8.0 UPGRADING LEDR FIRMWARE

8.1 Introduction

The LEDR radio's firmware can be upgraded with new software releases that may be issued from time-to-time by Microwave Data Systems. To support firmware upgrades while the radio is in use, the LEDR radio contains two complete copies of its firmware. Once the inactive version is replaced, the radio can be rebooted using the code in the new firmware. However, if an error occurs during the download, the radio can easily recover because it always has a complete copy of firmware available.

Reprogramming can be done through three common options:

1. Locally through the front panel CONSOLE Port.
2. Locally using TFTP and Telnet through the ETHERNET Port.
3. Remotely over a network connection using TFTP and Telnet to the ETHERNET Port.

The procedures that follow use one or both of two utilities found in MDS' *LEDR Utilities* package. These utilities will facilitate local and remote transferring of firmware files to and from the LEDR radio. These applications are available from Microwave Data Systems on floppy disk (P/N 03-3631A01) or on MDS' Internet sites FTP section of the primary site of **www.microwavedata.com**.

The following sections will explain how to program new firmware into the radio using each of the three connection options. They assume the LEDR Utilities are installed on each computer system named in the procedure.

NOTE: The ETHERNET, SERVICE CHANNEL and CONSOLE Ports share a common data channel when loading firmware over-the-air. Transferring the radio firmware image file (≈ 1 MB), may take up to 30 minutes if there is other activity on any of the other ports.

Regardless of your connection to the LEDR radio, loading data/firmware into the radio's SRAM is much slower than loading software onto a PC hard drive or RAM.

8.2 OPTION 1: Uploading Firmware via the CONSOLE Port

This method of upgrading the firmware is well suited to field service personnel that carry a laptop PC to field installation. Any computer running the Windows operating system is suitable. Figure 17 shows the basic arrangement.

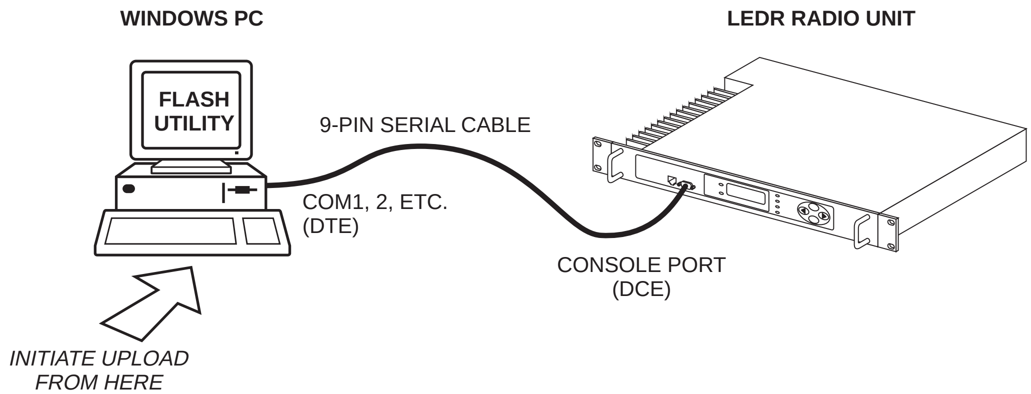


Figure 17. Direct connection through the LEDR CONSOLE Port

Setup

Connect a PC to the radio's front panel CONSOLE Port using a 9-pin RS-232 cable. (See Figure 33 on Page 129 for cable wiring details.) The CONSOLE Port supports RS-232 at 9600 bps to 38.4 kbps.

Download Procedure

1. Start the MDS MDS *Flash Utility* application.

2. From the **View>Options** menu, select the appropriate COM Port and baud rate. Ensure that **autobaud** is enabled (Look in the lower right-hand corner of the *Flash Utility* window).

3. From the **View** menu, select **console**. This will bring up a NMS window to the LEDR radio. At the **LEDR>** prompt, enter a login name and password and then close the session.

4. Using the **File|Open** dialog, select the directory where the new firmware is located. In the file window, highlight the correct (**.mpk**) file and then press the green **start** arrow.

Verification and Reboot

1. To verify the correct operation of the new firmware, open the NMS again by pressing **Alt + L**. Enter **boot** to determine which image is currently active. This command will respond as follows:

   boot: Image 1 is Active or, **boot: Image 2 is Active**

2. The new firmware is downloaded into the *inactive* image. Therefore, if the radio responded **Image 1 is Active**, enter "image verify" command, **iverify 2**, otherwise, enter **iverify 1**. The radio will respond indicating whether or not the image has been verified as being a valid file, it will not determine if the contents are complementary to the other firmware image. If the image does not verify, try downloading the firmware again into the radio.

NOTE: The following paragraph describes rebooting the radio. This action will disrupt the communications link.

3. Once the image has been verified, the radio must be rebooted using the new firmware. This is done by entering the command **boot 1** or **boot 2**, where the **1** or **2** corresponds with the image number used with the **iverify** command above.

4. Once the radio has rebooted and Flash Utility screen displays the **LEDR>** prompt, the firmware can be downloaded or copied into the other image. Often, copying the firmware from one image to the other can be faster than performing a second download. To copy the firmware over to the other image, simply enter **icopy**. The radio will prompt you for confirmation (**y/n**) and then begin copying.

8.3 OPTION 2: Uploading Firmware Locally by Telnet via Ethernet

This method can be used in the field or in a workshop by using a Windows computer equipped with an Ethernet interface. Figure 17 shows the basic arrangement.

NOTE: You must know the IP address of the LEDR Radio and the PC that you are going to connect together. (Both units must have the same Subnet, Netmask and Gateway addresses, or at least have routes to one another.) This is essential for a direct Ethernet connection.

If you do not know your Windows computer's IP address, you can use the **RUN** function from the **Start** menu and enter **winipcfg** to determine your local PC's IP address. The IP address of the radio can be found by the use of the radio's **ip** command.

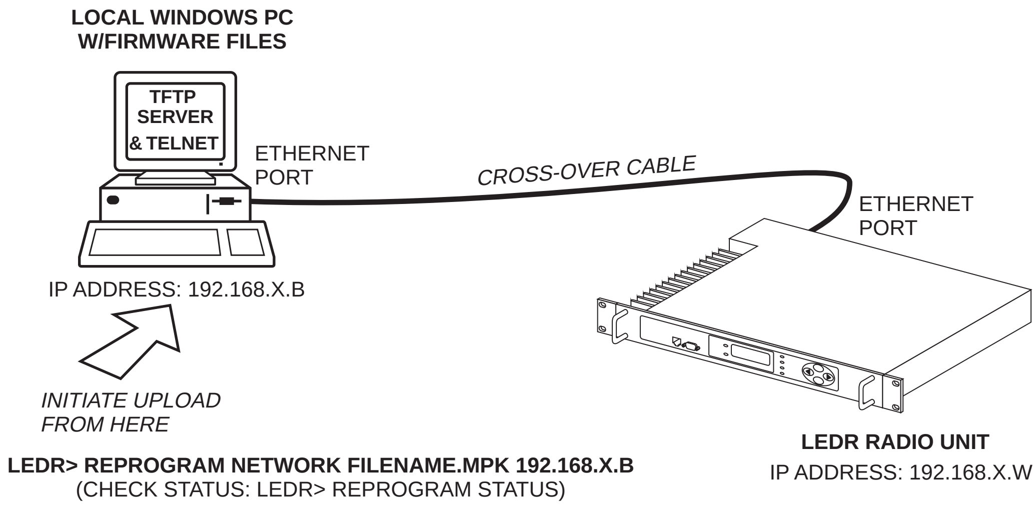
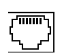


Figure 18. Direct connection through the LEDR ETHERNET Port

Setup

1. Connect the PC's Ethernet interface to the radio's ETHERNET Port  using a Category 5 Ethernet cross-over cable.

2. Copy the file LEDR firmware image file (**ledr.mpk)** into a known directory on your PC. For example, **c:\windows\LEDR\Firmware V2.5\.** This directory path will be used later by the TFTP server.

Download Procedure

1. Launch the MDS *TFTP Server* on a PC connected to the LEDR radio's ETHERNET Port through a cross-connect cable.

2. Point the *TFTP server* to the directory from which you desire to upload the new firmware. In the SNMP TFTP server, you should execute the **set root** command and point to the known directory where **ledr.mpk** has been copied.

3. Launch your Telnet application and login to the radio which you desire to load (reprogram) the firmware image file.

4. Determine the active (firmware) image from which you are currently executing by typing **boot.** The new firmware will downloaded into the *inactive* image.

5. Execute the command **reprogram network ledr.mpk [IP address].** In the command, in place of **[IP address]**, you should actually type the IP address of the TFTP server. For example, **reprogram network ledr.mpk 192.168.1.2**

6. If desired, the status of the transfer during reprogramming may be displayed by typing **reprogram status**.

7. The *TFTP Server* and radio will notify you when the programming is complete.

Verification and Reboot

1. To verify the integrity of the new firmware enter **boot** to determine which image is currently active. This command will respond as follows:

   boot: Image 1 is Active or, **boot: Image 2 is Active**

   If the radio responded to the **boot** command with **Image 1 is Active**, enter the "image verify" command, **iverify 2**, otherwise, enter **iverify 1**. The radio will respond indicating whether or not the image has been verified as being a valid file, it will not determine if the contents are complementary to the other firmware image. If the image does not verify, try downloading the firmware again into the radio.

NOTE: The following paragraph describes rebooting the radio. This action will disrupt the communications link.

2. Once the image has been verified, the radio must be rebooted using the new firmware. This is done by entering the command **boot 1** or **boot 2**, where the **1** or **2** corresponds with the image number used with the **iverify** command above.

3. Once the radio has rebooted and Flash Utility screen displays the **LEDR>** prompt, the firmware can be downloaded or copied into the other image. Often, copying the firmware from one image to the other can be faster than performing a second download. To copy the firmware over to the other image, simply enter **icopy**. The radio will prompt you for confirmation (**y/n**) and then begin copying.

8.4 OPTION 3: Uploading Firmware from a Remote Server via Ethernet

Setup

Connect the LEDR radio's ETHERNET connector to network which has a PC connected with the desired LEDR firmware on its hard drive. The "network" can be a local area network, a wide-area network or any IP network that can connect the two units.

The computer hosting the firmware image, must be running a TFTP server software. If not, install, launch and configure the MDS *TFTP Server* software found on the *LEDR Utilities* disk. The setup configuration is shown in Figure 19.

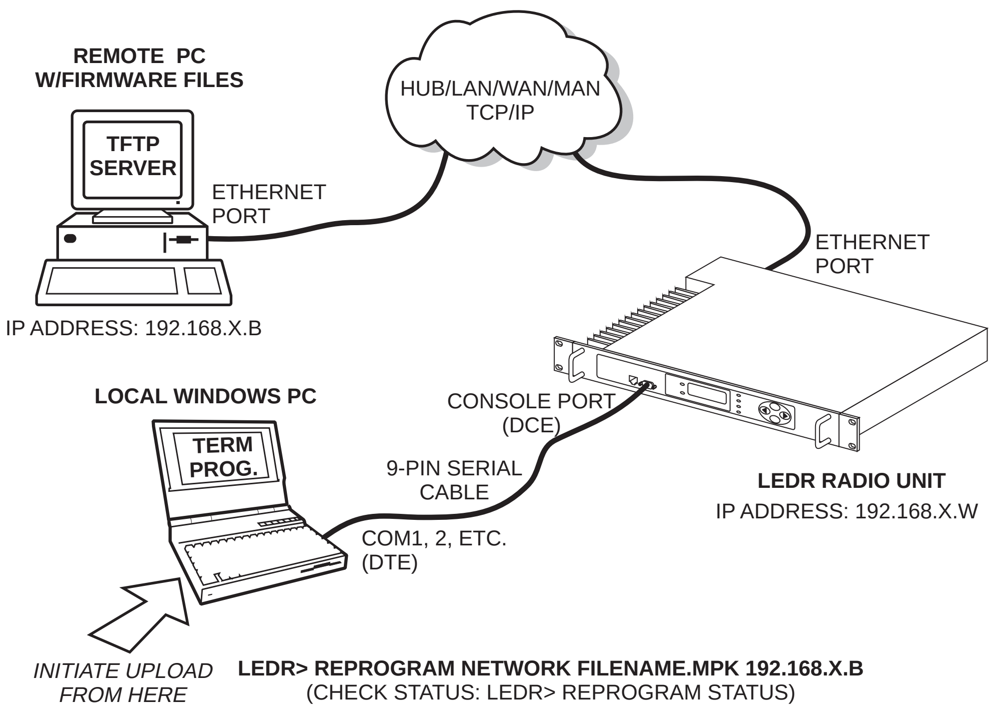


Figure 19. Uploading firmware from a remote server via Ethernet

Download Procedure

1. Start a terminal program, such as HyperTerminal, on the local PC.
2. Log into the LEDR radio using the **login** command.
3. Use the **ip** command to ensure that the radio has a valid IP address.
4. Use the **ping** command from the local PC to ensure that the PC and the radio have valid routes to pass information between them.
5. At the radio's **LEDR>** prompt, start the download by entering **reprogram network [filename] [source PC's IP Address].** The download can be monitored from the radio by entering **reprogram status.** When the download is complete the radio will sound two short beeps and the response from **reprogram status** will indicate that the download has finished.

SNMP Option

The TFTP download process can also be initiated using an SNMP manager. The **Firmware|FwProgTable** object provides a means for specifying the TFTP server IP address and the filename for the firmware.

Verification and Reboot

When the download is complete, verify the firmware image and reboot the radio as described under Verification and Reboot in Paragraph See “Verification and Reboot” on Page 95 for the procedure.

9.0 USING ORDERWIRE

9.1 Introduction

A handset may be plugged into the front panel of the LEDR radio to allow voice communications between radio sites (see Figure 20). This can be especially useful during setup and service of the radio equipment. All radios on the network can hear what is said by any individual speaking into a handset. No other radio may transmit on the orderwire until the current speaker is finished. Depending on the number of hops, the link data rates, and Interleave setting, there may be a noticeable latency from one end of the network to the other.

The front panel alert function (See “Unit ID” on Page 34) and **alert** command (Page 51) can be used to signal all units in the network or a specific radio.

Normal payload data is *not* affected by Orderwire use. The Orderwire uses voice-compression technology that introduces a slight, but noticeable, delay in Orderwire audio.

The orderwire will not interrupt the normal data flow through the LEDR data communication channel, however, it will reduce the throughput efficiency of any data communications on the Service Channel during periods of voice transmission.

A handset is available from MDS (P/N 12-1307A01), which has a push-to-talk button and provides basic communication services but does not contain a built-in DTMF (tone) keypad. (The Orderwire supports the transmission of DTMF-type signaling by detecting tones at the source, and regenerating them at the receiving end, however, there are no DTMF supported radio functions in the LEDR radios.)

9.2 Setup

Program the **vox** and **volume** setting for each radio. The volume setting is user preference. The **vox** setting requires some forethought. The higher the **vox** setting, the louder the user must speak to get the voice decoder to recognize the speech. This will, however, prevent noise from entering the “line.” A low **vox** level will recognize speech better but may transmit more noise with the speech. The user should experiment with the **vox** setting to determine the best level for the speaker and the noise environment.

9.3 Operation

1. Plug the handset into the front panel jack labeled . (Figure 32 on Page 129 provides pinout details for this connector.)

2. Press ◁ or ▷ at the menu’s top level until `Orderwire` appears on the LCD display. Press ENTER to move to the lower levels of the menu.

3. To call a specific radio station, enter the Unit ID number for the station to be called. (At this point, an alert signal (“ring”) will be sent to earpiece of the handset connected to the “called” station.

4. Press the PTT on handset to speak to the other station(s) listening to their handsets connected to LEDR equipment on the network.

   Release the handset PTT to listen. VOX (voice-activated transmit) operation is also supported. (See “vox” on Page 88.)

5. Alternatively, a DTMF-style handset can be used to “dial” the required radio station.

6. Remember, regardless of the number of users, only one may speak at a time.

NOTE: The LEDR radio has a built-in DTMF decoder in the orderwire circuitry. If a standard DTMF telephone test set is plugged into the orderwire, the user can dial in the three digit unit address on the handset to “ring” the earpiece of the handset of the associated LEDR unit.The LEDR chassis will not provide power to ring a standard bell or electronic ringer.

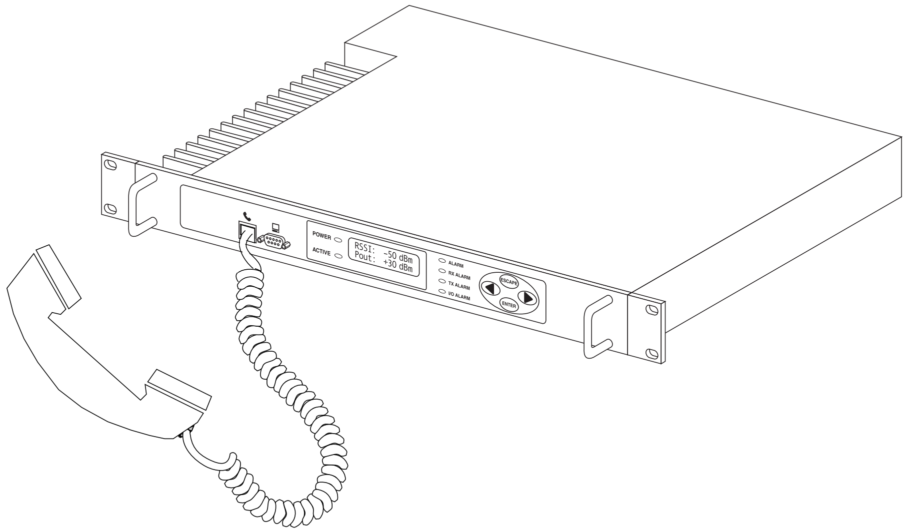


Figure 20. Orderwire Connection

9.4 Related NMS Commands

The orderwire can be configured by the NMS commands or through the front panel. The earpiece volume is more easily set by the front panel controls as the level is dependent on personal preference.

vox – Voice level (relative) at which speech will be detected by the software (See “vox” on Page 88)

volume – Sets/displays the handset volume (See “volume” on Page 88)

alert – Sends an orderwire alert to a specific radio or to all the radios on the network (See “alert” on Page 51)

10.0 USING THE SERVICE CHANNEL

10.1 Concept

The Service Channel sends and receives ASCII-based information at 9600 bps in a half-duplex broadcast mode throughout the network. This means that any data coming through the Service Channel Port of a radio will be broadcast to the Service Channel of each radio in the network. There can be only one radio transmitting Service Channel data over the network at a time and the data will always be sent to every radio on the network. *No other radio will be allowed to transmit until the current sender is finished*.

If a radio does receive data in the Service Channel Port while another radio is the active-sender, the data coming in the port will be queued and sent when the active sender is finished. Depending on the number of hops, link data rate, and Interleave setting, there may be a noticeable latency from one end of the network to the other.

10.2 Setup

The user can configure all the Service Channel parameters for a specific radio. The port may be enabled or disabled. In the disabled state (**svch port off**), any data that comes in the Service Channel port will be discarded and any Service Channel data that comes into the radio from another radio in the network will be passed along to the rest of the network but not sent out the Service Channel Port. When the Service Channel Port (**svch port on**) is enabled, it will behave based on the other settings.

The most important setting is the **echo** parameter. Echo is used with a terminal emulator on a PC and the program does not display on the screen character keyed in by the user.

When you set up a system, you must be careful to avoid an infinite loop. If echo is enabled, then every character that enters the Service Channel port will be echoed back out the port. When echo is disabled then data that comes in the Service Channel port is not sent back out the port. Trouble may arise if the device that is connected to the Service Channel also echoes the data it sends. In that case, the device will send characters into the Service Channel Port, the radio will echo the characters back to the device, the device will consider the echoed data to be input which it will in turn echo back to the radio, etcetera, until an overflow condition occurs.

You must also set the communication parameters (baud rate, stop bits, char length, and parity) via the **svch** subcommands so that the settings match those at the device connected to the Service Channel Port.

Lastly, the user can re-initialize the Service Channel port via the **svch reset** command. This may be helpful in the case where an infinite loop overflow condition has locked the port.

10.3 Usage

The Service Channel supports ASCII data transfer over the network in broadcast fashion. As a result, devices connected to the Service Channel Ports of different radios will appear to have a transparent half-duplex connection between them.

10.4 NMS Commands

This command is used to set/display Service Channel parameters.

Usage: **svch [subcommand] [<argument>]**

Subcommands: **baud**
char
echo
off
off
on
parity
reset
stop

on—Enable the Service Channel

off—Disable the Service Channel

reset—Re-initialize the Service Channel

echo—on/off

baud—300, 600, 1200, 2400, 4800 and 9600

char— 5, 6, 7, 8 (ASCII character length in bits)

parity—none, even, odd

stop—1, 2 (Stop bits)

11.0 PROTECTED CONFIGURATION

11.1 Introduction

The LEDR radio can be supplied in a protected (also called redundant or “1+1”) configuration (Figure 21). The protected version is designed to perform automatic switchover to a second radio in the event of a failure in the primary unit.

Protected operation is important for many mission-critical or revenue producing links. By configuring two identical LEDR radios in parallel and including a third switch box containing the RF switching circuits and the customer interfaces, it is possible to protect against failure in any of the LEDR radio sub-systems. Failures can be either malfunction or external environmental effects, such as multipath fading or nearby lightning strikes.

A Protected station consists of two standard LEDR Series radios and a Protected Switch Chassis (center unit in Figure 21). Ordinarily, the three chassis are mounted together in a “stacked” arrangement, one above the other, as shown in the figure.

The top unit is referred to as the system’s “Unit A”, and the lower one as “Unit B”. Each unit is considered to be the “sibling” of the other. The sibling of Unit A is Unit B, and the sibling of Unit B is Unit A. This distinction is used in the **rdnt** command found on Page 74 under the subheading “*Read & Write Commands.*”

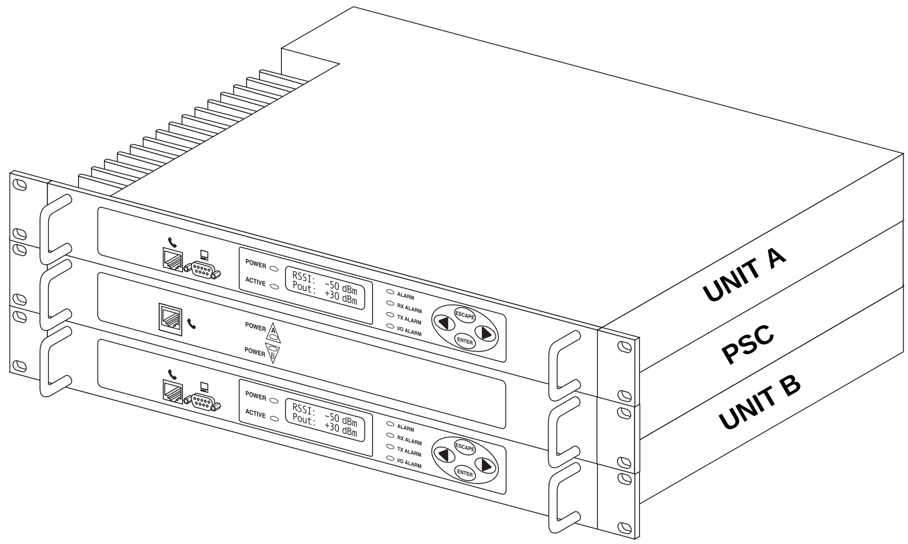


Figure 21. LEDR Radio Protected Version

The front panel of the Protected Switch Chassis (PSC) front panel has only two LEDs and an RJ-45 jack for an orderwire handset. The LEDs indicate by light and an arrow outline which LEDR chassis is active. It is assumed the two LEDR chassis will be mounted above and below the PSC as shown in Figure 21.

11.2 Protected Operation

During normal operation, one radio path is selected and the RF and interface switches are set to service that path. (The illuminated POWER LED indicator on the front panel of the Protected Switch Chassis (PSC) points to the currently active unit.) A switch in the transmitter circuitry allows one transmitter to be connected to the common ANTENNA port on the Protected Switch Chassis. On the receive path, a splitter in the Protected Switch Chassis allows both radio receivers to receive the incoming RF signal for processing.

The Protected Switch Chassis is a gateway for data coming and going between each of the LEDR radio units and the common data circuits connected to the PSC. The PSC monitors various RF and data signal paths for predefined fault-determining parameters. If signal conditions are not normal, the PSC’s microprocessor controller will issue an alarm and move the standby LEDR radio to the active mode.

Fault-determining parameters can be programmed from the Network Management System (NMS) software. Examples of these parameters are:

- Low transmitter power
- High transmitter temperature
- Synthesizers is out-of-lock
- Problem with the option board or framers
- CPU failure wherein the CPU watchdog causes a reset
- Fan fault

Transmitter Failure

Any failure on the "active" transmitter path will create a fault condition which will place the currently the active transmitter on standby and switch the "standby" transmitter to "active." The newly active transmit path will remain in use until a manual changeover returns the configuration to the original transmitter path. This allows the link to remain fully operational until the user has replaced the faulty transmitter circuitry.

Receiver Failure

Both receivers are fed via an RF splitter from the antenna port. Each RF path is buffered and monitored for receive signal integrity for uncorrectable bit-errors. If the "active" receive circuitry fails, uncorrectable bit-errors will be detected. The modem receive switch will first determine that the "standby" receive path is operational (no uncorrectable bit errors) and will switch accordingly.

11.3 Configuration Options

The protected LEDR radio is available with a number of configuration options, each designed to optimize particular system solutions:

1+1 Operation—Warm or Hot Standby

In a warm standby link, the standby transmitter is powered down. In a hot standby link, the standby transmitter is powered up and transmitted in a dummy load. The warm standby option offers the advantages of significantly reduced power consumption, since only one transmitter path is powered. However, upon transmitter failure, the switchover takes longer due to the transmitter having to be powered. Thus the hot standby mode offers the advantages of faster switchover time and increased overall system availability.

Symmetrical or Asymmetrical Receiver Splitters

The default protected radio is configured with a 3 dB splitter on the receive path, meaning that each radio's receiver signal level is equal, but typically 4dB worse than an unprotected radio (3 dB due to splitter, plus dB cabling and additional connectors). As an option, an asymmetrical splitter (1 dB / 10 dB) is offered. Using this option, the active path is 2 dB stronger than with a symmetrical splitter (1 dB compared to 3 dB splitter loss), allowing for a better fade margin and increased system availability during normal operation.

However, upon receiver change over, the receive signal strength will be significantly reduced due to the 10 dB of splitter loss rather than the equal splitter's 3 dB loss, making the link more sensitive to fading in this temporary switched state. Providing the failed standby receiver is replaced within a short period of time, many users find that the asymmetric splitter's increased normal performance offsets any deterioration in the temporary switched state.

11.4 PSC Rear Panel Connectors

The following are descriptions of the rear panel connections of the Protected Switch Chassis. The PSC's rear chassis is shown in Figure 22.

Figure 21 presents an inter-unit cabling diagram for protected configurations.

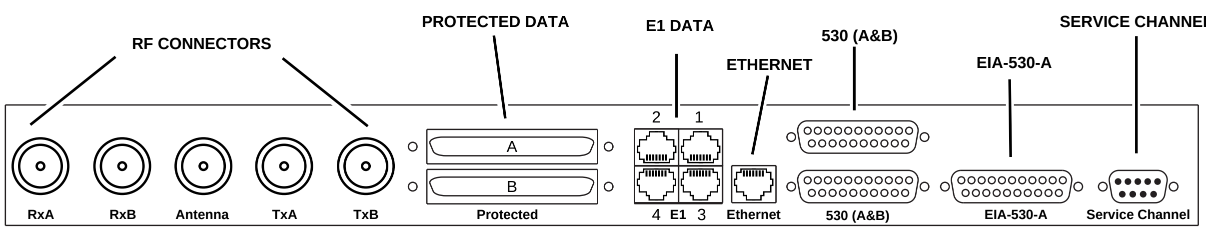


Figure 22. Protected Switch Chassis—Rear Panel

RxA

The RXA (Receive—Radio A) connector is a N-type coaxial connector. It connects to the RX port on the rear panel of Radio A via a short coaxial cable.

RxB

Same as RXA, but for Radio B.

Antenna

The ANTENNA connector is a N-type coaxial connector. It serves as the connection point for the station antenna.

TxA

The TXA (transmit, radio A) connector is a N-type coaxial connector. It connects to the TX port on the rear panel of Radio A via a short coaxial cable.

TxB

Same as TXA, but for Radio B.

Protected (Data)

This pair of connectors accepts G.703 signals from each of the LEDR radios. The top connector is for Radio A, and the bottom connector is for Radio B. For pinout information, see Figure 36 on Page 130.

E1

This is a block of four RJ-45 modular connectors for connection to a multiplexer or other customer-supplied E1 equipment. For detailed pin information, Figure 34 on Page 130.

These connectors are not operational on “S” Series (Subrate) radios.

Ethernet

The ETHERNET connector provides access to the embedded SNMP agent and other elements of the TCP/IP network management system. The connector is a standard 10 Base-T connection with an RJ-45 modular connector. For detailed pin information, see Figure 34 on Page 130.

530 (A&B)

This pair of DB-25 connectors accepts EIA-530 data signals from each of the LEDR radios. The top connector is for Radio A, and the bottom connector is for Radio B. For pinout information, see Figure 36 on Page 130.

EIA-530-A

This DB-25 connector provides a connection point for customer-supplied EIA-530 data equipment. Note: This port is not operational in full-rate models.

Service Channel

In a protected configuration, this DB-9 connector becomes the Service Channel connection for *both* LEDR radios. (In the protected radio configuration, the Service Channel connectors on the radios are non-functional.) For detailed pin information, see “Service Channel—Rear Panel” on Page 131.

11.5 Inter-Unit Cabling for Protected Stations

The required cabling between the two radios and the Protected Switch Chassis is dependent on the data interface, unit type (subrate versus full-rate), and transmit and receive antenna configuration.

The cabling for a pair of standard radios with internal duplexers is shown in Figure 23.

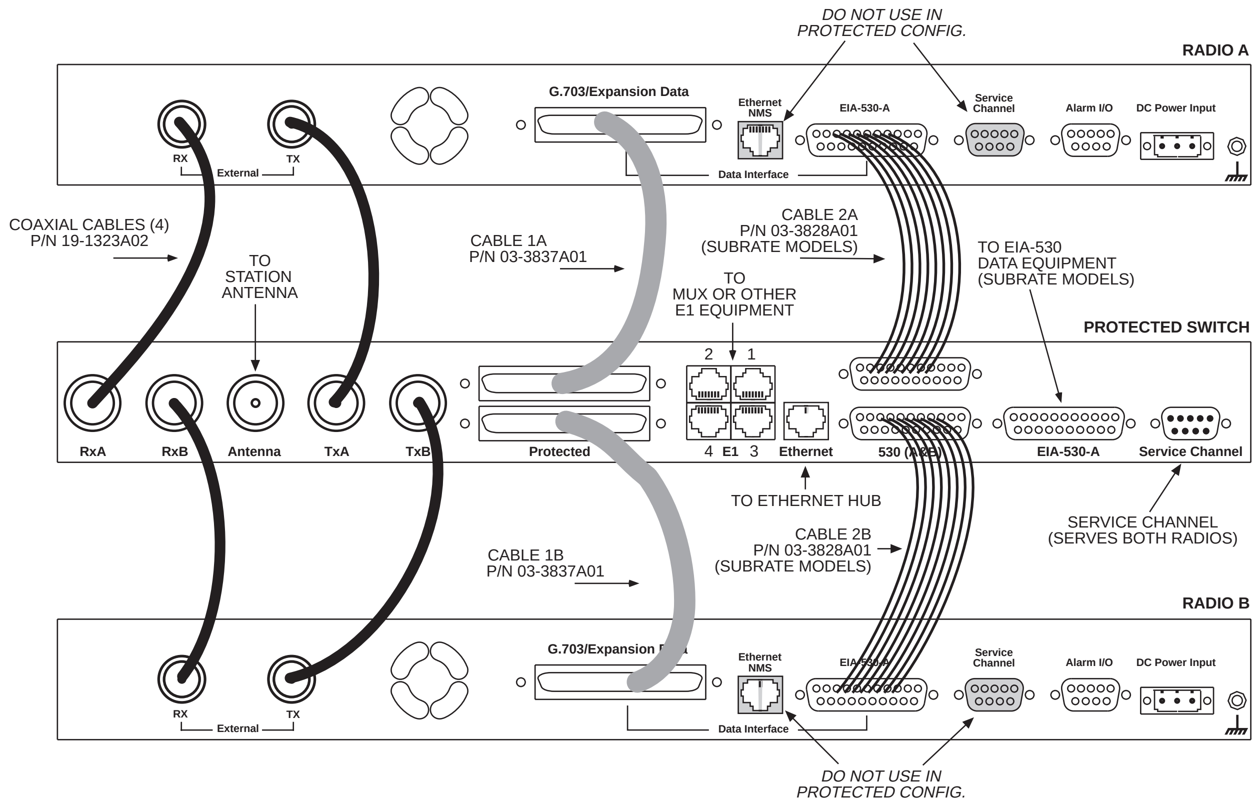


Figure 23. Inter-unit Cabling—Protected Version with Internal Duplexers

11.6 Configuration Commands for a Protected System

NOTE: In a protected link configuration, ensure that the E1/T1 interface settings are identical for both radios at a each end of the link.

Once the inner-chassis cabling is in place and the units are powered up, several parameters are required to place the LEDR radio into proper operation as a member of a protected system.

The tasks involved are reviewing and setting up of the following parameters:

- Radio Operation
  - General
  - Redundant Specific
- Data Interface
  - Subrate—Fractional-T1
  - Fullrate—E1/T1

Redundant Specific Parameters

There are several parameters that must be set to enable proper operation of a protected station. These are all covered under the **rdnt** command found on Page 74.

Sample Redundant Configuration Session

The following is a example of a session used to configure a LEDR radio to serve in a protected system. This sequence will need to be repeated for each radio in the protected pair.

1. Configure the protected mode to hot-standby:

```
LEDR> rdnt mode 1
rdnt {mode}: 1+1 Hot Standby
LEDR>
```

2. Configure the IP address of each radio:

```
LEDR> ip address 192.168.1.1
ip {netmask}: (255.255.0.0)
ip {gateway}: (0.0.0.0)
ip {port}:    (ETH)
ip {address}: 192.168.1.1
ip {netmask}: 255.255.0.0
ip {gateway}: 0.0.0.0
ip {port}:    ETH
ip: A reboot is strongly recommended. Do you wish to reboot? (y/n) >y
LEDR>
```

3. Configure the sibling IP address of each radio:

```
LEDR> rdnt ip 192.168.1.2
redundant {ip}: 192.168.1.2
LEDR>
```

4. Configure the hitless switching. (Note that the default is on.):

```
LEDR> rdnt hitless on
rdnt {hitless}: on
LEDR>
```

5. Configure the temperature (°C) threshold:

```
LEDR> rdnt temp 100
rdnt {temp}: 100
LEDR>
```

Transmit Clock Selection (Subrate Models Only)

The transmit clock selection must be addressed for every radio in a subrate radio system installation. The single most important consideration is that there be only *one* master clock in a subrate radio network. The master clock can originate from the radio or from the Customer Premises Equipment (CPE).

The radio is capable of several different clocking modes. Refer to Figure 24 on Page 111 for typical system clocking methods.

Refer to the `Clock Mode` screen description on Page 35 for setting the radio transmit clocking from the front panel. Refer to the **clkmode** description on Page 56 for setting the radio transmit clocking mode from the CONSOLE Port.

NOTE: When customer premises equipment (CPE) is operated in looped clock mode, it is recommended that the radio *not* be set to line clock mode. To do so may cause the transmitting radio's PLL to be pulled out-of-lock, especially when operating at 4E1 data rates.

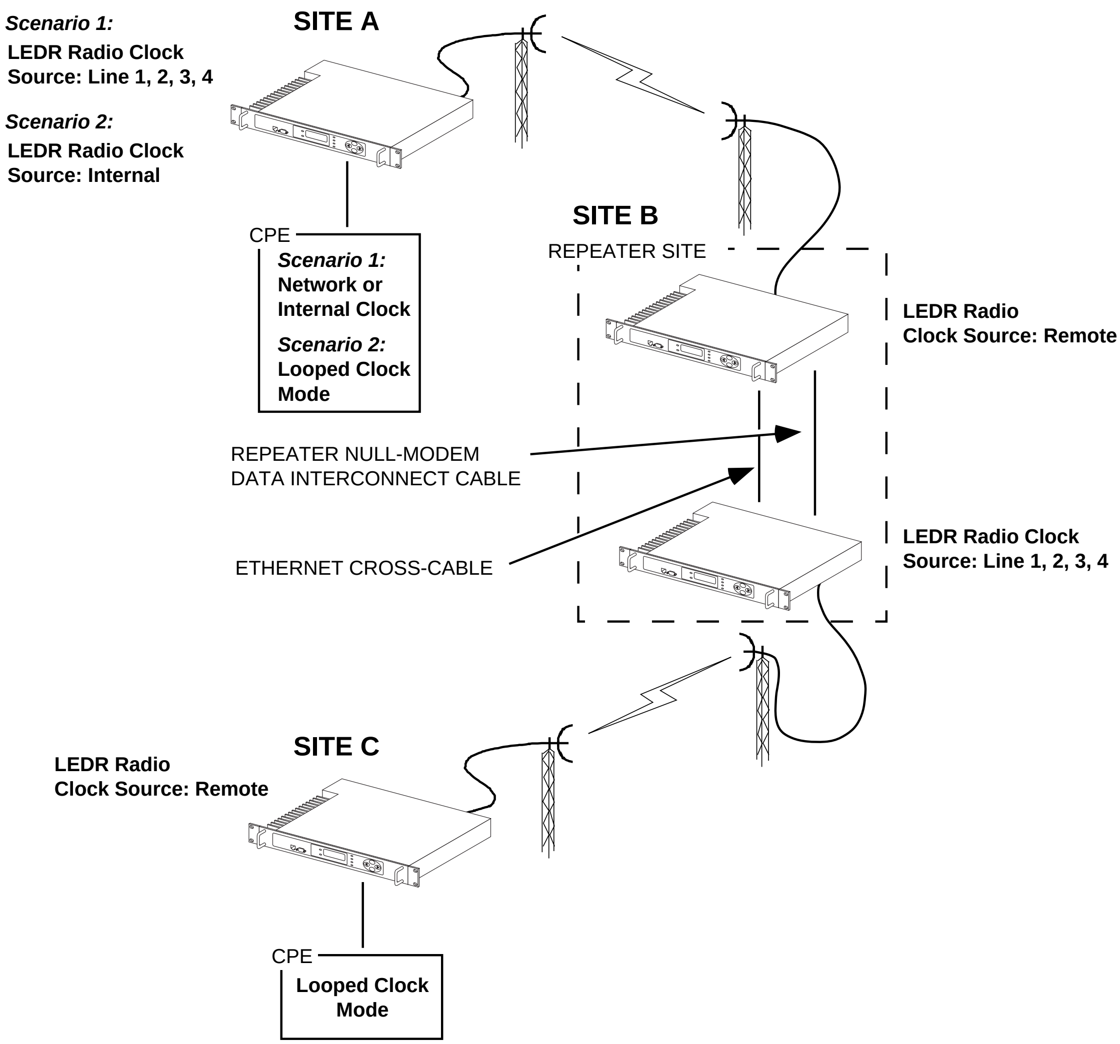


Figure 24. Typical Repeater Clocking Arrangement
(no multiplexer at repeater site)

12.0 SPACE DIVERSITY OPERATION

12.1 Introduction

Space diversity operation is an effective mechanism of increasing a radio link's resilience to transmission impairments such as multipath fading or frequency selective fading. In difficult transmission environments such as over highly reflective and moving water paths, or in arid environments where atmospheric ducting occurs, space diversity is the most effective way of maintaining a continuous radio link.

In a space diversity link, two radio receivers are operated in parallel, from two separate antennas mounted several wavelengths apart vertically on the antenna tower. The separation of antennas is such that when one antenna experiences fading due to multi-path interference, the other antenna, being several wavelengths away, is not likely to experience the same fade. Thus, one receive path may experience uncorrectable errors, while the other path will be error free. Similar to the protected operation, the receive modem switch will determine which buffered data path is operating with the highest integrity, and select that path without inducing any additional bit errors into the link.

Space diversity is especially effective in changeable multi-path environments such as over tidal water paths. Since water is highly reflective, there will be continual "constructive" and "destructive" interference at each single antenna over the course of the day as the water rises and falls and the reflected water path interferes with the line-of-sight path. By correct vertical positioning of the antennas, these effects can be negated, allowing one antenna to see a good signal while the other is experiencing fading, and the modem switching accordingly to allow the link to operate error- free.

The space diversity LEDR radio is available only in a hot standby configuration.

12.2 User Interface & Control

Protected operation is configured using the Redundant screen (Page 41) on either radio front panel, or with the **rdnt** command from a NMS terminal (see Page 74).

12.3 Transmit Clock Selection

There is no difference between a space diversity system and redundant radio arrangements with respect to transmit clock selection. Fullrate radios require no user intervention for clocking. Users of subrate systems should set the radio clocks as described for subrate systems. See "Transmit Clock Selection" on Page 112 for further information.

12.4 Inter-Unit Cabling for Space Diversity Stations

The RF cabling for space diversity stations depends on the location of the duplexers. The block diagram in Figure 25 shows the RF connections in a typical system with two external duplexers.

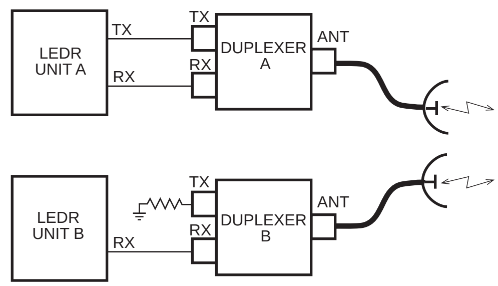


Figure 25. Block Diagram of a Space Diversity Station with External Duplexers

The inter-unit cabling for a space diversity system with external duplexers is shown in Figure 26.

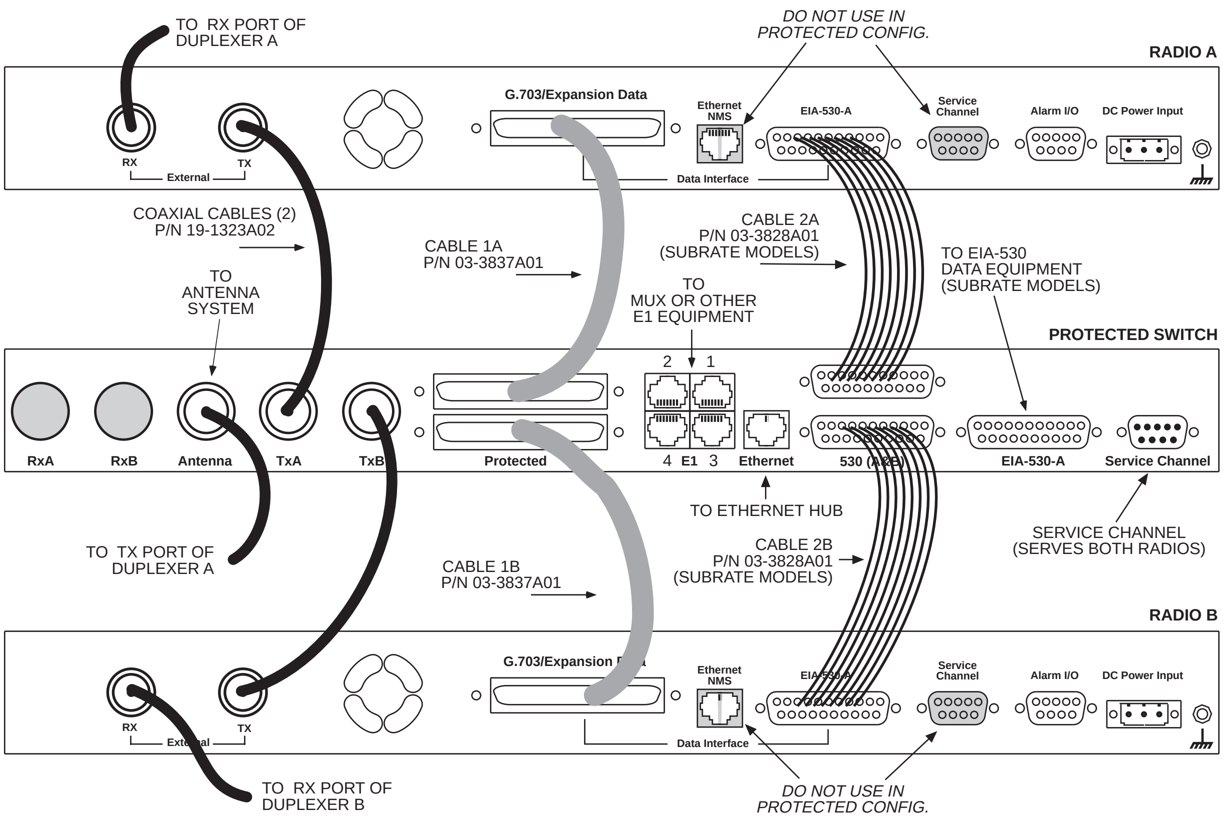


Figure 26. Inter-unit Cabling—Space Diversity with External Duplexers

The inter-unit cabling for a space diversity system with internal duplexers is shown in Figure 27.

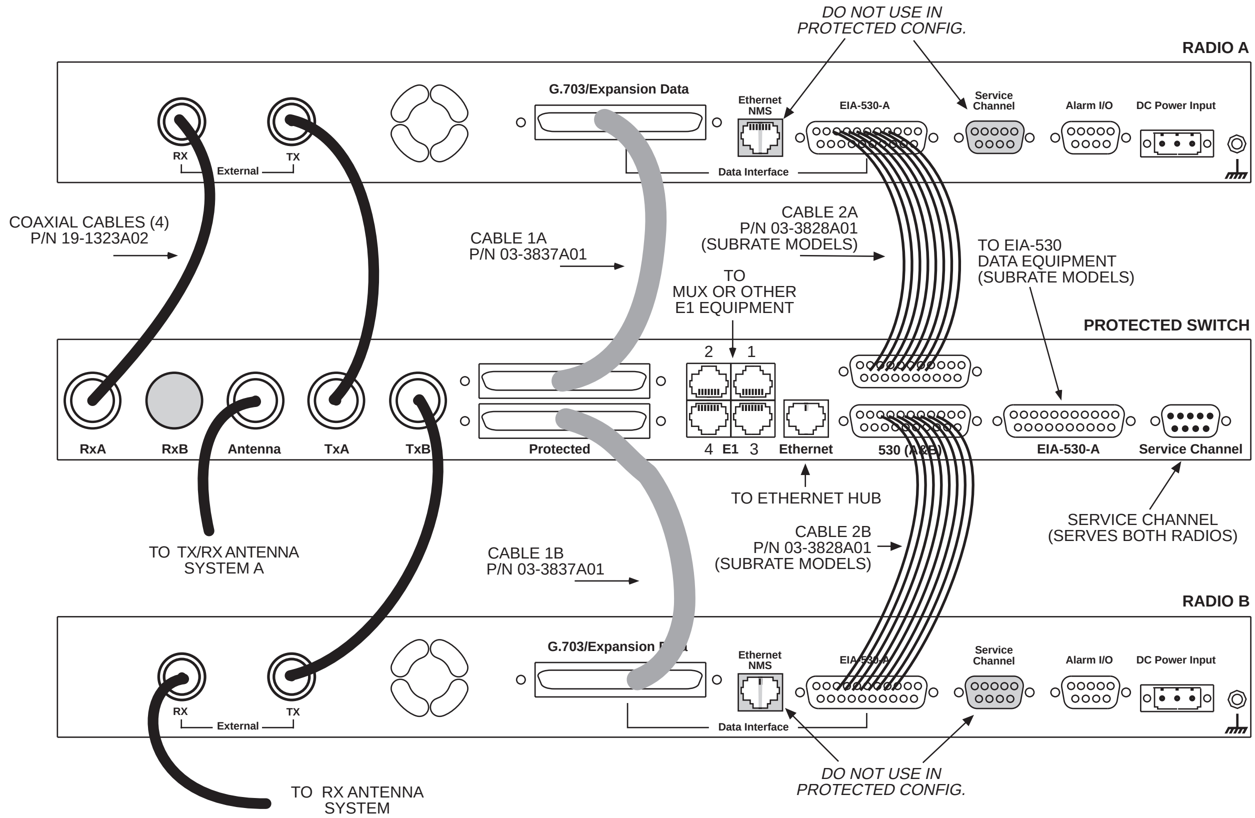


Figure 27. Inter-unit Cabling—Space Diversity with Internal Duplexers

13.0 SPARE PARTS, UNITS AND ACCESSORIES

13.1 Spares

Spare assemblies and units used for repair of LEDR radios are listed in Table 28. Field servicing, or replacement of PC boards and assemblies, should only be performed by qualified service personnel.

When ordering parts from the factory, always give the *complete* model number of the radio as found on the serial number label on the chassis. Contact information can be found on Page 140 of this guide.

Table 28. Field Replaceable Units for LEDR Radios

Item	Model	Part Number
Transceiver's SRAM Power Back-up Battery	All Models	27-3109A01
Protected Switch Chassis (Complete unit)	LEDR 400F	03-3873A01
	LEDR 900F	03-3873A02
	LEDR 1400F	03-3873A03
Duplexer (If equipped)	All Models	Frequency dependent; Contact factory.
FT1 Data Interface PCB	LEDR 900S	03-3846A01
E1/FE1 Data Interface PCB	LEDR 400F LEDR 400S LEDR 900F LEDR 900S LEDR 1400F LEDR 1400S	03-3846A02
Subrate Data Interface PCB	LEDR PSC	03-2824A01
Fullrate Data Interface PCB	LEDR PSC	03-3539A01

13.2 Accessories

Table 28 lists accessories available from the factory as a convenience to our customers. Factory contact information can be found on Page 140 of this guide.

Table 29. Accessory Items for LEDR Radios

Item	Description	Part Number
V.35 Interface Cable	6 ft (1.8 m) cable adapter used to convert subrate LEDR radio EIA-530 data interface to V.35 male data interface.	03-2174A01
G.703 Balun	Miniature G.703 balun used to convert a fullrate LEDR radio’s 120 Ω balanced data interface to two 75 Ω BNC coaxial data interfaces. *One balun required per E1 port.*	01-3494A01
EIA-530 Null-MODEM Crossover Cable	6 ft (1.8 m) cable adapter to connect subrate interfaces in a repeater configuration.	97-2841L06
SNMPc™ Network Management Manager	SNMP Management Software to access the LEDR embedded SNMP agent, allowing management of the LEDR radio network and any interconnected SNMP enabled peripherals. *For Windows 95 O/S*	03-3530A01
SNMPc™ Network Management Manager	SNMP Management Software to access the LEDR embedded SNMP agent, allowing management of the LEDR radio network and any interconnected SNMP enabled peripherals. *For Windows 98 or NT O/S.*	03-3530A02
Orderwire Handset	Voice handset with 4-wire cord (RJ-11 modular plug).	12-1307A03
Orderwire Handset Kit	Voice handset with 4-wire cord (RJ-11 modular plug), hanger and mounting bracket.	02-1207A01
AC Power Adapter	External AC power supply provides 24 Vdc to LEDR radio. Input: 110 Vac to 240 Vac, 50 to 60 Hz	03-3862A01

14.0 FRACTIONAL-T1 INTERFACE CARD 03-3846A01

FRACTIONAL-E1 INTERFACE CARD 03-3846A02

14.1 Introduction

The Fractional-T1 (FT1) and Fractional-E1 (FE1) Interface cards are optional assemblies which provide additional connectivity within a LEDR network for all subrate (S) models. The installation of the FT1/FE1 Interface card inside the radio allows the standard EIA-530 customer data interface to be bypassed and the radio data lines to be connected *directly* to a G.703 T1 or E1 interface.

With the optional FT1/FE1 Interface, users are able to place a LEDR link from a network service access point to a remote site, where an installation supports multiple communications devices. Direct interface to customer equipment, such as channel banks, is possible without the use of expensive protocol converters.

14.2 Fractional-T1/E1 Performance

The FT1 and FE1 Interface allows the LEDR radio to be connected directly with a G.703 T1 or E1 interface. The line rate of the interface operates at the T1 rate of 1.544 Mbps, or E1 rate of 2.048 Mbps. Twelve user selectable DS0 timeslots are transmitted over the air in either case. The FT1 interface is G.703 at 100 Ω line impedance. The FE1 interface is G.703 at 120 Ω line impedance. Physical connection is via an RJ-45 jack on the rear panel.

14.3 Configurable Parameters

The following performance specifications of the T1 fractional interface are adjustable by the user. All of these parameters are manageable locally, or over the air via SNMP network management. (Refer to the SNMP Handbook, P/N 05-3532A01 for more information.)

Timeslots and Framing

Twelve DS0 timeslots are permitted. In FT1, the timeslot selection is arbitrary. In FE1, timeslot 0 is always sent and the remaining timeslots are arbitrary with the exception of timeslot 16. (Timeslot 16 must be sent when any CAS frame structures are selected.) The selection of timeslots can be different at each end of the link, provided their *number* is equal. The timeslots may not be reordered.

Alarm signals RAI and AIS are generated as appropriate. The user may optionally have these signals forwarded over the RF link.

The frame formats available for **Fractional-T1** operation are as follows:

- FT only
- ESF without CRC checking and generation
- SF (D4)
- SF with JYEL indication
- ESF with CRC checking and generation

The frame formats available for **Fractional-E1** operation are as follows:

- FAS only
- FAS with BSLIP
- FAS with CRC
- FAS with CRC and BSLIP
- FAS and CAS
- FAS with CAS and BSLIP
- FAS with CAS and CRC
- FAS with CAS
- CRC and BSLIP.

The re-framing criteria may be adjusted to the following settings: 2 out of 4 Fbit errors, 2 out of 5 Fbit errors, 2 out of 6 Fbit errors. For FE1, the reframing criteria is selectable between consecutive FAS errors or CRC errors.

Line Codes

The following standard T1 line codes are supported: B8ZS, AMI, and per-channel B7ZS.

The following standard E1 line codes are supported: HDB3 and AMI.

Diagnostics

The T1 line at each end of the link may be tested using a variety of bit patterns. In normal operation, statistics are stored for any errors occurring at the line interface, such as framing errors, bipolar violations, and CRC errors.

Data may be looped back at the local port, through the T1 option only, and at the remote unit. Further, the unit will respond to in-band (SF) and data link (ESF) loopback codes at the local port.

When in ESF framing mode, the option can automatically generate performance report messages.

The following alarms may be monitored & logged. They may also be associated with a user-selectable indication (alarm contact or front panel LED): Remote Loopback, Lost Frame, Lost Signal, Lost Analog Signal, AIS, RAI (RYEL), MultiFrame RAI, Severely Errored Frame, Frame Re-Align, MultiFrame AIS, Far End Block Error, Line Code Error, CRC Errors and Frame Bit Error.

Clocking

The clock source is configurable for network, loopback, and internal timing, with secondary selections available should the primary source become faulty. Refer to the discussion of the **clkmode** command (Page 54) for more information

14.4 Field Installation of the FT1 Interface Board

An "S" Series LEDR radio can be fitted with a Fractional-T1 (FT1) or Fractional-E1 (FE1)Interface Board (Figure 28). The addition of an FT1/FE1 board enables the radio to operate with a G.703 interface at speeds up to 768 kbps.

To add the FT1/FE1 Interface Board to an existing LEDR radio transceiver, follow these steps:

1. Remove the top cover of the radio (4 Phillips screws).

2. Identify the installation area for the Interface Board (See Figure 29). Remove the three Phillips screws on the main PC board which correspond to the mounting holes on the Interface Board.

3. Install the threaded standoff spacers (furnished with the option board) onto the main PC board in the holes formerly occupied by the screws. (Note: Washers must *not* be used between the standoff spacers and either of the PC boards.)

4. Locate connectors J912 and J913 (See Figure 29). These connectors mate with the plugs on the bottom of the Interface board.

5. Carefully set the optional board into place, making sure to align the mounting holes with the threaded standoffs on the main PCB. (The Interface Board's rear panel connector should align with the rectangular cutout at the radio's rear panel, and the rear edge of the option board should be parallel to the main PC board.)

6. Look under the right edge of the Interface board to ensure that J912 is aligned with the mating connector on the option board. With the board properly aligned, push down firmly in the area directly above J913 and then over J912 at the edge. A distinct "locking" action will be felt as the connectors engage.

7. Install the Phillips mounting screws with lockwashers on the top of the FT1 board.

   For protected versions only: Install the plastic clip, if supplied, at the right rear corner of the Interface board. It slips over the edge of the main PC board and the option board. *Gently* tighten the hex screw to secure the clamp.)

CAUTION

POSSIBLE EQUIPMENT DAMAGE

The Interface board must be properly seated onto the LEDR radio's motherboard before powering up the radio chassis. Failure to properly install the board could result in permanent damage to the motherboard and the optional PCB.

8. Re-install the radio's top cover. This completes the Interface Board installation.

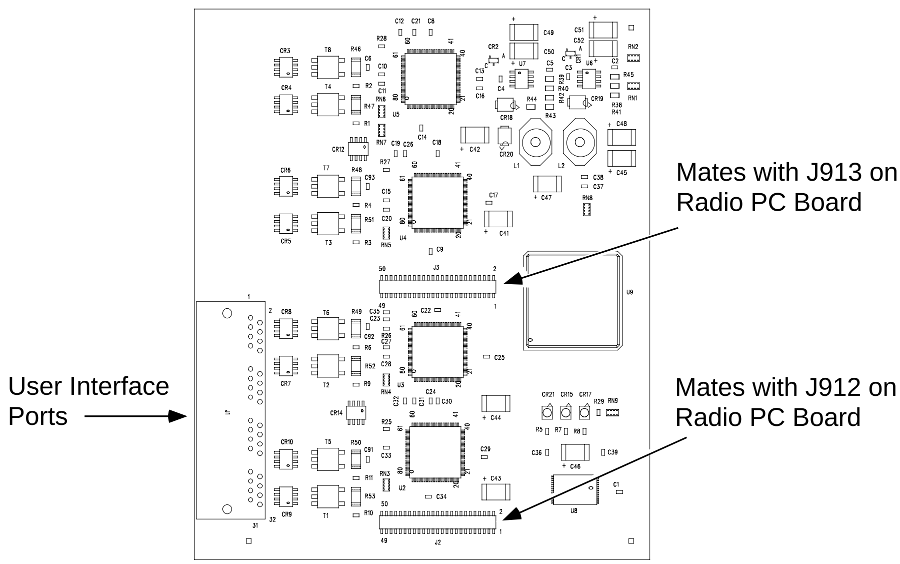


Figure 28. FT1/FE1 Interface Board—Optional Assembly
(Part No. 03-3846Axx)

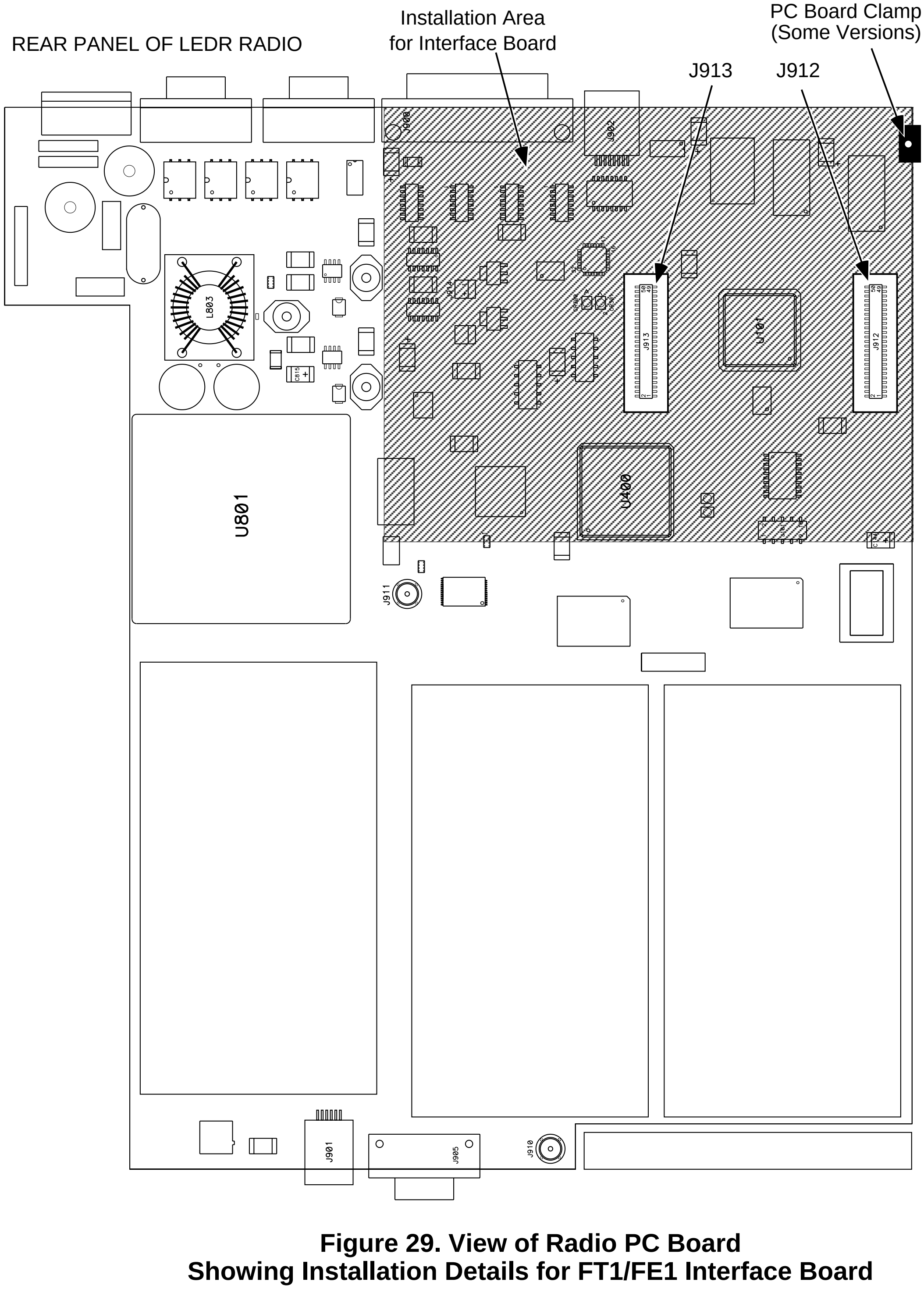


Figure 29. View of Radio PC Board
Showing Installation Details for FT1/FE1 Interface Board

Microwave Data Systems Inc.

15.0 INCREASE BANDWIDTH BY CHANGING TRANSMITTER AND RECEIVER FILTERS

15.1 Introduction

It is possible for qualified service personnel to upgrade LEDR Series radios in the field to increase the radios RF bandwidth. Listed in Table 30 are five upgrade kits. Each kit consists of three RF filters; one is used in the transmitter section and two are used in the receiver section. In addition, there is a unique software key that will allow the data circuitry to handle the higher data bandwidth. This key is based on the radio's serial number and can only be used with that radio.

Each kit consists of a set of 3 filters (transmitter 1; receiver 2), software activation key and instructions for converting radio's occupied bandwidth. The radio serial number must be provided to the factory for issue of authorization key.

Table 30. Hardware Upgrade Kits for Increased RF Bandwidth

For Subrate Radios	For Fullrate Radio
25 kHz to 50 kHz	500 kHz to 1.0 MHz
25 kHz to 100 kHz	500 kHz to 2.0 MHz
25 kHz to 200 kHz	1.0 MHz to 2.0 MHz
50 kHz to 100 kHz	
50 kHz to 200 kHz	
100 kHz to 200 kHz	

To realize the full benefit of the increased RF bandwidth, it may be necessary to upgrade the radio's data interface. Table 1 on Page 1 provides a simplified listing of radio bandwidth and compatible data interfaces.

15.2 Filter Removal and Replacement

These instructions describe the removal and replacement of filter modules inside a LEDR Transceiver, as well as the software commands necessary to authorize the new bandwidth.

CAUTION: This upgrade involves the removal of small, delicate parts. It must be performed by experienced personnel only, using proper tools and equipment to preserve the factory warranty. Precautions must be taken to prevent damage to components due to static discharge and other risks.

1. Remove the radio from service and disconnect all cabling from the rear panel.

2. Remove the top cover of the radio (four Phillips head screws).

3. Remove the Transmitter and Receiver section's RF shields (Figure 30). It will be necessary to unplug the ribbon cables that cross over the shields—record their locations as you remove them.

4. Locate and remove Filter FL700 from the transmitter section. In its place, install the replacement filter furnished with the upgrade kit. Ensure that the new filter is installed in the same orientation as the original unit.

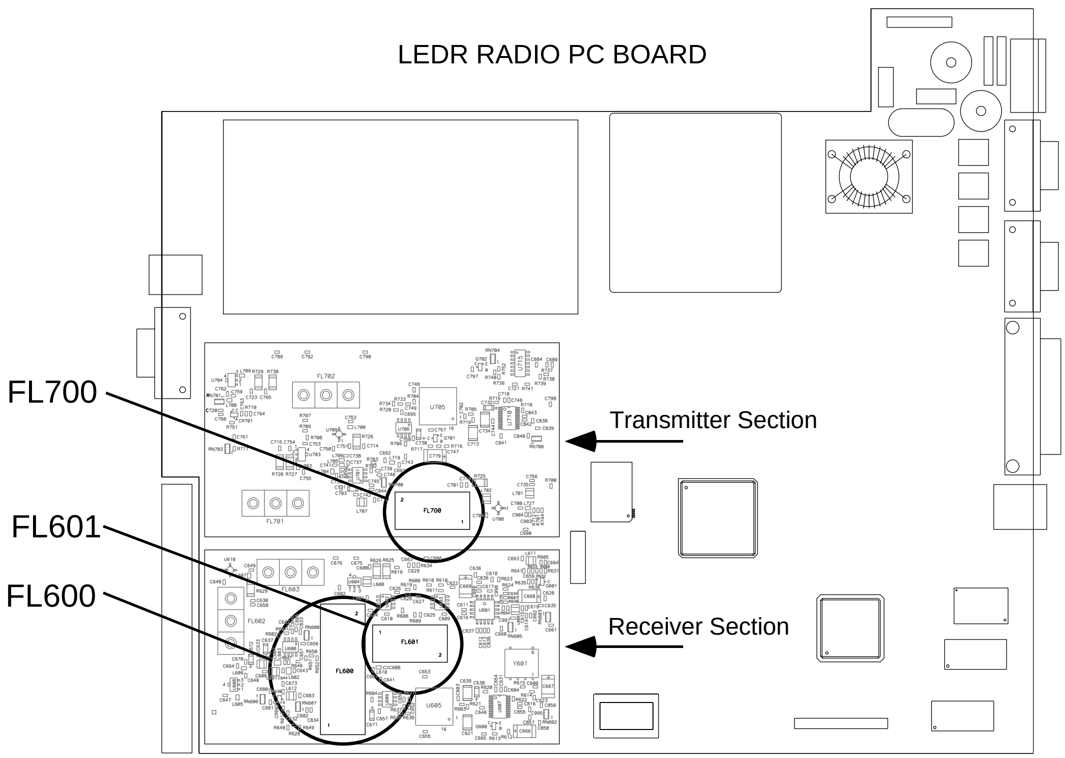


Figure 30. Location of Bandwidth Filters FL600, FL601 and FL700

5. Locate and remove Filters FL600 and FL601 from the Receiver module. In their place, install the replacement filters furnished with the upgrade kit. Ensure that the new filters are installed in the same orientation as the original units.

6. This completes the required hardware changes. Fasten the top cover and re-connect all cables to the rear panel.

7. Power up the radio and proceed to "Software Commands" below.

15.3 Software Commands

To activate the new filter bandwidth, it is necessary to enter an authorization key provided by Microwave Data Systems. This key is based upon the radio serial number and will authorize the new bandwidth of the radio. Contact the factory if you do not already have an authorization number.

1. Initiate a NMS terminal session with the LEDR radio. (Refer to Page 25 for login details.)

2. At the **LEDR>** prompt, type: **auth add <authorization number>**, where **<authorization number>** is the number provided to you by the factory. Press **ENTER**.

3. This completes the required software changes. If desired, the **auth show** command may be entered to display all of the current options for the LEDR radio.

4. Check for alarms on the front panel LED display. If no alarms are present, the basic functionality of the radio can be confirmed. If an alarm is present, double check all cable connections and radio settings.

16.0 BENCH TESTING OF RADIOS

In some cases, it may be necessary to test the operation of the equipment in a bench setting. Figure 31 shows a simple arrangement for bench testing using RF attenuators between the two units under test.

For weak signal tests (weaker than –80 dBm), additional physical separation between Radio 1 and Radio 2 may be required to prevent unintentional coupling between the radios.

On protected radio configurations, a weak received signal will cause the radio transceivers to switch.

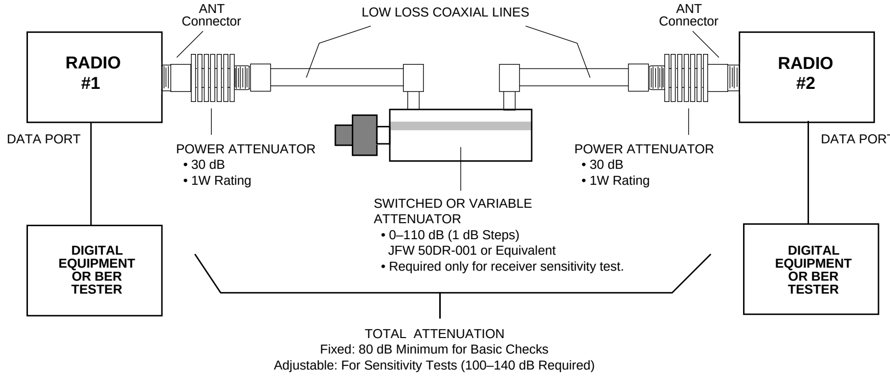


Figure 31. Back-to-Back Link Test

You can perform an over-the-air BER test on the bench or in the field. In this case, attach a separate piece of BER test equipment and feed it into one or more of the T1/E1 ports. At the other end of the link, you use another BER test box, or attach a loopback plug to the CPE data I/O port. This tests the quality of the radio link itself with regard to the user payload data. Such a bench, or over-the-air, test does not use the LEDR **bert** command.

NOTE: It is important to avoid over-driving the receiver as it can be damaged by strong signals. Signals stronger than -20 dBm should be avoided to protect the receiver.

NOTE: User BERT test equipment connected to a LEDR T1 data interface my yield different BERT results than the radio's **ber** command. This is likely when less than the channel's capacity is utilized by the timeslot command configuration.

17.0 TECHNICAL REFERENCE

17.1 Specifications— Models: LEDR 400S, LEDR 900S & LEDR 1400S

General

Frequency Ranges:	330–512 MHz (LEDR 400S) 800–960 MHz (LEDR 900S) 1350–1535 MHz (LEDR 1400S)
RF Occupied Bandwidth:	25, 50, 100 and 200 kHz
User Data Rates:	64, 128, 256, 384, 512 & 768 kbps With optional FT1 Interface Board: n x 64 kbps (Where n = 12)
Permitted Data Throughput:	<u>Channel Size</u> / <u>Data Rate</u> 25 kHz — 64 kbps 50 kHz — 64 kbps to 128 kbps 100 kHz — 64 kbps to 256 kbps 200 kHz — 64 kbps to 768 kbps
Modulation Type:	32 QAM, 16 QAM, QPSK
Forward Error Correction (FEC):	Reed-Solomon
Acquisition Time— Typical:	From power up, 10 seconds
Voltage Range:	24 Vdc or 48 Vdc (±20%)
Power Consumption:	Less than 60 watts (non-protected configuration)
Temperature Range:	– 5° to 50° C
Humidity:	≤ 90% non-condensing @ 40° C
Size:	1 RU; 19 Inch rack mount compatible 45 mm (1.75 in) high, 1RU 426 mm (16.75 in) wide (excluding rack brackets) 305 mm (12 in) deep

Transmitter

Transmit Power:	+30 dBm (1 watt) at antenna port
Output Control Range:	0 dB to –10 dB
Frequency Stability:	1.5 ppm
Spurious Outputs:	< –60 dBc 400S < –60 dBc 900S < –60 dBm 1400S

Receiver

Sensitivity (for 10^{-6} BER):	Bandwidth	Data Rate	Sensitivity
	25 kHz	64 kbps	–101 dBm
	50 kHz	128 kbps	–98 dBm
	100 kHz	256 kbps	–95 dBm
	200 kHz	768 kbps	–92 dBm

Residual BER:	< 1 x 10^{-10}
Dynamic Range:	> 65 dB

Interfaces

Data:	EIA-530, G.703 100 Ω, balanced (RJ-45) with optional FT1 Interface Board
Orderwire:	Voice handset interface, DTMF capable
Service Channel:	RS-232 @ 9600 bps
Ethernet:	10 Base-T
Console Port:	RS-232, 9600 bps to 38.4 kbps
Alarms:	4 programmable outputs; 4 inputs
Antenna:	50 Ω Impedance

Network Management System

Accessibility:	Via built-in HTTP server or command line interface
SNMP Management (Optional):	Using MIB II and custom enterprise MIB

Diagnostic Functions

Via Front Panel LEDs:	Power, Active, General Alarm, Rx Alarm, Tx Alarm & I/O Alarm
Via Front Panel LCD Display :	Measurements of RSSI, RF Power, Signal-to-Noise ratio, BER
Data Loopback:	Local and Remote

Agency Approvals

LEDR 400S

EMC:	ETS 300 385

LEDR 900S

Transmission:	FCC Part 101, RS-119
EMC:	FCC Part 15

LEDR 1400S

Transmission:	ETS 300 630, MPT 1717
Environmental:	ETS 300 019, Class 3.2
EMC:	ETS 300 385
Safety:	CE Mark

17.2 Specifications—
Models: LEDR 400F, 900F, 1400F

General

Frequency Ranges:	330–512 MHz (LEDR 400F) 800–960 MHz (LEDR 900F) 1350–1535 MHz (LEDR 1400F)	
RF Occupied Bandwidth:	500 kHz, 1 MHz & 2 MHz	
User Data Rates:	1 x E1 (2.048 Mbps) 2 x E1 (4.096 Mbps) 4 x E1 (8.192 Mbps)	
Permitted Data Throughput:	Channel Size	Data Rate
	500 kHz	1 x E1 (2.048 Mbps)
	1 MHz	2 x E1 (4.096 Mbps)
	2 MHz	4 x E1 (8.192 Mbps)
Modulation Type:	32 QAM, 16 QAM, QPSK	
Forward Error Correction (FEC):	Reed-Solomon	
Acquisition Time (Typical):	From power up, 10 seconds	
Voltage Range:	24 Vdc or 48 Vdc (±20%)	
Power Consumption:	Less than 60 watts (non-protected configuration)	
Temperature Range:	–5° to 50° C	
Humidity:	≤ 90% non-condensing @ 40° C	
Size:	1RU, 19 Inch rack mount compatible 45 mm (1.75 in) high, 1RU 426 mm (16.75 in) wide (excluding rack brackets) 305 mm (12 in) deep	

Transmitter

Transmit Power:	+30 dBm (1 watt) at antenna port
Output Control Range:	0 dB to –10 dB
Frequency Stability:	1.5 ppm
Spurious Outputs:	< –60 dBc (400F) < –60 dBm (1400F)

Receiver

Sensitivity (for 10^{-6} BER):	Bandwidth	Data Rate	Sensitivity
	500 kHz	1 x E1	–90 dBm
	1 MHz	2 x E1	–87 dBm
	2 MHz	4 x E1	–84 dBm
Residual BER:	$< 10^{-10}$		
Dynamic Range:	> 65 dB		

Interfaces

Data:	G.703 120 Ω, balanced (4 x RJ-45)
Orderwire:	Voice handset interface, DTMF capable
Service Channel:	RS-232 @ 9600 bps
Ethernet:	10 Base-T
Console Port:	RS-232, 9600 bps to 38.4 kbps
Alarms:	4 programmable outputs, 4 inputs
Antenna:	50Ω Impedance

Network Management System

Accessibility:	Via built-in HTTP server or command line interface
SNMP Management (Optional):	Using MIB II and custom enterprise MIB

Diagnostic Functions

Via Front Panel LEDs:	Power, Active, General Alarm, Rx Alarm, Tx Alarm, I/O Alarm
Via Front Panel LCD Display :	Measurements of RSSI, RF Power, Signal-to-Noise ratio, BER
Data Loopback:	Local and Remote

Agency Approvals

LEDR 1400F

Transmission:	ETS 300 630, MPT 1717
Environmental:	ETS 300 019, Class 3.2
EMC:	ETS 300 385
Safety:	CE Mark

17.3 Specifications— Protected Switch Chassis

Transmitter Coupling Loss:	2 dB (Typical)
Receive Coupling Losses:	4 dB with Symmetrical Splitter (Typical) 2 dB/10 dB with Asymmetrical Splitter (Typical)
Power Consumption:	Less than 135 watts (Two LEDR radios and Protected Switch Chassis)

17.4 Optional Equipment *(Consult factory for details)*

- Space Diversity
- Hot-standby Protected
- Warm-standby Protected
- Bandwidth Upgrade Kits

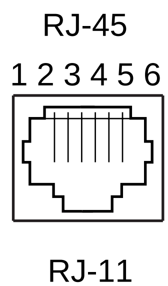
17.5 Accessories

- 120/240 Vac 50/60 Hz Power Supply (24 Vdc Output)
- Orderwire Handset
- Other items listed in Table 29 on Page 116

NOTE: The factory reserves the right to make changes to this specification without advance notice or obligation to any person.

17.6 I/O Connector Pinout Information

Orderwire—Front Panel



Pin	Signal	Direction
1	+ 12 Vdc	Output
2	Ground	—
3	Ear –	Output
4	Ear +	Output
5	Mouth	Input
6	Ground	—

Figure 32. Orderwire RJ-11 Connector

CONSOLE Port—Front Panel

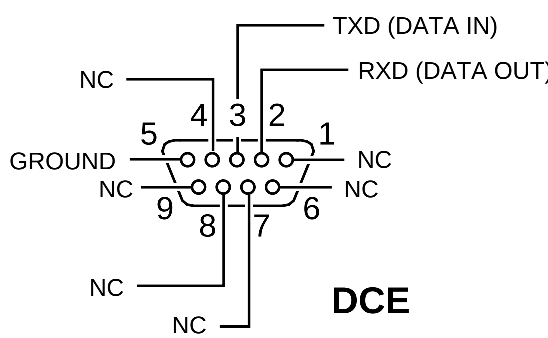
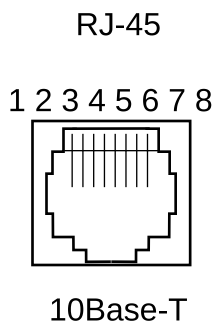


Figure 33. CONSOLE Port DB-9 Female Pinout

Ethernet—Rear Panel



Pin	Signal	Direction
1	Ethernet Transmit High	Output
2	Ethernet Transmit Low	Output
3	Ethernet Receive High	Input
4	No Connection	—
5	No Connection	—
6	Ethernet Receive Low	Input
7	No Connection	—
8	No Connection	—

Figure 34. Ethernet Connector

EIA-530-A Data—Rear Panel

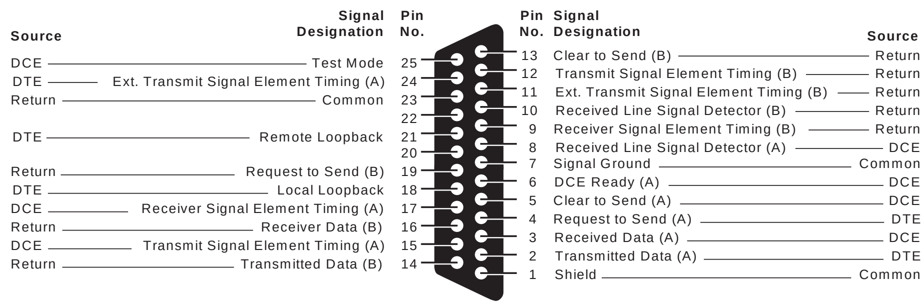
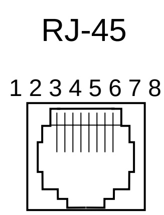


Figure 35. EIA-530 Connector Pinout (DB-25)

G.703 Data Connectors (4)—Rear Panel



Pin	Signal	Direction
1	Differential digital output signal, ring	Output
2	Differential digital output signal, tip	Output
3	Ground (Early models: No Connection)	—
4	Differential digital input signal, ring	Input
5	Differential digital input signal, tip	Input
6	Early models: No Connection Late models: Ground	—
7	No Connection	—
8	No Connection	—

Figure 36. G.703 Data Connector Pinout (RJ-45)

Service Channel—Rear Panel

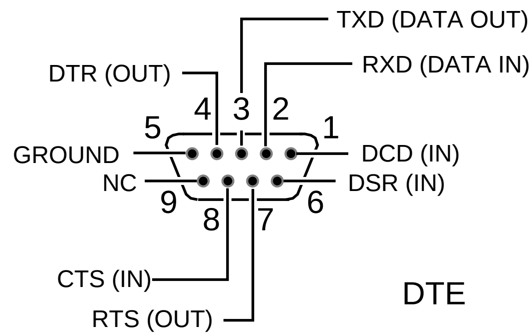


Figure 37. Service Channel Connector Pinout (DB-9 Male)

Alarm—Rear Panel

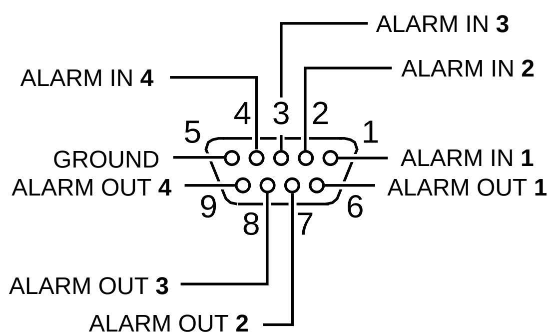


Figure 38. Alarm Connector DB-9 Female Pinout
(See *See "Alarm I/O" on Page 20* *for parameters.)*

17.7 Watts-dBm-Volts Conversion

Table 31 is provided as a convenience for determining the equivalent voltage or wattage of an RF power expressed in dBm.

Table 31. dBm-Volts-Watts Conversion Chart

dBm	V	Po
+53	100.0	200W
+50	70.7	100W
+49	64.0	80W
+48	58.0	64W
+47	50.0	50W
+46	44.5	40W
+45	40.0	32W
+44	32.5	25W
+43	32.0	20W
+42	28.0	16W
+41	26.2	12.5W
+40	22.5	10W
+39	20.0	8W
+38	18.0	6.4W
+37	16.0	5W
+36	14.1	4W
+35	12.5	3.2W
+34	11.5	2.5W
+33	10.0	2W
+32	9.0	1.6W
+31	8.0	1.25W
+30	7.10	1.0W
+29	6.40	800mW
+28	5.80	640mW
+27	5.00	500mW
+26	4.45	400mW
+25	4.00	320mW
+24	3.55	250mW
+23	3.20	200mW
+22	2.80	160mW
+21	2.52	125mW
+20	2.25	100mW
+19	2.00	80mW
+18	1.80	64mW
+17	1.60	50mW
+16	1.41	40mW
+15	1.25	32mW
+14	1.15	25mW
+13	1.00	20mW
+12	.90	16mW
+11	.80	12.5mW
+10	.71	10mW
+9	.64	8mW
+8	.58	6.4mW
+7	.500	5mW
+6	.445	4mW
+5	.400	3.2mW
+4	.355	2.5mW
+3	.320	2.0mW
+2	.280	1.6mW
+1	.252	1.25mW

dBm	V	Po
0	.225	1.0mW
-1	.200	.80mW
-2	.180	.64mW
-3	.160	.50mW
-4	.141	.40mW
-5	.125	.32mW
-6	.115	.25mW
-7	.100	.20mW
-8	.090	.16mW
-9	.080	.125mW
-10	.071	.10mW
-11	.064	
-12	.058	
-13	.050	
-14	.045	
-15	.040	
-16	.0355	

dBm	mV	Po
-17	31.5	
-18	28.5	
-19	25.1	
-20	22.5	.01mW
-21	20.0	
-22	17.9	
-23	15.9	
-24	14.1	
-25	12.8	
-26	11.5	
-27	10.0	
-28	8.9	
-29	8.0	
-30	7.1	.001mW
-31	6.25	
-32	5.8	
-33	5.0	
-34	4.5	
-35	4.0	
-36	3.5	
-37	3.2	
-38	2.85	
-39	2.5	
-40	2.25	.1µW
-41	2.0	
-42	1.8	
-43	1.6	
-44	1.4	
-45	1.25	
-46	1.18	
-47	1.00	
-48	0.90	

dBm	mV	Po
-49	0.80	
-50	0.71	.01µW
-51	0.64	
-52	0.57	
-53	0.50	
-54	0.45	
-55	0.40	
-56	0.351	
-57	0.32	
-58	0.286	
-59	0.251	
-60	0.225	.001µW
-61	0.200	
-62	0.180	
-63	0.160	
-64	0.141	

dBm	µV	Po
-65	128	
-66	115	
-67	100	
-68	90	
-69	80	
-70	71	.1nW
-71	65	
-72	58	
-73	50	
-74	45	
-75	40	
-76	35	
-77	32	
-78	29	
-79	25	
-80	22.5	.01nW
-81	20.0	
-82	18.0	
-83	16.0	
-84	11.1	
-85	12.9	
-86	11.5	
-87	10.0	
-88	9.0	
-89	8.0	
-90	7.1	.001nW
-91	6.1	
-92	5.75	
-93	5.0	
-94	4.5	
-95	4.0	
-96	3.51	
-97	3.2	

dBm	µV	Po
-98	2.9	
-99	2.51	
-100	2.25	.1pW
-101	2.0	
-102	1.8	
-103	1.6	
-104	1.41	
-105	1.27	
-106	1.18	

dBm	nV	Po
-107	1000	
-108	900	
-109	800	
-110	710	.01pW
-111	640	
-112	580	
-113	500	
-114	450	
-115	400	
-116	355	
-117	325	
-118	285	
-119	251	
-120	225	.001pW
-121	200	
-122	180	
-123	160	
-124	141	
-125	128	
-126	117	
-127	100	
-128	90	
-129	80	.1ƒW
-130	71	
-131	61	
-132	58	
-133	50	
-134	45	
-135	40	
-136	35	
-137	33	
-138	29	
-139	25	
-140	23	.01ƒW

18.0 RADIO EVENT CODES

Table 32 lists the event codes that may be encountered during operation of the radio. These codes may be read from a terminal using the **events pending** command. (See Page 57 for a full description of the **events** command.)

NOTE: The event codes listed here are available on radios equipped with the optional FT1 Interface Board. Standard "S" Series radios will display fewer codes.

Table 32. Event Codes

ID	EVENT NAME	DESCRIPTION	DEFAULT LED	SNMP TRAP LEVEL
0	EXT_ALARM_IN1	External Alarm Input #1	ALARM	CRITICAL
1	EXT_ALARM_IN2	External Alarm Input #2	ALARM	CRITICAL
2	EXT_ALARM_IN3	External Alarm Input #3	ALARM	CRITICAL
3	EXT_ALARM_IN4	External Alarm Input #4	ALARM	CRITICAL
4	MODULATOR_EV	Communication failure with modulator	ALARM	CRITICAL
5	DEMODULATOR_EV	Communication failure with demodulator	ALARM	CRITICAL
6	MOD_SELFTEST	Modulator selftest failed	NONE	CRITICAL
7	DEMOD_SELFTEST	Demodulator selftest failed	NONE	INFORM
8	PERM_REGN_CHECKSUM	Permanent region checksum failed	NONE	INFORM
9	APP1_REGN_CHECKSUM	Application #1 checksum failed	NONE	INFORM
10	APP2_REGN_CHECKSUM	Application #2 checksum failed	NONE	INFORM
11	BOOT_REGN_CHECKSUM	Boot loader checksum failed	NONE	INFORM
12	CONF1_REGN_CHECKSUM	Configuration Data region #1 checksum failed	NONE	INFORM
13	CONF2_REGN_CHECKSUM	Configuration Data region #2 checksum failed	NONE	INFORM
14	RTC_TEST	Real-time clock error	NONE	INFORM
15	BBRAM_TEST	NV-RAM test failed	NONE	INFORM
16	BATTERY_LOW	NV-RAM battery is low	ALARM	MAJOR
17	TX_SYNTH_LOCK	Transmit Synthesizer out-of-lock	TXALARM	CRITICAL
18	RX_SYNTH_LOCK	Receive Synthesizer out-of-lock	RXALARM	CRITICAL
19	DIG_POWER_REF	Digital Power Reference is out of specified range	ALARM	CRITICAL
20	TEMPERATURE	Temperature sensor reads over 80 degrees Celsius	ALARM	CRITICAL
21	TX_POWER_LOOP	Transmit Power Loop is out-of-lock	TXALARM	MAJOR
22	DEMOD_SNR_LOW	Demodulator Signal-to-Noise ratio is unacceptably low	NONE	MINOR

Table 32. Event Codes *(Continued)*

ID	EVENT NAME	DESCRIPTION	DEFAULT LED	SNMP TRAP LEVEL
23	DEMOD_AGC_RSSI	Demodulator Automatic Gain Controlled RSSI too low	NONE	MINOR
24	DEMOD_FEC_RECOVER	FEC circuitry has detected and corrected one or more errors	NONE	MINOR
25	DEMOD_FEC_UNRECOVER	FEC circuitry has detected one or more uncorrectable errors	NONE	MINOR
26	DEMOD_MULTIPATH	Excessive multipath distortion detected	NONE	MINOR
27	DEMOD_ACQUISITION	Demodulator lost sync. lock on received signal	RXALARM	CRITICAL
28	TX_TO_REMOTE_RX	Problem with link between the local transmitter & remote Rx	ALARM	CRITICAL
29	REDUNDANT_ALARM	Problem with redundant unit	ALARM	CRITICAL
30	WDOG_TIME_OUT	Processor watchdog has expired and reset the processor	ALARM	CRITICAL
31	RX_OFF	Radio is not receiving due to a weak signal or equipment failure	RXALARM	CRITICAL
32	SOFTWARE_TX_OFF	Software command has unkeyed the radio	TXALARM	CRITICAL
33	RTC_NOT_SET	The real time clock is not programmed	NONE	MINOR
34	IO1_DIG_LOC_lOOPBACK	The radio’s 530 or TELCO I/O port is in Digital local loopback mode	NONE	INFORM
35	IO2_DIG_LOC_lOOPBACK	The radio’s 2nd TELCO I/O port is in Digital local loopback mode	NONE	INFORM
36	IO3_DIG_LOC_lOOPBACK	The radio’s 3rd TELCO I/O port is in Digital local loopback mode	NONE	INFORM
37	IO4_DIG_LOC_lOOPBACK	The radio’s 4th TELCO I/O port is in Digital local loopback mode	NONE	INFORM
38	RF_LOCAL_LOOPBACK	The radio is in Local RF loopback test mode	NONE	INFORM
39	IO1_DIG_REM_LOOPBACK	The radio’s 530 or TELCO I/O port is in Digital Remote loopback mode	NONE	INFORM
40	IO2_DIG_REM_LOOPBACK	The radio’s 2nd TELCO I/O port is in Digital Remote loopback mode	NONE	INFORM

Table 32. Event Codes *(Continued)*

ID	EVENT NAME	DESCRIPTION	DEFAULT LED	SNMP TRAP LEVEL
41	IO3_DIG_REM_LOOPBACK	The radio's 3rd TELCO I/O port is in Digital Remote loopback mode	NONE	INFORM
42	IO4_DIG_REM_LOOPBACK	The radio's 4th TELCO I/O port is in Digital Remote loopback mode	NONE	INFORM
43	RAW_SERVICE_CHANNEL	The Raw Service Channel data frame is exhibiting error	ALARM	MAJOR
44	ATOD_REFERENCE	A fault is detected with the Analog to Digital converter	ALARM	CRITICAL
45	NEW_CONFIG_REV	A new revision of configuration data structure has been detected	NONE	INFORM
46	FPGA_LOAD	FPGA is not loaded correctly	NONE	INFORM
47	DATE_TIME_CHANGE	The date or time is been modified	NONE	INFORM
48	HARDWARE_TX_OFF	The transmitter key hardware is in an unkeyed state	TXALARM	CRITICAL
49	INACTIVE_ON	Current radio transceiver is in standby mode when in protected radio chassis	ALARM	MAJOR
50	NO_OPTION_UNIT	No Option Card is detected	NONE	INFORM
51	VOCODER_INIT_ERR	The voice processor initialization failed	ALARM	MAJOR
52	VOCODER_ERROR	The voice processor is reporting a problem	ALARM	MAJOR
53	POWER_ON_RESET	This indicates PowerOn Reset Cycle	NONE	INFORM
54	EXT_HARD_RESET	This indicates last Power-Up Cycle was due to External Hard Reset	NONE	INFORM
55	EXT_SOFT_RESET	This indicates last Power-Up Cycle was due to External Soft Reset	NONE	INFORM
56	INACT_CONFIG_SYNC	Protected 1+1 mode Active to Inactive Configuration data sync. error	ALARM	CRITICAL
57	NEW FIRMWARE LOADED	New firmware has been downloaded from flash memory.	NONE	INFORM
58	CONFIG_CHANGED	The radio transceiver configuration has been modified	NONE	INFORM

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Table 32. Event Codes *(Continued)*

ID	EVENT NAME	DESCRIPTION	DEFAULT LED	SNMP TRAP LEVEL
59	SELFTEST_COMPLETE	A self test has completed execution	NONE	INFORM
60	PERFORM_DEGRADED	A performance degradation threshold has been exceeded	ALARM	INFORM
61	DUPLICATE_UNIT_ID	Another unit with the same unit ID has been detected	ALARM	INFORM
62	LINK_UNAVAILABLE	The G821 status indicates that the link is unavailable	NONE	INFORM
63	EVENT_LOG_CLEARED	The event log has been cleared	NONE	INFORM
64	FAN1_TROUBLE	There is a problem with the fan	ALARM	INFORM
65	*Reserved for future use*	—	—	—
66	USER_REBOOT	The user has rebooted the radio	NONE	INFORM
67	MODEM_LOCAL_LOOPBACK	Modulator data path is locally looped back to Demodulator	NONE	INFORM
68	MODEM_REMOTE_LOOPBA CK	Demodulator data path is looped back to modulator for remote radio loopback application	NONE	INFORM
69	OPT_MUX_LOOBACK	Option card multiplexed data path from Line(s) is looped back	NONE	INFORM
70	IO1_REM_LOOPBACK_SERV	Radio is server for remote radio loopback mode with its payload data at Line IO #1 looped back to the commanding local radio	NONE	INFORM
71	IO2_REM_LOOPBACK_SERV	Radio is server for remote radio loopback mode with its payload data at Line IO #2 looped back to the commanding local radio	NONE	INFORM
72	IO3_REM_LOOPBACK_SERV	Radio is server for remote radio loopback mode with its payload data at Line IO #3 looped back to the commanding local radio	NONE	INFORM
73	IO4_REM_LOOPBACK_SERV	Radio is server for remote radio loopback mode with its payload data at Line IO #4 looped back to the commanding local radio	NONE	INFORM
74	IO1_RECVR_LOF	Line IO #1 receiver Loss-of-framing alarm.	I/O ALARM	CRITICAL

Table 32. Event Codes *(Continued)*

ID	EVENT NAME	DESCRIPTION	DEFAULT LED	SNMP TRAP LEVEL
75	IO1_RECVR_LOS	Line IO #1 receiver Loss-of-signal alarm	I/O ALARM	CRITICAL
76	IO1_RECVR_ALOS	Line IO #1 receiver Loss-of-analog-signal alarm	I/O ALARM	CRITICAL
77	IO1_RECVR_AIS	Line IO #1 receiver detected AIS alarm	I/O ALARM	CRITICAL
78	IO1_RECVR_RAI	Line IO #1 receiver detected RAI (yellow) alarm	I/O ALARM	CRITICAL
79	IO1_RECVR_MRAI	Line IO #1 receiver detected multi-framed RAI (yellow) alarm	I/O ALARM	CRITICAL
80	IO1_RECVR_SEF	Line IO #1 receiver detected Severely Errored Frames	I/O ALARM	CRITICAL
81	IO1_RECVR_COFA	Line IO #1 receiver detected Change-of-Frame-Alignment alarm	I/O ALARM	CRITICAL
82	IO1_RECVR_MAIS	Line IO #1 receiver detected multi-framed AIS alarm	I/O ALARM	CRITICAL
83	IO1_RECVR_FEBE	Line IO #1 receiver detected E1 Far-End-Block-Errors alarm	I/O ALARM	INFORM
84	IO1_RECVR_LCV	Line IO #1 receiver detected Line-Code-Violation alarm	I/O ALARM	INFORM
85	IO1_RECVR_CRC	Line IO #1 receiver detected CRC alarm	I/O ALARM	INFORM
86	IO1_RECVR_FBIT	Line IO #1 receiver detected Frame Bit Error	I/O ALARM	INFORM
87	IO2_RECVR_LOF	Line IO #2 receiver Loss-of-framing alarm	I/O ALARM	CRITICAL
88	IO2_RECVR_LOS	Line IO #2 receiver Loss-of-signal alarm	I/O ALARM	CRITICAL
89	IO2_RECVR_ALOS	Line IO #2 receiver Loss-of-analog-signal alarm	I/O ALARM	CRITICAL
90	I02_RECVR_AIS	Line IO #2 receiver detected AIS alarm	I/O ALARM	CRITICAL
91	IO2_RECVR_RAI	Line IO #2 receiver detected RAI (yellow) alarm	I/O ALARM	CRITICAL
92	IO2_RECVR_MRAI	Line IO #2 receiver detected multi-framed RAI (yellow) alarm	I/O ALARM	CRITICAL

Table 32. Event Codes *(Continued)*

ID	EVENT NAME	DESCRIPTION	DEFAULT LED	SNMP TRAP LEVEL
93	IO2_RECVR_SEF	Line IO #2 receiver detected Severely Errored Frames	I/O ALARM	CRITICAL
94	IO2RECVR_COFA	Line IO #2 receiver detected Change-of-Frame-Alignment alarm	I/O ALARM	CRITICAL
95	IO2_RECVR_MAIS	Line IO #2 receiver detected multi-framed AIS alarm	I/O ALARM	CRITICAL
96	IO2_RECVR_FEBE	Line IO #2 receiver detected E1 Far-End-Block-Errors alarm	I/O ALARM	INFORM
97	IO2_RECVR_LCV	Line IO #2 receiver detected Line-Code-Violation alarm	I/O ALARM	INFORM
98	IO2_RECVR_CRC	Line IO #2 receiver detected CRC alarm	I/O ALARM	INFORM
99	IO2_RECVR_FBIT	Line IO #2 receiver detected Frame Bit Error	I/O ALARM	CRITICAL
100	IO3_RECVR_LOF	Line IO #3 receiver Loss-of-framing alarm	I/O ALARM	CRITICAL
101	IO3_RECVR_LOS	Line IO #3 receiver Loss-of-signal alarm	I/O ALARM	CRITICAL
102	IO3_RECVR_ALOS	Line IO #3 receiver Loss-of-analog-signal alarm	I/O ALARM	CRITICAL
103	IO3_RECVR_AIS	Line IO #3 receiver detected AIS alarm	I/O ALARM	CRITICAL
104	IO3_RECVR_RAI	Line IO #3 receiver detected RAI (yellow) alarm	I/O ALARM	CRITICAL
105	IO3_RECVR_MRAI	Line IO #3 receiver detected multi-framed RAI (yellow) alarm	I/O ALARM	CRITICAL
106	IO3_RECVR_SEF	Line IO #3 receiver detected Severely Errored Frames	I/O ALARM	CRITICAL
107	IO3_RECVR_COFA	Line IO #3 receiver detected Change-of-Frame-Alignment alarm	I/O ALARM	CRITICAL
108	IO3_RECVR_MAIS	Line IO #3 receiver detected multi-framed AIS alarm	I/O ALARM	CRITICAL
109	IO3_RECVR_FEBE	Line IO #3 receiver detected E1 Far-End-Block-Errors alarm	I/O ALARM	INFORM

Table 32. Event Codes *(Continued)*

ID	EVENT NAME	DESCRIPTION	DEFAULT LED	SNMP TRAP LEVEL
110	IO3_RECVR_LCV	Line IO #3 receiver detected Line-Code-Violation alarm	I/O ALARM	INFORM
111	IO3_RECVR_CRC	Line IO #3 receiver detected CRC alarm	I/O ALARM	INFORM
112	IO3_RECVR_FBIT	Line IO #3 receiver detected Frame Bit Error	I/O ALARM	INFORM
113	IO4_RECVR_LOF	Line IO #4 receiver Loss-of-framing alarm	I/O ALARM	CRITICAL
114	IO4_RE CVR_LOS	Line IO #4 receiver Loss-of-signal alarm	I/O ALARM	CRITICAL
115	IO4_RECVR_ALOS	Line IO #4 receiver Loss-of-analog-signal alarm	I/O ALARM	CRITICAL
116	IO4_RECVR_AIS	Line IO #4 receiver detected AIS alarm	I/O ALARM	CRITICAL
117	IO4_RECVR_RAI	Line IO #4 receiver detected RAI (yellow) alarm	I/O ALARM	CRITICAL
118	IO4_RECVR_MRAI	Line IO #4 receiver detected multi-framed RAI (yellow) alarm	I/O ALARM	CRITICAL
119	IO4_RECVR_SEF	Line IO #4 receiver detected Severely Errored Frames	I/O ALARM	CRITICAL
120	IO4_RECVR_COFA	Line IO #4 receiver detected Change-of-Frame-Alignment alarm	I/O ALARM	CRITICAL
121	IO4_RECVR_MAIS	Line IO #4 receiver detected multi-framed AIS alarm	I/O ALARM	CRITICAL
122	IO4_RECVR_FEBE	Line IO #4 receiver detected E1 Far-End-Block-Errors alarm	I/O ALARM	INFORM
123	IO4_RECVR_LCV	Line IO #4 receiver detected Line-Code-Violation alarm	I/O ALARM	INFORM
124	IO4_RECVR_CRC	Line IO #4 receiver detected CRC alarm	I/O ALARM	INFORM

Table 32. Event Codes *(Continued)*

ID	EVENT NAME	DESCRIPTION	DEFAULT LED	SNMP TRAP LEVEL
125	IO4_RECVR_FBIT	Line IO #4 receiver detected Frame Bit Error	I/O ALARM	INFORM
126	DIG_REM_LOOPBACK	For EIA-530, local radio is in remote loopback mode	NONE	INFORM
127	SERV_REM_LOOPBACK	For EIA-530, local radio (as remote server) is serving remote loopback mode	NONE	INFORM
128	BAD_CLKMODE	Line framers detected bad clock mode configuration	NONE	INFORM

19.0 IN CASE OF DIFFICULTY

MDS products are designed for long life and trouble-free operation. However, this equipment, as with all electronic equipment, may have an occasional component failure. The following information will assist you in the event that servicing becomes necessary.

19.1 FACTORY TECHNICAL ASSISTANCE

Assistance for MDS products is available from our Technical Services group during business hours (8:00 A.M.–5:30 P.M. Eastern Time). When calling, please give the complete model number of the radio, along with a description of the trouble symptom(s) that you are experiencing. In many cases, problems can be resolved over the telephone, without the need for returning the unit to the factory.

Please use the following telephone numbers for product assistance:

716-241-5510 (Phone)
716-242-8369 (FAX)

19.2 FACTORY REPAIRS

Component level repair of radio equipment is *not* recommended in the field. Many components are installed using surface mount technology, which requires specialized training and equipment for proper servicing. For this reason, the equipment should be returned to the factory for any PC board repairs. The factory is best equipped to diagnose, repair and align your radio to its proper operating specifications.

If return of the equipment is necessary, you will be issued a Returned Material Authorization (RMA) number. The RMA number will help expedite the repair so that the equipment can be repaired and returned to you as quickly as possible. Please be sure to include the RMA number on the outside of the shipping box, and on any correspondence relating to the repair. *No equipment will be accepted for repair without an RMA number.*

A statement should accompany the radio describing, in detail, the trouble symptom(s), and a description of any associated equipment normally connected to the radio. It is also important to include the name and telephone number of a person in your organization who can be contacted if additional information is required.

The radio must be properly packed for return to the factory. The original shipping container and packaging materials should be used whenever possible. All factory returns should be addressed to:

Microwave Data Systems Inc.
Customer Service Department
(RMA No. XXXX)
175 Science Parkway
Rochester, NY 14620 USA

When repairs have been completed, the equipment will be returned to you by the same shipping method used to send it to the factory. Please specify if you wish to make different shipping arrangements.

MDS Microwave Data Systems Inc.

GLOSSARY

AMI—Alternate Mark Inversion. A bipolar format where consecutive marks (ones) have the polarity inverted. Spaces (ones) are represented by zero volts. This technique prevents long sequences of positive or negative voltages.

Analog—Signals with a continuously varying amplitude, such as the human voice.

BERT—Bit-error rate test. The results of a BERT are normally expressed as a ratio (power of 10) of the number of bits received in error compared to the total number received.

BER—Bit-error rate. See also *BERT*.

Bit—Binary digit. The smallest unit of digital data, often represented by a one or a zero. Eight bits usually comprise a byte.

bps—Bits-per-second. A measure of the information transfer rate of digital data across a communication channel.

Byte—A digital "word" usually made up of eight bits.

dBi—Decibels of gain relative to an isotropic radiator. (A hypothetical antenna which radiates equally in all directions.) Used to express antenna gain.

dBm—Decibels relative to one milliwatt. An absolute unit used to measure signal power, as in transmitter power output, or received signal strength.

DTR—Data Terminal Ready. A control signal sent from the radio indicating that it is ready to transmit data.

CPE—Customer premise (provided) equipment.

DCE— Data (circuit terminating) Communications Equipment. In data communications terminology, this is the "modem" side of a computer-to-modem connection. The transceiver is a DCE device which is designed to connect to a DTE device.

Decibel (dB)—A measure of the ratio between two signal levels. Frequently used to express the gain or loss of a system.

DSP—Digital Signal Processing. A processing technique that uses software algorithms to filter, shape, or otherwise modify the characteristics of a given signal. In the LEDR radio, DSP is used primarily in modulation and demodulation functions.

E1—An international telephony standard that operates at 2.048 megabits-per-second (Mbps). This transmission speed is commonly used throughout the world except for North America (which uses T1 1.544 Mbps). Framed E1 consists of 30 digitized telephone channels and two 64 Kbps control channels.

EIRP—Effective Isotropic Radiated Power. Commonly used to express the power radiated from a gain antenna. It is equal to the power transmitted (minus feedline loss) plus the antenna gain.

Fade Margin—The maximum tolerable reduction in received signal strength which still provides an acceptable signal quality. This compensates for reduced signal strength due to multipath, slight antenna movement or changing atmospheric losses. Expressed in decibels.

FEC—Forward Error Correction. Extra data is added to the transmitted signal to allow for detection and correction of some transmission errors.

Frame—A segment of data that adheres to a specific data protocol and contains definite start and end points. It provides a method of synchronizing transmissions.

Fresnel Zone—A point of maximum width or girth of the transmitted radio signal. Obstructions in this region (the "first Fresnel zone") can have a detrimental effect on reception quality. As a general rule, 60 percent of the first Fresnel zone should be free of obstructions in a well designed system. (Additional considerations are also required when planning a microwave path.

G.703—The ITU standard defining the characteristics of digital interfaces (pulse shape, voltage levels, etc.). This applies to high-speed, three-level data being sent over coaxial or twisted pair lines.

G.821—The ITU standard by which data transmission quality is measured. The analysis considers available vs. unavailable time.

Half-Power Beamwidth—The customary way of measuring the width of a directional antenna's radiation pattern. This beamwidth is measured in degrees between the half-power points (the point at which the power is reduced 3 dB with respect to the main beam).

HDB3—High density bipolar order of 3. A line interface standard for E1 transmission that employs coding to eliminate data streams with four or more consecutive zeros.

Hitless Switching Operation—Refers to the practice of switching between receive signal paths without introducing bit errors or timing slips. This feature is required for space or frequency diversity applications.

Hot Standby—Refers to a state of the inactive (standby) transceiver in a Protected or Redundant configuration. In a Hot Standby configuration, the standby transceiver is actively transmitting.

ITU—International Telecommunications Union.

kbps—Kilobits-per-second.

Linecode—Refers to the data coding format used by the radio for the line interface. (It does not pertain to the radio's modulation coding.) The available linecode selections are HDB3 and AMI.

Mbps—Megabits-per-second.

MIB—Management Information Base. The MIB stores SNMP messages that are directed to the management console. This can include Server events, statistical data and system queries.

Multipath Fading—Signals arriving at the receiver out of phase which have a tendency to cancel each other. It is caused by reflections of the transmitted wave and results in distortion at the receiver or weak received signal strength.

Multiplexer—A signal processing unit that combines multiple streams of data into one for transmission across a single data channel.

NMS—Network Management System. A software application used to configure, diagnose and monitor a communication network. The LEDR radio's SNMP program is an example of an NMS.

Protected Radio—A radio configuration where there are redundant modules that automatically become active in the event of a failure.

Protected Operation—Refers to the practice of providing redundant transmit and receive signal paths through the radio (antenna to customer payload interface) so that no single point of failure in a single radio will interrupt the link. This feature is also referred to as 1+1 Operation and is usually provided by operating the system using Hot Standby.

PSC—Protected Switch Chassis. Chassis holding data and RF control/switch circuitry in a redundant/protected configuration.

QAM—Quadrature Amplitude Modulation. Uses phase shifts and amplitude changes to send high-speed data in a comparatively narrow RF channel. See also *QPSK*.

QPSK—Quadrature Phase Shift Keying. Uses four levels of phase shift to send high-speed data with a higher system gain than QAM modulation. See also *QAM*.

Redundant Switching—Refers to the practice of switching between transmit signal paths when a fault condition occurs on the currently active radio.

RSSI—Received signal strength indication. Expressed in dBm.

SNMP—Simple Network Management Protocol. A common network management system (NMS) protocol used to monitor and control a communications network

SNR—Signal-to-noise ratio. Expressed in decibels (dB).

SWR—Standing Wave Ratio. A parameter related to the ratio between forward transmitter power and the reflected power from the antenna system. As a general guideline, reflected power should not exceed 10% of the forward power (2:1 SWR).

TFTP—Trivial File Transfer Protocol. A standard network protocol used to send and receive files between two devices.

Warm Standby—Refers to a state of the inactive (standby) transceiver in a Protected or Redundant configuration. In a Warm Standby configuration, the standby transceiver is not transmitting and must be keyed after switching.

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7. Set TCP/IP settings to enable SNMP and/or Telnet Network Management (If required)

- The unit IP address are factory configured with a unique address based on the last three digits of the unit serial number.
- Use **IP** command to change the IP address, set netmask, gateway and IP Port as necessary. In a protected radio, change the **RDNT** settings to match the user-assigned IP addresses.

8. Assign user configurable fields (As required)

Many items are user configurable, to ease customer use. These include, but are not limited to the following. See the **NMS** command description in the manual for more detail:

- Set user information fields using **INFO** command (Page 62).
- Set alarms and alarm mappings using the **ALARM** (Page 49) and **EVMAP** (Page 57) commands.
- Set alarm thresholds using the **THRESHOLD** command (Page 83).
- Set the SNMP community using the **SNMPCOMM** command (Page 81).

9. Perform bench tests to verify the performance of the radio

The data performance and NMS should be verified. Use the **LOOPBACK** commands (Page 69) to verify data throughput. (See “BENCH TESTING OF RADIOS” on Page 124.)

10.Install the link

Peak the antennas for maximum RSSI using the continuously updated **RSSI** command (Page 80) through the front panel screen or the **TREND** command (Page 86) via the NMS.

11. Verify proper operation by observing the LED display

- Refer to “Front Panel” on Page 13 for a description of the status LEDs.
- Aim directional antenna for maximum receive signal strength using the **RSSI** Screen.

12. Configure the SNMP Manager software

- Refer to the SNMP Handbook (Part No. 05-3532A01). (This manual is published by MDS in paper form, or may be downloaded from our web site at **www.microwavedata.com**.

End of Quick Start Guide

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