TrangoLINK Giga™

6GHz
11GHz
18GHz
23GHz

Point-to-Point Microwave
Wireless Ethernet Bridge
High-Capacity Backhaul Network

User Manual

January 2009
Revision 3.0

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Tables

Preface

This manual covers the basic configuration and installation of the TrangoLINK Giga™ Wireless Broadband System, and applies to the following radio part numbers:

Part Number	Description
Giga-IDU-1	TrangoLINK Giga™ Indoor Unit , 100Mbps Full Duplex, 1U rack mount (All Frequency Versions) ANSI/ETSI
Giga6-ODU-1A	TrangoLINK Giga™ Outdoor Unit, 6GHz, Band 1, ANSI 5.935-6.044 GHz
Giga6-ODU-1B	TrangoLINK Giga™ Outdoor Unit, 6GHz, Band 1, ANSI 6.187-6.296 GHz
Giga6-ODU-2A	TrangoLINK Giga™ Outdoor Unit, 6GHz, Band 2, ANSI 6.054-6.162 GHz
Giga6-ODU-2B	TrangoLINK Giga™ Outdoor Unit, 6GHz, Band 2, ANSI 6.306-6.414 GHz
Giga11-ODU-1A	TrangoLINK Giga™ Outdoor Unit, 11GHz, Band 1, ANSI 10.715-10.945 GHz
Giga11-ODU-1B	TrangoLINK Giga™ Outdoor Unit, 11GHz, Band 1, ANSI 11.215-11.445 GHz
Giga11-ODU-2A	TrangoLINK Giga™ Outdoor Unit, 11GHz, Band 2, ANSI 10.955-11.185 GHz
Giga11-ODU-2B	TrangoLINK Giga™ Outdoor Unit, 11GHz, Band 2, ANSI 11.445-11.685 GHz
Giga11E-ODU-1A	TrangoLINK Giga™ Outdoor Unit, 11GHz, Band 1, ETSI 10.715-10.945 GHz
Giga11E-ODU-1B	TrangoLINK Giga™ Outdoor Unit, 11GHz, Band 1, ETSI 11.215-11.445 GHz
Giga11E-ODU-2A	TrangoLINK Giga™ Outdoor Unit, 11GHz, Band 2, ETSI 10.955-11.185 GHz
Giga11E-ODU-2B	TrangoLINK Giga™ Outdoor Unit, 11GHz, Band 2, ETSI 11.445-11.685 GHz
Giga18-ODU-1A	TrangoLINK Giga™ Outdoor Unit, 18GHz, ANSI 17.700-18.140 GHz
Giga18-ODU-1B	TrangoLINK Giga™ Outdoor Unit, 18GHz, ANSI 19.265-19.700 GHz
Giga18E-ODU-1A	TrangoLINK Giga™ Outdoor Unit, 18GHz, Band 1 ETSI 17.7275-18.1950 GHz

Giga18E-ODU-1B	TrangoLINK Giga™ Outdoor Unit, 18GHz, Band 1 ETSI 18.7375-19.2050 GHz
Giga18E-ODU-2A	TrangoLINK Giga™ Outdoor Unit, 18GHz, Band 2 ETSI 18.1950-18.6225 GHz
Giga18E-ODU-2B	TrangoLINK Giga™ Outdoor Unit, 18GHz, Band 2 ETSI 19.2050-19.6725 GHz
Giga23-ODU-2A	TrangoLINK Giga ™ Outdoor Unit, 23GHz, Band 2 ANSI 21.800-22.395 GHz
Giga23-ODU-2B	TrangoLINK Giga ™ Outdoor Unit, 23GHz, Band 2 ANSI 23.000-23.595 GHz
Giga23E-ODU-2A	TrangoLINK Giga ™ Outdoor Unit, 23GHz, Band 2 ETSI 22.022-22.358 GHz
Giga23E-ODU-2B	TrangoLINK Giga ™ Outdoor Unit, 23GHz, Band 2 ETSI 23.030-23.366 GHz

Table 1: TrangoLINK Giga™ Part numbers

FCC Emission Designators

- 10M0D7W for 10 MHz BW rates and all modulations
- 20M0D7W for 20 MHz BW rates and all modulations
- 30M0D7W for 28/30 MHz BW rates and all modulations
- 40M0D7W for 40 MHz BW rates and all modulations
- 50M07DW for 50 MHz BW rates and all modulations
- 56M0D7W for 56/80 MHz BW rates and all modulations

European Telecommunications Standards Institute (ETSI)

ETSI models of the Giga product line have been tested and found to comply with the European Telecommunications Standards:

EN 302 217-2-1 V1.2.1 (2007-02)
EN 302 217-2-2 V1.2.2 (2007-04)
EN 301 489-1 V1.8.1 (2008-04)
EN 301 489-4 V1.4.1 (2008-09)
EN 60950-1

These standards cover all the essential requirements of Directive 1999/5/EC.

Warranty Information

Radios from Trango Broadband Wireless are warranted for two years from date of purchase. Please see www.trangobroadband.com for a complete description of warranty coverage and limitations. Extended warranty protection can be purchased through Trango Sales or Customer Service (1-858-391-0010).

Chapter 1 - Overview

About this Chapter

This chapter introduces the TrangoLINK Giga™ system, features, and its components

Introduction

The TrangoLINK Giga™ is a carrier grade high-performance point-to-point wireless microwave system designed for Enterprise, Carrier and WISP networks using licensed microwave spectrum. The TrangoLINK Giga™ provides a full duplex wireless connection over the air that is ideal for mixed traffic that requires both IP and telephony (T1/E1) connectivity.

The TrangoLINK Giga™ is a Frequency Division Duplex (FDD) radio which provides low latency of less than 150μs, over 1 million packets per second, and up to 600+ Mbps of data. The TrangoLINK Giga™ utilizes 4 GigE ports in combination with VLAN and QoS prioritization to offer great flexibility in offering high value added services. Consult your specific Giga datasheet for individual specifications based on frequency.

Contents

Each TrangoLINK Giga™ kit comes equipped with (2) TrangoLINK Giga-IDU-1 with rack mounting hardware, (1) Giga(XX)-ODU1(X), and (1) Giga(XX)-ODU-2(X). Please see Table 1 for specific frequency models.

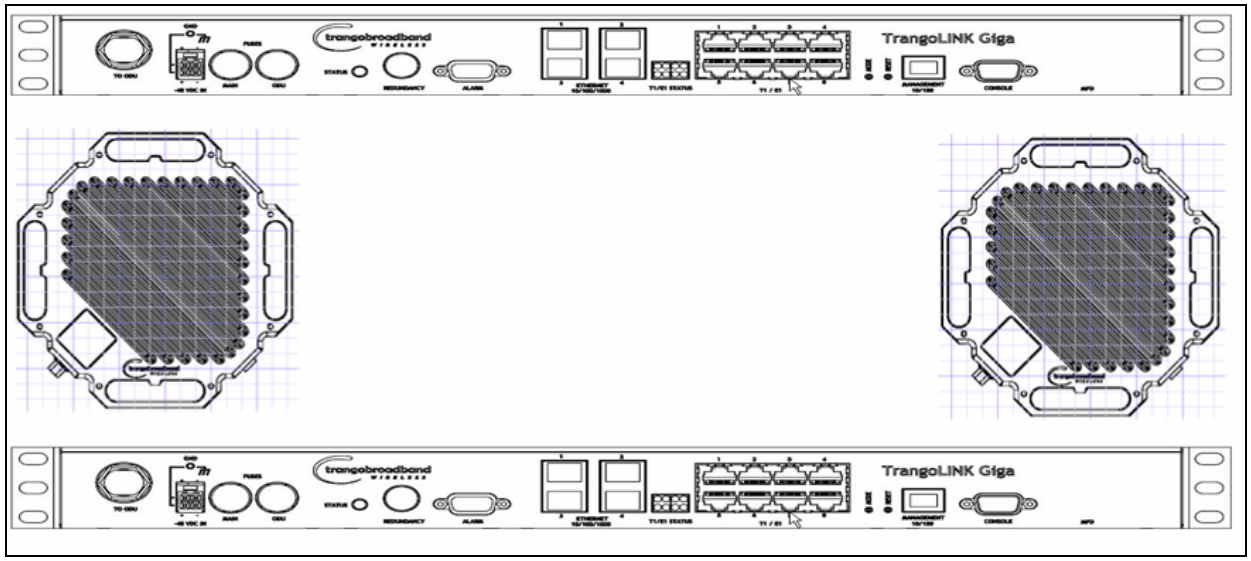


Figure 1: Components of a TrangoLINK Giga™ System

⚠ ADDITIONAL ACCESSORIES ARE REQUIRED FOR COMPLETE INSTALLATION OF THE TRANGOLINK GIGA™ SUCH AS POWER SUPPLIES, LMR-400 CABLES, WAVEGUIDE TRANSITIONS, AND ANTENNAS.

Indoor Unit Ports

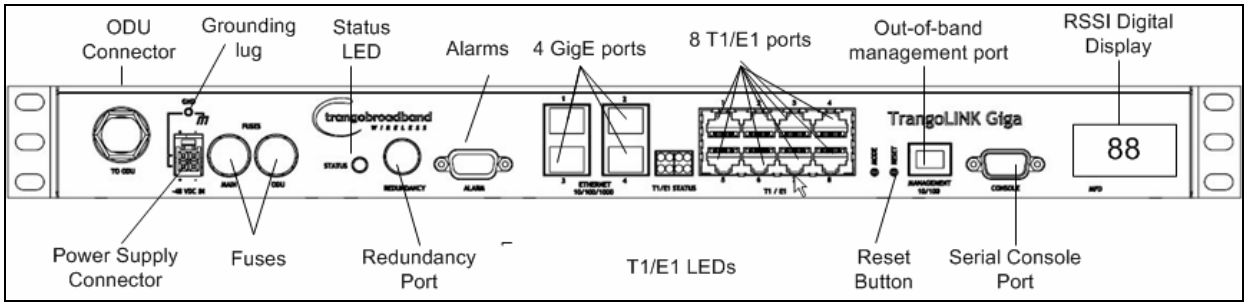


Figure 2: Front of IDU

The TrangoLINK Giga™ has a number of ports, connections, and LEDs on the front panel of the IDU.

N-Type Connector: The N-Type Connector connects the IDU to the ODU through LMR-400 Cable

Power Supply Connector: The IDU is powered by a -48V power supply (not included)

Fuses: These fuses protect the IDU and ODU in case of surges and power spikes

⚠ THE IDU USES A 3.5 AMP 250W FUSE WHILE THE ODU FUSE IS A 1.6 AMP 250W. Ensure your power supply has a minimum of 3.5 Amps.

Status LED: The LED is amber when there is no lock and green when the receiver is locked and demodulating data from the other end of the link.

Redundancy Port: This port is used to interconnect IDUs when the customer chooses the Hot Standby (HSB) equipment protection configuration (1+1).

⚠ WHEN A LINK OF TRANGOLINK GIGA™ IS CONFIGURED FOR HOT STANDBY (1+1) THE TWO IDU'S MUST BE MOUNTED DIRECTLY ABOVE ONE ANOTHER, BECAUSE THE "HEARTBEAT" SIGNAL EXCHANGED OVER THE REDUNDANCY PORT ARE CRITICAL AND THE CABLE LENGTH IS LIMITED TO NO MORE THAN 6 INCHES.

Alarms: The alarms are dry contact alarms and are user configurable.

4 GigE ports: 4 RJ-45 10/100/1000 Mbps auto-sensing GigE ports.

8 T1/E1 ports: 8 RJ-45 ports used for either T1 or E1 lines

Reset Button: Reset button reboots the unit.

Mode Button: Mode button when pressed and held for 5 seconds will factory default the unit.

Out of band management port: 1 RJ-45 10/100MBps Ethernet port used for management access

Serial Console Port: 1 serial RS-232 port used to manage unit.

RSSI Display: Receive Signal Strength Indicator (RSSI) digitally displayed in negative dBm (negative sign not shown). Example: display of "40" represents -40 dBm receive level.

Location of Serial Number

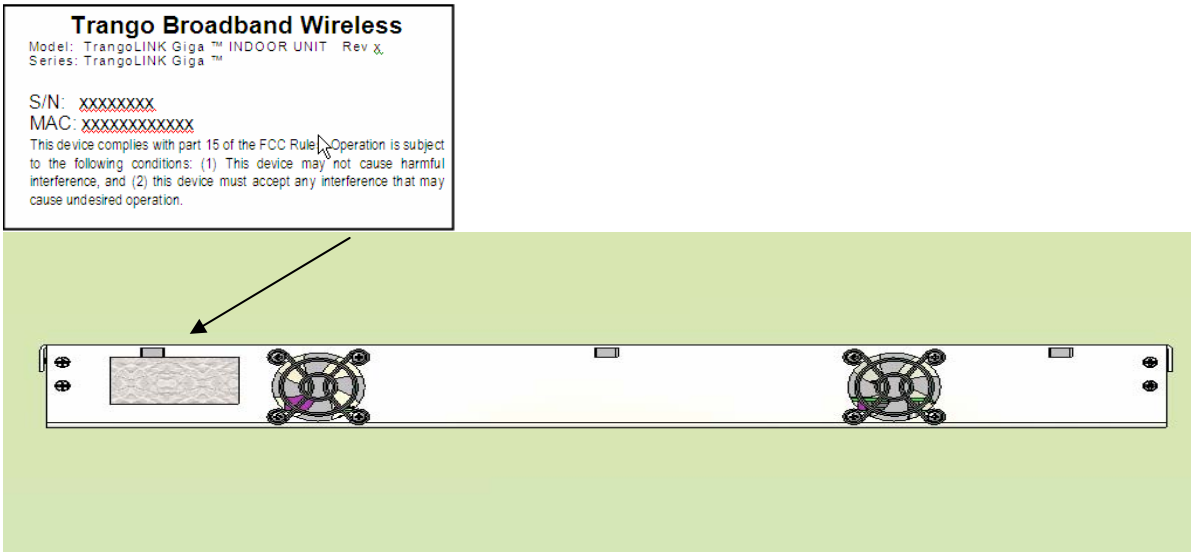


Figure 3: Back of Radio (Shows where MAC address can be found)

Outdoor Unit Ports

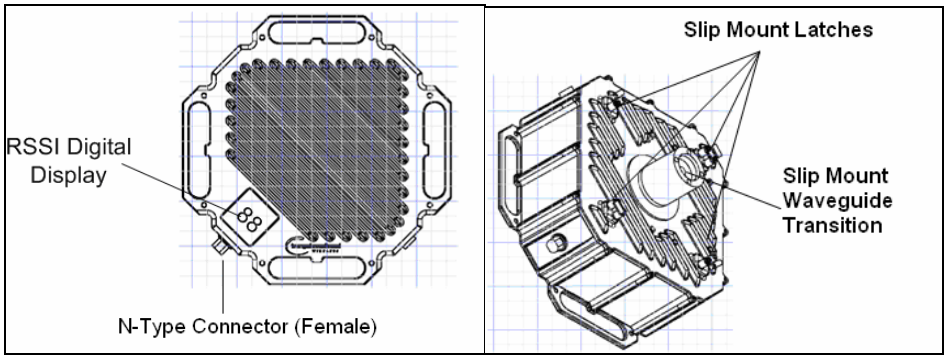


Figure 4: Outdoor Unit

N-Type Connector: The N-Type Connector (Female) connects the IDU to the ODU through LMR-400 Cable

RSSI Digital Display: RSSI value of the link is displayed on the digital display. NOTE: The display window has an RF shield mesh that may make the display window appear to have condensation.

Slip Mount Latches: Secures the ODU to the Antenna Assembly or mounting bracket and allows easy removal during maintenance.

Slip Mount Waveguide Transition: Transitions rectangular waveguide of the ODU to the antenna waveguide.

Chapter 2 - Getting Started

About this Chapter

This chapter discusses the basic steps to get started. The following topics will be covered in this chapter:

- Connection and Power
- Basic Configuration Concepts
- Management

It is recommended that you first provision and test the radios on the bench before deploying them in the field. This is a particularly useful exercise for the novice user.

Additional accessories are required for complete installation of the TrangoLINK Giga™ such as power supplies, LMR-400 cables, and antennas.

Connections and Power

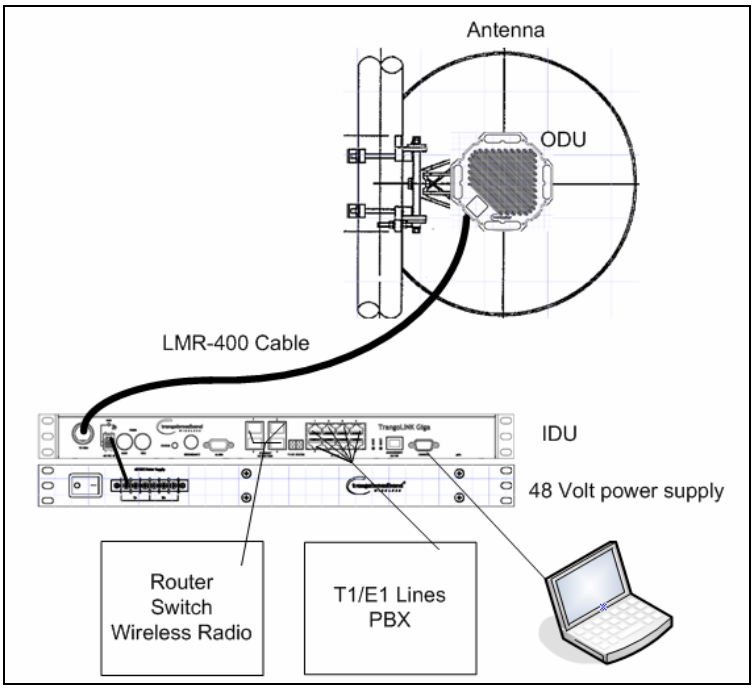


Figure 4: Wiring Diagram

- Connect LMR-400 cable between the ODU (outdoor unit) and the N-Type port of the IDU. Note that this cable carries the Transmit IF, the Receive IF, and the telemetry signals as well as power to the ODU.

⚠ Ensure you use 50 ohm "N" type connectors. Any other type of connector will prevent proper communication between the IDU and ODU.

- Out of Band Management Connection - If connecting to a COMPUTER to the out of band management port, use a Cross-Over Ethernet cable from the management port of the IDU to the computer's Ethernet port.
- When connecting a HUB, SWITCH, or ROUTER, to the GigE ports use a Straight-Thru cable.
- The IDU requires power from a -48Volt power supply. Trango Broadband recommends the use of a P-Supply-1U-48 and use of a ferrite suppressors supplied with the power connector to reduce noise that may couple into the IDU on the power line. Wrap both the + and – wires one time around the ferrite. See appendix C for a complete listing of accessories.

- To assemble the power connector, Trango Broadband recommends using a MOLEX crimp tool for .093 or .062 pins and 22 AWG wire (wire is not included with the system purchase).
- Properly strip and crimp the pin as depicted in Figure 6 Before inserting pin into connector.

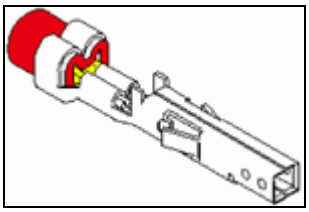


Figure 5: MOLEX pin

- Slide the crimped pin through the back of the MOLEX connector. You should feel it "click" or "lock" into position.
- The upper row of pins are for the primary power supply. If using a redundant power supply, simply connect the second set of wires to the lower row matching the same polarity as shown in Figure 7.
- Positive is on the left and marked with a (+) symbol and Negative is on the right marked with a (-) symbol.

Figure 6: Power Connector

MAKE SURE YOU USE A -48V POWER SUPPLY. IF CONNECTED TO A +48V POWER SUPPLY, YOU WILL CAUSE DAMAGE TO THE UNIT. THIS DAMAGE IS NOT COVERED UNDER WARRANTY.

You are now ready to configure the radio via the management Ethernet port.

If you cannot access the radio management functions via the management Ethernet port, it is possible that your PC is not set up with a properly routable subnet. If cannot access the radio via the management Ethernet port, use the Console Programming Cable and attach it to the Console Port located on the front panel of the IDU. The serial port setting can be found in the Console port

section in this Chapter

Basic - Concepts

The TrangoLINK Giga™ can be configured using either the Command Line Interface (CLI), or the Web Browser (HTTP) interface. Although both methods are comprehensive and powerful, the CLI method provides more functionality. Both methods of radio configuration require an understanding of the concept of Operation Mode (Opmode).

Opmode Concept

Before logging into a radio, it is important to understand the "Opmode" concept of the TrangoLINK Giga™. TrangoLINK Giga™ can be in one of two operational modes: Opmode "On" or Opmode "Off." When in Opmode "Off" the radio is not transmitting, and it is not attempting to make a wireless connection. Alternatively, when in Opmode "On," the radio is transmitting, and is attempting to make a wireless connection. The radio can still be managed when Opmode is "Off". The radio default is Opmode "Off" to ensure that nothing is transmitted until the installation is complete and there is no risk of unintentional RF radiation.

Default Opmode

Default Opmode setting controls whether opmode will be turned on after the boot process has completed. If Default Opmode is "Off" and Opmode is "On" the radio will not resume transmission upon rebooting. The default setting is Opmode "Off" to ensure that nothing is transmitted until the installation is complete and there is no risk of unintentional RF radiation.

Why is Opmode Important?

Opmode is important since if Opmode is not configured correctly the radio will not transmit to establish a link. There are also certain functions that can only be performed while the radio is in Opmode "Off." The following commands can only be performed with Opmode "Off"

- Setting / Changing Transmit Frequency
- Enabling Loopback

FACTORY DEFAULT OPMODE IS "OFF." DEFAULT OPMODE SHOULD BE CHANGED BEFORE RADIOS ARE DEPLOYED. CONSOLE MANAGEMENT IS POSSIBLE REGARDLESS OF OPMODE.

Mean Square Error Concept

Mean Square Error (MSE) is similar to Signal to Noise Ratio (SNR) except that is accounts for distortion and interference in addition to noise power. Distortion may come from several sources such as IF cables that are improperly constructed path degradations such as multi-path or Fresnel zone encroachment. Interference may not only come from other transmitters on the tower, but also from high power transmitters in the indoor shelter where the IDU is located or from transmitter located very close to the cable. There are maximum acceptable MSE values for each modulation which are useful in determining the quality of the link. The MSE value reported is only relevant to one tx-rx path, so the MSE of each tx-rx path must be evaluated to verify the link is operating cleanly. The lower the number the better so a -35dB is better than a -30dB. The table below shows the maximum MSE value to expect in IF Loopback, Normal Operation, and Absolute Maximum.

MSE Expected and Maximum values						
	QAM256	QAM128	QAM64	QAM32	QAM16	QPSK
Maximum Expected value IF loopback	-36	-36	-36	-36	-36	-36
Maximum Expected value Normal operation	-32	-32	-32	-32	-32	-32
Absolute Maximum for 1E-6 BER	-28	-25	-22	-19	-16	-9

Table 2: MSE Values

Max Power Input

The maximum power input, measured by RSSI, is as depicted in Table 3. If your RSSI value is higher than listed for the modulation that you are running, you may incur bit error rates as well as possible damage to the system.

256 QAM:	-34 dBm
128 QAM:	-32 dBm
64QAM:	-30 dBm
32QAM:	-28 dBm
16QAM:	-26 dBm
QPSK:	-24 dBm

Table 3: Max Power Input

RateShift & Downspeed

The Rateshift feature of the TrangoLINK Giga™ works in conjunction with the Downspeed command. The Rateshift command is an enable/disable command. Once Rateshift is enabled and link is lost the radio will shift down in modulation and speed based on the setting of Downspeed

THE RATESHIFT FEATURE WILL ONLY SHIFT THE MODULATION AND SPEED DOWN. IN ORDER TO RAISE THE MODULATION AND SPEED TO THE ORIGINAL SETTING REQUIRES MANUAL CONFIGURATION CHANGES.

ATPC & TargetRSSI

ATPC and TargetRSSI work together to control the remote side power achieving optimal signal strength. ATPC is an enable/ disable setting. Once enabled ATPC will adjust the power of the remote side based on the local TargetRSSI setting. If the RSSI value is lower than the TargetRSSI setting of the local radio, the remote radio will attempt to increase the output power in attempt to achieve the TargetRSSI setting. ATPC has step size and max power settings to limit the output power of the unit and prevent a violation of the FCC license.

POWER SETTING CAN NOT BE CHANGED ONCE ATPC IS ENABLED. IN ORDER TO MANUAL CHANGE THE POWER ATPC WILL NEED TO BE DISABLED.

ATPC Max Power & Step Size

The ATPC Max Power and the Step Size control how the ATPC function will behave in attempting to achieve the TargetRSSI. ATPC Max Power is the maximum power setting ATPC can set the power output to when trying to reach the TargetRSSI. The ATPC Step Size is the amount of dB per attempt that ATPC can change power output.

Port Mapping (802.1q) & Port Priority (802.1p)

The Port Mapping feature of the TrangoLINK Giga™ is a fixed setting and provides an additional amount of data security since traffic is segmented and isolated from other traffic across the link. Port Mapping allows for traffic from IDU1 port 1 to only be available from IDU2 port 1. This is applied to all GigE and T1 ports on the TrangoLINK Giga™. The Port Priority feature allows for an individual GigE port to have priority over the remaining GigE. The priority groups are 0-3 and can only be applied to GigE ports.

T1/E1 PORT WILL ALWAYS HAVE THE HIGHEST PRIORITY REGARDLESS OF GIGE PORT PRIORITY.

Class of Service (802.1p)

TrangoLINK Giga has Class Of Service capabilities that provide priority of types of traffic across the link. The traffic can be classified into 8 priorities 0-7 which can then be assigned to 4 queues.

Rapid Port Shutdown

The Rapid Port Shutdown (RPS) when enabled will shutoff the GigE interfaces of the IDU when the link is lost. This benefits networks that use Spanning Tree Protocol or other protocols which require ports to be shutdown in order to traffic to be re-routed.

Cable Loss

Cable loss refers to the amount of attenuation (in dB) caused by the IF Cable Equalization circuits in the ODU compensate for varying amounts of loss. Though Trango recommends LMR-400, we accommodate other cable selections (new or legacy installations) by requiring losses be entered in dB at each of the three frequencies exchanged between the IDU and ODU (IF up, IF down, and telemetry).

The 3 frequencies used to communicate between the IDU and ODU are 140MHz, 315MHz, and 915MHz. If installing one of Trango's pre-assembled IF Cables you can use Table 2 to identify the values that must be entered to properly configure the IDU to ODU interface. If the installation team is fabricating the IF Cable on site using LMR-400 you can interpolate linearly between values shown in Table 2. For example: a 75 ft LMR-400 IF Cable would have 1.11 dB of loss at 140 MHz (0.74 dB/50 ft * 75 ft = 1.11 dB).

If another coax cable type is used to connect the IDU and ODU, the installation team must know the cable loss characteristics at 140, 315, and 915 MHz and enter the correct values during configuration.

IN NO CASE CAN ANY IF CABLE LOSS EXCESS 14.83dB @ 140MHz, 22.52 dB @ 315MHz, 39.03 dB @ 915MHz SINCE THE ODU EQUALIZATION CIRCUITS CANNOT COMPENSATE FOR LOSSES OUTSIDE THIS RANGE.

LMR-400	140MHz	315MHz	915MHz
50ft	0.74 dB	1.13 dB	1.95 dB
100ft	1.48 dB	2.25 dB	3.9 dB
250ft	3.71 dB	5.63 dB	9.76 dB
500ft	7.42 dB	11.26 dB	19.51 dB
1000ft	14.83 dB	22.52 dB	39.03 dB

Table 4: Cable loss table

THE CABLE LOSS SETTING OF THE RADIO IS IMPORTANT. FAILURE TO SET THE PROPER SETTING CAN RESULT IN A NON-FUNCTIONAL LINK OR PRESENT FALSE RSSI READINGS.

Management

The TrangoLINK Giga™ can be managed through HTTP, HTTPS, Telnet, SSH, SNMP and console port. The default IP address is 192.168.100.100 and the passwords for the TrangoLINK Giga™ are below:

Access mode	Username	Password
CLI View Mode	Admin	trango
CLI Config Mode	N/A	trango
Web Interface	Admin	trango
SNMP Read Community	N/A	public
SNMP Write Community	N/A	private
SNMP Trap	N/A	trapstr

Table 5: Default Login Passwords

⚠ ALL TRANGO RADIOS ARE PRE-CONFIGURED AT THE FACTORY WITH A DEFAULT IP ADDRESS OF 192.168.100.100.

Browser Interface

To access the Browser interface simply open your web browser and enter the IP address of the radio (Figure 8).

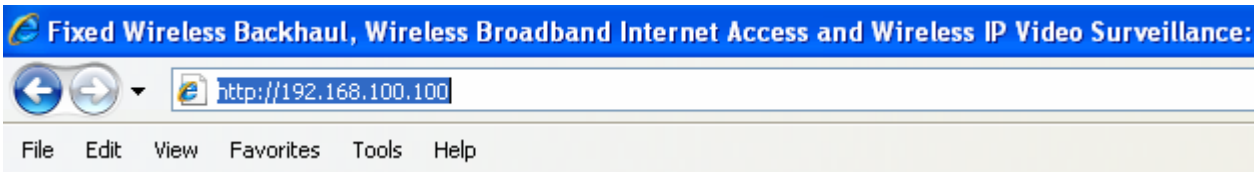


Figure 7: HTTP Login

A login window will pop up, requiring the user to enter username and password (Figure 9).

Enter the assigned user name and password, followed by pressing OK.

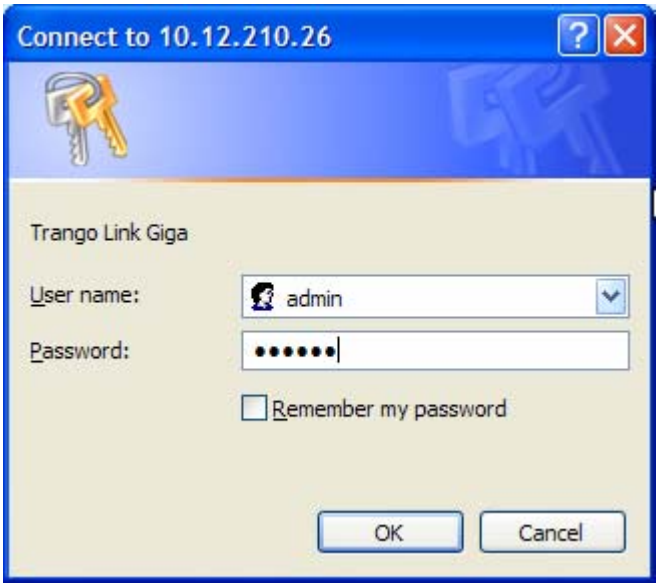


Figure 8: Web Browser Login

A valid combination of user name and password will open the SysInfo page (Figure 10).

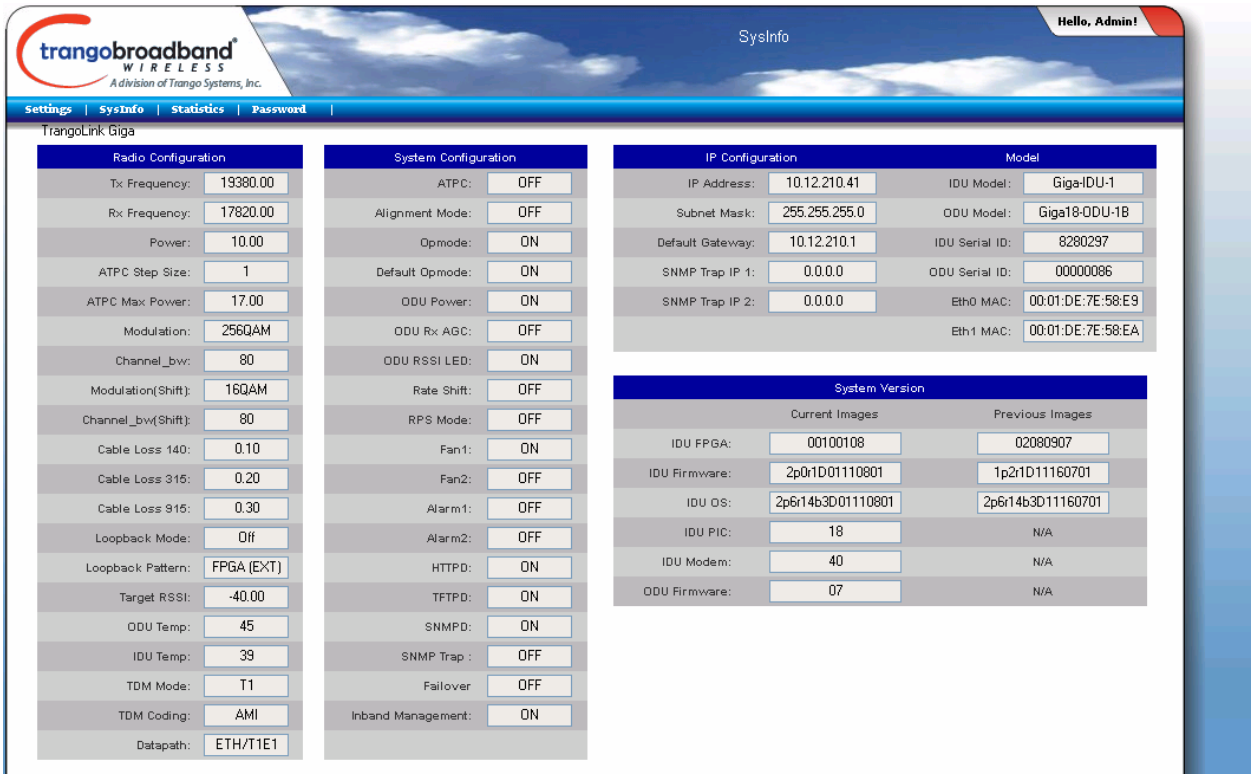


Figure 10: Browser Interface

The following describes the primary features and pages of the HTTP Browser interface:

Navigation Bar: The navigation bar is a blue bar on the top of all pages. The navigation bar contains all of the hotlinks to the following pages:

System Information Page: (Sysinfo) Shows most of the basic configuration parameters of the radio. It is the first page shown after login.

Settings Page: The essential parameters, such as IP address, Frequency, RF output power, Speed, and Cable Loss are set here.

Statistics Page: Counter information on all interfaces RF, T1/E1, and GigE is displayed. These statistics are used to determine the error rate of traffic

Password Page: User can change the "HTML" password.

Command Line Interface

All typical radio functions can be managed via the browser interface, but the Command Line Interface (CLI) has functionality that facilitates installation. The Command Line Interface has 3 modes View, Config, and Debug. Logging into the radio via Command Line Interface is covered here briefly, and a complete listing of all CLI commands is provided in Appendix A - Command Line Interface.

Launch Telnet

Open a command prompt (DOS) session on your PC (Windows® Start icon and select "Run"). Open a Telnet session by typing:

`telnet [`*`ip address of radio`*`]`

Example:

```
C:>telnet 192.168.100.100
Welcome to Trango-Link Giga Command Line Interface

trango login: admin
Password:

Trango Broadband Wireless:  TrangoLink Giga Command Line Interface v2.3.6

(trango-view)#
```

You will be prompted for a login and password. Type in the login and password and press enter.

To terminate a CLI session (Telnet or Console) simply close your console window.

The Command Line Interface has 3 levels of access. The first level is a view mode (read-only). The second level is the configuration level (read/write). The last level is the debug level.

Config Mode: Users can enter this mode by typing in the command "*config*" from the view mode. They will be prompted for a password and after successful authentication users enters the Config mode. All configuration settings can be changed here.

Any command entered without any parameters returns the current configured values similar to "view" mode.

Configuration changes are applied immediately and do not require a reboot. All config changes must be saved by issuing the "*save*" command. If the configuration is not saved, the system will resort to the last saved settings upon reboot.

ALL CONFIGURATION CHANGES HAVE TO BE SAVED IN ORDER TO BE PERSISTENT ACROSS REBOOT. A SINGLE "SAVE" COMMAND WILL SAVE ALL CONFIGURATION CHANGES

Users can go back to the "view" Mode by typing in the command "*exit*"

Example:

```
trango login: admin
Password:
Trango Broadband Wireless:  TrangoLink Giga Command Line Interface v2.3.6

(trango-view)# config
Password:
(trango-config)# exit
(trango-view)# exit
debug> cli

Trango Broadband Wireless:  TrangoLink Giga Command Line Interface v2.3.6

(trango-view)#
```

The Command Line Interfaces keeps a history of commands used, pressing the up arrow will display previous commands used. The CLI can complete a command being typed by pressing <tab> key. If a command is partially typed followed immediately by a "?" it will display all related commands.

Example:

```
(trango-config)# t?
  targetrssi  Displays target rssi value
  temp        Displays IDU and ODU temperature
  tftpd       Displays tftp server (tftpd) status
  threshold   Set the threshold for the radio parameters
  trapip      Displays SNMP Trap IP configuration
(trango-config)#
```

TYPE "?" FOR A LISTING OF ALL CLI COMMANDS.

Changing Password

The debug and view mode share the same password. The config mode has a separate password. The view and debug mode password is changed in the debug mode. The config mode password is changed in the config mode. Use the CLI command password to change the password. The example below demonstrates changing the password for the config mode to "control"

Syntax: password <*newpassword*>

Example:

```
(trango-config)# password control
(trango-config)# password
```

If the password is lost and you have been locked out of the unit contact Trango Broadband Technical Support for assistance.

Console Port

TrangoLINK Giga-IDU features a console port. The console port is useful in the event that the unit cannot be accessed via TCP/IP (HTTP or Telnet). A Terminal Emulation program (such as HyperTerminal on the Windows operating system) can be used to access the radio's CLI using the unit's console port, which is located on the front panel. To terminate a CLI session (Telnet or Console) type the command "*exit*"**.** Type **"***?*" for a listing of all CLI commands.

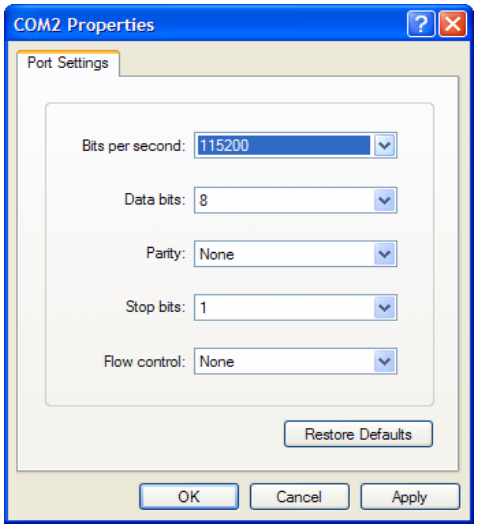


Figure 11: Hyper-Terminal Settings

Chapter 3 - Configuration

About this Chapter

This section describes how to establish a wireless link with the TrangoLINK Giga™, using the Browser (HTTP) Interface. This section addresses the basic steps in establishing a link in the lab environment. Trango strongly recommends that that you read this manual to gain an understanding and mastery of all important configuration parameters and procedures prior to deploying any wireless equipment.

In this section:

- Basic Configuration Screens and Parameters
- Essentials to Establish a Wireless Link

Basic Configuration Screens and Parameters

System Information

The TrangoLINK Giga™ has 4 main web pages. The "Sysinfo" page is a read-only page where the current configuration of the unit can been seen. The "Sysinfo" page consists of 4 sections the Radio Configuration, System Configuration, IP Configuration & Model, and the System version.

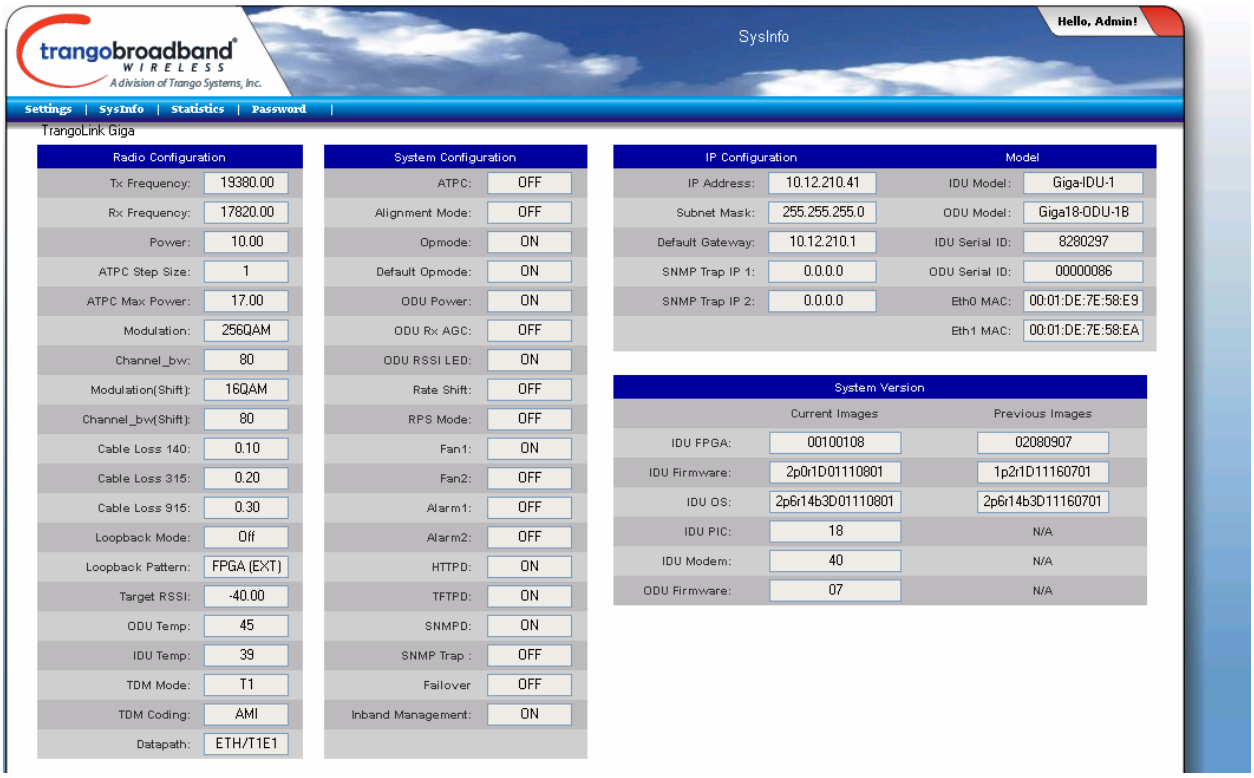


Figure 12: System Information Web Page

Radio Configuration

Frequency: Displays the Transmit and Receive Frequency of the radio in MHz

Power: Transmit power of the unit in dBm

ATPC Step Size: This is the amount (in dBm) that the Transmitter will alter the output power per command from the far end radio. Step size is user selectable from 1-5 dBm. Larger step sizes can track faster fading events but can cause "hits" if the far end receiver cannot track the change. A small step size is less likely to result in "hits" but may cause outages due to fast fading driving the far end receive signal below threshold.

ATPC Max Power: This is the maximum output power (in dBm) that the ODU will deliver. This is controlled by the FCC License ATPC output power allowed.

Modulation: Displays the current modulation from QPSK to 256QAM.

Channel_bw: Displays the current channel band width.

Modulation (Shift): Displays the modulation that will be used in the event of rateshift

Channel_bw (Shift): Displays the channel band width that will be used in the event of rateshift.

Cable Loss 140: Displays the cable loss of the LMR-400 IF cable at 140MHz in dB

Cable Loss 315: Displays the cable loss of the LMR-400 IF cable at 315MHz in dB

Cable Loss 915: Displays the cable loss of the LMR-400 IF cable at 915MHz in dB

Loopback Mode: Displays the current Loopback settings.

Loopback Pattern: Displays the current setting LB (loopback) pattern the unit will generate if Loopback testing is enabled.

Target RSSI: This is the RSSI value programmed as the nominal receive signal level (in dB determined during the path design). This value controls the receive attenuation in the ODU to allow maximum dynamic range.

ODU Temp: ODU temperature displayed in Celsius

IDU Temp: IDU temperature displayed in Celsius

TDM Mode: Time-Division Multiplexing mode is displayed

TDM Coding: Displays the current TDM coding

Datapath: Displays current datapath setting

System Configuration

The following settings are displayed in the "Sysinfo" page under System Configuration as either ON or OFF.

ATPC – Controls whether ATPC is

- Disabled ("Off") - the ODU delivers the maximum transmit power (a function of FCC license limitations for bandwidth and transmit power, and equipment design limitations determined by data modulation, or
- Enabled ("On") - the ODU will vary the output power under control of the far end radio to maintain Target RSSI.

Alignment Mode – Controls whether Alignment mode is

- Disabled ("Off") - The RSSI LED on the ODU will update once every 5 seconds
- Enabled ("On") – The RSSI LED on the ODU is updated 5 times every second and the following settings are disabled ATPC and ODU Rx AGC

Opmode – Operation Mode is

- Disabled ("Off") - The unit is accessible but will not transmit RF.
- Enabled ("On") – The unit will transmit to establish a link.

Default Opmode – Default Operation Mode is

- Disabled ("Off") - The unit will be in Opmode off upon startup.
- Enabled ("On") – The unit will go into Opmode on upon startup.

ODU Power – Outdoor unit power is

- Disabled ("Off") - The IDU does not send power to the ODU.
- Enabled ("On") – The ODU receives power from the IDU.

ODU Rx Gain – Outdoor unit receiver gain is

- Disabled ("Off") - The ODU receiver gain settings do not compensate for signal fading. The Target RSSI must be set appropriately for optimum MSE.
- Enabled ("On") – When enabled the IDU will dynamically adjust the ODU receiver gain settings based on the level present at the IDU IF input to compensate for flat signal fading. The target RSSI value is not considered. This is the recommended configuration.

ODU RSSI LED- Outdoor Receive Signal Strength Indicator is

- Disabled (“Off”) - The ODU RSSI LED is off and does not display any RSSI values.
- Enabled (“On”) – The ODU RSSI LED will display the RSSI values.

Rate Shift- Rate Shift is

- Disabled (“Off”) – There is no action taken if link is lost
- Enabled (“On”) – The unit will shift to speed defined in downspeed command when the link is lost.

RPS Mode- Rapid Port Shutdown is

- Disabled (“Off”) – The RPS mode is off and no action is taken.
- Enabled (“On”) – If the RPS is enabled the GigE ports are immediately shutdown in the event of a link loss in order to provide a fast switchover mechanism to the external routers and switches

FAN1

- Disabled (“Off”) - The FAN will be off to conserve power.
- Enabled (“On”) – The FAN will spin to dissipate heat.

FAN2

- Disabled (“Off”) - The FAN will be off to conserve power.

Enabled (“On”) – The FAN will spin to dissipate heat.

Alarm 1

- Disabled (“Off”) – No action is taken.
- Enabled (“On”) – The Alarm will be triggered when an event occurs

Alarm 2

- Disabled (“Off”) – No action is taken.
- Enabled (“On”) – The Alarm will be triggered when an event occurs

HTTPD – The Hyper-text transfer protocol daemon is

- Disabled (“Off”) - The web browser interface will be disabled.
- Enabled (“On”) – The web browser interface is enabled.

TFTPD – Trivial file transfer protocol daemon is

- Disabled (“Off”) - The unit will not accept TFTP file requests.

- Enabled (“On”) – The unit will accept TFTP file requests so that the unit can be upgraded.

SNMP Trap – Simple Network Management Protocol Trap

- Disabled (“Off”) - The unit will generate no SNMP Trap messages.
- Enabled (“On”) – SNMP Trap messages will be sent the IP destination configured.

Failover – When Failover settings is:

- Disabled (“Off”) – The setting has no effect.
- Enabled (“On”) – 1+1 failover is enabled and the Status LED on the IDU will start to blink.

Inband Management – Simple Network Management Protocol Trap

- Disabled (“Off”) – Management can only be done via out of band management port.
- Enabled (“On”) – Management can now be done via out of band management and in band management.

IP Configuration and Model

The following information is displayed in the IP configuration and model section of the "Sysinfo page".

IP Address – Displays the current configured Internet Protocol Address of the Indoor unit

Subnet Mask – Displays the current configured Subnet Mask the Indoor unit is using

Default Gateway- Shows the current Default Gateway for the Indoor unit.

SNMP Trap IP – SNMP traps will be sent the Internet Protocol Address shown

Ethernet MAC – The Ethernet Media Access Control Address of the Indoor unit

IDU Model – The model of the Indoor unit is shown

IDU Serial ID- The unique serial ID of the Indoor unit is shown

ODU Model – Displays the Outdoor unit model number

ODU Serial ID- The unique serial ID of the Outdoor unit is shown.

System Version

The Current and Previous Image information on the following settings is displayed in the System Version section.

IDU FPGA – Displays the current Indoor unit Field Programmable Gate Array (FPGA) version.

IDU Firmware- The current version of firmware the Indoor unit is displayed

IDU OS – The current version of the operating system the Indoor unit is shown

IDU PIC – Displays the current version of firmware for the microcontrollers of the Indoor unit.

ODU Firmware- Displays the current version of firmware the Outdoor unit

Settings Page

Configuration of the unit is performed under the “Settings” page. The “Settings” page is composed of the Radio Configuration, Ethernet Configuration, IP Configuration, and System Configuration.

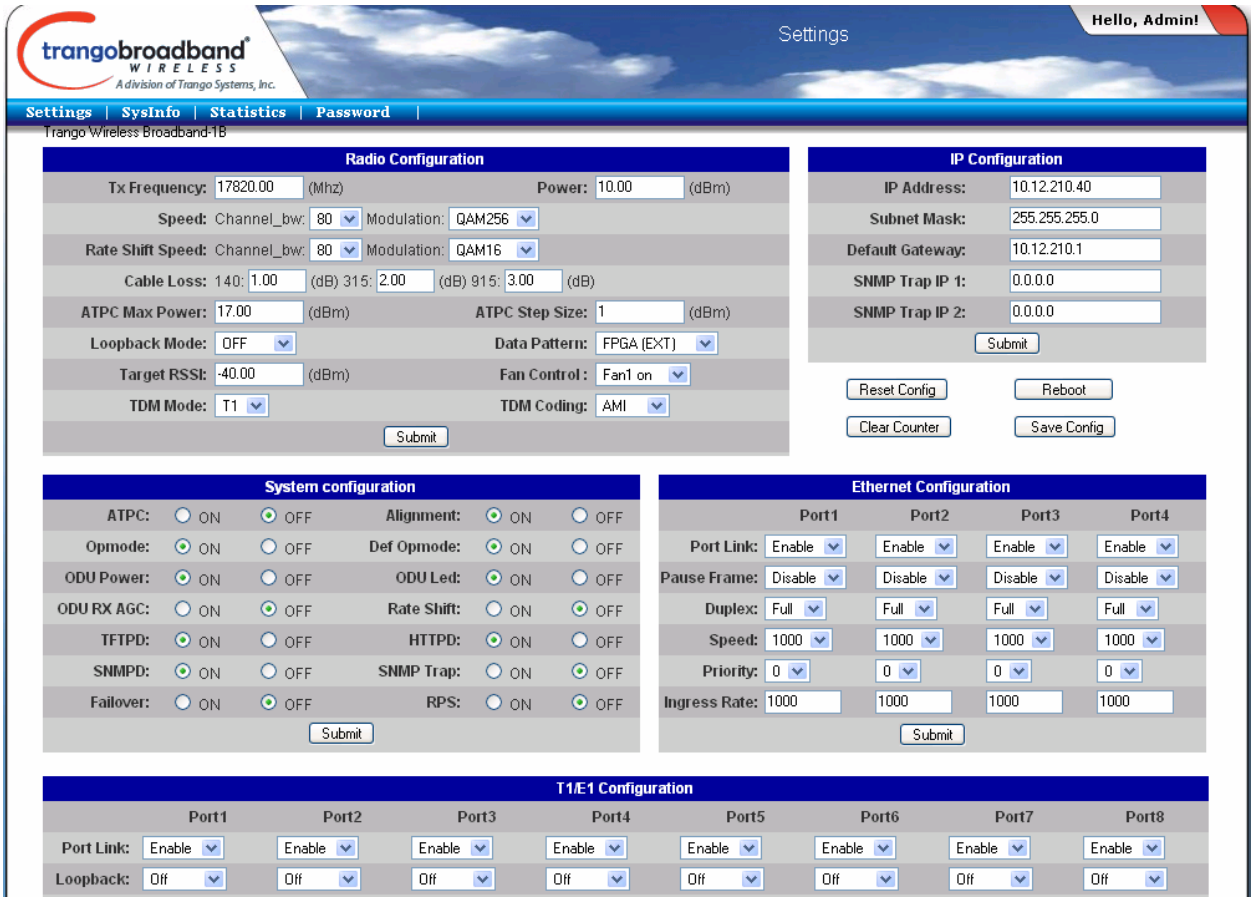


Figure 13: Settings Web Page

Radio Configuration

Frequency: Set the Center Frequency in accordance with the FCC License grant (MHz).

⚠ RADIO CONFIGURATIONS FOR CENTER FREQUENCY, BANDWIDTH, AND MAXIMUM TRANSMIT POWER MUST BE SET IN COMPLIANCE WITH THE FCC LICENSE GRANTED FOR THE LINK. THE TRANGOLINK GIGA™ USER IS RESPONSIBLE FOR CONFIGURING THE RADIO CORRECTLY.

Speed: Set the channel bandwidth (in MHz) in accordance with the FCC License grant using the channel_bw command and the modulation type should be selected from the pull-down menu in accordance with the Link Design

Rate Shift: This is a radio feature designed to maximize link availability by compensating for path anomalies. If Rate Shifting is enabled and traffic is lost (rain fade, etc.), both ends of the link will reconfigure to operate at a less complex modulation which provides a lower signal threshold. The lower threshold enables the link to reestablish communications faster but at a lower throughput. The user enters the Down Shift Bandwidth and the Down Shift Modulation.

The TrangoLINK Giga™ is shipped with default values

- Speed - 16 QAM and 10 MHz bandwidth which protect the user from inadvertently violating FCC constraints
- Down Shift – 16 QAM and 10 MHz bandwidth which protect the user from inadvertently violating FCC constraints

When the user configures the radio Speed, this value is automatically copied into the Down Shift Bandwidth in order to maximize throughput during a Down Shift and respecting the FCC License limitations.

If the user configures the radio Down Shift Bandwidth to a value different from the value entered in the Speed setting, the radio will respect this value (wider or more narrow).

The user is responsible for ensuring that changes to Speed and Rate Shift bandwidth values are consistent with the FCC License grant.

The user should know that most FCC Licenses require the user to operate at a Bit//Hz efficiency that demands modulations of 16QAM or higher.

Trango recommends that you do not reduce your Bandwidth below what is licensed since the increase in Receive Threshold is small relative to the restriction on throughput.

Always abide by the values with your FCC license.

If Down Shift is activated due to a path outage, the TrangoLINK Giga™ will continue to operate at the Down Shift settings until commanded (locally or remotely) to return to normal operation.

To resume normal operation, you must disable Downshift then increase the modulation. You may then re-enable the Downshift feature. There will be a momentary loss of traffic while your units are not at the same modulation.

Power: Transmit power (dBm). Transmit power is limited by two factors. First, the TrangoLINK Giga™ has equipment limitations (described in the Specification Appendix) that are a function of the channel bandwidth and signal modulation. At no time should the transmit power be set for a value greater than specified since this will degrade the link availability (BER will increase). Second, the FCC License grant may constrain power below what the TrangoLINK Giga™ can deliver so as to ensure there is no interference with an existing user. So the Power should be set to the lower of these two values (equipment limitations and FCC license grant).

Cable Loss: The cable loss of the IF cable between the IDU and ODU is required for 140, 315, and 915MHz

Loopback Mode: The settings allows for internal testing of the unit via loopback testing. There are 5 Loopback Mode settings OFF, IF, Digital, RF gen, and RF refl.

OPMODE MUST BE OFF IN ORDER TO ENABLE LOOPBACK. ONCE LOOPBACK IS DISABLED OPMODE CAN BE TURNED ON.

Data Pattern: This setting will determine the source of the signal for the Loopback testing. There are 2 Data (loopback) patterns FPGA which is an external signal and Modem which is an internal signal source.

Target RSSI: This is the RSSI value the unit will try to achieve. If ATPC is enabled, then the remote radio will increase or decrease output power in order to achieve the Target RSSI.

TDM Mode: This is the TDM mode that will T1/E1 interfaces will use

TDM Coding: This is the coding that the T1/E1 interfaces will use

Ethernet Configuration

Port Link: The option of Enabling or Disabling the GigE port.

Ingress Rate: The Ingress Rate is the amount of traffic that a port is limited on passing.

Priority: A priority can be assigned to the traffic based on the port.

IP Configuration

IP Address: The IP address assigned to the Unit.

Subnet Mask: The subnet mask assigned to the Unit.

Gateway: The gateway assigned to the Unit.

SNMP Trap IP: The IP address of the device that will receive SNMP traps.

System Configuration

ATPC (Automatic Transmit Power Control): ATPC enabled will allow the link elements to automatically adjust the output power of the ODU's to achieve the Target RSSI. This feature mitigates the effects of flat fading across the link.

Opmode: Opmode is short for operation mode. When opmode is enabled the unit will be transmit RF. If opmode is disabled the unit can still be managed but the RF portion of the device will be disabled.

NOTE: DO NOT ENABLE OPMODE UNTIL THE TRANSMIT FREQUENCY HAS BEEN SET TO THE LICENSED FREQUENCY

Default Opmode: Operation mode of the radio after a power cycle or reboot. Upon startup the unit will go into OPMODE "on" if Default Opmode is ENABLED. When the radio enters Opmode "on" it will be transmitting. When the radio enters Opmode "off" the radio is not transmitting, but can be accessed via the Ethernet port.

ODU Rx Gain: The settings assists in controlling the power received from the ODU to the IDU. If this parameter is enabled, the IDU will dynamically adjust the ODU receiver gain settings to compensate for flat signal fading, giving the maximum dynamic range possible. This is different than the target RSSI, which only adjusts the ODU receive gain once. This parameter can be enabled at the same time that ATPC is active without concern.

ODU Power: Controls the application of power from the IDU through the IF Cable to the ODU

ODU RSSI LED: The ODU RSSI digital display can be enabled or disabled.

HTTPD: Enable or Disable the WEB browser interface.

TFTPD: TFTP demon is enabled when upgrading firmware revisions.

FAN1: By default the fan is enabled and can be disabled to conserve power.

FAN2: By default the fan is disabled to conserve power.

ONLY ONE FAN CAN BE ENABLED AT ANY GIVEN TIME.

SNMP Trap: Enables the autonomous generation of SNMP traps from the radio to the IP address specified in the Configuration. The traps are used to notify the Network Management System or other SNMP Manager of a failure condition.

Failover: Enable or disabled 1+1 protection.

RPS: Enable or disable Rapid Port Shutdown.

T1/E1 Configuration

The T1/E1 supports PBX, DSX, Channel bank, DSLAM and DACS (Digital Access Cross connect) type of traffic. The T1/E1 is given the highest priority over the link due to the time/latency sensitivities of these telephony signals. The T1/E1 line interface supports AMI, B8ZS, and HDB3 coding on each interface. The T1/E1 mode and coding can be configured via the drop down boxes on the "Settings" page of the webpage or via the command line.

There are IDU Front Panel LED status indicators for each T1/E1. The T1/E1's are port mapped across the link so that a signal connected to IDU port #1 will be delivered to port #1 on the far end IDU. The T1/E1 signals can be connected between IDU's at a repeater site for transport to the drop location. Validating these signals at intermediary points requires a DSX cross-connect with monitor ports costing a few hundred dollars.

The T1/E1 interface connectors are RJ45. The following settings can be configured for the following loopback modes Off, Digital, Analog, Remote. The T1/E1 interfaces can be enabled/disabled via the CLI using the following command in Config mode:

```
port tdm tdm<port number> enable on

(trango-config)# port tdm tdm1 enable  on
Port tdm1: on

SUCCESS
(trango-config)#
```

CARE MUST BE TAKEN TO ENSURE THAT CUSTOMER PREMISE EQUIPMENT CONNECTORS MATCH THE CONVENTIONAL T1/E1 PIN USE.

Statistics Page

The Statistics page will display the status of the following areas: System, Link, Ethernet, RF, and T1/E1 (Figure 12).

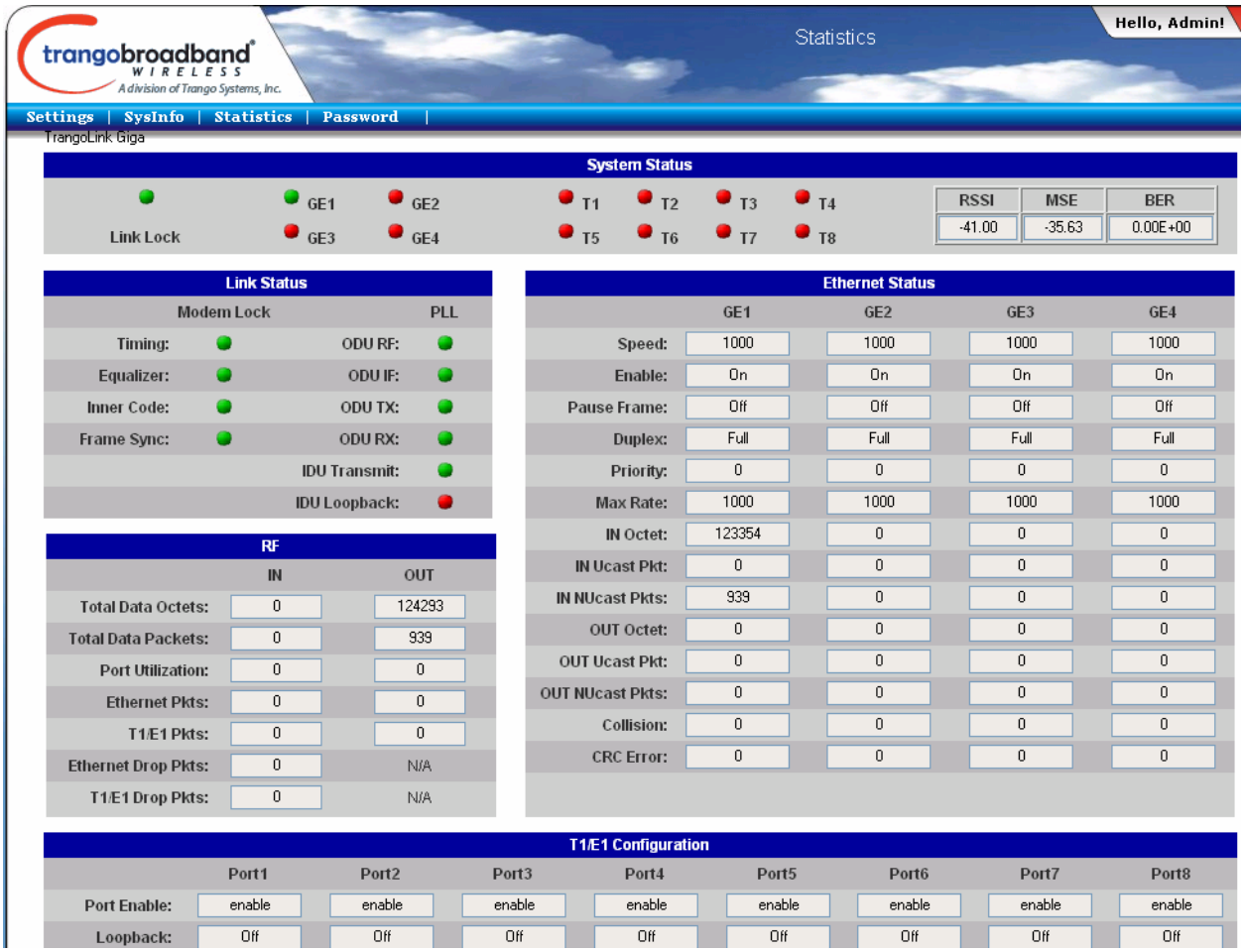


Figure 14: Statistics Web Page

System Status

The System status section of the statistic page will show which GigE and T1/E1 port are active. The section will also provides the RSSI, MSE, BER, and if the link has lock.

Link Status

The Link status section provides modem lock and pll information. This information is either Red for off or Green for on. In order to achieve link lock all items in this section need to be Green with the exception of IDU loopback.

THE QPSK AND 16QAM MODULATIONS DO NOT USE INNER CODE LOCK SO THESE WILL DISPLAY AS RED.

Modem Lock

- Timing – The RF signal from the far end has been detected and the symbol timing loop is locked
- Equalizer – The MSE is below threshold, indicating an acceptable MSE
- Inner Code – The Forward Error Correction (Trellis or Convolutional) part of the receiver is locked and producing data bytes out
- Frame Sync- The modem is detecting sync packet sent from the far end and the link is now usable for traffic

PLL Lock

- ODU RF – Outdoor unit RF Local PLL – Normally green
- ODU IF – Outdoor Unit RF Module Intermediate Frequency PLL Normally green
- ODU TX – Outdoor Unit transmit IF PLL - Normally green
- ODU RX – Outdoor Unit receive IF PLL - Normally green
- IDU Transmit – Indoor Unit transmit IF PLL - Normally green
- IDU Loopback – Indoor Unit transmit loopback PLL – This Lock is normally red unless IF loopback mode is activated.

Ethernet Status

The Ethernet status section provides the configuration information of each GigE port along with the following counters.

GigE Status

- Speed – Displays either 10, 100, or 1000
- Enabled – The GigE port can be either ON or OFF
- Pause Frame – The Pause frame can be either ON or OFF
- Duplex- The Duplex setting is either Half or Full
- Priority- The Priority ranges between 0 and 3
- Max Rate- the Max Rate can by any value between 0-1000

Counters

- In Octets – Total number of octets received for the port
- In Ucast – Total number of unicast packets received on the GigE port.
- InNUcast – Total number of Non-unicast packets received on the GigE port.
- Out Octets - Total number of octets transmitted
- OutUcast - Total number of unicast packets transmitted on the GigE port.
- OutNUcast - Total number of Non-unicast packets transmitted on the GigE port.
- Collisions – Total number of collisions on the port
- CRC errors – Total number of CRC errors on the port

RF Status

The RF status section will display the following counter in both IN and OUT with the exception of dropped Ethernet and T1/E1 which only display as IN.

- Total Data Octets- The Total number of octets received and transmitted
- Total Data Packets- The Total number of Data packets received and transmitted
- Ethernet packets- The Total number of Ethernet packets received and transmitted
- T1/E1 packets- The Total number of T1/E1 packets received and transmitted
- Ethernet Drop packets- The Total number of received Ethernet packets that were dropped
- T1/E1 drop packets- The Total number of received T1/E1 packets that were dropped

T1/E1 Status

The T1/E1 status section will display the following settings.

- Port Enabled
    - Disabled – The T1/E1 port is disabled
    - Enabled – The T1/E1 port is enabled.

- Loopback – The T1/E1 interfaces can be in 4 types of Loopback modes. Traffic entering the T1/E1 ports passes through the T1/E1 ports as analog data and is converted to digital traffic before being sent out to the ODU.

    - Disabled – The Loopback mode is off.
    - Digital – Loopback is enabled and traffic will be converted from analog to digital at the Line Interface Unit (LIU) then looped back.
    - Analog – Loopback is enabled and traffic is looped back in analog at the LIU without any conversion.
    - Remote – Loopback is enabled and traffic is converted from analog to digital sent to the remote side of the link and is looped back at the LIU digitally.

Password Web Page

The password can be changed from this web page. This will only change the web access password.

Figure 15: Password Web Page

Essentials to Establish a Wireless Link

In order to establish a wireless link there are a few essential parameters that must be configured properly. These settings must be configured correctly on both sides of the link.

- ODU Power must be enabled
    - This allows the IDU to power up the ODU through the IF cable.

- Cable loss parameters
    - The Cable loss parameters need to be accurate. The loss is based on the length of the IF cable at 140, 315, and 915 MHz.
    - NOTE: The return loss (S11 and S22) or VSWR of the coax cable must be below -15 dB and 1.4:1 respectively at 315 and 140 MHz to allow higher order 128 and 256 QAM modulation to be used. Otherwise signal quality (MSE) will degrade and could introduce bit errors. It is always best to test cables for VSWR before installing.

- ODU Transmit Power
    - This is the maximum output power the unit will transmit.

- Transmit Frequency
    - The transmit frequency in MHz is expected. The receive frequency is automatically set based on the transmit frequency.

- Modulation and Channel_BW
    - The modulation and channel_bw are configured with the “speed” command. The modulation and channel width need to match on both sides of the link.

- Default Opmode “ON”
    - Default Opmode must be on in order for the unit to transmit after a reboot.

- Save and Reboot
    - The save is needed so that setting changes are persistent through a reboot. A reboot is required for settings to take full effect.

If these parameters are met, and if the units are within range and properly aligned, the wireless link will automatically establish itself and Ethernet traffic will begin to pass between the radios.

Evaluate Link Quality

Link Test

A link test can only be performed on a link that is carrying traffic. Linktest can be used even without the link lock, but it's more meaningful when locked. The `linktest` can be performed from the CLI only and will display information pertaining to link quality. Link Test can be performed while carrying traffic without impacting customers.

The fields displayed are LOCK, RSSI, MSE, and BER.

LOCK: The receiver has locked onto and is able to demodulate the remote transmitter's signal. Once lock is achieved, the radio can pass traffic. If the lock is not "1", there are problems with the link setup that need to be evaluated.

RSSI: The receive signal level in dBm. This value should be compared to the expected signal level determined during the design phase of the project. Signal levels low by 10 dBm are typically associated with antenna misalignment (one antenna is aligned to a side lobe) Signal levels low by more than a few dB may indicate obstructions in the Fresnel zone or side lobe alignment. Make sure that your target RSSI is set correctly when evaluating RSSI readings.

THE RSSI SHOULD NOT EXCEED -20dB. EXCEEDING THIS FOR EXTENDED PERIOD OF TIME MAY CAUSE DAMAGE TO THE UNIT

MSE: Mean Square Error is calculated and displayed in dB. MSE is similar to Signal to Noise Ratio (SNR) except that is accounts for distortion and interference in addition to noise power.

BER: Bit Error Rate (BER is calculated between the ODU and IDU) The BER is displayed in 0.00E-00 format and measures the number of uncorrected bit errors divided by the number of bits transmitted. The BER value displayed in the linktest command is the instantaneous value of the BER for 1sec duration. Telephony circuits (T1/E1) can tolerate BER of 10^{-3}, but for IP traffic and reliable telephony traffic the BER should be no greater than 10^{-6}. Substandard BER performance is difficult to isolate and generally requires careful fault isolation using the loopback feature of the radio.

The linktest command can be executed by typing the command "*`linktest`*" followed by the number times to display results.

The example below displays the linktest command and 5 lines of data. Please note that once the command is launch the linktest cannot be interrupted.

Example:

```
(trango-view)# linktest  [0-99]

(trango-view)# linktest 5
        LOCK       RSSI          MSE            BER
  1>     1      -61.00 dBm      -25.00 dBm      0.00E+00
  2>     1      -61.00 dBm      -25.04 dBm      0.00E+00
  3>     1      -61.00 dBm      -25.05 dBm      0.00E+00
  4>     1      -61.00 dBm      -24.86 dBm      0.00E+00
  5>     1      -61.00 dBm      -25.00 dBm      0.00E+00
(trango-view)#
```

Chapter 4 - Deployment & Installation

About this Chapter

Once you are familiar with the basic operation of the radios you are ready for deployment in the field. The deployment process consists of the following steps:

- Mounting Hardware
- Grounding
- Weather Proofing
- Antenna alignment
- Upgrading Firmware

REFER TO CHAPTER 7 FOR BENCH TESTING THE EQUIPMENT

Installation

Mounting Hardware

The IDU is supplied with mounting brackets and screws for installation in a standard 19inch rack. The ODU has a unique slip-mount adapter design which allows for the ODU waveguide output to be coupled into antenna input with a minimum of loss and ease of installation. The ODU is secured to the antenna assembly using 4 easy, slip-mount latches. Please refer to the antenna installation instructions for proper installation of the antenna. The ODU can be secured to the tower/pole with high strength cable strung through any of the four carrying handles to discourage theft. Trango recommends using combination locks so that maintenance is not frustrated by lost keys.

Screw or Nut Size	Torque (in-lbs)
4-40	6
6-32	12
8-32	22
10-32	37
¼-20	65

Table 6: Torque

⚠ PLEASE REFER TO THE ANTENNA INSTALLATION INSTRUCTIONS FOR PROPER INSTALLATION OF THE ANTENNA.

⚠ 22 AWG TYPE WIRE IS RECOMMEND FROM THE POWER SUPPLY TO THE IDU. THESE CABLES ARE NOT SUPPLIED WITH PURCHASE. PLEASE REFERENCE CHAPTER 3 FOR POWER CONNECTION ASSEMBLY.

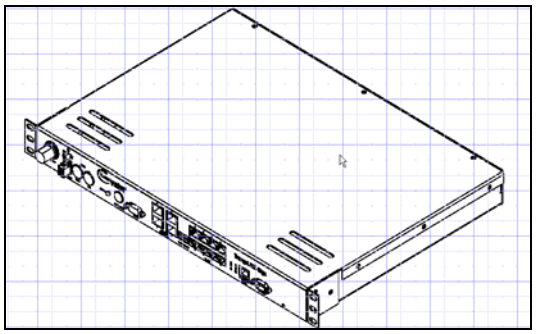


Figure 9: Mounting IDU Assembly

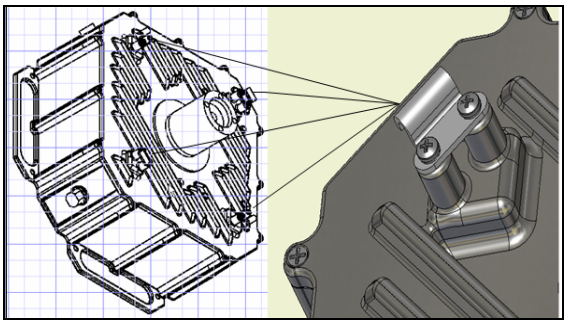


Figure 10: Mounting ODU Assembly

Ferrite Installation

The IDU ships with a ferrite (Figure 16) to prevent noise from entering the unit through the power cable. To install the ferrite, loop the power cable through at least once and close the ferrite. Be sure to install the ferrite as close as possible to the IDU (Figure 17).

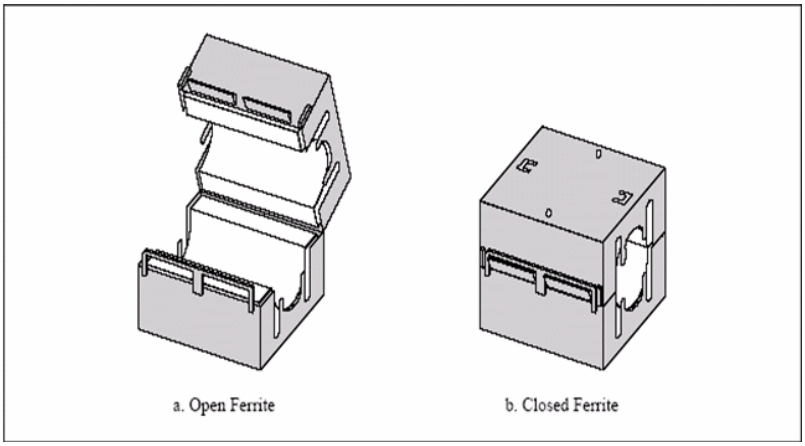


Figure 11: Ferrite

Figure 12: Ferrite Installed

When installing the ODU there are 2 keys factors in determining the polarity of radio.

1. The installation of the waveguide

2. The mounting of the ODU to the antenna.

IT IS IMPORTANT THAT THE WAVEGUIDE AND ODU ARE INSTALLED CORRECTLY. THE RESULTS OF IMPROPER INSTALLATION WILL RESULT IN TRANSMITTING AN INCORRECT POLARITY IN VIOLATION OF THE FCC LICENSE AND POTENTIAL LINK FAILURE.

Waveguide Transition Installation

Place the Waveguide Transition into the bore on the ODU. Use a small amount of silicone lubricant which is supplied with the transition. Evenly but not excessively, lubricate the O-Ring before placing on the ODU groove. Do not disturb the O-Ring position. Attach the waveguide transition using a Phillips screw driver and tighten securely. Note the alignment of the transition to the waveguide opening on the ODU.

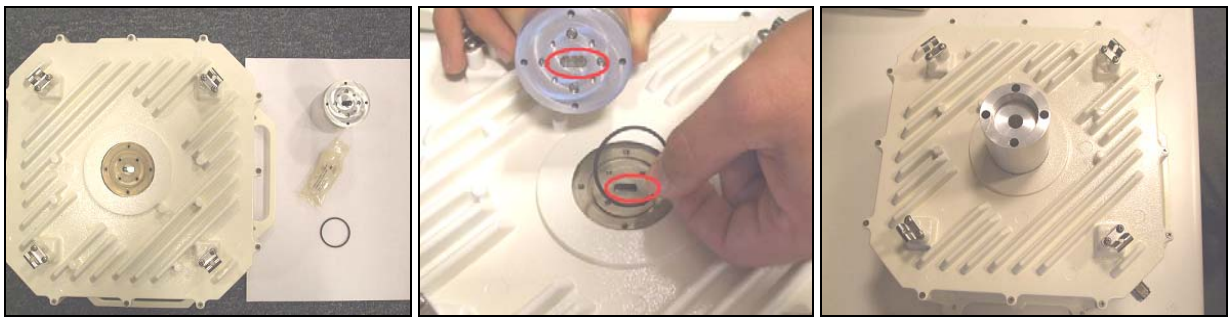


Figure 13: Waveguide transition installation.

INSTALLING THE WAVEGUIDE ADAPTER REQUIRES A SMALL DIAMETER SCREWDRIVER WITH A PHILLIPS HEAD WITH A MAX DIAMETER OF .225 AND ABOUT 2 1/2 INCHES LONG

THE INSTALLATION KIT MAY INCLUDE MATERIALS THAT ARE NOT USED FOR EVERY INSTALLATION. YOU MAY RECEIVE EXTRA OR NON-FITTING O-RINGS.

When placing the waveguide adapter onto the ODU ensure that orientation matches. Figure 14 shows the placement of the waveguide adapter.

Polarization

ODU mounting determines if the transmit signal polarity as vertical or horizontal. Changing polarity from vertical to horizontal is easy. Apply a small amount of silicone lubricant to the O-Ring that is already attached to the antenna. Then simply unlatch the ODU from the antenna and rotate counter-clockwise and reattach the ODU to the antenna. Figure 19 shows a unit mounted, with vertical polarization as well as one mounted with horizontal polarization. Please take special note of the LED panel and N-Connector position as this is used for polarity selection. The Trango Broadband™ logo should not be used for orientation purposes as different models of ODU may have the logo stamped in different positions.

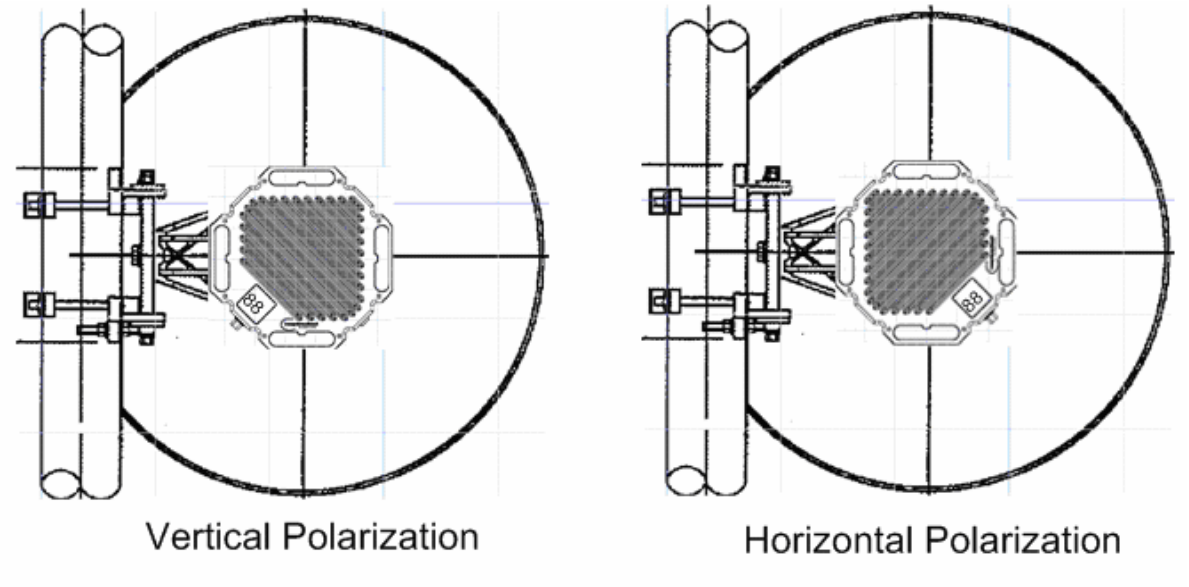


Figure 14: ODU Polarization (Left side mount)

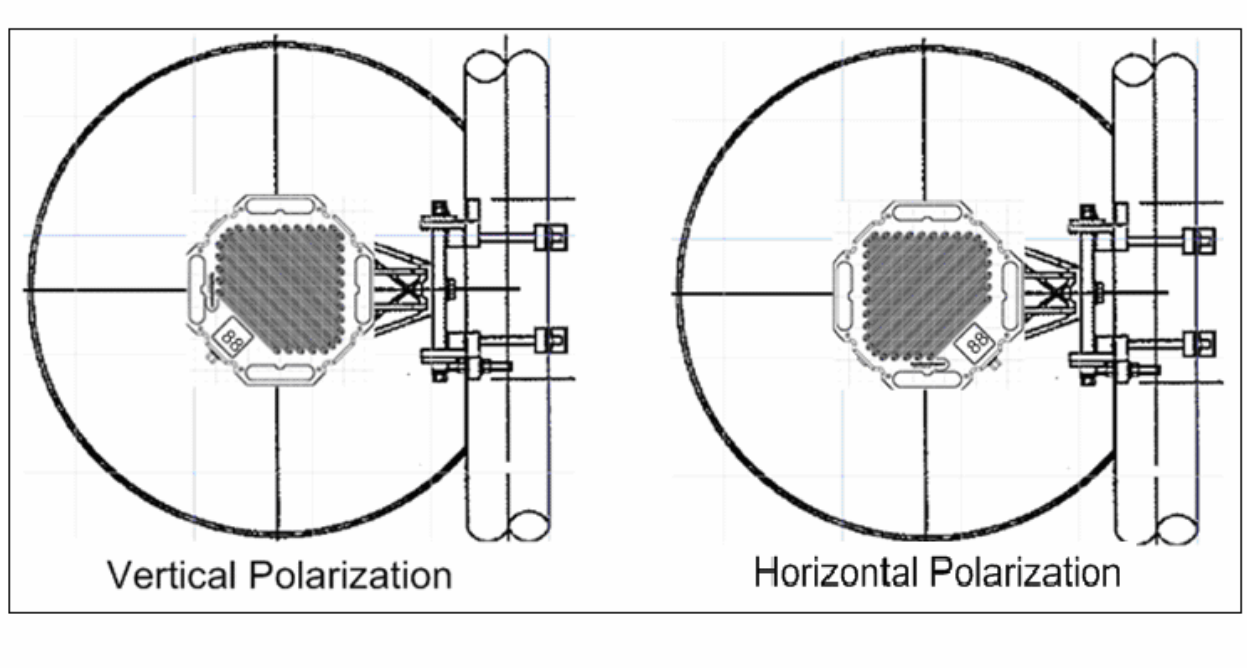


Figure 15: ODU Polarization (Right side mount)

1+1 Coupler Installation

The 1 +1 coupler is needed to install two ODU's to a single antenna. The mount has a single couple centered on one side (Figure 17) while there are 2 evenly spaced on the second side.

Figure 16: 1+1 Coupler

To install the mount simply attach the single sided coupler to the antenna mount and secure the latches as shown in Figure 18. Remember to use the supplied silicone lubricant as mentioned in the standard installation steps.

Figure 17: 1+1 Couple and latches

Once the 1+1 coupler has been installed (Figure 19) the ODU's can be mounted to the 1+1 coupler. The polarization for the 1+1 mount is determined by the transition between the mount and the antenna. The ODU's needs to be mounted in the H-Pol position on the 1+1 mount as the coupler determines polarity. Please order your correct polarity.

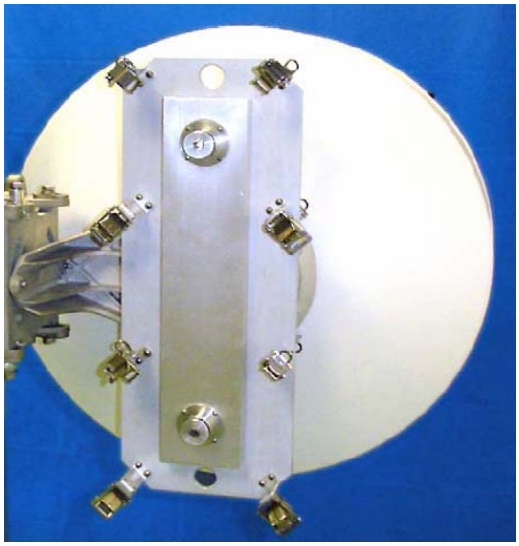


Figure 18: 1+1 Coupler installed on Antenna

Both Outdoor units must be mounted in the same position with the N-type connector on the bottom right side as shown in Figure 20 regardless of polarization.

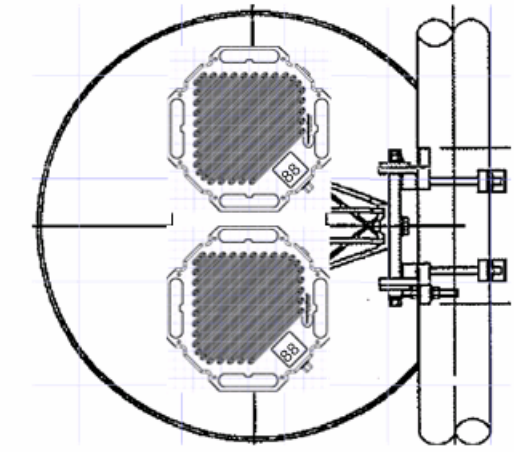


Figure 19: 1+1 ODU Mounting

THE ODU'S NEED TO BE MOUNTED IN THE SAME POSITIONS TO THE 1+1 MOUNT POLARAZATION IS DETERMINED BY THE COUPLER BETWEEN THE 1+1 MOUNT AND THE ANTENNA

Polarization of 1+1 Coupler

The 1+1 mount ships with a vertical polarized coupler. In order to change the polarization to horizontal the vertical couple must be replaced with a horizontal coupler. (Figure 21) This coupler has a “twist” transition so it will look slightly different than the coupler that connects to the ODU. The 1+1 coupler also has 2 slightly offset screw holes to ensure proper installation orientation.

Figure 20: Removing 1+1 coupler

The vertical and horizontal couplers have differences in the waveguide as shown in Figure 22.

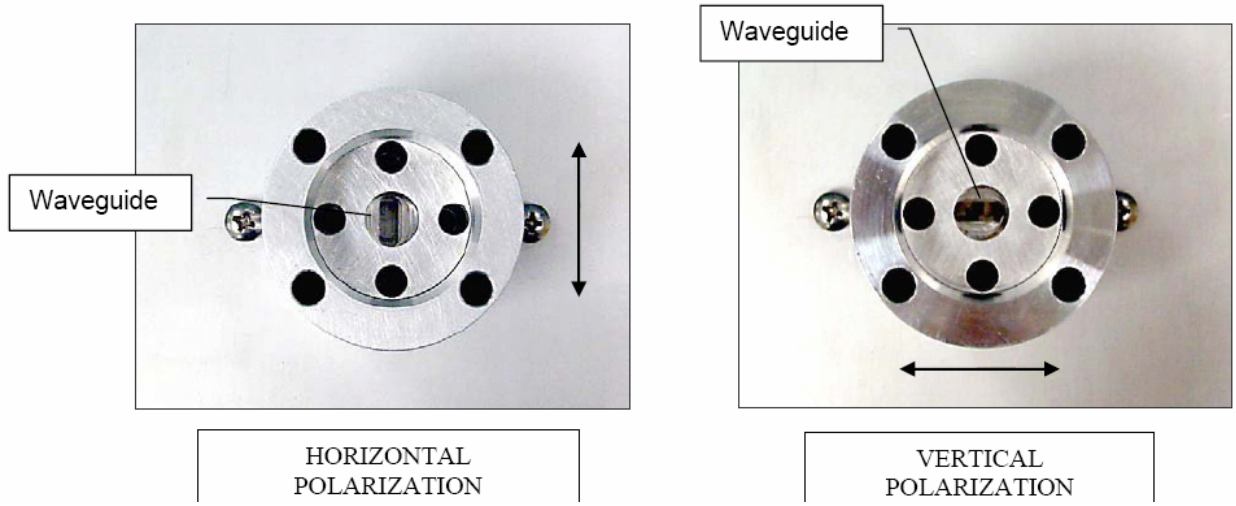


Figure 21: H & V 1+1 Couplers

IF Cable Installation

DO NOT USE THE N CONNECTORS TO PULL THE IF CABLE THROUGH CONDUIT OR RACEWAY. THIS MAY STRESS THE SHIELD OR CENTER CONDUCTOR RESULTING IN INTERCONNECT PROBLEMS THAT ARE DIFFICULT TO FAULT ISOLATE AND MAY NOT OCCUR UNTIL LONG AFTER INSTALLATION.

Lightning Mitigation Recommendations – Trango strongly recommends installing Lightning arrestors at two points in the IF Cable routing:

- At the closest point of the radio possible
- At the entry point to the building or equipment shelter

These connections should be secured to the tower or pole at a point where there all paint/plating has been removed to ensure a low impedance path to ground. NOTE: there is no guarantee that use of these arrestors will prevent Lightning damage to the radio or other electronics, but it is prudent system design to aggressively mitigate the effects. [See Appendix for Lightning Arrestor Kits compatible with LMR-400 IF Cables]

Cable Length Recommendations – Trango recommends that the IF Cable be installed with a 2 ft service loop next to each connector (i.e. below the ODU, next to Lightning Arrestors, next to the IDU, etc.) to allow for replacement terminations in the future.

Cable Connectivity – The IF Cable can be connected to the ODU and IDU with right angle N adapters (female towards the cable and male to the IDU/ODU) which prevent the bend radius (minimum 1 inch) from obstructing cabinet doors.

Cable Dress Recommendations – Properly securing the IF Cable to the tower or pole structure is important since poorly dressed cables can be abraded by the friction of wind action and cable connection can be degraded over time by the same stresses. When securing the IF Cable to the tower or pole, Trango recommends using tie wraps that are UV resistant (black) to minimize deterioration. Tie wraps should be at least ¼ in wide and pulled only as tight as needed to snug the cable to the structure. Narrow tie wraps or over-tightening a tie wrap can compromise the internal structure of the coax and degrade performance. The IF Cable should be secured to the tower or mounting pole at least every 3 to 6 ft with tie wraps or other approved methods. Hanger Assemblies and Cable Clamps are offered by tower companies that can provide an even more rigid attachment for high wind environments.

Cable Terminations - Robust cable and cable connections are CRITICAL to the long-term performance of the link. Any compromise in material, connection precision, or weatherproofing may result in problems that are difficult to fault isolate and only emerge after the link has been exposed to the normal stresses of temperature, rain, and winds.

Cable Type -Trango strongly recommends the use of quality LMR-400 cable and top of the line connectors complimented by well trained installation personnel following manufacturer's instructions. Other types of cable may not have adequate shielding and may cause or receive outside interference.

Grounding

Cable Grounding Recommendations – Ensure that the tower or mounting pole has been properly installed with a high current/low resistance path to earth ground. If this is not the case the IF Cable grounding and Lightning Arrestor will not be effective. The IF Cable should be grounded at the antenna and at a solid ground connection as close as possible to the building or equipment shelter entry point and every 75 feet along the tower leg. Appendix C provides information on IF Cable Grounding Kits available from Trango.

IF THE ANTENNA SUPPORT STRUCTURE IS NOT EARTH-GROUNDED THROUGH A LOW RESISTANCE, HIGH CURRENT PATH,DO NOT PROCEED WITH THE INSTALLATION.

IDU/ODU Grounding Recommendations

The ODU doesn't require any additional grounding since the ODU is attached directly to the antenna. Please note that if the antenna is attached to a metal pole that is earth-grounded, no other grounding is necessary unless directly specified by other electrical jurisdictions. The IDU includes a grounding lug located on the front left side of the panel and should be connected to a low resistance path to earth ground (typically through the rack frame (Figure 23). If your equipment rack chassis is not grounded you may experience intermittent issues and possibly damage the equipment. Equipment damage due to lack of grounding is not covered under warranty. Ensure all ground points have a +/- 0v to earth ground.

PLEASE NOTE TRANGO LINK-GIGA ™ USES A -48V POWER SUPPLY AND HAS A POSITIVE GROUND CHASSIS.

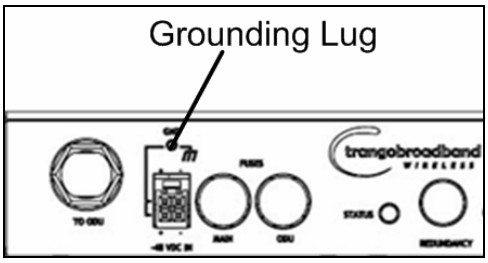


Figure 22: IDU Grounding

GROUNDING IS NOT TO BE CONSIDERED LIGHTNING PROTECTION. THE PURCHASE AND INSTALLATION OF LIGHTNING PROTECTION IS RECOMMENDED.

Weather Proofing Cabling

It is important to properly seal each antenna connection to protect against moisture and corrosion. Trango Broadband recommends using Coax-Seal which should be applied over the ODU N-Type connector. Coax-Seal is a gum-like tape which is applied by wrapping around the connector and then compressed/molded to form a single cohesive protective covering over the connector.

To properly apply the Coax-Seal product first wrap the connector/case as shown in Figure 28:

Figure 23: Weather Proofing of cable

Secondly, compress the Coax-Seal product to mold into a single protective covering (Figure 29):

Figure 24: Complete weather proofing of cable

IT IS IMPORTANT THAT THE COAXSEAL IS APPLIED PROPERLY TO THE CONNECTOR TO PREVENT WATER INTRUSION

Antenna Alignment

Aligning narrow beam width (< 2^{o}) over long distances can be a difficult process without the proper equipment, patience, and a careful process. Using a GPS compass and the Path Analysis to establish a crude azimuth and elevation the installation crew can mount the Antenna Assembly (Antenna and Mounting Kit) on the supporting structures at each end of the link. Once the antennas are installed and a rough antenna alignment has been established, then the fine alignment process can begin at one end of the link (typically the site with the smaller antenna). Once one side is aligned to achieve best RSSI, MSE, and BER then you can adjust the other side to improve the link. Alignment can be done using the Digital RSSI panel on the ODU.

Antenna Alignment Procedure

1. Ensure that both sides of the link are configured correctly.
2. Connect to the IDU from the management port or via the console port.
3. Login and enter config mode. Once in config mode enable the "alignment_mode"

```
trango login: admin
Password:

Trango Broadband Wireless:  TrangoLink Giga Command Line Interface
v2.3.6
(trango-view)# config
Password:

trango-config)# alignment_mode on
alignment_mode: on
SUCCESS
```

4. Once alignment mode is enabled the ODU's digital RSSI panel will update 5 times every second.
5. Once you are satisfied with the RSSI reading, tighten down the antenna in the optimum position.
6. Disable the alignment mode

WHEN ALIGNING THE ANTENNA THE CLOSER TO ZERO THE BETTER THE RSSI SINCE THE DISPLAY READ IN NEGATIVE dBm. "80" EQUATES TO -80 dBm WHEREAS "40" EQUATES TO -40 dBm, AS SIGNAL 10^{4} MORE POWERFUL.

Upgrading Firmware

The firmware on the TrangoLINK Giga can be upgraded through the management Ethernet port. A firmware release can consist of up to 6 files:

FPGA Image Firmware File	<idu_fpga_xxyy>
IDU OS Image Firmware File	<idu_os_xxyy>
IDU Firmware File	<idu_fw_xxyy>
IDU PIC Firmware File	<idu_pic_xxyy>
IDU Modem Firmware File	<idu_modem.bin>
ODU Image Firmware File	<odu_fw.bin>

Before beginning the upgrade procedure, be certain that all (sometimes it will be a subset of the above files) of these files have been downloaded and extracted to an easily accessible directory on your local hard drive.

Upgrade Procedures

ALWAYS CONSULT THE UPGRADE INSTRUCTIONS THAT ARE INCLUDED WITH A NEW FIRMWARE RELEASE AS CERTAIN FILES MAY NOT BE REQUIRED FOR AN UPGRADE.

Place the firmware files in an easily accessible directory path on your computer.

Telnet into the radio by Clicking on Start menu then RUN. (Figure 30) The figures use the default IP address; you must use the correct IP address for the TrangoLINK Giga.

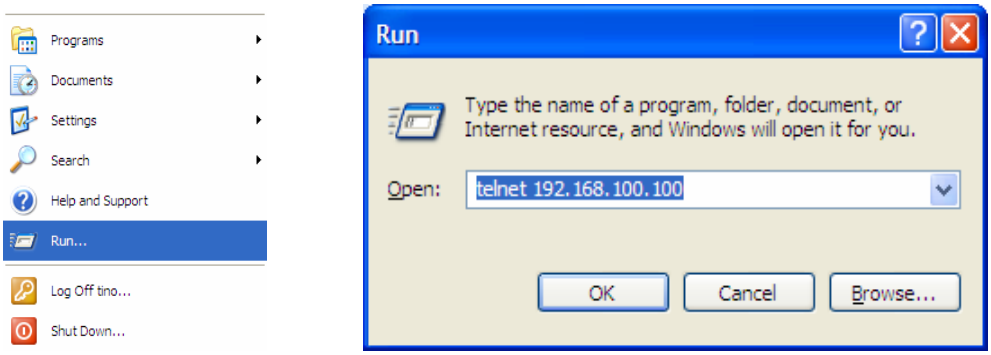


Figure 25: Windows Start & Telnet

1. At the login enter your username and password. The username is "*admin* "and default password is "*trango*"
2. Enter Config mode by typing "*config*" and entering you write access password. The default config mode password is *"trango"*
3. Enable the tftp daemon using the TFTPD command as shown below.

```
trango login: admin
Password:
Trango Broadband Wireless:  TrangoLink Giga Command Line Interface
v2.3.0

(trango-view)# config
Password:
(trango-config)#

(trango-config)# tftpd on
tftpd:  on
SUCCESS
(trango-config)#
```

4. Open a MS-DOS prompt (or other CLI interface) window and access the directory that you extracted the firmware files.

```
C:\CD Firmware
C:\Firmware
```

5. Using windows TFTP command line tool, we will upload the firmware file. The tftp syntax and an example are below.

```
TFTP [-i] host [GET | PUT] source [destination]

C:\firmware>tftp -i 192.168.100.100 put odu_fw.bin
Transfer successful: 1951744 bytes in 15 seconds, 130116 bytes/s
```

IF UPGRADING MULITPLE IMAGES AT A TIME. REPEAT STEP 5 WITH THE CORRECT FILE NAME.

YOU MAY NEED TO DISABLE YOUR FIREWALL FOR TFTP TO WORK PROPERLY

6. Once all file have been transferred successfully. Log back into the unit and apply the updates using the "bootimage" command from the config mode. Each firmware needs to be upgraded on the unit using the "bootimage upgrade" command.

```
(trango-config)#
(trango-config)# bootimage upgrade 5
```

Please note the following options for the "bootimage" command:

```
(trango-config)# bootimage upgrade <0-5>
```

0 upgrades the IDU FPGA

1 upgrades the IDU's OS

2 upgrades the IDU's Firmware

3 upgrades the IDU's PIC

4 upgrades the IDU's modem

5 upgrades the ODU's firmware

7. A reboot of the radio is required to load the new image after upgrade. If upgrading multiple images at a time (0,1,2,3 etc) it is not required to issue reboot after each upgrade. A single reboot can be issued after all the images have been successfully upgraded, to reduce the downtime.

```
(trango-config)# reboot
```

The upgrade time varies depending upon the images and the size of the image.

The firmware can be verified by logging into the radio via the CLI through the "version" command or Web browser sysinfo bottom right corner (Figure 31).

The Current images is the currently running firmware. The firmware which was replaced will be located in the Previous images.

```
(trango-config)# version
Current Image Version
IDU FPGA version:       06080907
IDU OS version:         2p6r14b3D10190701
IDU FW version:         2p361D10190701
IDU PIC version:        42
IDU Modem version:      43
ODU FW version:         0B

Previous Image Version:
IDU FPGA version:       02080907
IDU OS version:         2p6r14b3D09120701
IDU FW version:         1p0r1D09120701
IDU PIC version:        3
ODU FW version:         N/A
(trango-config)# status modem
```

System Version		
	Current Images	Previous Images
IDU FPGA:	02080907	02080907
IDU Firmware:	1p0r1D10120701	1p0r1D10110701
IDU OS:	2p6r14b3D10120701	2p6r14b3D10110701
IDU PIC:	3	N/A
IDU Modem:	40	N/A
ODU Firmware:	07	N/A

Figure 26: Verify Firmware Upgrade

PLEASE REFER TO THE CURRENT FIRMWARE UPGRADE INSTRUCTIONS FOR CORRECT AND UPDATED FIRMWARE VERSION NUMBERS. THIS INFORMATION IS OBTAINED BY CONTACTING TRANGO BROADBAND TECHNICAL SUPPORT.

Chapter 5 - Management

About this Chapter

The TrangoLINK Giga™ systems can be managed though a number of methods.

Network management can be performed by three methods

- Browser Interface (HTTP, HTTPS) - Chapter 3 Configuration
- CLI (Console, Telnet, SSH) - Command Set Reference Appendix A
- SNMP Manager - Discussed in this section

SNMP

TrangoLINK Giga™ supports Simple Network Management Protocol (SNMP) for network management. Network management consists of the following 4 categories: configuration, accounting, alarm, and monitoring and control. These capabilities allow the network operator to provide superior services through higher network accessibility and integrated accounting system. Use of SNMP requires the customer to have already implemented a NMS software package.

The Trango SNMP solution supports MIB-II (system only) and the Trango proprietary Management Information Base (MIB).

Users interested in using the SNMP functionality should review the entire TrangoLINK Giga™ MIB for a complete understanding of its features.

The following is an overview of a few of the more commonly used SNMP objects in the TrangoLINK Giga™ system.

Objects for Monitoring and Control

GigE Bandwidth Monitoring

- **gigeEth1InOctets** – Number of octets of payload received on GigE port 1.
- **gigeEth2InOctets** – Number of octets of payload received on GigE port 2.
- **gigeEth3InOctets** – Number of octets of payload received on GigE port 3.
- **gigeEth4InOctets** – Number of octets of payload received on GigE port 4.
- **gigeEth1OutOctets** – Number of octets of payload transmitted on GigE port 1.
- **gigeEth2OutOctets** – Number of octets of payload transmitted on GigE port 2.
- **gigeEth3OutOctets** – Number of octets of payload transmitted on GigE port 3.
- **gigeEth4OutOctets** – Number of octets of payload transmitted on GigE port 4.

RF Monitoring

- **rfInOctet** – Number of octets of payload received on the RF port.
- **rfOutOctet** – Number of octets of payload transmitted on the RF port.
- **rfEthernetInPackets** – Number of octets of payload received from the GigE ports to transmit on RF port.
- **rfEthernetOutPackets** – Number of octets of payload transmitted to GigE ports from RF port.
- **rfT1E1InPackets** – Number of octets of payload received from the T1/E1 ports to transmit on RF port.

- **rfT1E1OutPackets** – Number of octets of payload transmitted to T1/E1 ports from RF port.
- **rfRSSI** – The Receive Signal Sensitivity Indicator the unit receives from the distance end of the link.

Link Status Traps –Various traps are defined as follows:

- **trapReboot**– trap is triggered when the unit is rebooted
- **trapStartUp** – trap is triggered when the unit boots up.
- **trapBackupLink** – trap triggered when the backup status changes.
- **trapBackupTakeover** – The trap is triggered when the Backup unit has taken over.

Please review Appendix D MIB for a complete listing of MIB Objects.

Chapter 6 - Troubleshooting

About this Chapter

In this chapter we will cover some of the more common steps to take when encountering difficulties with the TrangoLINK Giga™.

- No Link
- High BER
- Ethernet Port
- T1 Port
- Web Interface

No LINK

- Ensure that Opmode is turned enabled for both sides of the link
- Verify that 50 ohm N-Type connectors have been used.
- Verify that the fuses are functional by using a multi-meter and check for continuity.
- Verify the Transmit frequency is configured correctly for each side of the link.
- Ensure the ODU's for the link are paired correctly. The pair must be 1A and 1B or 2A and 2B for a link to be established.
- Both sides of the link must be configured for the same speed, channel bandwidth and modulation
- Speed configuration changed without saving and rebooting.
- TargetRSSI incorrectly configured. Ensure that the targetrssi is set correctly so that the link doesn't decrease power to the point of losing the link.
- Check the power setting on both sides of the link
- Cable loss setting is set too high or too low.
- Check to make sure Loopback is disabled.
- Antennas are misaligned, verify RSSI values

High BER

A high Bit Error Rate can be caused by the following:

Extremely high receive signal strength. This can be prevented by enabling the following.

- Enable ATPC if the RSSI is too high for the desired modulation.
- Ensure the TargetRSSI is set correctly.
- Reduce the power of the remote side manually.
- Enabling ODURXAGC is also recommended to control the gain received during a fade event.
- Incorrect cableloss values.

- Ensure your IF cables are properly installed with no sharp bends or kinks.
- Make sure your connectors are SNUG (hand tight) on the IDU and ODU.

GigE Port

No traffic is passing

- Ensure cables are connected into correct ports. Port 1 traffic passes through the link so only Port 1 on the other side can see the traffic.
- Check the Ethernet cables to ensure they work properly.
- Ensure that the GigE port is enabled

Errors on GigE port

- Ensure there is no duplex mismatch.

The TrangoLINK Giga™ can be configured for Auto-negotiate, 1000 Full duplex, 1000 Half-duplex, 100 Full duplex, 100 Half-duplex, 10 Full-duplex, and 10 Half-duplex. The setting of the TrangoLINK Giga™ should match the setting of the connecting device.

- Verify correct Ethernet cable type is being used for GigE setting.
- The Ethernet cable connector is not properly crimped.

T1/E1 Port

Not passing traffic

- Mismatched T1 ports, since the T1 ports are port mapped T1 port 1 on IDU one must be connected to T1 port 1 on the second IDU.
- Ensure the port is enabled
- Verify pin outs of the T1 connector

Management

If you can not telnet into the radio or open an HTTP browser session,

- Check your cable connections
- Ensure proper cable is being used cross-over vs. straight-through cable
- Check PC's subnet to make sure it is routable to the radio's IP address.
- If you just performed a firmware upgrade and one file did not load properly and the system rebooted, you will loose management. Please call Technical Support for further assistance.

If there are still issues please contact Technical Support at 858-391-0010 or Email at techsupport@trangobroadband.com

Before calling please make sure you have the following information.

- Serial Number
- Description of the problem
- Steps taken so far to resolve the problem

.

The serial number can be located on the back of the IDU (Figure 28).

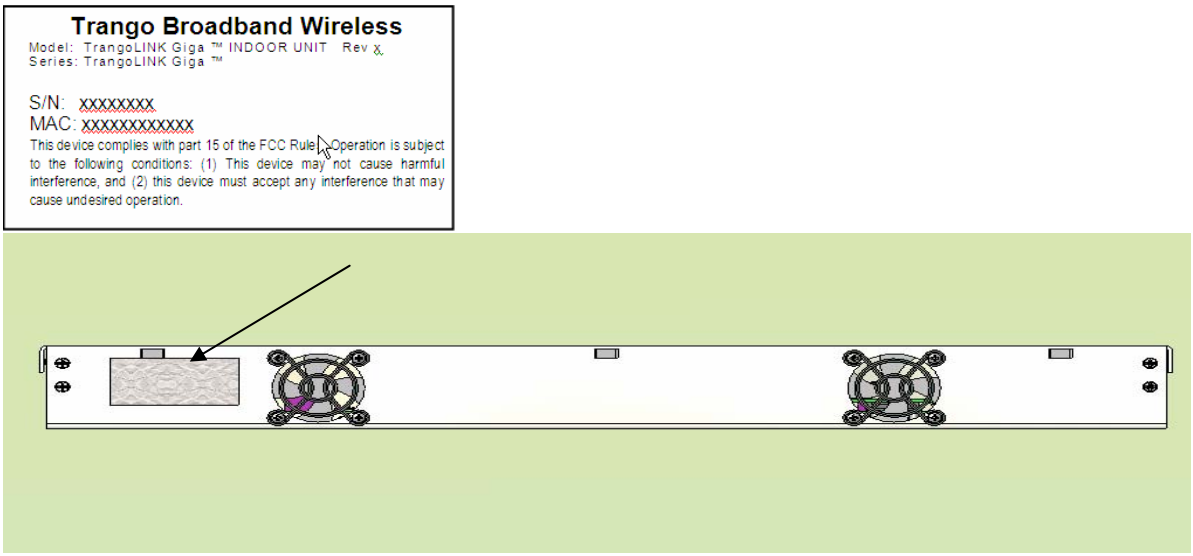


Figure 27: Serial Number Location

Chapter 7 – Bench Testing

About this Chapter

In this chapter we will cover the basic tips in setting up the equipment for bench testing the before deployment.

Bench test setup

Benching testing equipment before installation is a common practice for installers to perform before deploying the equipment. Bench testing provides the user with a baseline of results and helps ensures that the equipment operates according to specification before deployment. It is a preventive measure that saves time since equipment can be preconfigured before deployment. Please refer to Chapter 3 for configuration of the units.

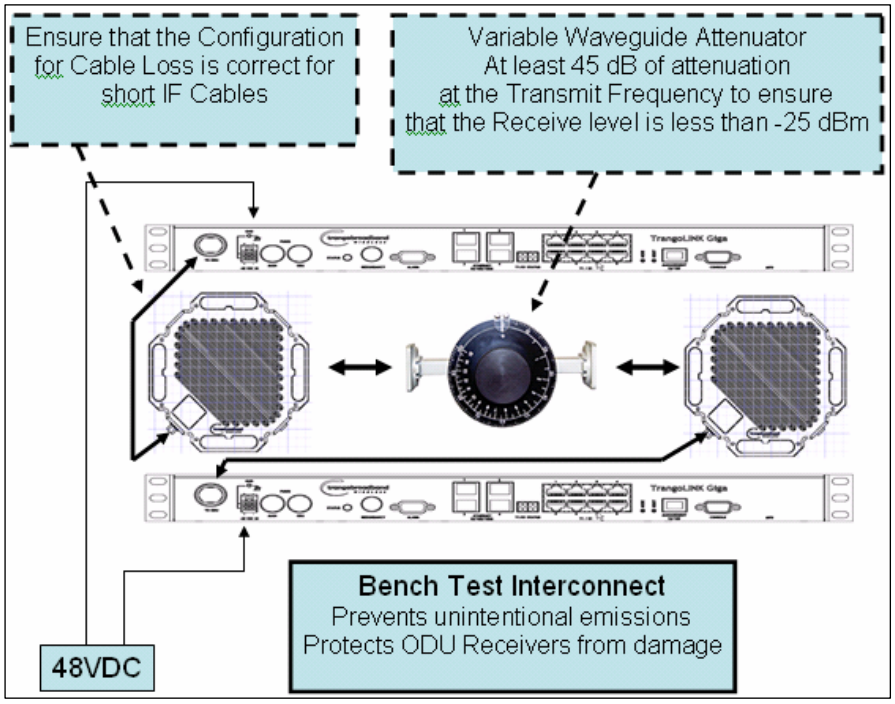


Figure 28: Bench test setup

The following are tips to ensure your bench test setup is done properly (Figure 29).

1. Ensure cable loss is correct for short IF cables
2. Have at least 45db of attenuation between ODU's
3. Connect attenuator directly to the ODU without waveguide adapter. (Figure 30)

Figure 29: Waveguide Attenuator

4. Ensure the RSSI is less than -28dBm. A RSSI reading of 0dBm to -28dBm can cause physical damage to the units.

Appendix A - Command Set Summary

System Command Keying

Key Functions

Tab

Completes a partial command name entry. When you enter a unique set of characters and press the Tab key, the system completes the command name. If you enter a set of characters that could indicate more than one command, the system beeps to indicate an error. Enter a question mark (?) immediately following the partial command (no space). The system provides a list of commands that begin with that string.

Del or Backspace

Erases the character to the left of the cursor.

Return

At the command line, pressing the Return key performs the function of processing a command. At the More prompt on a terminal screen, pressing the Return key scrolls down a line.

Space Bar

Allows you to see more output on the terminal screen. Press the space bar when you see the More prompt on the screen to display the next screen.

Left Arrow

Moves the cursor one character to the left.

Right Arrow

Moves the cursor one character to the right.

Up Arrow

Recalls commands in the history buffer, beginning with the most recent command. Repeat the key sequence to recall successively older commands.

DownArrow

Return to more recent commands in the history buffer after recalling commands with the Up Arrow or Ctrl-P. Repeat the key sequence to recall successively more recent commands.

Different Mode Levels

View Mode

This is the default node the users log in. This is strictly configuration and stats view only. No configuration changes can be made at this level

Command List in View Mode

alarm	Display Alarm status
alignment_mode	Display alignment mode status
atpc	Display ATPC status
atpc_max_power	Display ATPC max power status
atpc_step_size	Display ATPC power level step size
cableloss	Display Cable loss values
config	Enable Trango configuration mode
datapath	Display datapath from FPGA
datapattern	Display data source for data pattern
date	Display Time of Day
default_opmode	Display default Opmode status
downspeed	Display downshift modulation and symbol rate(speed
exit	Exit current mode and down to previous mode
fan	Display Fan status
freq	Display Rf Tx/Rx frequency
help	Display help command
httpd	Display Web server (httpd) status
Ibm	Display In Band Management configuration
ipconfig	Display radio management port configuration
linktest	Display link test values (RSSI, MSE, BER)
loopback	Display loopback Mode
model	Display IDU/ODU Model and serial number
mse	Display the MSE (Mean Square Errors) value
oduled	Display ODU rssiled status
odupower	Display ODU Power status
odurxagc	Display ODU Rx AGC status
opmode	Display Operation Mode status
power	Display Tx power in dBm
rateshift	Display current status of rate shift
remark	Display product remarks
rssi	Display RSSI value
Smart_mode	Display current SMART_Mode setting
snmpd	Display SNMP Agent Daemon (snmpd) status
snmptrap	Display SNMP Trap status TEST
speed	Display current modulation and symbol rate(speed)
status	Display status for different device and ports

sysinfo	Display MSE, FER information
syslog	Display system event log
targetrssi	Display target rssi value
temp	Display IDU and ODU temperature
tftpd	Display tftp server (tftpd) status
trapip	Display SNMP Trap IP configuration
uptime	Display system uptime
utype	Display unit type
version	Display IDU/ODU Software version

Config Mode

Users can enter this mode by typing in the command "config" from the view mode. They will be prompted for a password and after successful authentication users enters the config mode. All configuration settings can be changed here.

- All the commands entered without any parameters returns the current configured values and are similar to "view" mode.
- All configuration changes are applied immediately and don't require any reboot (except "speed" in which the settings are applied immediately, but it does require reboot after save).
- All configuration changes have to be saved in order to be persistent across reboot. A single "save" command will save all configuration changes
- Users can go back to the "view" mode by typing in the command exit

Command List in Config Mode

CLI	Ranges	Default Value
alarm	on/off	Off
alignment_mode	on/off	Off
atpc	on/off	Off
atpc_max_power	<0-20>	17
atpc_step_size	<1-5> dB	1dB
bootimage	<upgrade | toggle> <0-5>	N/A
cableloss	<0-20> <0-30> <0-50>	0,0,0
config	export, import,remove,view	N/A

cos		Priority 0: COS Queue = 0 Priority 1: COS Queue = 0 Priority 2: COS Queue = 1 Priority 3: COS Queue = 1 Priority 4: COS Queue = 2 Priority 5: COS Queue = 2 Priority 6: COS Queue = 3 Priority 7: COS Queue = 3
datapath	<0-2>	2
datapattern	<fpga | modem>	fpga
date	<0-99><1-12><1-31><0-23><0-60>	Linux System Date
default_opmode	<on/off>	Off
downspeed	<channel_bw> <modulation>	<0> <qam16>
exit	N/A	N/A
failover	<on/off>	Off
fan	<0-2>	1
freq	<17705-19695>	0 (this is exception to the valid range)
help / ?	N/A	N/A
httpd	<on/off>	On
ibm	<on/off> <ip address> <Vlan>	off
ipconfig	<ip address><netmask><gateway>	ip 192.168.100.100 netmask: 255.255.255.0 gateway: 192.168.100.100 Reset will not reset ipconfig, use "reset ipconfig" to reset the ip address settings.
license	<valid license key> 20byte Hex Key	None User needs to reenter license keys after reset
linktest	duration <1-99>	Default 1 (if duration not entered by user)
loglevel	<0: Setting, 1: Event, 2: Status>	0,1
loopback	<dig | if | rf_gen | rf_refl | off>	Off
model	N/A	No defaults, read directly from the IDU/ODU
mse	duration <1-99>	Default 1 (if duration not entered by user)
oduled	<on/off>	On
odupower	<on/off>	Off
odurxagc	<on/off>	Off
opmode	<on/off>	Off
passwd	<passwd> <confirm_passwd> (8char)	trango
port	<eth | tdm> <port#> <du	All 4 ports configured in the Auto-Neg Mode
duplex	<half | full>	Full
enable	on/off	on (for all 4 gige ports)
ingress_rate	0-1000 Mbps	0 (0 = 1000Mbps)
pause	<on | off >	Off
priority	0-3	0 (for all 4 gige ports)

speed	<10 | 100 | 1000>	1000
		TDM specific
enable	<on | off>	On
loopback	<analog | digital | remote | off>	Off
power	0-20	10dBm
rateshift	<on | off >	Off
reboot	N/A	N/A
relay	<relay1 | relay2> <on | off>	off (Both relays are off)
remark	<string 1-100bytes>	Trango Broadband Wireless Reset will not change the remark settings
remove	<config>	N/A
reset	N/A	N/A
rps_enable	on/off	off
rssi	Duration <1-99>	Default 1 (if duration not entered by user)
save	N/A	No Auto Save
show	<passwords>	CLI View Node: trango CLI Config Node: trango SNMP read comm: public SNMP write comm: private Web Interface: trango snmp trap: trapstr
smart_mode	<on | off >	on
snmpd	<on | off >	On
snmptrap	on/off	Off
speed	<channel_bw> <modulation>	<0> <qam16>
channel_bw	0-5 (10,20,30,40,50)	0
modulation	qpsk, qam16, qam64,qam128,qam256	qam16
status	<modem | fifo | pll | port | all | clear>	N/A
sync_state	Active | Standby	N/A
sysinfo	<0-6>	0 (if command executed without any param)
syslog	<clear>	N/A
targetrssi	<-88 - -25)	-40
tdm	<coding. <mode>	AMI T1
temp	N/A	N/A
tftpd	on/off	Off
threshold	<param> <min | max> <value> <action> param : 0 rssi, 1 mse, 2 ber, 3 fer, 4 idu_temp, 5 odu_temp min|max: param dependent action: 0 none, 1 alaram1, 2 alarm2 ,3 snmptrap	Default action is None.
trapip	<valid ipv4 address>	0.0.0.0 Reset will change the prev configured trapip

uptime	N/A	N/A
utype	N/A	Main
version	N/A	N/A

Debug Mode

This node is additional management port related settings and users enter the debug mode, by typing in the "Exit" command from the "*config*" mode. Users can re-enter the view node by entering the command "cli" from within the debug mode.

Command List in Debug Mode

cli	N/A	Used to Enter the CLI (trango-view) node
help	N/A	Display list of commands in the debug node
ping	<ip address>	ping network hosts
route	N/A	Display the current system routing table
ssh	<ip address>	ssh into another host
syslog	N/A	print system log
telnet	<ip address>	telnet into another host
tg_reboot	N/A	Reboot radio

CLI Command Description

alarm

SYNTAX	**Alarm <alarm1 | alarm2> <on off>**
DEFAULT VALUE	Off
DESCRIPTION	Alarm is used to display the current alarm status for the 2 alarms present in the unit. The alarms can also be manually set, if desired.
EXAMPLE	*(trango-config)# alarm* Alarm1: off *Alarm2: off*
RELATED	Threshold

alignment_mode

SYNTAX	alignment_mode < on | off >
DEFAULT VALUE	Off
DESCRIPTION	Alignment mode is used during initial antenna alignment. When enabled it display the RSSI on the ODU Led at a higher rate (5/sec) than during normal operation. Should be turned “off” during normal mode of operation. ATPC and odurxagc should are disabled during alignment_mode. Oduled should be ON for alignment_mode It is recommended to disable alignment_mode during normal operation.
EXAMPLE	Turn on the alignment_mode *(trango-config)# alignment_mode on* *alignment_mode: on*

	Check current alignment mode setting *(trango-config)# alignment_mode* *alignment mode: on*
RELATED	oduled, targetrssi

atpc

SYNTAX	atpc <on | off>
DEFAULT VALUE	Off
DESCRIPTION	Used to enable/disable ATPC ATPC is used to automatically adjust the remote end ODU transmit power in order to maintain the desired level of RSSI (targetrssi) at the local end. ATPC should be configured on both the radios. If one end has ATPC on and the other end has ATPC off, then ATPC will not work. User cannot change the power when ATPC in turned on. The system will adjust the power automatically based on the “maxatpcpower” and “atpc_step_size”. When ATPC is turned off, user entered power setting is restored back.
EXAMPLE	Turn on ATPC *(trango-config)# atpc on* *ATPC: on* Check current ATPC configuration *(trango-config)# atpc* *ATPC: on*
RELATED	atpc_max_power, atpc_step_size, targetrssi, power

atpc_max_power

SYNTAX	atpc_max_power <0-20>
DEFAULT VALUE	**Default 17**
DESCRIPTION	This command is used to set the upper limit on transmit power during ATPC. max atpc power setting is used only when ATPC is on.
EXAMPLE	To set max atpc power *(trango-config)# atpc_max_power 15* *ATPC max power: 15.0* Check current ATPC configuration *(trango-config)# atpc_max_power* *ATPC max power: 15.0*
RELATED	atpc, atpc_step_size, power, targetrssi

atpc_step_size

SYNTAX	atpc_step_size <range> where range = 1-5dB
DEFAULT VALUE	1dB
DESCRIPTION	atpc step size controls the ODU power change size during ATPC operation. The transmit power is changed in step size on the ODU, unless the maxatcpower or 0 is reached.
EXAMPLE	Set the atpc step size to 2 *(trango-config)# atpc_step_size 2* *ATPC step size: 2 dB* *SUCCESS*
RELATED	atpc

bootimage

SYNTAX	bootimage <upgrade | toggle> bootimage upgrade <0-5> 0: idu_fpga 1: idu_os 2: idu_fw 3. idu_pic 4. idu_modem.bin 5. odu_fw.bin bootimage <toggle>
DEFAULT VALUE	N/A
DESCRIPTION	Bootimage is used to upgrade the required software images on the radio, after the image is transferred on the radio via tftp. Toggle is used to switch to the alternate software image stored in the flash. The Giga radio is capable of storing 2 complete set of images in the flash. See “version” command. A reboot of the radio is required to load the new image after upgrade. If upgrading multiple images at a time (0,1,2,3 etc) it is not required to issue reboot after each upgrade. A single reboot can be issued after all the images have been successfully upgraded, to reduce the downtime. The upgrade time varies depending upon the images and the size of the image. Make sure the file names of the images to be transferred (via tftp) are in the following format. 0: idu_fpga_xxx 1: idu_os_xxx 2: idu_fw_xxx 3. idu_pic_xxx 4. idu_modem.bin 5. odu_fw.bin

EXAMPLE	Upgrade FPGA image Enable tftpd on the radio *(trango-config)#tftpd on* Transfer the image from PC(windows/linux) *C:\>tftp –I <IP Address of Radio> PUT idu_fpga_xxxx* Issue the upgrade command on the radio *(trango-config)# bootimage upgrade 0* Wait for the completion and the reboot *(trango-config)# reboot*
RELATED	version, tftpd, reboot

cableloss

SYNTAX	Cableloss <loss 140Mhz> <loss 315Mhz> <loss 915Mhz> All loss can be set in tenths of dB. Loss @140 <0-20> Loss @315 <0-30> Loss @915 <0-50>
DEFAULT VALUE	0,0,0
DESCRIPTION	Cableloss command is used to set the appropriate cable loss (in tenths of dB) for the 3 frequencies based on the length of the LMR cable used to connect the IDU and ODU Odu should be powered ON before the cable loss can be set.
EXAMPLE	Set the cable loss for 150ft LMR cable 140 2.23 315 3.38 900 5.85 *(trango-config)# cableloss 2.23 3.38 5.85* *cable loss at 140 Mhz: 2.23 dB* *cable loss at 315 Mhz: 3.38 dB* *cable loss at 915 Mhz: 5.85 dB*
RELATED	odupower

config

SYNTAX	Config <export | import | remove | view>
DEFAULT VALUE	**N/A**
DESCRIPTION	This command is used to view/remove and transfer current system configuration file ***Export***: The option allows the user to create a ASCII file (config.txt) of the current system configuration, which can then be tftp from the PC, which the user can edit/print or import to other system ***Import:*** This option allows the user to push a configuration file (should be in the format as created by export) into the system through tftp and then issue the "config import" command to apply the settings from the config.txt file to the system. Tftpd needs to be enabled/disabled as required. ***Remove:*** This option allows removing the current system configuration and the settings will be reset to factory defaults. ***View:*** The option displays the current system configuration in ASCII format on the console.
EXAMPLE	To view the current system config *(trango-config)# config view* *CONFIG_VER 20* *TX_FREQ 17920* *RX_FREQ 19480* *RX_FREQUENCY 0.0* *CABLELOSS_140 0.0* *CABLELOSS_315 0.0* *CABLELOSS_915 0.0* *POWER 6.0* *:* *:*
RELATED	Tftpd, reboot, save

COS

SYNTAX	Cos <priority> <queue>
DEFAULT VALUE	**Default Mappings are as shown below** Priority 0: COS Queue = 0 Priority 1: COS Queue = 0 Priority 2: COS Queue = 1 Priority 3: COS Queue = 1 Priority 4: COS Queue = 2 Priority 5: COS Queue = 2 Priority 6: COS Queue = 3 Priority 7: COS Queue = 3
DESCRIPTION	This command is used to map the priority of the incoming packet to one of the 4 CoS queues. The traffic class of the incoming packet is mapped 1:1 to the 8 priorities. The scheduling is strict priority with COSQ3> COSQ2> COSQ1 > COSQ0
EXAMPLE	To map priority 6 to CoS queue 1 *(trango-config)# cos 6 1* *COS map priority=6, queue=1* Check current CoS settings (trango-config)# cos COS scheduling: strict Priority 0: COS Queue = 0 Priority 1: COS Queue = 0 Priority 2: COS Queue = 1 Priority 3: COS Queue = 1 Priority 4: COS Queue = 2 Priority 5: COS Queue = 2 Priority 6: COS Queue = 1 Priority 7: COS Queue = 3
RELATED	

datapath

SYNTAX	datapath <0-2> Where 0: fpga 1: t1 2: Both
DEFAULT VALUE	2
DESCRIPTION	Datapath command is used to selectively enable Ethernet/TDM datapath. If the user doesn't intend to use the T1E1 ports, then only the Ethernet datapath can be set. No Ethernet/TDM traffic will flow through the radio if the corresponding datapath is disabled.
EXAMPLE	To Enable only Ethernet Datapath *(trango-config)# datapath 0* Datapath: ethernet enabled
RELATED	None

date

SYNTAX	date <year> <month> <date> <hour> <min> year: 0-99 month: 1-12 date: 1-31 hour: 0-24 min: 0-60
DEFAULT VALUE	Linux System Date
DESCRIPTION	Date command is used to set the system date and time. The radio has a built-in RTC.
EXAMPLE	Set the date to Aug 31st 2007, time to 11.00am *(trango-config)# date 07 08 31 11 00* Fri Aug 31 11:00:00 MDT 2007
RELATED	None

default_opmode

SYNTAX	Default_opmode <on | off>
DEFAULT VALUE	Off
DESCRIPTION	Default opmode command is used to set the default operational mode. If enabled the radio will be set to "opmode on" after power on. Opmode settings are dependent upon "default_opmode" after power up.
EXAMPLE	Set default_opmode on *(trango-config)# default_opmode on* *Default Opmode: on* To view current default opmode: *(trango-config)# default_opmode* *Default Opmode: off*
RELATED	Opmode

downspeed

SYNTAX	downspeed <channel_bw> < modulation> Channel_bw = <0-5> 0 = 10, 1 = 20, 2 = 28, 3 = 40, 4 = 50, 5 = 80 modulation: qpsk | qam16 | qam32 | qam64 | qam128 |qam256
DEFAULT VALUE	0, qam16
DESCRIPTION	Specifies the downshift speed after link lost, must turn on 'rateshift' option for it to take effect This is for maintaining the link operational in the event of fades at the cost of lower throughput.
EXAMPLE	To set downspeed speed (channel_bw/modulation) *(trango-config)# downspeed 1 qpsk* *symrate: 17.42* *modulation: QPSK* *speed: 21.30* *bpf: 14* *fcc_bw: 14* to see the current downspeed configuration: *(trango-config)# downspeed* *symrate: 46.000000* *modulation: qpsk* *speed: 81.800003* *bpf: 56* *fcc_bw: 80*
RELATED	Rateshift, speed

exit

SYNTAX	exit
DEFAULT VALUE	N/A
DESCRIPTION	Exit command is used to logout from the current node to the lower node.
EXAMPLE	To Switch back to “trango-view” node from trango-config *(trango-config)# exit* *(trango-view)#*
RELATED	cli, config

failover

SYNTAX	Failover <on | off>
DEFAULT VALUE	**Off**
DESCRIPTION	This command is to enable failover (1+1) feature. Once this feature is enabled the Status LED on the IDU will start blinking and will become solid when this feature is disabled. This needs to be enabled on both the units. After enabling failover the 2 units will participate in an election mechanism to elect the Active unit. The other unit will become the Standby unit. The transmitter for the Standby unit is muted and the GigE data ports are also disabled. However both units can receive data from the other side of the link. The 2 units exchange heartbeat messages between them through the redundancy serial cable connected between the 2 IDU’s. The cable needs to be connected before enabling this feature. All set commands on the Active unit are also executed on

	the Standby unit to keep the states synchronized. The 2 units have separate IP Settings/Mgmt Channel and can be upgraded independent of each other. In the event of System failure or link loss the Active transfers control to the Standby, only if the Standby is healthy. If the active unit is powered down or if the redundancy cable is unplugged then Standby will assume the role of the Active. Once the Standby unit takes over, the ODU of the failed active unit is powered off and the data ports disabled. The failed unit is not rebooted and can be used to diagnose the problem. Appropriate traps are sent in the case of Active failover, Standby detection and Standby taking over as Active. The “status modem” command on the Active unit will display the current health of the Standby unit. Standby Lock: 1 Standby ODU 1 Standby RSSI: -41 dBm The standby is considered healthy when the lock indicator and the ODU status are 1.
EXAMPLE	To Enable failover *(trango-config)# failover on* *Failover mode: on*
RELATED	Sync, utype,

fan

SYNTAX	fan <0: fans off | 1: fan1 on | 2: fan2 on>
DEFAULT VALUE	1: fan1 on
DESCRIPTION	Turn on the IDU fans, 0 means turn off fans, 1 for Fan 1 and 2 for fan 2. Only 1 fan can be turned ON at a time.
EXAMPLE	To turn ON fan2

	(trango-config)# fan 2 *Fan 2 On* SUCCESS To see the current fan configuration: *(trango-config)# fan* *Fan 2 On*
RELATED	**N/A**

freq

SYNTAX	freq <17705-19695> *(allowed range for each freq)*
DEFAULT VALUE	None
DESCRIPTION	This command is used to set the ODU transmit freq, this CLI will also return the corresponding receive frequency Only frequency specific to the ODU model can be set. The command will only accept frequency specific to the ODU model (Band1 11-1A/ Band2 11-1B). The ODU needs to be powered ON for setting the freq. The freq should be set after setting the required "cableloss"
EXAMPLE	To set tx frequency: *(trango-config)# freq 19480* *TX freq: 19480* *RX freq: 17920* *SUCCESS* To view current frequency setting: *(trango-config)# freq* *TX freq: 19480* *RX freq: 17920*
RELATED	Odupower, cableloss

help /?

SYNTAX	?
DEFAULT VALUE	N/A
DESCRIPTION	Typing the ? command will display the list of commands in the current node with a one line description of the commands
EXAMPLE	*(trango-config)#?* *<Display the List of cmds>*
RELATED	N/A

httpd

SYNTAX	httpd <on | off>
DEFAULT VALUE	ON
DESCRIPTION	Turn on httpd server for web interface access. The web interface supports both secure (https) and normal (http) access.
EXAMPLE	To turn off httpd: *(trango-config)# httpd off* *httpd: off* *SUCCESS* To view current httpd status: *(trango-config)# httpd* *httpd: off*
RELATED	Ipconfig

ibm

SYNTAX	Ibm <enable | id | ip > Ibm enable <on | off> Ibm id <1-4090> Ibm ip <valid ip address>
DEFAULT VALUE	**Enable : on** **Id : 1** **IP : 10.10.10.1**
DESCRIPTION	This command is used to configure the In Band Management (IBM) channel to manage the system. Both IBM and the Out of Band Management (OBM) can be used together. The management VLAN ID can be configured based on the user requirement from 1-4090. The IP address for the IBM channel is independent of the OBM port on the IDU. The 2 IP address needs to be unique. IBM only works through the GigE1 data port on the IDU.
EXAMPLE	To disable ibm *(trango-config)# ibm enable off* *IBM enable: off* Check current IBM configuration *(trango-config)# ibm* *IBM IP address: 10.10.10.1* *Inband management: on* *IBM vlan ID: 3*
RELATED	Ipconfig,

ipconfig

SYNTAX	Ipconfig <IP address> <Subnet mask> <Gateway IP>
DEFAULT VALUE	IP address: 192.168.100.100 Subnet Mask: 255.255.255.0 Default Gateway: 192.168.100.100
DESCRIPTION	This command is used to set IP address, subnet mask and default gateway for the management port of the system. All three parameter must be present. The system MAC address can be displayed via this command. The change takes place effect immediately.
EXAMPLE	To set IP configuration: *(trango-config)# ipconfig 10.8.1.203 255.255.255.0 10.8.1.1* *IP Address: 10.8.1.203* *Subnet Mask: 255.255.255.0* *Gateway IP: 10.8.1.1* *ETH0 MAC: 00:01:DE:00:05:07* *SUCCESS* To view current IP configuration: *(trango-config)# ipconfig* *IP Address: 10.8.1.203* *Subnet Mask: 255.255.255.0* *Gateway IP: 10.8.1.1* *ETH0 MAC: 00:01:DE:00:05:07*
RELATED	trapip, license, reset

datapattern

SYNTAX	datapattern <fpga | modem>

DEFAULT VALUE	fpga
DESCRIPTION	Sets datasource for the modem. datapattern can be generated from either fpga (external) or the modem (internal) The datapattern should be set to “fgpa” during normal mode of operation, otherwise no user data from GigE or the T1 ports will be transmitted.
EXAMPLE	To set loopback pattern source: *(trango-config)# lbpattern fpga* *Loopback pattern: fpga* *SUCCESS* *(trango-config)# lbpattern* Loopback pattern: fpga
RELATED	Loopback

license

SYNTAX	License <key> Key: 20byte hex string
DEFAULT VALUE	No key, Preconfigured for speed < 100Mbps
DESCRIPTION	License key command is used to set the license required for using higher speed (> 107Mbps) on the radio. The license key is specific to each unit (management port Ethernet mac address) and is not transferable. Entering the license command without any value, will show the current status of license (enabled/disabled)
EXAMPLE	Set the license key for speed > 107Mbps *(trango-config)# license XXXXX* *SUCCESS* Show the current status of license *(trango-config)# license* *License enabled*

RELATED	Speed, ipconfig

linktest

SYNTAX	Linktest <duration> Duration = 1-99sec
DEFAULT VALUE	Duration = 1
DESCRIPTION	Linktest command is used to test the current link status and can be used to monitor the link, based on the specified duration. CLI prompt will not be accessible while linktest is running The linktest shows the following in the output Lock: Radio Lock Status 1: if all modem locks are locked 0: if any lock is unlocked RSSI: The current RSSI value MSE: The current MSE value BER : The instantaneous BER value (1sec interval)
EXAMPLE	To test the link for 2 sec (trango-view)# linktest 2 LOCK RSSI MSE BER 1> 1 -46.80 dBm -33.35 dB 0.00E+00 2> 1 -47.00 dBm -34.55 dB 0.00E+00
RELATED	mse,rssi

loglevel

SYNTAX	loglevel <0-2>

	where 0: Setting 1: Event 2: Status/Statistics
DEFAULT VALUE	**Default 0 1**
DESCRIPTION	This command is used to set required log levels for system logging. The log level needs to be set for each activity to be monitored. Once the loglevels are set, the logs can be monitored through the *"syslog"* command E.g.: Setting the loglevel to 2 will only log Status/Stats. The loglevel needs to be set to "loglevel 0 1 2" to monitor all logs
EXAMPLE	To set the loglevel to monitor all logs *(trango-config)# loglevel 0 1 2* *Syslog level = 0 1 2*
RELATED	syslog

loopback

SYNTAX	loopback <off | dig | if | rf_gen | rf_refl>
DEFAULT VALUE	Off
DESCRIPTION	This command is to set the loopback mode. Digital and If loopback requires the ODU to be powered off and doesn't require a link. It use to isolate problems on the IDU only. In remote loopback configuration one radio of the link needs to be set as "rf_gen" and the other radio has to be "rf_refl".
EXAMPLE	To set the loopback mode to if Turn off the ODU power *(trango-config)# odupower off*

	Set loopback mode to if *(trango-config)# loopback if* *Loopback Mode: if* *SUCCESS* To view current loopback setting: *(trango-config)# loopback* *Loopback Mode: if*
RELATED	opmode, odupower, datapattern

model

SYNTAX	Model
DEFAULT VALUE	N/A
DESCRIPTION	Display system IDU/ODU model and serial numbers
EXAMPLE	To display the current model/serial# for IDU and ODU *(trango-config)# model* *IDU Model: Giga-IDU-1* *ODU Model: Giga11-ODU-1B* *IDU serial ID: 1287* *ODU serial ID: 00000022*
RELATED	Version

mse

SYNTAX	Mse <duration> Duration = 1-99sec

DEFAULT VALUE	Duration = 1sec
DESCRIPTION	Mse command is used to monitor the Mean Square Error (MSE) of the link. It is used to monitor the link, based on the specified duration. CLI prompt will not be accessible while linktest is running
EXAMPLE	To monitor the MSE for 2sec *(trango-view)# mse 2* *-33.81 dB* *-33.86 dB*
RELATED	Linktest, rssi

oduled

SYNTAX	oduled < on | off>
DEFAULT VALUE	On
DESCRIPTION	Turn on/off ODU led to display RSSI value on the ODU
EXAMPLE	To set odu rssi led status (trango-config)# oduled on odu rssiled: on SUCCESS To view oduled status: (trango-config)# oduled odu rssiled: on
RELATED	Rssi, odupower, alignment_mode

odupower

SYNTAX	odupower <on | off>

DEFAULT VALUE	OFF
DESCRIPTION	The command is used to Turn ON/OFF odupower. The ODU is powered from the IDU over the LMR cable @-48V It is recommended to turn off the ODU power during initial installing of the ODU on the tower and other maintenance
EXAMPLE	To turn on/off odupower: *(trango-config)# odupower on* *ODU power: on* *SUCCESS* To view current odupower setting *(trango-config)# odupower* *ODU power: on*
RELATED	**POWER**

odurxagc

SYNTAX	odurxagc <on | off>
DEFAULT VALUE	Off
DESCRIPTION	The command is used to set the odurx gain control loop in the system. This controls the receive level into the IDU from the ODU and keeps the received level within a predefined range. This helps to reduce MSE and increase system performance.
EXAMPLE	To turn ON/OFF odurxagc loop *(trango-config)# odurxagc on* *ODU Rx AGC: on* *SUCCESS* To view current odurxagc status: *(trango-config)# odurxagc* *ODU Rx AGC: off*
RELATED	targetrssi, cableloss

opmode

SYNTAX	opmode <on | off>
DEFAULT VALUE	Off
DESCRIPTION	Opmode command is used to enable the transmitter on the ODU. Opmode settings are not persistent across reboot. See default_opmode command Odupower needs to be ON before this command can be executed. Freq needs to be set, before opmode can be turned ON
EXAMPLE	Set opmode on *(trango-config)# opmode on* *opmode: on*
RELATED	Default_opmode, odupower, freq

passwd

SYNTAX	Passwd <new_passwd> <new_passwd>
DEFAULT VALUE	trango
DESCRIPTION	Passwd command is used to change the passwd for the config node. The change is persistent across reboot.
EXAMPLE	Set the passwd of config node to “giga” *(trango-config)# passwd giga giga* *SUCCESS*
RELATED	Show passwords, config

port

SYNTAX	port <eth | tdm> <port#> <settings> <value>

	For Ethernet Port the following commands are valid port eth <ge1|ge2|ge3|ge4> <duplex> <on|off> port eth <ge1|ge2|ge3|ge4> <enable> <on|off> port eth <ge1|ge2|ge3|ge4> <rate> <0-1000Mbps> port eth <ge1|ge2|ge3|ge4> <pause> <on|off> port eth <ge1|ge2|ge3|ge4> <priority> <0-3> port eth <ge1|ge2|ge3|ge4> <speed> <10 | 100 |1000> For TDM Port the following commands are valid (tdmx where x = 1-8) port tdm tdmx enable <on| off> port tdm tdm1 loopback <0-3> 0: analog loopback 1: digital loopback 2: remote loopack 3. loopback off
DEFAULT VALUE	For all 4 GigE Ports the default settings are Duplex: Full Enable: ON Rate: 1000Mbps Pause: OFF Priority: 0 Speed: 1000Mbps For TDM ports the default settings are Enable: ON Loopback: OFF
DESCRIPTION	Port command is used to set the GigE and TDM port settings.
EXAMPLE	To set ge1 speed 100Mbps *(trango-config)# port eth ge1 speed 100* *Port ge1 speed 100* *SUCCESS* To set the ingress rate limit on ge2 to 160Mbps *(trango-config)# port eth ge2 ingress 160* *Port ge2 Max rate: 160 Mbps* *SUCCESS*

	To set the digital loopback on tdm1 port *(trango-config)# port tdm tdm1 loopback 2* *Port tdm1: digital* SUCCESS
RELATED	Sysinfo

power

SYNTAX	Power <value> Value = 0-20dBm
DEFAULT VALUE	10dBm
DESCRIPTION	Power command is used to set the ODU transmit power level. The ODU must be powered on before this command can be executed. The max value is dependent upon the modulation. See datasheet. When the user sets the power to 20 for QAM256, it is internally adjusted to 17 (Max for QAM256). The user cannot change power when ATPC is ON.
EXAMPLE	Set the ODU power to 12dBm *(trango-config)# power 12* *Power: 12.0 dBm* *SUCCESS*
RELATED	Odupower, atpc

rateshift

SYNTAX	Rateshift <on | off>

DEFAULT VALUE	Off
DESCRIPTION	Rateshift command is used to enable rate shift down in the event of fades or bad signal conditions. The speed is changed to the user configured “downspeed”. This release only supports downshift. The user needs to manually reconfigure the upspeed when the link quality improves. The rateshift is triggered on link-loss. It is recommended to turn off rate shifting during image upgrade process. Rateshift should be disabled during any diagnostic operation and should be enabled only during normal link operation
EXAMPLE	To Set the rateshift on *(trango-config)# rateshift on*
RELATED	downshift

reboot

SYNTAX	Reboot
DEFAULT VALUE	N/A
DESCRIPTION	Reboot command is used to soft reboot the system. The command doesn’t ask for any confirmation. User caution is required before reboot.
EXAMPLE	To reboot he radio *(trango-config)# reboot* *(trango-config)# Restarting System*
RELATED	Reset, speed, bootimage

remark

SYNTAX	Remark <string>

	String = 0-100
DEFAULT VALUE	Trango Broadband Wireless
DESCRIPTION	Remark command is used to set any required name/info related with the Radio.
EXAMPLE	Set remark to “TranoLINK Giga” *(trango-config)# remark TrangoLINK Giga* *Remark: TrangoLINK Giga* *SUCCESS*
RELATED	N/A

remove

SYNTAX	Remove <config>
DEFAULT VALUE	N/A
DESCRIPTION	Remove config command is used to remove the current system configuration. This might be required during image upgrade process. A reboot is required after remove config. The command doesn’t ask for any confirmation. User caution is required before reboot.
EXAMPLE	Delete the current configuration *(trango-config)# remove config* *SUCESS*
RELATED	Reset

reset

SYNTAX	Reset <ipconfig>
DEFAULT VALUE	N/A
DESCRIPTION	Reset is used to restore factory default settings. All currently configured settings (except the one's listed below) will be lost. Reboot of the radio is required for the new settings to take effect. "reset" resets the software license key required for higher speed. "reset" doesn't reset the IP configuration, Trapip and remark settings "reset ipconfig" resets the current IP configuration for the management port. The command doesn't ask for any confirmation. User caution is required before reboot.
EXAMPLE	Restore factory default settings *(trango-config)# reset* *Default setting restored. Issue reboot command for the default to take effect* *SUCCESS*
RELATED	Reboot

rps_enable

SYNTAX	rps_enable < on | off>
DEFAULT VALUE	**Default_Off**
DESCRIPTION	This command is used to configure Rapid Port Shutdown (RPS) functionality. The RPS setting needs to be the same on both side of the link for proper operation. If the RPS is enabled the dataports (GigE) on both side of the link are immediately shutdown in the event of a link loss in order to provide a fast switchover mechanism to the external routers and switches.

EXAMPLE	To enabled rps *(trango-config)# rps_enable on* *Rapid port shutdown: on*
RELATED	Sysinfo,

rssi

SYNTAX	rssi <duration> Duration = 1-99sec
DEFAULT VALUE	Duration = 1sec
DESCRIPTION	rssi command is used to monitor the received signal level at the ODU. It is used to monitor the link, based on the specified duration. CLI prompt will not be accessible while rssi command is running
EXAMPLE	To monitor the RSSI for 2sec *(trango-view)# rssi 2* *-48.00* *2> -33.86*
RELATED	Linktest, mse

save

SYNTAX	save
DEFAULT VALUE	N/A
DESCRIPTION	Save command is used to save the current system configuration to the flash, so that system settings are persistent across reboot/power cycles. Save command should be used after system setting change. Otherwise it will be lost after reboot. Multiple changes can be saved by one save command.

EXAMPLE	Save current system settings. *(trango-config)# save* *New configuration saved* *SUCCESS*
RELATED	N/A

show

SYNTAX	show <passwords>
DEFAULT VALUE	N/A
DESCRIPTION	Show passwords command is used to view the currently configured passwords for different applications/nodes.
EXAMPLE	To display the currently configured passwords on the system *(trango-config)# show passwords* *CLI View node: trango* *CLI Config node: trango* *SNMP Read community: public* *SNMP Write community: private* *Web interface: trango* *snmp trap: trapstr*
RELATED	Passwd

smart_mode

SYNTAX	smart_mode <on|off>
DEFAULT VALUE	ON
DESCRIPTION	Enables or disables the inherent VLAN port mapping on the Gig-E ports. When disabled the 4 port become a switch. IBM cannot be enabled when smart_mode is off.
EXAMPLE	To disable smart_mode *(trango-config)# smart_mode off* *Success*

	To enable smart_mode *(trango-config)# smart_mode on* *Success*
RELATED	

snmpd

SYNTAX	snmpd <on | off>
DEFAULT VALUE	ON
DESCRIPTION	Turn on/off snmpd agent on the radio. Must be on to perform any SNMP get/set.
EXAMPLE	To turn snmpd off *(trango-config)# snmpd off* *snmpd: off* *SUCCESS*
RELATED	Ipconfig, snmptrap, trapip

snmptrap

SYNTAX	Snmptrap <on | off>
DEFAULT VALUE	Off
DESCRIPTION	Snmptrap command is used to enable/disable sending of the traps from the radio. Snmpd must be ON for snmptrap to be ON and trapip should be configured correctly.
EXAMPLE	Set snmptrap ON *(trango-config)# snmptrap on* *snmptrap: on* *SUCCESS*
RELATED	snmpd, trapip, ipconfig

speed

SYNTAX	Speed <channel_bw> <modulation> Channel_bw = <0-5> 0 = 10, 1 = 20, 2 = 28, 3 = 40, 4 = 50, 5 = 80 modulation: qpsk | qam16 | qam32 | qam64 | qam128 |qam256
DEFAULT VALUE	Channel_bw = 0 Modulation = qam16
DESCRIPTION	Speed command is used to set the required modulation and channel bandwidth on the modem. The set speed in Mbps is shown in the output Freq needs to be set before speed can be configured A one time license key is required to be set for speed > 100Mbps *AFTER ENTERING THE SPEED SETTINGS, SAVE THE CONFIG BY "SAVE" COMMAND AND REBOOT THE SYSTEMS
EXAMPLE	Set speed channel_bw = 80, modulation = qam256 *(trango-config)# speed 6 qam256* *symrate: 46.00* *modulation: 256QAM* *speed: 312.20* *bpf: 56* *fcc_bw: 80* SUCCESS
RELATED	Freq, license

status

SYNTAX	Status <modem | fifo | pll | port | all | clear>
DEFAULT VALUE	N/A

DESCRIPTION	Status command is used to display the current status/ Statistics of various elements in the radio. <Status clear> clears all the counters for the ports <status all> shows the status for modem.fifo, pll, port
EXAMPLE	To display the current status and statistics of the radio. *(trango-config)# status all* *<---------- Modem Status---------->* *MSE: -33.51 dB* *BER: 0.00E+00* *FER: 0.00E+00* *BER(cumulative): 0.00E+00* *FER(cumulative): 0.00E+00* *RSSI: -46.00 dBm* *Acquire Lock: 1* *Timing Lock: 1* *Equalizer Lock: 1* *Frame Sync Lock: 1* *Inner Code Lock: N/A* *<---------- FIFO Status ---------->* *Rx MAC FIFO Full: 0* *Rx MAC FIFO Empty: 0* *Rx MAC FIFO Underflow: 0* *Rx MAC FIFO Overrun: 0* *Tx MAC FIFO Full: 0* *Tx MAC FIFO Empty: 0* *Tx MAC FIFO Underflow: 0* *Tx MAC FIFO Overrun: 0* *<---------- ODU PLL Status ---------->* *ODU RF PLL: 1* *ODU IF PLL: 1* *ODU TX PLL: 1* *ODU RX PLL: 1* *IDU Loopback PLL: 0* *IDU Transmit PLL: 1* *<---------- Ethernet Port Status ---------->* *Port: ge1 ge2 ge3 ge4* *Status: on off off off* *In Octets: 0 0 0 0* *In Ucast Pkt: 0 0 0 0* *In NUcast Pkt: 0 0 0 0* *Out Octets: 6400 0 0 0* *Out Ucast Pkt: 100 0 0 0* *Out NUcast Pkt: 0 0 0 0* *CRC Errors: 0 0 0 0* *Collision: 0 0 0 0* *<---------- RF Status ---------->*

	IN OUT *Total Data Octets: 6500 0* *Total Data Packets: 100 0* *Ethernet Pkt: 100 0* *T1 Packets: 0 0* *KeepAlive Pkt: 82145112 N/A* *KeepAlive Drop Pkt: 0 N/A* *Ethernet Drop Pkt: 0 N/A* *T1/E1 Drop Pkt: 0 N/A*
RELATED	sysinfo

sync_state

SYNTAX	sync_state
DEFAULT VALUE	**N/A**
DESCRIPTION	This command is used to display the state of the synchronization between the Active and the Standby unit in the failover (1+1) setup and N/A for 1+0 setup On detecting the Standby unit the Active unit synchronized the current system setting with the Standby unit.
EXAMPLE	To display the current synchronization state *(trango-config)# sync_state* *Sync State: Synchronized*
RELATED	Failover

sysinfo

SYNTAX	Sysinfo <0-6> 0=All, 1=Management, 2=Radio Config, 3=System Config, 4=Ethernet, 5=TDM, 6=Threshold
DEFAULT VALUE	0
DESCRIPTION	Sysinfo command is used to display the current settings.
EXAMPLE	To display current radio settings *(trango-config)# sysinfo* *<----------1. MANAGEMENT---------->* *IP addres: 10.8.1.137* *Subnet Mask: 255.255.255.0* *Gateway IP: 10.8.1.1* *Trap IP Address:* *ETH0 MAC: 00:01:DE:7E:57:E1* *IDU serial ID: 8280033* *ODU serial ID: 00000022* *IDU FPGA version: 02080907* *IDU OS version: 2p6r14b3D09110701* *IDU FW version: 1p0r1D09110701* *IDU PIC version: 3* *IDU Modem version: 40* *ODU FW version: 07* *IDU Model: Giga-IDU-1* *ODU Model: Giga11-ODU-1B* *<----------2. RADIO CONFIGURATION---------->* *Cable loss(140): 0.10 (dB)* *Cable loss(315): 0.10 (dB)* *Cable loss(915): 0.10 (dB)* *Freq (TX): 19480 (Mhz)* *Freq (RX): 17920 (Mhz)* *Data pattern: fpga* *Loopback mode: off* *Datapath: eth and t1e1* *Power: 10.0 (dBm)* *ATPC step size: 1 (dB)* *ATPC max power: 17.0 (dBm)* *Target RSSI: -45.00 (dBm)* *Symbol Rate: 41.60* *Modulation: QPSK* *Speed: 76.30 (Mbps)* *BPF: 56* *FCC BW: 50* *Symbol Rate(Downshift): 46.00*

	Modulation(Downshift): QPSK *Speed(Downshift): 81.80 (Mbps)* *BPF(Downshift): 56* *FCC BW(Downshift): 80* *<----------3. System Configuration---------->* *Alignment Mode: off* *ATPC: off* *ODU power enable: on* *ODU Rx AGC: off* *ODU rssi led: on* *Opmode: on* *Default Opmode: off* *Rate shift enable: off* *Alarm 1: off* *Alarm 2: off* *tftpd: off* *httpd: on* *snmpd: on* *SNMP Trap: on* *Fan control: Fan 1 On* *<----------4. Ethernet Configuration---------->* *Port: ge1 ge2 ge3 ge4* *Enable: enabled enabled enabled enabled* *Status: on off off off* *Pause Frame: off off off off* *Speed(Mbps): 1000 1000 1000 1000* *Duplex: full full full full* *Priority: 0 0 0 0* *Max Rate(Mbps): 0 0 0 0* *<---------- 5. T1/E1 Port Status ---------->* *Port Status Enable Loopback* *tdm 1: off enabled off* *tdm 2: off enabled off* *tdm 3: off enabled off* *tdm 4: off enabled off* *tdm 5: off enabled off* *tdm 6: off enabled off* *tdm 7: off enabled off* *tdm 8: off enabled off* *<----------6. Threshold Info---------->* *min max action* *RSSI (dBm): -85.00 -20.00 none* *MSE (dB): -45.00 -15.00 none* *BER: 0.00E+00 1.00E-04 none* *FER: 0.00E+00 1.00E-04 none* *IDU Temp (celcius): 0.0 50.0 none* *ODU Temp (celcius): -50.0 50.0 none*
RELATED	Status

syslog

SYNTAX	Syslog <clear>
DEFAULT VALUE	N/A
DESCRIPTION	Syslog command is used to display system event log. All the configuration changes and errors are logged. The system log is a circular buffer and old entries will be deleted once the buffer becomes full. The buffer can have 1000 entries. Syslog clear, is used to clear the log buffer.
EXAMPLE	To display the current system log *(trango-config)# syslog* *Current 0:01:08:36.120* *0> 0:01:08:33.440 [1] [ATTN] eth_set_port_speed: port 0 speed=1000*
RELATED	N/A

targetrssi

SYNTAX	targetrssi <value> Value = -88 to –25 dBm
DEFAULT VALUE	-40dBm
DESCRIPTION	Targetrssi command is used to set the target signal level expected during the normal operation of the link. ATPC tracks the targetrssi.
EXAMPLE	Set the targetrssi at –45dBm *(trango-config)# targetrssi -45* *target rssi: -45.00 dBm* *SUCCESS*
RELATED	atpc, rssi

tdm

SYNTAX	Tdm <coding | mode > coding < 0 –2> 0: ami | 1:b8zs | 2:hdb3 mode <t1 | e1 >
DEFAULT VALUE	**Coding: AMI** **Mode : T1**
DESCRIPTION	This command is used to configure the TDM settings. The TDM port can be configured either as T1 or E1 ports. The required coding can be set by using the command “tdm coding X”. Make sure that IDU’s on both ends of the link are configured in the same way.
EXAMPLE	To set the mode to E1 *(trango-config)# tdm mode e1* *TDM mode: E1* Check current TDM coding *(trango-config)# tdm coding* *TDM line coding: AMI*
RELATED	port, sysinfo

temp

SYNTAX	temp
DEFAULT VALUE	N/A
DESCRIPTION	Temp command is used to display the current IDU/ODU temperature in Celsius.

EXAMPLE	To display current temp *(trango-config)# temp* *IDU Temperature: 42 celsius* *ODU Temperature: 43 celsius*
RELATED	N/A

tftpd

SYNTAX	tftpd <on | off>
DEFAULT VALUE	OFF
DESCRIPTION	Turn on tftp server. Used to transfer software images during upgrades
EXAMPLE	Enable tftp server *(trango-config)# tftpd on* *tftpd: on* *SUCCESS*
RELATED	Bootimage

threshold

SYNTAX	Threshold <param> <min | max> <value> <action> Param: <0-5> 0-rssi, 1-mse, 2-ber, 3-fer, 4-idu_temp, 5-odu_temp 6-in port util 7-out port util action: <0-3> 0-none, 1-alarm1, 2-alarm2,

	3-snmptrap
DEFAULT VALUE	No action
DESCRIPTION	Threshold command is used to set rules for monitoring the system. Whenever the threshold exceeds the programmed values the desired action is set. The 2 new thresholds 6/7 are for monitoring the Port Utilization Rate on the RF link. The link utilization doesn't include the KeepAlive packets sent on link for modem synchronization. The utilization rate is expressed as percentage of the current max speed based on the modulation.
EXAMPLE	Set Max In Port Utilization threshold to 70% to send a snmptrap. *(trango-config)# threshold 6 max 70 3* *max = 70* *SUCCESS*
RELATED	Alarm, snmptrap

trapip

SYNTAX	Trapip <ipv4 address>
DEFAULT VALUE	0.0.0.0
DESCRIPTION	Trapip is used to set the ip address of the snmptrap manager destination. Only 1 trapip can be configured.
EXAMPLE	Set trapip to 10.8.1.32 *(trango-config)# trapip 10.8.1.32* *Trap IP Address: 10.8.1.32* *SUCCESS*
RELATED	snmptrap, snmpd

uptime

SYNTAX	Uptime
DEFAULT VALUE	N/A
DESCRIPTION	Uptime is used to display how long the system has been running, since the last reboot/power cycle. It shows the current time and uptime.
EXAMPLE	To display current uptime *(trango-config)# uptime* *20:45:58 up 1:49, load average*
RELATED	Date

utype

SYNTAX	Utype
DEFAULT VALUE	**N/A**
DESCRIPTION	This command is to display the current unit type in the failover mode. The defined utypes are Active, Standby and no-utype. The units are in no-utype during the election period. After the election the units are either Active or Standby.
EXAMPLE	To display current utype *(trango-config)# utype* *utype: active*
RELATED	failover, sync_state

version

SYNTAX	Version
DEFAULT VALUE	N/A
DESCRIPTION	Version command is used to display the current /previous software images on the radio. The system is capable of have multiple images.
EXAMPLE	To display the current/previous software version *(trango-config)# version* *Current Image Version* *IDU FPGA version: 02080907* *IDU OS version: 2p6r14b3D10190701* *IDU FW version: 1p0r1D10190701* *IDU PIC version: 11* *IDU Modem version: 40* *ODU FW version: 07* *Previous Image Version:* *IDU FPGA version: 02080907* *IDU OS version: 2p6r14b3D10190701* *IDU FW version: 1p0r1D10190701* *IDU PIC version: 11* *ODU FW version: N/A*
RELATED	bootimage

Appendix B - Specifications

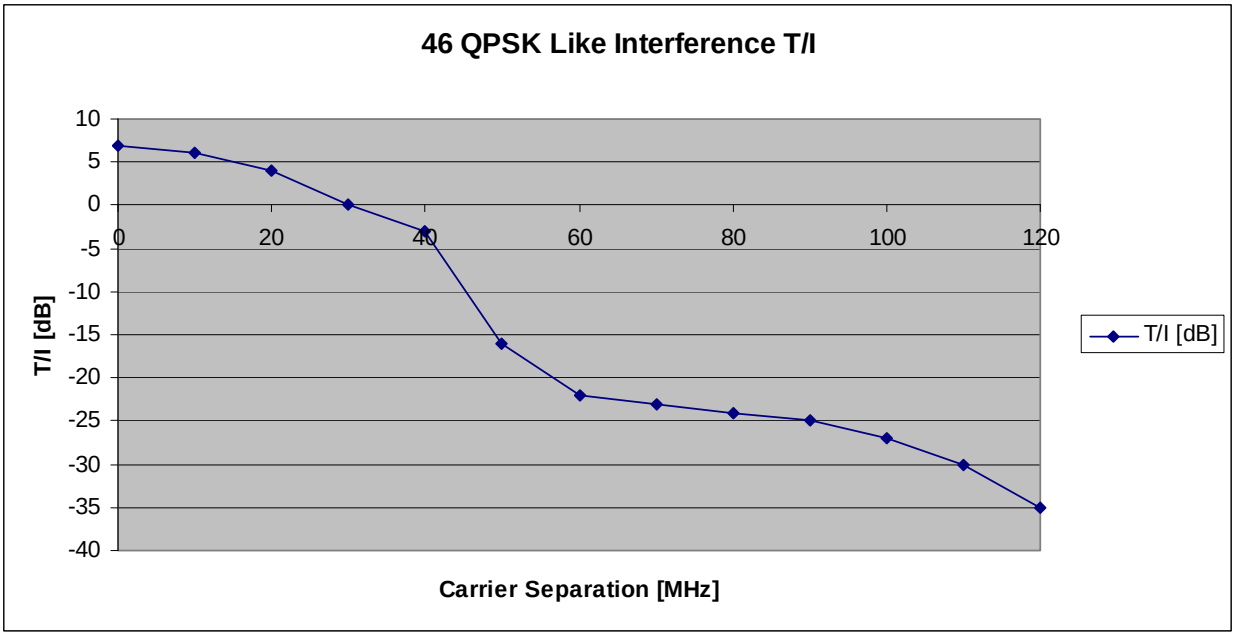
Interface Specifications

	Physical Interface	Bit rate	Impedance	Line Code	Standard	Jitter transfer and jitter tolerance requirement Compliance
E1	Electrical	2048 Kb/s +/-50 PPM	75 Ohm, unbalanced or 120 Ohm, balanced	HDB3	ITU-T G.703	ITU-T G.823
T1 (DS1)	Electrical	1544 Kb/s +/- 10 PPM	100 OHM balanced	AMI or B8ZS	GR-499-CORE, ANSI T1.102-1993	GR-499-CORE, ANSI T1.102-1993, ITU-T G.824
10 Base-T	Electrical	10 Mb/s	100 Ohm, balanced	Manchester 4B/5B	IEEE 802.3	IEEE 802.3
100 Base-T	Electrical	100 Mb/s	100 Ohm, balanced	Manchester 4B/5B	IEEE 802.3	IEEE 802.3
1000 Base-T	Electrical	1 Gb/s	100 Ohm, balanced	Manchester 4B/5B	IEEE 802.3	IEEE 802.3

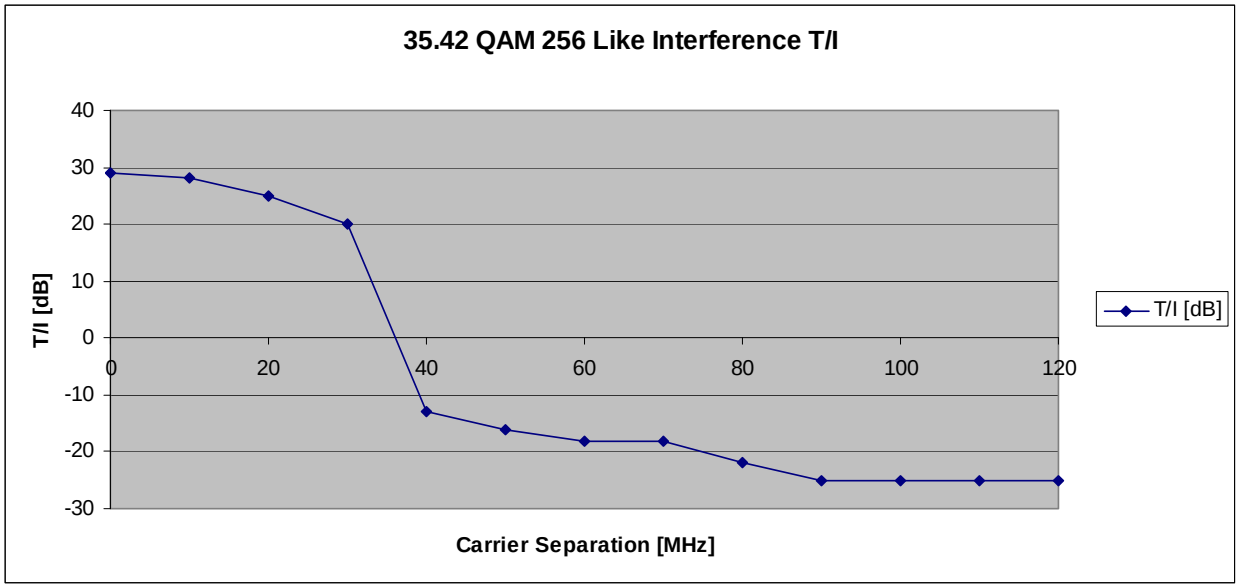
T/I Curves

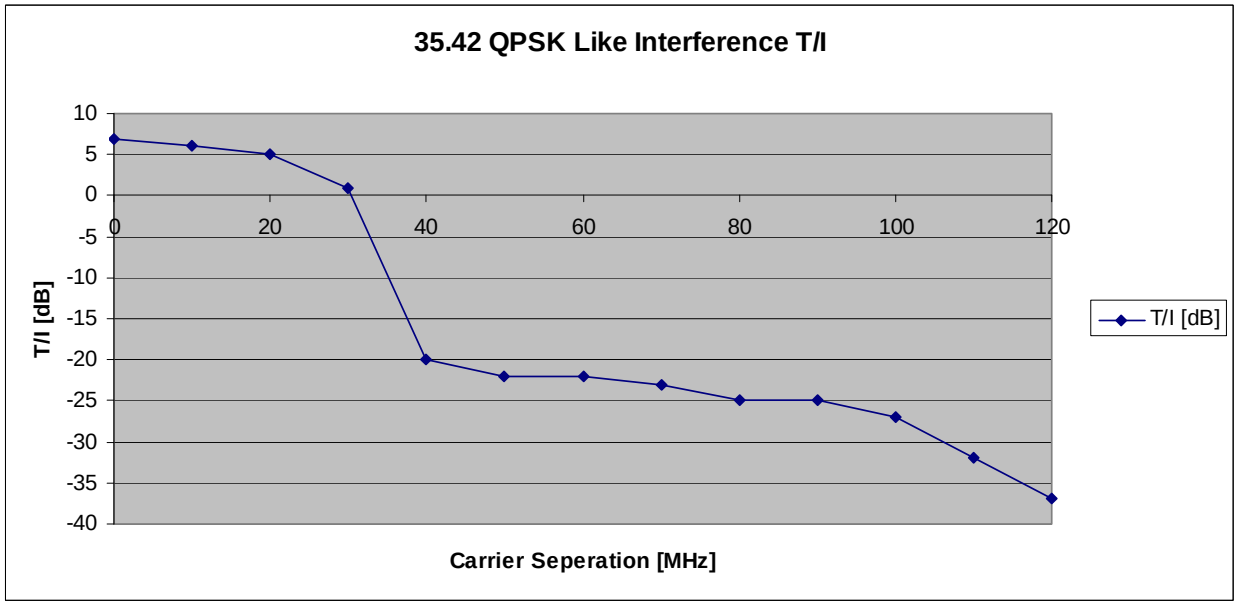
The Interference test measures the performance of the receiver under co-channel and adjacent channel interferers.

80 MHz channel (46 Symbol Rate)

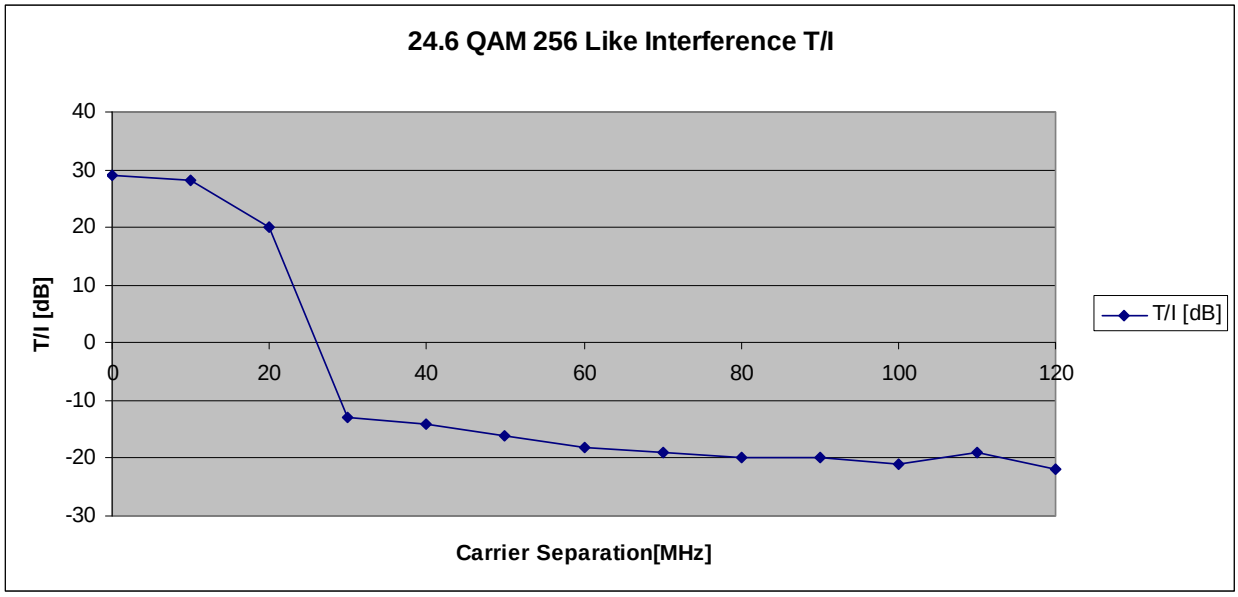


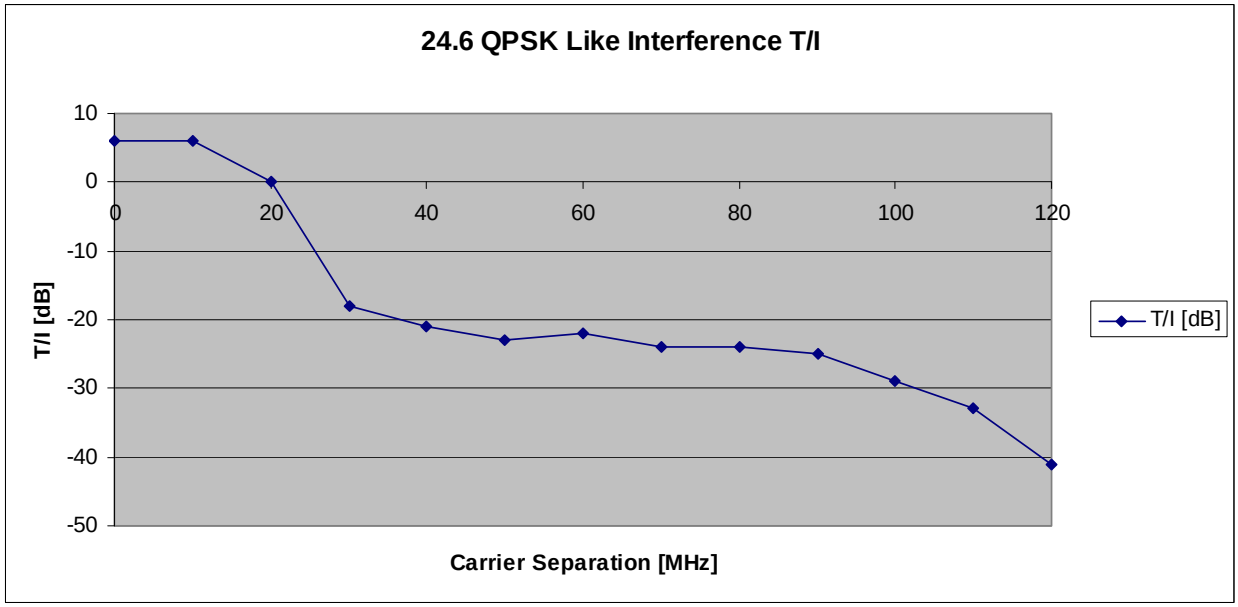
40 MHz channel (35.42 Symbol Rate)



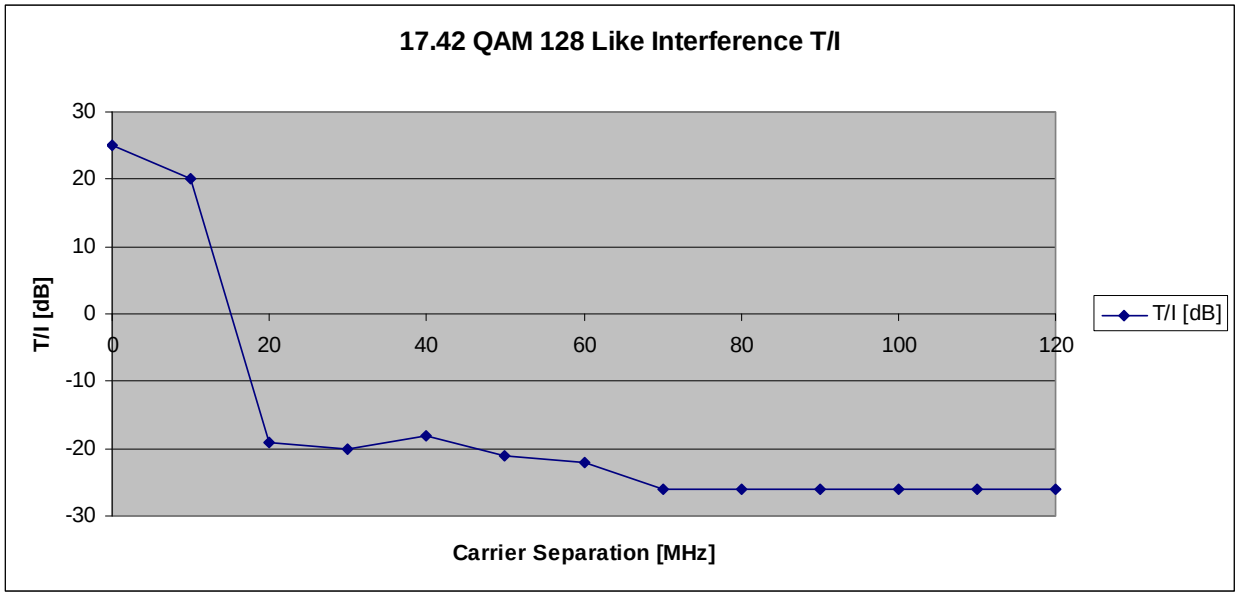


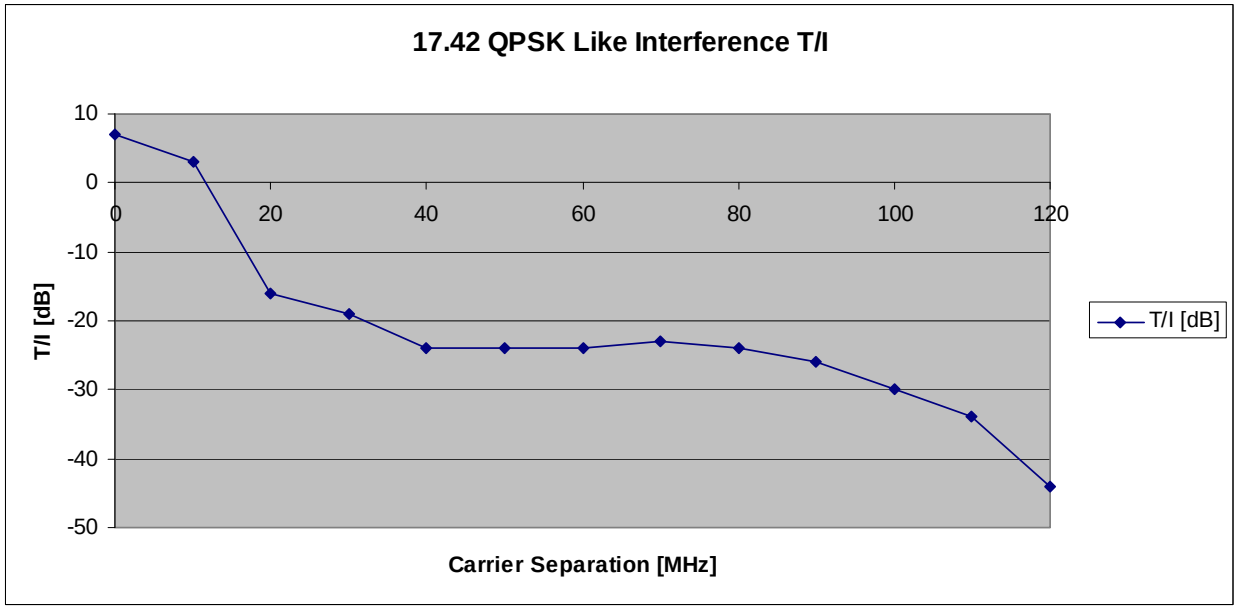
30 MHz channel (24.6 Symbol Rate)



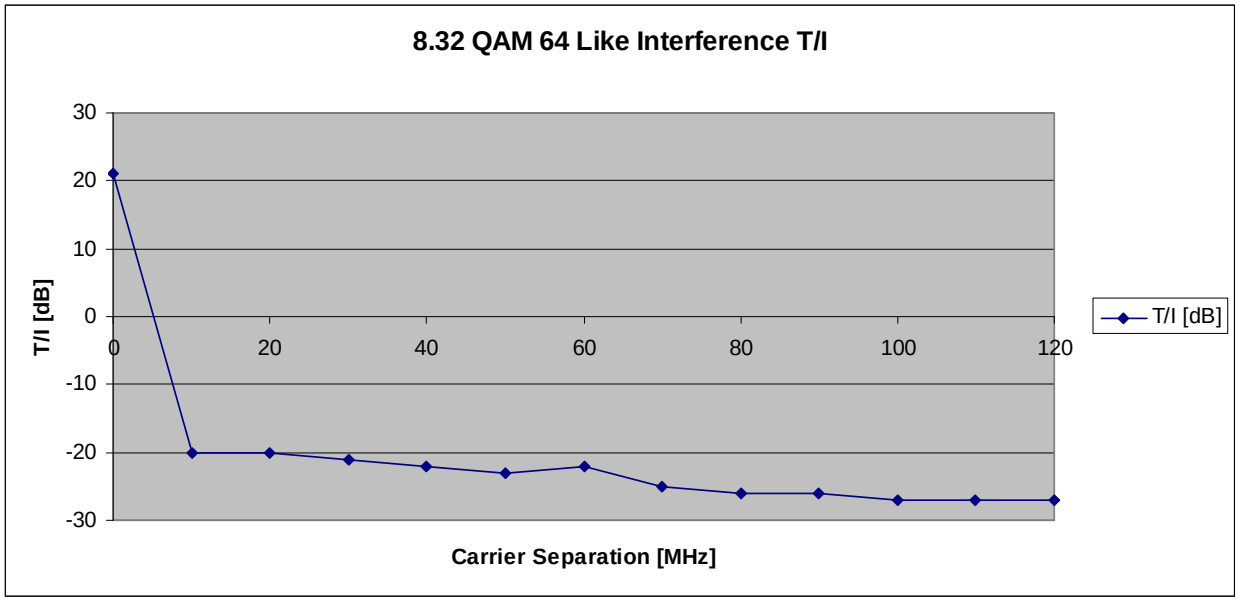


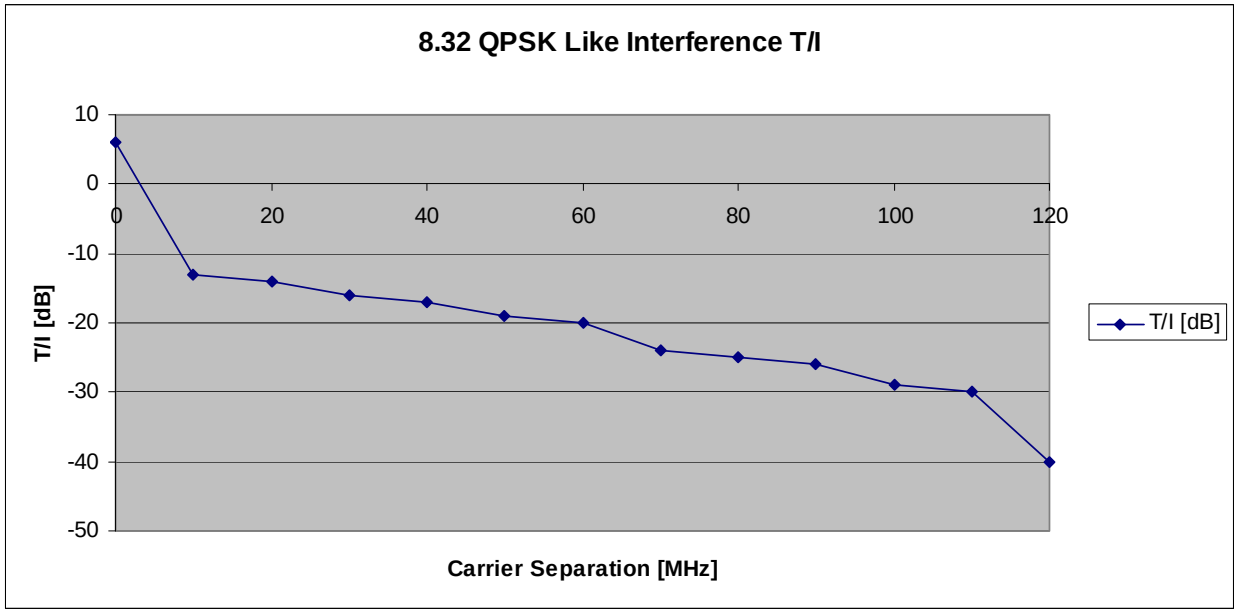
20 MHz channel (17.42 Symbol Rate)





10 MHz channel (8.32 Symbol Rate)





FCC Requirement of Frequency Spacing 6GHz

10 MHz maximum authorized bandwidth channels:

Transmit (receive) (MHz) 252.04 MHz Separation	Receive (transmit) (MHz)
5935.32	6187.36
5945.20	6197.24
5955.08	6207.12
5964.97	6217.01
5974.85	6226.89
5984.73	6236.77
5994.62	6246.66
6004.50	6256.54
6014.38	6266.42
6024.27	6276.31
6034.15	6286.19
6044.03	6296.07
6053.92	6305.96
6063.80	6315.84
6073.68	6325.72
6083.57	6335.61
6093.45	6345.49
6103.33	6355.37
6113.22 (Note 1)	6365.26
6123.10 (Note 1)	6375.14
6132.98 (Note 1)	6385.02
6142.87 (Note 1)	6394.91
6152.75 (Note 1)	6404.79
6162.63 (Note 1)	6414.67

Note 1 Alternate channels. These channels are set aside for narrow bandwidth systems and should be used only if all other channels are blocked.

30 MHz maximum authorized bandwidth channels:

Transmit (receive) (MHz)	Receive (transmit) (MHz)
252.04 MHz Separation	
5945.20	6197.24
5974.85	6226.89
6004.50	6256.54
6034.15	6286.19
6063.80	6315.84
6093.45	6345.49
6123.10.....(Note 1).....	.....6375.14
6152.75.....(Note 1).....	.....6404.79

Note 1 Alternate channels. These channels are set aside for narrow bandwidth systems and should be used only if all other channels are blocked.

FCC/IC Requirement of Frequency Spacing 11Ghz

10 MHz maximum authorized bandwidth channels:

Transmit (receive) (MHz)	Receive (transmit) (MHz)
490 MHz Separation	
10715…… IC ONLY	11205
10725…… IC ONLY	11215
10735	11225
10745	11235
10755	11245
10765	11255
10775	11265
10785	11275
10795	11285
10805	11295
10815	11305
10825	11315
10835	11325
10845	11335
10855	11345
10865	11355
10875	11365

10885.....11375
10895.....11385
10905.....11395
10915.....11405
10925.....11415
10935.....11425
10945.....11435
10955.....11445
10965.....11455
10975.....11465
10985.....11475
10995.....11485
11005.....11495
11015.....11505
11025.....11515
11035.....11525
11045.....11535
11055.....11545
11065.....11555
11075.....11565
11085.....11575
11095.....11585
11105.....11595
11115.....11605
11125……. 11615
11135……..Only if all others used 11625
11145……. Only if all others used.....11635
11155……. Only if all others used.....11645
11165……. Only if all others used.....11655
11175……. Only if all others used.....11665
11185…… IC ONLY.....11675
11195…… IC ONLY 11685

20 MHz maximum authorized bandwidth channels (IC ONLY):

Transmit (receive) (MHz) Receive (transmit) (MHz)
490 MHz Separation

10720.....11210
10740.....11230
10760.....11250

10780.....11270
10800.....11290
10820.....11310
10840.....11330
10860.....11350
10880.....11370
10900.....11390
10920.....11410
10940.....11430
10960.....11450
10980.....11470
11000.....11490
11020.....11510
11040.....11530
11060.....11550
11080.....11570
11100.....11590
11120.....11610
11140.....11630
11160.....11650
11180.....11670

30 MHz maximum authorized bandwidth channels (FCC ONLY):

Transmit (receive) (MHz) Receive (transmit) (MHz)
490 MHz Separation

10755.....11245
10795.....11285
10835.....11325
10875.....11365
10915.....11405
10955.....11445
10995.....11485
11035.....11525
11075.....11565
11115.....11605
11155……Only if all others used.....11645

30 MHz maximum authorized bandwidth channels (IC ONLY):

Transmit (receive) (MHz)	Receive (transmit) (MHz)
490 MHz Separation	
10725	11215
10755	11245
10785	11275
10815	11305
10845	11335
10875	11365
10905	11395
10935	11425
10965	11455
10995	11485
11025	11515
11055	11545
11085	11575
11115	11605
11145	11635
11175	11665

40 MHz maximum authorized bandwidth channels (FCC/IC/ETSI):

Transmit (receive) (MHz)	Receive (transmit) (MHz)
490 MHz Separation	
10735	11225
10775	11265
10815	11305
10855	11345
10895	11385
10935	11425
10975	11465
11015	11505
11055	11545

11095.....11585
11135……Only if all others used.....11625
11175……Only if all others used.....11665

FCC Requirement of Frequency Spacing 18Ghz

10 MHz maximum authorized bandwidth channels:

Transmit (receive) (MHz) Receive (transmit) (MHz)
1560 MHz Separation

17705.0 ..... 19265.0
17715.0 ..... 19275.0
17725.0 ..... 19285.0
17735.0 ..... 19295.0
17745.0 ..... 19305.0
17755.0 ..... 19315.0
17765.0 ..... 19325.0
17775.0 ..... 19335.0
17785.0 ..... 19345.0
17795.0 ..... 19355.0
17805.0 ..... 19365.0
17815.0 ..... 19375.0
17825.0 ..... 19385.0
17835.0 ..... 19395.0
17845.0 ..... 19405.0
17855.0 ..... 19415.0
17865.0 ..... 19425.0
17875.0 ..... 19435.0
17885.0 ..... 19445.0
17895.0 ..... 19455.0
17905.0 ..... 19465.0
17915.0 ..... 19475.0
17925.0 ..... 19485.0
17935.0 ..... 19495.0
17945.0 ..... 19505.0
17955.0 ..... 19515.0
17965.0 ..... 19525.0
17975.0 ..... 19535.0
17985.0 ..... 19545.0

17995.0 ..... 19555.0
11005.0 ..... 11565.0
11015.0 ..... 19575.0
11025.0 ..... 19585.0
11035.0 ..... 19595.0
18045.0 ..... 19605.0
18055.0 ..... 19615.0
18065.0 ..... 19625.0
18075.0 ..... 19635.0
18085.0 ..... 19645.0
18095.0 ..... 19655.0
18105.0 ..... 19665.0
18115.0 ..... 19675.0
18125.0 ..... 19685.0
18135.0 ..... 19695.0

20 MHz maximum authorized bandwidth channels:

Transmit (receive) (MHz) Receive (transmit) (MHz)

1560 MHz Separation

17710.0 ..... 19270.0
17730.0 ..... 19290.0
17750.0 ..... 19310.0
17770.0 ..... 19330.0
17790.0 ..... 19350.0
17810.0 ..... 19370.0
17830.0 ..... 19390.0
17850.0 ..... 19410.0
17870.0 ..... 19430.0
17890.0 ..... 19450.0
17910.0 ..... 19470.0
17930.0 ..... 19490.0
17950.0 ..... 19510.0
17970.0 ..... 19530.0
17990.0 ..... 19550.0
18010.0 ..... 19570.0
18030.0 ..... 19590.0
18050.0 ..... 19610.0
18070.0 ..... 19630.0
18090.0 ..... 19650.0
18110.0 ..... 19670.0
18130.0 ..... 19690.0
18590.0 ..... 18930.0

40 MHz maximum authorized bandwidth channels:

Transmit (receive) (MHz) Receive (transmit) (MHz)

1560 MHz Separation

17720.0 ..... 19280.0
17760.0 ..... 19320.0
17800.0 ..... 19360.0
17840.0 ..... 19400.0
17880.0 ..... 19440.0
17920.0 ..... 19480.0
17960.0 ..... 19520.0
18000.0 ..... 19560.0
18040.0 ..... 19600.0
18080.0 ..... 19640.0
18120.0 ..... 19680.0

80 MHz maximum authorized bandwidth channels:

Transmit (receive) (MHz) Receive (transmit) (MHz)

1560 MHz Separation

17740.0 ..... 19300.0
17820.0 ..... 19380.0
17900.0 ..... 19460.0
17980.0 ..... 19540.0
18060.0 ..... 19620.0

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10 MHz maximum authorized bandwidth channels:

Transmit (receive) (MHz) Receive (transmit) (MHz)

1200 MHz Separation

21825 [2] ..... [(2)] 23025
21835 [2] ..... [(2)] 23035
21845 [2] ..... [(2)] 23045
21855 [2] ..... [(2)] 23055
21865 [2] ..... [(2)] 23065
21875 [2] ..... [(2)] 23075
21885 [2] ..... [(2)] 23085
21895 [2] ..... [(2)] 23095
21905 [2] ..... [(2)] 23105
21915 [2] ..... [(2)] 23115
21925 [2] ..... [(2)] 23125
21935 [2] ..... [(2)] 23135
21945 [2] ..... [(2)] 23145
21955 [2] ..... [(2)] 23155
21965 [2] ..... [(2)] 23165
21975 [2] ..... [(2)] 23175
21985 [2] ..... [(2)] 23185
21995 [2] ..... [(2)] 23195
22005 23205
22015 23215
22025 23225
22035 23235
22045 23245
22055 23255
22065 23265
22075 23275
22085 23285
22095 23295
22105 23305
22115 23315
22125 23325
22135 23335
22145 23345

22155 23355
22165 23365
22175 23375
22185 23385
22195 23395
22205 23405
22215 23415
22225 23425
22235 23435
22245 23445
22255 23455
22265 23465
22275 23475
22285 23485
22295 23495
22305 [1] ..... [(1)]23505
22315 [1] ..... [(1)]23515
22325 [1] ..... [(1)]23525
22335 [1] ..... [(1)]23535
22345 [1] ..... [(1)]23545
22355 [1] ..... [(1)]23555
22365 [1] ..... [(1)]23565
22375 [1] ..... [(1)]23575
22385 [1] ..... [(1)]23585
22395 [1] ..... [(1)]23595

[(1)] Alternate channels. These channels are set aside for narrow bandwidth systems and should be used only if all other channels are blocked.
[(2)]These frequencies may be assigned to low power systems.

20 MHz maximum authorized bandwidth channels:

Transmit (receive) (MHz) Receive (transmit) (MHz)

1200 MHz Separation

21810 [2] ..... [(2)]23010
21830 [2] ..... [(2)]23030
21860 [2] ..... [(2)]23060
21880 [2] ..... [(2)]23080
21910 [2] ..... [(2)]23110

21930 [2] ..... [(2)]23130
21960 [2] ..... [(2)]23160
21980 [2] ..... [(2)]23180
22010 23210
22030 23230
22060 23260
22080 23280
22110 23310
22130 23330
22160 23360
22180 23380
22210 23410
22230 23430
22260 23460
22280 23480
22310 [1] ..... [(1)]23510
22330 [1] ..... [(1)]23530
22360 [1] ..... [(1)]23560
22380 [1] ..... [(1)]23580

[(1)] Alternate channels. These channels are set aside for narrow bandwidth systems and should be used only if all other channels are blocked.
[(2)]These frequencies may be assigned to low power systems.

30 MHz maximum authorized bandwidth channels:

Transmit (receive) (MHz) Receive (transmit) (MHz)

1200 MHz Separation

21835 [2] ..... [(2)]23035
21885 [2] ..... [(2)]23085
21935 [2] ..... [(2)]23135
21985 [2] ..... [(2)]23185
22035 23235
22085 23285
22135 23335
22185 23385
22235 23435
22285 23485
22335 [1] ..... [(1)]23535
22385 [1] ..... [(1)]23585

(1) Alternate channels. These channels are set aside for narrow bandwidth systems and should be used only if all other channels are blocked.
(2)These frequencies may be assigned to low power systems.

40 MHz maximum authorized bandwidth channels:

Transmit (receive) (MHz) Receive (transmit) (MHz)

1200 MHz Separation

21820 [2] ..... (2)23020
21870 [2] ..... (2)23070
21920 [2] ..... (2)23120
21970 [2] ..... (2)23170
22020 23220
22070 23270
22120 23320
22170 23370
22220 23420
22270 23470
22320 [1] ..... (1)23520
22370 [1] ..... (1)23570

(1) Alternate channels. These channels are set aside for narrow bandwidth systems and should be used only if all other channels are blocked.
(2)These frequencies may be assigned to low power systems.

50 MHz maximum authorized bandwidth channels:

Transmit (receive) (MHz)	Receive (transmit) (MHz)
1200 MHz Separation	
21825 [2]	[2]23025
21875 [2]	[2]23075
21925 [2]	[2]23125
21975 [2]	[2]23175
22025	23225
22075	23275
22125	23325
22175	23375
22225	23425
22275	23475
22325 [1]	[1]23525
22375 [1]	[1]23575

[1] Alternate channels. These channels are set aside for narrow bandwidth systems and should be used only if all other channels are blocked.
[2]These frequencies may be assigned to low power systems.

Appendix C – Cable Pin outs

DB9 Console cable Pin-outs

The console cable is a DB9 female (Figure35) on both sides. The pin outs for creating a console cable are listed in Table 9.

Console Cable Pin outs			
IDU	Signal	Direction	PC
1,6	CD	IN	4
2	RxD	IN	3
3	TxD	OUT	2
4	DTR	OUT	1,6
5	GND		5
7	RTS	OUT	8
	CTS	IN	7

Table 7: Console cable pin outs

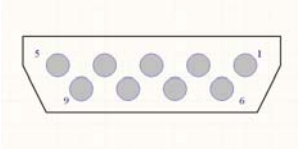


Figure 30: DB9

DB9 Alarm Pin-outs

The alarm port on the IDU is a DB9 female connector (Figure 35). The pin outs of the alarm port are listed in Table 10.

Pins	Function
1	Relay 1 Com
2	Relay 1 NC
3	Relay 1 NO
4	Input 1, 0-5V input
5	Ground
6	Relay 2 Com
7	Relay 2 NC
8	Relay 2 NO

9	Input 1, 0-5V input

Table 8: Alarm Pin outs

Industry Standard CAT-5 Pin-outs

Below are pictures depicting the cable pin-outs for straight-through and cross-over cables. The images below conform to EIA/TIA industry standard for 568 A and B. IF the first and second pin are orange, the cable is 568B. If the first and second pins are green, the cable is 568A (Figure 36). If one end of the cable is A and the other end is B then you now have a cross-over.

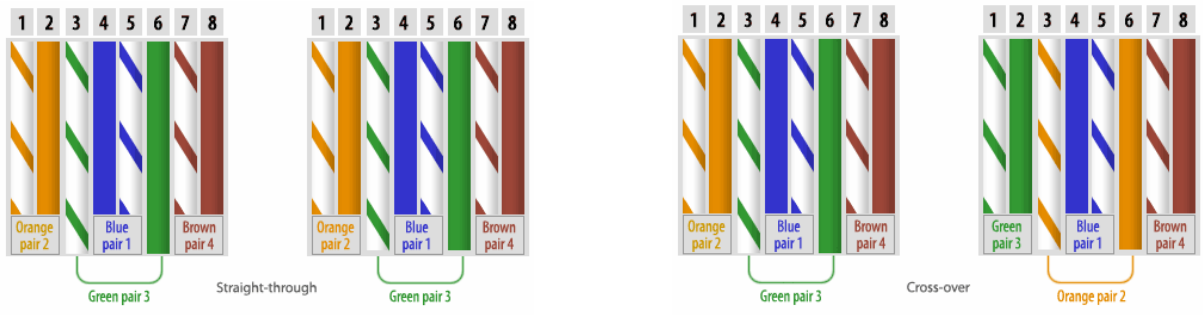


Figure 31: EIA/TIA 568 A & B pin outs.

Grounding Detail

Grounding of the IF cable should be at 75 ft intervals starting at the point of entry to the equipment enclosure room or base of the tower structure. Trango Broadband recommends the use of Trango part number LP-GND-1 (single LMR400 cable) or LP-GND (up to 9 LMR 400 cables). Please note that the use of Times Microwave ST-BC1 and ST-BC2 cable prep tools are recommended for these grounding kits. The same cable preparations can be made using a utility knife and/or a straight razor.

In addition to the cable prep tools Trango Broadband recommends the use of Times Microwave WK-TBC for weatherproofing the ground points.

Further detailed instructions can be obtained from Trango Broadband Technical support or your Trango Broadband Sales Representative.

Appendix D – MIB

The MIB appendix is broken down into the following sections: System, Modem, RF, GigE, T1, and Traps.

System OID's

Object ID	Name	Access	Range Limit	Default Value
.1.3.6.1.4.1.5454.1.50.1.1	sysUnitType	RW	0(NO_TYPE), 1(MAIN), 2(STANDBY)	1 (MAIN)
.1.3.6.1.4.1.5454.1.50.1.2.1	sysODUFWVer	RO	0..80	N/A
.1.3.6.1.4.1.5454.1.50.1.2.2	sysIDUFPGAVer	RO	0..80	N/A
.1.3.6.1.4.1.5454.1.50.1.2.3	sysIDUFWVer	RO	0..80	N/A
.1.3.6.1.4.1.5454.1.50.1.2.4	sysIDUOSVer	RO	0..80	N/A
.1.3.6.1.4.1.5454.1.50.1.2.5	sysIDUPICVer	RO	0..80	N/A
.1.3.6.1.4.1.5454.1.50.1.2.6	sysIDUAT91Ver	RO	0..80	N/A
.1.3.6.1.4.1.5454.1.50.1.2.7	sysIDUModel	RO	0..80	N/A
.1.3.6.1.4.1.5454.1.50.1.2.8	sysODUModel	RO	0..80	N/A
.1.3.6.1.4.1.5454.1.50.1.2.9	sysIDUFPGAPreVer	RO	0..80	N/A
.1.3.6.1.4.1.5454.1.50.1.2.10	sysIDUFWPreVer	RO	0..80	N/A
.1.3.6.1.4.1.5454.1.50.1.2.11	sysIDUOSPreVer	RO	0..80	N/A
.1.3.6.1.4.1.5454.1.50.1.3.1	sysMACFPGA	RO	12	N/A
.1.3.6.1.4.1.5454.1.50.1.3.2	sysMACeth1	RO	12	N/A
.1.3.6.1.4.1.5454.1.50.1.4.1	sysIdIDU	RO	0..127	N/A
.1.3.6.1.4.1.5454.1.50.1.4.2	sysIdODU	RO	0..127	N/A
.1.3.6.1.4.1.5454.1.50.1.5	sysBackupStatus	RO	0(OFF), 1(READY)	1(READY)
.1.3.6.1.4.1.5454.1.50.1.6.1	sysDefaultOpmode	RW	0(OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.50.1.6.2	sysOpmode	RW	deactivated(0), activate(1)	deactivated(0)
.1.3.6.1.4.1.5454.1.50.1.7.1	sysReadCommStr	RW	1..32	public
.1.3.6.1.4.1.5454.1.50.1.7.2	sysWriteCommStr	RW	1..32	private
.1.3.6.1.4.1.5454.1.50.1.8	sysSave	RW	1(Save)	N/A
.1.3.6.1.4.1.5454.1.50.1.9	sysReboot	RW	1(Reboot)	N/A
.1.3.6.1.4.1.5454.1.50.1.10	sysResetFactoryDefault	RW	1(Reset)	N/A
.1.3.6.1.4.1.5454.1.50.1.11.1	sysIPAddress	RW	16	192.168.100.100
.1.3.6.1.4.1.5454.1.50.1.11.2	sysSubnetMask	RW	16	255.255.255.0
.1.3.6.1.4.1.5454.1.50.1.11.3	sysDefaultGateway	RW	16	192.168.100.100
.1.3.6.1.4.1.5454.1.50.1.12	sysRemarks	RW	0..100	TrangoLink Giga
.1.3.6.1.4.1.5454.1.50.1.13.1	sysTFTPD	RW	Disable(0), Enable(1)	Disable(0)
.1.3.6.1.4.1.5454.1.50.1.13.2	sysHTTPD	RW	Disable(0), Enable(1)	Enable(1)
.1.3.6.1.4.1.5454.1.50.1.13.3	sysTELNETD	RW	Disable(0), Enable(1)	Enable(1)
.1.3.6.1.4.1.5454.1.50.1.14	sysFanControlOn	RW	0(FANOFF), 1(FAN1ON), 2(FAN2ON)	1(FAN1ON)
.1.3.6.1.4.1.5454.1.50.1.15	sysAlignmentMode	RW	0(OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.50.1.16	sysIDUTemp	RO	0-99	0
.1.3.6.1.4.1.5454.1.50.1.17	sysODUPowerEnable	RW	0(OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.50.1.18	sysDatapath	RW	0(eth), 1(t1), 2(both)	2(both)
.1.3.6.1.4.1.5454.1.50.1.19	sysFailover	RW	0(OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.50.1.20.1	sysTrapIpEnable	RW	0(OFF), 1(ON)	0(OFF)

.1.3.6.1.4.1.5454.1.50.1.20.2	**sysTrapIpAddress**	**RW**	**16**	**0.0.0.0**
.1.3.6.1.4.1.5454.1.50.1.20.3	**sysTrapCommStr**	**RW**	**1..32**	**public**
.1.3.6.1.4.1.5454.1.50.1.20.4	**sysTrapIpAddress2**	**RW**	**16**	**0.0.0.0**
.1.3.6.1.4.1.5454.1.50.1.21.1	**sysAlarm1**	**RW**	**0(OFF), 1(ON)**	**0(OFF)**
.1.3.6.1.4.1.5454.1.50.1.21.2	**sysAlarm2**	**RW**	**0(OFF), 1(ON)**	**0(OFF)**
.1.3.6.1.4.1.5454.1.50.1.22.1	**sysImageUpgrade**	**RW**	**0(FPGA), 1(LINUX), 2(ROOTFS),3(PIC), 4(MODEM), 5(ODU)**	**N/A**
.1.3.6.1.4.1.5454.1.50.1.22.2	**sysImageToggle**	**RW**	**0 (OFF), 1(TOGGLE)**	**0(OFF)**
.1.3.6.1.4.1.5454.1.50.1.23	**sysRPSEnable**	**RW**	**0(OFF), 1(ON)**	**0(OFF)**
.1.3.6.1.4.1.5454.1.50.1.24.1	**sysTdmMode**	**RW**	**0(T1), 1(E1)**	**0(T1)**
.1.3.6.1.4.1.5454.1.50.1.24.2	**sysTdmCoding**	**RW**	**0(AMI), 1(B8ZS), 2(HDB3)**	**0(AMI)**

Modem OID's				
Object ID	**Name**	**Access**	**Range Limit**	**Default Value**
.1.3.6.1.4.1.5454.1.50.2.1	modemLoopbackMode	RW	0(OFF), DIG(1), IF(2), RFGEN(3), RFREFL(4)	0(OFF)
.1.3.6.1.4.1.5454.1.50.2.2	modemDataPattern	RW	FPGA(0), MODEM(1)	0(FPGA)
.1.3.6.1.4.1.5454.1.50.2.3	modemBER	RO	N/A	N/A
.1.3.6.1.4.1.5454.1.50.2.4	modemMSE	RO	N/A	N/A
.1.3.6.1.4.1.5454.1.50.2.5	modemFER	RO	N/A	N/A
.1.3.6.1.4.1.5454.1.50.2.8.1	modemTxFIFOFull	RO	0(NORMAL), 1(FULL)	N/A
.1.3.6.1.4.1.5454.1.50.2.8.2	modemTxFIFOEmpty	RO	0(NORMAL), 1(EMPTY)	N/A
.1.3.6.1.4.1.5454.1.50.2.8.3	modemTxFIFOUnderflow	RO	0(NORMAL), 1(UNDERFLOW)	N/A
.1.3.6.1.4.1.5454.1.50.2.8.4	modemTxFIFOOverrun	RO	0(NORMAL), 1(OVERRUN)	N/A
.1.3.6.1.4.1.5454.1.50.2.8.5	modemRxFIFOFull	RO	0(NORMAL), 1(FULL)	N/A
.1.3.6.1.4.1.5454.1.50.2.8.6	modemRxFIFOEmpty	RO	0(NORMAL), 1(EMPTY)	N/A
.1.3.6.1.4.1.5454.1.50.2.8.7	modemRxFIFOUnderflow	RO	0(NORMAL), 1(UNDERFLOW)	N/A
.1.3.6.1.4.1.5454.1.50.2.8.8	modemRxFIFOOverrun	RO	0(NORMAL), 1(OVERRUN)	N/A
.1.3.6.1.4.1.5454.1.50.2.9.1	modemLockStatus	RO	0(NOACQUIRE), 1(INPROGRESS), 2(LOCKED)	N/A
.1.3.6.1.4.1.5454.1.50.2.9.2	modemTimingLock	RO	0(NORMAL), 1(LOCKED)	N/A
.1.3.6.1.4.1.5454.1.50.2.9.3	modemEqualizerLock	RO	0(NORMAL), 1(LOCKED)	N/A
.1.3.6.1.4.1.5454.1.50.2.9.4	modemInnerCodeLock	RO	0(NORMAL), 1(LOCKED)	N/A
.1.3.6.1.4.1.5454.1.50.2.9.5	modemFrameSyncLock	RO	0(NORMAL), 1(LOCKED)	N/A

RF OID's				
Object ID	**Name**	**Access**	**Range Limit**	**Default Value**

.1.3.6.1.4.1.5454.1.50.3.1.1	rfATPCEnable	RW	0 (OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.50.3.1.2	rfATPCMaxPower	RW	0-17	10
.1.3.6.1.4.1.5454.1.50.3.1.3	rfATPCStepSize	RW	1~5	17
.1.3.6.1.4.1.5454.1.50.3.2	rfTxFrequency	RW	17705~19695	0
.1.3.6.1.4.1.5454.1.50.3.3	rfRxFrequency	RO	17705~19695	0
.1.3.6.1.4.1.5454.1.50.3.4.1	rfSymrate	RO	8, 17, 35, 46	46
.1.3.6.1.4.1.5454.1.50.3.4.2	rfModulation	RW	0(QPSK), 1(16Q), 2(32Q), 3(64Q), 4(128Q), 5(256Q)	0(QPSK)
.1.3.6.1.4.1.5454.1.50.3.4.3	rfBPF	RO	14, 28, 56	56
.1.3.6.1.4.1.5454.1.50.3.4.4	rfChannelsWidth	RW	10(0), 20(1), 28(2), 40(3), 50(4), 80(5)	5(80)
.1.3.6.1.4.1.5454.1.50.3.5.1	rfSymrateRateshift	RO	8, 17, 35, 46	46
.1.3.6.1.4.1.5454.1.50.3.5.2	rfModulationRateShift	RW	0(QPSK), 1(16Q), 2(32Q), 3(64Q), 4(128Q), 5(256Q)	0(QPSK)
.1.3.6.1.4.1.5454.1.50.3.5.3	rfBPFRateShift	RO	14, 28, 56	56
.1.3.6.1.4.1.5454.1.50.3.5.4	rfChannelWidthRateShift	RW	10(0), 20(1), 28(2), 40(3), 50(4), 80(5)	5(80)
.1.3.6.1.4.1.5454.1.50.3.6	rfRateShiftEnable	RW	0 (OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.50.3.8	rfPower	RW	0-17	10
.1.3.6.1.4.1.5454.1.50.3.9.1	rfSetCableLost140	RW	0-20	0
.1.3.6.1.4.1.5454.1.50.3.9.2	rfSetCableLost315	RW	0-30	0
.1.3.6.1.4.1.5454.1.50.3.9.3	rfSetCableLost915	RW	0-50	0
.1.3.6.1.4.1.5454.1.50.3.10	rfODURSSILEDEnable	RW	0 (OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.50.3.11	rfODURxAGC	RW	0 (OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.50.3.12	rfODUTemp	RO	0-99	N/A
.1.3.6.1.4.1.5454.1.50.3.13	rfTargetRSSI	RW	(-25)~(-88)	-40
.1.3.6.1.4.1.5454.1.50.3.14	rfRSSI	RO	0-99	N/A
.1.3.6.1.4.1.5454.1.50.3.15.1	rfODURFpll	RO	0(NOLOCK), 1(LOCK)	N/A
.1.3.6.1.4.1.5454.1.50.3.15.2	rfODUIFpll	RO	0(NOLOCK), 1(LOCK)	N/A
.1.3.6.1.4.1.5454.1.50.3.15.3	rfODUTxpll	RO	0(NOLOCK), 1(LOCK)	N/A
.1.3.6.1.4.1.5454.1.50.3.15.4	rfODURxpll	RO	0(NOLOCK), 1(LOCK)	N/A
.1.3.6.1.4.1.5454.1.50.3.15.5	rfIDUTransmitpll	RO	0(NOLOCK), 1(LOCK)	N/A
.1.3.6.1.4.1.5454.1.50.3.15.6	rfIDULBpll	RO	0(NOLOCK), 1(LOCK)	N/A
.1.3.6.1.4.1.5454.1.50.3.16.1	rfInDataOctet	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.3.16.2	rfInDataPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.3.16.3	rfInEthernetPackets	RO	0-4294967296	N/A

.1.3.6.1.4.1.5454.1.50.3.16.4	rfInT1E1Packets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.3.16.5	rfInEthernetDropPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.3.16.6	rfInT1E1DropPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.3.16.7	rfInPortUtil	RO	0-100	N/A
.1.3.6.1.4.1.5454.1.50.3.17.1	rfOutDataPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.3.17.2	rfOutDataOctet	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.3.17.3	rfOutEthernetPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.3.17.4	rfOutT1E1Packets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.3.17.5	rfOutPortUtil	RO	0-100	N/A

Gig-E OID's

Object ID	Name	Access	Range Limit	Default Value
.1.3.6.1.4.1.5454.1.50.4.1.1	gigeIBMEnable	RW	0(OFF), 1(ON)	1(ON)
.1.3.6.1.4.1.5454.1.50.4.1.2	gigeIBMIp	RW	16	172.168.1.1
.1.3.6.1.4.1.5454.1.50.4.1.3	gigeIBMVlanID	RW	Jan-90	1
.1.3.6.1.4.1.5454.1.50.4.1.4	gigeDumbMode	RW	0(OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.50.4.2.1	gigeEth1Enable	RW	0(OFF), 1(ON)	1(ON)
.1.3.6.1.4.1.5454.1.50.4.2.2	gigeEth2Enable	RW	0(OFF), 1(ON)	1(ON)
.1.3.6.1.4.1.5454.1.50.4.2.3	gigeEth3Enable	RW	0(OFF), 1(ON)	1(ON)
.1.3.6.1.4.1.5454.1.50.4.2.4	gigeEth4Enable	RW	0(OFF), 1(ON)	1(ON)
.1.3.6.1.4.1.5454.1.50.4.3.1	gigeEth1Status	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.50.4.3.2	gigeEth2Status	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.50.4.3.3	gigeEth3Status	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.50.4.3.4	gigeEth4Status	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.50.4.4.1	gigeEth1Speed	RW	10, 100,1000	1000
.1.3.6.1.4.1.5454.1.50.4.4.2	gigeEth2Speed	RW	10, 100,1000	1000
.1.3.6.1.4.1.5454.1.50.4.4.3	gigeEth3Speed	RW	10, 100,1000	1000
.1.3.6.1.4.1.5454.1.50.4.4.4	gigeEth4Speed	RW	10, 100,1000	1000
.1.3.6.1.4.1.5454.1.50.4.5.1	gigeEth1Duplex	RW	0(HALF), 1(FULL)	1(FULL)
.1.3.6.1.4.1.5454.1.50.4.5.2	gigeEth2Duplex	RW	0(HALF), 1(FULL)	1(FULL)
.1.3.6.1.4.1.5454.1.50.4.5.3	gigeEth3Duplex	RW	0(HALF), 1(FULL)	1(FULL)
.1.3.6.1.4.1.5454.1.50.4.5.4	gigeEth4Duplex	RW	0(HALF), 1(FULL)	1(FULL)
.1.3.6.1.4.1.5454.1.50.4.6.1	gigeEth1priority	RW	0-3	0
.1.3.6.1.4.1.5454.1.50.4.6.2	gigeEth2priority	RW	0-3	0
.1.3.6.1.4.1.5454.1.50.4.6.3	gigeEth3priority	RW	0-3	0
.1.3.6.1.4.1.5454.1.50.4.6.4	gigeEth4priority	RW	0-3	0
.1.3.6.1.4.1.5454.1.50.4.7.1	gigeEth1MaxRate	RW	0-1000	1000
.1.3.6.1.4.1.5454.1.50.4.7.2	gigeEth2MaxRate	RW	0-1000	1000
.1.3.6.1.4.1.5454.1.50.4.7.3	gigeEth3MaxRate	RW	0-1000	1000
.1.3.6.1.4.1.5454.1.50.4.7.4	gigeEth4MaxRat	RW	0-1000	1000

	e			
.1.3.6.1.4.1.5454.1.50.4.8.1	gigeEth1PauseFrame	RW	0(OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.50.4.8.2	gigeEth2PauseFrame	RW	0(OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.50.4.8.3	gigeEth3PauseFrame	RW	0(OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.50.4.8.4	gigeEth4PauseFrame	RW	0(OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.50.4.9.1	gigeEth1InOctets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.9.2	gigeEth2InOctets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.9.3	gigeEth3InOctets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.9.4	gigeEth4InOctets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.10.1	gigeEth1InUcastPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.10.2	gigeEth2InUcastPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.10.3	gigeEth3InUcastPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.10.4	gigeEth4InUcastPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.11.1	gigeEth1InNUcastPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.11.2	gigeEth2InNUcastPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.11.3	gigeEth3InNUcastPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.11.4	gigeEth4InNUcastPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.12.1	gigeEth1InTotalPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.12.2	gigeEth2InTotalPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.12.3	gigeEth3InTotalPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.12.4	gigeEth4InTotalPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.13.1	gigeEth1OutOctets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.13.2	gigeEth2OutOctets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.13.3	gigeEth3OutOctets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.13.4	gigeEth4OutOctets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.14.1	gigeEth1OutUcastPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.14.2	gigeEth2OutUcastPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.14.3	gigeEth3OutUcastPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.14.4	gigeEth4OutUcastPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.15.	gigeEth1OutNUc	RO	0-4294967296	N/A

1	astPackets			
.1.3.6.1.4.1.5454.1.50.4.15.2	gigeEth2OutNUcastPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.15.3	gigeEth3OutNUcastPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.15.4	gigeEth4OutNUcastPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.16.1	gigeEth1OutTotalPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.16.2	gigeEth2OutTotalPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.16.3	gigeEth3OutTotalPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.16.4	gigeEth4OutTotalPackets	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.17.1	gigeEth1CRCErrors	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.17.2	gigeEth2CRCErrors	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.17.3	gigeEth3CRCErrors	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.17.4	gigeEth4CRCErrors	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.18.1	gigeEth1CollisionErrors	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.18.2	gigeEth2CollisionErrors	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.18.3	gigeEth3CollisionErrors	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.18.4	gigeEth4CollisionErrors	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.50.4.19.1	gigeEthPriority0COSQueue	RW	0-3	0
.1.3.6.1.4.1.5454.1.50.4.19.2	gigeEthPriority1COSQueue	RW	0-3	0
.1.3.6.1.4.1.5454.1.50.4.19.3	gigeEthPriority2COSQueue	RW	0-3	1
.1.3.6.1.4.1.5454.1.50.4.19.4	gigeEthPriority3COSQueue	RW	0-3	1
.1.3.6.1.4.1.5454.1.50.4.19.5	gigeEthPriority4COSQueue	RW	0-3	2
.1.3.6.1.4.1.5454.1.50.4.19.6	gigeEthPriority5COSQueue	RW	0-3	2
.1.3.6.1.4.1.5454.1.50.4.19.7	gigeEthPriority6COSQueue	RW	0-3	3
.1.3.6.1.4.1.5454.1.50.4.19.8	gigeEthPriority7COSQueue	RW	0-3	3
.1.3.6.1.4.1.5454.1.50.4.20.1	gigeEth1AutoNegotiate	RW	0(OFF), 1(ON)	1(ON)
.1.3.6.1.4.1.5454.1.50.4.20.2	gigeEth2AutoNegotiate	RW	0(OFF), 1(ON)	1(ON)
.1.3.6.1.4.1.5454.1.50.4.20.3	gigeEth3AutoNegotiate	RW	0(OFF), 1(ON)	1(ON)
.1.3.6.1.4.1.5454.1.50.4.20.4	gigeEth4AutoNegotiate	RW	0(OFF), 1(ON)	1(ON)

T1 OID's				
Object ID	**Name**	**Access**	**Range Limit**	**Default Value**
.1.3.6.1.4.1.5454.1.50.5.1.1	t1e1Port1Status	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.50.5.1.2	t1e1Port2Status	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.50.5.1.3	t1e1Port3Status	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.50.5.1.4	t1e1Port4Status	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.50.5.1.5	t1e1Port5Status	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.50.5.1.6	t1e1Port6Status	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.50.5.1.7	t1e1Port7Status	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.50.5.1.8	t1e1Port8Status	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.50.5.2.1	t1e1Port1Enable	RW	0(OFF), 1(ON)	1(ON)
.1.3.6.1.4.1.5454.1.50.5.2.2	t1e1Port2Enable	RW	0(OFF), 1(ON)	1(ON)
.1.3.6.1.4.1.5454.1.50.5.2.3	t1e1Port3Enable	RW	0(OFF), 1(ON)	1(ON)
.1.3.6.1.4.1.5454.1.50.5.2.4	t1e1Port4Enable	RW	0(OFF), 1(ON)	1(ON)
.1.3.6.1.4.1.5454.1.50.5.2.5	t1e1Port5Enable	RW	0(OFF), 1(ON)	1(ON)
.1.3.6.1.4.1.5454.1.50.5.2.6	t1e1Port6Enable	RW	0(OFF), 1(ON)	1(ON)
.1.3.6.1.4.1.5454.1.50.5.2.7	t1e1Port7Enable	RW	0(OFF), 1(ON)	1(ON)
.1.3.6.1.4.1.5454.1.50.5.2.8	t1e1Port8Enable	RW	0(OFF), 1(ON)	1(ON)
.1.3.6.1.4.1.5454.1.50.5.3.1	t1e1Port1LoopbackMode	RW	0(OFF), 1(ANALOG), 2(DIGITAL), 3(REMOTE)	0(OFF)
.1.3.6.1.4.1.5454.1.50.5.3.2	t1e1Port2LoopbackMode	RW	0(OFF), 1(ANALOG), 2(DIGITAL), 3(REMOTE)	0(OFF)
.1.3.6.1.4.1.5454.1.50.5.3.3	t1e1Port3LoopbackMode	RW	0(OFF), 1(ANALOG), 2(DIGITAL), 3(REMOTE)	0(OFF)
.1.3.6.1.4.1.5454.1.50.5.3.4	t1e1Port4LoopbackMode	RW	0(OFF), 1(ANALOG), 2(DIGITAL), 3(REMOTE)	0(OFF)
.1.3.6.1.4.1.5454.1.50.5.3.5	t1e1Port5LoopbackMode	RW	0(OFF), 1(ANALOG), 2(DIGITAL), 3(REMOTE)	0(OFF)
.1.3.6.1.4.1.5454.1.50.5.3.6	t1e1Port6LoopbackMode	RW	0(OFF), 1(ANALOG), 2(DIGITAL), 3(REMOTE)	0(OFF)
.1.3.6.1.4.1.5454.1.50.5.3.7	t1e1Port7LoopbackMode	RW	0(OFF), 1(ANALOG), 2(DIGITAL), 3(REMOTE)	0(OFF)
.1.3.6.1.4.1.5454.1.50.5.3.8	t1e1Port8LoopbackMode	RW	0(OFF), 1(ANALOG), 2(DIGITAL), 3(REMOTE)	0(OFF)

Trap OID's				
Object ID	**Name**	**Access**	**Range Limit**	**Default Value**
.1.3.6.1.4.1.5454.1.50.6.1	trapReboot	RO	N/A	N/A
.1.3.6.1.4.1.5454.1.50.6.2	trapStartUp	RO	N/A	N/A
.1.3.6.1.4.1.5454.1.50.6.3.1	trapModemLock	RO	0(NORMAL), 1(LOCKED)	N/A

.1.3.6.1.4.1.5454.1.50.6.3.2	trapTimingLock	RO	0(NORMAL), 1(LOCKED)	N/A
.1.3.6.1.4.1.5454.1.50.6.3.3	trapInnerCodeLock	RO	0(NORMAL), 1(LOCKED)	N/A
.1.3.6.1.4.1.5454.1.50.6.3.4	trapEqualizerLock	RO	0(NORMAL), 1(LOCKED)	N/A
.1.3.6.1.4.1.5454.1.50.6.3.5	trapFrameSyncLock	RO	0(NORMAL), 1(LOCKED)	N/A
.1.3.6.1.4.1.5454.1.50.6.4.1.1	trapMSEMinThreshold	RO	Current MSE value	N/A
.1.3.6.1.4.1.5454.1.50.6.4.1.2	trapMSEMaxThreshold	RO	Current MSE value	N/A
.1.3.6.1.4.1.5454.1.50.6.4.2.1	trapBERMinThreshold	RO	Current BER value	N/A
.1.3.6.1.4.1.5454.1.50.6.4.2.2	trapBERMaxThreshold	RO	Current BER value	N/A
.1.3.6.1.4.1.5454.1.50.6.4.3.1	trapFERMinThreshold	RO	Current FER value	N/A
.1.3.6.1.4.1.5454.1.50.6.4.3.2	trapFERMaxThreshold	RO	Current FER value	N/A
.1.3.6.1.4.1.5454.1.50.6.4.4.1	trapRSSIMinThreshold	RO	Current RSSI value	N/A
.1.3.6.1.4.1.5454.1.50.6.4.4.2	trapRSSIMaxThreshold	RO	Current RSSI value	N/A
.1.3.6.1.4.1.5454.1.50.6.4.5.1	trapIDUTempMinThreshold	RO	Current IDU Temp	N/A
.1.3.6.1.4.1.5454.1.50.6.4.5.2	trapIDUTempMaxThreshold	RO	Current IDU Temp	N/A
.1.3.6.1.4.1.5454.1.50.6.4.6.1	trapODUTempMinThreshold	RO	Current ODU Temp	N/A
.1.3.6.1.4.1.5454.1.50.6.4.6.2	trapODUTempMaxThreshold	RO	Current ODU Temp	N/A
.1.3.6.1.4.1.5454.1.50.6.4.7.1	trapInPortUtilMaxThreshold	RO	Current In port untilization	N/A
.1.3.6.1.4.1.5454.1.50.6.4.7.2	trapInPortUtilMinThreshold	RO	Current In port untilization	N/A
.1.3.6.1.4.1.5454.1.50.6.4.8.1	trapOutPortUtilMaxThreshold	RO	Current Out port untilization	N/A
.1.3.6.1.4.1.5454.1.50.6.4.8.2	trapOutPortUtilMinThreshold	RO	Current Out port untilization	N/A
.1.3.6.1.4.1.5454.1.50.6.5.1	trapStandbyLinkDown	RO	N/A	N/A
.1.3.6.1.4.1.5454.1.50.6.5.2	trapStandbyLinkUp	RO	N/A	N/A
.1.3.6.1.4.1.5454.1.50.6.5.3	trapSwitchover	RO	N/A	N/A
.1.3.6.1.4.1.5454.1.50.6.6.1	trapEth1StatusUpdate	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.50.6.6.2	trapEth2StatusUpdate	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.50.6.6.3	trapEth3StatusUpdate	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.50.6.6.4	trapEth4StatusUpdate	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.50.6.7.1.1	trapTdm1StatusUpdate	RO	0(OFF), 1(ON)	N/A

.1.3.6.1.4.1.5454.1.50.6.7.1.2	trapTdm2StatusUpdate	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.50.6.7.1.3	trapTdm3StatusUpdate	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.50.6.7.1.4	trapTdm4StatusUpdate	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.50.6.7.1.5	trapTdm5StatusUpdate	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.50.6.7.1.6	trapTdm6StatusUpdate	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.50.6.7.1.7	trapTdm7StatusUpdate	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.50.6.7.1.8	trapTdm8StatusUpdate	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.50.6.7.2	trapTdmBPV	RO	N/A	N/A
.1.3.6.1.4.1.5454.1.50.6.8	trapDownShift	RO	N/A	N/A
.1.3.6.1.4.1.5454.1.50.6.9	trapRapidPortShutdown	RO	N/A	N/A

Appendix E - Part Numbers

Part #	Description
Giga-IDU	TrangoLINK Giga™ Indoor Unit , 100Mbps Full Duplex, 1U rack mount (All Frequency Versions)
Giga6-ODU-1A	TrangoLINK Giga™ Outdoor Unit, 6GHz, Band 1, ANSI 5.935-6.044 GHz
Giga6-ODU-1B	TrangoLINK Giga™ Outdoor Unit, 6GHz, Band 1, ANSI 6.187-6.296 GHz
Giga6-ODU-2A	TrangoLINK Giga™ Outdoor Unit, 6GHz, Band 2, ANSI 6.054-6.162 GHz
Giga6-ODU-2B	TrangoLINK Giga™ Outdoor Unit, 6GHz, Band 2, ANSI 6.306-6.414 GHz
Giga11-ODU-1A	TrangoLINK Giga™ Outdoor Unit, 11GHz, Band 1, ANSI 10.715-10.945 GHz
Giga11-ODU-1B	TrangoLINK Giga™ Outdoor Unit, 11GHz, Band 1, ANSI 11.215-11.445 GHz
Giga11-ODU-2A	TrangoLINK Giga™ Outdoor Unit, 11GHz, Band 2, ANSI 10.955-11.185 GHz
Giga11-ODU-2B	TrangoLINK Giga™ Outdoor Unit, 11GHz, Band 2, ANSI 11.445-11.685 GHz
Giga18-ODU-1A	TrangoLINK Giga™ Outdoor Unit, 18GHz, ANSI 17.700-18.140 GHz
Giga18-ODU-1B	TrangoLINK Giga™ Outdoor Unit, 18GHz, ANSI 19.265-19.700 GHz
Giga23-ODU-2A	TrangoLINK Giga ™ Outdoor Unit, 23GHz, Band 2 ANSI 21.800-22.395 GHz
Giga23-ODU-2B	TrangoLINK Giga ™ Outdoor Unit, 23GHz, Band 2 ANSI 23.000-23.595 GHz
Giga23E-ODU-2A	TrangoLINK Giga ™ Outdoor Unit, 23GHz, Band 2 ETSI 22.022-22.358 GHz
Giga23E-ODU-2B	TrangoLINK Giga ™ Outdoor Unit, 23GHz, Band 2 ETSI 23.030-23.366 GHz
CBLDAT-N400-250	LMR400 cable with N-Male connections, 250 Foot
CBLDAT-N400-1K	LMR400 cable with N-Male connections, 1000 Foot
Giga-Srv-FC	Service, Frequency Coordination
Giga-Srv-Path	Service, Path Survey
Giga-Srv-FAP	Service, FCC application Preparation
Giga-Srv-FFE	Service, FCC Fees
Giga-Srv-EW3	Service, Extended Warranty, 3 years

Appendix F – Declaration

We, Trango Systems, Inc.,

14118 Stowe Drive
Ste B
Poway, California, 92127 USA

Tel +1 858 391-0010
Fax +1 858 391-0020

Hereby declare that the product(s) listed below,

Product Name: TrangoLINK Giga Indoor Unit,100Mbps Full Duplex,1U rck mnt
Model No: GIGA-IDU-1

Product Name: TrangoLINK Giga Outdoor Unit, 23GHz, Band 2A, ETSI
Model No: GIGA23E-ODU-2A

Product Name: TrangoLINK Giga Outdoor Unit, 23GHz, Band 2B, ETSI
Model No: GIGA23E-ODU-2B

To which this declaration relates, are in conformity with the following standards and/or other normative documents:

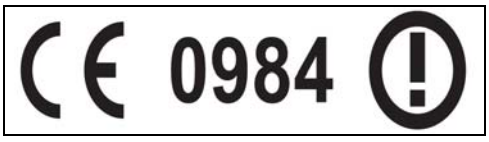
EN 302 217-2-2 (2007-04)
EN 302 217-2-1 ((2005-08)
EN 301 489-17 v1.2.1 (2002-08)
EN 60950-1/IEC 60950-1:2001 First Edition
EN 50385: 2002

We hereby declare that all essential radio test suites have been carried out and that the above named products are in conformity with all the essential requirements of Directive 1999/5/EC.

The conformity assessment procedure referred to in Article 10(5) and detailed in Annex IV of Directive 1999/5/EC has been followed with the involvement of the following Notified Body:

Compliance Certification Services (ID#0984)
47173 Benicia St.
Fremont, CA 94538 USA

All ETSI models will have the following label attached to them on the back of the individual radio unit and on the packing box:



Glossary - Acronyms

AGC	Automatic Gain Control
ATPC	Automatic Transmit Power Control
BER	Bit Error Rate
BPF	Band Pass Filter
Cat5	Category 5 Cable
COS	Class Of Service
dB	Decibel
E1	European-Carrier 1
FCC	Federal Communication Commission
FEC	Forward Error Correction
FPGA	Field Programmable Gate-Array
FTP	File Transfer Protocol
GigE	Gigabit Ethernet
HTTP	HyperText Transfer Protocol
HTTPD	HyperText Transfer Protocol Daemon
HTTPS	HyperText Transfer Protocol Secure
IDU	Indoor Unit
IF	Intermediate Frequency
LB	Loopback
LED	Light-emitting Diode
LIU	Line Interface Unit
MSE	Mean Square Error
ODU	Outdoor Unit
Opmode	Operation Mode

OS	Operating System
PIC	A Series of microcontrollers a product of the Microchip Technology
QAM	Quadrature Amplitude Modulation
QoS	Quality of Service
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RJ-45	Registered Jack - 45
RS-232	Recommended Standard 232
RSSI	Receive Signal Strength Indicator
Rx	Receive
SNMP	Simple Network Management Protocol
SSH	Secure Shell
Sysinfo	System Information
T1 T	1.544 Mbps telephony carrier 1
TDM	Time-Division Multiplexing
T/I	Threshold to Interference
TFTP	Trivial File Transfer Protocol
TFTPD	Trivial File Transfer Protocol Daemon
Tx	Transmit
VLAN	Virtual Local Area Network
WISP	Wireless Internet Service Provider