



**SYSTEM III REDUNDANT REPEATER  
REFERENCE MANUAL**

11/98, III-2



### WARNING

To reduce the risk of electric shock, do not remove the cover or back of the Repeater unit.  
There are no user-serviceable parts inside. Refer servicing to qualified, factory trained personnel.

This equipment meets part 90 and part 94 of the FCC rules.

### NOTICE

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus as set out in the radio interference regulations of the Canadian Department of Communications.

Le present appareil numerique n'emet pas de bruits radioelectriques depassant les limites applicables auq appareils numeriques de Classe A prescrites dans le reglement sur le brouillage radioelectrique edicte par le Ministere des Communications du Canada.

## INFORMATION TO USER

### Class B Digital Device or Peripheral

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

### Caution

- Changes or modifications not expressly approved by Aria Wireless Systems, Inc., could void the user's authority to operate the equipment.
- To minimize the potential for RF interference, Aria Wireless recommends shielded interconnecting cables to data terminal equipment.



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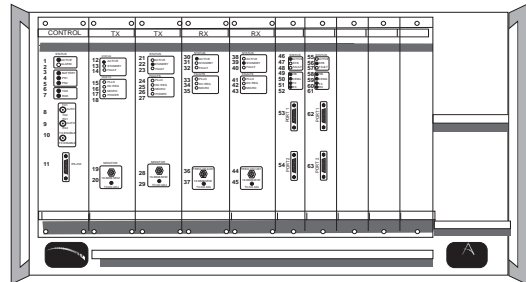


# 1 - About this Manual

## This is a Reference Guide for the System III Repeater

This book is the second in a series of four manuals designed to work together for Users, Installers and Service Technicians. The information contained in this reference guide covers:

- How the REPEATER works
- How to Install and configure your REPEATER unit
- How to interface your equipment through the Network
- REPEATER operations
- Troubleshooting REPEATER unit malfunctions



### It Does NOT Contain

Operation of any of the component equipment - this information is contained in:

Book#	Name
1	System III- IRM Reference Manual
3	System III - CEMA Reference Manual
4	System III - Network Manager Reference Manual

### Notes, Warnings and Tables

#### NOTE

Text in a white box emphasizes information pertinent to a sequential order, or the possibility of damage to the IRM network system.

#### WARNING

The black boxes with white text contain safety warnings, alerting you to possible bodily injury.

# 1.3 - Repeater Features

## System III Redundant Repeater

### Features

- Fault tolerant design
- Continuous duty rated
- 19.2 kbps data throughput
- 50 km range (radius)
- Modular design for rapid module replacement
- Serviceable during normal operation
- Remote control by Network Manager

### Description

The System III Repeater relays signals received from System III Intelligent Radio Modem (IRM) units to the remaining remote units in a wireless metropolitan area network. By installing the repeater at the top of a tall structure near the center of the desired coverage area, the repeater will support a radio network area of up to 100 km (60 miles) in diameter.

### Modular Design

The repeater has a reliable modular design which insures uninterrupted network operation and greatly facilitates serviceability. All field adjustments can be made at the front panel via a modem or via the wireless network. Modules can be removed and replaced while the repeater is operating. Each module provides clear status information through LED indicators. In addition, repeater status may be obtained via an attached PC or from a remotely located Network Manager station.

## The Repeater System:

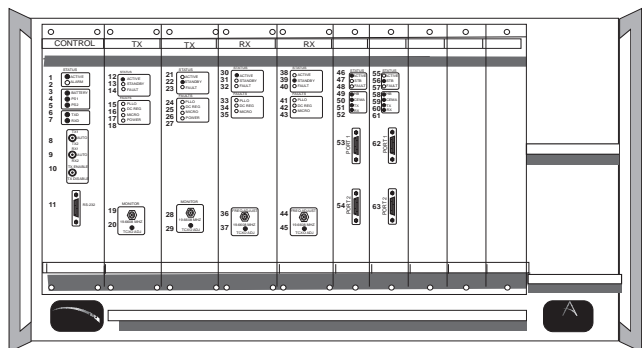
### Rack mount enclosure

Rack mount enclosure with five types of plug-in modules:

- Power supply
- Transmitter
- Receiver
- Control module
- Communications module

**The enclosure** houses a module support chassis and a backplane subsystem which is capable of holding two power supplies, two transmitter and receiver modules, one control module and one or two communications modules.

**The transmitter and receiver** modules comprise the RF subsystem which receives data from the currently transmitting IRM, then detects, reclocks and retransmits the data so that all IRM's within the coverage area can receive the originating IRM's information. The control module senses the operational status of the repeater's redundant modules, records failure events and supports configuration.



# 1.3 - Repeater Features

The **communications modules** enable the Repeater to become a participant on a radio network utilizing the Collision Eliminating Multiple Access (CEMA) protocol so that it may be controlled and monitored from a System III Network Manager station.

To provide a dependable **power source** the repeater houses two plug-in power supply modules and can also accept external DC power. Each plug-in power supply module converts 110 or 230 volt A/C mains power to the 12-15 volts DC which powers the other modules in the unit. During normal operations the repeater draws power from both power supplies so that should any single supply fail, the repeater will continue

normal operation with the remaining supply. To provide continued operation during A/C mains power failures the repeater will automatically switch over to 12 volt DC power from an external battery.

## Tx/Rx Backup

To insure continued network operation in the event of an RF module failure, the repeater continually monitors the health status of the two transmitter and receiver modules. Upon detecting a malfunction it causes a rapid switch over to the applicable backup module, and sends a message to the control module to provide appropriate alert notification.

## Specifications

### 1. Frequency Coverage and Data Rates

405-512 MHz	Ft ±5.0 MHz	Fr ±5.0 MHz
805-960 MHz	Ft ±7.5 MHz	Fr ± 7.5 MHz

Transmitter and receiver center Frequencies (Ft & Fr) to be specified at time of order. The operational frequencies can be programmed in the field within the above specified coverage limitations. Ft and Fr may be any value which lies between the lowest coverage frequency plus 5.0 MHz or 7.5 MHz and the highest coverage frequency minus 5.0 or 7.5 MHz as applicable.

# 1.3 - Repeater Features

DataRate	ChannelSpacing	Modulation
9,600 BPS	25.0 KHz	2 state FSK
9,600BPS	12.5 KHz	4 state FSK
19,200BPS	25.0 KHz	4 state FSK

## 2. Transmitter Module Specifications

- Maximum Power Output: 5 Watts (+37 dBm)
- Electrically Adjustable: +20 to +37 dBm
- Duty Cycle: 100%
- Turn-on Time: < 1 Millisecond
- Reference Frequency: 19.6608 MHz
- Frequency Stability:
  - Temperature: 1.5 ppm
  - Aging: 1.0 ppm per year
- Frequency Sources: TCXO  
Controlled Direct Digital Synthesis
- Modulation Deviation
  - 25 kHz: 3.20 kHz peak
  - 12.5 kHz: 2.88 kHz peak
- Spurious and Harmonic Radiation: <= -60 dBc

## 3. Receiver Module Specifications

- Type: Double conversion superheterodyne
- Reference Frequency: 19.6608 MHz
- Frequency Stability:
  - Temperature: 1.5 ppm
  - Aging: 1.0 ppm per year
- Receiver Selectivity
  - RF (1 dB) [805-960 MHz] +/-7.5 MHz
  - RF (1 dB) [405-512 MHz] +/-5.0 MHz
  - RF (45 dB) +/-50 MHz
  - IF (6 dB) [9600 BPS] +/-7.5 kHz
  - IF (6 dB) [19,200 BPS] +/-15 kHz
- Adjacent Channel Rejection
  - First Adjacent Channel 50 dB
  - Second Adjacent channel 60 dB
- Spurious Rejection 70 dB
- Image Rejection 70 dB
- Intermodulation Rejection 75 dB
- Noise Figure 6 dB
- Sensitivity (10<sup>-6</sup> Bit Error Rate)
  - 9600 BPS 25 kHz -105 dBm
  - 9600 BPS 12.5 kHz -95 dBm
  - 19,200 BPS 25 kHz -95 dBm

# 1.3 - Repeater Features

## 4. User Interface

- Rear Panel Connections
  - RF: Two “N” type female 50 ohms: TX and RX
  - External Duplexer required
  - Terminal strip for external alarm connection
  - Molex connector for external battery connection
- Transmitter module front panel
  - BNC Connector for TCXO output signal
- Receiver module front panel Multiplexed BNC Connector for TCXO output signal and RSSI DC level
- Control and Communications Module front panel RS-232 DB-25 female jack, configured as DCE

## 5. Regulatory Compliance

- Safety: UL, CSA, TUV
- Emissions: FCC Part 15, Sub-part B
- FCC Type Acceptance: Parts 22, 90 or 94 as applicable
- Canada Compliance: RSS-119 or RSS-122 as applicable
- FCC ID’s
  - 805-960 MHz: JK2DM208000B
  - 400-512 MHz: JK2DM204000
- Emission Designator:
  - 25 KHz: 17 K1F1D
  - 12.5 KHz: 11 K7F1D

## 6. Electrical and Mechanical

- External Power Requirements: 110/230 VAC, 50/60 Hz
- Power Consumption: 100 Watts Maximum
- Temperature Range:
  - Operating: 0 to +50 Degrees C
  - Storage: -40 to +80 Degrees C
- Humidity: 5-95% non-condensing at 40

Degrees C

- Dimensions: 12.3"H x 19"W x 16.3"D (312 x 482 x 414 mm)
- Weight: 25 lbs. (11.3 Kg) [Redundant unit]
- Packaging: Rack mount enclosure or table top
- Plug-In Module Slots: 11

## 7. Control Module

The Control Module exchanges configuration information and status with the two transmitter and receiver modules and also monitors the voltage level of the two external power supplies and the external battery. When the failure detection logic reports a switch over, the control module sets an alarm indicator and provides storage of the event in local memory for later retrieval by a service technician. To provide remote fault reporting, alerts and status may be communicated to the network manager via an external modem or the CEMA network.

The control module specifications are as follows.

- Switch Over Time: 1 Second (no loss of network)
- Microprocessor
  - Type: Motorola 68HC11
  - ROM: 48 K Bytes
  - RAM: 8 K Bytes
  - EEROM: 8 K Bytes

## 8. Communications Module

To enable the repeater to report its operating status and accept commands from the central network manager, the communications module provides the functionality of a participating remote station on the CEMA network. A front panel RS-232 connector allows connection of a PC or terminal to perform locally based network monitoring or terminal functions.

## 1.3 - Repeater Features

### The Communications Module Specifications are as follows

- Number of Communications Modules: One or Two
- Microprocessor: Motorola 68000, 14.7 MHz Clock
- Supplied Memory
  - 1024 KB Reprogramable Flash Memory
  - 256 KB Random Access Memory (RAM)
  - 8 KB Electrically Erasable Read Only Memory (EEROM)
- Integrated Watchdog Timer

### 9. Firmware

- Control Module
  - Initialize Repeater
  - Monitor repeater status
  - Malfunction Event Reporting
  - Configuration
  - Diagnostics
- Communications Module
  - CEMA Network control
  - Network Manager Message Support
  - User Port interface
- Configuration Method:
  - Via attached PC, modem or network manager
  - Parameters stored in nonvolatile EEROM


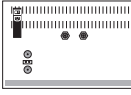
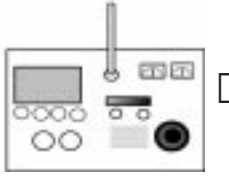

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All stated specifications are subject to change without notice or obligation.

# 2.1 - Installation

## What to do for Installation Startup

The following chapter will cover these steps for installing the Repeater unit and checking functionality:

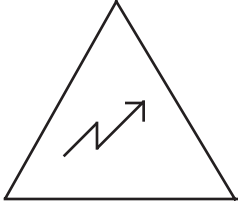

	1. Install the antenna		4. Configure frequency settings
	2. Install duplexer and coax		5. Perform a radio check-out
	3. Connect the power		6. Go operational

## Warnings to Heed before Installing Your Repeater Unit

### Safeguards

This section contains important safety instructions that apply to the installation, operation and servicing of the Repeater.

**The graphical symbols** marked on the Repeater have the following meaning:

	The lightning flash with arrowhead symbol, within an equilateral triangle, is intended to alert the user to the presence of uninsulated “dangerous voltage” within the product’s enclosure that may be of sufficient magnitude to constitute a risk of electric shock.
	The exclamation point within an equilateral triangle is intended to alert the user to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the unit.



## 2.1 Installation

### Safeguards

This section contains important safety instructions that apply to the installation, operation and servicing of the Repeater.

### Read the Instructions

All the safety and operating instructions should be read before the Repeater is operated.

### Retain the Instructions

The safety and operating instructions should be kept in an easily accessible place for future reference.

### Heed Warnings

Heed all warnings on the Repeater and in the operating instructions.

### Follow Instructions

All operating and use instructions should be followed.

### Water and Moisture

The Repeater should not be used near water. It is intended for indoor use only.

### Rack Mount Kit

The Repeater may be mounted in a standard 19-inch rack. Only the rack mount kit recommended by the manufacturer should be used.

### Ventilation

The Repeater should be situated so that its location or position does not interfere with its proper ventilation. Openings in the cabinet are provided for ventilation to ensure reliable opera-

tion and to protect it from overheating. These openings must not be blocked or covered. Do not place it in a built-in installation, such as a bookcase or cabinet that may impede the flow of air through the ventilation openings.

### Heat

The Repeater should only be situated away from heat sources such as radiators, heat registers, stoves or other equipment (including amplifiers) that produce heat.

### Power Sources

The Repeater should be connected to a power source of the type described in the operating instructions or as marked on the Repeater.

### Grounding or Polarization

The Repeater is equipped with a grounded polarized alternating current line plug. This plug will fit into the power outlet in only one way. This is a safety feature. If the plug should fail to fit into the outlet, contact your electrician to replace your obsolete outlet. If you need an extension, use a grounded polarized cord.

### Power-Cord Protection

Power-supply cords should be routed so that they are not likely to be walked on or pinched by items placed upon or against them, paying particular attention to cords at plugs, convenience receptacles, and the point where they exit from the Repeater.

### Cleaning

Unplug the Repeater from the wall outlet before cleaning. Do not use liquid cleaners or aerosol cleaners. Use only a damp cloth for cleaning.



## 2.1 Installation

### Power Lines

The Repeater antenna should be located away from power lines.

### Outdoor Antenna Grounding

Be sure the antenna system is grounded so as to provide some protection against voltage surges and built-up static charges. Section 810 of the National Electrical Code, ANSI/NFPA, No. 70-1984, provides information with respect to proper grounding of the mast and supporting structure, grounding of the lead-in wire to an antenna discharge unit, size of grounding conductors, location of antenna discharge unit, connection to grounding electrodes, and requirements for the grounding electrode.

### Nonuse Periods

When left unused for a long period of time, the power cord of the Repeater should be unplugged from the outlet.

### Object and Liquid Entry

Care should be taken so that objects do not fall and liquids are not spilled into the enclosure through openings.

### Damage Requiring Service

The Repeater should be serviced by qualified service personal when:

- The power-supply cord or plug has been damaged.
- Objects have fallen, or liquid has been spilled into the Repeater.
- The Repeater has been exposed to rain.
- The Repeater does not appear to operate normally or exhibits a marked change in performance.
- The Repeater has been dropped, or the enclosure damaged.

### Servicing

The user should not attempt to service the Repeater beyond what is described in the operating instructions. All other servicing should be referred to authorized service personnel.

## 2.2 Power Connection

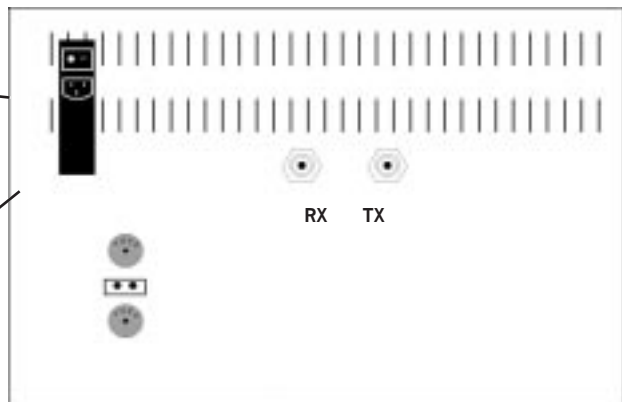


The Repeater may be operated from 110/120 VAC or 220/240 VAC, 50/60 Hz. Configure the unit for the correct power setting by locating the Input Power Select Module on the rear panel.

### WARNING

Failure to properly select AC voltage setting (110 or 220) may result in damage to the Repeater. Be sure the AC Voltage is set properly before applying power.

- 1.) REMOVE THE POWER ENTRY MODULE WITH A FLAT-HEAD SCREWDRIVER.
- 2.) TO SWITCH FROM 110 V TO 220, POP OUT THE FUSE MODULE AND TURN IT OVER.



### CAUTION

The input power setting coming from the factory is at 110/120 VAC. Make sure you select the input power 110/220 VAC for your installation to avoid equipment damage.

## 2.2 Power Connection

### Front End: Power Supply Module Conversions

At the end of the module, you will find a series of terminal blocks. With a Phillips head screwdriver, remove each screw and take off the shorting strap.

Replace the module drawer and secure it with screws.

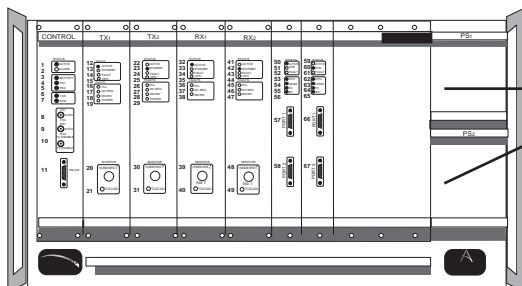
#### CAUTION

Make sure BOTH power supply modules are converted to your required voltage to avoid equipment damage.

#### NOTE

<u>Shorting Strap</u>	<u>Power Input</u>
Installed	110/120 VAC
Removed	220/240 VAC

From the front of the unit, unscrew the drawers with a flathead screwdriver. Pull out the power supply module drawers.

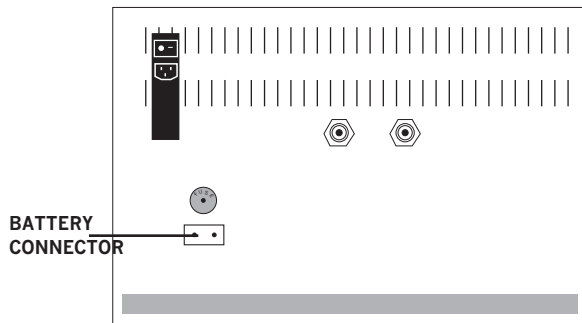


OPEN THESE DRAWERS. AT THE REAR END OF THE POWER SUPPLY MODULE, YOU'LL FIND THE TERMINAL BLOCKS (CLOSE-UP ABOVE)

## 2.2 Power Connection

### DC Operation

The Repeater may be operated from an external +12 V DC power source such as a battery. A Molex quick disconnect connector is provided in the rear panel for DC power input.

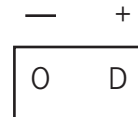


REPEATER REAR PANEL

### Caution

Observe proper polarity when connecting an External DC power source to the Repeater. Damage to the equipment may result from reversing the polarity.

The positive and negative terminals of the connector are marked on the rear panel, as shown below:



### DC Power Specifications

#### Voltage

Minimum	+11.5 VDC
Maximum	+15 VDC
AC Noise	±1 VAC

#### Current Requirements with Full Compliment of Modules

Maximum	7.0 amps
Average	5.5 amps

## 2.3 Antenna System Installation

### Antenna



The Repeater operates as the communication hub of the multiple access radio network. The Repeater receiver/transmitter, located at a central point in the network system, receives all remote messages and retransmits the messages to all remote stations in a real-time, bit-by-bit, repeat operation.

Since all devices establish radio communications via the Repeater, proper installation of its antenna is crucial. The choice of antenna and transmission cable are important factors in determining maximum range and overall system performance. The power budget calculation on the next page shows how the repeater antenna gain and the transmission cable loss influence range. An Omni antenna is required to achieve uniform circular coverage. Higher gain antennas will provide better performance, and may be used if the coverage area is limited to a sector instead of a circle.

Here are some typical Omni antennas used for this Repeater:

#### Typical Omni Repeater Antennas

Manufacturer	Model	Frequency (MHz)	Gain
Cellwave RFS	CV9900	928/952	9 dBd
SCALA/Kathrein	740-189	928/952	9 dBd
Sinclair	SRL-480	400-460	10 dBd
Antenna Specialist	ASP-952	806-941	9 dBd

## 2.3 Antenna System Installation

### Determining Expected Received Signal Level and Fade Margins

Frequency of Operation = 950 MHz

Free Space Loss Attenuation (dB) =  
 $96.6 + 20\text{Log}(\text{Dmiles}) + 20\text{Log}(\text{FGHz})$

Antenna gain is specified in decibels above an isotropic point source (dBi). Some antenna manufacturers specify their antenna gain in decibels referenced to a dipole (dBd). The relationship is  $\text{dBi} = \text{dBd} + 2.14$ .

Losses not in the power budget that should be considered in the fade margin:

- Multipath: the reinforcement or cancellation of the directly received signal by signals reflected from the terrain, buildings or other sources.

- Diffraction Loss: the scattering of the beam by buildings, terrain or other obstacles that are partially in the direct path.

- Foliage Loss: absorption of RF energy by trees in the direct path of the beam.

Systems operating in the frequencies of 400, 80 and 900 MHz suffer negligible losses due to atmospheric absorption, rain or snow.

### Power Budget Calculation

Transmit Power (5 watts)			+37.0dBm
Connector & T-Line Loss (100' 7/8" LLF)			-2.0dB
Duplexer Loss			-1.0dB
Omnidirectional Antenna gain			+11.0dBi
Repeater EIRP (Effective Isotropic Radiated Power)			+45.0dBm
Free Space Loss (15 miles, 24 km) @ 950 MHz			-120.0dB
7-element Yagi Antenna Gain			+13.0dBi
Connector & T-Line Loss (250' 1/2" LLF)			-6.0dB
Received Signal Strength at Connector			-68.0dBm
Minimum Receiver Signal Strength, 10-6 BER	-105 dB	-95 dBm	-95 dBm
Fade Margin	37 dB	27 dB	27 dB
Radio Type	2.5 kHz	12.5 kHz	25 kHz
	9.6 bps	9.6 bps	19.2 Kbps

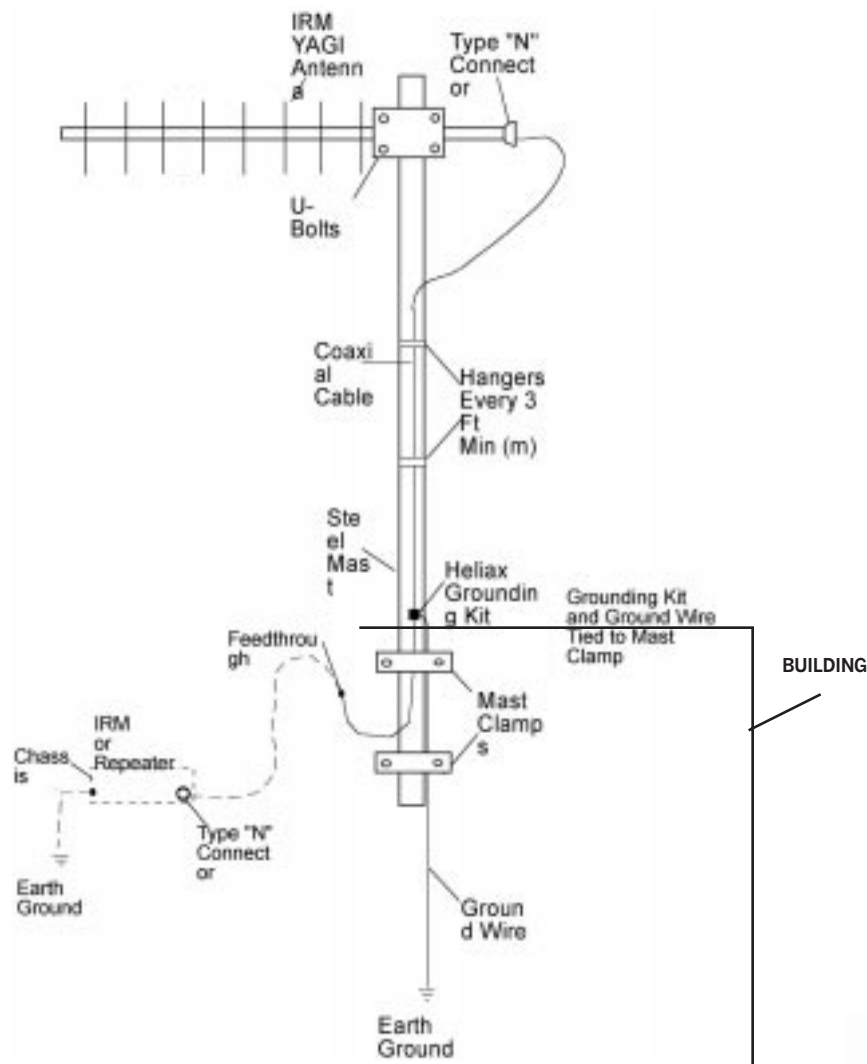
## 2.3 Antenna System Installation

### Antenna Mounting

The Repeater antenna should be mounted so that it has unobstructed line of sight to all remote stations. The antenna is usually mounted on a pipe mount or tower on top of a building or some other structure that will provide the proper elevation. The antennas used by repeaters are typically omnidirectional, meaning the energy radiated from the antenna is radiated equally in all directions in the horizontal plane. A typical omnidirectional antenna would have a gain of 10 dB, impedance of 50 ohms and a type N or EIA connector.

#### NOTE

Obstructions in the near field of the antenna can increase the antenna system VSWR or distort the pattern. Near field obstructions can reduce the overall system performance.



## 2.3 Antenna System Installation

### Duplexer

A duplexer is required to allow the Repeater full duplex radio operation on a single antenna. A typical duplexer is a 19-inch rack mount assembly with three N-type female connectors for the transmit, receive and antenna 50 ohm ports. The duplexer model is

dependent on the Repeater's operational frequency band. The transmit and receive connectors at the rear of the Repeater are connected to the duplexer transmit and receive connectors respectively and the antenna is connected to the duplexer antenna connector.

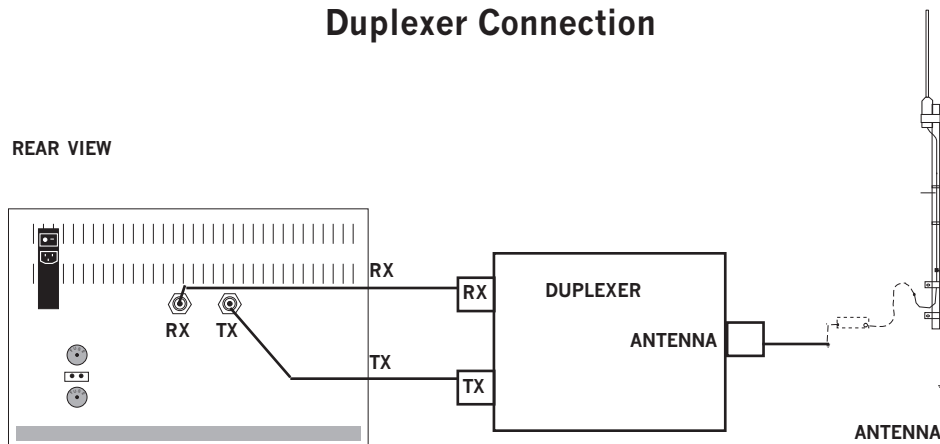
### Typical Duplexers

Manufacturer	Model	Frequency	Comments
TX/RX Systems	28-88-01A	890-960 MHz	< 24 MHz spacing
TX/RX Systems	28-65-02	406-420 MHz	
TX/RX Systems	28-70-02	450-470 MHz	
TX/RX Systems	28-69-02	470-512 MHz	
Cellwave	RFSPD-5078	928/952 MHz	US freq spacing
Cellwave	RFSPD-638	406-470,470-512	

The duplexer provides isolation between the transmit and receive ports to prevent the Repeater transmitter from interfering with the Repeater receiver (desensitization). The isolation required between the two ports is usually specified at the

transmit and receive frequencies. The minimum TX to RX isolation required in the duplexer system, regardless of the operational frequency or channel spacing is 70 dB.

### Duplexer Connection



## 2.3 Antenna System Installation

### Coaxial Cable

The coaxial cable carries the RF signal between the antenna and the Repeater/Duplexer. The type of cable used for any particular installation depends on the amount of RF signal loss that can be tolerated. A number of cable types and sizes are available. The lowest signal loss is achieved by the larger and more costly cables. The loss may range from 0.8 dB to 8.9 dB per 100 ft. among different cable types. The following table lists typical coaxial cables that are available and their loss at 950 MHz. (Losses will be less at lower frequencies).

### Running the Coaxial Cable

The cable is run from the antenna down the pole or mast into the building and connected to the Repeater duplexer by a male type N connector. The coaxial cable must be firmly supported through its entire run so it will not move under severe weather conditions. If a cable is allowed to move it will eventually fatigue mechanically and fail. A wide variety of hardware is available for mounting coaxial cables. Connect the antenna cable to the type N connector labeled ANTENNA at the rear of the duplexer.

**RF Repeater Cable Loss at 900 MHz**

Cable	Size and Type	Loss Per 100 Ft. (dB)	Loss Per 100 Meters (dB)
Andrew LDF7-50A	1 5/8 inch heliax	0.8	2.7
Andrew LDF5-50A	7/8 inch heliax	1.3	4.3
Andrew LDF4-50A	1/2 inch heliax	2.3	7.7
Andrew FSJH-50B	1/2 inch super flexible heliax	3.6	11.7
Belden 9913	7/16 inch PVC jacketed	4.5	14.8
Belden 9914	7/16 inch RG8/U	6.0	19.7
RG-213/U	7/16 inch PVC jacketed	8.9	29.2

It is not as important to have low loss cables between the Repeater and Duplexer since their lengths are short. Typically RG-213/U is used, however, proper connector installation is still important. Connect a coaxial cable between the duplexer TRANSMIT and the Repeater TRANSMIT connectors and between the duplexer RECEIVE and the Repeater RECEIVE connectors. Turn the screw type connectors by hand until they are tight.

**NOTE**

Improper installation of the cables or their connectors can increase the antenna system VSWR and reduce receive sensitivity.

## 2.3 Antenna System Installation

### Receiver Filters

Receive filters are occasionally required to be installed in series between the Repeater antenna port and the duplexer for the attenuation of interfering signals. These signals may be close to the desired frequency (within the passband of the receiver R.F. filters), or further out, mixing with other signals and producing intermodulation products within the I.F. bandwidth of the receiver.

#### Filter Type

The type of filter depends on the type of interference. The three basic models available are: band pass, band reject and pass-reject. Generally, bandpass and/or pass-reject filters will accommodate most types of interference.

#### Example of Attenuating Interfering Signals

A System III Network is installed with the repeater operating on a transmit frequency of 952.000 MHz and a receive frequency of 928.000 MHz. The repeater site is co-located with paging transmitters operational at 931 MHz (3 MHz away from our desired receive frequency) at a power level of 250 watts (+54 dBm).

The antennas are installed so that there is approximately -60 dB coupling between the two systems. Taking into account transmission line and duplexer loss, this corresponds to a signal of approximately a -10 dBm at 931 MHz at the Repeater receive connector. This signal is within the R.F. bandwidth (+/-7.5 MHz) and is +10 dB over the 1 dB compression point (-20 dBm) of the receiver. This signal would then degrade the repeater sensitivity by approximately 10 dB, severely affecting the performance of far sites.

#### Correcting Interference

Correct the situation by attenuating the interfering signal without attenuating the desired signal. This can be accomplished by the installation of a pass-reject filter (such as a TX RX 15-89-01, or equivalent). This filter will provide a 38 dB notch at 931 MHz while introducing only 0.4 dB insertion loss at 928 MHz. The interfering signal is then attenuated to a level of -48 dBm at the receiver port, within the specifications of the receiver.

#### Typical Receiver Filters

Manufacturer	Model	Frequency	Type
TX RX	11-88-01	890-960	Band Pass
TX RX	15-88-01	890-960	Pass Low, Reject High

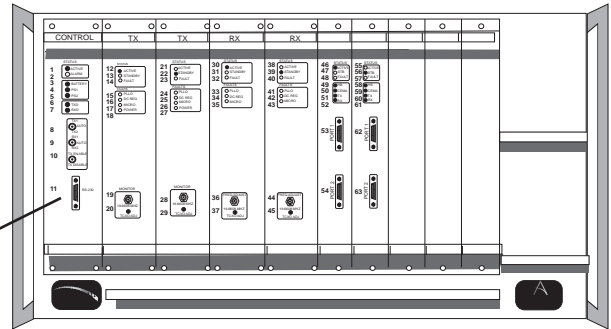
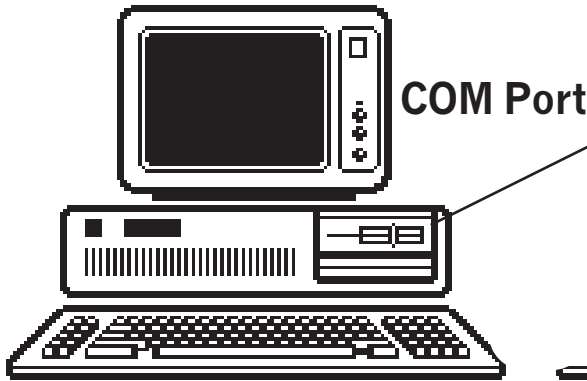
## 2.3 Antenna System Installation

### Recommendations

- Use only Aria Wireless Systems approved repeaters and duplexers.
- Use omnidirectional antennas for repeaters.
- Repeaters should be located indoors in a controlled environment. If this is impossible due to tower or building locations and the repeater must be outdoors, a proper outdoor enclosure must be used. Such enclosures must be weather tight, ventilated with a fan, white in color with a sunshield installed around the cabinet. In cold climates, a thermostatically controlled heater should be installed to maintain the inside temperature above +32 degrees Fahrenheit (0 degrees Celsius).
- Repeaters should be located in a low RF noise environment. If this is impossible, use of an external bandpass filter between the antenna cable and the receiver connector is recommended.
- The repeater should be located by itself, separate from host and remote installations.
- All repeaters must be maintained within Bison Data published specifications.

# 3.1 Frequency Setup

Using a standard 25-pin RS-232 serial cable, connect a PC serial port to the RS - 232 port of the Control module like this:



Use a PC based Terminal Program (such as Hyperterm, or Windows Terminal), set to 9600 bps, 8 data bits, 1 stop bit, no parity.

Use these commands to configure and control the repeater:

- ADC - display analog voltages
- ALARM - display failed devices
- COMCTRL ? or 1 or 0 - enable/disable backplane port. This allows remote access to the repeater functions.
- INSTALLED - which repeater cards are present
- MODE ? or Mode - defaults to REPEATER mode
- MODSCHEM ? or 2S25K or 4S12.5K or 4S25K
- NETBAUD ? or 9600 or 19200
- NETWORK - which COM cards are connected
- OPERATIONAL - which devices are functioning
- RESETALARM - clears all current alarms
- RESET[COM1...COM5, or TX1/2 or RX1/2]
- RXFREQ ? or the actual frequency e.g. rxfreq 928.3375
- SELECTED - which TX and RX is primary
- SETALARM - sets manual alarm state
- SWITCHES - front panel switch positions
- TOGGLETX/RX - switch over to other TX or RX
- TXFREQ ? or the actual frequency e.g. txfreq 952.3375

The parameters entered must agree with the hardware installed. If the wrong data is input, the repeater modules will fail to initiate correctly and will indicate this condition with a combination of red FAULT LEDs illuminating once the modules are plugged back into the repeater as explained in Section 4-1 LED and Control Descriptions. Operator can input or change any combination of parameters.

After the operator enters each parameter, the command processor will respond to a valid entry with an \*OK Set Control Module switches as follows:

- TX1 / TX2 - AUTO
- RX1 / RX2 - AUTO
- TX DISABLE / ENABLE - DISABLE

After all parameter values are entered, plug one module at a time back into the repeater gently using both top and bottom module handles. Note PC display: The command processor will respond to each module when it is plugged back into the repeater with similar indications as shown below:

- Transmitter 1 went from not available to failed
- Transmitter 1 went from failed to primary or secondary

After all modules have been plugged into the repeater, and have successfully initialized (yellow and green LEDs illuminated), tighten all module captive screws. The repeater is now ready for network operation.

**CAUTION:** Make sure the repeater RF ports at the back panel are connected to a duplexer and antenna or dummy loads before setting TX Disable / Enable switch on Control panel to Enable. Failure to proper load or antenna can result in transmitter module damage.

### 3.1.1 - Remote Repeater Control

Repeater software version 1.2 or greater has backplane support for the above commands, so that an RCC application running under CEMA 2.0 on a COM card plugged into COM slot 1 in the repeater cage, can control the repeater via DIP (Device Internal Protocol). Any Netmgr IRM can send a DIP command to the COM1 card (e.g. |kRptr “resetalarm” |) and the COM1 card will send the command over the backplane to the repeater control card, which will execute the command. The RCC Application running in COM1 will get the reply, and pass it back to the Netmgr IRM as the DIP reply. The value of COMCTRL must be 1, in order to enable backplane communications between the Repeater Control card and the COM1 card.

In order to control the repeater, the CEMA 2.0 software running in the COM 1 card must be IPX027 or greater, and must be configured as a Repeater Control Card Monitor application using Network Manager vers. 1.035 or greater.

The packet traffic to and from the repeater can be viewed on the Network Manager Real Time Display. Commands can be sent to the repeater via the COM 1 card (which must be installed and addressed as a full network participant) using the “Manual DIP (Device Internal Protocol)” function of the Network Manager.

The DIP commands are of the form:

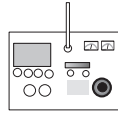
| kRptr “any command and data” |

Sent as a Remote command to the COM 1 card CEMA address. Any of the above listed commands are valid.

**DANGER: | kRptr “comctrl 0” | will disable communications along the backplane. If this command is sent from a remote site, you will no longer be able to control or monitor the repeater.**

## 3.2 - Frequency Checkout

### Radio Frequency Check



Once the Repeater is installed and configured, the frequency of each transmitter and receiver module must be checked.

Required Equipment: RF communications test set.

#### Procedure

1. Connect the coaxial cable from the front panel frequency Monitor port to the T/R port of the RF Communications Test Set.
2. Set the Communications Test Set to measure a 19 MHz signal.
3. Fine-Adjust the control labeled TCXO ADJ on the Repeater module by inserting a flat head screwdriver and turning it clockwise to increase frequency, or counterclockwise to decrease frequency and adjust to 19.66080 MHz +/- 10Hz.

#### NOTE

The reference frequency **must** be adjusted accurately. Every one Hertz error of the 19 MHz reference frequency corresponds to a much larger error of the carrier frequency.

The error depends on the Radio Type:

Radio Type	Carrier Frequency Error (per 1 Hz ref error)
800/900 MHz	128 Hz
400-500 MHz	64 Hz

#### Example

A 10 Hz reference error will yield a 1280 Hz error on an 800/900 MHz Repeater or a 640 Hz error on a 400/500 MHz Repeater.

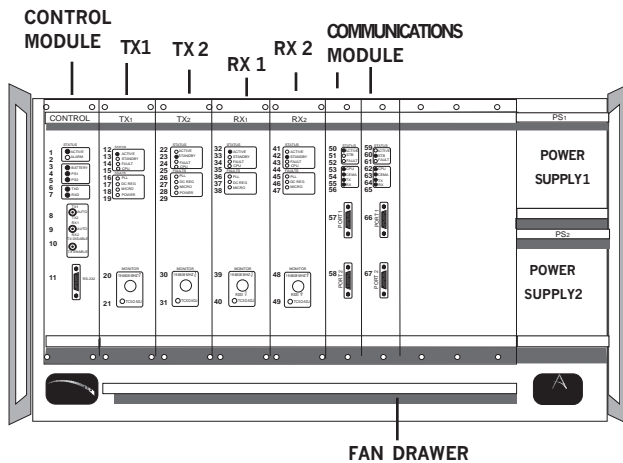
#### NOTE

Be sure to adjust **ALL FOUR** modules, **BOTH** transmitters and **BOTH** receivers.

# 4.1 Repeater Modules

## The Repeater Modules

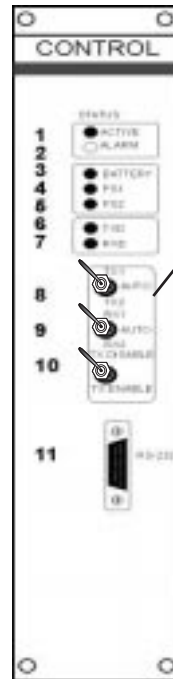
The Repeater is a fully redundant, modular system. Every critical function has separate primary and backup circuitry in individual modules. For easy maintenance without interrupting operation, the modules are simple, front panel plug-in types, illustrated below.



**NOTE**

The switches have a safety locking feature. They will not toggle with finger pressure. To switch between modes, PULL the switch out and place it in your desired mode. It will then lock and immobilize until pulled again to deselect.

## The Control Module



THESE TOGGLE SWITCHES OPERATE WITH A SAFETY FEATURE. SO THAT TRANSMISSION IS NOT INTERRUPTED DUE TO ACCIDENTAL MOVEMENT OF THE SWITCH. THE OPERATOR MUST PULL THE SWITCH OUT, AND SELECT EITHER OF THE THREE MODES. WHEN RELEASED, THE SWITCH LOCKS INTO POSITION.

SELECTING AUTO MODE WILL ENABLE THE CONTROL MODULE TO DECIDE WHICH TRANSMITTER MODULE WILL BE ACTIVE. MANUALLY SELECTING EITHER TX1 OR TX2 IS USUALLY RESERVED FOR TESTING PURPOSES.

This module provides the operator interface to control the switch-over operation and provides general status. The internal microprocessor monitors all the other modules and indicates a general Alarm if there are any faults. The status of the redundant power system and external battery source is also indicated here.

The operator can manually control which module is active via the front panel switches on this module. However, the Control Module is not required for automatic switch-over, thereby eliminating a single point failure.

### Auto Mode

When the control switches are left in the Auto position, switch-over will occur whenever the active module indicates a failure. The standby module will automatically take over operations.

The Control Module also provides an RS-232 serial data port for configuring by a PC-based Network Manager and for Repeater remote control by a wireline modem.

# 4.1 Repeater Modules

The Transmitter Modules



The Receiver Modules



The two Transmitter Modules are identical and interchangeable. At anyone time, one operates as the Active transmitter, the other as the Standby. Both are powered-up, but only the Active transmitter has its power amplifier on and is transmitting RF energy to the antenna.

The Transmitter Module indicates its status on front panel LEDs, described in detail in the next section. A monitor port is provided for adjusting the reference oscillator for the precise transmit frequency.

Similar to the Transmitter Modules, the two Receiver modules are also identical and interchangeable. They are both powered-up and operational, but only the Active unit is receiving the RF signal and sending the decoded data to the Transmitter.

The Receiver Module indicates its status on front panel LEDs, described in detail in the next section. A monitor port is provided for adjusting the reference oscillator for the precise receive frequency and to measure the Received Signal Strength (RSS) of the active receiver.

# 4.1 Repeater Modules

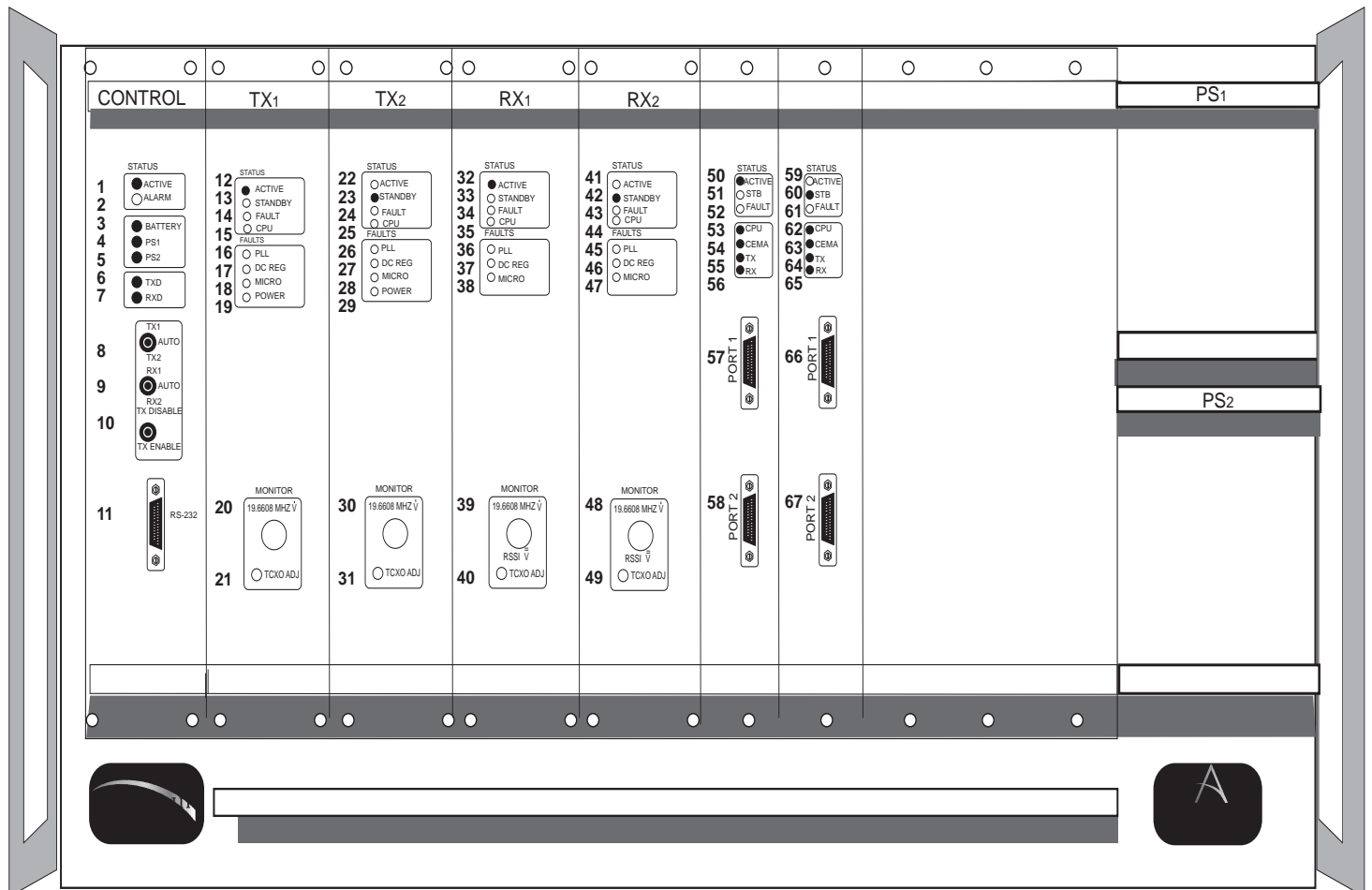
## The Communications Module



This module functions as a standard CEMA node, communicating on the radio network. The module consists of an IRM CPU card mounted in a carrier module for operation in the Repeater. It functions the same way an IRM would:

- This CPU is configured with a CEMA address and participates on the network.
- It uses the Repeater’s receiver and transmitter to listen to the network and insert packets when requested.
- Its data interface can communicate directly with the Control Module, giving remote access to all controllable functions, when the Communications Module is in slot #1 of the Repeater Chassis.

# THE SYSTEM III REDUNDANT REPEATER



## 4.2 LED & Control Descriptions

1. Control Module Status Active
2. Control Module Status alarm
3. Control Module Status Battery
4. Control Module Status PS1
5. Control Module Status PS2
6. Control Module Status TXD
7. Control Module Status RXD
8. Control Module TX1/Auto/TX2
9. Control Module RX1/Auto/RX2
10. TX Enable/TX Disable
11. Control Unit RS-232
- 12/21. Tx Status Active
- 13/22. Tx Status Standby
- 14/23. Tx Status Fault
- 15/25. Tx Status CPU
- 16/26. Tx Faults PLL
- 17/27. Tx Faults DC REG
- 18/28. Tx Faults Micro
- 19/29. Tx Faults Power
- 20/30. Tx Freq Monitor 19.6608 MHz
- 21/31. Tx Freq Adjust (TCX0)
- 32/41. RX Status Active
- 33/42. Rx Status Standby
- 34/43. Rx Status Fault
- 35/44. Rx Status CPU
- 36/45. Rx Faults PLL
- 37/46. Rx Faults DC REG
- 38/47. Rx Faults Micro
- 39/48. Rx Freq Monitor 19.6608 MHz
- 40/49. Rx Freq Adjust (TCXO)
- 50/59. Communications Module Status Active
- 51/60. Communications Module Status STB
- 52/61. Communications Module Status Fault
- 53/62. Communications Module CPU Activity
- 54/63. Communications Module Cema
- 55/64. Communications Module TX
- 56/65. Communications Module Rx
- 57/66. Communications Module Port 1
- 58/67. Communications Module Port 2

## 4.2 LED & Control Descriptions

Led/Switch/Port	What It Does	Normal Condition
1. Control Module Status Active	LED - Monitors each subsystem. When illuminated, means module is active.	Light is ON.
2. Control Module Status alarm	LED - when illuminated, means Control module has recognized a fault in one of the modules.	Light is OFF.
3. Control Module Status Battery	LED - When illuminated, means battery is the main power source.	Off - Battery Not Present On - Battery is Main Supply Blink - Battery Voltage < 10.4 V
4. Control Module Status PS1	LED - Power Supply 1 and 2 operate in parallel at all times. Only one is needed to operate the Repeater, the active power module LED will illuminate.	Off - Normal On - Failed Blink - Low Voltage
5. Control Module Status PS2		
6. Control Module Status TXD	LED- TD = Transmit Data. Shows data activity through the Repeater.	Off.
7. Control Module Status RXD	LED- TD = Receiver Data. Shows data activity through the Repeater.	Off.
8. Control Module TX1/Auto/TX2	Toggle Switch - UP = manually selects the LEFT module as active. DOWN = manually selects the RIGHT, module as active. CENTER - AUTO mode, Repeater will automatically select operating module.	Normal mode is in AUTO position.
9. Control Module RX1/Auto/RX2		
10. TX Enable/TX Disable	Toggle Switch - UP = disables transmitting mode, DOWN = enables transmitting mode.	Normal operating conditions require the Tx switched to Enable. Disable only for testing.
11. Control unit RS-232	Port - connects Network Manger or the External Modem Equipment.	Use only for configuration or remote access.

## 4.2 LED & Control Description

Led/Switch/Port	What It Does	Normal Condition
12/21. Tx Status Active	LED - indicates transmitter is active.	Illuminated on Active module. OFF on Standby module.
13/22. Tx Status Standby	LED - indicates transmitter is not selected, but is ready.	Not illuminated on Active module. Illuminated only on Standby module.
14/23. Tx Status Fault	Fault light - if light is illuminated, check the fault box for the applicable fault LED.	Not illuminated.
15/25. Tx Status CPU	LED - shows activity of the module's control processor.	Blinking
16/26. Tx Faults PLL	Fault light - indicates the internal Phase Lock Loop Oscillator is not operating properly or is transmitting at the wrong frequency.	Not illuminated.
17/27. Tx Faults DC REG	Fault light - indicates that any of the several DC power regulators inside the transmitter module are not operating correctly. This may be caused by an internal fault.	Not illuminated.
18/28. Tx Faults Micro	Fault light - indicates that the microprocessor in this transmitter module is not running. Transmitter does not run if microprocessor is not running.	Not illuminated.
19/29. Tx Faults Power	Fault light - indicates the transmitter power amplifier is not outputting its rated power. This may be caused by an internal fault.	Not illuminated.
20/30. Tx Freq Monitor 19.6608 MHz	Coaxial cable port - use to routinely monitor the transmitter frequency.	For test equipment connection.
21/31. Tx Freq Adjust (TCX0)	Temperature Compensated Crystal Oscillator adjustment screw - use to make frequency adjustments.	--
32/41. RX Status Active	LED - indicates receiver is selected.	Illuminated on Active module. OFF

## 4.2 LED & Control Description

Led/Switch/Port	What It Does	Normal Condition
33/42. Rx Status Standby	LED - indicates receiver is not selected, but is ready.	on standby module. Not Illuminated on Active Module. Illuminated only on Standby module
34/43. Rx Status Fault	Fault light - if light is illuminated, check the fault box for the applicable fault LED.	Receiver is selected either manually or from AUTO mode, and is active.
35/44. Rx Status CPU	LED - shows activity of the module's control processor.	Not Illuminated.
36/45. Rx Faults PLL	Fault light - indicates the internal Phase Lock Loop Oscillator is not operating properly.	Not illuminated.
37/46. Rx Faults DC REG	Fault light - indicates that any of the several DC power regulators inside the receiver module are not operating correctly. This may be caused by an internal fault.	Not illuminated.
38/47. Rx Faults Micro	Fault light - indicates that the microprocessor in this receiver module is not running. Receiver does not run if microprocessor is not running.	Not Illuminated.
39/48. Rx Freq Monitor 19.6608 MHz and RSSI	Coaxial Cable Port - dual purpose: 1.) Used to routinely monitor the receiver reference frequency [AC coupled]; 2.) Used to measure Received Signal Strength (RSS) [DC coupled].	For test equipment connection.
40/49. Rx Freq Adjust (TCXO)	Temperature Compensated Crystal Oscillator - adjustment screw used to make frequency adjustments.	
50/59. Communications Module Status Active	Indicates which module is active.	ON for selected module, OFF for STANDBY mode.
51/60. Communications Module Status STB	Indicates which Communications module is in standby mode.	

## 4.2 LED & Control Description

Led/Switch/Port	What It Does	Normal Condition
52/61. Communications Module Status Fault	Module microprocessor is in a fault condition.	Not illuminated.
53/62. Communications Module CPU Activity	Microprocessor "Heart Beat" indicates microprocessor is running.	Blinking.
54/63. Communications Module	LED -Module has synchronized with the CEMA network.	Blinking.
55/64. Communications Module TX	LED - LED - transmitting data activity.	Flashing when Communications module is transmitting data.
56/65. Communications Module Rx	LED - receiving data activity.	Flashing when Communications module is receiving data.
57/66. Communications Module Port 1	Data port.	Future use.
58/67. Communications Module Port 2	Data port.	Future use.

## 4.3 Recommended Operating Procedures

Before leaving the Repeater site, we recommend that you make sure of the following:

- Tx and Rx switches are in AUTO position
- One *transmitter* is ACTIVE (green light) and the other is in STANDBY (yellow light)
- One *receiver* is ACTIVE (green light) and the other is in STANDBY (yellow light)
- There are no FAULT (red lights) indications
- The Tx control switch is in ENABLE mode
- That the TxD and RxD LEDs on the CONTROL module are flashing to show data activity
- Battery or other uninterruptable power source is charging, if applicable.

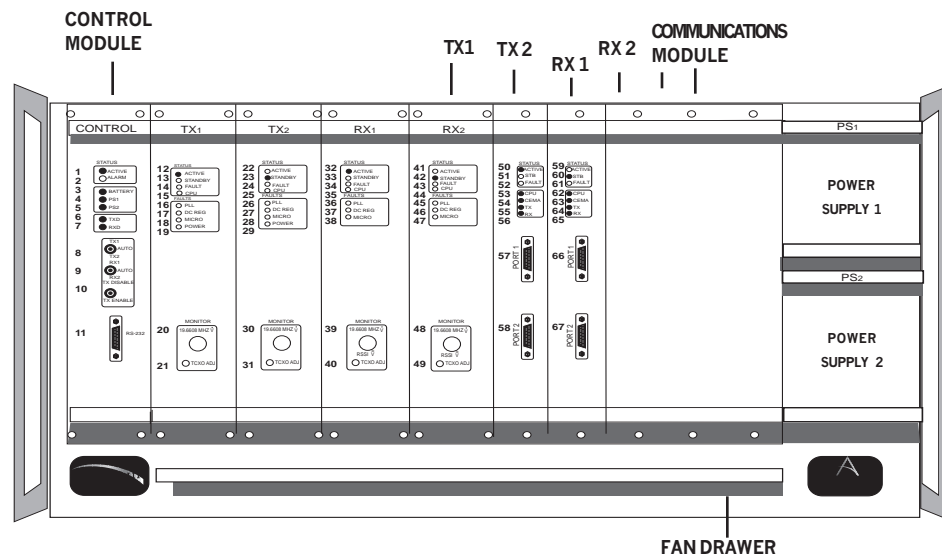
### Remote Control Options

In addition to controlling the Repeater from the front panel, status information can be monitored and standby switch-over can be controlled remotely. There are two methods of remote control:

- 1.) Via wire line modem
- 2.) Via Communications Module

# 4.4 Troubleshooting Guide

Diagram Number / LED	Problem	Solution
2. Control module Status Alarm	Any one of the seven modules is not operating correctly.	If any other module FAULTS are illuminated, refer to the individual module and troubleshoot it. If no other modules display FAULT LEDs, then replace the CONTROL module.
3. Control Module Status Battery	The repeater is operating off battery power because prime AC power is unavailable.	Check your AC power connection and your prime power source.
4. Control Module Status PS1	When not illuminated, means power supply 1 is not functioning.	Check the power module is fully seated in its slot, or, replace the module.
5. Control module Status PS2	When not illuminated, means power supply 2 is not functioning.	Check the power module is fully seated in its slot, or, replace the module.
6,7. Control Module Status Tx/D or Rx/D	If not illuminated, there is no data being exchanged between receiver and transmitter.	Check either the Tx or Rx.



**\*first try removing the module and reinserting it.**

## 4.4 Troubleshooting Guide

Diagram Number/ LED	Problem	Solution
12,21,30,38. Tx/RX Status Active	If not illuminated, check that the other Tx/Rx module is active.	Try to reactivate with Tx/Rx Control switch, or replace this module.
13,22,31,39. Tx/Rx Status Standby	If not illuminated, check that other Tx/Rx module is in standby.	Try to reactivate with Tx/Rx Control switch, or replace this module.
14, 23,32,40. Tx/Rx Status Fault	Means the Transmitter/Receiver recognizes that it has a problem.	Replace this module*.
15,24,33,41. Tx/Rx Faults PLL	Means the internal oscillator is not phase locked into the frequency reference. In the Receiver, it refers to the first local oscillator. In the transmitter, it refers to the Voltage Controlled Oscillator creating the RF carrier signal.	Replace this module*.
16,25,34,42. Tx/Rx Faults DC REG	Means the Transmitter/Receiver recognizes that it has a DC regulation problem.	Replace this module*.
17,26,34,42. Tx/Rx Faults micro	Means the Transmitter/Receiver recognizes that it has a micro controller problem.	Replace this module*.
18,27 Tx Power	Low RF Power means the Transmitter is not operating above it's minimum rated RF power level.	Replace this module*.

**\*first try removing the module and reinserting it.**

## 5.1 - Servicing

### General Servicing

#### WARNING

Servicing should only be performed by qualified service personnel. Removing the rear panel of the repeater creates the risk of electrical shock.

#### NOTE

Many hardware components are specified in metric. Be sure to use metric tools (nut drivers, wrenches, etc.) when appropriate.

#### WARNING

To avoid the risk of Electrical Shock always disconnect the AC Power before removing the rear panel of the repeater .

#### NOTE

Remember that you are working with ELECTROSTATIC SENSITIVE devices.

### Electrostatic Sensitive Device (ESD) Precautions

The Repeater modules contain electrostatic sensitive devices, and circuits may be damaged if proper precautions are not observed.

- Handle the modules only while wearing a grounded wrist strap and working at a static free workstation.
- Circuit boards and modules should be stored in antistatic bags and in their original shipping packaging.
- If a wrist strap and static free workstation are not available and a board must be handled, use the following procedure to reduce the possibility of ESD damage.
- To discharge any static charge from your body, place one hand in contact with the chassis before touching a circuit board. Keep your hand in contact with the chassis while handling the board. Do not touch any of the ICs and pick up the board only at the edges.
- Do not set the board down on a work surface.
- Return boards to the antistatic bags as soon as possible.

## 5.2 - Component Access

### Replaceable Assemblies

The following are replaceable assemblies in the Repeater:

- Power Modules
- Tx Modules
- Rx Modules
- Control Modules
- Communications Modules
- Coax Relays
- Fans

The backplane and chassis are not repairable in the field. Conditions involving these items require factory repairs.

### Hot Maintenance

Most maintenance can safely be performed on the Repeater while the power is on and it is operational, without disrupting service.

Except for the coax relays, all other field replaceable assemblies are plug-in modules. The modules slide in and out from the front panel and can be removed or replaced with the power on. There is no repair below this module level.

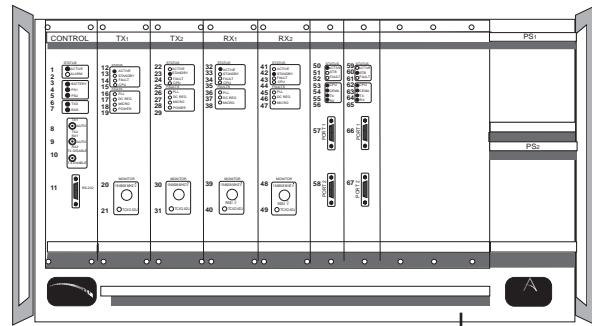
### Module Removal/Replacement

To remove a module:

1. Unscrew the four retaining screws, two at the top and two at the bottom, from the module front panel with a flat-head screwdriver. These are **captiv**e screws, so they stay with the module.
2. Grasp the module by its front panel handles and pull evenly until the module unplugs from the backplane. Slide the module out from the chassis.

To replace a module:

1. Align the modules card edges with the top and bottom card guides. Each module has its specific slots. Be sure to reinstall it in its correct location.



FAN DRAWER

2. Slide the module all the way back, then apply gentle, even pressure to the top and bottom handles until the module plugs in.
3. Tighten the four retaining screws.

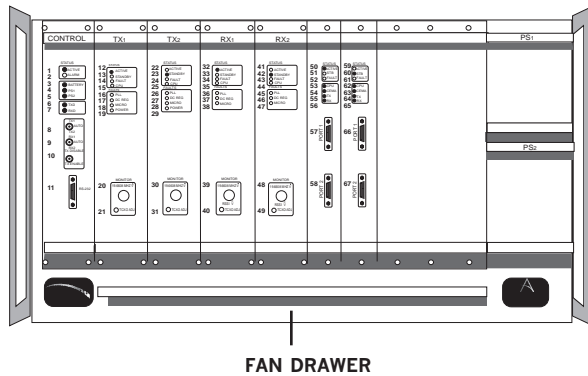
#### NOTE

Do not tighten the screws until the unit is fully seated in the backplane connector. Using the screws to force insertion could damage the connector.

## 5.2 - Component Access

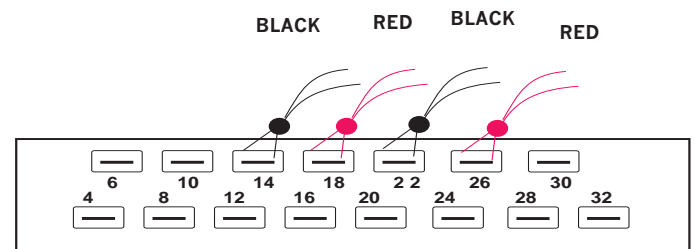
### Fan Removal/Replacement

There are two fans at the bottom of the Repeater to cool the unit. They are located in the lower fan drawer.



### Replacing A Fan

1. Mount the fan to the fan drawer with the four mounting bolts.
2. Replace the bottom screen and retaining panel, then tighten the center black knob.
3. Install the red and black wires to the rear panel power connector as shown:



BLACK 22 OR 14  
RED 26 OR 18

### Removing a Fan

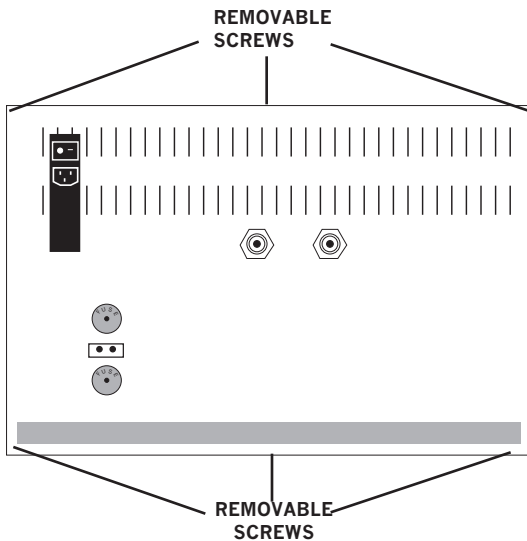
1. Remove the two retaining screws at each side of the fan drawer.
  2. Pull the drawer handle evenly and remove the drawer completely from the chassis.
  3. On the top center of the tray, unscrew the black knob completely to remove the bottom screen retaining panel. This will expose the fan's mounting nuts.
  4. With a narrow, flathead screwdriver, unscrew the four mounting bolts.
  5. Remove the spade lug red and black wires.
4. Gently slide the drawer back into the Repeater Chassis, applying even pressure until it clicks firmly into place.
  5. Tighten the two retaining screws.

## 5.2 - Component Access

### Coax Relay Removal

There are two coax relays on the rear panel, one for Rx, one for Tx.

1. Remove the six screws on the rear panel, three along the top edge, three along the bottom.



2. Disconnect the AC power cable of the rear panel from the backplane by pulling on the Molex quick-disconnect connector.
3. Disconnect the DC battery cable of the rear panel from the backplane by pulling on the Molex quick-disconnect connector.
4. For the Coax Relay to be replaced, unplug the Molex connector of the relay control cable from the backplane connector.
5. Disconnect the three RF coax cables from the Coax Relay by unscrewing the SMA connectors at the relay.
6. Remove the Coax Relay by unscrewing the two screws mounting it to the rear panel.

### To replace the Coax Relay:

Install the Coax Relay on the rear panel using the two mounting screws.

Connect the RF coax cable from the rear panel antenna port to Coax Relay center port marked "C".

Connect the RF coax cable from transceiver 1 backplane to the Coax Relay port marked "1", and the cable from transceiver 2 to port "2".

Connect the Relay control cable to the backplane quick disconnect connector at the lower right hand side of the backplane. The connectors are labeled Rx and Tx on the backplane, be sure to connect to the proper one.

Reconnect the rear panel AC power cable and DC Battery power cable to the backplane connectors.

Reinstall the rear panel to the chassis with the six screws.

## 5.3 - Receiver Module Checkout

### Receiver Module Alignment and Checkout

The Receiver Module is not repairable at the field level. Malfunctioned Receiver Module should be removed and replaced. The Receiver Module requires periodic checks of frequency, and RF receive signal strength level. These checks will insure the system continues to operate as it did when installed and will also satisfy regulatory authority frequency and power regulations.

### Frequency Check and Alignment

**NOTE**

Allow a minimum of 10 minutes warm-up time for the TCXO before attempting to align. This TCXO adjustment is made through the hole in the bottom panel.

1. Connect the coaxial cable from the front panel frequency Monitor port to the T/R port of the RF Communications Test Set.
2. Set the Communications Test Set to measure a 19 MHz signal.
3. Fine-Adjust the control labeled TCXO ADJ on the Repeater module by inserting a flat head screwdriver and turning it clockwise to increase frequency, or counterclockwise to decrease frequency and adjust to 19.66080 MHz +/- 10Hz.

If the frequency does not adjust to within these specified limits, replace the Receiver Module.

**NOTE**

The reference frequency **must** be adjusted accurately. Every one Hertz error of the 19 MHz reference frequency corresponds to a much larger error of the carrier frequency.

The error depends on the Radio Type:

Radio Type	Carrier Frequency Error (Per 1Hz Ref Error)
800/900 MHz	128 Hz
400-500 MHz	64 Hz

**NOTE**

After the first three months of operation, the TCXO may drift in frequency due to crystal aging. The alignment should be checked after this period if there is any questionable performance. After this initial period, the frequency should be checked yearly.

## 5.3 - Receiver Module Checkout

### Receiver Signal Level Check

The RF receive signal level check is a test of the RF path between a reference remote transmitter and the Repeater's receiver. If the level is lower than it was when the system was installed it is an indication of a problem. There may be an obstruction in the RF path, a problem with the antenna or a damaged coaxial cable. The receive level will provide an early indication of a problem that may be corrected before it causes disruption of service. Refer to Radio Test Data Sheet that came with the Repeater to convert the DC volt receiver signal strength indication to dBm, or use the following table.

If the signal strength has dropped by more than 5 dB, the problem should be investigated and corrected. The problem may be due to changes in the path (tree growth, new buildings, etc.), misaligned or faulty antenna and RF cables, or poor receiver performance. Use the RF Communications Test Set to check the receiver signal strength at the end of the antenna cable. If this signal strength has not degraded, then the receiver may have poor sensitivity.

### Receive Signal Strength Indication

400/500MHz		800/900MHz	
dBm	VDC	dBm	VDC
>-30	5.0V	>-30	5.0V
-40	5.0V	-40	4.75V
-50	4.9V	-50	4.25V
-60	4.4V	-60	3.75V
-70	3.8V	-70	3.25V
-80	3.2V	-80	2.75V
-90	2.6V	-90	2.25V
-100	2.0V	-110	1.75V
-110	1.3V	-110	1.3V
<-120	1.1V	<-120	1.1V

## 5.3 - Receiver Module Checkout

### Receiver Sensitivity Check

Measure the Receiver sensitivity by connecting the Repeater Transmit RF port to the RF Comm Test Set 50 ohm T/R port and connect the Repeater Receive RF port to the RF Comm Test Set Duplex port. Set the RF Comm Test Set to Duplex Mode. Enter the Repeater's transmit frequency (e.g. 952.0000 MHz) into the RF Comm Test Set for measurement. Also enter the Offset for the RF Comm Test Set's frequency generator. This will correspond to the difference between the Repeater's receive frequency and its transmit (e.g. 928-952 = -24 MHz). Set the RF Comm Test Set to modulate the generated RF carrier with a sine wave tone.

For 19.2 Kbps, 25 KHz radios, set the RF Comm Test Set to modulate Iwith a 4800 Hz sine wave tone at 3.2 KHz deviation. For 9600 bps, 12.5 KHz radios, set the modulation to a 2400 Hz sine wave tone at 2.9 KHz deviation. Monitor the Received Audio Pin of the Receiver Module's backplane connector. Decrease the power out of the RF COMM TEST SET until the point where the received data begins to loose data bits. Proper data decoding should occur down to the level shown in the table.

Radio Type	Deviation	Sinewave	Minimal Signal Level for Decoding
19.2 Kbs 25 KHz	3.2 KHz	4800Hz	-95dBm
9600 bps 25KHz	3.2 KHz	4800Hz	-105dBm
9600 bps 12.5 KHz	2.9 KHz	2400Hz	-95dBm

## 5.4 - Transmitter Module Checkout

### Transmitter Module Alignment and Checkout

The Transmitter Module is not repairable at the field level. Malfunctioned Transmitter Modules should be removed and replaced. The Transmitter Module requires periodic checks of frequency, output power and RF receive signal strength level. These checks will insure the system continues to operate as it did when installed and will also satisfy regulatory authority frequency and power regulations.

### Frequency Check and Alignment

**NOTE**

Allow a minimum of 10 minutes warm-up time for the TCXO before attempting to align. This TCXO adjustment is made through the hole in the bottom panel.

1. Connect the coaxial cable from the front panel frequency Monitor port to the T/R port of the RF Communications Test Set.
2. Set the Communications Test Set to measure a 19 MHz signal.
3. Fine-Adjust the control labeled TCXO ADJ on the Repeater module by inserting a flat head screwdriver and turning it clockwise to increase frequency, or counterclockwise to decrease frequency and adjust to 19.66080 MHz +/- 10Hz.

**NOTE**

The reference frequency **must** be adjusted accurately. Every one Hertz error of the 19 MHz reference frequency corresponds to a much larger error of the carrier frequency.

The error depends on the Radio Type:

Radio Type	Carrier Frequency Error (Per 1Hz Ref Error)
800/900 MHz	128 Hz
400-500MHz	64 Hz

**NOTE**

After the first three months of operation, the TCXO may drift in frequency due to crystal aging. The alignment should be checked after this period if there is any questionable performance. After this initial period, the frequency should be checked yearly.

## 5.4 - Transmitter Module Checkout

### Deviation Check

A deviation check is not necessary for routine calibration. The deviation parameters are embedded in the radio's firmware, so there is no risk of configuring with the wrong value. A deviation check can still be used as a quick operational test, but many RF Communications test sets are not accurate enough to measure the performance for a 4 state FSK radio. The deviation should be as follows:

Radio Type	Deviation
19.2k 25 kHz	+/- 3.2 kHz
9600 25 kHz	+/- 3.2 kHz
9600 12.5 kHz	+/- 2.9 kHz

### Output Power Check

With the equipment connected as described in section 5.3 of the Receiver Sensitivity Check, verify that the transmit power output of the Repeater is 4.0 watts, minimum. If the power out is not at least this value, check for excessive loss in the rear panel, RF cables or coax relays.

#### NOTE

Radios may have power output of 4 watts or more. Be sure to check that the maximum power output is in compliance with your local regulations. If the power is too high, add attenuation in your transmission line or consult the factory for lower power options.

# 6.1 - Power Subsystem

## The Power Subsystem

The Repeater has a fully redundant power subsystem that can operate from either AC or DC power. The schematic illustrates the signal paths. AC power enters the unit via the rear panel power entry module. This module contains the safety fuses for both 110/120 and 220/240 operation. The AC power is routed via the backplane to the two power supplies. These modules create +15V DC for all the other repeater modules.

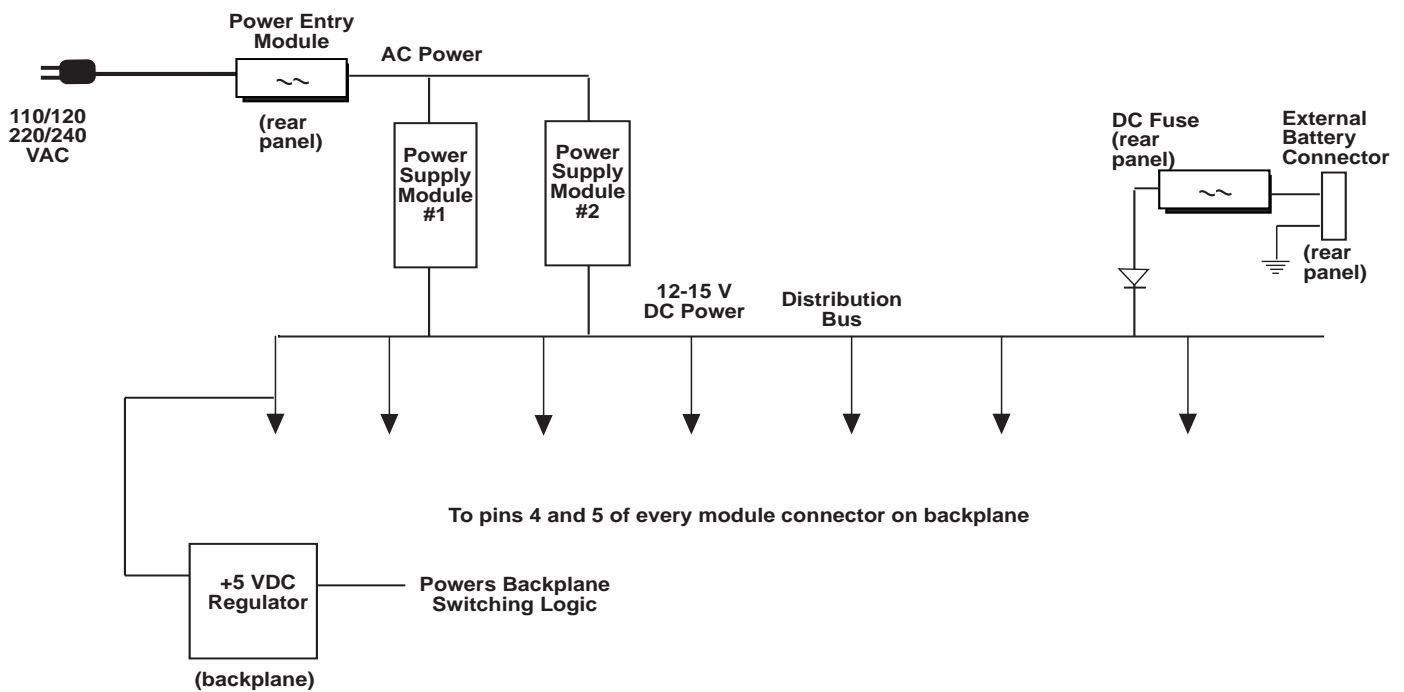
Every module in the Repeater operates exclusively from the 15V DC power. Any further DC power (such as +5V) is generated internal to each module.

Each power supply module is capable of driving the entire Repeater by itself. The output stage of each supply has blocking diodes that prevent the failure of one module from interfering with the other module.

The backplane contains a blocking diode for the external DC power source (usually a battery). Battery charging may be disabled by removing the rear panel DC fuse. The blocking diode prevents low external battery voltage from loading the internal DC supply.

Also on the backplane is a +5 VDC regulator to power the transceiver switching logic.

## Power Subsystem



# 6.2 Switchover Control Subsystem

## Switchover Control Subsystem

1. As described in the previous section, there is no switching of the redundant power modules. Both are always active and either one alone can power the Repeater. The Switchover Control Subsystem controls the activity of the receiver/transmitter modules.

2. Switchover is controlled by a single, composite logic chip on the backplane and by the Control Module. The Control Module is not a required component — the hot standby switchover function

will still occur with it not installed — it merely provides an operator interface for selection control and status display.

3. The backplane logic chip decides on which receiver or transmitter module to use based on selections from the Control Modules and Built In Test (BIT) status from each module. This select algorithm is used for both the receiver and transmitter as shown in the table:

Condition	Mode Selection
Front panel switch #1:	=> module 1
Front panel switch #2:	=> module 2
Front panel Auto:	
if #1 BIT status bad	=> module 2
if #2 BIT status bad	=> module 1
if both BIT statuses are good or both bad	
Control Module preference #1 =>	module 1
Control Module preference #2 =>	module 2

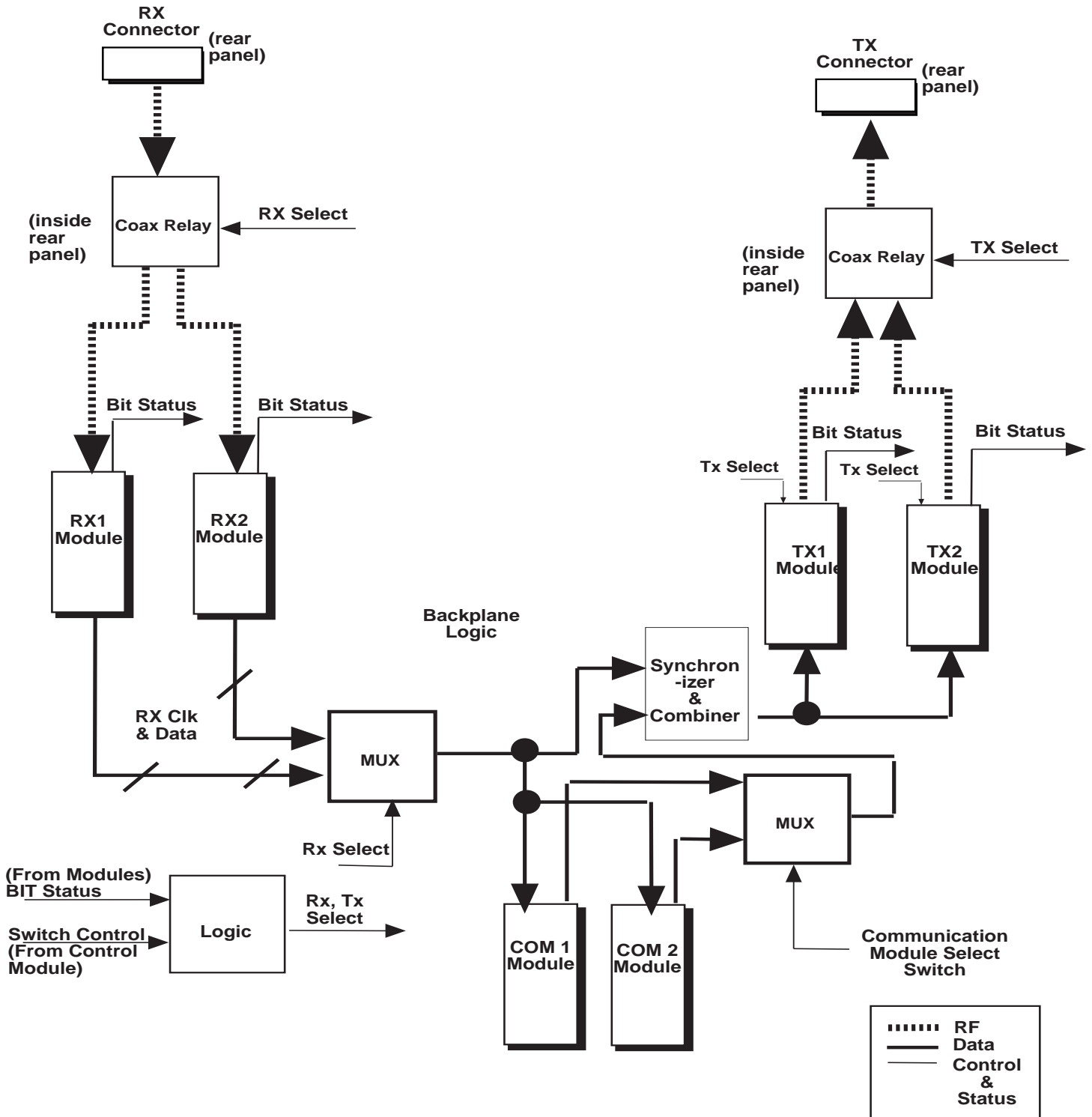
4. The following block diagram illustrates the redundant control operation. The received RF signal from the antenna is routed through a low loss coaxial switch that sends it to the selected Receiver Module. The coax switch is a latching relay type, so if it or the drive signal controlling it were to fail, it would remain in its last position and still operate.

5. Both Receiver Modules are always operating, but only the decoded clock and data from the selected one is used. The received data is sent to two places: to the Communications Modules so it can hear the network activity, and the transmitters for re-transmission.

6. The transmit data from the selected Communications Module is synchronized and combined with the received data and sent to both Transmit Modules. In this way, the Communications Module can participate on the network using the Repeater’s receiver and transmitter. Should a Communications Module fail and seize the transmitter for too long a period, the Control Module disables it.

7. Both Transmit Modules are powered on and receiving data, but only one is selected at a time for RF power output. This same select logic also drives the coax relay to direct the RF power out the antenna.

# 6.2 Switchover Control Subsystem



## 6.3 Transceiver Subsystem

### Transceiver Subsystem

The transceiver subsystem consists of redundant receiver/transmitter pairs. Each receiver or transmitter module is basically an IRM radio with only its receive or transmit portion enabled, mounted in a Repeater module carrier and optimized for single purpose use. For a description of how the receiver and transmitter operate, refer to the IRM Reference Manual.

At configuration time, the receive and transmit frequencies are programmed into the Control Module, which, in turn, programs each radio module. Once a radio module has been programmed with a valid frequency, it retains it in its non-volatile memory. If a module is removed and replaced without powering down the Repeater, it will stay at its last valid frequency. On power-up, each radio module is re-programmed by the Control Module with the configured frequency.

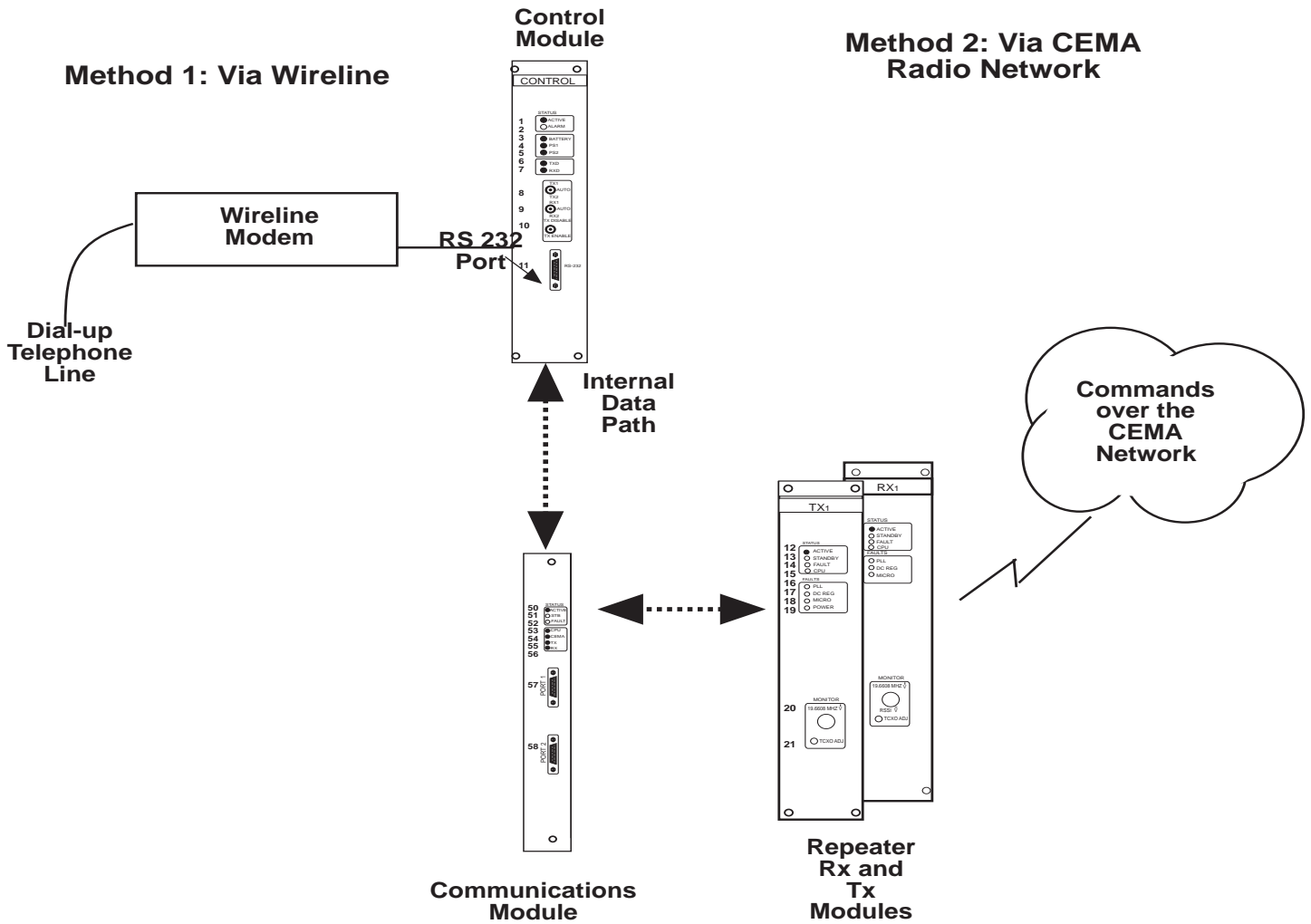
# 6.4 Remote Communications Subsystem

The Repeater can be remotely controlled via this subsystem. There are two methods:

**Wireline:** using a standard dial-up modem, an operator can remotely access the Control Module through the asynchronous, RS-232 front panel port.

**CEMA network:** the Communications Module functions as a standard CEMA addressable node. It shares the Repeater's receiver and transmitter to communicate with the Network Manager.

## Remote Communications Subsystem





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If ARIA determines that the product is not defective within the terms of this Limited Warranty, Customer shall pay ARIA for the cost for repair or replacement at ARIA's then prevailing rates. ARIA will provide an estimate of repair or replacement charges prior to commencing work. Freight/transportation charges to and from ARIA or its authorized service center shall be paid by the Customer for all non-warranty work.

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Call ARIA Wireless Systems, Inc. for service and coverage determination. If returned, the defective product should be *securely packaged in original boxes, insured and shipped freight prepaid*, to the. Customer agrees to insure and accept all liability for loss of or damage to this product in transit. **YOU MUST CALL TECHNICAL SUPPORT AT (716) 681-8750 FOR A RETURN MATERIAL AUTHORIZATION NUMBER (RMA) AND BEFORE SHIPPING ANY PRODUCT TO ARIA WIRELESS SYSTEMS, INC.** Please include a copy of your dated sales slip, the product serial number, and a detailed description of the problem you are experiencing.

The warranty shall not be applicable to the extent that any provision of this warranty is prohibited by any United States Federal, state or municipal law which cannot be preempted. This warranty gives you specific legal rights and you may also have other rights.

# 7.1 - CEMA 1.7 Application

## CEMA 1.7 Application Notes

**Using the System III Repeater in a CEMA 1.7 network.** The Aria System III Repeater (P/N SRR1x9.x) has been developed to support the new CEMA 2.0 network software. The repeater is also backward compatible with popular and current CEMA 1.7 network software. If your existing network is CEMA 1.7, please disregard all references in this manual to the following topics:

NETWORK MANAGER

IRM & REMOTE PROGRAMMING

The above mentioned features are System III CEMA 2.0 software features and do not apply to CEMA 1.7 networks. Users of CEMA 1.7 network software can upgrade to CEMA 2.0 software as applications become available.

## Communications Module Setup

### Procedure:

1. Using a standard 25-pin RS-232 serial cable, connect communications Port 2 on Communications module to a standard IBM PC compatible serial port.
2. Loosen captive screws on each Communications module installed in the Repeater. Grasp the top and bottom handles on each module and gently pull out until the configuration switches are visible. **(See "Switchless Configuration" below for newer software releases).** Set all switches except "4" to "ON" (Configuration mode) and plug the Communications module back into the repeater. Repeat this procedure for any additional modules as necessary.
3. Turn PC on and execute the "CFG\_96" or "CFG\_192" program depending on the Repeater type; 9.6Kbps or 19.2Kbps respectively.
4. Set TX ENABLE / DISABLE switch on Control Module to DISABLE. Set the Repeater power switch on the back to "ON" and note the

configuration mode indication on the Communications module; CPU, CEMA, TX, RX LEDs blinking concurrently. If all four LEDs are not blinking, the Communications module is not set in configuration mode. Re-check configuration switch settings.

5. Configure "PORT 2" of each Communications module. Be certain the port address is set correct and unique.

**NOTE:** It is highly recommended that Communications modules installed in the repeater are never configured to be partners; i.e., Addr 02 for Communications module #1 and Addr 03 for Communications module #2. This condition will cause the two Communications modules to internally arbitrate and severely reduce the throughput for the entire network. As a general rule, configure the Communications modules ports to be all hosts or all terminals.

6. After a successful download, set the Repeater "ON/OFF" switch to OFF. Unplug each Communications module from the Repeater and set all configuration switches back to normal position. Carefully plug each Communications module back into the Repeater and secure all captive screws.

## Switchless Configuration

An System III Repeater Communications Module running SX419, SX319, SX420, or SX320 allows a 10 second window on startup to download or upload configuration information without having to alter switch settings. The time period when an upload or download is accepted is indicated by all LEDs flashing simultaneously. The "switchless configuration" capability occurs on every other reboot, so that if a configuration PC is currently not connected to Port 1, the IRM resets itself and enters normal mode. Therefore, if the 10 second configuration is desired but does not occur, simply recycle power.

**NOTE:** Contact Aria Wireless Systems for "switchless configuration" upgrade information on other CEMA 1.7 protocol software.