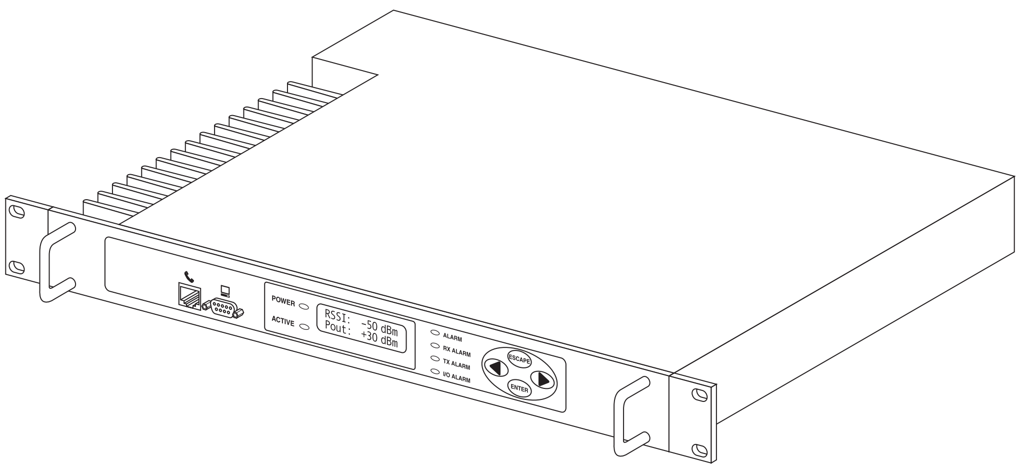
LEDR Subrate Series

Covers LEDR 400S, 900S and 1400S (plus optional fractional interface)



Digital Microwave Radio

MDS 05-3627A01, Rev. A
MARCH 2000

ADAPTIVE BROADBAND™

Installation and Operation Guide

QUICK START GUIDE

Below are the basic steps for installing the LEDR radio. When making cable connections, refer to page 10 for a rear panel view of the radio.

1. Install and connect the antenna system to the radio

- Ensure a path study has been conducted and that the radio path is acceptable.
- Use good quality, low loss coaxial cable. Keep the feedline as short as possible.
- Preset directional antennas in the direction of desired transmission/reception.

2. Connect the data equipment to appropriate rear panel connector

- For standard “S” Series radios, see Figure 25.
- For radios equipped with an FT1 Option Board, see Figure 26.
- Verify the data equipment is configured as DTE. (By default, the radio is configured as DCE.)

3. Apply DC power to the radio

- Verify that the voltage matches the power supply operating range (24 Vdc or 48 Vdc).
- The power connector is a three-pin keyed connector. The power source can be connected with either polarity. The center conductor is *not* connected.

4. Set the radio’s basic configuration using front panel or Console interface

- You must first login with a valid username and password (see page 16).
- Set the transmit/receive frequencies (**TX xxx.xxxx**/**RX xxx.xxxx**).
- Refer to this manual for other configuration settings.

5. Verify proper operation by observing the LED display

- Refer to “LEDs” on page 19 for a description of the status LEDs.
- Aim directional antenna for maximum receive signal strength using the **RSSI** Screen.

6. Configure the Simple Network Management Protocol (SNMP) MIB, if used

- Refer to the SNMP Handbook (Part No. 05-3532A01).

ADAPTIVE BROADBAND™

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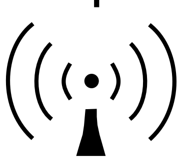
Operational Safety Notice

RF Exposure



The radio equipment described in this guide emits radio frequency energy. Although the power level is low, the concentrated energy from a directional antenna may pose a health hazard. Do not allow people to come in close proximity to the front of the antenna when the transmitter is operating.

This manual is intended to guide a professional installer to install, operate and perform basic system maintenance on the described radio.

Distress Beacon Warning

The 406 to 406.1 MHz band is reserved for use by distress beacons. Since the LEDR 400S radio is capable of transmitting in this band, take precautions to prevent the radio from operating between 406 and 406.1 MHz.

Notice

While every reasonable effort has been made to ensure the accuracy of this manual, product improvements may result in minor differences between the manual and the product shipped to you. If you have additional questions or need an exact specification for a product, please contact our Customer Service Team using the information at the back of this guide. Updated documentation may also be available on our web site at www.microwavedata.com.

1.0 INTRODUCTION

This manual is intended to help an experienced technician install, configure, and operate a LEDR 400S, 900S or 1400S digital radio. It begins with an overall description of radio features and is followed by the steps required to mount a LEDR radio and place it into normal operation.

After installation, we suggest keeping this guide near the radio for future reference.

1.1 Product Description

The LEDR radio (Figure 1) is a full duplex, point-to-point digital unit operating in the 330-512 MHz frequency band (model 400S), 800-960 (model 900S) or 1350–1535 MHz frequency band (model 1400S) with bandwidths ranging from 25 kHz to 200 kHz, depending on the radio model and installed options. The LEDR radio is designed to connect to industry-standard EIA-530 data interface equipment.

With the addition of a fractional T1 card option, the radio can be connected to industry-standard G.703 T1 data interface equipment. See page 67 for a complete description of the fractional T1 option.

The radio is also available as a protected “1+1” version (Figure 2) consisting of two identical LEDR radios and a Protected Switch Chassis. The protected version is designed to perform automatic switchover to a second radio in the event of a failure in the primary unit. See page 64 for detailed information on the protected version.

LEDR Features

- 64, 128, 256, 384, 512 and 768 kbps data rates
- n x 64 kbps data rates for units with an FT1 Option Board
- Network Management via SNMP version 1
- Protected operation (1+1) compatible
- 1.0 watt transmit power
- Rack space efficient (1RU) size
- Rugged, reliable design
- Voice Orderwire (DTMF compliant)
- Data service channel

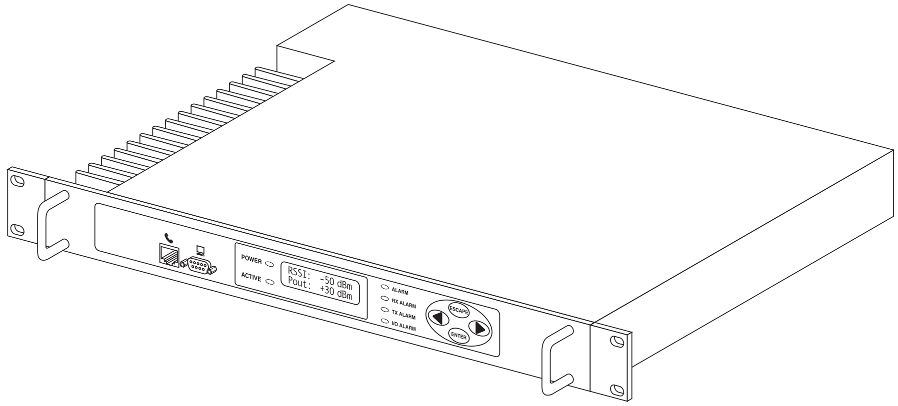


Figure 1. The LEDR Digital Radio (Non-Protected Version)

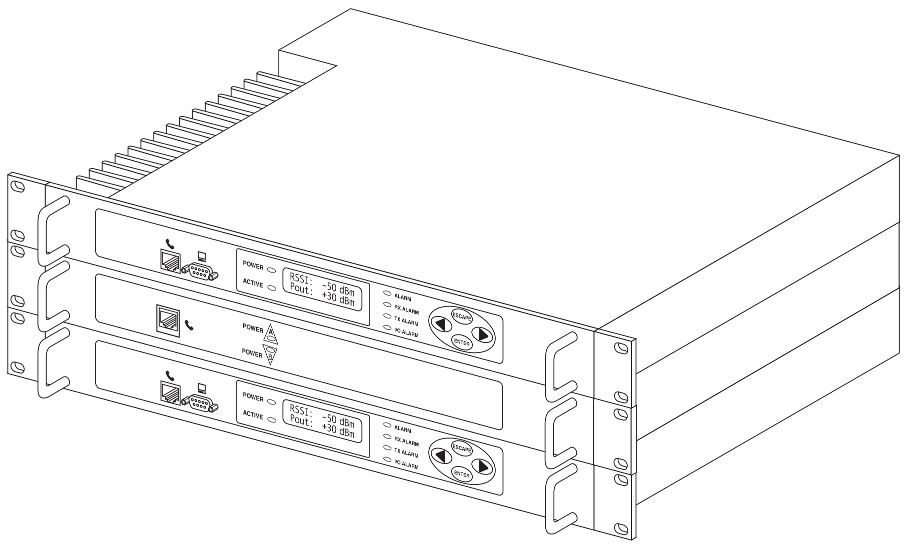


Figure 2. LEDR Digital Radio (Protected Version)

Typical Applications

- Point-to-point transmission applications
- Cost effective, “thin route” applications
- Long haul telecommunications links
- Cellular backhaul
- Last mile links
- Trunked radio links
- SCADA systems

1.2 Model Number Codes

The radio model number is printed on the serial number tag, which is affixed to the chassis. Figure 3, Figure 4 and Figure 5 show the significance of the model number string on the various LEDR "S" models. Contact the factory for specific information on optional configurations.

MODEL NUMBER CODES ARE SUBJECT TO CHANGE.

DO NOT USE FOR PRODUCT ORDERING.

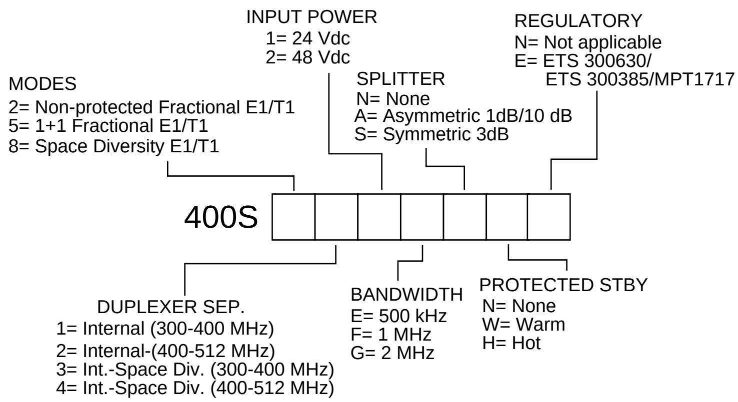


Figure 3. Model Number Codes (LEDR 400S)

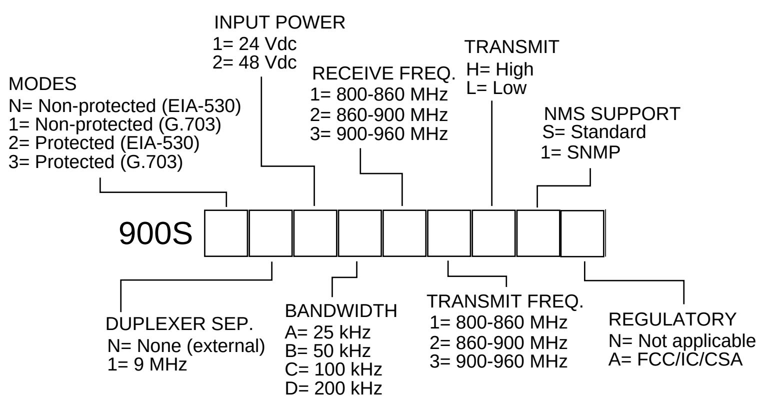


Figure 4. Model Number Codes (LEDR 900S)

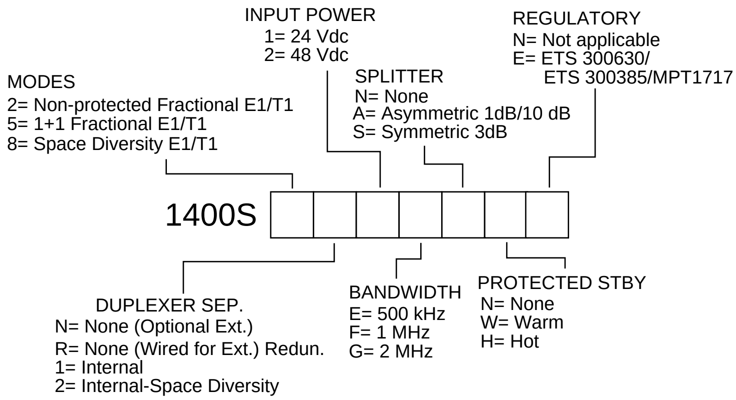


Figure 5. Model Number Codes (LEDR 1400S)

2.0 INSTALLATION

Installation of the LEDR transceiver is not difficult, but it does require some planning to ensure optimal efficiency and reliability. This section provides tips for selecting an appropriate site, choosing antennas and feedlines, and minimizing the chance of interference. This material should be reviewed before beginning equipment installation.

2.1 General Requirements

There are four main requirements for installing the transceiver—a suitable installation environment, adequate and stable primary power, a good antenna system, and the correct interface between the transceiver and the external data equipment. Figure 6 shows a typical station arrangement.

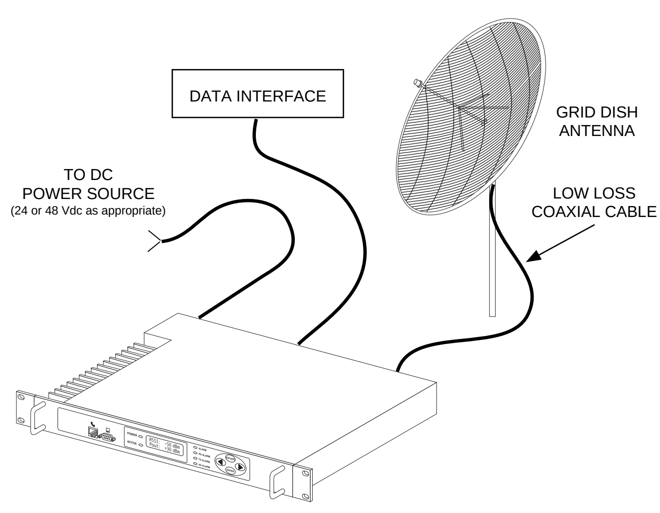


Figure 6. Typical Station Arrangement

Site Selection

For a successful installation, careful thought must be given to selecting proper sites for the radios and antenna systems. Suitable sites should offer:

- An antenna location that provides an unobstructed path in the direction of the associated station
- A source of adequate and stable primary power
- Suitable entrances for antenna, interface or other required cabling
- Adequate clearance around the radio for ventilation

These requirements can be quickly determined in most cases. A possible exception is the first item—verifying that an unobstructed transmission path exists. Microwave radio signals travel primarily by line-of-sight, and obstructions between the sending and receiving stations will affect system performance. This is especially important for the LEDR 1400S, which operates in the 1400 MHz microwave frequency band.

If you are not familiar with the effects of terrain and other obstructions on radio transmission, the following discussion will provide helpful background.

Terrain and Signal Strength

A line-of-sight path between stations is highly desirable, and provides the most reliable communications link in all cases. A line-of-sight path can often be achieved by mounting each station antenna on a tower or other elevated structure that raises it to a level sufficient to clear surrounding terrain and other obstructions.

The requirement for a clear transmission path depends upon the distance to be covered by the system. If the system is to cover only a limited distance, say 5 km (3.1 miles), then some obstructions in the transmission path may be tolerable. For longer-range systems, any obstruction could compromise the performance of the system, or block transmission entirely.

The signal strength at the receiver must exceed the receiver sensitivity by an amount known as the fade margin to provide reliable operation under various conditions.

Detailed information on path planning should be reviewed before beginning an installation. See RF Propagation Planning on page 87 for more information. Computer software is also available for this purpose that can greatly simplify the steps involved in planning a path.

Adaptive Broadband/MDS offers path analysis (for paths in the USA) as an engineering service. Contact the factory for additional information.

On-the-Air Test

If you've analyzed the proposed transmission path and feel that it is acceptable, an on-the-air test of the equipment and path should be conducted. This not only verifies the path study results, but allows you to see firsthand the factors involved at each installation site.

The test can be performed by installing a radio at each end of the proposed link and checking the Received Signal Strength Indication (RSSI) value reported at the front panel LCD screen of each radio. If adequate signal strength cannot be obtained, it may be necessary to mount the station antennas higher, use higher gain antennas, or select a different site for one or both stations.

A Word About Interference

Interference is possible in any radio system. However, since the LEDR radio is designed for use in a licensed system, interference is less likely because frequency allocations are normally coordinated with consideration given to geographic location and existing operating frequencies.

The risk of interference can be further reduced through prudent system design and configuration. Allow adequate separation between frequencies and radio systems.

C/I Curves

A carrier to interference (C/I) curve can help in frequency and space coordination. The information in this curve can aid greatly in helping plan geographic locations and frequency usage for radio systems. Contact the factory for additional information on carrier to interference curves. A whitepaper on the subject is available on request. Ask for Publication No. 05-3638A01.

Keep the following points in mind when setting up your point-to-point system:

1. Systems installed in lightly populated areas are least likely to encounter interference; those in urban and suburban environments are more likely to be affected by other devices operating in the radio's frequency band and adjacent services.

2. Directional antennas must be used at each end of a point-to-point link. They confine the transmission and reception pattern to a comparatively narrow beam, which minimizes interference to and from stations located outside the pattern. The larger the antenna, the more focused the transmission and reception pattern and the higher the gain.

3. If interference is suspected from another system, it may be helpful to use antenna polarization that is opposite to the interfering system's antennas. An additional 20 dB (or more) of attenuation to interference can be achieved by using opposite antenna polarization. Refer to the antenna manufacturer's instructions for details on changing polarization.

2.2 Antenna and Feedline Selection

Antennas

The antenna system is perhaps the most crucial part of the system design. An antenna system that uses poor quality feedline, or is improperly aligned with the companion site, will result in poor performance, or no communication at all.

A directional antenna must be used for point-to-point systems to minimize interference both to and from nearby systems. In general, cylindrical or dish type antennas with a parabolic reflector must be used. Yagi or corner reflector types may be acceptable in some applications. Check government regulations.

The exact style of antenna used depends on the size and layout of a system. In most cases, a directional "dish" type of antenna is used with the radio (Figure 7). Dish antennas maximize transmission efficiency and restrict the radiation pattern to the desired transmission path.

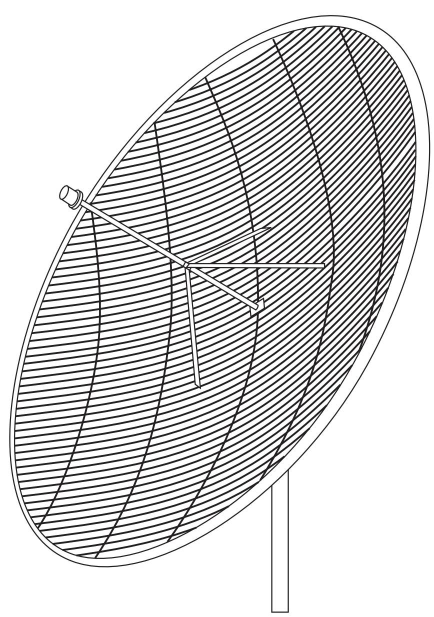


Figure 7. Typical Grid Dish Antenna

Table 1, Table 2 and Table 3 list some common grid dish antenna sizes and their approximate gains.

Table 1. Dish antenna size vs. gain at 400 MHz

Antenna Size Meters (feet)	Approximate Gain (dBi)
1.2 meters (4 feet)	13.1
2.0 meters (6 feet)	16.3
3.0 meters (10 feet)	19.6
4.0 meters (12 feet)	22.2

Table 2. Dish antenna size vs. gain at 900 MHz

Antenna Size Meters (feet)	Approximate Gain (dBi)
1.2 meters (4 feet)	18.4
2.0 meters (6 feet)	22
3.0 meters (10 feet)	26.4
4.0 meters (12 feet)	28

Table 3. Dish antenna size vs. gain at 1400 MHz

Antenna Size Meters (feet)	Approximate Gain (dBi)
1.2 meters (4 feet)	23.7
2.0 meters (6 feet)	26.1
3.0 meters (10 feet)	30.6
4.0 meters (12 feet)	32.1

Adaptive Broadband Corporation/MDS can also furnish antennas for use with the transceiver. Consult your sales representative for details.

Feedlines

For maximum performance, a good quality feedline must be used to connect the transceiver to the antenna. For short-range transmission, or where very short lengths of cable are used (up to 8 meters/26 feet), an inexpensive coax cable such as Type RG-213 may be acceptable.

For longer cable runs, or for longer-range communication paths, we recommend using a low-loss cable suited for 1400 MHz, such as Andrew Heliax®. Whichever type of cable is used, it should be kept as short as possible to minimize signal loss.

Table 4, Table 5 and Table 6 list several types of acceptable feedlines and the associated losses according to operating frequency.

Table 4. Feedline Loss Table (450 MHz)

Cable Type	3.05 Meters (10 Feet)	15.24 Meters (50 Feet)	30.48 Meters (100 Feet)	152.4 Meters (500 Feet)
RG-8A/U	0.51 dB	2.53 dB	5.07 dB	25.35 dB
1/2 in. HELIAX	0.12 dB	0.76 dB	1.51 dB	7.55 dB
7/8 in. HELIAX	0.08 dB	0.42 dB	0.83 dB	4.15 dB
1-1/4 in. HELIAX	0.06 dB	0.31 dB	0.62 dB	3.10 dB
1-5/8 in. HELIAX	0.05 dB	0.26 dB	0.52 dB	2.60 dB

Table 5. Feedline Loss Table (960 MHz)

Cable Type	3.05 Meters (10 Feet)	15.24 Meters (50 Feet)	30.48 Meters (100 Feet)	152.4 Meters (500 Feet)
RG-8A/U	0.85 dB	4.27 dB	8.54 dB	42.70 dB
1/2 in. HELIAX	0.23 dB	1.15 dB	2.29 dB	11.45 dB
7/8 in. HELIAX	0.13 dB	0.64 dB	1.28 dB	6.40 dB
1-1/4 in. HELIAX	0.10 dB	0.48 dB	0.95 dB	4.75 dB
1-5/8 in. HELIAX	0.08 dB	0.40 dB	0.80 dB	4.00 dB

Table 6 lists several types of acceptable feedlines and the associated losses at 1400 MHz.

Table 6. Feedline Loss Table (1400 MHz)

Cable Type	8 Meters (26 Feet)	15 Meters (49 Feet)	30 Meters (98 Feet)	61 Meters (200 Feet)
RG-213	3.0 dB	6.03 dB	12.05 dB	24.1 dB
1/2 in. HELIAX	0.73 dB	1.47 dB	2.93 dB	5.9 dB
7/8 in. HELIAX	0.42 dB	0.83 dB	1.66 dB	3.32 dB
1-5/8 in. HELIAX	0.26 dB	0.26 dB	1.05 dB	2.1 dB

2.3 Radio Mounting

The radio can be mounted either in a 19-inch equipment rack or on a table top. It should be located in a relatively clean, dust-free environment that allows easy access to the rear panel connectors as well as front panel controls and indicators. Air must be allowed to pass freely over the ventilation holes and heat sink on the side panel.

The dimensions of the LEDR radio are:

- 305 mm (12 in) deep
- 426 mm (16.75 in) wide—excluding rack brackets
- 45 mm (1.75 in) high—1RU

Attaching the Rack Brackets

The radio is normally shipped with the rack brackets uninstalled. To attach them, select the desired mounting position on the sides of the chassis. (The brackets may be mounted flush with the front panel, or near the middle of the chassis.)

Both short and long screws are provided with the brackets. Use the long screws for the heatsink (left) side of the chassis and the short screws for the right side of the chassis. Tighten the screws securely.

2.4 Radio Rear Panel Connectors

The rear panel of the standard LEDR "S" Series radio is shown in Figure 8. Figure 9 shows the rear panel of a radio equipped with an FT1 Option Board. Refer to the descriptions that follow for specific information regarding rear panel connections.

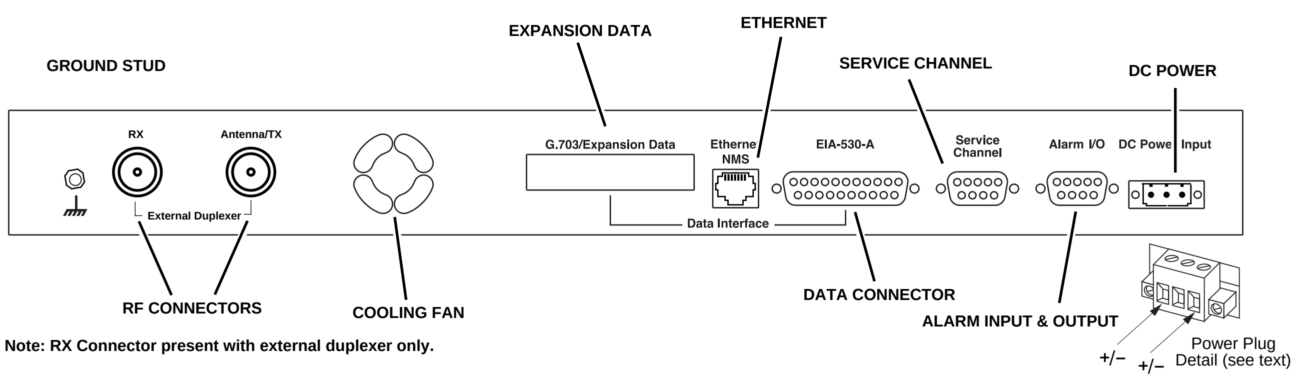


Figure 8. LEDR "S" Series Rear Panel (Standard)

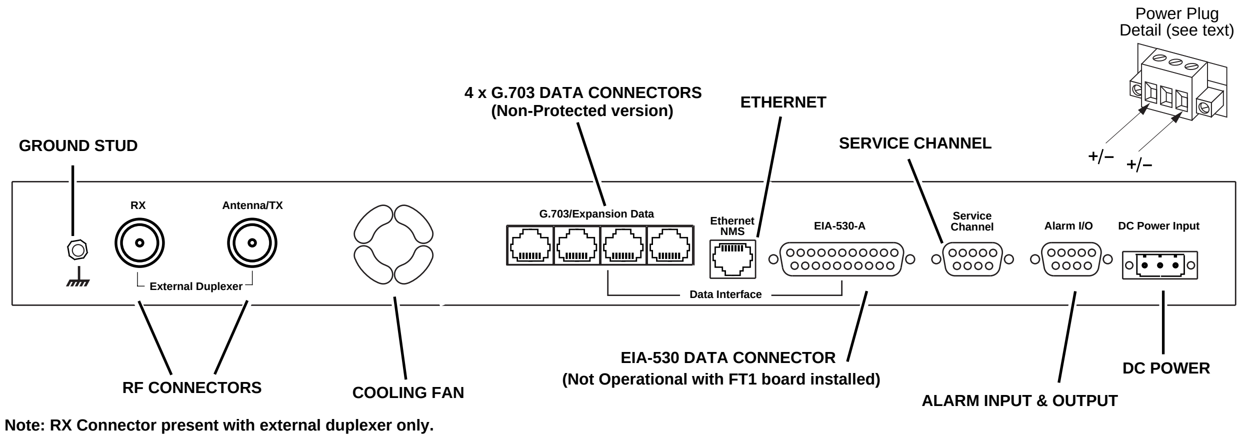


Figure 9. LEDR “S” Series Rear Panel (With FT1 Option Board)

Ground Stud

The ground stud on the rear panel provides a point to tie the radio’s chassis ground to earth ground for safety purposes.

Antenna/TX

The Antenna/TX connector is a coaxial N-type connector. When an internal duplexer is installed, it serves as the connection point for the station antenna. When an external duplexer is used, it acts as the transmitter RF output connector to the duplexer.

RX

The RX (receive) connector is a coaxial N-type connector. It is only installed if the radio is supplied for use with an external duplexer. It carries receive signals from the duplexer to the transceiver.

When an external duplexer is used, ensure that the higher frequency (transmit or receive) is connected to the duplexer connector marked HI and the lower frequency (transmit or receive) is connected to the duplexer marked LO.

G.703 Data Connectors (4)—*For radios with FT1 Option Bd.*

These RJ-45 jacks provide connection to G.703 customer-supplied data interface equipment. Only one of the jacks is active (user selectable in software). For pinout information, see Figure 26 on page 86.

Ethernet

The Ethernet connector provides access to the embedded SNMP agent and other elements of the TCP/IP network-management interface. The connector is a standard 10 base-T connection with an RJ-45 modular connector.

At a repeater site, the Ethernet connector must be connected to the other radio with a cross-cable for the Orderwire and service channel to function properly.

For detailed pin information see, Figure 24 on page 85.

EIA-530-A

The EIA-530-A connector is the main data input/output connector for the subrate radio. The EIA-530 interface is a high-speed serial data connector. For detailed pin information, see “EIA-530-A Data” on page 85.

Service Channel

This is a 9-pin serial port with EIA-232-type signaling. For detailed pin information, see “Service Channel” on page 86.

Alarm I/O

This is a 9-pin connector that has both inputs and outputs. The events that cause alarm output signals can be configured in the radio software. See “evmap” on page 43 for information on programing which events trigger an alarm. See Figure 28 on page 86 for Alarm I/O pinout information.

Power

CAUTION
POSSIBLE EQUIPMENT DAMAGE

Before connecting primary power to the radio, verify that it matches the power supply operating range. Improper voltages may damage the equipment. The allowable voltage limits are shown in Table 7. The power connector is not polarity-sensitive.

The DC power connector is a three-pin keyed connector. The power supply used can be connected with either polarity. The center conductor is not connected.

Table 7. Power Supply Options

Nominal Input Voltage	Allowable Voltage Range
24 Vdc	19.2 to 28.8 Vdc
48 Vdc	38.4 to 57.6 Vdc

Refer to the model number codes in Figure 3 to determine the radio’s power supply range.

2.5 Protected Switch Rear Panel Connectors

The rear panel of the Protected Switch Chassis is shown in Figure 10. Refer to the following descriptions for specific information regarding rear panel connections.

Figure 11 presents an inter-unit cabling diagram for protected configurations.

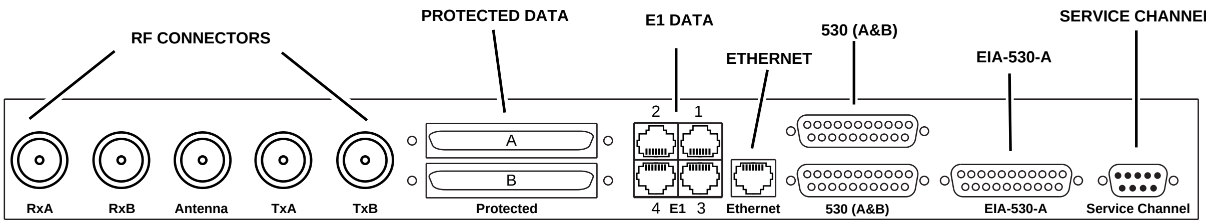


Figure 10. Protected Switch Chassis—Rear Panel

RxA

The RxA (receive, radio A) connector is a coaxial N-type 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 coaxial N-type connector. It serves as the connection point for the station antenna.

TxA

The TxA (transmit, radio A) connector is a coaxial N-type 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 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 26 on page 86.

E1

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 interface. The connector is a standard 10 base-T connection with an RJ-45 modular connector. For detailed pin information, Figure 24 on page 85.

530 (A&B)

This pair of DB-25 connectors accepts EIA-530 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 26 on page 86.

EIA-530-A

This DB-25 connector provides a connection point for customer-supplied EIA-530 data equipment.

Service Channel

In a protected configuration, this DB-9 connector becomes the Service Channel connection for *both* LEDR radios. (The Service Channel connectors on the radios become non-functional.) For detailed pin information, see “Service Channel” on page 86.

2.6 Inter-Unit Cabling for Protected Stations

The required cabling between the two radios and the Protected Switch chassis is shown in Figure 11.

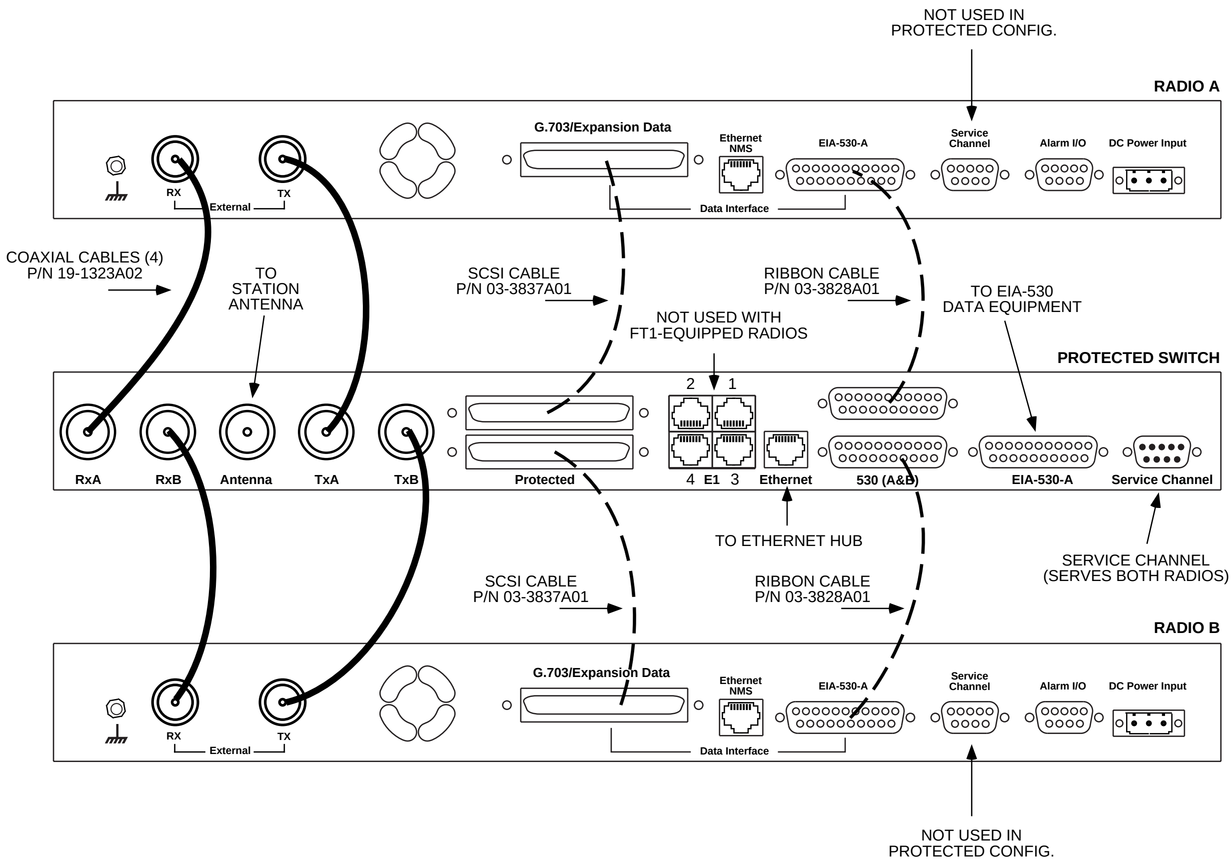


Figure 11. Inter-unit Cabling—Protected Version

3.0 OPERATION

The LEDR radio is designed for continuous, unattended operation. Under normal conditions, the only time operator intervention is required is to power the unit up or down, or to change an operating parameter. This section explains the use of the radio's controls and indicators and provides steps for initial startup of the equipment.

3.1 Initial Startup

NOTE: The LEDR radio is normally keyed continuously, and the radio will transmit whenever power is applied. Ensure there is a suitable load on the antenna connector before connecting power.

Operation of the radio can be started by simply connecting primary power to the unit. After a short self-test, a "default screen" similar to the following appears on the radio's LCD display:

```
  LEDR Link
RSSI: -60 dBm
```

Maximizing RSSI

For newly installed systems, one of the first tasks is to orient the station antenna for a maximum Received Signal Strength Indication (RSSI) as shown on the LCD screen. See “Performance” on page 30 for details. A maximum RSSI ensures the antenna is properly aimed at the associated station. Move the antenna slowly while an assistant observes the RSSI display for a maximum reading.

Initial Login—*Required to change radio settings*

When the radio is first powered up, it defaults to a read-only condition. That is, the radio parameters may be viewed, but cannot be changed. To enable changes to radio settings, a valid user name and password must be entered.

When the radio is shipped from the factory, it is pre-programmed with the following temporary login credentials:

Username: **SUPER**
Password: **SUPER**

Keypad Method

To log in from the front panel using the temporary credentials, follow these steps:

1. Go to the Login screen and press the front panel ENTER key. The Username screen appears with **SUPER** displayed.

2. Press the ENTER key again to access the Password screen. Use the arrow keys to scroll through the list of characters and individually select the letters spelling out the word **SUPER**. Press ENTER after each character selection. (For more information on character selection using the keypad, see “Communicating with the Radio” on page 18.)

3. When all of the characters have been entered, press ENTER again. The screen briefly displays **Login Success** and returns to the Login entry screen.

The user may now access any of the screens shown in Figure 14 with Administrator level privileges (the highest allowable user level).

Console Method

To login using a terminal connected to the front panel console port, follow the steps below. (For more information on connecting a terminal, see “Console Port” on page 35.)

1. Connect a terminal to the radio’s front panel console port and press ENTER. The **ADAP>** prompt will appear.

2. Enter **login SUPER**. The **Password >** prompt will appear.

3. Enter the password **SUPER**. The following response appears: **login: SUPER logged in.**

The user may now access any of the console commands listed in Table 12 on page 36 with Administrator level privileges (the highest allowable user level).

Changing the SUPER Password (Recommended)

The factory-programmed username and password (**SUPER**) is provided to enable a System Administrator to operate a newly installed radio. It is *highly* recommended that the password for **SUPER** be changed as soon as possible to maintain system security.

Follow these steps to change the factory-programmed password:

1. Login as **SUPER** using the Console Method described above. (Passwords cannot be changed using the front panel keypad.)

2. Enter the command **passwd**. At the next prompt, enter a new password (eight characters maximum).

3. Re-enter your new password (for verification purposes). If the entry is correct, the radio responds with **user: Command Complete**.

You may now set up additional accounts, set permission levels, or delete accounts as desired using the **user** command. See page 58 for complete description of this command.

NOTE: It is recommended that users log out when finished using the keypad or console terminal. This can be done using the Logout screen on the radio, or the **logout** command from a console terminal as appropriate. *If there is no keypad or terminal activity for 10 minutes, the radio automatically logs out and reverts to read-only status.*

3.2 Communicating with the Radio

There are four different methods available to set radio parameters and query the radio.

- **Front Panel—**The front panel is intended to serve as a convenient user interface for local radio management. Most, but not all, parameters and functions are accessible from the front panel.
- **SNMP Network Management System—**The SNMP agent interface is optimized to fulfill the fault configuration, performance and user access requirements of the LEDR radio system. A separate guide, P/N 05-3532A01 explains SNMP in more detail.
- **Telnet—**A standard network application protocol which provides a console-type interface to configure and query most radio parameters.
- **EMS (Element Management System)—**The EMS is used via a terminal connected to the front panel console port. It may be used to configure and query every manageable radio parameter on a given network using the out-of-band service channel. The EMS may be used on the local radio (**login** command) or on the remote radio (**rlogin** command).

Front Panel Controls

Figure 12 shows the LEDR radio's front panel controls and indicators. The front panel includes LEDs, an LCD display screen and a menu navigation keypad.

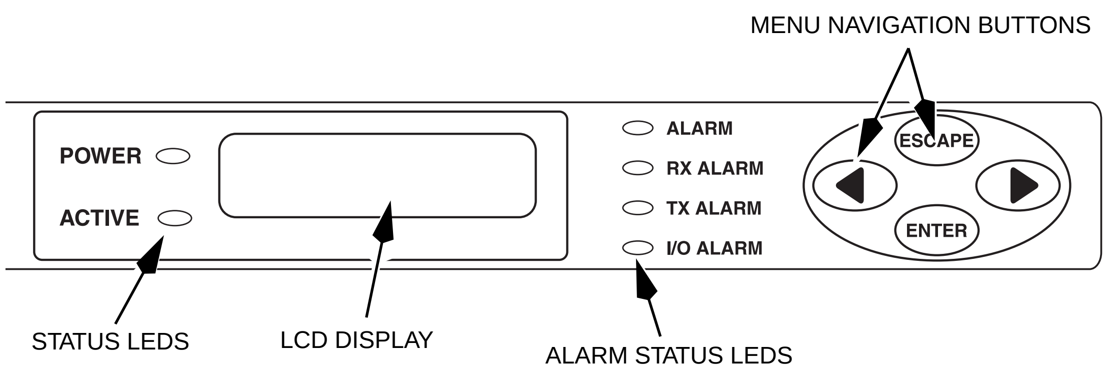


Figure 12. Front Panel Interface

LEDs

The front panel LEDs indicate the following conditions when lit:

POWER—Main Power is applied to radio.

ACTIVE—This is the Primary unit in a redundant configuration.

ALARM—A general alarm condition is present

RX ALARM—The modem is not locked to a receive signal

TX ALARM—There is a problem with the transmitter

I/O ALARM—There is a payload data interface error

LCD Display/Keypad

The LCD display provides a 2 line by 16 character readout of radio status and parameter settings. It is used with the menu navigation keypad on the right side of the front panel to control the radio's operation and access diagnostic information.

Use of the keypad (Figure 13) is simple, and allows many basic operating tasks to be performed without connecting an external terminal or using additional software.

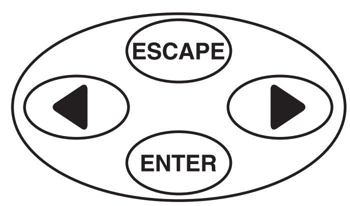


Figure 13. Menu Navigation Keypad

The keypad buttons can be used for two functions; Navigation, and Editing. The functions of the keys are automatically selected according to the screen that is being viewed by the user.

- **Navigation Mode—**This is the default mode. The left and right keys (◀▶) navigate through the available top level screens (see menu tree, Figure 14). The ENTER key allows entry into a screen, exposing another level of menus or entering edit mode for a radio parameter. The ENTER key always exits the current screen, causing the program to "pop out" one level.

- **Edit Mode—**In editable screens, pressing the ENTER key puts the screen in Edit mode. The technique for applying new data depends on the particular edit mode used by that screen. LEDR screens have four edit sub-modes; List, Character edit, Text Entry, and Horizontal Bar.

In **List mode**, the left and right keys scroll through a list of choices. Pressing (ENTER) when the desired choice is selected attempts to apply the changes. Pressing (ENTER) drops out of the edit mode without saving changes.

The **Character Edit mode** consists a *cursor move* mode and a *character scroll* mode. Upon entering the Character Edit mode, the left and right keys move the cursor in the corresponding direction. When the cursor is below the character to change, pressing (ENTER) again puts the screen in character scroll mode in which the left and right keys scroll through the available characters. Pressing (ENTER) saves the new character and reverts to cursor move mode. To save all changes made in cursor move mode, place the cursor under the special “Enter” character and press (ENTER). Pressing (ENTER) in character scroll mode reverts to cursor move mode. Pressing (ENTER) in cursor move mode cancels character edit mode without saving any changes.

The **Text Entry mode** is a slight modification to the Character Edit mode above. Upon entering Text Entry mode the cursor is in the leftmost position and the ◀ ▶ keys scroll through the available characters. Pressing (ENTER) saves the current character and moves the cursor to the next position to the right. When the text is correctly entered, moving the cursor to the special “Enter” character and pressing (ENTER) attempts to save the new text. Pressing (ENTER) in cursor move mode cancels Text Entry mode without saving any changes.

The **Horizontal Bar mode** is used in some menu screens. It allows adjustment of the LCD display for the best contrast using the ◀ ▶ keys (see Front Panel menu, page 33). The right key corresponds to upward viewing angle; the left key corresponds to downward viewing angle. Pressing (ENTER) saves the adjusted value as the default setting.

It works in a similar manner for the Orderwire menu (see page 33) to adjust the Volume and VOX threshold.

Front Panel Menu Tree

The LEDR radio contains several top level menus (see Table 8). These serve as entry points to a variety of sub menus that can be used to view or adjust operating parameters and diagnose the radio link.

Table 8. Top Level Menu Screens

1) Login/Logout	9) Modem
2) Network	10) Console
3) General	11) Diagnostics
4) RF Configuration	12) Orderwire

Table 8. Top Level Menu Screens *(Continued)*

5) IO Configuration	13) Front Panel
6) Line Configuration	14) Redundant
7) Performance	15) Remote Status
8) G.821	

Figure 14 on the following page shows a pictorial view of the front panel menu tree. Detailed explanations of the screens are given in Section 3.3, *Front Panel LCD Menu Descriptions* (beginning on page 24).

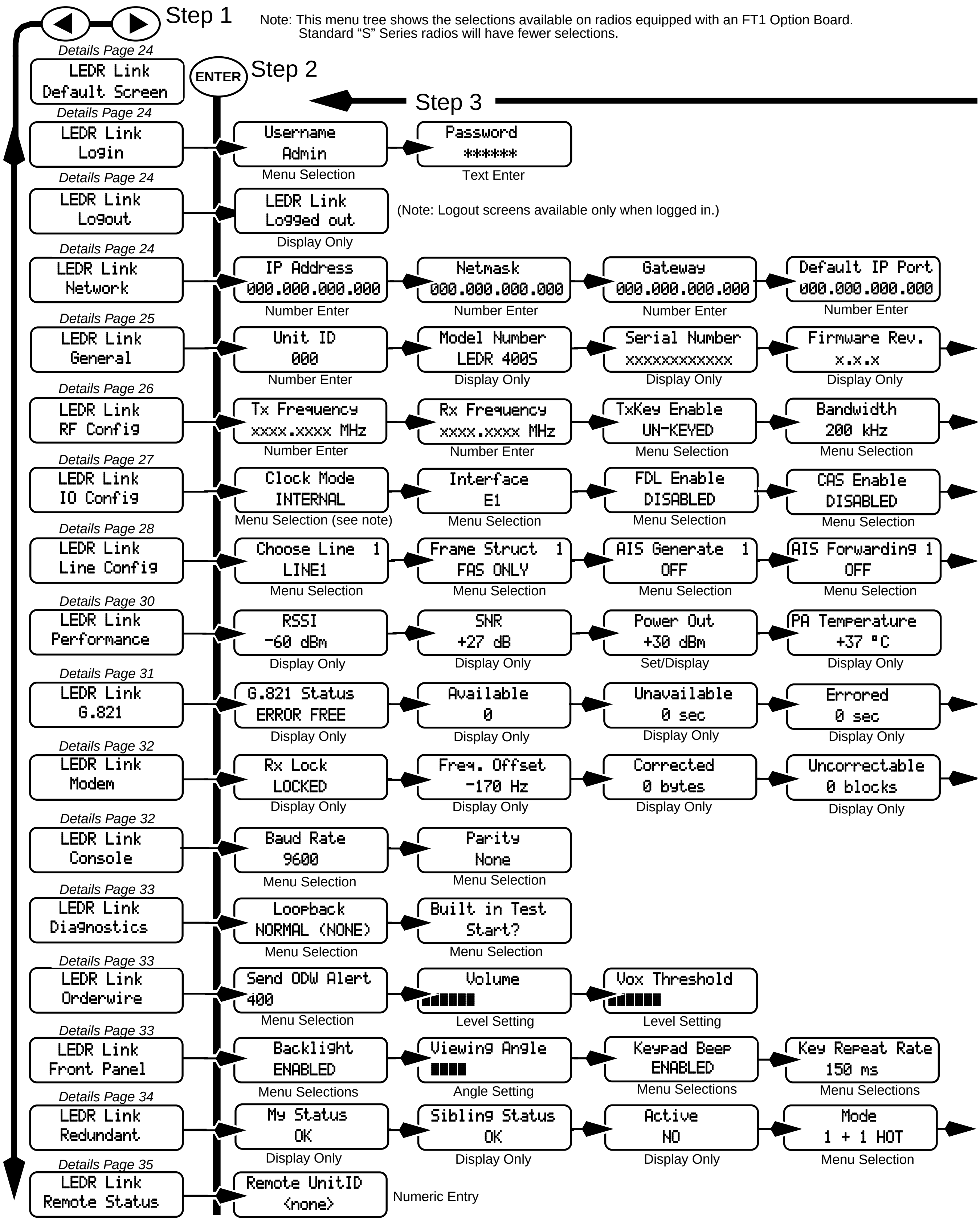
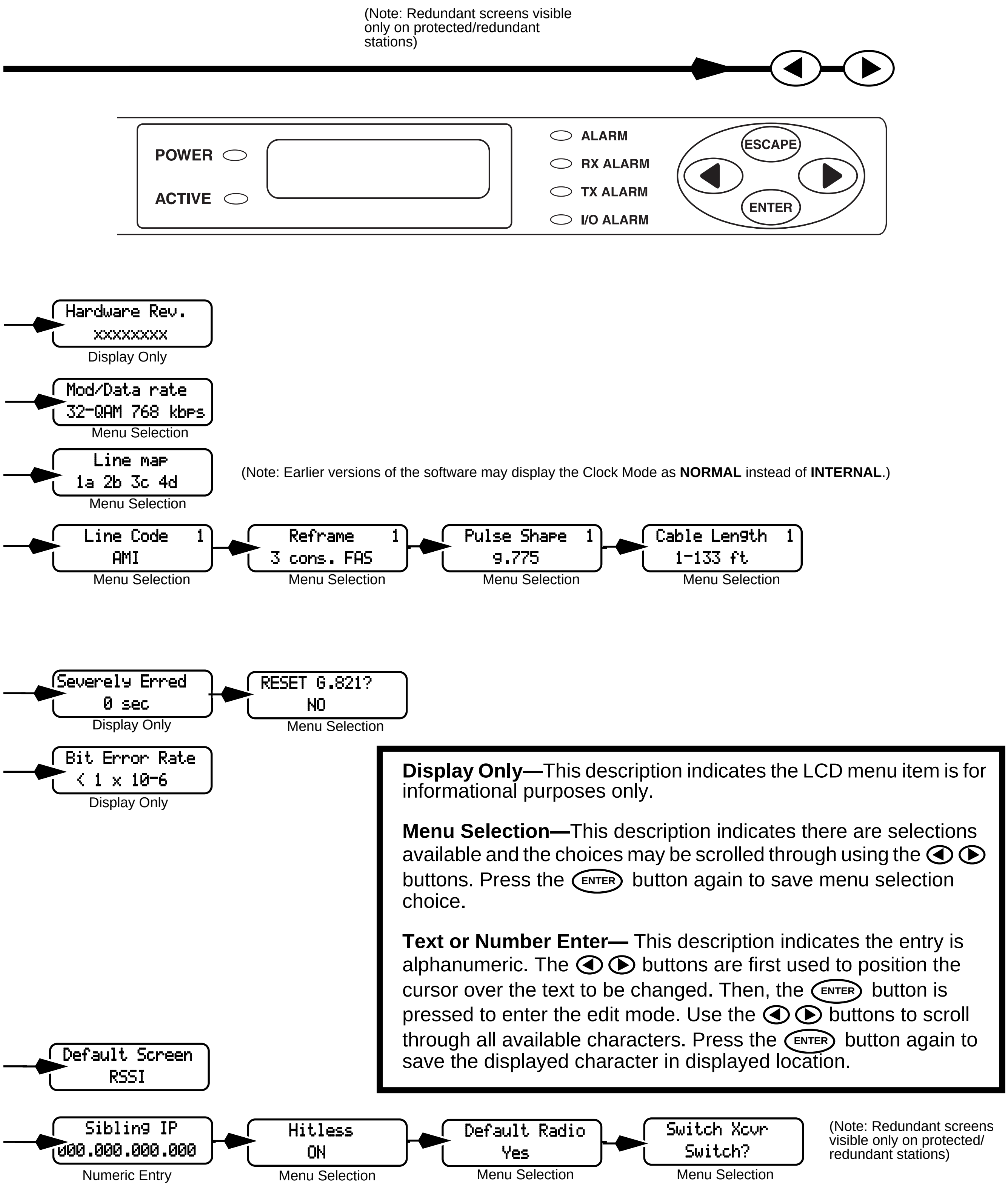


Figure 14. Front Panel LCD Menu Navigation



Display Only—This description indicates the LCD menu item is for informational purposes only.

Menu Selection—This description indicates there are selections available and the choices may be scrolled through using the ◀ ▶ buttons. Press the ENTER button again to save menu selection choice.

Text or Number Enter— This description indicates the entry is alphanumeric. The ◀ ▶ buttons are first used to position the cursor over the text to be changed. Then, the ENTER button is pressed to enter the edit mode. Use the ◀ ▶ buttons to scroll through all available characters. Press the ENTER button again to save the displayed character in displayed location.

3.3 Front Panel LCD Menu Descriptions

Default Parameters

```
LEDR Link
Default Screen
```

This menu allows you to view the default screen that appears on the LCD display. If desired, the default screen may be changed (see “ Default Screen” on page 34).

Login

The login menus allow you to log in to the radio’s operating system and gain access to configuration and diagnostics functions permitted for your assigned access level.

The username menu is where you specify the user name assigned by the user access administrator.

```
Username
Admin
```

For the console command-line equivalent, see “login” on page 48

```
Password
******
```

The password screen is where you specify the password associated with your user name to gain access to the login account. A maximum of eight characters are allowed.

For the console command-line equivalent, see “passwd” on page 51

Network

This menu allows changes to the radio’s IP address. The IP address is used for SNMP connectivity. The IP address also allows new radio software to be downloaded over-the-air.

```
IP Address
000.000.000.000
```

For the console command-line equivalent, see “ip” on page 46

```
Netmask
000.000.000.000
```

This menu allows the subnet mask to be viewed and changed. The subnet mask specifies which bits of the host IP address can be re-used for increased network addressing efficiency.

Example: Consider an IP address in a Class C network, such as 150.215.017.009. The Class C network means that the right-most group of numbers (009) identifies a particular host on this network. The other three groups of numbers (150.215.017) represent the network address.

Subnetting allows the further division of the host part of the address (right-most group of numbers) into two or more subnets. A subnet mask of 255.255.255.127 allows half of the host portion of the IP address to be reused to define sub-networks.

For the console command-line equivalent, see "ip" on page 46

```
 Gateway
000.000.000.000
```

This menu allows the Gateway IP address to be viewed or set. The Gateway IP address is the address of the radio that connects the radio network to an IP network.

For the console command-line equivalent, see "ip" on page 46

```
Default IP Port
   Ethernet
```

This menu allows selection of the Default IP port for networking connections to the LEDR radio. The **Ethernet** selection is used for cable connection to a Local Area Network (LAN) or repeater via the radio's rear panel ETHERNET NMS connector.

The **AIR** selection is commonly used for over-the air (RF) networking between radios, but may also be used with a back-to-back cable connection between two radios via the radio's rear panel ETHERNET NMS connector. This type of communication uses the SNAP protocol and requires the use of an ethernet crossover cable.

For the console command-line equivalent, see "ip" on page 46

General

```
   Unit ID
     000
```

This menu allows the Unit ID of the radio to be displayed or changed. The Unit ID allows an individual radio to be signaled for Orderwire use.

For the console command-line equivalent, see "unitid" on page 58

```
 Model Number
  LEDR 1400S
```

This menu displays the radio model number. The radio type cannot be changed by the user.

For the console command-line equivalent, see "model" on page 51

```
Serial Number
xxxxxxxxxxxx
```

This menu displays the radio serial number and matches the serial number on the chassis sticker. The radio serial number cannot be changed by the user.

For the console command-line equivalent, see "sernum" on page 55

```
Firmware Rev.
xxxxxxxx
```

This menu displays the firmware revision level of the internal radio software.

For the console command-line equivalent, see "ver" on page 59

```
Hardware Rev.
xxxxxxxx
```

This menu displays the hardware revision level of the main PC board in the radio.

For the console command-line equivalent, see "ver" on page 59

RF Configuration

```
Tx Frequency
```

This menu is used to set or view the transmit (TX) frequency of the radio.

For the console command-line equivalent, see "freq" on page 44

```
Rx Frequency
```

This menu is used to set or view the receive (RX) frequency of the radio.

For the console command-line equivalent, see "freq" on page 44

```
Tx Key Enable
```

This menu is used to enable (key) or disable (dekey) the transmitter or to verify that the radio is keyed and the transmitter is active. The radio is normally keyed and transmitting whenever power is applied.

For the console command-line equivalent, see "txkey" on page 58

```
Bandwidth
```

This menu displays the bandwidth setting of the radio. The bandwidth is set at the factory and cannot be changed by the user. Refer to Table 17 on page 61 for allowable combinations of bandwidth, data rates, and modulation types.

```
Mod/Data rate
32-QAM 768 kbps
```

This menu displays the modulation type and the aggregate link data rate. The available modulation types are 16 QAM, 32 QAM, and 64 QAM. The data rate can be changed, but is dependent on the modulation type. See “Bandwidths, Data Rates and Modulation Types” on page 61.

For the console command-line equivalent, see “modem” on page 51

IO Configuration

```
Clock Mode
INTERNAL
```

This screen is used to set or display the data clocking method. For synchronization purposes, several different clocking schemes can be used. See “Transmit Clock Selection” on page 62.

For the console command-line equivalent, see “clkmode” on page 42

NOTE: Earlier versions of the software may display the Clock Mode as **NORMAL** instead of **INTERNAL**.

```
Interface
E1
```

This screen is used to set or display the payload data interface. The available selections are E1 and T1, depending on hardware configuration of the LEDR radio.

For the console command-line equivalent, see “interface” on page 46

```
FDL Enable
DISABLED
```

This screen is used to set or display the Facility Data Link (FDL) status for T1 operation. Valid selections are Enabled and Disabled.

For the console command-line equivalent, see “modem” on page 51

```
CAS Enable
DISABLED
```

This screen is used to set or displays the Channel Associated Signaling (CAS) status. The available selections are Enabled and Disabled.

For the console command-line equivalent, see “modem” on page 51

```
Line map
1a 2b 3c 4d
```

This screen is used to set or display the current span mapping configuration. The entry consists of from 1 to 4 alpha-numeric characters specifying line interface to span mapping. Valid numbers are 1–4. Valid span characters are a–d.

Example: Entering 1a 2b 3c 4d causes the following:

maps line 1 to span a
maps line 2 to span b
maps line 3 to span c
maps line 4 to span d

For the console command-line equivalent, see "linemap" on page 47

Line Configuration

Choose Line 1
LINE1

This screen is used to choose or display the line (1-4) that is selected. This selection will be active for all of the screens that follow in the Line Configuration menu and will be displayed in the upper right hand corner of each screen.

For the console command-line equivalent, see "linename" on page 48

Frame Struct 1
FAS ONLY

This screen is used to set or display the span(s) frame structure. The allowable selections are shown in Table 9.

Table 9. Frame Structure—Allowable Selections

T1 Operation	E1 Operation
0–FT only (Default)	0–FAS Only (Default)
1–ESF	1–FAS + BSLIP
2–ESF + PRM	2–FAS + CRC
3–SF	3–FAS + CRC + BSLIP
4–SF + JYEL	4–FAS + CAS
5–ESF + CRC	5–FAS + CAS + BSLIP
6–ESF + CRC + PRM	6–FAS + CRC + CAS
	7–FAS +CRC + CAS +BSLIP

For the console command-line equivalent, see "fstruct" on page 44

AIS Generate 1
OFF

This screen is used to set or display the Alarm Indication Signal (AIS) status. It may be set to ON or OFF. When generation is enabled, fault conditions within the link or at the line interface will cause the appropriate AIS signaling to occur.

For the console command-line equivalent, see "ais" on page 40

This screen is used to set or display the Alarm Indication Signal (AIS) forwarding status. It may be set to ON or OFF. When forwarding is enabled, AIS/RAI signaling at the line interfaces will be detected and passed to the other end of the radio link.

For the console command-line equivalent, see “ais” on page 40

This screen is used to set or display the linecode used by the radio. The available selections are AMI or HDB3.

For the console command-line equivalent, see “linecode” on page 47

This screen is used to set or display the reframe criteria of the LEDR radio. The setting is based on the number of errors encountered. The available selections for T1 and E1 operation are listed in Table 10 below.

Table 10. Reframe Criteria Selections

T1 Operation	E1 Operation
2 out of 4 Fbit errors (Default)	3 consecutive FAS errors (Default)
2 out of 5 Fbit errors	915 CRC errors
2 out of 6 Fbit errors	

For the console command-line equivalent, see “reframe” on page 53

This command is used to select or display the pulse template according to the data interface cable being used. Table 11 below shows the available selections for T1 and E1 operation.

Table 11. Line Selections vs. Cable Type

T1 Operation—100 Ω Twisted Pair Cable	E1 Operation ITU-T G.703, 120 Ω Cable
0–1 to 133 feet (Default)	g.775 (Default)
1–133 to 266 feet	i.431
2–266 to 399 feet	
3–399 to 533 feet	
4–533 to 655 feet	

For the console command-line equivalent, see “line” on page 47

This command is used to set or display the cable length being used for the data interface. The available selections are:

1 to 133 feet (Default)
133 to 266 feet
266 to 399 feet
399 to 533 feet
533 to 655 feet

For the console command-line equivalent, see “line” on page 47

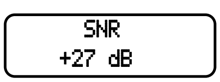
Performance

The performance menu items provide diagnostics information regarding the radio. The following diagnostic parameters are available on a continuous, updating basis:

- **RSSI—**Received Signal Strength Indicator
- **SNR—**Signal/Noise Ratio (not valid if there is an RX Alarm)
- **POUT—**Power Output
- **PA Temperature—**Power amplifier temperature

The RSSI display indicates the strength of the radio signal being received at the radio receiver. The measurement is in dBm. Therefore, an RSSI of –80 dBm is stronger than a –100 dBm signal.

For the console command-line equivalent, see “rssi” on page 54



The SNR display indicates the relationship of the amount of intelligence versus noise on the radio signal. The higher the SNR, the better the quality of the radio signal.

For the console command-line equivalent, see “snr” on page 55

```
Power Out
+30 dBm
```

The Power Output display indicates the transmitter power output in dBm. (+30 dBm is equal to 1.0 watt; +20 dBm is 100 mW.)

For the console command-line equivalent, see “rfout” on page 54

```
PA Temperature
+37 °C
```

The PA Temperature display indicates the internal temperature (degrees Celsius) at the hottest point on the transceiver’s printed circuit board (near the power amplifier section of the radio).

For the console command-line equivalent, see “temp” on page 56

G.821

```
LEDR Link
G.821
```

This menu contains radio link performance information. The G.821 standard defines descriptive words associated with bit-error rate performance. Refer to the ITU-T G.821 recommendations for definitions and standards.

```
G.821 Status
Error Free
```

This display shows summary information regarding the bit-error-rate (BER) status of the radio.

```
Available
0 sec
```

This screen shows the available seconds of the radio link. The G.821 standard defines Available Seconds as the period of time following a period of 10 consecutive seconds, each of which has a BER of less than $1x10^{-3}$.

```
Unavailable
0 sec
```

This screen shows the unavailable seconds of the radio link. The G.821 standard defines Unavailable Seconds as the period of time following a period of 10 consecutive seconds, each of which has a BER of higher than $1x10^{-3}$.

```
Errored
0
```

This screen shows the errored seconds of the radio link. The G.821 standard defines Errored Seconds as a one second period in which one or more bits are in error.

```
Severely Erred
0
```

This screen shows the severely errored seconds of the radio link. The G.821 standard defines Severely Errored Seconds as a one second period that has a BER higher than $1x10^{-3}$.

```
Reset G.821?
NO
```

This screen allows the user to reset the G.821 performance monitoring screens.

Modem

Rx Lock
LOCKED

This menu indicates whether the receiver demodulator has detected a signal, acquired the carrier, and data rate, as well as achieved a Forward Error Correction (FEC) lock.

Freq. Offset
-170 Hz

This screen shows the frequency offset of the LEDR radio as measured in Hertz.

Corrected
0 bytes

This menu shows how many frames have been corrected by the radio's FEC capability.

Uncorrectable
0 blocks

This menu shows how many bytes could *not* be corrected by the radio's FEC capability.

Bit Error Rate
< 1 x 10-6

This menu shows the current bit error rate (BER) of the LEDR radio.

Console

Baud Rate
9600

This menu allows you to set or view the current data rate setting for the console port serial interface. Refer to Figure 23 on page 85 for pinout information of the console port. See "Console Port" on page 35 for additional information.

For the console command-line equivalent, see "con" on page 41

Parity
None

This menu allows you to set or view the current parity setting for the console port serial interface. Refer to Figure 23 on page 85 for pinout information for the console port. Refer to Console Port on page 35 for additional information. Typically, this will be set to NONE.

For the console command-line equivalent, see "con" on page 41

Diagnostics

```
Loopback
NORMAL (NONE)
```

This menu is used to start the loopback mode for testing purposes. Remote loopback port selection is relative to the local port. The radio link will translate any line mapping to select the correct physical remote port to loop back, based on the selected local port.

When conducting RF loopback testing, see page 49 (**loopback** console command) for additional information.

For the console command-line equivalent, see "loopback" on page 49

```
Built in Test
Start?
```

This menu is used to start built in radio tests to check radio function.

For the console command-line equivalent, see "test" on page 56

Orderwire

```
Send ODW Alert
```

This menu allows you to "ring" the Orderwire at a specified radio site. Refer to Using the Orderwire on page 60 for instructions on using the Orderwire.

For the console command-line equivalent, see "alert" on page 40

```
Volume
███
```

This screen is used to set or display the Orderwire volume. Use the ◀ ▶ keys to adjust the screen. Pressing ENTER saves the adjusted value as the default setting.

For the console command-line equivalent, see "volume" on page 59

```
Vox Threshold
██
```

This screen is used to set or display the Orderwire vox threshold (activation level). Use the ◀ ▶ keys to adjust the screen. Pressing ENTER saves the adjusted value as the default setting.

For the console command-line equivalent, see "vox" on page 59

Front Panel

```
Backlight
ENABLED
```

This screen provides control of the front panel LCD illumination. The LCD illumination may need to be enabled to view the LCD depending on ambient lighting conditions.

This screen allows you to adjust the viewing angle (top to bottom) of the LCD screen. The angle may need to be adjusted depending the mounting position and ambient lighting conditions of the radio. Use the ◄ ► keys to adjust the screen. Pressing ENTER saves the adjusted value as the default setting.

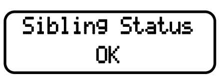
This screen allows the radio beeper to be disabled or enabled. The beeper provides a short “chirp” whenever a keypad button is pressed.

This screen allows you to set the time delay that occurs before a button will start repeating its function when held down.

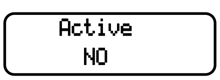
This screen allows you to set the default screen that appears when the radio is first turned on, or is left idle for more than 10 minutes. The RSSI screen is commonly chosen, but any screen may be selected as a default.

Redundant

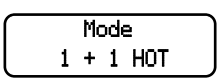
This screen is used to display the status of the radio currently being used. “OK” is displayed when no problems are detected.



This screen is used to display the status of the “other” radio in a protected configuration (the one not currently being used). “OK” is displayed when no problems are detected.



This screen is used to set or display whether the currently selected radio is the active unit.



This screen is used to set or display the radio’s redundancy mode. The available selections are: redundant hot standby (1+1 Hot), redundant warm standby (1+1 Warm) or stand-alone configuration.

This screen is used to set or display the sibling radio’s Internet Protocol (IP) address. (See note below.)

NOTE: The associated radio IP address should be programmed to the IP address of the other radio connected to the protected switching chassis. The associated radio IP address is used by the redundant radio to share information between the units. This address is necessary for warm-standby switching but not for hot-standby. However, the redundant radio will perform better if their associated radio IP address is programmed correctly. The associated radio IP address does *not* affect IP routing and forwarding, SNMP, or Telnet.

Hitless
ON

This screen sets or displays whether the radio is set to perform error-free switchover in the event of an alarm condition.

Default Radio
Yes

This screen displays whether or not the radio is the default radio in a protected configuration. The default radio is determined by which one is connected to the top connector of the Protected Switch Chassis rear panel. (See Figure 11 on page 15.)

Switch Xcvr
Switch?

This screen is used to force a switchover to the non-active transceiver. (The newly selected unit becomes the active transceiver).

Remote Status

Remote UnitID
<none>

This screen is used to set or display the unit identification for the remote radio.

3.4 Console Port

The Console Port on the front panel provides full access to configuration and diagnostics information.

The console port is an EIA-232 type connection that provides ASCII text communications to a connected terminal. Refer to Pinout Information on page 84 for connector wiring details.

Although the console interface is compatible with a VT-100-type terminal, ANSI terminal emulation displays the menus with the best results.

NOTE: It is important to use a terminal or terminal-emulator that supports 80 characters per line and 25 lines per screen. The menus will be distorted if terminals with different line characteristics are used.

The command line can be used to configure and query the radio parameters and setup information. The available commands can be listed on the display by typing **help** at the **ADAP>** prompt, then **ENTER** .

Using the Console Port

1. Connect a terminal to the front panel DB-9 connector labeled 🖳.
2. Open an ANSI terminal application on the terminal. (If using a windows operating system, a HyperTerminal window can be used.)
3. Press **ENTER** a few times. When communications are established with the radio, an **ADAP>** text prompt appears on the terminal screen.
4. Type **login <your username>** (or **rlogin <your username>** for remote access) and press Enter. At the **password>** prompt, type your password (eight characters maximum).

Once you are successfully logged in, the commands shown in Table 12 are available at the command line prompt (**ADAP>**).

NOTE: The console commands listed in this manual show the selections available on radios equipped with an FT1 Option Board. Standard “S” Series radios will have fewer selections.

Table 12. Console Port Commands

Command	Description	Reference
?	Displays the available console commands. May also be entered after any other command to obtain context sensitive help. (Note: **help** may be entered in place of **?**).	page 39
ais	Echoes/enables/disables Alarm Indication Signal (AIS) generation and Remote Alarm Indication (RAI) detection, AIS and RAI Signal (RAIS) forwarding on given span(s).	page 40
alarm	Provides control of alarm outputs and displays state of alarm inputs.	page 40
alert	Sends an alert sound to the specified radio	page 40
ber	Display pre-FEC and post-FEC bit error rate	page 41
bert	Provides a means to test the link between the radio and the customer equipment. (Not implemented at press time.)	--
boot	Displays or reboots the board with either software image	page 41

Table 12. Console Port Commands *(Continued)*

Command	Description	Reference
buzzer	Briefly sounds the radio's piezo buzzer to test its operation.	page 41
coffset	Displays modem carrier frequency offset in Hz.	page 41
con	Set/display console parameters	page 41
config	Used to get or send a radio configuration file.	page 41
date	Set/display current date	page 41
dtren	Set/display DTR enable	page 42
clkmode	Set/display transmit clocking mode	page 42
ethernet	Displays Ethernet address	page 43
events	Event log commands	page 43
evmap	Set/display alarm port and alarm LED settings	page 43
fan	Displays fan status	page 43
fec	Display corrected and uncorrected FEC errors	page 43
freq	Set/display operating frequencies	page 44
fset	Display absolute frequency limits	page 44
fstruct	Set/display current span(s) frame structure	page 44
g821	Show/Reset G.821 information	page 44
group	Set/display network group	page 44
help	Displays the available console commands. May also be entered after any other command to obtain context sensitive help. (Note: **?** may be entered in place of **help**).	page 39
icopy	Firmware image copy	page 45
idlepat	Set/display timeslot idle pattern	page 45
info	Set/display radio/owner information	page 45
interface	Echoes or sets the payload data interface	page 46
interleave	Set/display interleave depth	page 46
ip	Set/display the radio's IP numbers	page 46
iverify	Firmware image verify	page 46
lcd	Tests radio's front panel LCD display.	page 46
led	Tests radio's front panel LEDs.	page 46
line	Set/display pulse shape settings	page 47
linecode	Set/display the linecode used by span(s)	page 47
linerr	Show/enable/clear line errors	page 47
linemap	Set/display current linemapping configuration	page 47
linename	Echoes or sets names for line interfaces	page 48
log	View, sort, clear, send event log information	page 48
login	Console user level access	page 48

Table 12. Console Port Commands *(Continued)*

Command	Description	Reference
logout	Console user exit	page 49
loopback	Set/display loopback modes	page 49
menu	Runs Menu Wizard	page 51
model	Display radio model number	page 51
modem	Set/display radio modulation type and data rate	page 51
network	Display network numbers	page 51
passwd	Sets new user password (8 characters max.)	page 51
pll	Displays Phase Locked Loop status	page 52
pmmode	Enables/disables modem modulator power measurement mode (on/off).	page 52
rdnt	Redundant command (Valid only on Protected models)	page 52
reframe	Set/display the reframe criteria	page 53
reprogram	Reprograms radio software	page 54
rfocal	Set/display RF power output calibration sequence.	page 54
rfout	Displays transmit power	page 54
rlogin	Log in to remote radio	page 54
route	Add/delete/modify IP routing table entries	page 54
rssi	Displays received signal strength	page 54
rssical	Set/display RSSI calibration sequence.	page 54
rxlock	Displays current modem lock status	page 55
sabytes	Echo/set sa bytes in E1 multi-frame	page 55
sernum	Displays radio serial number	page 55
snmpcomm	Set/display SNMP community names	page 55
snr	Displays signal to noise ratio	page 55
status	Displays performance and configuration data	page 55
svch	Set/display service channel configuration	page 56
telnetd	Displays or kills (terminates) telnet session(s)	page 56
temp	Displays PA temperature	page 56
test	Runs self-test of radio	page 56
threshold	Set/display performance degradation threshold(s)	page 57
time	Set/display system time	page 57
timeslot	Selects which timeslots to transmit for a span(s). Default action is to enable.	page 57
trapfilter	Set/display which events cause SNMP traps.	page 58
trapmgr	Set/display the trap manager IP address	page 58

Table 12. Console Port Commands *(Continued)*

Command	Description	Reference
trend	Displays continuously updated readings of: RSSI, radio temperature, RF output, signal-to-noise ratio, and FEC errors (correc ted and uncorrected).	page 58
txkey	Key or unkey radio	page 58
unitid	Displays the unit identification	page 58
uptime	Displays how long the radio has been operating	page 58
user	Administration tool for adding, modifying or deleting user accounts	page 58
ver	Displays software version	page 59
volume	Set/display handset volume	page 59
vox	Set/display vox threshold	page 59
who	Displays the radio users list	page 59

Command Descriptions

The following commands are available through the console port. The conventions used for these commands are similar to UNIX command-line structure. These commands all require the Enter or Return key be pressed after the command.

The following conventions are used to help describe the usage of the commands.

> Square brackets **[ ]** contain subcommands that may or may not be needed as part of the desired command. If there is more than one possible subcommand a vertical line **|** separates the commands within the square brackets. A subcommand is an optional extension of the command and changes the basic command.
>
> Angle brackets **<>** contain arguments. The arguments are values needed to carry out the command such as a frequency value or option.

? or help

Usage: **help**

This command returns a list of currently available commands. In addition, entering **help** as a subcommand before or after a command returns usage information regarding the command. A **?** (question mark) can be also be used to invoke help.

Command example:

rssi help [ENTER]

Returns:

Usage: command [subcommand] <argument>

ais

Usage: **ais [linelist] [-g <on|off>] [-f <on|off>]**

This command enables or disables alarm signal generation and forwarding on specified lines. When generation is enabled, fault conditions within the link or at the line interface will cause the appropriate AIS/RAI signaling to occur. When forwarding is enabled, AIS/RAI signaling at the line interfaces will be detected and passed to the other end of the link.

Command example:

ais -f on -g on ENTER

Returns:

AIS on RAI on

alarm

Usage: **alarm [1-4|all <open|close|read>]**
[input [1-4|all]]

This command is used to control the alarm outputs and to display the state of the alarm inputs.

Command example #1:

alarm all ENTER

Returns:

alarm: Starting test (all alarms)
alarm: Test complete (all alarms)

Command example #2:

alarm 2 close ENTER

Returns:

alarm: alarm 2 closed

Command example #3:

alarm input 3 ENTER

Returns:

alarm: alarm input 3 = open

alert

Usage: **alert <3 digit unit ID>|all**

This command is used to sound the alert buzzer on another radio station. This function allows you to signal a radio and alert someone that the handset for the Orderwire should be picked up.

The three-digit number following the command indicates the unit ID of the radio that will be signaled. See “Using the Orderwire” on page 60. for more information.

ber

Usage: **ber**

This command displays pre-FEC and post-FEC Bit Error Rate (BER).

Returns: **ber 10-6**

boot

Usage: **boot [<1-2>]**

This command is used to view or change the radio’s active software image. If **boot** is entered alone, the currently active image is displayed. A selection of 1 or 2 after the command (e.g., **boot 2**) indicates which software image to boot. (A message appears to confirm that you wish to reboot the software.) Upon reboot, the radio software and all radio functions are restarted in a manner similar to turning the radio power off and then on again. The radio is taken out of service until it reinitializes.

A choice of software images allows booting an alternate version of radio software. The ability to have two radio resident software images allows radio software reprogramming over-the-air and the ability to restore operation to the original software if required.

buzzer

Usage: **buzzer**

This command briefly sounds the radio’s piezo buzzer for testing.

Example response:

buzzer: Starting test
buzzer: Test complete

coffset

Usage: **coffset**

This command displays the Modem Carrier Frequency Offset.

con

Usage: **con (baud [300|1200|2400|4800|9600|19200|38400|115200]) (parity [none|even|odd])**

This command sets or displays the console serial port operating parameters. The console data rate is set or displayed using the **baud** subcommand. The parity is set or displayed using the **parity** subcommand.

config

Usage: **config [get|send] [filename] [hostIP] [useCals**

This command is used to get or send a radio configuration file.

clkmode

Usage 1 (EIA-530 operation): **clkmode [<internal|exttx|looped|extdce>]**

Usage 2 (E1/T1 operation): **clkmode [<internal|remote|1-4|linename>]**

This command is used to set or display the master clock source for the radio system. Several different clocking schemes can be used. See “Transmit Clock Selection” on page 62 for clocking arrangements.

NOTE: Earlier versions of the software may display the Clock Mode as **NORMAL** instead of **INTERNAL**.

Usage 1 Subcommands:

internal—Internal oscillator source (default).
exttx—Clock from external equipment.
looped—Recovered RF (RX) clock.
extdce—Some other source.

Usage 2 Subcommands:

internal—Internal oscillator source (default).
remote—Over-the-air, RX data derived.
1-4—Recovered RF (RX) clock.
linename—Loop timing from specified line interface.

In E1/T1 operation only, the **clkmode** command allows the various possible clock sources to be prioritized for fallback. As timing sources become available, the highest-priority source will be chosen by the system. If attaching to the network or equipment that provides timing, a universal form of the command would be **clkmode 1234 internal**.

If attaching to equipment that will provide looped-back timing, a universal form of the command would be **clkmode remote internal**. If both ends of the link provide looped-back timing, the internal clock source should be selected by entering **clkmode internal**. Note that at least one end of the link should have either network or internal timing selected.

date

Usage: **date [MM/DD/YYYY]**
Subcommands: date format [<1-3>] (1-US, 2-European, 3-generic)

This command sets or displays the date and time of the radio’s internal real-time clock. The real time clock operates from an internal lithium battery so it is running even if the radio has no DC power connected. The date format may also be set or displayed from this screen for one of three formats: U.S., European, or generic.

The real time clock is fully compliant with year 2000 standards.

Example response: **date: 07-JUN-1999 08:11:30**
date format: dd-MON-yyyy (3)

dtren

Usage: **dtren [<on|off>]**

The **dtren** command sets or displays the status of the DTR (handshaking) enable.

Example response: **dtren: on**

ethernet

Usage: **ethernet**

This command displays the fixed hardware address of the radio's Ethernet port. This number is assigned at the factory and cannot be changed.

events

Usage: **events [subcommand] [<arguments>]**

Subcommands:
pending
filter [event#] [count]
init
desc [<event#>]

This command allows viewing the pending events (**pending**), setting the number of occurrences per log entry (**filter**), initializing events processing (**init**) and display of event descriptions (**desc**). To turn off logging for a particular event, the filter count value should be set to zero.

Example response:
events {events}: -DEMOD_ACQUISITION (Event #27)
events: Event#0 Filter count=1
events {init}: The event log has been re-initialized
events {desc}: Event#40 Description-
IO2_DIG_REM_LPBACK

evmap

Usage: **evmap [subcommand] [event #] [arguments]**

Subcommands:
led [ioalarm|txalarm|rxalarm|alarm|active] [...]
aout [1|2|3|4] [...]
dump

This command sets or displays which radio system events cause alarm indications on the front panel LEDs or the rear panel ALARM I/O connector. The subcommands specify which output will be asserted upon occurrence of an event #. Multiple outputs can be specified with spaces between them.

See Figure 12 for reference of the Front Panel LEDs. Refer to Alarm on page 86 for the pinouts of the Alarm I/O connector.

Example response:
evmap: Event #0 LED alarm
evmap: Event #0 Alarm Output NONE

fan

Usage: **[fan]**

This command is used to read the status of the radio's cooling fan.

Example response:
fan1: Working
fan2: Working

fec

Usage: **[fec <clr>]**

This command displays corrected and uncorrected FEC errors.

Example response: **fec: 1812992 Correctable Bytes**
fec: 6912 Uncorrectable Blocks

freq Usage: **freq [<tx/rx>] [<freq>] [<freq>]**

This command sets or displays the transmit and receive frequency.

Example response: **freq {TxFreq}: 942175000 Hz**
freq {RxFreq}: 944175000 Hz

fset Usage: **fset [<min freq>] [<max freq>]**

This command sets the absolute frequency limits of the LEDR radio.

Example response: **fset {MinFreq}: 900000000**
fset {MaxFreq}: 960000000

fstruct Usage: **fstruct [linelist] [mode <0-7>]**

This command is used to set or display the span(s) frame structure. The **[linelist]** variable represents a list of line interfaces. This entry can be either a single line number or linename (see **linename** command), a comma separated list of line numbers or linenames, a range of line numbers (i.e., 1-4), or if linelist is not given *all* lines. Table 13 shows a list of valid line numbers.

Table 13. T1/E1 Line Numbers

Mode for T1	Mode for E1
0–FT only (default)	0–FAS only (default)
1–ESF	1–FAS + BSLIP
2–ESF + PRM	2–FAS + CRC
3–SF	3–FAS + CRC + BSLIP
4–SF + JYEL	4–FAS + CAS
5–ESF + CRC	5–FAS + CAS + BSLIP
6–ESF + CRC +PRM	6–FAS + CRC + CAS
	7–FAS + CRC + CAS + BSLIP

g821 Usage: **demod|io1|io2|io3|io4|all[clr]**

This command is used to show or reset the radio's G.821 information.

Example Response: **Demodulator: ERROR FREE**
Savail: 1036
Sunavail: 0
ES: 0
SES: 0

group Usage: **[<group>]**

This command sets or displays the network group that the radio is operating in.

Example response: **group: 1**

help or ? Usage: **help**

This command can be used alone or with a specific command. Entering **help** before or after a command will display the usage and possible subcommands of the command. The character **?** may also be used to obtain help.

icopy Usage: **icopy [<app|dsp|fpga|scripts>]**

This command is used to copy the active software image to the inactive software image.

There are two independent radio operating software files residing in the radio. The radio uses one of the files as the *active* software which is running. The other software file is *inactive* and is not running. The ability to have two radio software images allows radio software reprogramming to be done over-the-air and provides the ability to restore operation to the original software if required.

To run the software image see “boot” on page 41.

idlepat Usage: **idlepat [<linelist>] [slots <slotlist>] <pattern>**

This command is used to set or display the timeslot(s) idle pattern.

variable definitions:

linelist: Represents a list of line interfaces. It can consist of a single line number or linename, a comma separated list of line numbers or linenames, a range of line numbers (i.e., 1–4), or if linelist is not given *all* lines. See Table 13 on page 44 for a list of line numbers.

slotlist: A list of timeslots consisting of a single slot number, comma separated list of slot numbers, or a range of slot numbers (i.e., 2-8).

pattern: A 2 hex digit value (default value is 17).

info Usage: **info [<owner|contact|name|location>] [<string>]**

This command is used to program information into radio memory that is particular to the radio site or installation. The information is intended for identification and memorandum needs.

Four separate text fields are provided. The owner’s name string is limited to 10 characters. The contact, location, and name text fields are limited to 254 characters. Any standard, printable ASCII characters are allowed.

To display the owner's name text field enter **info owner**. To display the contact information enter **info contact**. To display the name information enter **info name.** To display the location information enter **info location.**To display all the parameters enter **info**.

To change the info text, enter text after **info owner** or other info field name.

interface

Usage: **interface: [e1|t1]**

This command is used to set or display the payload data interface. The user may select between EIA-530 and T1, or EIA-530 and E1.

Example response:

interface: {Line}: e1

interleave

Usage: **interleave [depth]**

This command is used to set or display the interleave depth.

Example response:

interleave: 1

ip

This command sets or displays the Internet Protocol (IP) data for the LEDR radio. The subcommands allow you to set the IP address, IP netmask, IP gateway, or IP port.

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

Subcommands: **address [x.x.x.x]**
netmask [x.x.x.x]
gateway [x.x.x.x]
IP port [ETH|AIR]

See "Network" on page 24 for additional information.

Example response: **IP Address: 10.2.142.143**
IP Netmask: 255.255.0.0
IP Gateway: 0.0.0.0
IP Port: ETH

iverify

Usage: **iverify [1–2] [<app|dsp|fpga|scripts>]**

This command is used to determine the data integrity of the two software image files that reside in the radio. (See also **icopy**, above.)

Example response:

iverify: Image has been verified

lcd

Usage: **lcd [<on|off|restore>]**

This command starts a two-part test of the radio's front panel LCD. When **lcd** is first entered, the display should appear with all blocks. When the Return key is pressed, the screen should change to completely blank.

led

Usage: **led [<alarm|rxalarm|txalarm|ioalarm|all|restore>] [<on|off>]**

This command is used to test the front panel LEDs. If no argument is given, all front panel LEDs (except POWER) should flash in sequence. Press Control-C to end the test.

Command example:

led alarm on

Returns:

led: Alarm LED ON

line

Usage: **line [linelist] [cable <0-4> [spec]**

This command is used to set or display the pulse template according to the cable characteristics shown in Table 14 below.

Table 14. Line Selections vs. Cable Type

T1 Operation—100 Ω Twisted Pair Cable	E1 Operation ITU-T G.703, 120 Ω Cable
0–1 to 133 feet (Default)	g.775 (Default)
1–133 to 266 feet	i.431
2–266 to 399 feet	
3–399 to 533 feet	
4–533 to 655 feet	

linecode

Usage: **linecode [linelist] [HDB3|AMI]**

This command sets or displays the radio's linecode (B8ZS or AMI in T1 mode, HDB3 or AMI in E1 mode).

The **[linelist]** variable represents a list of line interfaces. It can consist of a single line number or linename, a comma separated list of line numbers or linenames, a range of line numbers (i.e., 1–4), or if linelist is not given *all* lines. See Table 13 on page 44 for a list of line numbers.

Example response:

linecode: HDB3

linerr

Usage: **linerr [linelist] [on|off]**

This command is used to display, enable, or disable line errors. The **[linelist]** variable represents a list of line interfaces. It can consist of a single line number or linename, a comma separated list of line numbers or linenames, a range of line numbers (i.e., 1–4), or if linelist is not given *all* lines. See Table 13 on page 44 for a list of line numbers.

linemap

Usage: **linemap [maplist**

This command is used to set or display the current span mapping configuration. The **maplist** variable consists of from 1 to 4 alpha-numeric characters specifying line interface to span mapping. Valid numbers are 1–4. Valid span characters are a–d.

Example: Entering **linemap 1d 2b 3a 4c** causes the following:

maps line 1 to span d
maps line 2 to span b
maps line 3 to span a
maps line 4 to span c

linename

Usage: **linename <linelist> <namelist>**

This command is used to set or display the names for line interfaces.The **[linelist]** variable represents a list of line interfaces. It can consist of a single line number or linename, a comma separated list of line numbers or linenames, a range of line numbers (i.e., 1–4), or if linelist is not given *all* lines. See Table 13 on page 44 for a list of line numbers.

The namelist variable consists of a list of names. It can consist of a single name or a comma/whitespace separated list of names. Names can be up to 16 characters long.

log

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

Subcommands: **view [critical|major|minor|inform]]**
filter [event #] [count]]
clear
send [filename] [hostIP]

This command is used to display and manage the event log file as follows:

The **view** subcommand displays the list of events with the associated time and date as well as other system parameters.

The **filter** subcommand is used to sort events.

The **clear** subcommand resets the event log and purges all events from memory.

The **send** subcommand uploads the send event log information to an IP address using TFTP protocol.

login

Usage: **login**

This command allows access to configuration and diagnostics information as allowed by the radio system administrator.

Example:

ADAP> login ENTER .

Returns:

Username>

Type:

john (or appropriate user name) ENTER

Returns:

Password>

Type: (password) ENTER

NOTE: Passwords must not exceed eight characters.

See **user** command on page 58 for more information on user access levels.

logout

Usage: **logout**

This command is used to log out as a user of the radio configuration and diagnostics functions.

loopback

Usage 1: **loopback none|rf|local|remote|iol [linelist]|ior [linelist] <timeout>]**

Usage 2: **loopback [inb|outb] [linelist] [on|off] [-u <code>] [-d <code>]**

The **loopback** command is used to set or display the loopback mode that can be used for diagnostic purposes. Entering **loopback** without any parameters displays the current loopback mode.

Usage 1 subcommands:

The **none** subcommand disables all loopback operation. This is the mode for normal point-to-point operation.

The **rf** subcommand enables an RF loopback mode. This mode allows testing of the local transceiver's transmit and receive chain.

RF loopback testing is a valuable diagnostic tool, but it should not be considered an exhaustive test of the transceiver. In some cases, interaction between the transmit and receive phase-locked loops (PLLs) can occur, causing erroneous results during testing. Changing the transceiver's RF output setting may resolve these problems.

In addition, on all LEDR radios except the LEDR 1400 Series, the transmit and receive frequencies must be within the same band for RF loopback to function.

The **local** subcommand enables a local digital loopback mode. With this test, incoming bits are sent back out the radio's DATA connector before the modem module. This can be used to verify proper interconnection between the radio and the connected equipment. None of the radio's RF circuitry is involved in this test. (This description is true for EIA-530 operation only.)

For T1/E1 operation, the **local** subcommand enables a local digital MUX loopback in the transceiver's T1/E1 option card before going out to the main board.

The **remote** subcommand instructs the radio at the other end of the link to "echo" all of the data it receives. This is an effective way of testing the entire communications system, including the transmission path over the air. (In the event of a communications failure with the remote radio, the message "Remote Error" is displayed, and no loopback mode is selected. (This description is true for EIA-530 operation only.)

For T1/E1 operation, the **remote** subcommand mimics the **ior** subcommand described below.

The **iol** subcommand refers to the *local* line loopback.

The **linelist** variable represents a list of local line interfaces. It can consist of a single line number or linename, a comma separated list of line numbers or linenames, a range of line numbers (i.e., 1–4), or if linelist is not given *all* lines. See Table 13 on page 44 for a list of line numbers.

The **ior** subcommand refers to the *remote* line loopback. Remote loopback port selection is relative to the local port. The radio link will translate any line mapping to select the correct physical remote port to loop back, based on the selected local port.

The **timeout** variable may be set between 0 minutes (never time out) and 60 minutes.

Usage 2 subcommands:

The **inb** subcommand refers to the *inband* loopback configuration.

The **outb** subcommand refers to the *outband* ESF (Extended Super Frame) loopback configuration.

The **linelist** subcommand is identical to that described for Usage 1.

The **on|off** subcommands allow turning the loopback feature on or off.

The **-u <code>** subcommand allows setting of the inband|outband loop-back *upcode*.

The **-d <code>** subcommand allows setting of the inband|outband loop-back *downcode*.

The inband code consists of 1-7 bits, binary format.

Example: 00001

The outband code consists of 6 bits within the 16 bit ESF data link code-word.

Example: 000111
within 16 bit codeword: 0<000111>0 11111111

menu

This command starts the LEDR radio's menu wizard.

model

Usage: **model**

This command displays the radio model number. This information is programmed at the factory and cannot be changed.

modem

Usage: **modem [matrix id] [bandwidth] [+fdl] [+cas]**

This command sets or displays the radio modem and data rate. Table 15 shows the available number-letter combinations that can be entered for a radio with a 200 kHz bandwidth. Note that the E1/T1 selections are only valid on radios equipped with an FT1 Option Board.

Table 15. Modem Command Arguments[1]

Modulation Type	64 kbps	128 kbps	256 kbps	384 kbps	512 kbps	768 kbps
QPSK	A1	A2	—	—	—	—
16 QAM	B1	B2	B3	B4	B5	—
32 QAM	—	—	—	—	—	C6

1. The available selections depend on the radio's factory programmed bandwidth. See Table 17 on page 61 for the allowable combinations of bandwidth, data rates and modulation types.

Command Example: To set 16-QAM/384 kbps, enter **modem B4 200**

network

Usage: **network**

This command displays the radios that can be reached via the service channel for Orderwire and Element Management System (EMS) diag-nostics.

passwd

Usage: **passwd**

This command is used to program a new password for the user currently logged in. A maximum of 8 characters is allowed.

pll

Displays several key frequency control parameters, including the Minimum Frequency Step, the Reference Frequency, Oscillator Output Current, TX Frequency, RX Frequency, and TX/RX PLL status.

Example response:

```
pll:

Min Freq Step = 25000 Hz, Reference = 400000 Hz, ICPO = 1600 uA
Tx Freq = 438075000 Hz, Rx Freq = 428075000
Tx PLL Status: Locked
Rx PLL Status: Locked
```

pmmode

Usage: **pmmode <On|Off>**

This command is used to set or display the Modem Modulator Power Measurement Mode.

Example Response:

```
pmmode: off
```

rdnt

Usage: **rdnt [subcommand] [arguments]**

Subcommands:	**active**
	default
	hitless
	ip
	status
	swxcvr
	temp
	mode

The **rdnt** command is used to manage protected operation of the LEDR radio and display operating status through the use of the following subcommands:

The **active** subcommand shows whether the currently selected transmitter is active or inactive.

The **default** subcommand displays whether the radio is the default radio in a protected configuration.

The **hitless** subcommand sets or displays the hitless (error-free) switching status. It can be enabled or disabled using the **hitless on|off** command.

The **ip** subcommand is used to set or display the associated (sibling) radio's IP address.

NOTE: The associated radio IP address should be programmed to the IP address of the other radio connected to the protected switching chassis. The associated radio IP address is used by the redundant radio to share information between the units. This address is necessary for warm-standby switching but not for hot-standby. However, the redundant radio will perform better if their associated radio IP address is programmed correctly. The associated radio IP address does *not* affect IP routing and forwarding, SNMP, or Telnet.

The **status** subcommand shows the state of both radios. Two status lines are displayed; **This Radio** and **Other Radio.**

The **swxcvr** subcommand forces a switchover to the non-active transceiver. (The newly selected unit becomes the active transceiver.)

The **temp** command is used to set or display the over-temperature limit (where switchover to the other radio occurs).

The **mode** command is used to set or display one of three redundant operation modes (**0**= Standalone, **1**= 1+1 Hot Standby, **2**= 1+1 Warm Standby).

Example Response for **rdnt** command:

```
rdnt {status}:This Radio = OK
rdnt {status}: Other Radio = OK
rdnt {active}: inactive
rdnt {mode}: 1+1 Hot Standby
rdnt {ip}: 10.2.142.143
rdnt {hitless}:on
rdnt {default}: yes
rdnt {temp}: 80
```

reframe

Usage: **reframe [linelist] [2of4 | 2of5 | 2of6 | CFAS | CRC]**

This command is used to set or display the reframe criteria. The **[linelist]** variable represents a list of line interfaces. It can consist of a single line number or linename, a comma separated list of line numbers or linenames, a range of line numbers (i.e., 1–4), or if linelist is not given *all* lines. See Table 13 on page 44 for a list of line numbers.

For Fractional T1:

2of4 – 2 out of 4 Fbit errors (default)
2of5 – 2 out of 5 Fbit errors
2of6 – 2 out of 6 Fbit errors

For Fractional E1:

CFAS – Consecutive FAS errors (default)
CRC – 915 CRC (rx framer only)

reprogram

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

Subcommands: **serial [type] [length] [<offset>]**
network [filename] [hostIP]
status

This write command reprograms the radio application software using Trivial File Transfer Protocol (TFTP). A TFTP server must be running on the network and properly configured to serve the necessary file(s).

rfocal

Usage: **rfocal <freq region#> <cal-point#>**

This command starts the RFOUT Calibration Sequence. Example entry: **rfocal 0 0**.

Example response:

Region 0
Index 0, Rfout = 18 dbm, Gain = 17
Index 1, Rfout = 20 dbm, Gain = 28
Index 2, Rfout = 22 dbm, Gain = 47
Index 3, Rfout = 25 dbm, Gain = 79
Index 4, Rfout = 27 dbm, Gain = 110
Index 5, Rfout = 30 dbm, Gain = 170
Index 6, Rfout = 32 dbm, Gain = 210

rfout

Usage: **rfout**

This command displays the transmitter RF power output in dBm. See "Watts dBm Volts conversion" on page 92.

rlogin

Usage: **[<toUnitID>[<UserName>]**

The **rlogin** command is used to login to the remote radio via the console.

route

The **route** command is used to add, delete or modify the IP routing table entries.

Example resp:	Destination	Next Hop	Net Mask	Interface
	0.0.0.0	0.0.0.0	0.0.0.0	ETH
	10.0.0.0	10.2.142.143	255.255.0.0	ETH
	10.2.0.0	10.2.142.143	255.255.0.0	ETH
	10.2.142.144	10.2.142.143	255.255.255.255	AIR
	127.0.0.1	10.2.142.143	255.255.255.255	LPBK

rssi

Usage: **rssi**

This command displays the received signal strength indication in dBm.

rssical

Usage: **rssical <freq region#> <cal-point#>**

This command starts the RSSI Calibration Sequence. Example entry: **rssical 0 0**.

Example response:

Region 0
Index 0, RSSI = –110 dbm, Gain = –104
Index 1, RSSI = –90 dbm, Gain = –40
Index 2, RSSI = –75 dbm, Gain = +1
Index 3, RSSI = –60 dbm, Gain = +28
Index 4, RSSI = –45 dbm, Gain = +61
Index 5, RSSI = –30 dbm, Gain = +97

rxlock

Usage: **rxlock**

This command displays the current modem lock status.

Example response: **rxlock: Modem is locked**

sabytes

Usage: **sabytes [linelist] [bytes <bytelist]**

This command is used to set or display SA bytes in E1 multiframing. The **[linelist]** variable represents a list of line interfaces. It can consist of a single line number or linename, a comma separated list of line numbers or linenames, a range of line numbers (i.e., 1–4), or if linelist is not given *all* lines. See Table 13 on page 44 for a list of line numbers.

The **bytelist** variable consists 5 hex bytes (i.e., 3c) representing SA[4-8]. To keep a bytes present value when modifying higher bytes (i.e., modifying SA[7] only) use a * character in the respective byte position. Example: **sabytes 1 bytes *,*,*,3c** changes only SA[7] for line 1 to 3c.

sernum

Usage: **sernum**

This command displays the serial number of the radio. The number displayed with this command matches the serial number printed on the serial number sticker on the radio chassis.

snmpcomm

Usage: **[<read|write|trap>][<string>]**

This command is used to set or display SNMP community names.

Example response:
snmpcomm {read}: public
snmpcomm {write}: private
snmpcomm {trap}: public

snr

Usage: **snr**

This command displays the signal-to-noise ratio (SNR) of the received signal in dB. The SNR is an indication of the quality of the received signal. The higher this number, the higher the quality of the received signal. SNR readings are not valid when there is an RX Alarm.

status

Usage: **status**

This command is used to display the performance and configuration data.

Example response:

status {Tx Freq}: 438075000
status {Rx Freq}: 428075000
status {Bandwidth}: 100 kHz
status {Data Rate}: 256 kbps
status {Clock Mode}: internal, remote, Line1, Line2, Line3, Line4
status {RSSI}: –100 dBm
status {SNR}: 0 dB
status {Rx Lock}: Unlocked
status {Tx RF Out}: 18.0 dBm
status {Temp}: 37 Degrees C

svch

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

Subcommands:
baud [300|1200|2400|4800|9600|19200|38400]
csize [5–8]
parity [none|even|odd]
stop [0–2]

This command sets or displays the service channel settings.

telnetd

[kill <session>]

This command is used to display or kill (terminate) the telnet session(s).

Ex. resp:	Session	Username	Rem. Addr.	Connected
	tns0	ENGR	10.2.129.22	07/01/1999 @ 13:57:17

temp

This command displays the radio's power amplifier (PA) temperature.

Example response: **temp: 35 Degrees C (PA Temperature)**

test

Usage: **test [<0–n>|<testname>]**

This command starts a self-test function of the radio. There are several separate tests that can be run individually by specifying the test number after the command.

The internal self tests are listed in Table 16.

Table 16. Internal self tests

Description	Test Number	Test Name
Flash memory test	0	flash
DRAM memory test	1	dram
Configuration test	2	config
Battery test	3	batt
Atod test	4	atod
Transmitter phase locked loop test	5	txpll
Receiver phase locked loop test	6	rxpll
Real Time Clock test	7	rtc
FPGA logic test	8	fpga
DSP test	9	dsp
CODEC test	10	codec

threshold

Usage: **[<threshold>] [<level>]**

This command sets or displays the performance degradation threshold(s) of the LEDR radio.

Example response:

threshold {MinRssi}: 0
threshold {MinSNR}: 0
threshold {MaxTemp}: 70
threshold {Max15ErrSec}: 900
threshold {Max15SevereErrSec}: 900
threshold {Max24ErrSec}: 86400
threshold {Max24SevereErrSec: 86400

time

Usage: **time [HH:MM[:SS]**

This command displays or sets the time of the radio's internal real-time clock. The radio's real time clock operates from an internal lithium battery so it is running even if the radio has no DC power connected.

The real time clock is fully compliant with year 2000 standards.

timeslot

Usage 1: **timeslot [-d] [slotlist]**

Usage 2: **timeslot -c**

This command has two uses; In usage 1, the timeslots can be set or displayed. In usage 2, all pending timeslots are committed.

Modifications to the timeslot list are kept pending until *all available* slots have been assigned. The user can choose to commit slots when the last available slot is added to the pending list or by using the **-c** option. (See Usage 2.)

The default action is to enable given timeslots. If no arguments are entered, the currently active timeslots and pending timeslots are displayed.

The **slotlist** variable is a list of timeslots and can be a single slot number, comma separated list of slot numbers, or a range of slot numbers (i.e., 2-8). Timeslots can be entered in any order and are automatically configured. Extra slots will be ignored. Unassigned timeslots in the pending list are signified by **MA** (must assign).

Options:

–d Disable timeslot(s)
–c Commit pending timeslots

NOTE: T1 timeslots are 1–24. E1 timeslots are 0–31.

trapfilter

Usage: **trapfilter [<critical|major|minor|inform>]**

This command sets or displays which events cause SNMP traps.

trapmgr

[<1-5>] [<IP address>]

This command sets or displays the trap manager IP addresses.

Example response:

trapmgr: 1 = 10.2.129.22
trapmgr: 2 = 0.0.0.0
trapmgr: 3 = 0.0.0.0
trapmgr: 4 = 0.0.0.0
trapmgr: 5 = 10.2.129.1

trend

Usage: **trend**

This command is used to display continuously updated readings of: RSSI, radio temperature, RF output, signal-to-noise ratio, and FEC errors (correc ted and uncorrected). The display can be stopped by pressing Control-C on the terminal.

txkey

Usage: **txkey [on|off]**

This command sets or displays the transmitter status. ON indicates the radio is keyed and transmitting. OFF indicates the transmitter is not keyed and is not transmitting.

unitid

Usage: **unitid [<ID>]**

This command sets or displays the radio's unit identification number. This number is used for Orderwire signaling and the EMS (Element Management System).

uptime

Usage: **uptime**

This command displays how long the radio has been powered-on.

user

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

Subcommands:
add <user> <pass> <perm>
del <user>
perm <user> <perm>
pass

This command provides administrator access for setting new user accounts and permission levels.

The password (**pass**) and user names are case sensitive and may not exceed eight characters. The characters \\ may be used as a "blank" password.

User permission (**perm**) may be set to: read (**r**), write (**w**), network (**n**) or administrator (**a**). The privileges granted by each level are as follows:

- Read (**r**) is the lowest level of user access and allows radio information to be viewed only. Changes to radio settings are not allowed.

- Write (**w**) allows most, but not all radio settings to be changed.
- Network (**n**) allows everything permitted by lower levels, and also allows changes to the radio's IP configuration.
- Administrator (**a**) allows everything permitted in lower levels, and also allows changes to be made to user accounts (add, delete, modify). It is normally used by a System Administrator or other person responsible for the radio system.

Example entry: **user add John <password> w**

The above example shows the command string for adding a new user (John), with "write" permission.

Example response: **user: Command Complete**

NOTE: If you are logging in for the *first time* since the radio was shipped from the factory, refer to page 16 for important login information.

---

ver

Usage: **ver [frw|hdw|ext]**

This command displays radio version information for firmware (**frw**), hardware (**hdw**) and Extended Version Information (**ext**).

Example response: **ver: ADAP Part #06-3451A01**
ver: 1.0.0

volume

<volume>

This command sets or displays the orderwire handset volume.

Example response: **volume: 100**

vox

<vox threshold>

The vox command sets or displays the orderwire vox (voice-operated transmit) threshold.

Example response: **vox: 5**

who

Usage: **who**

This command displays users currently logged in to the radio operating system.

3.5 SNMP Network Management

Simple Network Management Protocol (SNMP) offers a comprehensive solution to network management. It allows full configuration, performance monitoring, fault diagnosis and security administration of an entire LEDR radio network.

The LEDR radio uses approximately 140 specific SNMP manageable objects in a IETF standard MIB II as well as a custom MIB. Off the shelf SNMP managers such as SNMPc and HP OpenView may be used to access the LEDR radio's SNMP MIB to manage the network. Using industry-standard SNMP managers allows seamless integration of the LEDR network or existing systems.

Detailed information for using SNMP is provided in the SNMP Handbook (P/N 05-3532A01) available from Adaptive Broadband/MDS.

3.6 Using the Orderwire

A handset may be plugged into the front panel of the LEDR radio to allow voice communications between radio sites (see Figure 15). This can be especially useful during setup and service of the radio equipment. The Orderwire function operates similar to a party line. All radios on the network can hear what is said by any individual speaking into a handset. The alert function however, can be directed toward 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 supports the use of DTMF-type (tone) signaling.

An optional handset (P/N 12-1307A01) is required to use the Orderwire.

1. Plug the handset into the front panel jack labeled 📞. (Figure 22 on page 84 provides pinout details for this connector.)
2. Press ◁ or ▷ until `Orderwire` appears on the LCD display.
3. To call a specific radio station, enter the Unit ID number for the station to be called. (At this point, an alert signal will be sent to a specific station to "ring" the desired unit.)
4. Press the PTT on handset and speak to the other station(s). Release the handset PTT to listen. VOX (voice-activated transmit) operation is also supported.
5. Alternatively, a DTMF-style handset can be used to "dial" the required radio station.

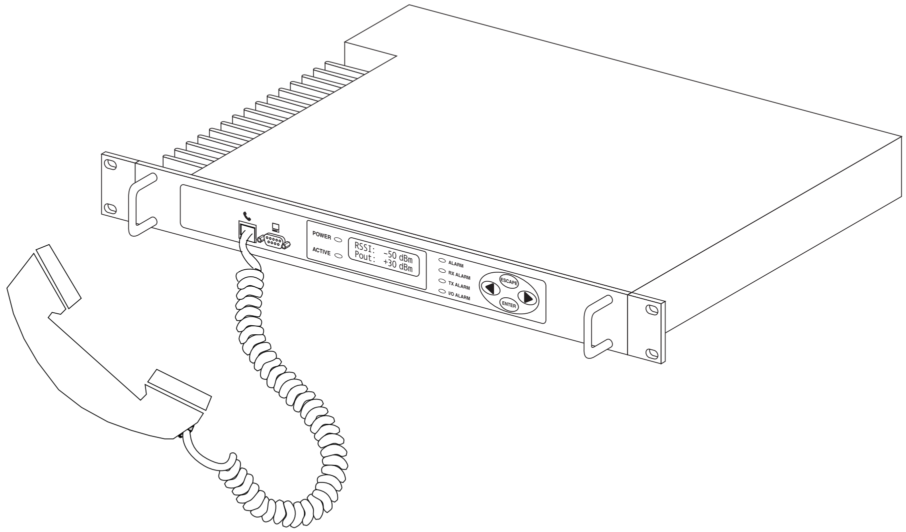


Figure 15. Orderwire Connection

3.7 Bandwidths, Data Rates and Modulation Types

The available bandwidth is permanently configured at the factory and cannot be changed by the user. However, the modulation type and data rate can be changed *provided the bandwidth is sufficient to support the modulation type and data rate.* Table 17 shows the combinations of radio bandwidth, data rates and modulation types that are available at the time of publication.

Use of the **modem** command (page 51) automatically determines if the combination of data rate, bandwidth and modulation type is allowable.

Table 17. Bandwidth vs. Modem Selection

Radio Bandwidth	Modem Selection	Data Rate(s)	Modulation
25 kHz	B1	64 kbps	16-QAM
50 kHz	A1	64 kbps	QPSK
50 kHz	B2	128 kbps	16-QAM
100 kHz	A2	128 kbps	QPSK
100 kHz	B3	256 kbps	16-QAM
200 kHz	A3	256	QPSK
200 kHz	B4, B5	384, 512 kbps	16-QAM
200 kHz	C6	768 kbps	32-QAM

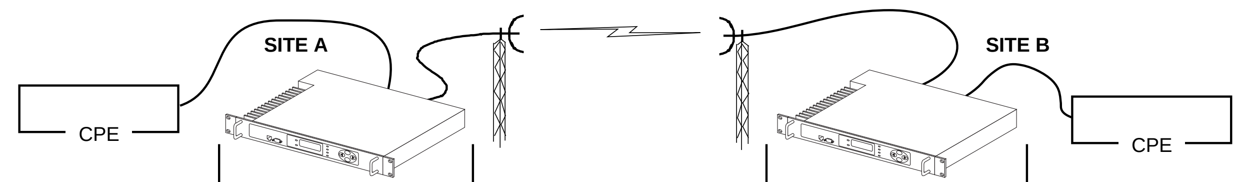
3.8 Transmit Clock Selection

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

The radio is capable of several different clocking modes. Refer to Figure 16, Figure 17 and Figure 18 for typical system clocking methods.

Refer to the `Clock Mode` screen description on page 27 for setting the radio transmit clocking from the front panel. Refer to the **clkmode** description on page 42 for setting the radio transmit clocking mode from the console port.

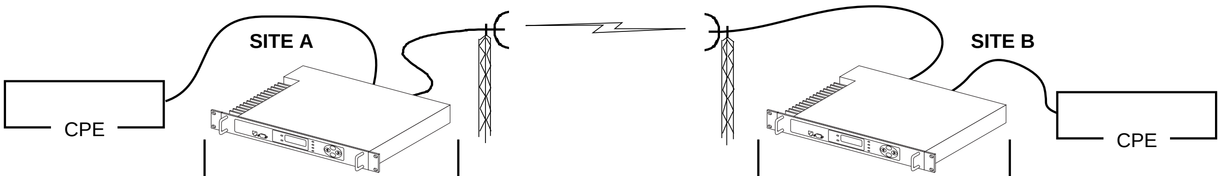
NOTE: When customer premises equipment (CPE) is operated in looped clock mode, it is recommended that the radio *not* be set to line clock mode. To do so may cause the transmitting radio's PLL to be pulled out-of-lock, especially when operating at 4E1 data rates.



Customer Premises Equipment (CPE)	LEDR Radio Clock Source	Over-the-Air RF Path	LEDR Radio Clock Source	Customer Premises Equipment (CPE)
Network	Line 1, 2, 3, 4	↔	Remote	Looped Clock
Network*	Line 1, 2, 3, 4	↔	Line 1, 2, 3, 4	Network
Looped Clock	Internal Clock	↔	Remote	Looped Clock
Internal Clock	Line 1, 2, 3, 4	↔	Remote	Looped Clock

* This mode suitable for most voice applications. It is *not* recommended for data transmission between computing equipment.

Figure 16. E1/T1 and Fractional Clocking Arrangements
(Between computing equipment unless both devices at the ends of the link are driven by a common clock source)



Customer Premises Equipment (CPE)	LEDR Radio Clock Source	Over-the-Air RF Path	LEDR Radio Clock Source	Customer Premises Equipment (CPE)
Internal Clock	External Clock	←→	Looped Clock	External Clock
External Clock	Internal Clock	←→	Looped Clock	External Clock

Figure 17. EIA-530 Clocking Arrangements

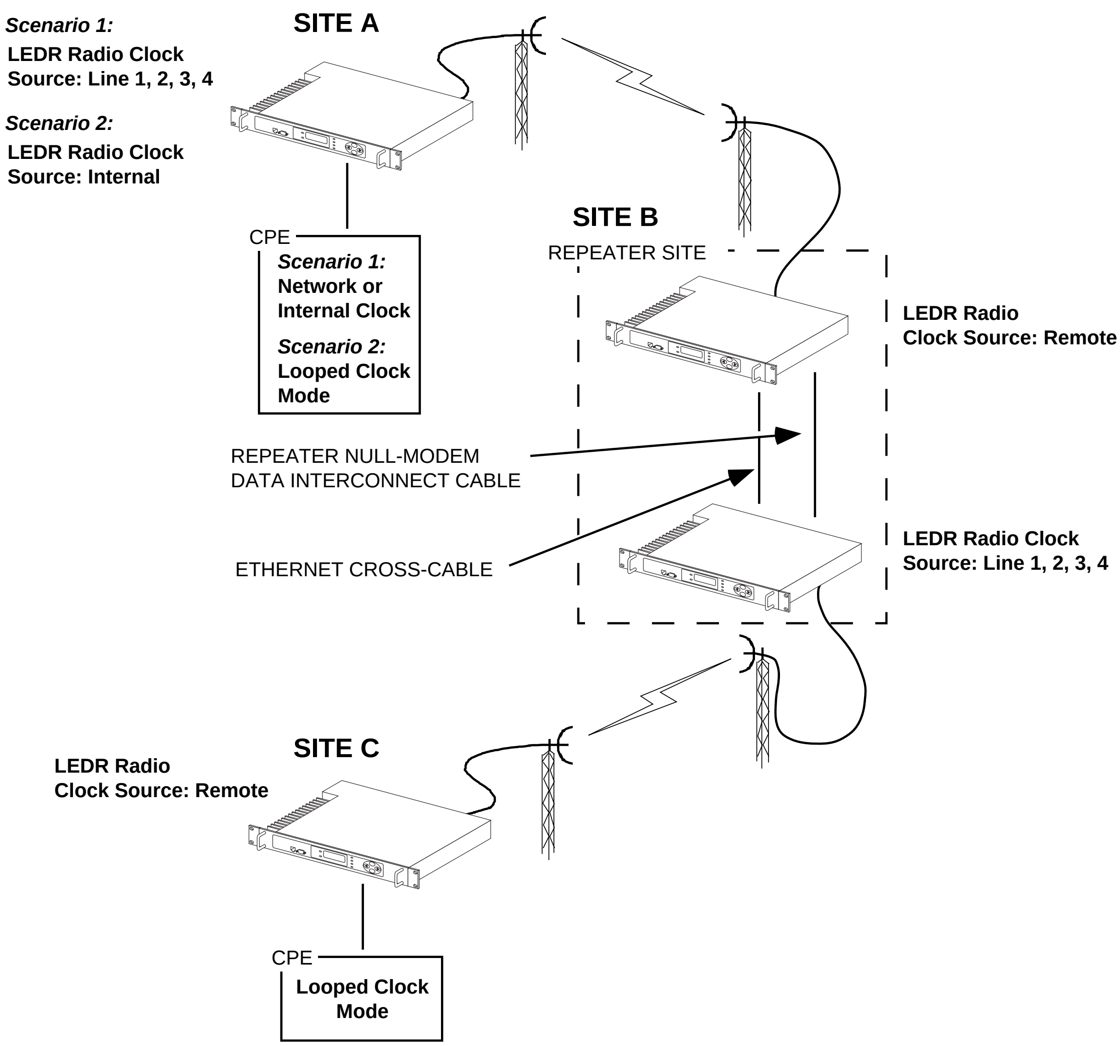


Figure 18. Typical Repeater Clocking Arrangement
(no multiplexer at repeater site)

3.9 Protected (1+1) LEDR Radio

The LEDR radio may also be supplied in a Protected (redundant) configuration (Figure 19). 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, either through malfunction or external environmental effects such as multipath fading or nearby lightning strikes.

A Protected station consists of two standard LEDR radios and a Protected Switch Chassis (center unit in Figure 19). Ordinarily, the three chassis are mounted together in a "stacked" arrangement as shown.

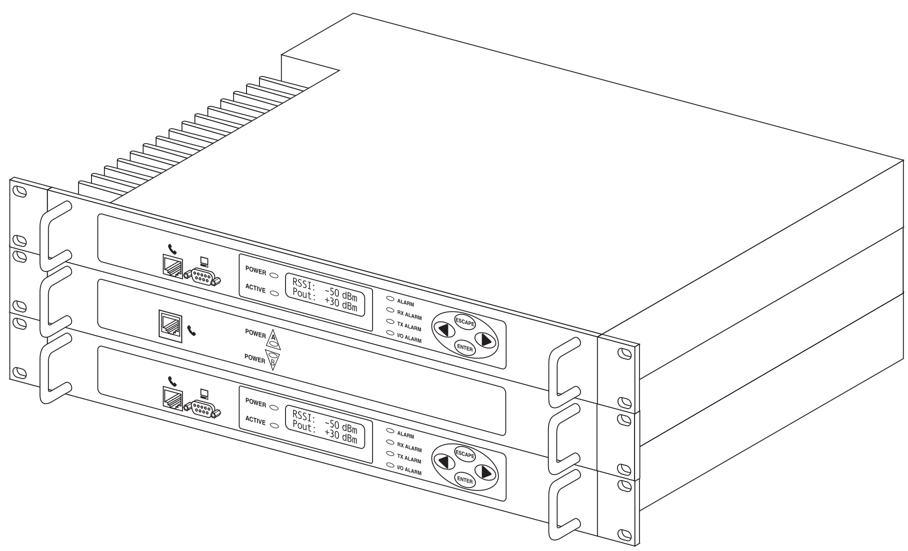


Figure 19. LEDR Radio Protected Version

Protected Operation

During normal operation, one radio path is selected and the RF and interface switches are set to service that path. (An LED indicator on the front panel of the Protected Switch Chassis shows the active unit.) A switch on the transmitter circuitry allows one transmitter to be connected to the antenna port. On the receive path, a coupler allows both radio receivers to detect the receive signal.

Transmitter Failure

Any failure on the "active" transmitter path will raise a fault condition causing the transmit switch to change and the "standby" transmitter to become the "active" unit. Fault conditions can be programmed from the Network Management System (NMS) software, and can be parameters such as:

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

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. Both receive paths are buffered and monitored for receive signal integrity via 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.

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 offers the advantages of faster switchover time and increased overall system availability.

- *1+0 operation:* In some applications the user wants the flexibility to offer protected (1+1) operation in the future, but operates a critical link that cannot be decommissioned for the upgrade. The 1+0 configuration provides a single LEDR radio wired through the switch box. This configuration can be upgraded to a full 1+1 protected radio by adding the second radio, without taking the 1+0 radio out of commission and losing critical data.

- *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 (3dB due to splitter, plus 1dB cabling and additional connectors). As an option, an asymmetrical splitter (1dB / 10dB) is offered. Using this option, the active path is 2 dB stronger than with a symmetrical splitter (1dB compared to 3dB 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 10dB of splitter loss rather than the equal splitter's 3dB loss, making the link more prone to fades in this temporary changed over 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 derating in the temporary switched state.

Space Diversity Operation

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, will not 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, with a symmetrical 3dB coupler on the receive paths.

User Interface & Control

Protected operation is configured using the Redundant screen (page 34) on either radio front panel, or with the **rdnt** command from a console terminal (see page 52).

3.10 Fractional T1 Interface Card (Optional Equipment)

The fractional T1 interface (FT1) option (P/N 03-3846A01) provides additional connectivity within a LEDR network. The installation of an FT1 option board inside the radio allows the standard EIA-530 customer data interface to be bypassed and connection directly to a G.703 T1 interface.

With the FT1 option, 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.

See “Field Installation of FT1 Option Board Non-protected: 03-3846A01 Protected: 03-3539A01” on page 78 for instructions on adding this option to a LEDR radio.

Fractional T1 Performance

The FT1 option allows the LEDR radio to be connected directly with a G.703 T1 interface. The line rate of the interface operates at the T1 rate of 1.544 Mbps. Twelve user selectable DS-0 timeslots are transmitted over the air in the maximum FCC / IC allowed 200 kHz occupied bandwidth in the 960 MHz FCC / IC frequency band. The T1 interface is G.703 at 100 Ω line impedance. Physical connection is via an RJ48C jack on the rear panel.

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 DS-0 timeslots are permitted, with selection arbitrary. The selection of timeslots may 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 format is selectable among: FT only, ESF without CRC checking and generation, SF (D4), SF with JYEL indication, ESF with CRC checking and generation.

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.

Line Codes—Standard T1 line codes are supported: B8ZS, AMI, and per-channel B7ZS.

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.

4.0 RADIO EVENT CODES

Table 18 lists the event codes that may be encountered during operation of the radio. These codes may be read from a console terminal using the **events pending** command. (See page 43 for a full description of the **events** command.)

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

Table 18. 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

Table 18. Event Codes *(Continued)*

ID	EVENT NAME	DESCRIPTION	DEFAULT LED	SNMP TRAP LEVEL
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
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

Table 18. Event Codes *(Continued)*

ID	EVENT NAME	DESCRIPTION	DEFAULT LED	SNMP TRAP LEVEL
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
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

Table 18. Event Codes *(Continued)*

ID	EVENT NAME	DESCRIPTION	DEFAULT LED	SNMP TRAP LEVEL
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 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 transceiver configuration has been modified	NONE	INFORM
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

Table 18. Event Codes *(Continued)*

ID	EVENT NAME	DESCRIPTION	DEFAULT LED	SNMP TRAP LEVEL
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
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

Table 18. Event Codes *(Continued)*

ID	EVENT NAME	DESCRIPTION	DEFAULT LED	SNMP TRAP LEVEL
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
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

Table 18. Event Codes *(Continued)*

ID	EVENT NAME	DESCRIPTION	DEFAULT LED	SNMP TRAP LEVEL
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
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

Table 18. Event Codes *(Continued)*

ID	EVENT NAME	DESCRIPTION	DEFAULT LED	SNMP TRAP LEVEL
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
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

5.0 FIELD REPROGRAMMING

The LEDR radio's firmware can be upgraded with new software releases that may be issued from time to time by Adaptive Broadband/MDS. Reprogramming can be done serially through the front panel console port or over a network connection via TFTP. The TFTP method provides a way of downloading to the radio without being physically at the radio's location.

To support firmware upgrades while the radio is in use, the LEDR radio contains two complete copies of its firmware. Once the download is complete, the radio can be rebooted using the new code. However, if an error occurs during the download, the radio can easily recover because it always has a complete copy of firmware available.

The steps below explain how to program new firmware into the radio using both the console port and TFTP methods.

5.1 Reprogramming via the Console Port

Set Up

Connect a PC to the radio's front panel console port using a 9-pin RS-232 cable. (See Figure 23 on page 85 for cable wiring details.)

Download Procedure

1. Start the FlashUtil Windows application available from Adaptive Broadband/MDS. From the **View|Options** menu, select the appropriate com port and baud rate.

2. Ensure that **autobaud** is enabled (see lower right corner of the FlashUtil window). From the **View** menu, select **console**. This will bring up a console window to the LEDR radio. At the **ADAP>** prompt, enter a login name and password and then close the console.

3. 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

To verify the new code, open the console 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**

The new firmware is downloaded into the *inactive* image. Therefore, if the radio responded **Image 1 is Active**, enter **iverify 2**, otherwise, enter **iverify 1**. The radio will respond indicating whether or not the image has been verified. If the image does not verify, try downloading the code again. If the download fails after repeated attempts, the hardware may be damaged. For a replacement board please contact the factory using the information given at the back of this manual.

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

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.

Once the radio has rebooted and displays the **ADAP>** prompt again, 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.

5.2 Reprogramming via a Network Connection

Set Up

Connect the LEDR radio's ETHERNET NMS connector to a PC via a network connection This can be done in one of three ways: 1) by connecting both the radio and the PC to a network hub, 2) by connecting them directly through an ethernet cross-over cable, or 3) by connecting them to a common LAN.

If the radio is near the PC, an RS-232 cable can be connected between them in order to run the console commands. However, if the radio is some distance away, such as at a remote site, telnet or **rlogin** can be used to execute the necessary commands.

Download Procedure

1. Log in to the radio using the **login** command. Use the **ip** command to ensure that the radio has a valid IP address.

2. "Ping" the radio from the PC to ensure that the PC and the radio have valid routes to pass information between them.

3. Start a TFTP server application on the PC. At the radio's **ADAP>** prompt, start the download by entering **reprogram network [filename] [PC's IP Address].** The download can be monitored from the radio by

entering **reprogram status**. When the download is complete the radio will emit 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 code and reboot the radio as described under Verification and Reboot in Paragraph 5.1 above.

6.0 FIELD REPLACEABLE UNITS

The Field Replaceable Units and their part numbers are listed below. Field servicing or replacement of PC boards and assemblies should be performed by qualified service personnel.

When ordering parts from the factory, always give the *complete* model number of the radio. Refer to the inside rear cover of this guide for contact information.

- Transceiver Main PCB, 400S (P/N 03-3820Axx)
- Transceiver Main PCB, 900S (P/N 03-3810Axx)
- Transceiver Main PCB, 1400S (P/N 03-3830Axx)
- “FT1” Option Board—Non-protected (P/N 03-3846A01)
- “FT1” Option Board—Protected (P/N 03-3539A01)
- Battery for Transceiver’s Backed-up SRAM (P/N 27-3109A01)
- Transceiver Front Panel Assembly (P/N 03-3815A01)
- Transceiver/Protected Sw. Chassis, Base (P/N 03-3810A01)
- Transceiver/Protected Sw. Chassis, Cover (P/N 03-3801A02)
- Duplexer (if equipped)—frequency dependent, contact factory
- Protected Switch Interface Board (P/N 03-3831Axx)
- Protected Switch Ethernet Hub Assy. (P/N 08-3809A01)
- Protected Switch Front Panel Assembly (P/N 03-3855A01)

6.1 Field Installation of FT1 Option Board
Non-protected: 03-3846A01
Protected: 03-3539A01

An “S” Series LEDR radio can be fitted with a Fractional T1 (FT1) interface board (Figure 20). The addition of an FT1 board enables the radio to operate with a G.703 interface at speeds up to 768 kbps.

To add the FT1 option board to an existing LEDR II radio, follow these steps:

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

2. Locate the installation area for the FT1 option board (see Figure 21). Remove the three phillips screws on the main PC board which correspond to the mounting holes on the FT1 option 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 21). These connectors mate with the plugs on the bottom of the FT1 option board.

5. Carefully set the option board into place, making sure to align the mounting holes with the threaded standoffs on the main PCB. (The FT1 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 FT1 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 "snapping" 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 FT1 option board. It slips over the edge of the main PC board and the option board. *Gently* tighten the hex screw to secure the clamp.)

8. Re-install the radio's top cover. This completes the FT1 board installation.

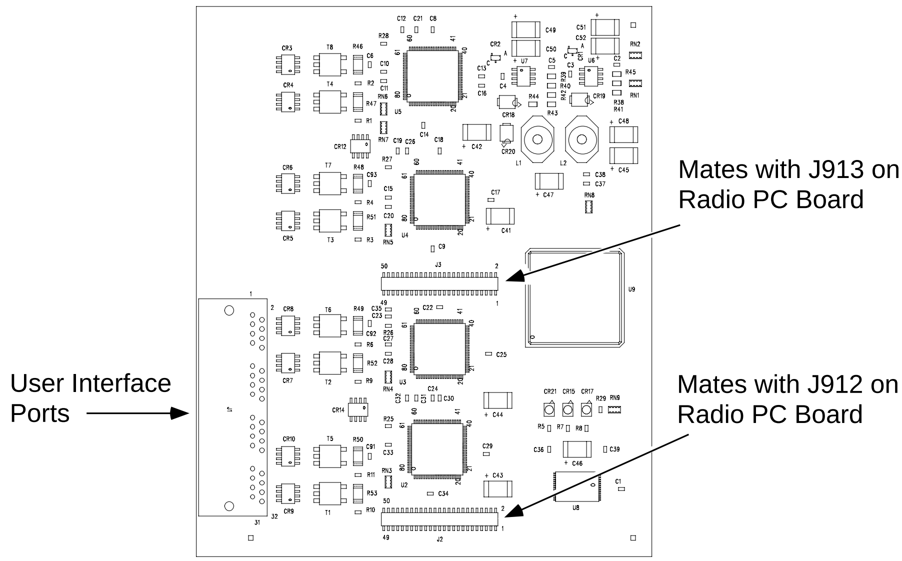


Figure 20. FT1 Option Board—Component Side
(03-3846A01 shown, 03-3539A01 similar)

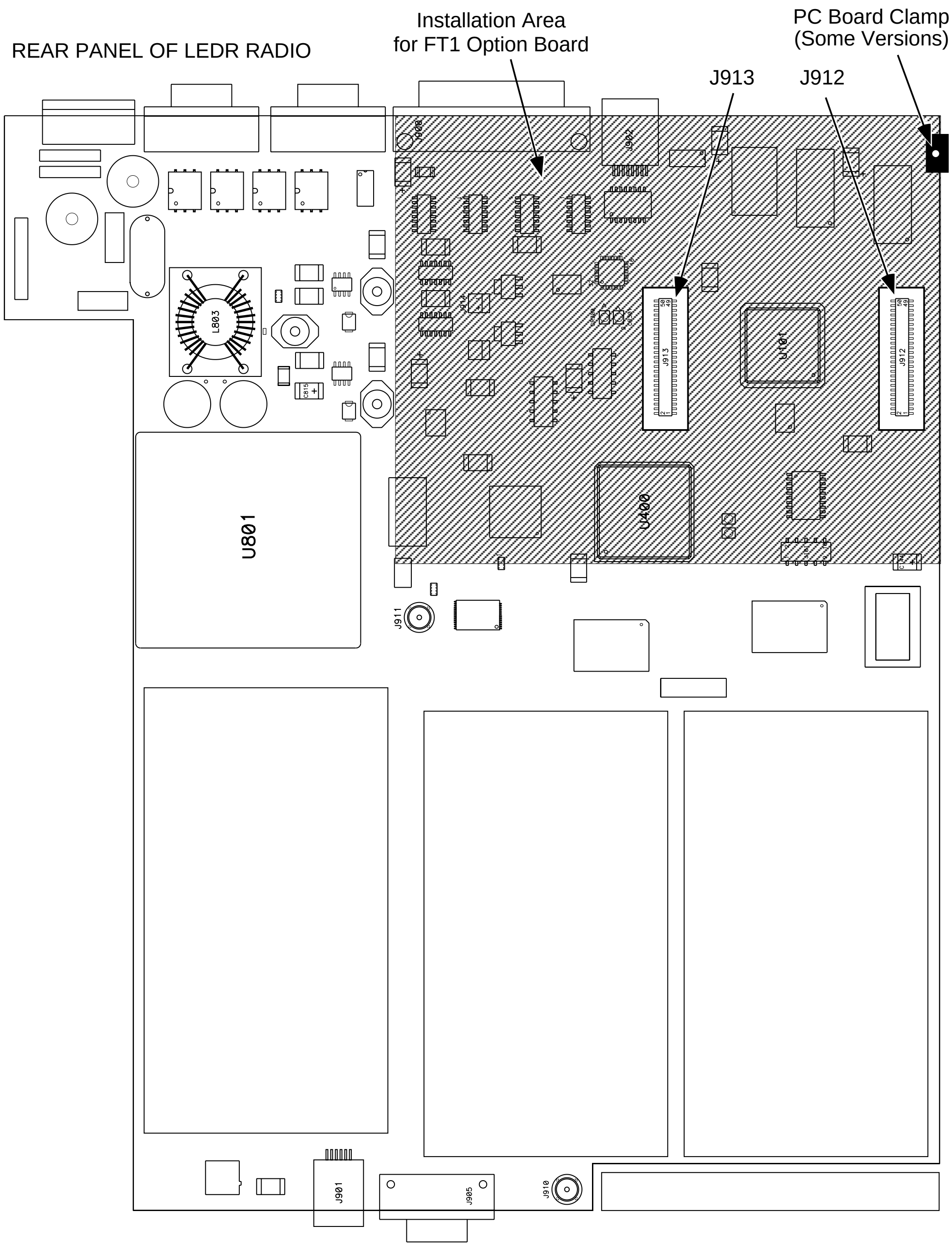


**Figure 21. View of Radio PC Board
Showing Installation Details for FT1 Option Board**

7.0 TECHNICAL REFERENCE

7.1 Specifications

General

Frequency Ranges:	330–512 MHz (LEDR 400S) 800 to 960 MHz (LEDR 900S) 1350–1535 MHz (LEDR 1400S)
Frequency Selection:	Programmable within each frequency range
RF Occupied Bandwidth:	Standard "S" Series radios: 25, 50, 100 and 200 kHz
User Data Rates:	Standard "S" Series radios: 64, 128, 256, 384, 512, 768 kbps With FT1 Option Board: n x 64 kbps (Where n= 1,2,4,6,12)
Permitted Data Throughput:	Standard "S" Series radios: <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) Less than 135 watts (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 (LEDR 400S) <-60 dBm (LEDR 1400S) <-60 dBc (LEDR 900S)

Receiver

Sensitivity (for 10^{-6} BER): Standard "S" Series radios:

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:: $<1 \times 10^{-10}$

Dynamic Range: >65 dB

Protected Switch Chassis

Transmitter Coupling Losses (Typical): 2 dB

Receive Coupling Losses (Typical): 4 dB (Symmetrical Splitter)
2 dB/10 dB (Asymmetrical Splitter)

Interfaces

Data: EIA-530
With FT1 Option: G.703

Orderwire: 600Ω balanced, DTMF capable

Data 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

Element Management: Via built-in menu or command line interface

Optional SNMP Management: Using MIB II and custom enterprise MIB

Diagnostic Functions

Local LED Indicators (front panel): Power, Active, General Alarm, Rx Alarm, Tx Alarm, I/O Alarm

LCD Display Measurements: RSSI, RF Power, Signal-to-Noise ratio, BER

Loopback: Local and Remote

Agency Approvals (LEDR 400S)

Transmission: FCC Part 90

Environmental: ETS 300 019, Class 3.2

Industry Canada: RS-119

Safety: UL, CSA

EMC: ETS 300 385, FCC Part 15

:**Agency Approvals (LEDR 900S)**

Transmission:	FCC Part 101
Environmental:	ETS 300 019, Class 3.2
Industry Canada:	932 to 944 MHz in Canada
Safety:	UL, CSA
EMC:	ETS 300 385, FCC Part 15

Agency Approvals (LEDR 1400S)

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

Options *(Consult factory for details)*

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

Accessories

110/240 Vac 50/60 Hz Power Supply, Orderwire Handset

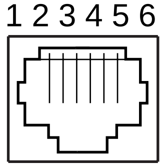
NOTE: The factory reserves the right to make changes to this specification without advance notice or obligation to any person.

7.2 Pinout Information

Orderwire

RJ-45

1 2 3 4 5 6



RJ-11

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

Figure 22. Orderwire Connector

Console

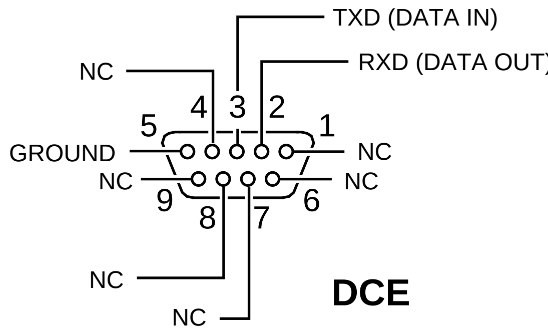
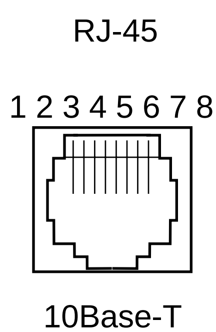


Figure 23. Console Port DB-9 Female Pinout

Ethernet



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 24. Ethernet Connector

EIA-530-A Data

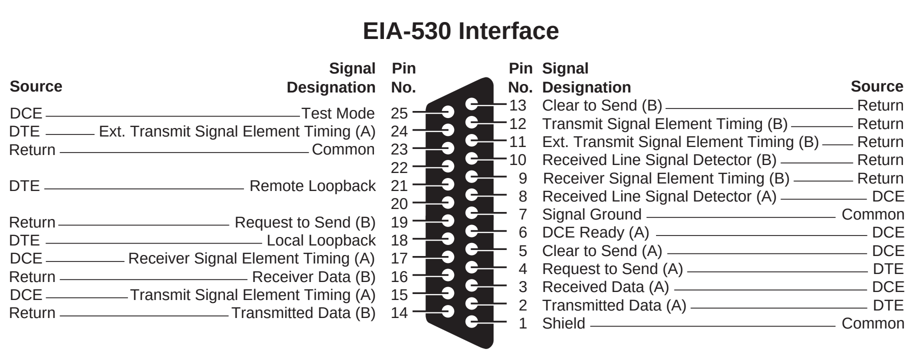
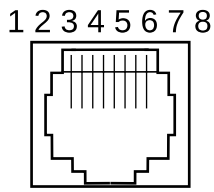


Figure 25. EIA 530 DB-25 Connector and Similar Data Pinout

G.703 Data Connectors (4 on rear panel)



Pin	Signal	Direction
1	Differential digital output signal, ring	Output
2	Differential digital output signal, tip	Output
3	No Connection	—
4	Differential digital output signal, ring	Input
5	Differential digital output signal, tip	Input
6	No Connection	—
7	No Connection	—
8	No Connection	—

Figure 26. G.703 Data Connector Pinout

Service Channel

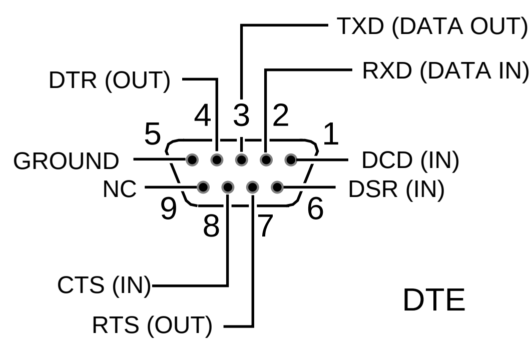


Figure 27. Service Channel Connector DB-9 Male Pinout

Alarm

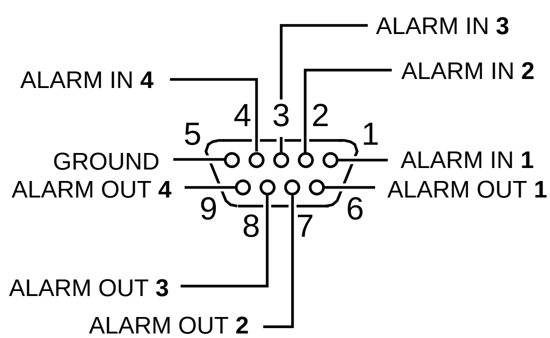


Figure 28. Alarm Connector DB-9 Female Pinout

7.3 RF Propagation Planning

Establishing a reliable point-to-point radio link requires system planning and design. It is helpful to have an understanding of the physical parameters affecting propagation. The following material discusses these factors, and will assist you in designing a dependable transmission path for your radio link.

NOTE: This section is intended for use as a guideline when planning transmission paths. It does not consider all of the local conditions that may be present, nor does it guarantee that adequate signal strength will be obtained in a given system. There is no substitute for an on-the-air test to verify the predicted path results, and to check the overall operation of the radio system.

To ensure a highly reliable path, a line of sight between both ends of the link is desirable. For short paths (up to 5 kilometers/3.1 miles), some obstructions may be acceptable, but the performance of a blocked path is always less predictable than a clear path.

Fresnel Zone Clearance

As the distance spanned by a link gets longer, it is necessary to have more than just a grazing path between the two ends; the path must clear the ground or other obstacles by some percentage of a Fresnel zone.

The Fresnel zone corresponds to the width or girth of the radio signal. There are first, second, and third Fresnel zones, but the first zone is the only one that has substantial effects on signal strength.

The first Fresnel zone can be visualized as an oval-shaped volume between two station antennas (Figure 29). As the width of the radio wave front gets blocked by obstructions, less of the signal can get to the receiver antenna.

In addition to blocking the signal, obstructions in the first Fresnel zone may also cause multipath interference due to reflective and refractive signal paths. The reflected or refracted signal may arrive at the receiver out of phase with the desired signal and cause a cancelling effect.

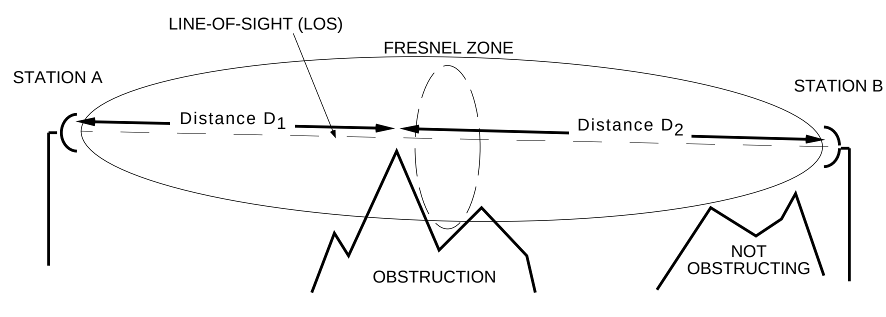


Figure 29. Fresnel Zone Obstructions

Experience has shown that 60 percent of the first Fresnel zone must be clear of obstructions (0.6 x F) to allow a clear, unobstructed microwave path.

Remember, the first Fresnel zone calculation is only one parameter determining path quality.

Earth Curvature

As the distance of a communication link increases, the clearance problem is compounded by the earth's curvature. Radio waves traveling through typical atmospheric conditions bend slightly, which is represented by treating the earth as though it were slightly flatter than it actually is. Experience has shown that if we consider the earth's radius to be 4/3rds of its actual size, we get good agreement between theory and measured propagation results.

Figure 30 shows a representation of the 4/3 earth "radio horizon." This figure shows that under normal radio propagation conditions, a station with its antenna 15 meters above flat terrain will have a radio horizon approximately 15 kilometers away, well beyond the visual horizon.

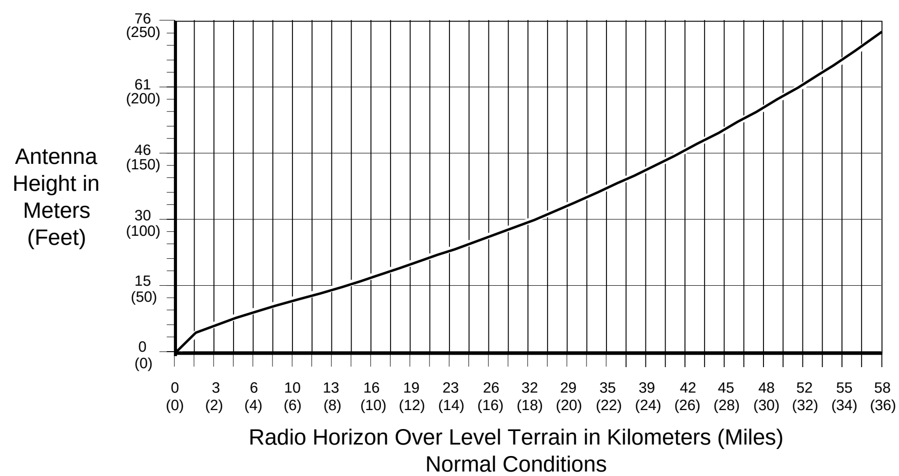


Figure 30. Antenna Height vs. Theoretical Radio Horizon

Fade Margins

Variations in the temperature and humidity of the atmosphere with elevation cause the signals to bend more or less, resulting in fading at the receiver. The longer the path is, the more likely that deep fades will occur; hence, the greater the fade margin required.

Different parts of the world have differing propagation which can be categorized as favorable, average, or adverse. In general, mountainous areas have favorable propagation conditions, while tropical areas and those near large bodies of water have adverse conditions.

Based upon the desired level of link availability, path length, and terrain type, it is possible to calculate the recommended fade margin.

The following standard formulas are provided for assistance in determining system installation parameters.

Free Space Path Loss

$$\alpha_{fs} = 92.4 + 20\log_{10} f + 20\log_{10} d$$

Where:

α_{fs} = free space loss in dB
d = path distance in kilometers
f = frequency in GHz

Parabolic Antenna Gain

$$G = (20)\log_{10}(7.4Df)$$

Where:

G = antenna gain in dBi
D = dish diameter in meters
f = frequency in GHz

This formula assumes a typical 50 percent antenna illumination efficiency and is representative of a full parabolic antenna.

Fresnel Zone Boundary

$$F_n = 17.3\sqrt{(nd_1 \cdot d_2)/(fD)}$$

Where:

F_n = Fresnel zone boundary in meters
d_1 = distance from one end of the path to the Fresnel zone boundary in kilometers)
d_2 = distance from the other end of the path to the Fresnel zone boundary (in kilometers)
D = total path distance (d_1+d_2) in kilometers
f = frequency in GHz
n = Fresnel zone, 1 (for 1st) is used here

Parabolic Antenna Beamwidth

$$\phi = 21.3/(fD)$$

Where:

ϕ = beamwidth in degrees (between –3 dB points)
f = frequency in GHz
D = dish diameter in meters

This formula is representative of a full parabolic antenna.

Theoretical Signal Strength

$$RSSI = EIRP - \alpha_{fs} + G_{ra} - L_{rfl}$$

Where:

RSSI = signal strength at the receiver in dBm
EIRP = RF Power Output in dBm + G_{ta} $-L_{tfl}$
α_{fs} = free-space path loss in dB
G_{ra} = receive antenna gain in dBi
L_{rfl} = receive feedline loss in dB
L_{tfl} = transmit feedline loss in dB
G_{ta} = transmit antenna gain in dBi

Probability of System Fading

$$FProb = a \times b \times 6.0 \times 10^{-7} \times f \times d^{3} \times 10^{(-F)/10}$$

Where:

$FProb$ = probability of fading more than F
a = terrain factor
- 4 is used for very smooth terrain such as over water
- 1 is used for average terrain, with moderate roughness
- 0.25 is used for mountainous, or very rough terrain

b = climate factor
- 0.5 is used for a hot, humid climate
- 0.25 is used for temperate or northern areas
- 0.125 is used for a very dry climate

f = frequency in GHz
d = path length in km
F = fade margin, in dB

7.4 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 transceivers to switch.

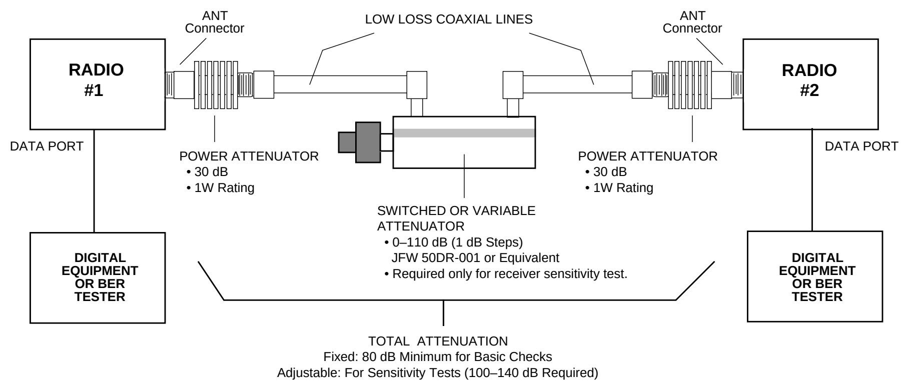


Figure 31. Back-to-Back Link Test

7.5 Watts dBm Volts conversion

Table 19 is provided as a convenience for determining the equivalent voltage or wattage of an RF power expressed in dBm.

Table 19. 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	.1fW
-130	71	
-131	61	
-132	58	
-133	50	
-134	45	
-135	40	
-136	35	
-137	33	
-138	29	
-139	25	
-140	23	.01fW

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.

ESF—Extended Super Frame.

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.

IP—Internet Protocol.

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.

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*.

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).

T1—A telephony standard that operates at 1.544 megabits-per-second (Mbps). This transmission speed is commonly used in North America.

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

IN CASE OF DIFFICULTY...

Adaptive Broadband Corporation/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.

FACTORY TECHNICAL ASSISTANCE

Technical assistance for Adaptive Broadband/MDS products is available from our Customer Support Team 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:

716-242-9600 (Phone)
716-242-9620 (FAX)

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:

Adaptive Broadband Corp.
MDS Products Group
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.

ADAPTIVE BROADBAND™

MDS Products Group
175 Science Parkway, Rochester, New York 14620
General Business: +1 (716) 242-9600
FAX: +1 (716) 242-9620
www.microwavedata.com