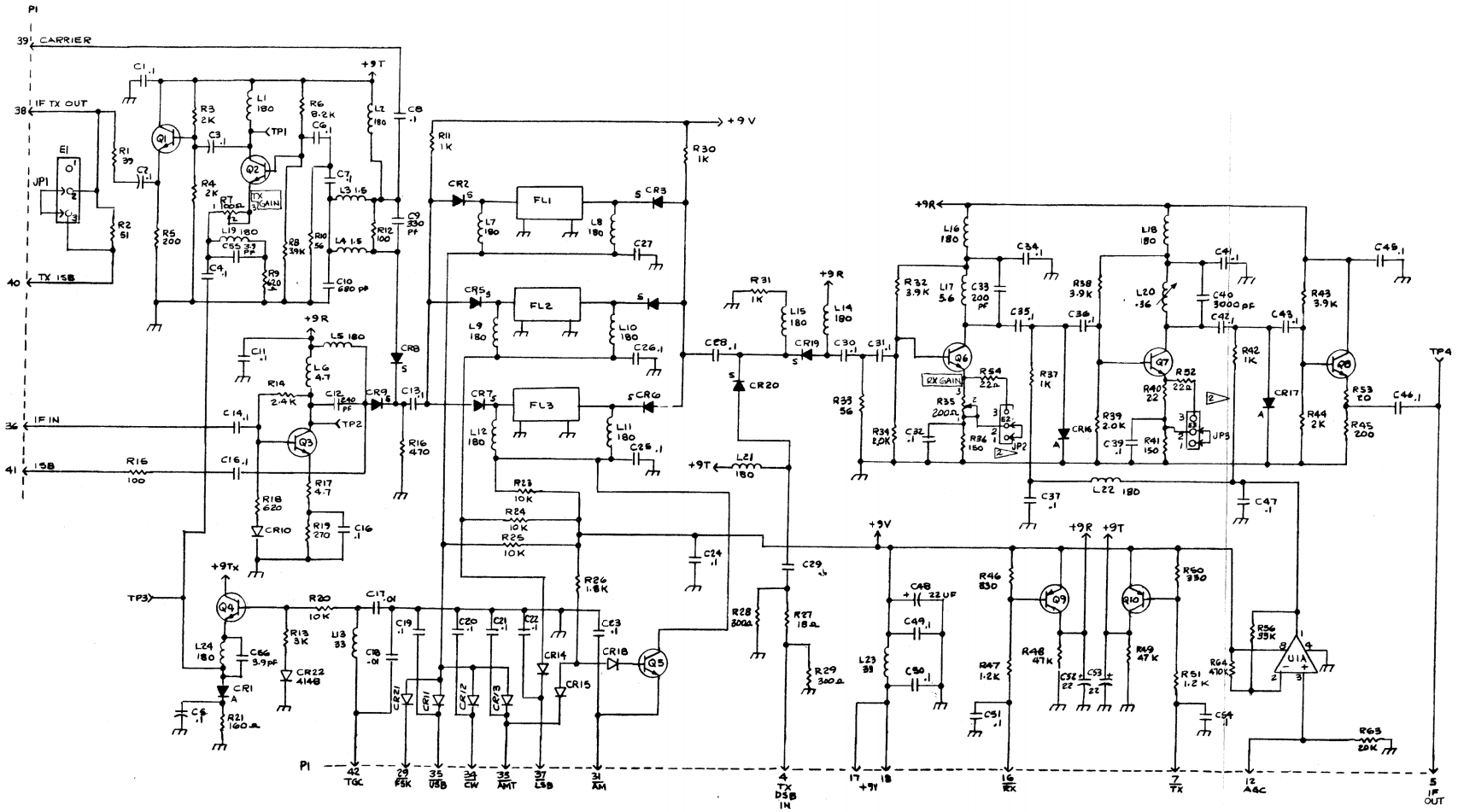
IF Filter (601076-536-014)

PART NUMBER	DESCRIPTION	SYMBOL
600302-314-013	CAP. .1UF, MYLAR, 50V	C1-8,11, 13-16, 19-32,
600293-314-681	CAP. 680PF, CERAMIC, 50V	C10
600293-314-241	CAP. 240PF, CERAMIC, 50V	C12
600302-314-007	CAP. .01UF, MYLAR, 63V	C17,18
600302-314-013	CAP. .1UF, MYLAR, 50V	C34-37, 39,41-43
600293-314-201	200PF, CERAMIC 50V	C40
600302-314-013	CAP. .1UF, MYLAR, 50V	C45-47, 49-51,54
600297-314-016	CAP. 22UF, ALUM, 25V	C48,52, 53
600265-314-008	CAP. 3.9PF, CERAMIC 100V	C55,56
600293-314-331	CAP. 330PF, CERAMIC; 50V	C9
600156-410-001	DIODE HP3080	CR1,16, 17
600109-410-001	DIODE IN4148	CR10-14, 18,21,22
600052-410-001	DIODE IN270	CR15
600144-410-001	DIODE HP3188	CR2-9, 19,20
600198-608-005	CONN. HEADER, 3 PIN, TIN	E1-3
600084-529-001	FILTER, USB	FL1
600083-529-001	FILTER, LSB	FL2
600190-608-001	CONN, JUMPER, 2 POS.	JP1-3
600125-376-022	CHOKE 180UH	L1,2,5, 7-12, 14-16,18
600125-376-007	CHOKE 33UH	L13,23
600125-376-043	CHOKE 5.6UH	L17
600125-376-022	CHOKE 180UH	L19,21, 22,24
600247-376-001	COIL, VAR, .283-.405UH	L20
600125-376-033	CHOKE 1.5 UH	L3,4
600125-376-030	CHOKE 4.7UH	L6

PART NUMBER	DESCRIPTION	SYMBOL
600229-413-003	TRANSISTOR 2N3904 TO-92	Q1-8
600116-413-002	TRANS, 2N3906	Q9,10
639094-341-075	RES. 39, 1/4W, 5%	R1
656094-341-075	RES. 56, 1/4W, 5%	R10,33
610014-341-075	RES. 1K, 1/4W, 5%	R11,30, 31,37,42
610004-341-075	RES. 100, 1/4W, 5%	R12,15
630014-341-075	RES. 3K, 1/4W, 5%	R13
624014-341-075	RES. 2.4K, 1/4W, 5%	R14
647004-341-075	RES. 470, 1/4W, 5%	R16
647084-341-075	RES. 4.7, 1/4W, 5%	R17
627004-341-075	RES. 270, 1/4W, 5%	R19
651094-341-075	RES. 51, 1/4W, 5%	R2
610024-341-075	RES. 10K, 1/4W, 5%	R20,23-25
616004-341-075	RES. 160, 1/4W, 5%	R21
618014-341-075	RES. 1.8K, 1/4W, 5%	R26
618094-341-075	RES. 18, 1/4W, 5%	R27
630004-341-075	RES. 300, 1/4W, 5%	R28,29
620014-341-075	RES. 2K, 1/4W, 5%	R3,4,31 39,44
600066-360-005	POT. 200, 1/2W,CERMET, RT/AN	R35
615004-341-075	RES. 150, 1/4W, 5%	R36,41
622094-341-075	RES. 22, 1/4W, 5%	R40,52, 54
633004-341-075	RES. 330, 1/4W, 5%	R46,50
612014-341-075	RES. 1.2K, 1/4W, 5%	R47,51
647024-341-075	RES. 47K, 1/4W, 5%	R48,49
620004-341-075	RES. 200, 1/4W, 5%	R5,45
620094-341-075	RES. 20, 1/4W, 5%	R53
633024-341-075	RES. 33K, 1/4W, 5%	R56
682014-341-075	RES. 8.2K, 1/4W, 5%	R6
620024-341-075	RES. 20K, 1/4W, 5%	R63
647034-341-075	RES. 470K, 1/4W, 5%	R64
600066-360-004	POT. 100, 1/2W, CERMET, RT/AN	R7
639014-341-075	RES. 3.9K, 1/4W, 5%	R8,32, 38,43
662004-341-075	RES. 620, 1/4W, 5%	R9,18
600150-415-001	IC LM358,OP AMP, LP DUAL	U1

Figure 4.16-1

IF Filter Board Assembly



NOTES:

1. JP1 BETWEEN E1-2 AND E1-3 FOR NORMAL OPERATION, BUT FOR A MSR-6700 WITH ISB PUT JP1 BETWEEN E1-1 AND E1-2.
2. PLACE JP2 AND JP3 BETWEEN PINS 1 AND 2 FOR VOICE MODE. CONNECT JP2 AND JP3 BETWEEN PINS 2 AND 3 FOR DATA MODE.

CAPACITORS IN UF
RESISTORS 1/4W 5%

IC = LM358 GND PINS 1,2,44,24,48.
CHOKES IN uH 1/4W
TRANSISTORS 2N3904 NPN 2N3906 PNP
DIODES = 1N4148
= HP5082-3188
= HP5082-3180

NOT USED	LAST USED
R22,55,57-62	L24
C38	Q10
C44	D64
	C56
	CR22
	JP3
	E3

Figure 4.16-2

IF Filter Board Schematic

IF FILTER BOARD, A9, A10

PIN CONNECTIONS AND VOLTAGE READINGS

A9P1/A10 P1

GND	1	2	GND
	3	4	TX DSB IN 200 mVPP (-10 dBm) TYPICAL
-30 dBm IF OUT (R)	5	6	
LOGIC "0" OR 1 $\overline{TX}$	7	8	
	9	10	
	11	12	AGC INPUT 0 TO +6 VDC (R)
	13	14	
	15	16	$\overline{RX}$ LOGIC "0" OR 1
+9 VDC	17	18	+9 VDC @ 100 ma $\overline{RX}$/80ma $\overline{TX}$
	19	20	
	21	22	
GND	23	24	GND
	25	26	
	27	28	
LOGIC "0" OR 1 $\overline{FSK}$	29	30	
LOGIC "0" OR 1 $\overline{AM}$	31	32	
LOGIC "0" OR 1 $\overline{AMT}$	33	34	$\overline{CW}$ LOGIC "0" OR 1
LOGIC "0" OR 1 $\overline{USB}$	35	36	REC. IF IN -106 to -20 dBm
LOGIC "0" OR 1 $\overline{LSB}$	37	38	5 MHz TX IF OUT -8 dBm MAX.
(AMT) -18 - 25 dBm 5 MHz	39	40	ISB IF OUT (NOT USED)
ISB OUT (NOT USED)	41	42	TGC +2 TO +5.5 VDC (T)
GND	43	44	GND

4.17 TRANSMIT MODULATOR BOARD, A11, A12

4.17.1 GENERAL

The Transmit Modulator board processes audio inputs and generates the double sideband RF signal at the transmitter's IF frequency. This Double Sideband (DSB) signal is ultimately transmitted after being filtered to remove the unwanted sideband, shifted to the desired channel frequency, and amplified. This board also contains a portion of the Automatic Level Control (ALC) circuitry which maintains constant transmitter output power.

The following subcircuits are located on this board: audio input circuits, audio limiter, modulator, control circuits, and ALC circuit.

4.17.2 MODULATOR SECTION

The modulator (M1) is a double-balanced diode ring mixer. The 5 MHz third Local Oscillator (LO) signal is applied to the LO port of the mixer, pin 8 and audio is applied to the IF port, pins 3 and 4. The Double Sideband (DSB) signal is output from pin 1. Because of the inherent balance of the mixer, the carrier is suppressed about 50 dB with no adjustment necessary. Resistor R47 properly terminates the mixer output.

4.17.3 DOUBLE SIDEBAND AMPLIFIER

The DSB signal is amplified by common emitter amplifier Q4. A variable output level is provided by changing Q4's gain via pin diode CR29. The resistance of CR29 depends on the DC current through it as determined by the setting of the DSB output level pot, R51. When the current through CR29 is highest, its resistance is lowest and therefore the gain of Q4 is highest because the emitter resistance is low (being mainly determined by R52). When the resistance of CR29 is high, Q4's emitter resistance is high and its gain is low. Inductor L10 decouples R49 and forces almost all of the signal current to flow through C38 and CR29 so that the gain can be determined by CR29. Inductor L6 and capacitor C39 in the collector circuit of Q4 transform R54 down to 50 ohms to match the input of the IF Filter board. Q4 receives its supply voltage from the +9V Tx source which is only on when the /Tx line is low.

4.17.4 THIRD LO AMPLIFIER

The 5 MHz third LO is input at P1-14 and is amplified by Q5. The gain of Q5 is mainly determined by R25. Inductor L5 and capacitor C33 transform R28 down to 50 ohms to match the mixer impedance.

4.17.5 CARRIER INJECTION

4.17.5.1 AME Mode

Some third LO signal is needed to provide transmitted carrier during AME and A3A operation. This signal must bypass the filters, so a separate carrier output is provided at P1-39. This signal is routed to IF Filter board and mixed with the sideband signal after the filters. Transistor Q12 is a switch used to turn off the carrier output when it is not wanted in CW and sideband modes. In AM transmit, the /AMT signal will be low so that U4B-1 will also be low. This turns off Q6 which allows current to flow through R93, R94 and R95 and turn on Q12. This also allows the third LO signal to flow from R15 and C7 through pin diode CR8 (when Q6 is on, the third LO is shorted out by C69). The carrier ouput level is determined by the resistance of pin diode CR8, which in turn is determined by the DC current in CR8. This is controlled by the carrier pot R17.

4.17.5.2 A3A Mode

In A3A Mode, the /A3A command at P1-5 will by low, so that U4C-14 will be high. This turns on Q12 via current flow through R96, R97, and R95 and allows third LO signal to flow from R20 and C8 through pin diode CR9. Since Q6 is now on, third LO signal cannot flow through CR8 and so is controlled entirely by CR9. The carrier output level in A3A mode is controlled by the voltage on P1-9 (ACC override) which determines the resistance of CR9. This voltage comes from the High Pass Filter board which contains the A3A carrier level adjustments.

4.17.6 AUDIO COMPRESSOR

The purpose of the audio compressor is two-fold. One is to limit the maximum audio level which is applied to the modulator, so that distortion does not occur. The second is to raise the average transmit power by compressing the voice amplitude range. The compressor consists of U1, Q1, Q2, and associated components. U1A is a normal inverting amplifier stage with its gain controlled by the resistance of FET, Q1. This amplifier has two inputs: one through R5 and one through R6. With Q1 off, the gain from each input to the output at U1A-1 is approximately unity. When Q1 is turned on completely, the U1A stage gain is reduced about 26 dB. The gain is controlled by a feedback loop to keep the output level at U1A-1 constant in the following manner: Comparator U1C compares the audio output level on U1C-12 with a fixed threshold voltage on U1C-13. When the voltage on U1C-12 exceeds that on U1C-13, U1C-14 goes high and this voltage is rectified by CR4. It is then applied to the gate of Q1 which decreases its resistance and reduces the gain of the U1A stage. The compressor attack time constant is R14 x C6 or 4.7 msec and the release time constant is R13 x C6 or 1 sec. A feature of the compressor is the Audio indicator, DS1, which lights when there is sufficient audio level to activate the compressor. The error voltage developed at U1C-14 is rectified by CR5, stored in C62 and U1D-9. U1D-8 goes high and furnishes current to DS1. When the compressor is not active there will be no error voltage at U1C-14 so DS1 will not be lit. The last part of the compressor is a buffer amplifier made up of U1B and Q2, a unity-gain amplifier. Emitter-follower Q2 gives the amplifier enough drive capability for the 100 ohm load (R48 + the 50 ohm input impedance of mixer M1). Resistor R48 matches the input impedance of M1 at audio frequencies and C34 enables R48 to serve as a termination of the IF port at the LO frequency of 5 MHz. The buffer amplifier also allows reduction of the DSB output level during AME and low power modes in the following manner: When the radio is in neither the low power mode or AM mode, both U4A-2 and U4B-1 will be high, holding CR6 and CR7 off. Since the input impedance of the buffer amplifier at U1B-5 is extremely high, series series resistor R9 has no effect on the gain. When /AMT goes low, U4B-1 will go low, turning on CR6. This will form a voltage divider between R9 and R11 which will reduce the output level about 7.5 dB. When the low power signal is high, U4A-2 goes low, turning on CR7. This forms a voltage divider with R9. Low power and AM transmit conditions are not intended to be present simultaneously, and this combination of conditions is prohibited by the radio's software.

4.17.7 AUDIO INPUT CIRCUITS

The purpose of the audio input circuits is to condition and amplify the microphone and line audio inputs.

4.17.7.1 600 Ohm Line Circuits

The 600Ω line audio is applied to P1-40 and P1-42. This is a balanced input, transformer coupled by T1 and terminated by the parallel combination of R3 and R4. Zener diodes CR1 and CR2 protect the input from high voltage spikes on the line. U2A is an amplifier with a gain adjustable via R1 over the range of x 5.1 to x 0.1 to accommodate input levels from -26 dBm to 0 dBm. The amplifier output on U2A-1 is fed to the input of audio gate U6A, and the output of the audio gate is fed to the input of the compressor at R5. Gate U6A is ON (allows audio to pass) unless /TUNE is low, or /CW is low, or /ISB INH is low.

4.17.7.2 High-Level Dynamic Mic Input

The dynamic microphone input is P1-38. Components C43, L7 and C44 form an RF filter for the input. Capacitor C45 is a DC blocking capacitor and R56 is the input resistor for the dynamic mic input. Amplifier U2B has three different gain ranges depending on which microphone input is used. With reference to the dynamic mic input, the gain range is x 2 to x 23 adjustable via R58 Mic Input Adjust. The output of the amplifier, U2B-14 is fed to the input of audio gate U6B. This gate is ON (allows audio to pass) except when the /TUNE is low or /CW is low.

4.17.7.3 Low-Level Dynamic Mic Input

The other microphone input, P1-36 (Carbon/Dyn Mic) can be set via jumper JP1 to accommodate either a carbon or a low-level dynamic microphone. When JP1 is in the 2-3 position, the input

is set for a low-level dynamic. Components C47, L8, and C48 form an RF filter. C49 is a DC blocking cap and R59 is the amplifier input resistor. With reference to the low-level dynamic input, amplifier U2B has a gain range of x 20 to x 230 adjustable via R58 Mic Input Adjust.

4.17.7.4 Carbon Microphone Input

When JP1 is in the 1-2 position, P1-36 is configured as a Carbon Mic Input. DC current for the carbon element is provided by Q9 through R61. The purpose of Q9 is to provide a noise and ripple-free source of DC microphone current. Q9 provides the filtering action via the combination of R62 and C51, which filter the base voltage and thus the emitter voltage. With reference to the Carbon Mic Input, amplifier U2B has a gain range of x 0.5 to x 5.5 adjustable via R58 Mic Input Adjust.

4.17.7.5 Sidetone Output

Amplifier U2C provides a sidetone output which is designed to drive the earpiece of a handset. The amplifier input resistor, R65, is connected to U2B-14, the microphone amplifier output. The sidetone output level is adjustable via R67, Sidetone Level.

4.17.7.6 Center-Tap Key

An arrangement for keying the radio via a DC voltage on 600 ohm audio line is provided by Q10. This feature is furnished to comply with the TADIL-A high speed data specification. With JP2 in the 1-2 (Yes) position, a +6V DC level on the audio line input at P1-40 or P1-42 will turn on Q10 and pull P1-26 to ground. The jumper JP2 may be placed in 2-3 (No) position to disable this feature.

4.17.7.7 1 kHz Input Circuit

The 1kHz tone used to modulate the transmitter during CW operation is fed from P1-25 to the input of audio gate U6D through C54, a blocking capacitor. Resistors R70 and R71 bias the audio gate inputs to +4.5V for linear operation. Audio gates U6D and U6E are turned on and off together at U6D-3 and U6E-5. These gates are turned on only when /CW is low, /PTT is low, and /TUNE is high. (This occurs when the transmitter is in CW mode and is keyed.) The output of audio gate U6E is fed to the compressor input R6. Use of the compressor for the CW tone eliminates the need for a tone level adjustment. The CW sidetone output is taken from U6D-2 through C55 and R72. This output at P1-28 is fed to the Audio/Squelch board in the MSR 8050A to provide CW sidetone during transmit.

4.17.8 CONTROL CIRCUITS

This section describes the miscellaneous control circuits used on the Transmit Modulator board.

4.17.8.1 Internal Power Supplies

The +9V TX source generated by Q3 furnishes power to the LO amplifier Q5 and the DSB amplifier Q4. Q3 is a saturated transistor switch which is turned on when the /Tx line is low and turned off when the /Tx line is high. While most of the circuits on the board operate from the +9V supplied by the radio at P1-17 and P1-18, an on-board +5V regulator, U5, provides good stability of the low-level bias voltages. The +5V can be monitored at TP4. Three voltages are derived from the +5V at U5-2: The threshold voltage for the compressor, 4.66V, is derived with a voltage divider consisting R45, R44, and R43. This same voltage divider supplies the input voltage to U2D-5. U5D is a voltage follower providing +4.5V, which should really be thought of as an analog ground. This voltage is used as the threshold voltage for the digital inputs and can be monitored at TP3.

4.17.8.2 Compressor Control

The audio compressor can be disabled by either an external signal or jumper on the board. The disabled circuit is arranged so that by either method, the compressor is NOT disabled when /CW is low (in CW mode). This is because the limiter is needed to control the level of the 1 kHz signal applied to the modulator in CW mode. Comparator U4D is used for the disable function. When U4D-13 is low, the gate of FET Q1 is held to ground, disabling the compressor and allowing full gain from U1A. U4D-10 is normally held at +2V by R79 and R80. If jumper JP3 is placed in 1-2 (Out) position, or if /COMP, P1-34 is pulled lower than about +1.3V, U4D-13 goes low and

disables the compressor. If the /CW input is low however, U3D-8 will go high turning on Q11, which will pull U4D-10 low through CR25. Since CR25 is a Ge (0.2V drop) diode and CR23 and CR24 are Si (0.7V drop) diodes, U4D-10 can always go lower than U4D-10 can always go lower than U4D-13 can be pulled. This means that when /CW is low, U4D-13 cannot go low, and the compressor remains enabled.

4.17.8.3 /PTT, /TUNE, and /CW Control

The /PTT command from the front panel is routed to the board at P1-30. Components L9 and C57 form an RF filter. U3C is the /PTT comparator. Assume that the radio is in CW mode; /CW will be low and U3D-8 will be high which assures that CR22 is cut off. When the voltage on U3C-6 is pulled below +1.5V, U3C-7 goes high. This will turn off CR17 and allow U6D-3 and U6E-5 to rise and key on the 1 kHz tone. This will also turn off CR31 and allow the ACC voltage at Q7 and Q8 bases to rise at a rate determined by C67. The purpose of this is to control the rate-of-rise of the CW envelope and limit its overshoot. The /CW command is input at P1-37. The CW comparator is U3D. When the voltage at U3D-9 is lower than +1.5V, U3D-8 goes high, turning off CR22 and turning on Q11. The collector of Q11 goes low, which pulls U4D-10 low through CR25 and pulls U6B-6 and U6A-12 low through CR27 and CR28, respectively. This cuts off audio gates U6A and U6B, inhibiting audio inputs to the compressor. Because CR22 is cut off, a /PTT command will cause U6D-3 and U6E-5 to rise, keying on the 1kHz tone.

The purpose of the /TUNE command at P1-35 is to set the Tx Modulator board for coupler tuning; that is AM carrier only with no audio or 1kHz tone. When /TUNE goes low, it pulls the /MUTE line low via CR18 (this mutes receive audio). It also inhibits the 1kHz tone by pulling U6D-3 and U6E-5 low with CR19, and inhibits the audio by pulling U6A-12 and U6B-6 low with CR21 and CR20.

4.17.9 ALC CIRCUIT

The purpose of the ALC circuit is to keep the transmitted output constant regardless of changes in signal path gain, temperature or load. The ALC circuit is used for this purpose in Sideband, CW and A3A modes, while the ACC circuit located on the Half Octave Filter board is used to control the output level control when the radio is driving an external power amplifier, such as the MSR 1020 1KW Amplifier. The ALC system is a VOLTAGE ALC, that is feedback action holds the RF output voltage constant. This RF voltage is set to 79V so that when the transmitter is loaded with 50 ohms, 125W is produced. If the output load impedance is different from 50 ohm, a different amount of power will be produced, as the output voltage is held constant at 79V. A VSWR sensing circuit on the Half Octave Filter board cuts the output voltage to protect the Power Amplifier (PA) if too low or too high a load impedance is presented to the transmitter.

4.17.9.1 Internal ALC

The following description assumes that jumper JP4 is in 2-3 (New) position for use with a -002 or higher group number Half Octave Filter board. The 1-2 position of JP4 is for use only with a group -001 Half Octave board. The 1-2 position lowers the ALC loop gain to make the system less sensitive to variations in the ALC detector output on the group -001 boards.

The internal ALC circuit is enabled when /AMT is high, meaning that U4B-1 is high, and therefore CR15 is cut off. When /AMT is low, diodes CR15 and CR14 are both on, which disables both the internal and external ALC circuits. The ALC circuit takes its input from the ALC Detector located on the Half Octave Filter board. The detector generates a voltage which is proportional to the RF output voltage and applies it to P1-29. This voltage is set on the Half Octave Filter board to be +6.0V when the RF output is 79V. A reference voltage is applied to U3A-12 which is generated by R81 through R84.

During normal (not low power) operation, diode CR16 is off and the reference voltage is determined by the voltage divider made up of R81, R82 and R83. It is adjustable via R83, ALC threshold, and is set at 4.0V. The reason it is set at 4.0V and not 6.0V, is that the voltage divider made up of R36 and R37 cuts the 6.0V input from the ALC detector to 4.0V at U3A-13.

During low power operation, U4A-2 will be low turning CR16 on, effectively adding R84 in parallel with R83 and R82. The low power threshold will then be adjusted with R84 low power adjust. Note that since the adjust interact, R83 ALC threshold must be adjusted first.

When the ALC voltage at U3A-13 is lower than the reference voltage at U3A-12, there is no ALC action; U3A-14 is high, CR10 is off, CR11 is off and (assuming that the unit is keyed and CR31 is off) the voltage at Q7 and Q8 base is about +7V, determined by R30 and R31. (This also assumes that U3B-1 is high, meaning that the external ALC is not in use, that /Rx is high so that CR13 is cut off, and that the ACC circuit on the Half Octave Filter board does not have the ACC line, P1-21, pulled low.) This puts the TGC line, P1-19 and P1-20 at about +6.4V which insures no gain cut on the IF Filter board.

The transmit gain is determined by the voltage on the Transmit Gain Control (TGC) line. This is the way that the ALC amplifier controls the system RF output voltage. A TGC line voltage of +6V or more produces no gain cut, while +1V produces maximum gain cut. This gain control circuit is located on the IF Filter board.

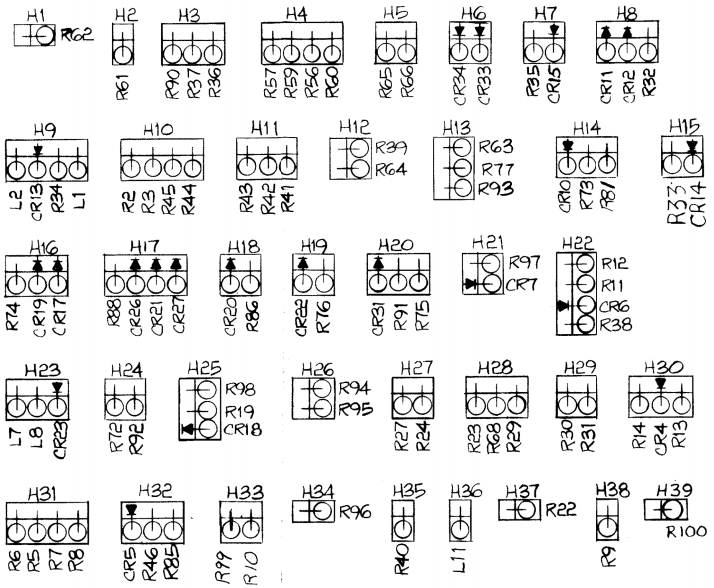
When the ALC voltage at U3A-13 exceeds the threshold voltage on U3A-12, U3A-14 drops in voltage causing the TGC voltage to drop at P1-19 and P1-20. This action cuts the transmit gain and thus the RF output voltage. Feedback action causes the TGC voltage to stabilize at some voltage between +6V and +1V or whatever is required to produce 79V RF output. Because the DC open loop gain of the ALC control loop is very high, the final RF output voltage depends only on the characteristics of the ALC detector; not on the gain of the transmit signal path. The response of the ALC ciruit is governed by components R36, R35 and C20, and R91 and C67. The dominant pole in the ALC feed-back system which governs loop stability is R36 x C20. A zero in the response is located at R35 x C20; this improves the transient response.

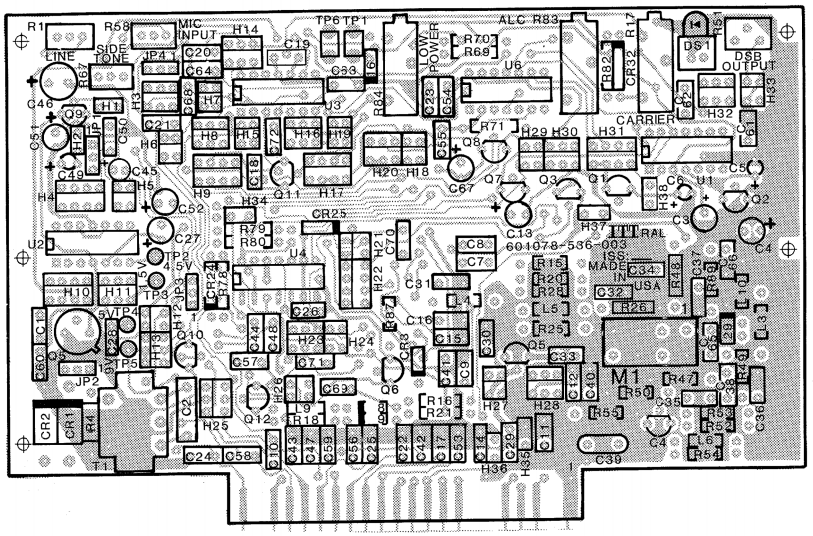
4.17.9.2 External ALC

The external ALC voltage is applied to P1-27, which is connected to the input resistor, R33 of the external ALC amplifier, U3B. U3B is biased so that with no voltage on P1-27, U3B-1 is high so that CR12 is cut off and out of the circuit. As the voltage is increased on the Ext. ALC lines, the voltage on U3B-1 goes lower and lowers the voltage on the TGC line, causing more gain cut in the transmit signal path. The gain of U3B is such that it takes about +3V on P1-27 to cause full gain cut in the radio.

4.17.10 ACC

The Automatic Carrier (ACC) circuit is responsible for controlling the transmitter output in AME mode. This circuit is located on the Half Octave Filter board, but uses Q7 and Q8 to control the TGC line voltage. The ACC line, P1-21, is the ACC circuit interface with the TX Modulator board. An open-collector output on the Half Octave board pulls this line low to control the transmit gain as necessary to control the output voltage.





Transmit Modulator (601078-536-003)

Figure 4.17-1

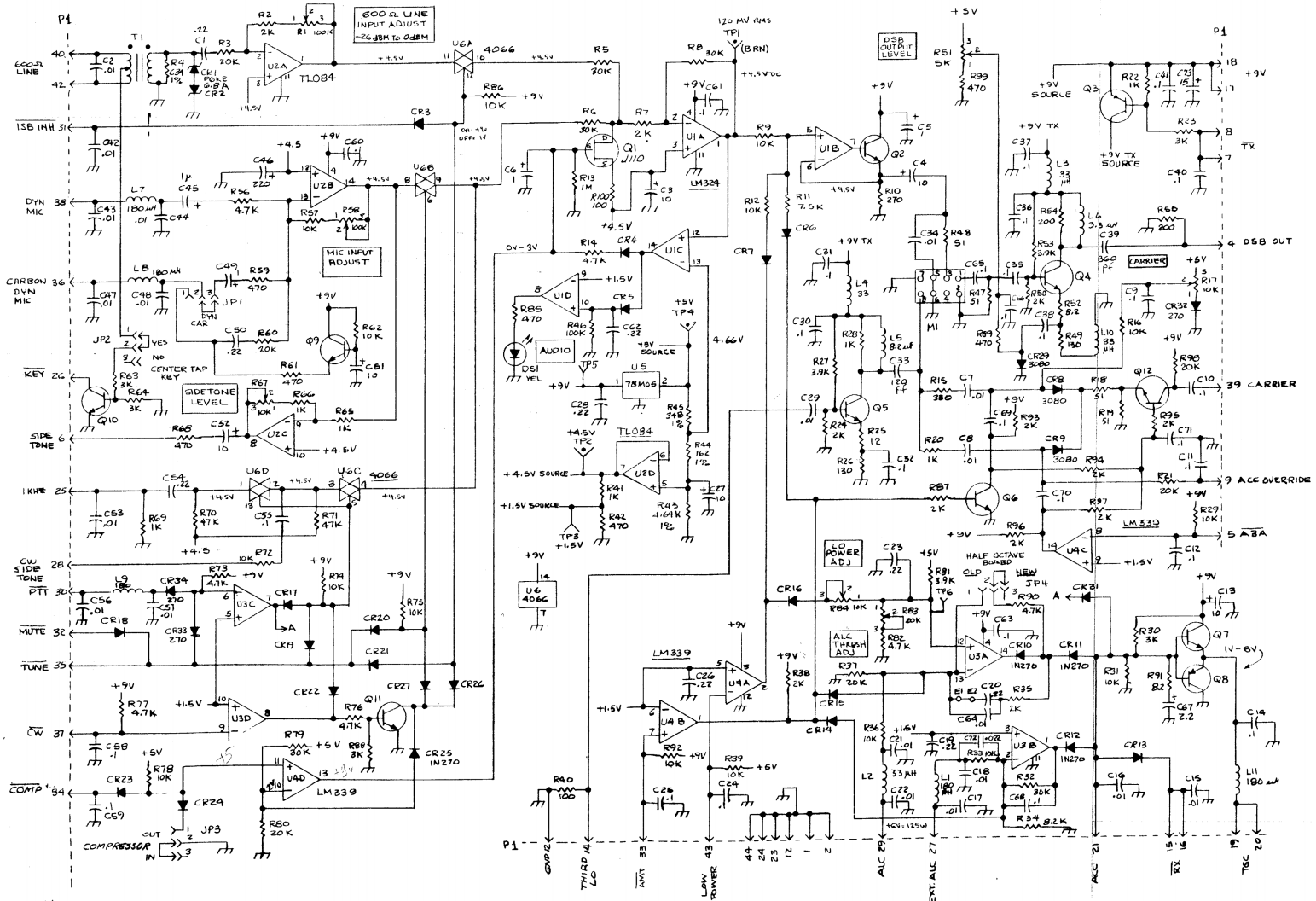
Transmit Modulator Board Assembly

PART NUMBER	DESCRIPTION	SYMBOL
600302-314-015	CAP. .22UF, MYLAR, 50V	C1,19,20 23,28,50 54,62
600204-314-001	CAP. .01UF, MYLAR, 400V	C2
600202-314-018	CAP. 10UF, 25V, TANT.	C3,4,13, 27,51,52
612003-306-501	CAP. 120PF, 3%, MICA, 500V	C33
636003-306-501	CAP. 360PF, 3%, MICA, 500V	C39
600297-314-037	CAP. 220UF, ALUM, 10V	C46
600202-314-007	CAP. 1UF, 35V, TANT.	C5,6, 45,49
600202-314-011	CAP. 2.2UF, 35V, TANT.	C67
600302-314-007	CAP. .01UF, MYLAR, 63V	C7,8, 15-18, 21,22,29 34,42-44 47,48,53 56,57,64
600302-314-009	CAP. .022UF, MYLAR, 63V	C72
600202-314-020	CAP. 15UF, 20V, TANT.	C73
600302-314-013	CAP. .1UF, MYLAR, 50V	C9-12,14 24,25, 30-32 35-38 40,41,55 58-61 63,65,66, 68,71

PART NUMBER	DESCRIPTION	SYMBOL
600028-411-001	DIODE, VOLT.SUPRESSOR P6KE6,8A	CR1,2
600052-410-001	DIODE IN270	CR10-12, 25,32-34
600109-410-001	DIODE IN4148	CR3-7, 13-24,26 27,31
600156-410-001	DIODE HP3080	CR8,9,29
600043-390-002	LED, YEL	DS1
600005-635-001	LED MOUNT	(DS1)
600064-419-005	1 POSITION VERTICAL MT	H1,2, 34-39
600064-419-003	3 POSITION VERTICAL MT	H23,25, 28,30,32
600064-419-004	2 POSITION VERTICAL MT	H24,26, 27,29,33
600064-419-003	3 POSITION VERTICAL MT	H3,8,11, 13,14 16,20
600064-419-001	4 POSITION VERTICAL MT	H4,9,10, 17,22,31
600064-419-004	2 POSITION VERTICAL MT	H5-7,12, 15,18 19,21
600198-608-005	CONN. HEADER, 3 PIN, TIN	JP1-4
600190-608-001	CONN, JUMPER, 2 POS.	(JP1-4)
600125-376-022	CHOKE 180UH	L1,7, 8,9,11
600125-376-007	CHOKE 33UH	L2-4, 10
600125-376-034	CHOKE 8.2UH	L5
600125-376-006	CHOKE 3.3UH	L6
600008-455-001	MIXER SLB-1	M1
600349-413-001	TRANSISTOR J 110, JFET	Q1

PART NUMBER	DESCRIPTION	SYMBOL
600229-413-003	TRANSISTOR 2N3904 TO-92	Q2,4-7 9-12
600116-413-002	TRANS, 2N3906	Q3,8
600089-360-014	POT. 100K, 1/2W, CERMET, RT/AN	R1,58
627004-341-075	RES. 270, 1/4W, 5%	R10
675014-341-075	RES. 7.5K, 1/4W, 5%	R11
610044-341-075	RES. 1M, 1/4W, 5%	R13
647014-341-075	RES. 4.7K, 1/4W, 5%	R14,55, 73,76 77,82,90
633004-341-075	RES. 330, 1/4W, 5%	R15
600063-360-010	POT. 10K, 15 TURN	R17,84
651094-341-075	RES. 51, 1/4W, 5%	R18,19, 47,48
620014-341-075	RES. 2K, 1/4W, 5%	R2,7,24, 35,38,50 87,93-97
610014-341-075	RES. 1K, 1/4W, 5%	R20,22, 28,41 65,66,69
630014-341-075	RES. 3K, 1/4W, 5%	R23,30,63 64,88
612094-341-075	RES. 12, 1/4W, 5%	R25
613004-341-075	RES. 130, 1/4W, 5%	R26,49
639014-341-075	RES. 3.9K, 1/4W, 5%	R27,51,81
620024-341-075	RES. 20K, 1/4W, 5%	R3,21,37 60,80,98
682014-341-075	RES. 8.2K, 1/4W, 5%	R34
663401-342-059	RES. 634, 1/8W, 1%	R4
610004-341-075	RES. 100, 1/4W, 5%	R40,100
647004-341-075	RES. 470, 1/4W, 5%	R42,59, 61,68,85 89,99

PART NUMBER	DESCRIPTION	SYMBOL
646411-342-059	RES. 4.64K, 1/8W, 1%	R43
616201-342-059	RES. 162, 1/8W, 1%	R44
634801-342-059	RES. 348, 1/8W, 1%	R45
610034-341-075	RES. 100K, 1/4W, 5%	R46
630024-341-075	RES. 30K, 1/4W, 5%	R5,6, 8,32,79
600066-360-009	POT. 5K, 1/2W, CERMET, RT/AN	R51
682084-341-075	RES. 8.2, 1/4W, 5%	R52,91
620004-341-075	RES. 200, 1/4W, 5%	R54,55
600089-360-010	POT. 10K, 1/2W, CERMET, RT/AN	R67
647024-341-075	RES. 47K, 1/4W, 5%	R70,71
600063-360-011	POT. 20K, 15 TURN	R83
610024-341-075	RES. 10K, 1/4W, 5%	R9,12, 16,29 31,33,36 39,57,62 72,74,75 78,86,92
635234-501-001	TRANSFORMER, 600 OHM, AUDIO	T1
600114-611-001	BROWN TEST POINT	TP1
600261-230-001	TERMINAL	TP2-5
600114-611-006	TEST JACK	TP6
600171-415-001	IC LM324, OP AMP, 741 QUAD	U1,3
600485-415-002	IC TL084, OP AMP, QUAD	U2
600324-415-001	IC LM339, COMPARATOR	U4
600331-415-001	IC 78M05, 5V REG	U5
600186-415-101	IC 4066BDC, CMOS BIL SW, QUAD	U6
600017-419-001	TRANSISTOR PAD	(U5)



NOTES:

1. RESISTORS ARE ¼W 5% UNLESS OTHERWISE NOTED.
   UNMARKED DIODES ARE 1N4148
   NPN TRANSISTORS ARE 2N3904
   PNP TRANSISTORS ARE 2N3906
   CAPACITORS IN MICROFARADS

Figure 4.17-2

Transmit Modulator Board Schematic

TRANSMIT MODULATOR BOARD, A9, A10

PIN CONNECTIONS AND VOLTAGE READINGS

A9P1, A10P1

GND	1	2	GND	
	3	4	DSB OUTPUT 0 dBm (5 MHz)	
LOGIC "0" OR 1 $\overline{\text{A3A}}$	5	6	SIDETONE (AUDIO - 20 dBm)	
LOGIC "0" OR 1 $\overline{\text{TX}}$	7	8	$\overline{\text{TX}}$ LOGIC "0" OR 1	
0 - +4 VDC ACC OVERRIDE	9	10		
	11	12	GND	
	13	14	LO 3 - 15 dBm (5 MHz)	
LOGIC "0" OR 1 $\overline{\text{RX}}$	15	16	$\overline{\text{RX}}$ LOGIC "0" OR 1	
+8.9 - 9.1 VDC +9V	17	18	+9V +8.9 - 9.1 VDC	
1 TO 6 VDC TGC	19	20	TGC 1 TO 6 VDC	
0 - +6 VDC ACC IN	21	22		
GND	23	24	GND	
.46 VRMS 1 kHz OUT	25	26	$\overline{\text{KEY}}$	
0 - +9 VDC (T) EXT. ALC IN	27	28	SIDETONE	
0 - +9 VDC (T) ALC IN	29	30	$\overline{\text{PTT}}$ LOGIC "0" OR 1	
LOGIC "0" OR 1 ISB INH	31	32	$\overline{\text{MUTE}}$ LOGIC "0" OR 1	
LOGIC "0" OR 1 $\overline{\text{TX}}$ $\overline{\text{(AM)}}$	33	34	$\overline{\text{COMP}}$	
LOGIC "0" OR 1 $\overline{\text{TUNE}}$	35	36	CARBON MIC. INPUT .15-2.0 VRMS	
LOGIC "0" OR 1 CW	37	38	DYNAMIC MIC. INPUT .007-.1 VRMS	
-25 - -18 dBm (5MHz) carrier insert	39	40	600 OHM AUDIO IN -10 dBm	
	41	42	BAL. XFMR RETURN FOR PIN 40	
LOGIC "0" OR 1 LOW PWR	43	44	GND	

4.18 COUPLER INTERFACE BD, A13

The Coupler Interface board performs two basic transmitter functions: control of transmitter keying and control of a system antenna coupler.

4.18.1 Keying Inputs and Outputs

This section lists the various keying inputs and outputs, along with the restrictions governing their use.

PIN 20 $\overline{\text{TONE KEY}}$ - A low signal at this input will key the transmitter under all conditions. This pin is connected to the TONE KEY output of the optional Tone Key/Modem board.

PIN 16 $\overline{\text{EXT KEY}}$ - This input from the radio's rear panel will also key the transmitter whenever it is pulled low.

PIN 18 $\overline{\text{FSK KEY}}$ - This rear panel input will key the transmitter only if the radio is in the FSK mode, with Pin 35, $\overline{\text{FSK}}$, low.

PIN 28 $\overline{\text{CW KEY}}$ - This front panel input will key the exciter only when the radio is in the CW mode, with Pin 39, $\overline{\text{CW}}$, low, and Pin 32, REM, low.

PIN 14 $\overline{\text{PTT}}$ - Another front panel input, a low at pin 14 keys the exciter in any mode unless Pin 32, REM is high.

PIN 32 REM - This controlling input is high whenever the radio is being remotely controlled. This high signal disables the $\overline{\text{CW KEY}}$ and $\overline{\text{PTT}}$ inputs.

PIN 22 µP KEY - This input comes directly from the microprocessor and keys the transmitter whenever it is high.

PIN 8 $\overline{\text{KEY ENABLE}}$ - This input comes from the system coupler and keys the transmitter during an RF tune cycle. A low at this input keys the exciter only while an RF tune cycle is being commanded by a high signal at Pin 33, Tune B.

The following pins are transmitter keying outputs:

PIN 25 $\overline{\text{TX1}}$ - This is the basic keying output which puts all radio signal path boards into the transmit mode. This output also controls the front panel TX LED. $\overline{\text{TX1}}$ is an open collector output which goes low to key.

PIN 36 $\overline{\text{TX2}}$ - This open collector output is used to key external equipment connected to the radio.

PIN 37 $\overline{\text{TX3}}$ - This keying output is similar to $\overline{\text{TX1}}$ and $\overline{\text{TX2}}$ with the exception that is not disabled by the TX INHIBIT circuitry. $\overline{\text{TX3}}$ is used to control the coupler bypass circuitry, disabling the bypass relay whenever the transmitter is keyed.

PIN 24 $\overline{\text{AUDIO KEY}}$ - This keying output differs from TX1 in that it is not affected by any CW delay. It is used to control transmitter modulation in the CW mode.

PIN 17 $\overline{\text{AMT}}$ - This output is low when the transmitter is keyed while in the AME mode (pin 19 low).

The following inputs all inhibit transmitter keying. When active, the TX INHIBIT LED will light and the corresponding test point (TP1 through TP4) will be low.

PIN 11 KEY INTERLOCK - This input is used by the antenna coupler to ensure that the transmitter will not be keyed at any time that the coupler is vulnerable to damage. Keying is inhibited unless this input is pulled low. If no antenna coupler is in the system, a grounding plug must be connected to the radio's accessory connector. The grounding plug shorts pin 11 to ground so that the transmitter can be keyed.

PIN 38 $\overline{\text{LL}}$ - This inhibiting input goes low whenever a Loss of Lock is experienced by the synthesizer. This prevents transmitter keying unless the transmitter is locked onto a valid frequency.

PIN 29 $\overline{\text{TX INHIBIT}}$ - This input is used by the microprocesser to prevent keying at any time that the software decides that keying is inappropriate. For example, keying is inhibited while changing modes or during a silent tune cycle.

PIN 34 $\overline{\text{PS FAULT}}$ - This inhibiting input from the power supply prevents keying whenever the power supply is disabled.

4.18.2 Keying Control Circuit Description

When any of the keying inputs (other than the coupler KEY ENABLE input) commands the transmitter to key and all restrictions particular to that input are met. U1-8 will be high. This will bring the AUDIO KEY output low. U10A and associated components provide available CW delay when the radio is in the CW mode. A high at U3-2 prolongs the duration of the transmit time whenever the radio is keyed in CW.

Keying can be prevented by a high at U3-11 or U6-6. U3-11 is high during an RF tune cycle. See 4.18.3 for further information. U6-6 is high if any of the inhibit inputs are active (pins 29, 34, 38 low, pin 11 high). The corresponding test point (TP1-TP4) will be low and the TX INHIBIT LED, DS1 will be lit.

If neither of these signals are high, a keying input causes TX1, TX2, and TX3 to be low. Note that TX3 is not affected by the TX inhibit signals. TX3 does not key the exciter; it is used to turn off the coupler bypass relay during transmitter keying.

4.18.3 Coupler Control Circuit Description

Inverter-drivers U13A, U12C, U14D, U14C and U14B interpret coupler control inputs even if excessive line loss is experienced because of long coupler control lines.

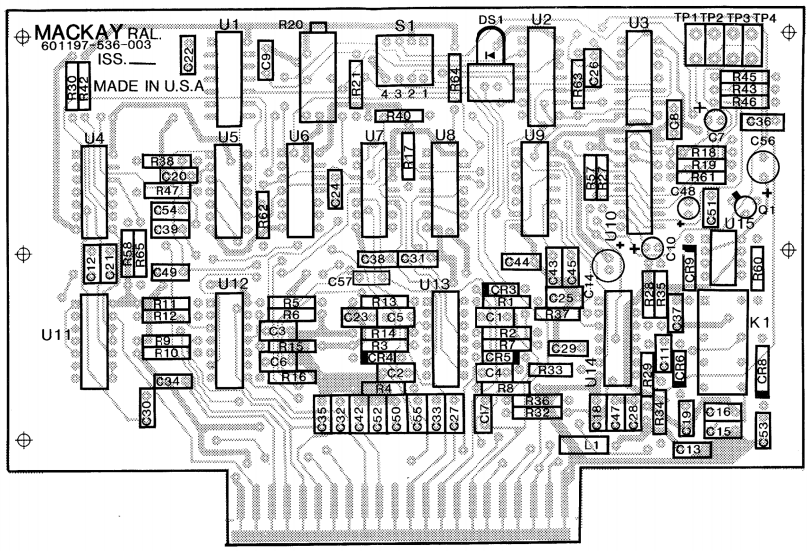
The TUNING line, pin 10, is low while the antenna coupler is tuning. If S1-3 is closed, this provides a high at pin 7, BEEP. This line commands the radio to create a pulsing audio signal during a coupler tune cycle.

VSWR RETUNE is an optional coupler feature which provides for an automatic RF tune whenever a VSWR fault is experienced by the antenna coupler or an LPA in the system. The antenna coupler or LPA requests the tune cycle by momentarily pulling the TUNING input at pin 10 low while the coupler is not in a tune cycle. U10B prolongs the duration of this momentary low on Pin 10 to a longer pulse that can be detected by the microprocessor at pin 31. If the VSWR RETUNE feature is not desired, S1-2 is left open, deactivating U10-B **NOTE: Selection of the VSWR RETUNE feature requires the closure of the VSWR RETUNE coupler option switch located elsewhere in the radio.**

Coupler tune commands from the microprocessor are TUNE B at pin 33 for an RF tune and SILENT B at pin 26 for a silent tune. These commands are inverted by the open collector gates U8D and U8E, and leave the board at pin 15, TUNE and pin 9, SIL TUNE.

U15 and K1 prevent these coupler tune commands from being sent to the coupler before the radio has been turned on long enough to clear any transient pulses.

While an RF tune cycle is commanded by a high at pin 33, U3-11 is high, which disables all keying inputs except the coupler keying input KEY ENABLE. The coupler pulls this signal low when it needs an RF signal to determine correct tuning element settings.



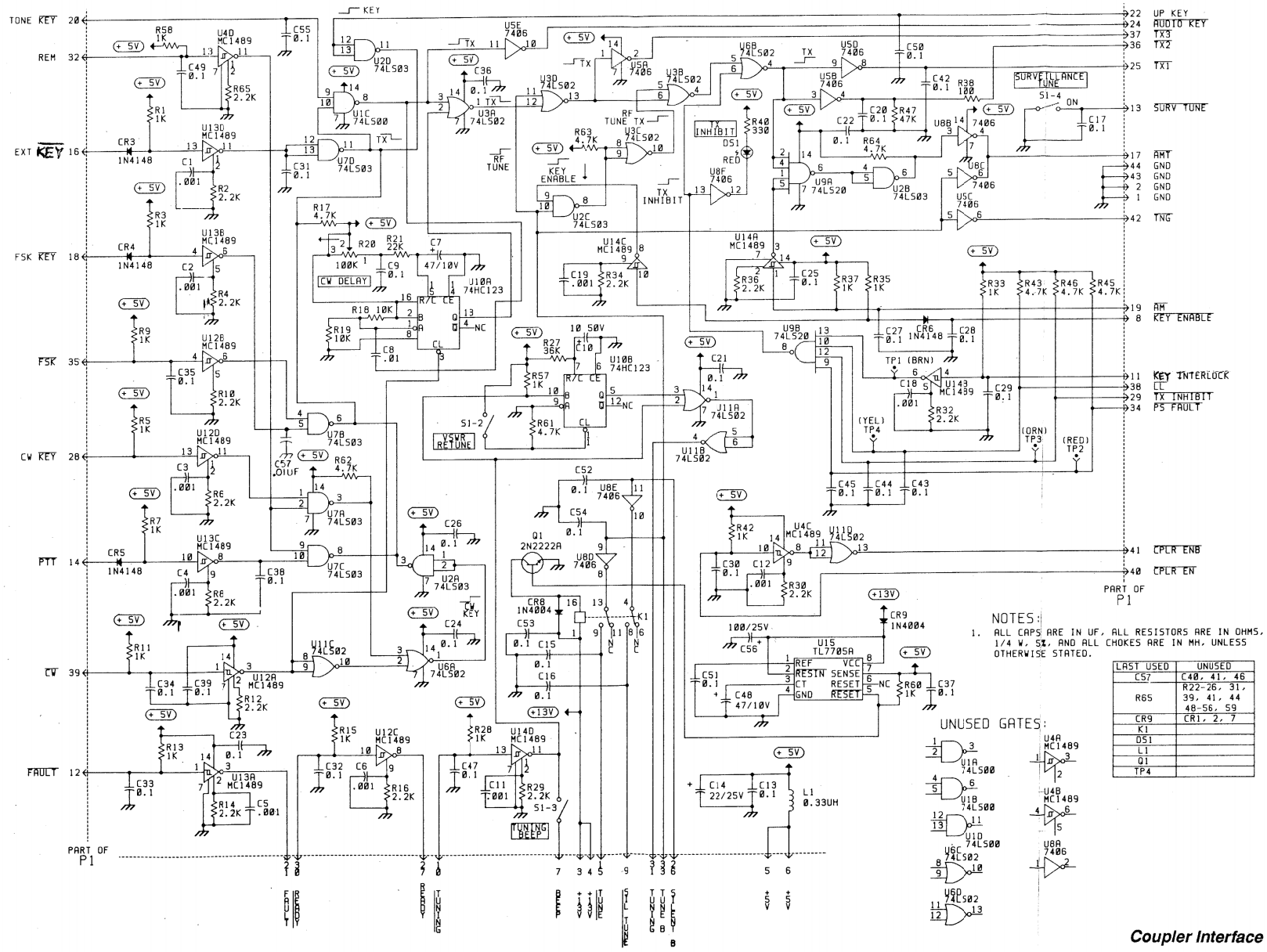
Coupler Interface (601197-536-003)

PART NUMBER	DESCRIPTION	SYMBOL
600302-314-001	CAP. .001UF, MYLAR, 63V	C1-6 11,12 18,19
600297-314-013	CAP. 10UF, ALUM, 50V	C10
600297-314-016	CAP. 22UF, ALUM, 25V	C14
600302-314-013	CAP. .1UF, MYLAR, 50V	C9,13, 15-17, 20-39, 42-45, 47,49-55
600297-314-032	CAP. 100UF, ALUM, 25V	C56
600297-314-024	CAP. 47UF, ALUM, 10V	C7,48
600302-314-007	CAP. .01UF, MYLAR, 63V	C8,57
600109-410-001	DIODE IN4148	CR3-6
600011-416-002	DIODE IN4004	CR8,9
600036-390-001	LED, RED	DS1
600005-635-001	LED MOUNT	(DS1)
600073-403-003	RELAY, DPDT, 5V	K1
600125-376-001	CHOKE .33UH	L1
600080-413-001	TRANSISTOR 2N2222A	Q1
610014-341-075	RES. 1K, 1/4W, 5%	R1,3,5, 7,9,11 13,15,28 33,35,37 42,57,58 60
647014-341-075	RES. 4.7K, 1/4W, 5%	R17,43, 45,46 61-64
610024-341-075	RES. 10K, 1/4W, 5%	R18,19
622014-341-075	RES. 2.2K, 1/4W, 5%	R2,4,6, 8,10,12 14,16,29 30,32,34 36,65

PART NUMBER	DESCRIPTION	SYMBOL
600063-360-014	POT. 100K, 15 TURN	R20
622024-341-075	RES. 22K, 1/4W, 5%	R21
636024-341-075	RES. 36K, 1/4W, 5%	R27
610004-341-075	RES. 100, 1/4W, 5%	R38
633004-341-075	RES. 330, 1/4W, 5%	R40
647024-341-075	RES. 47K, 1/4W, 5%	R47
622014-341-075	RES. 2.2K, 1/4W, 5%	R44
600264-616-001	SWITCH, DIP, 4 POS.	S1
600114-611-001	BROWN TEST POINT	TP1
600114-611-002	RED TEST POINT	TP2
600114-611-003	ORANGE TEST POINT	TP3
600114-611-004	YELLOW TEST POINT	TP4
600114-415-001	IC 74LS00, NAND, QUAD 2-IN	U1
600326-415-001	IC 74LS123, MULTVBR, RTRG	U10
700123-415-001	I.C. TL7705A	U15 (+5v Super-visor)
600239-415-001	IC 74LS03, NAND, O/C, 2-IN	U2,7
600118-415-001	IC 74LS02, NOR QUAD 2-IN	U3,6,11
600415-415-001	IC 1489, LNRCVR, QUAD	U4,12, 13,14
600016-415-001	IC 7406, HEX INV. ,O/C	U5,8
600158-415-001	IC 74LS20, NAND DUAL 4-IN	U9

Figure 4.18-1

Coupler Interface Board Assembly



LAST USED	UNUSED
C57	C40, 41, 46
R65	R22-26, 31, 39, 41, 44 48-56, 59
CR9	CR1, 2, 7
K1	
DS1	
L1	
Q1	
TP4	

Figure 4.18-2

Coupler Interface Board Schematic

PIN CONNECTIONS AND VOLTAGE READINGS

A13P1

		GND	1	2	GND		
		+13 VDC	3	4	+13 VDC		
		+5 VDC	5	6	+5V DC		
LOGIC "Ø" OR "1"	BEEP		7	8	KEY ENABLE	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	SIL TUNE		9	10	TUNING	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	KEY INTERLOCK		11	12	FAULT	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	SURV TUNE		13	14	PTT	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	TUNE		15	16	EXT. PTT	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	AMT		17	18	FSK KEY	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	AM		19	20	TONE KEY	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	FAULT		21	22	UP KEY	LOGIC "Ø" OR "1"	
			23	24	AUDIO KEY	LOGIC "Ø" OR "1"	
			25	26	SILENT B	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	READY		27	28	CW KEY	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	TX INHIBIT		29	30	READY	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	TUNING		31	32	REM	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	TUNE B		33	34	PS FAULT	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	FSK		35	36	TX2	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	TX3		37	38	LL	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	CW		39	40	CPLR EN	LOGIC "Ø" OR "1"	
LOGIC "Ø" OR "1"	CPLR EN B		41	42	TNG	LOGIC "Ø" OR "1"	
	GND		43	44	GND		

4.19 SYNTHESIZER BOARDS

This section electrically groups the synthesizer boards which produce the three local oscillator signals for frequency translation. Included are the Reference board A19, the Minor Loop board, A18, the Translator Loop board A17 and the Major Loop board A16. The third LO is normally a fixed five MHz signal from the Reference board. With the BFO option in the MSR 5050A receiver, the third LO is obtained from the optional BFO board. Figure 4.19-1 is a block diagram showing the interconnections and major functions within the boards.

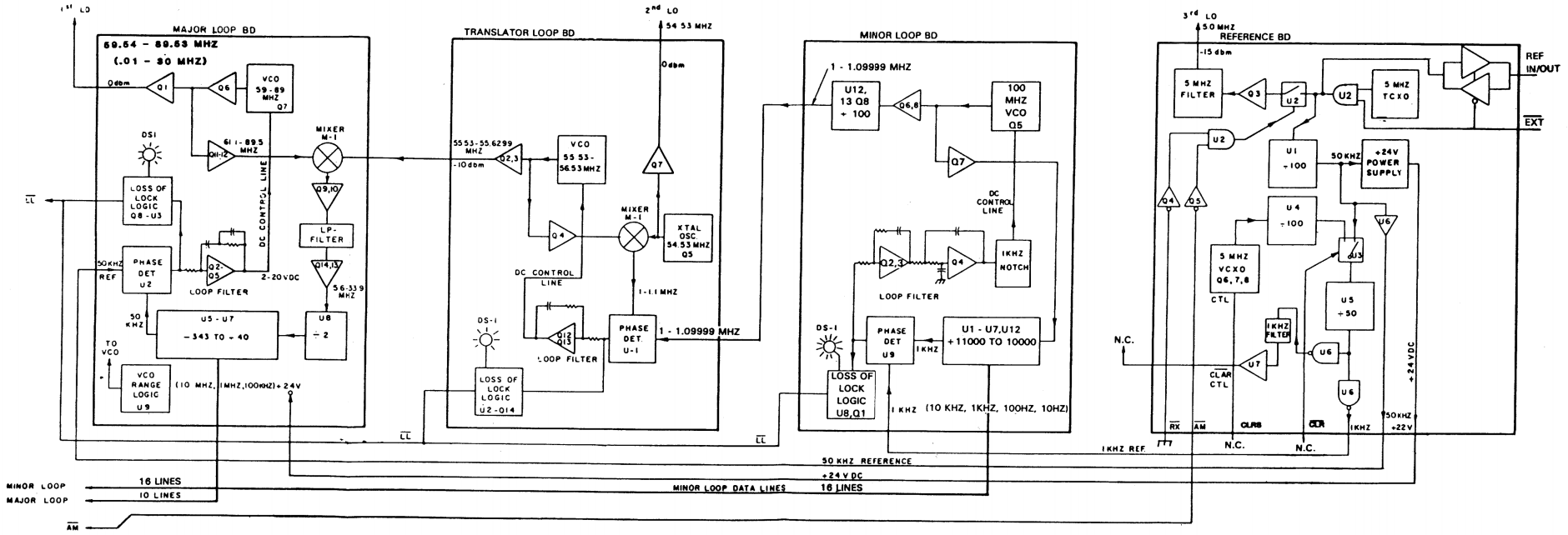


Figure 4.19-1

Synthesizer Block Diagram

4.19.1 REFERENCE BOARD

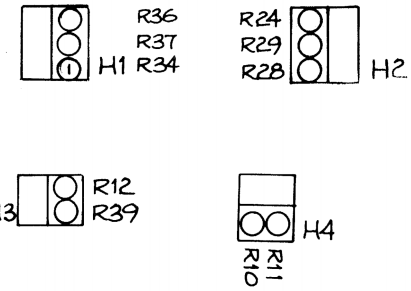
The Reference board contains the 5 MHz temperature compensated crystal oscillator (TCXO), from which are derived the 50 kHz reference for the major loop, the 1 kHz reference for the minor loop, the 1 kHz CW tone and the 5 MHz third LO signal. This board also contains the clarifier oscillator and a +24 volt bias supply for the major loop.

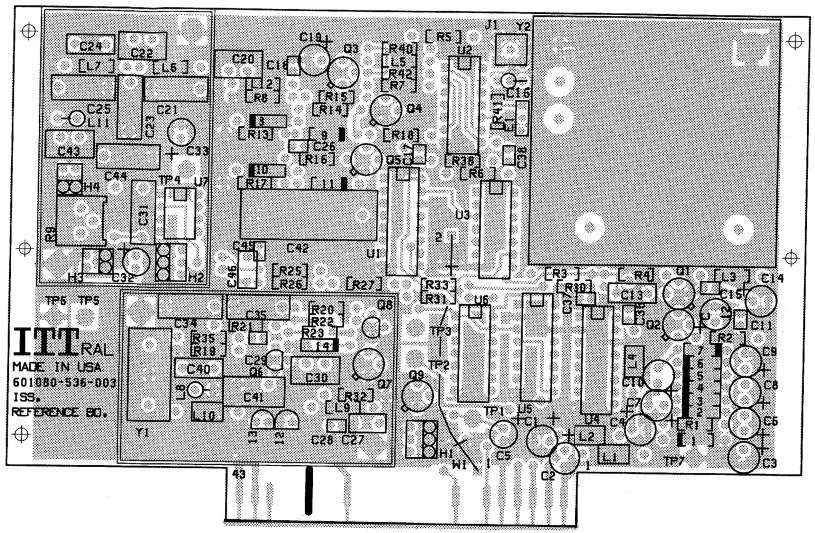
The TCXO output is connected to a coax connector J1 via a jumper and then to a nand gate buffer. With a high stability oven controlled oscillator (OCXO) installed in the radio, the jumper is removed and OCXO output replaces the TCXO signal via connector J1. Tristate buffers (U3) allow an external (rear panel) reference signal to be input to U2 pin 1 or allows the internal reference (either TCXO or OCXO) to be output via P9-12 depending on the $\overline{\text{EXT}}$ TTL input to P9-14 (from rear panel switch). Conditioned to accept an external reference, the internal signal at U2-10 is disabled by the TTL low at U2-9.

From U2 pin 8, the 5 MHz splits into two paths. One goes to the third LO switch, pin 1 of U2. The other goes to U1, a dual decade counter, which is connected to divide-by-100. The output of U1 on pin 3 is buffered by U6 pin 8, to become the 50 kHz reference signal to the Major Loop board. The 50 kHz signal also drives the voltage multiplier from U6 pin 10. Transistors Q1 and Q2 are high current drivers which drive the voltage multiplier with a 50 kHz square wave of approximately 11.5 volts peak-to-peak amplitude. Diodes CR2 through CR6 and associated capacitors form a voltage multiplier. The output is regulated to +24 volts at TP1 by zener CR1, and is designed to supply approximately 2 mA to the Major Loop board.

The $\overline{\text{AM}}$ and $\overline{\text{RX}}$ lines are buffered and inverted by Q4, Q5 and associated circuitry, and routed to pins 4 and 5 of U2. If the radio is in AM receive, the $\overline{\text{AM}}$ and $\overline{\text{RX}}$ lines will both be low, so pins 4 and 5 of U2 will both be high. This drives pin 6 (U2) low, which makes pin 3 high, inhibiting the third LO output. Transistor Q3 is an emitter-follower which drives the third LO output through a harmonic filter made up of L12, L6, L7, L11 and associated capacitors. The third LO output level is adjustable with R9. The output level is normally set to 0 dBm (.225 volts RMS).

The clarifier (not used in some radios) shifts the receive frequency by substituting a variable 1 kHz reference for the fixed 1 kHz, which normally supplies the minor loop. The clarifier oscillator, Q6, is a Colpitts configuration crystal oscillator whose operating frequency is determined principally by Y1, L10 and varicaps CR13 and CR12. The CLARIFIER control on the front panel varies the bias on the varicaps from 0 volts to +9 volts. This causes the frequency of the nominally 5 MHz oscillator to shift at least ± 1250 Hz. The output is buffered by Q7, which drives U4, a dual decade counter which is connected to divide by 100 and gives a 50 kHz output at pin 9. The clarifier will be ON only if the RX line is low and CLRS (clarifier switch) line is low. If this is true, U2 pins 13 and 12 will be high, pin 11 will be low. This disables the pin 11 gate of U3. Since pin 3 is high, Q8 is turned on, which enables the clarifier oscillator. The 50 kHz at U3 pin 8, is now being supplied by the clarifier oscillator rather than the TCXO. U5 is connected to divide by 50 to produce 1 kHz at its output, pin 3. When the clarifier is on, the 1 kHz at TP3 will vary at least ± 0.25 kHz with the clarifier control setting. The 1 kHz reference signal to the minor loop is provided by U6 pin 6. U6 pin 3 drives a three section RC filter which converts the square wave at pin 3 into a sine wave at R25. The lower amplifier of U7 is simply a voltage follower used to bias the upper half output at one half of the supply voltage. Pin 1 of U7 provides the 1 kHz tone output. Additional filtering of the signal is provided by C31 and R24. The frequency of the TCXO Y2 can be adjusted by first removing the access screw on the cover. A small screwdriver may be then used to adjust the frequency.





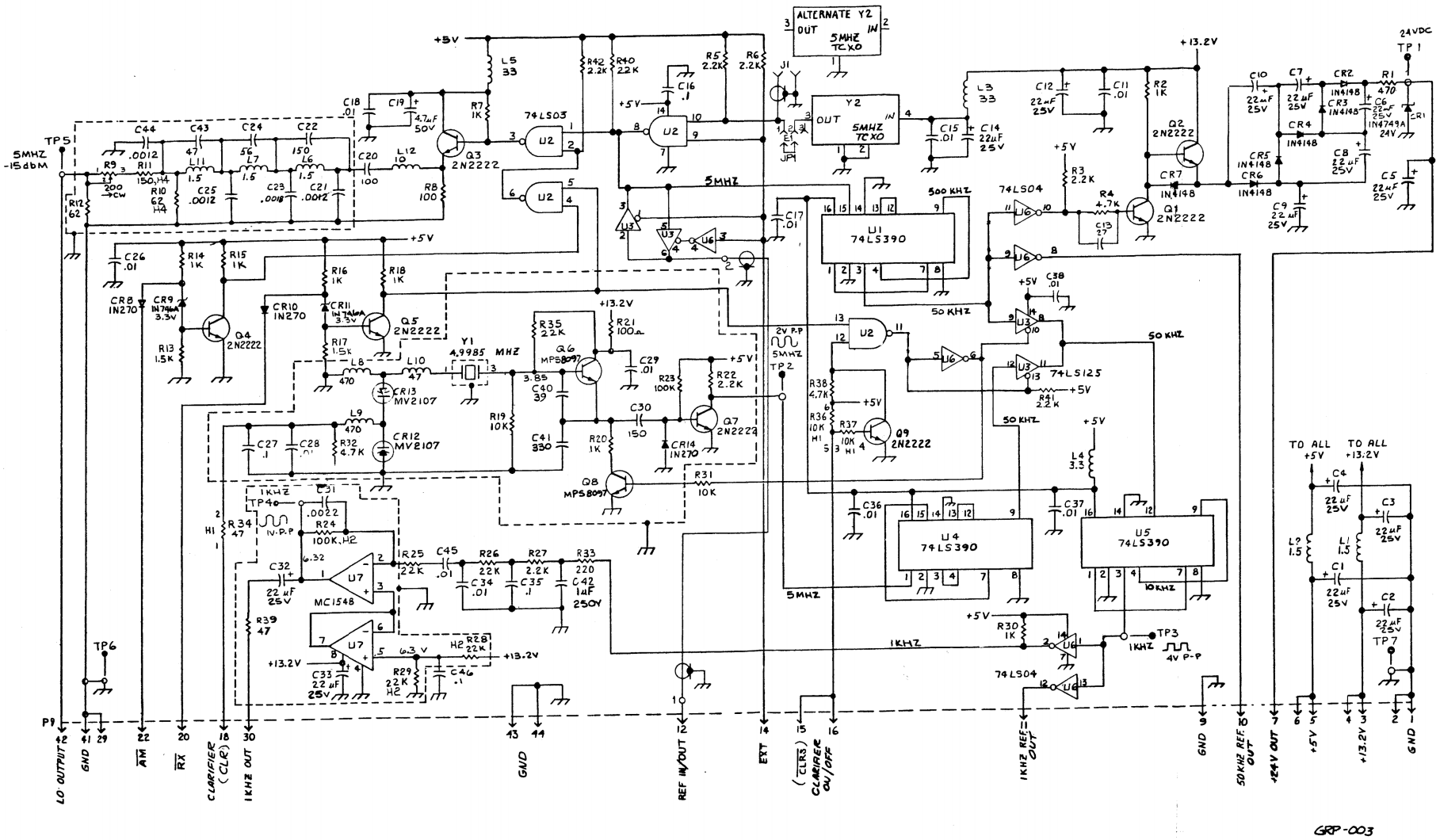
Reference (601080-536-003)

PART NUMBER	DESCRIPTION	SYMBOL
600297-314-016	CAP. 22UF, ALUM, 25V	C1-10,12 14,32,33
600268-314-008	CAP. .01UF, CERAMIC, 50V	C11, 15-18 26,28
600269-314-016	CAP. 27PF, CERAMIC, 500V	C13
600297-314-010	CAP. 4.7UF, ALUM, 50V	C19
610003-306-501	CAP. 100PF, 3%, MICA, 500V	C20
600204-314-039	CAP. .0012UF, MYLAR, 630V	C21, 24,44
615003-306-501	CAP. 150PF, 3%, MICA, 500V	C22,30
600204-314-041	CAP. .0018UF, MYLAR, 630V	C23
600269-314-024	CAP. 56PF, CERAMIC, 100V	C24
600226-314-008	CAP. .1UF, CERAMIC, 50V	C27,46
600204-314-029	CAP. .0022UF, MYLAR, 1KV	C31
600204-314-001	CAP. .01UF, MYLAR, 400V	C34
600204-314-020	CAP. 0.1UF, MYLAR, 100V	C35
600269-314-020	CAP. 39PF, CERAMIC, 100V	C40
633003-306-501	CAP. 330PF, 3%, MICA, 500V	C41
600204-314-008	CAP. 1UF, MYLAR, 250V	C42
647093-306-501	CAP. 47PF, 3%, MICA, 500V	C43
600006-411-052	DIODE IN4749A 24V	CR1
600123-410-004	DIODE, VARACTOR, MV2107	CR12,13
600109-410-001	DIODE IN4148	CR2-7,15
600052-410-001	DIODE IN270	CR8,10, 14
600002-411-001	DIODE, ZENER, 1N746A	CR9,11
600198-608-002	CONN. HEADER, 3 PIN, GOLD	E1
600064-419-003	3 POS. VERTICAL MT	H1,2

PART NUMBER	DESCRIPTION	SYMBOL
600064-419-004	2 POS. VERTICAL MT	H3,4
600198-606-002	CONN. MALE MIN. RF, PC MOUNT	J1
600190-608-001	CONN, JUMPER, 2 POS.	JP1
600125-376-033	CHOKE 1.5 UH	L1,2,6, 7,11
600072-376-033	CHOKE 47UH	L10
600125-376-032	CHOKE 10UH	L12
600125-376-007	CHOKE 33UH	L3,5
600125-376-006	CHOKE 3.3UH	L4
600125-376-015	CHOKE 470UH	L8,9
600080-413-001	TRANSISTOR 2N2222A	Q1-5, 7,9
600025-419-001	TRANSISTOR PAD	(Q1-9)
600278-413-001	TRANSISTOR MPS8097	Q6,8
647004-341-075	RES. 470, 1/4W, 5%	R1
662094-341-075	RES. 62, 1/4W, 5%	R10,12
615004-341-075	RES. 150, 1/4W, 5%	R11
615014-341-075	RES. 1.5K, 1/4W, 5%	R13,17
610024-341-075	RES. 10K, 1/4W, 5%	R19,31, 36,37
610014-341-075	RES. 1K, 1/4W, 5%	R2,7, 14-16, 18,20,30
610034-341-075	RES. 100K, 1/4W, 5%	R23,24
622024-341-075	RES. 22K, 1/4W, 5%	R25,26, 28,29,35
622014-341-075	RES. 2.2K, 1/4W, 5%	R3,5,6, 22,27, 40-42
622004-341-075	RES. 220, 1/4W, 5%	R33
647094-341-075	RES. 47, 1/4W, 5%	R34,39
647014-341-075	RES. 4.7K, 1/4W, 5%	R4,32,38
610004-341-075	RES. 100, 1/4W, 5%	R8,21
600072-360-005	POT. 200, 1/2W, CERMET, TOP	R9
600535-415-001	IC 74LS390, 2 DEC RIP CNTR	U1,4,5
600239-415-001	IC 74LS03, NAND, O/C, 2-IN	U2
600274-415-001	IC 74LS125, BUFFER 3-ST	U3
600111-415-001	IC 74LS04, HEX INV	U6
600039-415-002	IC SN72558P	U7
600123-378-002	CRYSTAL, 4.99850 MHZ	Y1
600167-378-001	TCXO, 5MHZ	Y2

Figure 4.19-2

Reference Board Assembly



LAST DESIG. USED
R42, C44, CR15, L12, U7 Q9, Y2, TP7, J1, JP1, E1
DELETED
C39

NOTES:
1. UNLESS OTHERWISE NOTED. RESISTORS ARE IN OHMS, 1/4W, ±5%; CAPACITOR VALUES ONE OR GREATER ARE IN PICOFARADS (pF), VALUES LESS THAN ONE ARE IN MICROFARADS (μF); INDUCTORS ARE IN MICROHENRYS (μH).

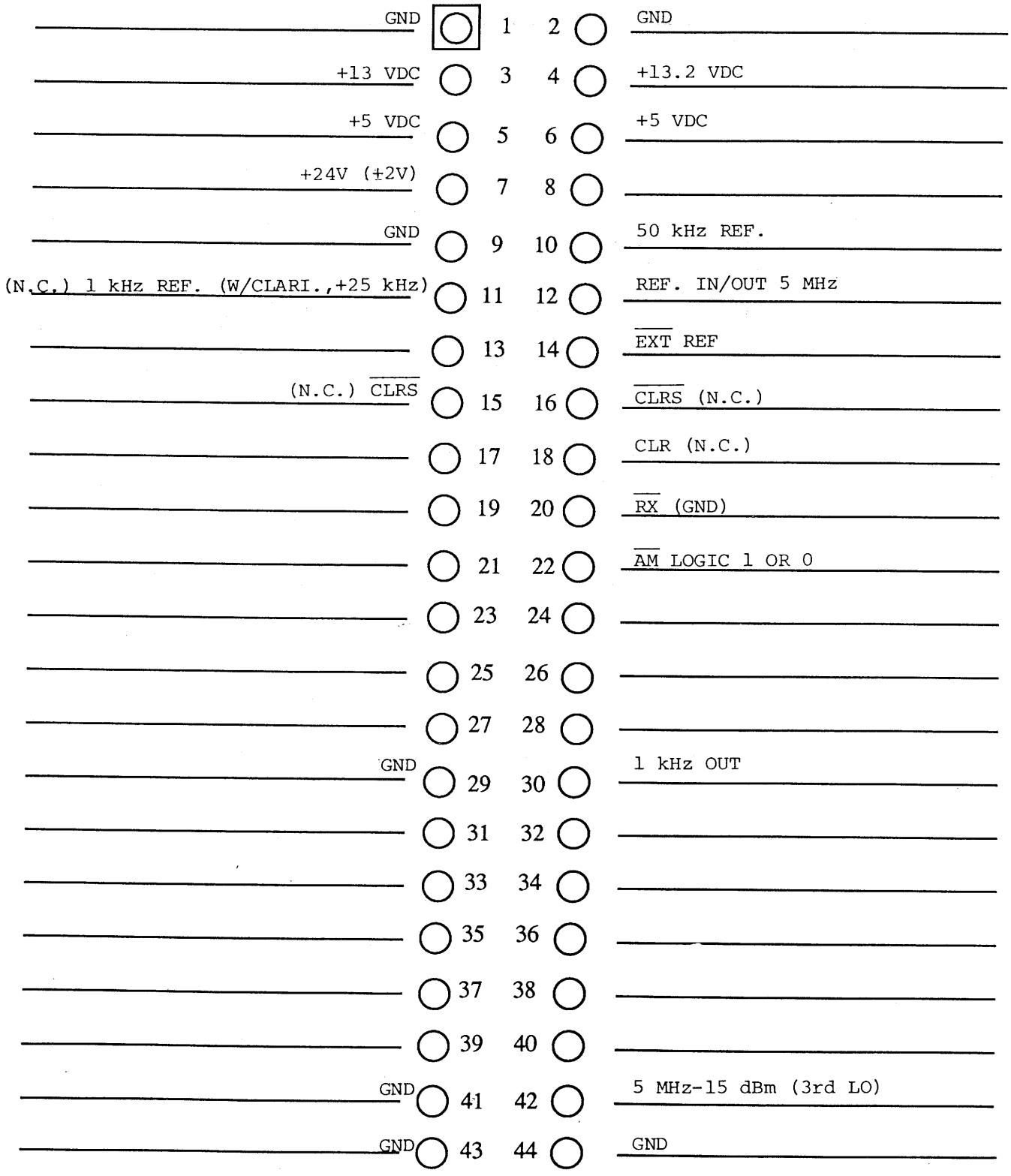
Figure 4.19-3

Reference Board Schematic

REFERENCE BOARD, A19

PIN CONNECTIONS AND VOLTAGE READINGS

A19P9



4.19.2 MINOR LOOP BOARD, A18

The Minor Loop generates the small (10 Hz) steps in the synthesizer. Its output, a 1.000 to 1.09999 MHz signal, is the reference for the Translator Loop.

The VCO (Q5, C1, C2, L1 and CR1) is a Colpitts oscillator whose frequency (100.000 to 109.999 MHz) is determined by the DC voltage at the junction of CR1 and C1. The VCO output drives two isolation buffers. The first (Q6 and associated components) drives a divide by 10 prescaler U12, whose output drives U13, a divide by 10 counter. The Minor Loop output (pin 12 of U13) is passed through a filter and then applied to Q8. The second buffer (Q7 and associated components) drives U11 which drives programmable divider U1 through U6.

The programmable divider functions in the following manner: U3, U4, U5 and U6 are parallel-loadable UP/DOWN counters which are cascaded and permanently connected to count DOWN. Counter U6 is the most significant digit and is permanently connected to load 10 each time its load line goes low; U1 is the least significant.

U7 is an array of open collector inverters which have their outputs connected together to form a NOR gate. The output (pins 2,4,6,8,10 and 12) can only go high if all the inputs (pins 1,3,5,9,11 and 13) are low. The U7 inputs are connected so that the output goes high when the counter (U6-U3) contains the number 002. To understand the operation, assume that the counter has just been loaded with the number 1240. The counters begin counting down. Because the D input (pin 2) is low, pin 5 of U2 (Q) stays low and pin 6 ($\overline{Q}$) stays high. After 10,000 pulses, U6 underflows and pin 1 (U7) goes low.

After another 100 pulses, U5 underflows and U7 (pin 3) goes low. After another 20 pulses, U4 underflows and U7 (pin 5) goes low. After another 2 pulses, pins 9,11 and 13 of U7 are low, so the "output" of number 0020 and the D input (pin 2 of U2) goes high again loading U1, U3, U5, and U6 with the divide number. The next pulse (number 000) toggles pin 6 high and pin 5 low. The cycle can now repeat. U1 controls the least significant number. When it overflows, it gets U2 (pin 9) which sets U11 to divide by 10 or 11.

The output of the programmable divider (U2, pin 5) is fed to the phase/frequency detector U9, where it is compared with the 1 kHz reference. If the divider output is too low in frequency (lagging the 1 kHz reference in phase), the phase detector output (pins 5 and 10) goes down. This causes the voltage of the VCO control line to rise, which raises the frequency to correct the error.

The Loop Amplifier consists of Q2 and Q3, which form a high input impedance inverting stage. The amplifier and feedback components (R20, R19, C31 and C32) form an active loop filter which determines the overall loop stability. Transistor Q4 with components R17, R16, C28 and C27, forms an active low pass filter with a sharp corner and steep roll-off to attenuate reference sidebands. Compo-nents R11, R10 and R12, and C24, C25 and C23, form a Twin-T notch filter centered on 1 kHz to further attenuate the first order sidebands.

The loss-of-lock circuitry works as follows: phase detector outputs pin 11 and pin 4 are normally high with nearly 100 percent duty cycle in a properly locked loop. This means that the base and therefore, the emitter of Q1 is also high, driving pin 2 of U8 low. This makes pins 12 and 4 of U8 high so the LED is off. When the loop loses lock, the duty cycle will drop at either pin 11 or pin 4 of U9. This discharges C35 through R24 faster than it can be recharged by R22 so the base voltage of Q1 drops, causing pin 2 of U8 to go high. This turns on the LED and drives the LL line low. The pin number (11 or 4) that goes low in loss-of-lock, depends on whether the VCO frequency is too high or too low.

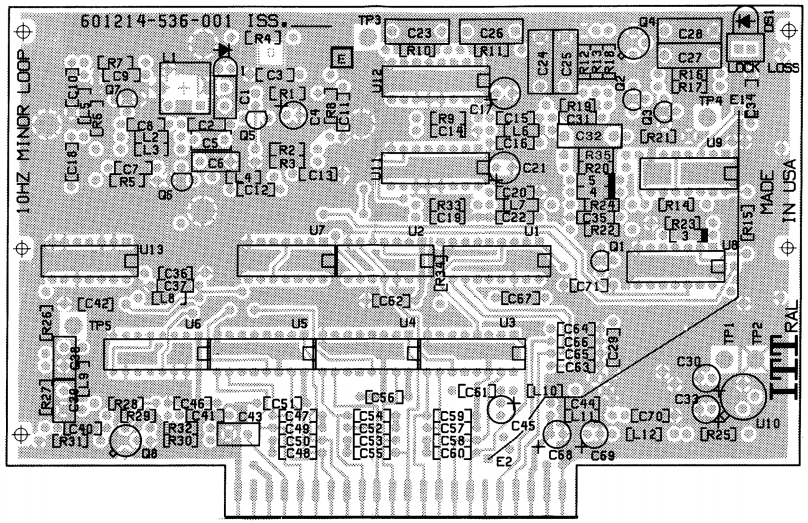
An on-card 8-volt regulator (U10) supplies the linear circuits with clean power. Table 4.19-2 lists the Minor Loop output frequency and divider input frequency information.

Table 4.19-1 MINOR LOOP IN LOCK VOLTAGES

LAST 4 DIGITS OF FREQUENCY	ADJUST	DC VOLTS AT TP3
0000	L1	2.2 ± .02V
9999		5.5 - 6.5V

Table 4.19-2 MINOR LOOP FREQUENCY INFORMATION

LAST 3 DIGITS OF RX or TX FREQ. MHz	VCO FREQ MHz	PROGRAM NUMBER		
		10 kHz	1 kHz	100 Hz
000	1.0000	0	0	0
001	1.0001	0	0	1
002	1.0002	0	0	2
003	1.0003	0	0	3
004	1.0004	0	0	4
005	1.0005	0	0	5
006	1.0006	0	0	6
007	1.0007	0	0	7
008	1.0008	0	0	8
009	1.0009	0	0	9
010	1.0010	0	1	0
020	1.0020	0	2	0
030	1.0030	0	3	0
040	1.0040	0	4	0
050	1.0050	0	5	0
060	1.0060	0	6	0
070	1.0070	0	7	0
080	1.0080	0	8	0
090	1.0090	0	9	0
100	1.0100	1	0	0
200	1.0200	2	0	0
300	1.0300	3	0	0
400	1.0400	4	0	0
500	1.0500	5	0	0
600	1.0600	6	0	0
700	1.0700	7	0	0
800	1.0800	8	0	0
900	1.0900	9	0	0



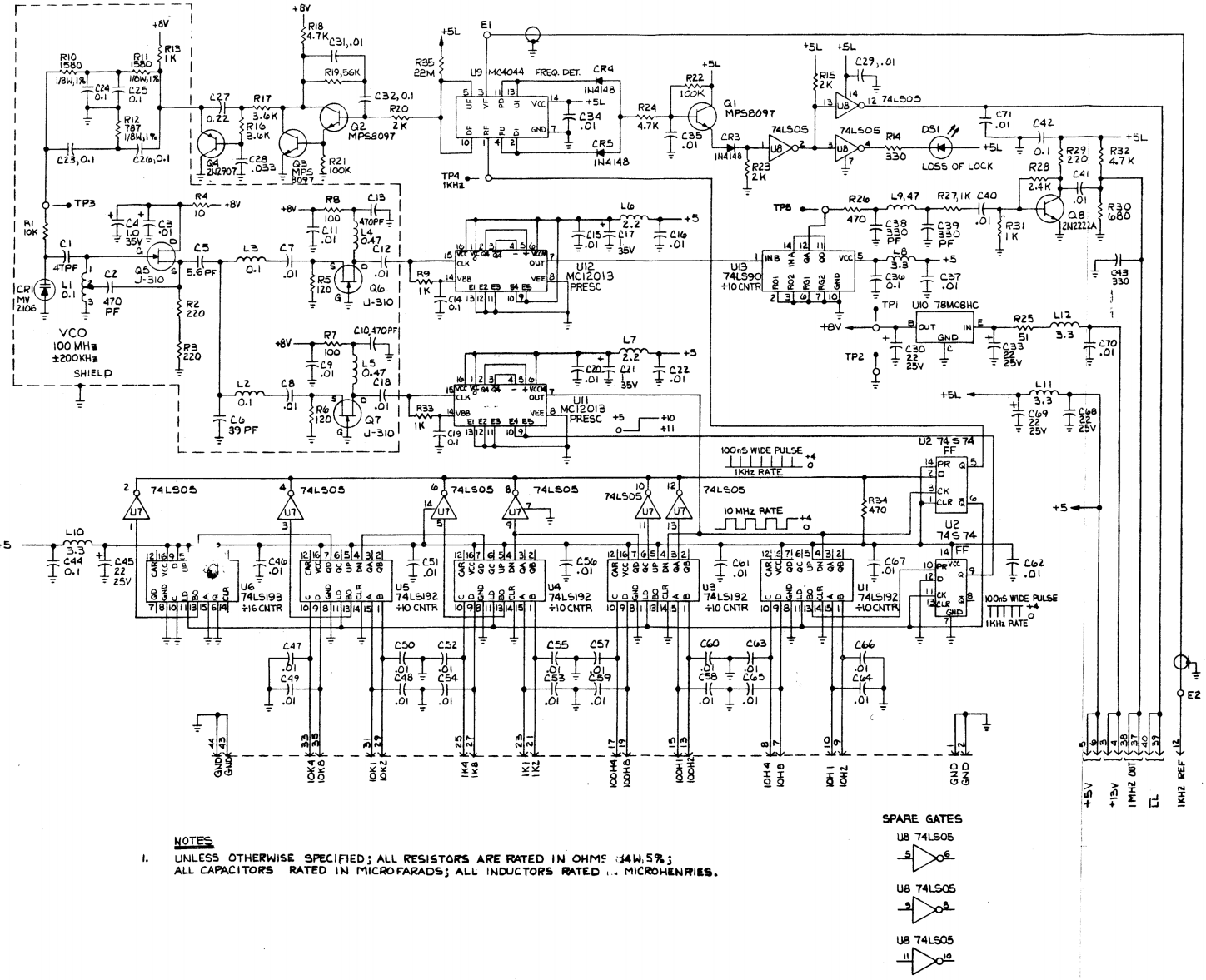
Minor Loop (601214-536-001)

PART NUMBER	DESCRIPTION	SYMBOL
647093-306-501	CAP. 47PF, 3%, MICA, 500V	C10
600272-314-001	CAP. .1UF, CERAMIC, 50V	C3,7-9, 11,12,15, 16,18,20, 22,29,34, 35,37,40, 41,46,47, 51-67, 70,71
600272-314-003	CAP. .01UF, CERAMIC, 50V	C18,20 22,29 34,35
600272-314-005	CAP. 470PF, CERAMIC, 50V	C2,10 13,43
600204-314-027	CAP., 100V MYLAR	C23-26, 28,31
600297-314-016	CAP. 22UF, ALUM, 25V	C30,33, 45,68, 69
647093-306-501	CAP. 47PF, 3%, MICA, 500V	C38,39
600202-314-007	CAP. 1UF, 35V, TANT.	C4,17,21 27,32
600269-314-006	CAP. 5.6PF, CERAMIC, 500V	C5
600269-314-020	CAP. 39PF, CERAMIC, 100V	C6
600123-410-003	DIODE, VARACTOR, MV2106	CR1
600109-410-001	DIODE IN4148	CR3-6
600036-390-001	LED, RED	DS1
600173-376-001	COIL, VAR, .1UH	L1
600125-376-028	CHOKE .1UH	L2,3
600125-376-027	CHOKE .47UH	L4,5
600125-376-016	CHOKE 2.2UH	L6,7
600125-376-006	CHOKE 3.3UH	L8,10-12
600125-376-008	CHOKE 47UH	L9,13

PART NUMBER	DESCRIPTION	SYMBOL
600278-413-001	TRANSISTOR MPS8097	Q1-3
600154-413-001	TRANSISTOR 2N2907A	Q4
600259-413-001	TRANSISTOR J310	Q5-7
600080-413-001	TRANSISTOR 2N2222A	Q8-11
610024-341-075	RES. 10K, 1/4W, 5%	R1,38
652311-342-059	RES., 5.23K, 1/8W, 1%	R10,11
626111-342-059	RES. 2.61K 1/8W 1%	R12
633004-341-075	RES. 330, 1/4W, 5%	R14
620014-341-075	RES. 2K, 1/4W, 5%	R15,20,23
636014-341-075	RES. 3.6K, 1/4W, 5%	R16,17
647014-341-075	RES. 4.7K, 1/4W, 5%	R18,24, 32,35,36
630024-341-075	RES. 30K, 1/4W, 5%	R19
622004-341-075	RES. 220, 1/4W, 5%	R2,3
610034-341-075	RES. 100K, 1/4W, 5%	R21,22
647004-341-075	RES. 470, 1/4W, 5%	R27,34
633014-341-075	RES. 3.3K, 1/4W, 5%	R28
662004-341-075	RES. 620, 1/4W, 5%	R30
622014-341-075	RES. 2.2K, 1/4W, 5%	R31
622024-341-075	RES. 22K, 1/4W, 5%	R37
622054-341-075	RES. 22M, 1/4W, 5%	R39
610094-341-075	RES. 10, 1/4W, 5%	R4
612004-341-075	RES. 120, 1/4W, 5%	R5,6
610004-341-075	RES. 100, 1/4W, 5%	R7,8
610014-341-075	RES. 1K, 1/4W, 5%	R9,13, 26,33
651094-341-075	RES. 51, 1/4W, 5%	R25
600225-415-001	IC 74LS192, UP/DN CNTR, SYNC	U1,3-6,14
600157-415-001	IC 74S74, D FLIP-F, DUAL	U2
600240-415-001	IC 74LS05, HEX INV, O/C	U7,8
600092-415-001	IC MC4044, PHASE DET.	U9
600526-415-001	IC 78M08, 8V REG	U10
600241-415-001	IC 2013, 2-MOD	U11,12
600535-415-001	IC 74LS390, 2 DEC RIP CNTR	V13

Figure 4.19-4

Minor Loop Board Assembly



NOTES

1. UNLESS OTHERWISE SPECIFIED; ALL RESISTORS ARE RATED IN OHMS ¼W, 5%; ALL CAPACITORS RATED IN MICROFARADS; ALL INDUCTORS RATED IN MICROHENRIES.

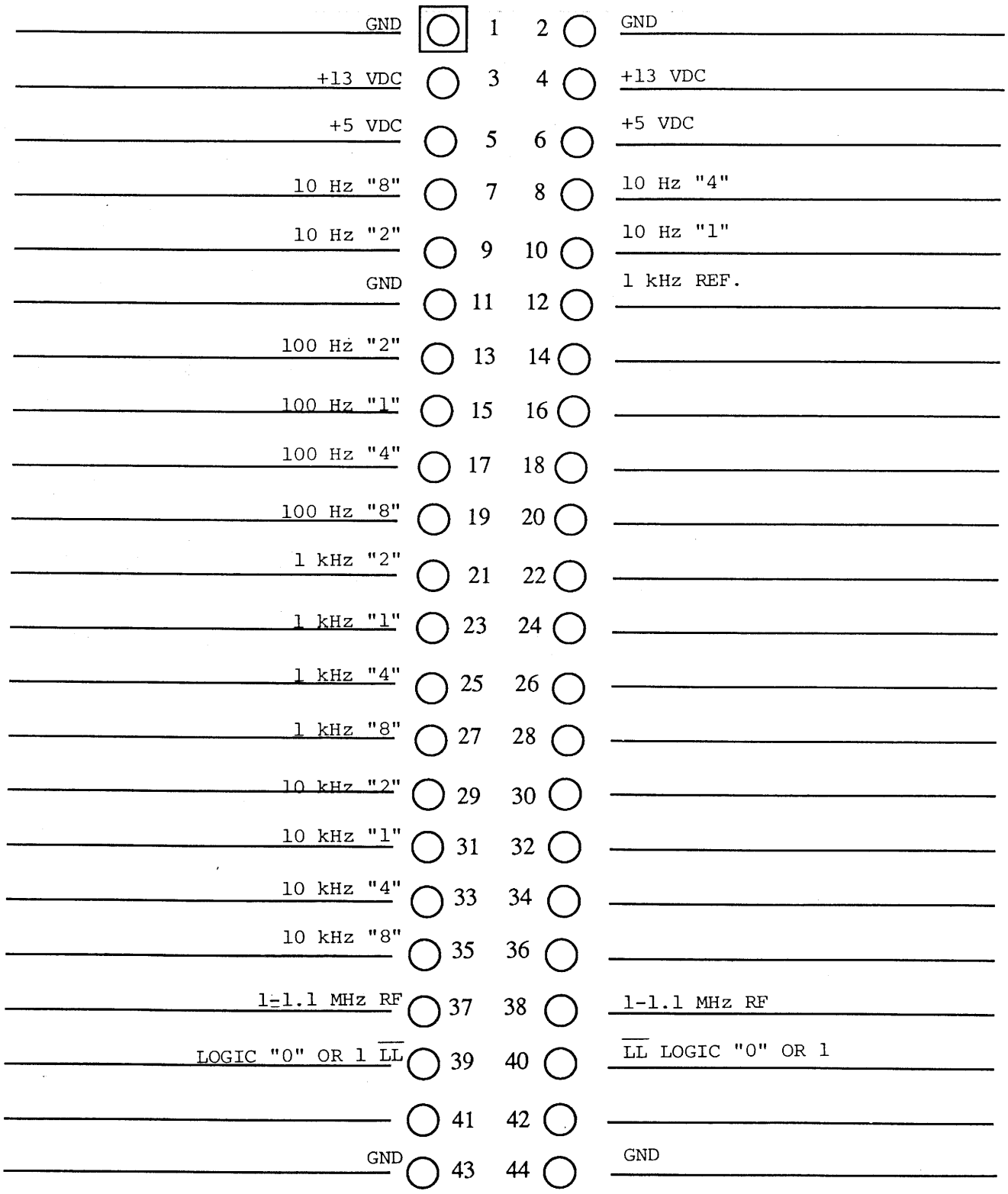
Figure 4.19-5

Minor Loop Board Schematic

MINOR LOOP BOARD, A18

PIN CONNECTIONS AND VOLTAGE READINGS

A18P1



4.19.3 TRANSLATOR LOOP BOARD, A17

The Translator Loop board provides the 55.530 to 55.6299 MHz signal for use by the Major Loop and provides the 54.53 MHz second LO for the Receiver/Exciter.

The second LO signal is generated by a Colpitts configuration crystal oscillator, Q6 and associated components. The crystal is a parallel resonant type and is adjusted on frequency by trimmer C61. An uncompensated crystal can be used because both the first and second LO signals are derived from it, so any 54.53 MHz frequency drift cancels in the transmit and receive frequency, leaving the overall frequency stability dependent only on the TCXO reference oscillator.

The output of the 54.53 MHz oscillator is split into two paths. One path goes to buffer Q5, which drives mixer M1. The other path goes to buffer Q7, which provides the 0 dBm second LO output. The output amplitude can be adjusted to 0 dBm by C64. Components L13, C39, C46 and C41 form a harmonic filter.

The Translator output is the sum of the second LO (54.53 MHz) and the Minor Loop output (1.00000 to 1.09999 MHz).

The VCO, consisting of Q1, L6, C63, C60 and associated components, is a Colpitts oscillator whose frequency is varied by changing the control line voltage at TP6. A change in the DC voltage here will change the bias on varicap CR4, changing the VCO tank capacitance and thus, the VCO frequency.

The output signal is split into two paths. One path goes through output level adjust C15, then to cascode amplifier Q2 and Q3.

The cascode amplifier provides excellent reverse isolation and a -10 dBm output level through Harmonic Filter L3, L2 and associated capacitors.

The other path from the VCO goes to buffer Q4, which drives pin 8 of mixer M1. The output of the mixer (pins 3 and 4) is a 1.00000 to 1.09999 MHz signal. This signal is amplified by a 15 dB amplifier (Q8, Q9 and associated components) and then coupled through R54 and C57 to Lowpass Filter L14, L16, C54, C55 and C56, to provide a 100 millivolt p-p signal at TP4. From here, the signal is amplified by high gain common emitter amplifiers Q10 and Q11 to generate a 4 volt p-p waveform for the loop input to the phase/frequency detector (pin 1). the reference frequency is the 1.00000 to 1.09999 MHz signal from the Minor Loop and is fed to pin 3 of U1. Thus, the loop translator causes the VCO to generate a frequency, which when 54.53 MHz is subtracted by M2, is the same as the minor loop input frequency.

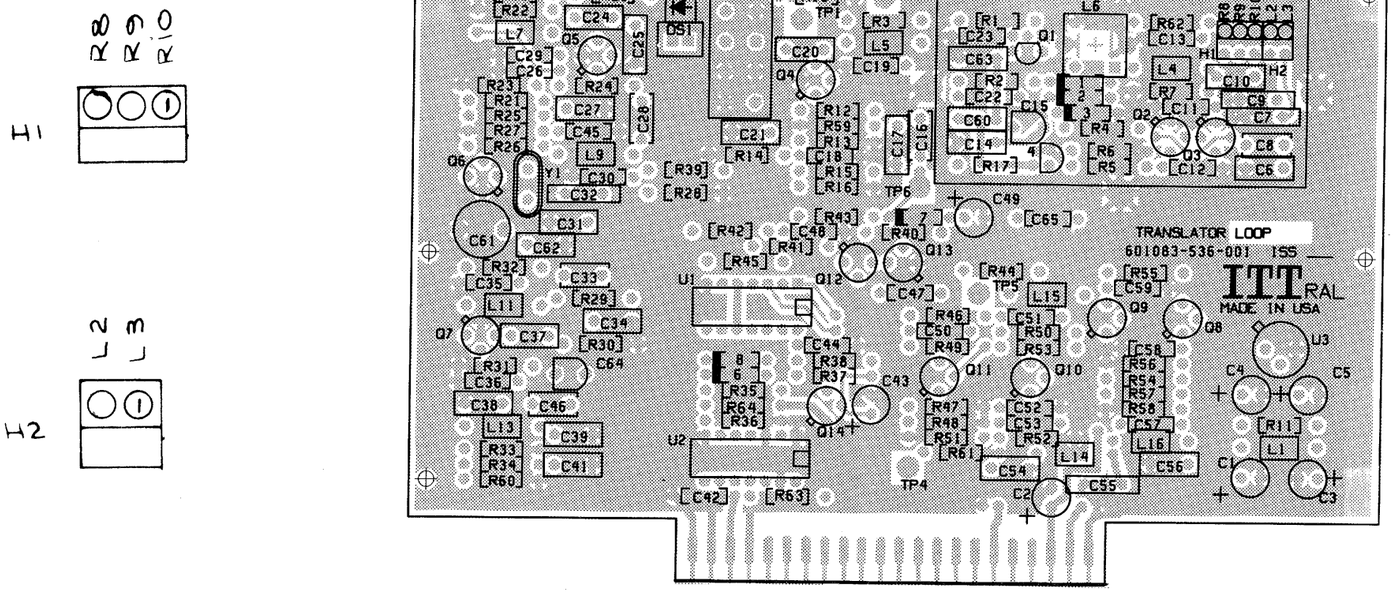
The output of phase detector, U1 is at pins 5 and 10 and is a high impedance when the loop is locked. This output is connected to a lead-lag type active loop filter consisting of Q12, Q13, R42, R41,C48, C47 and R40. The filter output goes through R43 to TP6. Diode CR7 prevents the voltage at TP6 from dropping below 4.3 volts and the VCO frequency from falling below 54.53 MHz, which would cause a false lock. The loss-of-lock circuitry works as follows.

Phase detector outputs, pin 11 and pin 4, are normally high with nearly 100% duty cycle in a properly locked loop. This means that the base, and therefore the emitter of Q14 is also high, driving pin 6 of U2 low. This makes pins 8 and 10 of U2 high, so the LED is off. When the loop loses lock, the duty cycle will drop at either pin 11 or pin 4 (of U1). This discharges C43 through R37 faster than it can be recharged by R38, so the base voltage of Q14 drops causing pin 6 of U2 to go high. This turns on the LED and drives the LL line low. The pin number (11 or 4) that goes low in loss-of-lock depends on whether the VCO frequency is too high or too low.

As an on-card 8-volt regulator, U3 supplies the linear circuits with clean power.

Table 4.19-3 Translator In-Lock Voltages

LAST 4 DIGITS OF FREQUENCY	ADJUST	DC VOLTS AT TP3
0000	L6	5.6 - 5.8V
9999		5.9 - 6.2V



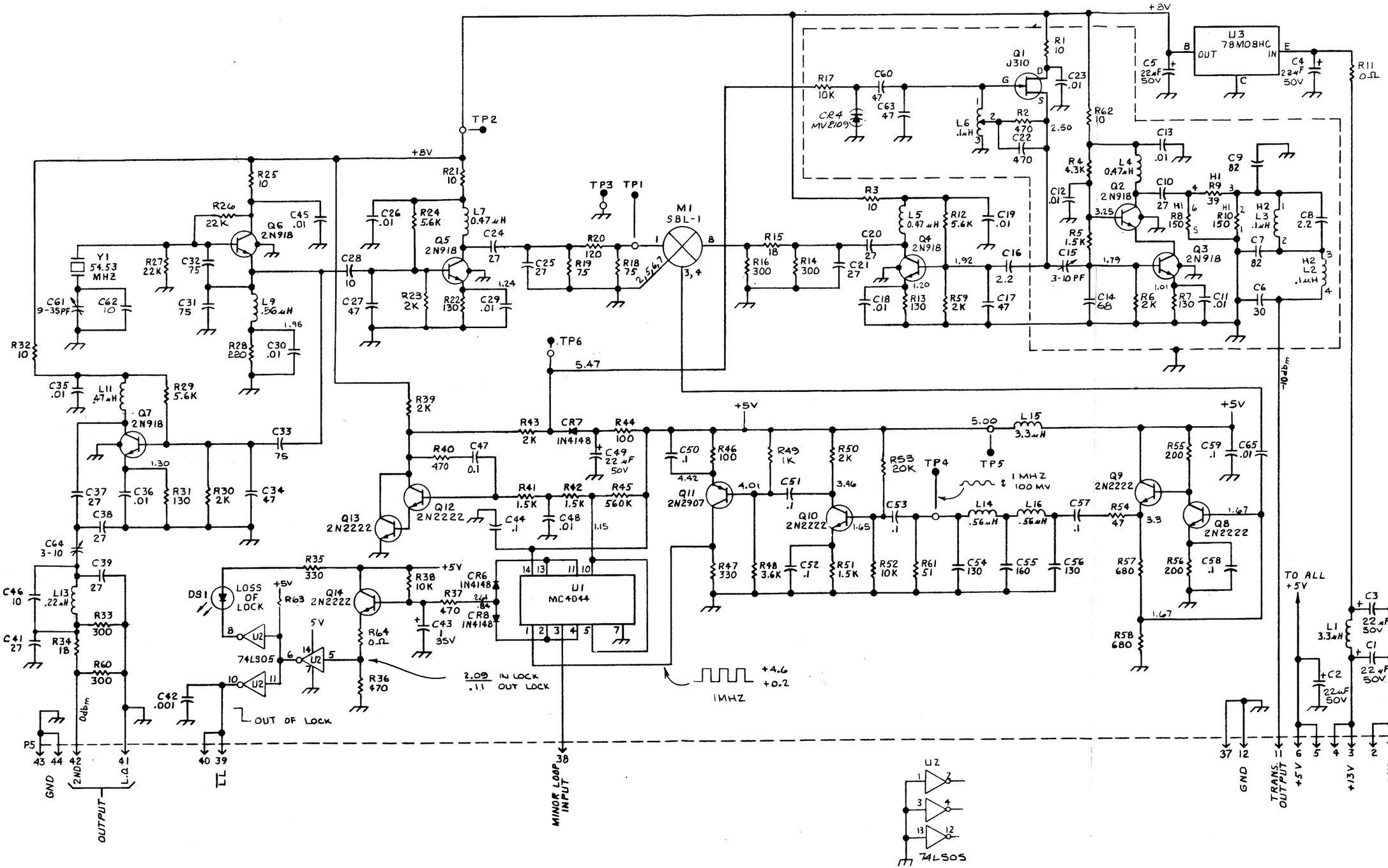
Translator Loop (601083-536-001)

PART NUMBER	DESCRIPTION	SYMBOL
600145-419-001	HEATSINK	
600297-314-018	CAP. 22UF, ALUM, 50V	C1-5,49
600269-314-016	CAP. 27PF, CERAMIC, 500V	C10,20, 21,24,25, 37-39,41
600272-314-003	CAP. .01UF, CERAMIC, 50V	C11-13, 18,19, 23,26, 29,30,35, 36,45,48, 65
600269-314-026	CAP. 68PF, CERAMIC, 100V	C14
600052-317-001	CAP. VAR, 3-10PF	C15,64
600269-314-022	CAP. 47PF, CERAMIC, 100V	C17,2[illegible], 34,60,63
600272-314-005	CAP. 470PF, CERAMIC, 50V	C22
600269-314-009	CAP. 10PF, CERAMIC, 500V	C28,46,62
600269-314-027	CAP. 75PF, CERAMIC, 100V	C31,32,33
600272-314-008	CAP. .001UF, CERAMIC, 50V	C42
600202-314-007	CAP. 1UF, 35V, TANT.	C43
600272-314-001	CAP. .1UF, CERAMIC, 50V	C44,50-53
600204-314-020	CAP. 0.1UF, MYLAR, 100V	C47
600269-314-033	CAP. 130PF, CERAMIC, 100V	C54,65
600269-314-035	CAP. 160PF, CERAMIC, 100V	C55
600269-314-017	CAP. 30PF, CERAMIC, 500V	C6
600018-317-004	CAP. VAR, 9-35PF	C61
600269-314-028	CAP. 82PF, CERAMIC, 100V	C7,9
600269-314-002	CAP. 2.2PF, CERAMIC, 500V	C8,16
600123-410-008	DIODE, VARACTOR, MV2109	CR4
600109-410-001	DIODE IN4148	CR6-8
600036-390-001	LED, RED	DS1
600064-419-003	3 POSITION VERTICAL MT	H1
600064-419-004	2 POSITION VERTICAL MT.	H2
600125-376-006	CHOKE 3.3UH	L1,15
600125-376-003	CHOKE .22UH	L13
600125-376-028	CHOKE .1UH	L2,3
600125-376-027	CHOKE .47UH	L4,5,7,11
600173-376-001	COIL, VAR, .1UH	L6

PART NUMBER	DESCRIPTION	SYMBOL
600125-376-005	CHOKE .56UH	L9,14,16
600008-455-001	MIXER SLB-1	M1
600259-413-001	TRANSISTOR J310	Q1
600154-413-001	TRANSISTOR 2N2907A	Q11
600025-419-001	TRANSISTOR PAD	Q2-14
600085-413-001	TRANSISTOR 2N918	Q2-7
600080-413-001	TRANSISTOR 2N2222A	Q8-10, 12-14
610094-341-075	RES. 10, 1/4W, 5%	R1,3,21, 25,32,62
600000-341-075	RES. 0, 1/4W, 5%	R11,64
656014-341-075	RES. 5.6K, 1/4W, 5%	R12,24,29
630004-341-075	RES. 300, 1/4W, 5%	R14,16, 33,60
618094-341-075	RES. 18, 1/4W, 5%	R15,34
610024-341-075	RES. 10K, 1/4W, 5%	R17,38,52
675094-341-075	RES. 75, 1/4W, 5%	R18,19
647004-341-075	RES. 470, 1/4W, 5%	R2,36
612004-341-075	RES. 120, 1/4W, 5%	R20
622024-341-075	RES. 22K, 1/4W, 5%	R26,27
622004-341-075	RES. 220, 1/4W, 5%	R28
633004-341-075	RES. 330, 1/4W, 5%	R35,47
643014-341-075	RES. 4.3K, 1/4W, 5%	R4
610004-341-075	RES. 100, 1/4W, 5%	R44,46
656034-341-075	RES. 560K, 1/4W, 5%	R45
636014-341-075	RES. 3.6K, 1/4W, 5%	R48
610014-341-075	RES. 1K, 1/4W, 5%	R49
615014-341-075	RES. 1.5K, 1/4W, 5%	R5,41, 42,51
620024-341-075	RES. 20K, 1/4W, 5%	R53
647094-341-075	RES. 47, 1/4W, 5%	R54
620004-341-075	RES. 200, 1/4W, 5%	R55,56
668004-341-075	RES. 680, 1/4W, 5%	R57,58
620014-341-075	RES. 2K, 1/4W, 5%	R6,23,30, 39,43, 50,59,63
651094-341-075	RES. 51, 1/4W, 5%	R61
613004-341-075	RES. 130, 1/4W, 5%	R7,13, 22,31
615004-341-075	RES. 150, 1/4W, 5%	R8,10
639094-341-075	RES. 39, 1/4W, 5%	R9
600261-230-001	TERMINAL	TP1-6
600092-415-001	IC MC4044, PHASE DET.	U1
600240-415-001	IC 74LS05, HEX INV, O/C	U2
600017-419-001	TRANSISTOR PAD	U3
600526-415-001	IC 78M08, 8V REG	U3
600005-635-001	LED MOUNT	XDS1
600163-378-001	CRYSTAL, 54.53 MHZ	Y1

Figure 4.19-6

Translator Loop Board Assembly



NOTES:
1. UNLESS OTHERWISE NOTED:
   RESISTORS ARE IN OHMS, 1/4W, ±5%
   CAPACITOR VALUES ONE OR GREATER ARE IN PICOFARADS (pF), VALUES LESS THAN ONE ARE MICROFARADS (uF).

LAST DESIG. USED
R64, C63, CR8, DS1, L16, Q14, M1, TP6, U3, Y1
DELETED
L8, L10, CR1-3

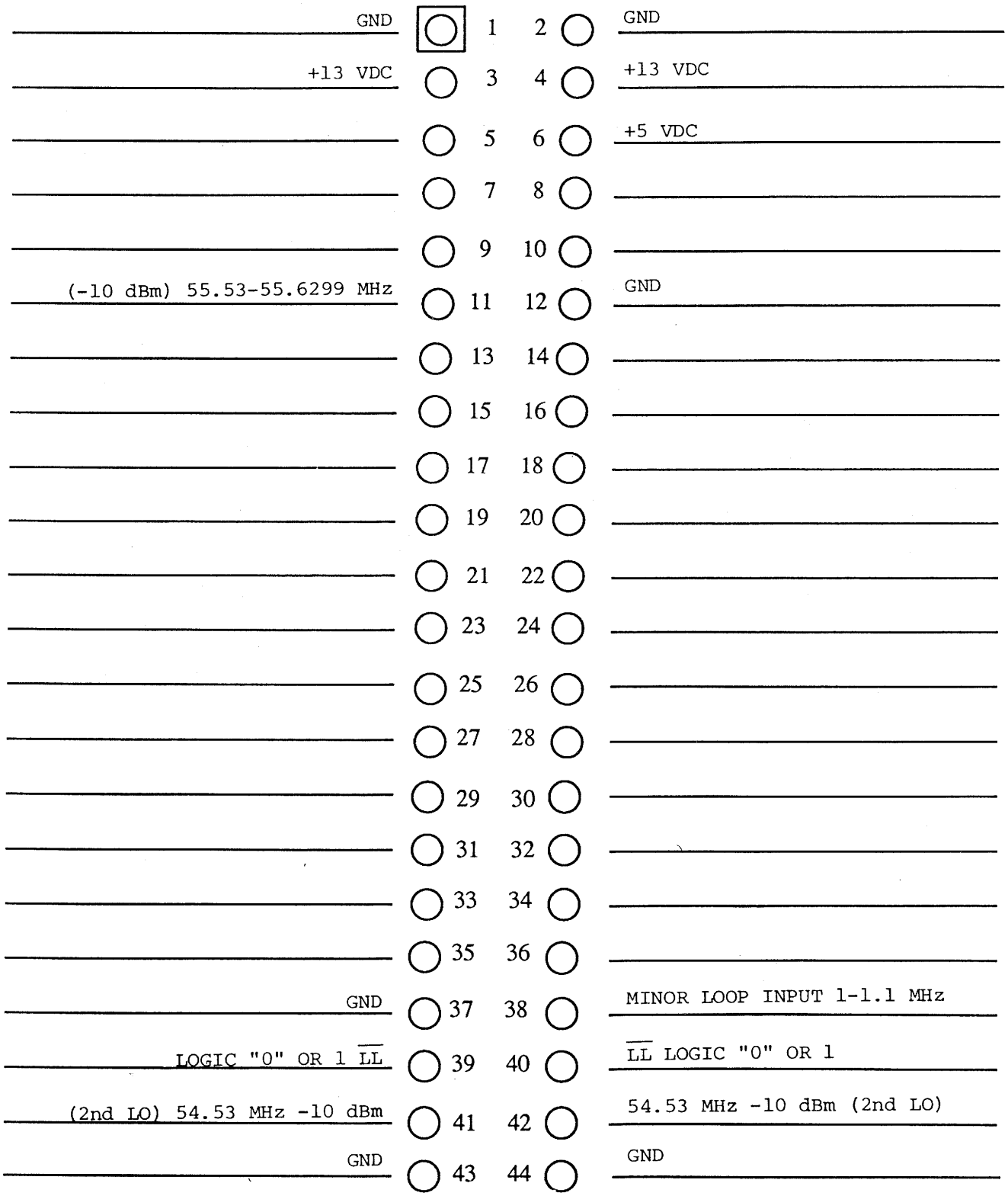
Figure 4.19-7

Translator Loop Board Schematic

TRANSLATOR LOOP BOARD, A17

PIN CONNECTIONS AND VOLTAGE READINGS

A17-P5



4.19.4 MAJOR LOOP BOARD, A16

The Major Loop provides the first local oscillator (LO) signal (59.53 MHz to 89.53 MHz) for the first mixer in the signal path. The loop itself uses a 50 kHz reference frequency and generates 10 MHz, 1 MHz and 100 kHz steps. Smaller step sizes are possible by stepping the translator RF input to the Major Loop from 55.53 MHz to 55.6299 MHz. The Translator Loop takes 10 Hz steps over this range, which also gives the Major loop output 10 Hz steps. The smaller step sizes are actually generated by the Minor Loop, so different step sizes are possible by changing Minor Loops.

The VCO, Q7 is a Colpitts oscillator with three switched ranges. The VCO control line is the junction of varicaps CR7 and CR8 driven through decoupling choke, L4. The oscillator covers 59.53 MHz to 89.53 MHz in three course ranges (see Table 4.19-4). This keeps the loop gain expression kvkp/N * nearly constant, which insures that loop dynamics (stability, settling time) are constant throughout the range. Range switching is accomplished by pin diodes CR13 and CR2. The top range has only varicaps CR7 and CR8 in combination with L3 determining the VCO frequency. In the middle range, CR2 is turned on, which puts C71 and C73 in parallel with the varicaps. In the low range, CR2 remains on and CR13 turned on, which adds parallel capacitors C72 and C74 to the tank circuit. Diodes CR4, CR5 and CR6 limit the oscillation amplitude. Resistor R23 sets the static FET operating point, and unbypassed resistor R13 degenerates the gain slightly to limit high order harmonic production. The output of Q6 is taken from 3:1 broadband transformer L1 (L7 and L8 are similar transformers) and fed to two additional buffers. Cascode amplifiers Q12 and Q11 provide extremely good reverse isolation (70 to 80 dB) and feeds mixer M1.

The first LO output is from buffer Q1. Components L9, L10, C42, C43 and C77 provide harmonic filtering. R52 is used to adjust the output level.

The Translator Loop frequency is fed to pin 1 of mixer M1 and the VCO is fed to pin 8. The output on pins 3 and 4 is amplified to Q9 and Q10 and fed to a bandpass filter consisting of L5, L6 and associated capacitors. The filter passes the difference frequency of 4 to 33.9 MHz to be further amplified by Q13 and Q14. Both the sum FVCO + FTRANS and difference FVCO - FTRANS are present in the mixer output. The output is fed to the clock input of U8, which is a D flip-flop connected to toggle (÷2). Resistors R44 and R48 bias U8's clock input at threshold for reliable triggering. The presence of the ÷2 is compensated for by using a 50 kHz (not 100 kHz) reference signal for the loop.

The programmable divider determines the VCO frequency in the following manner: the output of the programmable divider (U8, pin 9) is always 50 kHz if the loop is locked. The input frequency (U8, pin 9) is always 50 kHz if the loop is locked. The input frequency (U8, pin 11) then is N x 50 kHz where N is the programmed divide number. Working back up to the VCO: (N x 50 kHz x 2) + FTRANS + FVCO.

The programmable divider functions in the following manner: U5, U6 and U7 are parallel - loadable UP/DOWN counters which are cascaded and permanently connected to count DOWN. Counter U5 is the most significant digit; U7 the least significant. U4 is an array of open collector inverters which have their outputs connected together to form a NOR gate. The output (pins 4,6,8,10 and 12) can only go high if all the inputs (pins 3,5,9,11 and 13) are low. The U4 inputs are connected so that the output goes high when the counter (U5-U7) contains the number 002. To understand the operation, assume that the counter has just been loaded with the number 124. The counters begin counting down. Because of the D input, pin 12 is low, pin 9 of U8 (Q) stays low and pin 8 ($\overline{Q}$) stays high. After 100 pulses, U5 underflows and U4, pin 3 goes low. After another 2 pulses, U6 underflows and U4, pin 5 goes low. After another 2 pulses, pins 9, 11 and 13 of U8 are low, so the "output" of U4, pins 4,6,8,10 and 12 can go high.

The counter now contains the number 002 and the D input, pin 12 of U8 goes high (this is the programmable divider output pulse). The pin goes low, again loading U5, U6 and U7 with the divide number. The next pulse (number 000) toggles pin 8 high and pin 9 low. The cycle can now repeat.

The output of the programmable divider (U8, pin 9) is fed to the phase/frequency detector U2, where it is compared with the 50 kHz reference. If the divider output is too low in frequency or lagging the 50 kHz reference in phase, the phase detector output (pins 5 and 10) goes down. This causes the voltage of the VCO control line to rise, which raises the frequency to correct the error.

The loop amplifier consists of Q5, Q4 and Q3, which form a high input impedance inverting stage.The amplifier and feed-back components (C7, R12, R11 and C8) form an active loop filter which determines the overall loop stability. Transistor Q2, with components R10, R58, C12 and C66, forms an active lowpass filter with a sharp corner and steep roll-off to attenuate the reference sidebands. The amplifier and active lowpass are fed +24 volts from the Reference board. The +24 volts is needed to increase the varicap range.

The loss-of-lock circuitry works as follows: phase detector outputs, pin 11 and pin 4, are normally high with nearly 100% duty cycle in a properly locked loop. This means that the base, and therefore the emitter of Q8, is also high, driving pin 4 of U3 low. This makes pins 2 and 6 of U3 high so the LED is off. When the loop loses lock, the duty cycle will drop at either pin 11 or 4 (of U2). This discharges C25 through R32 faster than it can be recharged by R25, so the base voltage of Q8 drops, causing pin 4 of U3 to go high. This turns on the LED and drives the LL line low. The pin number (11 or 4) that goes low in loss-of-lock, depends on whether the VCO frequency is too high or too low.

An on-card 8-volt regulator, U1, supplies the linear circuits with clean power.

While a complete discussion of loop theory is beyond the scope of this technical description, the following is an extremely simplified explanation.

The loop response time and setting time depends on the time constants of the loop filter components and the loop "gain" kvkp/N. Where kv is the VCO transfer constant in Radian/Sec/Volt, kp is the phase detector constant in Volts/Radian, and N is the programmable divide number. Typical numbers for the major loop might be:

kv = 3.14 x 106
kp = .44 so kvkp = 11.1 x 103
N = 124

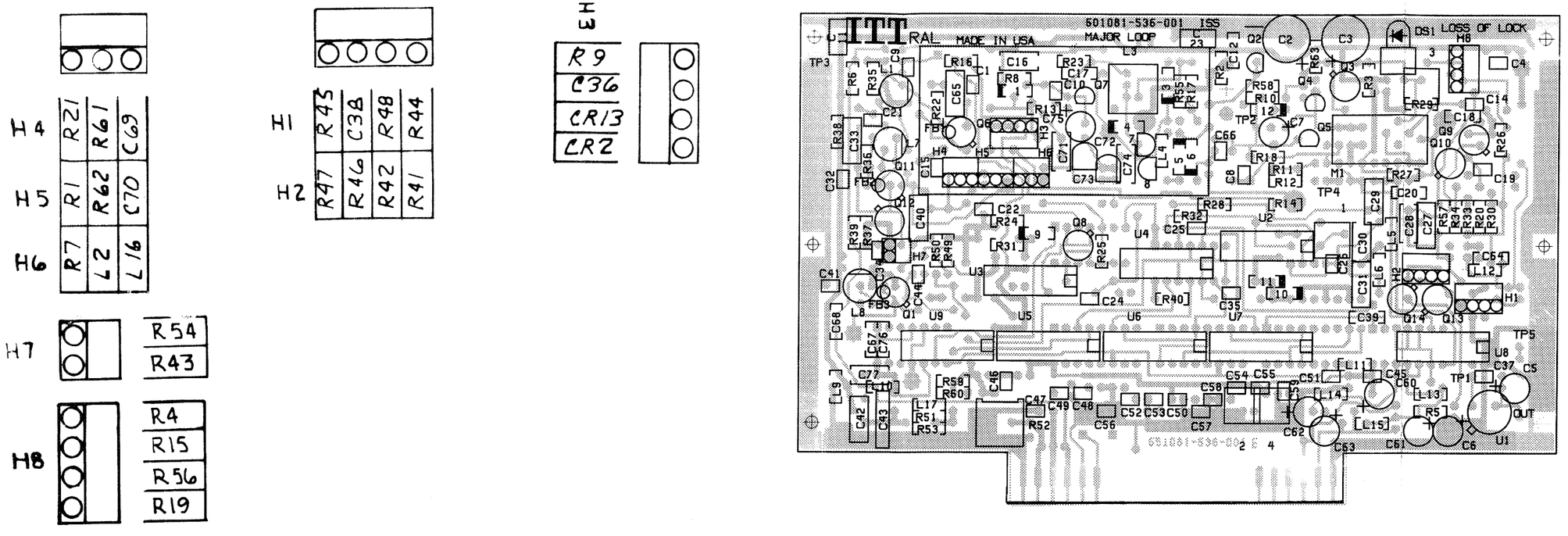
Table 4.19-4 lists Major Loop VCO output frequency and divider program information.

Table 4.19-4 Major Loop Frequency Information

FIRST 3 DIGITS OF RX or TX FREQ. MHz	VCO FREQ. MHz	PROGRAM NUMBER	U9 PIN 8	U9 PIN 6	CR13	CR2
160 5.90	61.13 65.43	056 to 099	LOW	LOW	ON	ON
6.00 15.90	65.53 75.43	100 to 199	HIGH	LOW	ON	OFF
16.00 29.90	75.53 89.43	200 to 399	HIGH	HIGH	OFF	OFF

FIRST 3 DIGITS OF FREQUENCY MHz	ADJUST	DC VOLTS TP2
29.9	L3	18.4 to 18.6
16.0		3.6 to 5.00
15.9	C72	18.2 to 18.7
06.0		2.9 to 4.5
05.9	C73	18.2 to 18.7
01.6		5.50 to 5.70

Major Loop In-Lock Loop Voltage



Major Loop (601081-536-001)

PART NUMBER	DESCRIPTION	SYMBOL
600145-419-001	HEATSINK	
600025-419-001	TRANSISTOR PAD	
600268-314-008	CAP. .01UF, CERAMIC 50V	C1,4,9, 10,14,19, 21,22, 24-26,32, 34,35,37, 41,44-59
600226-314-014	CAP. 1UF, CERAMIC, 50V	C11,23
600272-314-008	CAP. .001UF, CERAMIC, 50V	C12
600267-314-002	CAP. 100PF, CERAMIC, 100V	C15
600269-314-002	CAP. 2.2PF, CERAMIC, 500V	C16,28
600272-314-005	CAP. 470PF, CERAMIC, 50V	C17,36 68,69,70
600272-314-001	CAP. .1UF, CERAMIC, 50V	C18,20, 38,64, 67,76
600297-314-026	CAP. 47UF, ALUM, 50V	C2,3
600269-314-012	CAP. 18PF, CERAMIC, 500V	C27,31
600269-314-014	CAP. 22PF, CERAMIC, 500V	C29
600269-314-001	CAP. 10PF, CERAMIC, 500V	C30
600269-314-022	CAP. 47PF, CERAMIC, 100V	C33,40,65
600272-314-007	CAP. .01UF, CERAMIC, 100V	C39
600269-314-016	CAP. 27PF, CERAMIC, 500V	C42
600269-314-027	CAP. 75PF, CERAMIC, 100V	C43
600297-314-016	CAP. 22UF, ALUM, 25V	C5,6,60, 61,62, 63,75
600268-314-004	CAP. .0027UF, CERAMIC, 50V	C66

PART NUMBER	DESCRIPTION	SYMBOL
600202-314-003	CAP. .22UF, 35V, TANT.	C7
600269-314-009	CAP. 10PF, CERAMIC, 500V	C81
600052-317-001	CAP. VAR, 3-10PF	C72,73
600269-314-007	CAP. 6.8PF, CERAMIC, 500V	C74
600269-314-011	CAP. 15PF, CERAMIC, 500V	C77
600268-314-011	CAP. .015UF, CERAMIC, 50V	C8
600006-411-001	DIODE, ZENER, IN4728A 4V	CR1
600144-410-001	DIODE HP3188	CR2,13
600109-410-001	DIODE IN4148	CR3-6, 9-12
600123-410-009	DIODE, VARACTOR, MV2112	CR7,8
600036-390-001	LED, RED	DS1
600017-419-001	TRANSISTOR PAD	FOR U1,L7
600064-419-001	4 POSITION VERTICAL MT	H1-3,H8
600064-419-003	3 POSITION VERTICAL MT	H4-6
600064-419-004	2 POSITION VERTICAL MT	H7
600094-512-001	TRANSFORMER, 3:1, BALUN	L1,7,8
600125-376-006	CHOKE 3.3UH	L11,13-15
600125-376-040	CHOKE 1.0UH	L12
600125-376-032	CHOKE 10UH	L17
600125-376-030	CHOKE 4.7UH	L2,16
600173-376-001	COIL, VAR, .1UH	L3
600125-376-007	CHOKE 33UH	L4
600125-376-033	CHOKE 1.5 UH	L5,6
600125-376-028	CHOKE .1UH	L9,10
600008-455-001	MIXER SLB-1	M1
600085-413-001	TRANSISTOR 2N918	Q1,6,9-14
600278-413-001	TRANSISTOR MPS8097	Q2,4,5
600080-413-001	TRANSISTOR 2N2222A	Q3,8
600259-413-001	TRANSISTOR J310	Q7
620014-341-075	RES. 2K, 1/4W, 5%	R1,7,12, 22,24,31, 39,44,49
620024-341-075	RES. 20K, 1/4W, 5%	R10,58
615014-341-075	RES. 1.5K, 1/4W, 5%	R11,37

PART NUMBER	DESCRIPTION	SYMBOL
651094-341-075	RES. 51, 1/4W, 5%	R13,26, 27,29
610044-341-075	RES. 1M, 1/4W, 5%	R14
622004-341-075	RES. 220, 1/4W, 5%	R15,19
656014-341-075	RES. 5.6K, 1/4W, 5%	R16,43
622024-341-075	RES. 22K, 1/4W, 5%	R17,59-62
610034-341-075	RES. 100K, 1/4W, 5%	R18,25
639014-341-075	RES. 3.9K, 1/4W, 5%	R2,9
682004-341-075	RES. 820, 1/4W, 5%	R20,57
613004-341-075	RES. 130, 1/4W, 5%	R21,41, 46,50,54
633004-341-075	RES. 330, 1/4W, 5%	R28
647024-341-075	RES. 47K, 1/4W, 5%	R3,63
636004-341-075	RES. 360, 1/4W, 5%	R30
618024-341-075	RES. 18K, 1/4W, 5%	R32
627004-341-075	RES. 270, 1/4W, 5%	R33
651004-341-075	RES. 510, 1/4, 5%	R34
643014-341-075	RES. 4.3K, 1/4W, 5%	R36
647004-341-075	RES. 470, 1/4W, 5%	R4,23, 40,45,47
610014-341-075	RES. 1K, 1/4W, 5%	R42
662004-341-075	RES. 620, 1/4W, 5%	R48
600000-341-075	RES. 0, 1/4W, 5%	R5
618004-341-075	RES. 180, 1/4W, 5%	R51,53
600072-360-004	POT. 100, 1/2W, CERMET, TOP	R52
627014-341-075	RES. 2.7K, 1/4W, 5%	R55
624094-341-075	RES. 24, 1/4W, 5%	R56
610094-341-075	RES. 10, 1/4W, 5%	R6,35,38
610004-341-075	RES. 100, 1/4W, 5%	R8
600261-230-001	TERMINAL	TP1-5
600526-415-001	IC 78M08, 8V REG	U1
600092-415-001	IC MC4044, PHASE DET.	U2
600240-415-001	IC 74LS05, HEX INV, O/C	U3,4
600225-415-001	IC 74LS192, UP/DN CNTR, SYNC	U5,6,7
600157-415-001	IC 74S74, D FLIP-F, DUAL	U8
600221-415-001	IC 74LS26, NAND, HV, QUAD	U9
600005-635-001	LED MOUNT	XDS1

Figure 4.19-8

Major Loop Board Assembly

NOTES:
1. UNLESS OTHERWISE NOTED.
   RESISTORS ARE IN OHMS, 1/4W, ±5%
   CAPACITOR VALUES ONE OR GREATER ARE IN MICROFARADS (μF), VALUES LESS THAN ONE ARE MICROFARADS (μF).

LAST DESIG. USED
R63, C77, CR13, L17, U9, Q14, M1, TP3, FB3, DS1
DELETED
C13

Figure 4.19-9

Major Loop Board Schematic

MAJOR LOOP BOARD, A16

PIN CONNECTIONS AND VOLTAGE READINGS

A16P3

GND	1	2	GND
+13 VDC	3	4	+13 VDC
	5	6	
+24 VDC	7	8	+24 VDC
50 kHz REF.	9	10	GND
GND	11	12	55.53-55.6299 MHz -10 dBm
	13	14	
	15	16	
	17	18	
100 kHz "2"	19	20	
100 kHz "1"	21	22	
100 kHz "4"	23	24	
100 kHz "8"	25	26	
1 MHz "2"	27	28	
1 MHz "1"	29	30	
1 MHz "4"	31	32	
1 MHz "8"	33	34	
10 MHz "2"	35	36	
10 MHz "1"	37	38	
LOGIC "Ø" or "1" $\overline{LL}$	39	40	$\overline{LL}$ LOGIC "Ø" or "1"
	41	42	59.63-89.53 MHz 0 dBm (lstLO)
GND	43	44	GND

4.20 SWITCHING POWER SUPPLY, A20

4.20.1 GENERAL

The 600460-705 Power Supply is a switching type design that provides up to 400 watts of output power on a continuous basis. The +26 VDC output can provide up to 15 amps current while the +5 VDC output can deliver up to 2 amps current. Built in overcurrent and overtemperature protection is also provided. The unit's physical size is less than 195 cubic inches. It is mounted inside the MSR 8050 Transceiver or the MSR 6700A Exciter. Connections to it are made through a wire harness (P1-P4) at the rear of the unit. Line voltage connection is made via an AC socket on the rear panel.

The power supply Input Assembly board contains two fuse holders and two line voltage switches for manual 115/230 VAC selection.

4.20.2 INPUT VOLTAGES

4.20.2.1 Input Voltage (for full performance)

115V Range = 103 VAC to 132 VAC
40 Hz to 410 Hz
230V Range = 185 VAC to 264 VAC
48 Hz to 62 Hz

4.20.2.2 Operational

115V Range = Down to 88 - 100 VAC
230V Range = Down to 172 - 185 VAC

4.20.2.3 Input Current

4.0 amps RMS maximum at 230 VAC input and 400W output
8.0 amps RMS maximum at 115 VAC input and 400W output

4.20.2.3 Apparent Power

(True RMS current x RMS line voltage)

805W nominal at 230 VAC input and 400W output
615W nominal at 115 VAC input and 400W output

4.20.2.4 Real Power/Efficiency

(Calculated from current and voltage waveforms)

520W nominal at 115/230 VAC input and 400W output, 77% efficiency

4.20.3 /ON CONTROL LINE, P1-2

The DRIVE indicator shall extinguish when the voltage of the /ON is taken from +6 VDC to open circuit (open circuit voltage may rise as much as +35 VDC). It will glow and take approximately one second to reach full brilliance when the voltage on the /ON line is taken from 0 to +4 VDC.

4.20.4 FAULT OUTPUT, P1-4

When operating into a load of 1k ohms connected to +5 VDC, the output voltage must be less than +1.2 VDC under either low voltage fault conditions or overtemperature fault conditions.

4.20.5 TEMPERATURE SENSE VOLTAGE

The voltage at TP5 must correspond to the heatsink temperature by the following relationship:

V (TP5) = 10 mV/degrees Kelvin
Tolerance is ± 6°K

(Example: 3.00 VDC = 300° Kelvin = 27° C)

4.20.6 +26V OUTPUT

This output is specified in Section 4.20.13.

4.20.7 +5V OUTPUT

This output is specified in Section 4.20.13.

4.20.8 LOW LINE TRIP POINT

The power supply shall turn OFF, and the FAULT indicator shall light when the +18V bus drops between +17 VDC and +15 VDC. This is typically a line voltage of 84 VAC ± 2V, and 166 VAC ± 5V on line ranges 115 VAC and 230 VAC, respecspectively. (Line voltages are typical and are not specified.)

4.20.9 INTERNAL OPERATING VOLTAGE

With 115 VAC or 230 VAC input, the following internal voltages should be generated:

At TP3: +18 VDC ±0.5V
At U3-16: +5 VDC ±0.5V

4.20.10 DRIVE

The drive pulse waveform at TP10 shall have the following characteristics:

Pulse period: 24 µSec to 26 µSec (41.6 kHz to 38.5 kHz)

Amplitude: 14V pk-pk

ON duty cycle: 46% to 50% (The ON portion of the pulse is the positive-going portion.)

The DRIVE indicator, DS4, shall glow with a brightness proportional to the drive duty cycle.

4.20.11 CIRCUIT PROTECTION

4.20.11.1 Primary Current Limit, R6

This control shall set the primary current limit threshold to 20A (at nominal line voltage).

4.20.11.2 Output Current Limit, R14

This control shall set the maximum output (short-circuit) current limit to 6A.

4.20.11.3 Current Limit Pulse Width, TT9

When triggered, U4 (one-shot) shall produce a pulse width of 12.0 mSec to 13.0 mSec at TP4.

4.20.11.4 Temperature, R2

This control shall set the overtemperature threshold of the heatsink to +82°C.

4.20.12 INDICATORS

4.20.12.1 +18 VDC (Yellow), DS1

This LED shall light when +18 VDC is present.

4.20.12.2 +5 VDC (Yellow) DS2

This LED shall light when +5 VDC is present.

4.20.12.3 Output (Yellow), DS3

This LED shall light when the +26 VDC output voltage is present.

4.20.12.4 Drive (Yellow), DS4

This LED shall light when drive pulses are present.

4.20.12.5 Primary Current Limit (Red), DS5

This LED shall light when the primary current limit circuit is active.

4.20.12.6 Output Current Limit (Red), DS6

This LED shall light when the output current limit circuit is active.

4.20.12.7 FAULT (Red), DS7

This LED shall light when a fault condition, over-temperature, or low-line voltage is detected.

4.20.13 OUTPUT SPECIFICATIONS

4.20.13.1 +26V Output Specifications

The +26 VDC output shall be measured across connectors P3/P4 and P2 with a 15 µF/35V tantalum capacitor from +26V to ground, and the +5 VDC output loaded with 2 amps.

Output Voltage(25°C and 1.5A load) : +26.4 VDC ± 0.2V

Design Output Current: 15 amps

Peak Output Current (at nominal line voltage): 18 amps, min. 5% duty cycle

Short Circuit Current: 5 amps to 7 amps

Ripple (PARD): 300 mV pk-pk, 30 mV RMS (20 Hz to 50 MHz)

Load Effect: 2% or less change in output voltage for load currents of 1.5 to 15 amps.

Source Effect: 2% or less change in output voltage for input voltages specified in 4.20.2.1 and 4.20.2.2.

Temperature Effect: 0.02% of output per degree C after 30 minutes warmup.

Load Transient Recovery: Output recovers to within 100 mV in less than 1 mSec following a load current change from 5 to 10 amps or from 10 to 5 amps.

4.20.13.2 +5V Output Specifications

The +5V output shall be measured across output connector pins P1-3 and P1-5 with a 15 μF/35V tantalum capacitor from +5 VDC to ground, and the +26V output loaded with 1.5A.

Output Voltage: +5.12 VDC to +5.28 VDC

Design Output Current (continuous): 2.0 amps

Short Circuit Current: 3.4 amps to 4.5 amps

Ripple: 75 mV pk-pk and 26 mV RMS

Temperature Effect: Output voltage change shall be ± 1 % or less over temperature range specified in Section 4.20.13.3.

5.20.13.3 Environmental

The power supply shall operate within specification in an environment with the following parameters (except as noted):

Ambient Temperature: -30°C to +55°C, to +65°C at 10% duty cycle

Relative Humidity: 95% at +50°C

Altitude: 10,000 ft. maximum

Table 4.20-1 Power Supply Subassemblies

DESIGNATOR	DESCRIPTION	PART NUMBER
A20	Power Supply Assembly	600460-705-001
A20A1	Power Supply Control Board	602015-536-001
A20A2	Transformer Board	602016-536-001
A20A3	FET Heat Sink Assembly	600428-537-001
A20A3A1	FET Drive Board	602017-536-001
A20A4	Input Board	602018-536-001
A20A5	Chassis	600219-651-001

4.20.14 CIRCUIT DESCRIPTION

4.20.14.1 General

The 600460-705 Power Supply utilizes an LM3524 switching regulator IC. This chip provides a reference voltage, an error amplifier, and a pulse-width modulator. The drive signal from this IC is transformer-coupled to two power FETs, and output voltages of +26 VDC and +5 VDC are generated. In addition, overcurrent and overtemperature protection is provided.

4.20.14.2 Input PC Board, A20A4

Input voltage is selected via S1 and S2 for 115 VAC and 230 VAC operation. C1-C4, along with T1, provide noise filtering of the AC input. Transformer T2 provides a nominal 24 VAC output which is rectified, filtered, and supplied as +30 VDC to the Control board via connector P1. This voltage is used to generate a regulated +18 VAC supply for use by the control circuitry. R5 provides surge-current protection for bridge rectifier CR1, while zener diode CR3 limits the maximum DC voltage delivered to the Control board.

Resistors R3 and R4 provide surge-current protection for bridge rectifier CR101, mounted on the power supply chassis. R3 and R4 are shunted by the relay K1, which closes when the /ON line at connector P1 is ground, allowing the (+) and (-) buses to reach full potential.

4.20.14.3 Control PC Board, A20A1

The Control board receives a nominal +30 VDC from the Input board via connector J1, and applies that voltage to regulator U1, which supplies +18 VDC to the control circuitry. Indicator DS1 glows to show the presence of the +18 VDC which remains on as long as AC line power is supplied to the unit.

The heart of the control circuit is a switching regulator 1C, LM 3524. A +5 VDC reference output is provided at pin 16 for control and protection circuitry. Negative-going pulses at pin 13 are applied to the base of Q4. The drive signal is then inverted by Q4 and applied to the base of Q5, an emitter-follower. The output from Q5 is then coupled through connector J4 to the FET driver transformers located on the FET DRIVE PC board.

The output of Q5 is also used to power DS4, which indicates the presence of drive pulses. The frequency of the drive signal is adjusted using R35, which connects to U3-6 through a 2k ohm resistor.

Pins U3-1 and U3-2 are error amplifier inputs to the switching regulator. A reference voltage is applied to U3-2. A sample of the +26V output voltage is then applied to U3-1 via voltage divider R44, R36 and R37. Zener diode CR13 limits the maximum DC voltage input to U3-1.

U3-9, the error amplifier output, is also used for loop compensation and ON/OFF control. Loop stability is maintained by filter components C19, C18 and R31. When U3-9 goes low via CR9, the switching regulator is disabled. CR9 action is controlled by the protection and /ON-function circuitry.

When the /ON line is taken low (J1-3), U2-2 (comparator input) is also pulled low, causing output pin U2-1 to go high. U3-9 voltage is allowed to rise (via CR9) such that the switching regulator output is enabled.

The Control board protection circuitry provides primary current, output current, and overtemperature sensing for the power supply. A low-line sensing circuit is also provided to disable the regulator in the event of low AC input voltage.

The primary current is monitored pulse-by-pulse through current-sense transformer T1, located on the FET Drive board and routed to the Control board via connector J4-5. Diode CR15 prevents the output of T1 from exceeding the +18 VDC supply. T1 output is filtered by C11, coupled to rectifiers CR1 and CR2, then fed to U5-10 for comparison with an adjustable DC voltage at U5-11. If the average voltage of the primary current pulse exceeds the current-sense threshold voltage, U5-13 then goes low, triggering one-shot multivibrator U4. The output pulse from U4-13 turns on Q6, which disables the remainder of the drive pulse via CR11. The circuit then recovers to monitor the next pulse. Output U5-13 also turns on primary limit indicator, DS5 via Q3. The

primary limit threshold, R8, is normally set to begin current limiting at 18A output current.

The primary current limit cannot limit the absolute output short-circuit current to the desired value because circuit delays make it impossible to get the FET drive pulse short enough. Therefore, a 0.025 ohm resistor, R49, is placed in series with the output ground lead and the negative-going voltage drop across this resistor is sensed by R17. R18 is used to pull up the voltage at U5-9.

The threshold at U5-8 is normally zero until the output voltage falls below approximately +4.4 VDC, turning on Q2 and causing the voltage to rise at U5-8.

U5-14 then goes low, causing U2-7 to go low. When U2-7 goes low, U3-9 is pulled low via CR9 and the switching regulator is disabled. The Output Limit indicator, DS6, is turned on when U5-14 goes low, turning on Q1. R14 is used to adjust the short circuit current to six amps.

Overtemperature sensing is achieved using temperature sensor CR3, located on the FET Drive board assembly. The temperature sensor has an output characteristic of 10 mV/degrees Kelvin so the heatsink temperature can be read easily by measuring the voltage at TP5. A voltage reading of 3.0 VDC for example, indicates a temperature of 300°K or 27°C (0°C = 273°k, so therefore 300° - 273° = 27°).

Voltage from temperature sensor CR3 is applied to U5-4. Bias voltage for the sensor is applied through R4. The voltage at U5-4 is compare the threshold voltage of +3.55 VDC (= +82°) set by R2. If the voltage at U5-4 goes higher than the threshold, U5-2 goes low.

U6-4 then goes high, which causes U6-8 to go low, lighting the FAULT indicator, DS7. U6-6 also goes low whenever the FAULT indicator turns on, pulling the fault output line low at TB1-4.

Low line voltage conditions are detected by comparing a sample of the +18 VDC bus with the +5 VDC reference voltage. As line voltage drops, U1 voltage also decreases. Voltage divider R20 and R22 feed approximately +6 VDC to U5-7. When this voltage drops below the +5 VDC threshold at U5-6, U5-1 goes low, which causes U6-12 to go high. When U6-12 goes high, both U6-10 and U6-2 go low.

U6-10 disables the switching regulator at U3-9 via CR9. CR7, R21 and R20 provide hysteresis so that the line voltage must rise somewhat above the threshold before the power supply will restart. Diode CR3 is used to lower the primary current threshold whenever U3 is disabled. A soft-start feature is provided with the time constant generated by R30, R26 and C17, thus allowing the output to rise slowly.

Final filtering of the +26 VDC output is also done on the Control board by C28, C29, C30, C31 and bifilar choke T1. The unfiltered voltage is taken from the XFMR and C101.

4.20.14.4 FET Heatsink Assembly, A20A3

The FET Heatsink Assembly consists of the FET Drive Board, heatsink and the FET transistors, connected together as an integral unit. During final assembly the power supply side chassis is secured to the FET heatsink assembly to improve the thermal characteristics of the unit.

4.20.14.5 FET Drive PC Board, A20A3A1

The FET Drive board consists of two FET switches (Q1 and Q2), driver transformers (T2, T3), related snubber networks, and voltage regulator U1 and associated circuitry. The FET board also contains a current-sense transformer (T1) and temperature sensor (CR3). The complete assembly is mounted on a heatsink, forming a module which plugs into the Transformer board.

Bus voltage is supplied to the FETs via connector P1-1, 2(+) and P1-4,5 (-). The (+) bus is connected to the drain of Q1 through primary current sense transformer T1.

FET current pulses are sensed through the primary winding of T1, with its secondary connected to the Control board via P4-5. The source of Q1 is connected through P2-4,5 to primary lead #1 of the power transformer on the Transformer board. The source of Q2 is connected to the (-) bus. The

drain of Q2 is connected to primary lead #2 of the power transformer through P2-1,2. Gate drive signals are independently applied, in-phase to Q1 and Q2 via T2 and T3, respectively. The gate drive signal comes from the Control board through connector P4-1. Capacitors C2 and C3 provide high voltage DC protection for the transformers.

Due to the nature of switch-mode power supply design, high voltage "spikes" are produced. Also, stray inductances may cause higher than normal voltages to be produced. Consequently, the breakdown voltage rating of the FETs may be exceeded. Therefore, spike suppression or snubber networks are necessary. Snubber networks consisting of C4/R6 and C5/R7 reduce spikes across the FETs. CR1 and CR2 act as "catcher" diodes and are turned on if the FET voltage should rise above the bus voltage.

Voltage regulator U1 is an LM350 which furnishes the power supply's +5 VDC output. The circuit is adjustable and furnishes a nominal 2 amp output for use by the transceiver. The +5 VDC output is taken to the Control board through connector P5-5 (+) and P5-4 (GND), where it is filtered and output from TB1-3. U1 input voltage is taken from P3-2 (+) and P3-1 (GND) and is nominal +20 VDC from the Transformer board. R9 provides output adjustment for the regulator and filtering is accomplished with C6, C7, C9, and C10.

4.20.14.6 Transformer PC Board, A20A2

The Transformer board has two major circuits: the high voltage bus circuit and the power output circuit. The bus circuit receives its DC input from bridge rectifier CR101, mounted on the power supply chassis.

Bifilar choke T1, along with capacitor C1, provide noise filtering for the (+) and (-) buses. Capacitors C2, C3, C4 and C5 provide primary filtering for the buses and are configured as a voltage-doubler for 115 VAC line input, switched with S2 on the Input PC board via the connection at E3. Resistors R1 and R2 are equalizing resistors which also bleed energy from the bus capacitors when power is removed. The high voltage (+) bus is taken from the positive terminals of C2 and C3, while the (-) bus is taken from the negative terminals of C4 and C5. The bus lines are then taken to the FET Drive PC board through connector J1-1, 2 (+) and J1-4,5 (-).

During the "ON" cycle, the FETs are driven to saturation, and the resultant energy is stored in primary circuit of power transformer T2 via connector J2-4,5 (primary lead #1) and J2-1,2 (primary lead #2). A forward converter design is used to produce the +26 VDC output. As current flows into the primary of T2, current also flows in-phase through the +26 VDC secondary winding. Current flows through rectifier CR2 and inductor L4 stores energy. During the "OFF" transition, current flows via CR3 and L4, R3, C6 and C7 form a snubber network around L4 to reduce spikes that result from FET switching and circuit inductance.

A flyback converter design generates the +5 VDC output. The core of T2 is slightly gapped in order to store energy during the FETs "ON" time.

During the "OFF" cycle, energy stored in the core of T2 is released and flows out of phase with the primary circuit into CR1. Capacitors C8 and C9 filter the resultant voltage, nominally +20 VDC, which is fed to the +5 VDC regulator circuit in the event that the +26 VDC output load is less than 2 amps.

4.20.14.7 Power Supply Cover, 1A5A3

The top cover of the power supply is fitted with viewing holes for the LED status indicators (BITE). The holes are labeled for easy identification during testing and troubleshooting.

4.20.15 TROUBLESHOOTING

4.20.15.1 Troubleshooting Chart

Table 4.20-2 describes the LED status indicators that are visible through the top cover of the power supply. Table 4.20-3 outlines symptoms and probable causes of some power supply failure.

4.20.16 USE OF EXTENSION CABLES

The power supply can operate in a partially disassembled mode through the use of optional exten-

sion cables. Follow diassembly procedures in Section 4.20.18 until the FET Drive board has been removed. Reconnect the FET Drive board to the Control board (P4 to J4 and P5 to J5) outside of the power supply. Use the extension cables to connect P1, P2 and P3 of the FET board to J1, J2 and J3 of the Transformer board. Lay the Control board/ FET board assembly in front of the power supply with the FETs face down. Use the last extension cable to connect J1 of the Control board to P1of the Input board. In all cases, be careful not to twist the cables or reverse any of the connections. Do not operate the supply at high current output for long intervals because the cooling fan is not connected in this state.

Finally, the power supply can be turned on and off by moving jumper P2 from J2, pins 2 and 3, to J2 pins 1 and 2.

4.20.17 POWER SUPPLY REMOVAL

To remove the power supply from the radio, follow the steps below.

1. Disconnect AC power cord from rear of radio.

2. Remove top and bottom covers of radio. Top cover is held by two (2) quarter-turn fasteners and bottom cover is secured by ten screws. Remove four (4) pan head screws that fasten power supply to radio Mother board.

3. Disconnect power supply wiring harness from radio by removing P1-4 from their mating connectors.

4. Remove 2 screws that secure steel top shield to top of power supply. Remove this shield.

5. Remove power supply unit from radio chassis. Steel bottom shield may now be removed also.

Table 4.20-2 LED Status Indicators

INDICATOR	NORMAL OPERATION	FUNCTION
DS1	ON	+ 18 VDC present
DS2	ON	+ 5 VDC present
DS3	ON	+ 26 VDC present
DS4	ON	Drive signal present
DS5	OFF	Primary current limit active
DS6	OFF	Output limit active
DS7	OFF	Fault condition present

Table 4.20-3 Power Supply Troubleshooting Chart

SYMPTOM	PROBABLE CAUSES
1 Power Supply does not operate. All indicators off or dim.	1) Fuse F1 and /or F2 blown. 2) Line voltage switches improperly set. 3) Bridge rectifier CR101 defective. 4) Resistors R2/R3 open. 5) Low voltage bridge rectifier defective. 6) Voltage regulator does not operate. 7) Contactor K1 inoperative. 8) On-line circuit open.
2 +18V indicator DS1 off or dim.	1) Low line voltage. 2) Line voltage switch S1 improperly set. 3) Regulator input voltage at TP2 less than +18 VDC. 4) Regulator U1 defective. 5) Transformer T2 defective. 6) Excessive load on +18 bus.
3 +5V indicator DS2 off or dim.	1) Excessive loading of +5 VDC output (greater than 3A). 2) Faulty regulator circuit (FET board).
4 +26V indicator DS3 off or dim; output limit indicator DS6 and primary limit indicator DS5 on; drive indicator DS4 off.	1) Excessive output load. 2) Defective power FETs (FET board). 3) CR2 and/or CR3 (Transformer board) defective. 4) CR1 and CR2 (FET board) defective. 5) Defective snubber network C6, C7, C11, R3 (Transformer board)
5 Drive indicator DS4 off or dim.	1) On-line circuit open or not pulled low. 2) Output limit or primary limit circuit tripped.
6 Fault indicator DS5 on.	1) Low line voltage. 2) Temperature threshold exceeded or misadjusted. 3) Temperature sensor CR3 (FET board) defective.

4.20.18 DISASSEMBLY OF POWER SUPPLY

These instructions assume the power supply has already been removed from its radio. Refer to the Installation section of the radio manual for this procedure.

4.20.18.1 Top Cover Removal

Remove the 14 screws that fasten the power supply top cover to its chassis. Note that some units are equipped with a steel shield over the top cover. This shield is held by two of the 14 top cover screws and must be removed first. Lift the top cover from the chassis.

Notice the large cylindrical capacitor C101. It is secured to the side panel by a c-clip that is fastened with a screw. This screw should not be removed.

4.20.18.2 Side Panel Removal

1. Remove the three (3) screws that fasten the side panel to the fan bracket.

2. Remove the two (2) screws securing the side panel to the input bracket. Next, lay the power supply on its side and remove the five (5) screws that hold the side panel to the bottom position of the main chassis (A20A5).

3. Return the supply upright and remove the five (5) screws that fasten the side panel to the internal FET heatsink. Do not remove the screw holding the c-clip, but gently pull the side panel outward until the wiring harness can be lifted up and over the top of the input bracket. While pressing the bottom of C101 toward the fan, slide the side panel away from the fan until the c-clip slides off of the end of C101.

4.20.18.3 Control Board Removal

The Control board can be removed with disconnecting it from the wiring harness or C101.

Remove two screws on either end of the Control board. You may have to loosen the black output ground lead at terminal E4 to remove one of the screws. Unplug the fan at connector J3.

Gently work the control upward until the three PC mount connectors (J2, J4, J5) are free. The Control board, C101 and the wiring harness can now be draped over the side wall of the main chassis. If the Control board must be totally removed, disconnect C101 at terminals E1 and E2.

4.20.18.4 FET Heatsink Assembly Removal

The FET Heatsink Assembly can be removed by gently pulling it upward until the three connectors (P1, P2, P3) between it and the Transformer board are disenaged.

4.20.18.5 Final Disassembly

Further disassembly is usually not required, but careful visual inspection at this state will show the remaining disassembly steps to be self-evident.

4.20.19 POWER SUPPLY REASSEMBLY

4.20.19.1 General

These instructions apply to a power supply whose FET Heatsink Assembly and Control board have been removed, but whose Transformer board and Input board are still installed in the main chassis along with the input and fan brackets.

4.20.19.2 FET Heatsink Assembly Installation

The FET Heatsink assembly plugs directly onto the Transformer board by aligning P1, P2 and P3 of the FET board with J1, J2 and J3 of the Transformer board, and carefully pressing downward to engage the connectors.

4.20.19.3 Control Board Installation

Carefully work the Control board underneath the lugs of the main chassis side panel and align J4 and J5 of the Control board with P4 and P5 of the FET drive board. Align J1 of the Control board with P1 of the Input board and gently press the Control board into place. Replace the two screws that secure the Control board in place.

4.20.19.4 Side Panel Replacement

Place the output wire harness in its place between C101 and the Input board and route it through its normal exit point a notch in the input bracket. Align the edge of the side panel nearest the fan with its corresponding place on the fan bracket and carefully press the side panel into place, guiiding C101 into its c-clip. This will require a moderate amount of pressure. Be sure the wiring harness and C101 are in place and reinstall all of the screws into the side panel.

4.20.19.5 Top Cover Replacement

Align the holes of the top cover with the corresponding holes in the main chassis and install the screws holding it in place. Tighten all screws securely. If the power supply has a top shield, place it over the top cover of the supply before installing the final two screws that hold it in place.

4.20.20 POWER SUPPLY REINSTALLATION

The steps in this section are to be followed for reinstalling the power supply into the radio.

1. Place bottom half of steel shield into power supply cavity, being careful to align four holes in shield with corresponding holes in Mother board.

2. Place power supply unit into its cavity while guiding output wiring harness into its slot in radio inner dividing wall.

3. Align power supply unit, steel bottom shield, and four (4) holes in radio Mother board and install four (4) pan head screws. Tighten securely.

4. Place steel top shield over top of power supply unit. Reinstall two (2) screws at opposite corners of shield and tighten securely.

5. Reconnect wiring harness P1-4 to appropriate jacks on radio.

6. Reinstall top and bottom covers of radio and reconnect AC line cord to rear of unit.

4.20.21 ADJUSTMENT PROCEDURES

4.20.21.1 General

The power supply is factory preset and should need no further adjustment, but a procedure is presented here for use in the event an adjustment is necessary. It is assumed the technician has a variable load with current indicator. All adjustments are made on the Control board. Adjustment tolerances can be found in Performance Specifications, Section 4.20.13.

4.20.21.2 Switching Frequency

The Switching Frequency is approximately 40 kHz. It can be measured with an oscilloscope at TP10.

The frequency is set at the factory to optimize current limit circuit performance and should not be readjusted.

4.20.21.3 +26V Output Adjustment

The +26V output should be set to 26.4 VDC while loaded to 1.5 amps. Potentiometer R37 is for this adjustment.

4.20.21.4 +5V Output Adjustment

While the +26V output is loaded to 1.5 amps, adjust the +5V output for +5.2 VDC. This adjustment is made with potentiometer R9, located on the FET Drive board. An access hole is provided in the Control board near J5.

4.20.21.5 Temperature Threshold Adjust

The over-threshold temperature of the FET heatsink should be set to +82°C. This is done by adjusting potentiometer R2 while measuring the DC voltage at TP4. The adjustment voltage is 355 mV.

4.20.21.6 Primary Current Threshold

This adjustment is made with potentiometer R6 by slowly increasing the loading of the +26V out-

put until the primary limit indicator (D55) just begins to turn on, and adjusting R6 so that this occurs at a loading of 18 amps. This ensures proper voltage foldback at a load current of about 20 amps.

4.20.21.7 Short Circuit Current Limit Adjustment

This adjustment is made with potentiometer R14. Increase the loading on the +26V output until foldback occurs, the output voltage drops to a low valve, and the current drops to about 6 amps. The primary current indicator DS5, the output limit indicator DS6, and the fault indicator, DS7 will come on. The fan will stop. R14 should be adjusted for a load current reading of 6 amps.

4.20.22 PERIODIC MAINTENANCE

4.20.22.1 Intake Air Filter

The intake air filter should be inspected often and cleaned when necessary. A clogged air filter will cause inefficient performance of the power supply, resulting in higher operating temperatures and possible failure. When the overtemperature threshold is reached, the power supply FAULT indicator will come "ON", but the power supply will still be operational. A signal is sent to the host radio which will disable the transmit function if this condition persists.

4.20.23 OPTIONS AND ACCESSORIES

4.20.23.1 Extension Cable Kit

The optional extension cable kit, P/N 600289-700-001, can be used as a troubleshooting aid, allowing operation of the power supply in a partially disassembled state. This allows access to PC boards and components that otherwise are inaccessible during operation. The cable kit consists of a set of three cables (P/N 600891-540-001) and a set of one cable (P/N 600891-540-002).

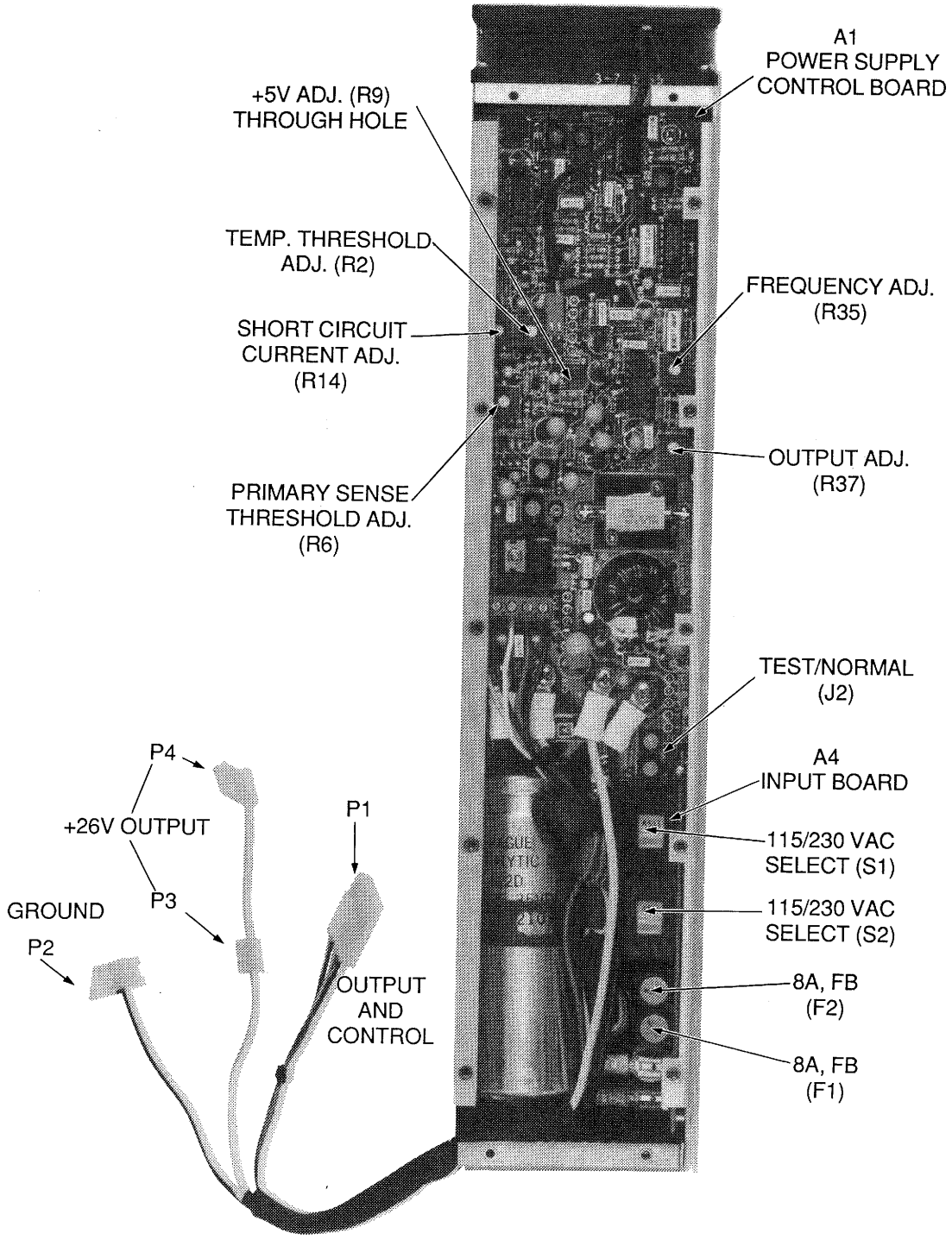


Figure 4.20-1 Power Supply Top View, Cover Removed

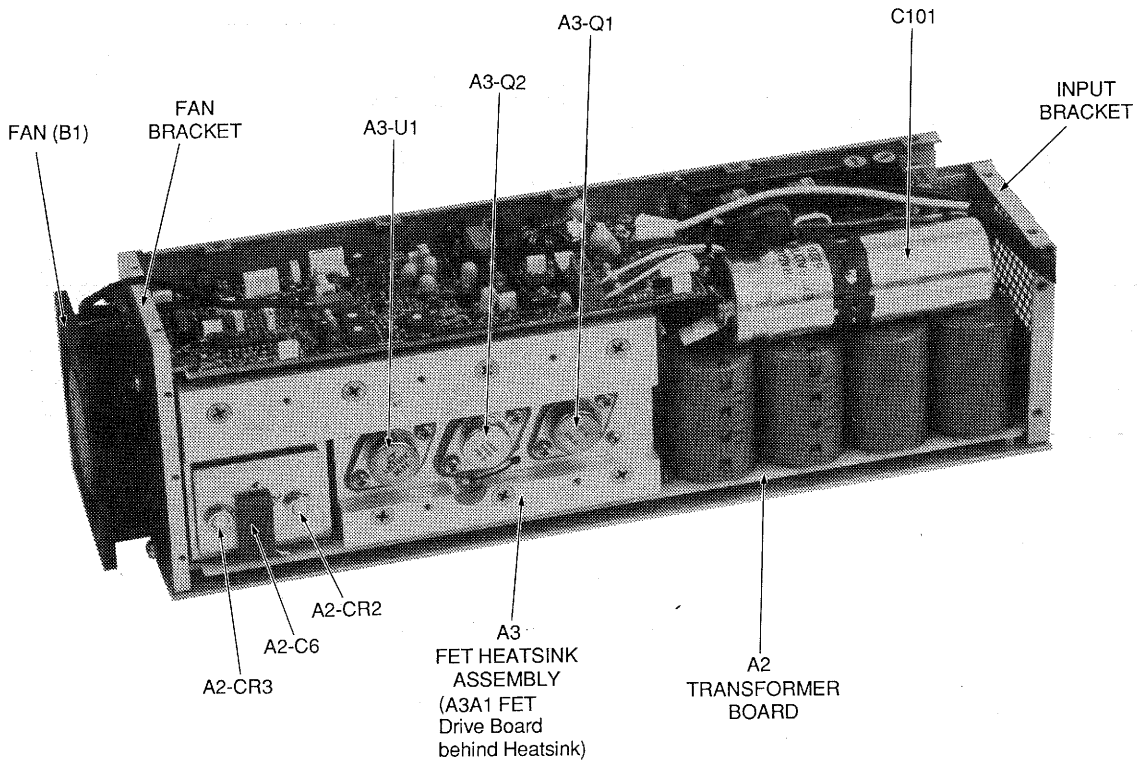


Figure 4.20-2 Power Supply Major Assemblies

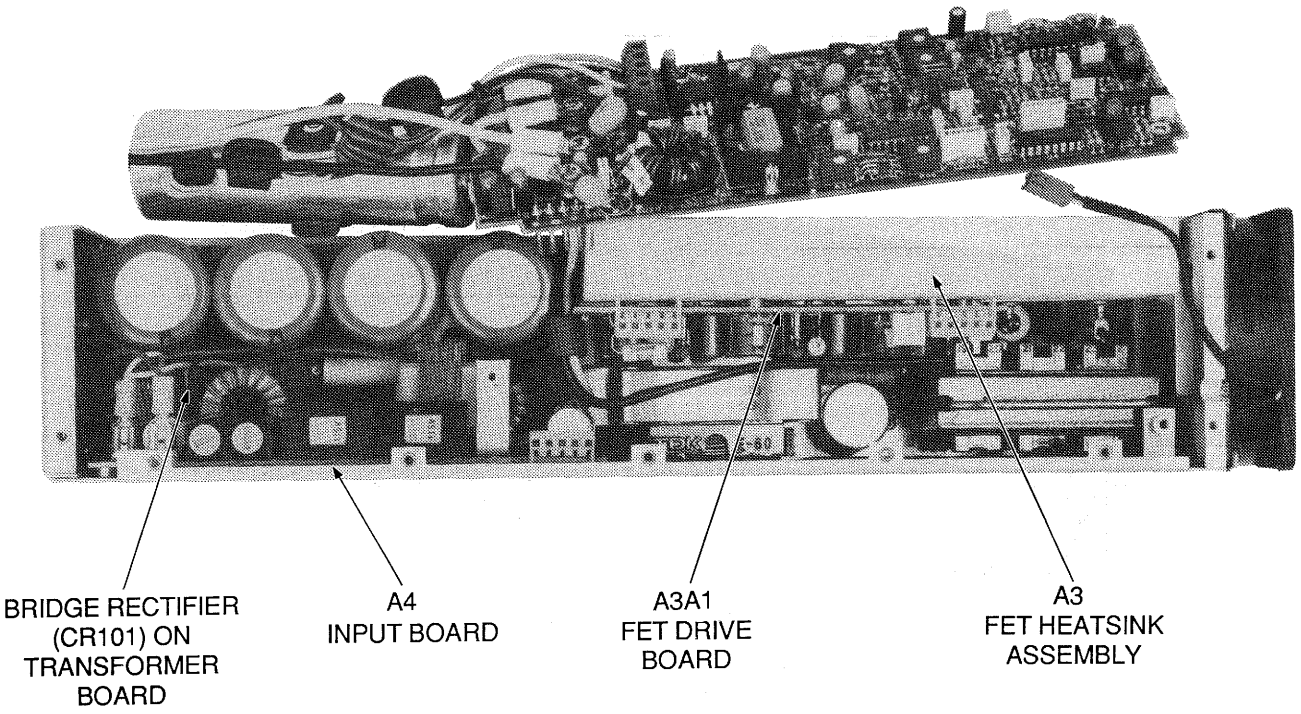
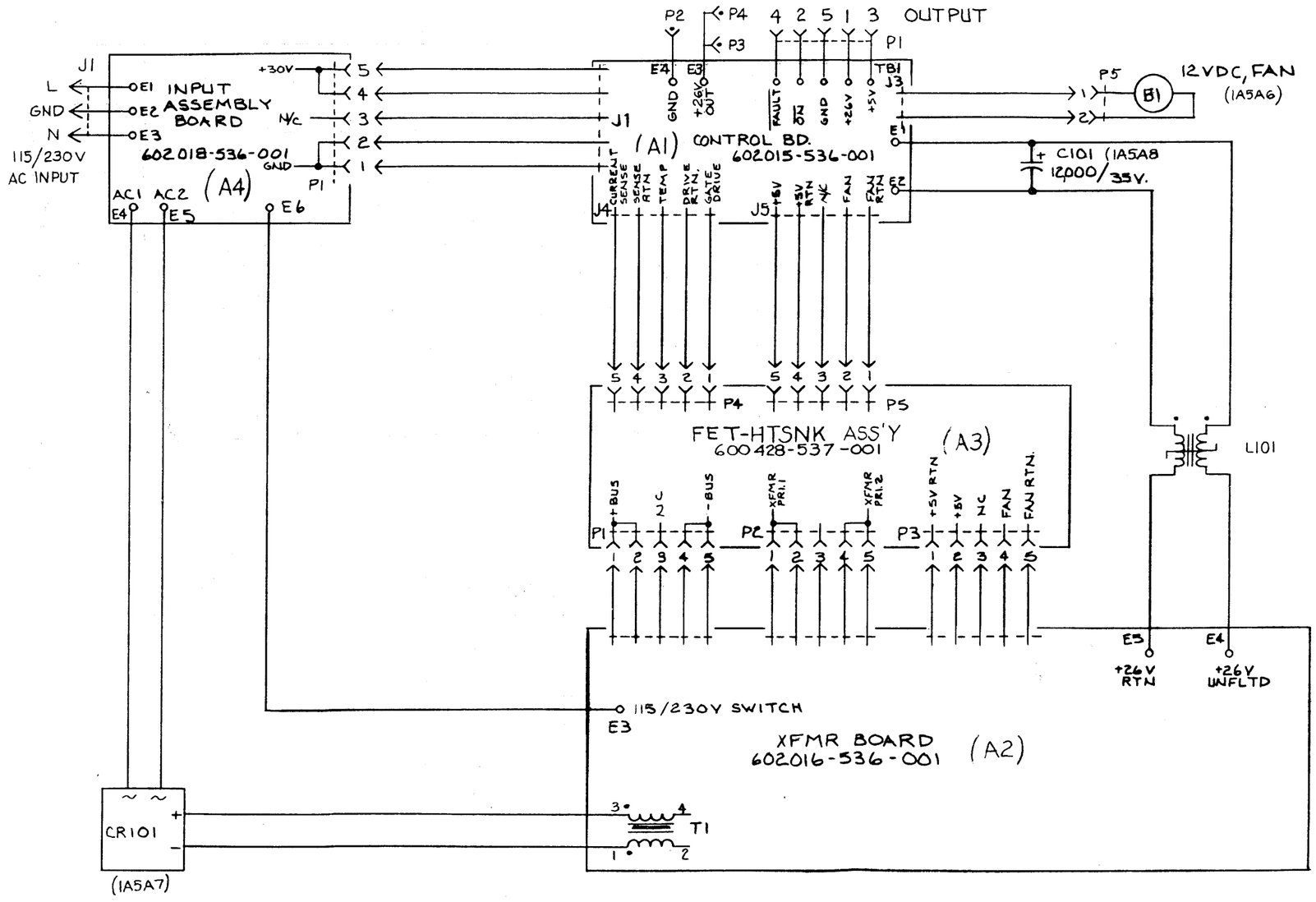


Figure 4.20-3 Power Supply Top View, Control Board Removed

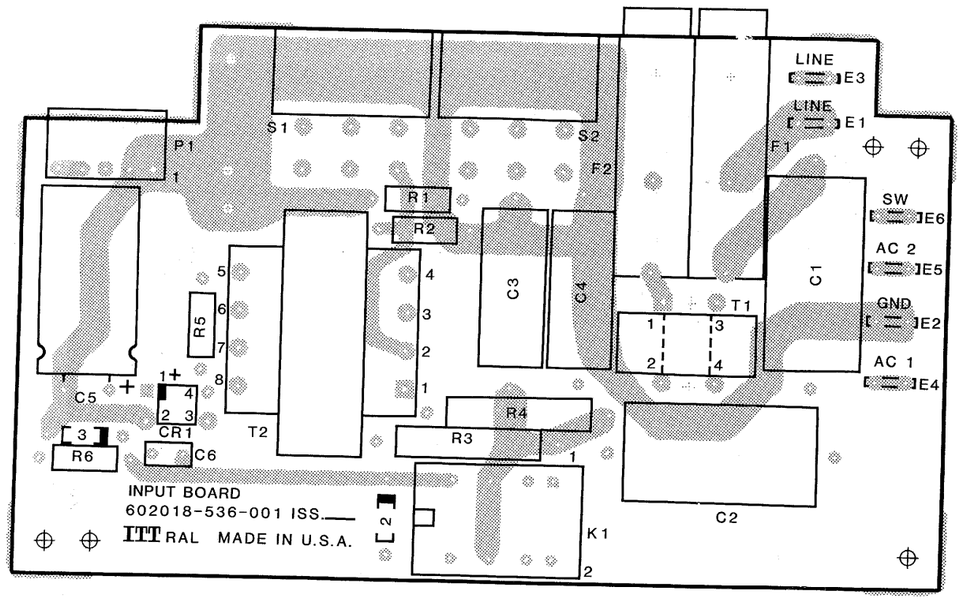


Power Supply (600460-705-001)

PART NUMBER	DESCRIPTION	SYMBOL
602015-536-001	PS CONTROL PBA	A1
602016-536-001	PS TRANSFORMER PBA	A2
600428-537-001	FET HEATSINK ASSY	A3
602018-536-001	PS INPUT PBA	A4
600031-387-001	FAN 3-15 CFM	B1
600183-314-036	CAP. 12000UF, ALUM, 35V	C101
600070-416-105	RECT. BRIDGE, MDA 2500	CR101
600116-611-001	RECEPTACLE	J1
600267-622-001	TOROID CORE	L101
600352-606-001	5 PIN CONNECTOR	P1
600471-608-002	CONN. HOUSING, MOLEX, 2 POS	P5
600471-608-001	CONN TERMINAL	(P5)
600219-651-001	CHASSIS	
604386-602-001	INPUT BRACKET	
604539-602-001	CHASSIS SIDE	
604384-602-001	FAN BRACKET SUPPORT	
604382-602-001	FAN BRACKET	
600267-622-001	TOROID CORE	
601067-609-001	PS COVER MARKED	

Figure 4.20-4

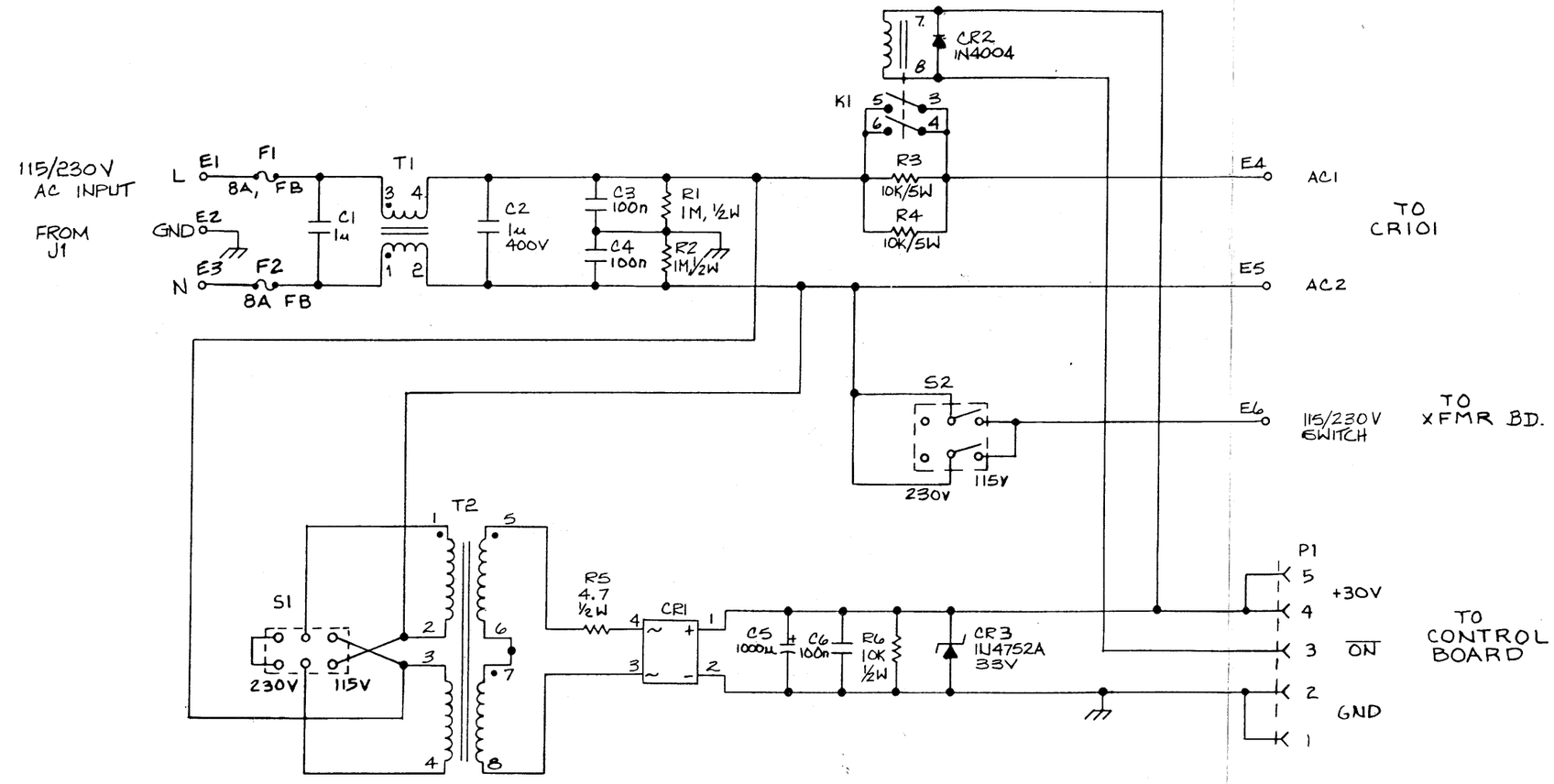
Power Supply Board Assembly/Schematic



Input (602018-536-001)

PART NUMBER	DESCRIPTION	SYMBOL
600472-314-013	CAP. 1UF, POLYPROP, 400V	C1,2
600472-314-007	CAP. 0.1UF, POLYPROP, 630V	C3,4
600297-314-042	CAP. 1000UF, ALUM, 50V	C5
600302-314-013	CAP. .1UF, MYLAR, 50V	C6
600014-416-001	RECT. BRIDGE, MDA 920A-6	CR1
600011-416-002	DIODE IN4004	CR2
600006-411-055	DIODE, ZENER, IN4752A 33V	CR3
600004-396-018	FUSE, 8A,FB	F1,2
600078-403-001	RELAY, 24V, PC MOUNT	K1
600121-608-016	CONN. SOC. MOLEX, 5 PIN RT/AN	P1
610044-341-205	RES. 1M, 1/2W, 5%	R1,2
600062-340-048	RES. 10K, 5W, 5%	R3,4
647084-341-205	RES. 4.7 1/2 W 5%	R5
610024-341-205	RES., 10K, 1/2W, 5%	R6
600381-616-001	SWITCH, SLIDE, DPDT, RT/AN	S1,2
600166-513-003	COIL, TOROID, BIFILAR	T1
600198-512-001	TRANSFORMER, DUAL, 24V SEC.	T2
600144-613-001	FUSE HOLDER	XF1,2

Figure 4.20-5 Input Board Assembly

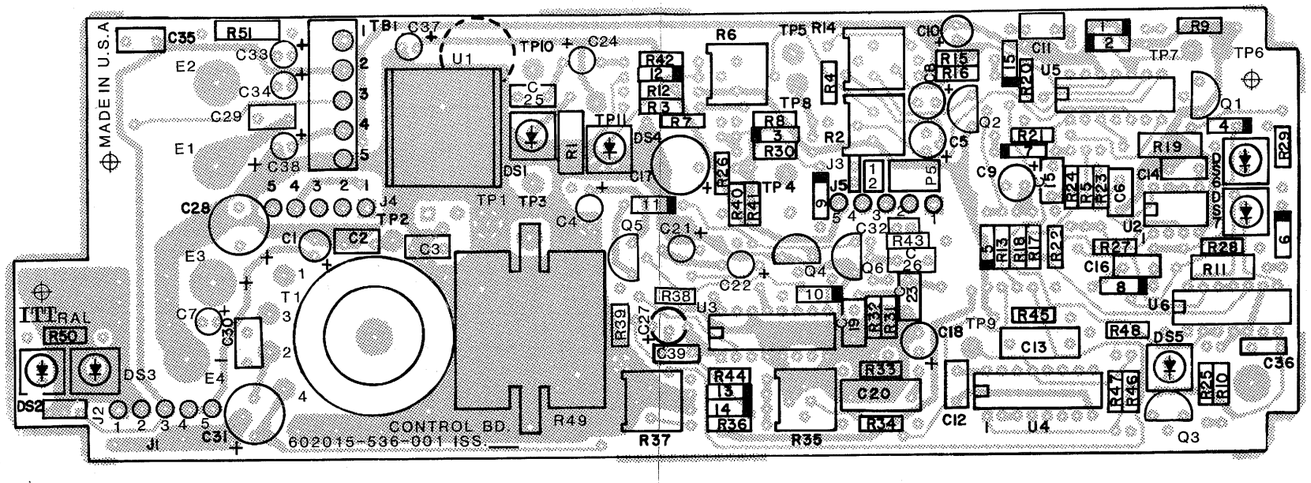


NOTES:

1. RESISTOR VALUES ARE IN OHMS, UNLESS FOLLOWED BY MULTIPLIER K OR M, AND ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED.
2. CAPACITOR VALUES ARE IN FARADS, UNLESS FOLLOWED BY MULTIPLIER u, n OR P.

Figure 4.20-6

Input Board Schematic



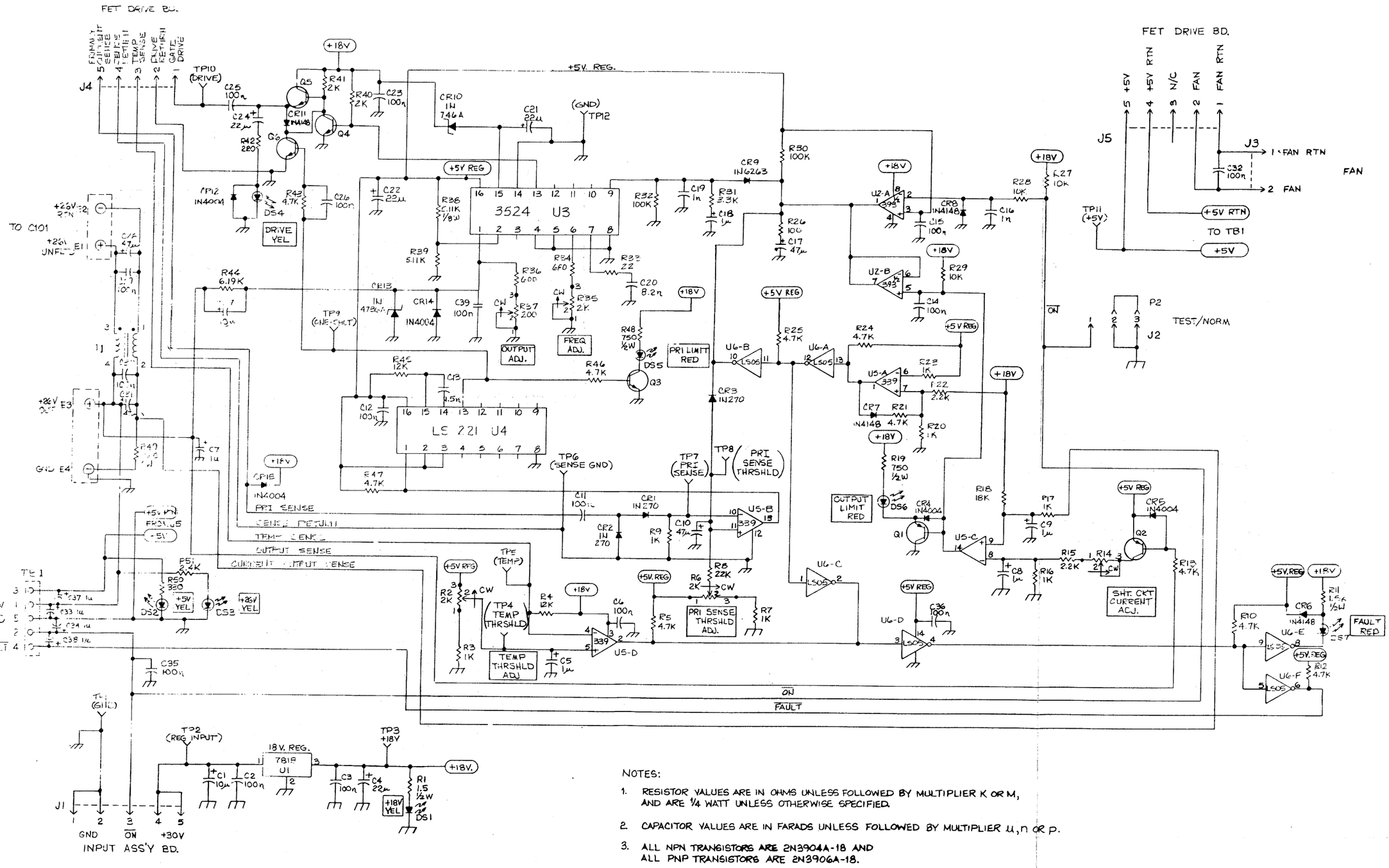
Control (602015-536-001)

PART NUMBER	DESCRIPTION	SYMBOL
600202-314-007	CAP. 1UF, 35V, TANT.	C5,7-9,18, 33,34,37, C38
600202-314-007	CAP. 1UF, 35V, TANT.	C27
600202-314-038	CAP. 10UF, 35V, TANT.	C4,21, 22,24
600202-314-041	CAP. 22UF, 35V, TANT.	C17
600202-314-044	CAP. 47UF, 20V, TANT.	C28,31
600202-314-045	CAP. 47UF, 35V, TANT.	C20
600204-314-031	CAP. .0082UF, MYALR, 630V	C13
600204-314-040	CAP. .0015UF, MYLAR, 630V	C32
600226-314-008	CAP. .1UF, CERAMIC, 50V	C1
600297-314-013	CAP. 10UF, ALUM, 50V	C10
600297-314-024	CAP. 47UF, ALUM, 10V	C16,19,26
600302-314-001	CAP. .001UF, MYLAR, 63V	C2,3,6,11, 12,14,15, C23,25,29, 30,35,36, C39
600302-314-013	CAP. .1UF, MYLAR, 50V	CR1-3
600302-314-013	CAP. .1UF, MYLAR, 50V	CR6-8,11
600052-410-001	DIODE IN270	CR9
600109-410-001	DIODE IN4148	CR10
600145-410-001	DIODE IN6263	CR13
600002-411-001	DIODE, ZENER, IN746A	CR4,5,12, 14,15
600006-411-009	DIODE IN4736A 68V	DS5-7
600011-416-002	DIODE IN4004	DS1-4
600036-390-001	LED, RED	J1,4,5
600043-390-002	LED, YEL	J2
600121-608-013	CONN. HEADER, MOLEX, 5 PIN	J3
600198-608-005	CONN. HEADER, 3 PIN, TIN	P2
600471-608-003	CONN. HEADER, MOLEX 2 PIN	Q1,2
600190-608-001	CONN. JUMPER, 2 POS.	Q3-6
600116-413-002	TRANS, 2N3906	R49
600229-413-003	TRANSISTOR 2N3904 TO-92	
600009-340-049	RES .025 10W, 3%, HEATSINK	

PART NUMBER	DESCRIPTION	SYMBOL
610004-341-075	RES. 100, 1/4W, 5%	R26
610014-341-075	RES. 1K, 1/4W, 5%	R3,7,9, 16,17, 20,23
610024-341-075	RES. 10K, 1/4W, 5%	R27-29
610034-341-075	RES. 100K, 1/4W, 5%	R30,32
612024-341-075	RES. 12K, 1/4W, 5%	R4,45
615014-341-205	RES. 1.5K, 1/2W, 5%	R1,11
618024-341-075	RES. 18K, 1/4W, 5%	R18
620014-341-075	RES. 2K, 1/4W, 5%	R40,41
622004-341-075	RES. 220, 1/4W, 5%	R42
622014-341-075	RES. 2.2K, 1/4W, 5%	R15,22
622024-341-075	RES. 22K, 1/4W, 5%	R8
622094-341-075	RES. 22, 1/4W, 5%	R33
624014-341-205	RES. 2.4K, 1/2W, 5%	R51
633004-341-075	RES. 330, 1/4W, 5%	R50
633014-341-075	RES. 3.3K, 1/4W, 5%	R31
647014-341-075	RES. 4.7K, 1/4W, 5%	R5,10,12, 13,21, 24,25
647014-341-075	RES. 4.7K, 1/4W, 5%	R43,46,47
668004-341-075	RES. 680, 1/4W, 5%	R34
675004-341-205	RES. 750, 1/2W, 5%	R19,48
651111-342-059	RES. 5.11K, 1/8W, 1%	R38,39
660001-342-059	RES. 600, 1/8W, 1%	R36
661911-342-059	RES. 6.19K, 1/8W, 1%	R44
600072-360-005	POT. 200, 1/2W, CERMET, TOP	R37
600072-360-008	POT. 2K, 1/2W, CERMET, TOP	R2,6,35
600072-360-009	POT. 5K, 1/2W, CERMET, TOP	R14
600261-230-001	TERMINAL	TP1-11
650128-513-001	TRANSFORMER	T1
600231-631-001	CONN	TB1
600240-415-001	IC 74LS05, HEX INV, O/C	U6
600324-415-001	IC LM339, COMPATATOR	U5
600335-415-001	IC 7818 REG. 18V	U1
600392-415-001	IC 74LS221, MONO MLTVB, DUAL	U4
600466-415-001	IC LM3524, P-W MOD	U3
600486-415-001	IC LM393, DUAL VOL COMP	U2
600182-419-001	HEAT SINK	

Figure 4.20-7

Control Board Assembly



NOTES:

1. RESISTOR VALUES ARE IN OHMS UNLESS FOLLOWED BY MULTIPLIER K OR M, AND ARE ¼ WATT UNLESS OTHERWISE SPECIFIED.
2. CAPACITOR VALUES ARE IN FARADS UNLESS FOLLOWED BY MULTIPLIER µ, n OR p.
3. ALL NPN TRANSISTORS ARE 2N3904A-18 AND ALL PNP TRANSISTORS ARE 2N3906A-18.

Figure 4.20-8

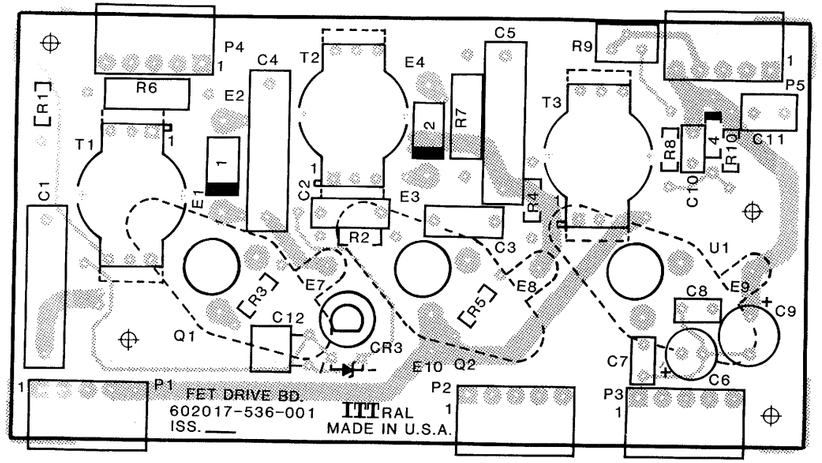
Control Board Schematic

FET Heatsink Assembly (600428-537-001)

PART NUMBER	DESCRIPTION	SYMBOL
602017-536-001	FET DRIVE BOARD	A3
600598-415-001	DIODE LM335Z, PREC TEMP SENSOR	CR3
641320-542-013	FET PR IRF451-MATCHED	Q1,2
600817-415-001	IC LM350K, ADJ VOL REG	U1
604388-602-001	HEATSINK,FET	
604554-602-001	HEATSINK,TOP	
604555-602-001	HEATSINK,BOT	

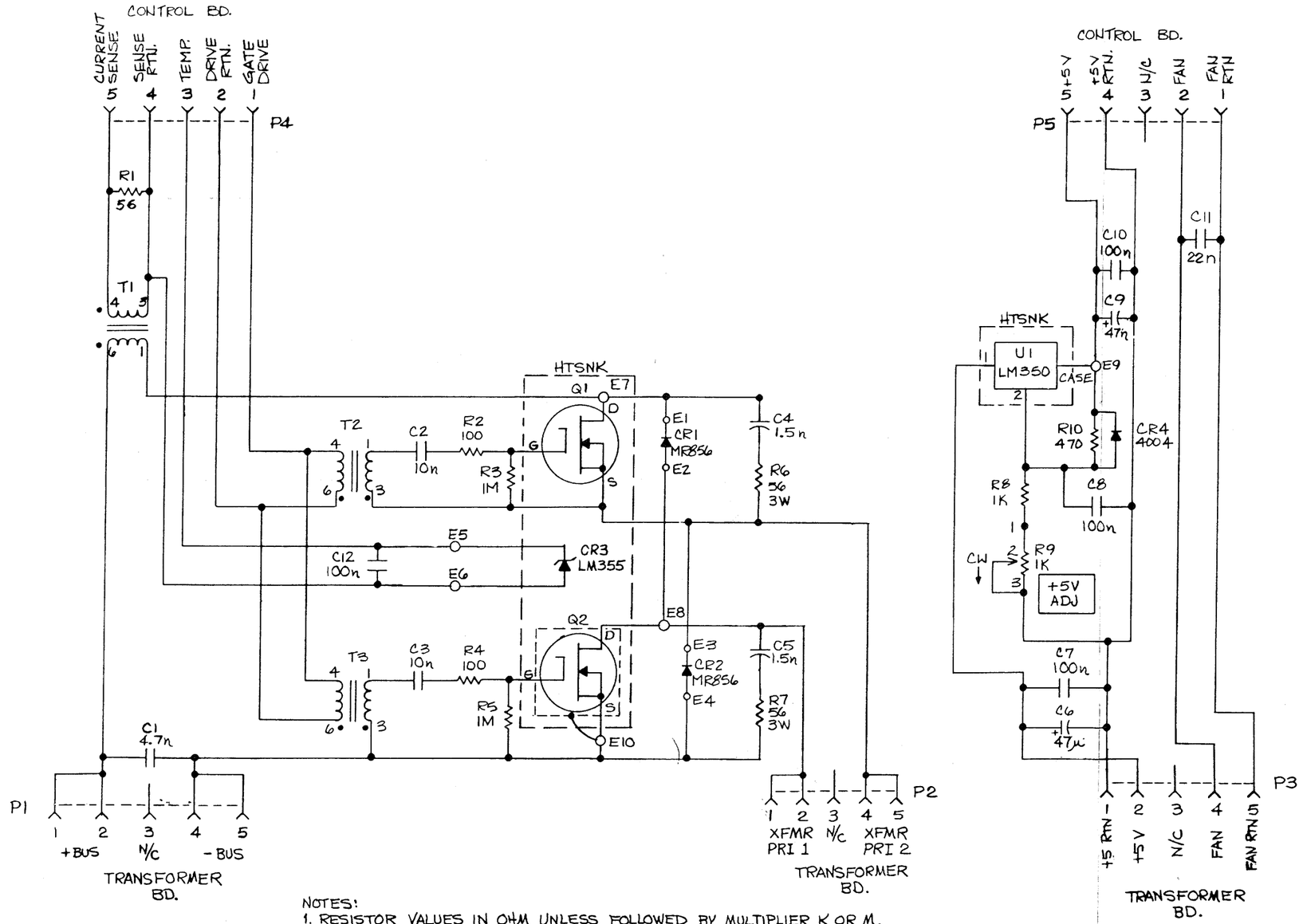
Figure 4.20-9

FET Heatsink Assembly



FET Drive Board (602017-536-001)

PART NUMBER	DESCRIPTION	SYMBOL
600357-314-005	CAP. .0047UF, POLYPROP, 1500V	C1
600302-314-015	CAP. .22UF, MYLAR, 50V	C11
600204-314-001	CAP. .01UF, MYLAR, 400V	C2,3
600357-314-002	CAP. .0015UF, POLYPROP,	C4,5
600297-314-026	CAP. 47UF, ALUM, 50V	C6
600302-314-013	CAP. .1UF, MYLAR, 50V	C7,8, 10,12
600202-314-044	CAP. 47UF, 20V, TANT.	C9
600042-416-002	DIODE MR856, FAST RECOVERY	CR1,2
600011-416-002	DIODE IN4004	CR4
600260-230-001	LARGE TURRET TERMINAL	E1-4
600121-608-016	CONN. SOC. MOLEX, 5 PIN RT/AN	P1-5
656094-341-075	RES. 56, 1/4W, 5%	R1
647004-341-075	RES. 470, 1/4W, 5%	R10
610004-341-075	RES. 100, 1/4W, 5%	R2,4
610044-341-075	RES. 1M, 1/4W, 5%	R3,5
600062-340-056	RES. 56, 3W, 5%	R6,7
610014-341-075	RES. 1K, 1/4W, 5%	R8
600066-360-007	POT. 1K, 1/2 W, CERMET, RT/AN	R9
635323-501-001	TRANSFORMER, CURRENT SENSE	T1
635312-501-001	TRANSFORMER, FET DRIVER	T2,3

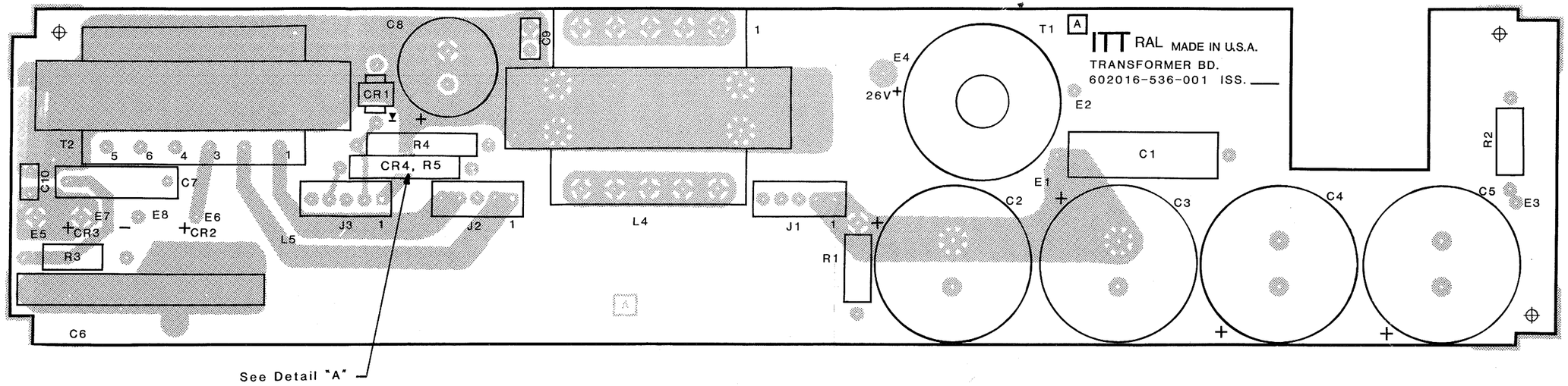


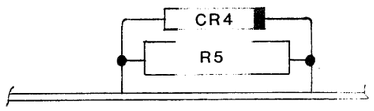
NOTES:
1. RESISTOR VALUES IN OHM UNLESS FOLLOWED BY MULTIPLIER K OR M, AND ARE ¼W UNLESS OTHERWISE SPECIFIED.

2. CAPACITOR VALUES IN FARADS UNLESS FOLLOWED BY MULTIPLIER µ, n OR p.

Figure 4.20-10

FET Heatsink Schematic





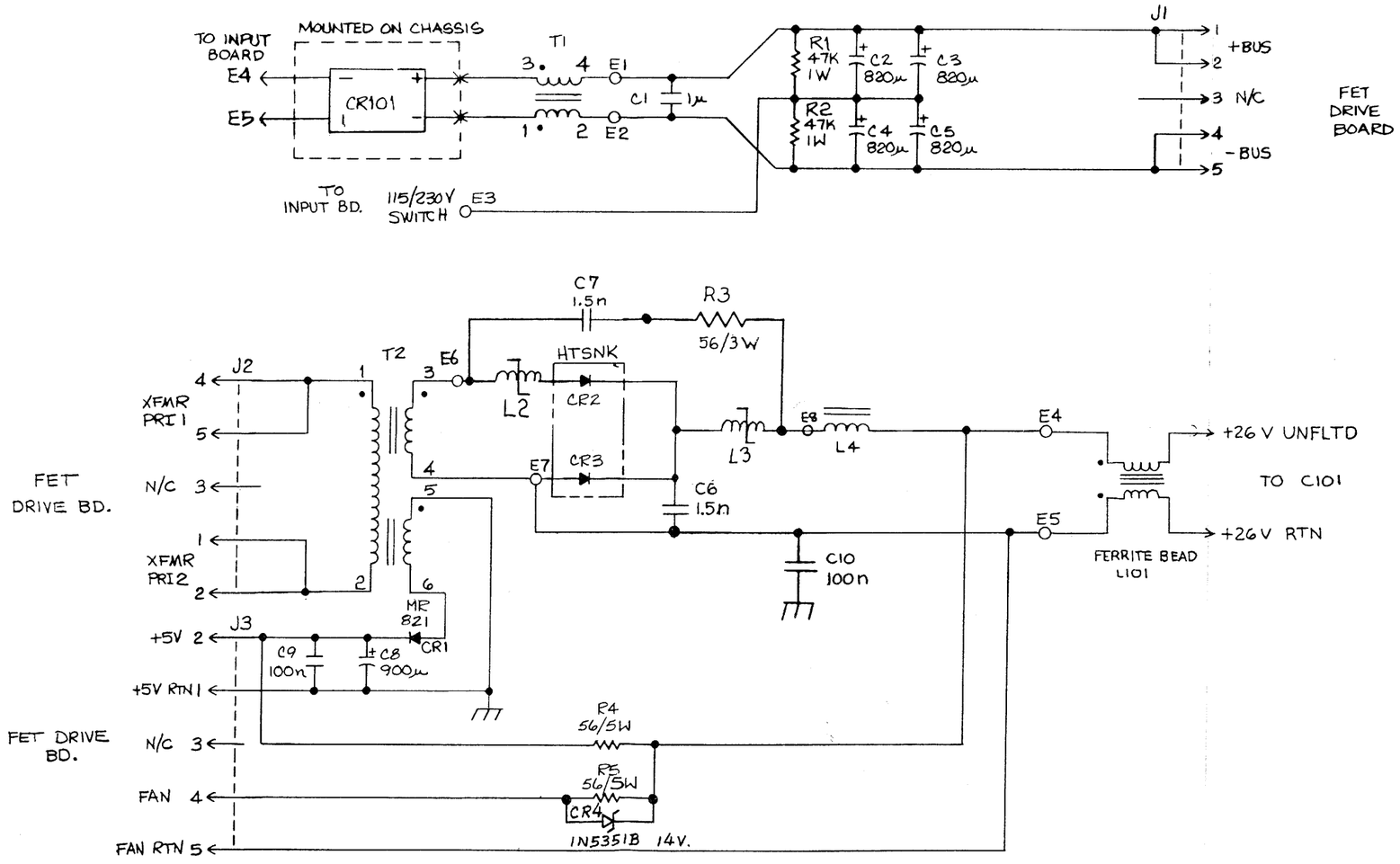
Detail "A"

Figure 4.20-11

Transformer Board Assembly

Transformer (602016-536-001)

PART NUMBER	DESCRIPTION	SYMBOL
600270-314-005	CAP. 1.0 UF, 400V	C1
600366-314-002	CAP. 820UF, ALUM, 200V	C2-5
600357-314-002	CAP. .0015UF, POLYPROP, 1500V	C6,7
600257-314-006	CAP. 900UF, ALUM, 25V	C8
600302-314-013	CAP. .1UF, MYLAR, 50V	C9,10
600062-416-001	DIODE MR821, FAST RECOVERY	CR1
604387-602-001	HEATSINK, RECT	(CR2,3)
600470-608-001	RECT, CONN BD	(CR2,3)
600170-419-005	DIODE INSULATOR	(CR2,3)
700001-416-001	DIODE MUR-5020, ULTRA FAST REC	CR2,3
600121-608-013	CONN. HEADER, MOLEX, 5 PIN	J1,2,3
600267-622-001	TOROID CORE	L2,3
635048-510-001	TRANSFORMER	L4
647024-341-325	RES. 47K 1W 5%	R1,2
600062-340-056	RES. 56, 3W, 5%	R3
600062-340-001	RES. 56, 5W, 5%	R4,5
600166-513-002	COIL, TOROID, BIFILAR	T1
635340-501-002	TRANSFORMER, POWER	T2



NOTES:

1. RESISTOR VALUES ARE IN OHMS UNLESS FOLLOWED BY MULTIPLIER K OR M AND ARE ¼ WATT UNLESS OTHERWISE SPECIFIED.

2. CAPACITOR VALUES ARE IN FARADS UNLESS FOLLOWED BY MULTIPLIER µ,n OR p.

Figure 4.20-12

Transformer Board Schematic

SECTION 5

OPTIONS

5.1 TONE KEY AND FSK MODEM OPTION (Tone Key/Modem Board A14)

This factory-installed option provides two separate capabilities to the MSR 6700A Exciter/MSR 5050A Receiver: 1) Tone keying for increased CW keying rate (MSR 6700A) and 2) FSK communication between MSR 5050A/6700A and the MSR 6420 remote control unit over a telephone line or a pair of wires.

The option (P/N 700015-700-001) consists of Tone Key/Modem board (P/N 602025-536-002) which is plugged into the Mother board.

The explanations include instructions for the setting of switches on the Mother board, the Interface board, and the Tone Key/Modem board in order to attain the functions desired.

5.1.1 FSK MODEM CIRCUIT

This circuit provides frequency-shift-keyed (FSK) communication between the exciter and the RCU at 300 Baud. The circuit transmits and receives binary data over standard telephone lines or a pair of wires. The modem will operate at 300 Baud only. When FSK communication is desired, switches S1, S2 and S3 on the Interface boards of the MSR 5050A and MSR 6700A must be set according to Table 3.1 in section 3 of the manual.

5.1.1.1 FSK Modem Theory

A brief description of FSK modem theory is provided to allow the user to understand the operation of this circuit.

Two FSK modems are required for data transmission. At the transmit end of the signal path, a modem modulates a digital signal by converting the logic 1 (high) and logic 0 (low) signals into separate audio frequency tones. The tones are transmitted over a pair of lines to the second modem at the receive end of the signal path. This modem demodulates the audio tones by converting them back into a serial digital data stream.

Two-way communication is required, so each modem must be able to modulate and transmit as well as receive and demodulate. This is accomplished by using different frequency tones. There are two sets of tones. One modem receives on tone set A and transmits on tone set B. The other modem receives set B and transmits set A.

The modems are differentiated by placing one in the "Originate" mode and the other in the "Answer" mode. These are the tones used:

	Logic	Transmit	Receive
Originate	1	1270 Hz	2225 Hz
	0	1070 Hz	2025 Hz
Answer	1	2225 Hz	1270 Hz
	0	2025 Hz	1070 Hz

The transmitting section of the modem is comprised of tone generating circuitry. Correct frequency tones are generated in response to the digital data input. The receive section contains filters and demodulators which respond to the audio tones, converting them to a serial data output.

5.1.1.2 Modem IC U1

The heart of the FSK modem circuitry is U1, a single chip modem circuit. The chip operates at 300 Baud and contains modulation, demodulation and filtering. All necessary audio tones are generated by crystal oscillator circuitry, along with crystal Y1 and capacitors C6 and C7. The oscillator frequency can be measured at TP4.

Digital data to be transmitted comes into the board on pin 18 and is fed directly to pin 10 of U1. This data is converted to audio tones and leaves the chip on pin 16. The tones can be monitored

at TP6.

Received tones pass through U3 and into pin 15 of U1, and may be monitored at TP5. These incoming tones are converted into serial deigital data by U1, leave the chip at pin 4 and the board at pin 19. The digital data stream may be monitored at TP1.

A carrier-detect indicator, DS1, is provided to show when the modem has acquired a carrier signal from another modem and communication between the two is possible. The carrier light is driven by pin 2 of U1 and buffered by U2A and U2B. U1-2 goes low when a carrier is detected. Components R2 and C8 determine the time constant of the carrier detector.

The frequencies of transmitted and received tones depend on whether the modem is in the ORIGINATE or ANSWER mode; this depends on the state of U1-12. If U1-12 is high, the modem is in the ORIGINATE mode, and if low, in the ANSWER mode. Pin 11 of the board is controlled by the MSR 5050A/6700a microprocessor.

5.1.1.3 Active Hybrid U3

The purpose of the active hybrid is to simultaneously receive input tones from, and couple transmit tones into, a single 600 ohm line. The transmit tones are buffered by U3A, which drives output transformer T1 through terminating resistor R14. Received tones are amplified and buffered by U3B.

If the 600 ohm line is actually 600 ohms, the transmit signals from U3A are prevented from entering the receive port of U1 by the canceling effect of the differential input of U3B. In actual practice, only 10 dB of cancellation is provided and no more is needed because of effective filtering built into U1.

If the Addressable Audio I/0 option is installed in the radio, the external FSK 600Ω lines come into the Audio interface board (see section 3 of the manual for Option jumper instructions) instead of the Tone Key/Modem board. Analog gates U6D, U6C are opened (by a ground on pin 40 caused by inserting the Audio Interface board). This disconnects Tone Key/Modem board circuits; and the U1 Modem chip RCVA, TXA signals go to the Audio Interface board.

5.1.2 TONE KEY CIRCUIT (MSR 6700A only)

When the MSR 6700A system is in the Tone Key mode, the RCU uses a 2930 Hz tone mixed with the standard audio to signal the exciter to transmit. This allows extremely fast CW keying rates which are not limited by digital command communication delays. If normal keying is desired, the board can be switched to the Serial Key mode, bypassing the Tone Key circuitry.

When the RCU is keyed, a 2930 Hz tone is mixed with the standard audio and sent to the exciter. The exciter detects this tone and keys (transmits) whenever the tone is present. A notch filter removes the 2930 Hz keying tone before the audio signal is sent on to modulate the RF carrier in the exciter.

5.1.2.1 Tone Key IC U5

The heart of the tone key circuitry is U5, a single-frequency bandpass filter, band reject filter, and tone generator, with a selectable-input buffer amplifier.

The tone generator frequency is controlled by an external crystal. The standard crystal supplied produces a 2930 Hz tone. Other crystals may be used to provide tones from 1500 Hz to 3400 Hz. The band reject filter is used to "notch out" all audio at the tone frequency. The bandpass filter extracts the tone from the input audio signal to allow detection of the keying tone. The selectable-input buffer amplifier can be switched to amplify either the unfiltered audio input, or the filtered audio input with the keying frequency has been notched out. The state of the notch-enable line, pin 10, determines which signal will be amplified. A low on pin 10 switches in the notched audio, and a high causes the unfiltered audio to be amplified. The buffered signal leaves the IC on pin 9.

5.1.2.2 Circuit Operation At Exciter

Switch S1 in the Tone Key position:

Standard audio comes into the board on pins P1-23 and P1-25, and into U5 on pin 1. The notch-enable line, U5-10 is low so the audio is notched at 2930 Hz before leaving U5 at pin 9. The audio signal is amplified by U7C and leaves the board at P1-31. No output level setting (U7D) is required because of the compresson circuitry in the exciter.

When the RCU is keyed, a 2930 Hz tone is present on the incoming audio. This tone passes through the bandpass filter on the chip, leaving U5 on pin 12. The keying tone is amplified and rectified by U7A. U7B and associated circuitry are used as a variable threshold detector. The purpose of the variable threshold is to keep the exciter key pulse duration identical to that of the key pulse at the RCU. This is accomplished by triggering the detector always on the leading edge of the rectified keying pulse signal. When the RCU is first keyed, the signal level at U7-12 is low and begins to rise. The threshold is now relatively low, set by R30. U7B-14 switches to high as the rectified tone begins to rise. When the RCU is unkeyed, the rectified signal at U7B-14 begins to drop. The threshold at U7B-14 is raised so that U7B-14 switches to low as the rectified keying tone signal begins to drop,rather than after it has decayed to a low level. This preserves the correct key pulse duration. The threshold is raised by the rectifying action of CR11, R39 and C32.

While the keying tone is detected, U7B-14 is high. DS1 lights to indicate the keyed condition U2D inverts this high level to a low level signal which keys the exciter via the REMOTE KEY input to the Coupler Interface board.

Switch Slim the Serial Key Mode:

Switch S1 jumpers REMOTE KEY IN and REMOTE KEY OUT together. This removes control of the REMOTE KEY line from the Tone Key board.

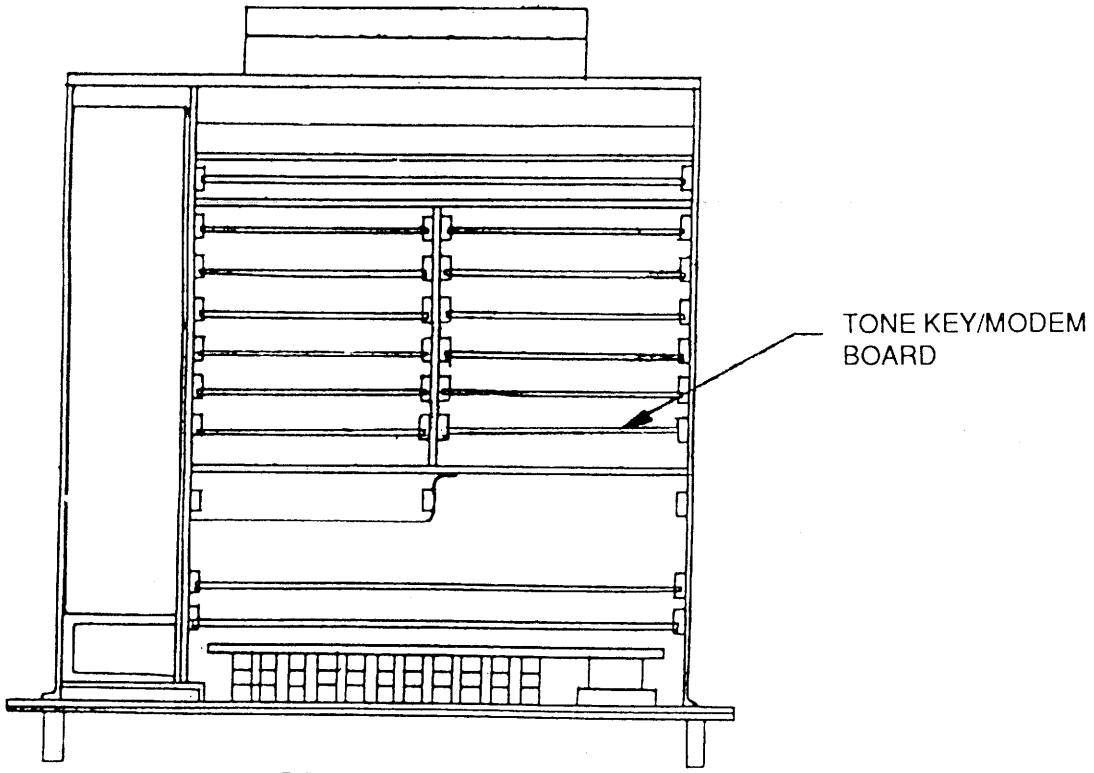
The notch-enable line (U5-10) is no longer low so the standard audio signal coming into the chip does not pass through the notch filter before exiting at U5-9.

5.1.2.3 Audio Ground Reference Voltage

Resistors R27 and R28 set up a reference "audio ground voltage", VAG, which is one-half of the +13v supply voltage level. VAG is used as a dc reference voltage in the audio portions of the tone key circuitry. This prevents the need for a negative supply voltage for U5, U6 and U7.

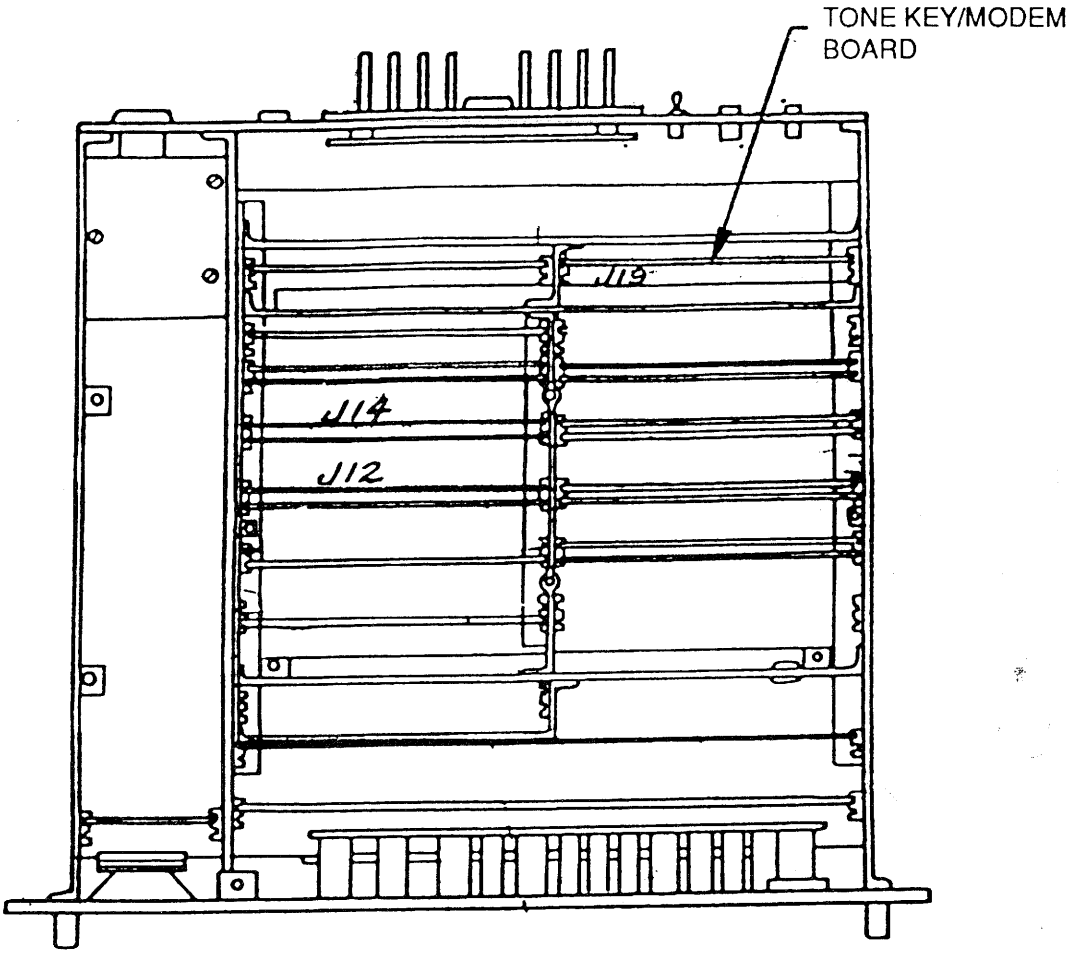
5.1.2.4 On-Board Power Generation

Positive 12 volts is generated from the +13v line by zener diode CR1 and resistor R1. Negative 5 volts is generated by U4, NE 555 timer IC, and associated circuitry as follows: The output of U4 is a 10 kHz square wave at U4-3. When U4-3 is high, C14 is charged via R6 and CR4. When U4-3 goes low, the charge on C14 is transferred to C13 via CR3. Note that a negative voltage is transferred to C13. Zener diode CR2 limits the negative voltage to -5v. C11 and C12 provide additional filtering



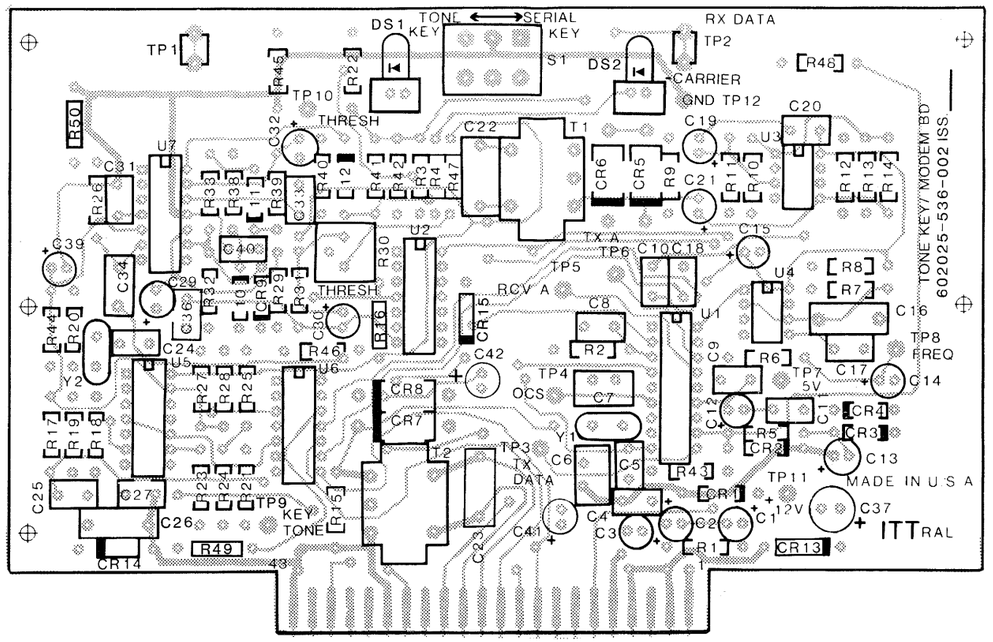
NOTE: SLIDE SWITCH ON BOARD TO LEFT FOR "SERIAL KEY", TO RIGHT FOR "TONE KEY".
REFER TO RADIO MANUAL FOR POSITION OF JUMPERS ON MOTHER BOARD.

Figure 5.1-1 Installation, MSR 6700A



NOTE: REFER TO RADIO MANUAL FOR POSITION
OF JUMPERS ON MOTHER BOARD.

Figure 5.1-2 Installation, MSR 5050A



Tone Key/Modem (602025-536-002)

PART NUMBER	DESCRIPTION	SYMBOL
600202-314-018	CAP. 10UF, 25V, TANT.	C1-3, 12-15,19, 28,30,41, 42
600204-314-003	CAP. .015UF, 400V	C16
600297-314-016	CAP. 22UF, ALUM, 25V	C21
600204-314-001	CAP. .01UF, MYLAR, 400V	C22,23
600302-314-013	CAP. .1UF, MYLAR, 50V	C25,27, 31,33,40
600204-314-026	CAP., .047UF, 250V	C26
600202-314-007	CAP. 1UF, 35V, TANT.	C29,32
647003-306-501	CAP. 470PF, 3%, MICA, 500V	C34
600302-314-015	CAP. .22UF, MYLAR, 50V	C36
600297-314-032	CAP. 100UF, ALUM, 25V	C37
600202-314-022	CAP. 22UF, 15V, TANT.	C39
600302-314-013	CAP. .1UF, MYLAR, 50V	C4,5,9, 10,18, 20,24,
615091-306-501	CAP. 15PF, 1%, MICA, 500V	C6,7
600302-314-007	CAP. .01UF, MYLAR, 63V	C8,11,17
600033-411-022	DIODE, ZENER, 1N4242B	CR1
600052-410-001	DIODE IN270	CR12, 14,15
600011-416-002	DIODE IN4004	CR13
600006-411-006	DIODE, ZE	CR2
600109-410-001	DIODE IN4148	CR3,4, 9-11
600028-411-001	DIODE, VOLT.SUPRESSOR P6KE6,8A	CR5-8
600043-390-002	LED, YEL	DS1,2
636094-341-075	RES, 36,1/4W, 5%	R1
682014-341-075	RES. 8.2K, 1/4W, 5%	R10
615004-341-075	RES. 150, 1/4W, 5%	R14
662004-341-075	RES. 620, 1/4W, 5%	R15

PART NUMBER	DESCRIPTION	SYMBOL
647024-341-075	RES. 47K, 1/4W, 5%	R17,21, 44,46
610014-341-075	RES. 1K, 1/4W, 5%	R18,31, 32,39,47
639014-341-075	RES. 3.9K, 1/4W, 5%	R19,48
610044-341-075	RES. 1M, 1/4W, 5%	R2,20
620024-341-075	RES. 20K, 1/4W, 5%	R23,25
611024-341-075	RES. 11K, 1/4W, 5%	R26
610024-341-075	RES. 10K, 1/4W, 5%	R27-29, 33,38,49,
610024-341-075	RES. 10K, 1/4W, 5%	R3,11-13, 16,22,24,
600072-360-007	RES. 1K POT	R30
647004-341-075	RES. 470, 1/4W, 5%	R4,5,8,45
610024-341-075	RES. 10K, 1/4W, 5%	R40-43,
620014-341-075	RES. 2K, 1/4W, 5%	R50
610004-341-075	RES. 100, 1/4W, 5%	R6
647014-341-075	RES. 4.7K, 1/4W, 5%	R7
622024-341-075	RES. 22K, 1/4W, 5%	R9
600130-616-001	SWITCH, SLIDE, DPDT, PC MOUNT	S1
635234-501-001	TRANSFORMER, 600 OHM, AUDIO	T1,2
600114-611-001	BROWN TEST POINT	TP1
600114-611-002	RED TEST POINT	TP2
600871-415-001	TMS 99532	U1
600016-415-001	IC 7406, HEX INV. ,O/C	U2
600039-415-002	IC SN72558P	U3
600074-415-001	IC NE555, TIMER	U4
601003-415-001	IC S3526B, 2600 HZ BAND PASS	U5
600186-415-001	IC MC14066B, QUAD BIL SWITCH	U6
600171-415-001	IC LM324, OP AMP, 741 QUAD	U7
600206-378-001	CRYSTAL	Y1
600206-378-001	CRYSTAL	Y2

Figure 5.1-3

Tone Key/Modem Board Assembly

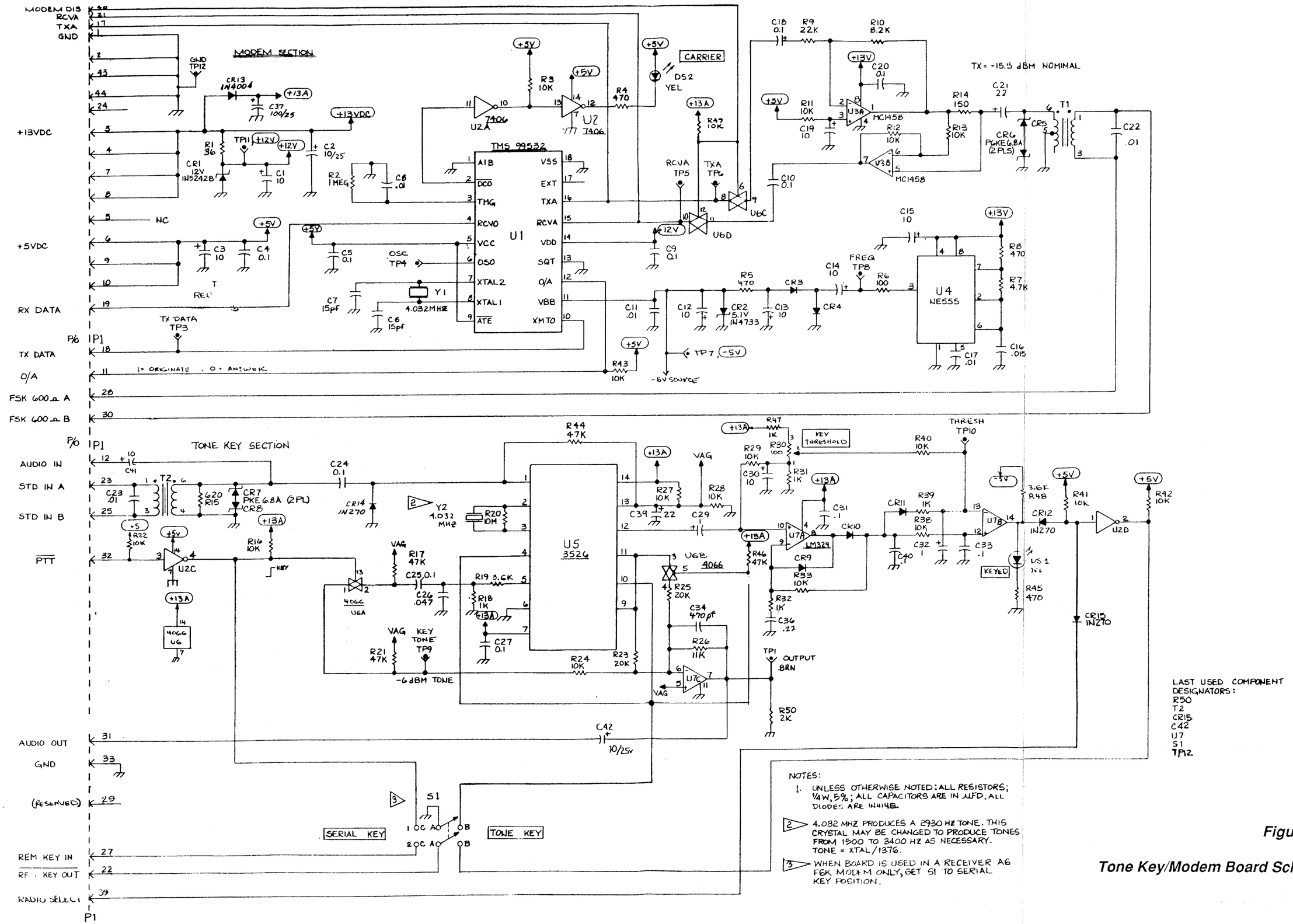


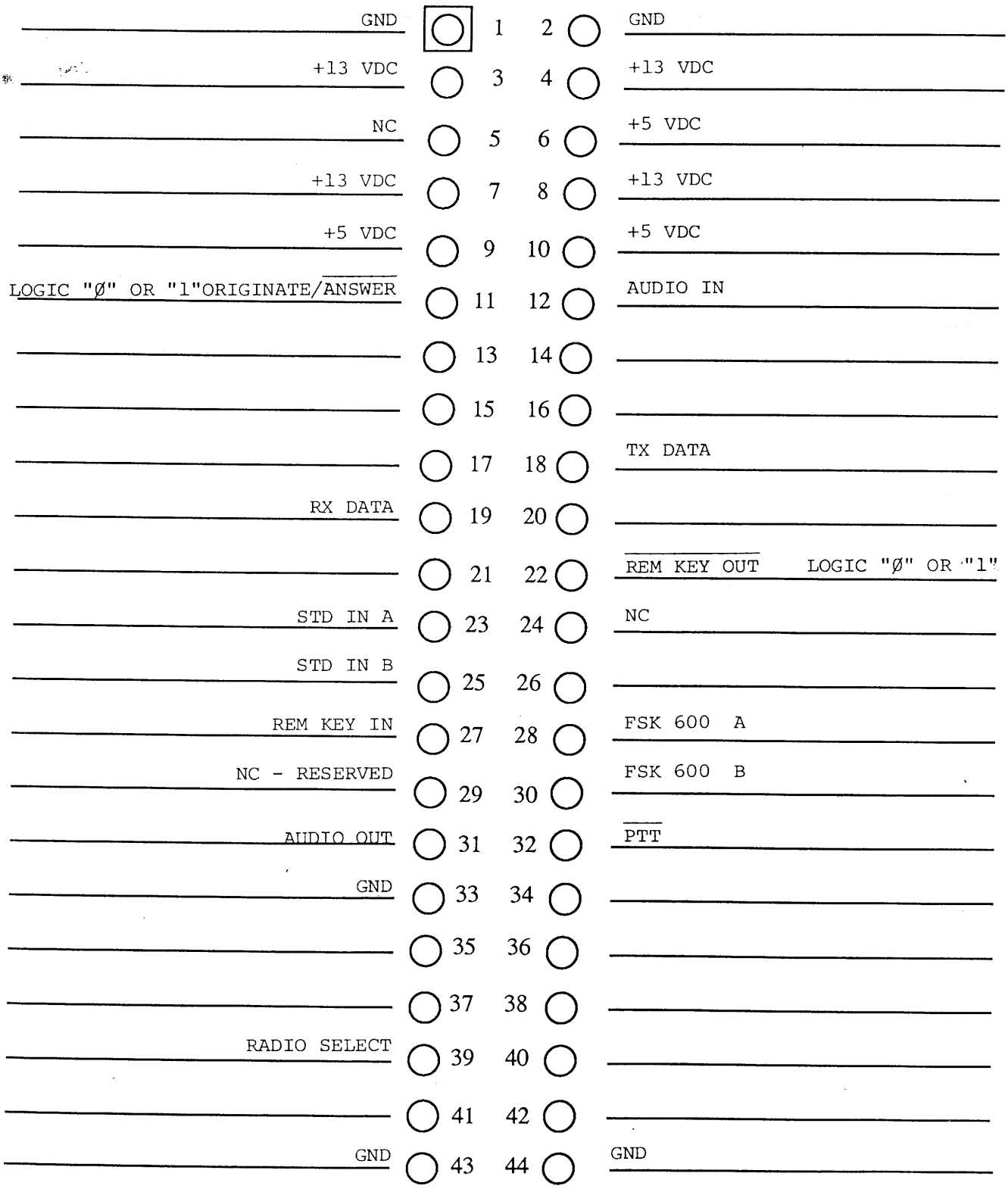
Figure 5.1-4

Tone Key/Modem Board Schematic

TONE KEY MODEM BOARD A14

PIN CONNECTIONS AND VOLTAGE READINGS

A14P1



5.2 ADDRESSABLE AUDIO I/O OPTION (Audio Interface Board A15)

5.2.1 GENERAL

The Audio Interface board (figure 5.2-5) is used in systems with a single MSR 6420 Remote Control Unit controlling more than one MSR 5050A, MSR 6700A (single-remote, multi-radio systems).

The audio portion of the board is put in series with the radio's 600Ω audio lines to provide proper routing of audio signals. The remainder of the board is used in conjunction with the modem circuitry of the Tone Key/Modem board for passing 300 baud FSK Modem Control/Status information between the RCU and the radios.

The Tone Key/Modem board works by itself as a 300 baud modem for single-remote, single-radio systems. The board is automatically reconfigured for multi-radio systems when the Audio Interface board is plugged into the radio.

When the Audio Interface board is not installed, jumper plugs on the radio maintain continuity of the 600Ω audio lines. (See section 3 option jumpers.)

The simplified block diagram (Figure 5.2-1) shows how the radios are connected in a single-remote, multi-radio configuration. Each radio has both switched and unswitched audio lines. The switched lines are connected through relays to a parallel audio bus. Only one switched audio relay is ever closed at any time. Refer to the MSR 6420 for system installation details.

The 300 BAUD FSK CNTL/STAT lines are "daisy-chained" from one radio to the next, so control commands originated by the RCU are heard by all radios. The commands are preceded by an address code which identifies the radio that should execute the command. One of the commands selects which switched-audio relay is closed at any time. The radios, upon command, provides status information to the RCU.

The RCU and radios can be configured by switches on the Interface board so that another communciation mode (RS-232, IEEE 488, etc.) can be used instead of the 300 baud modem. (See Section 3, Table 3.1 for switch settings). In these cases, the Tone Key/Modem board is not required.

5.2.2 AUDIO CONTROL CIRCUIT

The audio control circuitry routes the 600Ω audio lines and controls the switched audio.

The board must be configured to control outgoing audio or incoming audio by correctly setting switches S1 and S2.

MSR 6700A - All 6 switch positions up
MSR 5050A - All 6 switch positions down

Figure 5.2-5 shows all switches set for MSR 5050A operation. The remainder of this explanation will pertain to MSR 5050A operation. The circuit operates similarly when used in the MSR 6700A with the audio signals traveling in the opposite direction.

Standard audio enters the board at T3 and flows through U1C, leaving the board on pins 16 and 18. Similarly, ISB audio enters at T6, flows through U2-B and exits at pins 40 and 42.

5.2.3 CIRCUIT DESCRIPTION

Refer to the Audio Interface board schematic, Figure 5.2-5 and also to the Tone Key/Modem board schematic, Figure 5.1-4.

5.2.3.1 300 Baud Modem Circuit

The modem circuit receives control commands from the RCU and returns status information on the CNTL/STAT lines. The circuit is normally in the receive mode, with the ORIGINATE/ANSWER line, pin 15, high. This keeps FET Q1 and Q4 on and FET Q5 off.

Audio frequency control commands from the RCU enter through transformer T1 or T2 and leave the board at the other transformer to continue on to the next radio in the chain. These commands are received by U1A and pass through Q1 to the modem chip on the Tone Key/Modem board.

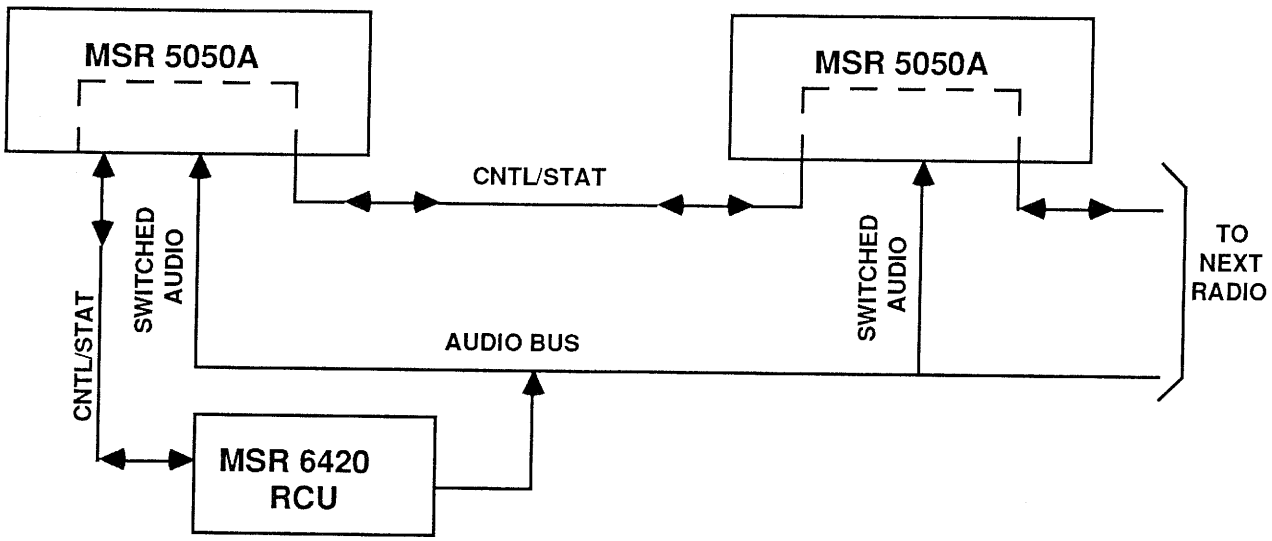
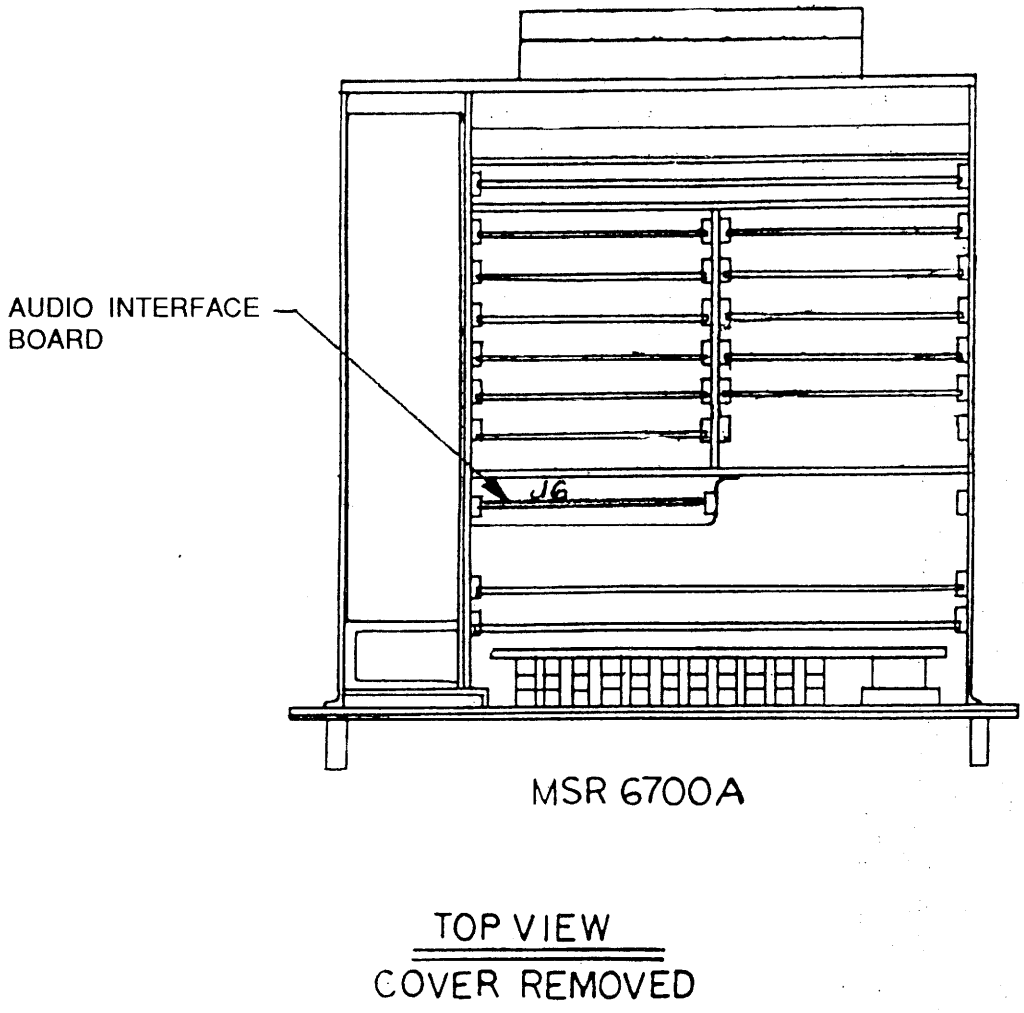


Figure 5.2-1 Remote Interconnect Diagram

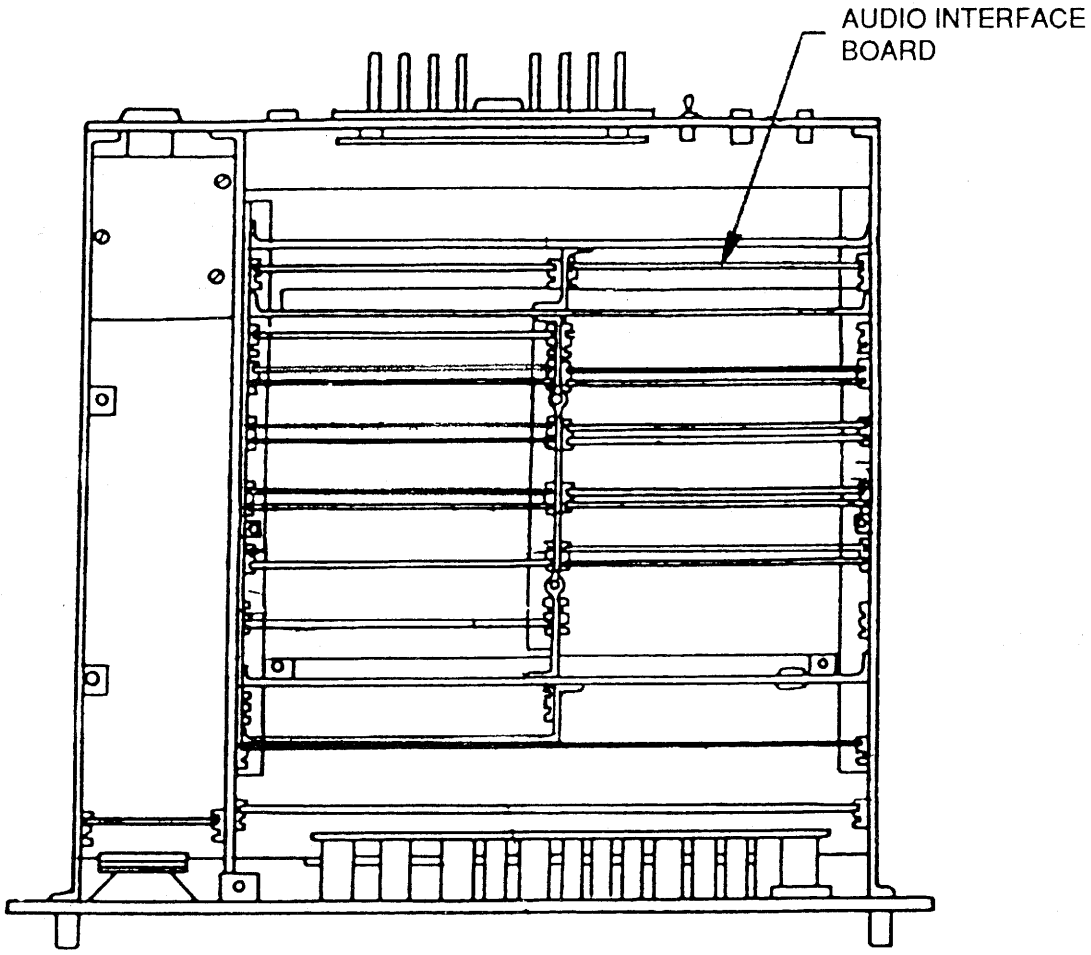
If the radio receives a status request from the RCU, the ORIGINATE/ANSWER line switches to low. Q1 and Q4 are turned off and Q5 on. Audio frequency status signal tones from the radio's modem chip come in on pin 17 and flow through U1B and Q5 to resistors R4/R5. The signal is split and travels out of the radio in both directions on the CNTL/STAT lines. To properly terminate the 600Ω CNTL/STAT lines, an unused port should be terminated with a 600Ω resistor.

Audio signals may be sent to a particular radio from the RCU using the audio bus and the switched audio inputs. When commanded by the RCU, that particular radio takes the RADIO SELECT (RADSEL) line, pin 19, high. Relay K2 is closed connecting the radio to the audio bus. Switched standard audio enters the board through T4 and is mixed with the standard audio from T3 at U1-C. Radios configured for ISB may also receive switched ISB audio signals from an ISB audio bus.



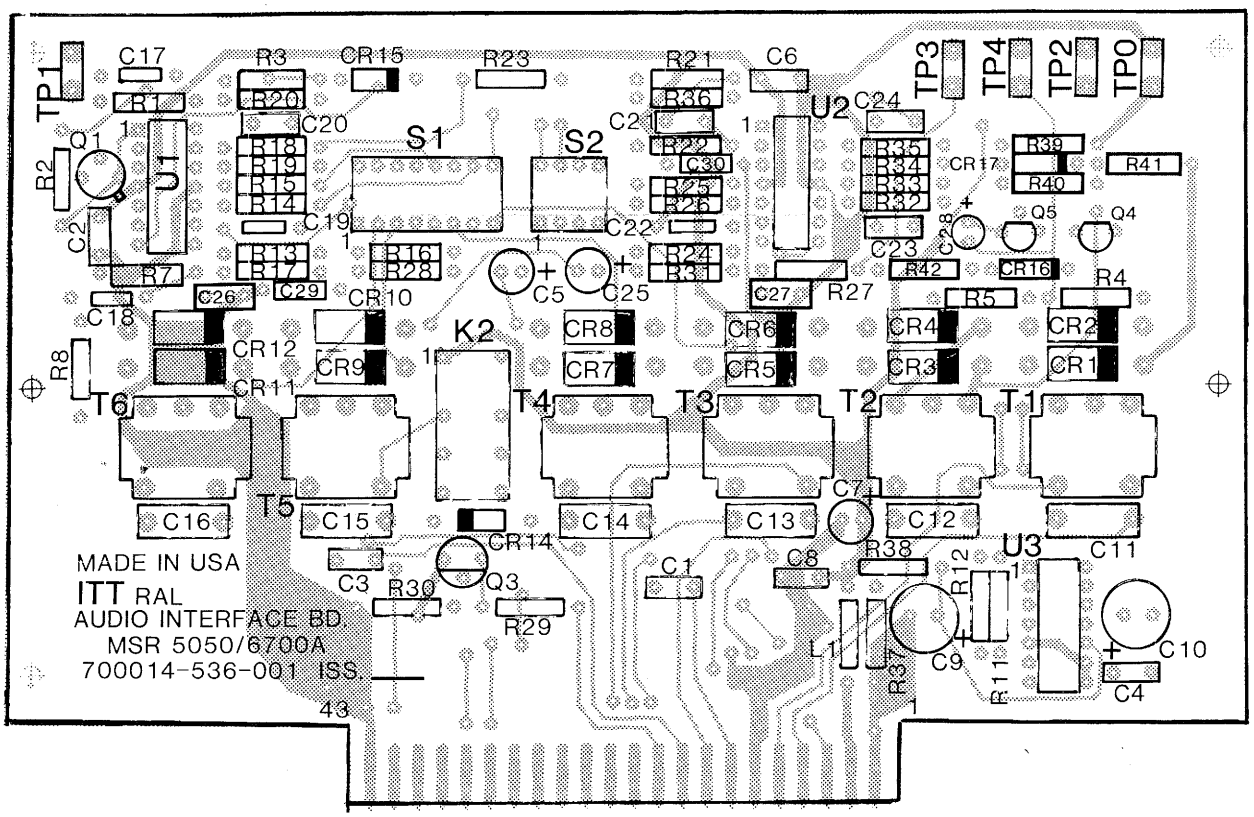
NOTE: ALL SWITCHES ON BOARD IN "UP" POSITION. REFER TO RADIO MANUAL FOR POSITION OF JUMPERS ON MOTHER BOARD.

Figure 5.2-2 Installation, MSR 6700A



NOTE: ALL SWITCHES ON BOARD IN "DOWN" POSITION. REFER TO RADIO MANUAL FOR POSITION OF JUMPERS ON MOTHER BOARD.

Figure 5.2-3 Installation, MSR 5050A

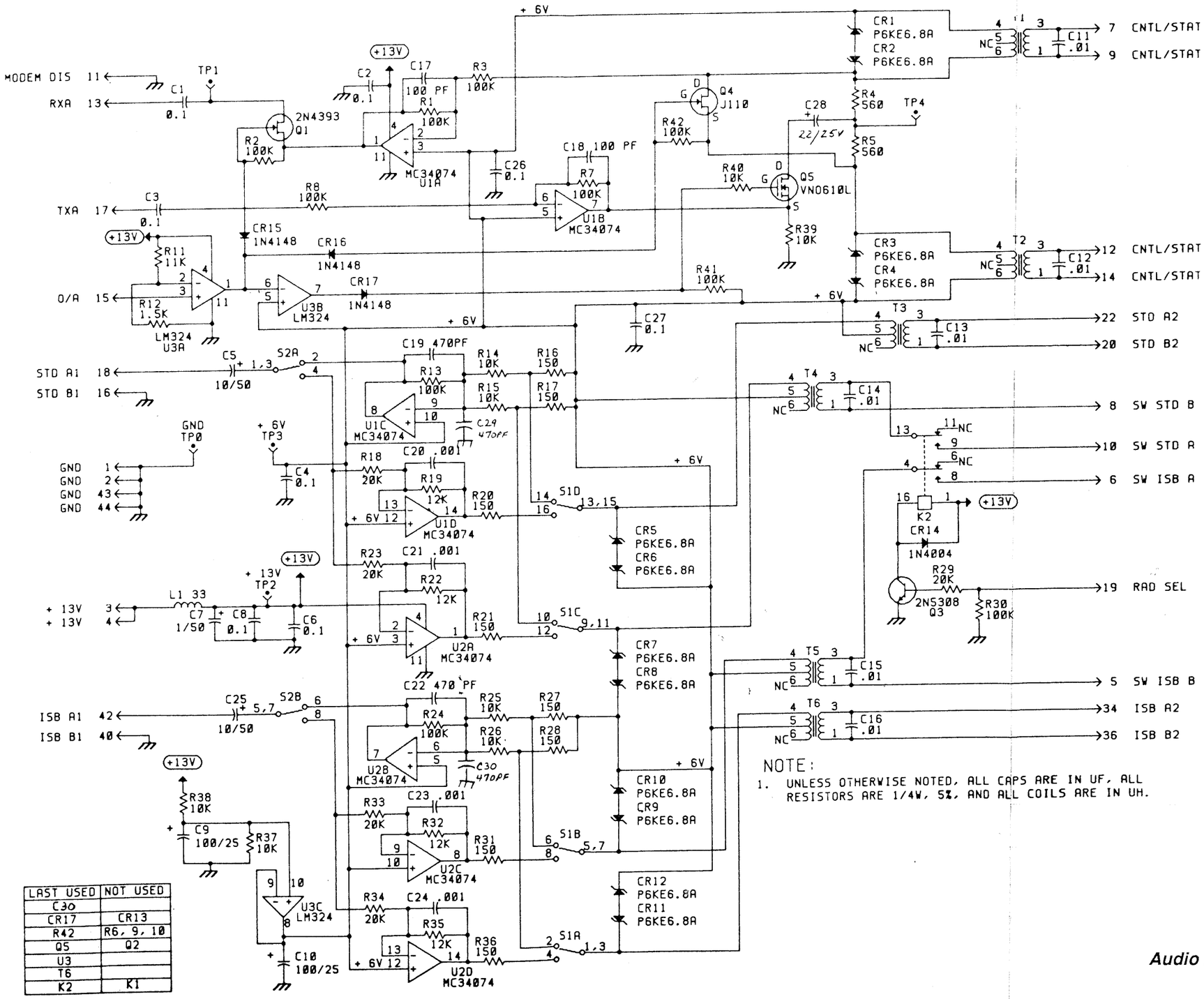


Audio Interface (700014-536-001)

PART NUMBER	DESCRIPTION	SYMBOL
600302-314-013	CAP. .1UF, MYLAR, 50V	C1-4,6, 8,26,27
600204-314-001	CAP. .01UF, MYLAR, 400V	C11-16
600293-314-101	CAP 100PF 50V 5%	C17,18
600272-314-005	CAP. 470PF, CERAMIC, 50V	C19,22, 29,30
600302-314-001	CAP. .001UF, MYLAR, 63V	C20,21, 23,24
600297-314-016	CAP. 22UF, ALUM, 25V	C28
600297-314-013	CAP. 10UF, ALUM, 50V	C5,25
600297-314-003	CAP. 1UF, ALUM, 50V	C7
600297-314-032	CAP. 100UF, ALUM, 25V	C9,10
600028-411-001	DIODE, VOLT.SUPRESSOR P6KE6,8A	CR1-12
600011-416-002	DIODE IN4004	CR14
600109-410-001	DIODE IN4148	CR15,16, 17
600094-403-003	RELAY, DPDT, 12V, 3A CONTACTS	K2
600125-376-011	CHOKE 33UH	L1
700001-413-001	TRANSISTOR, 2N4393	Q1
600221-413-002	TRANSISTOR 2N5308	Q3
600349-413-001	TRANSISTOR J 110, JFET	Q4
600390-413-001	POWER MOSFET,VN0610L	Q5
610034-341-075	RES. 100K, 1/4W, 5%	R1-3 7, 8,30, 41,42

PART NUMBER	DESCRIPTION	SYMBOL
611024-341-075	RES. 11K, 1/4W, 5%	R11
615014-341-075	RES. 1.5K, 1/4W, 5%	R12
624024-341-075	RES 24K, 1/4W, 5%	R13,24
610024-341-075	RES. 10K, 1/4W, 5%	R14,15, 25,26, 37-40
615004-341-075	RES. 150, 1/4W, 5%	R16,17, 20,21,27 28,31,36
620024-341-075	RES. 20K, 1/4W, 5%	R18,23, 29,33,34
612024-341-075	RES. 12K, 1/4W, 5%	R19,22, 32,35
656004-341-075	RES., 560, 1/4W, 5%	R4,5
600244-616-004	SWITCH, 4 X SPDT, DIP	S1
600244-616-002	SWITCH, 2 X SPDT, DIP	S2
635234-501-001	TRANSFORMER, 600 OHM, AUDIO	T1-6
600114-611-010	BLACK TEST POINT	TP0
600114-611-001	BROWN TEST POINT	TP1
600114-611-002	RED TEST POINT	TP2
600114-611-003	ORANGE TEST POINT	TP3
600114-611-004	YELLOW TEST POINT	TP4
700121-415-001	IC, QUAD OP AMP, MC33074	U1,2
600171-415-001	IC LM324, OP AMP, 741 QUAD	U3

Figure 5.2-4 Audio Interface Board Assembly



LAST USED	NOT USED
C30	
CR17	CR13
R42	R6, 9, 10
Q5	Q2
U3	
T6	
K2	K1

NOTE:

1. UNLESS OTHERWISE NOTED, ALL CAPS ARE IN UF, ALL RESISTORS ARE 1/4W, 5%, AND ALL COILS ARE IN UH.

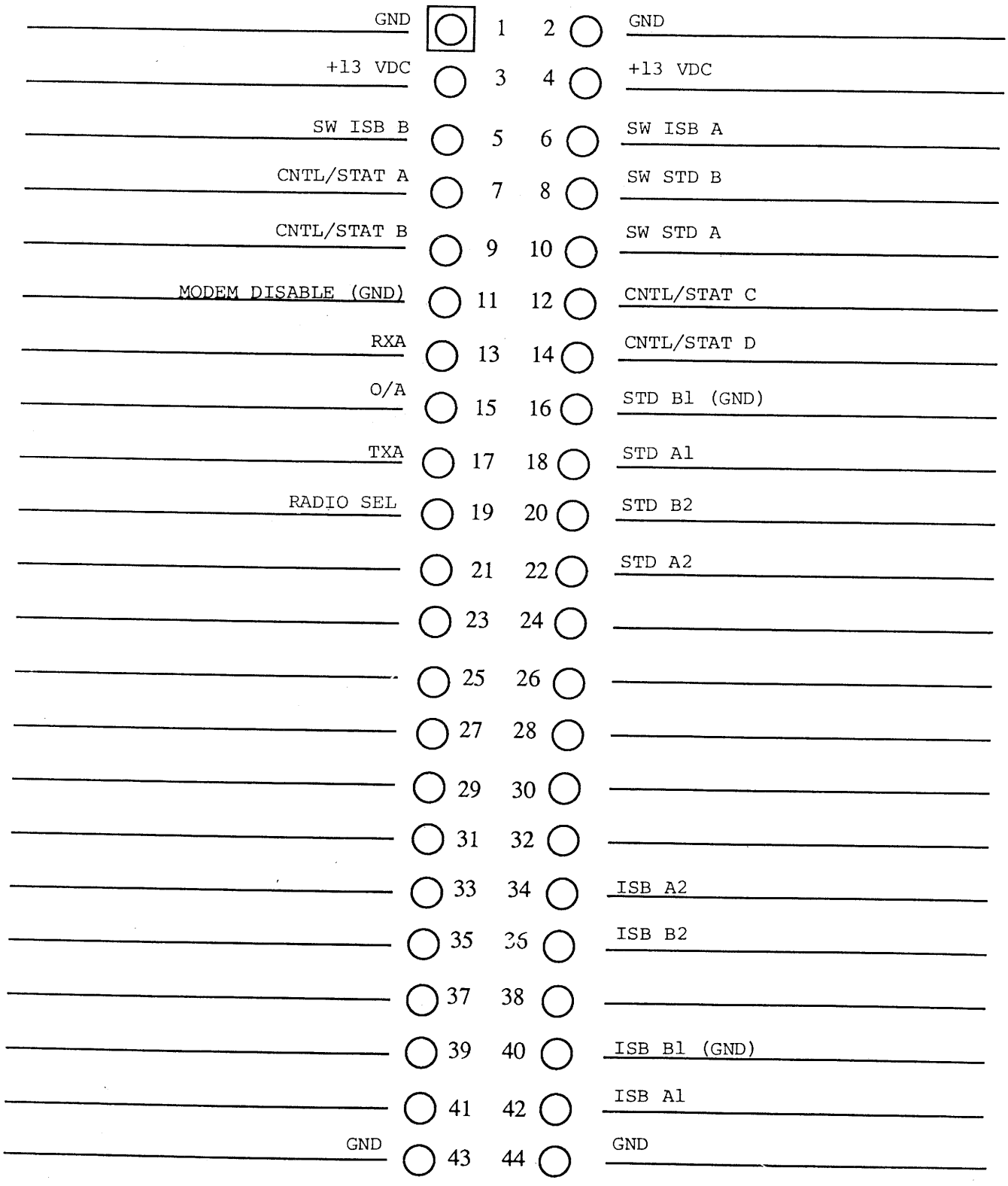
Figure 5.2-5

Audio Interface Board Schematic

MSR 5050A/6700A AUDIO INTERFACE BOARD A15

PIN CONNECTIONS AND VOLTAGE READINGS

A15P1



5.3 PRESELECTOR OPTION

5.3.1 GENERAL

The Preselector Option (P/N 700007-700-001) adds front end selectivity to the Receiver to prevent interference from strong off-channel interference. It may also be added to an exciter or transceiver to reduce broadboard noise at the LPA input.
The standard Preselector Option consists of:

a) MSR 6300 Preselector, P/N 699038-000 (separate manual supplied)
b) 12 VDC/1.6 Amp Power Supply, P/N 600055-391-001 (separate manual supplied)
c) Preselector Interface Cable, P/N 600878-540-002.

Additional components of the Preselector Option are added depending on the radio involved as follows:

a) 700007-700-001: BCD Interface Kit (MSR 5050A) 700022-700
b) 700007-700-002: BCD Interface Kit (MSR 6700A) 700021-700,Signal Routing Kit 600279-700

5.3.2 DESCRIPTION

(Refer to Figure 5.3-1 for typical installation.)

The Preselector is a digitally-tuned bandpass filter with 38 dB rejection at Fo ±10%. It is tuned to the radio operating frequency by 14 BCD input signals provided from the radio by the BCD Interface Kit. It tunes from 1.6 to 10 MHz in 20 kHz steps and 10 MHz to 29.9 MHz in 100 kHz steps with a 3 dB bandpass of Fo ±1% and a gain of -1 ±3 dB. The Preselector and Receiver are protected from large steady state antenna signals by relays which open the antenna circuit at two watts (with an accompanying indicator light). Gas tubes protect the Preselector and Receiver from transients on the antenna line. The Preselector is automatically bypassed (and indicated by a front panel light) below 1.6 MHz allowing the Receiver to tune to 10 kHz. In transmit mode, the exciter path is broken for the same condition preventing RF input to the PA below 1.6 MHz. A front panel switch can be operated to bypass the internal amplifier allowing 10 dB less gain for operation under extreme signal interference where receiver sensitivity is not critical. The amplifier is always in the circuit in transmit - independent of switch position. The power supply provides +12 VDC at up to 1.6 amperes for the Preselector. With this supply, the Preselector must be internally strapped in the "LO V" regulator bypass position. The power supply may be operated from 115 VAC, 47 to 400 Hz. To operate from 230 VAC, the power supply cover must be removed to move a black and white wire on separate transformer terminals to a common terminal "D" as described in the power supply manual.

The Preselector Interface Connector interconnects the Receiver and Preselector with 14 BCD lines, a TRANSMIT status line, and a signal common. Two lines branch out from the Preselector mating connector to connect to the power supply for 12 VDC. A standard cable length of 4.5 feet provides ample strain relief while extending individual units from the rack for service or inspection.

To operate as an exciter postselector, a signal routing kit must be added to the MSR 6700A or MSR 8050A. This kit consists of a jumper cable and rear panel connectors which allow the Preselector to be electrically inserted before the PA.

The Preselector can be used with a transceiver to add filtering in both the receive path to the antenna and in the transmit path (before the PA). Relays in the Preselector operate with a TX signal from the transceiver to transfer the filter circuits between the two paths.

The MSR 6700A rear panel connector J44 contains both remote control functions as well as BCD preselector controls. Therefore, if simultaneous remote control and preselector operation is required, the external connector must "Y" out into two cables.

5.3.3 CHECKOUT PROCEDURES

5.3.3.1 Installation

The equipment is connected and power applied. The radio has been previously tested. Ensure that the internal preselector jumper is in the "LO V" position to bypass the internal regulator for +12 volt operation. Ensure that the power supply transformer is internally wired for the desired line voltage. Normal configuration is 115 VAC, 47 to 400 Hz. Operation from 230 VAC is obtained by moving (and soldering) a black and white wire from separate transformer taps to a single tap labeled "D".

5.3.3.2 Test

The MSR 6700A is factory-aligned with no insertion loss between the J48/J49 preselector connectors. This results in a standard SSB high power output specification of 125 watts ± 0.5 dB from 1.6 to 29.9999 MHz. Because of the insertion loss of the preselector (-1 ± 3 dB vs. frequency), the output power may be degraded as much as 4 dB at some frequency -- although typically less than 1 dB (to 100 watts).

To verify performance, the transmit power should be checked in all preselector bands at 1.6, 2.58; 2.6, 3, 4.28; 4.3, 5.1, 6.8; 6.9, 9, 11.2; 11.3, 15, 18.3; 18.4, 25, 29.9 MHz.

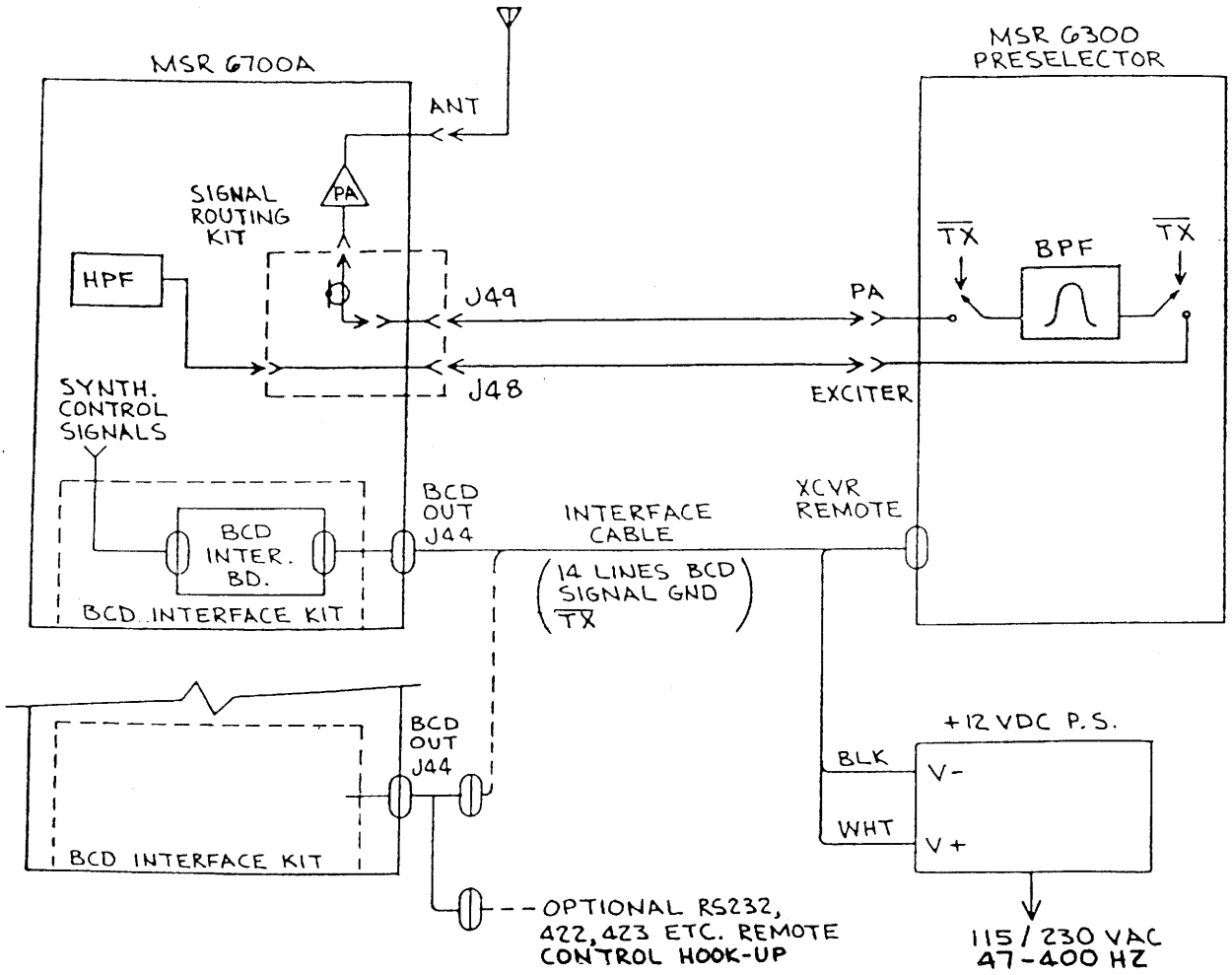


Figure 5.3-1 Typical Installation, MSR 6700A

5.4 BCD INTERFACE KIT

The BCD Interface Kit provides a rear panel BCD output (positive TTL) representing the tuned frequency of the radio from 1.6 to 29.9 MHz. The outputs appear on J44, a 25-pin subminiature "D" connector, which is added to the rear panel as part of the kit, replacing the existing RS-232 connector and cable. If RS-232 operation is also desired, its external connections are made by "Y"ing two cables to the J44 connector.

5.4.1 DESCRIPTION

The BCD Interface Kit is a factory-installed option consisting of a BCD input cable, a BCD output cable (containing J44, the rear panel connector) and a BCD Interface board.

The BCD Interface board creates the BCD output signals by subtracting 4 MHz from the modified BCD code used by the frequency synthesizer in the radio.

The BCD input cable is soldered to the radio Mother board and brings the 10 MHz, 1 MHz, 100 kHz and 10 kHz synthesizer control signals to the BCD Interface board for conversion.

5.4.2 EXTERNAL INTERFACE

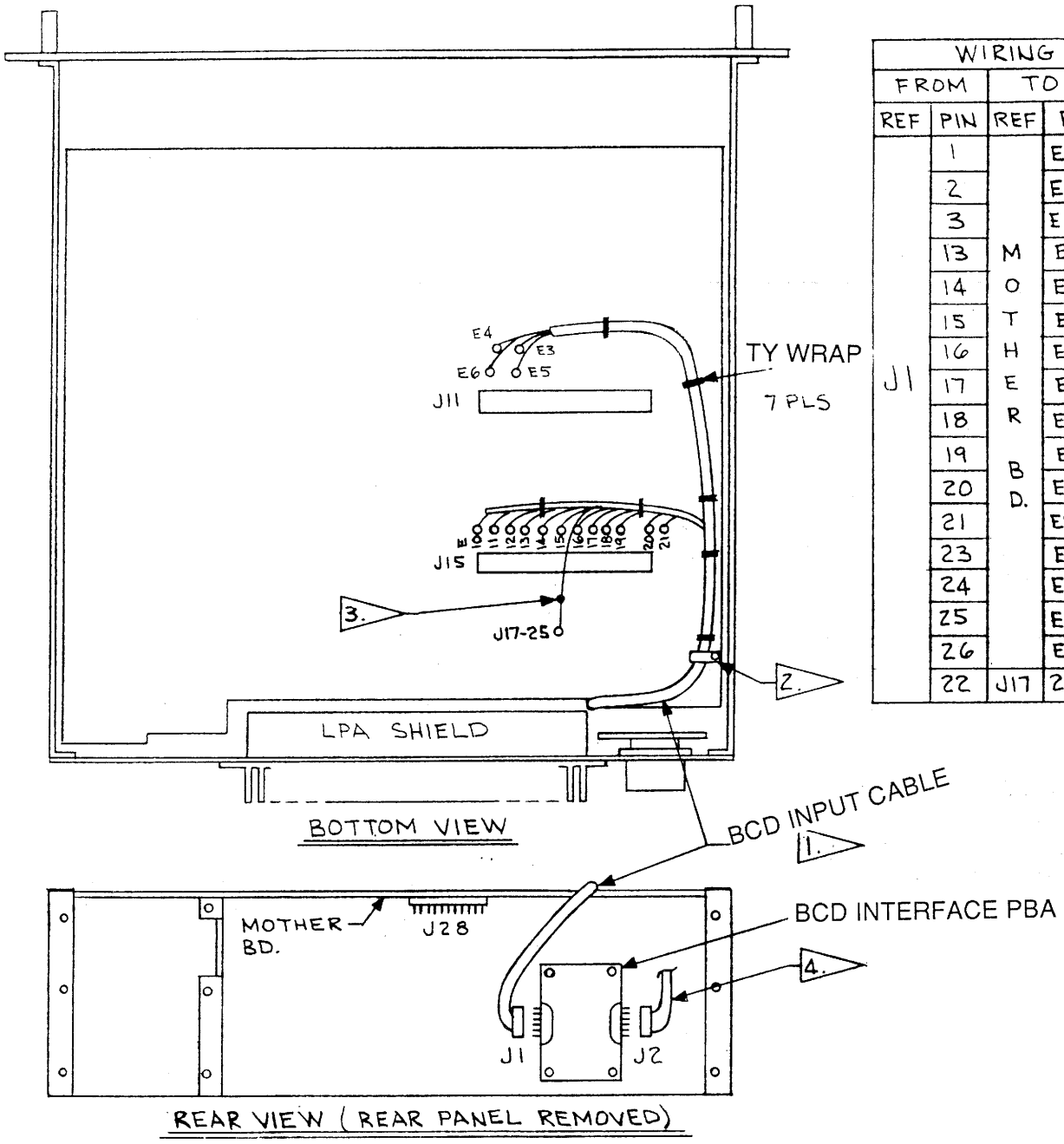
Pin assignments for the rear panel connector, J44 (BCD OUT) are:

PIN	DESCRIPTION	
12	10K1	
25	10K2	10 kHz DECADE
23	10K4	
21	10K8	
11	100K1	
13	100K2	100 kHz DECADE
24	100K4	
22	100K8	
15	1M1	
14	1M2	1 MHz DECADE
1	1M4	
5	1M8	
17	10M1	10 MHz
16	10M2	
2	GND	
20	/TX	

These are in addition to the remote control signals in the standard radio on J44. (See Table 2.4 of Section 2 in this manual.)

BCD Interface Kit (700021-700-001)

PART NUMBER	DESCRIPTION	SYMBOL
602021-536-002	BCD INTERFACE PBA	A22
600866-540-036	RIBBON CABLE ASSY	
600877-540-001	BCD INPUT CABLE	
700006-540-001	RIBBON CABLE, SHIELDED	



WIRING LIST				
FROM		TO		COLOR
REF	PIN	REF	PIN	
J1	1	MOTHER BD.	E13	RED
	2		E14	YEL
	3		E12	BLU
	13		E4	WHT/BLU
	14		E18	WHT/YEL
	15		E3	WHT/RED
	16		E19	WHT/BRN
	17		E5	WHT/GRY
	18		E17	WHT/VIO
	19		E6	WHT/GRN
	20		E16	WHT/ORN
	21		E21	BLK
	23		E20	VIO
	24		E15	GRN
	25		E11	ORN
	26		E10	BRN
	22	J17	25	WHT

1. FORM WIRES AT RIGHT ANGLES TO "E" NOS. CUT OFF EXCESS WIRE. STRIP AND SOLDER.
2. ROUTE CABLE ASSY, UNDER CABLE CLAMP.
3. GLUE WIRE TO BOARD USING TAK-PAK OR EQUIVALENT.
4. DISCARD EXISTING CABLE ASSY IN J44 POSITION ON REAR PANEL AND REPLACE WITH SHIELDED CABLE ASSY. CONNECT MIDDLE CONNECTOR TO J2 OF BCD BD, AND END CONNECTOR TO J28 ON MOTHER BD. (USE LOCKTITE ON CONNECTOR MOUNTING SCREWS.)

Figure 5.4-1 BCD Interface Kit, MSR 6700A

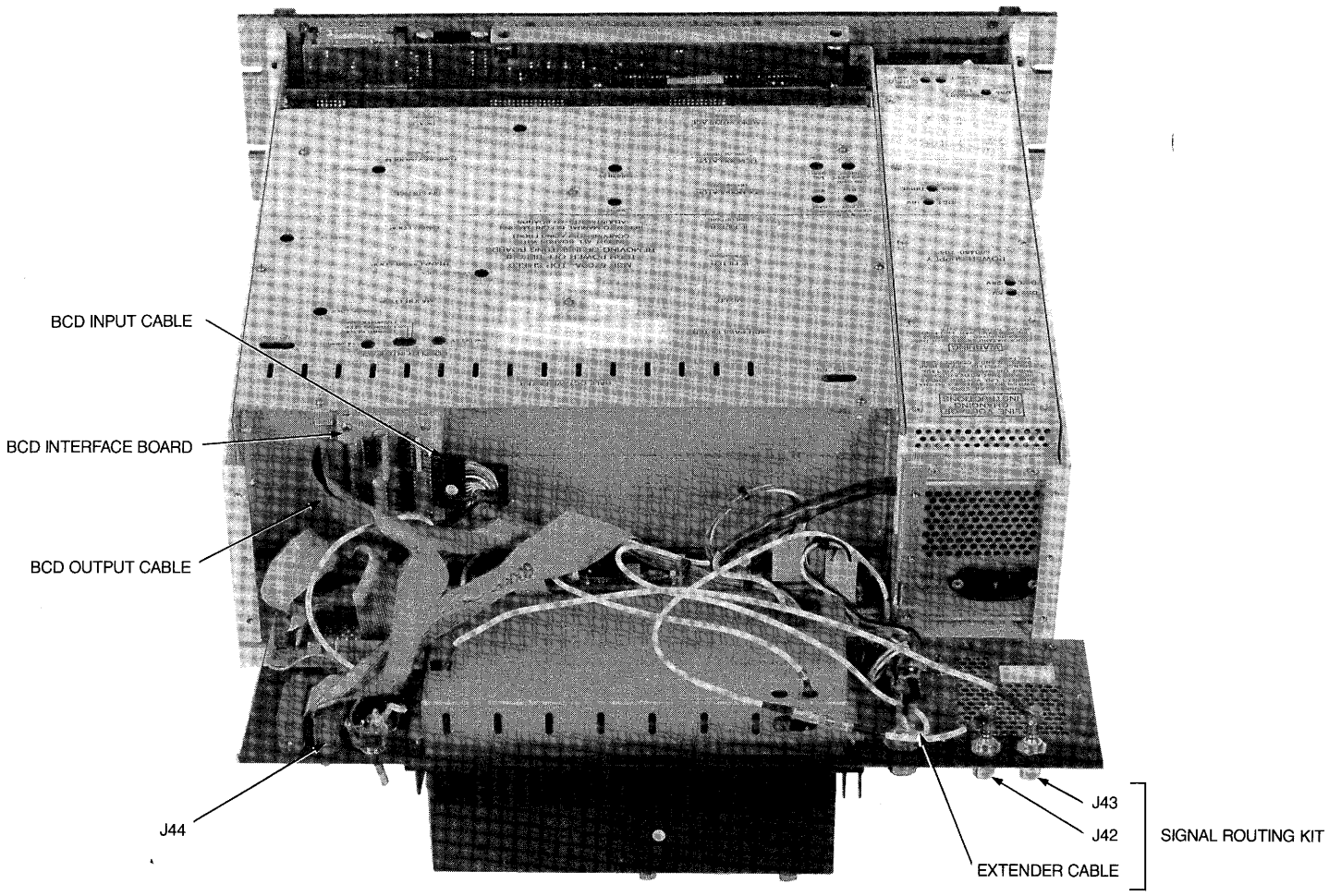


Figure 5.4-2

Rear View with Preselector, Rear Panel Laid Down

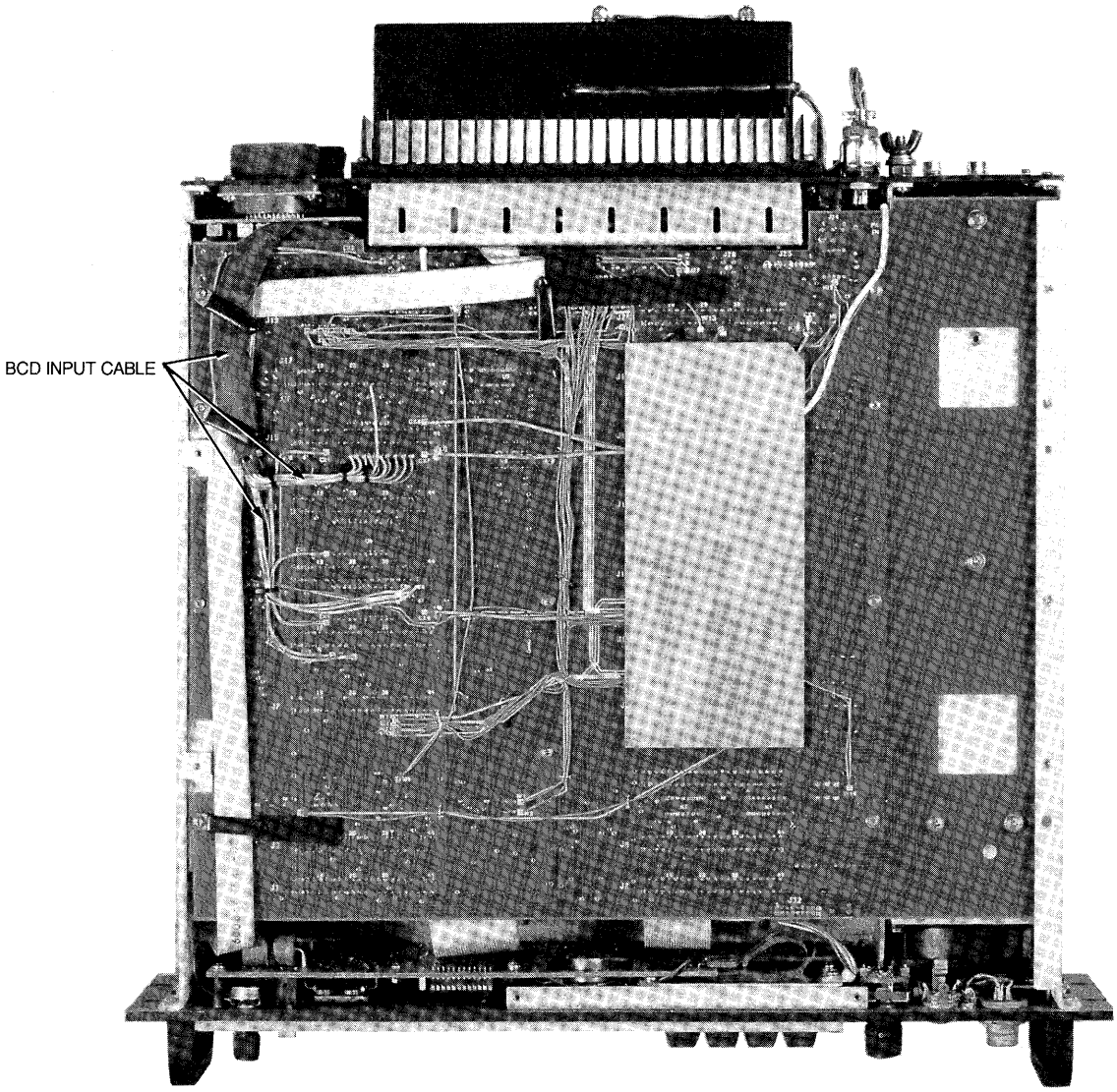


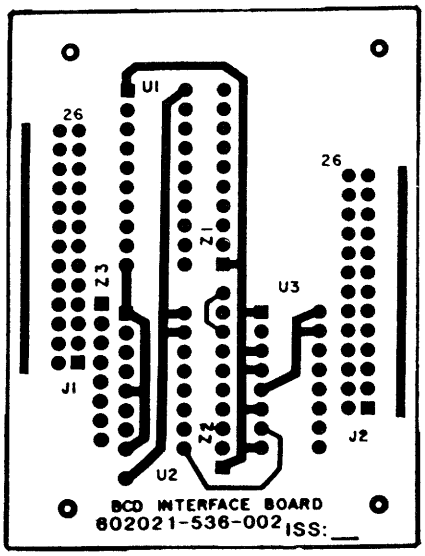
Figure 5.4-3 MSR 6700A Bottom View with Preselector

5.4.3 BCD INTERFACE BOARD, A22

The BCD Interface board (P/N 602021-536) modifies the BCD synthesizer control signals in the MSR 5050A/MSR 6700A to BCD outputs corresponding to the input frequency to which the radios are tuned. This is done by logically subtracting 4 MHz from the BCD synthesizer signals. This board is used as part of a Preselector/ Postselector option for the radios where BCD frequency information is required to tune the Preselector.

U2 and U3 are CMOS NBCD adders which are connected to subtract 4 from the 10 MHz and 1 MHz BCD inputs. U2 is conditioned to subtract 4 from the "MHz" inputs by adding the 9's complement of 4 + 1 (U2, pins 3, 15) and biasing the "CARRY" input high (U2, pin 7). U3 is conditioned to subtract "0" from the "10 MHz" inputs adding the "9" complement of 8 + 1 (pins 5, 15).

U1 is an octal tri-state buffer which provides buffered BCD outputs from the "10 kHz" and "100 kHz" decades. These outputs are independent of the 10 MHz, 1 MHz signals and are not affected by the 4 MHz subtraction.



BCD Interface (602021-536-002)

PART NUMBER	DESCRIPTION	SYMBOL
600380-314-002	CAP SIP .1UF X 9	Z1,2
600282-415-001	IC 74LS244, 3-ST BUFFER	U1
601012-415-001	IC 4560, NBCD ADDER	U2,3
600201-537-001	RES NETWORK 4.7K X 7	Z3
600174-608-015	HEADER, 26 PIN	J1,2

Figure 5.4-4 BCD Interface Assembly

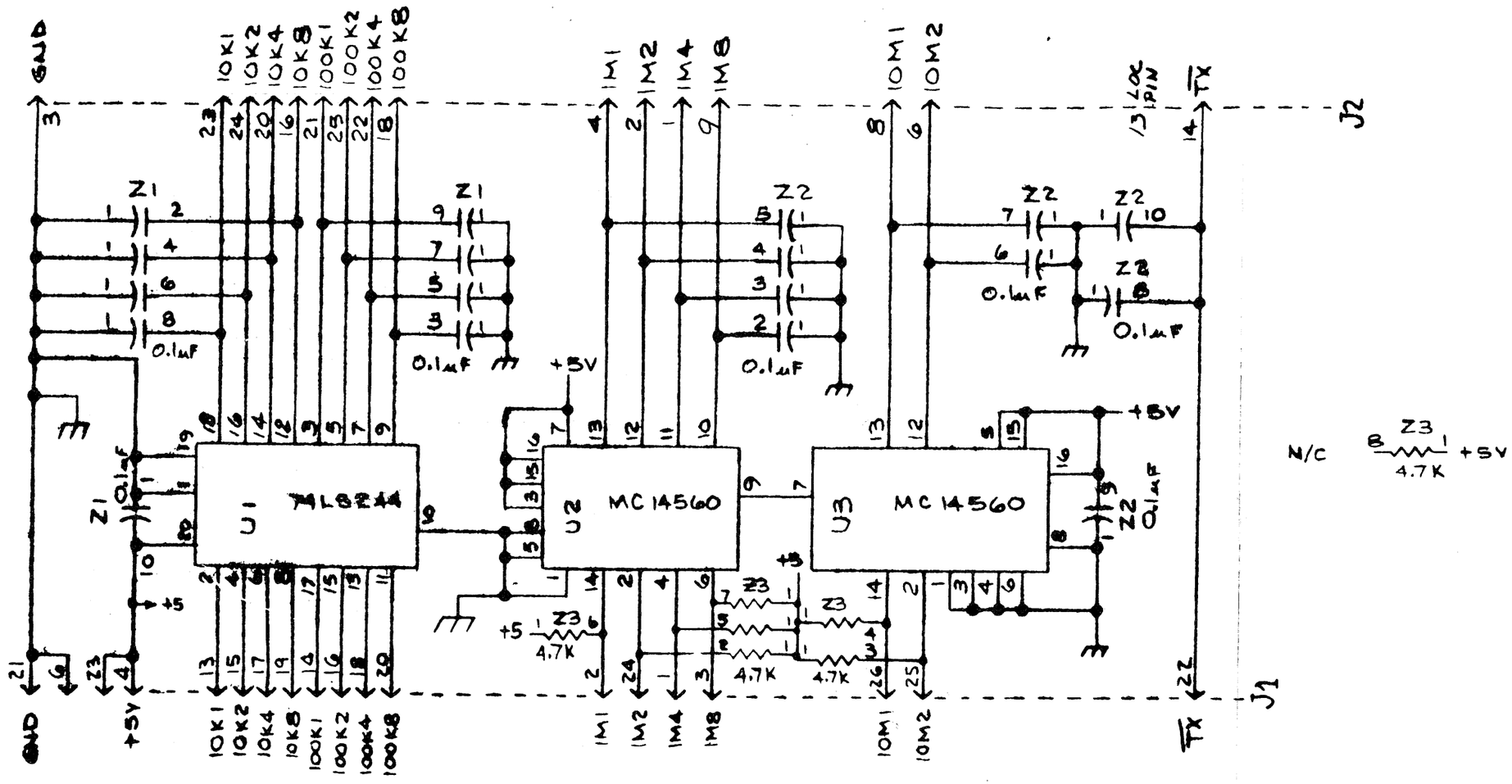


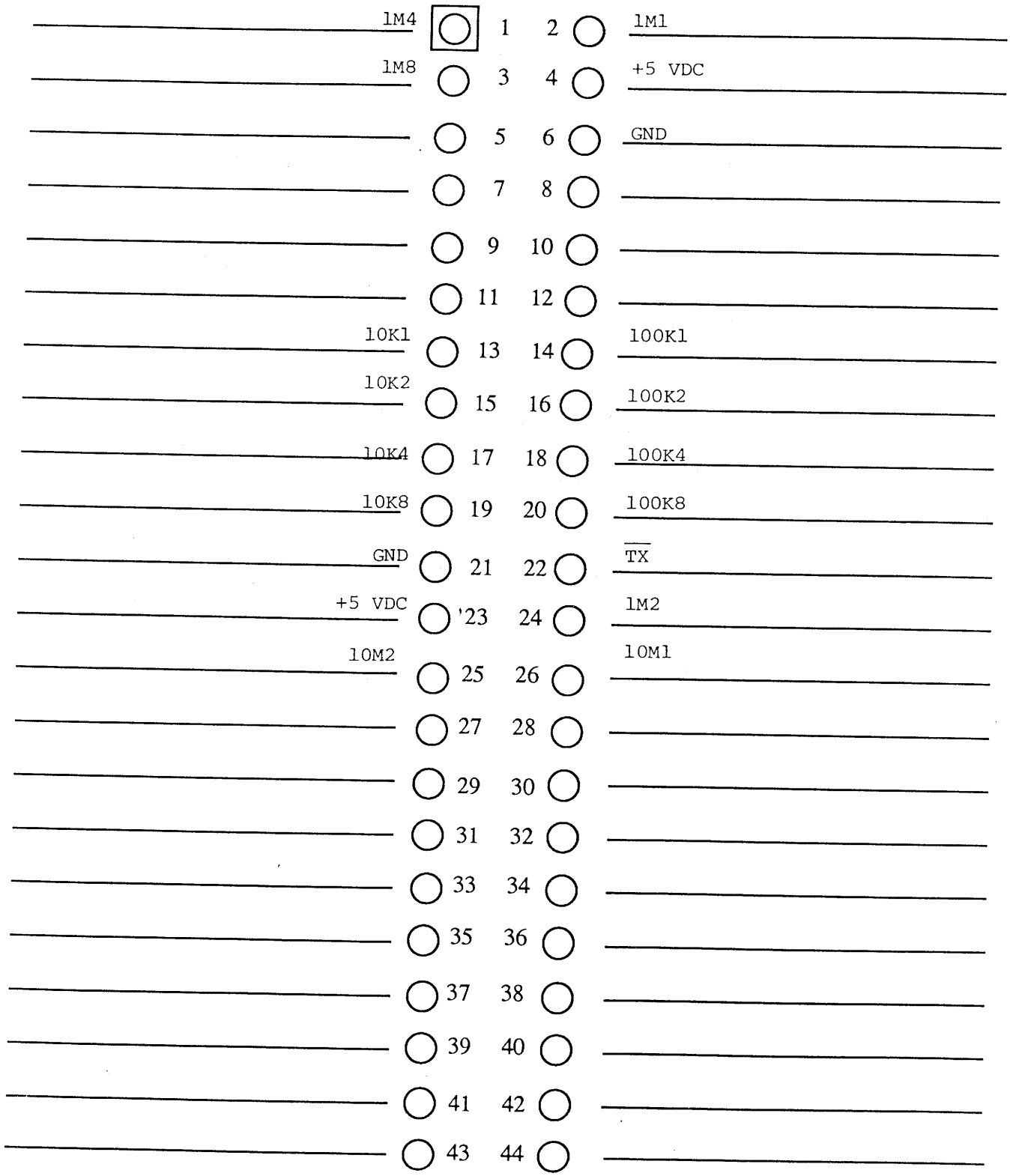
Figure 5.4-5

BCD Interface Board Schematic

BCD INTERFACE BOARD, A22

PIN CONNECTIONS AND VOLTAGE READINGS

A22J1



NOTE: ALL SIGNALS EXCEPT GND, +5V, $\overline{TX}$ ARE STATIC TTL LEVELS (HIGH FOR ENABLE) REPRESENTING 4 MHz HIGHER THAN RADIO FREQUENCY IN BCD, FORMAT.

BCD INTERFACE BOARD, A22

PIN CONNECTIONS AND VOLTAGE READINGS

A22J2

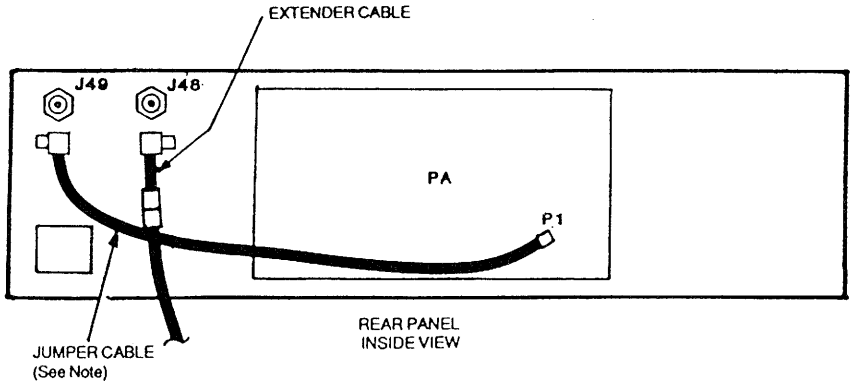
1M4	1	2	1M2	
GND	3	4	1M1	
	5	6	10M2	
	7	8	10M1	
1M8	9	10		
	11	12		
LOCATING PIN	13	14	$\overline{\text{TX}}$ TTL 1/Ø	
	15	16	10K8	
	17	18	100K8	
	19	20	10K4	
100K1	21	22	100K4	
10K1	23	24	10K2	
100K2	25	26		
	27	28		
	29	30		
	31	32		
	33	34		
	35	36		
	37	38		
	39	40		
	41	42		
	43	44		

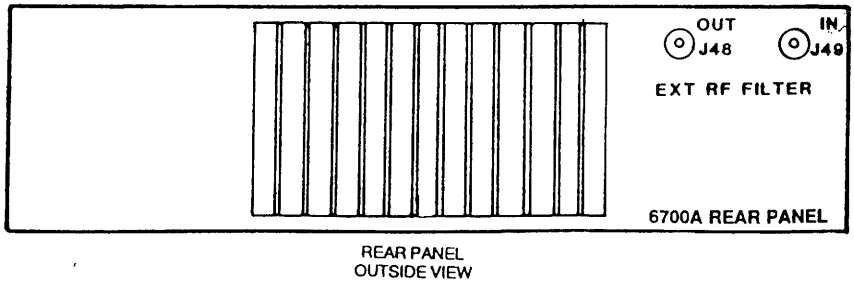
NOTE: ALL SIGNALS EXCEPT GND, +5 VDC, $\overline{\text{TX}}$ ARE STATIC TTL SIGNALS (HIGH ENABLE) REPRESENTING RADIO FREQUENCY IN BCD FORMAT.

5.4.4 SIGNAL ROUTING KIT

The Signal Routing Kit (P/N 600279-700) provides two rear panel BNC connectors which break the transmit signal path at the MSR 8050 LPA input. This allows reduction of broadband transmit noise by an external filter. The kit is normally installed as part of the Preselector Option (P/N 700021-700-001). Figure 5.3-1 shows a typical installation. Figure 5.4-6 shows installation details of the Signal Routing Kit which adds a coax jumper cable and two rear panel BNC/SMB connectors.

PART NO.	DESCRIPTION	SYMBOL
600881-540-001	Coax Cable Assembly	------
600221-605-001	Conn - Bulkhead	------
600267-622-001	Toroid Core	------
600002-115-002	Tie Wrap Small	------





NOTE: Remove the cable from P1 on the PA as shown and connect it to J48 on the MSR 6700 with extender cable. Jumper cable is connected to P1 on PA with right-angle connector being connected to rear panel J49.

(See Figure 5.4-3 for photo.)

Figure 5.4-6 Detailed Installation, Signal Routing Kit

5.5 HIGH STABILITY REFERENCE OPTION

This factory-installed option provides a high stability OCXO with frequency stability of $\pm 1 \times 10^{-8}$ from 0° C to 65° C. With this option, the MSR 6700A tuning frequency can be held to ± 0.3 Hz at 30 MHz.

5.5.1 TECHNICAL CHARACTERISTICS

- Output Frequency: 5,000,000 Hz.
- Output Waveform: TTL
- Frequency Stability:
  Ambient = $\pm 1 \times 10^{-8}$ from 0° C to 65° C
  Aging = $\pm 1 \times 10^{-6}$ per year
- Warm-Up: 30 minutes from 25° C
- Power Requirement: Oscillator and Oven = +15 VDC, 670 mA maximum during warm-up
- Steady State Power: 200 mA type at 25° C

5.5.2 TECHNICAL DESCRIPTION

+26 VDC from the MSR 6700A switching power supply is applied to an LM 340K-15 regulator, U1. The 15V output of U1 is applied to the OCXO pin #1. A coaxial cable is connected to pin 3 of the OCXO for 5 MHz reference output.

This cable is connected to J1 of the Reference board to replace the standard 5 MHz reference from the on-board TCXO. JP1 is positioned on E1 pin 2, 3 (down) to disconnect the TCXO.

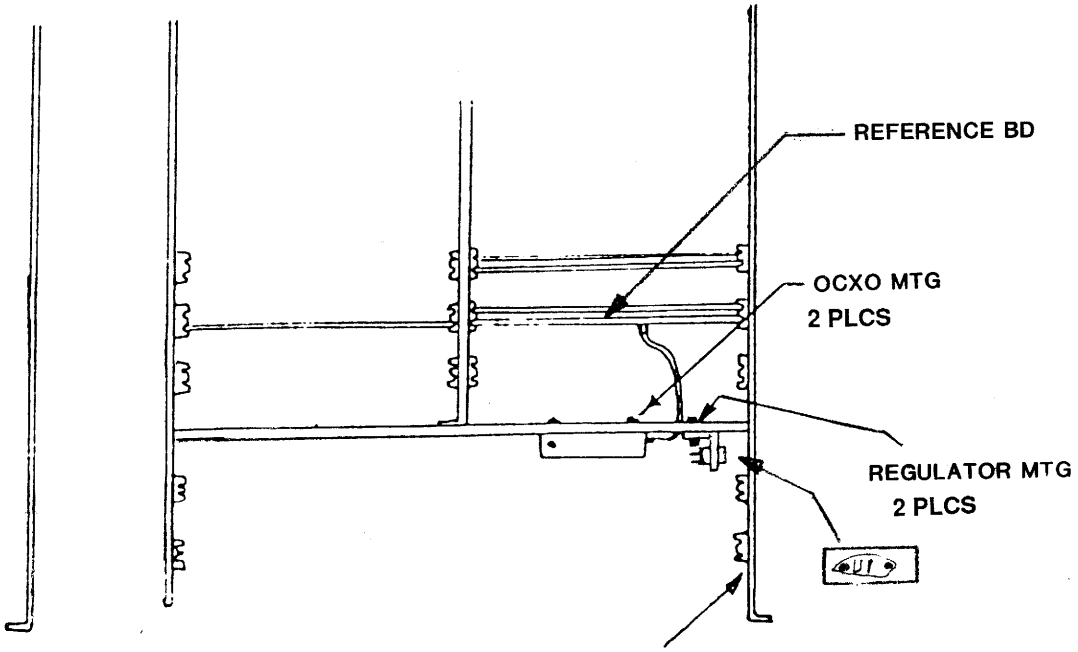


Figure 5.5-1 Locations

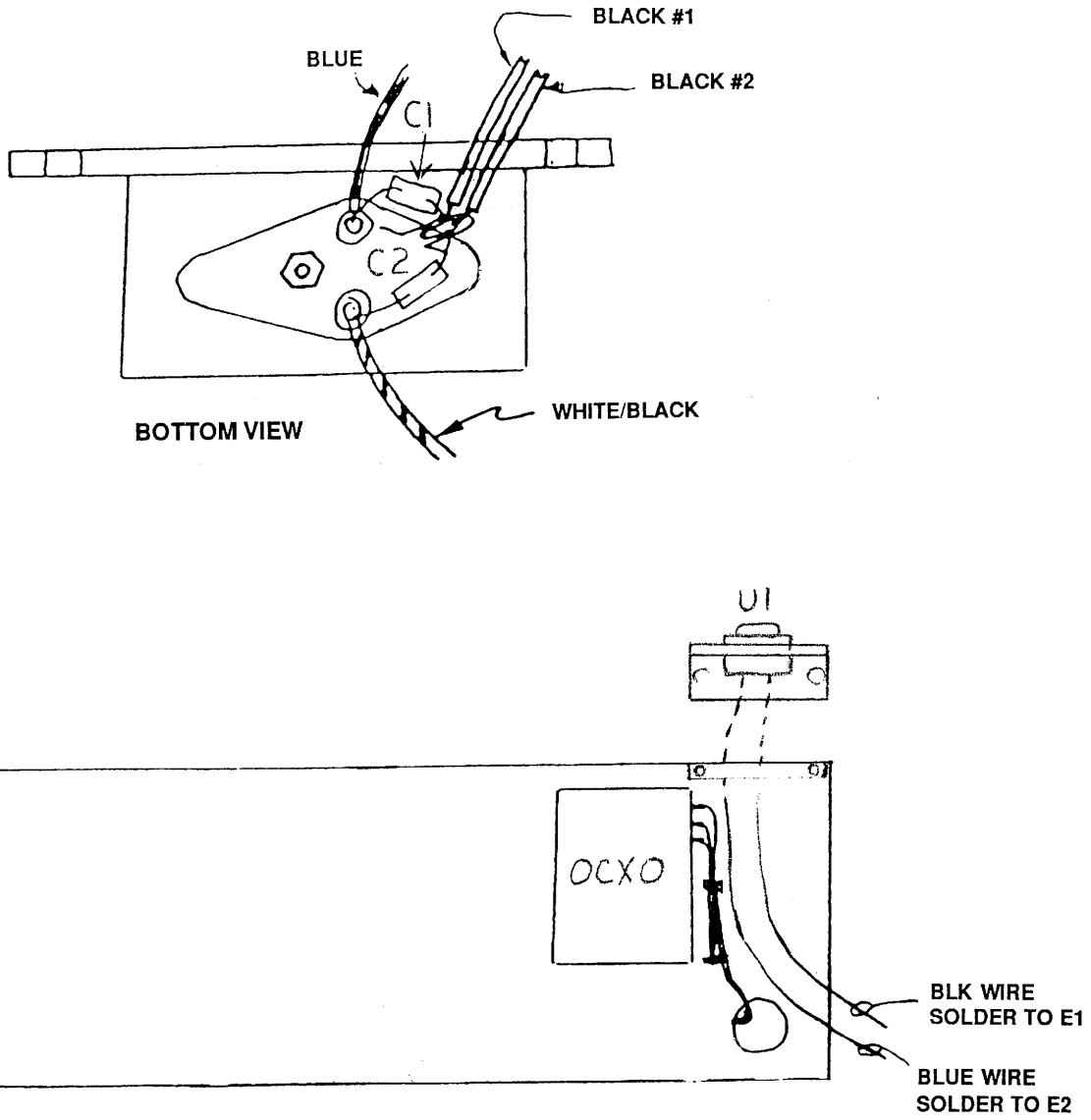
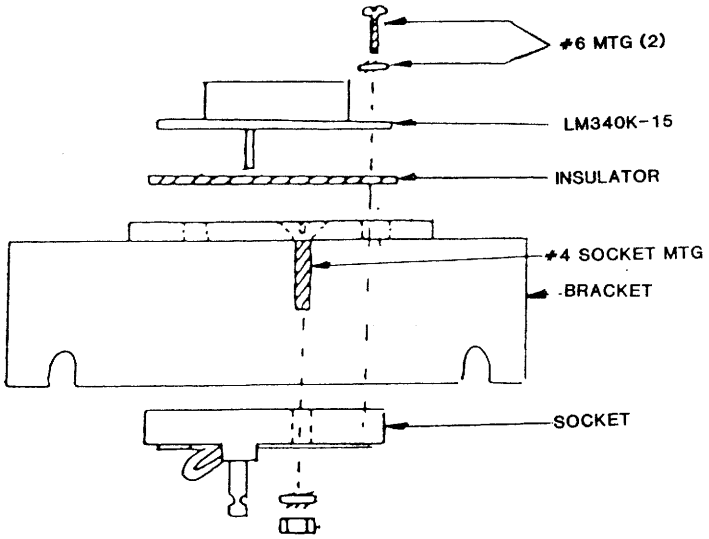


Figure 5.5-2 Wiring Instructions



15V REGULATOR BRACKET ASSEMBLY SKETCH (GROUP -002 ONLY)

Figure 5.5-3 Bracket Assembly

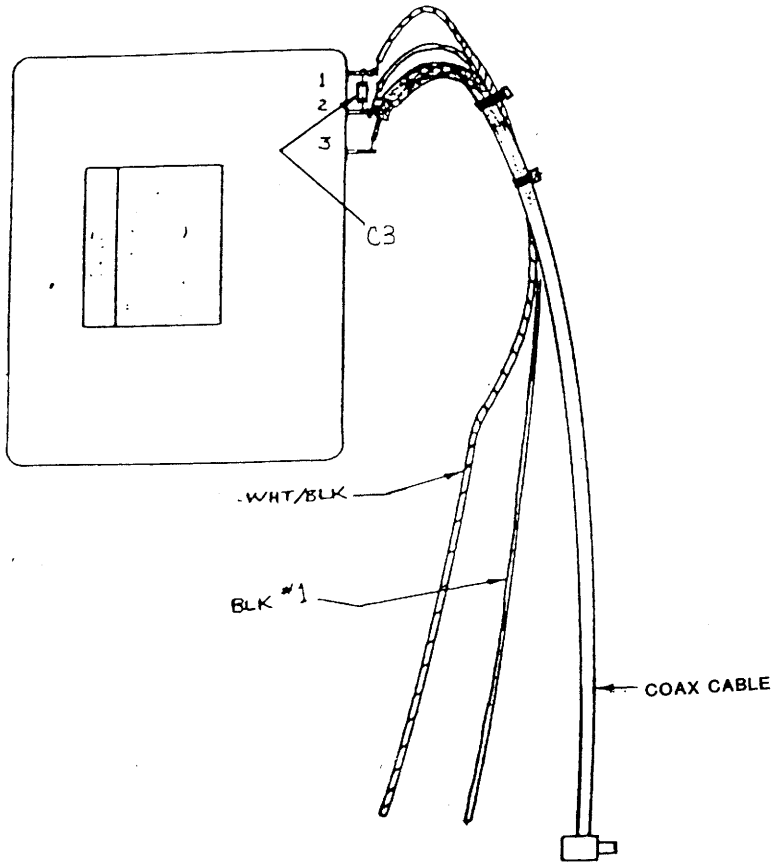


Figure 5.5-4 OCXO Assembly

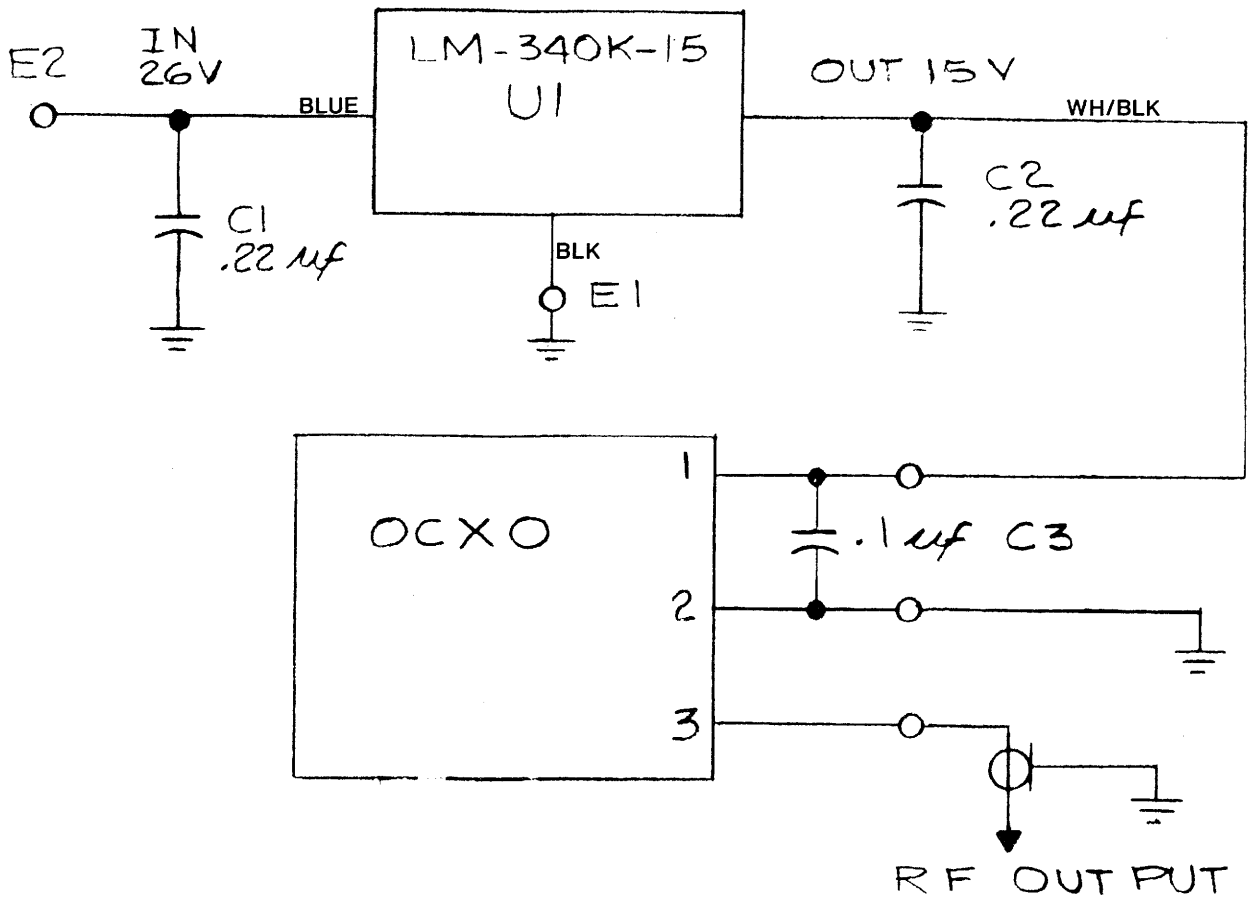


Figure 5.5-5 High Stability Option Schematic

High Stability Reference Option (700402-700-002)

PART NUMBER	DESCRIPTION	SYMBOL
600302-314-015	CAP. .22UF, MYLAR, 50V	C1,C2
600272-314-001	CAP. .1UF, CERAMIC, 50V	C3
600450-415-001	ICLM340K-15	U1
600170-419-001	TRANS INSULATOR	
600250-419-001	TO-3 SOCKET	
600440-540-003	COAX CABLE ASSY	
604371-602-001	BRACKET	
600173-376-001	OCXO, 5 MHZ	

5.6 ISB OPTION

The ISB option (700006-700-001) provides simultaneous USB and LSB transmit outputs each with its own independent audio input. The two paths are independent except for the ALC/TGC circuits which attenuate the level of both signal paths to maintain the rated maximum output (i.e. 125 watts PEP for the MSR 6700A, or 1 kW PEP with the MSR 1020 added, for power levels 2 or 4, respectively).

The ISB audio path is accommodated with all other options. The remote Addressable Audio I/O option provides addressable and fixed 600 ohm inputs for ISB as well as standard (USB, LSB, CW, AME, A3A, FSK) inputs.

The option consists of an additional Transmit Modulator (A12) and IF Filter board, A10. A12 is identical to the Standard Transmit Modulator, A11 and is described in Section 4.17. The IF Filter, A10 is identical to the standard IF Filter, A9, except that the USB filter FL1 is removed. See Section 4.16 for details.

5.6.1 INSTALLATION (See Figure 5.6-1)

5.6.1.1

Insert Transmit Modulator #2, A12 (P/N 601078-536-003) into Mother board J8. Check jumper positions for desired operation (also refer to Section 4.17):

JP3 (audio compressor) should be in position 2-3. This enables the compressor for voice signals. The compressor is disabled by a rear panel $\overline{\text{FSK}}$ key or by audio line key (via a 6 VDC signal impressed on the 600 ohm line as from a data modem). Position 1-2 does not allow the compressor to be enabled.

JP4 (Half Octave Filter board) should be in position 2-3. Position 1-2 is used on other radios with a different Half Octave Filter board.

JP2 (audio line center-tap key) is normally in position 2-3. Position 1-2 allows transmitter keying by a 6 VDC signal on the 600 ohm audio input line. The signal is obtained from the center-tap on the input transformer (which is at signal ground and does not affect the audio signal).

JP1 (CAR/DYN) is normally in position 2-3 for low level dynamic microphone operation. (See Section 4.6.8 for microphone operation.) Position 1-2 provides a d.c. bias for carbon microphones.

Jumpers should be checked on Transmit Modulator #1, A11 as well. Jumper characteristics are identical.

5.6.1.2

Insert IF Filter board #2, A10 (P/N 601076-536-015). Check jumpers for desired operation. Also see Section 4.16.

JP1 should be in position 2, 3 on E1 (down). This produces 50 ohm output impedance. Position 1-2 produces 100 ohm output impedance.

JP2,3 should be in position 1, 2 or E2, E3 (left). This is a receiver function and is not used in this radio.

5.6.1.3

Remove Logic board and engage switch S1 position 1 (down). This enables the ISB routines in the μP program to recognize ISB functions. Reinsert Logic board.

5.6.2 CHECKOUT

Assuming the radio has previously been aligned with the standard IF Filter board #1 and Transmit Modulator board #1, the only adjustment necessary is to equalize the LSB output with the USB output in ISB mode. Refer to alignment section, 4.6. Monitor the transmit output on a spectrum analyzer at any frequency (i.e. 29.9 MHz), and apply equal audio inputs to the rear panel 600 ohm standard input J42-24, 23 and ISB input J42-22, 21 (i.e. -10 dBm/1 kHz). Adjust R51 on Transmit Modulator board #2 to equalize USB and LSB tones on the analyzer.

If the transmitter has been adjusted for other audio input levels, the audio gains may have to be equalized. This may be done by monitoring the

audio indicator LED, DS1, on the Transmit Modulator boards, visible through the top shield. Adjust R1 for 600 ohm rear panel audio gain, R58 for microphone gain -- both accessable for both Transmit Modulator boards through the top shield.

5.6.3 OPERATION

ISB operation is enabled by sequentially pressing the front panel MODE key until the bar graph display indicates "ISB".

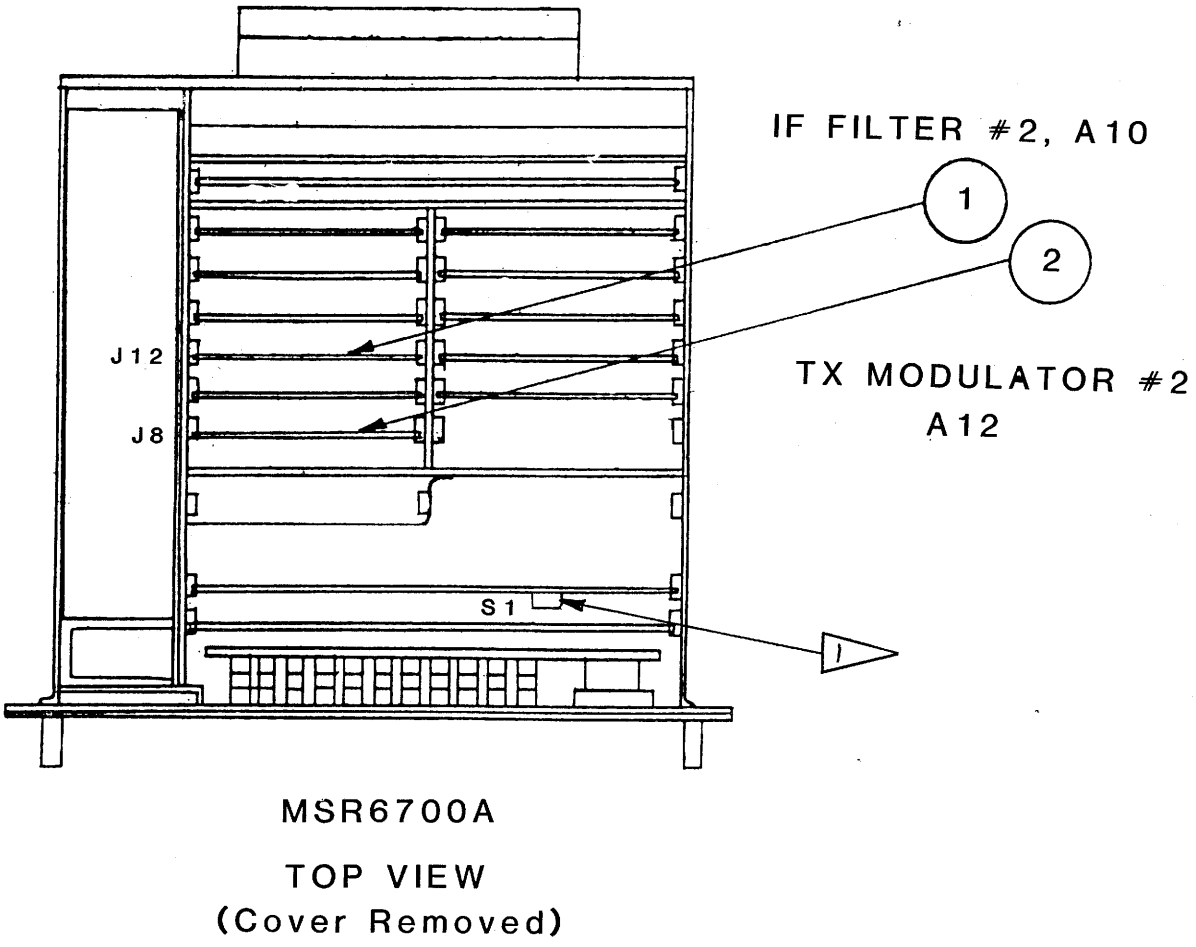


Figure 5.6-1 Installation, ISB Option

5.7 DATA FILTER OPTION

The Data Filter option (P/N 700417-700-XXX) substitutes controlled group delay filters for USB and LSB filters in the IF Filter boards. The filter characteristics conform to those specified in MIL-STD 188-203-1 for TADIL A data modems. They will be compatible with most high speed multitone RF data modems where tight control of amplitude and group delay (timing) in the passband is required. The specifications for the USB filter P/N 600127-529-001 are as follows. LSB filter P/N 600128-529-001 has identical specs with mirrored frequencies:

BW 2 dB +450 Hz to +3050 Hz
BW 3 dB +300 Hz to >+ 3050 Hz
BW 60 dB -400 Hz to +4400 Hz
Ripple 2 dB maximum
Diff. Time Delay 815 Hz to 3050 Hz: 500μS max.
Frequencies are referenced to the carrier and amplitudes are referenced to peak passband response.

Option 700417-700-001 (for the standard radio) replaces IF Filter board #1 (A9) P/N 601076-536-014 with P/N 601076-536-025. (See Section 4.16.) The new board is identical except for FL1 and FL2, the new USB and LSB filters:

FL1 = P/N 600127-529-001 (vs.600084-529-001)
FL2 = P/N 600128-529-001 (vs.600083-529-001)

Option 700417-700-002 applies to an MSR 6700A with ISB Option also installed. The #1 IF Filter board A9 (P/N 601076-536-014) is replaced by P/N 601076-536-026 with:

FL1 = P/N 600127-529-001 (vs.600084-529-001)
FL2 and FL3 are vacant.

The #2 IF Filter board A10 (P/N 601076-536-015) is replaced by P/N 601076-536-018 with:

FL2 = P/N 600128-529-001 (vs.600083-529-001)
FL1 and FL3 are vacant.

The FSK mode in the radio automatically selects the USB filter. The radio is keyed by a TTL low on rear panel connector J42, pin 25 ($\overline{\text{FSK}}$) to ground or pin 18 ($\overline{\text{EXT KEY}}$) to ground.

Selecting the USB or LSB mode selects the obviously associated filter. The radio is keyed by a TTL low on J42, pin 18 ($\overline{\text{EXT KEY}}$) to ground.

The radio may also be keyed by a +6 VDC impressed on the 600 ohm audio lines STD A, STD B (J42, pins 24, 23). To do this, the AUDIO KEY jumper (JP2) on the Transmit Modulator board must be in the proper position. This key mode is used in TADIL A modems (per MIL-STD 188-203-1).

APPENDIX I

PROTOCOL SPECIFICATIONS

INTRODUCTION

The MSR 5050A receiver, MSR 6700A exciter, and MSR 8050A transceiver have built- in remote control capability which can be accessed either by an MSR 6420 Universal Remote Control unit, or by the CSW 1000 communications program which runs on a PC. When the "Remote" key is pressed on the front panel, the radio will be ready for remote control. The radio waits for a "command string" from the Remote Control Unit (RCU) and then responds by returning a "Status string". Commands range from a "Status request" to radio control commands. There must be at least a 100 mS delay from the time the radio returns status, before the next command is sent to the radio.

The radios can communicate using RS-232C, RS-422, RS-423, MIL-STD-188C or FSK. Communication Baud rates available are 300, 600, 1200, 2400, 4800 and 9600. The format is 1 Start bit, 1 Stop bit, 8 Data bits, Even Parity, and Half Duplex. (There are 11 bits transferred per word). The least significant data bit is sent first. See Figure A1.1.

RADIO COMMANDS

The radio command string consists of the following parts:

The Sync Word: This is always the first word of any command. See Figure A1.2. The Sync word has the format:

Bits 6-7 => (2 High Order Bits) always 1.
Bit 5 => PTT (1=on, 0=off) Always "0" for an MSR 5050A. A "1" will cause an MSR 6700A and an MSR 8050A to key. A "0" will cause an MSR 6700A and an MSR 8050A to unkey.
Bit 4 => Specifies whether command that follows refers to Transmit or Receive Frequency. (1=Xmt, 0=Rcv)
Bit 3 => Specifies whether all radios in Remote Control Network should change their Switched Audio or not. (0=Change Switched Audio, 1=Not Change Switched Audio)
Bits 0-2 => Always 000 for Remote to Radio commands. Always 111 for Remote to Remote commands.

NOTE: Bit 4 is important for MSR 8050A. Bit 4 is meaningless for MSR 5050A and MSR 6700A.

NOTE: Bit 3 is important for jointly controlled MSR 5050A/MSR 6700A pairs. When this bit is low, any radio in the Remote Control Network not addressed in the Command String that follows will deselect its Switched Audio. Of course, the radio that is addressed will turn on its Switched Audio path. When this bit is high, any radio in the Remote Control Network will not change its Switched Audio path, regardless of whether it has its Switched Audio path on or not, and regardless of whether it is addressed or not in the Command String that follows. Thus, if the Remote is controlling a 5050A/6700A pair, this bit provides the means by which both radios can be alternately addressed without causing either radio to deselect its Switched Audio path.

NOTE: Bits 0-2 are used by the radio to determine if the command that follows is a command for a radio or a command for another remote.

The Radio Address: This is always the second word of any command string, and it is a 2 -digit BCD number. The radio address is programmed at the radio, and is set while the radio is in local mode.

BCD

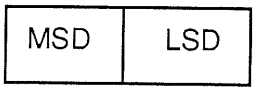
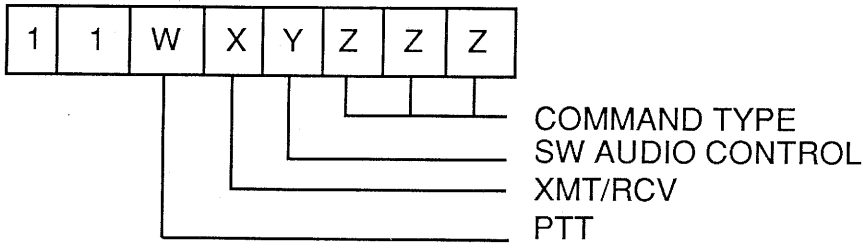


Figure A1.1 Protocol Word Format

START	DATA 1	DATA 2	DATA 3	DATA 4	DATA 5	DATA 6	DATA 7	DATA 8	PARITY	STOP

(EVEN PARITY)

Figure A1.2 Sync Word Format



The Command Word: This is always the third word of a command string. It is the actual command. (See the command word list.)

The Data Word(s): The needed data words for a command follow the command word. The number and type of data words depends on the command. Data words may not be omitted.

THE COMMAND WORD LIST

The command words are given as hexadecimal numbers, the data words which follow are BCD unless otherwise stated. These commands are used in all radios unless otherwise stated.

STATUS REQUEST

(Sync), (ADDR), (7F), (Remote Addr.)

The radio will return status (refer to the status string format) to the remote specified by the data word. The radio will continue to make all responses to this remote until another status request changes the remote address. Bit 4 of the Sync Word causes an MSR 8050A to select Transmit Mode if it is a "1" and Receive Mode if it is a "0". The MSR 8050A returns either the transmit or the receive information for the channel, depending on whether Bit 4 of the Sync Word is a "1" or a "0", respectively. Bit 4 of the Sync Word has no effect, of course, if the radio is an MSR 5050A or an MSR 6700A, since those radios only contain either receive information or transmit information, respectively.

CHANNEL RECALL

(Sync), (ADDR), (1A), (Channel Number)

The radio will "look up" the information for the channel specified by the data word. If the radio is an MSR 8050A, the radio will "look up" either the transmit or the receive information for the channel, depending on whether Bit 4 of the Sync Word is a "1" or a "0", respectively. Bit 4 of the Sync Word has no effect, of course, if the radio is an MSR 5050A or an MSR 6700A, since those radios only contain either receive information or transmit information, respectively. That channel information is returned through the return status, but the channel is not selected by the radio (the radio does not switch channels).

CHANNEL SELECT

(Sync), (ADDR), (0B), (Channel Number)

The radio will switch to the channel number specified by the data word. Bit 4 of the Sync Word has no effect, since the channel is selected regardless of whether it contains transmit information or receive information or both.

CHANNEL DATA SAVE

(Sync), (ADDR), (1B), (10 MHz, MHz), (100 KHz, 10 KHz), (1 KHz, 100Hz), (10Hz, Mode), (AGC, Filter), (BF01), (BF02), (Pwr. Lev.)

The radio will save the data given in the currently selected channel. Zeros are inserted where the above given data does not pertain to the type of radio being controlled. If the radio is an MSR 8050A, the radio will save either the transmit or the receive frequency for the channel, depending on whether Bit 4 of the Sync Word is a "1" or a "0", respectively. Bit 4 of the Sync Word has no effect, of course, if the radio is an MSR 5050A or an MSR 6700A, since those radios only contain either receive frequency or transmit frequency respectively. The first 3 data bytes are Frequency (in BCD). The other bytes are:

DATA BYTE #	BITS	USAGE
4	4-7	10 Hz. Freq.
4	0-3	Mode
5	4-7	AGC
5	0-3	Filter
6	6-7	Always 0
6	4-5	Tuning Rate
6	3	BFO Sign
6	0-2	BFO 1 KHz
7	4-7	BFO 100 Hz
7	0-3	BFO 10 Hz
8	2-7	Always 0
8	0-1	Power Level

MODE SELECT

(Sync), (ADDR), (0F), (Mode)

The radio will select the Mode specified in the data byte. Refer to the code translation table for Mode. If the radio is an MSR 8050A, the radio will select either a transmit mode or a receive mode for the channel, depending on whether Bit 4 of the

Sync Word is a "1" or a "0", respectively. Bit 4 of theSync Word has no effect, of course, if the radio is an MSR 5050A or an MSR 6700A, since those radios offer only one mode per channel.

POWER LEVEL SELECT

(MSR 6700A and MSR 8050A ONLY)
(Sync), (ADDR), (1C), (Power Level)

The radio will select the power level specified in the data byte. Refer to the code translation table for Power Level. Bit 4 of the Sync Word has no effect.

FREQUENCY SELECT

(Sync), (ADDR), (0D), (10 MHz, 1 MHz), (100 KHz, 10 KHz), (1 KHz, 100 Hz), (10 Hz, 0000)

The radio will select the frequency specified in the data. If the radio is an MSR 8050A, the radio will select either a transmit or a receive frequency for the channel, depending on whether Bit 4 of the Sync Word is a "1" or a "0", respectively. Bit 4 of the Sync Word has no effect, of course, if the radio is an MSR 5050A or an MSR 6700A, since those radios only contain one frequency per channel.

AGC SELECT

(MSR 5050A AND MSR 8050A ONLY)
(Sync), (ADDR), (1D), (AGC)

The radio will select the AGC specified in the data byte. Refer to the translation table for AGC. Bit 4 of the Sync Word has no effect.

FILTER SELECT

(MSR 5050A ONLY)
(Sync), (ADDR), (1E), (Filter)

The radio will select the Filter specified in the data byte. Refer to the translation table for Filter. Bit 4 of the Sync Word has no effect.

METER SELECT

(Sync), (ADDR), (1F), (Meter Meaning)

The radio's meter will change to the function specified in the data byte. Refer to the translation table for Meter Meaning. Bit 4 of the Sync Word has no effect.

START TUNE CYCLE

(MSR 6700A AND MSR 8050A ONLY)
(Sync), (ADDR), (03), (Tune Type)

The radio will initiate a tune cycle (assuming there is a coupler in the system). The type of tune (RF or Silent) is determined by the data byte. 1 => Silent, 2 => R.F. Tune. Bit 4 of the Sync Word has no effect.

TOGGLE COUPLER BYPASS

(MSR 6700A AND MSR 8050A ONLY)
(Sync), (ADDR), (20)

The radio will toggle the coupler bypass. This command has no data bytes. Bit 4 of the Sync Word has no effect.

BFO SELECT

(MSR 5050A ONLY)
(Sync), (ADDR), (21), (BFO1), (BFO2)

The radio will select the BFO value determined by the data bytes. Refer to the translation table for BFO. Bit 4 of the Sync Word has no effect.

SWITCH REMOTE CONTROL

(Sync), (ADDR), (22), (CONTROL MODE)

If the control mode is 0 the radio will switch to local operation. If the control mode is non-zero, the radio will switch to Remote control. Bit 4 of the Sync Word has no effect.

RF GAIN SELECT

(MSR 5050A AND MSR 8050A ONLY)
(Sync), (ADDR), (0E), (RF GAIN)

The radio will select the RF Gain Level based on the non-BCD number that it detects in the RF GAIN Byte of this Command String. The number in the RF GAIN Byte must be a hexadecimal number between 0H and 14H. Since the remotely controlled RF Gain function in the radio has a 20-step range, a hexadecimal 14 translates to a decimal 20, which produces maximum RF Gain in the Radio. A 0AH translates to a decimal 10, which produces the median RF Gain Level. A 0H of course produces zero or minimum RF Gain in the Radio. Bit 4 of the Sync Word has no effect.

THE RADIO STATUS STRING

Once the radio has seen and identified a command string, the radio will carry out whatever commands are necessary, and then return its status. The status string gives to the Remote current radio data, such as the currently selected channel, frequency, mode, AGC, filter, band, BFO, power level, meter data, and coupler data. The information which is returned depends on the type of radio. For example, coupler data and power level only apply to the MSR 6700A and MSR 8050A, while AGC only applies to the MSR 5050A and MSR 8050A. Refer to the section for the specific radio.

There must be at least 100 mS delay from the time the radio returns status, before the next command is sent to the radio.

All radios have the same first two bytes in the return status. The first byte is the Sync Word. The format for the Sync word is similar to the one used for command Sync Words described in the section on Commands.

Sync Word Format

Bits 6-7 => (2 High Order Bits) always 1.
Bit 5 => PTT (1=on, 0=off) Always "0" for an MSR 5050A. A "1" indicates that an MSR 6700A or an MSR 8050A is keyed. A "0" indicates that an MSR 6700A or an MSR 8050A is unkeyed.
Bit 4 => Local response flag. (1=radio is in local mode, 0=radio is in remote).
Bits 0-3 => Radio type. 1 - MSR 8050A
2 - MSR 6700A
3 - MSR 5050A

The second byte of return status is the remote address. This is the address of the last remote to do a status request (7F Hex) of the radio. The remote adress is a two digit BCD number (00-99).

ERROR HANDLING AND RESPONSES

The radios do error checking to protect themselves and attached equipment. The radios use error checking to trap invalid Sync Words, invalid Addresses, invalid Commands and invalid Data. If a radio receives an improper Address or an improper Command, it will not respond. Instead, it will ignore the data in the Command string and wait for the next valid Command sequence. If the radio receives improper Data Words, it will change the improper Data to a default value, after which it will return its current Status.

Radios check for receive errors which are caused by one of the following:

A Parity Error (Parity is Even).
A Framing Error.
An Overrun Error.

If there is a receive error in any byte of a Command String, the radio will ignore the rest of the Command String and wait for the next valid Command String with no errors. Note that there must be at least 100 mS delay from the time the radio returns Status, before the next Command is sent to the radio. Otherwise, a receive error could occur.

Radios check for valid Commands in a Command Sequence. Radios will not attempt to execute Commands that are not part of their Command Library. For example, an MSR 5050A receiver will not execute a coupler command, and an MSR 6700A exciter will not select AGC.

Radios check to determine if certain Data words have non-BCD characters in them. If these Data Words have non-BCD characters in them, the radio will change the improper Data to a default value, after which it will return its current Status.

Radios check every word for Sync Word characteristics. The only word that may have ones in the two high order bit positions is the Sync Word. If the radio sees any word with the two high order bits set, it will interpret that word as a Sync word and thus the start of a new Command String.

1	1	X	X	X	X	X	X

This combination only applies to the Sync Word.

Radios will inform their respective Remotes if they are experiencing a BITE Fault. The radio does this by shortening its Status String to four Bytes, as follows:

(Sync), (ADDR), (30), (BITE Fault)

Note the radio sends an illegal frequency of 30 MHz in the third Byte to inform the Remote of a BITE Fault. In a normal Status String, the third Byte contains the 10 MHz/1 MHz information, which will never be higher than 29, unless a BITE Fault has occurred. The fourth Byte in the BITE Fault String contains either a 1 or a 2. The meaning of these BITE Fault numbers is described as follows:

1 = Radio Power Supply BITE Fault
2 = Radio Synthesizer Loss of Lock BITE Fault

OPERATION IN LOCAL MODE

If the radio is in LOCAL mode, it is not ready to talk to a Remote, but it does monitor to see if a Remote sends a Command. If a Remote sends a Command to the radio while it is in LOCAL mode, then the radio will return Status. However, Bit 4 in the Return Status Sync word will be set to indicate that the radio is in LOCAL mode. The radio will not carry out any Commands while it is in LOCAL mode. It will only return Status. If the radio is busy doing something while in LOCAL mode, (such as changing frequency), then the radio will not be able to respond to the Remote. The Remote Control can use the "Switch Remote Control" command to put the radio into Remote mode (refer to the section on Remote Control Commands).

NORMAL RETURN STATUS FOR THE MSR 5050A RECEIVER

BYTE #	DATA
1	(Sync Word)
2	(Remote Address)
3	(10 MHz, 1 MHz)
(Frequency)	Bit 7 => Always 0
	Bit 6 => Always 0
	Bits 4-5 => 10 MHz
	Bits 0-3 => 1 MHz
4	(100 KHz, 10 KHz)
5	(1 KHz, 100 Hz)
6	(10 Hz, Mode)
7	(Channel Number)
8	(Meter Data)
	Bits 0-4 => Strength (0-20).
	Bits 5-6 => Meter Meaning.
	Bit 7 => Always 0.
9	(The Radio's Address)
10	(AGC, Filter)
11	(BFO1)
12	(BFO2)

NORMAL RETURN STATUS FOR THE MSR 6700A EXCITER

BYTE #	DATA
1	(Sync Word)
2	(Remote Address)
3	(10 MHz, 1 MHz)
(Frequency)	Bit 7 => Always 0
	Bit 6 => Always 1
	Bits 4-5 => 10 MHz
	Bits 0-3 => 1 MHz
4	(100 KHz, 10 KHz)
5	(1 KHz, 100 Hz)
6	(10 Hz, Mode)
7	(Channel Number)
8	(Meter Data)
	Bits 0-4 => Strength (0-20).
	Bits 5-6 => Meter Meaning.
	Bit 7 => Always 0.
9	(The Radio's Address)
10	(Coupler/Power Data)
	Bit 7 => Always 0
	Bit 6 => Fault (1=True)
	Bit 5 => Ready(1=True)
	Bit 4 => Coupler Bypass(1=True)
	Bit 3 => Silent Tuning (1=True)
	Bit 2 => R.F. Tuning (1=True)
	Bits 0-1 => Power Level

NORMAL RETURN STATUS FOR THE MSR 8050A TRANSCEIVER

BYTE #	DATA
1	(Sync Word)
2	(Remote Address)
3	(10MHz, 1 MHz)
(Frequency)	Bit 7 => Always 0
	Bit 6 => 1=Xmt Freq, 0=Rcv Freq
	Bits 4-5 => 10 MHz
	Bits 0-3 => 1 MHz
4	(100 KHz, 10 KHz)
5	(1 KHz, 100 Hz)
6	(10 Hz, Mode)
7	(Channel Number)
8	(Meter Data)
	Bits 0-4 => Strength (0-20).
	Bits 5-6 => Meter Meaning.
	Bit 7 => Always 0.
9	(The Radio's Address)
10	Bits 0-3 => AGC
	Bits 4-7 => Unused (Normally 0's)
11	(Coupler/Power Data)
	Bit 7 => Always 0
	Bit 6 => Fault (1=True)
	Bit 5 => Ready (1=True)
	Bit 4 => Coupler Bypass (1=True)
	Bit 3 => Silent Tuning (1=True)
	Bit 2 => R.F. Tuning (1=True)
	Bits 0-1 => Power Level

TRANSLATION TABLES

TYPE	CODE	MEANING
MODE	0	ISB
	1	AM
	2	CW
	3	USB
	4	LSB
	5	FSK
	6	A3A
	7	FM
	8	DATA
AGC	0	Off
	1	Slow
	2	Medium
	3	Fast
FILTER	0	Very Wide
	1	Wide
	2	Medium
	3	Narrow
	4	Very Narrow
	5	(Unused)
	6	FM
	7	SSB
BF01		
	(bits 6-7)	Always 0
	(bits 4-5)	Tuning Rate (below)
	(bit 3) 0	Minus
	1	Plus
	(bits 0-2)	1 KHz
BF02		(100 Hz, 10 Hz)
POWER LEVEL	0	Level 1 (25 watts)
	1	Level 2 (125 watts)
	2	Level 3 (500 watts)
	3	Level 4 (1000 watts)
TUNING RATE	0	Lock
	1	10 Hz
	2	1 KHz
	3	100 KHz
METER MEANING	0	Forward Power
	1	Reflected Power
	2	Signal Strength
	3	Audio Level