

# **VIKING<sup>®</sup> VX 800 MHz LTR 75W-175W Repeater**

Models: VX-RL82, VX-RL83  
Part No. 242-2008-232/234

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**VIKING® VX**  
**800 MHz LTR REPEATER**  
**PART NO. 242-2008-232/234**

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**LAND MOBILE PRODUCT WARRANTY**

The manufacturer's warranty statement for this product is available from your product supplier or from the EF Johnson, Inc., 299 Johnson Avenue, Box 1249, Waseca, MN 56093-0514. Phone (507) 835-6222.

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DO NOT allow the antenna to touch or come in very close proximity with the eyes, face, or any exposed body parts while the radio is transmitting.

DO NOT operate the transmitter of a mobile radio when a person outside the vehicle is within one (1) meter of the antenna.

DO NOT operate the transmitter of a stationary radio (base station, repeater or marine radio) when a person is within one (1) meter of the antenna.

DO NOT operate the radio in explosive or flammable atmospheres. The transmitted radio energy could trigger blasting caps or cause an explosion.

DO NOT operate the radio without the proper antenna installed.

DO NOT allow children to operate or play with this equipment.

*NOTE: The above warning list is not intended to include all hazards that may be encountered when using this radio.*

This device complies with Part 15 of the FCC rules. Operation is subject to the condition that this device does not cause harmful interference. In addition, changes or modification to this equipment not expressly approved by EF Johnson could void the user's authority to operate this equipment (FCC rules, 47CFR Part 15.19).

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## A 800 MHz CHANNEL FREQUENCY CHART

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SECTION 1 INTRODUCTION AND OPERATION

1.1 SCOPE OF MANUAL

This service manual provides installation, operation, programming, service, and alignment information for the VIKING® VX LTR® Repeater, Part No. 242-2008-232/234.

1.2 REPEATER DESCRIPTION

The VIKING VX repeater is designed for operation in a Johnson LTR system. It operates on the 800 MHz channels from 851-869 MHz (repeater transmit). The repeater receive frequencies are 45 MHz below these frequencies (806-824 MHz). Channel spacing is 25 kHz and RF power output is adjustable from 25 to 75 watts (Part No. 242-2008-232) or 75-175W (Part No. 242-2008-234) with the high power amplifier.

This repeater is modular in design for ease of service. There are separate assemblies for the logic cards, receiver, exciter, power amplifier and power supply sections.

This repeater is programmed with a laptop or personal computer using the repeater software, Part No. 023-9998-297.

1.3 REPEATER IDENTIFICATION

The repeater identification number is printed on a label that is affixed to the inside of the repeater cabinet. The following information is contained in that number:

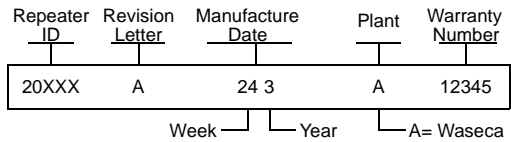


Figure 1-1 REPEATER IDENTIFICATION

1.4 MODEL NUMBER BREAKDOWN

The following breakdown shows the part number scheme used for the Viking VX.

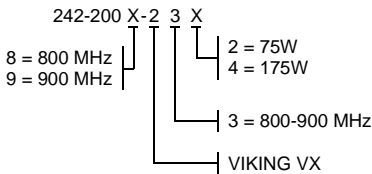


Figure 1-2 PART NUMBER BREAKDOWN

## 1.5 ACCESSORIES

The accessories available for the Viking VX LTR repeater are listed in Table 1-1. A brief description of some of these accessories follows.

**Table 1-1 ACCESSORIES**

Accessory	Part No.
2-Wire Telephone Interface Card (TIC)	023-2000-370
LTR System ID Validator	023-4408-500
2000 Series Service Kit <sup>1</sup>	250-2000-230
Battery Back-Up Option <sup>2</sup>	023-2000-835
3' RG-58 BNC M-M HSDB cable	023-4406-505
6' RG-58 BNC M-M HSDB cable	597-3001-214
Custom Frequency Programming & Setup	023-2000-100
PC Programmer PGMR Software	023-9998-297
Programming Cable Kit	023-2000-195
Service Microphone	589-0015-011
50 ohm Termination HSDB	023-4406-504
RJ-11 to RJ-11 cable	597-2002-200
Telewave Combining Systems High Power	
5-channel 115V AC <sup>3</sup>	585-1157-135
5-channel 230V AC <sup>3</sup>	585-1157-145
Telewave Combining Systems Low Power	
3-channel 115V AC <sup>4</sup>	250-2008-054
3-channel 230V AC <sup>4</sup>	250-2008-064
5-channel 115V AC <sup>5</sup>	250-2008-055
5-channel 230V AC <sup>5</sup>	250-2008-065
5-channel 115V AC <sup>6</sup>	250-2008-050
5-channel 230V AC <sup>6</sup>	250-2008-060
10-channel 115V AC <sup>7</sup>	250-2008-051
10-channel 230V AC <sup>7</sup>	250-2008-061
15-channel 115V AC <sup>8</sup>	250-2008-052
15-channel 230V AC <sup>8</sup>	250-2008-062
20-channel 115V AC <sup>9</sup>	250-2008-053
20-channel 230V AC <sup>9</sup>	250-2008-063
Duplexer (high power only)	585-1157-101
RF Lightning Protector <sup>10</sup>	
Type N lightning arrestor (low pwr only)	585-0898-001
Polyphaser™	585-0898-003
Floor Mount 19" Open Rack <sup>11</sup>	
7' with accessories, setup and test	023-2000-216
7' 6" with accessories, setup and test	023-2000-217
8' with accessories, setup and test	023-2000-218
AC Power Distribution	
AC Power Strip 115V AC <sup>12</sup>	597-1004-010
AC Power Strip 230V AC <sup>12</sup>	023-2000-212

**Table 1-1 ACCESSORIES**

Accessory	Part No.
<sup>1</sup> Includes: extender card, extender cables, TIC bias cable and programming cable kit.	
<sup>2</sup> +26V DC input with cable	
<sup>3</sup> 2-antennas and 1-rack.	
<sup>4</sup> 1-antenna and 1-rack (single rack configuration)	
<sup>5</sup> 1-antenna/1-8' rack (single rack configuration)	
<sup>6</sup> 1-antenna/2-additional rack (combining rack included)	
<sup>7</sup> 1-antenna/3-additional racks (combining rack included)	
<sup>8</sup> 2-antennas/3-additional racks (combining rack included)	
<sup>9</sup> 2-antennas/4-additional racks (combining rack included)	
<sup>10</sup> 1-lightning protector per antenna.	
<sup>11</sup> Accessories include all mounting hardware, rack ground bar and wire to repeaters.	
<sup>12</sup> 1-per 3 repeaters Low Power 1-per 2 repeaters High Power	

**2000 Series Service Kit**- This kit includes an extender card, extender cables, TIC bias cable and programming cable. These items are used when tuning the repeater and while troubleshooting.

**Battery Backup Option** - It includes the +26V DC battery backup module that resides in the power supply and the necessary interconnect cabling to connect the repeater to the batteries (see Section 2.5).

**Companding Module** - This enhances the receive and transmit audio when used in conjunction with the Telephone Interface Card (TIC).

**Three Foot Cable** - This is a 3' RG-58 coax cable with BNC male connectors for the HSDB (High Speed Data Bus).

**Six Foot Cable** - This is a 6' RG-58 coax cable with BNC male connectors for the HSDB (High Speed Data Bus).

**Custom Frequency** - This is a factory frequency programming and repeater setup.

**PGMR 2000 Programming Software** - 3.5" programming disk used to program the repeater.

**Service Microphone** - This is a speaker and microphone combination that plugs into the MAC connectors. The microphone provides local audio and push-to-talk, while the speaker provides local audio adjusted with the volume control.

**RF Lightning Protector** - This accessory provides lightning, static and surge protection on the AC power line. This line protector is rack mounted with multiple outlets.

**RJ-11 to RJ-11 Cable** - This three foot cable is used to connect two or more repeaters to the high speed data bus through the modular jack on the rear of the repeater.

## 1.6 PRODUCT WARRANTY

The warranty statement for this transceiver is available from your product supplier or from the

Warranty Department  
E.F. Johnson  
299 Johnson Avenue,  
Box 1249,  
Waseca, MN 56093- 0514

This information may also be requested by phone from the Warranty Department as described in Section 1-4. The Warranty Department may also be contacted for Warranty Service Reports, claim forms, or any questions concerning warranties or warranty service by dialing (507) 835-6222.

## 1.7 FACTORY CUSTOMER SERVICE

The Customer Service Department of the E.F. Johnson provides customer assistance on technical problems and the availability of local and factory repair facilities. Regular Customer Service hours are 7:30 a.m. - 5:30 p.m. Central Time, Monday - Friday. The Customer Service Department can be reached using one of the following telephone numbers:

**Toll-Free: (800) 328-3911**  
(From within continental United States only)

**International: (507) 835-6911**

**FAX: (507) 835-6969**

**E-Mail: First Initial/Last Name@efjohnson.com**  
(You need to know the name of the person you want to reach. Example: dthompson@efjohnson.com)

*NOTE: Emergency 24-hour technical support is also available at the 800 and preceding numbers during off hours, holidays, and weekends.*

When your call is answered at E.F. Johnson, you will hear a brief message informing you of numbers that can be entered to reach various departments. This number may be entered during or after the message using a tone-type telephone. If you have a pulse-type telephone, wait until the message is finished and an operator will come on the line to assist you. When you enter some numbers, another number is requested to further categorize the type of information you need.

You may also contact the Customer Service Department by mail. Please include all information that may be helpful in solving your problem. The mailing address is as follows:

E.F. Johnson Company  
Customer Service Department  
299 Johnson Avenue  
P.O. Box 1249  
Waseca, MN 56093-0514

## 1.8 FACTORY RETURNS

Repair service is normally available through local authorized E.F. Johnson Land Mobile Radio Service Centers. If local service is not available, the equipment can be returned to the factory for repair. However, it is recommended that you contact the Customer Service Department before returning equipment because a service representative may be able to suggest a solution to the problem so that return of the equipment would not be necessary.

Be sure to fill out a Factory Repair Request Form #271 for each unit to be repaired, whether it is in or out of warranty. These forms are available free of charge by calling the repair lab (see Section 1-4) or by requesting them when you send a unit in for repair. Clearly describe the difficulty experienced in the space provided and also note any prior physical damage to the equipment. Then include a form in the shipping container with each unit. Your telephone number and contact name are important because there are times when the technicians have specific questions that need to be answered in order to completely identify and repair a problem.

When returning equipment for repair, use a PO number or some other reference number on your paperwork in case you need to call the repair lab about your unit. These numbers are referenced on the repair order and it makes it easier and faster to locate your unit in the lab.

Return Authorization (RA) numbers are not necessary unless you have been given one by the Field Service Department. RA numbers are required for exchange units or if the Field Service Department wants to be aware of a specific problem. If you have been given an RA number, reference this number on the Factory Repair Request Form sent with the unit. The repair lab will then contact the Field Service Department when the unit arrives.

## 1.9 REPLACEMENT PARTS

E.F. Johnson replacement parts can be ordered directly from the Service Parts Department. To order parts by phone, dial the toll-free number as described in Section 1-4. When ordering, please supply the part number and quantity of each part ordered. E.F. Johnson dealers also need to give their account number. If there is uncertainty about the part number, include the designator (C112, for example) and the model number of the equipment the part is from.

You may also send your order by mail or FAX. The mailing address is as follows and the FAX number is shown in Section 1-4.

E.F. Johnson  
Service Parts Department  
299 Johnson Avenue  
P.O. Box 1249  
Waseca, MN 56093-0514

## 1.10 INTERNET HOME PAGE

The E.F. Johnson has a home page on the World Wide Web that can be accessed for information on such things as products, systems, and regulations. The address is <http://www.transcrypt.com>.

## 1.11 SOFTWARE UPDATES/REVISIONS

All inquiries concerning updated software, its installation and revisions should be directed to the Customer Service Department (see Section 1-4).

## 1.12 REPEATER OPERATION

### 1.12.1 MAIN PROCESSOR CARD (MPC)

Refer to Figure 1-4.

- Programming Jack

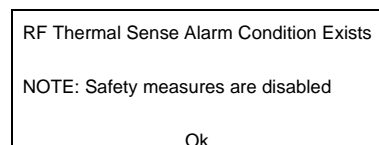
J1 provides input connection from the computer and the "flash memory" in the MPC. The programming information in an IBM® PC programs the MPC directly from the serial card through an interconnect cable to the COM1 or COM2 port.

- Reset

S1 provides a manual reset of the Main Processor Card (MPC). A manual reset causes a complete power-up restart.

- Display and LEDs

Each combination of DS1 display read-out and CR4/CR5 indication refers to an active alarm. See Table 1-2 for alarms and definitions. LED indications: CR1 is blinking; MPC is operational, CR2 on; high power, off is low power and CR5 on; indicates an LTR Repeater.



**Figure 1-3 ALARM IN TEST MODE**

### Alarms

When the Repeater is in Test mode the safety measures are disabled. Therefore, if the Repeater is keyed for an extended period and the power amplifier temperature increase, thermal shutdown will not occur. There are pop-up windows that appear in the Test mode screens to alert the user that there is an alarm and action should be taken. Refer to Figure 1-3 for an example of this type of alarm.



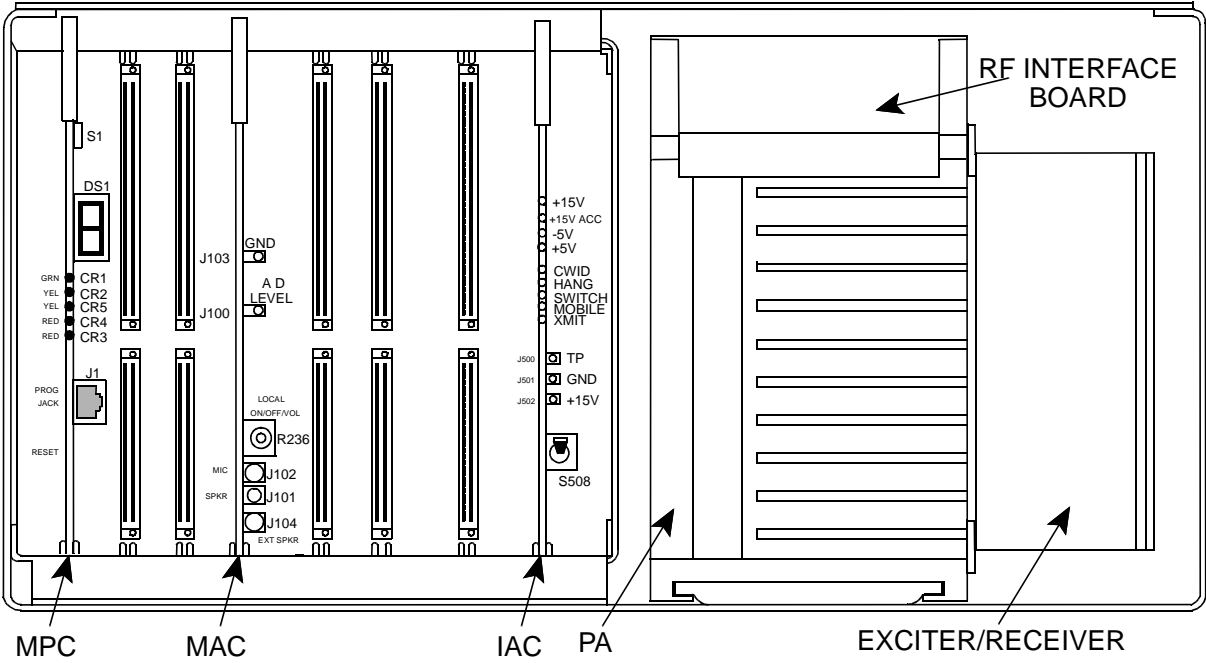


Figure 1-4 REPEATER CARDS

**Table 1-2 ACTIVE REPEATER ALARMS**

Alarm No.	DS1	CR3	CR4	Definition
0	0	Off	On	Test Mode
1	1	Off	On	IAC input 1 Active
2	2	Off	On	IAC input 2 Active
3	3	Off	On	IAC input 3 Active
4	4	Off	On	IAC input 4 Active
5	5	Off	On	IAC input 5 Active
6	6	Off	On	IAC input 6 Active
7	7	Off	On	IAC input 7 Active
8	8	Off	On	IAC input 8 Active
9	9	Off	On	MAC Processor Alarm
10	A	Off	On	HSDB Processor/Cable Alarm
11	B	Off	On	IRDB Cable Alarm
12	C	Off	On	RNT/CIM Channel Problem Alarm
13	D	Off	On	TIC Processor Alarm
14	E	Off	On	MMC Processor Alarm
15	F	Off	On	VNC Alarm
16	0	On	Off	AC Power Failure
17	1	On	Off	Battery Power Failure
18	2	On	Off	Power supply thermal sense
19	3	On	Off	Fan 1 current out of specification
20	4	On	Off	Fan 2 current out of specification
21	5	On	Off	IAC mismatch
32	0	On	On	RF shutdown
33	1	On	On	RF Half Power Mode
34	2	On	On	Thermal sense in RF portion
35	3	On	On	RF Finals 1-2 power out failure
36	4	On	On	RF Finals 3-4 power out failure
37	5	On	On	RF VSWR Failure
38	6	On	On	Normal Synthesizer Tx Lock failure
39	7	On	On	Normal Synthesizer Rx Lock failure
40	8	On	On	HS Synthesizer Tx Lock failure
41	9	On	On	HS Synthesizer Rx Lock failure
42	A	On	On	RF Quarter Power Alarm

### 1.12.2 MAIN AUDIO CARD (MAC)

Refer to Figure 1-4.

- External Speaker Jack

J104 provides repeater audio output to an external speaker. The local volume control adjusts the volume level of this speaker.

- Speaker/Microphone Jacks

J102 provides audio input from a microphone. J101 provides the receive audio to the microphone.

- Local On/Off/Volume Control

R236 provides control of the receive audio output to J101 and J104. Turning this control clockwise past the detent applies voltage to the local audio amplifier.

- A D Level Test Point

J100 provides audio/data level output for test level checks.

- Ground

J103 is connected to ground for test equipment when monitoring test point J100.

### 1.12.3 INTERFACE ALARM CARD (IAC)

Refer to Figure 1-4.

- Voltage Test Output

J502 provides a +15V test point on the IAC.

- Ground

J501 is connected to ground for test equipment when monitoring voltage test point J502.

- A D Level Test Point

J500 provides a test point to monitor audio and data levels, AC fail and thermal sensor.

- Power Supply On/Off Switch

S508 turns the power supply DC voltages on and off from the IAC in the front of the repeater.

- Power Indicator

CR501 indicates the +5V supply is at normal level and applied to the IAC. CR524 indicates -5V supply is at normal level and applied to the IAC. CR523 indicates the +15V accessory supply is at normal level. CR525 indicates that the +15V supply is at normal level and applied to the IAC.

- CWID Indicator

Indicates that the CW Identification is being transmitted on the lowest-frequency repeater. The CWID is a continuous-wave (CW) transmission of the station call letters in Morse Code to satisfy the station identification requirement. The CWID is programmed into the repeater memory. This indicator also is used when an alarm is transmitted with Morse code.

- Hang Indicator

Indicates that the hang word is being transmitted by the repeater. This word is transmitted on calls in which the channel is held for the duration of the call and not just for the duration of the transmission. The hang word tells the mobiles to stay on the same channel and not re-access the system when responding to a call.

- Switch Call Indicator

Not used in the LTR repeater.

- Mobile Call Indicator

Mobile-to-repeater transmission in progress is indicated by the Mobile Call Indicator.

- Xmit Indicator

This indicates that the repeater transmitter is keyed by the logic.

### 1.12.4 POWER SUPPLY

The 2000 Series Repeater Power Supply is a quad output 800W supply with power factor correction. A battery back-up module, PN 023-2000-830, can be added to the power supply to provide automatic battery revert in the event of AC power failure (see Section 2.5) The Battery Back-Up module charges the batteries when AC is present at the power supply (see Section 2.4 and 8.5).

## 1.13 REPEATER INFORMATION

### 1.13.1 INTRODUCTION

*NOTE: The VIKING VX does not require a separate LTR logic drawer.*

The repeater model used in an LTR system is determined by frequency range. 800 MHz systems use the VIKING VX (-232/-234) or LTR 8000s, UHF use 1010s, and VHF use 1100s. Repeaters operate on a single frequency (one repeater is required for each channel). The MPC in each repeater performs all control and signaling functions on that channel. Information is exchanged between repeaters via a high-speed data bus (modular cable). No system controller is required.

Optional accessories, such as the Telephone Interconnect Card (TIC) can be installed in the repeater and the ID Validator drawer can be installed in the repeater rack. Refer to Johnson LTR ID Validator Manual, Part No. 001-4408-501 and Johnson Telephone Interconnect Card Manual, Part No. 004-2000-370 for detailed information.

### 1.13.2 HOME REPEATERS

All mobiles have one of the site repeaters assigned as its "Home" repeater. This is the repeater from which it receives most of its control information. When a mobile is not placing or receiving a call, it is always monitoring its Home repeater to determine which channel is free and if it is being called by another mobile.

The Home repeater is always used to make a call unless it is busy. When the Home repeater is busy, any other repeater in the site may then be used. Up to 250 ID codes are assigned to each repeater. An ID

code and Home repeater number are the "address" of the mobiles in the system. Therefore, up to 1250 separate addresses can be assigned in a 5-repeater system and up to 5000 can be assigned in a 20-repeater system. An ID code may be assigned to an individual mobile or a group of mobiles as required.

### 1.13.3 INTER-REPEATER DATA COMMUNICATION

Data communication between VIKING VX and LTR repeaters at a site is via a high-speed data bus. This bus cable is installed in a daisy-chain manner between repeaters. If both VIKING VX and LTR repeaters are located at a site, 20 repeaters can be interconnected. Refer to Section 1.9 for information on connecting the data bus.

### 1.13.4 MOBILE TRANSCEIVERS

The mobile and handheld transceivers used in an LTR system must be compatible with the type of signaling in use and also the frequency range.

## 1.14 REPEATER DATA BUS SIGNALING

### 1.14.1 GENERAL

A single-line serial data bus interconnects the logic units of all the LTR repeaters at the site. The first repeater powered on generates the synchronization pulse that is used by all other repeaters to determine their time slot on the data bus. If all repeaters are powered on at the same time, the lowest numbered repeater generates the synchronization pulse. There are 21 slots with 1-20 used for repeater reporting and 21 used by the ID Validator (see Section 1.14.3). The time slot used by a repeater is determined by the number assigned to that repeater by the programming in the MPC. Repeater 1 uses time slot 1, repeater 5 uses time slot 5, and so on. The data rate on the repeater data bus is 18,750 bits per second.

In its time slot, each repeater places information on the data bus indicating its status. If a repeater is not busy, only start bits appear in its slot. If a repeater is busy, it places in its slot the Home repeater and ID code of the mobile receiving the call on that repeater. If a repeater number is unassigned, nothing appears in that time slot.

### 1.14.2 MOBILE DATA MESSAGE ORDER

Each repeater monitors all the time slots on the repeater data bus. If it detects its number in another time slot, it begins transmitting an additional data message to its mobiles. This message tells mobiles programmed to detect that ID code to go to that repeater to receive a call. This additional message continues for as long as the mobile is transmitting on the other repeater.

The sequence of data messages transmitted on a home repeater is as follows: Every third message is to the mobile currently receiving a call on that repeater. Then alternating between these messages are messages to its mobiles that have been trunked to other repeaters. For example, assume that five different mobiles on a five-repeater system are making calls. If all have Repeater 1 as their home channel (not very likely in actual practice), the data message order on Repeater 1 is as follows: 1 2 3 1 4 5 1 2 3 and so on.

### 1.14.3 ID VALIDATOR OPERATION

If the ID Validator is used, it is programmed with the status of up to all 5000 home repeater/ID code combinations possible with a 20-channel system. Each combination is programmed as either valid or invalid. Information in the twenty time slots on the repeater data bus is monitored. If an invalid home repeater/ID code combination is detected, the ID Validator places in time slot 21 the number of the repeater being used by the invalid mobile and also the ID code. When a repeater detects its number in slot 21, it transmits the turn-off code (31) to the mobile receiving the call. That mobile then squelches and resumes monitoring its home channel. This effectively disables the invalid mobile because it cannot talk to anyone. When the turn-off code is sent, the repeater places "21" in the repeater position of its time slot to indicate to the ID validator that turn-off has occurred.



## SPECIFICATIONS

### GENERAL<sup>1</sup>

Frequency Range	806-824 MHz Receive, 851-869 MHz Transmit
Dimensions	9.125" H x 17" W x 20.9" D
AC Voltage/Frequency	100-240V AC/50-60 Hz
AC Current (Low Power)	0.40A (Standby), 1.7A (25W), 2.8A (75W)
AC Current (High Power)	0.40A (Standby), 3.8A (75W), 5.8A (175W)
AC Input Power (Low Power)	45W (Standby), 199W (25W), 328W (75W)
AC Input Power (High Power)	45W (Standby), 445W (75W), 680W (175W)
DC Current at 26.5V DC (Low Power)	5.2A (25W), 9.8A (75W)
DC Current at 26.5V DC (High Power)	11.5A (75W), 19.5A (175W)
Number of Channels	1 (Synthesized, programmable)
Channel Spacing	25 kHz
Channel Resolution	12.5 kHz
Temperature Range	-30°C to +60°C (-22°F to +140°F)
Duty Cycle	Continuous
FCC Type Acceptance	ATH2422008, ATH2422008-1
FCC Compliance	Parts 15, 90

### RECEIVER

12 dB SINAD	0.35 $\mu$ V
20 dB Quieting	0.50 $\mu$ V
Signal Displacement Bandwidth	$\pm 2$ kHz
Adjacent Channel Rejection	-85 dB
Intermodulation Rejection	-80 dB
Spurious & Image Rejection	-90 dB
Audio Squelch Sensitivity	12 dB SINAD
Audio Response	+1/-3 dB TIA
Audio Distortion	Less than 3% at 0.5W/16 ohms
Local Audio Power	0.5W/16 ohms
Audio Sensitivity	$\pm 1.5$ kHz
Hum & Noise Ratio	-45 dB
Frequency Spread	6 MHz
Frequency Stability	$\pm 1$ PPM -30°C to +60°C (-22°F to +140°F)

### TRANSMITTER

RF Power Out (Low Power)	75W (Default setting), 25W (Variable Set Point)
RF Power Out (High Power)	175W (Default setting), 75W (Variable Set Point)
Spurious Emissions	-90 dBc
Harmonic Emissions	-90 dBc
Audio Deviation	$\pm 3.5$ kHz
LTR Data Deviation	$\pm 1$ kHz
CWID Deviation	$\pm 2$ kHz
Repeat Deviation	$\pm 1.5$ kHz
Audio Response	+1/-3 dB TIA
Audio Distortion	Less than 2%
Hum & Noise (TIA)	-45 dB
Frequency Spread	6 MHz
Frequency Stability	$\pm 1$ PPM -30°C to +60°C (-22°F to +140°F)
Emission Designators	14K0F3E, 16K0F3E, 14K0F3D, 16K0F3D, 14K0F1D, 16K0F1D

1. These general specifications are intended for reference and are subject to change without notice. Contact the Systems Applications consultants for guaranteed or additional specifications.





## SECTION 2 INSTALLATION

### 2.1 INTRODUCTION

Information in this section tells how to set up the repeater for operation in an LTR system. It is assumed that the repeater has been previously aligned at the factory or as described in the alignment procedure in Section 7.

Even though each repeater is thoroughly aligned and tested at the factory, it is good practice to check performance before it is placed in service. This ensures that no damage occurred during shipment and that the repeater is otherwise operating properly. Performance testing is described in Sections 7.1, 7.2, 7.3 and 7.4.

#### 2.1.1 SITE PREPARATION AND ANTENNA INSTALLATION

Site preparation and antenna installation are not within the scope of this manual. Basic installation requirements are discussed in the "Dealer Guide To Site Preparation", Part No. 004-8000-100. Factory installation is also available. Contact your Johnson representative for more information.

### 2.2 ENVIRONMENT

The following conditions should be considered when selecting a site for the Repeater.

Operating Temperature.

-30°C to +60°C (-22°F to +140°F).

Humidity.

Less than 95% relative humidity at 50°C.

Air Quality.

For equipment operating in a controlled environment with the Repeaters rack mounted, the airborne particles must not exceed 30 µg/m<sup>3</sup>.

For equipment operating in an uncontrolled environment with the Repeaters rack mounted, the airborne particles must not exceed 100 µg/m<sup>3</sup>.

*NOTE: If the Repeater is installed in an area that exceeds these environmental conditions, the site should be equipped with air filters to remove dust and dirt that could cause the equipment to overheat. The cabinets and filters should be placed on a maintenance schedule.*

When the repeaters are installed in an environment that contains small airborne particles, e.g. grain dust or salt fog, the repeater cabinets need to be sealed. A heat exchanger, i.e. air conditioner, is then required to cool the cabinets. The air conditioners must be suited for the environment. Each low power repeater (75W) requires >1200 BTU/hr dissipation to maintain exterior cabinet temperature. Each high power (160W or 175W) requires >2100 BTU/hr dissipation to maintain exterior cabinet temperature.

### 2.3 VENTILATION

The RF modules and the power supply are equipped with fans, controlled by thermostats, that force air through the equipment for cooling. The air flow is from the front to the back of the equipment. This permits the Repeaters to be stacked or rack mounted (see Figure 2-4). There are a few considerations when installing Repeaters to provide adequate air circulation.

1. The Repeaters should be mounted with a minimum of 6 inches clearance between the front or back of the cabinet for air flow. The power supply requires a minimum of 18 inches at the back of the Repeater for removal.

*NOTE: Repeaters should not touch. Leave a minimum of one empty screw hole (approximately 1/2") between repeaters vertically especially for bottom ventilation slots in high power repeaters.*

- Cabinet enclosures must provide air vents for adequate air circulation.
- Temperature and humidity must be considered when several Repeaters are installed at a site. This might require air conditioning the site.

## 2.4 AC POWER

The AC power source to the Johnson VIKING VX Repeater can be 120V AC or 240V AC. Nothing need be done to the power supply for 240V AC operation. However, a 240V AC outlet requires that the 120V AC power plug be replaced. A locking AC power cord is provided for the supply.

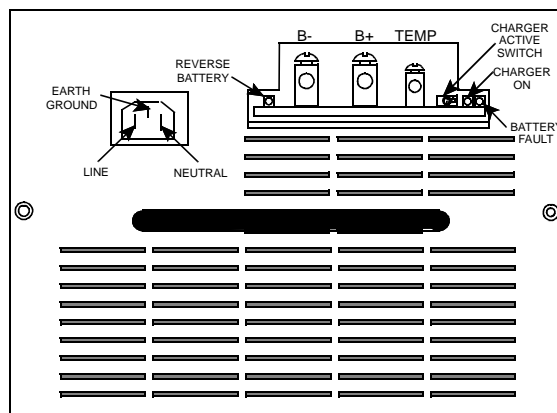
The 120V AC cord is a standard 3-wire grounded cord used with a standard AC wall outlet. The outlet must be capable of supplying a maximum of 328W (-232) or 680W (-234). With the nominal 120V AC input, the source must supply 3A for each 75W repeater or 6A for each 175W repeater and should be protected by a circuit breaker. It is recommended that all of the repeaters in a rack should not be on the same breaker in order to provide one operational repeater in the event a breaker trips. An AC surge protector is recommended for all equipment.

Each Repeater requires an outlet, so for a 5-channel system, a minimum of 5 outlets is required. An additional three outlets should be added for test equipment. The outlets must be within 3 feet of each Repeater cabinet. Future system expansion should be considered when electrical work is being planned for the initial system.

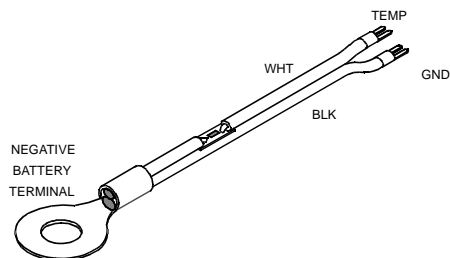
The VIKING VX Repeater power supply can be equipped with an optional 24V DC back-up in the event of AC power failure. Since the transmitter will remain on full power, if desired, the DC power source must have a current capability of about 15A per 75W repeater (25A per 175W repeater) or 75A for 5-75W repeaters (125A for 5-175W repeaters). The multi-coupler requires another 0.5A for a total system requirement at 24V DC of 75.5A for 75W repeaters (125.5A for 175W repeaters).

## 2.5 BATTERY BACKUP

If the power supply is equipped with battery backup, screw lugs are provided on the front of the power supply for battery connections (see Figure 2-1). A switch is provided for charging the battery or can be off if a separate battery charger is used. A battery temperature sensor connection is also provided. The temperature sensor cable is shown in Figure 2-2. LED indicators are provided to show Reverse Battery connection, Charger On/Off and Battery Fault.



**Figure 2-1 BATTERY BACKUP CONNECTOR**



**Figure 2-2 TEMPERATURE SENSOR CABLE**

## 2.6 800W POWER SUPPLY

The power supply has four voltage output levels (see Table 2-1). Each voltage is set to  $\pm 1\%$  at  $+25^{\circ}\text{C}$  ( $+77^{\circ}\text{F}$ ). The output of this supply is capable of running any 2000 series repeater.

Each output is overload protected such that the power supply current limits and automatically resets when the overload is removed (see Table 2-1).

Each output is over voltage protected such that the power supply shuts down when an over voltage condition exists, usually when a component in the supply has failed (see Table 2-2). The power supply must be manually reset by toggling the Enable Line or removing AC power for more than 10 seconds.

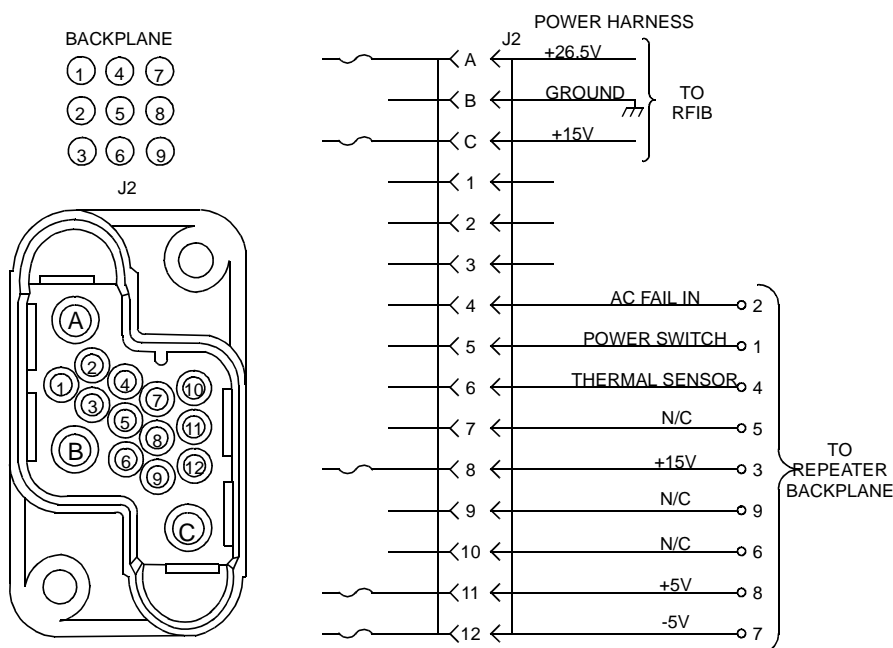


Figure 2-3 POWER CABLE CONNECTOR AND SCHEMATIC

Table 2-1 OUTPUT VOLTAGES

Voltage	Current	Wattage
+26.5V	22A	583W
+15V	5A	75W
+5.2V	5A	26W
-5V	1A	5W

Table 2-2 OVER VOLTAGE

Voltage	Range
+26.5V	+32V to +33V
+15V	+16V to +18V
+5.2V	+6V to +7V
-5V	-6V to -7V

## 2.6.1 AC INPUT REQUIREMENTS

AC Input Voltage:	100-240V AC
Line Frequency:	50-60 Hz
AC In-rush:	60A maximum
Overall Efficiency:	>70% at 100V AC >80% at 240V AC
Lightning protection:	6kV for < 1ms
Power Factor:	>0.97 at full load
Brown Out Voltage:	80V AC
Temperature	-30°C - +60°C (full power)

Power factor correction per IEC555. The Power supply has the following safety agency approvals pending: UL1950, CSA22.2-950, TUV EN60950 (IEC950)

When the AC input voltage is below 90V AC, the maximum output power is decreased to keep the input current constant. If a battery back-up is installed, the batteries take over when the AC input voltage falls below 80V AC (dependant on power output).

The AC input connector is an IEC connector equipped with a locking mechanism.

The operating temperature range is -30°C to +60°C (-22°F to +140°F), i.e. the same as the repeater. The fan is thermostatically controlled by the internal temperature. When the internal heatsink temperature reaches +45°C (113°F) the fan turns on. When the heatsink temperature drops below +35°C (95°F) the fan turns off. If the internal heatsink temperature reaches +90°C (+194°F) the power supply turns off until the heatsink temperature drops below +85°C (+185°F). The over-temperature shutdown and restart are automatic.

## 2.7 GROUNDING

### CAUTION

*PROPER SITE GROUNDING AND LIGHTNING PROTECTION ARE VERY IMPORTANT TO PREVENT PERMANENT DAMAGE TO THE REPEATER.*

As in any fixed radio installation, measures should be taken to reduce the possibility of lightning damage to the Viking VX equipment. Proper grounding eliminates shock hazard, protects against electromagnetic interference (EMI) and lightning.

Ground each piece of equipment separately. Do not ground one piece of equipment by connecting it to another grounded piece of equipment.

A good DC ground must be found or created at the site. Rooftop site grounds can be researched through the building management or architects. Tower site grounds must be made with grounding rods. The many techniques for providing adequate grounds for towers and poles and for installing building ground bus lines are beyond the scope of this manual. Refer to National Electrical Code article 250 "Grounding Techniques," article 800 "Communications Systems" and follow local codes.

The ground bus should be routed to the floor area within 5 feet of the system with a runner of 6 AWG or larger solid copper wire or 8 AWG stranded copper wire.

The outer conductor of each transmission line at the point where it enters the building should be grounded using 6 AWG or larger solid copper wire or 8 AWG stranded wire.

Secondary protection (other than grounding) provides the equipment protection against line transients that result from lightning. There are two types of secondary protection, RF and Telephone Line. Use the same wire sizes as specified for coaxial cables for any ground connections required by the secondary protectors.

### • RF

An RF protector keeps any lightning strike to the antenna feed line or tower from damaging the Repeaters. Install this protection in-line with the combiner and antenna feed line.

RF protectors are selected by calculating the maximum instantaneous voltage at the output of the combiner. Do this by using the following equation.

$$V_p = 1.414(X)(\sqrt{P(50)})$$

where:

$V_p$  = Voltage at the output of the combiner.

P = repeater output in watts

X=	for	VSWR=
1.05		1.10 : 1
1.09		1.20 : 1
1.13		1.30 : 1
1.17		1.40 : 1
1.20		1.50 : 1
1.30		1.86 : 1

Example: Repeater power output of 60W with a VSWR of 1.3 : 1 (for this VSWR, X = 1.13):

$$V_p = 1.414(1.13)(\sqrt{60(50)})$$

$$V_p = 1.59782(\sqrt{60(50)})$$

$$V_p = 1.59782(54.772256)$$

$$V_p = 87.52V$$

### • Telephone Line

There are four types of protection suppressors for telephone lines; Gas Tube, Silicon Avalanche Diode, Metal Oxide Varistor and Hybrid.

The hybrid protector is ideal for Transcrypt International, Inc. equipment, and is strongly recommended. A hybrid suppressor combines several forms of protection not available in just one type of device.

For example, a high-speed diode reacts first, clamping a voltage strike within 10 ns, a heavy duty heat coil reacts next to reduce the remainder of the current surge, and a high-powered three-element gas tube fires, grounding Tip and Ring.

## 2.7.1 PROTECTION GUIDELINES

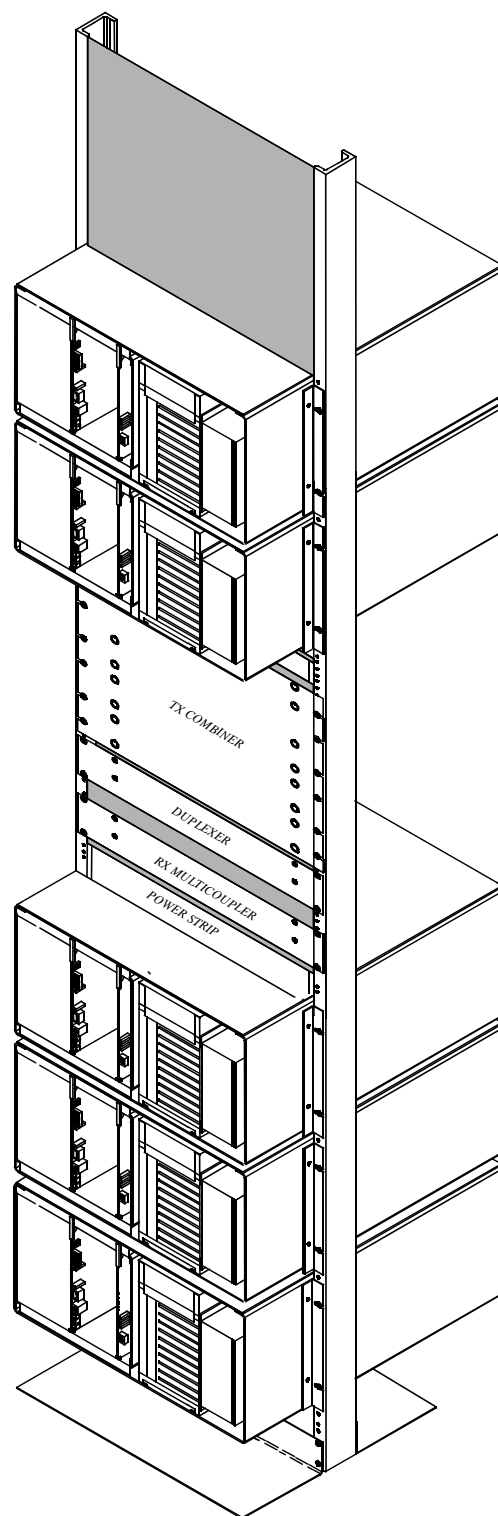
Follow these guidelines for grounding and lightning protection. Each Repeater installation site is different; all of these may not apply.

- Ensure that ground connections make good metal-to-metal contact (grounding rod, grounding tray, metal conduit) using #6 gauge solid wire or braided wire straps.
- With surge protectors, ensure that ground wires go directly to ground, and not through other equipment.
- Run the ground wire for RF coax protectors directly to ground.
- With coax protectors, ensure maximum instantaneous voltage does not exceed the rated voltage.
- Do not run ground wires parallel to any other wiring (e.g. a ground wire parallel to a telephone line), except other ground wires.
- Double check all equipment for good ground and that all connections are clean and secure.

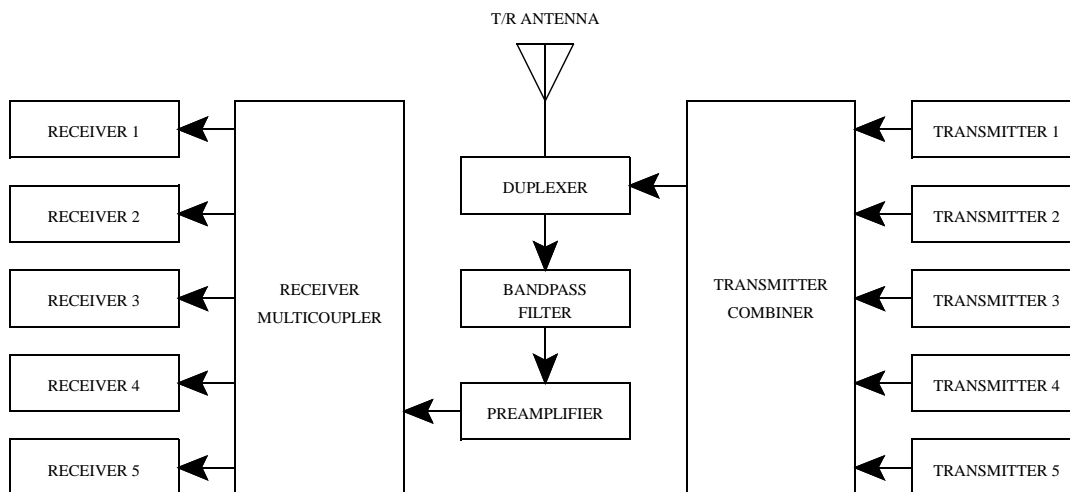
## 2.8 UNPACKING AND INSPECTION

Transcrypt Internation, Inc. ships the Repeater securely crated for transportation. When the Repeater arrives, ensure the crates remain upright, especially if storing the crates temporarily.

When unpacking the Repeater, check for any visible damage or problems caused by shipping. If there is obvious damage from shipping mishaps, file claims with the carrier. If there appears to be any damage caused before shipping, file a claim with Transcrypt Internation, Inc. Contact Customer Service for assistance (see Section1.7).



**Figure 2-4 RACK MOUNTED REPEATERS**



**Figure 2-5 5-CHANNEL COMBINING SYSTEM**

If everything appears undamaged, remove the Repeater equipment from the crate, using normal precautions for unpacking.

*NOTE: Do not discard the packing materials. If you must return an item; use the same packing materials and methods (including static protective bags for circuit cards) to repack the equipment. You are responsible for proper repacking. Transcrypt International, Inc. cannot be responsible for damage to equipment caused by negligence.*

*NOTE: Repeaters should not touch, leave a minimum of one empty screw hole (approximately 1/2") between repeaters vertically especially for bottom ventilation slots in high power repeaters.*

*NOTE: Each repeater should be grounded separately by connecting a ground bus from the ground lug on the back side of the RF module to the ground bar on the rack (see Figure 2-8).*

## 2.9 REPEATER DATA BUS INSTALLATION

VIKING VX repeaters with High Speed Data Bus (HSDB) software Version 201 or earlier (reference U14 label) installed on the MPC board must use the optional RJ-11 to BNC Adapter Module (see Table 1-1 and Figure 2-9) to connect the HSDB. Any

VIKING VX repeater (regardless of the HSDB software version, see Section 4.5.4) that connects to a HSDB that is also servicing LTR 8000/8900 repeaters, other VIKING VX repeaters that use VIKING VNC cards, or an ID Validator must also use the adapter module. The BNC Adapter Module is installed on the back of the VIKING VX repeater cabinet (see Figure 2-13 and Figure 2-14).

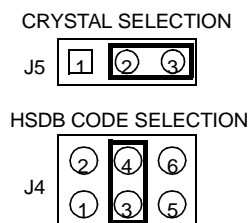
Systems constructed only with LTR VIKING VX repeaters that have Version 202 or later HSDB software ( see Section 4.5.4) and do not use VNC cards can be connected directly to the HSDB from the RJ-11 jack on the back of the repeater.

### 2.9.1 MPC DATA BUS SWITCH SETTINGS

Switch settings on the MPC for the two types of installations require S2 and S3 sections to be switched as indicated in Figures 2-10 through 2-14.

### 2.9.2 MPC DATA BUS JUMPER SETTINGS

Refer to Figure 2-6 for crystal selection and HSDB Code selections jumper placement. The jumper on J5, pins 2-3 selects 12 MHz crystal for LTR. The jumper on J4, pins 3-4 connects EPROM U14, pin 27 (A14) to +5V for LTR single-ended 5V data bus.



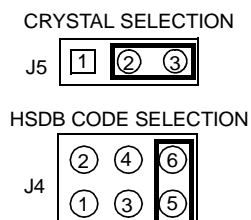
**Figure 2-6 RJ-11 TO BNC MPC JUMPERS**

Jumper J4 must be placed with the following guidelines (see Figure 2-6):

J4, pins 3-4 for operation with the RJ-11 to BNC adapter module and mixed systems (2008 and 8000) with any version of HSDB software.

J4, pins 3-4 for operation with the RJ-11 to BNC adapter module with 2008 only systems with any version of HSDB software.

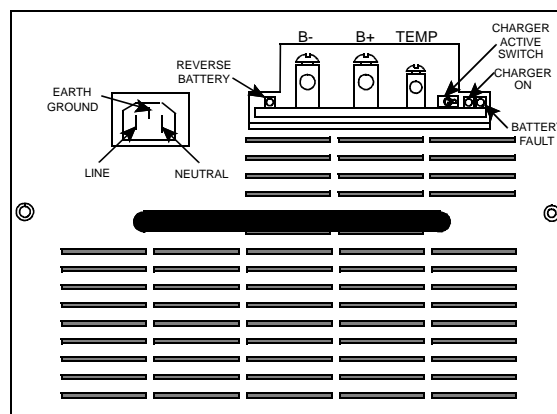
J4, pins 5-6 for operation with the RJ-11 to RJ-11 cable with 2008 only systems with Version 202 or later HSDB software.



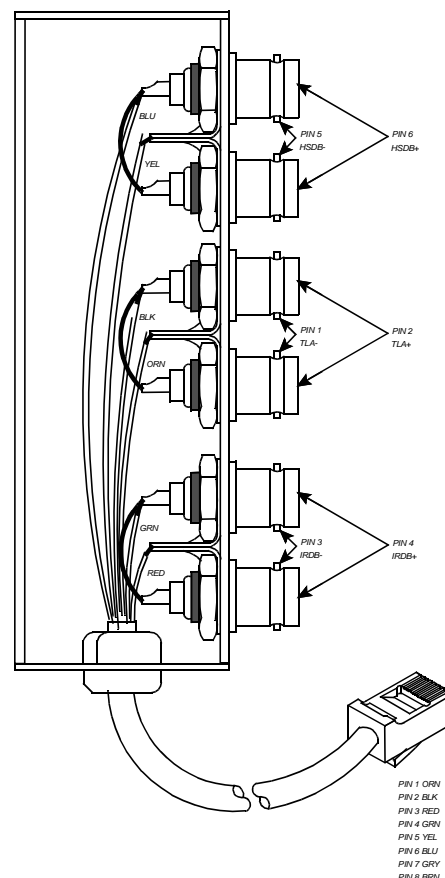
**Figure 2-7 RJ-11 TO RJ-11 MPC JUMPERS**

## 2.10 CONNECTING RECEIVE AND TRANSMIT ANTENNAS

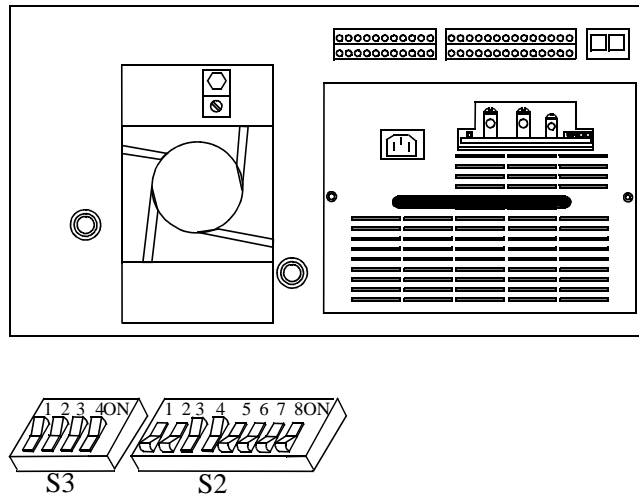
Receive and Transmit antenna connector locations are shown in Figure 2-8. Although each transmitter and receiver could be connected to a separate antenna, this is usually not done because of the large number of antennas required by a multiple repeater installation. Therefore, an antenna combining system is usually used. An example of a combining system for a five-channel system is shown in Figure 2-5. The amount of power loss introduced by a combiner depends on the type of combiner used. If it has a loss of 3 dB, power output to the antenna is reduced by half.



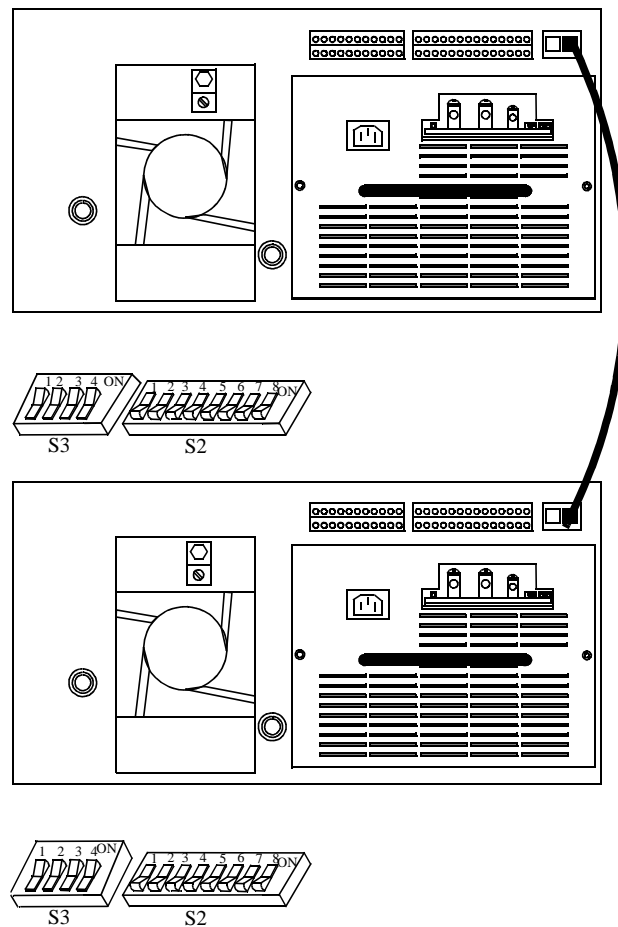
**Figure 2-8 ANTENNA CONNECTIONS**



**Figure 2-9 RJ-11 TO BNC ADAPTER MODULE**



**Figure 2-10 SINGLE REPEATER INSTALLATION**



**Figure 2-11 TWO REPEATER INSTALLATION**



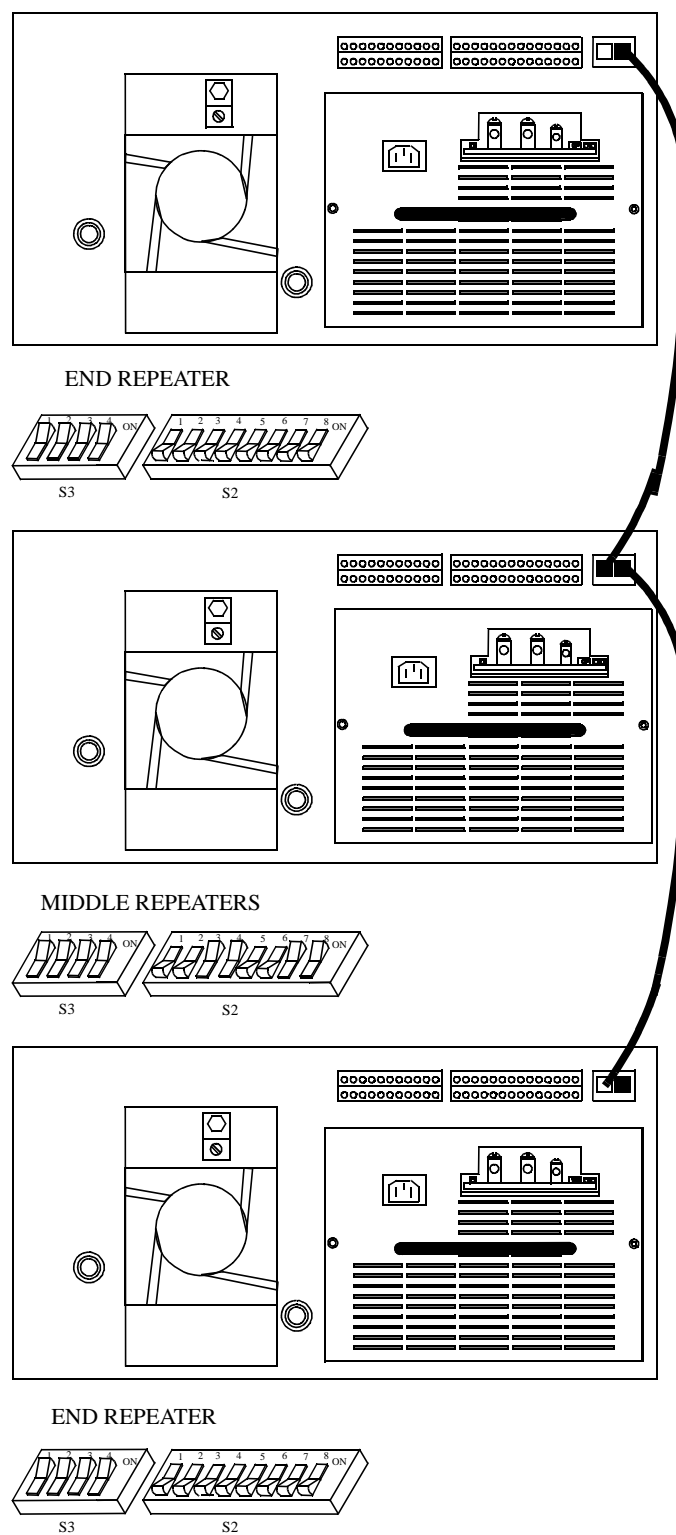


Figure 2-12 THREE OR MORE REPEATERS INSTALLATION

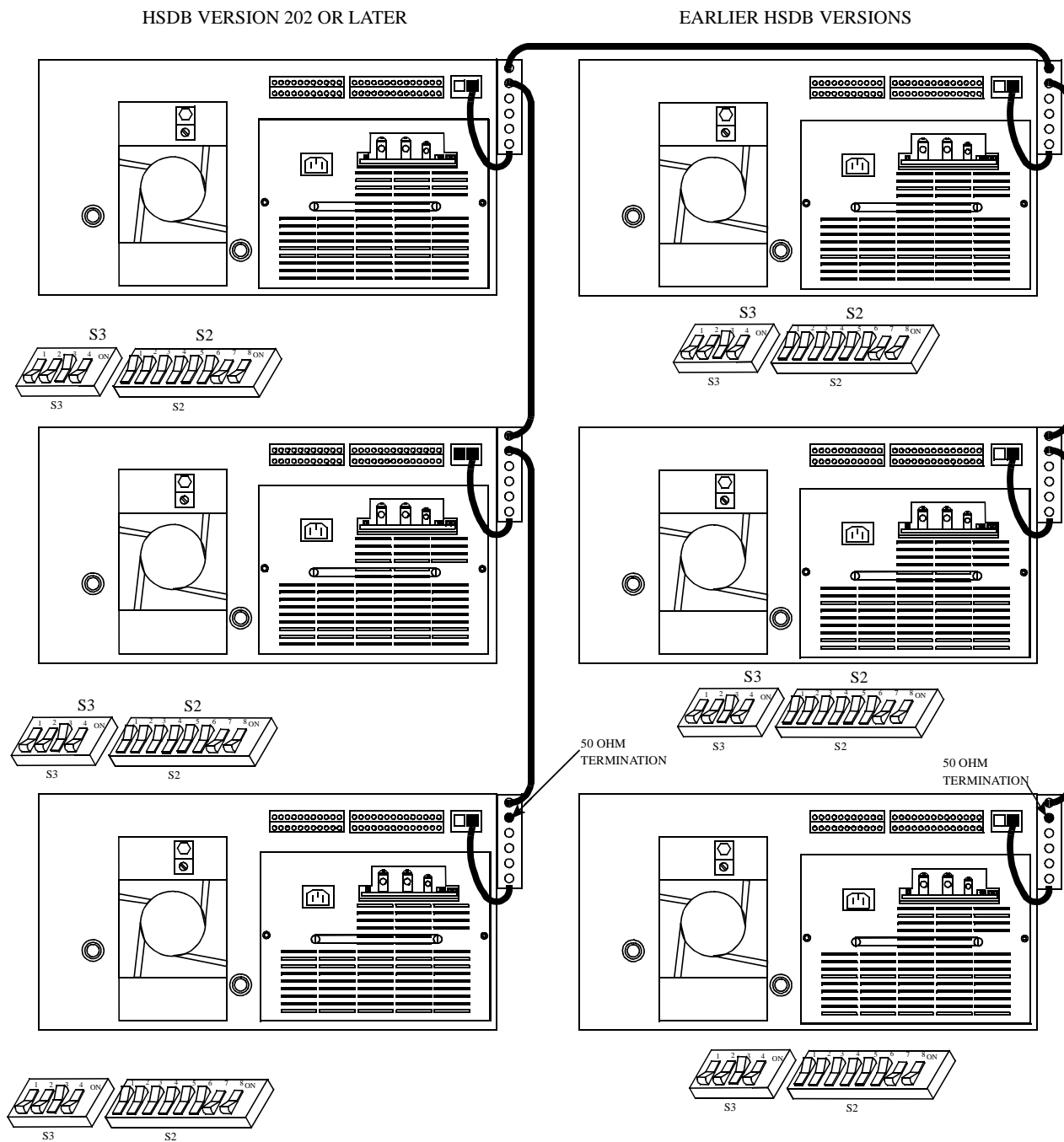


Figure 2-13 MIXED VIKING VX REPEATER INSTALLATION

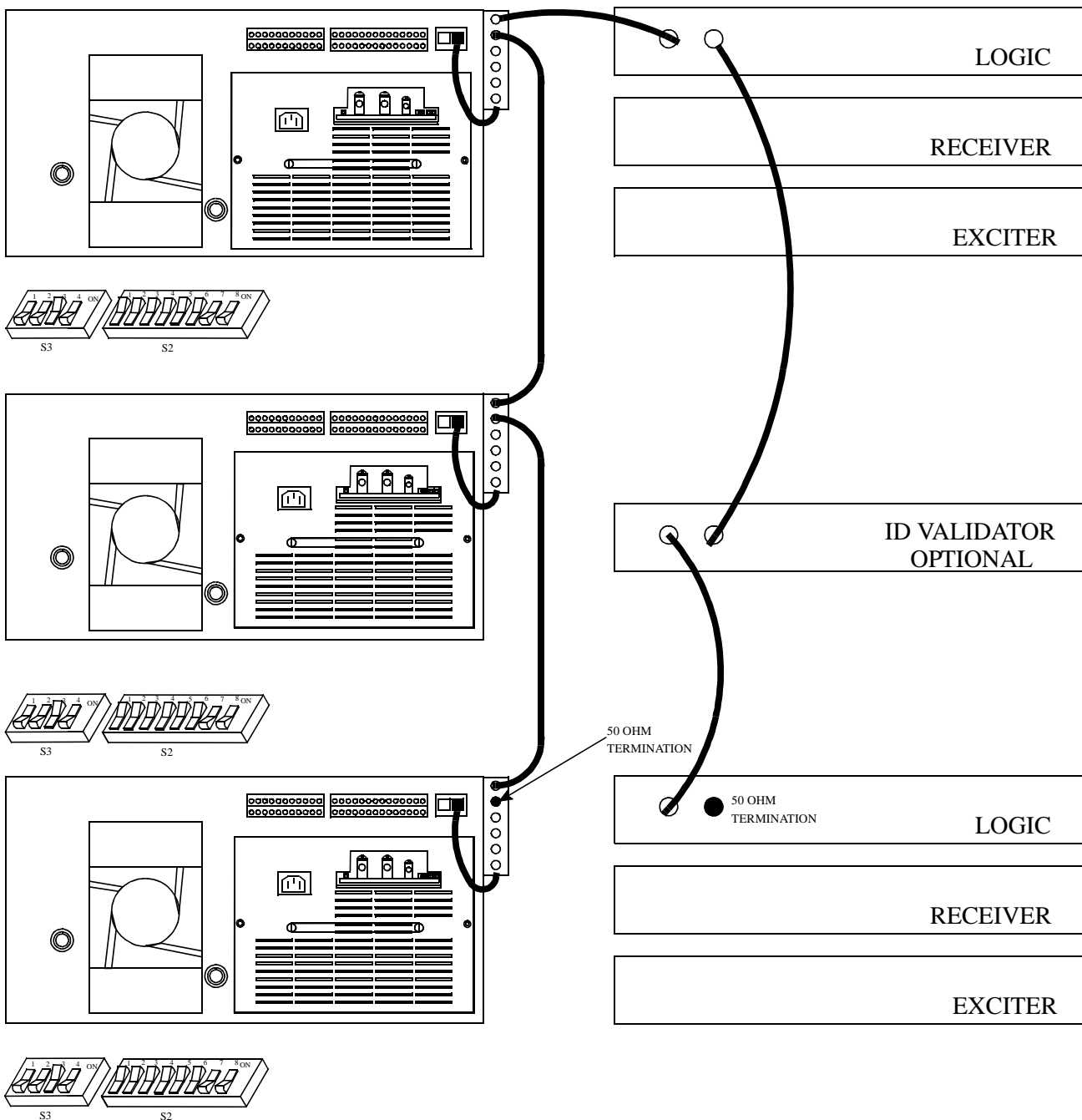


Figure 2-14 MIXED VIKING VX AND CR1010 REPEATER INSTALLATION



## SECTION 3 SOFTWARE

### 3.1 INTRODUCTION

The Johnson Summit QX Repeater Program on 3.5 inch disk, Part No. 023-9998-297, uses an IBM® personal computer to program the EEPROM Memory in the Main Processor Card (MPC). To lessen the chance of programming errors and simplify operation, the program uses yes/no questions or toggles through the available responses.

The computer is connected directly from the serial card to the MPC. The interconnect cables used are shown in Figure 4-30. The DB-9 to 8-pin modular adapter is connected to the serial port of the computer and an interconnect cable connects the adapter to the MPC.

*NOTE: These connections are for the IBM computer and may differ from an IBM compatible. In which case, consult the manuals for your computer for serial card outputs and connections.*

#### 3.1.1 HOW TO USE THIS MANUAL

This manual introduces the program and illustrates how to use the features. This manual is organized to easily find programming information with the Table of Contents, Index and Parameter Tables for the responses required for programming.

Graphic reproductions of the screens are shown for reference. Adjacent to the screens are tables to provide the parameters, available responses and a brief description of the parameter. It is not the intent of this manual to teach computer operation, but to allow the user to become familiar with the available screens and the responses without having to be at the computer.

#### 3.1.2 GETTING STARTED

*NOTE: Before starting you should already know how to start MS-DOS®, format and make backup copies of disks, copy and delete files, and run programs. If you are unfamiliar with any of these actions, refer to the MS-DOS manual for your computer for more information (see Section 5).*

Follow the computer instructions for loading the disk. The MS-DOS Revision 2.0 or later operating system is needed to run the programs. The computer needs to have RS-232C capability, for example, the Serial Card in slot "COM1" or "COM2".

#### 3.1.3 COMPUTER DESCRIPTION

The programming software is designed to run on an IBM PC or compatible computer that meet the following minimum requirements.

- One 3.5" high density disk drive
- 640K of memory
- MS-DOS version 2.0 or higher
- One serial port
- Monochrome or color monitor and video card

Although the program uses color to highlight certain areas on the screen, a monochrome (black and white) monitor or LCD laptop also provide satisfactory operation. Most video formats such as EGA and VGA are supported. A serial port is required to connect the repeater to the computer. This port is standard with most computers.

The cables from the repeater to the computer are not included. With most computers, the adapter-to-computer cable is a standard DB-25 M-F cable, PN 023-5800-017, (the male connector plugs into the adapter). If your computer requires a male connector, a male-to-male cable is also available, PN 023-5800-016. The cable from the adapter to the repeater has a DB-9 to 8-pin connector (see Figure 4-30).

#### 3.1.4 EEPROM DATA STORAGE

The data programmed into the MPC is stored by an EEPROM memory. Since this type of device is nonvolatile, data is stored indefinitely without the need for a constant power supply. A repeater can be removed from the site or even stored indefinitely with-

out affecting programming. Since EEPROM memory is also reprogrammable, a new device is not needed if programming is changed.

### 3.1.5 COMMAND LINE OPTIONS

- Help

To show all options available from the command line type: /h or /?. Either ' ' or '-' can be used. For example: 2000pgmr /h

The options can be entered in any order. For example: 2000pgmr /d /b /c

- COM Port

The Johnson programming software defaults to serial port COM1. However, if this port is already in use, the software can be reconfigured to use serial port COM2. To do this, use one of the following methods:

1. When running the compiled (.EXE) version, type /c2 on the command line after the program name. For example: 2000pgmr /c2 or -c2
2. Select COM port from Utilities heading.

### BAUD RATE

The software defaults to 9600 baud, however this rate can be changed. To do this from the command line, type /bxxxx (xxxx = baud rate). For example: 2000pgmr /b or -b

*NOTE: When the baud rate is changed on the command line the baud rate jumpers on J3 in the MPC must also be changed to the same baud rate (see Section 6.10.8).*

### DEMO MODE

To view the screens for Read Setup Parms and Write Setup Parms from the Transfer menu when a repeater is not connected to the computer this option is used. Normally these screens are not available without a repeater connected. To do this from the command line, type: /d or -d.

For example: 2000pgmr /d

### 3.1.6 COLOR OR MONOCHROME OPERATION

The programming software utilizes color for a color monitor and video card. However, with LCD-type displays, this may make some information hard to read because the contrast is poor. To improve contrast, a monochrome mode can be selected in the display mode from Utilities heading.

## 3.2 REPEATER PROGRAM SOFTWARE

### 3.2.1 INSTALLING THE SOFTWARE

When you receive the programming software, make a backup copy and store the master in a safe place. Copy the distribution disks using DOS DISK-COPY command. For example, type:

DISKCOPY A: A: (single floppy drive)

or

DISKCOPY A: B: or C: (multi-drive systems).

If you have a hard disk drive, you may want to create one or more separate directories for transceiver programming and then transfer the program disk files to those directories. To create a new directory, use the MKDIR command. For example, to create directory RADIOPRG, type:

MKDIR \RADIOPRG.

Then to make the new directory the current directory, use the CHDIR command. For example, to change to the \RADIOPRG directory, type

CHDIR \RADIOPRG.

To copy all files from a floppy disk in drive A: to this directory, type:

COPY A: \*.\*

If you have a single floppy drive and no hard disk drive, you need to create programming disks. The reason for this is that there is not adequate space on the backup disk(s) for storing radio files. If your computer has dual floppy disk drives, the backup disk can be placed in one drive and then the radio files stored on a disk in the second drive.

To make a programming disk, format a blank disk using `FORMAT B:` or `FORMAT B: /S` (use `/S` if it must be a bootable disk). Then copy the required program file or files to the programming disk. To do this, type `COPY A:(filename.ext) B:(filename.ext)`. For example, to copy the file `2000pgm2.exe` from drive A to drive B, type

```
COPY A:2000pgm2.exe B:2000pgm2.exe
```

This procedure works for either single or dual drive computers. Refer to your computer reference manual for more information on these DOS commands.

The programming software is shipped in a compressed format. The name of the compressed file is `2000pgm2.exe` and it extracts the following files so the program can be used on a PC.

2000PGMR.EXE	480K
2000PGMR.HLP	42K
TESTM8L.HLP	2K
2000PGMR.LNF	173K
TESTM8H.LNF	11K
TESTM8L.LNF	225K
TESTM9H.LNF	11K
TESTM9L.LNF	208K
TESTT8L.LNF	53K
TESTT9L.LNF	51K

The `2000PGM2.EXE` file is self extracting which means that the files extract automatically when executed. To extract these files so the program can be used, first make the current directory the destination directory for these files. For example, to make it the `\RADIOPRG` directory on drive C: (if not the current directory), type `C:` (Return) and then `CD \RADIOPRG` as just described. To make it the disk in drive B:, simply type `B:`. Then insert the program disk in drive A: and type `A:2000PGM2` (or `B: 2000PRM2` if drive B: is being used). The program files are automatically extracted into the current directory or disk.

### 3.2.2 MINIMUM FREE MEMORY REQUIRED

Approximately 525K of free conventional memory is required to run this program (use the `CHKS` or `MEM` command to display the amount of free memory). If you have at least 640K of memory and not enough is available, there may be other programs that

are also being loaded into conventional memory. Contact Customer Service for information on how these programs can be moved or disabled to make more space available.

## 3.3 REPEATER PROGRAMMER

When the program is loaded into the computer and executed, the menu shows the files available from the directory. The program is used to create, edit, transfer and receive the repeater and channel parameters described in Section 5.

### IMPORTANT

*The commands and displays referred to in this manual are for the IBM PC and may differ from IBM compatible. Refer to the computer's operating system manual for command explanations.*

#### 3.3.1 PROGRAM FILES

The files that appear in the program directory are needed for program operation.

## 3.4 ALIGNMENT SOFTWARE

The software for the Summit QX repeater programs the MPC to open and close the audio/data gates necessary for the alignment selected from the Test-Full Repeater menu. Under the menu heading Test are the alignment procedures for the PA (see Section 7.3), Receiver (see Section 7.1), Exciter (see Section 7.2) and overall Full Repeater (see Section 7.5) including the MAC card (see Figure 3-1).

File Edit Transfer Hardware Test Utilities

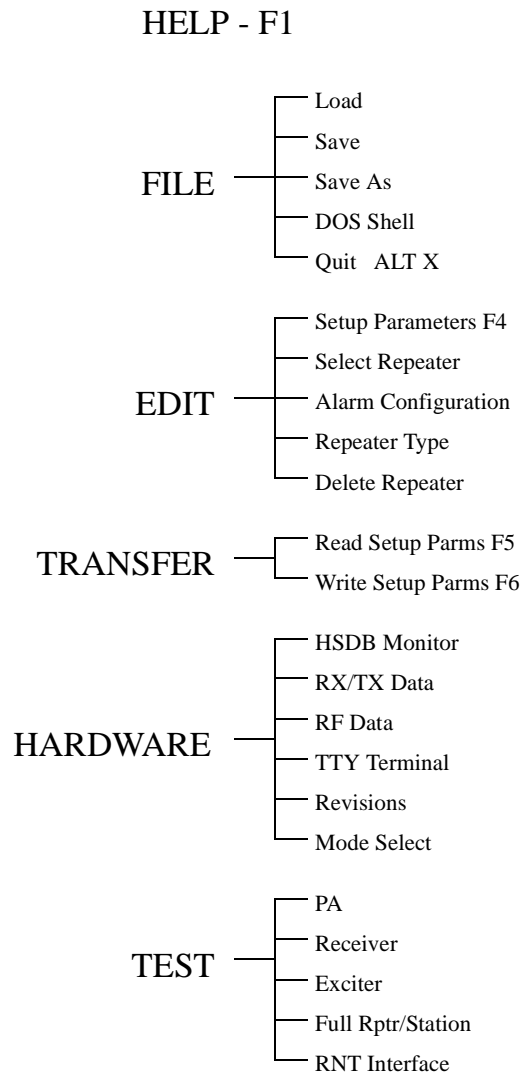
PA
Receiver
Exciter
Full Rptr/Station
RNT Interface
Telephone Interface
VNC Interface

**Figure 3-1 REPEATER TEST MENU**

Refer to Section 7 for alignment procedures as shown in the program, alignment points diagrams and test setup diagrams.

### 3.5 HELP F1

Help screens are available for most parameters and options in this program. Whenever a parameter or options clarification is needed, press F1 and if a help screen is available it will pop-up on the screen. Press Escape <ESC> to exit the pop-up screen.



**Figure 3-2 PROGRAMMING FLOWCHART**



## SECTION 4 PULL DOWN MENUS

### 4.1 MENU DISPLAYS

The menus available are listed at the top of the screen (see Figure 3-2). Move the cursor with the arrow keys to highlight the menu name. Press Enter to view the menu and the arrow keys to scroll through the menu. Call up the highlighted selection by pressing Enter.

### 4.2 FILE MENU

This menu manipulates new or existing files into directories and saves files to be called up at another time.

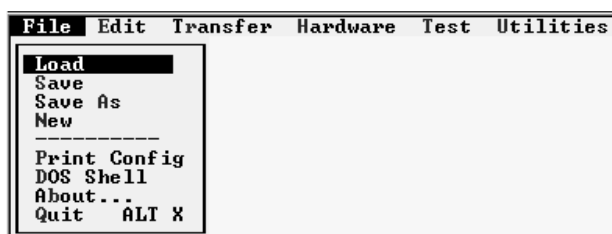


Figure 4-1 FILE MENU

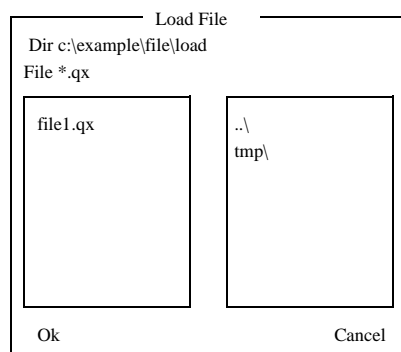


Figure 4-2 LOAD FILE

#### 4.2.1 LOAD

Load reads information from a stored file. The program requests the filename to be loaded into the buffer. The filename from a disk can be entered in the highlighted area. Then move the cursor down with the arrow key and highlight "Ok" and press Enter. To select an existing file, use the arrow keys to move down the menu list and press Enter when the highlighted filename is the file to load.

#### 4.2.2 SAVE

This saves the edited version of an existing file loaded in the buffer under the same filename in the directory and deletes the old file. It loads a new file created in the Edit menu into the directory.

#### 4.2.3 SAVE AS

This saves the edited version of an existing file loaded in the buffer under a new filename or gives a new file created in the Edit menu a filename.

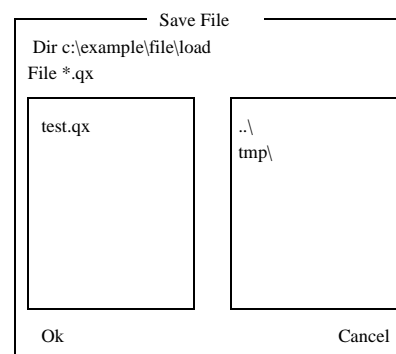


Figure 4-3 SAVE FILE

#### 4.2.4 NEW

This menu selection erases all Site and Repeater information in the programmer and loads factory defaults. If the current data has been changed, selecting File -> New provides the opportunity to save the data before loading the defaults.

#### 4.2.5 PRINT REPEATER CONFIGURATION

Select the destination for the configurations.

Printer - Prints to printer connected to PC.

File - Writes printable test to selected filename.

Select which repeater data will be printed.

All Repeaters - Prints the data for all valid repeaters.

Single Repeater - Prints the data for the entered repeater number.

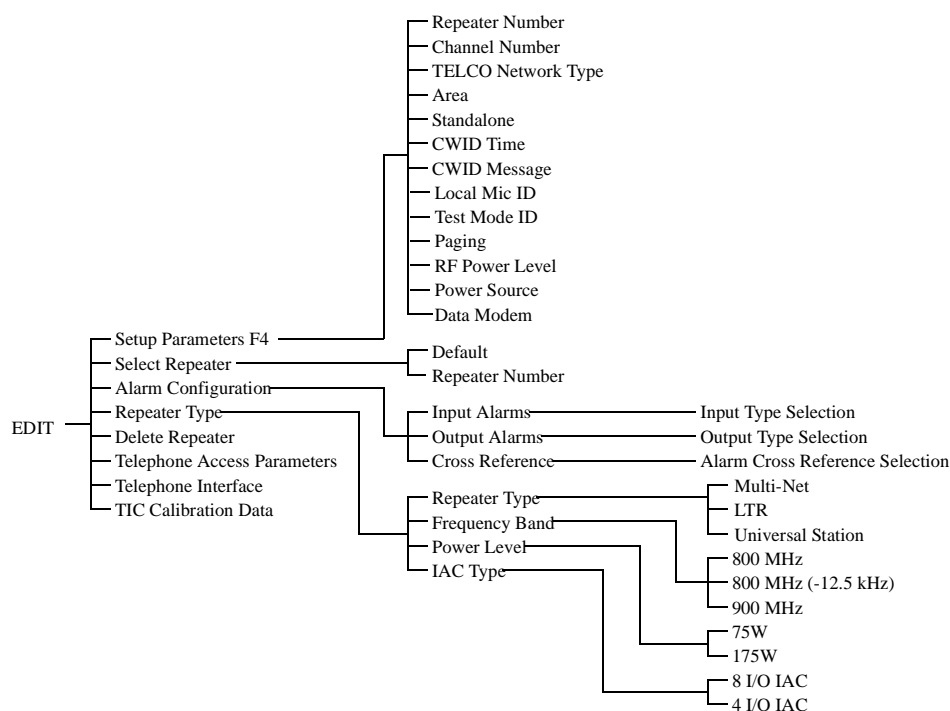
*NOTE: A list of valid repeaters can be seen under the Edit-Select Repeater menu selection.*

#### 4.2.6 DOS SHELL

DOS shell temporarily suspends the program and returns to DOS. Directories and other DOS commands can be performed. To return to the program from DOS, type EXIT and press Enter.

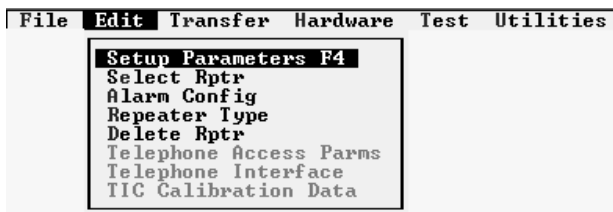
#### 4.2.7 QUIT (ALT X)

Quit exits the repeater program and returns to DOS. Save all files before exiting the repeater program.



**Figure 4-4 EDIT PROGRAMMING FLOWCHART**

## 4.3 EDIT



**Figure 4-5 EDIT MENU**

This menu is used to create new files and set or change the repeater operating parameters. The file-name for the repeaters in this file is shown in the lower left corner of the screen.

### 4.3.1 SETUP PARAMETERS

First see Section 4.3.4 to select repeater type to setup LTR Parameters. This menu programs the repeater parameters and options of each repeater at a site. Table 5-1 lists the parameters that are set by this screen (see Figure 5-1) and gives a brief description of each.

*NOTE: The parameters are shown in the lower left of the pop-up screen for reference.*

- Repeater Number

Each repeater is programmed with a repeater number from 1-20. Make sure that this number agrees with the Home repeater number programmed in the mobiles assigned to this repeater.

- Channel Number

Each repeater is programmed with a channel number (1-920).

*NOTE: Repeater program channel numbers 1-599 increment in 25 kHz steps. Program channel numbers 600-920 increment in 12.5 kHz steps. See Appendix A to determine the correct operating frequency.*

- Telco Network Type

None is used for LTR system repeaters.

- Area

This is the same as the area bit used when programming the mobiles. This bit is usually "0".

- Sync Repeater

None is used for LTR system repeaters.

- Stand Alone

Select if the repeater is not connected to additional repeaters via the high speed data bus.

- ID Validator (Not applicable at this time.)

- CWID Time

The time interval between transmission of the repeater's CWID message.

- CWID Message

FCC regulations require that the station call letters be transmitted periodically on the lowest- frequency repeater in the system and disabled on all the others. Morse code is used to encode these letters/ numbers for continuous-wave (CW) transmission (15 characters/numbers UPPER CASE).

- Local Mic ID

The local microphone connected to the MAC jack is assigned a Group ID for transmitting when the local microphone PTT is active. This allows the Repeater to operate as a base station.

- Test Mode ID

This is the Group ID transmitted when the Repeater is in Test Mode. Mobiles with the same Group ID can communicate with the Repeater in Test Mode.

- RF Power Level

This is the default power level. Enter the power level for transmit power.

*NOTE: This is not the actual power out level. Other factors must be considered for true power out.*

• Power Source

This indicates the primary power source for the Repeater (AC/DC). If AC is selected and Battery Backup is installed, the transmitter goes to half rated power (max.) when AC fails. If DC is selected and AC fails, power output is unchanged.

• Paging

This indicates if there is an optional paging terminal connected to the repeater. This option is not compatible with the LTR Data Modem, TIC or VNC options.

• Data Modem

This is selected if the Data Modem option is installed. This option is not compatible with Paging, TIC, or VNC.

4.3.2 SELECT REPEATER

Select the repeater number to be programmed or edited from the pop-up menu (see Figure 4-6). Move the cursor with the arrow keys to highlight the repeater number and press Enter.

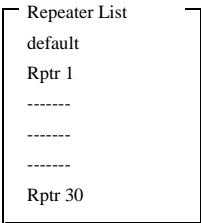


Figure 4-6 REPEATER LIST

4.3.3 ALARM CONFIGURATION

This programs the input alarm (see Figure 4-8) and output alarm (see Figure 4-9) configurations and provides a cross reference screen.

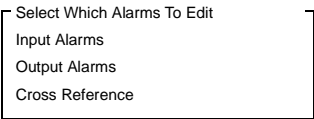


Figure 4-7 ALARM CONFIGURATION

Use the arrow keys to move down the list. Use the Space bar to toggle through the parameters: Disabled, Active Low, Active High, for each alarm.

• Input Alarms

There are four input alarms that can be activated by external devices (see Section 6.12). These inputs can be disabled, energized or de-energized. Alarms 3 and 4 can also be analog input.

If the input is disabled, the input alarm line is inactive. When energized and current flow is detected, the alarm is activated. When de-energized and no current flow is detected, the alarm is activated. Analog inputs provide a detection of an analog input out of limit condition. Select the Low and High Limit pair to trip an Analog Input Alarm. The High Limit must be greater in value than the Low Limit (0.0V-5.0V in 0.1V steps).

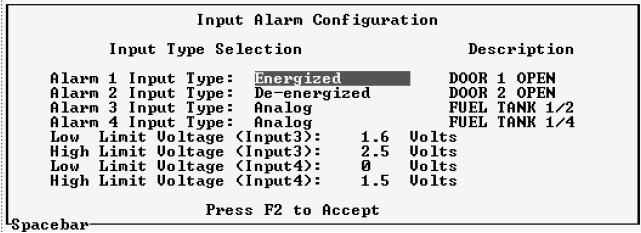


Figure 4-8 INPUT ALARMS

• Output Type Selection

Select the operation of the Output Alarm. The available types are:

Active Open - An active alarm opens (no contact) the output lines.

Active Closed - An active alarm closes (contact) the output lines.

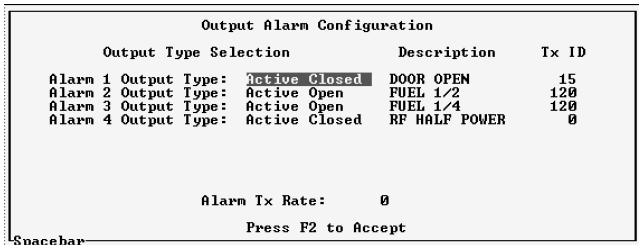


Figure 4-9 OUTPUT ALARMS

- Alarm Description

This is a text string (up to 15 characters) to describe the alarm. This test string is sent via Morse code if the alarm input is programmed with a Tx ID and an output is selected in the cross reference menu (see Figure 4-10).

- Transmit ID

Each of the 8-alarm outputs can be assigned a Group ID from 1-225. The default setting is 0 (zero) for disabled. This Group ID and the Repeater number identify an alarm that is active. This ID can be programmed into a transceiver so that when the alarm is active, the alarm description is received in Morse code.

- Alarm Transmit Rate

This sets the time interval for transmitting the alarm message in Morse code. If more than one alarm is active, this is the inter-alarm time.

- Cross Reference

The cross reference screen selects the output alarm that is activated by each input alarm. There are up to 48 alarms (0-47), 8 external input alarms and 40 internal alarms (see Table 1-2). There are eight output alarms. An alarm condition on any input can cause an output alarm. This screen configures which input alarm activates an output alarm.

*NOTE: More than one alarm condition can have the same output alarm (see Figure 4-10).*

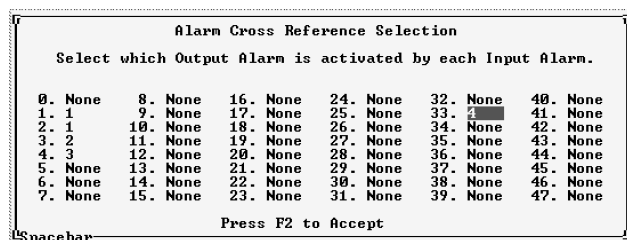


Figure 4-10 ALARM CROSS REFERENCE

#### 4.3.4 REPEATER TYPE

This screen (see Figure 4-11) selects the repeater type (LTR signaling protocol and features):

Frequency Band      800 MHz  
                              800 MHz [-12.5 kHz]  
                              900 MHz  
 Power Level         75W  
                              175W

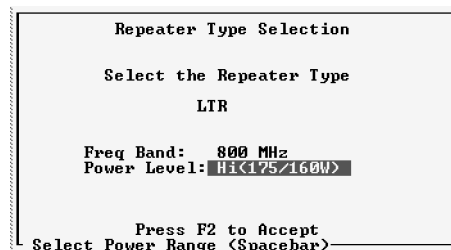


Figure 4-11 REPEATER TYPE

#### 4.3.5 DELETE REPEATER



Figure 4-12 DELETE REPEATER

#### 4.3.6 TELEPHONE PARAMETERS

Refer to the Telephone Interface Card manual, Part No. 004-2000-370, for information on the Telephone Access Parameters, Telephone Interface and TIC Calibration Data.

#### 4.4 TRANSFER



Figure 4-13 TRANSFER MENU

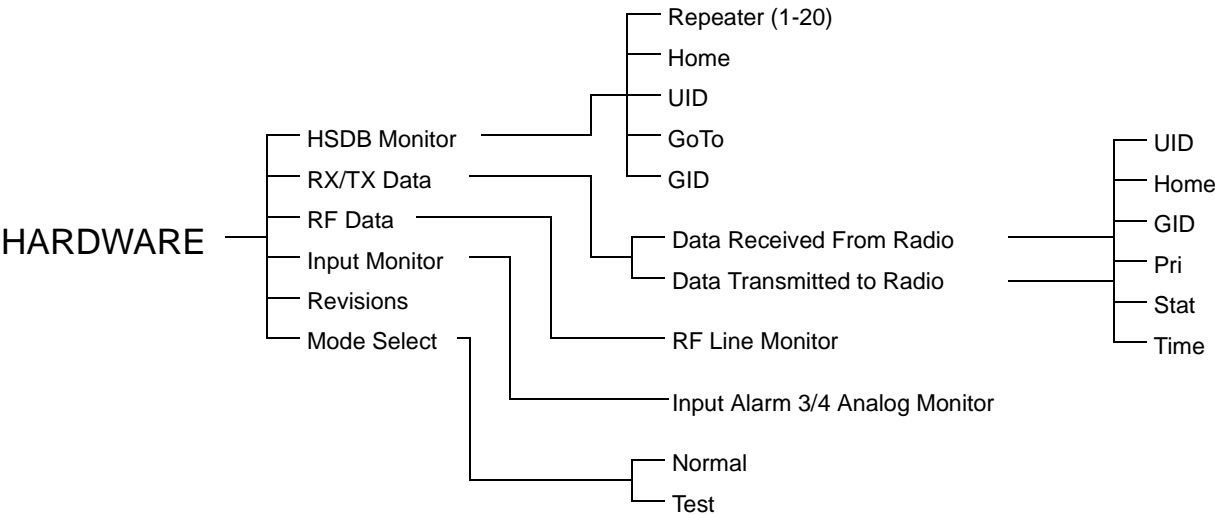


Figure 4-14 HARDWARE PROGRAMMING FLOWCHART

4.4.1 WRITE SETUP PARAMETERS

This command sends the contents of a file to the repeater and programs the EEPROM memory in the Main Processor Card (MPC).

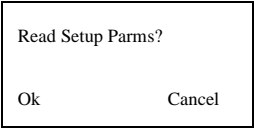


Figure 4-17 READ SETUP PARAMETERS

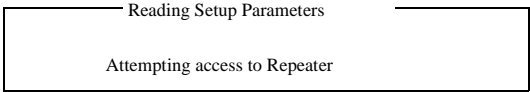
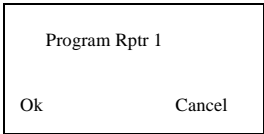


Figure 4-15 WRITE SETUP PARAMETERS

Figure 4-18 READING SETUP

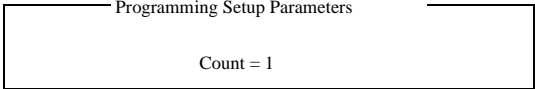


Figure 4-16 PROGRAM WRITE SETUP

4.4.2 READ SETUP PARAMETERS

This command reads the contents of the EEPROM memory of a repeater and loads it into a buffer. The contents of the buffer is then displayed to show the programming of the repeater.

4.5 HARDWARE

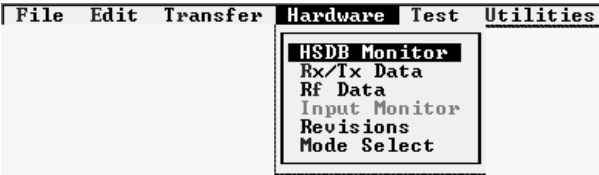


Figure 4-19 HARDWARE MENU

### 4.5.1 HSDB MONITOR

High Speed Data Bus (HSDB) connects all repeaters at a site and continually sends updates on the status of each repeater. This information screen provides a list of all repeaters at the site (1 to 20). If a repeater is not sending data, IDLE is next to the repeater number. The data sent by the repeater is used to determine the Home, GID and UID of destination (mobile) users to receive the call placed by the originator.

The Home column refers to the Home repeater number of the originator, therefore the Repeater number and the Home number may not be the same number. The UID is the Unique ID used to identify the originator of special calls. The GID column refers to the Group ID of the talk group of the originator (236=UID Call, 237 Telco call). The GoTo column shows the repeater channel all destination users switch to so they receive the call.

HSDB Monitor									
Rptr	Home	UID	Goto	GID	Rptr	Home	UID	Goto	GID
1					16				
2					17				
3					18				
4					19				
5					20				
6					21				
7					22				
8					23				
9					24				
10					25				
11					26				
12					27				
13					28				
14					29				
15					30				

**Figure 4-20 HSDB MONITOR**

### 4.5.2 RECEIVE/TRANSMIT DATA

This is an information screen used at the repeater site while the computer (laptop) is connected to the MPC in the repeater being monitored. This information is contained in the receive data stream exchanged between the repeater and the destination user (mobile) and the data content of the repeater transmit data stream. The message contains data received from the destination and data sent to the mobile by the repeater. The repeater receives the destination's: Unique ID, Home Repeater Number, Group ID, Priority, Status and Time Stamp. The information sent to the destination in the update message from the repeater includes: Unique ID of originator, Home Repeater Number,

Group ID, GoTo Channel Number, Free Channel Number and Priority of the current repeater. The time stamp is included because messages are sent continually and this provides a reference for when a data exchange took place.

Mobile Traffic Monitor											
Data Received From Radio						Data Transmitted to Radio					
UID	Home	GID	Pri	Stat	Time	UID	Home	GID	Goto	Free	Pri

**Figure 4-21 MOBILE TRAFFIC MONITOR**

### 4.5.3 RF DATA

The A/D Monitor Screen shows the state of the lines (see Figure 4-22). These lines are monitored by the A to D converter in the IAC. The normal values for each line are defined as follows.

Synthesizer Lock Lines	Yes or No
Forward Power (LP)	25-75 Watts
Forward Power (HP)	75-175 Watts
Reflected Power	0-6 Watts
Final Out (ratio)	approx equal
Chassis Temp	27°C-55°C
Wideband Audio Output	approx 200
LO Injection	approx 200
RSSI	20-150
Fan Current	100-200, 0
Fan	On or Off
Power Supply Temp	22°C-45°C
Battery Voltage	21V-28V

Values with no label are the actual A to D reading. To calculate the voltage on the line, divide the value by 51. Example: Value ÷ 51 = Volts. Any variation from the above values may indicate a problem in that area. Values on this screen are relative measurements only.

RF Line Monitor			
Synthesizer Lock Lines		Receive Parameters	
Exciter Synthesizer:	No	Wideband Audio Output:	0
Receive Synthesizer:	No	LO Injection:	0
Exciter High Stability:	No	RSSI:	0
Receive High Stability:	No		
Transmit Parameters (Not Calibrated)		System Parameters	
Forward Power:	0 Watts	Fan 1 Current:	0
Reflected Power:	0 Watts	Fan 2 Current:	0
Final Out 1/2:	0/ 0	Fan On:	Off
Final Out 3/4:	0/ 0	Chassis Temp:	0 C
		Power Supply Temp:	0 C
		Battery Voltage:	0 Volts

**Figure 4-22 RF LINE MONITOR**

## 4.5.4 REVISION/VERSION

The Revision/Version is displayed for the repeater modules in this screen. The format is R.V (revision.version) for all modules. The MPC information also includes the release date of the software and the serial number of the repeater.

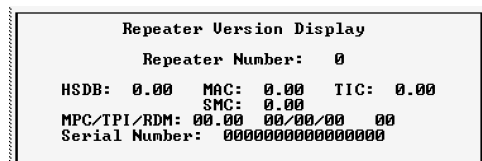
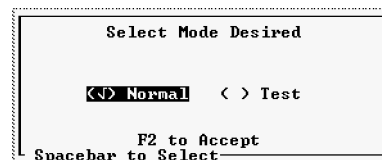


Figure 4-23 REVISION/VERSION

## 4.5.5 MODE SELECT

The Mode Select screen places the repeater either in the Normal mode or the Test mode. In the Normal mode the repeater operates as a normal repeater.

In the Test mode the repeater transmits a test word. This test word is the Test Mode ID setup in the Setup Parameters (see Section 4.3.1).



## CAUTION

While in the test mode the repeater is "busy", therefore it is important to place the repeater in Normal mode when the test mode is no longer required.

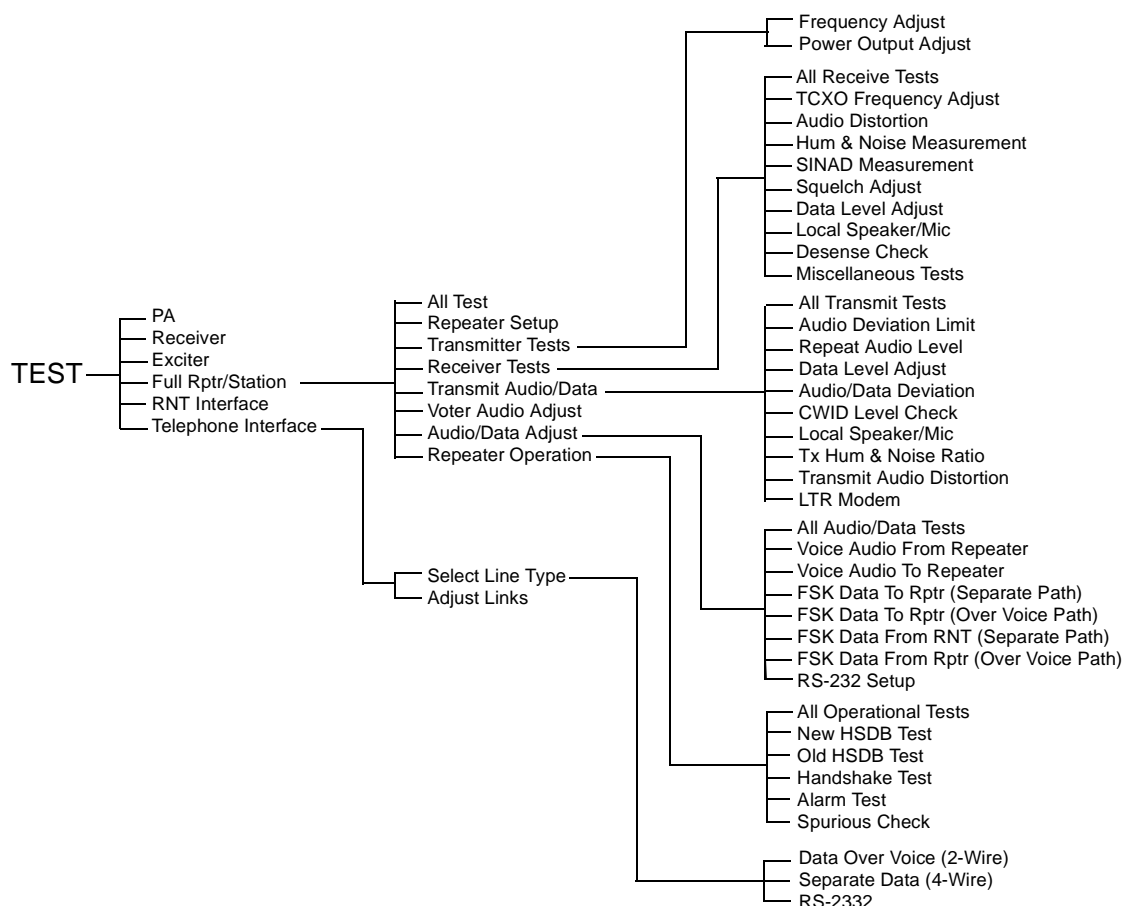
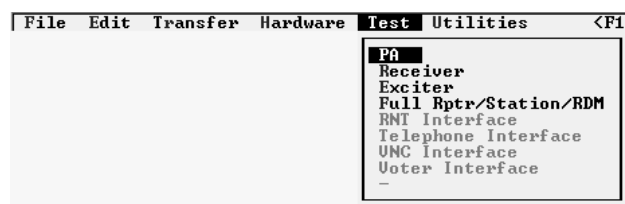


Figure 4-24 TEST PROGRAMMING FLOWCHART



## 4.6 TEST



**Figure 4-25 TEST MENU**

### 4.6.1 POWER AMPLIFIER

This menu selection walks through the alignment of the Power Amplifier and RF Interface Board on the computer screen. Refer to Sections 7.3 and 7.4 for the PA and RFIB alignment in this manual and Figures 7-3, 7-6, 7-4 and 7-7 for an alignment points diagram and Figures 7-10 and 7-11 of the Power Amplifier.

### 4.6.2 RECEIVER

This menu selection walks through the alignment of the receiver on the computer screen. Refer to Section 7.1 for the Receiver alignment in this manual and Figure 7-1 for an alignment points diagram and Figure 7-8 of the Receiver.

### 4.6.3 EXCITER

This menu selection walks through the alignment of the Exciter on the computer screen. Refer to Section 7.2 for the Exciter alignment and Figure 7-2 for an alignment points diagram and Figure 7-9 for a test setup of the Exciter.

### 4.6.4 FULL REPEATER

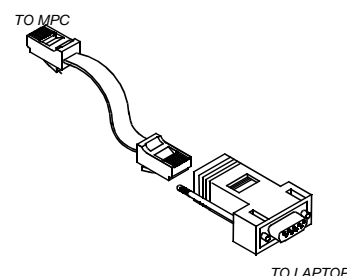
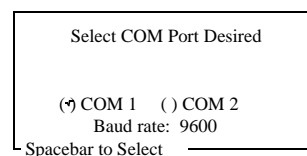
This menu selection walks through the alignment of the entire repeater. The Receiver and Exciter portions are performance tests and adjustments. The Audio and Data portions are level adjustments for the Main Audio Card (MAC). Refer to Figure 7-18 for an alignment points diagram for the MAC.

## 4.7 UTILITIES



### 4.7.1 COM PORT

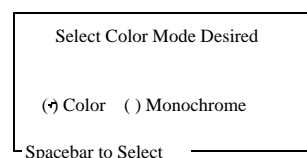
This is the COM port used to send and receive data from the Repeater MPC. An interface cable connects the Repeater to the computer (see Figure 4-26). This screen also selects the data baud rate.



**Figure 4-26 LAPTOP CABLE**

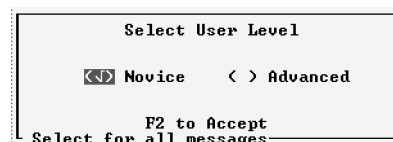
### 4.7.2 DISPLAY MODE

This screen allows the color mode to be selected for color monitors. When using a laptop, monochrome is recommended for better resolution.



### 4.7.3 USER LEVEL

There are two levels to choose from, Novice and Advanced. The Novice uses prompts in the Edit-Parameters screens when Escape or F2 keys are pressed that ask "are you sure" before the task is executed. The Advanced selection performs the task without asking the question.





## SECTION 5 REPEATER PROGRAMMING

### 5.1 CREATING A NEW FILE

An example will be used to show the programming for a new file created for Site 1.

*NOTE: At any point in the programming sequence, if F1 is selected, a help screen appears to explain the menu selection highlighted at that point.*

#### 5.1.1 SELECT REPEATER TO EDIT

A repeater is selected to program. When no file exists with programmed repeaters, the default is selected and edited.

1. Highlight EDIT, press Enter.
2. Highlight SELECT REPEATER, press Enter.
3. Default is the only repeater in this list, press Enter.
4. Highlight EDIT, press Enter.
5. Highlight SETUP PARAMETERS, press Enter.
6. The Setup Parameters screen appears (see Figure 5-1). Fill in the parameters for this repeater. A brief description of the parameters is in Table 5-1. Full descriptions are in Section 4.3.1.
7. Select parameters, press F2 to accept.
8. Highlight EDIT, press Enter.
9. Highlight ALARM CONFIGURATION and press Enter, if alarms are to be configured.
10. Program the Alarms to be configured (see Section 4.3.3), press F2 to accept.
11. Highlight FILES, press Enter.
12. Highlight SAVE, press Enter.

13. Type in a valid DOS filename. For this example site1.dat is used.

14. The file consists of default and repeater one under the filename of site1.dat.

### 5.2 ADDING A REPEATER TO A FILE

The example used for Site 1 will again be used to add repeaters to the filename site1.dat.

1. Highlight EDIT, press Enter.
2. Highlight SELECT REPEATER, press Enter.
3. The repeater list shown for this file includes default and repeater one. These contain the same parameters with the exception that when selected for edit the programmed repeater can be overwritten and the data lost.
4. Highlight DEFAULT, press Enter.
5. Highlight EDIT, press Enter.
6. Highlight SETUP PARAMETERS, press Enter.
7. Change the Repeater number and other parameters as required for this repeater, press F2.
8. Highlight EDIT, press Enter.
9. Highlight ALARM CONFIGURATION and press Enter, if alarms are to be configured.
10. Program the Alarms to be configured (see Section 4.3.3), press F2 to accept.
11. Highlight FILES, press Enter.
12. Highlight SAVE, press Enter.
13. Repeater 2 is added to the Repeater List in file site1.dat.

**Table 5-1 REPEATER SETUP PARAMETERS**

Parameter	Response	Description
Repeater Number	1-20	Each repeater is assigned a Home Repeater number from 1-20.
Channel Number	1-920	Each repeater is programmed with a number of the channel that it is operating on.
Telco Network Type	None FSK RS232 FSK Blank & Burst TIC VNC	Data signaling type for RNT, FSK, RS232 or FSK B&B. None=LTR dispatch only. TIC is for Telephone Interface Card w/o RNT. VNC=network telephone interconnect w/o RNT.
Area	0, 1	Same as value of the Area bit in the mobiles.
Sync Repeater	No	Not used.
Stand Alone	Yes, No	Select if the repeater is not connected to additional repeaters (via HSDB).
ID Validator	Yes, No	Not used.
CWID Time	0 = disabled 1-60 min	Time between CWID transmissions.
CWID Message	15 characters/numbers UPPER CASE	Station call letters.
Local MIC ID	0 = transmits carrier 1-250, 253	Group ID transmitted when the local microphone PTT is active.
Test Mode ID	0 =transmits carrier 1-250, 254 (default)	Group ID transmitted when the Repeater is in the Test Mode.
RF Power Level	25-75, 75-175	Power level in watts for transmit power.
Power Source	AC or DC	The type of primary power source for the Repeater.
Paging	Yes, No	Select if a paging terminal is installed.
Data Modem	Yes, No	Select if the Data Modem option is installed.

**LTR Repeater Setup Parameters Edit**

<b>Repeater Number:</b> 1 <b>Channel Number:</b> 100  <b>Sync Repeater:</b> No <b>Stand Alone:</b> Yes <b>ID Validator:</b> N/A  <b>Local MIC ID:</b> 0 <b>Test Mode ID:</b> 254  <b>Paging:</b> No	<b>Telco Network Type:</b> None <b>Area:</b> 0  <b>CWID Time:</b> 0 <b>CWID Message:</b> REDHAWK  <b>RF Power Level:</b> 75 <b>Power Source:</b> AC  <b>Data Modem:</b> No
---	---

Press F2 to Accept

**Repeater Home (1-20)**

**Figure 5-1 SETUP PARAMETERS**