Tsunami / Lynx

Lynx.GX Wireless Radios

Tsunami Wireless Ethernet Bridges

Installation and Maintenance

CPN 62140

Issue Date: 12/01/02

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This device must be installed professionally.

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About This Book

This book provides the information needed to install, maintain, and troubleshoot the Lynx.GX and Tsunami (GX platform) Radios.

Be sure to read "Product Safety Instructions" in Chapter 1 before installing this product.

This device must be professionally installed. Instructions for setting the transmitter RF output power are referenced in "Output Power Adjustment."

This device is to be used exclusively for fixed point-to-point operation that employs directional antennas.

Intended Audience

This book is designed for network engineers and field service personnel responsible for installing, maintaining, and troubleshooting the Lynx.GX and Tsunami wireless radios. It is assumed you have an understanding of networks in general and a basic understanding of the following subjects:

- Microwave fundamentals
- Microwave test equipment
- T1/E1, DS-3
- Ethernet, Fast Ethernet
- IP networking

Support

For technical support, contact Proxim Technical Support at WANSUPPORT@proxim.com or at 1-408-542-5390.

Chapter 1. Introduction

Proxim Corporation introduces the GX platform of wireless bridge products - Lynx.GX wireless radios and the Tsunami wireless bridges. The split-box design lets you install both units indoors, or one unit indoors (the IDU, or indoor unit) and one unit outdoors (the RFU, or RF Unit).

The units can be mounted in a 19-inch rack; each piece is 1.75" high, occupying one rack unit (RU). Two pieces fit in two rack unit spaces for indoor installation, or you can mount the RF processor unit outdoors on a pole.

The units then are connected to one another with an IF coaxial cable; the antenna is connected to the outdoor unit. The outdoor unit directly contributes to significant cost savings of cable and antennas, improved system availability, and enhanced path performance.

A simplified and standardized user interface for product management is provided across all models, with a full network management system (NMS) for remote equipment management.

Basic Equipment Features

The following features apply to the GX product series:

- Split Box design with IDU Modem and RDU unit for addressing user's budget, maintenance, and performance requirements
- User selectable channel plans
- Full featured Fault and Configuration Management via web browser, SNMP, Telnet, or serial connection
- Advanced diagnostics – spectrum analyzer, RSL time strip charting, alarm logging
- Voice and data interfaces – T1 or E1 or 10/100BT –available up to 45 Mbps aggregate capacity, full duplex
- Auxiliary interfaces include wayside T1 or E1 channels for selected models, serial data port, and orderwire connection (VF bridge)
- Link ID authentication algorithm to insure highly secure link transmission
- Models ranging in capacity from 1T1 to DS-3, 10/100BaseT (45 Mbps)

Lynx.GX Models

The following tables list the Lynx.GX models as well as some of their basic specifications. For full specifications, see "Appendix C: Product Specifications."

Model Number	Manufacturing Part Number	Ports	Frequency	Compliance	
51145-10L0 51145-10H0	62139 62142	8 T1 ports	5.8 GHz	ISM	
51145-20L0 51145-20H0	62144 62145	8 E1 ports	5.8 GHz	ISM	
51155-20L0 51155-20H0	62148 62149			U-NII	
51850-10L0 51850-10H0	TBD TBD	4 T1 ports	5.8 GHz	ISM	
51850-20L0 51850-20H0	TBD TBD	4 E1 ports	5.8 GHz	ISM	
51600-10L0 51600-10H0	TBD TBD	2 T1 ports	5.8 GHz	ISM	
51700-20L0 51700-20H0	TBD TBD	2 E1 ports	5.8 GHz	ISM	
51000-L0 51000-H0	TBD TBD	1 T1 port	5.8 GHz	ISM	
51400-L0 51400-H0	TBD TBD	1 E1 port	5.8 GHz	ISM	
52290-10L0 52290-10H0	TBD TBD	16 T1 ports	5.8 GHz	ISM	
52250-20L0 52250-20H0	TBD TBD	12 E1 ports	5.8 GHz	ISM	
57710-91L0 57710-91H0	TBD TBD	DS-3 circuit	5.8 GHz	U-NII	
57710-81L0 57710-81H0	TBD TBD	28 T1 ports	5.8 GHz	U-NII	
57710-71L0 57710-71H0	TBD TBD	21 E1 ports	5.8 GHz	U-NII	
57750-91L0 57750-91H0	TBD TBD	DS-3 circuit	5.3 GHz	U-NII	

Basic Specifications for Lynx.GX models

	Bandwidth (MHz)	Typical Output Power	Chnl Plans	Main Interface Connectors	Aggreg. Capacity (Mbsp)	Line Code/ Channel	Line Buildout/ channel
8 T1	125	≥20 dBm	2	DSX-1 [RJ48c]	13.5	AMI/B8ZS	0–600 ft., selectable
8 E1	100 or 125				18	18	
4 T1/E1	125		3	DSX-1 [RJ48c]; CEPT-1 [RJ48c or 2xBNC]	9	AMI/B8ZS; HDB3	
16 T1			1	DSX-1 and CEPT-1: using 64 pin DSX connector	27		
12 E1							
DS-3	100	≥17 dBm			54		
28 T1							
21 E1							

Tsunami Models

The following tables list the Tsunami models as well as some of their basic specifications. For full specifications, see "Appendix C. Product Specifications.".

Model Number	Manufacturing Part Number	Ports	Frequency	Compliance	
51145-41L0 51145-41H0	TBD TBD	10/100 Base-T, 100 Base-FX, plus T1 port (10 Mbps)	5.8 GHz	ISM	
51145-42L0 51145-42H0	TBD TBD	10/100 Base-T, 100 Base-FX, plus E1 port (10 Mbps)	5.8 GHz	ISM	
57710-51L0 57710-51H0	TBD TBD	10/100 Base-T, 100 Base-FX, plus 2 T1 ports (45 Mbps)	5.8 GHz	U-NII	
57710-52L0 57710-52H0	TBD TBD	10/100 Base-T, 100 Base-FX, plus 2 E1 ports (45 Mbps)	5.8 GHz	U-NII	
57750-51L0 57750-51H0	TBD TBD	10/100 Base-T, 100 Base-FX, plus 2 T1 ports (45 Mbps)	5.3 GHz	U-NII	
57750-52L0 57750-52H0	TBD TBD	10/100 Base-T, 100 Base-FX, plus 2 E1 ports (45 Mbps)	5.3 GHz	U-NII	

Basic Specifications for Tsunami models

	Bandwidth (MHz)	Typical Output Power	Chnl Plans	Main Interface Connectors	Aggreg. Capacity (Mbsp)	Line Code / Channel	Line Buildout/ channel
10/100 +2T1	125	≥20 dBm	2	10/100 Base-TX RJ-45 female; Fiber SC	>20	AMI/B8ZS for wayside	0–655 ft., selectable, for wayside
10/100 +2E1	125	≥20 dBm	2	10/100 Base-TX RJ-45 female; Fiber SC	>20	HBD3 for wayside	
100/100 + 2 T1	100	≥ 17 dBm	1	10/100 Base-TX RJ-45 female; Fiber SC	> 108	AMI/B8ZS for wayside	0–655 ft., selectable, for wayside
100/100 + 2 E1	100					HBD3 for wayside	

Product Safety Instructions

This product should be installed, used, and maintained by experienced telecommunications personnel only.

This unit should be installed in a Restricted Access location in accordance with Articles 110-28, 110-26, and 110-27 of the United States National Electric Code ANSI/NFPA 70.

This equipment should be installed in accordance with Article 810 of the United States National Electrical Code.

When installed, this equipment is to be connected to a Lightning/Surge Protection Device that meets all applicable national Safety requirements.

To avoid injury, risk of fire, and damage, do not connect this product directly to an antenna. Ensure that proper lightning isolation is also provided between this unit and other equipment.

Equipment is to be used and powered by the type of power source indicated on the marking label only.

Lynx radios are intended to be connected to a ± 24 VDC or ± 48 VDC power source, which must be electrically isolated form any AC sources and reliably earthed.

Only a DC power source that complies with the Safety Extra Low Voltage (SELV) requirements in the Standard for the Safety of Information Technology Equipment, including Electrical Business Equipment, CAN/CSA C22.2, No. 950-95 * UL 1950, Third Edition, can be used with this product.

A 15-Amp circuit breaker is required at the power source. In addition, an easily accessible disconnect device should be incorporated into the facility wiring.

Always use copper conductors only for all power connections.

Do not connect or disconnect the power cable to the equipment when the other end of the cable is connected to the DC power supply.

This product must be serviced by trained personnel only.

Do not:

- Disassemble this product. By opening or removing any covers, you could expose yourself to hazardous energy parts. Incorrect reassembly of this product can cause a malfunction or electrical shock when the unit subsequently is used.
- Insert any objects of any shape or size inside this product while powered. Objects could contact hazardous energy parts, resulting in a risk of fire or personal injury.
- Spill any liquids of any kind on or inside this product.
- Cover or block any of the openings (to protect this product from overheating). Side openings are provided for ventilation.

Always ensure the following:

- Always ensure that sufficient space is provided above and below this product.

  This product can be installed in a standard 19-inch rack. Check the size and clearance requirements for this product and ensure that enough clearance is provided for installation. Consideration should be given to the mechanical loading of the rack and the equipment to avoid potential hazards.
- If this product is to be powered from the same source as other units, ensure that the power supply circuit is not overloaded.
- When installed in a rack, always ensure that proper air flow is provided for this product.
- If you are using a handset not provided by Proxim with this product, ensure that the handset is a UL-Listed (ITE) device that has been evaluated to the Standard for the Safety of Information Technology Equipment, including Electrical Business Equipment, CAN/CSA C22.2, No. 950-85 * UL 1950, Third Edition.

The maximum room ambient temperature (Tmra) for this product is 65° C. When installed in a closed or multiunit rack, consideration should be given to installing this equipment in an environment compatible with the Tmra.

Equipment is suitable for mounting on concrete or other noncombustible surfaces only.

This equipment must be earthed. If you are not using the power supply provided by Proxim, you must connect the earthing conductor of your power source to the earthing terminal located on the back of the unit; or, connect an earthing conductor between the unit's earthing terminal and your earthing point. For safe operation, always ensure that the unit is earthed properly, as described in this book and shown in the following figure.

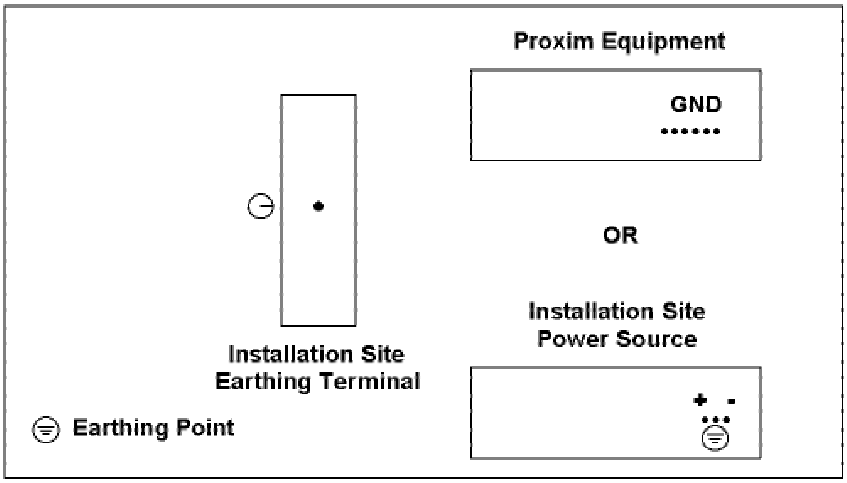


Figure 1 Proper Equipment Earthing/Grounding

Grounding

Be sure to:

- Use a common ground for everything
- Ground the radio to the rack

Be careful with DC power grounding:

- Grounding DC supply may create ground loops
- If DC source is referenced to ground, use DC power and jumper to ground
- Best if DC source "floats" in case of lightning or other surge

Other grounding:

- Mast
- Transmission line

Chapter 2. Planning for Installation

There are several planning factors to be considered prior to installing the Tsunami or Lynx radio system.

In addition to selecting the installation site, you must:

Calculate:

- Predicted Path Availability
- Anticipated RSL and Fade Margin

Determine:

- Frequency Plan
- Required Antenna Size and Type
- Required Transmission Line Types and Lengths

Plan for:

- The unit's continuous power consumption needs
- Antenna installation
- Lightning protection and system grounding
- Radio hardware mounting
- Cable installation including egress

Also, before installing the system, you may want to perform a back-to-back test of the radio pair. Back-to-back testing is a simple way to verify that the radios are fully operational before they are installed. The process of installation adds several variables (such as antenna alignment and path dynamics) which can lead to system turn-up delays during troubleshooting. By pre-testing the radios, you reduce the chance of their being the cause of system turn-up problems, so you can focus on other factors, such as transmission line, antenna alignment, path clearance, and other factors. See "Back-to-Back Testing" on page 58.

Selecting a Site

The radio site must have:

- Access to appropriate power
- Access to the telecommunications system you want to interconnect
- Line-of-sight to the other radio location with adequate path clearance
- Location for mounting the antenna

Line-of-Sight and Path Clearance Guidelines

The frequencies of these radio transmissions are not intended to pass through trees or other obstacles. Factors to consider include earth curvature, future growth of trees, and height of buildings. In addition to the line-of-sight requirement, a well-engineered path has additional path clearance to allow for signal loss due to partial obstructions, atmospheric ducting, and ground reflections.

To maximize link availability, calculate 0.6 times the first Fresnel zone and add this value to path clearance based upon the primary path (in addition to earth curvature, trees, buildings, and so on).

The radios will not perform properly unless they have line-of-sight and proper path clearance between their corresponding antennas.

Calculating Availability

Availability of the microwave path is a prediction of the percent of time that the link operates without producing an excessive bit error rate (BER) due to multipath fading. In the absence of direct interference, availability is affected by the following:

- Path length
- Fade margin
- Frequency
- Terrain (smooth, average, mountainous)
- Climate (dry, temperate, humid)

Depending upon the type of information carried over the link and the overall network design redundancy, you may want to design for a specific availability rate. For example, if the data or voice traffic carried by the radio is critical, the link can be designed for a very high availability rate (for example, 99.999% or 5.3 minutes of predicted outage per year).

Availability can be improved by increasing the fade margin either by making the path shorter or by using higher gain antennas in conjunction with lower loss transmission line (using a higher quality transmission line, shortening the length, or both).

Calculating Received Signal Level and Link Budget

Use the following formula to estimate the received signal level (RSL):

RSL (dBm) = P_{out} - L_1+ G_1 + G_2 - L_2 - L_p

where:

P_{out} is the transmitter output power (in dBm)

L_1 is the total loss of all transmission elements between the antenna and the RF Unit on one side of the link (in dB)

G_1 is the gain of the antenna on one side of the link (in dB)

G_2 is the gain of the antenna on the opposite side of the link (in dB)

L_2 is the total loss of all transmission elements between the antenna and the RF Unit on the opposite side of the link (in dB)

L_p is the Path loss, defined by:

$$Lp\ (dB) = 96.6 + 20\ \log_{10}F + 20\ \log_{10}D$$

where:

F is the Frequency of the radio system in GHz (5.8 in the case of this model)
D is the Distance of the path in miles

The results of this link budget calculation are very important for determining any potential problems during installation. If you have calculated the expected RSL, you can verify that it has been achieved during installation and troubleshooting, if necessary.

In the USA and Canada, this model radio can be installed with any gain directional antennas, as there is no Effective Isotropic Radiated Power (EIRP) limit for the application of these systems for fixed point-to-point applications. In other countries, EIRP limits may apply.

In the case of EIRP limits, use the lesser of either (P_{out} - L_1+ G_1) or the EIRP limit within the previous equation. You may have to check this equation in both directions to assure legal application.

An EIRP limit is the maximum RF energy allowed to be transmitted, as measured at the transmitting antenna, and is usually determined by government regulations.

Calculating Fade Margin

The fade margin is the difference between the actual received signal and the radio's threshold. Using the formula provided in the previous section, you can calculate the anticipated RSL. Compare this RSL to the specified threshold of the Lynx radio, and calculate the fade margin as the difference between the two signal levels.

Proxim Corporation recommends that you design your link to your desired availability standard, as discussed in a following section. However, independent of the availability standard, the following guidelines are recommended for minimum fade:

- Greater than or equal to 15 dB for all paths, whenever possible, and always for path lengths greater than 2 miles.
- No less than 10 dB for any path length (this is not recommended, but can provide adequate performance if the path length is very short—less than 2 miles over non-reflective terrain and in non-refractive atmospheric conditions).

Determining the Frequency Plan

When configuring radios in a hub or repeater configuration, perform careful engineering of the radio frequency plans and antenna locations to minimize potential interference between the nearby radios.

As a rule of thumb, do not place *opposite* frequency plan radios (such as A1 and A2) at the same site. In most cases, you should use the same frequency plan (such as A1 and A1) or, in some cases, a different frequency plan from the same side of the band (such as A1 and B1, when more than one channel plan is available).

With careful engineering, you can easily place more than one radio of the same frequency channel plan at the same site. When designing these configurations, antenna size, antenna polarization, and antenna location are critical.

Using alternate channels (such as A1 and A2) is highly unlikely to be successful (and therefore not recommended) due to the high level of transmitter-to-receiver isolation required from the antenna system.

Antenna polarization should always be oriented such that 'adjacent' links are oppositely polarized relative to one another (that is, vertically and horizontally). This provides additional discrimination of the received signals coming into the hub site. If you must place an odd number of links at the same location, ensure that the largest angle is bounded by the two links of like polarization. Further interference analysis may be required to ensure these adjacent links will provide adequate separation.

Though external interference conditions are rare when using these radios, when these conditions do occur, you can often overcome them by exchanging the radios from end-to-end, thereby changing the receive frequency to the opposite channel at each end. Changing polarization on the antenna system to the orientation that provides the maximum rejection to the interference is also an extremely effective measure. The channel plan is illustrated in the following figure.

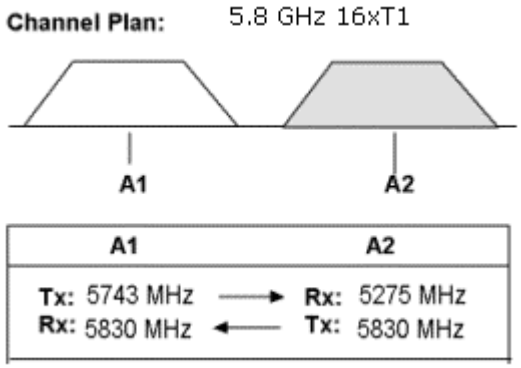


Figure 2 Channel Plan for 5.8 GHz 16xT1

The radio must have access to a supply of appropriate power, either DC or AC (if the AC adapter option has been ordered). The unit can be powered from a DC battery system, or from a solar or generator power plant, usually with battery reserves. Typically, either a ± 24 or ± 48 volt supply is used.

For DC, be sure the cable is of sufficient gauge to carry the necessary current and is less than three (3) meters (9.75 feet) in length. A minimum gauge of **14** is recommended.

Before you install the radio, plan for the unit's continuous power consumption needs. You also should plan for backup power for critical communication circuits. Backup power allows the radios and associated equipment continuous operation when primary power is interrupted.

Planning for Antenna Installation

In general, the larger the antenna used with the radio, the better the link performs. Larger antennas have narrower beamwidth and higher gain, which yield better link performance (higher fade margin, better availability) and improve immunity to interference (due to the narrower beamwidths).

However, larger antennas are more costly to purchase and install than smaller antennas and, in some cases, require special installation equipment and more robust mounting structures (due to increased weight and wind loading). You should consider all of these factors when selecting an antenna.

Prior to installation, determine the specific antenna location and mounting. The transmission line should be kept as short as possible, so when line-of-sight placement of antennas allow flexibility, it is always desirable for the equipment to be located closer to the antenna.

This advanced planning also yields the transmission line requirements.

Note: In areas for which transmitted output power restrictions apply, the use of larger antennas benefit narrow beamwidths and receive gain. However, you may need to reduce output power to meet regulations.

Only directional antennas should be used with Lynx radios. These typically are flat-panel or solid parabolic antennas. Proxim Corporation recommends a minimum 3 dB beamwidth of 10° for directional systems.

The following tables list antenna types, performance, and manufacturers.

Antenna Manufacturer Information			
Antenna Type	**Manufacturer**	**Model Number**	**Mid-Band Gain (dBi)**
1-foot flat panel	Gabriel Andrew RFS	DFPD1-52 FPA5250D12-N MA0528-23AN	23.5 23.6 23.0
2-foot flat panel	Gabriel Andrew RFS	DFPD2-52 FPA5250D24-N MA0528-28AN	28.0 28.2 28.0
2-foot parabolic	Gabriel Gabriel Radio Waves Andrew RFS	SSP2-52B HSSP2-52 SP2-5.2 P2F-52 SPF2-52A	28.5 28.1 28.3 29.4 27.9
3-foot parabolic	Radio Waves Andrew RFS	SP3-5.2 P3F-52 SPF3-52A	31.4 33.4 31,4
4-foot parabolic	Gabriel Gabriel Andrew Radio Waves RFS RFS	SSP4-52A HSSP4-52 P4F-52 SP4-52 SPF4-52A SDF4-52A	34.2 33.9 34.9 34.6 33.9 33.9

6-foot parabolic	Gabriel Gabriel Radio Waves Andrew RFS RFS	SSP6-52A HSSP6-52 SP6-5.2 P6F-52 SPF6-52A SDF6-52A	37.5 37.2 37.7 37.6 37.4 37.4
8-foot parabolic	Gabriel Gabriel	SSP8-52A HSSP8-52	39.8 39.6

Transmission Line				
Type	**Manufacturer**	**Model Number**	**Loss/100 (dB) ft.**	**Notes**
½-inch foam coax	Andrew	LDF 4-50	6.1	Add –0.25 dB per connector
$^{5}/_{8}$-inch foam coax	Andrew	LDF 4.5-50	4.7	Add –0.25 dB per connector
Waveguide	Andrew	EW-52	1.2	Does not include transitions
½-inch foam coax	Times Microwave	LMR-600	7.3	Add –0.25 dB per connector
$^{5}/_{8}$-inch foam coax	Times Microwave	LMR-900	4.9	Add –0.25 dB per connector

Within the USA and Canada, antennas other than those illustrated in these tables can be used with this radio, but must be of the same type (flat panel or solid parabolic), dimensions, and gain as those listed in the table. Antennas with gain less than 23.5 dBi are not approved for use within the USA or Canada. Consult governmental regulations or Proxim Corporation for applications outside of the USA or Canada.

For further information regarding antenna installation and adjustment, see "Installing and Adjusting the Antenna" on page 25.

The Formula for determining the maximum output power setting for 5.25-5.35 GHz U-NII (LE-LAN) Transmitters (@ EIRP=30dBm) is:

Max Tx (dBm) is the lesser of 24 dBm and 30 - G + FL

The Formula for determining the maximum output power setting for 5.725-5.825 GHz U-NII (LE-LAN) Transmitters (@ EIRP=53dBm) is:

Max Tx (dBm) is the lesser of 25 dBm and 53 - G + FL

The Formula for determining the maximum output power setting for 5.725-5.850 GHz Spread Spectrum Transmitters (@ EIRP=54.5dBm) is:

Max Tx (dBm) is the lesser of 25 dBm and 54.5 - G + FL

(note: EIRP shall never exceed 54.5 dBm. This is for the compliance to the CFR 47 Part 1.1310 for RF exposure)

Reviewing the Installation Process

The following is an overview of the installation process to assist you in your planning activities.

1. Test radios back-to-back and configure

- Use a minimum of 60 dB and no more than 80 dB attenuation and a short low-loss RF transmission line to connect the two radios.
- Apply power.
- Verify the RF Link LED is not red.
- Verify configuration settings (through the Web Interface) for proper configurations.
- Connect to services if possible to verify network connection and configurations.

2. Mount antennas

- Antenna height can be critical for path clearance and line of sight.
- Ensure that antennas will not be blocked by people.
- Antenna structure must be secure for wind load and whatever climbing may be necessary.

3. Run transmission line route and egress, including lightning arrestors

- Use proper transmission line.
- Proper termination is critical, especially at 5.8 GHz.
- Be careful with the bend radius and never kink the transmission line.
- Secure transmission line to structures; be careful not to crush.
- A direct connection to the antenna feed is ideal (if required, you can use a flexible jumper at the antenna, a properly specified 90-degree connector/adaptor, or both).
- Weatherproof all outdoor connections when completed with installation.
- RF Lightning arrester is best located at the building egress point when the RF Unit is placed indoors.
- Three lightning arrestors are recommended when the RF Unit is placed outdoors; one at the RF input (from the antenna), one at the junction between the RF Unit and the interconnect cable, and one at the building egress point.
- All lightning arrestors and transmission line must be properly grounded.

4. Connect radios to antennas and power, including grounding

- Connect to RF transmission line from antenna directly or using flexible jumper, if necessary.
- Do not use 90° adapters unless rated at operating frequency.
- Connect RFU-to-IDU cable.
- Test power voltages and pinouts before connecting power to IDU.

5. Align antennas

- Rough align antenna azimuth and elevation based upon path planning (using compass bearing or milestone sighting, telescopic sight, binoculars, and so on).
- Use a Digital Volt Meter (DVM) or headphones/earpiece/speaker to read the radio's RSL voltage provided on the RFU to peak antennas.
    - If the RFU is mounted indoors, you may need to temporarily run separate wires from the RSL port to antenna. Alternatively:
        - The RSL value can be provided by a 'verbal relay' or by two-way radio (or similar communications device) from the radio location to antenna alignment personnel.
        - The RFU can be taken to the antenna location temporarily for the purposes of antenna alignment. An additional short transmission line jumper may be required for this approach, along with TNC-to-N adaptors at each end of the primary transmission line.
        - Coaxial couplers can be placed temporarily at each end of the primary transmission line to allow for the RSL voltage to be sent to the antenna location.
- Make sure antenna polarization is the same at both ends.
    - Adjust alignment of one antenna at a time, one plane (azimuth versus elevation) at a time.
    - Adjust each end multiple times until predicted RSL is achieved.

6. Check RSL against predicted results, iterate, and troubleshoot

- Is the RF Link LED red?
    - If so, keep aligning.
    - If not (or green), the radios are talking!
- Does the measured RSL at both ends closely match the predicted value?
    - If too strong, probably OK.
    - If not strong enough, keep aligning.
    - If still not strong enough, double-check the prediction and compare to the actual installation (verify antenna gains, lengths/type of transmission line, path length, and so on).
    - Are you sure you have line of sight?
    - Did you test the radios in advance?
    - You could have a bad cable, connector termination, or antenna
- Do you need to adjust the output power down?
    - Check path calculations and regulations.
    - Re-verify RSL after power is adjusted.

7. Troubleshooting

- Most common problems are poor transmission line connector terminations.
  - Best way to test is a return loss measurement (VSWR).
  - Basic function can be tested using a continuity and short test with DVM.
  - The transmission line can be evaluated with a spectrum analyzer connected to the radio through the cable and comparing when spectrum analyzer is connected directly to the radio without the cable.
  - Transmission line loss can be evaluated with a back-to-back RSL test.
  - "Tap and wiggle" testing of all terminations while monitoring RSL and alarms can expose poor terminations.
- Could be a faulty antenna.
  - Very hard to tell without swapping.
  - VSWR test on antenna feed can identify antenna problems.
  - "Tap" test can expose a faulty feed for moisture or connector problems.
- Could be a faulty radio.
  - Back-to-back RSL testing normally exposes a faulty radio.
- Could be a path obstruction.
  - Re-evaluate path clearance including Fresnel zone criteria.

8. Connect services and test connectivity

- Perform a loopback test, a BER test, or both.
- Connect T1 connections, NMS connections, and so on.
- Test network connectivity.
- Double-check line codes and LBOs for all T1 connections.

Helpful Hints

- Telephones plugged into the Orderwire jack provide verbal communication across the link after the link is synchronized (very helpful to coordinate alignment and testing).
- Use the FAR END button to determine status and RSL of the far-end radio for troubleshooting.
- Keep radios at maximum (factory) power for the alignment phase.

Chapter 3. Installing the Units

Mounting the Units

Assembling Required Materials

The radios are shipped in boxes unless ordered as an integrated system and configured at the factory. In that case, the equipment may be racked and shipped in a crate. The equipment is packaged so as to prevent damage in transit.

The following figures illustrate the items required for installation:

Figure 3 Shipping Container Contents for 2-Piece Radios

In addition to the above installation components, the following items are also included:

- Terminal block and locking block (for DC power connection)
- 9-pin D connectors (for mating to the Alarm and IDU CONFIG ports)
- 8-pin Modular connectors (for mating to the VF, AUX DATA, NMS, T1/E1 traffic ports)
- Factory test data sheet
- Publications and Software CD

Save the test data sheet that is provided. The test data sheet can be placed where the Lynx terminal is installed for future reference. All units are tested individually and the actual measured performance recorded on the Factory Test Data Sheet. This information should be useful during installation, troubleshooting, and maintenance. You should have a copy of test data sheets from both ends of the radio link at each radio location, as well as a copy at the primary radio management center for reference.

Quick installation instructions are also provided at the back page of the Factory Test Data Sheet; this document can be useful for reference during installation.

The boxes should be left intact and sheltered until arrival at the installation site.

If the shipping container shows signs of damage, notify the transportation company immediately. Upon receipt, inspect contents to make sure no parts are missing or damaged.

You should retain all the packaging materials (including all internal boxes). In the unlikely event that you must return the equipment to the factory, use the original packing materials for return shipment. The packaging materials also are recommended for transporting the equipment from location to location.
The following accessories are shipped with your system:

IDU

The shipping container accessory kit includes the following items for IDU bracket mounting:

- Rack-mounting bracket
- Bracket screws
- IF cable for connecting to the RF unit if the RF unit is installed indoors alongside the IDU

RF Unit

The shipping container accessory kit includes the following items for outdoor RF Unit pole mounting:

- 1/4-inch split lock washers
- Hex nuts
- Flat washers
- Threaded rods
- Socket head screws
- Antenna cable
- Mounting brackets
- Mounting plate

Required Tools

The following sections list the tools needed when installing the Lynx radios.

IDU Installation Tools

You must obtain the following tools before installing the IDU:

- Phillips (cross-tip) screwdrivers (for 19-inch rack mounting and attachment of brackets)
- Small blade standard screwdriver (for power supply connector)
- Wire strippers (for removing insulation from power supply wiring and other wiring)
- Wire crimpers (if using any 8-pin modular (RJ-45 and RJ-48C) connectors that are not pre-made)
- Soldering iron (if using any D-type connector)

Outdoor RF Unit Installation Tools

You must obtain the following tools before installing the RFU:

- Adjustable 6-inch or 8-inch wrench (for installing the RF cable)
- Weatherproofing material (butyl and electrical tape, butyl tape or self-vulcanizing adhesive) such as Scotch brand 700 commercial grade Electrical tape (for sealing the IDU, antenna, and RSL connectors)

Test and Configuration Tools

The following tools are necessary or useful to have available for testing and configuring the radios:

- Digital Voltmeter (to measure RSL, DC power, and so on)
- RF power meter (to measure transmitter output power)
- Cellular phone or two-way radio (for talking with far-end crew and tower crew)
- Bit Error Rate test set (to test link after installation)
- Computer with Ethernet Network Interface Card, CAT5 cable and Internet browser software (for NMS access)
- Pair of touch-tone telephones (to test Orderwire circuits and for communication with far-end)
- Headphone or audio device with BNC adapter (for antenna alignment)

Additional tools may be needed for antenna and transmission line installation and antenna alignment as well as the lightning arrestor mounting and grounding. Consult the antenna manufacturer documentation and review "Installing and Adjusting the Antenna."

Mounting the Lynx and Tsunami Radio Units

The following sections provide installation procedures:

- IDU Installation
- Indoor RF Unit Installation
- Outdoor RF Unit Installation

There are two primary ways to install the Lynx and Tsunami radio system.

- The first is the case in which both units (the IDU and the RFU) are mounted indoors or in a suitable enclosure, stacked on top of one another, in a rack or on a tabletop.
- The second is the case in which the IDU is mounted indoors and the RFU is mounted outdoors, either near the antenna or simply at a location somewhere between the enclosure/structure egress point and the antenna.

Complete installation of all cables and the antenna system prior to connecting power; refer to "Antenna Installation and Adjustment Guidelines" for important information.

Installing the Indoor Unit

Rack mounting of the IDU is the ideal configuration. The Lynx and Tsunami radio alternatively can be placed on a tabletop or a cabinet shelf. You should secure the radio system with a strap when not mounted directly to a racking system.

For rack mounting, to avoid interference with the RF unit or antenna cables, you should mount the unit at the highest space in a standard 19-inch rack. Empty rack-mounting spaces above and below the unit are recommended, especially if the surrounding equipment dissipates a considerable amount of heat (over 40W). If you plan to mount the RFU indoors, use the top two rack spaces for the radio system, mounting the IDU and RFU directly adjacent; leave a minimum of one space above the total 2-unit space for the radio.

Set up the radio for mounting (using the rack mounting brackets enclosed with the screws in the shipping container) with the front edge projecting from the front face of a standard 19-inch rack. Alternatively, you can reverse the rack-mounting brackets to install the unit at a flush position.

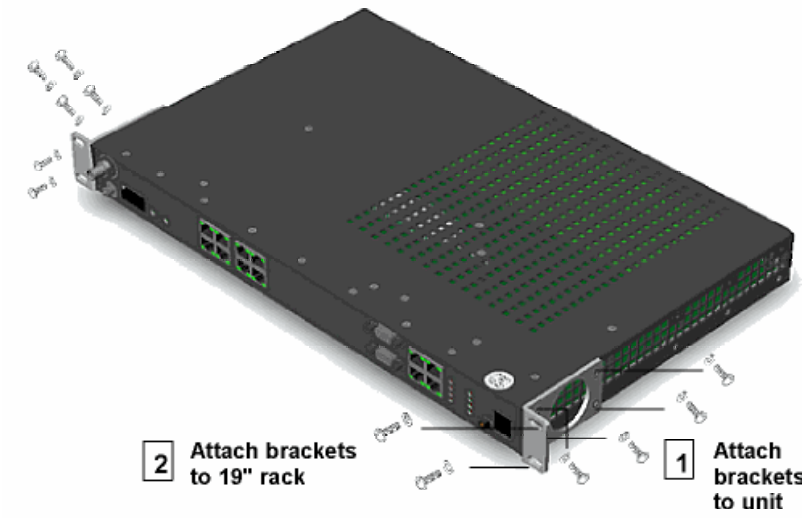
The radio has internal fans that intake on the left side and exhaust on the right side of the chassis. When rack mounting, leave a small gap between the outer edges of the radio and the inside edge of the rack.

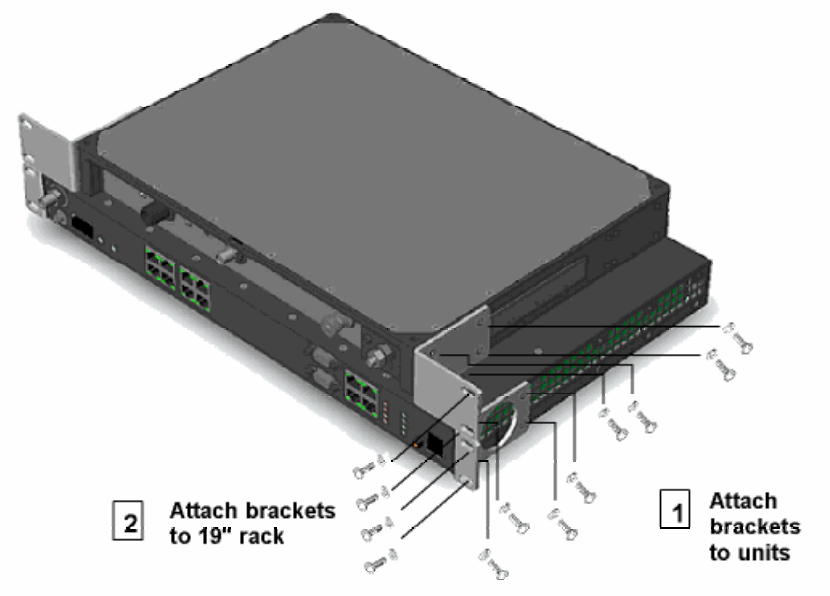
To rack-mount the IDU:

1. Set the unit on a flat surface and, using a screwdriver, remove the front screws on each side of the unit. You must remove these screws to prepare the unit for bracket attachment.

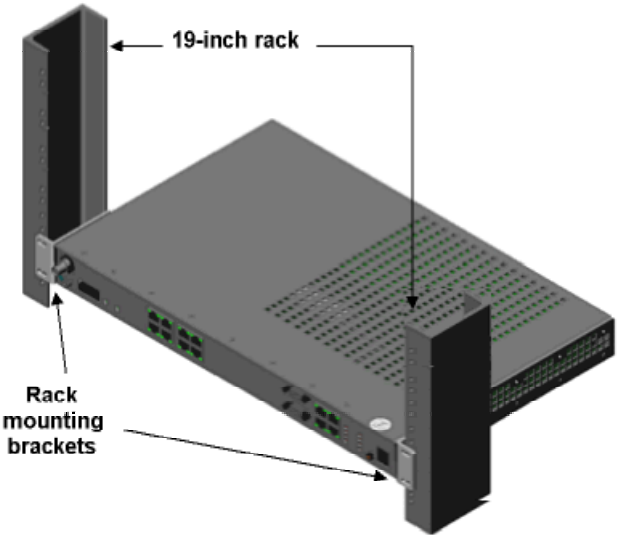
2. Attach a mounting bracket to each side of the unit using the long mounting screws that are provided in the IDU accessory kit.

   The following figures illustrate mounting bracket attachment for the IDU only (occupying one space in a 19-inch rack) and for the combined IDU and RFU (occupying two spaces in a 19-inch rack).

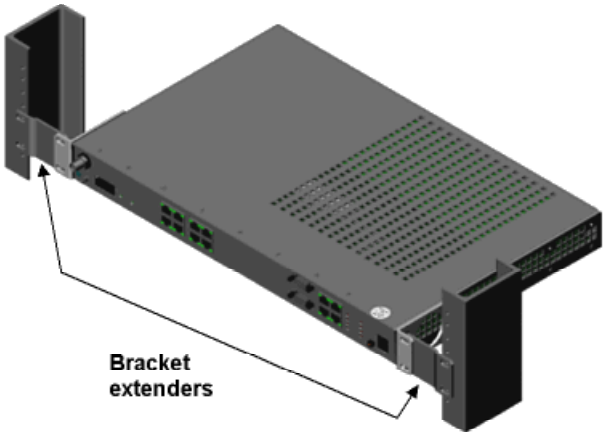




3. Position the radio in the rack and align the holes in the mounting bracket with the holes in the rack.



If you are installing the IDU in a 23-inch rack, you must attach extenders to the rack mounting brackets, as shown in the following figure:



4. Insert two bolts and lock washers, appropriate for your 19-inch rack, into each of the mounting brackets and tighten.

Important:	When the RFU is rack mounted, it must be mounted directly above the IDU and facing with the connectors forward in the same direction as the front panel of the IDU (as shown). The IDU fan exhaust is used to cool the RFU in a rack mount configuration. Also, if one unit is projection mounted, both units should be projection mounted. In either configuration, an empty rack mount space is required above and below the configuration.

Installing the RF Unit in an Outdoor Configuration

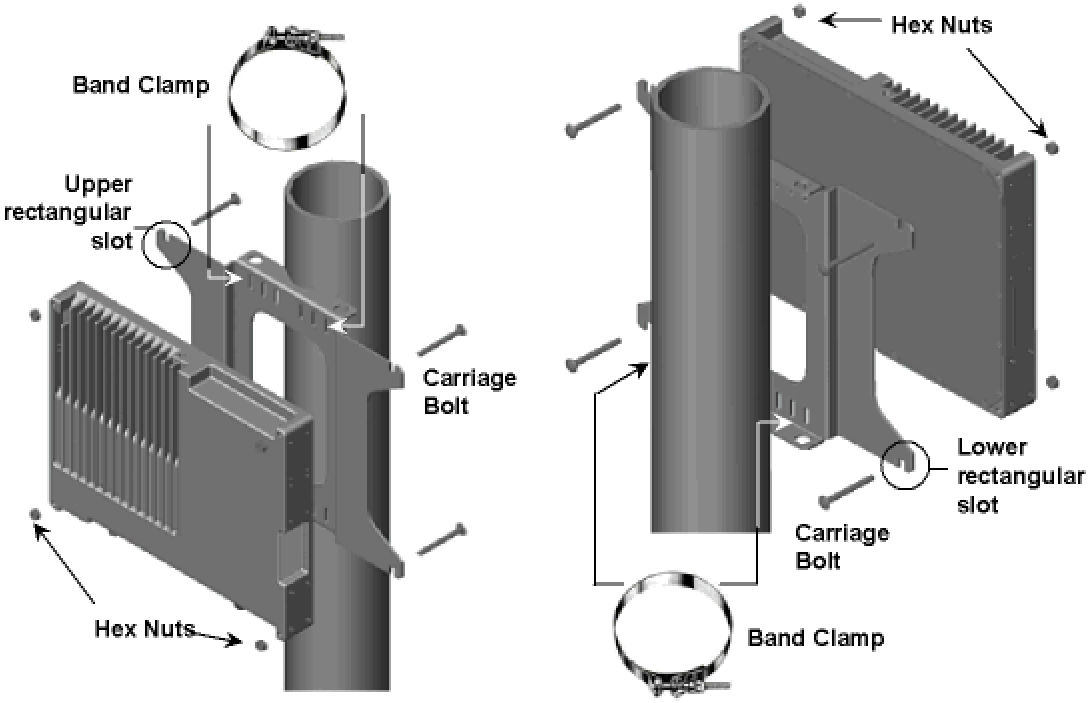
The outdoor RFU installation is a two-step procedure:

- Install the mounting bracket and plate onto the pole. Use two band clamps (not included).
- Mount and secure the RFU on the mounting plate.

To install the RFU, follow these steps:

1. Hold the mounting plate with the upper and lower V-cut tabs in contact with the pole.

2. Wrap band clamp around pole/mast and through the vertical slots near the top of the mounting plate. Repeat for lower slots.



3. Tighten both band clamps sufficiently to prevent the mounting plate from rotating on the pole/mast; you are now ready to mount the RF unit onto the bracket assembly.

4. Orient the RFU for mounting onto the mounting plate so that the connectors are pointed down and the heatsink fins are facing away from the bracket.

5. Insert carriage bolts into the upper holes. Place both thumbs over the hex nuts; place the RFU onto the mounting plate by setting the square portion of the carriage bolts into the upper, rectangular slots on the mounting plate. Loosely attach the self-locking hex nuts.

6. Insert carriage bolts into the lower holes. Loosely attach the self-locking hex nuts.

7. Tighten all hex nuts sufficiently to prevent the RF U from any movement. Ensure the heads of the carriage bolts are firmly against the mounting plate prior to tightening the self-locking hex nuts.

8. Install the RF lightning arrestor that connects to the antenna cable to the RFU Type-N connector labeled **To Antenna** and seal the connectors using weatherproofing material (butyl and electrical tape, butyl tape or self-vulcanizing adhesive) listed in "Installation Requirements."

9. Install the IF/DC-passing lightning arrestor that connects to the IDU cable to the RFU TNC connector labeled **To IDU** and seal the connectors using weatherproofing material.

Installing and Adjusting the Antenna

The installation information discussed in this section is generic. For installation procedures specific to the antenna you are installing, refer to the antenna manufacturer's documentation.

Antenna Installation

WARNING (FCC requirement for implementation in the USA):

Antennas used for the transmitter must be fix-mounted on outdoor permanent structures with a separation distance of at least 1.5 meters from all persons during normal operation. Antennas must be professionally installed. Installers must be provided with antenna installation instructions and transmitter operating conditions, including antenna co-location requirements of CFR47 Part 1.1307(b)(3), for satisfying RF exposure compliance.

Antenna installation consists of permanently mounting the antenna to the mast, pole, or tower and then attaching the RFU to it.

The antenna and RFU assembly must be mounted outdoors on a tower, building roof, or other location that provides line-of-sight path clearance to the far-end location. In some cases, the antenna can be mounted indoors, behind a window. However, RF attenuation through windows can vary greatly, depending upon the glass and any coatings that might be present, plus the precise location and angle of the antenna relative to the window. In cases of indoor installations, ensure that the antenna location is restricted and bear in mind the RF exposure requirements of the warning statement above.

In general, antennas smaller than 2.0 feet diameter, or 1-foot panels, are not recommended for use with these radios.

Antennas should be:

- Ordered with the suitable mounting kit specific to the site requirements.
- Very rigidly mounted, with adequate room for azimuth and elevation adjustment from the rear.

The antenna polarization must be the same at both ends of the link, either vertical or horizontal.

In general, antenna mountings require a support pipe to which upper and lower support brackets are attached with U-bolts. The antenna and optional elevation and azimuth adjustment rods are then mounted onto the support brackets. The entire structure must be adequately grounded for lightning protection. The antenna system must always be installed according to the manufacturer's instructions.

Unless special test equipment is available, two operating Lynx radios are required to align the antennas. Alternatively, you can use a CW generator to transmit a signal toward the end being aligned.

The antenna is coarse-aligned using visual sighting and then fine-aligned using the receive signal level (RSL) voltage of the radio.

The RSL voltage reading still can be used to peak antennas even if the wireless units have not synchronized; however, you cannot measure far-end RSL from the near-end terminal until the units are synchronized.

Alignment Guidelines

When aligning antennas, if the RFU is located indoors or distant from the antenna location, you may want to run wires or a cable from the RSL test point to the antenna so that the voltmeter reading or audio device is directly visible and audible to the technicians aligning the antenna. Alternatively, you can use coaxial couplers to couple the RSL voltage from an IDU to bring the voltage to the antenna location. If this approach is used, remove couplers after alignment is complete. You may also temporarily mount the RFU near the antenna for the purposes of alignment (an additional short RF transmission line may be required).

A cellular telephone or two-way radio can be useful for coordinating alignment activities between both ends of the link. Once you have coarse-aligned and synchronized the units, you also can use the built-in order wire phone service to coordinate installation.

An order wire telephone can provide end-to-end voice communications once the units are synchronized. Synchronization usually can be accomplished by coarse alignment alone. After synchronization, you can use the orderwire phones to communicate between radio sites for antenna fine alignment activities. The phone interconnect cable can be extended to the antenna when desired.

The larger the antenna size, the more critical alignment becomes. For example, with a 2-foot dish at 5.8 GHz, the antenna can be moved ±3 degrees off the correct heading before the receive signal level drops by 3 dB. This compares with a 6-foot dish, which may only be moved ±1 degree for the same degradation.

- It is critical that antenna alignment be performed on one end of the link at a time, one plane at a time.
- One antenna should remain stationary at all times.
- Each end should be fine-aligned several times, until the planned RSL is reached.

In some cases, you may need to perform coarse alignment using a wide arc in both azimuth and elevation while reading the RSL to find the main beam of the opposite end antenna.

Note: The RSL voltage is slightly delayed, so make small incremental adjustments during the fine alignment phase and wait for the RSL voltage to settle at each adjustment. When aligned to maximum RSL, ensure that all antenna mechanics are tightened without impacting the alignment.

Coarse Alignment

To coarse-align the antenna, set the antenna for flat elevation (no up-tilt or down-tilt) using a spirit level; point the antenna at a heading marker obtained using a compass/GPS (magnetic corrected) back-bearing from an adjacent location (ideally, 100 feet or more away from the antenna). If the path has substantial change to elevation from one end to the other, this may not be an advisable method for starting the alignment activities. In such cases, compare antenna elevations at each end of the link and set the initial elevation of the antenna to roughly match the anticipated up-tilt or down-tilt.

If you cannot set a heading marker sufficiently far away (for example when on a city building roof or looking through a window), obtain a rough azimuth setting by sighting along the antenna feed or based upon compass measurements made during the path planning stage.

Note: Use the instructions provided by the antenna manufacturer to verify that both antennas are on the same polarization; otherwise, the RSL will be approximately 25 to 30 dB below the calculated level.

Because maximizing the receive RF signal level at each end of the radio link is critical, most antennas also require fine alignment using an operating link.

Once the coarse alignment is completed at both ends, the link can be powered and some level of reliable communication established. The voltage at the Lynx test point can be measured with a DVM to determine the relative receive RF signal level.

Note: Make sure that you read Power Connections prior to powering up the Lynx radios.

Fine Alignment

When fine-aligning the antenna:

- Adjust the azimuth and then the elevation of the local antenna to maximize the RSL voltage.
- Align the far-end antenna in the same manner, using the RSL voltage of its local RFU.

RSL Voltage Guidelines

The following example graph illustrates the typical variation of RSL voltage as the receive signal level is increased from threshold to a higher level. There is some variation between receivers, but an approximate estimate of the potential RSL value can be made using this figure.

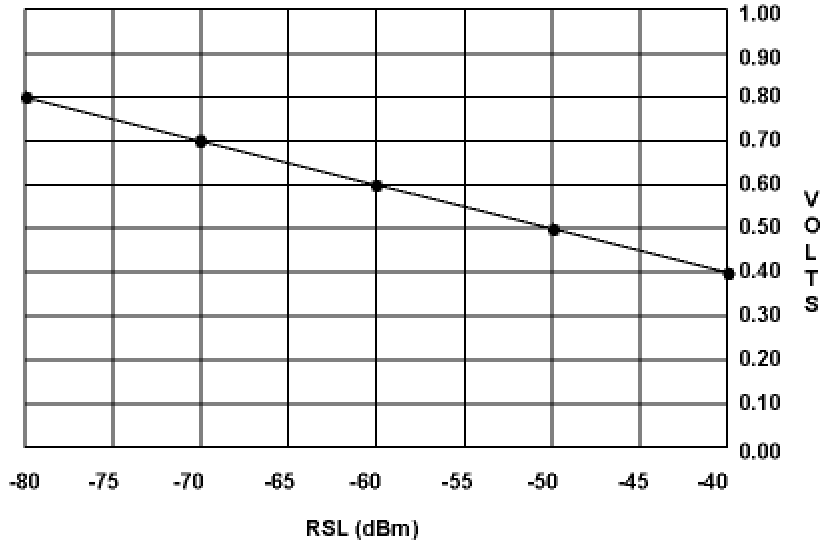


Figure 4 Typical RSL Voltage vs. Receive RSL

Note: Use the Factory Test Data Sheet shipped with your terminal to obtain the best estimate of your RSL.

Above -30 dBm RSL, the receiver can produce errors; however this level is rarely exceeded. Refer to Calculating Received Signal Level and Link Budget to calculate the anticipated RSL.

During anomalous propagation conditions, the RSL can fade up but does not typically increase by more than 10 dB (except in unusual, very long paths, which may increase by 15 dB).

Antenna alignment should enable the RSL to peak to the level calculated in the link budget. If the RSL is peaked but is approximately 20 dB below the calculated level, it is likely the antennas are aligned on a sidelobe of the antenna's radiated signal. In such case, you must adjust the antennas in a wide arc in both azimuth and elevation (at both sides) until the main lobe is located.

Other typical causes of low RSL are:

- Path obstructions
- Excess loss in connectors/cables (poor terminations, improper bend radius, kinked, crushed, and so on)
- Poor quality or unaccounted for adapters and pigtail jumper cables
- Different antenna polarization at each end of the link
- Misadjustment of the radio's transmit power output adjustment
- Insufficient RF output power (faulty radio transmitter)
- Faulty antenna

Establishing Connections

Antenna Connection

The Lynx radio is equipped with an N-type female connector at the antenna port. You can use a short length jumper cable (such as 1/4-inch to 1/2-inch coax or pigtail of approximately 6 feet in length) fitted with two N-type male connectors to connect the antenna port to the antenna (if the RFU is located near the antenna) or to the primary transmission line (if the RFU is mounted remotely from the antenna).

A low-loss 50-ohm cable is recommended for the antenna transmission line between the RFU and the antenna (such as Andrew LDF4-50 or Times LMR-600 1/2-inch coaxial cable, an Andrew LDF4.5-50 or Times LMR-900 5/8-inch coaxial cable, or an EW-52 waveguide).

The return loss presented by the transmission line at the RFU interface should be as high as possible (20 dB minimum recommended). The length of the antenna transmission line should be kept as short as possible to minimize losses.

To minimize feeder losses, use an elliptical wave guide (typical loss is 1.25 dB/100 ft. at 5.8 GHz) for implementations with longer transmission line lengths (such as >200 feet) or long paths (such as >20 miles). Depending upon path length and transmission line feeder length, ½-inch or $^{5}/_{8}$-inch coaxial cables are often sufficient.

Antenna Cabling Guidelines for 5.8 GHz Units

- Coaxial cables of $^{7}/_{8}$-inch or larger diameter can exhibit moding at 5.8 GHz and are never recommended. Also, some small diameter cable types, such as RG-8, will have high loss or poor VSWR at these frequencies. If small diameter cables are required, be certain to keep the lengths of these cables as short as possible.
- For wave guide transmission line at 5.8 GHz, EW-52 wave guide is recommended. EW-63 will also work, but may exhibit more loss.
- Do not use right angle N-type connectors with the Lynx radios operating at 5.8 GHz unless the connector has been specifically rated and tested up to 5850 MHz. Unless specifically designed for these frequencies, these connectors may present high loss at these frequencies.
- Do not use a low quality jumper cables with the radios.
- Always precisely follow manufacturer's recommended procedures and tools for termination.

Transmission Line Connection

If the RFU is mounted near the antenna, the RF transmission line can be pre-terminated at both ends and simply attached from the antenna feed to the RFU without any special consideration to securing the transmission line to the antenna structure (as the length is likely to be very short).

In this configuration, Proxim recommends you place an RF lightning suppression device specified for use at 5.8 GHz (such as Polyphaser LSX) between the RF transmission line and the RFU's RF port, as close as possible to the RFU. Always properly ground any lightning suppression device.

When the RFU is mounted near the antenna, generally follow the following instructions for the cable that is used to connect the RFU to the IDU. This cable is likely to be longer and will also egress the structure in which the IDU is located. It may require more care for installation, including grounding and securing the cable.

Lightning suppression is required at the interconnection cable junction as close as possible to the RFU, as well as at the egress point. For this cable, the lightning suppressors must be designed to pass DC and support the intermediate frequencies (approximately 800 MHz) and the digital signals carried by this cable. Polyphaser carries an appropriate device for this application.

To prepare the transmission line feeder or the RFU-to-IDU cable:

1. Cut the cable to the approximate length (allowing some excess).
2. Install the appropriate connector on the antenna or RF Unit end:

   Place tape or a covering over the connector end so that debris cannot harm the connector.
   Pull the transmission line through the cable ducts, trays, or conduit (as required) to the antenna, while being careful not to kink or damage the transmission line in any way.

RF transmission line must never be bent, twisted, or deformed in any way.
Pay close attention to the transmission line specifications for bend radius when installing.

3. Support the transmission line in a tray on horizontal runs and by hangers on vertical runs. Space hangers according to the manufacturer instructions (typically every five feet under conditions of no ice and not greater than 85 mph winds).

4. Ground the transmission line using the manufacturer grounding kit. Grounding kits attach to the outer copper conductor. Install grounds at the antenna, at the bottom of the antenna structure (if applicable), and where the transmission line enters the building. Be sure to ground long transmission line runs every 100 feet.

5. Install lightning protection devices, including proper grounding and termination to cables. There should always be a lightning protection device at the egress point for whatever cables egress the building or enclosure.

   For an all-indoor implementation, the in-line lightning protection device must be rated for the operating frequency of the Lynx (5.8 GHz).

   Lightning protection for the RFU-to-IDU connection portion of an outdoor implementation of the RFU must be rated to 800 MHz and must be non-blocking to DC. Proxim recommends placing lightning arrestors near the RFU and at the egress point for 2-piece systems. Lightning arrestors must be properly grounded to operate.

6. After installation, terminate the transmission line with an N-type male connector or adapter attached at the equipment end. For wave guide, this typically requires a CPR-to-N adapter.

   Be sure to use manufacturer-specified connectors and termination tools, and follow termination instructions precisely. Improper transmission line terminations can cause excess losses and reflections that can lead to many problems with the system.

7. Prior to operation, check the electrical integrity of the transmission line, including all connectors, with a simple DC check between the center conductor and outer conductor (this is neither possible, nor required for wave guide).

   The transmission line ideally should be connected directly to the antenna at one end and to the Lynx antenna port at the other end (through the RF Lightning arrestor). However, short pigtail jumper cables may be required to avoid sharp bends in the primary transmission line to limit stress on either connection.

Power Connections

The following sections describe the wiring and power connections for the Lynx radios.

The Lynx radios do not have a power on/off switch. When you connect the DC power, the unit powers up and is operational immediately. There can be up to 200mW of RF power present at the antenna port. The antenna port should be terminated (either connected to an antenna or an appropriate 50-ohm load, such as provided by a fixed RF attenuator) before power is applied. Connect the cable between the IDU and the RFU prior to applying power. The IDU can be powered separately (with no cable or RFU present), but do not connect the RFU without removing power first; then connect the cable and re-apply power.

Power is connected using the terminal block contained in the accessory kit. The terminal connector is a 3-pin mating connector.

Use the pin information listed in following tables, along with the associated figures, to wire the terminal and connect the DC power supply properly.

For DC power return connection, connect to the opposite voltage (either the -DC or the +DC Pin) and connect the return to ground at the DC power plug on pin **2.**

Necessary ONLY if power supply needs to be referenced to chassis ground.

Negative DC Power Input Pin Assignment (-20 to -63 VDC)	
Pin Number	Function
1	Power (–DC)
2	Power (–DC)
3	Ground

Figure 5 Negative Voltage DC Connection

Necessary ONLY if power supply needs to be referenced to chassis ground.

Positive DC Power Input Pin Assignment (+20 to +63 VDC)	
Pin Number	Function
1	Return (–DC)
2	Return (–DC)
3	Ground

Figure 6 Positive Voltage DC Connection

Note: Each Lynx terminal block must be fused externally with an 8 Amp maximum fuse. The DC power cable must be shorter than 3 meters (9.75 feet).

To wire the DC power, wire the power cable with an adequate current rating (minimum 18 AWG) into the terminal block using the screw connections on the terminal block.

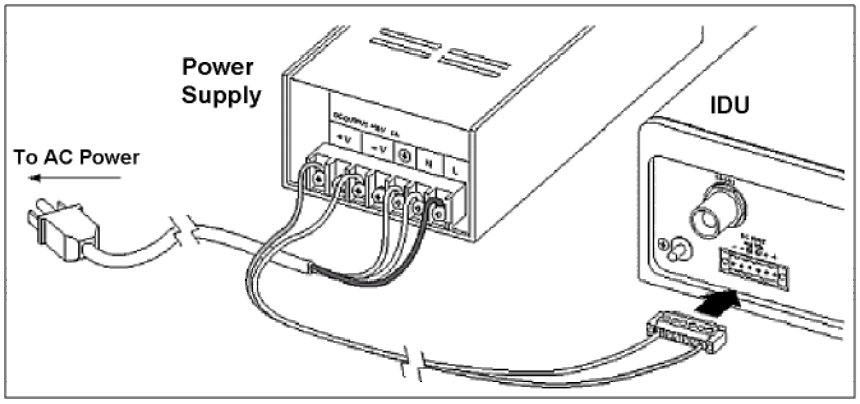


Figure 7 Power Connection for IDU

The recommended minimum current rating of external fuses and cables is 5 amps. The Lynx radios consume less than 3.1 Amp ± 48V.

- If using **negative power**, connect the negative voltage to pin **1**. Connect the ground return connection to pin **3** and use an optional jumper to pin **2** for ground reference.
- If using **positive power**, connect the positive voltage to pin **3**. Connect the ground return connection to pin **1** and use an optional jumper to pin **2** for ground reference.

The ground connection is available using pin **2**. ***Do not ground both sides of the power supply***.

Proxim recommends you leave the ground connection floating if the power supply also is floating. This configuration can help avoid ground loops and provide the best lightning protection; however, if the power source is referenced to ground, this configuration may not provide adequate grounding for lightning protection. This configuration is more susceptible to lightning damage no matter what grounding scheme for the radio power supply is chosen.

A grounding screw and nut is provided on the left front panel of the IDU. Be sure to use the local electrical code to determine wire size and proper connection to the grounding screw.

Note: Proper grounding, either through the chassis or the power supply, is important for protecting the unit against lightning. A grounding screw hole is provided on the front panel.

After wiring the terminal block for power connection, use a digital voltmeter (DVM) to verify voltage and polarity of the plug.

CAUTION! Do not connect the DC power plug to the terminal until the RFU is connected to the IDU and the antenna, or appropriate termination.

Do not connect the RFU-to-IDU cable while power is applied to the IDU. The IDU can be powered without the RFU connected; however, power should be removed before the RFU is connected and reapplied after the cable is connected and the RFU is properly terminated at the RF port.

Adjusting Output Power

In certain cases, you may need to adjust the output power lower from the factory setting; for example, to:

- Meet EIRP (Effective Isotropic Radiated Power) limits
- Avoid exceeding the maximum far-end RSL of -30 dBm
- Coordinate a hub or repeater location

Note: In certain countries, Effective Isotropic Radiated Power (EIRP) limits dictate the maximum output power the Lynx radio can transmit, given transmission line loss and antenna gain. Consult with appropriate government agencies or Proxim Corporation if there is any question regarding maximum output power allowed. Never adjust power above the factory default settings.

Using the NMS port, you can adjust the output power from factory settings.

Note: For precise measurement of transmitter power, a calibrated RF power meter (such as the HP 435B with Power Sensor HP8481) is recommended. This power sensor can be connected directly to the output of the radio without exceeding the power rating. With some power meters, it may be necessary to place a calibrated in-line fixed attenuator between the radio antenna port and the power meter so as to not exceed the power meter's maximum input level. Thruline power meters do not operate at Lynx RF frequencies.

If adjusting the output power to meet an EIRP limit, you must calculate the overall system gains and losses, including feeder losses for the type of transmission line installed and the antenna gain.

You can determine the radio transmit power for EIRP limited installations using the following equation:

Tx Power (dBm) = EIRP Limit (dBm) + Transmission System Losses (dB) - Antenna Gain (dB)

Establishing a Connection Between the Units

Follow these steps to establish connection between the radios:

1. Ensure that the antennas at both ends are aligned.

   Perform a general alignment of the antennas on both ends of the path using binoculars, compass, or other related tools. You must have the antennas aligned as accurately as possible before putting radio

traffic over the link. This helps in getting the system running more rapidly. Assure that both antennas are set for the same polarization (vertical or horizontal at both ends).

2. Connect the transmission line to the antenna and feed it to the Lynx radio location.

   Connect the opposite end of the transmission line to the N-type female connector located on the RFU through a lightning arrestor. If the RFU is mounted indoors or in a shelter, the lightning protection should be located at the cable egress point. If the RFU is mounted outdoors, it can be mounted at the RF input port of the RFU. The transmission line connection must be terminated into an antenna or a load before DC power is applied to the radio.

3. Connect RFU to IDU.

   Connect the cable the runs from the RFU to the IDU. If the RFU is mounted outdoors, ensure that proper lightning protection is used at the shelter or building egress point as well as at the RFU connector.

4. Confirm DC power connection.

   With the DC power source active but not plugged into the Lynx radio, confirm with a voltmeter that the DC mating connector has the proper power connections as discussed in Power Connections.

   - Verify the polarity and the absolute voltage on all pins.
   - Verify ground connection for power (if applicable).
   - Ensure that the RF Antenna port connection is properly terminated before applying power.

5. Connect power to the Lynx radio.

   When the unit is initially powered-on, some alarm conditions may be present. This is normal and alarms can be ignored at this time.

6. Adjust RF power (if necessary).

   Using the NMS port, verify the RF output power setting and, if necessary, adjust the output power of the local transmitter in accordance with the path analysis calculations.

   In cases of no EIRP limits, the radio transmitter output power should be left at the factory setting, except for very short paths using very high gain antennas, where excessive power may not be advised (in which case power should be reduced).

   Terminate the RF output port at all times when power is applied to the Lynx radio. Therefore, disconnect power to the unit before connecting a power meter; reapply power once connected.

   Often, an RF power meter has a limit to the input power it can measure without damage. Proxim advises you place a calibrated fixed value RF attenuator (typically 20 dB or more) between the Lynx radio and the power meter to ensure proper operation and safety for the RF power meter. The value of this fixed

attenuation then can be added to the value of the RF power meter reading to obtain the actual transmitter output power.

7. Confirm Received Signal Level (RSL).

   Connect a voltmeter to the RSL measurement port on the RF Unit. This voltage reading corresponds to the Received Signal Level (RSL) of the near-end radio. RSL is the amount of signal the near-end radio is receiving from the far-end radio. Because the antennas have not been finely aligned, the RSL value at this time will not be very high. However, you can verify that some communication is taking place between the two units.

   Use the RSL voltage reading to align the antennas. Align one antenna at a time as discussed in "Alignment Guidelines" on page 31. Align both ends of the link before proceeding.

   The RSL voltage output on the unit's front panel puts out a voltage over the usable range of the unit.

   The RSL of both sides of the link can also be measured using the NMS port.

   Several factors can contribute to low RSL:

   - Incorrect antenna alignment (aligned on a sidelobe and not on the main signal)
   - Improper polarization orientation of antennas (horizontal versus vertical)
   - Transmission line problems (loose connections, bent or damaged cables, "loss-y" adapters, improper termination)
   - Path obstructions (trees, buildings, hills, and so on)
   - Path clearance (line-of-sight, earth curvature, Fresnel zone, diffraction, and partial obstruction)
   - Weather (inversion layers, ducting, and multipath)
   - Antenna feed (coaxial/connector) problem
   - Highly reflective surfaces of the path terrain

   If RSL is lower than anticipated, re-check the path clearance and transmission line, as these are the typical causes of low RSL.

   You can verify radio operations by connecting units back-to-back with attenuators (60-80 dB), as described in "Back-to-Back Testing" on page 58. If the problem persists, see "Troubleshooting" on page 49.

   The transmitter output power adjustment on the radio affects the RSL. Depending upon EIRP limits (if any), path distance, and antenna gain, you may need to adjust the output transmit power to the proper level before putting the units in service.

8. Verify the channel plans.

   Verify that the units follow the same channel plan and that the opposite Tx and Rx frequencies complete a matched pair of radios (for example, A1 and A2 make up a matched pair).

9. Connect the unit to the intended telecommunications equipment to pass the T1 traffic.

   Connect to the T1 circuits using 8-pin modular (RJ-48C) connectors. All front panel LEDs should either be off or green. If any LEDs are red, see "LED and Control Button Descriptions" on page 42 or "Troubleshooting Alarms" on page 55.

Viewing the Radio Front Panel

This section describes the front panel components, LEDs, and control buttons for the Lynx.GX .

The IDU front panel can be thought of as having three distinct parts.

- The left portion of the IDU contains the connection for the RF Unit, the DC power connection, and the RSL and GND test points.
- The middle portion of the IDU contains connectors specific to the Lynx 16T model.
- The right portion contains LEDs, CONFIG, ALARMS, and ORDERWIRE connections, and a FAR END toggle switch.

Figure 8 illustrates the left and right portions of the IDU, which are the same for all Lynx.GX models. The front panel components shown in this figure are described following the figure.

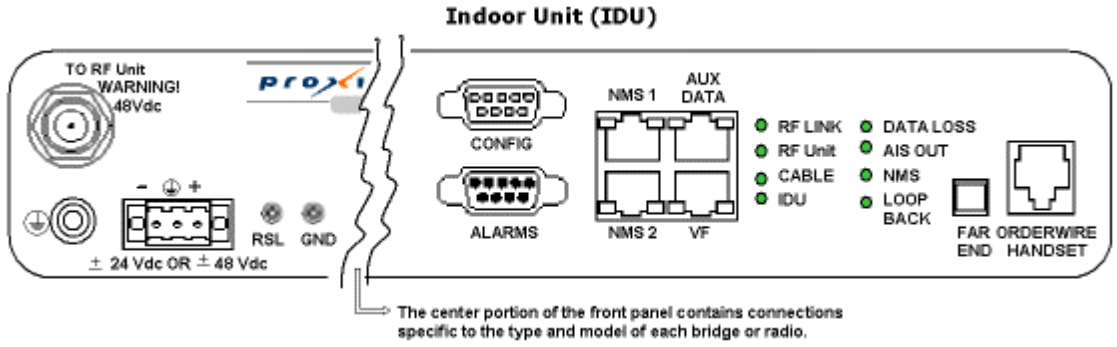


Figure 8 IDU Front Panel

Control Button and LED Descriptions

Control Button Descriptions

To RFU

This is an RF TNC female connector that is an integral part of the system. The TNC connector is used to connect the IDU to the RF Unit.

The voltage on this connector is 42 VDC.

± 24 VDC OR ±48 VDC

The power receptacle recommendation for positive or negative DC power is 24 or 48. However, it will accept any voltage between 20 and 63 Volts. Optionally, you can use an AC power adapter. For additional information, see "Power Connections" on page 36.

RSL / GND

There are two front panel test points. Connecting a voltmeter across the GND and RSL front panel test points, the voltage reading corresponds to the Received Signal Level (RSL) of the near-end radio. For example, a value of .65V corresponds to –65 dB. Pressing and holding the FAR END button while measuring the voltage at these test points displays the RSL of the far-end radio.

CONFIG

This is a serial interface port (RS-232) to the radio using a Female DB-9 connector. This port provides connection to a computer or terminal using a standard null-modem cable for retrieving diagnostic information, and allows IP and SNMP Community String configuration for the radio. The settings for this port are 9600 bps, 8 data bits, No Parity, 1 Stop Bit, and No Flow Control. The terminal emulation is VT100. See "Appendix B. Connectors and Pin Assignments" on page 63 for ALARM port connector information.

ALARMS

This connector provides alarms for external alarm collection systems using a Male DB-9 connector. There are two Form C relays that can be connected to other transmission equipment for monitoring alarm status locally or remotely. One alarm represents Major alarms (usually alarm conditions) and the other Minor alarms (usually warning conditions). See "Appendix B. Connectors and Pin Assignments" on page 63 for ALARM port connector information.

NMS1 and NMS2

There are two Ethernet 10/100 Base-TX connections for access to the Network Management System (NMS) using SNMP, HTTP, or Telnet. Both of these connections auto-negotiate speed and duplex, and auto-sense MDI or MDI-X connections.

AUX DATA

This is a serial interface port (RS-232) using an RJ-45 connector, which supports speeds from 2400 to 19200 baud (set through the NMS). This allows auxiliary serial data connection from one end of the

wireless link to the other. It can be used for separate data connections for serial devices. See "Appendix B. Connectors and Pin Assignments" on page 63 for AUX DATA port connector information.

VF

This RJ-45 connector is used to link two Lynx radios at a repeater site for Orderwire operation. This allows Orderwire calls to and from any point in the network. The circuit is a 4-wire audio (2xTX and 2xRX) that also can be connected to other existing Orderwire networks. All phones off hook hear and participate in the call. See "Appendix B. Connectors and Pin Assignments" on page 63 for VF port connector information.

LED Descriptions

LED Descriptions		
LED	**Color**	**Description**
RF Link	Green Yellow Red Flashing Red	Error-free operation Bit errors occurring Excessive bit errors or radio link failure Link Security ID mismatch within the last minute
RF Unit	Green Yellow Red	RF UNIT OK RF UNIT warning RF UNIT alarm
Cable	Green Red	Cable between system board and RF UNIT is OK Cable short longer than 5 seconds detected in the last minute
IDU	Green Yellow Red	IDU OK IDU warning IDU alarm
T1 INPUT (listed by priority)	Red Yellow Green Off	T1 Input Alarm enabled; T1 data not present on at least one channel T1 Input Alarm disabled; T1 data present on at least one channel T1 Input Alarm enabled; T1 data present on at least one channel T1 Input Alarm disabled; T1 data not present on all channels
AIS OUT	Off Yellow	Not injecting all 1s in data stream upon RF Link Red alarm Injecting AIS in data stream upon RF Link Red alarm
NMS	Green Off	Tx or Rx NMS data present on the interface No NMS interface connection detected or no data present
LOOPBACK	Flashing Yellow Solid Yellow Off	At least one data channel in loopback Internal loopback has detected at least one error No loopbacks on any channels

FAR END

When the LED on this button is red, alarms exist on the far-end radio. Press and hold the button to view those alarms on this radio's front panel. If the far-end radio is not available, all LEDs flash red. Pressing and holding this button while powering on the radio resets the IP address settings and passwords to default values.

ORDERWIRE HANDSET

This connection is used to access the electronic orderwire function (a facility for telephone style service from one radio to another). A standard analog telephone (with an electronic ringer) plugs into this connector. You can dial the orderwire address of the far-end radio (or any radio in the network) to cause that radio and any connected orderwire phone to ring; however, communications is automatically established when both handsets are lifted off hook. This communication does not interrupt or interfere with the other radio communications. The radio link must be operational to use this facility. The orderwire feature can be very useful for installation, maintenance, and troubleshooting.

Note: All Lynx radios connected to the same orderwire network should have unique address settings (telephone numbers).

Establishing Near-End to Far-End Communications using Orderwire

To establish near-end to far-end communications using orderwire:

1. Connect the telephone to the near-end and far-end radios.

   Using a standard RJ-11 telephone cable, connect a standard electronic telephone (a touch tone phone, complete with dialer) to the Orderwire connector on the radio front panel. This connector is wired identically to a standard two-wire telephone jack. For connector pin assignment, see "Appendix B. Connectors and Pin Assignments" on page 63.

2. Call the far-end radio.

   With a telephone connected to each radio on opposite ends of the link, either telephone can be used to dial-up the far-end location. The far-end radio internal ringer and the connected telephone ring, and if answered, two-way full-duplex voice communication is established.

If the radios are connected in a repeater configuration, you can establish Orderwire services in the network by connecting the radios (by cabling their front-panel VF connectors).

Orderwire operates on radios at each end of the repeater and at the repeater site. You can extend this function through several repeater sites. For hub connections of three or more Lynx radios, an external 4-wire radio is required to connect all devices for Orderwire operations.

Dialing an * [asterisk/star key] on the orderwire telephone implements an "all call" feature that rings all connected radios. All telephones provide communication to all other telephones in the connected network. Even if a particular telephone does not ring, it can still be used to talk and listen to any ongoing orderwire activity if the orderwire is in use at other terminal locations.

Also, if a phone anywhere in the connected network has accidentally been left off-hook, the # [pound] key can be used to mute all off-hook handsets until they are placed on and off hook again.

Port/Circuit Connections by Model

The following connection types are illustrated in the figures that follow.

10/100 BaseT / 100 BaseFX

The Tsunami Bridges use **100 Base-TX** and **100 Base-FX** RJ-48 modular port connectors and ST connectors for the Fast Ethernet interface. They carry the signals in and out of the radio.

CH*n*

T1 or E1 data channels.

T1

A wayside data channel for T1 (DSX-1) interface voice connection. This channel does not affect the Ethernet traffic.

E1

A balanced (120 ohm) wayside data channel for CEPT-1 interface connections.

Note:	If an unbalanced 75 ohm connection (RJ-45 connector) is required, an optional 75ohm to 125 ohm balun will provide this interface. If you cannot locate these devices, contact Customer Support.

DS-3

The connection for the DS-3 signal is BNC female (75 Ohm, unbalanced).

DS-3 input: 75 ohms unbalanced connection, shield floating with respect to chassis ground (user may ground this shield if necessary).

DS-3 output: 75 ohms, configured by default as single-ended, with shield connected to chassis ground.

Note:	DS-3 output can be changed to a 75 ohm output with shield floating with respect to chassis ground by repositioning an internal jumper. This alternate configuration is recommended if the shield is already grounded at the receiving end of the cable. Contact customer service for more information.

10/100 Base-T and 100 Base-FX Ethernet Connections

The radios use 10/100 Base-T and 100 Base-FX RJ-48 modular port connectors and ST connectors for the Fast Ethernet interface. They carry the signals in and out of the radio.

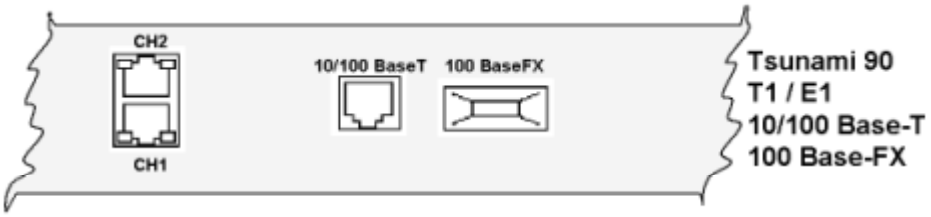


Figure 9 IDU Front Panel – Data Interface (Middle section)

12xE1 Radio Connections

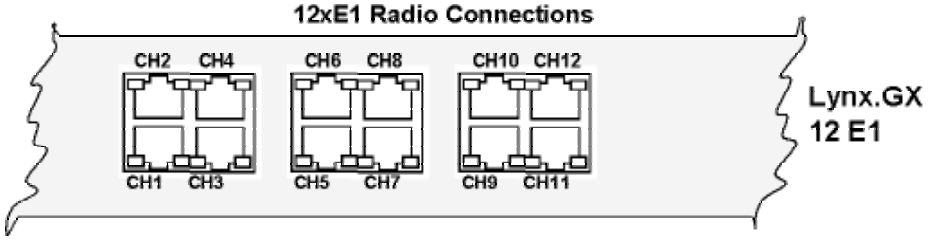


Figure 10 12xE1 Radio Connections

4xT1 and 4xE1 Connections

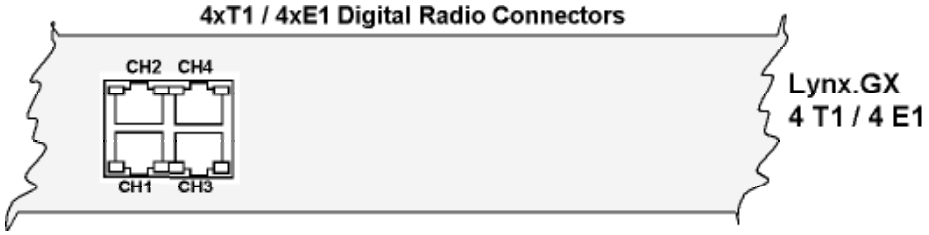


Figure 11 4xT1 and 4xE1 Connections

8xT1 and 8xE1 Connections

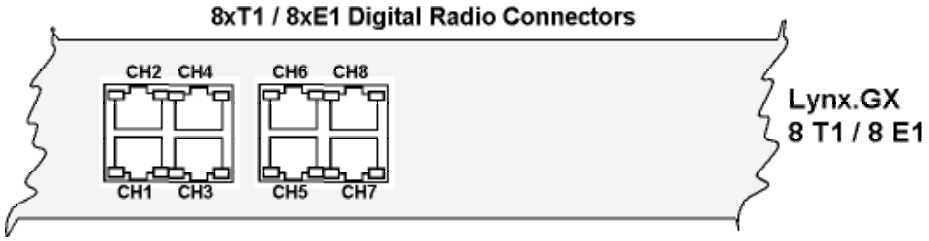


Figure 12 8xT1/8xE1 Digital Radio Connections

DS-3 Digital Connections

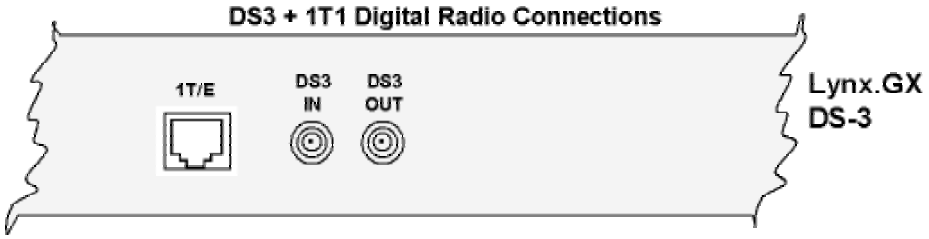


Figure 13 DS-3 Digital Radio Connections

16xT1 Connections

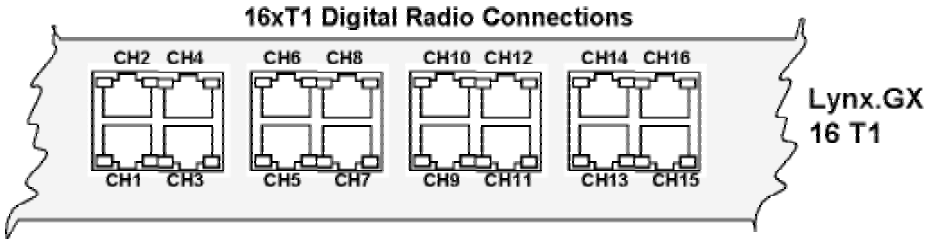


Figure 14 16xT1 Digital Radio Connections

21xE1 and 28xT1 Connections

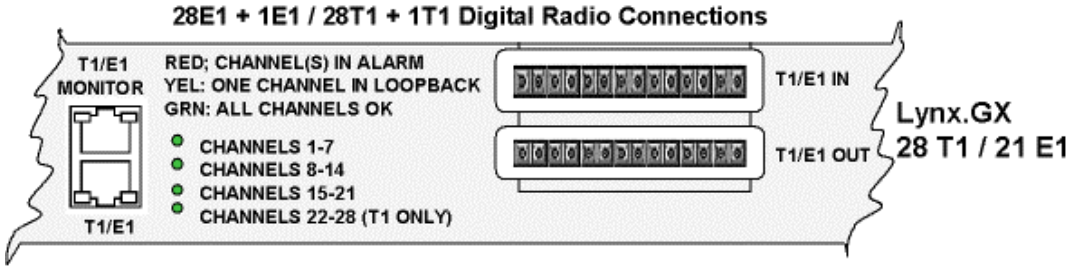


Figure 15 21xE1 and 28xT1 Connections

Appendix A. Troubleshooting

This chapter provides information about:

- Maintaining the radio
- Troubleshooting data stream errors and interference
- Troubleshooting alarms
- Measuring radio function
- Troubleshooting radio management tools
- Repair policy

Maintaining the Radio

The radio does not require any regular maintenance. However, it is prudent to monitor the radio link at regular intervals to ensure that the link conditions are not changing. When visiting a radio site for maintenance, you should check the following items and record the results:

- RSL voltage
- Power voltage
- Far-end RSL voltage
- Alarm conditions

Also, be sure to verify that the unit has adequate ventilation and that the security ID is set similarly at each unit through the network management system.

If any alarm conditions exist, you should record them. See "Troubleshooting Alarms" on page 55.

Data Stream Errors

When the radio is in service, errors in the data stream may occur. This is usually known to the operator either by faulty data indications of downstream equipment or by external bit error rate testing.

It is possible that no alarms appear on the front panel during normal operations, even when there are errors present in the data stream.

Some errors do not result in an alarm (such as bipolar violations, slow "dribbling" errors, improperly terminated connections or incorrect settings), but are exhibited on downstream data processing equipment or during a BER test.

In other cases, there may be data errors due to atmospheric conditions (fading), interference, or other reasons, but not at a high enough error level to be indicated with the BER alarm LED. In the case of these types of errors, the following information can be helpful to troubleshoot the radio link.

Indications

- During external BER test, test equipment indicates errors
- Downstream equipment (mux, channel bank, codec, router, and so on) indicates errors

Possible Causes

- Path fading due to atmospheric conditions
- Poor transmission line connections
- Antenna problems, misalignment or path clearance
- Received signal level (RSL) is too strong
- Far-end radio transmitter circuitry is faulty
- Near-end radio receiver circuitry is faulty
- Interference

Recommended Actions

- Verify 100 Base-T wiring
- Follow the troubleshooting instructions described in "Radio Fail Alarms."

Changing Frequency Plans

The information in this section can be used for indoor unit models only.

The Lynx.GX frequency selections are listed in "Frequency Plan Determination." The near-end radio and the far-end radio must be corresponding (for example, A1 / A2).

The frequency of a given Lynx terminal is set by:

- The specific filter
- The physical orientation of this assembly
- A setting within the CONFIG port (see "CONFIG Port Command Line Interface").

With respect to a given filter, the frequencies are fixed, because tuned RF filters are required for normal operation. Changing of the (pre-tuned) radio frequencies may be required when installing spares or for special situations (such as interference mitigation). This is accomplished by installing an alternate filter.

1. Remove any cables connected to the antenna connector on the diplexer (filter) and then remove the two screws that mount the filter to the Lynx chassis.

2. Slowly remove the filter from the chassis being careful to not endanger the cables that are connected to the rear side of the filter.

3. Disconnect the two SMA connectors that are attached to the rear of the filter with a 5/16-inch open end wrench.

4. Select the new filter such that the frequency channel label on the filter corresponds to the desired frequency channel (or rotate filter if applicable).

5. Connect the two SMA connectors to the new or reoriented filter with the 5/16-inch open end wrench.
6. Slowly place the wired filter assembly so that it is flush with the rear panel.
7. Install the two screws that mount the filter to the rear panel.
8. Modify the operating frequency as described in the CONFIG menus.
9. Single-band versions of this radio can be interchanged from A1 to A2 by changing (but not rotating) the installed filter. After the filter is changed, you must change the frequency settings within the configuration menu (NMS) to match the installed filter.

Dual-band versions of this radio can also change channels, but the orientation of low-side or high-side transmit must be retained. That is, an A1 radio can only be changed into a B1 radio with a new filter, but not into an A2 or a B2. Likewise, the A2 radio can only be changed into a B2 radio with a new filter, but not into an A1 or B1. The diplexer filters can go on any radio and must be properly oriented. After the filter is changed, you must change the frequency setting within the configuration menu (NMS) to match the installed filter.

Servicing Channel Orientations

For dual-band units, a spare of each band may be required. For single-band units, one spare Lynx terminal can service both channel orientations. See "Changing Frequency Plans" for how to change frequencies of a spare radio.

Customers with several radios, or radios in critical operations, are encouraged to purchase one or more spare radios of each model in their system. This allows for rapid restoration of radio service in the unlikely event of a radio failure.

Counteracting and Evaluating Interference

The recommended interference countermeasures available are:

- Short paths
- Narrow beam antennas (high gain)
- Frequency selection
- Antenna Polarization
- Transmit Power
- Equipment/Antenna Location
- Use of a Spectrum Analyzer to evaluate potential interference

Short Paths

The single most effective countermeasure against interference is to maintain "short path" length. This may be achieved by dividing long paths into multiple small paths by cascading hops. Intermediate repeaters can be formed using back-to-back Lynx terminals and transmit output power reduced, if required.

By definition, "short path" is defined as a path where fades are extremely rare and signal levels vary by no more than ±3 dB during fades. This distance varies with the RF frequency. Typically a "short path" is defined as any path length shorter than 5 miles at 5.3/5.8 GHz.

Narrow Beam Antennas (High Gain)

This is the next most effective countermeasure. Narrow-beam antennas ensure that the transmitted power is sent in a single direction; this minimizes the possibility of causing interference inadvertently to other users. Narrow beam antennas also reject off-azimuth signals being received from potential sources of interference and have high gain, which boosts desired receive levels and improves the carrier-to-interference ratio.

When selecting narrow beam antennas, it is helpful to know that larger antennas generally out-perform smaller antennas. Another important antenna specification is the front-to-back ratio, which ensures rejection of unwanted signals from azimuth angles behind the antenna.

Frequency Selection

The Lynx radios offer several distinct non-overlapping frequency channel plans (see "Determining the Frequency Plan" on page 16 and "Changing Frequency Plans" on page 50) and the unit's RF filter can reject interference more than 10 MHz away from the receive frequency.

Offset frequencies combined with other countermeasures may enable several receive channels to operate at a single hub site. Because of the limited spreading ratio used, frequency selection is more efficient than code selection for interference rejection when operating multiple Lynx terminals at a single site.

You often can overcome interference by exchanging frequencies of both ends of the radio link (for example, change your A1 terminal to an A2 and change the other end from an A2 to an A1). Also, changing channel plans (for example, from A to B) can be very effective.

Note: The information in this section can be used for indoor unit models only.

The Lynx frequency selections are listed in "Determining the Frequency Plan" on page 16. The near-end radio and the far-end radio must be corresponding (such as A1 / A2).

The frequency of a given Lynx terminal is set by the specific filter, the physical orientation of this assembly, and a setting within the CONFIG port.

With respect to a given filter, the frequencies are fixed, because tuned RF filters are required for normal operation. Changing of the (pre-tuned) radio frequencies may be required when installing spares or for special situations, such as interference mitigation. This is accomplished by installing an alternate filter.

1. Remove any cables connected to the antenna connector on the diplexer (filter) and then remove the two screws that mount the filter to the Lynx chassis.

2. Slowly remove the filter from the chassis, being careful to not endanger the cables that are connected to the rear side of the filter.

3. With a 5/16-inch open end wrench, disconnect the two SMA connectors that are attached to the rear of the filter.

4. Select the new filter such that the frequency channel label on the filter corresponds to the desired frequency channel (or rotate filter if applicable).

5. Connect the two SMA connectors to the new or reoriented filter with the 5/16-inch open end wrench.

6. Slowly place the wired filter assembly so that it is flush with the rear panel; install the two screws that mount the filter to the rear panel.

7. Modify the operating frequency as described in the CONFIG menus (see "CONFIG Port Command Line Interface" **Error! Bookmark not defined.**).

8. Single-band versions of this unit can be interchanged from A1 to A2 by changing (but not rotating) the installed filter.

   After the filter is changed, the frequency settings within the configuration menu (NMS) must be changed to match the installed filter.

   Dual-band versions of this unit also can change channels, but the orientation of low-side or high-side transmit must be retained. That is, an A1 unit can only be changed into a B1 unit with a new filter, but not into an A2 or a B2. Likewise, the A2 unit can only be changed into a B2 unit with a new filter, but not into an A1 or B1. The diplexer filters can go on any radio and must be properly oriented. After filter is changed, the frequency setting within the configuration menu (NMS) must be changed to match the installed filter.

Servicing Channel Orientations

For dual-band units, a spare of each band may be required. For single-band units, one spare Lynx terminal services both channel orientations.

Customers with several units, or units in critical operations, are encouraged to purchase one or more spare radios of each model in their system. This allows for rapid restoration of radio service in the unlikely event of a radio failure.

Antenna Polarization

Cross-polarized antennas can provide approximately 20 to 30 dB discrimination of unwanted signals. The actual discrimination depends upon the antenna design and any rotation of polarization along the path (for example, due to reflections). Discrimination only exists between two orthogonal polarizations:

- Vertical versus horizontal
- Left-hand circular versus right-hand circular

There is only 3 dB discrimination between circular and linear (vertical or horizontal) polarization.

Interference can sometimes be overcome by changing antenna polarization at both ends of the link.

Transmit Power

The maximum level into the receiver is -30 dBm. Errors can occur in the receive data stream above this level. You should reduce transmit output power on very short paths to avoid overload.

Equipment/Antenna Location

Interference is occasionally caused by the unit or the antenna being too close to another similar transmitter. Moving the unit, the antennas, or the interfering equipment can reduce or eliminate interference.

Interference countermeasures rely to some extent on the measurement of the received interference level and frequency. Before turning up a new hop, use a spectrum analyzer to monitor the spectrum at each end to check for possible interfering signals. For more details, see the section that follows.

Use of a Spectrum Analyzer to Evaluate Potential Interference

Connecting to the antenna and using "peak hold" on a spectrum analyzer, the spectrum across the receive frequency range of the radio can be swept and any signals being received at levels above the radio's specified threshold identified.

If potential interfering signals are found, you can change the Lynx frequency plan to avoid a receive channel that may contain significant interference (see "Changing Frequency Plans" on page 50). For example, interference can be reduced by moving from the A1/A2 plan to the B1/B2 plan, or by swapping terminals or RF filters so that A1 becomes A2. Signals outside the receiver frequency range can be ignored: they do not cause interference.

If a spectrum analyzer is not available, you can use the RSL voltage to indicate the background noise and interference level within the receiver RF filter band when the far-end transmitter is turned off. With the far-end radio turned off, if an RSL voltage level above the radio's threshold level is measured, there is potential interference in this frequency channel.

When using a spectrum analyzer for determining the presence of interference, use very narrow resolution bandwidth settings to detect signals down to the unit's threshold (approximately -80 dBm, depending upon the type of radio).

Troubleshooting Alarms

Use these troubleshooting guidelines when you receive:

- RF Link Alarms
- Radio Fail Alarms
- Far End Alarms

RF Link Alarm

This LED indicates that the demodulator function is not synchronizing with the intended received signal.

Possible Causes

- Severe path fading due to atmospheric conditions, usually accompanied by low RSL voltage reading
- Poor transmission line connections, usually accompanied by low RSL voltage reading
- Antenna problems, misalignment, or path clearance, usually accompanied by low RSL voltage reading
- Improper radio settings (such as frequency channel)
- Received signal level (RSL) is too strong
- Interference
- Far-end radio transmitter circuitry is faulty
- Near-end radio receiver circuitry is faulty
- Link security ID not the same for each radio

Recommended Actions

Check the following at each end of the link:

- Verify that rear panel filters are opposite channel plans on each end (for example, one is A1 and other is A2).
- Verify that radio frequency settings match each installed filter using the **NMS Config** menu.
- Verify that all connections between radios and antennas are secure and all devices between radios and antennas are rated for the radio frequency band (5.3/5.8 GHz).

Measure RSL by placing a voltmeter across RSL and GND test points and:

1. Comparing this voltage to the Factory Test Data Sheet and estimating the RSL in dBm.
2. Comparing this to the RSL that was expected using path calculations (see "Calculating RSL and Link Budget" on page 15).
3. Pressing and holding the DISPLAY FAR END button and measuring the far-end RSL (while continuing to hold the button) or on those models without FAR-END RSL on the front panel, using the built-in browser software to acquire the near-end and far-end RSLs.

4. Comparing these RSLs to the Factory Test Data Sheet for the far-end radio and estimating the RSL in dBm.

5. Comparing this RSL to the expected RSL from the link budget calculations.

Excessive Loss

If RSL from both ends of the radio are approximately the same as each other, but lower than anticipated for this installation, then the likely cause of the BER alarm is excessive losses between the radios. Excessive loss problems could include the transmission line at either end, all adapters, connectors, the antennas, the antenna alignment, as well as the path itself (any obstructions or clearance problems).

Verify antenna alignment, line-of-sight, and path clearance; if this does not improve RSL, check all devices between the radios and their antennas at both ends. Make sure all transmission lines, connectors, and any other devices are properly rated for operation at the radio's frequency (5.3/5.8 GHz).

Power Adjustment

If only one end has low RSL, this could be caused by low transmit output power from the opposite end radio. Verify that the transmitter output power of the radio opposite to the low RSL receiver has been set in accordance to path calculations or EIRP restrictions (where applicable).

Power adjustment must be performed by professional installation personnel only. The PWR test point can be used and compared with the Factory Test Data Sheet; the front panel recessed potentiometer can be turned clockwise to increase power. If an RF power meter is available, you can connect it to the RF output of the radio for precision measurement. This test also verifies that the radio transmitter is working properly.

If one terminal (or both) has high RSL, this could be caused by a very short path or interference.

Short Path or Interference

To verify the possible presence of interference, remove DC power to the unit opposite the one that is reading high RSL. Once power is removed, measure RSL on the remaining radio. If RSL voltage is lower than that listed for "Threshold" in the Factory Test Data Sheet, an interfering signal is present.

If interference is suspected, the easiest potential remedy is to swap frequency channels on both sides of the link. (see "Changing Frequency Plans" on page 50). Swap terminals at both ends of the link so they are the opposite of their original installation. After both ends are moved, reconnect the radios and determine whether the BER alarm is still active. If so, you can install other frequency channels or try other interference counter-measures, as discussed in "Counteracting and Evaluating Interference" on page 51.

Possible Radio Failure

If all path related and data input problems have been pursued and the BER alarm is still active, the problem could be related to a radio failure. Although radio failure typically is indicated by more severe alarm conditions, it is possible that one of the radios may be out of specification, and this could be the cause of the BER alarm. A back-to-back test verifies proper radio operation. See "Back-to-Back Testing" on page 58 for more information. A threshold test on both radios, along with a test to verify proper RF output power, would be beneficial.

Perform a back-to-back test before returning any radio terminal to the factory for repair. A back-to-back test verifies radio operation.

If the radios pass their back-to-back testing successfully, the problem is likely with the path, with the connections between the radio and the antenna, or interference. Before you reinstall the radios, be sure to set the output power to the appropriate level for the installation.

Radio Fail Alarms

This LED indicates a known problem with the radio hardware.

Possible Causes

- Internal synthesizers are unlocked
- Internal digital circuits have failed

Recommended Actions

1. Remove power from the unit.
2. Verify that the correct frequency is configured on the browser Configuration tab.
3. Check to make sure power supply voltages are within specification.
4. Reapply power to the unit, even if the voltages were within specification.

If the RADIO FAIL alarm clears, place the radio back into service.
If the RADIO FAIL alarm does not clear, perform a back-to-back test to verify radio operation.
If the RADIO FAIL alarm is still active in a back-to-back test, return the radio to the factory for repair.

Far End Alarms

This LED indicates that there is an alarm condition present on the far-end radio. When the DISPLAY FAR END button is pressed (and held), the status LEDs indicate the alarm conditions of the far-end radio.

Possible Causes

One or more alarm condition(s) exist on the far-end radio.

Recommended Actions

Press and hold the DISPLAY FAR END button and observe the LED status.

Follow the troubleshooting instructions provided in "RF Link Alarms" and "Radio Fail Alarms."

Measuring Radio Function

You can measure radio function using Back-to-Back Testing and Link Testing, which are described in this section.

Back-to-Back Testing

Back-to-back testing is an ideal method of testing the Lynx radio. This testing eliminates link problems caused by auxiliary equipment, installation, or the radio path, and isolates potential radio hardware problems.

Note: Back-to-back testing must be performed to verify a radio problem before returning any radio to the factory for repair.

Required Equipment for Test

Back-to-back testing must be performed with both radios at the same location. The following test equipment is required:

- DC power source capable of supplying approximately 90 Watts (total) to the radios (or two AC adapters)
- One low-loss coaxial cable, N-to-N male
- One (or more) coaxial in-line calibrated fixed attenuators, 40 to 80 dB total attenuation

The following test equipment may also be useful for further testing of the radio:

- BER tester
- Variable (60 dB range or more) RF attenuator (rated for the proper frequency, 2.4 or 5.8 GHz)
- RF power meter

When the equipment is connected as shown in the following figure, both radios should have no alarm conditions. If these conditions have been met, it is likely that the radio is operating in accordance to specifications. If errors or alarms occur during this test, verify alarm status. If alarms or errors are still present, the radio is likely to be faulty.

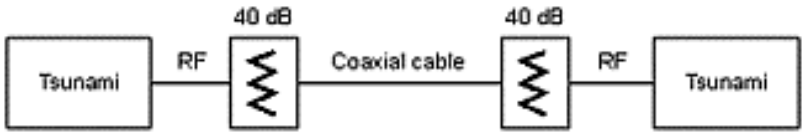


Figure 16 Back-to-Back Test Configuration

If further troubleshooting is required, you can insert a variable RF attenuator between the radios to fade down the path to determine that the threshold specification is being met. You can run the threshold tests in both directions to isolate the radio problem (if any). See "Link Testing" below for more information. You can use an RF power meter to individually test each radio's output power.

The Lynx radios will be damaged if appropriate attenuation is not supplied between radios. You must provide a minimum of 40 dB and no more than 80 dB attenuation between the two radios.

Link Testing

Link testing is the preferred way to evaluate a radio link's performance. It can be performed from end-to-end or in link test mode (which tests both directions of the radio path). The following figure illustrates a typical test configuration (which may include the radio's path instead of in-line attenuators).

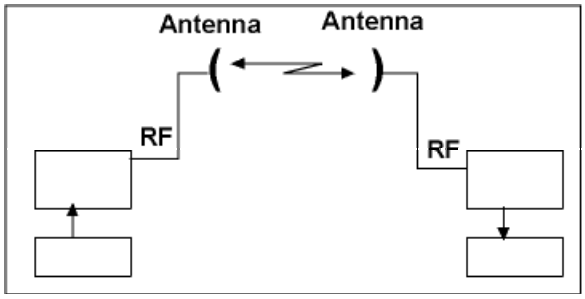


Figure 17 Link Testing Configuration

When performing testing, make sure of the following:

- Disconnect all 100 Base-T inputs and outputs to both radios
- Verify all configuration settings

You can perform link testing on the bench with two terminals back-to-back, or over the radio path. Also, it can be performed from end-to-end (which requires two 100BaseT test sets over a link, the far-end unit slaved to the near-end unit's clock) or in loopback mode.

Note: If link testing indicates an unacceptable level of errors, follow the instructions in "RF Link Alarms" or perform a back-to-back test as described in "Back-to-Back Testing" on page 58.

Troubleshooting Management Tools

The following two scenarios may help you troubleshoot management functions.

Troubleshooting the Console Management Tool

Problem

- Non-functioning CONFIG port
- No access to the main menu

Solution

To verify your PC settings and RS-232 cable, bring up a HyperTerminal session with one end of the cable plugged into the PC com port and the other end unplugged.

Using a piece of wire, short pins 2 and 3 together on the unplugged end of the cable. Make sure the HyperTerminal window is active and enter some characters from the keyboard. You should see the characters displayed in the HyperTerminal window. If you cannot see the characters, make sure the **com** port settings are correct and try a different cable.

Double-check the HyperTerminal configuration settings and plug the cable back into the radio **config** port. If the characters displayed as previously described, the HyperTerminal configurations are correct, and the menu still is not displayed when you press the **Enter** key twice, the **config** port may already be "logged in."

Once you are logged in to the **Config** menu, the **config** port stays logged in for the timeout period specified under Main Menu item 4, **User Configuration**. The default is 7200 seconds or 2 hours.

If you unplug the cable or shut down HyperTerminal while you are still logged in and you restart the HyperTerminal session, it appears as if you have a blank screen that is not responding.

To get started again, press the <Tab> key a few times. If you were in a screen with multiple entry fields when you shut down, you will see the cursor move between those fields. Bring the cursor back to the command field on the lower right part of the screen and press the **<H>** key followed by **Enter** to go back to the Main Menu.

To log out of the **config** port, go to the command field and press the **<H>** key; then press **Enter** to go to the Main Menu. Then press **<O>** and **Enter** to go to the Logon menu.

From the command field in the logon screen, press **<D>** and **Enter** to end the session. Pressing **Enter** twice restarts the session and brings up the logon screen.

Troubleshooting the Web Interface Management Tool

Problem

- Slow Web Interface
- Unable to logon to the Web Interface

Solution

Check the Ethernet duplex settings of the NMS port and the PC or switch connected to it. If the NMS port is set to **full duplex** and the device connected to it is set to **half duplex**, or vice versa, the web browser still works but is slow.

Make sure the duplex settings all match. The duplex setting for the NMS port can be set in the **Config Port** menu, under submenu 3, **Network Configuration**, item 9, **Ethernet Duplex**. Ignore item 5, **Ethernet auto select access** as it is an artifact from the original application from which the code was ported and has no function.

Repair Policy

The Lynx terminal includes comprehensive alarm indicators designed to diagnose potential faults. Should a fault occur, it often can be resolved by operator adjustment.

Should a fault occur that cannot be resolved by operator adjustment and has been confirmed by back-to-back testing, the equipment should be returned to the factory for repair.

The Lynx radios are complex systems not designed for user repair. Do not remove the cover or open any part of the terminal. The complete terminal should be sent back in its original packing material for factory repair.

Contact the factory in advance of returning the product. You will be assigned a Return Material Authorization (RMA) number that authorizes your return. Units sent to the factory without an RMA number may delay the repair process.

Be sure to include the following information:

- RMA number
- Description of the problem
- Your name and telephone number
- Return shipping address
- Urgency of repair

See the published Warranty policy for repair policy details.

Lynx radios should be packaged in their original packing boxes for shipment. Whenever possible, Proxim Corporation can provide an empty box shipment to facilitate proper packaging. Regardless, proper and adequate packaging must be used for shipments to protect the units from damage. Proxim Corporation cannot be held responsible for any repairs due to inadequately packed materials. Damage caused by improper packing will likely result in higher repair costs and delays. See "Warranty" for explicit product warranty information.

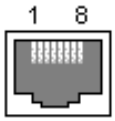
Proxim Corporation provides 24-hour telephone technical support with purchased service plans. We do, however, encourage you to troubleshoot your Lynx radio and link according to the troubleshooting methods provided in this document.

Appendix B. Connectors and Pin Assignments

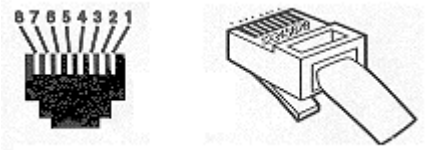
This appendix describes the Lynx.GX radio port connectors and pin assignments for the IDU (Indoor Unit) and RF Unit.

IDU Main Traffic T1/E1 Connection

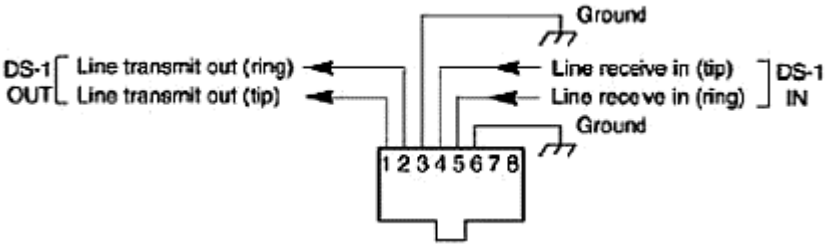
The main traffic ports for T1 or E1 formats appear on the front panel as multiple 8 pin modular jack connectors wired per RJ48C. The following figures illustrates the traffic port pin assignment, followed by a table listing the pin assignment descriptions.



8-Pin Modular Jack, Front View



8-Pin Modular Plug, Front and Top Views

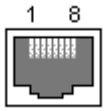


T1/E1 Port Connector Pin Assignments

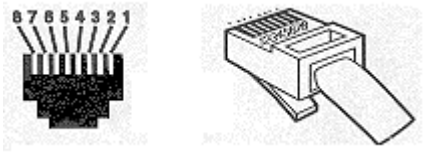
T1/E1 Traffic Port Connector Pin Assignment Description	
Pin	**Description**
1	DS-1 OUT-tip: Line transmit out (tip)
2	DS-1 OUT-ring: Line transmit out (ring)
3	GND: Chassis Ground
4	DS-1 IN-tip: Line receive in (tip)
5	DS-1 IN-ring: Line receive in (ring)
6	GND: Chassis Ground
7	NC: No Connection
8	NC: No Connection

IDU VF Port

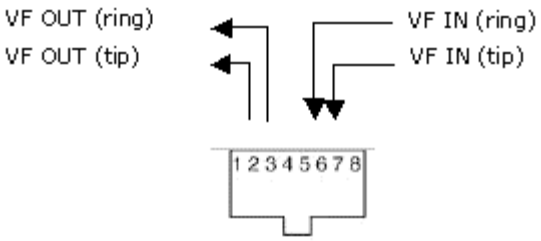
The front panel VF (Voice Frequency) Port supports standard audio interfaces (600 ohm balanced, 0 dBm maximum level) on an 8 pin modular jack as shown below.



8-Pin Modular Jack



8-Pin Modular Plug

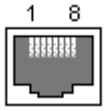


VF Port Connector Pin Assignments

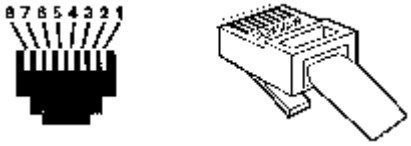
VF Port Connector Pin Assignment Description	
Pin	**Description**
1	NC: No Connection
2	VF OUT-tip: Audio Output (tip)
3	VF OUT-ring: Audio Output (ring)
4	NC: No Connection
5	NC: No Connection
6	VF IN-ring: Audio Input (ring)
7	VF IN-tip: Audio Input (tip)
8	NC: No Connection

IDU Aux Data Port

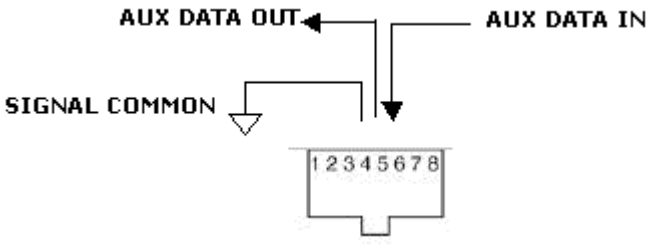
The front panel Aux (Auxiliary) Data Port supports EIA-561 serial data on an 8 pin modular jack as shown below. The data rate is user selectable to 2400, 4800, or 9600 bps. The asynchronous data is configured for 1 start bit, 8 data bits, and 1 stop bit.



8-Pin Modular Jack for Aux Port



8-Pin Modular Plug, Aux Port

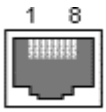


Aux Port Pin Assignments

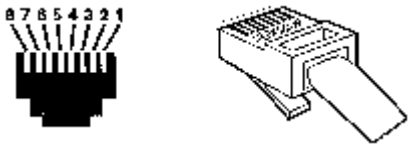
Aux Data Port Connector Pin Assignment Description	
Pin	**Description**
1	NC: No Connection
2	+3.3 V (Data Set Ready)
3	NC: No Connection
4	Common Signal/Chassis Ground
5	Aux Data Out
6	Aux Data In
7	+3.3 V (Clear To Send)
8	NC: No Connection

IDU NMS Port

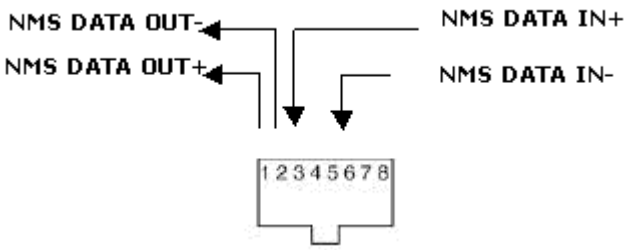
The two front panel NMS (Network Management System) Port connectors (NMS1 and NMS2) support 10BaseT and 100BaseT Ethernet serial data using two 8-pin modular jack connectors. Shown below is the wiring for each connector per USOC 568B. Two jacks permit bridging to other Ethernet devices without the need for an additional Ethernet hub or switch.



NMS Port Jack



NMS Port Plug



NMS Port Pin Assignments

NMS Port Connector Pin Assignment Description	
Pin	**Description**
1	NMS Data Out+
2	NMS Data Out-
3	NMS Data In+
4	*
5	*
6	NMS Data In-
7	*
8	*
*	Connected to cross-talk suppression circuits.

IDU Alarm Port Connector and Pin Assignment

External alarm outputs are provided using the 9-pin, D-type ALARM female connector. Two Form C summary alarm relays capable of switching 30 VDC at 1A are provided. Both relays are energized in the normal state and de-energized in the alarm state.

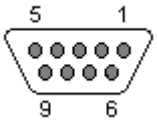
- Summary alarm is activated by any near-end front panel LED alarm condition, including when the internal test mode is enabled.
- Out-of-service alarm is activated by any of the following alarm conditions: RF LINK, Radio Fail, Internal Test

All alarms are active for a minimum of one second, or as long as the alarm condition persists, which ever is longer duration.

Two alarm inputs are also available for monitoring dry switch contacts. Grounding an input causes the alarm to go TRUE.

The following figure illustrates the Alarm port pin assignment followed by a table listing the assignment descriptions.

DA9S Jack



DA9S Jack Pin-Out

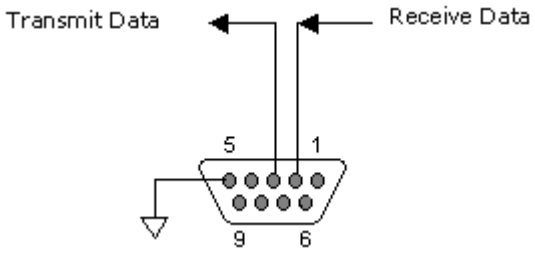
Alarm Port Connector Pin Assignment Description	
Pin	**Description**
1	NO, Summary Alarm, Form C: normally open connection on summary alarm relay. Closed when in alarm.
2	NC, Summary Alarm, Form C: normally closed connection on summary alarm relay.
3	COMMON CHASSIS/SIGNAL GROUND. Open when in alarm.
4	NO, Out-of-Service Summary Alarm, Form C: normally open connection on out-of-service summary alarm relay. Closed when in alarm.
5	NC, Out-of-Service Summary Alarm, Form C: normally closed connection on out-of-service summary alarm relay. Open when in alarm.
6	C, Summary Alarm, Form C: common connection on the summary alarm relay.
7	Contact Alarm 1 Input: 4.7K pull-up resistor to 3.3V, Alarm1 TRUE when grounded.
8	Contact Alarm 2 Input: 4.7K pull-up resistor to 3.3V, Alarm2 TRUE when grounded.
9	C, Out-of-Service Summary Alarm, Form C: common connection for the out-of-service summary alarm relay.

IDU Configuration Port Connector and Pin Assignment

Configuration (CONFIG) port connections to modems, computers, or terminals, as well as auxiliary data connections, are made using a 9-pin, D-type, female connector. The CONFIG port is configured as a DTE (Data Terminal Equipment) so a null modem cable is required when connecting to a DTE such as on a standard PC Serial COM port.

The following figure illustrates the CONFIG port/AUX port connector.

IDU Config Port Connector (DA9S)



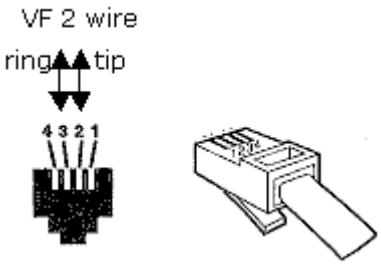
IDU Config Port Pin Assignments

Configuration Port Connector Pin Assignment Description	
Pin	**Description**
1	NC: No Connection (Data Carrier Detect)
2	Serial Data Input (Receive Data)
3	Serial Data Output (Transmit Data)
4	+3.3V (Data Terminal Ready)
5	Common Signal/Chassis Ground
6	NC: No Connection (Data Set Ready)
7	+3.3V (Request To Send)
8	NC: No Connection (Clear To Send)
9	NC: No Connection (Ring Indicator)

IDU Orderwire Handset Port

The IDU front panel Orderwire Handset Port supports connection to standard telephone handsets on a 6 pin RJ12 modular jack as shown below. Note that 4 pin RJ11 modular plugs from standard handsets fit into 6 pin modular jacks, automatically centering themselves. A two wire connection for VF interfaces can also be used as shown.

RJ12 6-Pin Modular Jack, Front View



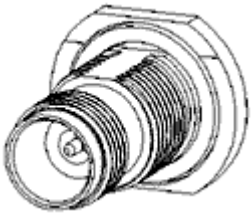
RJ11 4-Pin Modular Plug (typical handset termination)

Orderwire Handset Port Connector Pin Assignment Description	
Pin	**Description**
1	NC: No Connection
2	NC: No Connection
3	Orderwire Tip (pin 2 on RJ11)
4	Orderwire Ring (pin 3 on RJ11)
5	NC: No Connection
6	NC: No Connection

IDU/RFU Cable Connector and Pin Assignment

The IDU (Indoor Unit) is connected to the RFU (RF Unit) using a 50-ohm coaxial cable terminated with male TNC (Threaded Neill Concelman) connectors on each end. The female TNC connector provides termination for this coaxial cable on both the IDU front panel and RFU enclosures. The single coaxial cable carries power, telemetry, receive IF signals, and transmit IF signals between the IDU and the RFU.

The following figure illustrates the IDU/RFU port TNC connector.



TNC Remale Front Panel Connector

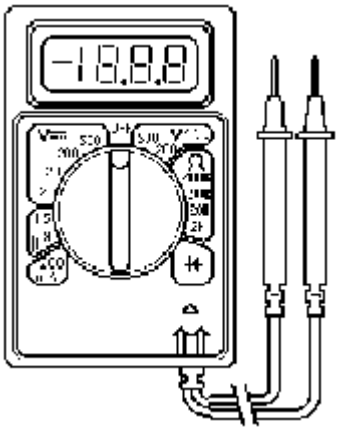
TNC Male Connector, Coaxial Cable Termination

TNC Port Connector Pin Assignment Description	
Pin	**Description**
Center	42 VDC, 125 kHz Telemetry, 140 MHz Receiver IF, 748 MHz Transmitter IF
Outer	Common Signal/Chassis Ground

RSL and GND Connectors

The RSL (Received Signal Level) and GND (Ground) front panel connector are both single connection female connectors that permit insertion of a 0.062" test probe pin from a VOM (Volt Ohm Meter).

Front Panel Test Points



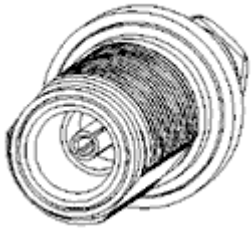
Typical VOM Showing Test Probes

RSL and GND Connector Pin Assignment Description	
Pin	**Description**
RSL	Received Signal Level: Voltage = -0.01 * RSL(dBm) Example: +0.5 volts indicates a -50 dBm received signal level.
GND	Common Signal/Chassis Ground

RFU/Antenna Connector and Pin Assignment

The RFU (RF Unit) is connected to the antenna using a 50 ohm coaxial cable terminated with male Type N (Neill) connectors on each end. The female Type N connector provides termination for this coaxial cable on the RFU enclosure and antenna assembly.

The following figure illustrates the RFU Antenna port Type N connector.



Antenna Type N Female Front Panel Connector

Antenna Type N Male Connector

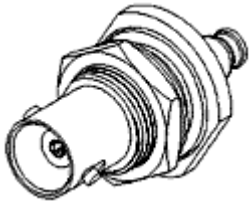
TNC Port Connector Pin Assignment Description	
Pin	**Description**
Center	Transmitter and Receiver RF
Outer	Common Signal/Chassis Ground

RFU RSL/Tone and Pin Assignment

The RFU (RF Unit) is provided with a BNC (Bayonet Neill Concelman) connector that provides a dual function for assisting in antenna installation and steering:

- Provide a high impedance drive DC voltage level corresponding with the RSL (Received Signal Strength). A standard DVM (Digital Volt Meter) is used for this purpose.
- Provide a low impedance drive AC voltage tone that indicates the RSL. This tone is monitored using a 40 ohm headset. A higher pitch tone indicates a stronger signal

The following figure illustrates the BNC connector.



RSL/Tone BNC Female Panel Connector

RSL/Tone BNC Male Connector to DVM or Headphone

BNC Port Connector Pin Assignment Description	
Pin	**Description**
Center	DVM mode: Lower voltages for higher strength signals: Received Signal Level: RSL (dBm) = -100 * BNC (volts) Examples: -70 dBm: 0.7 V -50 dBm: 0.5 V -30 dBm: 0.3 V Earphone mode: Higher pitch tones for higher strength signals: BNC Audio: Tone Frequency (Hz) = 460800/(-2 * RSL (dBm) +76) Examples: -70 dBm: 2133 Hz -50 dBm: 2618 Hz -30 dBm: 3388 Hz
Outer	Common Signal/Chassis Ground

Appendix C. Technical Specifications

Specifications that apply to all Lynx.GX models are presented in the next section, followed by the general specifications for Tsunami models. Specifications that are specific to individual product types follow.

Lynx.GX General Specifications

General System Parameters	
Operating Frequency	5.3 – 5.8 GHz
Product Configuration	1+0 IDU + RF Unit (RFU with outdoor option)
Digital Capacity	1.544 Mbps (T1) to 44.564 Mbps (DS-3)
Intermediate Frequency	749 MHz, 140 MHz (+/- 2 Mhz)
Digital Interface	DSX-1, NxDSX-1, DSX-3; CEPT-1, NxCEPT-1
Error Floor	10^{-11}
Latency (msec)	<500 usec
Error Correction	FEC, Reed-Solomon Decoding
Security	12 character Link ID code
Regulatory Compliance	FCC Part 15.247 ISM; Part 15.407 U-NII
FCC ID	HZB –US5358-GX1

Transceiver Specifications	
Frequency Range	5.250 – 5.350 GHz, 5.725 – 5.850 GHz
Modulation type	QPSK
System Gain	See Unit specifications
Aggregate Data Rate	See unit specifications
Transmit Output Power	See Unit specifications
RF Transmit Power Range	20 dB
Transmit Frequency Stability	± 5 ppm
Receive Threshold at 10-6 BER	See Unit specifications
Maximum Receive Level	-20 dBm error free, 0 dBm without damage

Digital Interface (on IDU)	
Main Line Interface	
Interface	DSX-1 (T1), DSX-3 (DS-3) or CEPT-1 (E1)
Line Rate	1.544 Mbps up to 44.564 Mbps
Connector(s)	RJ-48C for 1 x T1 or E1, up to 16 T1 or 12 E1 64-pin DSX, 28T1 or 21 E1

Line Code	T1: AMI or B8ZS, selectable; E1: HDB3
Line Buildout	T1: 0 to 655 ft, selectable
Blue Code	AIS (Alarm Indication Signal)
Regulatory Compliance	DSX-1, DSX-3 (ANSI-T1-102-1987); CEPT-1 (ITU-T G.703)
Wayside Channel	
Interface	DSX-1 (T1)
Connector	RJ-48C, modular jack
Line Code	AMI or B8ZS, selectable
Line Buildout	0 to 655 ft, selectable
Blue Code	AIS (Alarm Indication Signal)
Regulatory Compliance	ANSI-T1-102-1987
T1/E1 Monitor (Only on 28xT1 or 21xE1 models)	
Interface	DSX-1 (T1)
Connector	RJ-48C
Signal	Duplicate port for monitoring the transmit signal or the receive signal of any of the 28 T1 or 21 E1 channels; independent control of line coding and line buildout
Orderwire (for DTMF Handset)	
Connector	2-wire, 4-pin mod jack RJ-11
REN	1.0 dB
DTMF Tones	Within ± 1.5% of nominal frequency (+0 to 6 dB)
Ringing Voltage	48 Vdc, typical
Address	00 to 99
VF (Orderwire Bridge)	
Connector	RJ-45 jack (4-wire); bridged to Orderwire RJ-11
Input Level	0 dBm
Output Level	0 dBm
Impedance	600 ohm balanced
Configuration Port	
Connector	DB-9 DTE (female, 9 pin D sub)
Protocol	RS-232 (8 bit data, No Parity, 1 Stop Bit)
Data Rate	9.6 kbps
Auxiliary Data Port	
Connector	RJ-45 DCE (modular jack, unkeyed)
Protocol	RS-232 (8 bit Data, No Parity, 1 Stop Bit)
Data Rate	2.4 kHz, 4.8 kHz, 9.6kHz, 19.2 kHz
Alarms Port	
Connector	DB-9 (male, 9 pin D sub)

Form C Relay (NO, NC)	Summary Alarm, Out-of-Service Alarm
Test Points	RSL and Tx power output (DC voltage)
Network Management System	
Connector	RJ-45 (modular jack, unkeyed) 2 each
NMS 1	10/100 Base-Tx (out-of-band)
NMS 2	100Base-Tx (in-band)

Interface (RF Unit)	
Antenna Port	
Connector	Type-N female
Impedance	50 ohms
Signal	See Unit Specifications for frequency channels
IF Port	
Connector	TNC female
Impedance	50 ohms
Signal	Uplink: 749 MHz; Downlink: 140 MHz; +48Vdc
Output RSL	
Connector	BNC female, cap and chain
Output Level	0.5 to 3.0 Vdc corresponds to -90 to –20 dBm 500 Hz to 3 kHz for earphone jack
Audio Tone	RSL and RSL earphone connectors are combined onto single connector

Fault and Configuration Management	
Type	Integral SNMP Agent Integral Web Server Serial Craft Terminal CLI Telnet, via 10/100BT
100 Base-Fx Ethernet port	In-band RJ-45 modular jack Auto-negotiate duplex
10/100 Base-Tx Ethernet port	Out-of-Band RJ-45 modular jack Auto-negotiate speed and duplex
Configuration port	VT-100 Craft Terminal; 9-pin D sub; 9600 baud
SNMP	SNMP v2, MIB II, Proxim Enterprise MIB
Network Element Managers	HPOpenView or equivalent
SNMP Reports	Alarm traps sent to up to 5 Managers; via MIB variables
Web Browser Compatibility	Any IE version above 5.0 (5.0, 5.5, 6.0) Netscape 6.1 in both Windows and Linux Netscape 6.21 in Windows

	Not compatible: Netscape 6.21 in Linux
User Access Security	Two level password protection
Performance Management	ES, SES, BER, LOS; near and far end
Alarm Log	up to 1000 entries
Software Updates	Download via TFTP over Ethernet
Configuration Management	Local end only, via IP address
Advanced features	Spectrum Analyzer – 10 channels RSL Time charting
Temperature and Environment	
Operating Temperature, RF Unit	-30° to +55° C
Operating Temperature, IDU	0° to +50° C
Humidity, IDU	95% max, non-condensing
Humidity, ODU	100%, all weather
Altitude	10,000 ft., maximum
Wind (RF unit)	Up to 115 miles per hour
Compliance	N/A
Power Requirements	
VDC nominal input voltage (IDU)	-48 Vdc or +24 Vdc
IDU DC Input Voltage Range (IDU)	-20 to –63 Vdc or +20 to +63 Vdc
Power Consumption Per Terminal	< 100 watts
Power Consumption	IDU: < 60 watts; ODU: <40 watts
AC Adapter (external) for IDU	130 watts; 50/60 Hz, 110/220 VAC; -48 Vdc, 2A
DC Power Connector (IDU)	3-pin barrier strip type, plug-in
Connector (RF Unit)	Uses coax cable for delivery
ODU voltage level	+48 volts DC
Power delivery to ODU	DC voltage over coax cable

Mechanical	
IDU Size (w x h x d) Weight	17.2 x 1.75 x 11 inch (1RU) < 11 lbs
RF Unit Size (w x h x d) Weight	14 x 1.75 x 11 inch (1RU) < 13 lbs
Mounting	IDU: EIA rack mount 19-inch rack mount; 23-inch extenders in kit RF Unit: EIA rack mount 19-inch rack mount; Pole-mounted, 1.5 to 3 inch diameter pole using mounting plate
Cooling	IDU: 3 each DC fans RF Unit: Heatsink
Cable Specifications	
RF Cable to antenna	
Cable type	LMR-400, equivalent or better

Cable connector	Type-N male
Impedance	50 ohm
IDU-RF Unit interconnection	
Cable Type	LMR-240 or equivalent for <100 meters LMR-400 or equivalent for <300 meters
Cable Connector	TNC male
Impedance	50 ohm
Regulatory Information	
FCC Rules	Part 15.247 ISM; 15.407 U-NII
Industry Canada Requirements	IC RSS210
UL and Safety	N/A

IDU Controls	
Far End Pushbutton	Yes

Front Panel LEDs	
IDU	Green = Indoor Unit OK Yellow = Warning condition in IDU (over-temp or both fans failed) Red = All fans failed, over-temp (> 55°C), or NMU/IDU communication failure
Cable	Green = ODU Cable OK Red = ODU Cable shorted
ODU	Green = Outdoor Unit OK Red = Over-temp (>65°C), IDU to ODU communication failure, DC power loss, or Outdoor Unit detected hardware failure Yellow = Over temperature alarm, exdeeds 60°C
RF Link	Green = Link established with BER <10E-6 Yellow = BER ≥ 10E-6; any bit errors due to FEC overload Red = BER > 10E-3 or Loss of Sync Blinking Red = Link ID does not match with far end ratio
Loopback	Flashing Yellow = Loopback service is enabled Solid Yellow = Internal signal generator turned on and errors detected online
NMS (10/100 Base-T)	Green = Tx or Rx data present on the NMS interface (handshaking is occurring) Off = No NMS data, interface connection detected

NMS Connector LEDs	
10/100 Base-Tx NMS	Link: Green = Link On; Off = Link Off Duplex: Green = Full/Auto; Off = Half Duplex
100 Base-Tx	Link: Green = Link On; Off = Link Off Duplex: Green = Full/Auto; Off = Half Duplex

Lynx.GX 28T1 and Lynx.GX DS-3 (U-NII 5.8 GHz) Specifications

Product Information		
Product Name	Lynx.GX 28T1	Lynx.GX DS-3
Product Part Number	57710-81L0, -81H0	57710-91L0, -91H0
Frequency Band of Operation	5.725 to 5.825 MHz	
Digital Capacity	28 x T1 (28 x 1.544 Mbps)	44.736 Mbps
Frequency Channels	A1: 5749 MHz A2: 5801 MHz	
T/R Spacing	52 MHz	
Regulatory Compliance	Part 15.407 (U-NII)	
FCC ID	HZB-US5358-GX1	

System and Transceiver Specifications	
Frequency Range	5.725 – 5.825 GHz
Modulation type	QPSK
System Gain	100 dB
Aggregate Data Rate	54 Mb/sec
Transmit Output Power	+17 dBm minimum, +20 dBm typical
RF Transmit Power Range	20 dB
Transmit Frequency Stability	± 5 ppm
Receive Threshold at 10-6 BER	-80 dBm
Maximum Receive Level	-20 dBm error free, 0 dBm without damage
FEC	T=8, Reed Solomon decoding

Digital Interface		
Main Line Interface		
Interface	DSX-1 (T1)	DS-3 (T3)
Line Rate	16 x 1.544 Mbps	44.736 Mbps
Connector(s)	16 x RJ-48C	BNC (2 each)
Line Code	AMI or B8ZS, selectable	B3ZS
Line Buildout	0 to 655 ft, selectable	N/A
Blue Code	AIS (Alarm Indication Signal)	AIS (Alarm Indication Signal)
Regulatory Compliance	ANSI-T1-102-1987	ITU-T G.703
Wayside Line Interface		
Interface	DSX-1 (T1)	
Line Rate	1.544 Mbps	
Connector(s)	1 x RJ-48C	
Line Code	AMI or B8ZS, selectable	

Line Buildout	0 to 655 ft, selectable
Blue Code	AIS (Alarm Indication Signal)
Regulatory Compliance	ANSI-T1-102-1987

Front Panel LEDs	
Data Loss	Red = Any of the 28 T1 or DS-3 data ports has experienced a data signal loss Off = None of the 28 T1 or DS-3 ports has experienced a data signal loss
AIS Out	Green = AIS output enabled, when data loss has been detected Yellow = AIS output enabled, loss of RF link detected Off = AIS output not enabled (no data loss has been detected)

Lynx.GX 21E1 (U-NII 5.8 GHz) Specifications

Product Information	
Product Name	Lynx.GX 21E1
Product Part Number	57710-71L0, -71H0
Frequency Band of Operation	5.725 to 5.825 MHz
Digital Capacity	21 x E1 (21 x 2.048 Mbps)
Frequency Channels	A1: 5749 MHz A2: 5801 MHz
T/R Spacing	52 MHz
Regulatory Compliance	Part 15.407 (U-NII)
FCC ID	HZB-US5358-GX1

System and Transceiver Specifications	
Frequency Range	5.725 – 5.825 GHz
Modulation type	QPSK
System Gain	100 dB
Aggregate Data Rate	54 Mb/sec
Transmit Output Power	+17 dBm minimum, +20 dBm typical
RF Transmit Power Range	20 dB
Transmit Frequency Stability	± 5 ppm
Receive Threshold at 10-6 BER	-80 dBm
Maximum Receive Level	-20 dBm error free, 0 dBm without damage
FEC	T=8, Reed Solomon decoding

Digital Interface	
Main Line Interface	
Interface	CEPT-1 (E1)
Line Rate	1 x 2.048 Mbps
Connector(s)	1 x RJ-48C
Line Code	HDB3
Line Buildout	N/A
Blue Code	AIS (Alarm Indication Signal)
Regulatory Compliance	CEPT-1 (ITU-T G.703)
Wayside Line Interface	
Interface	CEPT-1 (E1)
Line Rate	1 x 2.048 Mbps
Connector(s)	1 x RJ-48C
Line Code	HDB3
Line Buildout	N/A

Blue Code	AIS (Alarm Indication Signal)
Regulatory Compliance	ITU-T G.703

Front Panel LEDs	
Data Loss	Red = Any of the 21 E1 data ports has experienced a data signal loss Off = None of the 21 E1 ports has experienced a data signal loss
AIS Out	Green = AIS output enabled, when data loss has been detected Yellow = AIS output enabled, loss of RF link detected Off = AIS output not enabled (no data loss has been detected)

Lynx.GX 16T1 and Lynx.GX 12E1 (ISM) Specifications

Product Information		
Product Name	Lynx.GX 16T1	Lynx.GX 12E1
Product Part Number	52290-10L0, -10H0	52250-20L0, -20H0
Frequency Band of Operation	5.725 to 5.850 MHz	
Digital Capacity	16 x T1 (16 x 1.544 Mbps)	12 x E1 (12 x 2.048 Mbps)
Frequency Channels	A1: 5745 MHz A2: 5830 MHz	
T/R Spacing	85 MHz	
Regulatory Compliance	Part 15.247 (ISM)	
FCC ID	HZB-US5358-GX1	

System and Transceiver Specifications	
Frequency Range	5.250 – 5.350 GHz, 5.725 – 5.850 GHz
Modulation type	QPSK
System Gain	106 dB
Aggregate Data Rate	27.5 Mb/sec
Transmit Output Power	+20 dBm minimum, +23 dBm typical
RF Transmit Power Range	20 dB
Transmit Frequency Stability	± 5 ppm
Receive Threshold at 10-6 BER	-83 dBm
Maximum Receive Level	-20 dBm error free, 0 dBm without damage
FEC	T=4, Reed Solomon decoding

Digital Interface		
Main Line Interface		
Interface	DSX-1 (T1)	CEPT-1 (E1)
Line Rate	16 x 1.544 Mbps	12 x 2.048 Mbps
Connector(s)	16 x RJ-48C	12 x RJ-48C
Line Code	AMI or B8ZS, selectable	HDB3
Line Buildout	0 to 655 ft, selectable	N/A
Blue Code	AIS (Alarm Indication Signal)	AIS (Alarm Indication Signal)
Regulatory Compliance	ANSI-T1-102-1987	ITU-T G.703

Front Panel LEDs	
Data Loss	Red = Any of the 16 T1 or 12 E1 data ports has experienced a data signal loss Off = None of the 16 T1 or 12 E1 ports has experienced a data signal loss
AIS Out	Green = AIS output enabled, when data loss has been detected

	Yellow = AIS output enabled, loss of RF link detected Off = AIS output not enabled (no data loss has been detected)

Lynx.GX 8T (ISM) Specifications

Product Information	
Product Name	Lynx.GX 8T1
Product Part Number	51145-10L0, -10H0
Frequency Band of Operation	5.725 to 5.850 MHz
Digital Capacity	8 x T1 (8 x 1.544 Mbps)
Frequency Channels	A1: 5734 MHz A2: 5819 MHz B1: 5756 MHz B2: 5841 MHz
T/R Spacing	85 MHz
Regulatory Compliance	Part 15.247 (ISM)
FCC ID	HZB-US5358-GX1

System and Transceiver Specifications	
Frequency Range	5.725 – 5.850 GHz
Modulation type	QPSK
System Gain	109 dB
Aggregate Data Rate	13.5 Mb/sec
Transmit Output Power	+20 dBm minimum, +23 dBm typical
RF Transmit Power Range	20 dB
Transmit Frequency Stability	± 5 ppm
Receive Threshold at 10-6 BER	-86 dBm
Maximum Receive Level	-20 dBm error free, 0 dBm without damage
FEC	T=4, Reed Solomon decoding

Digital Interface	
Main Line Interface	
Interface	DSX-1 (T1)
Line Rate	8 x 1.544 Mbps
Connector(s)	8 x RJ-48C
Line Code	AMI or B8ZS, selectable
Line Buildout	0 to 655 ft, selectable
Blue Code	AIS (Alarm Indication Signal)
Regulatory Compliance	ANSI-T1-102-1987

Front Panel LEDs	
Data Loss	Red = Any of the 8 T1 data ports has experienced a data signal loss Off = None of the 8 T1 ports has experienced a data signal loss
AIS Out	Green = AIS output enabled, when data loss has been detected Yellow = AIS output enabled, loss of RF link detected

	Off = AIS output not enabled (no data loss has been detected)

Lynx.GX 8E ISM Specifications

Product Information	
Product Name	Lynx.GX 8E1
Product Part Number	51145-20H0, -20L0
Frequency Band of Operation	5.725 to 5.850 MHz
Digital Capacity	16.384 Mbps (8 x E1)
Frequency Channels	A1: 5745 MHz A2: 5831 MHz
T/R Spacing	85 MHz
Regulatory Compliance	Part 15.247 (ISM)
FCC ID	HZB-US5358-GX1

System and Transceiver Specifications	
Frequency Range	5.750 – 5.850 GHz
Modulation type	QPSK
System Gain	106 dB
Aggregate Data Rate	27.5 Mb/sec
Transmit Output Power	+20 dBm minimum, +23 dBm typical
RF Transmit Power Range	20 dB
Transmit Frequency Stability	± 5 ppm
Receive Threshold at 10-6 BER	-83 dBm
Maximum Receive Level	-20 dBm error free, 0 dBm without damage
FEC	T=4, Reed Solomon decoding

Digital Interface	
Main Line Interface	
Interface	CEPT-1 (E1)
Line Rate	8 x 2.044 Mbps
Connector(s)	8 x RJ-48C
Line Code	HDB3
Blue Code	AIS (Alarm Indication Signal)
Regulatory Compliance	ITU-T G.703

Front Panel LEDs	
Data Loss	Red = Any of the 8 E1 data ports has experienced a data signal loss Off = None of the 8 E1 ports has experienced a data signal loss
AIS Out	Green = AIS output enabled, when data loss has been detected Yellow = AIS output enabled, loss of RF link detected Off = AIS output not enabled (no data loss has been detected)

Lynx.GX 8E (U-NII) Specifications

Product Information	
Product Name	Lynx.GX 8E1
Product Part Number	51155-20H0, -20L0
Frequency Band of Operation	5.725 to 5.850 MHz
Digital Capacity	16.384 Mbps (8 x E1)
Frequency Channels	A1: 5741.5 MHz A2: 5793.5 MHz B1: 5756.5 MHz B2: 5808.5 MHz
T/R Spacing	52 MHz
Regulatory Compliance	Part 15.407 (UNII)
FCC ID	HZB-US5358-GX1

System and Transceiver Specifications	
Frequency Range	5.725 – 5.825 GHz
Modulation type	QPSK
System Gain	103 dB
Aggregate Data Rate	18 Mb/sec
Transmit Output Power	+20 dBm minimum, +23 dBm typical
RF Transmit Power Range	20 dB
Transmit Frequency Stability	± 5 ppm
Receive Threshold at 10-6 BER	-83 dBm
Maximum Receive Level	-20 dBm error free, 0 dBm without damage
FEC	T=8, Reed Solomon decoding

Digital Interface	
Main Line Interface	
Interface	CEPT-1 (E1)
Line Rate	8 x 2.044 Mbps
Connector(s)	8 x RJ-48C
Line Code	HDB3
Blue Code	AIS (Alarm Indication Signal)
Regulatory Compliance	ITU-T G.703

Front Panel LEDs	
Data Loss	Red = Any of the 8 E1 data ports has experienced a data signal loss Off = None of the 8 E1 ports has experienced a data signal loss
AIS Out	Green = AIS output enabled, when data loss has been detected Yellow = AIS output enabled, loss of RF link detected Off = AIS output not enabled (no data loss has been detected)

Lynx.GX 4T1 and Lynx.GX 4E1 (ISM) Specifications

Product Information		
Product Name	Lynx.GX 4T1	Lynx.GX 4E1
Product Part Number	51850-10L0, -10H0	51850-20L0, -20H0
Frequency Band of Operation	5.725 to 5.850 MHz	
Digital Capacity	4 x T1 (4 x 1.544 Mbps)	4 x E1 (4 x 2.048 Mbps)
Frequency Channels	A1: 5731.5 MHz A2: 5816.5 MHz B1: 5745 MHz B2: 5830 MHz C1: 5758.5 MHz C2: 5843.5 MHz	
T/R Spacing	85 MHz	
Regulatory Compliance	Part 15.247 (ISM)	
FCC ID	HZB-US5358-GX1	

System and Transceiver Specifications	
Frequency Range	5.250 – 5.350 GHz, 5.725 – 5.850 GHz
Modulation type	QPSK
System Gain	112 dB
Aggregate Data Rate	9 Mb/sec
Transmit Output Power	+20 dBm minimum, +24 dBm typical
RF Transmit Power Range	20 dB
Transmit Frequency Stability	± 5 ppm
Receive Threshold at 10-6 BER	-88 dBm
Maximum Receive Level	-20 dBm error free, 0 dBm without damage
FEC	T=4, Reed Solomon decoding

Digital Interface		
Main Line Interface		
Interface	DSX-1 (T1)	CEPT-1 (E1)
Line Rate	4 x 1.544 Mbps	4 x 2.048 Mbps
Connector(s)	4 x RJ-48C	4 x RJ-48C
Line Code	AMI or B8ZS, selectable	HDB3
Line Buildout	0 to 655 ft, selectable	N/A
Blue Code	AIS (Alarm Indication Signal)	AIS (Alarm Indication Signal)
Regulatory Compliance	ANSI-T1-102-1987	ITU-T G.703

Front Panel LEDs

Data Loss	Red = Any of the 4 T1 or 4 E1 data ports has experienced a data signal loss Off = None of the 4 T1 or 4 E1 ports has experienced a data signal loss
AIS Out	Green = AIS output enabled, when data loss has been detected Yellow = AIS output enabled, loss of RF link detected Off = AIS output not enabled (no data loss has been detected)

Lynx.GX 2T1 and Lynx.GX 2E1 (ISM) Specifications

Product Information		
Product Name	Lynx.GX 2T1	Lynx.GX 2E1
Product Part Number	51600-10L0, -10H0	51700--20L0, -20H0
Frequency Band of Operation	5.725 to 5.850 MHz	
Digital Capacity	2 x T1 (2 x 1.544 Mbps)	2 x E1 (2 x 2.048 Mbps)
Frequency Channels	A1: 5728.5 MHz A2: 5813.5 MHz B1: 5735 MHz B2: 5820 MHz C1: 5741.5 MHz C2: 5826.5 MHz D1: 5748 MHz D2: 5833 MHz E1: 5754.5 MHz E2: 5839.5 MHz F1: 5761.0 MHz F2: 5846 MHz	
T/R Spacing	85 MHz	
Regulatory Compliance	Part 15.247 (ISM)	
FCC ID	HZB-US5358-GX1	

System and Transceiver Specifications	
Frequency Range	5.250 – 5.350 GHz, 5.725 – 5.850 GHz
Modulation type	QPSK
System Gain	115 dB
Aggregate Data Rate	4.5 Mb/sec
Transmit Output Power	+20 dBm minimum, +24 dBm typical
RF Transmit Power Range	20 dB
Transmit Frequency Stability	± 5 ppm
Receive Threshold at 10-6 BER	-91 dBm
Maximum Receive Level	-20 dBm error free, 0 dBm without damage
FEC	T=4, Reed Solomon decoding

Digital Interface		
Main Line Interface		
Interface	DSX-1 (T1)	CEPT-1 (E1)
Line Rate	2 x 1.544 Mbps	2 x 2.048 Mbps
Connector(s)	2 x RJ-48C	2 x RJ-48C
Line Code	AMI or B8ZS, selectable	HDB3
Line Buildout	0 to 655 ft, selectable	N/A
Blue Code	AIS (Alarm Indication Signal)	AIS (Alarm Indication Signal)
Regulatory Compliance	ANSI-T1-102-1987	ITU-T G.703

Front Panel LEDs	
Data Loss	Red = Any of the 2 T1 or 2 E1 data ports has experienced a data signal loss Off = None of the 2T1 or 2 E1 ports has experienced a data signal loss
AIS Out	Green = AIS output enabled, when data loss has been detected Yellow = AIS output enabled, loss of RF link detected Off = AIS output not enabled (no data loss has been detected)

Lynx.GX T1 and Lynx.GX E1 (ISM) Specifications

Product Information		
Product Name	Lynx.GX T1	Lynx.GX E1
Product Part Number	51000-L0, -H0	51400-L0, -H0
Frequency Band of Operation	5.725 to 5.850 MHz	
Digital Capacity	1 x T1 (1 x 1.544 Mbps)	1 x E1 (1 x 2.048 Mbps)
Frequency Channels	A1: 5727 MHz A2: 5812 MHz B1: 5731 MHz B2: 5816 MHz C1: 5735 MHz C2: 5820 MHz D1: 5739 MHz D2: 5824 MHz E1: 5743 MHz E2: 5828 MHz F1: 5747MHz F2: 5832 MHz G1: 5751 MHz G2: 5836 MHz H1: 5755 MHz H2: 5840 MHz J1: 5759 MHz J2: 5844 MHz K1: 5763 MHz K2: 5848 MHz	
T/R Spacing	85 MHz	
Regulatory Compliance	Part 15.247 (ISM)	
FCC ID	HZB-US5358-GX1	

System and Transceiver Specifications	
Frequency Range	5.250 – 5.350 GHz, 5.725 – 5.850 GHz
Modulation type	QPSK
Emission Bandwidth	2.7 MHz per channel (-6 dB)
System Gain	116 dB
Aggregate Data Rate	2.7 Mb/sec
Transmit Output Power	+20 dBm minimum, +24 dBm typical
RF Transmit Power Range	20 dB
Transmit Frequency Stability	± 5 ppm
Receive Threshold at 10-6 BER	-93 dBm
Maximum Receive Level	-20 dBm error free, 0 dBm without damage
FEC	T=4, Reed Solomon decoding

Digital Interface		
Main Line Interface		
Interface	DSX-1 (T1)	CEPT-1 (E1)
Line Rate	1 x 1.544 Mbps	1 x 2.048 Mbps
Connector	1 x RJ-48C	1 x RJ-48C

Line Code	AMI or B8ZS, selectable	HDB3
Line Buildout	0 to 655 ft, selectable	N/A
Blue Code	AIS (Alarm Indication Signal)	AIS (Alarm Indication Signal)
Regulatory Compliance	ANSI-T1-102-1987	ITU-T G.703

Front Panel LEDs	
Data Loss	Red = Any T1 or E1 data ports has experienced a data signal loss Off = No T1 or E1 ports has experienced a data signal loss
AIS Out	Green = AIS output enabled, when data loss has been detected Yellow = AIS output enabled, loss of RF link detected Off = AIS output not enabled (no data loss has been detected)

Lynx.GX DS-3 (U-NII 5.3 GHz) Specifications

Product Information	
Product Name	Lynx.GX DS-3
Product Part Number	57750-91L0, -91H0
Frequency Band of Operation	5.250 to 5.350 MHz
Digital Capacity	44.736 Mbps
Frequency Channels	A1: 5274 MHz A2: 5326 MHz
T/R Spacing	52 MHz
Regulatory Compliance	Part 15.407 (U-NII)
FCC ID	HZB-US5358-GX1

System and Transceiver Specifications	
Frequency Range	5.250 – 5.350 GHz
Modulation type	QPSK
System Gain	96 dB
Aggregate Data Rate	54 Mb/sec
Transmit Output Power	+17 dBm minimum, +20 dBm typical
RF Transmit Power Range	20 dB
Transmit Frequency Stability	± 5 ppm
Receive Threshold at 10-6 BER	-80 dBm
Maximum Receive Level	-20 dBm error free, 0 dBm without damage
FEC	T=4, Reed Solomon decoding

Digital Interface	
Main Line Interface	
Interface	CEPT-1 (E1)
Line Rate	1 x 2.048 Mbps
Connector(s)	1 x RJ-48C
Line Code	HDB3
Line Buildout	N/A
Blue Code	AIS (Alarm Indication Signal)
Regulatory Compliance	ITU-T G.703
Wayside Line Interface	
Interface	CEPT-1 (E1)
Line Rate	1 x 2.048 Mbps
Connector(s)	1 x RJ-48C
Line Code	HDB3
Line Buildout	N/A

Blue Code	AIS (Alarm Indication Signal)
Regulatory Compliance	ITU-T G.703

Front Panel LEDs	
Data Loss	Red = Any of the 21 E1 data ports has experienced a data signal loss Off = None of the 21 E1 ports has experienced a data signal loss
AIS Out	Green = AIS output enabled, when data loss has been detected Yellow = AIS output enabled, loss of RF link detected Off = AIS output not enabled (no data loss has been detected)

Tsunami General Specifications

General System Parameters	
Operating Frequency	5.3 – 5.8 GHz
Product Configuration	1+0 IDU + RF Unit (RFU with outdoor option)
Digital Capacity	1.544 Mbps (T1) to 44.564 Mbps (DS-3)
Intermediate Frequency	749 MHz, 140 MHz (+/- 2 Mhz)
Digital Interface	10/100BaseTx
Error Floor	10^{-11}
Latency (msec)	<500 usec
Error Correction	FEC, Reed-Solomon Decoding
Security	12 character Link ID code
Regulatory Compliance	Part 15.407 U-NII
FCC ID	HZB –US5358-GX1

Transceiver Specifications	
Frequency Range	5.250 – 5.350 GHz, 5.725 – 5.850 GHz
Modulation type	QPSK
System Gain	See Unit specifications
Aggregate Data Rate	See unit specifications
Transmit Output Power	See Unit specifications
RF Transmit Power Range	20 dB
Transmit Frequency Stability	± 5 ppm
Receive Threshold at 10-6 BER	See Unit specifications
Maximum Receive Level	-20 dBm error free, 0 dBm without damage

Digital Interface (on IDU)	
Main Line Interface	
Interface	10/100BaseTx for RJ-45; 100BaseFx for ST fiber connector
Line Rate	20 Mbps up to 90 Mbps, full duplex
Connector(s)	1 x RJ-48C; 1 x ST fiber
Regulatory Compliance	IEEE 802.3d
Wayside Channel	
Interface	DSX-1 (T1)
Connector	RJ-48C, modular jack

Line Code	AMI or B8ZS, selectable
Line Buildout	0 to 655 ft, selectable
Blue Code	AIS (Alarm Indication Signal)
Regulatory Compliance	ANSI-T1-102-1987
Orderwire (for DTMF Handset)	
Connector	2-wire, 4-pin mod jack RJ-11
REN	1.0 dB
DTMF Tones	Within ± 1.5% of nominal frequency (+0 to 6 dB)
Ringing Voltage	48 Vdc, typical
Address	00 to 99
VF (Orderwire Bridge)	
Connector	RJ-45 jack (4-wire); bridged to Orderwire RJ-11
Input Level	0 dBm
Output Level	0 dBm
Impedance	600 ohm balanced
Configuration Port	
Connector	DB-9 DTE (female, 9 pin D sub)
Protocol	RS-232 (8 bit data, No Parity, 1 Stop Bit)
Data Rate	9.6 kbps
Auxiliary Data Port	
Connector	RJ-45 DCE (modular jack, unkeyed)
Protocol	RS-232 (8 bit Data, No Parity, 1 Stop Bit)
Data Rate	2.4 kHz, 4.8 kHz, 9.6kHz, 19.2 kHz
Alarms Port	
Connector	DB-9 (male, 9 pin D sub)
Form C Relay (NO, NC)	Summary Alarm, Out-of-Service Alarm
Test Points	RSL and Tx power output (DC voltage)
Network Management System	
Connector	RJ-45 (modular jack, unkeyed) 2 each
NMS 1	10/100 Base-Tx (out-of-band)
NMS 2	100Base-Tx (in-band)

Interface (RF Unit)	
Antenna Port	
Connector	Type-N female
Impedance	50 ohms
Signal	See Unit Specifications for frequency channels

IF Port	
Connector	TNC female
Impedance	50 ohms
Signal	Uplink: 749 MHz; Downlink: 140 MHz; +48Vdc
Output RSL	
Connector	BNC female, cap and chain
Output Level	0.5 to 3.0 Vdc corresponds to -90 to –20 dBm 500 Hz to 3 kHz for earphone jack
Audio Tone	RSL and RSL earphone connectors are combined onto single connector

Fault and Configuration Management	
Type	Integral SNMP Agent Integral Web Server Serial Craft Terminal CLI Telnet, via 10/100BT
100 Base-Fx Ethernet port	In-band RJ-45 modular jack Auto-negotiate duplex
10/100 Base-Tx Ethernet port	Out-of-Band RJ-45 modular jack Auto-negotiate speed and duplex
Configuration port	VT-100 Craft Terminal; 9-pin D sub; 9600 baud
SNMP	SNMP v2, MIB II, Proxim Enterprise MIB
Network Element Managers	HPOpenView or equivalent
SNMP Reports	Alarm traps sent to up to 5 Managers; via MIB variables
Web Browser Compatibility	Any IE version above 5.0 (5.0, 5.5, 6.0) Netscape 6.1 in both Windows and Linux Netscape 6.21 in Windows Not compatible: Netscape 6.21 in Linux
User Access Security	Two level password protection
Performance Management	ES, SES, BER, LOS; near and far end
Alarm Log	up to 1000 entries
Software Updates	Download via TFTP over Ethernet
Configuration Management	Local end only, via IP address
Advanced features	Spectrum Analyzer – 10 channels RSL Time charting
Temperature and Environment	
Operating Temperature, RF Unit	-30° to +55° C
Operating Temperature, IDU	0° to +50° C
Humidity, IDU	95% max, non-condensing

Humidity, ODU	100%, all weather
Altitude	10,000 ft., maximum
Wind (RF unit)	Up to 115 miles per hour
Compliance	N/A
Power Requirements	
VDC nominal input voltage (IDU)	-48 Vdc or +24 Vdc
IDU DC Input Voltage Range (IDU)	-20 to –63 Vdc or +20 to +63 Vdc
Power Consumption Per Terminal	< 100 watts
Power Consumption	IDU: < 60 watts; ODU: <40 watts
AC Adapter (external) for IDU	130 watts; 50/60 Hz, 110/220 VAC; -48 Vdc, 2A
DC Power Connector (IDU)	3-pin barrier strip type, plug-in
Connector (RF Unit)	Uses coax cable for delivery
ODU voltage level	+48 volts DC
Power delivery to ODU	DC voltage over coax cable

Mechanical	
IDU Size (w x h x d) Weight	17.2 x 1.75 x 11 inch (1RU) < 11 lbs
RF Unit Size (w x h x d) Weight	14 x 1.75 x 11 inch (1RU) < 13 lbs
Mounting	IDU: EIA rack mount 19-inch rack mount; 23-inch extenders in kit RF Unit: EIA rack mount 19-inch rack mount; Pole-mounted, 1.5 to 3 inch diameter pole using mounting plate
Cooling	IDU: 3 each DC fans RF Unit: Heatsink
Cable Specifications	
RF Cable to antenna	
Cable type	LMR-400, equivalent or better
Cable connector	Type-N male
Impedance	50 ohm
IDU-RF Unit interconnection	
Cable Type	LMR-240 or equivalent for <100 meters LMR-400 or equivalent for <300 meters
Cable Connector	TNC male
Impedance	50 ohm
Regulatory Information	
FCC Rules	Part 15.247 ISM; 15.407 U-NII
Industry Canada Requirements	IC RSS210
UL and Safety	N/A

IDU Controls	
Far End Pushbutton	Yes

Front Panel LEDs	
IDU	Green = Indoor Unit OK Yellow = Warning condition in IDU (over-temp or both fans failed) Red = All fans failed, over-temp (> 55°C), or NMU/IDU communication failure
Cable	Green = ODU Cable OK Red = ODU Cable shorted
ODU	Green = Outdoor Unit OK Red = Over-temp (>65°C), IDU to ODU communication failure, DC power loss, or Outdoor Unit detected hardware failure Yellow = Over temperature alarm, exceeds 60°C
RF Link	Green = Link established with BER <10E-6 Yellow = BER ≥ 10E-6; any bit errors due to FEC overload Red = BER > 10E-3 or Loss of Sync Blinking Red = Link ID does not match with far end ratio
Loopback	Flashing Yellow = Loopback service is enabled Solid Yellow = Internal signal generator turned on and errors detected online
NMS (10/100 Base-T)	Green = Tx or Rx data present on the NMS interface (handshaking is occurring) Off = No NMS data, interface connection detected

NMS Connector LEDs	
10/100 Base-Tx NMS	Link: Green = Link On; Off = Link Off Duplex: Green = Full/Auto; Off = Half Duplex
100 Base-Tx	Link: Green = Link On; Off = Link Off Duplex: Green = Full/Auto; Off = Half Duplex

Tsunami 20 + 2T1 and Tsunami 20 + 2E1 Specifications

Product Information		
Product Name	Tsunami 20 +2 T1	Tsunami 20 +2E1
Product Part Number	51145-41H0, -41L0	51145-42H0, -42L0
Frequency Band of Operation	5.725 to 5.850 MHz	
Digital Capacity	10 Mbps	
Frequency Channels	A1: 5734 MHz A2: 5819 MHz B1: 5756 MHz B2: 5841 MHz	
T/R Spacing	85 MHz	
Regulatory Compliance	Part 15.247 (ISM)	
FCC ID	HZB-US5358-GX1	

System and Transceiver Specifications	
Frequency Range	5.725 – 5.850 GHz
Modulation type	QPSK
System Gain	109 dB
Aggregate Data Rate	13.5 Mb/sec
Transmit Output Power	+20 dBm minimum, +23 dBm typical
RF Transmit Power Range	20 dB
Transmit Frequency Stability	± 5 ppm
Receive Threshold at 10-6 BER	-86 dBm
Maximum Receive Level	-20 dBm error free, 0 dBm without damage
FEC	T=4, Reed Solomon decoding

Digital Interface		
Main Line Interface		
Interface	10/100BaseTx	
Line Rate	20 Mbps (10 Mbps full duplex)	
Connector(s)	1 x RJ-48C, 1 x ST (fiber)	
Line Code	N/A	
Line Buildout	N/A	
Blue Code	N/A	
Regulatory Compliance	IEEE 802.3d	
Wayside Line Interface		
Interface	DSX-1 (T1)	CEPT-1 (E1)
Line Rate	2x 1.544 Mbps	2 x 2.048 Mbps
Connector(s)	2 x RJ-48C	2 x RJ-48C
Line Code	AMI or B8ZS, selectable	HDB3

Line Buildout	0 to 655 ft, selectable	N/A
Blue Code	AIS (Alarm Indication Signal)	AIS (Alarm Indication Signal)
Regulatory Compliance	ANSI-T1-102-1987	ITU-T G.703

Front Panel LEDs	
Data Loss	Red = 10/100BT port has experienced a data signal loss Off = 10/100BT port has not experienced a data signal loss
AIS Out	Green = AIS output enabled, when data loss has been detected Yellow = AIS output enabled, loss of RF link detected Off = AIS output not enabled (no data loss has been detected)

Tsunami 90 +2T1 and Tsunami 90 +2E1 (U-NII 5.8 GHz) Specifications

Product Information		
Product Name	Tsunami 90 +2T1	Tsunami 90 +2E1
Product Part Number	57710-51L0, -51H0	57710-52L0, -52H0
Frequency Band of Operation	5.725 to 5.825 MHz	
Digital Capacity	44.736 Mbps	44.736 Mbps
Frequency Channels	A1: 5749 MHz A2: 5801 MHz	
T/R Spacing	52 MHz	
Regulatory Compliance	Part 15.407 (U-NII)	
FCC ID	HZB-US5358-GX1	

System and Transceiver Specifications	
Frequency Range	5.725 – 5.825 GHz
Modulation type	QPSK
System Gain	100 dB
Aggregate Data Rate	54 Mb/sec
Transmit Output Power	+17 dBm minimum, +20 dBm typical
RF Transmit Power Range	20 dB
Transmit Frequency Stability	± 5 ppm
Receive Threshold at 10-6 BER	-80 dBm
Maximum Receive Level	-20 dBm error free, 0 dBm without damage
FEC	T=4, Reed Solomon decoding

Digital Interface		
Main Line Interface		
Interface	100BaseTx	100BaseTx
Line Rate	90 Mbps (45 Mbps full duplex)	90 Mbps (45 Mbps full duplex)
Connector(s)	1 x RJ-48C, 1 x ST (fiber)	1 x RJ-48C, 1 x ST (fiber)
Line Code	N/A	N/A
Line Buildout	N/A	N/A
Blue Code	N/A	N/A
Regulatory Compliance	IEEE 802.3d	IEEE 802.3d
Wayside Line Interface		
Interface	DSX-1 (T1)	CEPT-1 (E1)
Line Rate	2 x 1.544 Mbps	2 x 2.048 Mbps
Connector(s)	2 x RJ-48C	2 x RJ-48C
Line Code	AMI or B8ZS, selectable	HDB3

Line Buildout	0 to 655 ft, selectable	N/A
Blue Code	AIS (Alarm Indication Signal)	AIS (Alarm Indication Signal)
Regulatory Compliance	ANSI-T1-102-1987	ITU-T G.703

Front Panel LEDs	
Data Loss	Red = 100BaseTx port has experienced a data signal loss Off = 100BaseTx port has not experienced a data signal loss
AIS Out	Green = AIS output enabled, when data loss has been detected Yellow = AIS output enabled, loss of RF link detected Off = AIS output not enabled (no data loss has been detected)

Tsunami 90 +2T1 and Tsunami 90 +2E1 (U-NII 5.3 GHz) Specifications

Product Information		
Product Name	Tsunami 90 +2T1	Tsunami 90 +2E1
Product Part Number	57750-51L0, -51H0	57750-52L0, -52H0
Frequency Band of Operation	5.250 to 5.350 MHz	
Digital Capacity	44.736 Mbps	44.736 Mbps
Frequency Channels	A1: 5274 MHz A2: 5326 MHz	
T/R Spacing	52 MHz	
Regulatory Compliance	Part 15.407 (U-NII)	
FCC Emission Designator	HZB-US5358-GX1	

System and Transceiver Specifications	
Frequency Range	5.250 – 5.350 GHz
Modulation type	QPSK
System Gain	96 dB
Aggregate Data Rate	54 Mb/sec
Transmit Output Power	+17 dBm minimum, +20 dBm typical
RF Transmit Power Range	20 dB
Transmit Frequency Stability	± 5 ppm
Receive Threshold at 10-6 BER	-78 dBm
Maximum Receive Level	-20 dBm error free, 0 dBm without damage
FEC	T=4, Reed Solomon decoding

Digital Interface		
Main Line Interface		
Interface	100BaseTx	100BaseTx
Line Rate	90 Mbps (45 Mbps full duplex)	90 Mbps (45 Mbps full duplex)
Connector(s)	1 x RJ-48C, 1 x ST (fiber)	1 x RJ-48C, 1 x ST (fiber)
Line Code	N/A	N/A
Line Buildout	N/A	N/A
Blue Code	N/A	N/A
Regulatory Compliance	IEEE 802.3d	IEEE 802.3d
Wayside Line Interface		
Interface	DSX-1 (T1)	CEPT-1 (E1)
Line Rate	2 x 1.544 Mbps	2 x 2.048 Mbps
Connector(s)	1 x RJ-48C	1 x RJ-48C
Line Code	AMI or B8ZS, selectable	HDB3

Line Buildout	0 to 655 ft, selectable	N/A
Blue Code	AIS (Alarm Indication Signal)	AIS (Alarm Indication Signal)
Regulatory Compliance	ANSI-T1-102-1987	ITU-T G.703

Front Panel LEDs	
Data Loss	Red = 100BaseTx port has experienced a data signal loss Off = 100BaseTx port has not experienced a data signal loss
AIS Out	Green = AIS output enabled, when data loss has been detected Yellow = AIS output enabled, loss of RF link detected Off = AIS output not enabled (no data loss has been detected)

Warranty

GENERAL TERMS

1.1 All Definitions contained in Proxim's Conditions of Sale (Proxim document number CS96-8), apply to the Warranty.

1.2 Subject to the provisions of the Warranty, Proxim warrants that the equipment described in Paragraph 1.3 shall conform to their specifications described in Paragraph 1.4 in all material respects and that the equipment shall be free from material defects in materials and workmanship.

1.3 This Warranty applies to all original purchases of Proxim manufactured equipment and accessories (collectively the "Equipment").

1.4 This Warranty applies to the specifications contained in the most recent version of the manual for the model of the Equipment purchased (the "Specifications").

1.5 This Warranty does not apply to the following items of Equipment which are covered by the Original Equipment Manufacturer's warranty:

(a) antenna systems, including coax cable, waveguide, connectors flex-sections, mounts, other parts of the antenna system and installation materials;

(b) non-Proxim manufactured rack mounted equipment that is assembled wired and tested at Proxim's factory or supplied as part of a system, including orderwire items, channel banks, multiplexers, fuse/alarm panels, remote alarm items; and

(c) equipment which is not listed in Proxim's price book.
1.6 The effective period of this Warranty shall start on the date of shipment of the Equipment and shall end:

(a) for all spread spectrum unlicensed radio products and for all licensed digital microwave radio products, two (2) years later;

(b) for all analog microwave radio products, three (3) years later; or

(c) for all baseband products, five (5) years later (in each case the "Warranty Period").

1.7 The Customer acknowledges that Proxim does not represent or warrant that the services provided by Proxim under this Warranty will ensure uninterrupted or error-free operation of the Equipment.

RETURN OF EQUIPMENT UNDER WARRANTY

2.1 If an item of Equipment malfunctions or fails in normal intended usage and maintenance within the applicable Warranty Period:

(a) the Customer shall promptly notify Proxim of the problem and the serial number of the defective item;

(b) Proxim shall, at its sole option, either resolve the problem over the telephone or provide the Customer with a Returned Materials Authorization number (RMA #) and the address of the location to which the Customer may ship the defective item;

(c) if the problem is not resolved over the telephone, the Customer shall attach a label to each Returned item describing the fault and the Customer's Return address. The Customer shall, at its cost, properly pack the item to be Returned, prepay the insurance and shipping charges, and ship the item to the specified location;

(d) if the Proxim product shall prove to be defective in material or workmanship upon examination by Proxim, Proxim shall either repair or replace the Returned item at its sole option. The replacement item may be new or refurbished; if refurbished, it shall be equivalent in operation to new Equipment. If a Returned item is replaced by Proxim, the Customer agrees that the Returned item shall become the property of Proxim.

(e) Proxim shall at its cost, ship the repaired item or replacement to any destination within the United States of America by carrier and method of delivery chosen by Proxim. If the Customer has requested some other form of conveyance, such as express shipping, or is located beyond the USA borders, then the Customer shall pay to the cost of return shipment.

2.2 Equipment which is repaired or replaced by Proxim under this Warranty shall be covered under all of the provisions of this Warranty for the remainder of the applicable Warranty Period or ninety (90) days from the date of shipment of the repaired item or replacement, whichever period is longer.

DEFAULT AND TERMINATION

3.1 Proxim may immediately terminate this Warranty and all of its performance under this Warranty, upon notification to the Customer, if the Customer:

(a) makes any unauthorized modifications to the Equipment;

(b) assigns or transfers the Customer's rights or obligations under this Warranty without the written consent of Proxim;

(c) becomes bankrupt or insolvent, or is put into receivership; or

(d) has not paid Proxim all amounts for the Equipment, services, or other additional charges within thirty (30) days of receipt of written notice from Proxim.

3.2 If this Warranty is terminated by Proxim, the Customer shall remain liable for all amounts due to Proxim.

FORCE MAJEURE

4.1 "Force Majeure" has the same meaning as defined in Proxim's Conditions of Sale (Proxim document number CS96-8).

4.2 Proxim shall not be responsible for failure to discharge

its obligations under this Warranty due to Force Majeure.

LIMITATIONS AND QUALIFICATIONS OF WARRANTY

5.1 This Warranty does not apply to any damage, defect or failure caused by:

(a) any part of the Equipment having been modified, adapted, repaired, or improperly installed, operated, maintained, transported or relocated by any person other than Proxim personnel or a Proxim authorized service agent, without Proxim's prior written consent;

(b) storage or environmental conditions which do not conform to the applicable sections of the appropriate Proxim Equipment Manual;

(c) failure to conform with the Equipment Installation, Operating and Maintenance Instructions of the appropriate Proxim Equipment Manual;

(d) external causes, including external electrical stress or lightning, or use in conjunction with incompatible equipment, unless such use was with Proxim's prior written consent;

(e) cosmetic damage;

(f) accidental damage, negligence, neglect, mishandling, abuse or misuse, other than by Proxim personnel or a Proxim authorized service agent; or

(g) Force Majeure.

Please see reverse side for additional limitations on damages.

LIMITATIONS ON DAMAGES (North America)

6.1 THE WARRANTY STATED IN THIS DOCUMENT IS THE CUSTOMER'S EXCLUSIVE WARRANTY FOR THE EQUIPMENT; PROXIM SPECIFICALLY DISCLAIMS ALL OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND OF MERCHANTABILITY.

6.2 PROXIM SHALL NOT BE LIABLE IN TORT, INCLUDING LIABILITY IN NEGLIGENCE OR STRICT LIABILITY, AND SHALL HAVE NO LIABILITY AT ALL FOR INJURY TO PERSONS OR PROPERTY. PROXIM'S LIABILITY FOR FAILURE TO FULFIL ITS OBLIGATIONS UNDER THIS WARRANTY OR ANY OTHER LIABILITY UNDER OR IN CONNECTION WITH THE EQUIPMENT SHALL BE LIMITED TO THE AMOUNT OF THE PURCHASE PRICE OF THE EQUIPMENT. THE REMEDIES STATED IN THIS WARRANTY ARE THE CUSTOMER'S EXCLUSIVE REMEDIES AGAINST PROXIM REGARDING THE EQUIPMENT.

6.3 EVEN IF PROXIM HAS BEEN ADVISED OF THE POSSIBILITY OF THEM, PROXIM SHALL NOT BE LIABLE FOR ANY INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES, INCLUDING THE COST OF LABOR BY THE CUSTOMER'S OWN EMPLOYEES, AGENTS OR CONTRACTORS IN IDENTIFYING, REMOVING OR REPLACING THE DEFECTIVE ITEM; LOST PROFITS, AND REVENUES; FAILURE TO REALIZE EXPECTED SAVINGS; ANY CLAIM AGAINST A CUSTOMER BY A THIRD PARTY; OR ANY OTHER COMMERCIAL OR ECONOMIC LOSSES OF ANY KIND.

6.4 THESE LIMITATIONS AND DISCLAIMERS ARE NOT MADE BY PROXIM WHERE PROHIBITED BY LAW.

LIMITATIONS ON DAMAGES (International)

6.1 THE WARRANTY STATED IN THIS DOCUMENT IS THE CUSTOMER'S EXCLUSIVE WARRANTY FOR THE EQUIPMENT; ALL OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND OF MERCHANTABILITY ARE EXCLUDED TO THE FULLEST EXTENT PERMITTED BY LAW.

6.2 PROXIM'S LIABILITY FOR FAILURE TO FULFIL ITS OBLIGATIONS UNDER THIS WARRANTY OR IN TORT OR AS A RESULT OF STRICT LIABILITY OR ANY OTHER LIABILITY UNDER OR IN CONNECTION WITH THE EQUIPMENT OR ITS SUPPLY SHALL BE LIMITED, EXCEPT IN RESPECT OF DEATH AND PERSONAL INJURY CAUSED BY PROXIM'S NEGLIGENCE, TO THE AMOUNT OF THE PURCHASE PRICE OF THE EQUIPMENT. THE REMEDIES STATED IN THIS WARRANTY ARE THE CUSTOMER'S EXCLUSIVE REMEDIES AGAINST PROXIM REGARDING THE EQUIPMENT.

6.3 EVEN IF PROXIM HAS BEEN ADVISED OF THE POSSIBILITY OF THEM, PROXIM SHALL NOT BE LIABLE FOR ANY INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES, INCLUDING THE COST OF LABOR BY THE CUSTOMER'S OWN EMPLOYEES, AGENTS OR CONTRACTORS IN IDENTIFYING, REMOVING OR REPLACING THE DEFECTIVE ITEM; LOST PROFITS, AND REVENUES; FAILURE TO REALIZE EXPECTED SAVINGS; ANY CLAIM AGAINST A CUSTOMER BY A THIRD PARTY; OR ANY OTHER COMMERCIAL OR ECONOMIC LOSSES OF ANY KIND.

DEFINITIONS

1.1 In these Conditions, unless there is something in the subject
matter or context necessarily inconsistent:

(a) "Proxim" means Proxim Multiplex Corporation (d.b.a. Proxim Multiplex), Sunnyvale, CA;

(b) "Equipment" means the equipment itemized on the Quotation/Order Acknowledgment;

(c) "International" means any location other than United States
of America and Canada, including their territories and possessions;

(d) "North America" means any location in the United States of
America and Canada, including their territories and possessions;

(e) "Order Acknowledgment" means the sales order acknowledgment provided by Proxim to the Customer;

(f) "Payment Instructions" means Proxim's payment instructions, (Proxim document P197-1);

(g) "Quotation" means the quotation signed by an authorized representative of Proxim and provided to the Customer;

(h) "Shipping Date" means the actual date on which the Equipment left Proxim's factory at Sunnyvale, CA, U.S.A.;
(i) "Warranty" means Proxim's warranty, document W97-1;
(j) "Invoice" means the bill of goods prepared by Proxim for the equipment with the shipping and any insurance costs.

1.2 Headings have been inserted in these Conditions for convenience of reference only and will not effect their construction.

ENTIRE AGREEMENT

2.1 The Quotation, these Conditions of Sale, the Order Acknowledgment, the Payment Instructions and the Warranty shall apply to all sales made by Proxim and shall constitute the entire agreement by Proxim and the Customer (the "Agreement ").

2.2 Any terms and/or conditions of sale, which may be included on the Customer's purchase order form or any communication from the Customer, that are not identical with the terms and conditions steed in this document shall NOT become a part of the agreement of sale unless expressly agreed to in writing in the Quotation.

2.3 Proxim's failure to object to any terms and/or conditions of sale contained in any communication from the Customer shall not be considered as acceptance of such terms and/or conditions or as a waiver of the terms and conditions of sale contained herein.

2.4 Proxim shall sell to the Customer, and the Customer shall purchase from Proxim, the Equipment in accordance with the Agreement. Proxim accepts the Customer's purchase orders for Equipment and agrees to deliver the Equipment to the Customer only on the terms of the Agreement.

2.5 No variation of the Agreement shall be binding unless agreed to in writing by authorized representatives of Proxim and the Customer.

PRICING

3.1 All prices in the Quotation are exclusive of all shipping charges and all applicable taxes including but not limited to, federal, state, local, excise, sales and use taxes.

3.2 All prices in the Quotation unless otherwise stated:

(a) for North American customers are FOB Sunnyvale, CA, USA. (New York Uniform Commercial Code); or

(b) for international customers are Ex-Works, Sunnyvale, CA, U.S.A. (Incoterms 1990).

3.3 All prices in the Quotation include standard domestic packing, unless a separate line item is provided detailing export or special packing charges.

SHIPPING AND INSURANCE

4.1 Proxim shall arrange shipping and insurance when requested by the Customer, and shall bill the Customer for the Equipment with the shipping and any insurance costs as separate items, on an invoice (the "Invoice").

4.2 Delivery dates quoted by Proxim are to be considered estimates only. In no event will Proxim be liable for any loss or damage resulting from its failure to deliver products within a specified time.

TERMS OF PAYMENT

5.1 The Customer shall pay for all Equipment, including shipping and insurance in accordance with the terms of the Invoice.

5.2 All Invoices for North American Customers are due and payable in thirty (30) days from the date of the Invoice.

5.3 International Customers shall make payments in accordance with Proxim's Payment Instructions by either:

(a) providing a wire transfer (telegraphic transfer) for the full amount of the Equipment, shipping and insurance charges contained in the Quotation or the pro-forma Invoice sent to the Customer, prior to the Shipping Date; or

(b) establishing an acceptable Letter of Credit (LC) for the full amount of the Equipment, shipping and insurance charges contained in the Quotation prior to the order being booked and accepted by Proxim.

5.4 If a Customer fails to pay an Invoice when due, Proxim may, without prejudice to am other remedy, postpone shipments, alter payment terms, terminate the Agreement and charge interest on all overdue amounts the rate of 1.5% per month compounded monthly (or if less, the maximum allowed by law). Upon demand, the Customer shall pay all such interest charges and all reasonable collection fees, including reasonable legal expenses.

SECURITY FOR PAYMENT

6.1 If the Customer is located in North America, the Customer grants to Proxim a purchase money security interest in the Equipment to secure the payment of the purchase price of the Equipment and all other amounts due from the Customer.

6.2 If the Customer is not located in North America:

(a) despite delivery and passing of risk in the Equipment and any other provision of these Conditions, the title in the Equipment shall not pass to the Customer until Proxim has received payment in full of the purchase price of the Equipment and all other amounts then due from the Customer, and (b) until the title in the Equipment passes to the Customer:

(i) the Customer shall hold the equipment as Proxim 's fiduciary agent and bailee, and shall properly store, protect and insure the Equipment and shall identify the Equipment as Proxim property;

(ii) if the Customer fails to pay Proxim in accordance with the agreed payment terms, Proxim may require the Customer to deliver up the Equipment to Proxim, and, if the Customer does not, Proxim may enter on the premises where the Equipment is stored and repossess the Equipment; and

(iii) the Customer shall not pledge the Equipment by way

of security for any, indebtedness of the Customer, but if the Customer does so all moneys owed by the Customer to Proxim shall, without prejudice to any other remedy of Proxim, immediately become due.

CHANGES TO PRODUCT SPECIFICATIONS

7.1 Proxim may, without notice to the Customer, make changes to the specifications of Equipment which do not materially affect the quality or performance of the Equipment.

EQUIPMENT CONFIGURATION AND EXPEDITING CHARGES

8.1 At the Customer's request, Proxim may, for a fee agreed in advance:

(a) reconfigure the Equipment; or

(b) expedite the Customer's order.

CONDITIONS OF SALE

SHORTAGES

9.1 The customer shall not make any claim for shortages (which are items that the Invoice does not show are on back-order) after twenty-one (21) days after the date of the Invoice.

RETURNS AND EXCHANGES

10.1 The return of defective Equipment is covered by the Warranty .

10.2 The Customer may only return Equipment that is not defective if:

(a) the Equipment does not correspond with the Customer's purchase order; or

(b) the Equipment has been ordered in error by the Customer and Proxim has permitted the Customer to remedy the mistake by ordering the correct equipment and resuming the Equipment and the Customer obtains a Returned Materials Authorization number ("RMA #") from Proxim prior to returning any Equipment.

10.3 Proxim reserves the right to charge a fee for returned equipment under Subparagraph 10.2(b) with the amount of the fee being determined prior to an RMA # being given by Proxim.

10.4 Authorized returns of equipment under Paragraph 10.2 must be in an undamaged condition, in the original configuration, in the original packing materials and within a time period agreed to when the RMA # was issued.

10.5 If the Customer does not comply with the provisions of Paragraphs 10.2, 10.3, and 10.4, the Customer shall pay the full amount of the Invoice.

10.6 The party liable for all shipping, insurance and any other expenses incurred by the Customer in returning the Equipment under Paragraph 10.2 and for all loss or damage to the Equipment until received by Proxim, shall be: (a) for all items returned under Subparagraph 10.2(a), Proxim and (b) for all items resumed under Subparagraph 10.2(b), the Customer.

CANCELLATION

11.1 If the Customer cancels an order before the Shipping Date, Proxim reserves the right to charge the Customer a cancellation charge up to 100% of the amount of the order.

11.2 The Customer shall pay all cancellation charges within thirty (30) days from date of the Invoice.

FORCE MAJEURE

12.1 Proxim shall not be liable if its performance of the Agreement becomes commercially impractical due to any contingency beyond Proxim's reasonable control, including acts of God, fires, floods, wars, sabotage, civil unrest, accidents, labor disputes or shortages, government laws, rules and regulations, whether valid or invalid, inability to obtain material, equipment or transportation, incorrect, delayed or incomplete specifications, drawings or data supplied by the Customer or others (collectively "Force Majeure"). In no event of Force Majeure shall Proxim be required to purchase goods from others to enable it to deliver the Equipment under the Agreement.

ENGINEERING AND SYSTEM DESIGN

13.1 The Customer is solely responsible for the engineering, design, integration and normal preventative and remedial maintenance of the Customer's system for which Proxim supplies Equipment.

13.2 Proxim is not responsible for the satisfactory operation of the Equipment in conjunction with other manufacturer's equipment, nor for any losses which may occur as a result of a failure of the Equipment to operate in conjunction with other manufacturer's equipment.

WARRANTY

14.1 All Equipment is covered by the Warranty.

14.2 THE WARRANTY CONTAINS LIMITATIONS ON THE CUSTOMER'S RIGHTS AND REMEDIES AGAINST PROXIM UNDER THE AGREEMENT. THE CUSTOMER ACKNOWLEDGES HAVING READ, UNDERSTOOD AND AGREED TO THOSE LIMITATIONS.

DAMAGES FOR BREACH OF AGREEMENT

15.1 If either party is successful in any litigation between the parties based on the Agreement, the successful party shall recover from the other, in addition to direct damages, the successful party's reasonable attorney's fees and other costs of litigation.

INSOLVENCY OF CUSTOMER, ETC.

16.1 Proxim may cancel the Agreement and suspend any further deliveries under the Agreement without any liability to the Customer, and, if Equipment has been delivered but not paid for, the price shall become immediately due and payable despite any other agreement to the contrary if:

(a) any proceedings in bankruptcy, insolvency, receivership or liquidation are taken against the Customer;

(b) the Customer makes an assignment for the benefit of creditors or commits an act of bankruptcy or insolvency;

(c) the Customer ceases, or threatens to cease, to carry on the ordinary course of its business, or transfers all or substantially all of its property;

(d) the Equipment is seized under any legal process or confiscated; or

(e) Proxim in good faith believes that the ability of the Customer to pay or perform any provision of the Agreement is impaired, or that any of the events mentioned above is about to occur.

NOTICE

17.1 All requests, instructions and notices from one party to the other must be in writing and may be given via registered post or facsimile transmission to the address of the parties shown on the Quotation or Order Acknowledgment.

EXPORT PROVISIONS

18.1 The Customer shall not, whether directly or indirectly (including facilitating a third party) export or re-export the Equipment outside the country in which the Customer has stated these items are to be used without obtaining the licenses required under ail applicable rules. The Customer shall indemnify Proxim against any liability incurred by Proxim due to any violation by the Customer of any of the provisions of this Section, but this indemnity shall not apply if the Customer reasonably relies on information supplied to it by Proxim with respect to export licenses. Upon receipt of a governmental consent to export the receiving party shall immediately notify the other in writing.

MISCELLANEOUS

19.1 No waiver by Proxim of any breach of this Agreement shall be considered as a waiver of any subsequent breach of the same or any other provision.

19.2 Any provision of the Agreement which is, or is deemed to be, unenforceable in any jurisdiction shall be severable from the Agreement in that jurisdiction without in any way invalidating the remaining portions of the Agreement, and that unenforceability shall not make that provision unenforceable in any other jurisdiction.

19.3 The rights which accrue to Proxim by virtue of the Agreement shall inure for the benefit of and be binding upon the successors and assigns of Proxim.

19.4 The agreement shall be governed by the laws of the State of California including the California Uniform Commercial Code. However Proxim may enforce the provisions of the Agreement in accordance with the laws of the jurisdiction in which the Equipment is situated. The United Nations Convention on the Sale of Goods (The Vienna Convention) shall not apply to the Agreement.

19.5 Les parties ont exigés que cette entente soit rédigée en anglais.

Acronyms / Glossary

10 Base-T/F
This designation is an Institute of Electrical and Electronics Engineers (IEEE) shorthand identifier. The "10" in the media type designation refers to the transmission speed of 10 Mbps. The "Base" refers to baseband signaling, which means that only Ethernet signals are carried on the medium. The "T" represents twisted-pair; the "F" represents fiber optic cable.

100 Base-TX/FX
The "100" in the media type designation refers to the transmission speed of 100 Mbps. The "Base" refers to baseband signaling, which means that only Ethernet signals are carried on the medium. The "TX" represents two pairs of data grade twisted-pair wire; the "FX" represents a two-strand optical fiber cable.

AC
Alternating Current

Alternating current
In electricity, alternating current (AC) occurs when charge carriers in a conductor or semiconductor periodically reverse their direction of movement.

amp
Ampere. An ampere is a unit of measure of the rate of electron flow or current in an electrical conductor. One ampere of current represents one coulomb of electrical charge (6.24×10^{18} charge carriers) moving past a specific point in one second.

amplifier
An electronic device that increases the voltage, current, or power of a signal.

analog
An analog signal is one in which a base carrier's alternating current frequency is modified in some way, such as by amplifying the strength of the signal or varying the frequency, in order to add information to the signal.

antenna
A device used for radiating or receiving electromagnetic energy.

attenuate
To lessen the strength of.

AUX
Auxiliary

azimuth
Azimuth and elevation are angles used to define the apparent position of an object in the sky, relative to a specific observation point. The observer is usually (but not necessarily) located on the earth's surface. The azimuth (az) angle is the compass bearing, relative to true (geographic) north, of a point on the horizon directly beneath an observed object. As seen from above the observer, compass bearings are measured clockwise in degrees from north. Azimuth angles can thus range from 0 degrees (north) through 90 (east), 180 (south), 270 (west), and up to 360 (north again).
The elevation (el) angle, also called the altitude, of an observed object is determined by first finding the compass bearing on the horizon relative to true north, and then measuring the angle between that point and the object, from the reference frame of the observer. Elevation angles for objects above the horizon range from 0 (on the horizon) up to 90 degrees (at the zenith).

back-to-back testing
A simple way to verify that the radios are fully operational before they are installed.

bandwidth
The width of a band of electromagnetic frequencies. Used to mean (1) how fast data flows on a given transmission path, and (2), somewhat more technically, the width of the range of frequencies that an electronic signal occupies on a given transmission medium. Any digital or analog signal has a bandwidth.

baseband
Any frequency band on which information is superimposed, whether or not the band is multiplexed and information is sent on sub-bands. The frequency band is not shifted to some other frequency band but remains at its original place in the electromagnetic spectrum.

baud
Baud was the prevalent measure for data transmission speed until replaced by a more accurate term, bps (bits per second).

beamwidth, half power
In a plane containing the direction of the maximum lobe of the antenna pattern, the angle between the two directions in which the radiated power is one-half the maximum value of the lobe.

BER
Bit Error Rate. The bit error rate (BER) is the percentage of bits that have errors relative to the total number of bits received in a transmission, usually expressed as ten to a negative power.

BNC connector
Developed in the late 1940's as a miniature version of the Type C connector, BNC stands for Bayonet Neill Concelman and is named after Amphenol engineer Carl Concelman. The BNC product line is a miniature quick connect/disconnect RF connector.

broadband
In general, broadband refers to telecommunication in which a wide band of frequencies is available to transmit information. Because a wide band of frequencies is available, information can be multiplexed and sent on many different frequencies or channels within the band concurrently, allowing more information to be transmitted in a given amount of time (much as more lanes on a highway allow more cars to travel on it at the same time).

CLI
Command Line Interface.

coax
Coaxial cable. A cable comprised of a center conductor, surrounded by an insulating core, with a braided or solid shield. Conductive shield surrounds the core with outside insulation.

codec
The term **codec** is also an acronym that stands for "**co**mpression/**dec**ompression." A codec is an algorithm or specialized computer program that reduces the number of bytes consumed by large files and programs.

dB
Decibel. In electronics and communications, the decibel (abbreviated as dB, and also as db and DB) is a logarithmic expression of the ratio between two signal power, voltage, or current levels.

dBi
Used to define the gain of an antenna system relative to an isotropic radiator at radio frequencies. The symbol is an abbreviation for "decibels relative to isotropic."

dBm
Used to define signal strength in wires and cables at radio and audio frequencies. The symbol is an abbreviation for "decibels relative to one milliwatt," where one milliwatt (1 mW) equals 1/1000 of a watt (0.001 W or 10^{-3} W).

DC
Direct Current

DCE
Distributed Computing Environment. An industry-standard software technology for setting up and managing computing and data exchange in a system of distributed computers.

demux
De-multiplexer

diffraction
The apparent bending of light waves around obstacles in its path.

digital
Electronic technology that generates, stores, and processes data in terms of two states: positive and non-positive.

diplexer
Combines signals so only one coaxial wire needs to be run.

dipole antenna
A straight electrical conductor measuring ½ wavelength from end to end and connected at the center to a radio-frequency feed line.

direct current
DC (Direct current) is the unidirectional flow or movement of electric charge carriers, usually electron.

DTE
Data Terminal Equipment. In computer data transmission, the RS-232C interface that a computer uses to exchange data with a modem or other serial device.

duplex
Duplex communication means that both ends of the communication can send and receive signals at the same time. Full duplex communication is the same thing. Half duplex is also bidirectional communication, but signals can only flow in one direction at a time.

DVM
Digital Volt Meter.

E1
E1 (or E-1) is a European digital transmission format devised by the ITU-TS and given the name by the Conference of European Postal and Telecommunication Administration (CEPT). It is the equivalent of the North American T-carrier system format. The E1 signal format carries data at a rate of 2.048 million bits per second and can carry 32 channels of 64 Kbps each. E1 carries at a somewhat higher data rate than T-1 (which carries 1.544 million bits per second) because, unlike T-1, it does not do *bit-robbing* and all eight bits per channel are used to code the signal. E1 and T-1 can be interconnected for international use.

EIA
Electronic Industries Association. Comprises individual organizations that together have agreed on certain data transmission standards such as EIA/TIA-232 (formerly known as RS-232).

EIRP
Effective Isotropic Radiated Power. The product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna.

elevation
See azimuth.

ERP
Effective Radiated Power. The product of the power supplied to the antenna and its gain relative to a half-wave dipole in a given direction.

fade margin
Difference between the actual received signal level and the radio's threshold.

FCC
Federal Communications Commission.

FEC Forward Equivalence Classes.
A Forward Equivalence Class is a description of the criteria used to determine whether a set of packets is to be forwarded in an equivalent fashion along the same label switch path.

Fresnel Zone
The area around the visual line-of-sight that radio waves spread out into after they leave the antenna. This area must be clear or else signal strength will weaken.

FTP
File Transfer Protocol. A standard Internet protocol; the simplest way to exchange files between computers on the Internet.

gain
A ratio, expressed in decibels, of the action of an antenna increasing the strength of a signal.

GPS
Global Positioning System. Lets you ascertain your location anywhere on earth.

HD
High Density.

heatsink
A device that is attached to a microprocessor chip to keep it from overheating by absorbing its heat and dissipating it into the air. Most heatsinks are aluminum and have "fins" that extend from the base.

hertz
The unit for expressing frequency, (f). One hertz equals one cycle per second.

HTTP
Hypertext Transfer Protocol. The set of rules for exchanging files (text, graphic images, sound, video, and other multimedia files) on the World Wide Web.

HyperTerminal
A program that you can use to connect to other computers, Internet telnet sites, bulletin board systems (BBSs), online services, and host computers, using either your modem or your network card.

IDU
Indoor Unit.

IF
Intermediate Frequency.

IP
Internet Protocol. The method or protocol by which data is sent from one computer to another on the Internet. Each computer (known as a host) on the Internet has at least one IP address that uniquely identifies it from all other computers on the Internet.

ISM
Industrial, Scientific, Medical.

isotropic antenna
An antenna capable of radiating or receiving equally well in all directions, and equally responsive to all polarization of electric and/or magnetic fields.

isotropic radiator
An electronic device that converts energy from one form to another, producing useful electromagnetic field output in all directions with equal intensity and at 100% efficiency, in three-dimensional space.

ITE
Information Technology Equipment.

kbit
Kilobit. A transmission rate of 1 **kbit**/s corresponds to 1,000 bits per second.

kHz
The kilohertz, abbreviated kHz or KHz*, is a unit of alternating current (AC) or electromagnetic (EM) wave frequency equal to one thousand hertz (1,000 Hz).

LED
Light-emitting diode. A device that emits visible light when an electric current passes through it.

link testing
The preferred way to evaluate a radio link's performance. It can be performed from end-to-end or in link test mode (which tests both directions of the radio path).

LNA
Low Noise Amplifier

lobe, antenna
A part of the antenna radiation pattern between adjacent minima.

loopback
A test signal sent to a network destination that is returned as received to the originator. The returned signal may help diagnose a problem.

Mbps
Megabits per second

MHz
Megahertz.
A unit of alternating current (AC) or electromagnetic (EM) wave frequency equal to one million hertz (1,000,000 Hz).

MIB
Management Information Block. A formal description of a set of network objects that can be managed using the Simple Network Management Protocol (SNMP) Management Information Block

modem
MOdulator DEModulator. A device that translates a stream of digital data created by computer into the curious squeaking and

hissing sounds that can be transmitted across phone lines.

multiplexing
The combining of several signals in the same communications channel, usually with the aim of increasing the amount of data that can be transmitted.

mux
Multiplexer.

mW
Milliwatt

narrowband
Generally, narrowband describes telecommunication that carries voice information in a narrow band of frequencies. More specifically, a specific frequency range set aside by the U.S. FCC for mobile or radio services, including paging systems, from 50 cps to 64 Kbps.

NMS
Network Management System

ohm
The standard unit of electrical resistance in the International System of Units (SI). Ohms are also used, when multiplied by imaginary numbers, to denote reactance in alternating-current (AC) and radio-frequency (RF) applications.

Ohm's Law
Ohm's Law is the mathematical relationship among electric current, resistance, and voltage.

oscillator
An electronic device used for the purpose of generating a signal. Oscillators are found in computers, wireless receivers and transmitters, and audio-frequency equipment.

parabolic antenna
An antenna consisting of a parabolic reflector and a source at or near the focus. A microwave dish antenna is an example of a parabolic antenna.

parallel
More than one event happening at a time.

parallel processing
In computers, parallel processing is the processing of program instructions by dividing them among multiple processorss with the objective of running a program in less time.

parity
A technique of checking whether data has been lost or written over when it has moved from one place in storage to another or when transmitted between computers.

polarization
An expression of the orientation of the lines of electric flux in an electromagnetic field. Polarization is important in wireless communications systems. The physical orientation of a wireless antenna corresponds to the polarization of the radio waves received or transmitted by that antenna.

PPP
Point-to-Point Protocol. A protocol for communication between two computers using a serial interface.

protocol
In information technology, the special set of rules that end points in a telecommunication connection use when they communicate.

QAM
Quadrature amplitude modulation. QAM is a method of combining two amplitude-modulated (AM) signals into a single channel, thereby doubling the effective bandwidth. QAM is used with pulse amplitude modulation (PAM) in digital systems, especially in wireless applications.

QPSK
Quadrature Phase Shift Keying. A digital frequency modulation technique used for sending data over coaxial cable networks. Since it's both easy to implement and fairly resistant to noise, QPSK is used primarily for sending data from the cable subscriber upstream to the Internet.

resistance
The opposition that a substance offers to the flow of electric current.

RF
Radio Frequency

RIP
Routing Information Protocol. A widely-used protocol for managing router information within a self-contained network such as a corporate local area network or an interconnected group of such LANs.

RMA
Return Material Authorization

RS-232C
A long-established standard ("C" is the current version) that describes the physical interface and protocol for relatively low-speed serial data communication between computers and related devices.

RSL
Received Signal Level

RU
Rack Unit

SELV
Safety Extra Low Voltage.

serial
One event at a time.

SMA connector
SMA is an acronym for SubMiniature version A and was developed in the 1960's. It uses a

threaded interface. 50 Ω SMA connectors are semi-precision, subminiature units that provide excellent electrical performance from DC to 18 GHz.

SMTP
A TCP/IP protocol used in sending and receiving e-mail.

SNMP
Simple Network Management Protocol. The protocol governing network management and the monitoring of network devices and their functions.

Spectrum Analyzer
An RF Spectrum Analyzer is a very special kind of superhetrodyne receiver which receives a chosen range of signals and displays the relative signal strength on a logarithmic display, usually a cathode ray oscilloscope.

T1
The T-carrier system, introduced by the Bell System in the U.S. in the 1960s, was the first successful system that supported digitized voice transmission. The original transmission rate (1.544 Mbps) in the T-1 line is in common use today in Internet service provider (ISP) connections to the Internet. The T-carrier system is entirely digital, using pulse code modulation and time division multiplexing. The system uses four wires and provides duplex capability (two wires for receiving and two for sending at the same time).

Telnet
A user command and an underlying TCP/IP protocol for accessing remote computers.

Tmra
Temperature, Maximum Room Ambient.

TNC connector
TNC stands for Threaded Neill Concelman and is named after Amphenol engineer Carl Concelman. Designed as a threaded version of the BNC, the TNC series features screw threads for mating. TNC are miniature, threaded weatherproof units with a constant 75 Ω impedance and they operate from 0 - 11 GHz.

UL-listed
Listed by Underwriter's Laboratories, an independent, not-for-profit product safety testing and certification organization.

U-NII
Unlicensed National Information Infrastructure. The U-NII spectrum is located at 5.15-5.35 GHz and 5.725-5.825 GHz. U-NII devices do not require licensing.

VDC
Volts of direct current.

VF
Voice Frequency.

voltage
Voltage, also called *electromotive force*, is a quantitative expression of the potential difference in charge between two points in an electrical field.

VOM
Volt Ohm Meter.

VSWR
Return loss measurement

WAN
Wide Area Network.

waveform
A representation of how alternating current (AC) varies with time.

wave guide
A hollow, tube shaped device constructed of metal with a vinyl or polypropylene coating, used for conducting RF energy from an emission source, such as a microwave transmitter, to an antenna.