EE125-CM-MMC-010/R-2412/U

NSN 0913-LP-283-7700

OPERATION AND MAINTENANCE INSTRUCTIONS

ORGANIZATIONAL

RECEIVER, DUAL
VHF - UHF
R-2412/U

Cubic Communications Incorporated
305 Airport Road
Oceanside, California 92054-1297

Telephone: (619) 757-7525 Telex: 695435 Cubicom Ocen
Telefax: (619) 433-9085

Contract No. N00612-87-C-0380

16 July 1990

LIST OF EFFECTIVE PAGES

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

NOTE: THE PORTION OF THE TEXT AFFECTED BY THE CHANGES IS INDICATED BY A VERTICAL LINE IN THE OUTER MARGIN OF THE PAGE. CHANGES TO ILLUSTRATIONS ARE INDICATED BY MINIATURE POINTING HANDS. CHANGES TO WIRING DIAGRAMS ARE INDICATED BY SHADED AREAS.

Dates of issue for original and changed pages are:

Original...0...16 July 1990

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 91 CONSISTING OF THE FOLLOWING:

Page No.	*Change No.
Title	0
A	0
i - v	0
vi Blank	0
Blank 1-0	0
1-1 - 1-6	0
2-1 - 2-6	0
3-1 - 3-28	0
4-1 - 4-9	0
4-10 Blank	0
5-1 - 5-6	0
6-1	0
6-2 Blank	0
7-1	0
7-2 Blank	0
8-1 - 8-2	0
FP-1	0
FP-2 Blank	0
FP-3	0
FP-4 Blank	0
FP-5	0
FP-6 Blank	0
FP-7	0
FP-8 Blank	0
FP-9	0
FP-10 Blank	0
FP-11	0
FP-12 Blank	0
FP-13	0
FP-14 Blank	0
FP-15	0
FP-16 Blank	0
FP-17	0
FP-18 Blank	0
FP-19	0
FP-20 Blank	0

*Zero in this column indicates an original page.

RECORD OF CHANGES

CHANGE NO.	DATE	TITLE OR BRIEF DESCRIPTION	ENTERED BY

FOREWORD

SCOPE

This manual contains information for the installer and operator to obtain best performance from the R-2412/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.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

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 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

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. Pages 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

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

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 and 2-4.

CAUTION

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

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.

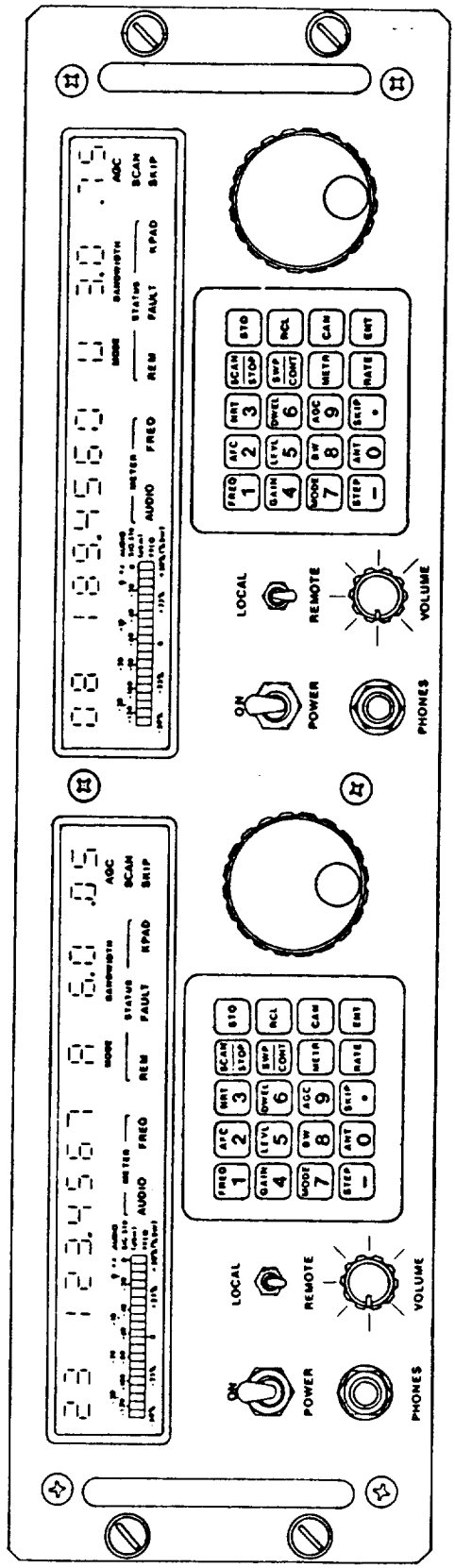


Figure 1-1. R-2412/U Receiver Front View.

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-2412/U contains two independently controlled, high performance, multi-mode, surveillance receivers (receiver A and receiver B) in a single chassis covering a frequency range from 20 to 1200 MHz.

NOTE

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

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 manually (locally) 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 (figure 2-1) allow serial connection of up to eight receivers (four R-2412/U chassis). One of the two bus cables attaching to the rear panel is hard-wired to provide a unique address for each receiver in the chassis.

If an IEEE-488 remote control bus is used, a single connector (J15) on the rear panel allows parallel connection of up to fifteen devices including the bus controller. (Each R-2412/U chassis is counted as two devices).

In manual operation, 20 button keypads select frequency, mode, 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) 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 a remote control bus. Choice of tuned frequency, mode, 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), and single sideband (SSB) signals (full carrier, reduced carrier, suppressed carrier, and frequency shift keyed).

All detector and audio signals are available as fixed level outputs on a single rear panel connector. 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. Wideband and narrow-band IF output signals at 21.4 MHz are available for analysis by other equipment on individual rear panel connectors. Table 1-1 lists the equipment specifications.

1-3 EQUIPMENT SUPPLIED AND REQUIRED.

Table 1-2 lists the items furnished and required.

1-4 STORAGE DATA.

There are no special storage requirements for the R-2412/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.

Table 1-1. R-2412/U Specifications.

Item	Specification
Frequency:	
a. Range	20 to 1200 MHz
b. Resolution	100 Hz in AM and FM modes, 10 Hz in SSB mode
c. External Std.	Input/Output: 1, 5, or 10 MHz internally selectable, 0 dBm, 50 ohms nominal.
d. Internal Std.	10 MHz with a stability of 0.2 PPM over the specified temperature range (after 10 minute warm-up).
e. Synthesizer Lock Time	5 ms typical, 15 ms worst case
Modes	
a. Selectable	LSB, USB, AM, FM
b. Coupled to mode	AM and FM Video outputs
RF Section	
a. RF Input	50 ohms, two TNC female connectors per receiver labeled Antenna 1 and Antenna 2.
b. RF Input VSWR	Less than 3:1
c. RF Protection	Withstands application of RF power up to 10 watts without damage. (Overload protection opens RF line in 1ST MIXER module at approximately 1 watt.) Protection circuit automatically resets.
d. RF Noise Figure (NF)	12 dB max below 1000 MHz, 15 dB max 1000 - 1200 MHz
e. RF Sensitivity (Measured at the Audio Output) (Below 1000 MHz)	AM (6 kHz BW/-101 dBm input), 10dB ((S+N)/N) FM (50 kHz BW/-95 dBm input) 18dB ((S+N)/N) 15 kHz deviation
f. IF Bandwidth (6)	3 kHz ±300 Hz at -6 dB; 7.5 kHz Max at -60 dB (SSB only) 6 kHz Min at -6 dB; 15 kHz Max at -60 dB (AM/FM only) 15 kHz Min at -6 dB; 37.5 kHz Max at -60 dB (AM/FM only) 50 kHz Min at -6 dB; 125 kHz Max at -60 dB (AM/FM only) 200 kHz Min at -6 dB; 1.0 MHz Max at -60 dB (AM/FM only) 1 MHz Min at -6 dB; 4 MHz Max at -60 dB (AM/FM only)
g. Pre-Selector Filters	Band — Frequency Range (MHz) 1 — 20 to 33 2 — 33 to 56 3 — 56 to 93 4 — 93 to 156 5 — 156 to 260 6 — 260 to 430 7 — 430 to 720 8 — 720 to 1200

Table 1-1. R-2412/U Specifications-CONT.

Item		Specification
AGC		
a. LSB/USB	Fast Attack	7.5 ms ±2 ms
	Decay Time	Zero 0.00 second Fast 0.20 second Medium 0.75 second Slow 2.00 seconds Off (MGC)
b. AM		Average Type .05 second
c. FM		N/A
Interference Immunity		
a. IF Rejection		100 dB minimum
b. Image Rejection		90 dB minimum
c. Spurious Responses		-120 dBm equivalent or less for -50 dBm input signals.
d. Generated Spurious		-123 dBm input equivalent or less.
e. Cross Modulation		Unmodulated wanted signal of -73 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 unwanted signal of -7 dBm spaced 100 kHz away, is less than 3 dB (15 kHz BW).
g. Inherent Local Oscillator Re-radiation		-87 dBm, worst case up to 3 GHz from receiver connection into 50 ohms.
h. Intermodulation Distortion (Out of Band)		
	Second Order Intermodulation Distortion	Intercept point +35dBm. Valid with test tones to -25 dBm.
	Third-Order Intermodulation Distortion	Intercept point +10 dbm minimum. Valid with test tones up to -20 dBm with 50 kHz signal spacing.
i. Intermodulation Distortion (In Band)		Two tones, in band, separated by 110 Hz with an input level of -10 dBm max. Intermodulation products -50 dBm min. relative to either tone.
Output Signals		
a. IF Output		WBIF: Pre-Selective 21.4 MHz, 4 MHz BW Output NBIF: Post-Selective 21.4 MHz Output
b. Audio		AM, LSB, USB: 0 ± 3 dBm over AGC dynamic range, FM: 0 ± 3dBm for deviation equal to ± 1/3 of selected bandwidth, 600 ohms balanced pair on audio connector (2 pair per assembly). Less than 5% distortion at rated output. Short circuit protected.
c. Headphones or Speaker		Dual, 0 to 12V 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.

Table 1-1. R-2412/U Specifications-CONT.

Item	Specification
d. FM Video	4V p-p max with sensitivity (Volts/kHz) selected to match selected bandwidth. Positive sense, DC coupled 93 ohm single ended output. Uses two pins on audio connector.
e. Audio 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	Two TNC females per receiver, keypad or remotely selectable. (4 per assembly)
Remote Control Bus Functions	
a. Selected Frequency	100 Hz increments AM/FM, 10 Hz increments SSB
b. Mode	LSB, USB, AM or FM
c. IF Bandwidth	AM and FM = 6 kHz, 15 kHz, 50 kHz, 200 kHz, or 1 MHz. SSB = 3 kHz fixed.
d. Gain Control	Automatic or Remote
e. AGC Decay time	0.0, 0.2, .75 or 2.0 seconds (LSB/USB modes only)
f. IF Gain	0 to -120 dB reduction min in 1 dB increments
g. Sweep/Scan functions	Setup, Start and Stop
h. Memory Channels	Storage and Recall
i. Sweep Step Size	Settable - 100 Hz to 1 MHz
j. Squelch threshold for Sweep/Scan	-120 dBm to 0 dBm (min range)
k. Dwell Time Sweep and Scan	Settable (1 to 9 seconds and indefinite)
l. Bridge Time Sweep and Scan	Settable (1 to 9 seconds and indefinite)
m. Skip Memory Flag	Settable (on or off)
n. Antenna Selection	Selectable 1 of 2
Automatic Frequency Control (AFC).	
AM and FM only	When enabled, keeps the receiver centered on the desired signal as long as the signal strength exceeds the programmed threshold level. Tracking range is ± 10 times the selected IF bandwidth. Upon loss of signal, the receiver remains tuned to the frequency of the desired signal until commanded to change, or another signal above the threshold and within the passband becomes active.

Table 1-1. R-2412/U Specifications-CONT.

Item	Specification
Noise Riding Threshold (NRT).	
AM and FM only	Measures the level of the IF background noise and activates the audio output when the operator selected threshold for that frequency or scan range is exceeded. When the NRT is enabled, the operator entered threshold is the signal-to-noise ratio that is to be exceeded by the signal before activation of the signal activity indicators. This entry is not an absolute measure of signal-to-noise ratio.
Physical Characteristics	
a. Dimensions	height: 5.219 in. depth: 20.840 in. width: 19.000 in. (Front panel) 16.800 in. (Chassis)
b. Weight	57 lb
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, 210 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
2871-1000-1	R-2412/U VHF/UHF Receiver (Serial Bus)	Furnished
2871-1000-2	R-2412/U VHF/UHF Receiver (IEEE-488 Bus)	Furnished
-	R-2412/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

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
HP8642B	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.

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.

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/BFO 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.

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 rear panel 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.* Using coaxial cables (not supplied), connect RF inputs to the ANTENNA TNC connectors J2 (antenna 1) and J3 (antenna 2) for receiver B, and J4 (antenna 1) and J5 (antenna 2) for receiver A (50 ohms nominal).

2-4.3 *Wideband IF Monitor.* The wideband IF (WBIF) signal for each receiver in the chassis is available for monitoring on the WBIF TNC connectors J6 (receiver B) and J7 (receiver A). This signal is centered at 21.4 MHz with a bandwidth of approximately 4 MHz. The signal level has approximately 18 dB gain from the input into 50 ohms.

2-4.4 *Narrow-Band IF Monitor.* The narrow-band IF (NBIF) signal for each receiver in the chassis is available for monitoring on the NBIF TNC connectors J10 (receiver B) and J11 (receiver A). This signal is centered at 21.4 MHz with a bandwidth equal to that of the selected IF filter. The signal level should be +1 dBm, $\pm$ 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 using switch S1 on the rear panel. With S1 set to the EXT position, the 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 the REFERENCE OUT TNC connector J9.

2-4.6 *Phones.* An 8 ohm speaker or headphones may be connected to the PHONES jacks J12 (receiver B) and J13 (receiver A). These jacks are wired in parallel with the front panel PHONES jacks and are controlled by the front panel VOLUME controls.

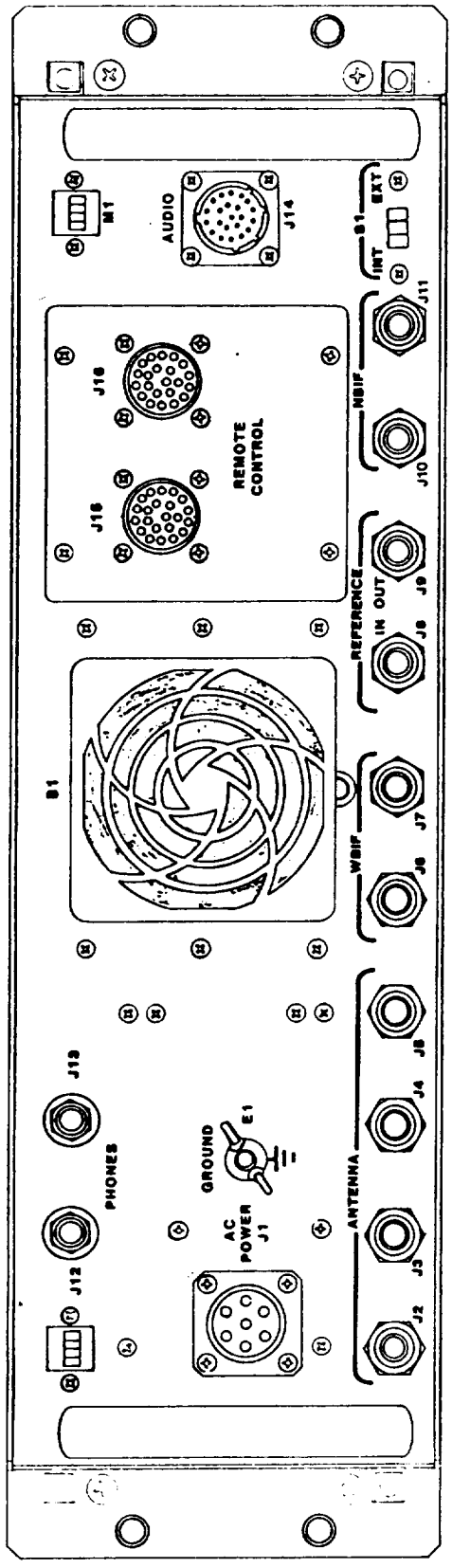


Figure 2-1. R-2412/U Rear Panel.

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.

2-4.7 *Audio.* The AUDIO connector J14 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-2412/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.

If an IEEE-488 bus is used, one remote control connector (J15) 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-2412/U chassis is counted as two devices). Each receiver in the chassis must have a unique bus address set by the keypad. Table 2-3 lists the signals on each pin of the IEEE-488 bus connector. Set the bus address as described in table 2-3.

2-4.9 *AC Power Input.*

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. 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.

NOTE

Refer to chapter 3 for operating procedures.

Table 2-1. Audio Connector (J14) 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 Connectors (J15) 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 address for each receiver in the chassis as follows:

With the receiver in LOCAL mode:

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 to keep the current address or:
8. If desired, change the IEEE-488 bus address with either the main adjustment knob or the keypad. (Range = 0 to 30).
9. Press ENT to immediately select the new IEEE-488 bus address.

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. Front Panel Controls.

Control	Function
(See figure 3-1)	
POWER Switch	Toggle type switch/circuit breaker
PHONES Jack	Headphone jack
VOLUME Control	Adjusts volume to PHONES jack
LOCAL/REMOTE Switch	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 shaft encoder on the shaft of the knob

3-2.1 *Power On and Initial Set Up.* To turn on, and initially set-up the R-2412/U, perform the following 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.

NOTE

Allow at least ten minutes for warmup at normal room temperature.

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 the CAN or ENT key on the keypad is pressed. Refer to table 3-5 for the normal state display indications.

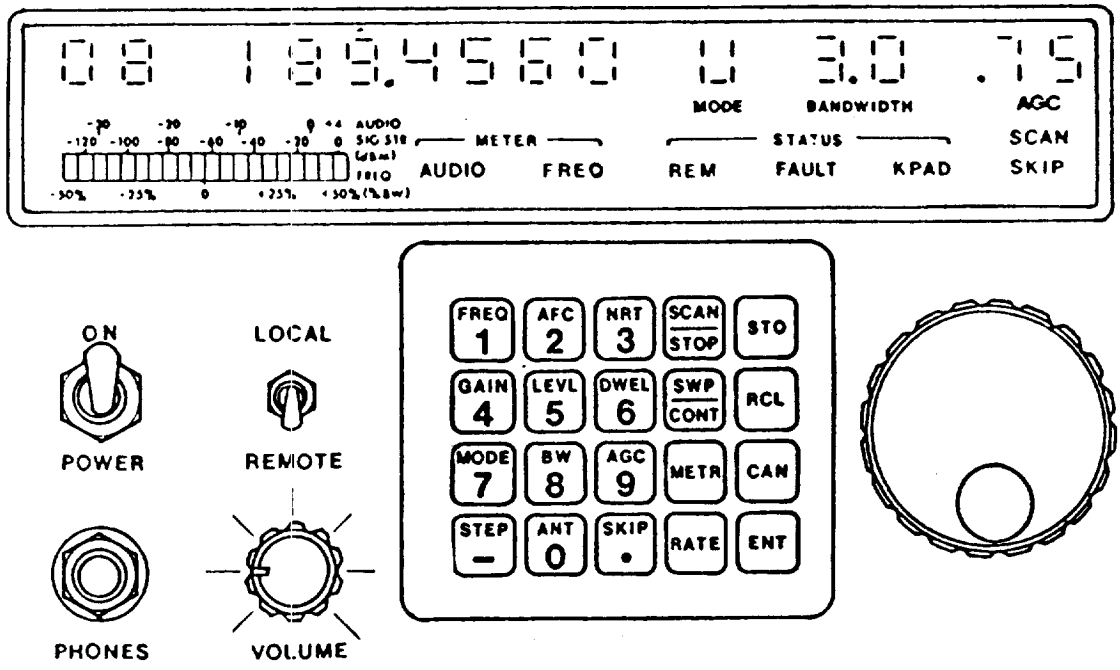


Figure 3-1. R-2412/U Front Panel Controls and Displays.

Table 3-2. Keypad Functions.

Key	Function
(See figure 3-1)	
FREQ[1] [1]	Allows frequency adjustment or numeric entry.
AFC [2]	Sequences automatic frequency control on/off in AM or FM reception modes, or numeric entry.
NRT[1] [3]	Activates noise riding threshold as the squelch source in AM or FM reception modes if the current squelch source is threshold level, or numeric entry. Allows adjustment of the NRT value using main adjustment knob, or keypad. If threshold level is the current squelch source when the NRT key is pressed, the display will be blank. If a new NRT value is selected with the keypad or main adjustment knob, the threshold level function is disabled. (Refer to "LEVL 5" below.)
SCAN STOP	SCAN: Selects scan function of 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, step size, manual gain setting, threshold level, antenna selected, squelch source, bandwidth, dwell time, bridge time, receive mode, NRT value, skip flag, and AGC decay time in designated memory channel.
GAIN[1] [4]	Allows RF gain adjustment, or numeric entry.
LEVL[1] [5]	Activates threshold level as the squelch source in all reception modes if the current squelch source is NRT, or numeric entry. Allows adjustment of the threshold level using main adjustment knob, or keypad. If NRT is the current squelch source when the LEVL key is pressed, the display will be blank. If a new threshold level is selected with the keypad or main adjustment knob in AM or FM reception modes, the NRT function is disabled. (Refer to "NRT 3" above.)
DWEL[1] [6]	Allows adjustment of length of time that the receiver will stay on channels/frequencies where signals are detected in scan/sweep function using main adjustment knob, or keypad, or numeric entry. ENT key enters selected dwell time and allows adjustment of bridge time. Additional press of numeric key enables keypad, and disables main adjustment knob. ENT key enters selected bridge time.
SWP CONT	SWP: Selects sweep function of frequencies between two selected odd and even 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 [-] or [.] keys to activate special functions.

Table 3-2. Keypad Functions-CONT.

Key	Function
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 reception modes.)
AGC [9]	Sequences AGC decay time and selects AGC off for MGC, or numeric entry. (AGC is fixed in AM and FM reception mode.)
METR	Sequences the signals to be displayed on bargraph meter.
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. Clears sweep and scan parameters.
STEP [-]	Allows setting of frequency step size for sweep function. [-] used in conjunction with special functions.
ANT[1] [0]	Allows antenna selection, or numeric entry.
SKIP[1] [.]	Alternate presses toggle the channel skip flag used during scan/sweep of memory channels, or numeric entry. [.] also used in conjunction with special functions.
RATE	Sequences main adjustment knob frequency and step tuning rate. Rate indicated by brighter digit in main display. Operates only during frequency or step entries.
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, observe the KPAD light is off. If the KPAD light is on, 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

(See figure 3-1)

Function — Two alphanumeric characters at left of display:

00 - 99 = Channel number
AF = Automatic frequency control
Ad = Remote control bus address
An = Antenna selected
bd = Serial bus baud rate
bG = Bridge time
br = Display brightness
CL = Clear
d = Dwell time
Fn = Function
Fr = Frequency
GA = Gain
L = Threshold level
LP = Serial bus line parameters
nr = Noise riding threshold
OF = Threshold offset
SE = Step frequency amount
SL = Signal level
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).

Noise Riding Threshold -- Two digits indicating the operator entered noise riding threshold. Displayed when NRT key is pressed (if selected as the squelch source).

RF Gain -- Minus sign and three digits. Indicates RF gain in dB below maximum. Displayed when GAIN key is pressed.

Level -- Minus sign and three digits. Indicates threshold level in dBm. Displayed when LEVL key is pressed (if selected as the squelch source).

Dwell Time -- One digit. Indicates length of time in seconds during scan or sweep function that the receiver will sample the signal that has exceeded the selected squelch level. Displayed when DWEL key is pressed.

Bridge Time -- One digit. Indicates length 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 such as push-to-talk (PTT) voice communications.

Table 3-3. Display Functions-CONT.

Display	Function
	Step Frequency -- Two to five digits and decimal point. Indicates frequency increment in kHz that the receiver will step during sweep function. Displayed when STEP key is pressed.
	Antenna -- One digit. Indicates selected antenna. Displayed when ANT key is pressed.
	Threshold Offset -- Plus or minus sign and three digits. Indicates the amount of threshold offset in dB (from the preset threshold level in each memory channel) that the receiver will use during sweep or scan functions.
	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 the current remote control bus address of the receiver. Displayed when special function three is selected.
	Serial Bus Baud Rate (serial bus only)-- One to five digits. Indicates serial bus baud rate. Displayed when special function four is selected.
	Serial Bus Line Parameters (serial bus only) -- Three groups of characters: Group one - two characters representing the number of data bits in one message character (7b or 8b). Group two - two characters representing the number of stop bits (1S or 2S). Group three - one character representing the parity selection (O = odd, E = even, and - = none). Displayed when special function five is selected.
	Display Brightness -- two or three digits. Displays current brightness level of main display from 1 to 100%. Displayed when special function six is selected.
MODE	Single character. Indicates the receive modes of operation: A = Amplitude modulation (AM) F = Frequency Modulation (FM) L = Lower sideband (LSB) U = Upper sideband (USB)
BANDWIDTH	Two digits and decimal point. Indicates approximate IF bandwidths as follows: LSB or USB = 3 kHz (fixed). AM or FM = 6 kHz, 15 kHz, 50 kHz, 0.2 MHz, or 1.0 MHz.
AGC	Two digits and decimal point. Indicates approximate AGC decay time in seconds as follows: AM or FM only = .05 (fixed). LSB/USB = .00, .20, .75, or 2.0. Off = manual gain control.

Table 3-3. Display Functions-CONT.

Display	Function
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 -35 to +4 dBm. Each segment of the display represents approximately 2 dB. 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 display segment represents approximately 5% of the total IF bandwidth as follows: Bandwidth / Display Segment Value 3 kHz — 150 Hz 6 kHz — 300 Hz 15 kHz — 750 Hz 50 kHz — 2.5 kHz 0.2 MHz — 10.0 kHz 1.0 MHz — 50.0 kHz 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 7 dB. When the AGC display is dark (manual gain control), the main adjustment knob is used to manually control the receiver gain after pressing the GAIN [4] key.
Annunciators:	
--METER--	AUDIO -- Lights when meter displays audio level.
	FREQ -- Lights when meter displays approximate frequency.
	(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.

Table 3-4. Preliminary Control Settings.

SIGNAL	PARAMETERS			
	MODE[1]	BANDWIDTH[2]	AGC[3]	Remarks
AM voice	AM	6 kHz	.05	
SSB voice	LSB/USB	3 kHz	2.0	
FM NB voice	FM	15 kHz	.05	Narrow-band
FM WB voice	FM	0.2 MHz	.05	Wideband
FSK NB data	FM	6 kHz	.05	Narrow-band
FSK WB data	FM	50 kHz	.05	Wideband
Pulse	AM	1.0 MHz	off	Manual gain control

[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 kHz bandwidth is automatically selected in LSB/USB receive modes.

[3]If enabled, a fixed AGC of .05 is automatically selected in AM or FM receive modes.

3-2.3.1.1 *Automatic Frequency Control (AFC).* To set or change the automatic frequency control setting in the AM or FM receive modes, perform the following:

Quick Reference: AFC (Repeat)

1. Repeatedly press the AFC [2] key.
2. Observe "AF" in function display when AFC is on and blank when the AFC is off.

3-2.3.1.2 *Automatic Gain Control (AGC).* To set or change the automatic gain control decay time setting of the receiver, perform the following:

Quick Reference: AGC (Repeat).

1. Repeatedly press the AGC [9] key.
2. Observe the AGC display change. (Sequence for SSB = .00, .20, .75, 2.0 seconds, or off). (Sequence for AM or FM = .05 second, or off). (Off = manual gain control.)
3. Press the key to select desired AGC.

3-2.3.1.3 *Antenna.* To select or change the antenna, perform the following:

Quick Reference: ANT, [#], ENT.

1. Press the ANT [0] key.
2. Observe "An" in function display, and current antenna selection in the main display.
3. To select the desired external antenna, use the main adjustment knob, or keypad.
4. Press ENT key to enter the data. (When using the keypad, the receiver does not change the antenna until the ENT key is pressed.)

3-2.3.1.4 *Bandwidth.* To set or change the bandwidth, perform the following:

Quick Reference: BW (Repeat).

NOTE

Bandwidth is fixed at 3 kHz in LSB and USB.

Table 3-5. Normal State Conditions.

Display	Conditions	
Function	Off or memory channel	
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)

1. Repeatedly press the BW [8] key.
2. Observe the BANDWIDTH display change as the bandwidth is selected. (Sequence = 6 kHz, 15 kHz, 50 kHz, 0.2 MHz, and 1.0 MHz.)

3-2.3.1.5 *Channel Data Recall.* This function recalls all previously entered receiver parameters for a selected channel. To recall a selected memory channel, perform the following:

Quick Reference: RCL, [##], NRT,* GAIN,* LEVL,* DWEL,* STEP,* ANT,* (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 the front panel display.
5. If desired, observe the main display for additional recalled channel parameters as follows: (The receiver remains set to the current parameters unless the ENT key is pressed.)

a. Press the NRT [3] key to review the NRT value. (Blank if threshold level is the squelch source.)
b. Press the GAIN [4] key to review the RF gain.
c. Press the LEVL [5] key to review the threshold level. (Blank if NRT level is the squelch source.)
d. Press the DWEL [6] key to review the dwell and bridge time.
e. Press the STEP [-] key to review the step size.
f. Press the ANT [0] key to review the antenna selection.
g. Press CAN to cancel recall of displayed data, or ENT to enter selected channel data into the receiver.

3-2.3.1.6 *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, Dwell time, Step size setting, Bridge time, Squelch source selection, Receive mode selection, Threshold level setting, Skip flag on or off, NRT value setting, AGC selection and setting, Antenna selection, Manual gain setting, and Bandwidth selection. To store parameters in a selected memory channel, perform the following:

Quick Reference: (Select each desired parameter), STO, [##].

1. Select all desired receiver parameters (frequency, mode, bandwidth, etc.) using the keypad, and/or main adjustment knob.
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 3-2.3.1.16.7.

3-2.3.1.7 *Dwell/Bridge Time Setting/Storing.* The dwell time setting is the time duration (in seconds) the receiver stays on an individual channel or frequency that has exceeded the selected squelch source (threshold level or NRT value) during the scan or sweep function. If the dwell time is set to zero, and the signal exceeds the threshold level (or NRT value), the receiver will stay on this frequency until the signal falls below the threshold.

(See figure 3-2.) The bridge time function may be used to monitor intermittent signals such as push-to-talk (PTT) voice communications. 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 or store the dwell and bridge time, perform the following:

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

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 one 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.

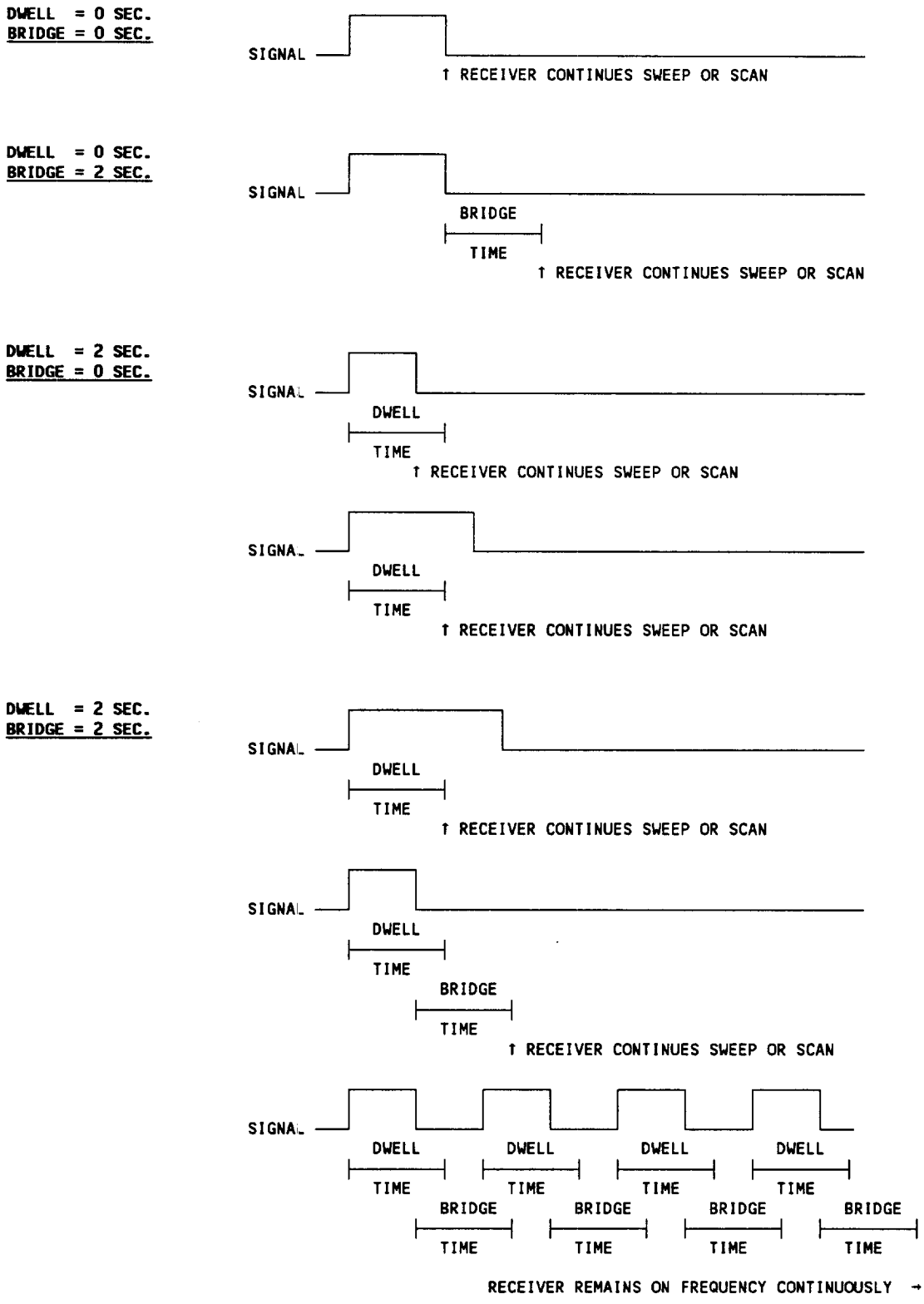


Figure 3-2. Dwell Time/Bridge Time Relationship.

3-2.3.1.8 *Frequency.* This function sets or changes the receiver frequency. To set or change the receiver frequency, perform the following:

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

NOTE

Repeatedly pressing the RATE key changes the brighter digit in the main display. The brighter digit indicates the amount of frequency that the main adjustment knob will change.

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 = 20.00000 to 1200.000 MHz.)
4. Press ENT key to enter the frequency. (When using the keypad, the receiver does not tune to the new frequency until 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:

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.

NOTE

If AGC is on and a new gain setting is entered, the AGC is automatically turned off.

3. Select manual gain in one dB steps, using the main adjustment knob, or keypad. (Range = -110 to -000 dB.)
4. Press ENT to enter the manual gain. (When using the keypad to select the manual 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 selects desired signals for meter display. The METER annunciators 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:

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. Four modes are available: Amplitude Modulation (AM), Frequency Modulation (FM), Lower Sideband (LSB), and Upper Sideband (USB). To select the desired reception mode, perform the following:

Quick Reference: MODE (Repeat).

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

3-2.3.1.12 *Noise Riding Threshold.* This function selects the noise riding threshold (NRT) as the squelch source for the receiver and can only be set in AM or FM receive modes. The NRT circuits measure the level of the IF background noise and activates the audio output only when the noise quieting exceeds the operator selected value. The NRT value 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 NRT value set in that channel. The operator entered value is the approximate signal to noise ratio that is to be exceeded by the signal before activation of the signal activity indicators. The entered value is not an absolute measure of signal to noise ratio. To activate NRT as the squelch source, and set the NRT value, perform the following:

NOTE

When NRT is selected, threshold level is deactivated as the squelch source. (Refer to paragraph 3-2.3.1.17.)

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

1. Press the NRT [3] key
2. Observe "nr" in the function display and the current NRT value in the main display.

NOTE

If the current squelch source is threshold level, the NRT value will be blank.

3. While observing the NRT in the main display, select the NRT value in one dB steps, using the main adjustment knob, or keypad. (Range = 00 to 30 dB.)
4. Press ENT to select and enter the NRT.

3-2.3.1.13 *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.

Scan is the sequential continuous recall of each memory channel. The CPU in the receiver uses the data stored in each channel to select frequency, mode, bandwidth, selected squelch source, 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 preset threshold level or NRT value 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 the 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:

NOTE

The offset function only affects channels that have threshold level as the squelch source.

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

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

1. Press RCL key.
2. Select the desired start channel using the main adjustment knob or the keypad.
3. Press ENT key.
4. Press RCL key.
5. Select the desired stop channel using the main adjustment knob, or the keypad. (Do not press ENT key.)
6. Press the SCAN/STOP 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 threshold level in each channel.)
9. Press ENT to start the scan.
10. The receiver will sequentially scan from the start channel to the stop channel continuously.

NOTE

If the skip flag is set in a particular channel in the sequence, that channel will not be a part of the scan sequence. 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 3-2.3.1.14.)

NOTE

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.

3-2.3.1.14 *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 3-2.3.1.15 to skip selected frequencies for the sweep function.)

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

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:

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

1. During scan when stopped on an unwanted channel, press the SKIP key.
2. The channel is skipped during the next and successive scans.

3-2.3.1.15 *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 stores up to 100 selected frequencies. (Also refer to paragraph 3-2.3.1.14 to skip selected channels for the scan function.) To store a selected frequency in the sweep skip memory, perform the following:

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 3-2.3.1.16.2 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. The channel is skipped during the next and successive scans.

3-2.3.1.16 *Special Functions.* Special functions are available to the operator as listed in table 3-6. Each special function is discussed in the following paragraphs:

Table 3-6. Special Functions.

Function	Description
RCL [.] 1	Software version number
RCL [.] 2	Clear skip memory
RCL [.] 3	Remote control bus address
RCL [.] 4	Serial bus baud rate (serial bus only)
RCL [.] 5	Serial bus line parameters (serial bus only)
RCL [.] 6	Display brightness
RCL [.] 7 - 0	Not used
RCL [-] 1	Input signal strength
RCL [-] 4	Front panel displays test
RCL [-] 2, 3, 5 - 0	Not used or not applicable
RCL [.] [.] 9 1 1	Clear all memory channels

3-2.3.1.16.1 *Software Version Number.* This function shows the installed software version number. To view the installed software version, perform the following:

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.

3-2.3.1.16.2 *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:

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.

3-2.3.1.16.3 *Remote Control Bus Address.* This function displays or selects the remote control bus address for the receiver. To display/select the remote control bus address perform the following:

NOTE

Only the IEEE-488 configured receiver bus address may be changed using the keypad. To change the serial bus configured receiver refer to table 2-2. Either receiver configuration may display the current bus address.

Quick Reference: RCL, [.], [3], [##]*, ENT
***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 [3] numeric key.
6. Observe Ad in function display, and receiver current address in main display.
7. Press CAN key to keep the current address or;
8. If desired, change the IEEE-488 bus address with either the main adjustment knob or the keypad. (Range = 0 to 30.)
9. Press ENT to immediately select the new IEEE-488 bus address.

3-2.3.1.16.4 *Serial Bus Baud Rate Selection.* This function displays or selects the serial bus baud rate. To display/select the serial bus baud rate, perform the following:

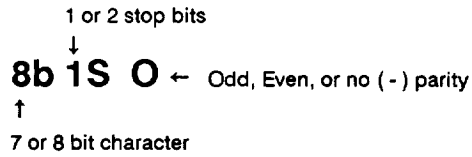
Quick Reference: RCL, [.], [4], [#####]*
(CAN/ENT). *If desired

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 the current baud rate or;
8. If desired, change the baud rate using the keypad. (Range = 8 to 125000.)
9. When correct baud rate is displayed, press ENT key or;
10. To return to previous baud rate, press CAN.

3-2.3.1.16.5 *Serial Bus Line Parameter Selection.* This function selects or displays the 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:

Quick Reference: RCL, [.], [5], STEP* ENT.
***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 or rotate the main adjustment knob.
9. Observe line parameters change in display.
10. When correct line parameters are displayed, press ENT key.

3-2.3.1.16.6 *Display Brightness.* This function displays or selects the current brightness level of the front panel displays. To display or adjust the display brightness level, perform the following:

Quick Reference: RCL, [.], [6], CAN.

1. Press RCL key.
2. Observe two dashes in function display.
3. Press SKIP [.] key.
4. Observe Fn in function display.
5. Press [6] numeric key.
6. Observe br in function display, and current display brightness level in main display.
7. If desired, change the display brightness using the main adjustment knob.
8. Observe brightness level digits change and actual brightness change in displays. (100 = most bright, 01 = least bright.)

3-2.3.1.16.7 *Input Signal Strength.* This function displays the selected antenna's input signal strength in dB. To display the input signal strength in dB, perform the following:

Quick Reference: RCL, [-], [1], ENT or CAN.

1. Press RCL key.
2. Observe two dashes in function display.
3. Press STEP [-] key.
4. Observe Fn in function display.
5. Press [1] numeric key.
6. Observe SL in function display, and current signal strength in main display. (Range 000 to -127 dB.)
7. Press ENT or CAN to return to normal state.

3-2.3.1.16.8 *Front Panel Displays Test.* This function activates all front panel displays to ensure correct operation. To activate the front panel displays, perform the following:

Quick Reference: RCL, [-], [4], ENT or CAN.

1. Press RCL key.
2. Observe two dashes in function display.
3. Press STEP [-] key.
4. Observe Fn in function display.
5. Press [4] numeric key.
6. Observe all display segments on the front panel are lit.
7. Press ENT or CAN to return to the normal state.

NOTE

Special functions RCL [.] 7, 8, 9, 0, and RCL [-] 2, 3, 5, 6, 7, 8, 9, 0 are not used or not applicable.

3-2.3.1.16.9 *Clear All Memory Channels.* This function clears all memory channels of all entered parameters and replaces the parameters as follows:

Frequency = 121.5 MHz
Dwell time = 0 sec.
Step size setting = 25.0 kHz
Bridge time = 3 sec.
Squelch source = Threshold level
Receive mode selection = AM
Threshold level setting = -127 dBm
Skip flag = off
NRT = off
AGC selection/setting = on/.05 sec
Antenna selection = 1
Manual gain setting = -000 dBm
Bandwidth selection = 6 kHz

NOTE

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

To clear all memory channels, perform the following:

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 channels sequence on main display as each channel is cleared.

3-2.3.1.17 *Squelch.* Two types of receiver squelch are available: Threshold level and NRT. To select and enter the desired squelch level values, refer to the following paragraphs:

Threshold level - paragraph 3-2.3.1.20

NRT - paragraph 3-2.3.1.12

3-2.3.1.18 *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. To select the step increment setting, perform the following:

NOTE

The step increment frequency should be stored in even numbered channels. (Refer to paragraph 3-2.3.1.19.)

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 using the main adjustment knob, or keypad. (Range = 0.1 to 1000.0 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.

NOTE

Repeatedly pressing the RATE key changes the brighter digit in the main display. The brighter digit indicates the amount of step frequency that the main adjustment knob will change.

3-2.3.1.19 *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.

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 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 expired. 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:

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.

3-2.3.1.20 *Threshold Setting.* This function selects the threshold level as the squelch source for the receiver and may be used in all receive modes. 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.

NOTE

When threshold level is selected, NRT is deactivated as the squelch source. (Refer to paragraph 3-2.3.1.17).

To activate threshold level as the squelch source, and set the threshold level, perform the following:

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 dBm.)
4. Press ENT to enter the threshold level.

3-3 REMOTE CONTROL OPERATION.

The receiver may be configured for remote control operation using either a serial bus, or IEEE-488 bus. Check the remote control connector(s) on the rear panel to determine the configuration. Either configuration must use an external bus controller (not supplied). Operation is similar for either configuration. Refer to paragraph 3-3.1 for serial bus remote control operation, and paragraph 3-3.2 for IEEE-488 bus remote control operation.

To operate in the remote mode, 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. If the front panel LOCAL/REMOTE switch is in the LOCAL position, the remote controller can not change any receiver operating parameters, but may still read receiver status messages.

NOTE

When REMOTE is selected, 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.

Refer to table 3-7 for an alphabetical list of command and reply messages used with either receiver version.

NOTE

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

3-3.1 *Serial Bus Operation.* Before remote operation with a serial bus, refer to paragraph 2-4.8 for the correct installation and address selection procedures. The baud rate, number of data bits, type of parity used, number of stop bits, and address must match the requirements of the system controller. Refer to paragraphs 3-2.3.1.16.3 through 3-2.3.1.16.5 to set in correct serial bus operating parameters.

3-3.1.1 *Serial Bus Description.* The bus conforms to EIA standard RS-232C for voltage levels. However, the bus is physically and electrically different from the RS-232C standards as described below.

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-2412/U chassis) may be connected to a single bus controller.

3-3.1.2 *Serial Bus Message Format.* All transmissions, whether from the controller to a receiver or from a receiver to the controller, 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 3-2.3.1.16 to set or change the parameters.) All characters are in ASCII code.

All messages are ASCII encoded and inserted into the data field of transmissions. Messages from the controller may use lower or upper case for all alphabetic characters. The receiver always uses upper case.

3-3.1.3 *Serial Bus Interface Messages.* Communications with the serial bus interface system is by interface command messages, and interface status messages. These messages are similar to the radio command and reply messages but are used specifically to communicate with the interface. Each interface message type is discussed in the following paragraphs:

Table 3-7. Remote Control Radio Command and Reply 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 OR FM mode, Z, S, M, or L will only select S time.
BG?	Request the current bridging status. 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. Sweep bands are numbered consecutively as follows: Band 00 = CH 00/01, band 01 = CH 02/03, band 02 = CH 04/05..... etc., band 49 = CH 98/99. Reply will be BN## during sweep. Otherwise the reply will be BN--.
BT?	Request the current bridge timer setting.
BT#	Change the bridge time. # represents a one character number to set the bridge time between signal detection during sweep or scan operation. (Range: 0 through 9)
C	Continue a stopped scan or sweep operation.
C?	Request report of all parameters that are now different from when that parameter was last reported.
CC?	Request the carrier centered status. If the received signal is centered in the IF passband (within approximately 2 percent of the IF bandwidth) the reply will be CC1. Otherwise the reply will be CC0. Note: The reply to this signal does not imply that a signal is or is not present.
CD?	Request the carrier detection status. 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. 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.
D?	Request current dwell time.

Table 3-7. Remote Control Radio Command and Reply Messages-CONT.

Message[1]	Definition
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 seconds)
DG?	Request the current dwelling status. 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.
E#	Change antenna selection. E1 = ant. no. 1, E2 = ant. no. 2.
F?	Request current frequency.
F123456789	Change receiver operating frequency. Digits 1 through 9 represent the nine digits of the receiver operating frequency with 1 representing the most significant (1 GHz) digit and 9 representing the least significant (10 Hz). (Range: 20 to 1200 MHz or F002000000 through F120000000)
FS?	Request the current fault status. 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: 0 through 110)
ID?[2]	Request receiver identification.
K	Cancel the command in progress, and clear all sweep and scan parameters
L?	Request current threshold level setting.
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: 0 through 110). Changing the level disables NRT squelch.
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, and F for FM.
N?	Request current noise riding threshold (NRT) setting. A reply of N-- indicates NRT not active.
N12	Change the NRT setting. Digits 1 and 2 represent the significant figures of the signal-to-noise ratio in dB that the signal must have to enable the audio output. The 1 represents tens of dB and 2 represents units of dB. Changing NRT disables level squelch.

Table 3-7. Remote Control Radio Command and Reply Messages-CONT.

Message[1]	Definition
O?	Request the current threshold offset.
O ± 12	Change the threshold offset used in scan or sweep operation. The + or - sign and 1 through 2 represent the offset value. 1 = 10, 2 = the unit increments in dBm. (Range: -30 through +30 dBm)
P?	Request current step size.
P12345	Change Step Size. 12345 represents the step size during sweep operation as a frequency increment with 100 hertz resolution. The 1 represents MHz units and the 5 represents the 100 Hz units. (Range: 0 through 1000.0 kHz).
Q?	Request current automatic frequency control (AFC) status.
Q#	Change the AFC function status. # represents either 1 = AFC off, or 0 = AFC on.
R?[3]	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.
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: 0 through 128).
SC##	Begin scan of memory channels. The ## represents the two digits of the highest memory channel to be scanned. The scan begins at the memory channel most recently recalled with the RC## command. (Range: 00 through 99).
SG?	SRQ trigger (IEEE-488 only) - Used to determine the cause of a previous SRQ message sent by the receiver on the bus. Reply will be SG12345678. Numbers 1 thru 8 represent one of the SRQ conditions as listed after the SM12345678 (SRQ mask) message below. Only one condition digit in the reply will be a "1" representing the condition that caused the previous SRQ message to be generated by the receiver.
SM12345678	SRQ mask (IEEE-488 only) - Controls which conditions will generate an SRQ message on the bus when they occur. Numbers 1 thru 8 represent an SRQ condition as follows: 1 Illegal value in bus message received 2 Unrecognized bus message received 3 LOCAL/REMOTE switch placed in LOCAL position 4 LOCAL/REMOTE switch placed in REMOTE position 5 Occurrence of receiver fault condition 6 Removal of receiver fault condition 7 Squelch has just opened (occurrence of signal) 8 Squelch has just closed (loss of signal)

Table 3-7. Remote Control Radio Command and Reply Messages-CONT.

Message[1]	Definition
SM12345678 Continued	A "1" in one of the message positions causes that SRQ condition to occur. A "0" in one of the positions causes that SRQ condition NOT to occur. Example: "SM00100011" - This message causes an SRQ to be generated whenever the LOCAL/REMOTE switch is set to LOCAL, and whenever a signal either opens or closes the squelch. Power up default is SM11111111 (all conditions unmasked).
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
SR12345	Change step rate from the default (30 ms per step) to up to 30 seconds. Must be in sweep or scan. 1 = tens of seconds, 2 = units of seconds, 3 = tenths of seconds, 4 = hundredths of seconds, 5 = thousandths of seconds. (Range = 00030 to 30000 ms).
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: 01 through 99 - odd channels only).
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).

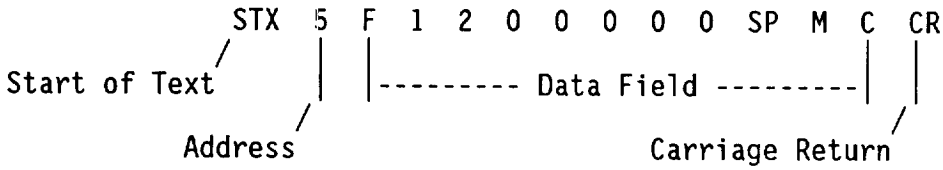
[1]All radio reply messages use the same format as the radio command message for that parameter. For example, the reply to the radio command message "L?" (current threshold level setting) is "L123." (The same format as the radio command message to change the level). When more than one parameter is being reported, the individual parameters are separated by a blank (space) character.

[2]The following represents a typical reply to the ID? command.

R-3500 Ver 2.00 01-17-89 Copyright 1989 Cubic Communications, Inc.

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

F123456789 G123 L123 W# A* M* D# P## E# O±123 S123 BT# CD# CN# CC# DG# BG# FS# BN##



NOTES:

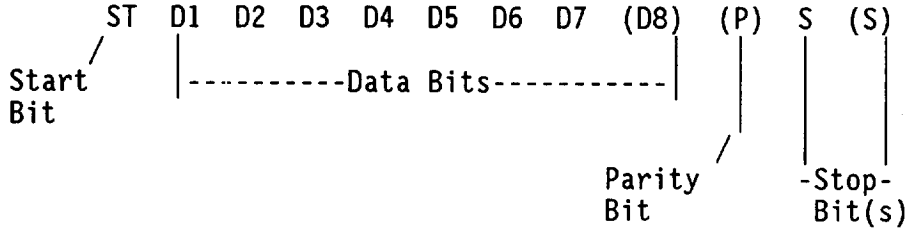
The first character of a transmission is always STX (start of text.)

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 changed from the keypad.

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

Figure 3-4. Serial Bus Character Format.

3-3.1.3.1 *Interface Command Messages.* 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 as listed in table 3-8. Each of the three modes are discussed below:

Table 3-8. Serial Bus Interface Command Messages.

Message	Definition
:ACKN	Set acknowledge interface mode
:IND1	Set independent mode 1
:IND2	Set independent mode 2
:NORM	Set normal interface mode
:?	Request interface status message

a. 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.

b. 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 (such as F?), and no errors or faults have been detected, the receiver replies with the requested 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.

c. 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. The independent mode should be used only in non-controller systems with a terminal or printer (unless the controller implements a method of handling contention). The receiver may use one of two independent sub-modes as follows:

IND1 - receiver automatically sends signal strength reply when squelch is broken. (Same as S? reply.)

IND2 - receiver automatically sends complete status message when squelch is broken. (Same as R? reply.)

3-3.1.3.1.2 *Interface Status Messages.* Interface status messages (refer to table 3-9) 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 those that request an explicit status message) with an interface status message.

Table 3-9. 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
OK:IND2	No errors, independent mode 2
RE:FALT	Radio error - fault was detected

3-3.2 *IEEE-488 Bus Operation.* Before remote operation with an IEEE-488 bus, refer to paragraph 2-4.8 for the correct installation and address selection procedures. Table 3-10 lists the IEEE-488 bus capabilities as implemented in the receiver.

3-3.2.1 *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.

Table 3-10. R-2412/U IEEE-488 Bus Capabilities.

Mnemonic	Description/Capability
SH1	Source handshake, complete capability, no states omitted
AH1	Acceptor handshake, complete capability, no states omitted
TE0	Extended talker not implemented
T6	Basic talker, serial poll, unaddressed if my listen address (MLA)
LE0	Extended listener not implemented
L4	Basic listener, unaddressed if my listen address (MLA)
SR1	Service request, complete capability, no states omitted
RL1	Remote local, complete capability, no states omitted
PP0	Parallel poll not implemented
DC1	Device clear, complete capability, program dependent
DT0	Device trigger not implemented
C0	No controller functions implemented
E2	Tri-state data bus driver

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. Only one controller may be used on the bus. 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.

The R-2412/U acts as a talker and a listener. 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 3-11.

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: Data Valid (DAV), Not Ready for Data (NRFD), and Not Data Accepted (NDAC). The DAV signal is sent by the source to indicate that the byte on the eight data lines is valid. The NRFD and NDAC signals are sent by the acceptors to indicate when they are ready for data and when they have accepted data. Table 3-12 defines the three handshake lines.

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.

Table 3-11. 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 multi-byte sequence.

Table 3-12. 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.

One 24-pin, D-type interface connector (J15) 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-2412/U chassis is counted as two devices.) Each receiver in the chassis must have a unique address set by the keypad.

3-3.2.2 *IEEE-488 Bus Listen Data Sequence.* When a receiver is addressed to listen, it accepts data from the bus. This information is used to set the operating parameters of the receiver or request status information. (Refer to table 3-7.)

All commands and replies are sent using ASCII characters. Alphabetic characters may be either upper or lower case. If multiple commands are sent to the receiver in one message, the receiver will respond with all the replies in one message. Each command must be separated from the next by one or more space characters.

3-3.2.3 *IEEE-488 Bus Talk Data Sequence.* When a radio command message requesting a reply ("?") is sent to a receiver, the receiver will format a reply and wait for the controller to address it to talk. The receiver will then respond with the requested status information. For example, if the controller sends F?, and then addresses the receiver to talk, the receiver will send the frequency reply F123456789. A timeout timer is started after the "?" command is received. If the receiver is not addressed to talk within a predetermined amount of time, the reply message is aborted and a fault generated. Once the talk address has been received, another timeout timer is started. If the entire reply message has not been accepted by the controller before the timeout, a fault will also be generated.

3-3.2.4 *IEEE-488 Bus Service Request.* A service request (SRQ) message is generated by a receiver when certain internal conditions occur. The controller can control which of these conditions will generate an SRQ by sending an SRQ mask message ("SM12345678") to the receiver. If the receiver sends an SRQ, and more than one condition is currently unmasked, the controller can request the status message ("SG?") to determine which condition triggered the previous SRQ message. Refer to table 3-7 under the "SG?" and "SM12345678" message.

Bit 7	6	5	4	3	2	1	0
NOT USED	SRQ	SWITCH IN LOCAL	SWITCH IN REMOTE	FAULT TRUE	FAULT FALSE	SQUELCH OPEN	SQUELCH CLOSED

SRQ - Indicates to the controller that receiver requests service

SWITCH IN LOCAL - LOCAL/REMOTE switch is set to LOCAL

SWITCH IN REMOTE - LOCAL/REMOTE switch is set to REMOTE

FAULT TRUE - A fault condition is present in the receiver

FAULT FALSE - No fault condition is present in the receiver

SQUELCH OPEN - A signal is present that is above the current level or NRT setting, or the level or NRT setting is at the lower limit.

SQUELCH CLOSED - No signal is present that is above the current level or NRT setting.

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

3-3.2.5 *IEEE-488 Bus Serial Poll.* The bus controller conducts a serial poll of all receivers on the bus in response to receiving an SRQ. Figure 3-5 shows the status byte message that is sent by a receiver in response to a serial poll.

3-4 EMERGENCY OPERATION.

There are no emergency operating procedures for the receiver.

CHAPTER 4

GENERAL THEORY OF OPERATION

4-1 INTRODUCTION.

This chapter contains a block diagram description of the dual receiver. Each receiver in the R-2412/U contains four functional areas:

- o Power Distribution
- o Synthesizer
- o Signal Processing
- o Control

The functional areas are discussed in the paragraphs below.

4-2 POWER DISTRIBUTION.

(See figure FO-2 sheet 2.) Each receiver in the chassis contains its own separate Power Supply module. Power from the Power Supply module is distributed to the rest of the modules through the motherboard. A separate +8V output and return line is distributed by dedicated motherboard circuit tracks to the Display board. An elapsed time meter displays the cumulative time the receiver has been powered up and is enabled by the -16V output.

4-2.1 *Power Supply Module.* Each Power Supply module is a switching regulated type that provides +17, +8 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 voltage and should be set to the 110 position. 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 to ON, input power is applied to the corresponding Power Supply module through the AC Line Filter board.

4-3 SIGNAL PROCESSING.

(See figure FO-2 sheet 1.) The signal processing section processes the incoming signal, and consists of the Antenna Select module, 1ST Mixer module, 2ND Mixer module, 3RD Mixer module, IF Filter module, Detector module, SSB module, and the Audio board. Each is discussed in the following paragraphs.

4-3.1 *Antenna Select Module.* The incoming RF signal is applied through one-of-two CPU selectable rear panel antenna connectors (ANT1 or ANT2). The signal is then applied to a low-pass and high-pass filter. The filters only pass the desired receive frequencies and prevent the 1ST LO (local oscillator) signal from being radiated back out the antenna. Overall gain through this module is approximately -2 dB.

4-3.2 *1ST Mixer Module.* The filtered RF signal enters the module where an RF detector and relay circuit protects eight preselector bandpass filters by opening the RF line if the signal level exceeds approximately one Watt.
Under CPU control, logic circuits select the desired antenna in the Antenna Select module and automatically selects the correct bandpass filter in the 1ST Mixer module for the selected receive frequency. After filtering, the signal is amplified before application to the first mixer.

The first mixer converts the output of the selected preselector filter to the first intermediate frequency (IF) of 1640 MHz. The incoming RF signal is mixed with the tunable first local oscillator (LO) frequency (1660 - 2840 MHz in 1 MHz steps) from the 1ST LO module, producing the IF. The first LO frequency is determined by the first group of four digits in the desired receive frequency ("1234".xxxx MHz). An RF amplifier at the module output provides signal gain.

A fault detector sends a fault signal to the CPU and lights the FAULT light on the 1ST Mixer module if the 1ST LO signal falls below a preset level.

Overall gain through this module is approximately 9 dB.

4-3.3 *2ND Mixer Module.* The 2ND Mixer module filters, amplifies, and converts the 1ST IF at 1640 MHz, to the 2ND IF of 160 MHz.

The 1ST IF signal enters the module where a bandpass filter allows only frequencies between 1625 and 1655 MHz to pass. An RF amplifier at the output of the filter compensates for any signal loss. The signal passes through an attenuator for gain adjustment.

The 2ND IF of 160 MHz is produced by mixing the 1ST IF at 1640 MHz with the fixed 2ND LO frequency at 1480 MHz. A fault detector sends a fault signal to the CPU and lights the FAULT light on the 2ND Mixer module if the 2ND LO signal falls below a preset level. After amplification, a bandpass filter only allows frequencies between 150 and 170 MHz to pass. Overall gain through the module is approximately +8 dB.

4-3.4 *3RD Mixer Module.* The 3RD Mixer module provides gain control, amplification, filtering, and produces the 3RD IF signal.

The 2ND IF signal at 160 MHz is coupled to a gain control stage. The stage contains PIN diode attenuator circuits that vary the signal gain using the 2ND IF GAIN CTL voltage from the Detector module.
The signal is then mixed with the tunable 3RD LO frequency (180.4 - 181.4 MHz in 100 Hz steps) producing the 3RD IF. The 3RD LO frequency is determined by the second group of four digits in the desired receive frequency (xxxx."5678" MHz).

After amplification, a bandpass filter allows only frequencies between 19.4 and 23.4 MHz to pass. The signal is amplified again and applied to a splitter circuit. The signal is distributed to the WBIF (wideband IF) jack on the rear panel for external monitoring and to the IF Filter module for processing.

A fault detector sends a fault signal to the CPU and lights the FAULT light on the 3RD Mixer module if the 3RD LO signal falls below a preset level.

Overall gain through this module is approximately +4 dB.

4-3.5 *IF Filter Module.* The IF Filter module amplifies and filters the 3RD IF signal. After amplification, the signal is applied to an attenuator. The attenuator is used for impedance matching and reduction of intermodulation distortion.

Serial data from the CPU is clocked and latched into a shift register selecting the desired bandpass filter. The serial data is also shifted through this register to the Antenna Select, 1ST Mixer and SSB modules. When USB or LSB is selected the 6 kHz filter is automatically selected. The 4TH LO and BFO signals are automatically adjusted in frequency to place the 6 kHz filter as required with respect to the desired signal.

After passing through the selected filter, the signal is amplified, split, and applied to the Detector and SSB modules for detection. Overall gain through the module is approximately +16 dB.

4-3.6 *Detector Module.* The Detector module demodulates the 3RD IF signal in AM and FM receive modes, provides gain control voltages, and provides signal strength voltages for the front panel meter.

The MODE SELECT logic signals from the CPU (through the shift register in the SSB module) control three sets of switches in the Detector module. Each switch selects the correct signal output for the selected receive mode as follows:

(1) Video Select Switch - selects the correct detector output (AM or FM) for amplification and application to the VIDEO OUT jack on the rear panel.
(2) Gain Control Select/Audio Select Switch - a dual switch that selects the correct gain control voltage (AM or SSB) for control of the 2ND IF signal, and the correct audio output for amplification and output to the Audio board.
(3) Signal Strength Select Switch - selects the correct automatic gain control (AGC) voltage (AM or SSB) to develop the analog signal strength signal to the rear panel.

The AGC EN signal from the CPU (through the shift register in the SSB module) selects either manual gain control (MGC) or automatic gain control (AGC). The MGC voltage from the CPU provides either local (front panel) or remote manual gain control. When MGC is selected, the output should be monitored and periodic adjustments made to keep the signal amplitude in the middle of the detector's output range (Front panel signal strength meter to mid-scale). The 3RD IF signal is applied to each detector circuit as described in the following subparagraphs.

4-3.6.1 *Envelope Detector.* Amplitude modulated (AM) and pulse type signals are demodulated in the envelope detector. The 3RD IF signal enters the Detector module where the signal is sent to a gain control stage. The stage contains PIN diode attenuator circuits that vary the signal gain using the same gain control voltage used to control the gain of the 2ND IF. The signal is amplified and sent to another RF amplifier as the narrow-band IF (NBIF) signal available on the rear panel for monitoring.

The envelope detector produces a video signal which is applied to the AM input of the video select switch. When the AM receive mode is selected, the output of the envelope detector is applied to a gain control circuit. The gain of the video signal is controlled by the AM/FM LEVEL CONTROL signal from the CPU.

The video signal is amplified and applied to the VIDEO OUT jack on the rear panel for monitoring. The video signal is also applied to a capacitor that detects the audio component of the signal. When the AM receive mode is selected, the audio signal passes through a low-pass filter allowing only signals below 4 kHz to pass. The audio signal is amplified and applied to the Audio board as the DET AUDIO signal.

The envelope detector's output is also applied to a low-pass filter. This circuit derives the AGC voltage in both the AM and FM receive modes. When AGC is selected, the AGC voltage is used by the gain control circuits in the Detector and 3RD Mixer modules. The AGC DUMP logic signal from the CPU resets the AGC voltage during frequency changes when sweeping or scanning. This ensures that a false signal is not immediately sensed.

4-3.6.2 *Narrow-band FM Detector.* Narrow-band FM signals are demodulated by the NBFM detector. When the bandwidth is set to 50 Khz or below in the FM receive mode, the output of the NBFM detector is automatically selected.

The 3RD IF signal enters the Detector module where the signal is amplified, amplitude limited, and applied to both FM detectors circuits. The signal is detected in the NBFM detector producing a video signal. The signal is applied to the NBIF and SSB inputs of the video select switch, and directly to the Audio board as the NB FM MUX (multiplex) signal.

The video select switch is controlled by the MODE SELECT signals from the CPU (through the shift register in the SSB module). When FM (with 50 kHz or below bandwidth) or SSB is selected, the NBIF signal is applied to a gain control circuit. The gain of the video signal is controlled by the AM/FM LEVEL CONTROL signal from the CPU. The video signal is amplified and applied to the VIDEO OUT jack on the rear panel for monitoring.

The video signal is also applied to a capacitor that detects the audio component of the signal. When the NBFM detector is used, the audio signal passes through a 750 microsecond delay circuit that de-emphasizes the high frequency components of the audio signal.

The signal is then applied to the NBFM input of the audio select switch. The audio select switch is also controlled by the MODE SELECT signals from the CPU (through the shift register in the SSB module). When FM (with 50 kHz or below bandwidth) is selected, the NBFM audio signal is applied to an audio amplifier. The audio signal is amplified and applied to the Audio board as the DET AUDIO signal.

4-3.6.3 *Wideband FM Detector.* Wideband frequency modulated (WBFM) signals are demodulated by the WBFM detector. When the bandwidth is set to .02 or 1.0 MHz in the FM receive mode, the output of the WBFM detector is automatically selected.

The 3RD IF signal enters the Detector module where the signal is amplified and amplitude limited before application to the WBFM detector. The signal is detected in the WBFM detector producing a video signal. The signal is applied to the WBIF input of the video select switch, and directly to the Audio board as the WB FM MUX signal. A 21.5 kHz band-pass filter provides the NOISE MUX signal used for noise riding threshold (NRT) to the Audio board.

The video select switch is controlled by the MODE SELECT signals from the CPU (through the shift register in the SSB module). When FM (with .02 or 1.0 MHz bandwidth) is selected, the WBIF signal is applied to a gain control circuit. The gain of the video signal is controlled by the AM/FM LEVEL CONTROL signal from the CPU. The video signal is amplified and applied to the VIDEO OUT jack on the rear panel for monitoring.

The video signal is also applied to a capacitor that detects the audio component of the signal. When the WBFM detector is used, the audio signal passes through a 75 microsecond delay circuit that de-emphasizes the high frequency components of the audio signal.

The signal is then applied to the WBFM input of the audio select switch. The audio select switch is also controlled by the MODE SELECT signals from the CPU (through the shift register in the SSB module). When FM (with .02 or 1.0 MHz bandwidth) is selected, the WBFM audio signal is applied to an audio amplifier. The audio signal is amplified and applied to the Audio board as the DET AUDIO signal.

4-3.7 *Single Sideband (SSB) Module.* Suppressed and reduced carrier signals are demodulated in the SSB module. The 3RD IF signal at 21.4 MHz enters the module and is mixed with the 4TH LO signal developing the 4TH (SSB) IF. The 4TH LO signal is shifted in frequency depending if LSB or USB is selected. A fault detector sends a fault signal to the CPU and lights the FAULT light on the SSB module if the 4TH LO signal falls below a preset level. The output of the fourth mixer is amplified and sent to a bandpass filter. The frequency of the signal through the filter is 455 kHz.

The signal is then sent to a gain control stage (AGC ATTN). The stage contains PIN diode attenuator circuits that vary the signal gain using the AGC voltage from the peak detector or MGC voltage from the CPU. The AGC EN signal from the CPU (through the shift register) selects either MGC or AGC. The MGC voltage from the CPU provides either local (front panel) or remote manual gain control. When MGC is used, the output should be monitored and periodic adjustments made to keep the signal amplitude in the middle of the detector's output range (Front panel meter to mid-scale).

The output from the AGC ATTN stage is amplified and applied to the peak and product detectors. The peak detector is used to derive the AGC voltage in SSB receive modes only. This voltage is used by the gain control circuits in the SSB and 3RD Mixer module. AGC DECAY logic signals from the CPU (through the shift register) control the decay time of the AGC control voltage. The AGC DUMP logic signal from the CPU resets the AGC voltage during frequency changes or when the AGC decay time is changed from slow to fast. This ensures that a false signal is not immediately sensed. The output of the peak detector is also sent to the signal strength select switch in the Detector module and the meter select switch on the Audio board.

The product detector mixes the 4TH IF signal with the BFO signal. The BFO signal is substituted for the suppressed carrier frequency and is shifted in frequency depending if the LSB or USB receive modes are selected. The resultant audio signal is passed by a low-pass filter and sent to the Detector module for selection by the logic circuits. A fault detector sends a fault signal to the CPU and lights the FAULT light on the SSB module if the BFO signal falls below a preset level.

Serial data from the CPU is clocked and latched into a shift register (through the shift register in the IF Filter module). This register distributes the following control data:

(1) FAULT DET DISABLE - disables the SSB fault detection circuits in AM or FM modes.
(2) AGC DECAY time - two logic signals that select one of the available SSB AGC decay times.
(3) MODE SELECT - two logic signals that select one of the receive modes of operation.
(4) AGC EN - selects either automatic or manual gain control.
(5) BFO/4TH LO ON/OFF - enables the BFO and 4TH LO signals in SSB receive mode.

4-3.8 *Audio Board.* The Audio board amplifies and detects the selected audio signals. The DET AUDIO signal from the Detector module is applied to one contact of the squelch switch. The squelch switch is controlled by the CPU (through the Panel Interface module) to inhibit the audio outputs when the signal level does not exceed the operator selected value. Either threshold level or NRT type squelch may be selected by the operator as a software function.

The DET AUDIO signal is amplified and transformer coupled to the 600 OHM LINE AUDIO jack on the rear panel. The signal is also sent to the front panel volume control, amplified, and then sent to the PHONES jacks.

The A/D MUX data signals from the CPU (through the Panel Interface module) control the A/D select switch. The multiplexed outputs of the switch are amplified and sent to the A/D converter in the CPU. The signals are described as follows:

AM/FM SIG STR - Analog voltage converted to digital by the CPU Module to drive the front panel digital meter. AM or FM receive mode must be selected and both meter annunciators must be off (RF signal strength selected).

DET AUDIO - Analog voltage converted to digital by the CPU Module to drive the front panel digital meter. Any receive mode may be selected and the AUDIO annunciator must be on.

NOISE MUX - Analog voltage converted to digital by the CPU Module as the NRT noise reference.

NB FM MUX - Analog voltage converted to digital by the CPU Module for automatic frequency control (AFC). Also used to drive the front panel digital meter when FREQ annunciator is on. Only used in FM receive mode with a bandwidth of 50 kHz or below.

WB FM MUX - Analog voltage converted to digital by the CPU Module for automatic frequency control (AFC). Also used to drive the front panel digital meter when FREQ annunciator is on. Only used in FM receive mode with a bandwidth above 50 kHz.

SSB SIG STR - Analog voltage converted to digital by the CPU Module to drive the front panel digital meter. USB or LSB receive mode must be selected and both meter annunciators must be off (RF signal strength selected).

4-4 SYNTHESIZER.

(See figure FO-2 sheet 2.) The synthesizer section produces the specific frequencies used for signal frequency conversion. Synthesizer modules include the 1ST LO, 2ND LO, 3RD LO, 4TH LO, and the Reference/BFO modules. Each module uses phase-locked loop (PLL) circuits and are discussed in the following paragraphs.

4-4.1 *1ST LO Module.* This module provides the 1ST LO signal to the first mixer. The module contains a CPU controlled voltage controlled oscillator (VCO) operating between 1660 and 2840 MHz in 1 MHz steps.

The LO1/LO2 serial data containing the frequency information from the CPU is clocked through a shift register using the CLK signal. The data is also clocked into a synthesizer control integrated circuit through the shift register. At the correct time, the LO1/LO2 data is latched into each device by the PRI EN signal.

The VCO frequency is controlled by phase locking the output to an integer multiple of the reference frequency. The synthesizer control circuit uses the 10 MHz reference frequency (supplied through the 2ND LO module) to produce an internal reference frequency. The VCO output frequency is divided to produce a corresponding frequency representing the actual VCO frequency.

The divided VCO frequency and the divided reference frequency are phase compared in the synthesizer control circuit. The synthesizer control circuit develops a correction DC control voltage, keeping the selected VCO on frequency. A loop filter switch, containing four selectable filters, provides loop bandwidth correction. The correct filter is automatically selected depending on the frequency of the loop. If the loop loses phase lock, a fault detector circuit lights the FAULT light and sends a fault signal to the CPU.

Voltage regulators provide the necessary internal voltages for the module. The +55V is also used by the 2ND LO module.

4-4.2 *2ND LO Module.* This module provides the 2ND LO signal to the second mixer. The module contains a CPU controlled VCO operating at a fixed frequency of 2960 MHz.

The LO1/LO2 serial data containing the frequency information from the CPU is clocked into the synthesizer control integrated circuit using the CLK signal. At the correct time, the LO1/LO2 data is latched in by the SEC EN signal.

The VCO frequency is controlled by phase locking the output to an integer multiple of the reference frequency. The reference frequency enters the module where it is amplified and applied to the synthesizer control circuit. The reference frequency is also sent back out of the module and applied to the 1ST LO module. The synthesizer control circuit uses the 10 MHz reference frequency to produce an internal reference frequency. The VCO output frequency is divided to produce a corresponding frequency representing the actual VCO frequency.

The divided VCO frequency and the divided reference frequency are phase compared in the synthesizer control circuit. The synthesizer control circuit develops a correction DC control voltage, keeping the selected VCO on frequency. The VCO output is divided by two, amplified, and filtered to provide the 2ND LO output frequency at 1480 MHz. If the loop loses phase lock, a fault detector circuit lights the FAULT light and sends a fault signal to the CPU.

Voltage regulators provide the necessary internal voltages for the module.

4-4.3 *3RD LO Module.* This module provides the 3RD LO signal to the third mixer. The module contains three CPU controlled VCOs and produces an output frequency of 180.4 to 181.4 MHz in 100 Hz steps.

The 3RD LO FINE and 3RD LO COARSE serial data containing the frequency information from the CPU is clocked into the fine and coarse loop synthesizer control integrated circuits using the CLK signal. At the correct time, the data is latched into each device by the PRI EN signal.

The main loop (output) VCO frequency is controlled by phase locking the output to the sum of the coarse loop frequency (175.4 - 176.4 MHz) and the fine loop frequency (500 - 510 MHz). The fine loop frequency is divided by 100 to provide a frequency of 5.0 to 5.1 MHz.

The coarse and fine loops are phase locked to an integer multiple of the reference frequency. The reference frequency (supplied through the 4TH LO module) enters the module where it is amplified and applied to both synthesizer control circuits. Each synthesizer control circuit uses the 10 MHz reference signal to produce internal reference frequencies.

The outputs of the coarse and fine VCOs are divided to produce corresponding frequencies representing the actual frequency of each VCO. The divided VCO frequencies and the internal reference frequencies are phase compared in the synthesizer control circuits. Each synthesizer control circuit develops a correction DC control voltage, keeping the coarse and fine loop VCOs on frequency.

The output frequency of the coarse loop VCO is mixed with the output frequency of the main loop. The resultant frequency is filtered, amplified, and applied to one input of a phase detector. The other input to the phase detector is the fine loop frequency divided by 100. The two frequencies are phase compared developing a fine control voltage that keeps the main loop VCO on the correct frequency.

One output of the main loop VCO is amplified and applied to a mixer closing the main loop. The other output is sent out of the module as the 3RD LO signal. If any of the three loops lose phase lock, a fault detector circuit lights the FAULT light and sends a fault signal to the CPU.

Voltage regulators provide the necessary internal voltages for the module.

4-4.4 *4TH LO Module.* This module provides the 4TH LO signal to the fourth mixer in either LSB or USB receive mode. The module contains three CPU controlled VCOs and produces an output frequency between 20.94 and 20.95 MHz in 10 Hz steps.

The 4TH LO FINE and 4TH LO COARSE serial data containing the frequency information from the CPU is clocked into the fine and coarse loop synthesizer control circuits using the CLK signal. At the correct time, the data is latched into each device by the PRI EN signal.

The main loop (output) VCO frequency is controlled by phase locking the output to the sum of the fixed coarse loop frequency (204.4 MHz) and the fine loop frequency (500 - 510 MHz). The fine loop frequency is divided by 100 to provide a frequency between 5.0 and 5.1 MHz.

The coarse and fine loops are phase locked to an integer multiple of the reference frequency. The reference frequency enters the module where it is amplified and applied to both synthesizer control circuits. The 10 MHz reference frequency is also sent out of the module and applied to the 3RD LO module. Each synthesizer control circuit uses the 10 MHz reference signal to produce internal reference frequencies.

The outputs of the coarse and fine VCOs are divided to produce corresponding frequencies representing the actual frequencies of the VCO. The divided VCO frequencies and the internal reference frequencies are phase compared in the synthesizer control circuits. Each synthesizer control circuit develops a correction DC control voltage, keeping the coarse and fine loop VCOs on frequency. Loop filters are used to filter AC components from the DC correction voltage.

The output frequency of the coarse loop VCO is mixed with the output frequency of the main loop. The resultant frequency is filtered, amplified, and applied to one input of a phase detector. The other input to the phase detector is the fine loop frequency divided by 100. The two frequencies are phase compared developing a fine control voltage that keeps the main loop VCO on the correct frequency.

One output of the main loop VCO is amplified and applied to a mixer closing the main loop. The other output is divided by 10 and sent out of the module as the 4TH LO signal. The 4TH LO output is only enabled in SSB receive modes (by the CPU through the

shift register in the SSB module). If any of the three loops lose phase lock, a fault detector circuit lights the FAULT light and sends a fault signal to the CPU. Voltage regulators provide the necessary internal voltages for the module.

4-4.5 *Reference/BFO Module.* The Reference/BFO module provides the 10 MHz reference signal to the four LO modules and the internal beat frequency oscillator (BFO) circuits. It also provides the variable BFO signal to the Detector module used to develop an audio signal from suppressed carrier transmissions. The reference and BFO sections are discussed separately in the following paragraphs.

4-4.5.1 *Reference Signal.* The 10 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 oven controlled crystal oscillator (OCXO) produces the internally generated 10 MHz 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 10 MHz reference frequency. The 10 MHz output is sent to a splitter circuit for application to the 2ND and 4TH LO modules and the internal BFO circuits. The 10 MHz is then cabled from the 2ND LO module to the 1ST LO module, and from the 4TH LO module to the 3RD LO module. A fault detector (also used by the BFO circuits) sends a fault signal to the CPU and lights the FAULT light on the module if the 10 MHz reference signal falls below a preset level.

4-4.5.2 *BFO Signal.* The BFO frequency is generated by a VCO with a frequency range between 45.32 and 45.68 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 PRI EN logic signal.

The VCO output is divided by 100 to generate fixed BFO frequencies of 453.2 (USB) and 456.8 kHz (LSB). When enabled by the BFO/4TH LO ON/OFF signal from the CPU, the BFO signal is applied to the product detector in the Detector/Audio module for use when the USB or LSB reception modes are selected.

The VCO frequency is controlled by phase locking the output to an integer multiple of the reference frequency. A synthesizer control circuit uses the 10 MHz reference frequency to produce an internal reference frequency. The VCO output frequency is divided to produce a corresponding frequency representing the actual VCO frequency.

The divided VCO frequency and the divided internal 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 and lights the FAULT light on the module if the BFO loop loses lock.

4-5 CONTROL.

The control section of the receiver performs the following functions: interface to the remote control bus, synthesizer control, antenna selection, receiver band and bandwidth selection, AGC/MGC selection, detector selection, fault detection, front panel control interpretation, channel parameter storage, and front panel display control.

The control section includes the optional bus connector board, optional CPU module, Panel Interface module, Front Panel Display board, and front panel controls. Each is discussed in the paragraphs below.

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 CPU/Remote module and the Serial Bus Connector board. Each is described in the following subparagraphs.

4-5.1.1 *CPU/Remote Module.* The optional CPU/Remote module controls all receiver functions using resident software and data from the front panel controls or the remote control bus. The CPU/Remote module consists of two functional sections as follows:

a. CPU

The CPU section contains: (1) The microprocessor, (2) Erasable programmable read-only memory (EPROM) containing the software program, (3) Random access memory (RAM) used for temporary registers and calculations, (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, squelch, AFC, NRT, and signal strength reporting, (5) The digital-to-analog (D/A) converter providing remote or manual gain control and AM/FM level control, (6) The output ports providing data to the modules, and (7) A Control/Data bus connecting all devices.

b. Remote control section

The remote control section of the module contains the remote interface controller to convert serial data from the serial bus to parallel data for the microprocessor. It also converts the parallel data from the microprocessor to serial data for the serial bus.

4-5.1.1.1 *Data Flow.* The CPU/Remote module accepts control and data information directly from the Panel Interface module or the Serial Bus Connector board, 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/Remote module. Under resident software control, the microprocessor sends the correct control logic signals to the output ports, the D/A converter, and the Panel Interface module.

4-5.1.1.2 *Input/Output.* The output ports provide the data outputs to the other receiver modules. Outputs include:

LO DATA and BFO DATA for synthesizer frequency control.

SIGNAL CTL DATA to select: the desired antenna, the preselector filter, IF filter, AGC decay, receive mode, the SSB module fault detector disable when in the AM or FM receive mode, and AGC or MGC.

AGC DUMP to reset the AGC during frequency changes.

CLK to clock each serial data bit into the modules.

PRI and SEC EN signals to latch data into the modules at the correct time.

The D/A converter provides the manual gain control voltage to the SSB and Detector Modules, and the AM/FM level control voltage to the Detector Module.

The A/D converter accepts analog voltages from the Detector module through the Audio module. Through the A/D converter the CPU can read AGC voltage (SIG STR), audio output level, noise voltage, and frequency error voltage.

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

4-5.1.2 *Serial Bus Connector Board.* The optional Serial Bus Connector board is common to both receivers in the chassis. The board provides signal level conversion and data buffering between the CPU/Remote module and the external remote control bus. 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 CPU/IEEE-488 module and the IEEE-488 Bus Connector board. Each is described in the following paragraphs.

4-5.2.1 *CPU/IEEE-488 Module.* The optional CPU/IEEE-488 module controls all receiver functions using resident software and data from the front panel controls or the remote control bus. The CPU/IEEE-488 module consists of two functional sections as follows:

a. CPU

The CPU section contains: (1) The microprocessor, (2) Erasable programmable read-only memory (EPROM) containing the software program, (3) Random access memory (RAM) used for temporary registers and calculations, (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, squelch, AFC, NRT, and signal strength reporting, (5) The digital-to-analog (D/A) converter providing remote or manual gain control and AM/FM level control, (6) The output ports providing data to the modules, and (7) A Control/Data bus connecting all devices.

b. Remote control section

The remote control section of the module handles all handshaking on the bus without disturbing the operation of the CPU.

4-5.2.1.1 *Data Flow.* The CPU/IEEE-488 module accepts control and data information directly from the Panel Interface module or the IEEE-488 Bus Connector board, 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/IEEE-488 module. Under resident software control, the microprocessor sends the correct control logic signals to the output ports, the D/A converter, and the Panel Interface module.

4-5.2.1.2 *Input/Output.* The output ports provide the data outputs to the other receiver modules. Outputs include:

LO DATA and BFO DATA for synthesizer frequency control.

SIGNAL CTL DATA to select: the desired antenna, the preselector filter, IF filter, AGC decay, receive mode, the SSB module fault detector disable when in the AM or FM receive mode, and AGC or MGC.

AGC DUMP to reset the AGC during frequency changes.

CLK to clock each serial data bit into the modules.

PRI and SEC EN signals to latch data into the modules at the correct time.

The D/A converter provides the manual gain control voltage to the SSB and Detector Modules, and the AM/FM level control voltage to the Detector Module.

The A/D converter accepts analog voltages from the Detector module through the Audio module. Through the A/D converter the CPU can read AGC voltage (SIG STR), audio output level, noise voltage, and frequency error voltage.

All module fault signals are detected by the CPU/IEEE-488 module. When a fault is detected, the microprocessor signals the external bus controller over the remote control bus, and sends a signal to the Display board to light the front panel FAULT light.

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

4-5.3 *Panel Interface Module.* The Panel Interface module provides buffering and data exchange between the CPU and the front panel of the receiver. It contains: (1) the display interface to operate the front panel displays, (2) Front panel input circuits for the keypad, main adjustment knob shaft encoder, and LOCAL/REMOTE switch input, (3) The output ports to control the audio outputs, (4) The non-volatile channel memory to store channel parameters and other parameters.

4-5.4 *Front Panel Display Board.* The Front Panel Display board contains light display elements plus the digit and segment select drivers.

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.
4. 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.

5. Connect a coaxial test cable from a frequency counter to the REFERENCE OUT connector J9 on the receiver rear panel.
6. 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.

7. Turn on receiver under test. Allow at least 10 minutes for warm-up before taking frequency reading.
8. Verify frequency counter reading is 10 MHz ± 2 Hz.
9. Repeat steps 5 through 8 for other receiver.
10. Turn off receiver power.
11. Disconnect test equipment. If J9 was originally connected, reconnect to original configuration.
12. Set S1 on receiver rear panel to its original position.
13. Slide receiver chassis drawer in and tighten holding screws.
14. 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 750.126 MHz at -110 dBm.
6. Set multimeter to measure voltage and connect multimeter to the 600 ohm audio output, J14 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 750.125 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-2412/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.* The modules with fault detectors are: Power Supply, 1ST Mixer, 2ND Mixer, 3RD Mixer, SSB, 1ST LO, 2ND LO, 3RD LO, 4TH LO, Reference/BFO, and CPU.

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: IF FILTER module, DETECTOR module, Audio board, PANEL INTERFACE module, Display board, Bus Connector board, Motherboard, and AC Line Filter board. A failure of the receiver at all frequencies, bandwidths, and selected attenuation could be caused by a failure in any of the above. 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 wide-band IF, narrow-band 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 procedures:

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	1ST MIXER
2ND MIXER	Loss of 2ND LO	2ND MIXER
3RD MIXER	Loss of 3RD LO	3RD MIXER
SSB	Loss of 4TH LO	REF/BFO, SSB
1ST LO	Loss of phase lock	2ND LO
2ND LO	Loss of phase lock	-
3RD LO	Loss of phase lock	4TH LO
4TH LO	Loss of phase lock	-
REF/BFO	Loss of Ref freq or BFO	Ext reference frequency
CPU/REMOTE	Internal fault	Bus Connector Board
POWER SUPPLY	Wrong voltage/current	Any module

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

Fault Lights On	Suspect Module
1ST MIXER and 1ST LO	1ST LO
2ND MIXER and 2ND LO	2ND LO
3RD MIXER and 3RD LO	3RD LO
1ST LO, 2ND LO, 3RD LO, 4TH LO, 2ND MIXER, REF/BFO, (SSB)	REF/BFO or external freq. standard
1ST MIXER, 2ND MIXER, 1ST LO, 2ND LO	1ST LO

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/REMOTE, POWER SUPPLY
Inoperative on one band	1ST MIXER, CPU/REMOTE
Inoperative on one bandwidth	IF FILTER, CPU/REMOTE
Inoperative on one mode	DETECTOR, CPU/REMOTE
Meter inoperative	DETECTOR, CPU/REMOTE, Panel Interface, Audio Board
No audio output only	DETECTOR, Audio Board
No detector output only	DETECTOR
No IF outputs only	DETECTOR, 3RD MIXER

Table 5-4. Typical Rear Panel Monitor Signals.

Freq	Signal In Ant	Test Point[1]	Correct Observation[2]	Suspect Module If Not Correct
30 MHz	-10 to -100 dBm	NBIF MON	21.4 MHz 800 mV p-p (+1 dB ±3 dBm)	1ST MIXER, 1ST LO, 2ND MIXER, 2ND LO, 3RD MIXER, 3RD LO, IF FILTER
30 MHz	-20 dBm	NBIF MON	21.4 MHz 620 mV p-p (gain 20 dB ±3 dB)	1ST MIXER, 1ST LO, 2ND MIXER, 2ND LO, 3RD MIXER, 3RD LO

[1]Test points terminated with 50 ohms.

[2]All levels measured with receiver in AM mode, 6 kHz bandwidth.

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°F (-62 to +71°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.)

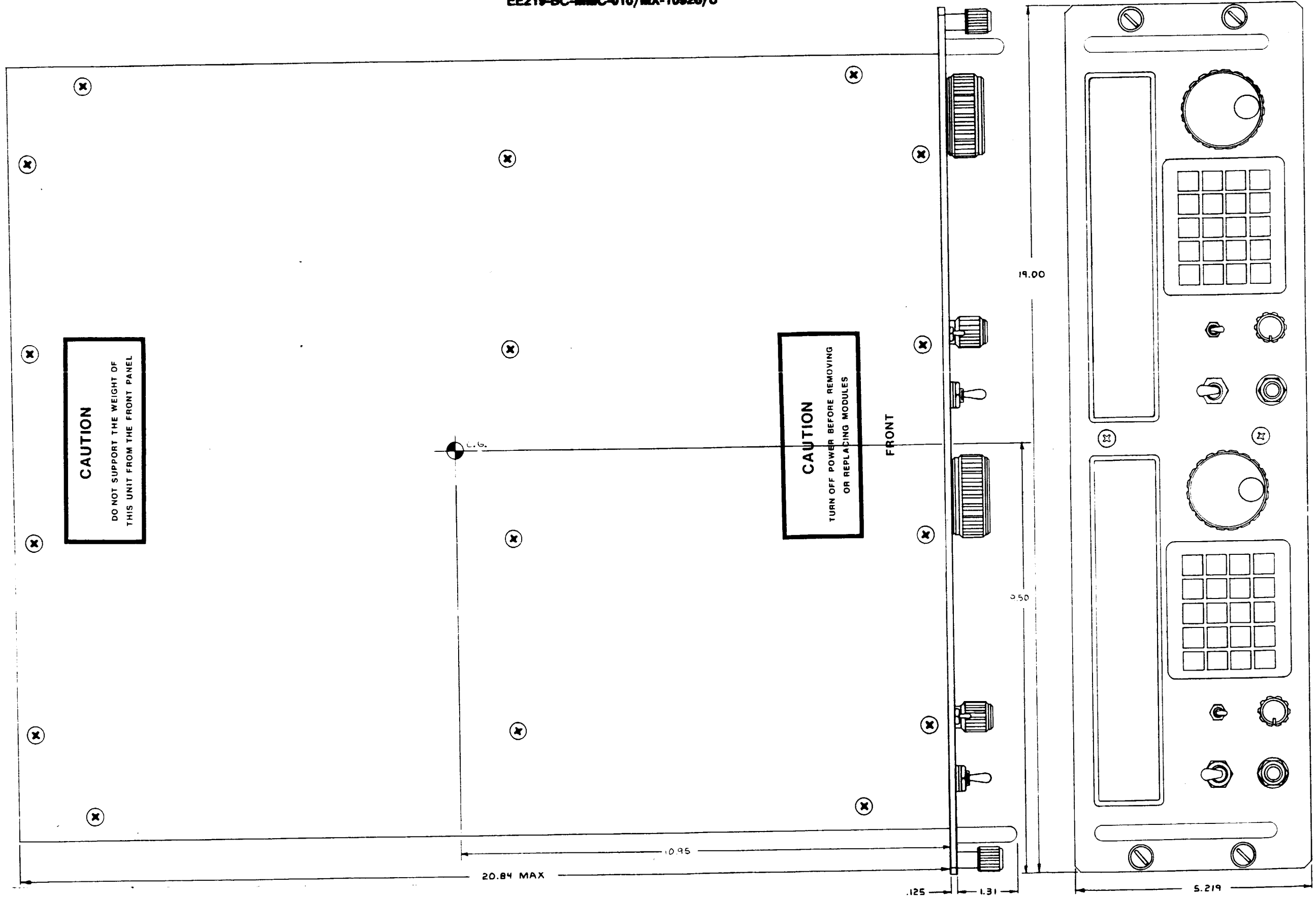
Table 8-1. Replaceable Parts List.

Qty	Description	Part Number	Notes	Mfr
2	Front Pnl Display bd	2140-2016		59532
2	Panel Intfc module	2871-1102		59532
2	CPU/Remote module	2871-1103	With Prgrm. Opt.	59532
2	Pwr Sply (+17/+8/-16)	2871-1104		59532
2	Ref/BFO module	2871-1105		59532
2	4TH LO module	2871-1106		59532
2	SSB module	2871-1107		59532
2	Detector module	2871-1108		59532
2	IF Filter module	2871-1109		59532
2	1ST Mixer module	2871-1110		59532
2	2ND Mixer module	2871-1111		59532
2	1ST LO module	2871-1112		59532
2	2ND LO module	2871-1113		59532
2	3RD LO module	2871-1114		59532
2	3RD Mixer module	2871-1115		59532
2	Antenna Sel module	2871-1123		59532
2	CPU/IEEE-488 module	2871-1124	With Prgrm. Opt.	59532
2	Motherboard	2871-2001		59532
2	Audio board	2871-2016		59532
1	AC Line Filter board	2871-2018		59532
1	IEEE-488 Bus Conn bd	2871-2025	Opt.	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
1	Remote Cont Conn bd	2861-2017	Opt.	59532

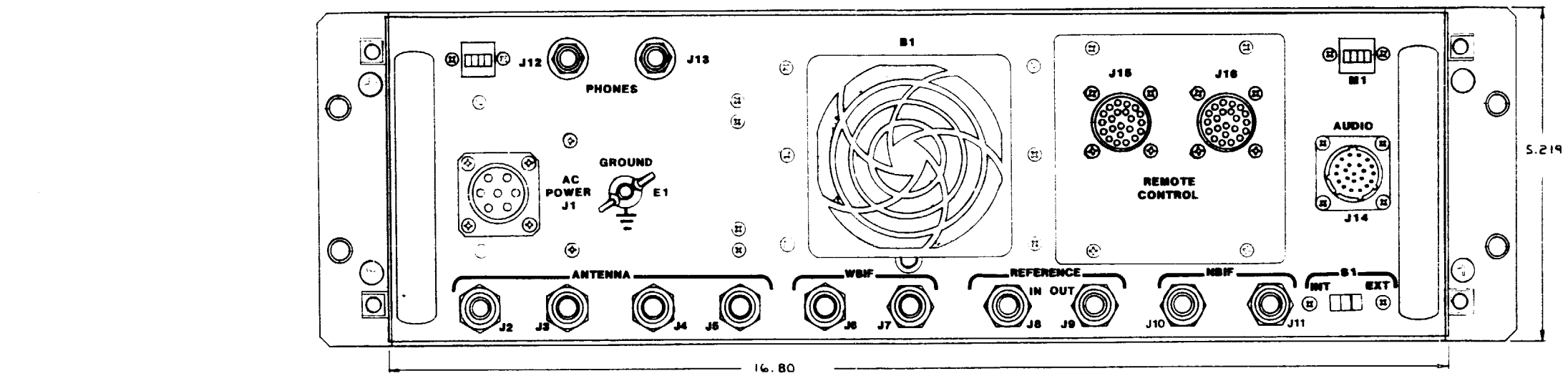
Table 8-1. Replaceable Parts List-CONT.

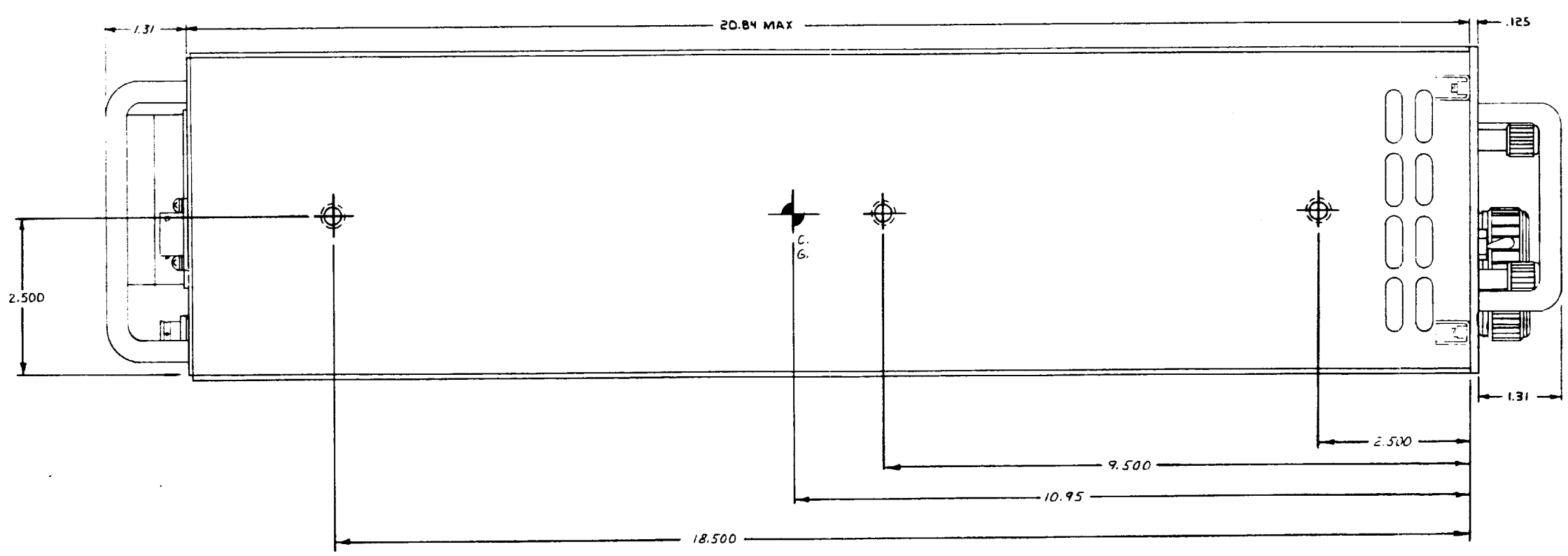
Qty	Description	Part Number	Notes	Mfr
2	Keyboard, Sealed	173-012 (88JB-2)	Note[1]	59532 (81073)
2	Ckt brkr/pwr switch	482-062 (AP-12-1-71F-302)	Note[1]	59532 (82415)
2	Local/remote switch	172-081 (7101-S-Y-Z-Q)	Note[1]	59532 (09353)
4	Phones jack	342-040 (L112B)	Note[1]	59532 82389)
2	Handles, rnd, front	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	180-009	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.

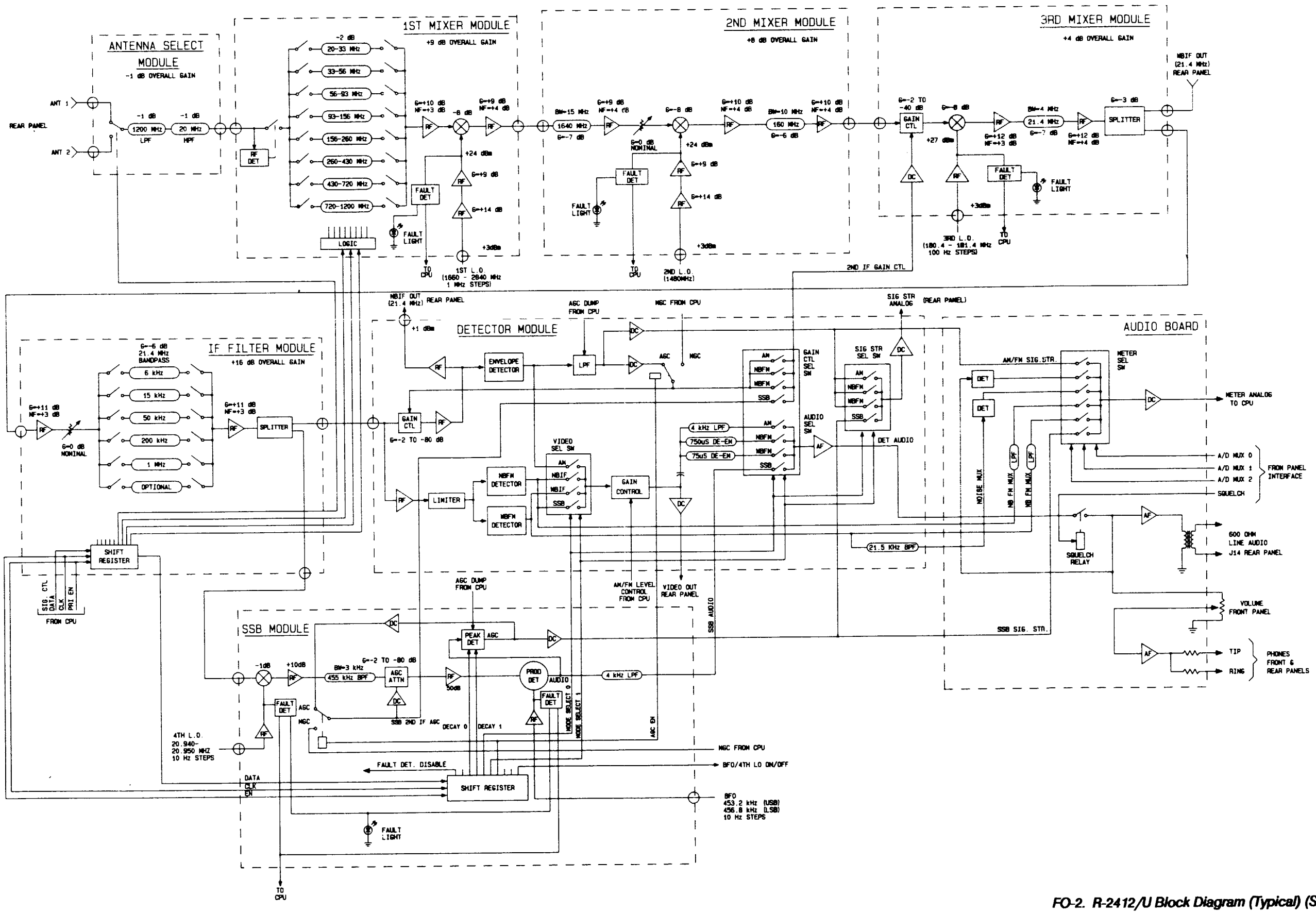


FO-1. R-2412/U Outline and Mounting Drawing (Sheet 1 of 2).

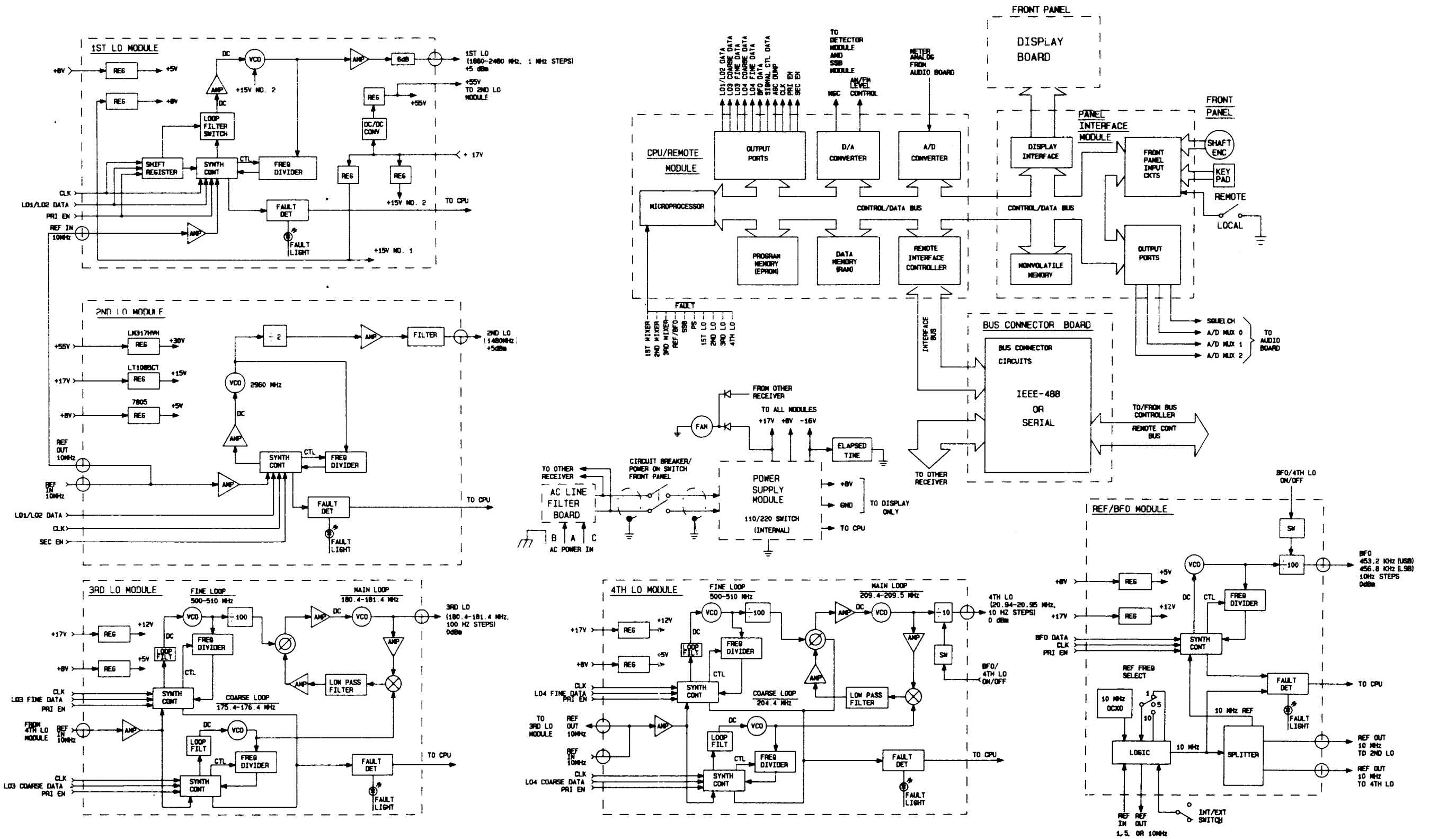




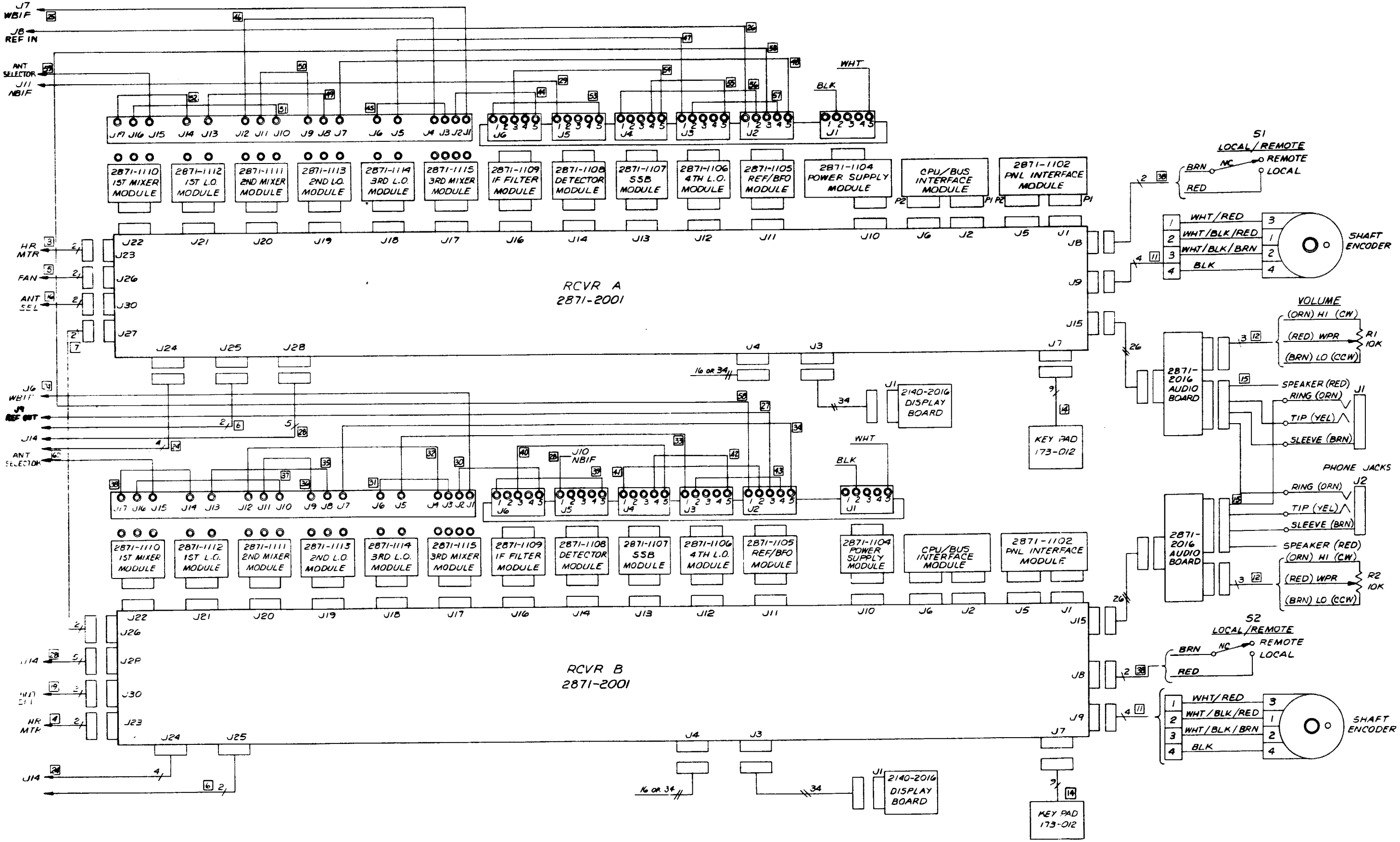
FO-1. R-2412/U Outline and Mounting Drawing (Sheet 2 of 2).



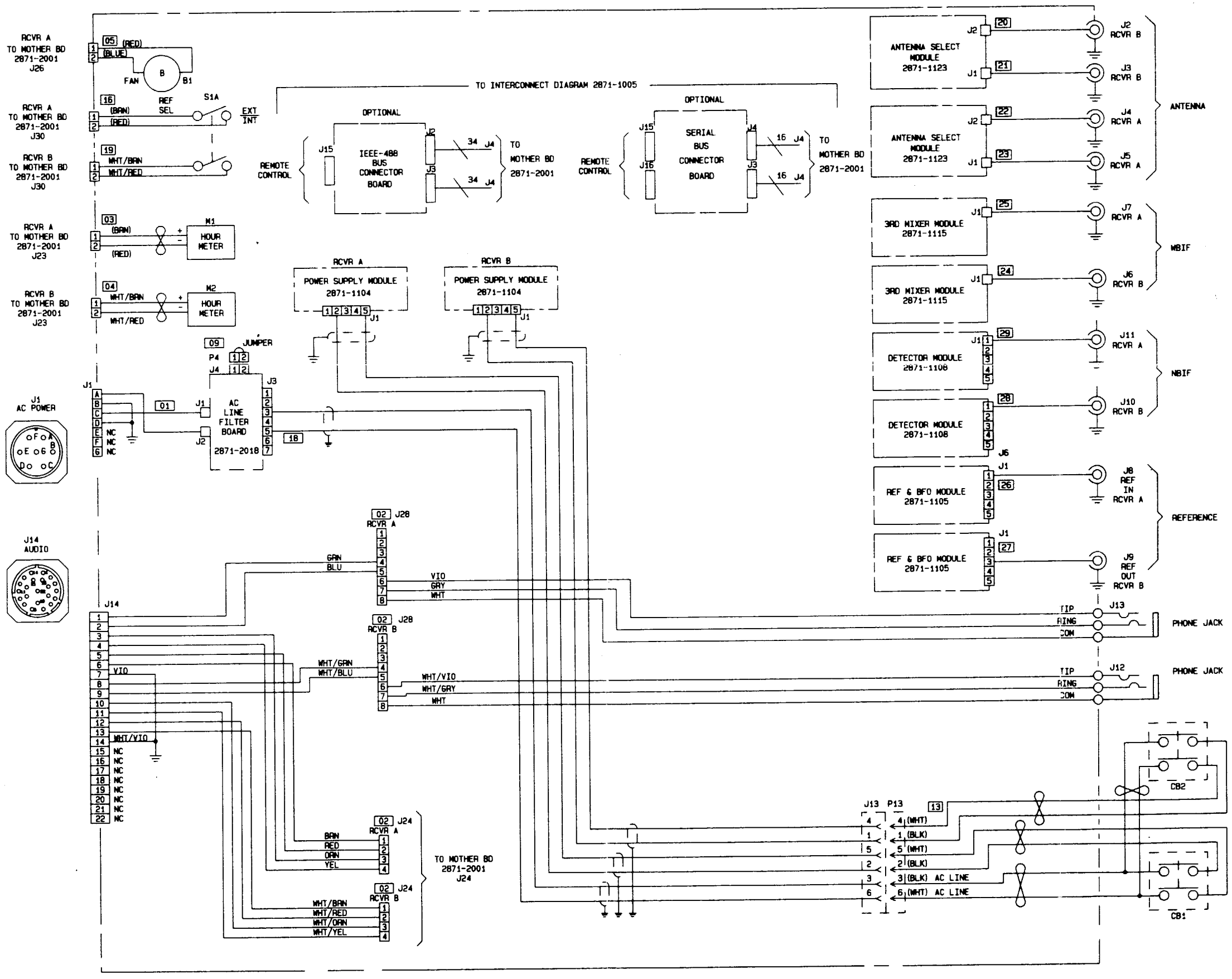
FO-2. R-2412/U Block Diagram (Typical) (Sheet 1 of 2).



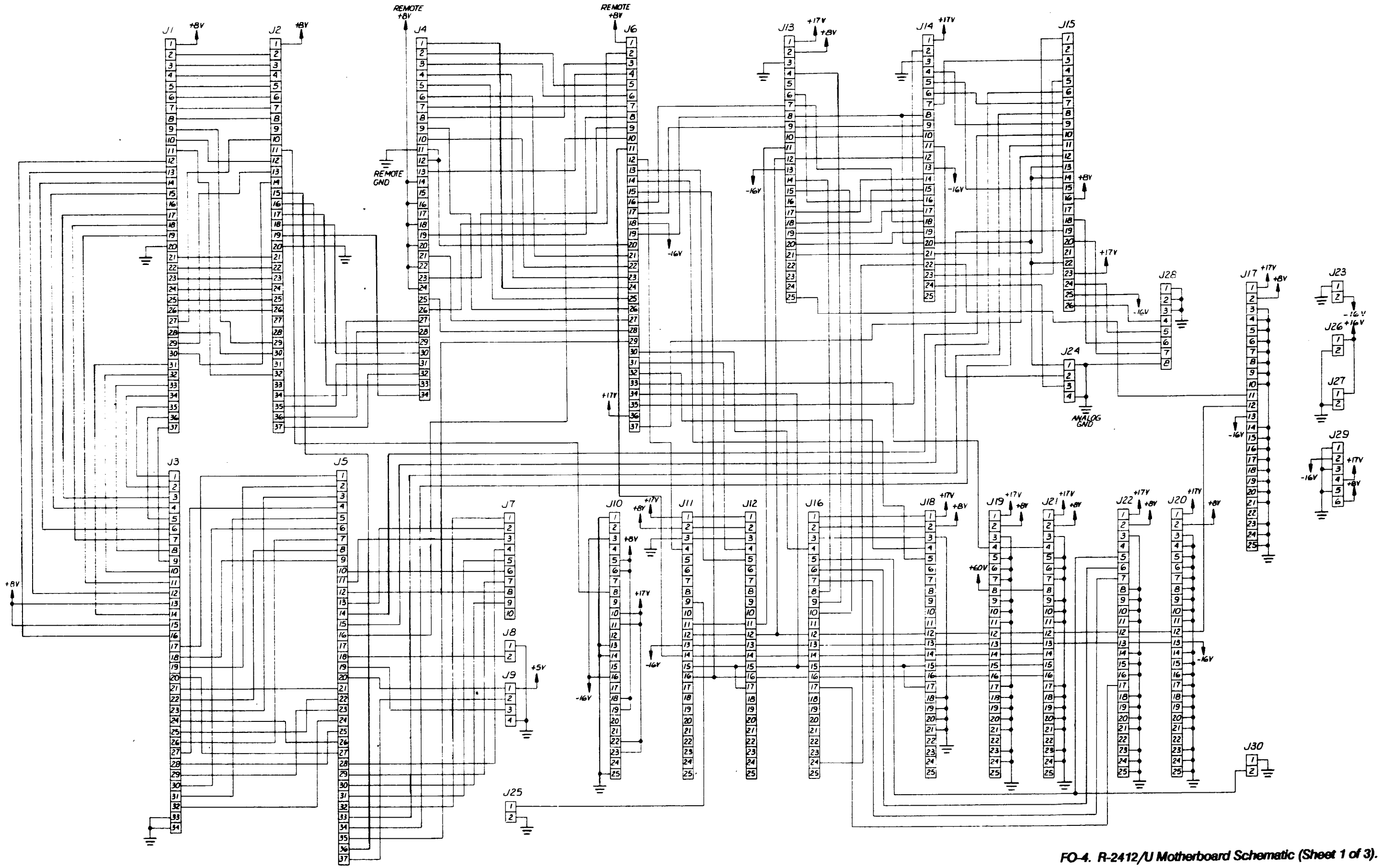
FO-2. R-2412/U Block Diagram (Typical) (Sheet 2 of 2).



FO-3. R-2412/U Interconnect Diagram (Sheet 1 of 2).



FO-3. R-2412/U Interconnect Diagram (Sheet 2 of 2).



FO-4. R-2412/U Motherboard Schematic (Sheet 1 of 3).

J1	
PANEL INTERFACE MODULE P1	
PIN	DESCRIPTION
1	+8 VOLTS
2	AD0
3	AD2
4	AD4
5	AD6
6	AD8
7	AD10
8	AD12
9	$\overline{CMEN}$
10	$\overline{PIDEN}$
11	$\overline{RD}$
12	SEG DP3
13	SEG F3
14	SEG D3
15	SEG B3
16	OUT SPARE
17	DG2
18	DG4
19	DG6
20	GND
21	AD1
22	AD3
23	AD5
24	AD7
25	AD9
26	AD11
27	$\overline{FPEN}$
28	ALE
29	$\overline{DT}$/R
30	$\overline{WR}$
31	SEG G3
32	SEG E3
33	SEG C3
34	SEG A3
35	DG1
36	DG3
37	DG5

J5	
PANEL INTERFACE MODULE P2	
PIN	DESCRIPTION
1	SEG A1
2	SEG B1
3	SEG D1
4	SEG F1
5	SEG DP1
6	SEG G2
7	SEG E2
8	SEG C2
9	SEG A2
10	ROW 3
11	ROW 1
12	COL4
13	COL2
14	A/D MUX 0
15	A/D MUX 2
16	$\overline{INTA0}$
17	N.C.
18	$\overline{LOCAL}$
19	ENC PHASE B
20	+5 VOLT OUT
21	SEG C1
22	SEG E1
23	SEG G1
24	SEG DP2
25	SEG F2
26	SEG D2
27	SEG B2
28	ROW 4
29	ROW 2
30	COL 5
31	COL3
32	COL1
33	A/D MUX 1
34	SQUELCH
35	INT0
36	$\overline{A2D\ INT}$
37	ENC PHASE A

J3	
FRONT PANEL DISPLAY	
PIN	DESCRIPTION
1	DG1
2	SEGA3
3	DG2
4	SEGB3
5	DG3
6	SEGD3
7	DG4
8	SEGC3
9	DG5
10	SEGE3
11	DG6
12	SEGF3
13	+8V-DISPLAY
14	SEGG3
15	+8V-DISPLAY
16	SEGDP3
17	SEGA1
18	SEGA2
19	SEGB1
20	SEGB2
21	SEGC1
22	SEGC2
23	SEGD1
24	SEGD2
25	SEGE1
26	SEGE2
27	SEGF1
28	SEGF2
29	SEGG1
30	SEGG2
31	SEGDP1
32	SEGDP2
33	DISPLAY GND
34	DISPLAY GND

J4		
REMOTE INTERFACE		
PIN	SERIAL	IEEE
1	$\overline{TXEN}$	NRFD
2	ADR0	DAV
3	ADR1	NDAC
4	TXD	EOI
5	$\overline{DTR}$	IFC
6	RXD	DIO4
7	$\overline{CTS}$	SRQ
8	$\overline{RXC}$	DIO3
9	ADR2	ATN
10	EXTINT	DIO2
11	REM GND	REM GND
12	REM GND	REM GND
13	DIO1	$\overline{TXC}$
14	REM +8 V	REM +8 V
15	N.C.	N.C.
16	+8 VOLTS	N.C.
17	N.C.	
18	+8 VOLTS	
19	TMR1 IN	TE
20	+8 VOLTS	
21	TMR1 OUT	CONT
22	+8 VOLTS	
23	SPARE ENABLE	
24	+8 VOLTS	
25	RESERVED	SYSCON
26	RESERVED	REN
27	N.C.	N.C.
28	RESERVED	DIO8
29	N.C.	N.C.
30	RESERVED	DIO7
31	N.C.	N.C.
32	RESERVED	DIO6
33	N.C.	N.C.
34	RESERVED	DIO5

J2		
CPU MODULE P1		
PIN	SERIAL	IEEE
1	+8 VOLTS	
2	AD0	
3	AD2	
4	AD4	
5	AD6	
6	AD8	
7	AD10	
8	AD12	
9	N.C.	
10	$\overline{FPEN}$	
11	$\overline{FAULT}$	
12	$\overline{PIDEN}$	
13	$\overline{DT}$/R	
14	$\overline{WR}$	
15	$\overline{A2D\ INT}$	
16	N.C.	N.C.
17	N.C.	N.C.
18	RESERVED	DIO7
19	RESERVED	DIO5
20	PWR GND	
21	AD1	
22	AD3	
23	AD5	
24	AD7	
25	AD9	
26	AD11	
27	N.C.	
28	N.C.	
29	$\overline{CMEN}$	
30	ALE	
31	N.C.	
32	$\overline{RD}$	
33	N.C.	
34	N.C.	N.C.
35	N.C.	N.C.
36	RESERVED	DIO8
37	RESERVED	DIO6

J6		
CPU MODULE P2		
PIN	SERIAL	IEEE
1	REM +8 V	REM +8 V
2	RESERVED	REN
3	$\overline{RXC}$	DIO3
4	$\overline{TXC}$	DIO1
5	ADR0	DAV
6	ADR1	NDAC
7	$\overline{CTS}$	SRQ
8	TMR1 IN	TE
9	SPARE EN	SPARE EN
10	$\overline{INTA0}$	
11	SERIAL CLOCK	
12	BFO DATA	
13	LO4 COARSE DATA	
14	LO3 COARSE DATA	
15	AUX SERIAL ENABLE	
16	AGC DUMP	
17	MANUAL GAIN	
18	-16 VOLTS	
19	ANALOG GND	
20	REM GND	REM GND
21	RXD	DIO4
22	EXTINT	DIO2
23	TXD	EOI
24	$\overline{TXEN}$	NRFD
25	$\overline{DTR}$	IFC
26	ADR2	ATN
27	TMR1 OUT	$\overline{CONT}$
28	RESERVED	SYSCON
29	INT0	
30	SIGNAL CTRL DATA	
31	LO4 FINE DATA	
32	LO3 FINE DATA	
33	LO1/LO2 DATA	
34	PRI SERIAL ENABLE	
35	AM/FM GAIN	
36	+17 VOLTS	
37	METER ANALOG-CPU	

J7	
FRONT PANEL KEYPAD	
PIN	DESCRIPTION
1	COL1
2	COL2
3	ROW1
4	ROW4
5	COL3
6	ROW3
7	ROW2
8	COL4
9	COL5
10	N.C.

J8	
LOCAL/REMOTE	
PIN	DESCRIPTION
1	GND
2	$\overline{LOCAL}$

J9	
FRONT PANEL SHAFT ENCODER	
PIN	DESCRIPTION
1	+5V
2	ENC PHASE A
3	ENC PHASE B
4	GND

FO-4. R-2412/U Motherboard Schematic (Sheet 2 of 3).

J1C	
POWER SUPPLY MODULE	
PIN	DESCRIPTION
1	GND
2	N.C.
3	-16 VOLTS
4	N.C.
5	+8 VOLTS
6	+8 VOLTS
7	N.C.
8	FAULT
9	N.C.
10	+17 VOLTS
11	+17 VOLTS
12	N.C.
13	GND
14	GND
15	N.C.
16	-16 VOLTS
17	N.C.
18	+8 VOLTS
19	+8 VOLTS
20	N.C.
21	N.C.
22	+17 VOLTS
23	+17 VOLTS
24	N.C.
25	GND

J11	
REF/BFO MODULE	
PIN	DESCRIPTION
1	+17 VOLTS
2	+8 VOLTS
3	GND
4	BFO DATA
5	N.C.
6	N.C.
7	N.C.
8	N.C.
9	REF SEL
10	N.C.
11	BFO/4th LO ENABLE
12	FAULT
13	-16 VOLTS
14	SERIAL CLOCK
15	PRI SERIAL ENABLE
16	AUX SERIAL ENABLE
17	N.C.
18	N.C.
19	N.C.
20	N.C.
21	N.C.
22	N.C.
23	N.C.
24	BFO CONT VOLT T.P.
25	N.C.

J12	
4TH LO MODULE	
PIN	DESCRIPTION
1	+17 VOLTS
2	+8 VOLTS
3	GND
4	LO4 FINE DATA
5	LO4 COARSE DATA
6	N.C.
7	N.C.
8	N.C.
9	N.C.
10	N.C.
11	BFO/4th LO ENALBE
12	FAULT
13	-16 VOLTS
14	SERIAL CLOCK
15	PRI SERIAL ENABLE
16	AUX SERIAL ENABLE
17	PRI SERIAL ENALBE
18	N.C.
19	N.C.
20	N.C
21	N.C.
22	N.C.
23	MAIN CONT VOLT TP
24	CRSE CONT VOLT TP
25	FINE CONT VOLT TP

J13	
SSB MODULE	
PIN	DESCRIPTION
1	+17 VOLTS
2	+8 VOLTS
3	GND
4	IF/SSB DATA
5	N.C.
6	SPARE SHIFT REG2
7	AGC DUMP
8	ANALOG GROUND
9	MANUAL GAIN
10	SSB 2nd IF AGC
11	BFO/4th LO ENABLE
12	FAULT
13	-16 VOLTS
14	IF/SSB SERIAL CLOCK
15	IF/SSB SERIAL ENABLE
16	N.C
17	MODE SELECT 0
18	MODE SELECT 1
19	AGC ENABLE
20	SSB AUDIO
21	SSB SIG STRENGTH
22	N.C.
23	N.C
24	N.C.
25	SPARE SHIFT REG1

J14	
DETECTOR MODULE	
PIN	DESCRIPTION
1	+17 VOLTS
2	AM/FM GAIN
3	GND
4	NB FM MUX
5	DETECTOR AUDIO
6	WB FM MUX
7	NOISE MUX
8	ANALOG GROUND
9	MANUAL GAIN
10	SSB 2ND IF AGC
11	SIG STR ANALOG OUT
12	FAULT
13	-16 VOLTS
14	MODE SELECT 0
15	MODE SELECT 1
16	SPARE SHIFT REG2
17	AGC ENABLE
18	AGC DUMP
19	SSB AUDIO
20	ANALOG GROUND
21	SSB SIG STRENGTH
22	2ND IF AGC
23	AM/FM SIG STRENGTH
24	VIDEO OUT
25	N.C.

J15	
AUDIO BOARD	
PIN	DESCRIPTION
1	SSB SIG STRENGTH
2	N.C.
3	NOISE MUX
4	N.C.
5	AM/FM SIG STRENGTH
6	A/D MUX 2
7	WB FM MUX
8	A/D MUX 1
9	NB FM MUX
10	A/D MUX 0
11	SQUELCH
12	METER ANALOG
13	ANALOG GROUND
14	ANALOG GROUND
15	DETECTOR AUDIO
16	+8 VOLTS
17	N.C.
18	PHONES TIP
19	SPARE SHIFT REG1
20	PHONES RING
21	N.C.
22	ANALOG GROUND
23	+17 VOLTS
24	600 OHM LINE
25	16 VOLTS
26	600 OHM RETURN

J16	
IF FILTER MODULE	
PIN	DESCRIPTION
1	+17 VOLTS
2	+8 VOLTS
3	GND
4	SIGNAL CTRL DATA
5	ANTENNA SELECT
6	BAND 1
7	BAND 0
8	IF/SSB SERIAL CLK
9	IF/SSB DATA
10	IF/SSB SERIAL ENBL
11	NC
12	FAULT
13	-16 VOLTS
14	SERIAL CLOCK
15	PRI SERIAL ENABLE
16	AUX SERIAL ENABLE
17	BAND 2
18	N.C.
19	N.C.
20	N.C.
21	N.C.
22	N.C.
23	N.C.
24	2ND IF AGC
25	N.C.

J17	
3RD MIXER MODULE	
PIN	DESCRIPTION
1	+17 VOLTS
2	+8 VOLTS
3	GND
4	GND
5	GND
6	GND
7	GND
8	GND
9	GND
10	GND
11	2ND IF AGC
12	FAULT
13	-16 VOLTS
14	GND
15	GND
16	GND
17	GND
18	GND
19	GND
20	GND
21	GND
22	N.C.
23	GND
24	GND
25	GND

J18	
3RD LO MODULE	
PIN	DESCRIPTION
1	+17 VOLTS
2	+8 VOLTS
3	GND
4	LO3 FINE DATA
5	LO3 COARSE DATA
6	N.C.
7	N.C.
8	N.C.
9	N.C.
10	N.C.
11	N.C.
12	FAULT
13	-16 VOLTS
14	SERIAL CLOCK
15	PRI SERIAL ENABLE
16	AUX SERIAL ENABLE
17	PRI SERIAL ENALBE
18	GND
19	GND
20	GND
21	GND
22	N.C.
23	MAIN CONT VOLT TP
24	CRSE CONT VOLT TP
25	FINE CONT VOLT TP

J19	
2ND LO MODULE	
PIN	DESCRIPTION
1	+17 VOLTS
2	+8 VOLTS
3	GND
4	LO1/LO2 DATA
5	GND
6	GND
7	GND
8	+60 VOLTS
9	GND
10	GND
11	GND
12	FAULT
13	-16 VOLTS
14	SERIAL CLOCK
15	PRI SERIAL ENABLE
16	AUX SERIAL ENABLE
17	GND
18	GND
19	GND
20	GND
21	GND
22	N.C.
23	GND
24	GND
25	CONT VOLTAGE T. P.

J20	
2ND MIXER MODULE	
PIN	DESCRIPTION
1	+17 VOLTS
2	+8 VOLTS
3	GND
4	GND
5	GND
6	GND
7	GND
8	GND
9	GND
10	GND
11	GND
12	FAULT
13	-16 VOLTS
14	GND
15	GND
16	GND
17	GND
18	GND
19	GND
20	GND
21	GND
22	N.C.
23	GND
24	GND
25	GND

J21	
1ST LO MODULE	
PIN	DESCRIPTION
1	+17 VOLTS
2	+8 VOLTS
3	GND
4	LO1/LO2 DATA
5	GND
6	GND
7	GND
8	+60 VOLTS
9	GND
10	GND
11	GND
12	FAULT
13	-16 VOLTS
14	SERIAL CLOCK
15	PRI SERIAL ENABLE
16	AUX SERIAL ENABLE
17	GND
18	GND
19	GND
20	GND
21	GND
22	N.C.
23	GND
24	GND
25	CONT VOLTAGE T.P.

J22	
1ST MIXER MODULE	
PIN	DESCRIPTION
1	+17 VOLTS
2	+8 VOLTS
3	GND
4	N.C.
5	ANTENNA SELECT
6	BAND1
7	BAND0
8	GND
9	GND
10	GND
11	GND
12	FAULT
13	-16 VOLTS
14	GND
15	GND
16	GND
17	BAND2
18	GND
19	GND
20	GND
21	GND
22	N.C.
23	GND
24	GND
25	GND

J23	
HOUR METER	
PIN	DESCRIPTION
1	GND
2	-16 VOLTS

J24	
VIDEO CONNECTOR (J24)	
PIN	DESCRIPTION
1	ANALOG GND
2	SIG STR ANALOG OUT
3	VIDEO OUT
4	ANALOG GND

J25	
INT/EXT REF SW (J25)	
PIN	DESCRIPTION
1	REFERENCE SEL
2	GND

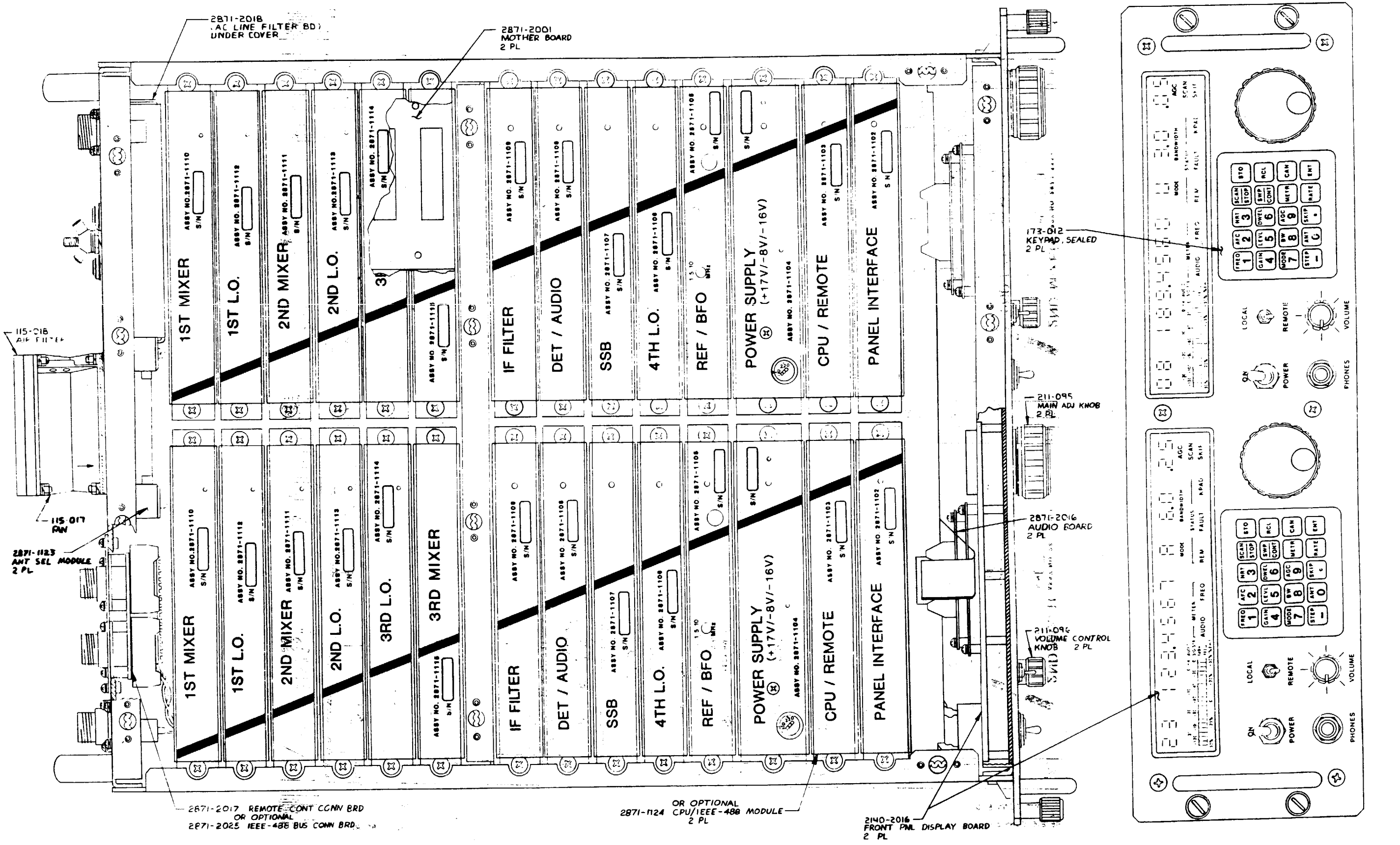
J26 AND J27	
COOLING FAN	
PIN	DESCRIPTION
1	+16 VOLTS
2	POWER GROUND

J26	
AUDIO/REAR PANEL	
PIN	DESCRIPTION
1	POWER GROUND
2	POWER GROUND
3	POWER GROUND
4	600 OHM RETURN
5	600 OHM LINE
6	PHONES TIP
7	PHONES RING
8	ANALOG GND

J29	
ACCESSORY POWER	
PIN	DESCRIPTION
1	POWER GROUND
2	-16 VOLTS
3	POWER GROUND
4	+17 VOLTS
5	POWER GROUND
6	+8 VOLTS

J30	
ANTENNA SELECTION	
PIN	DESCRIPTION
1	GND
2	ANTENNA SELECT

FO-4. R-2412/U Motherboard Schematic (Sheet 3 of 3).



FO-5. R-2412/U Replaceable Parts Locator Diagram.