EE125-RD-MMC-010/R-2411/U

NSN 0913-LP-283-7600

OPERATION AND MAINTENANCE INSTRUCTIONS

ORGANIZATIONAL

RECEIVER, DUAL

MF - HF

R-2411/U

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FOREWORD

SCOPE

This manual contains information for the installer and operator to obtain best performance from the R-2411/U dual receiver. The information includes: a general description, preparation for use and installation instructions, operating instructions, general theory of operation, maintenance instructions, preparation for reshipment, storage, and parts list.

Component level maintenance is not included in this manual. Component level maintenance and internal adjustments should be performed in the designated maintenance depot.

WARRANTY

Cubic Communications Incorporated warrants any failed unit when either one of the following conditions exist:

a. Elapsed time meter reading of less than 2,000 hours after Government acceptance.

b. Government acceptance of the unit occurred less than 5 years before failure.

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SAFETY SUMMARY

The following are general safety precautions that are not related to any specific procedures and therefore do not appear elsewhere in this publication. These are recommended precautions that personnel must understand and apply during many phases of operation and maintenance.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must at all times observe all safety precautions. Dangerous potentials may exist internally with the POWER switches in the off position and input voltage connected. Input voltage is wired directly to the POWER switch contacts through the AC Line Filter board. Always remove and tag input voltage when removing or installing equipment.

DO NOT SERVICE OR ADJUST ALONE

Under no circumstances should any person reach into the equipment for the purpose of servicing or adjusting the equipment except in the presence of someone who is capable of rendering aid.

RESUSCITATION

Personnel working with or near high voltages should be familiar with modern methods of resuscitation. Such information may be obtained from the Bureau of Medicine and Surgery.

The following warnings and cautions appear in the text in this volume, and are repeated here for emphasis.

WARNING

When the top cover is removed, high voltage may be present at the rear panel AC power connector, the AC Line Filter board, and the front panel POWER switch connections. Use caution when working in these areas. Pages 2-1, 5-1, and 5-3.

CAUTION

Do not attempt to operate the receiver if internal damage is found. Additional damage may occur. Page 2-1.

CAUTION

Before removing the bottom cover, ensure the front panel POWER switches are off. Equipment damage may occur if tools or metal objects are allowed to come in contact with receiver components. Page 2-1, and 5-1.

CAUTION

Do not support the weight of the unit by the front panel alone. The chassis may bend or warp. Use chassis slides or a suitable support shelf. Pages 2-1, and 6-1.

CAUTION

Ensure the switches on top of both power supply modules are set to the 110 position or the equipment may be damaged when power is applied. Page 2-1.

CAUTION

Ensure slide mounting screws are of the proper length. If screws are too long internal equipment damage may occur. Page 2-2.

CAUTION

Before connecting AC power, ensure each internal power supply module selector switch is set correctly or equipment damage may occur. Page 2-4.

CAUTION

Do not operate the receiver for extended periods of time with the top cover removed. The receiver may overheat from lack of forced-air cooling. Page 5-3.

CAUTION

Turn off power before removing or replacing modules. Equipment damage may occur if modules are removed or replaced with power applied. Page 5-4.

CAUTION

Do not use a sharp tool to pry up the module. The module may be scratched or marred. Use a small wood or plastic pry- bar. Page 5-4.

CAUTION

When installing modules, ensure the module connector is aligned correctly with the connector in the chassis or the connectors may be damaged. On modules with both a coaxial cable connector and a standard connector, mate the standard connector first and then engage the coaxial connector. Page 5-4.

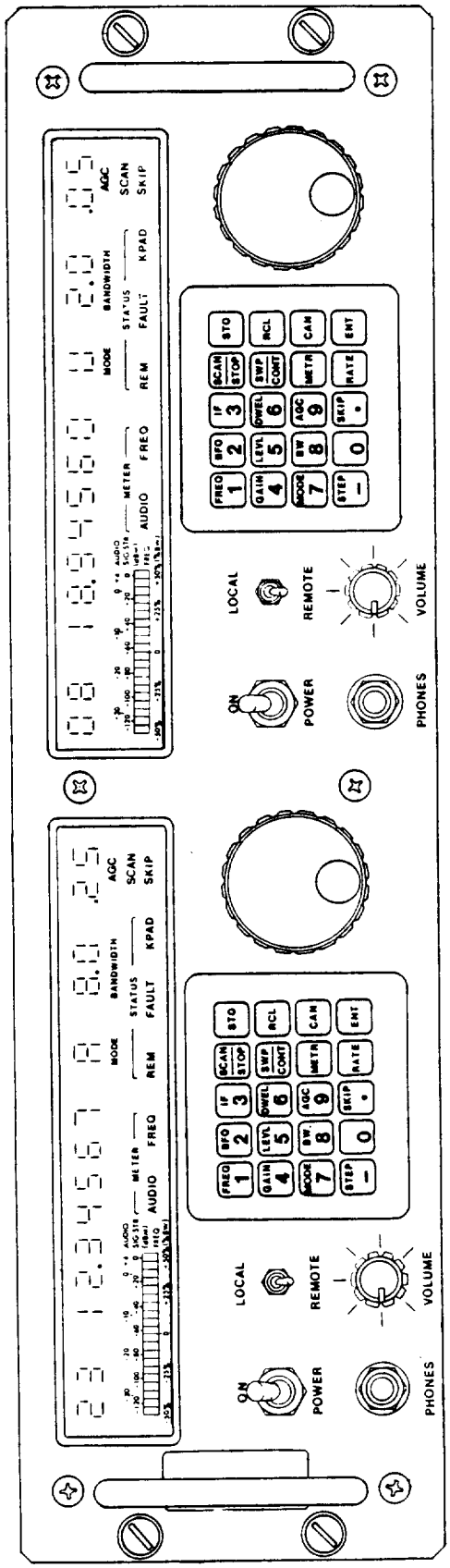


Figure 1-1. R-2411/U Receiver Front View.

CHAPTER 1

GENERAL DESCRIPTION

1-1 INTRODUCTION.

This chapter contains a description of the equipment, equipment supplied, equipment required but not supplied, storage data, and recommended tools and test equipment.

1-2 EQUIPMENT DESCRIPTION.

(See figure 1-1). The R-2411/U contains two independently controlled, high performance, multimode, surveillance receivers (receiver A and receiver B) in a single chassis covering a frequency range from 50 kHz to 30 MHz.

NOTE

Receiver A is located on the left, and receiver B is located on the right as viewed from the chassis front panel.

NOTE

The R-2411/U may be operated below 50 kHz with degraded performance.

Each receiver contains individually shielded, interchangeable module assemblies mounted in a single 19 by 5 1/4 inch rack mount chassis. The receivers share common control bus, audio connector, AC input power connector, external frequency standard input connector, and internal/external reference frequency selector switch. Each receiver has individual power supplies with individual power switches.

The receivers may be operated locally (manually) using independent front panel controls and indicators or remotely using an optional, addressable, remote control bus.

If a serial bus is used, two bus connectors on the rear panel allow serial connection of up to eight receivers (four R-2411/U chassis). Each bus cable attaching to the rear panel is hard-wired to provide a unique address for each receiver in the chassis.

If an IEEE-488 bus is used, a single connector on the rear panel allows parallel connection of up to fifteen devices on the bus including the bus controller. (Each R-2411/U chassis is counted as two devices). Two bus address and function switches (one for each receiver) are also provided on the rear panel.

In manual operation, 20 button keypads select frequency, mode, BFO offset, IF shift, manual gain, and other parameters. Manual adjustment knobs may also control many of the above parameters. The front panel displays show frequency, mode, bandwidth, and AGC time constant as well as (when selected) BFO offset, IF shift, manual gain, squelch threshold level, and other parameters. Light bar type meters indicate signal strength, audio signal level, or relative frequency of the input signal.

In remote operation, a computer system operator controls the receivers by an optional remote control bus. Choice of tuned frequency, mode, BFO offset (when the CW mode is selected), AGC time constant, and other parameters are selected through a system console.

The receiver can detect and demodulate a wide variety of signals including: amplitude modulated (AM), frequency modulated (FM), on/off keyed, and single sideband (SSB) signals (full carrier, reduced carrier, suppressed carrier and frequency shift keyed).

All detector outputs are available as fixed level audio signals on a 600 ohm balanced line. The FM detector output is also available as a DC coupled signal on a single ended line. Headphone jacks are provided on both the front and rear panel -- the signal level on these headphone jacks is controlled by front panel volume controls.

1ST IF output signals at 40.455 MHz and 2ND IF output signals at 455 KHz are available for analysis by other equipment on rear panel connectors. Refer to table 1-1 for specifications of the equipment.

1-3 EQUIPMENT SUPPLIED AND REQUIRED.

Table 1-2 lists the items furnished, and required.

Table 1-1. R-2411/U Specifications.

Item	Specification
Frequency:	
a. Range	50 kHz to 30 MHz
b. Resolution	10 Hz
c. External Std.	Input/output: 1, 5, or 10 MHz internally selectable, 0 dBm, 50 ohms nominal.
d. Internal Std.	Reference oscillator: 10 MHz, stability of ±1 PPM over the specified temperature range.
e. Synthesizer Lock Time	5 ms typical, 15 ms worst case
Modes:	
a. Selectable	LSB, USB, AM, CW, FM
b. Always active	FM Video
RF Section:	
a. RF input	50 ohms, TNC
b. RF input VSWR	less than 3:1
c. RF protection	Withstands application of RF power up to 10 watts without damage. Protection circuit automatically resets.
d. RF noise figure (NF)	13 dB max. above 1.6 MHz 20 dB max. below 1.6 MHz to 50 kHz NF below 50 kHz not applicable
e. RF sensitivity for 10 dB SINAD (above 1.6 MHz)	SSB (3 kHz bandwidth) min. -116 dBm (500 Hz bandwidth) min. -124 dBm AM (8 kHz bandwidth 90% modulation) min. -107 dBm
Preselection:	Automatic
a. Filter shape factor	Approximately 4:1
b. Bands:	Frequency Range (MHz):
1	0.0 to 0.499
2	0.5 to 1.599
3	1.6 to 2.299
4	2.3 to 3.299
5	3.3 to 4.799
6	4.8 to 6.899
7	6.9 to 9.899
8	9.9 to 14.299
9	14.3 to 20.499
10	20.5 to 30.000

Table 1-1. R-2411/U Specifications-CONT

Item	Specification
IF Bandwidth Selection:	
a. 1ST IF	40.455 MHz
b. 2ND IF	455 kHz
c. 1ST IF bandwidth	-6 dB, 10 kHz min.
d. 2ND IF bandwidth	Selectable: 1. 500 Hz ±50 Hz at -6dB, 4 kHz max. at -60 dB 2. 1000 Hz ±100 Hz at -6 dB, 6 kHz max. at -60 dB 3. 3000 Hz ±300 Hz at -6 dB, 6 kHz max. at -60 dB 4. 8000 Hz ±800 Hz at -6 dB, 20 kHz max. at -60 dB
AGC RF derived in selected bandwidth:	
AGC range	120 dB min.
AGC threshold	0.5 uV (audio -6dB ref. level at 50 uV)
AGC disable	AGC or manual gain control
Manual gain control	0 to 120 dB gain reduction (min.), local or remote in 1 dB increments
a. Fast Attack:	
Attack Time	Less than 10 ms nominal
Decay Time (Locally or remotely selectable)	Zero: 15 ms max. Short: 250 ms nom. Medium: 1 second nom. Long 3 seconds nom. Off Manual Gain Cont. only
b. Average type:	AM Mode only.
Attack/release time	50 milliseconds nom.
Interference Immunity	
a. IF Rejection:	100 dB min.
b. Image Rejection:	90 dB min.
c. Spurious Responses:	-130 dBm equivalent or less for -50 dBm input signals
d. Generated Spurious:	-123 dBm input equivalent or less, 2 to 30 MHz. -110 dBm input equivalent, or less, 50 kHz to 2 MHz.
e. Cross Modulation:	Unmodulated wanted signal of -67 dBm together with a modulated (30% at 1 kHz) unwanted signal of -20 dBm spaced 50 kHz apart produces less than 10% cross modulation of wanted signal.
f. Blocking:	Attenuation of a wanted RF signal of -67 dBm and caused by an unmodulated signal of 1V spaced 100 kHz away, is less than 3 dB.
g. Inherent Local Oscillator Reradiation:	-107 dBm, up to 1 GHz from receiver antenna connector into 50 ohms.

Table 1-1. R-2411/U Specifications-CONT

Item	Specification
Interference Immunity-continued	
h. Intermodulation Distortion: (out of band)	Second-Order Intermodulation Distortion: The receiver provides a second-order input intercept point of +50 dBm. The measurement is valid with test tones up to -5 dBm. Third-Order Intermodulation Distortion: The receiver provides a third-order input intercept point of +33 dBm min. The measurement is valid with test tones up to -5 dBm with 100 kHz signal spacing.
i. Intermodulation Distortion: (In band)	Two tones, in band, separated by 400 Hz with input level -10 dBm max. Intermodulation products -50 dB min. relative to either tone. Medium or long time constant.
Output Signals	
a. 1ST IF:	40.455 MHz with 1 MHz min. bandwidth, 50 ohms at approximately 10 dB gain from input.
b. 2ND IF:	455 kHz at selected bandwidth and nom. -10 dBm level, ±3 dB, over AGC dynamic range.
c. Audio:	AM, CW, LSB, USB: 0 ±3 dB over AGC dynamic range. FM 0.5v/kHz AC coupled (4V p-p max), 600 ohms balanced pair on audio connector (2 pair per assembly), short circuit protected, less than 5% distortion at rated output.
d. Headphones or Speaker:	Dual 0 to 12 V p-p, 8 ohm source impedance to front and rear panel phone jacks. Front jack with ring contact to adjacent receiver, both jacks with tip contact to own receiver. Short circuit protected.
e. FM Video:	1 V per kHz (positive sense, DC coupled) 93 ohm single ended. Uses two pins on audio connector.
f. Signal Strength:	Analog format using two pins on audio connector (0 to 5 VDC).
Input Signals	
a. Synthesizer Reference:	1, 5, or 10 MHz selectable, 0 dBm, 50 ohms; one TNC connector per two receiver assembly.
b. Antenna:	50 kHz to 30 MHz, 50 ohms nom.

Table 1-1. R-2411/U Specifications-CONT

Item	Specification
Remote Control Bus Functions	
a. Selected Frequency	10 Hz increments
b. Modes	LSB, USB, AM, CW or FM
c. IF Bandwidth	0.5, 1, 3, or 8 kHz
d. BFO Frequency	±9.99 kHz offset in 10 Hz steps
e. Gain Control	Automatic or Remote
f. AGC Decay Time	0, 250, 1000 or 3000 msec
g. IF Gain	0 to -120 dB reduction (min.) in 1 dB increments
h. Sweep and Scan functions	Start/Stop control
i. Memory Channels	Storage and Recall functions
j. Sweep Step Size	Settable (0.1 to 9.9 kHz)
k. Thresholds	Settable (-120 dBm to 0 dBm) for Sweep and Scan (min. range)
l. Dwell Time for Sweep and Scan.	Settable (1 to 9 seconds and indefinite)
m. Skip memory flag	Settable (on or off)
o. IF Shift	Settable (±9.99 kHz shift in 10 Hz steps)
Physical Characteristics	
a. Dimensions	Height: 5.219 in. Depth: 20.840 in. Width: 19.000 in. (front panel) 16.800 in. (chassis)
b. Weight	50.4 lb (without slides)
c. Volume	2432 cubic in.
Power Requirements	110 VAC (90 to 150 VAC), 47 to 450 Hz, or 220 VAC (180 to 260 VAC), 47 to 450 Hz, 100 watts maximum per chassis.
Environmental Conditions	Sheltered controlled environment
a. Temperature	32 to +122°F (0 to +50°C) - operating, -80 to +160°F (-62 to +71°C) - nonoperating
b. Fungus	Resistant IAW para 3.3.5.6 of MIL-E-16400G.
c. Shock	Will perform its function under HI shock when mounted in a shock isolated 19 in. rack.
d. Vibration	Will perform its function if subjected to vibrations which may be encountered aboard naval ships when mounted in a shock isolated 19 in. rack.

Table 1-2. Items Furnished and Required.

Part No.	Nomenclature	Furn/Reqd
2861-1000-1	R-2411/U MF/HF Receiver (Serial Bus)	Furnished
2861-1000-2	R-2411/U MF/HF Receiver (IEEE-488 Bus)	Furnished
-	R-2411/U Operation and Maintenance Instructions	Furn. Separately
-	Bus Controller and attaching cables	Optl. Not supplied
-	Antenna and attaching cables	Reqd. Not supplied
-	AC power source	Reqd. Not supplied

1-4 STORAGE DATA.

There are no special storage requirements for the R-2411/U. The receiver should be stored indoors in the original shipping container if available.

1-5 TOOLS AND TEST EQUIPMENT.

Table 1-3 lists recommended tools and test equipment for organizational level maintenance. There are no special tools or test equipment required.

1-6 SAFETY PRECAUTIONS.

Safety precautions are presented in this manual preceded by the word WARNING or CAUTION just before the point where the hazard is likely to be encountered. Warnings and cautions are defined as follows:

WARNING

Refers to a procedure or practice that, if not correctly followed, could result in injury, death, or long term health hazard.

CAUTION

Refers to a procedure or practice that, if not correctly followed, could result in damage to, or destruction of equipment.

Table 1-3. Recommended Tools and Test Equipment (Or Equivalent).

Part No.	Nomenclature	Manufacturer
-	No. 2 Phillips screwdriver, 6 in.	Standard Issue
-	Small plastic or wood pry-bar	Locally procured
HP8656B	RF signal generator	Hewlett Packard
465B	Oscilloscope	Tektronix
8050A	Digital multimeter	Fluke
HP5381A	Frequency counter	Hewlett Packard
HP8568	Spectrum analyzer	Hewlett Packard[1]
-	No. 1 Phillips screwdriver, 6 in.	Standard issue[1]
-	No. 2 Phillips screwdriver, 12 in.	Standard issue[1]
6500-001-0016	Insertion tool (16 ga.)	Matrix[1]
M81969/14-16	Extraction tool (16 ga.)	Matrix[1]
MS27534-20 (red)	Insertion tool (20 ga.)	Bendix[1]
MS27534-20 (white)	Extraction tool (20 ga.)	Bendix[1]
JT-R-INS, MS27509A22	Insertion tool (22 ga.)	Bendix[1]
JT-R-EXT, MS27509R22	Extraction tool (22 ga.)	Bendix[1]
SP-40	Soldering iron (40 W)	Wheeler[1]
MT-10	Soldering iron chisel tip, 1/4 in.	Wheeler[1]
-	Nut driver, deep, 3/16 in.	Standard issue[1]
-	Nut driver, deep, 1/2 in.	Standard issue[1]
-	Nut driver, deep, 5/8 in.	Standard issue[1]
-	Wrench, open end, 1/2 in.	Standard issue[1]
-	Wrench, open end, 9/16 in.	Standard issue[1]
-	Allen wrenches, set	Standard issue[1]

[1]Optional tool/equipment not required for organizational level maintenance. Optional tools/equipment should only be used at the organizational level if directed by higher authority for emergency maintenance.

CHAPTER 2

PREPARATION FOR USE AND INSTALLATION INSTRUCTIONS

2-1 INTRODUCTION.

This chapter contains unpacking, inspection, installation, connections, and initial alignment procedures for the receiver.

2-2 UNPACKING AND INSPECTION.

To unpack and inspect the receiver for damage, perform the following procedures:

1. Inspect the shipping carton for damage before unpacking the receiver.

NOTE

If the carton is damaged, open the carton in the presence of a shipping carrier agent if possible. If damage is found after the receiver is unpacked, retain the carton and packing materials for inspection.

2. Open the carton and remove the foam packing material on top of the receiver.
3. Lift the receiver from the carton.

NOTE

The carton should be saved for possible reshipment.

4. Inspect the receiver for external damage including dents and scratches.
5. If external damage is found, remove the top and bottom covers of the receiver using a no. 2 Phillips screwdriver. Push down, and turn all captive fasteners on the covers 1/4 turn counter-clockwise. Inspect for internal damage such as loose or damaged modules.

CAUTION

Do not attempt to operate the receiver if internal damage is found. Additional damage may occur.

2-3 INSTALLATION.

The receiver is designed for rack slide mounting in a relatively dust free environment with an ambient temperature range between +32 and 122°F (0 and +50°C). Before installing the equipment, remove the top cover to check/set the correct input voltage and external reference frequency as follows:

WARNING

When the top cover is removed, high voltage may be present at the rear panel AC power connector, the AC Line Filter board, and the front panel POWER switch connections. Use caution when working in these areas.

CAUTION

Before removing the bottom cover, ensure the front panel POWER switches are off. Equipment could be damaged if tools or metal objects are allowed to come in contact with receiver components.

CAUTION

Do not support the weight of the unit by the front panel alone. The chassis may bend or warp. Use chassis slides or a suitable support shelf.

1. Using a no. 2 Phillips screwdriver, push down, and turn all captive fasteners on the top cover 1/4 turn counter-clockwise.
2. Remove the top cover.

CAUTION

Ensure the switches on top of both power supply modules are set to the 110 position or the equipment may be damaged when power is applied.

3. Locate both Power Supply modules near the front of the chassis, and ensure the rotary switch on top of each Power Supply module is set to the 110 position.
4. Locate both REFERENCE & 2ND LO modules, and set the MHz switch on top of each module to the desired external reference frequency to be used. (Make sure both switches are positioned alike).

NOTE

If the INT/EXT switch (S1) is set to INT, and both receivers in the chassis are powered up, the B receiver provides the reference frequency to the REF OUT connector. However, if the INT/EXT switch is set to INT and the B receiver is powered off, the A receiver provides the reference frequency to the REF OUT connector. If both receivers are off, the REF IN connector is connected to the REF OUT connector.

5. Replace top cover, and lock captive fasteners by pushing down, and turning all captive fasteners 1/4 turn clockwise.

CAUTION

Ensure slide mounting screws are of the proper length. If screws are too long internal equipment may be damaged.

NOTE

See figure FO-1 for clearance requirements and mounting details.

6. Securely mount the outer section of the slides to the rack cabinet being sure to select the correct mounting holes.
7. Attach indicated right and left slide rails to each side of unit.
8. Before tightening the mounting screws, slide the chassis assembly into the rack mounted portion of the slides and adjust the hardware position as required for a smooth sliding fit.
9. Remove unit from rack and securely tighten all hardware.

2-4 CONNECTIONS.

The following paragraphs describe the connections to the equipment. (See figure 2-1).

2-4.1 *Ground.* Optionally connect a ground wire to the GROUND stud (E1). This connection is only required to satisfy ground loop interference reduction requirements.

2-4.2 *Antennas.* Connect antenna coaxial cables (not supplied) to the ANTENNA TNC connectors J2 and J3 (50 ohms nominal).

2-4.3 *1ST IF Monitor.* The 1ST IF signal for each receiver in the chassis is available for monitoring on the 1ST IF MON TNC connectors J4 and J5. This signal is centered at 40.455 MHz with a 1 MHz minimum bandwidth. The signal level has approximately 10 dB gain from the input into 50 ohms.

2-4.4 *2ND IF Monitor.* The 2ND IF signal for each receiver in the chassis is available for monitoring on the 2ND IF MON TNC connectors J6 and J7 . This signal is centered at 455 kHz with a bandwidth equal to that of the selected IF filter. The signal level should be -10 dBm, ±3 dB over the AGC dynamic range.

2-4.5 *Reference Frequency.* Each receiver in the chassis may use either an individual internal or common external reference frequency. Select the desired source frequency using switch S1 on the rear panel. With S1 set to the EXT position, REFERENCE IN TNC connector J8 will accept an input from an external frequency standard. The external reference frequency may be either 1, 5, or 10 MHz. To select or change the external reference frequency refer to paragraph 2-3. The selected reference frequency (either internal or external) is available on REFERENCE OUT TNC connector J9.

2-4.6 *Phones.* An 8 ohm speaker or headphones may be connected to the PHONES jacks J10 and J11. These jacks are wired in parallel with the front panel PHONES jacks and are controlled by the front panel VOLUME control.

NOTE

If stereo headphones are used, both receivers may be monitored at the same time using either front panel PHONES jack. The receivers will be heard in opposite ears.

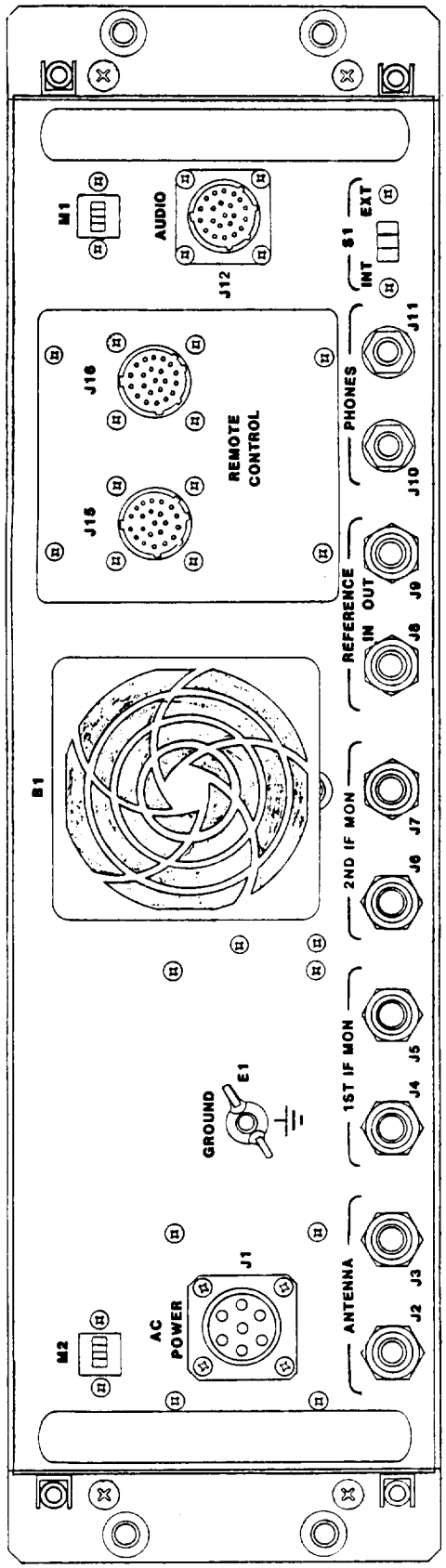


Figure 2-1. R-2411/U Rear Panel (Typical).

2-4.7 *Audio.* The AUDIO connector J12 provides auxiliary connections for external equipment. Table 2-1 lists the signals on each pin of the connector.

2-4.8 *Remote Control.* If a serial bus is used, two remote control connectors J15 and J16 provide serial connection of up to eight receivers (four R-2411/U chassis) to the bus. The signals on each connector are wired in parallel. Table 2-2 lists the signals on each pin of the serial bus connector. Set the bus addresses as described in the NOTE of table 2-2.

If an IEEE-488 bus is used, one remote control connector J13 provides parallel connection for both receivers in the chassis. Up to fifteen devices, including the bus controller, may be connected to the bus. (Each R-2411/U chassis contains two IEEE-488 devices). Each receiver in the chassis has individual bus address and function switches on the rear panel. Table 2-3 lists the signals on each pin of the IEEE-488 bus connector. Set the DIP switches on the chassis rear panel as described in the NOTE of table 2-3.

2-4.9 *AC Power Input.*

CAUTION

Before connecting AC power, ensure each internal power supply module selector switch is set correctly or equipment damage may occur. Refer to paragraph 2-3.

Connect the power cord to the AC POWER connector (J1), and connect the other end of the power cord to the AC power source. Table 2-4 lists the signals on each pin of the connector.

Table 2-4. AC POWER (J1) Pin Descriptions.

PIN	FUNCTION	REMARKS
A	AC	Line
B	GROUND	Chassis ground
C	AC	Neutral
D	GROUND	Shield (optional)
E	NC	Not connected
F	NC	Not connected
G	NC	Not connected

2-5 INITIAL ALIGNMENT PROCEDURES.

There are no initial alignment procedures required.

Table 2-1. Audio Connector (J12) Pin Descriptions.

Pin	Function	Remarks
1	AUDIO BAL (REC A)	600 Ohms
2	AUDIO RTN (REC A)	600 Ohms
3	VIDEO (REC A)	FM video 93 ohms
4	VIDEO RTN (REC A)	Analog ground
5	SIG STR ANALOG (REC A)	0 - 5V
6	SIG STR ANALOG RTN (REC A)	Analog ground
7	SHIELD	Chassis ground
8	AUDIO BAL (REC B)	600 ohms
9	AUDIO RTN (REC B)	600 Ohms
10	VIDEO (REC B)	FM video 93 ohms
11	VIDEO RTN (REC B)	Analog ground
12	SIG STR ANALOG (REC B)	0 - 5V
13	SIG STR ANALOG RTN (REC B)	Analog ground
14	SHIELD	Chassis ground
15-22	NC	Not connected

Table 2-2. Serial Bus Remote Control Connectors (J15/J16) Pin Descriptions.

Pin	Function	Remarks
1	SHIELD	
2	TRANSMITTED DATA	Receiver output
3	TRANSMITTED DATA RETURN	
4	RECEIVED DATA	Receiver input
5	RECEIVED DATA RETURN	
6	RCVR A ADDRESS 0	Refer to NOTE[1]
7	RCVR A ADDRESS 0 RETURN	
8	RCVR A ADDRESS 1	
9	RCVR A ADDRESS 1 RETURN	
10	RCVR A ADDRESS 2	
11	RCVR A ADDRESS 2 RETURN	
12	RCVR B ADDRESS 0	
13	RCVR B ADDRESS 0 RETURN	
14	RCVR B ADDRESS 1	
15	RCVR B ADDRESS 1 RETURN	
16	RCVR B ADDRESS 2	
17	RCVR B ADDRESS 2 RETURN	
18-22	NC	

[1]Each receiver's bus address must be "hard-wired" at the interface connector attaching to the receiver. Connecting the RCVR ADDRESS pins to their associated RETURN pins specifies a logic low. Address pins left open are pulled up to a logic high by circuits inside the receiver. The address selections are defined below.

Address	Address Pins 2 1 0	Address	Address Pins 2 1 0	Address	Address Pins 2 1 0	Address	Address Pins 2 1 0
0	L L L	2	L H L	4	H L L	6	H H L
1	L L H	3	L H H	5	H L H	7	H H H

L indicates pin connected to associated address return pin (low). H indicates pin open (pulled high).

Table 2-3. IEEE-488 Bus Remote Control Connector (J13) Pin Descriptions.

Pin	Function	Remarks
1	D1	Data Bit 1
2	D2	Data Bit 2
3	D3	Data Bit 3
4	D4	Data Bit 4
5	EOI	End Or Identify (Bus management)
6	DAV	Data Valid (Handshake)
7	NRFD	Not Ready For Data (Handshake)
8	NDAC	Not Data Accepted (Handshake)
9	IFC	Interface Clear (Bus management)
10	SRQ	Service Request (Bus management)
11	ATN	Attention (Bus management)
12	SHIELD	-
13	D5	Data Bit 5
14	D6	Data Bit 6
15	D7	Data Bit 7
16	D8	Data Bit 8
17	REN	Remote Enable (Bus management)
18	GND 6	Twisted with pin 6
19	GND 7	Twisted with pin 7
20	GND 8	Twisted with pin 8
21	GND 9	Twisted with pin 9
22	GND 10	Twisted with pin 10
23	GND 11	Twisted with pin 11
24	LOGIC GND	Signal common

NOTE: Set the DIP switch on the rear panel for each receiver as follows: (0 = switch down, 1 = switch up). For normal operation, set the TLK and LIS switches down and the SRQ switch up. This turns off the talker only and listen only modes and enables the service request mode. If the switches are changed while power is applied, turn the POWER switch momentarily off and then on for the unit to recognize the new address. When choosing addresses, be sure that the number selected is not in use by any other device on the bus.

ADDRESS SWITCHES (A4 - A0):

BUS ADR	CODE 43210	BUS ADR	CODE 43210	BUS ADR	CODE 43210	BUS ADR	CODE 43210
0	00000	8	01000	16	10000	24	11000
1	00001	9	01001	17	10001	25	11001
2	00010	10	01010	18	10010	26	11010
3	00011	11	01011	19	10011	27	11011
4	00100	12	01100	20	10100	28	11100
5	00101	13	01101	21	10101	29	11101
6	00110	14	01110	22	10110	30	11110
7	00111	15	01111	23	10111	31	11111

CHAPTER 3

OPERATING INSTRUCTIONS

3-1 INTRODUCTION.

This chapter contains both manual (local) and remote control receiver operating instructions.

3-2 MANUAL OPERATION.

Manual (local) operation is performed using the front panel controls and displays. (See figure 3-1.) Table 3-1 lists the front panel controls and functions; table 3-2 lists the keypad control functions; and table 3-3 lists the displays and functions.

Table 3-1. R-2411/U Front Panel Controls.

Control	Function
POWER Switch	Toggle type switch/circuit breaker.
PHONES Jack	Headphone jack.
VOLUME Control	Adjusts volume to PHONES jack.
LOCAL/REMOTE	Selects either local (manual) or remote control operation.
Keypad	Provides data entry of receiver parameters.
Main Adjustment Knob	Provides adjustment of some parameters using an optical encoder on the knob's shaft.

3-2.1 *Power On and Initial Set Up.* To turn on, and initially set-up the R-2411/U, perform the following procedures for each receiver:

1. Turn the VOLUME control to minimum.
2. Set the LOCAL/REMOTE switch to LOCAL.
3. Set the POWER switch to ON.
4. Observe front panel display for previous parameters.
5. Headphone Operation
   a. Plug the headphone into the PHONES jack.
   b. Adjust the VOLUME control as desired.

NOTE

If stereo headphones are used, both receivers may be monitored at the same time using either front panel PHONES jack. The receivers will be heard in opposite ears.

6. To shut down the receiver set the POWER switch to off (down).

3-2.2 *Initial Adjustments and Control Settings.* To receive the desired signals, refer to table 3-4 and set the receiver to the recommended preliminary parameters. Further adjustment may be required depending on operator preference and propagation conditions.

3-2.3 *Normal Operation.* Receiver functions are set or changed by watching the front panel display, while using the keypad (and/or main adjustment knob) to select and enter the parameters. After a function is selected on the keypad, the main adjustment knob may be used to select the desired parameter. If a numeric key is pressed after the function is selected, the main adjustment knob is disabled and the keypad must be used to select the parameters. The selected parameter is then entered using the ENT key. When no attempt is being made to change any of the receiver functions, the receiver is known to be in the "normal state." The normal state is entered when the receiver is first powered up or CAN or ENT key is pressed. Refer to table 3-5 for the normal state display indications.

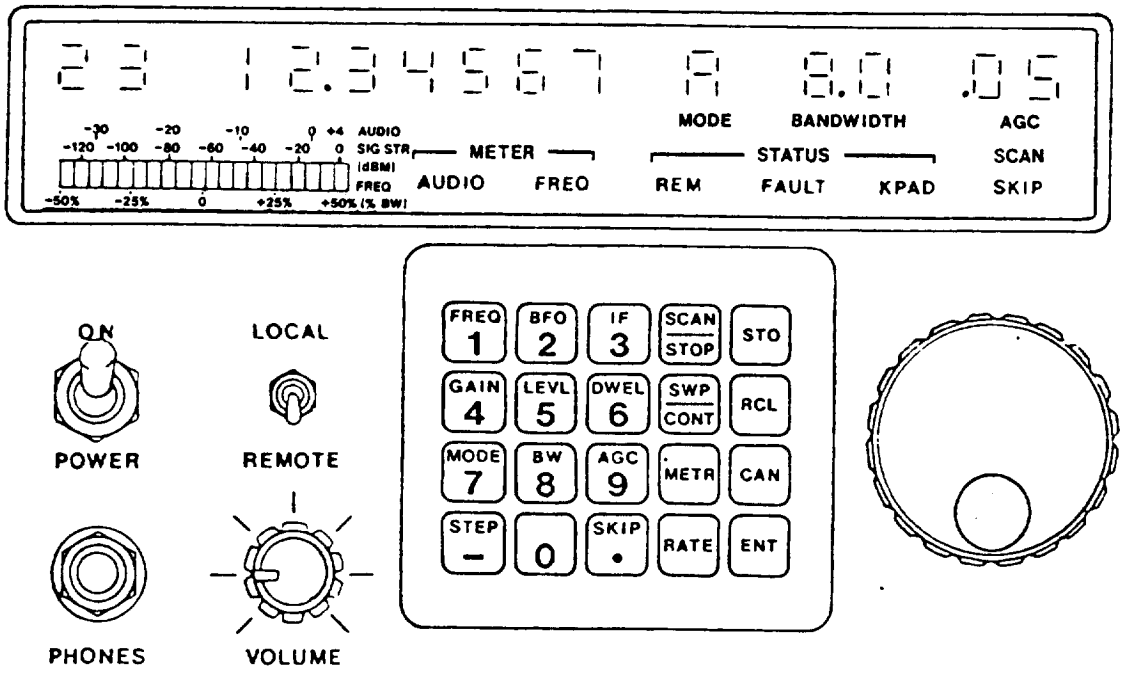


Figure 3-1. R-2411/U Front Panel Controls and Displays.

Table 3-2. Keypad Functions.

Key	Function
(See figure 3-1)	
FREQ[1] [1]	Allows frequency adjustment or numeric entry.
BFO[1] [2]	Allows BFO adjustment (in CW reception mode only) or numeric entry.
IF[1] [3]	Allows IF frequency shift adjustment (in CW reception mode only) or numeric entry.
SCAN STOP	SCAN: Selects scan function of preset memory channels between two selected channels. STOP: Stops scan or sweep function on current channel or frequency. Receiver parameters may be adjusted in stop.
STO	Allows storage of current frequency, mode, bandwidth, AGC hold time, BFO offset, IF shift, manual gain setting, scan threshold, scan dwell time, and channel skip flag in designated memory channel.
GAIN[1] [4]	Allows RF gain adjustment or numeric entry.
LEVL[1] [5]	Allows adjustment of squelch threshold level or numeric entry
DWEL[1] [6]	Allows adjustment of amount of time that the receiver will stay on channels/frequencies where signals are detected in scan/sweep function or numeric entry. ENT key enters selected dwell and allows adjustment of bridge time (software version 6.0 and higher only). ENT key then enters selected bridge time.
SWP CONT	SWP: Selects sweep function of frequencies between two selected even and odd numbered channels. CONT: Continues stopped scan or sweep function from current channel or frequency.
RCL	Recalls stored parameters in selected memory channels for display. Used with [.] to activate special functions.
MODE [7]	Sequences receive mode selection or numeric entry.
BW [8]	Sequences installed IF filters with different bandwidths or numeric entry. (Bandwidth is fixed in LSB or USB modes.)
AGC [9]	Sequences AGC decay time or numeric entry. (AGC is fixed in AM reception mode.)
METR	Sequences the signal source to be displayed on bargraph meter.

Table 3-2. Keypad Functions-CONT

Key	Function
CAN	Cancels current keypad operations (before ENT key press), and returns receiver to normal state. Disables main adjustment knob. Does not cancel data changed by main adjustment knob.
STEP[1] [-]	Allows setting of frequency step size for sweep function or numeric entry.
[0]	Numeric entry only.
SKIP[1] [.]	Alternate presses toggle the channel skip flag used during scan/sweep of memory channels or numeric entry. [.] used in conjunction with special functions and numeric entry.
RATE	Sequences main adjustment knob frequency tuning rate to 10 Hz, 100 Hz, or 1 kHz per step. Rate indicated by brighter digit in main display.
ENT	Enters keypad, or main adjustment knob settings, and returns receiver to normal state.

[1]First press of function/numeric key enables main adjustment knob. Additional press of function/numeric key allows keypad entry, and disables main adjustment knob.

3-2.3.1 *Setting or Changing Receiver Functions.* To set or change receiver functions, refer to the following paragraphs. (Functions are in alphabetical order.)

NOTE

Before setting or changing each receiver function, press CAN to ensure normal state condition. The CAN key may be used to cancel data before the ENT key is pressed unless data has been changed using the main adjustment knob. (The KPAD annunciator goes off after ENT or CAN is pressed.)

NOTE

A quick reference is provided before each procedure. Press each key in the order given. [##] indicates a numeric entry that may be made using the main adjustment knob, or the keypad.

Example:

Quick Reference: RCL, [##], ENT.

RCL = RCL key. [##] = two digit numeric entries.
ENT = ENT key.

Table 3-3. Display Functions.

Display	Function
Function	Two alphanumeric characters at left of display: 00 - 99 Channel number Ad Remote control bus address bd Serial bus baud rate bF BFO offset bG Bridge time (Software version 6.0 and higher only) CL Clear d Dwell time Fn Function Fr Frequency GA Gain IF IF shift L Threshold level LP Serial bus line parameters OF Threshold offset SE Step frequency amount Sn Software version number SP Sweep memory clear
Main	Seven digits with decimal points and minus sign. Used for the following functions: Frequency -- Seven digits plus decimal point indicating MHz (normal display). BFO Offset -- Blank or minus sign and three digits. Indicates BFO offset in kHz. Displayed in CW reception mode when BFO key is pressed. IF Shift -- Blank or minus sign and three digits. Indicates amount of IF bandwidth shift in kHz. Displayed in CW reception mode when IF key is pressed. RF Gain -- Minus sign and three digits. Indicates RF gain in dB. Displayed when GAIN key is pressed. Level -- Minus sign and three digits. Indicates threshold level in dB. Displayed when LEVL key is pressed. Dwell Time -- One digit. Indicates amount of time in seconds during scan or sweep function that the receiver will sample the signal that has exceeded the threshold level. Displayed when DWEL key is pressed. Bridge Time -- (Software version 6.0 and higher only.) One digit. Indicates amount of time in seconds that receiver will remain on a frequency during scan or sweep during dwell time after the signal has gone below the preset threshold level. Used to monitor intermittent signals. Step Frequency -- Two digits and decimal point. Indicates frequency increment that the receiver will shift during sweep function. Displayed when STEP key is pressed.

Table 3-3. Display Functions-CONT

Display	Function
Main-continued	Threshold Offset -- plus or minus sign and two digits. Indicates the amount of threshold offset in dB (from the level value in each memory channel) that the receiver will use during sweep or scan functions. Displayed after SWEEP or SCAN key pressed. Software Version -- two or three digits and decimal point. Indicates the software version installed in the receiver. Displayed when special function one is selected. Remote Control Bus Address -- Two decimal digits. Indicates current bus address of receiver. Displayed when special function three is selected. Serial Bus Baud Rate -- Three to five digits. Indicates serial bus baud rate. Displayed when special function four is selected. May be changed with STEP key. Serial Bus Line Parameters -- Three groups of characters: Group one is two characters representing number of data bits in one message character (7b or 8b). Group two is two characters representing number of stop bits (1S or 2S). Group three is one character representing parity selection (O = odd, E = even, and - = none). Displayed when special function five is selected. May be changed with STEP key.
MODE	Single character. Indicates the following receive modes: L Lower sideband (LSB) U Upper sideband (USB) A Amplitude modulation (AM) C Continuous wave (CW) F Frequency Modulation (FM)
BAND-WIDTH	Two digits and decimal point. Indicates approximate IF bandwidth in kHz as optionally ordered. Fixed in LSB/USB.
AGC	Two digits and decimal point. Indicates approximate AGC decay time in seconds as follows: 0.0, .25, 1.0, 3.0, off. (off = manual gain control) Fixed .05 sec. in AM reception mode.
Meter	Twenty segment light bar meter. Indicates one of the following: Audio - When the AUDIO annunciator is on, the meter indicates audio level to the 600 Ohm line output from -34 to +4 dBm. Each segment of the display represents approximately 2 dB.

Table 3-3. Display Functions-CONT

Display		Function
Meter-continued		Frequency - When the FREQ annunciator is on, the meter indicates the approximate frequency of the signal with respect to the center of the IF bandwidth. Each segment of the display represents approximately 5% of the total IF bandwidth as follows: Bandwidth — Display Segment Value 8.0 kHz — 400 Hz 3.0 kHz — 150 Hz 1.0 kHz — 50 Hz 0.5 kHz — 25 Hz When exactly on the center frequency, the meter light segments on either side of 0 should be alternately flashing. RF signal strength - When both annunciators are off, the meter indicates RF signal strength from -120 to 0 dBm (when AGC display is enabled). Each segment of the display represents approximately 6 dB. When the AGC display is dark (manual gain), the main adjustment knob is used to manually control the IF gain after selecting GAIN [4] key. The indicator should be set to the middle of the meter scale.
Annunciators:		
--METER--	AUDIO	Lights when meter displays audio level.
	FREQ	Lights when meter displays approximate frequency shown in main display.
	(Off)	If both annunciators are off, meter displays RF signal strength.
--STATUS--	REM	Lights when receiver is remotely controlled.
	FAULT	Lights when fault condition exists.
	KPAD	Lights when keypad is used for data entry.
SCAN	SKIP	Lights when a channel is skipped during scan/sweep operations.

3-2.3.1.1 *Automatic Gain Control (AGC).* To set or change the automatic gain control decay time setting of the receiver, perform the following procedures:

Quick Reference: AGC (Repeat).

1. Repeatedly press the AGC [9] key.
2. Observe the AGC display change. (Sequence = 0.0, .25, 1.0, 3.0 seconds, and off..... or .05 and off in AM mode.) (off = manual gain control)
3. Press the AGC key to select desired AGC.

3-2.3.1.2 *Bandwidth.* To set or change the bandwidth, perform the following procedures:

Quick Reference: BW (Repeat).

1. Repeatedly press the BW [8] key.
2. Observe the BANDWIDTH display change (sequence = 0.5, 1.0, 3.0, and 8.0 kHz). (Bandwidth is fixed in LSB and USB.)

Table 3-4. Preliminary Control Settings.

SIGNAL	PARAMETERS			
	MODE[1]	BANDWIDTH[2]	AGC[3]	BFO[4]
AM voice	AM	8 kHz	.05	N/A
SSB voice	LSB/USB	3 kHz	1.0	N/A
SSB WB voice	CW	8 kHz	1.0	Adjust until clear
SSB NB data	CW	1 kHz	0.0	1 to 3 kHz
SSB WB data	CW	8 kHz	0.0	1 to 3 kHz
CW Morse	CW	0.5 kHz	1.0	.8 to 1 kHz
FSK NB data	CW	0.5 to 1 kHz	0.0	N/A
FSK WB data	CW	1 to 8 kHz	0.0	N/A
Pulse	AM	8 kHz	Off	N/A
Sweep	CW	8 kHz	0.0	1 kHz

[1]The displayed receiver frequency (except in LSB or USB modes) is the actual center of the information band. In the LSB or USB modes, the center of the information band will be automatically shifted. The display in LSB and USB indicates the suppressed carrier frequency.

[2]A fixed 3.0 kHz bandwidth is automatically selected in LSB/USB modes.

[3]A fixed .05 second AGC is automatically selected in AM mode.

[4]The BFO may be used to vary the pitch of the audio. When receiving SSB signals in CW mode, vary the BFO until the audio is clear. In the CW reception mode only, the IF shift function may be used to shift the center of the bandpass up or down from the displayed frequency to reduce reception of adjacent unwanted signals.

3-2.3.1.3 *Beat Frequency Oscillator (BFO).* This function can only be set in the CW reception mode, and is used to vary the tone of the audio produced by the received signal. To set or change the BFO, perform the following procedures:

Quick Reference: BFO, [#.##], ENT.

1. Press the BFO [2] key.
2. Observe "bF" on function display.
3. Observe main display for the current BFO offset.
4. While listening for the desired CW tone, and observing the main display, adjust the main adjustment knob, or use the keypad to tune the BFO. The main display will show the BFO offset from the selected frequency. (Range = -9.99 to 9.99 kHz.)
5. Press ENT key to enter the BFO frequency. (When using the keypad to tune the BFO, the receiver does not select the new BFO frequency until the ENT key is pressed.)

Table 3-5. Normal State Conditions.

Display	Conditions	
Function	Off or memory channel number	
Main	Selected frequency	
MODE	Selected reception mode	
BANDWIDTH	Selected bandwidth	
AGC	Selected AGC	
Meter	Indicating as determined by meter annunciators	
Annunciators:		
--METER--	AUDIO --	Off. (On if meter indicates audio level)
	FREQ --	Off. (On if meter indicates frequency)
	(Off) --	If both annunciators are off, meter indicates RF signal strength
--STATUS--	REM --	Off in manual operation
	FAULT --	Off
	KPAD --	Off
SCAN	SKIP --	Off (On if skip flag is set)

3-2.3.1.4 *Channel Data Recall.* This function recalls all previously entered receiver parameters for a selected channel. To recall a selected memory channel, perform the following procedures:

Quick Reference: RCL, [##], BFO,* IF,* GAIN,* LEVL,* DWEL,* STEP,* (CAN/ENT).

*** If desired.**

1. Press the RCL key.
2. Observe two dashes in the function display, and the KPAD annunciator lit.
3. Select the desired channel using the main adjustment knob or the keypad. (Range = 00 to 99.)

NOTE

If the main adjustment knob is used to select the channel, rotate the knob counter-clockwise to select channel 00, and clockwise to select channel 01 and higher.

4. Observe selected channel number, frequency, mode, bandwidth, and AGC on display.
5. If desired, observe the main display for additional recalled channel parameters as follows: (The receiver remains set to the current parameters until the ENT key is pressed.)
   a. Press BFO [2] key to review the BFO offset of that channel.
   b. Press IF [3] key to review the IF shift.
   c. Press GAIN [4] key to review RF gain.

d. Press LEVL [5] key to review threshold level.
e. Press DWEL [6] key to review dwell and bridge time. (Bridge time is only available in R-2411/U with software version 6.0 and higher.)
f. Press STEP [-] key to review step size.

6. Press CAN to cancel recall of displayed data, or ENT to enter selected channel data into the receiver.

3-2.3.1.5 *Channel Data Storing.* This function stores all selected receiver parameters in a selected memory channel. All receiver parameters are first entered using the keypad and/or main adjustment knob. The memory channel is then selected, and all data is transferred to the memory channel. The following parameters may be stored in each memory channel: Frequency setting, Bandwidth selection, Step size setting Dwell setting, Receive mode selection, Skip flag on or off, Threshold level setting, Manual gain setting, AGC selection and setting, BFO setting, and IF shift setting.

To store parameters in a selected memory channel, perform the following procedures:

Quick Reference: (Select desired parameters, ENT), STO, [##].

1. Select all desired receiver parameters (frequency, mode, bandwidth, etc.) using keypad, and/or main adjustment knob. Press ENT.
2. Press the STO key.
3. Observe two dashes in the function display.

NOTE

The main adjustment knob is disabled in this step.

4. Press two numeric keys for desired channel (00 through 99), to select the memory channel for data entry.
5. All parameter data is stored in the indicated channel memory.

NOTE

To clear all parameters from all memory channels refer to paragraph 3-2.3.1.15.6.

3-2.3.1.6 *Dwell/Bridge Time Setting.* The dwell time setting is the time duration (in seconds) the receiver stays on an individual channel or frequency that has exceeded the threshold level during the scan or sweep function. If the dwell time is set to zero, and the signal exceeds the threshold level, the receiver will stay on this frequency until the signal falls below the threshold.

NOTE

Bridge time function is only available in R-2411/U with software version 6.0 and higher.

(See figure 3-2.) The bridge time function may be used to monitor intermittent signals. This function supplements the dwell time function by causing the receiver to stay on a frequency longer than the preset dwell time during scan or sweep. Bridge time is activated during dwell time if a signal is present and then goes below the preset threshold level. If the signal returns before bridge timeout, dwell time is restarted from zero. The receiver will stay on a frequency where intermittent signals are found until; (1) the signal stays on longer than the dwell time setting or; (2) the signal stays off longer than the bridge time setting. If the bridge time is set to zero, the bridge timer is disabled. To set the dwell and bridge time, perform the following procedures:

Quick Reference: DWEL, [#], ENT, [#], ENT, STO, [##].

1. Press the DWEL [6] key.
2. Observe "d" in the function display and current dwell setting in the main display.
3. While observing the dwell time in the main display, adjust the main adjustment knob, or use the keypad to set the dwell time in 1-second steps. (Range = 0 to 9.)
4. Press ENT to enter dwell time.
5. Observe "bG" in the function display and current bridge time setting in the main display.
6. While observing the bridge time setting in the main display, adjust the main adjustment knob, or use the keypad to set the bridge time setting in one second steps. (Range = 0 to 9.)
7. Press ENT to enter the bridge time.
8. Press STO, followed by the desired channel number.

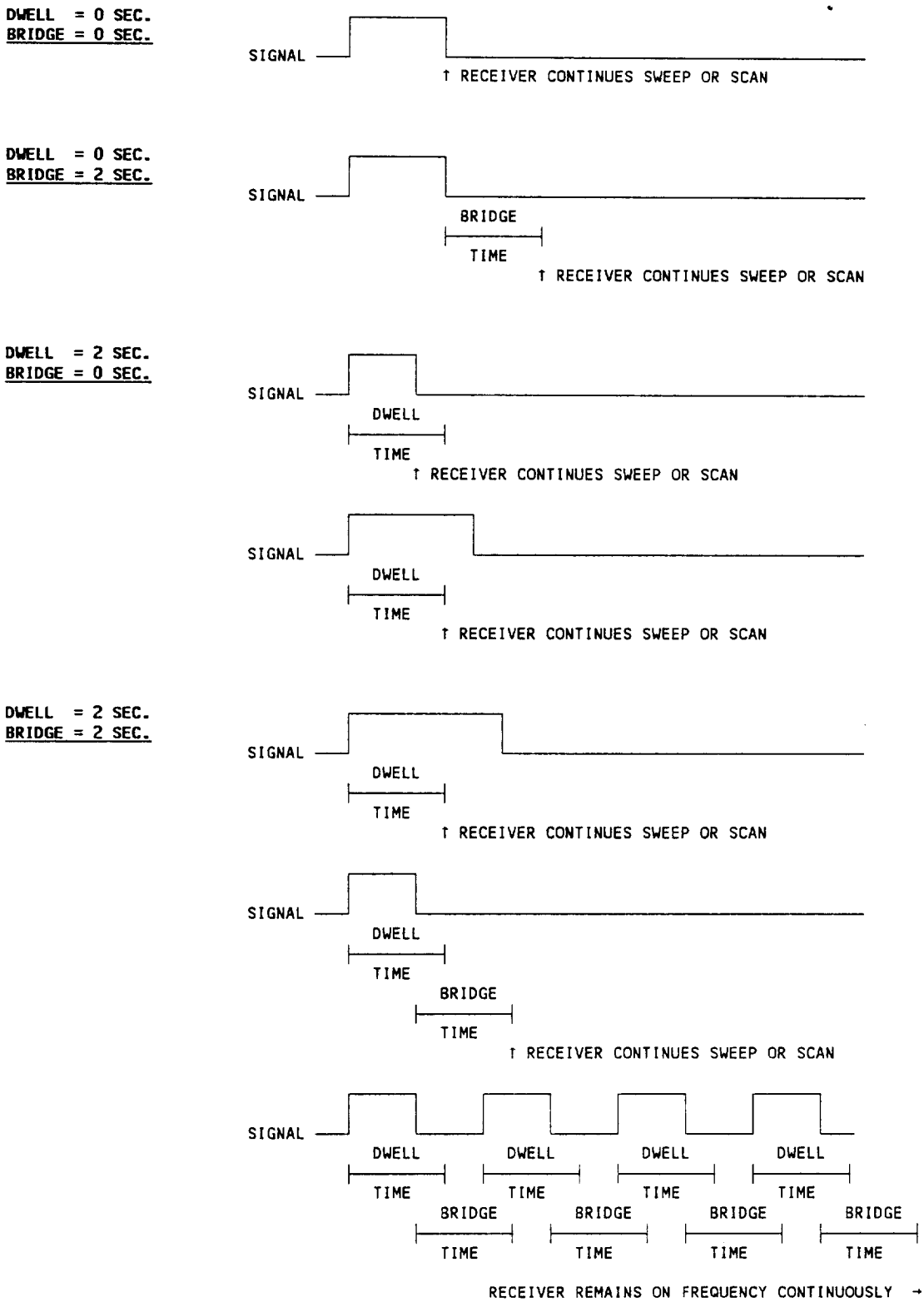


Figure 3-2. Dwell Time/Bridge Time Relationship.

3-2.3.1.7 *Frequency.* This function sets or changes the receiver frequency. To set or change the receiver frequency, perform the following procedures:

Quick Reference: FREQ, [##.#####], ENT.

NOTE

Repeatedly pressing the RATE key changes the brighter digit in the main display. The brighter digit indicates the tuning resolution of the main adjustment knob.

1. Press the FREQ [1] key.
2. Observe "Fr" in the function display.
3. Select the desired frequency, using the main adjustment knob or keypad. (Range = 0.00000 to 30.00000 MHz.)
4. Press ENT key to enter the frequency. (When using the keypad to select the frequency, the receiver does not tune to the new frequency until the ENT key is pressed.)

3-2.3.1.8 *IF Shift.* This function can only be set in CW reception mode, and is used to shift the bandpass up or down from the displayed frequency. This function helps reduce reception of adjacent unwanted signals. To set or change IF shift, perform the following procedures:

Quick Reference: IF, [#.##], ENT.

1. Press the IF [3] key.
2. Observe "IF" in the function display, and current IF shift in the main display.
3. Shift the IF bandpass using main adjustment knob, or keypad. (Range -9.99 to 9.99 kHz.)
4. Press ENT to enter the IF shift. (When using the keypad to select the IF shift, the receiver does not change to the new value until the ENT key is pressed.)

3-2.3.1.9 *Manual Gain.* This function manually selects the IF gain of the receiver. To select manual gain, perform the following procedures:

Quick Reference: GAIN, [###], ENT.

1. Press the GAIN [4] key.
2. Observe "GA" in the function display, and current gain setting in the main display (The AGC display goes off).
3. Select manual gain in one dB steps, using the main adjustment knob, or keypad. (Range = -127 to -000 dB.)
4. Press ENT to enter the manual gain. (When using the keypad to select the IF gain, the receiver does not change to the new value until the ENT key is pressed.)

3-2.3.1.10 *Meter Display.* This function is used to select the signals for meter display. The METER annunciators will change as the METR key is pressed. (If both annunciators are off the meter displays RF signal strength.) To select the signals for meter display, perform the following procedures:

Quick Reference: METR (Repeat).

1. Repeatedly press the METR key.
2. Observe the METER annunciators change from off, to AUDIO to FREQ, and to off again. Also observe the bargraph meter indicator change.

3-2.3.1.11 *Mode.* This function selects the reception mode of the receiver. Five modes are available: Continuous wave (CW), Amplitude Modulation (AM), Lower Sideband (LSB), Upper Sideband (USB), and Frequency Modulation (FM). To select the desired reception mode, perform the following procedures:

Quick Reference: MODE (Repeat).

1. Repeatedly press the MODE [7] key.
2. Observe the MODE display change as the reception mode is selected. (C=CW, F=FM, L=LSB, U=USB, A=AM.)

3-2.3.1.12 *Scan Starting and Stopping.*

NOTE

Before performing a scan function, frequencies and parameters to be sampled should be determined and set into designated memory channels.

NOTE

Bridge time function is only available in R-2411/U with software version 6.0 or higher.

Scan is the sequential continuous recall of each memory channel. The CPU in the receiver uses data stored in each channel to select frequency, mode, bandwidth, threshold level, AGC and all other stored parameters to operate the receiver. The receiver will stop on a frequency (for the dwell time set in that channel) when a received signal exceeds the threshold level set in the channel. If the signal goes away before the dwell timer has timed out, the receiver will not continue the scan until bridge time has expired. If the signal returns before bridge timeout, dwell time is restarted from zero. If dwell time is set to zero, the receiver remains on frequency until the signal falls below the threshold level, and then continues the scan. The operator may offset the threshold level from the value set in each memory channel before starting the scan. To start and stop the scan function, perform the following:

Quick Reference: RCL, [##], ENT, RCL, [%%], SCAN, [***], ENT.

Where [##] = start channel, [%%] = stop channel, and [***] = offset.

1. Press RCL key.
2. Select desired start channel using main adjustment knob or keypad.
3. Press ENT key.
4. Press RCL key.
5. Select desired stop channel using main adjustment knob, or keypad (do not press ENT).
6. Press SCAN/STOP key.
7. Observe "OF" in function display, and threshold level offset in main display.
8. If desired, change threshold level offset with either main adjustment knob or keypad. (Range = ±30 dB from threshold level in each channel.)
9. Press ENT to start the scan.
10. The receiver will sequentially scan from start channel to the stop channel continuously.

NOTE

If the skip flag is set in a particular channel in the sequence, the receiver will immediately skip to the next consecutive channel. If the receiver stops on an unwanted signal, the SKIP key may be pressed to set the skip flag in that channel. That channel will then be skipped on the next and successive scans. (Refer to paragraph 3-2.3.1.13.)

NOTE

If no signal is present on a sampled channel the scan rate may be slowed using the main adjustment knob.

11. Press the SCAN/STOP key to stop the scan.

NOTE

Receiver parameters may be changed with the keypad and/or main adjustment knob during stop with no affect on the memory channels. The audio will be enabled during stop.

12. Press the SWP/CONT key to continue the scan from stop.
13. Press the CAN key to leave the scan function during scan or stop.

3-2.3.1.13 . *Skipping Channels.* This function sets or erases a skip flag in a designated memory channel. If the skip flag is set, that channel will be skipped during the scan function. The skip flag may be set or erased before the scan. The skip flag may also be set when stopped on an unwanted frequency during the scan. (Refer to paragraph 3-2.3.1.14 to skip selected frequencies for the sweep function.)

a. To store or erase the skip flag in a selected memory channel before the scan function, perform the following procedures:

Quick Reference: RCL, [##], ENT, SKIP, STO, [##].

1. Press the RCL key.
2. Observe two dashes in the function display, and the KPAD annunciator lit.
3. Select the desired channel (00 through 99), using the main adjustment knob or keypad.
4. Press ENT key.
5. Observe SCAN display. (If SKIP annunciator is lit, skip flag is set. If SKIP annunciator is off, skip flag is not set.)
6. Press SKIP key to either turn SKIP annunciator on and skip the selected channel, or off to not skip the selected channel.
7. Press STO key.
8. Enter desired channel.

b. To set the skip flag in a selected memory channel during the scan function when stopped on an unwanted channel, perform the following procedures:

Quick Reference: SKIP (when stopped on unwanted channel).

1. During scan when stopped on an unwanted channel, press the SKIP key.
2. Observe the SKIP annunciator light.
3. Observe the SKIP annunciator momentarily light when the channel is skipped during the next and successive scans.

3-2.3.1.14 *Skipping Frequencies.* The frequency skip function selects frequencies to be skipped during the sweep function. This prevents the receiver from stopping on unwanted signals on the next and successive sweep. A separate skip memory in the receiver stores up to 100 selected frequencies. (Also refer to paragraph 3-2.3.1.13 to skip selected channels in the scan function.) To store a selected frequency in the sweep skip memory, perform the following procedures:

NOTE

If all 100 skip memory locations contain frequencies, the next frequency stored "bumps" the first entered frequency from the skip memory. A rotating buffer ensures the first entered frequency will always be bumped out. Refer to paragraph 3-2.3.1.15.2 to clear the skip memory.

Quick Reference: SKIP (when stopped on unwanted frequency).

1. During sweep when stopped on an unwanted frequency, press the SKIP key.
2. Observe the SKIP annunciator light.

3-2.3.1.15 *Special Functions.* Special functions are available to the operator as listed in table 3-6. Each of the special functions are discussed in the following paragraphs:

Table 3-6. Special Functions.

Function	Description
RCL [.] 1	Software version number
RCL [.] 2	Clear skip memory
RCL [.] 3	Bus address
RCL [.] 4	Serial bus baud rate
RCL [.] 5	Serial bus line parameters
RCL [.] 6 - 0	Not used or not applicable
RCL [.] [.] 911	Clear all memory channels

3-2.3.1.15.1 *Software Version Number.* This function shows the installed software version number. To view the installed software version, perform the following procedures:

Quick Reference: RCL, [.], [1], CAN.

1. Press RCL key.
2. Observe two dashes in function display.
3. Press SKIP [.] key.
4. Observe "Fn" in function display.
5. Press [1] numeric key.
6. Observe "Sn" in function display, and software version number in main display.
7. Press CAN to return to the normal state.

3-2.3.1.15.2 *Clear Sweep Skip Memory.* This function clears all frequencies in the sweep skip memory. To clear all frequencies in the sweep skip memory, perform the following procedures:

Quick Reference: RCL, [.], [2], ENT.

1. Press RCL key.
2. Observe two dashes in function display.
3. Press SKIP [.] key.
4. Observe "Fn" in function display.
5. Press [2] numeric key.
6. Observe "SP" in function display and SKIP Annunciator lit.
7. Press ENT key.

3-2.3.1.15.3 *Bus Address.* This function displays the current bus address for the receiver. To display the current address perform the following procedures:

Quick Reference: RCL, [.], [3], CAN.

1. Press RCL key.
2. Observe two dashes in function display.
3. Press SKIP [.] key.
4. Observe "Fn" in function display.
5. Press [3] numeric key.
6. Observe "Ad" in function display, and receiver current address in main display.
7. Press CAN key.

3-2.3.1.15.4 *Serial Bus Baud Rate Selection.* This function allows serial bus baud rate display or selection. To display/select the serial bus baud rate, perform the following procedures:

Quick Reference: RCL, [.], [4], STEP* ENT* CAN.

*** If desired.**

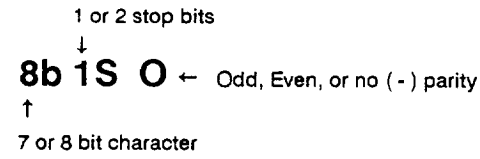
1. Press RCL key.
2. Observe two dashes in function display.
3. Press SKIP [.] key.
4. Observe "Fn" in function display.
5. Press [4] numeric key.
6. Observe "bd" in function display, and current baud rate in main display.
7. Press CAN to keep current baud rate, or:
8. Repeatedly press the STEP key.
9. Observe baud rate change in main display.
10. When correct baud rate is displayed, press ENT key.

3-2.3.1.15.5 *Serial Bus Line Parameter Selection.* This function allows display or selection of serial bus parameters including: number of data bits per character, number of stop bits, parity bit on/off, and parity bit odd/even. To display/select the serial bus line parameters, perform the following procedures:

Quick Reference: RCL, [.], [5], STEP* ENT* CAN.

*** If desired.**

1. Press RCL key.
2. Observe two dashes in function display.
3. Press SKIP [.] key.
4. Observe "Fn" in function display.
5. Press [5] numeric key.
6. Observe "LP" in function display, and current line parameters in main display as follows:



7. Press CAN to keep current parameters, or;
8. Repeatedly press the STEP key.
9. Observe line parameters change in main display.
10. When correct line parameters are displayed, press ENT key.

NOTE

Special functions 6, 7, 8, 9, and 0 are not used or not applicable.

3-2.3.1.15.6 *Clear All Memory Channels.* This function clears all memory channels of all entered parameters and replaces the parameters as follows:

Frequency = 10 MHz
Bandwidth selection = 8 kHz
Step size setting = 1 kHz
Dwell setting = 0 sec.
Receive mode selection = AM
Bridge time setting = 3 sec. (Software version 6.0 and higher only.)
Threshold level setting = -127 dBm
Skip flag on or off = off
AGC selection and setting = on/.05 sec.
Manual gain setting = -000 dBm
IF shift = off
BFO = 000 kHz

NOTE

All previous channel parameter data will be lost when the ENT key is pressed.

To clear all the memory channels, perform the following procedures:

Quick Reference: RCL, [.], [.], [9], [1], [1], ENT.

1. Press RCL key.
2. Observe two dashes in function display.
3. Press SKIP [.] key.
4. Observe "Fn" in function display.
5. Press SKIP [.] key.

6. Observe "CL" in function display, and (..) in main display.
7. Press numeric keys 9, 1, 1.
8. Observe (..911) in main display.
9. Press ENT key.
10. Observe (..911) flashing in main display while memory clears.

3-2.3.1.16 *Step Increment Frequency Setting.* When the sweep function is enabled, the receiver will sample a selected frequency, and then "step" to the next frequency. The step function determines the amount of frequency change between steps.

NOTE

The step increment frequency should be stored in even numbered channels. (Refer to paragraph 3-2.3.1.17.)

To select the step increment setting, perform the following procedures:

Quick Reference: STEP, [#.#], ENT, STO, [##].

1. Press the STEP [-] key.
2. Observe "SE" in the function display, and current step increment frequency in the main display.
3. While observing the step increment frequency in the main display, select the step increment frequency in .1 kHz steps using the main adjustment knob, or keypad. (Range = 0.1 to 9.9 kHz.)
4. Press ENT to enter the step increment frequency.
5. Press STO key.
6. Observe two dashes in function display.
7. Select desired even numbered memory channel.

3-2.3.1.17 *Sweep Starting and Stopping.*

NOTE

Before performing a sweep function, frequency bands and parameters to be sampled should be determined and set into designated memory channels.

NOTE

Bridge time function is only available in R-2411/U with software version 6.0 and higher.

The sweep function is used to sequentially tune between frequencies in two consecutive memory channels. The start frequency is selected by entering an even numbered channel (for example 02) containing the desired start frequency.

The stop frequency is selected by entering a higher odd numbered channel (for example 03) containing the desired stop frequency. All other parameters (threshold level, dwell time, reception mode, bandwidth, AGC, step frequency, skip flag, etc.) used during the sweep are selected from the even numbered start channel.

The step increment frequency stored in the even numbered channel determines the amount of frequency change the receiver sequentially tunes to during the sweep. When the frequency in the stop channel is reached, the receiver starts over again from the entered start channel. The frequency in the stop channel may be higher or lower than the start frequency.

If the stop channel entered is higher than the next consecutive odd numbered channel (for example 09 instead of 03 in the previous example), the receiver will sequentially tune to the frequency in the consecutive odd numbered channel (03), and then select the next consecutive even numbered channel (04). The parameters in this even numbered channel (04) are then used during the sweep to the next higher odd numbered channel (05). The sweep function continues until the final stop channel (09) is reached. The sweep then starts over again from the originally entered start channel (02).

NOTE

If the skip flag is set in a particular even numbered channel in the sequence, the receiver will immediately skip to the next consecutive even numbered channel.

The receiver will stop on a frequency (for the preset dwell time set in the even channel), when the signal exceeds the preset threshold level. If the signal goes away before the dwell timer has timed out, the receiver will not continue the sweep until bridge time has ex-

pired. If the signal returns before bridge timeout, dwell time is restarted from zero. If the dwell time is set to zero, the receiver remains on frequency until the signal falls below the preset threshold level. The operator may offset the threshold level from the value set in the even numbered start channel before starting the scan. To start and stop the sweep function, perform the following procedures:

Quick Reference: RCL, [##], ENT, RCL, [%%], SWP, [***], ENT.

Where [##] is the start (even) channel, [%%] the stop (odd) channel, and [***] the threshold offset.

1. Press RCL key.
2. Select the desired even numbered start channel containing the start frequency and parameters using the main adjustment knob, or keypad.
3. Press ENT key.
4. Press RCL key.
5. Select the desired odd numbered stop channel containing the stop frequency using the main adjustment knob, or keypad (do not press ENT key).
6. Press the SWP/CONT key.
7. Observe "OF" in the function display, and threshold level offset in the main display.
8. If desired, change the threshold level offset with either the main adjustment knob or the keypad. (Range = ±30 dB from the preset threshold level in the even numbered channel(s).)
9. Press ENT to start the sweep.

NOTE

If no signal is present on a sampled frequency the sweep rate may be slowed using the main adjustment knob.

NOTE

If the receiver stops on an unwanted signal, the SKIP key may be pressed to skip that frequency on the next and successive sweeps. (Refer to paragraph 3-2.3.1.14.)

10. Press the SCAN/STOP key to stop the sweep.

NOTE

Receiver parameters may be changed with the keypad and/or main adjustment knob during stop with no affect on the memory channels. The audio will be enabled during stop.

11. Press the SWP/CONT key to continue the sweep from stop.
12. Press the CAN key to leave the sweep function during sweep or stop.

3-2.3.1.18 *Threshold Setting.* This function is used to select the threshold level of the receiver. The setting determines the signal threshold level that will activate the audio output. The setting also determines when the receiver will stop during scan or sweep functions if stored in a memory channel. When the scan or sweep function is enabled, the receiver will stop at channel frequencies with RF signal levels higher than the threshold level set in that channel. To set the threshold level, perform the following procedures:

Quick Reference: LEVL, [###], ENT.

1. Press the LEVL [5] key.
2. Observe "L" in the function display and current threshold level in the main display.
3. While observing the level in the main display, select the threshold level in one dB steps, using the main adjustment knob or keypad. (Range = -127 to 000 dB.)
4. Press ENT to enter the threshold level.

3-3 REMOTE OPERATION USING SERIAL BUS.

The receiver may be operated under remote control using a serial bus and a suitable bus controller. To operate in this manner, set the front panel LOCAL/REMOTE switch to the REMOTE position. If the controller takes control, the REM annunciator on the display panel will light. The front panel LOCAL/REMOTE switch has positive control over the remote control function. However, the bus controller may allow local control or prevent local control when the switch is in the REMOTE position.

Ensure that the communications parameters are set in accordance with the system requirements. Refer to Chapter 2 for the correct installation procedures. The baud rate, number of data bits, type of parity used, and number of stop bits must match the requirements of the system controller. Refer to paragraphs 3-2.3.1.15.3, 3-2.3.1.15.4, and 3-2.3.1.15.5 to set in correct serial bus operating parameters.

3-3.1 *Serial Bus Description.* The bus conforms to EIA standard RS-232C for voltage levels. However, the bus is physically and electrically different from RS-232C standards as described in the following paragraphs:

The bus consists of a single signal line for each direction of transmission. (Refer to table 2-2.) Each signal line is associated with a separate return connection that is connected inside each receiver to a signal ground circuit. The line driver associated with the transmitted data circuit for each receiver is in a high impedance state except when that unit has been commanded by the system controller to transmit. When done transmitting, the line driver returns to the high impedance state. This allows all receivers to share a single signal line for transmitting and a single signal line for receiving.

Two 22-pin, parallel connected, circular interface connectors (J15 and J16) allow a serial connection between receiver chassis. A single line receiver connects the two separate receivers in each chassis to minimize the loading on the receive data circuit. A maximum of eight receivers (four R-2411/U chassis) may be connected to a single bus controller.

3-3.2 *Serial Bus Message Format.* All transmissions, in either direction, conform to the message format shown in figure 3-3.

Each character in the message is passed in an asynchronous serial format as shown in figure 3-4. The number of data bits, number of stop bits, parity options and baud rate are all selectable from the front panel of the receiver through the keypad. These selections are stored in non-volatile memory. (Refer to paragraph 3-2.3.1.15 to set or change the parameters.) All characters are in ASCII code.

3-3.3 *Serial Bus Message Types.* All messages are divided into two major categories: command messages and status messages. Each category is discussed in the following paragraphs:

3-3.3.1 *Serial Bus Command Messages.* Command messages are sent from the controller to one of the receivers and are subdivided into two classes as follows:

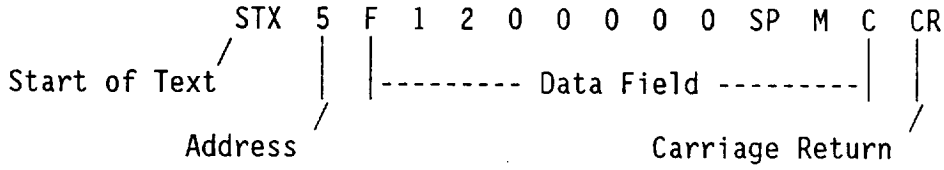
3-3.3.1.1 *Serial Bus Radio Command Messages.* Radio command messages contain commands that are passed to the receiver. They may command the receiver to change operational parameters or to report back operational status.

3-3.3.1.2 *Serial Bus Interface Command Messages.* Interface command messages contain commands that are acted upon by the communications interface in the receiver. These commands cause the interface to change modes or other parameters.

3-3.3.2 *Serial Bus Status Messages.* Status messages are sent from one of the receivers to the controller and are subdivided into two classes as follows:

3-3.3.2.1 *Serial Bus Radio Status Messages.* Radio status messages contain information about the operational status of the receiver. These messages are sent as a reply to radio command messages that request a status report.

3-3.3.2.2 *Serial Bus Interface Status Messages.* Interface status messages contain error status information caused by a previous command message or other source. When in the proper interface mode, the interface will respond to all command messages except ones that request an explicit status message and there are no errors.



NOTES:

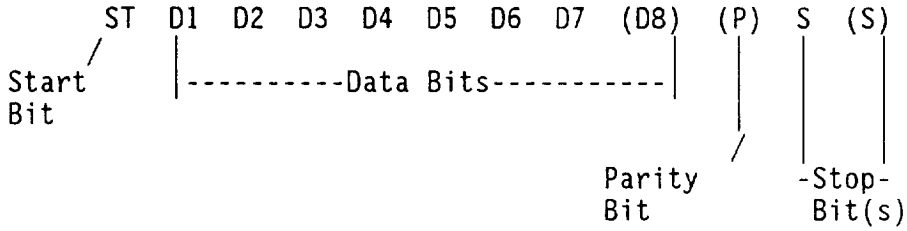
The first character of a transmission is always STX (start of text).

The second character contains the receiver address (coded in decimal). The address code for any receiver may be any digit from 0 to 7 provided that it is not used by any other unit connected to the bus. This transmission is from the controller addressed to receiver 5. The controller has no address.

The third character is the beginning of the data field. This field may contain as few as 1 or as many as 73 characters. The data field may contain one or more messages. If more than one message is contained in the data field, each message will be separated from the next by a single space (SP) character. There is no maximum number of messages that may be included in the data field provided the maximum number of characters is not exceeded. This transmission contains two messages in the data field: "F1200000" and "MC".

The last character is a CR (carriage return). This character always follows the last character of the data field.

Figure 3-3. Serial Bus Message Format.



NOTES:

Each character contains a start bit, 7 or 8 data bits (least significant bit sent first), an optional parity bit (odd or even), and 1 or 2 stop bits. The serial baud rate may be one the following standard baud rates: 110, 150, 200, 300, 600, 1200, 2400, 4800, 9600, or 19200.

Throughput of commands may be slower than the selected baud rate to allow for message processing.

Figure 3-4. Serial Bus Character Format.

3-3.4 *Serial Bus Message Protocol.* The interface system operates in one of three modes: normal, acknowledge, or independent. These modes are selected by sending the receiver(s) the appropriate interface command message. Each of the three modes are discussed in the following paragraphs:

3-3.4.1 *Serial Bus Normal Mode.* In normal mode the addressed receiver processes command messages but does not acknowledge receipt to the controller. The controller can verify the command message was received without error by later requesting a status message from the receiver. This mode is used if fast processing time is required (many receivers on the bus). The controller does not have to wait for each receiver to process the message(s) before addressing another receiver.

3-3.4.2 *Serial Bus Acknowledge Mode.* In acknowledge mode the receiver processes the command message and replies with an interface status message. If the command message contains a radio status message request (R?), and no errors or faults have been detected, the receiver replies with a radio status message. This increases processing time because the controller must wait for the reply status message before issuing another command. This mode is used when command message reception verification is required.

3-3.4.3 *Serial Bus Independent Mode.* In independent mode the receiver sends a status message whenever a pre-defined condition occurs (such as a threshold break or a fault is detected). This occurs independently of command messages. This mode should be used only in non-controller systems with a terminal or printer (unless the controller implements a method of handling contention). Several different sub-modes are possible for different pre-defined conditions.

3-3.5 *Serial Bus Message Definition.* All messages are ASCII encoded and inserted into the data field of transmissions as defined in paragraph 3-3.2. Messages from the controller may use lower or upper case for all alphabetic characters. The receiver always uses upper case.

Each message that can be sent or displayed using the bus controller is listed in the following tables:

- o Table 3-7. Serial Bus Interface Command Messages.
- o Table 3-8. Serial Bus Interface Status Messages.
- o Table 3-9. Serial Bus Radio Command/Status Messages.

NOTE

Radio command messages are similar to manual key press sequences. (Refer to paragraph 3-2.)

Table 3-7. Serial Bus Interface Command Messages.

Message	Definition
:ACKN	Set acknowledge interface mode
:IND1	Set independent mode 1
:NORM	Set normal interface mode
:?	Request interface status message

Table 3-8. Serial Bus Interface Status Messages.

Message	Definition
IE:IVAL	Illegal value
IE:OVFL	Interface error - buffer overflow
IE:UNKN	Interface error - unrecognized msg.
LE:PRTY	Line error - parity
LE:FRMG	Line error - framing
LE:OVRN	Line error - overrun
OK:NORM	No errors, normal mode
OK:ACKN	No errors, acknowledge mode
OK:IND1	No errors, independent mode 1
RE:FALT	Radio error - fault was detected

Table 3-9. Serial Bus Radio Command/Status Messages.

Message[1]	Definition
A?	Request current AGC decay time.
A*	Change receiver AGC decay time. * represents one of the following characters: Z for zero decay time, S for the shorter of the available times, M for the medium time selection, L for the longest selection, and O for AGC off (MGC). In AM mode, Z, S, M, or L will only select S time.
B?	Request current BFO setting.
B±123	Change the BFO offset. + or - sign and 1 through 3 represent the significant figures of the BFO offset with 1 representing the kHz units, 2 the 100 Hz, and 3 the 10 Hz increments. Valid in CW mode only. (Range: -999 through +999.)
BG?	Request the current bridging status. (Software version 6.0 and higher only.) If the receiver is set to sweep or scan and it is currently bridging between signals, the reply to this request will be BG1. Otherwise the reply will be BG0.
BN?	Request the current band number being swept during sweep. (Software version 6.0 and higher only.) Sweep bands are numbered consecutively as determined by operator selection before start of sweep. Band 01 = first two sweep channels selected, band 02 = second two sweep channels selected, etc. Reply will be BN## during sweep. Otherwise the reply will be BN--.
BT?	Request the current bridge timer setting. (Software version 6.0 and higher only.)
BT#	Change the Bridge time. (Software version 6.0 and higher only.) # represents a number to set the bridge time between signal detection during sweep or scan operation. (Range: 0 through 9)
CO	Continue a stopped scan or sweep operation. ("SP" stops the sweep or scan.)
C?	Request parameters that are different from those reported in last radio status msg.
CD?	Request carrier detection status. (Software version 6.0 and higher only.) If the current received signal is greater than the threshold level or the noise riding threshold (open squelch) the reply will be CD1. Otherwise the reply will be CD0.
CL	Clear all 100 memory channels to default parameters. The receiver takes approximately 15 seconds to complete this command. No other radio command messages should be sent during this time.
CN?	Request the current channel number. (Software version 6.0 and higher only.) If receiver parameters have not been changed since the last recall or store operation, the reply will be CN## where ## is the channel number recalled or stored. Otherwise the reply will be CN--. During scan operation the reply will be the current channel being scanned.
CS	Clear the list of skip frequencies used during sweep operation.

Table 3-9. Serial Bus Radio Command/Status Messages-CONT

Message[1]	Definition
D?	Request current dwell time.
D#	Change dwell time. # represents a one character number to select the dwell time after signal detection during scan or sweep operations. (Range: 0 through 9)
DG?	Request the current dwelling status. (Software version 6.0 and higher only.) If the receiver is set to sweep or scan and it is currently dwelling on a signal, the reply to this request will be DG1. Otherwise the reply will be DG0.
E?	Request the current antenna number (Not used)
E#	Change the antenna selection (Not used)
F?	Request current frequency.
F1234567	Change receiver frequency. Digits 1 through 7 represent the seven digits of the receiver operating frequency with 1 representing the most significant (10 MHz digit) and 7 representing the least significant (10 Hz). (Range: 0000000 through 3000000)
FS?	Request the current fault status. (Software version 6.0 and higher only.) If a fault condition has been detected in the receiver the reply to this request will be FS1. Otherwise the reply will be FS0.
G?	Request current manual gain setting.
G123	Change manual gain. Digits 1 through 3 represent the significant figures of the IF gain reduction in dB with 1 representing the 100 dB, 2 the 10 dB, and 3 the unit dB increments. Changing the manual gain turns the AGC off. (Range: 000 thru 127)
I?	Request current IF shift setting.
I±123	Change the IF shift. + or - sign and 1 through 3 represent the significant figures of the IF shift with 1 representing the kHz units, 2 the 100 Hz, and 3 the 10 Hz increments. (Range: -999 through +999)
K	Cancel the command in progress. Exits scan or sweep operations.
L?	Request current threshold level setting. Reply will be -127 if "SP" was sent.
L123	Change the threshold level. Digits 1 through 3 represent the signal threshold level to activate the audio circuits and stop the sweep or scan if stored in a memory channel. 1 = 100, 2 = 10, and 3 = unit increments of the threshold level in dBm. (Range: 000 through 127)
M?	Request current receive mode.
M*	Change receiver operating mode. The * represents a one character code chosen from the following set: L for LSB, U for USB, A for AM, C for CW, and F for FM.

Table 3-9. Serial Bus Radio Command/Status Messages-CONT

Message[1]	Definition
O?	Request the current threshold offset.
O±123	Change the threshold offset used in scan or sweep operation. The + or - sign and 1 through 3 represent the offset value. 1 = 100, 2 = 10, and 3 = the unit increments in dBm. (Range: -030 through +030 dBm.) This function should be set before starting a sweep or scan.
P?	Request current step size.
P##	Change Step Size. The first # represents the kilohertz and the second # represents the 100 hertz increment of the step size to be used in sweep operation. (Range: 00 through 99)
R?[2]	Request radio status message of all parameters.
RC##	Recall operating parameters from memory channel. The ## represents the two digits of the memory channel from which to recall the parameters. Recalled data is entered immediately. This command is also used to set the starting channel for a scan or sweep operation in which case it is followed by a scan or sweep command. (Range: 00 through 99)
S?	Request radio status message of the received signal strength. Reply will be "S123". Digits 1 through 3 represent the significant digits of the signal strength in dB below one milliwatt where 1 represents the 100 dB, 2 represents the 10 dB, and 3 represents the unit dB increments. (Range: 000 through 127)
SC##	Begin scan of memory channels. Where ## represents the two digits of the highest memory channel to be scanned. The scan starts at the memory channel most recently recalled. Offset should be set before sending this command. NOTE: If receiver is currently scanning or sweeping, send a "K" command before this command or the receiver will interpret this command as an "SP" command. (Range: 01 through 99)
SK or NSK	Skip Flag. SK sets the skip flag and NSK removes the skip flag for scan operations. During sweep operations, SK stores the current frequency in the sweep skip memory. Command must be followed by a store operation to be effective in a later scan or sweep.
SP	Stop the scan or sweep operation in progress but save parameters. Threshold level is temporarily set to -127 dBm. ("CO" continues scan or sweep.)
ST##	Store current operating parameters into memory channel. The ## represents the two digits of the memory channel being stored to. (Range: 00 through 99)
SW##	Begin sweep of frequency bands. The ## represents the two digits of the highest odd numbered memory channel from which to take the sweep stop frequency. The sweep starts at the frequency of the channel most recently recalled with the RC## command. (Range: 00 through 99) Offset ("O") should be set first.

Table 3-9. Serial Bus Radio Command/Status Messages-CONT

Message[1]	Definition
T	Allow local (manual) operation (enable front panel with LOCAL/REMOTE switch in REMOTE position).
W?	Request current IF bandwidth.
W#	Change receiver IF bandwidth. The # represents a one character number to select the IF bandwidth ranging from 0 for the narrowest bandwidth up to 5 for the widest bandwidth. The number of bandwidths available varies with the receiver configuration so the highest bandwidth number may be less than 5.
X	Remote control operation only (disable front panel with LOCAL/REMOTE switch in REMOTE position).

[1]All radio status messages (replies) use the same format as the radio command message for that parameter. For example, the reply to the radio command message "B?" (current BFO setting) is "B±123". (The same format as the radio command message to change the BFO). When more than one parameter is being reported, the individual parameters are separated by a blank (space) character.

[2]The following represents the reply to the R? command. Items in {brackets} indicate the response for software versions below 6.0. Refer to the table for a definition of each character.

{F1234567 B±123 I±123 G123 L123 W# A* M* D# P## E# O±123 S123} BT# CD# CN# DG# BG# FS# BN##

3-4 Remote Operation Using IEEE-488 Bus.

The receiver can be operated under remote control, using an IEEE-488 bus, if the optional IEEE-488 bus module, bus connector, and appropriate software is installed. To operate in the remote mode, set the REMOTE/LOCAL switch to the REMOTE position. When the switch is in the REMOTE position, the controller determines whether the receiver is in the remote or local mode.

NOTE

The controller can command the receiver to enter the local mode. When the controller commands the receiver to enter the local mode, the front panel REM indicator will go off.

3-4.1 *IEEE-488 Bus Description.* The IEEE-488 bus uses a party-line bus structure consisting of 16 signal lines. (Refer to table 2-3.) Devices are connected in parallel to the bus and information is passed in a byte serial/bit parallel fashion. Refer to IEEE Std 488 for a complete description of the IEEE-488 bus.

Sixteen signal lines are divided into three major functional groups: bus management lines, handshake lines, and data lines. There are five bus management lines, three handshake lines, and eight data lines. Data and message transfer is asynchronous. Devices connected to the bus may be talkers, listeners, or controller. Multiple controllers may be connected to the bus but only one controller may be in charge at a time. The controller dictates the role of the other devices by setting the ATN (attention) line true and sending the talk or listen addresses on the data lines. While the ATN line is true, all devices must listen to the data lines. When the ATN line is false, only devices that have been addressed will actively send or receive data. All others ignore the data lines.

Several listeners can be active simultaneously but only one talker can be active at a time. Whenever a talk address is put on the data lines (while the ATN is true), all other talkers will automatically be unaddressed.

The bus management lines conduct an orderly flow of information across the bus. The five bus management signals are listed in table 3-10.

Table 3-10. IEEE-488 Bus Management Signals.

Name (Mnemonic)	Description
Attention (ATN)	Causes all devices to interpret data on the bus as a controller command. When ATN is true, the bus is placed in the "Command Mode". All devices on the bus interpret data on the eight data lines as commands. When ATN is false, the bus is placed in the "Data Mode". All active listeners on the bus interpret data on the eight data lines as data.
Interface Clear (IFC)	Clears the bus. Sets the bus to an idle state.
Service Request (SRQ)	Alerts the controller to a need for communication.
Remote Enable (REN)	Enables devices to respond to remote program control when addressed by the controller.
End or Identify (EOI)	Indicates last byte of multibyte sequence.

Table 3-11. IEEE-488 Bus Handshake Lines.

Name (Mnemonic)	Description
Data Valid (DAV)	Sent by source to indicate that data on the bus is valid. All active devices on the bus can accept the byte as true information.
Not Ready for Data (NRFD)	Sent by acceptor to indicate that a device is not ready to accept data.
Not Data Accepted (NDAC)	Sent by acceptor to indicate that the data byte has not yet been read from the bus.

The three handshake lines coordinate the transfer of data over the bus. Transfer is asynchronous and the transfer rate automatically adjusts to the speed of the source and acceptor. The transfer rate will be that of the slowest active device. The three handshake lines are defined in table 3-11.

The eight bidirectional data lines (D1 - D8) transfer the data bytes on the bus. The bus management signals determine which device sends and which devices receive the byte. The handshake lines determine how long the byte remains on the bus.

One 24-pin, D-type interface connector (J13) provides parallel connection for both receivers in each chassis. A maximum of fifteen devices, including the bus controller, may be connected to the bus. (Each R-2411/U chassis is counted as two devices.) Each receiver in the chassis must have a unique address set by the rear panel switches.

The receiver may act as a talker and a listener. The SRQ function is selectable by means of a switch on the rear panel. If the SRQ function is disabled, the receiver can not request controller attention for communication. Two other switches on the rear panel are used to select the unaddressed talk only and listen only modes.

3-4.2 *IEEE-488 Bus Listen Data Sequence.* When the receiver is addressed to listen, it accepts data from the bus. This information is used to set the operating parameters of the receiver. Table 3-12 alphabetically lists the listen protocol for the receiver.

All characters are sent using ASCII code. The command sequence must be terminated with a carriage return and a line feed character. Only one command may be sent per listen data sequence (message). The R-2411/U IEEE-488 interface will not hold off the NRFD handshake while it processes the command just received (that is, NRFD will go false as normal after the last byte of the message), but will set the BUSY bit (bit 3) in its serial poll response byte to indicate that it is not yet ready for another command. The bus is free to be used to control other devices on the bus during this time.

When the R-2411/U is done processing the command it will clear the BUSY bit to indicate that it is ready to accept another command. If high speed control of the R-2411/U is implemented, the bus controller should conduct a serial poll of the R-2411/U before sending each command and proceed with sending the command only if the BUSY bit is clear.

Table 3-12. IEEE-488 Bus Listen Protocol.

Message	Definition
NOTE: [1]Indicates leading zeros must be sent.	
A*	Change receiver AGC decay time. * represents one of the following characters: Z for zero decay time, S for the shorter of the available times, M for the medium time selection, L for the longest selection, and O for AGC off (MGC). In AM mode, Z, S, M, or L will only select S time.
B±123[1]	Change the BFO offset. + or - sign and 1 through 3 represent the significant figures of the BFO offset with 1 representing the kHz units, 2 the 100 Hz, and 3 the 10 Hz increments. Valid in CW mode only. (Range: -999 through +999.)
CO	Continue a stopped scan or sweep operation. ("SP" stops the sweep or scan.)
CL	Clear all 100 memory channels to default parameters. The receiver takes approximately 15 seconds to complete this command. No other radio command messages should be sent during this time.
CS	Clear the list of skip frequencies used during sweep operation.
D#	Change dwell time. # represents a one character number to select the dwell time after signal detection during scan or sweep operations. (Range: 0 through 9)
F1234567[1]	Change receiver operating frequency. Digits 1 through 7 represent the seven digits of the receiver operating frequency with 1 representing the most significant (10 MHz digit) and 7 representing the least significant (10 Hz). (Range: 0000000 through 3000000)
G123[1]	Change manual gain. Digits 1 through 3 represent the significant figures of the IF gain reduction in dB with 1 representing the 100 dB, 2 the 10 dB, and 3 the unit dB increments. Changing the manual gain turns the AGC off. (Range: 000 through 127)
I±123[1]	Change the IF shift. + or - sign and 1 through 3 represent the significant figures of the IF shift with 1 representing the kHz units, 2 the 100 Hz, and 3 the 10 Hz increments. (Range: -999 through +999)
K	Cancel the command in progress. Exits scan or sweep operations. Does not cancel commands previously processed.
L123[1]	Change the threshold level. Digits 1 through 3 represent the signal threshold level to activate the audio circuits and stop the sweep or scan if stored in a memory channel. 1 = 100, 2 = 10, and 3 = unit increments of the threshold level in dBm. (Range: 000 through 127)
M*	Change receiver operating mode. The * represents a one character code chosen from the following set: L for LSB, U for USB, A for AM, C for CW, and F for FM.
O±123[1]	Change the threshold offset used in scan or sweep operation. The + or - sign and 1 through 3 represent the offset value. 1 = 100, 2 = 10, 3 = the unit increments in dBm. (Range: -030 through +030 dBm) This function should be set before starting a sweep or scan.

Table 3-12. IEEE-488 Bus Listen Protocol-CONT

Message	Definition
Q##[1]	Where ## are two ASCII characters representing a hexadecimal byte between 00 and 3F to control the SRQ function activation on the bus. This byte masks (bit value = 0) or activates (bit value = 1) the appropriate trigger in the receiver to activate an SRQ. In other words, if the receiver faults when Bit 2=1, the receiver will activate the SRQ flag. All the bits are set (all bits = 1) during power up if the SRQ switch on the rear panel is enabled. When set, the bit positions represent the following functions: Bit 0 - When the receiver breaks squelch Bit 1 - When the receiver closes squelch Bit 2 - No fault to fault status change Bit 3 - Fault to no fault status change Bit 4 - Receiver switched from Local to Remote Bit 5 - Receiver switched from Remote to Local To interpret the ASCII characters, total the HEX VALUES using the following table: BIT HEX VALUE: 5 = 2; 4 = 1; 3 BIT HEX VALUE: 3 = 8; 2 = 4; 1 = 2; 0 = 1; 15* TOTAL (1ST) (2ND) ASCII CHARACTER * If the 2ND ASCII CHARACTER TOTAL has a value between 10 and 15, use the following table to determine the hexadecimal value: 10 = A; 11 = B; 12 = C; 13 = D; 14 = E; 15 = F The ASCII character in the above example would be: 3 **15** = 3 **F**
RC##[1]	Recall operating parameters from memory channel. The ## represents the two digits of the memory channel from which to recall the parameters. Recalled data is entered immediately. This command is also used to set the starting channel for a scan or sweep operation in which case it is followed by a scan or sweep command. (Range: 00 through 99)
RD	Allows AGC voltage to be smoothly adjusted during remote frequency changes. Used for remote fine tuning or sweep.

Table 3-12. IEEE-488 Bus Listen Protocol-CONT

Message	Definition
SC##[1]	Begin scan of memory channels. Where ## represents the two digits of the highest memory channel to be scanned. The scan starts at the memory channel most recently recalled. Offset should be set before sending this command. NOTE: If receiver is currently scanning or sweeping, send a "K" command before this command or the receiver will interpret this command as an "SP" command. (Range: 01 through 99)
SD	Dumps AGC voltage when remote frequency changes are sent from the interface. Used for remote scan.
SE##[1]	Change Step Size. The first # represents kilohertz and the second # represents the 100 hertz increment of the step size for sweep operation. (Range: 00 through 99)
SK or NSK	Skip Flag. SK sets the skip flag and NSK removes the skip flag for scan operations. Command must be followed by a store operation to be effective in a later scan.
SP	Stop the scan or sweep operation in progress but save parameters. Threshold level is temporarily set to -127 dBm. ("CO" continues scan or sweep.)
ST##[1]	Store current operating parameters into memory channel. The ## represents the two digits of the memory channel being stored to. (Range: 00 through 99)
SW##[1]	Begin sweep of frequency bands. The ## represents the two digits of the highest odd numbered memory channel from which to take the sweep stop frequency. The sweep starts at the frequency of the channel most recently recalled with the RC## command. (Range: 01 through 99) Offset ("O") should be set first.
T	Allow local (manual) operation (enable front panel with LOCAL/REMOTE switch in REMOTE position).
W#	Change receiver IF bandwidth. The # represents a one character number to select the IF bandwidth ranging from 0 for the narrowest bandwidth up to 5 for the widest bandwidth. The number of bandwidths available varies with the receiver configuration so the highest bandwidth number may be less than 5.
X	Remote control operation only (disable front panel with LOCAL/REMOTE switch in REMOTE position).

To send multiple commands to the receiver, the controller must execute a serial poll between commands to determine the status of the receiver.

The receiver will return a status byte to the controller indicating its condition, that is, busy or not busy. The controller can check the status of the receiver by checking the BUSY bit (bit 3) in the serial poll response. Refer to paragraph 3-4.4 for further information about the serial poll status byte.

Table 3-13 lists the IEEE-488 capabilities, both universal and addressed, as implemented in the receiver.

3-4.3 *IEEE-488 Bus Talk Data Sequence.* When the controller commands a receiver to talk, the receiver responds with status information. The controller specifies what operating parameter the receiver is to return. The controller command for status information is a letter followed by "?". Table 3-14 is an alphabetical list of controller status requests.

NOTE

Refer to paragraph 3-4.2 for radio response definitions.

Table 3-13. IEEE-488 Bus Capabilities.

Identification	Description/Capability
SH1	Source handshake, complete capability, no states omitted
AH1	Acceptor handshake, complete capability, no state omitted
T5	Basic talker, serial poll, talk only mode, will stop talking if addressed to listen, and no states omitted
L3	Basic listener, listen only mode, and will stop listening if addressed to talk
SR1	Service request, complete capability, no states omitted
RL1	Remote local, complete capability, no states omitted
PP0	Parallel poll not implemented
DC0	Device clear not implemented
DT0	Device trigger not implemented
C0	No controller functions implemented
E2	Tri-state data bus driver

3-4.4 *IEEE-488 Bus Serial Poll Status Byte.* Since the receiver automatically sets the NDAC and NRFD lines high upon receipt of commands and data, the controller must poll the receiver to send another set of commands or data to the same unit. This prevents the controller from sending data to a unit that is not actually ready to receive data even though the NRFD line is high. The status byte (in response to a serial poll) is shown in figure 3-5.

When the receiver is configured as a talker and a listener and the SRQ function is enabled, the receiver sets the SRQ line true any time the conditions enabled by the "Q##" command are true. (Refer to table 3-12.)

3-4.5 *IEEE-488 Bus Talk Only Mode.* When the unit is set to be a talker only, by the rear panel selector switch, it sends a complete status report message any time the SRQ status is set. The receiver will send the message whether sweeping, scanning, or stopped on a channel or frequency. Only one device on the bus may be a talker only. The talk only function is useful when an unaddressed printer is connected to the bus and is used for logging frequencies where activity is sensed. The talk only mode can not be used if there is a controller on the bus as a command conflict will result.

3-4.6 *IEEE-488 Bus Listen Only Mode.* When the unit is set to be a listener only, by the rear panel selector switch, the unit will respond to all messages sent on the bus regardless of address. The receiver will talk only if specifically addressed. When addressed to talk, the receiver can send status information on the bus.

3-5 EMERGENCY OPERATION. There are no emergency operating procedures for the receiver.

Table 3-14. IEEE-488 Bus Controller Status Requests.

Message[1]	Definition
A?	Request current AGC decay time.
B?	Request current BFO setting.
D?	Request current dwell time.
F?	Request current frequency.
G?	Request current manual gain setting.
I?	Request current IF shift setting.
L?	Request current threshold level setting. Reply will be -127 if scan or sweep is stopped by "SP" command.
M?	Request current receive mode.
O?	Request the current threshold offset.
Q?	Request the SRQ control setting?
R?[2]	Request radio status message of all parameters.
SE?	Request the step size.
SS?	Request radio status message of the received signal strength. Reply will be "S123". Digits 1 through 3 represent the significant digits of the signal strength in dB below one milliwatt where 1 represents the 100 dB, 2 represents the 10 dB, and 3 represents the unit dB increments. (Range: 0 through 127.)
W?	Request current IF bandwidth.

[1]All radio replies use the same format as the radio status request message for that parameter. For example, the reply to the radio status request message "B?" (current BFO setting) is "B±123". (The same format as the radio command message to change the BFO.)

[2]The following represents the reply to the R? command. Refer to the table for a definition of each character.

F1234567B±123I±123G123L123W#A*M*D#SE##SS123

Bit 7	6	5	4	3	2	1	0
FAULT	SRQ	NA	SQUELCH	BUSY	ERROR	REMOTE SWITCH	NA

FAULT - Receiver fault. Updated when receiver is given another command.

SRQ - IEEE-488 SRQ status. Cleared after serial poll.

SQUELCH - Receiver has an open squelch.

BUSY - Receiver is not ready for another command.

ERROR - Receiver did not recognize last command.

REMOTE SWITCH - LOCAL/REMOTE switch is in REMOTE position.

Figure 3-5. IEEE-488 Bus Status Byte.

CHAPTER 4

GENERAL THEORY OF OPERATION

4-1 INTRODUCTION.

This chapter contains a block diagram description of the R-2411/U. Each receiver in the R-2411/U contains four functional areas: Power Distribution, Signal Processing, Synthesizer, and Control. Each area is discussed below. (See figure FO-2.)

4-2 POWER DISTRIBUTION.

Each receiver in the chassis contains its own separate Power Supply module. Voltages are distributed to modules through the motherboard. A separate +8V output and return is distributed by dedicated motherboard circuit tracks to the Display board. A forced-air cooling fan is powered by either +16V output.

4-2.1 *Power Supply Module.* Each Power Supply module is a switching regulated type that provides +8, +16, and -16 VDC to each set of receiver modules. A rotary switch on top of the module allows selection of either 110 or 220 VAC input power, and should be set to the 110 position. An elapsed time meter displays the cumulative amount of time the receiver has been on and is enabled by the -16V output. Fault detector circuits send a fault signal to the CPU and light the FAULT light on top of the module if any of the voltages fall below a preset level.

4-2.2 *AC Line Filter Board.* The AC Line Filter board keeps internally generated power supply switching noise off the AC input line, and is shared by both receivers in the chassis. When either front panel POWER switch is set ON, input power is applied to the corresponding Power Supply module through this board.

4-3 SIGNAL PROCESSING.

The signal processing section processes the incoming signal, and consists of the Preselector module, 1ST Mixer module, 2ND Mixer module, 2ND IF module, Detector module, and the Audio board. Each is discussed in the following paragraphs.

4-3.1 *Preselector Module.* Eight bandpass and two low-pass filters are used to pass only selected received RF signals from the antenna. Low-pass filters are used between 0.0 and 1.6 MHz, while bandpass filters are used between 1.6 and 30.0 MHz.

The incoming signal is applied through the rear panel ANTENNA connector to the Preselector module. An RF detector and relay protects the filters by opening the RF line if the signal level exceeds about one Watt.

Under CPU control, a band control logic circuit automatically selects the correct filter for the selected receive frequency. The Preselector module also contains an RF amplifier. Overall gain through this module is approximately 4 dB.

4-3.2 *1ST Mixer Module.* The 1ST Mixer module converts the input signal to the 1ST intermediate frequency (IF) of 40.455 MHz. The signal applied to the 1ST Mixer module is filtered through a 30 MHz low-pass filter. The filter rejects the 1ST local oscillator (LO) frequency preventing it from being radiated back out the antenna. The filter also rejects input signals at the 1ST IF and image frequencies.

The incoming RF signal is mixed with the tunable 1ST LO frequency from the Output Loop module, producing the IF. The output of the mixer is amplified and available for monitoring at the 1ST IF MON connector on the rear panel. An RF amplifier is used at the output of the module. A fault detector sends a fault signal to the CPU if the 1ST LO signal falls below a preset level. Overall maximum gain through the module is approximately -5 dB.

4-3.3 *2ND Mixer Module.* The 2ND Mixer module filters and converts the 1ST IF at 40.455 MHz, to the 2ND IF of 455 kHz.

The 1ST IF signal enters the module where a bandpass filter provides a 1ST IF bandwidth of 10 kHz. An RF amplifier at the filter output, compensates for any signal loss. Gain control of the signal is provided by three PIN diode attenuators that receive the 1ST IF GAIN CTL voltage from the Detector module. The signal is then amplified before application to the mixer.

The 2ND IF of 455 kHz is produced by mixing the 1ST IF at 40.455 MHz with the 2ND LO frequency at 40 MHz. A fault detector sends a fault signal to the CPU if the 2ND LO signal falls below a preset level. An additional RF amplifier is used at the output of the module. Overall gain through the module is approximately +25 dB.

4-3.4 *2ND IF Module.* The 2ND IF module contains 4 selectable bandwidth IF filters (ranging from 500 Hz to 8 kHz) and the first stage of significant gain. An amplifier before the filters provides moderate gain and is used to isolate the filters from the previous module. When USB or LSB is selected the 3 kHz filter is automatically selected. The 1ST LO and BFO signals are automatically adjusted in frequency to place the 3 kHz filter as required with respect to the desired signal. Gain control of the signal is provided by a PIN diode attenuator that receives the 2ND IF GAIN CTL voltage from the Detector module. An additional RF amplifier is used at the output of the module. Overall gain through the module is approximately +51 dB.

4-3.5 *Detector Module.* The Detector module demodulates the 2ND IF signal, provides gain control voltages, and provides signal strength voltages for the front panel meter. The DET SEL logic signals from the CPU module select one of the three detector circuit outputs depending on the receive mode.

Two fault detection circuits compare a sample of the BFO and the 500 kHz LO signal to a preset reference. A low value of either signal enables the FAULT signal to the CPU module. The BFO signal fault detection circuitry is disabled in the AM and FM modes.

After initial amplification, the 2ND IF signal is applied to the detector circuits as follows:

4-3.5.1 *FM Detector.* Frequency modulated signals are demodulated in the FM detector. This circuit mixes the 2ND IF signal at approximately 455 kHz with a 500 kHz LO signal from the BFO module. The resulting signal at approximately 45 kHz is applied to a pulse count type discriminator for demodulation.

The demodulated signal is applied to the FM video line for monitoring by external equipment regardless of the receive mode selected. When the FM mode is selected, the output is applied to the Audio board.

4-3.5.2 *Envelope Detector.* Amplitude modulated and pulse type signals are demodulated in the envelope detector. An averaging detector is used to derive the AGC signal in the AM receive mode. In all other receive modes the output is peak detected to develop the AGC voltage. Three AGC DECAY logic signals from the CPU module determine the peak detected AGC decay time.

The AGC EN signal from the CPU module selects either manual gain control (MGC) or automatic gain control (AGC). The MGC voltage from the CPU module provides either local (front panel) or remote gain control. When MGC is selected, the automatic gain control circuits are disabled. The output of the peak detector should be monitored and adjustments made to keep the signal amplitude in the middle of the detector's output range.

4-3.5.3 *Product Detector.* Suppressed and reduced carrier signals are demodulated in the product detector. This circuit mixes the 2ND IF signal with the BFO signal which is substituted for the suppressed carrier frequency. The resultant signal is amplified and sent to the audio board when selected by the logic circuits.

4-3.6 *Audio Board.* The Audio board amplifies the selected audio signal from the Detector module for application to the 600 ohm balanced lines and PHONES jack. A detector circuit is used for monitoring audio signal level by the CPU module for display on the front panel meter.

Analog voltages corresponding to the signal strength sensed by the Detector module and an analog voltage corresponding to the frequency of the received signal (with respect to the IF center frequency) are sent to this module for selection by CPU module.

Data signals from the CPU module (over the Control/Data Bus) are used to control the logic circuits of the Audio board. The logic circuits select the correct analog signal for input to the CPU. The logic circuit also inhibits the audio outputs when the receiver is squelched.

4-4 SYNTHESIZER.

The synthesizer section produces the specific frequencies used for signal frequency conversion. Synthesizer modules include the Output Loop, Step Loop, Fine Loop, Reference/2ND Local Oscillator, and BFO. Each module uses phase-locked loop (PLL) circuits and are discussed in the following paragraphs.

4-4.1 *Output Loop Module.* The Output Loop module provides the 1ST LO signal to the 1ST Mixer. The module contains three CPU selectable voltage controlled oscillators (VCOs) operating between 40.455 and 70.455 MHz in 10 Hz steps. Each VCO is selected by the OUTPUT VCO SELECT signal from the shift register in the Fine Loop module.

The frequency of each VCO is controlled by phase locking the selected VCO to the sum of the STEP RF and FINE RF frequencies. A sample of the VCO output signal is mixed with the STEP RF signal, producing a difference frequency. The difference frequency passes through a low-pass filter (LPF) and gated to a phase detector. The phase detector compares the difference frequency with the FINE RF and develops the correction fine tune DC control voltage, keeping the selected VCO on frequency. A fault detector sends a fault signal to the CPU if the loop loses phase lock.

The wrong-side lock detector ensures that the output frequency locks up only if the VCO frequency is higher than the STEP RF signal. If the VCO frequency is lower than the STEP RF, the logic circuit will not allow the mixer output signal to pass through the gate circuit. This causes the phase detector to provide a DC correction voltage that drives the VCO to a higher frequency.

4-4.2 *Step Loop Module.* The Step Loop module provides the STEP RF signal and COARSE TUNE voltage to the Output Loop module. The module contains three CPU selectable VCOs operating between 40.4 and 70.4 MHz in 0.1 MHz steps. Each VCO is selected by the STEP VCO SELECT signal from the shift register in the Fine Loop module.

The output frequency of the selected VCO is controlled by phase locking it to an integer multiple of the reference frequency. A synthesizer control circuit contains a counter that divides the 1 MHz reference signal by 10, producing an internal 100 kHz reference. A dual modulus prescaler circuit (divide by P), together with two CPU controlled counters (in the synthesizer control) provide a divided VCO frequency representing the actual VCO frequency.

The divided VCO frequency and the 100 kHz reference frequency are phase compared in the synthesizer control circuit. The synthesizer control circuit develops the correction fine tune DC control voltage, keeping the selected VCO on frequency. A fault detector sends a fault signal to the CPU if the loop loses phase lock.

The serial STEP DATA from the CPU is clocked through a shift register circuit into the synthesizer control circuit. A digital-to-analog (D/A) converter operating from the shift register develops the coarse tune voltage for both the step loop and output loop VCOs.

4-4.3 *Fine Loop Module.* The Fine Loop module provides the fine loop signal to the Output Loop module. The module contains three VCOs operating between 55 and 154.99 MHz. A divide by 1,000 circuit produces output frequencies between 55 and 154.99 kHz in 10 Hz steps. A low-pass filter passes only these lower frequencies.

The output frequency of the selected VCO is controlled by phase locking the VCO to an integer multiple of the reference frequency. A synthesizer control circuit contains a counter that divides the 1 MHz reference signal by 100, producing an internal 10 kHz reference frequency.

A dual modulus prescaler circuit (divide by P), together with two CPU controlled divide counters (in the synthesizer control), provide a divided VCO frequency representing the actual VCO frequency.

The divided VCO frequency and the 10 kHz reference frequency are phase compared in the synthesizer control circuit. The synthesizer control develops the correction fine tune DC control voltage, keeping the selected VCO on frequency. A fault detector sends a fault signal to the CPU if the fine loop loses lock.
The serial FINE DATA from the CPU controls the divider circuits. The data is clocked through a shift register which also selects the fine, step, and output loop VCOs.

4-4.4 *Reference & 2ND LO Module.* The Reference & 2ND LO module provides the 1 MHz reference signal to the BFO, Step Loop, and Fine Loop modules, and the 40 MHz 2ND LO signal to the 2ND Mixer module. The 1 MHz reference signal is either produced internally or by using one of three external frequency standards (1, 5, or 10 MHz). The internal frequency standard may also be used to produce one of the three frequency standards for output on the REF OUT connector.

A rear panel switch selects either the internal or external frequency standard. If the external frequency standard is selected, a switch on top of both modules in the chassis must be set to correspond with the input frequency. If both front panel POWER switches are set to off, a relay in the logic circuits automatically connects the REF IN connector to the REF OUT connector. This prevents interruption of a "daisy-chained" signal when power is removed from a receiver in the external frequency standard loop.

If the internal frequency standard is selected, a highly stable 10 MHz frequency standard produces the internally generated reference signal. A switch on top of the module may be set to any of the three positions allowing generation of a 1, 5, or 10 MHz frequency on the REF OUT connector. This signal may be used as the external frequency standard for other receivers if desired.

NOTE

If the INT/EXT switch is set to INT and both receivers in the chassis are powered up, the B receiver provides the reference frequency to the REF OUT connector. However, if the INT/EXT switch is set to INT and the B receiver is powered off, the A receiver provides the reference frequency to the REF OUT connector.

Depending on the selected frequency standard, logic circuits divide or pass the frequency to produce the 1 MHz reference frequency. The 1 MHz output is sent to a splitter circuit for application to the BFO and Fine Loop modules. A buffer amplifier in the BFO module then applies the 1 MHz reference frequency to the Step Loop module. A fault detector sends a fault signal to the CPU if the reference frequency amplitude falls below a preset level.

The 40 MHz 2ND LO signal is developed by multiplying the output of a 20 MHz voltage controlled crystal oscillator (VCXO) by 2. A sample of the VCXO signal is divided by 40 and compared with the 1 MHz reference which was divided by 2. A phase comparator compares the two divided frequencies at 500 kHz and develops a DC correction voltage to keep the VCXO on frequency.

4-4.5 *BFO Module.* The BFO (beat frequency oscillator) module provides: (1) A variable RF signal used to develop an audio signal from suppressed carrier or CW transmissions for the product detector circuits, (2) A 500 kHz LO frequency used in the FM Detector circuits, and (3) Buffering and amplification of the 1 MHz reference signal for use by the Step Loop module.

The BFO frequency is generated by a voltage controlled oscillator (VCO) with a frequency range between 44.501 and 46.499 MHz in 1 kHz steps. The frequency of the BFO is controlled by the BFO DATA serial input clocked in from the CPU. The data is latched into the module by the SYN EN logic signal.

The VCO output is divided by 100 to generate BFO frequencies between 445.01 and 464.99 kHz in 10 Hz steps. The signal is amplified and applied to the product detector in the Detector module for use when the USB, LSB, or CW reception modes are selected.

The output frequency of the VCO is controlled by phase locking the VCO to an integer multiple of the reference frequency. A synthesizer control circuit contains a counter that divides the 1 MHz reference signal by 100, producing an internal 10 kHz reference frequency.

A dual modulus prescaler circuit (divide by P), together with two CPU controlled divide counters (in the synthesizer control), provide a divided VCO frequency representing the actual VCO frequency.

The divided VCO frequency and the 10 kHz reference frequency are phase compared in the synthesizer control circuit. The synthesizer control circuit develops a DC control voltage selecting the VCO frequency. A fault detector sends a fault signal to the CPU if the loop loses lock.

4-5 CONTROL.

The control section of the receiver performs the following functions: interface to the remote control bus, synthesizer control, receiver band and bandwidth selection, AGC and detector selection, front panel control interpretation, and front panel display control. The control section includes the optional Bus Interface module, optional Bus Connector board, CPU module, Panel Interface module, and Front Panel Display board. Each is discussed in the following paragraphs.

NOTE

If the radio is configured for serial bus operation refer to paragraph 4-5.1. If the radio is configured for IEEE-488 bus operation refer to paragraph 4-5.2.

4-5.1 *Serial Bus.* If the unit is optionally configured for serial bus remote control operation, the unit will contain the Serial Interface module and the Serial Bus Connector board. Each is described in the following paragraphs.

4-5.1.1 *Serial Interface Module.* The optional Serial Interface module converts serial data from the bus to parallel data for the CPU module. It also converts

parallel data from the CPU to serial data for the serial bus. The module contains its own microprocessor, program memory, and input/output device. If an internal fault is detected, the BUS FAULT signal is sent to the CPU module.

4-5.1.2 *Serial Bus Connector Board.* The optional Serial Bus Connector board is common to both receivers in the chassis. It provides signal level conversion and data buffering between the Serial Interface module and the external remote control bus. Signal levels on the external bus are approximately +10 volts for logic low and -10 volts for logic high. The Serial Interface module requires TTL logic levels of 0 volts for logic low and +5 volts for logic high. The Remote Control Connector board makes the necessary conversion of these voltage levels. The data flows in serial form in both directions through the board.

4-5.2 *IEEE-488 Bus.* If the unit is optionally configured for IEEE-488 bus remote control operation, the unit will contain the IEEE-488 Interface module and the IEEE-488 Bus Connector board. Each is described in the following paragraphs.

4-5.2.1 *IEEE-488 Interface Module.* The optional IEEE-488 Interface module contains its own microprocessor and program memory to interface with the control bus plus two output ports that are read by the microprocessor in the CPU module as memory locations. The IEEE-488 Interface module handles all handshaking on the bus without disturbing the operation of the CPU.

4-5.2.2 *IEEE-488 Bus Connector Board.* The optional IEEE-488 Bus Connector board contains the bus configuration switches and connects the external bus connector with the IEEE-488 Bus Interface circuits through a ribbon cable. This board is only used when the optional IEEE-488 Interface module (and appropriate software) is installed.

Two bus configuration DIP switches (one for each receiver in the chassis) contain eight small switches accessible on the rear panel. The operator may select one of thirty-one addresses using the ASW0 - ASW4 switches. Three additional switches set the listen only, talk only, and SRQ enable bus functions.

4-5.3 *CPU Module.* The CPU module controls all receiver functions using resident software and data from the front panel controls or the remote control bus. The CPU module contains: (1) The microprocessor, (2) Erasable programmable read-only memory (EPROM) containing the software program, (3) Random access memory (RAM) used for temporary registers, calculations, and current operating parameters, (4) The analog-to-digital (A/D) converter used to convert the analog signals from the audio board into digital signals to control the front panel meter, (5) The digital-to-analog (D/A) converter providing remote or manual gain control analog signals, (6) The port expander drivers providing serial data to the synthesizer modules and parallel data to the other modules, and (7) A combination data/address bus connecting all devices.

4-5.3.1 *Data Flow.* The CPU module accepts control and data information from the Panel Interface module or the Serial Interface module, depending on the position of the LOCAL/REMOTE switch. Data is transferred between the modules on the Control/Data Bus which extends into the CPU module. Under resident software control, the microprocessor sends the correct control logic signals through the port expander I/O lines, the D/A converter for manual or remote gain control, and the Panel Interface module to control the front panel displays.

4-5.3.2 *Input/Output.* The port expander provides both parallel and serial data outputs. Parallel outputs include: BAND CONT to select the correct Preselector module filter, BW CONT to select the correct 2ND IF module bandwidth filter, AGC DECAY to select the AGC decay time, DET SEL to select the correct detector circuit, and AGC EN to select either automatic or manual gain control.

Serial outputs for the synthesizer section include STEP DATA, FINE DATA, and BFO DATA to select the correct frequency output from the synthesizer modules. The SYN CLK signal clocks each serial data bit into the modules, and the SYN EN signal latches the data into the modules at the correct time.

The A/D converter accepts analog meter voltages from the Detector module selected by switches in the Audio board. The switches are controlled by data from the CPU module. The data is sent over the Control/Data Bus, to the Panel Interface module where it is latched into the logic circuits in the Audio board.

All module fault signals are detected by the CPU module. When a fault is detected, the CPU signals the bus controller over the remote control bus, and sends a signal to the Display board to light the front panel FAULT light.

4-5.4 *Panel Interface Module.* The Panel Interface module provides buffering and data exchange between the CPU module and the front panel of the receiver. It contains: (1) The output latches and drivers to operate the displays and inhibit the audio outputs, (2) The keypad, adjustment knob, and LOCAL/REMOTE switch input circuits, (3) The 100 channel memory to store changeable preset frequencies and other parameters, and (4) The nonvolatile memory to store the current frequency and other parameters when power is lost. When power is restored, the CPU restores the receivers last parameters using the data stored in the nonvolatile memory.

4-5.5 *Front Panel Display Board.* The Front Panel Display board contains LED display elements plus the digit and segment select drivers. Normal intensity digits are turned on for 2 milliseconds every 16 milliseconds (a refresh rate of 62.5 Hz) while the intensified digit in the main display (when enabled) is turned on for 6 milliseconds every 16 milliseconds. Current switching transistors and current limiting resistors are located on the rear side of the board.

CHAPTER 5

MAINTENANCE INSTRUCTIONS

Section I. PREVENTIVE MAINTENANCE

5-1 INTRODUCTION.

This chapter contains both preventive and corrective organizational level maintenance instructions. The information includes cleaning and lubrication, inspection, performance verification, troubleshooting, and module replacement.

5-2 CLEANING AND LUBRICATION.

Clean the external surfaces and front panel of the receiver every 2 weeks using a vacuum cleaner or small soft brush to remove any dirt or dust. Do not use any cleaning agents.

Remove and clean the air intake filter (located on the rear chassis fan) every 2 weeks using mild soap and water. Do not use any cleaning agents. There are no lubrication requirements.

5-3 INSPECTION.

If the receiver is faulty or suspected to be faulty perform a visual inspection as follows:

5-3.1 *External Inspection.*

1. Check the front panel for physical damage.
2. Check the external case and slides for physical damage.
3. Check the rear panel for physical damage.
4. Check all rear panel connectors for corrosion.

5-3.2 *Internal Inspection.*

WARNING

When the top cover is removed, high voltage may be present at the rear panel AC power connector, the AC Line Filter board, and the front panel POWER switch connections. Use caution when working in these areas.

CAUTION

Before removing the bottom cover, ensure the front panel POWER switches are off. Equipment may be damaged if tools or metal objects are allowed to come in contact with receiver components.

1. Remove the top and bottom covers of the receiver using a no. 2 Phillips screwdriver. Push down, and turn all captive fasteners on the covers 1/4 turn counter-clockwise.
2. Check for loose modules and circuit boards.
3. Check all suspected internal connectors for corrosion or burn marks, and pushed or bent pins.
4. Check all cables and wiring for frayed or broken wires.
5. Make sure that RF connectors are seated correctly and tight.

5-4 PERFORMANCE VERIFICATION.

Performance verification of the receiver should be performed quarterly as described in the following paragraphs.

5-4.1 *Frequency Accuracy.* To check the accuracy of the internal frequency standard of both receivers in the chassis, perform the following procedures:

1. Turn off receiver power.
2. Loosen four screws holding receiver chassis in mounting rack assembly.
3. Slide receiver chassis drawer to fully extended position.

WARNING

When the top cover is removed, high voltage may be present at the rear panel AC power connector, the AC Line Filter board, and the front panel POWER switch connections. Use caution when working in these areas.

4. Loosen screws holding receiver chassis top cover. Remove cover.
5. Note setting of switches on top of the Reference and 2ND LO modules, then set switches to 10 MHz.
6. Note setting of switch S1 on receiver rear panel, then set switch S1 to INT.

NOTE

If REFERENCE OUT connector J9 is already connected, remove connection before connecting test cable.

7. Connect a coaxial test cable from a frequency counter to the REFERENCE OUT connector J9 on the receiver rear panel.
8. Turn on and set the frequency counter to display a 10 MHz signal at 1 Hz resolution.

NOTE

There are two receivers (A and B) in each chassis. If the POWER switches to both receivers are ON, the B receiver signal will be measured at REFERENCE OUT connector J9. To measure the A receiver signal, turn B receiver power off and A receiver power ON.

9. Turn on receiver under test. Allow at least 10 minutes for warm-up before taking frequency reading.
10. Verify frequency counter reading is 10 MHz ±10 Hz.
11. Repeat steps 7 through 10 for other receiver.
12. Turn off receiver power.
13. Disconnect test equipment. If J9 was originally connected, reconnect to original configuration.
14. Set S1 on receiver rear panel to its original position.
15. Set switches on top of the Reference and 2ND LO modules to their original positions.
16. Install receiver chassis cover and tighten holding screws.
17. Slide receiver chassis drawer in and tighten holding screws.
18. Turn on power. Return receiver to normal configuration.

5-4.2 *Receiver Sensitivity.* This procedure verifies that the receiver's signal sensitivity is at least 10 dB above the noise threshold. To check the sensitivity of the receiver perform the following procedures:

1. Turn off receiver power.
2. Loosen four screws holding receiver chassis in mounting rack assembly.
3. Slide receiver drawer to the fully extended position.
4. Connect RF signal generator to the ANTENNA jack of the receiver under test.
5. Turn on and set the RF signal generator output for a CW signal of 12.126 MHz at -116 dBm.
6. Set multimeter to measure voltage and connect multimeter to the 600 ohm audio output, J12 on the rear panel. (Pins 1 and 2 are for the left receiver and pins 8 and 9 are for the right receiver.) Turn on multimeter.
7. Ensure the receiver is in LOCAL mode. Turn on receiver power.
8. Set the receiver frequency to 12.125 MHz in USB (upper sideband) reception mode.
9. Turn off receiver AGC and set receiver GAIN to -000 on front panel display.
10. Record voltage reading and establish reference on meter.
11. Remove CW signal input to the receiver.
12. Voltage reading should be at least 10 dB less than the reading obtained in step 10.
13. Turn off power to receiver under test.
14. Repeat steps 4 through 13 for the other receiver in the receiver chassis.
15. Disconnect test equipment.
16. Return front panel controls to their normal positions.
17. Slide receiver drawer back into mounting rack assembly. Insert and tighten four screws holding drawer in place.
18. Turn on power. Return receiver to normal configuration.

Section II. CORRECTIVE MAINTENANCE

5-5 TROUBLESHOOTING.

Since the R-2411/U contains two receivers in one chassis, suspected modules can be substituted with known operational modules from the other receiver until the failed module is located. If both receivers in the chassis have like symptoms, components common to both receivers should be suspect.

Equipment troubleshooting should be performed in the following order:

1. Fault identification.
2. Initial checks.
3. Fault light interpretation.
4. Signal tracing. (If required)
5. Module replacement.

Refer to the paragraphs below for details.

5-5.1 *Fault Identification.* A fault is usually indicated when the fault bit of the status message is set, the FAULT lamp lighting on the front panel display, or by the receiver not detecting a known good signal. If a fault is detected, the front panel FAULT lamp, and the individual module fault lights may help isolate the fault.

5-5.2 *Initial Checks.* Before detailed troubleshooting, perform the following:

1. Check that the displays on the front panel are on, and the POWER switches are in the ON position. If the front panel displays are off, and the POWER switches are set ON, ensure that applied voltage is correct.
2. Check operation in both LOCAL and REMOTE.
3. Check that proper frequency, bandwidth, and other parameters are correctly set.
4. Check both receivers in the same chassis for common symptoms.
5. Check for correct external reference frequency (if used). Ensure that the rear panel reference selector switch (S1) is set correctly. If an external reference frequency is used, try setting the reference selector switch to the INT position (to use the internal reference frequency) and re-check the receiver.

5-5.3 *Fault Light Interpretation.* Modules that produce or use internally generated signals are monitored for faults. A fault light on top of these modules lights indicating a fault in the module. The modules with fault detectors are: Power Supply, 1ST Mixer, 2ND Mixer, Detector, Reference & 2ND LO, Output Loop, Step Loop, Fine Loop, BFO, and Bus Interface.

NOTE

Most module fault lights will normally flash and go out, when the receiver is powered-up.

If the front panel FAULT lamp remains on for more than a few seconds after power-up, remove the top cover of the receiver using the following procedures:

WARNING

When the top cover is removed, high voltage may be present at the rear panel AC power connector, the AC Line Filter board, and the front panel POWER switch connections. Use caution when working in these areas.

CAUTION

Do not operate the receiver for extended periods of time with the top cover removed. The receiver may overheat from lack of forced-air cooling.

1. Using a no. 2 Phillips screwdriver, push down, and turn all captive fasteners on the top cover 1/4 turn counter-clockwise.
2. Remove the top cover.
3. Check the lights on top of the modules to determine if one or more are on.
   a. If only one fault light is on, refer to paragraph 5-5.3.1.
   b. If more than one fault light is on, refer to paragraph 5-5.3.2
   c. If no fault lights are on, refer to paragraph 5-5.3.3

5-5.3.1 *One Fault Light On.* If only one fault light is on, the failure is usually in the indicated module. A wiring failure or a failure in the output of another module connected to the indicated module, may give a false indication. Table 5-1 lists and identifies possible failures and alternate possible failed module(s).

5-5.3.2 *Multiple Fault Lights On.* If multiple fault lights are on, refer to table 5-2 to aid in module isolation.

5-5.3.3 *No Fault Lights On.* If no fault lights are on, the fault may be in a module with no fault detector, or in a circuit in any module that is not monitored for faults. The modules/boards without fault detectors are: Preselector, 2ND IF, Audio, CPU, Panel Interface, Bus Connector, Display, Motherboard, and AC Line Filter. A failure of the receiver at all frequencies, bandwidths, and selected attenuation could be caused by a failure in any of the above modules. Certain partial failures, can be isolated using table 5-3.

5-5.4 *Signal Tracing.* If the failed module or board cannot be isolated using the initial check or fault light interpretation, isolate the failed component using signal tracing techniques. Make comparisons between both receivers in the chassis to help isolate the fault. Refer to chapter 4 for signal flow descriptions.

Signals are checked at various locations in the equipment using a signal generator and oscilloscope (see figures FO-2, FO-3, and FO-4). The 1ST IF, 2ND IF, reference signal, and audio outputs may be checked on the rear panel monitor jacks. Table 5-4 lists typical signals at the rear panel monitor jacks. RF signals may be checked by removing the module where the signal in question terminates, and checking the signal at the RF coaxial cable in the chassis. To reach power and control signal voltage check points on the motherboards, remove the bottom cover of the receiver chassis.

5-6 MODULE REPLACEMENT.

CAUTION

Turn off power before removing or replacing modules. Equipment may be damaged if modules are removed or replaced with power applied.

To remove and replace a module perform the following:

5-6.1 *Removal.*

1. Using a no. 2 Phillips screwdriver, push down and turn the captive fasteners on the module base 1/4 turn counter-clockwise to release the fasteners.

CAUTION

Do not use a sharp tool to pry up the module. The module may be scratched or marred. Use a small wood or plastic pry-bar.

2. Pry up on the top outer edge of the module to lift the module from the receiver.

5-6.2 *Replacement.*

NOTE

A short, diagonal black stripe on top of each module shows the correct module location in the chassis. When all modules are installed in their correct locations, the short diagonal stripes form a long continuous diagonal stripe. (See figure FO-5.)

1. Identify and orient the module to align the connectors on the bottom of the module with the connectors in the chassis.

CAUTION

Ensure the module connector is aligned correctly with the connector in the chassis or the connectors may be damaged. On modules with both a coaxial cable connector and a standard connector, mate the standard connector first and then engage the coaxial connector.

2. Press the module firmly down to seat the connectors.
3. Using a no. 2 Phillips screwdriver, press down firmly on the captive fasteners, and turn them 1/4 turn clockwise until they lock.

5-6.3 *Reassembly.* When all modules have been replaced, install the top cover as follows:

1. Orient and place the top cover on top of the chassis.
2. Using a no. 2 Phillips screwdriver, press down firmly on the captive fasteners, and turn them 1/4 turn clockwise until they lock.

Table 5-1. Fault Isolation - One Fault Light.

Fault Light On	Possible Failure	Alternate Module(s)
1ST MIXER	Loss of 1ST LO signal	OUTPUT LOOP
2ND MIXER	Loss of 2ND LO signal	REFERENCE & 2ND LO
DETECTOR	Loss of BFO or 500 kHz LO	BFO
OUTPUT LOOP	Loss of phase lock	STEP, FINE LOOP, REF & 2ND LO
STEP LOOP	Loss of phase lock	REFERENCE & 2ND LO
FINE LOOP	Loss of phase lock	REFERENCE & 2ND LO
REF & 2ND LO	Loss of ref signal	Ext reference signal
BFO	Loss of phase lock or reference signal	REF & 2ND LO, STEP LOOP
BUS INTERFACE	Internal fault	Bus Connector board
POWER SUPPLY	Wrong voltage/current	AC Line Filter, pwr source

Table 5-2. Fault Isolation - Multiple Fault Lights.

Fault Lights On	Suspect Module
1ST MIXER and OUTPUT LOOP	OUTPUT LOOP or FINE LOOP
2ND MIXER and REF & 2ND LO	REFERENCE & 2ND LO
OUTPUT LOOP and STEP LOOP	STEP LOOP
OUTPUT LOOP and FINE LOOP	FINE LOOP
REF & 2ND LO, FINE LOOP, STEP LOOP, OUTPUT LOOP, and BFO	REF & 2ND LO or external freq. standard
FINE, STEP, and OUTPUT LOOP	REF & 2ND LO or external freq. standard
BUS INTERFACE, FINE LOOP, STEP LOOP, and 1ST MIXER	CPU or PANEL INTERFACE
PWR SUPPLY, FINE LOOP, OUTPUT LOOP	POWER SUPPLY

Table 5-3. Fault Isolation - No Fault Lights.

Symptoms Of Failure	Suspect Module(s)
No Display	PWR SUPPLY, Display board, PANEL INTFC.
Completely inoperative	CPU, POWER SUPPLY, Bus Connector Board
Inoperative on one band	PRESELECTOR, CPU
Inoperative on one bandwidth	2ND IF, CPU
Inoperative on one mode	DETECTOR, CPU
Meter inoperative	DETECTOR, CPU, PANEL INTFC, Audio board
No audio, detector, and IF outputs	PRESELECTOR, 1ST MIXER
No audio output only	DETECTOR, Audio board
No detector output only	DETECTOR
No 2ND IF output only	DETECTOR

Table 5-4. Typical Rear Panel Monitor Signals.

FREQ.	SIGNAL IN ANT	TEST POINT[1]	CORRECT OBSERVATION[2]	SUSPECT MODULE IF NOT CORRECT
0.0000	None	1ST IF MON	120 mV p-p, 40.455 MHz	1ST MIXER, OUTPUT LOOP
10 MHz	None	1ST IF MON	15 mV p-p, 50.455 MHz	1ST MIXER, OUTPUT LOOP
10 MHz	-10 dBm	1ST IF MON	500 mV p-p, 40.455 MHz	1ST MIXER, PRESELECTOR
10 MHz	-10 dBm	2ND IF MON	120 mV p-p, 455 kHz	1ST MIXER, 2ND MIXER, DET
10 MHz	-100 dBm	2ND IF MON	120 mV p-p, 455 kHz	DETECTOR

[1]Test points terminated with 50 ohms.

[2]All levels measured with receiver in AM mode, 8 kHz bandwidth, and the AGC set to .05 seconds.

CHAPTER 6

PREPARATION FOR RESHIPMENT

6-1 INTRODUCTION.

This chapter contains information to prepare the equipment for reshipment including disassembly and removal from the rack mount, packaging, and shipping.

6-2 DISASSEMBLY AND REMOVAL.

To disassemble and remove the dual receiver from the rack mount, perform the following procedures:

1. Ensure the POWER switches are set off (down).
2. Disconnect the AC power cable from the receiver.
3. Disconnect all cables from the rear panel.

CAUTION

Do not support the weight of the unit by the front panel alone. The chassis may bend or warp. Use chassis slides or a suitable support shelf.

4. Remove the receiver from the rack mount.

6-3 PACKAGING.

NOTE

The receiver should be packed in the original shipping container if available.

To package the equipment for reshipment perform the following steps:

1. Ensure that there is sufficient foam packing material in the shipping container to protect the unit from any hard impact.
2. Cover the unit with foam or bubble-type packing material.
3. Place the unit in the center of the shipping container.
4. If using a cardboard packing carton, securely tape the seams of the carton's top cover, bottom cover, and side flaps with reinforced packing tape.
5. Attach labels or stamp in indelible ink the word FRAGILE on the top, bottom, and all sides of the container.

6-4 SHIPPING.

There are no special shipping requirements for the equipment. Commercial or military surface or air shipping services may be used.

CHAPTER 7

STORAGE

7-1 INTRODUCTION.

This chapter contains information for storage of the equipment including environmental conditions and any special preservation requirements.

7-2 STORAGE ENVIRONMENT.

The receiver should be stored indoors in the original shipping container (or similar container) as described in chapter 6. The environment should be dry with a temperature range between -80 to $+160^{O}$F (-62 to $+71^{O}$C).

7-3 PRESERVATION.

There are no special coverings or preservation materials required to store the receiver.

CHAPTER 8
PARTS LIST

8-1 INTRODUCTION.

This chapter contains the parts list for replaceable modules and chassis-mounted components at the organizational maintenance level.

8-2 REPLACEABLE PARTS LISTING.

Table 8-1 lists the replaceable modules and chassis-mounted components. Items in parenthesis indicate the vendor part numbers for parts purchased by the prime contractor. There are no replaceable commercial parts listed. (See figure FO-5 for locations.)

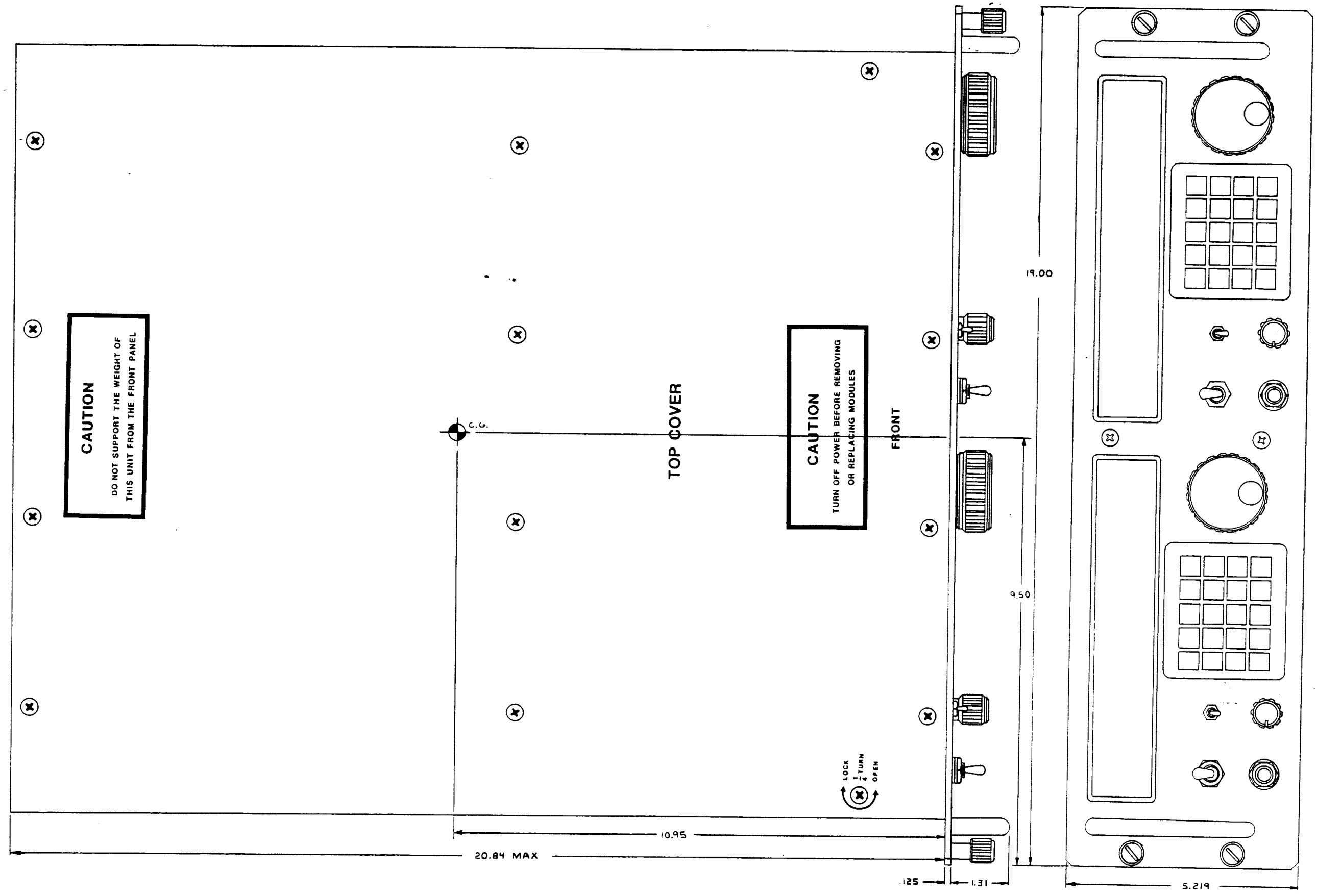
Table 8-1. Replaceable Parts List.

Qty	Description	Part Number	Notes	Mfr
2	Front Pnl Display bd	2140-2016		59532
1	IEEE-488 Bus conn bd	2140-2021	Optional	59532
2	Panel Intfc module	2861-1102		59532
2	CPU module	2861-1103	With program	59532
2	Serial Bus Intfc mdl	2861-1104	With prgrm, Opt.	59532
2	Ref/2ND LO module	2861-1105		59532
2	Fine Loop module	2861-1106		59532
2	Output Loop module	2861-1107		59532
2	Step Loop module	2861-1108		59532
2	BFO module	2861-1109		59532
2	Detector module	2861-1110		59532
2	2ND IF module	2861-1111		59532
2	2ND Mixer module	2861-1112		59532
2	1ST Mixer module	2861-1113		59532
2	Preselector module	2861-1114		59532
2	Power Supply module	2861-1115		59532
2	IEEE-488 Bus itfc mdl	2861-1121	With prgrm, Opt.	59532
2	Motherboard	2861-2001		59532
2	Audio board	2861-2016		59532
1	Serial Bus conn bd	2861-2017	Optional	59532
1	AC Line Filter board	2861-2020		59532
1	Air Filter Assy	115-018		59532
		(GR80-1)		(9T708)
1	Fan, DC, 3-1/8 in.	115-017		59532
		(8112K)		(23936)
2	Volume Control knob	211-096		59532
2	Main Adj knob	211-095		59532

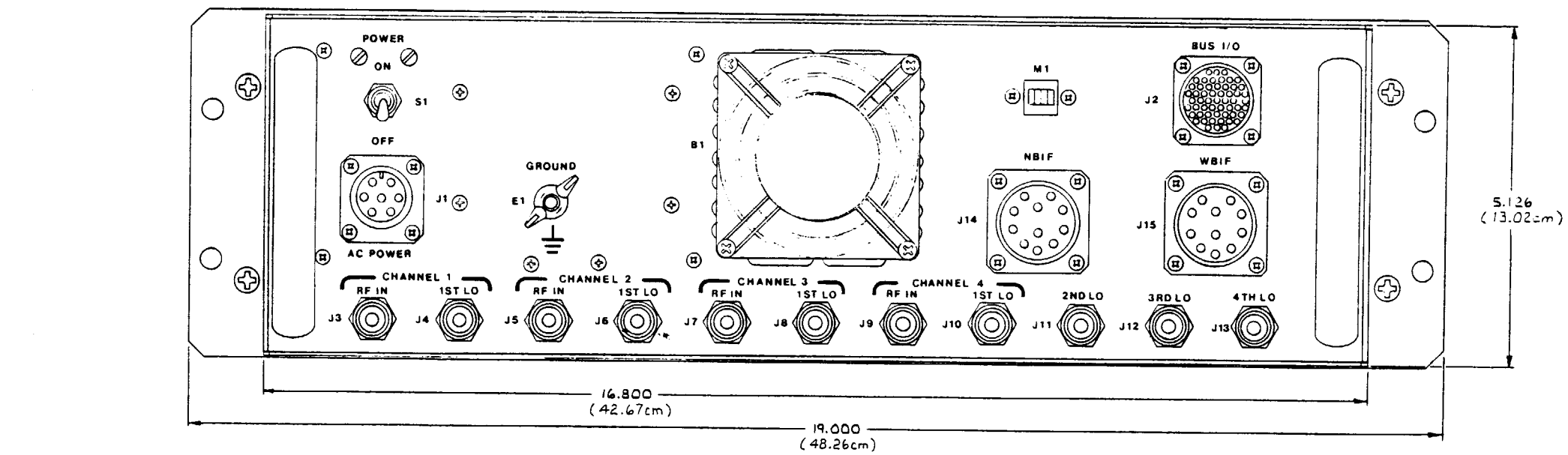
Table 8-1. Replaceable Parts List-CONT.

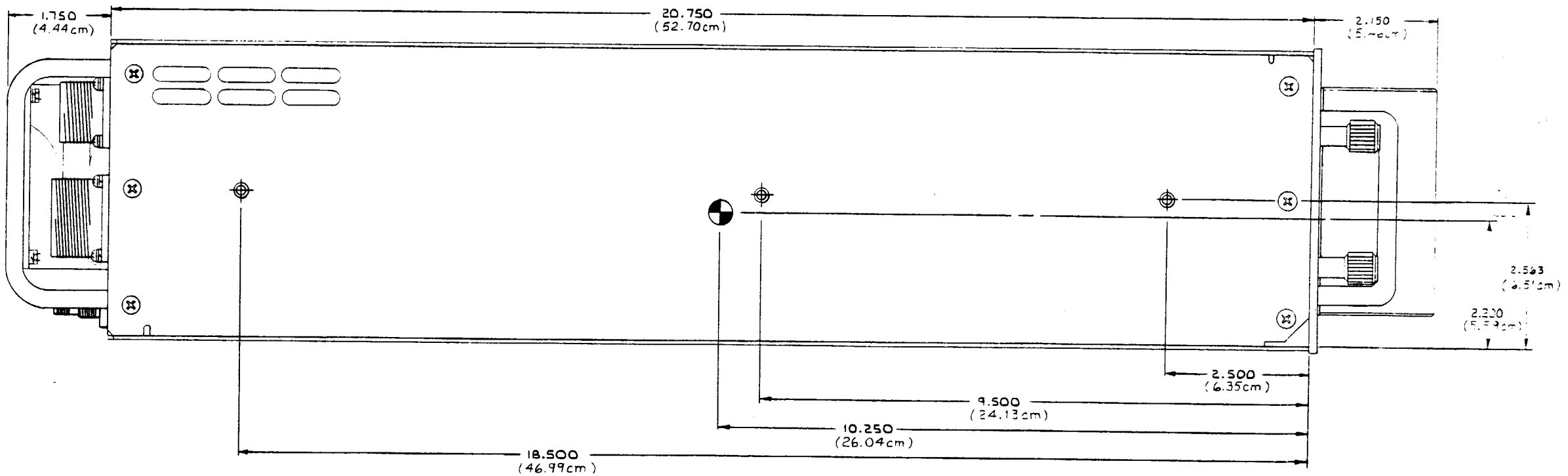
Qty	Description	Part Number	Notes	Mfr
2	Keyboard, Sealed	173-012 (88JB-2)	Note[1]	59532 (81073)
2	Ckt bkr/pwr switch	482-053 (AP12-1-72F-202)	Note[1]	59532 (82415)
2	Local/remote switch	172-081 (7101-S-Y-Z-Q)	Note[1]	59532 (09353)
4	Phones jack	342-040 (L112B)	Note[1]	59532 (82389)
2	Handles, rnd, front	222-045 (415-1264-01-12-00)	Note[1]	59532 (71279)
2	Handles, rear	222-049 (246-14AL10-32A)	Note[1]	59532 (57177)
2	Keypad overlay	180-008	Note[1]	59532
2	Meter, elapsed time	112-048 (D16C8VC)	Note[1]	59532 (10236)
1	AC power connector	320-008 (MS-3452W-16S-1P)	Note[1]	59532 (14283)
1	Stud, self clinch	761-227 (FHS-0420-16)	Note[1]	59532 (46384)
10	TNC connector	344-422 (216-036-A591)	Note[1]	59532 (00795)
1	INT/EXT switch	172-098 (11A1211)	Note[1]	59532 (82389)
1	Audio connector	320-017 (D38999/20WC35PN)	Note[1]	59532 (77820)

[1]Optional part not required for normal organizational level maintenance. Optional parts should only be replaced at the organizational level if directed by higher authority for emergency maintenance.

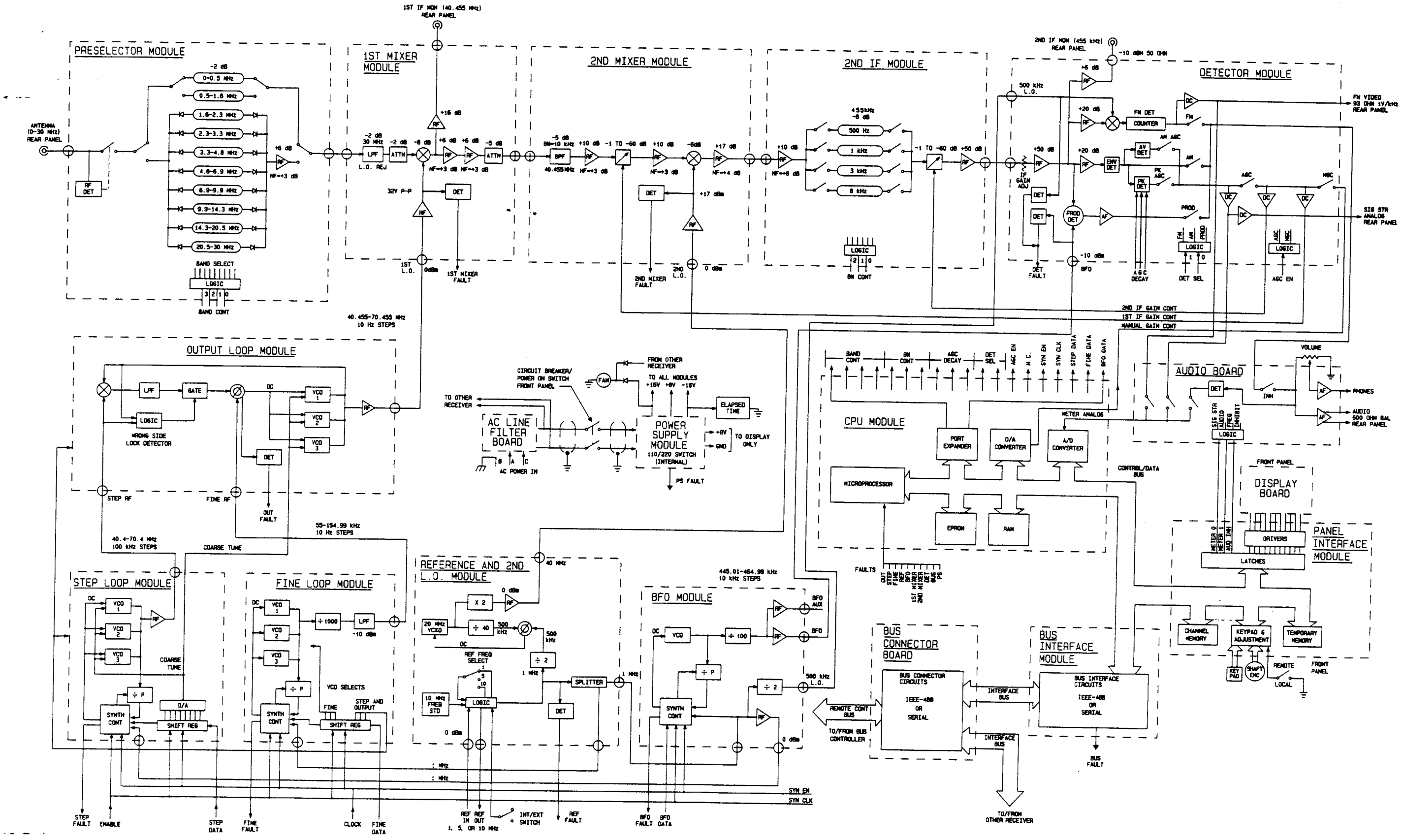


FO-1. R-2411/U Outline and Mounting Drawing (Sheet 1 of 2).

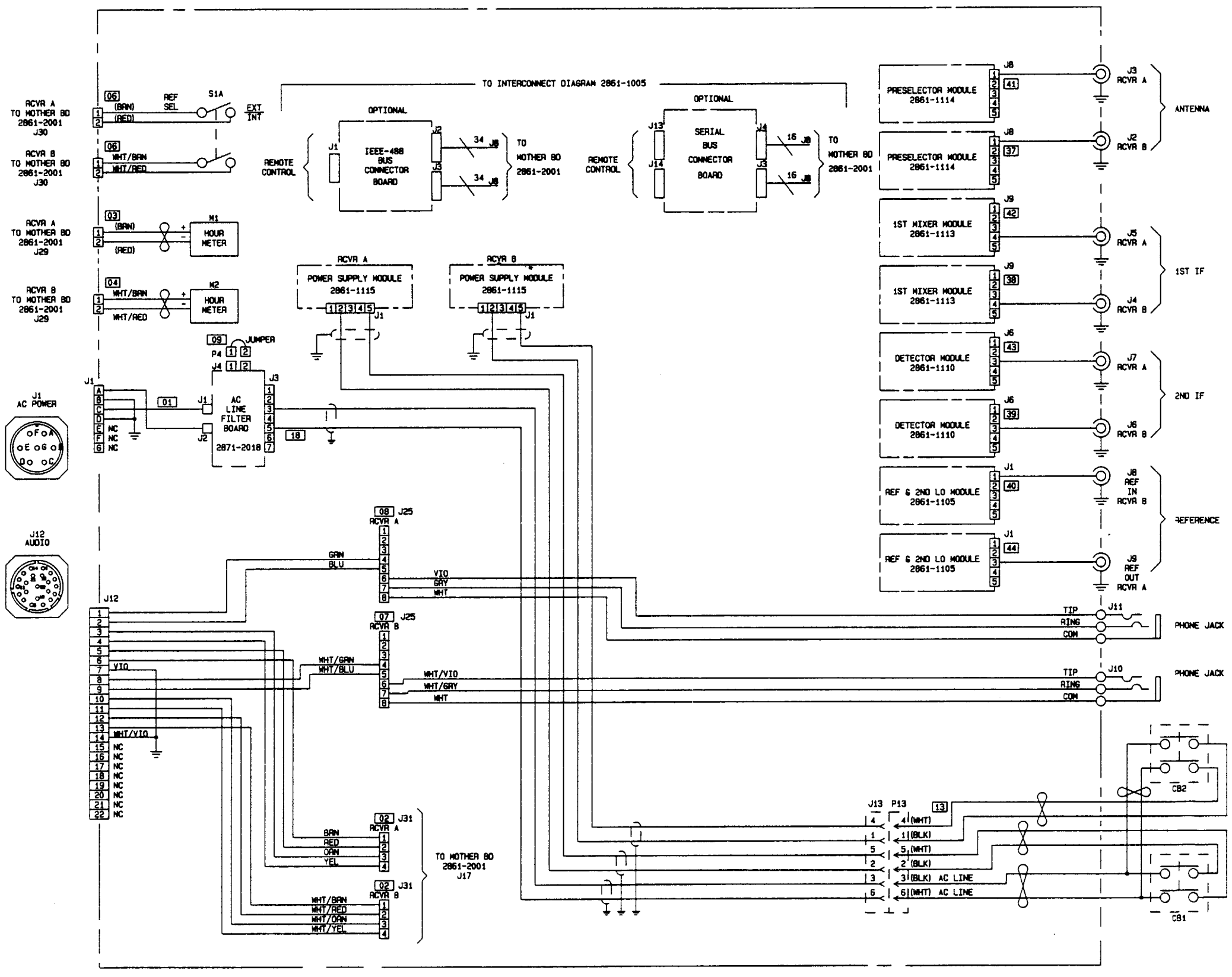




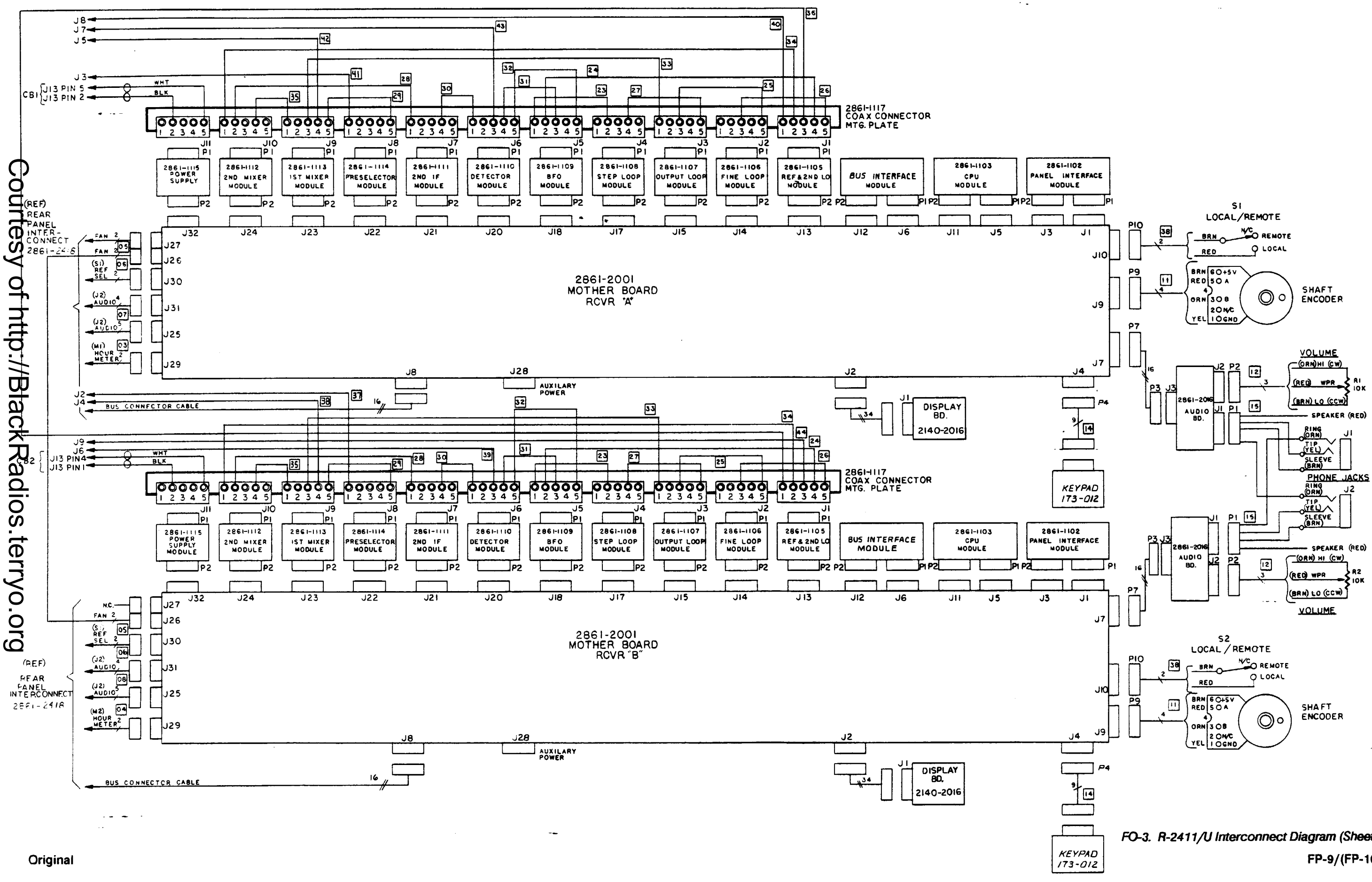
FO-1. R-2411/U Outline and Mounting Drawing (Sheet 2 of 2).



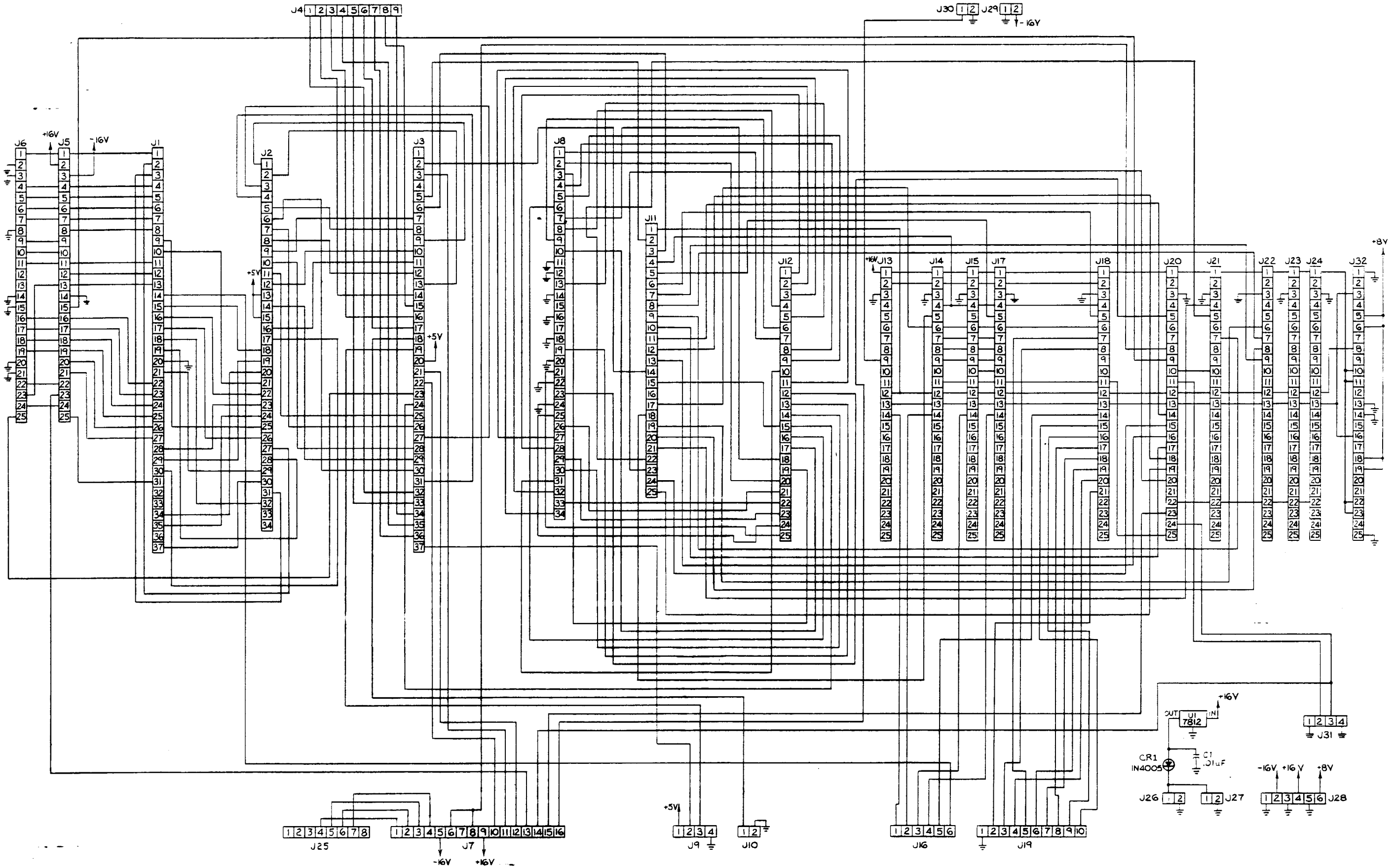
FO-2. R-2411/U Block Diagram (Typical).



FO-3. R-2411/U Interconnect Diagram (Sheet 1 of 2).



FO-3. R-2411/U Interconnect Diagram (Sheet 2 of 2).



FO-4. R-2411/U Motherboard Schematic (Sheet 1 of 2).

J3A

POWER SUPPLY (P2)	
PIN	DESCRIPTION
1	GND
2	NC
3	-16V
4	NC
5	+8V
6	+8V
7	NC
8	FAULT
9	NC
10	+16V
11	+16V
12	NC
13	GND
14	GND
15	NC
16	-16V
17	NC
18	+8V
19	+8V
20	NC
21	NC
22	+16V
23	+16V
24	NC
25	GND

J22

PRESELECTOR (P2)	
PIN	DESCRIPTION
1	+16V
2	NC
3	GND
4	NC
5	NC
6	BAND Ø
7	BAND 3
8	BAND 2
9	BAND 1
10	NC
11	NC
12	FAULT (NIC)
13	-16V
14	NC
15	NC
16	NC
17	NC
18	NC
19	NC
20	NC
21	NC
22	1ST I.F AGC (NIC)
23	NC
24	NC
25	NC

J23

1ST MIXER (P2)	
PIN	DESCRIPTION
1	+16V
2	NC
3	GND
4	NC
5	NC
6	NC
7	NC
8	NC
9	NC
10	NC
11	NC
12	FAULT
13	-16V
14	NC
15	NC
16	NC
17	NC
18	NC
19	NC
20	NC
21	NC
22	1ST I.F AGC (NIC)
23	NC
24	NC
25	NC

J24

2ND MIXER (P2)	
PIN	DESCRIPTION
1	+16V
2	+8V
3	GND
4	NC
5	NC
6	NC
7	NC
8	NC
9	NC
10	NC
11	NC
12	FAULT
13	-16V
14	NC
15	NC
16	NC
17	NC
18	NC
19	NC
20	NC
21	NC
22	1ST I.F. AGC.
23	NC
24	NC
25	NC

J21

2ND I.F. (P2)	
PIN	DESCRIPTION
1	+16V
2	NC
3	GND
4	BW Ø
5	BW 2
6	NC
7	BW 1
8	NC
9	NC
10	2ND I.F. AGC
11	NC
12	FAULT (NIC)
13	-16V (NIC)
14	NC
15	NC
16	NC
17	NC
18	NC
19	NC
20	NC
21	NC
22	1ST I.F. AGC (NIC)
23	NC
24	NC
25	NC

J20

DETECTOR (P2)	
PIN	DESCRIPTION
1	+16V
2	NC
3	GND
4	NC
5	DET AUD
6	NC
7	NC
8	AUDIO COMMON
9	MGC VOLTAGE
10	2ND I.F. AGC
11	STR ANA
12	FAULT
13	-16V
14	DET Ø
15	DET 1
16	HOLD Ø
17	AGC EN
18	DUMP
19	HOLD 1
20	PB Ø (NIC)
21	NC.
22	1ST IF AGC
23	DET SIG STR
24	FM VID
25	BFO ON/OFF

J18

BFO (P2)	
PIN	DESCRIPTION
1	+16V
2	+8V
3	GND
4	SYN EN
5	BFO DATA
6	SYN CLK
7	ANTENNA 4
8	ANTENNA 1
9	NC
10	NC
11	BFO ON/OFF
12	FAULT
13	-16V (NIC)
14	TP BFO MOD
15	ANTENNA 3
16	ANTENNA 5
17	ANTENNA 6
18	ANTENNA 7
19	ANTENNA 8
20	ANTENNA 2
21	COMMON
22	NC
23	NC
24	NC
25	NC

J17

STEP LOOP MODULE (P2)	
PIN	DESCRIPTION
1	+16V
2	+8V
3	GND
4	SYN EN
5	STEP DATA
6	SYN CLK
7	VCO LO
8	VCO HI
9	VCO MID
10	COARSE TUNE
11	BFO ON/OFF
12	FAULT
13	-16V
14	TP STEP LOOP MOD
15	NC
16	NC
17	NC
18	NC
19	NC
20	NC
21	NC
22	NC
23	NC
24	NC
25	NC

J3

PANEL INTERFACE (P2)	
PIN	DESCRIPTION
1	NC
2	INTR
3	MET 1
4	NC
5	INTA
6	IO/M
7	DG 5
8	DG 3
9	DG 1
10	SEG F3
11	SEG DP3
12	SEG C3
13	SEG A3
14	COL 2
15	COL 4
16	ROW 1
17	ROW 3
18	LOCAL
19	ENCODER PHASE B
20	+5V
21	AUDIO INHIBIT
22	MET Ø
23	RINT
24	WR
25	DG 6
26	DG 4
27	DG 2
28	SEG E3
29	SEG G3
30	SEG D3
31	SEG B3
32	COL 1
33	COL 3
34	COL 5
35	ROW 4
36	ROW 2
37	ENCODER PHASE A

J1

PANEL INTERFACE (P1)	
PIN	DESCRIPTION
1	+8V
2	SEG F1
3	SEG DP1
4	ADR/DAT 1
5	ADR/DAT 3
6	ADR/DAT 5
7	ADR/DAT 7
8	A9
9	SEG E1
10	SEG C1
11	RD
12	EN 4
13	ALE
14	SPARE 3 (NIC)
15	SEG A2
16	SEG C2
17	SEG E2
18	SEG DP2
19	SEG F2
20	GND
21	SEG G1
22	ADR/DAT Ø
23	ADR/DAT 2
24	ADR/DAT 4
25	ADR/DAT 6
26	A8
27	A10
28	SEG D1
29	SEG B1
30	SEG A1
31	EN 5
32	NC
33	NC
34	SEG B2
35	SEG D2
36	NC
37	SEG G2

J2

DISPLAY INTERCONNECT	
PIN	DESCRIPTION
1	DG 1
2	SEG A3
3	DG 2
4	SEG B3
5	DG 3
6	SEG D3
7	DG 4
8	SEG C3
9	DG 5
10	SEG E3
11	DG 6
12	SEG F3
13	+8V
14	SEG G3
15	+8V
16	SEG DP3
17	SEG A1
18	SEG A2
19	SEG B1
20	SEG B2
21	SEG C1
22	SEG C2
23	SEG D1
24	SEG D2
25	SEG E1
26	SEG E2
27	SEG F1
28	SEG F2
29	SEG G1
30	SEG G2
31	SEG DP1
32	SEG DP2
33	+8V RTN
34	+8V RTN

J8

REMOTE INTERCONNECT		
PIN	IEEE-488	SERIAL
1	NRFD	P14
2	DAV	P13
3	NDAC	P15
4	EOI	TxD
5	IFC	
6	D4	RxD
7	SRQ	CTS
8	D3	RxC
9	ATN	P16
10	D2	EXT INT
11	GND	
12	GND	
13	D1	TxC
14	GND	+8V
15	NC	
16	GND	
17	NC	
18	GND	
19	ASW 4	
20	GND	
21	ASW 3	
22	GND	
23	ASW 2	
24	GND	
25	ASW 1	
26	REN	
27	ASW Ø	
28	D8	
29	LIS EN	
30	D7	
31	TLK EN	
32	DG	
33	SRQ EN	
34	D5	

J27

FAN MOTHER BD INTER	
PIN	DESCRIPTION
1	+12V
2	GND

J19

ANTENNA INTERFACE	
PIN	DESCRIPTION
1	GND
2	COMMON
3	ANTENNA 1
4	ANTENNA 2
5	ANTENNA 4
6	ANTENNA 6
7	ANTENNA 7
8	ANTENNA 8
9	ANTENNA 5
10	ANTENNA 3

J28

ACCESSORY POWER	
PIN	DESCRIPTION
1	GND
2	-16V
3	GND
4	+16V
5	GND
6	+8V

J4

KEYPAD	
PIN	DESCRIPTION
1	COL 1
2	COL 2
3	ROW 1
4	ROW 4
5	COL 3
6	ROW 3
7	ROW 2
8	COL 4
9	COL 5

J10

FRONT PANEL SWITCH	
PIN	DESCRIPTION
1	LOCAL
2	GND

J30

REAR PANEL SWITCH	
PIN	DESCRIPTION
1	REF SEL
2	GND

J16

TEST POINTS	
PIN	DESCRIPTION
1	TP REF. MOD
2	TP FINE LOOP MOD
3	TP OUTPUT LOOP MOD
4	TP STEP LOOP MOD
5	TP BFO MOD
6	SPARE 3

J7

AUDIO BD. INTERFACE	
PIN	DESCRIPTION
1	600 OHM LINE
2	TIP
3	600 OHM RETURN
4	RING
5	-16V
6	AUDIO COMMON
7	NC
8	AUDIO COMMON
9	+16V
10	MET Ø
11	MET 1
12	AUDIO INHIBIT
13	METER ANALOG
14	FM VID
15	DET SIG STR
16	DET AUD

J25

AUDIO INTERCONNECT	
PIN	DESCRIPTION
1	SPARE 1
2	SPARE 2
3	NC
4	600 OHM LINE
5	600 OHM RETURN
6	TIP
7	RING
8	PHONE COM

J26

FAN	
PIN	DESCRIPTION
1	+12V
2	GND

J9

SHAFT ENCODER	
PIN	DESCRIPTION
1	-5V
2	ENCODER PHASE A
3	ENCODER PHASE B
4	GND

J31

AUDIO TO REAR PANEL	
PIN	DESCRIPTION
1	STR ANA RTN
2	STR ANA
3	FM VID
4	VIDEO RTN

J29

METER	
PIN	DESCRIPTION
1	GND
2	-16V

J5

CPU MODULE (P1)	
PIN	DESCRIPTION
1	+8V
2	+16V
3	-16V
4	ADR/DAT 1
5	ADR/DAT 3
6	ADR/DAT 5
7	ADR/DAT 7
8	A9
9	A2
10	A0
11	RD
12	EN 4
13	ALE
14	GND
15	MGC VOLTAGE
16	ADR/DAT Ø
17	ADR/DAT 2
18	ADR/DAT 4
19	ADR/DAT 6
20	A8
21	A10
22	A1
23	METER ANALOG
24	BI
25	EN 5

J11

CPU MODULE (P2)	
PIN	DESCRIPTION
1	FAULT
2	INTA
3	IO/M
4	SYN EN
5	STEP DATA
6	BFO DATA
7	BAND 1
8	BAND 3
9	BW 1
10	AGC EN
11	DET Ø
12	DUMP
13	HOLD Ø
14	INTR
15	WR
16	RESET OUT
17	SYN CLK
18	FINE DATA
19	BAND Ø
20	BAND 2
21	BW Ø
22	BW 2
23	PB Ø
24	DET 1
25	HOLD 1

J6

REMOTE INTERFACE (P1)		
PIN	IEEE	SERIAL
1	+8V	
2	GND	+8V
3	GND	
4	ADR/DAT 1	
5	ADR/DAT 3	
6	ADR/DAT 5	
7	ADR/DAT 7	
8	GND	
9	A2	
10	A0	
11	RD	
12	NC	
13	NC	
14	GND	
15	GND	
16	ADR/DAT Ø	
17	ADR/DAT 2	
18	ADR/DAT 4	
19	ADR/DAT 6	
20	GND	
21	GND	
22	A1	
23	ALE	
24	BI	
25	RINT	

J12

REMOTE INTERFACE (P2)		
PIN	IEEE	SERIAL
1	D8	
2	DG	
3	D5	
4	D3	RxC
5	D1	TxC
6	ATN	P16
7	NRFD	P14
8	EOI	TxD
9	IFC	
10	TLK EN	
11	ASW Ø	
12	ASW 2	
13	ASW 4	
14	D7	
15	WR	
16	D4	RxD
17	D2	EXT INT
18	SRQ	CTS
19	NDAC	P15
20	DAV	P13
21	REN	
22	SRQ EN	
23	LIS EN	
24	ASW 1	
25	ASW 3	

J13

REFERENCE (P2)	
PIN	DESCRIPTION
1	+16V
2	+8V
3	GND
4	NC
5	NC
6	NC
7	NC
8	NC
9	REF SEL
10	NC
11	NC
12	FAULT
13	-16V (NIC)
14	TP REF MODULE
15	NC
16	NC
17	NC
8	NC
19	NC
20	NC
21	NC
22	NC
23	NC
24	NC
25	NC

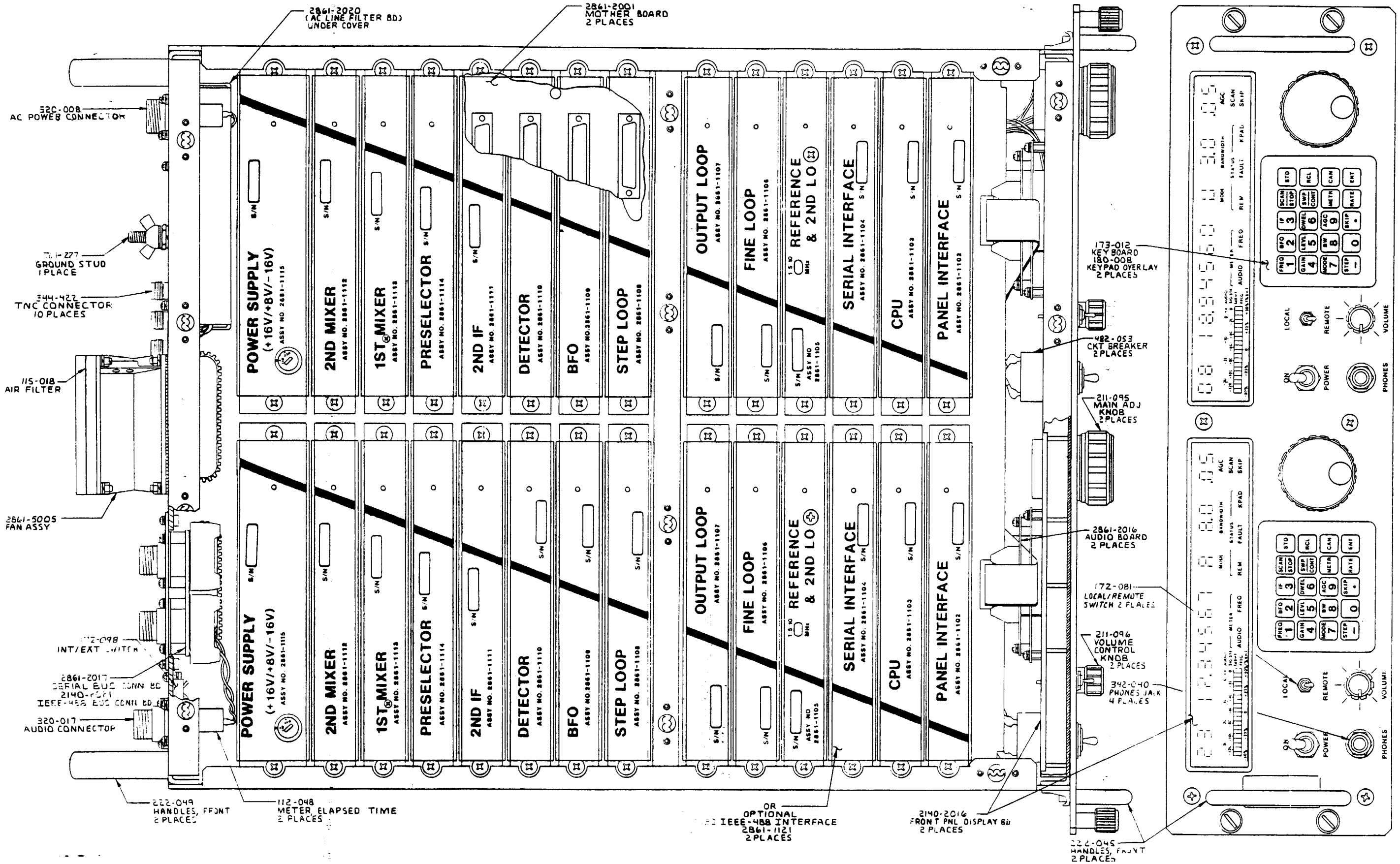
J14

FINE LOOP MOD (P2)	
PIN	DESCRIPTION
1	+16V
2	+8V
3	GND
4	SYN EN
5	FINE DATA
6	SYN CLK
7	VCO LO
8	VCO HI
9	VCO MID
10	NC
11	BFO ON/OFF
12	FAULT
13	-16V
14	TP FINE LOOP MOD
15	NC
16	NC
17	NC
18	NC
19	NC
20	NC
21	NC
22	NC
23	NC
24	NC
25	NC

J15

OUTPUT LOOP MOD (P2)	
PIN	DESCRIPTION
1	+16V
2	+8V
3	GND
4	SYN EN
5	NC
6	SYN CLK
7	VCO LO
8	VCO HI
9	VCO MID
10	COARSE TUNE
11	BFO ON/OFF
12	FAULT
13	-8V
14	TP OUTPUT LOOP MOD
15	NC
16	NC
17	NC
18	NC
19	NC
20	NC
21	NC
22	NC
23	NC
24	NC
25	NC

FO-4. R-2411/U Motherboard Schematic (Sheet 2 of 2).



FO-5. R-2411/U Replaceable Parts Locator Diagram.