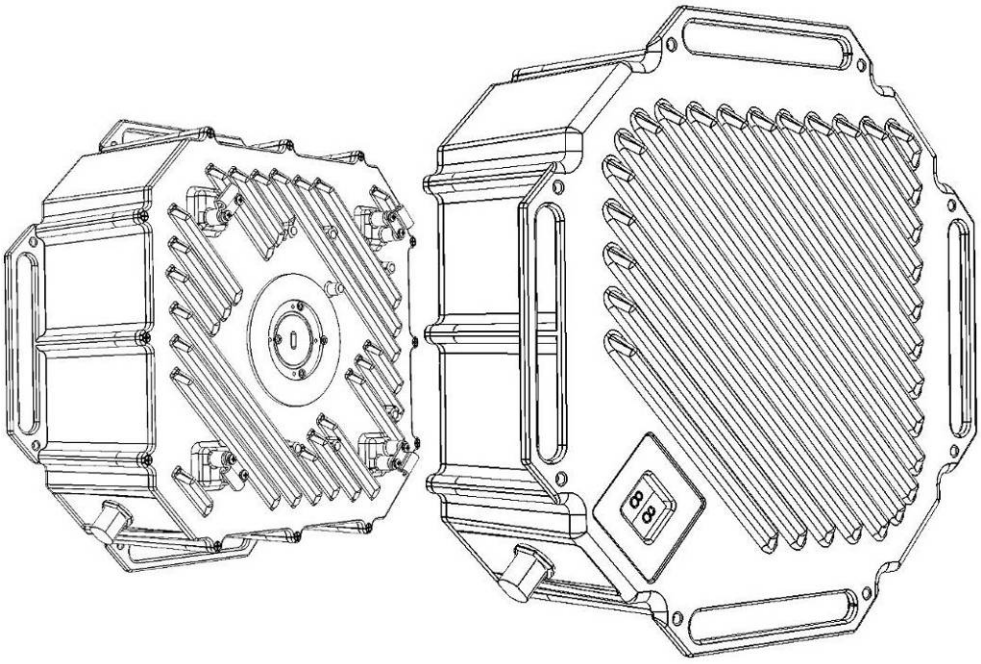


TrangoLINK® Apex

11 GHz, 15 GHz, 18 GHz, 23 GHz

All-in-One High-Capacity Point-to-Point
Licensed Microwave Native Ethernet Backhaul

User Manual

September 2009 — Revision 2.1

Table of Contents

Figure Guide

Table Guide

Preface

This manual covers the basic configuration and installation of the TrangoLINK® Apex licensed microwave backhaul system, and applies to the following part numbers:

Part Number	Description
TLINK-APEX11-1	TrangoLINK® Apex point-to-point system, 11GHz, ANSI Band 1
APEX11-1A	TrangoLINK® Apex Outdoor Unit, 11GHz, Band 1A, ANSI
APEX11-1B	TrangoLINK® Apex Outdoor Unit, 11GHz, Band 1B, ANSI
TLINK-APEX11-2	TrangoLINK® Apex point-to-point system, 11GHz, ANSI Band 2
APEX11-2A	TrangoLINK® Apex Outdoor Unit, 11GHz, Band 2A, ANSI
APEX11-2B	TrangoLINK® Apex Outdoor Unit, 11GHz, Band 2B, ANSI
TLINK-APEX11E-1	TrangoLINK® Apex point-to-point system, 11GHz, ETSI Band 1
APEX11E-1A	TrangoLINK® Apex Outdoor Unit, 11GHz, Band 1A, ETSI
APEX11E-1B	TrangoLINK® Apex Outdoor Unit, 11GHz, Band 1B, ETSI
TLINK-APEX11E-2	TrangoLINK® Apex point-to-point system, 11GHz, ETSI Band 2
APEX11E-2A	TrangoLINK® Apex Outdoor Unit, 11GHz, Band 2A, ETSI
APEX11E-2B	TrangoLINK® Apex Outdoor Unit, 11GHz, Band 2B, ETSI
TLINK-APEX15E-1	TrangoLINK® Apex point-to-point system, 15GHz, ETSI Band 1
APEX15E-1A	TrangoLINK® Apex Outdoor Unit, 15GHz, Band 1A, ETSI
APEX15E-1B	TrangoLINK® Apex Outdoor Unit, 15GHz, Band 1B, ETSI
TLINK-APEX18-1	TrangoLINK® Apex point-to-point system, 18GHz, Band 1
APEX18-1A	TrangoLINK® Apex Outdoor Unit, 18GHz, Band 1A, ANSI
APEX18-1B	TrangoLINK® Apex Outdoor Unit, 18GHz, Band 1B, ANSI
TLINK-APEX18E-1	TrangoLINK® Apex point-to-point system, 18GHz, ETSI Band 1
APEX18E-1A	TrangoLINK® Apex Outdoor Unit, 18GHz, Band 1A, ETSI
APEX18E-1B	TrangoLINK® Apex Outdoor Unit, 18GHz, Band 1B, ETSI
TLINK-APEX18E-2	TrangoLINK® Apex point-to-point system, 18GHz, ETSI Band 2
APEX18E-2A	TrangoLINK® Apex Outdoor Unit, 18GHz, Band 2A, ETSI
APEX18E-2B	TrangoLINK® Apex Outdoor Unit, 18GHz, Band 2B, ETSI
TLINK-APEX23-2	TrangoLINK® Apex point-to-point system, 23GHz, ETSI Band 1
APEX23-1A	TrangoLINK® Apex Outdoor Unit, 23GHz, Band 2A, ANSI
APEX23-1B	TrangoLINK® Apex Outdoor Unit, 23GHz, Band 2B, ANSI
TLINK-APEX23E-2	TrangoLINK® Apex point-to-point system, 23GHz, ETSI Band 2
APEX23E-2A	TrangoLINK® Apex Outdoor Unit, 23GHz, Band 2A, ETSI
APEX23E-2B	TrangoLINK® Apex Outdoor Unit, 23GHz, Band 2B, ETSI
PSUPPLY-48	19” Rack Mount -48 Volt Power Supply
PSUPPLY-DT-48	-48 Volt Universal Power Supply, Rev A

PoE-APEX-48	PoE injector for TrangoLINK® APEX
CBLDAT-3	Serial Console Cable for Apex
APEX18-KEY-1	Software Key to Allow Throughputs up to 200Mbps
APEX18-KEY-2	Software Key to Allow Throughputs up to 370Mbps
APEX11-KEY-1	Software Key to Allow Throughputs up to 263Mbps
APEX15-KEY-1	Software Key to Allow Throughputs up to 167Mbps
APEX23-KEY-1	Software Key to Allow Throughputs up to 200Mbps
APEX23-KEY-2	Software Key to Allow Throughputs up to 370Mbps

Table 1: TrangoLINK® Apex part numbers

Federal Communications Commission (FCC) Emission Designators

- 10M0D7W for 10 MHz BW rates and all modulations
- 20M0D7W for 20 MHz BW rates and all modulations
- 30M0D7W for 27.5/28/30 MHz BW rates and all modulations
- 40M0D7W for 40 MHz BW rates and all modulations
- 50M0D7W for 50 MHz BW rates and all modulations
- 56M0D7W for 55/56/80 MHz BW rates and all modulations

European Telecommunications Standards Institute (ETSI)

ETSI models of the TrangoLINK® Apex 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

TrangoLINK® APEX units purchased from Trango Systems, Inc. are warranted for two years from date of purchase. Please see www.trangosys.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® Apex system, features, and its components.

Introduction

The TrangoLINK® Apex is a carrier grade high-performance all outdoor point-to-point wireless microwave system designed for Carrier, Enterprise, and WISP networks using either 11, 15, 18 or 23 GHz licensed spectrum. The TrangoLINK® Apex provides a full duplex wireless connection over the air that is ideal for copper RJ45 Ethernet connections as well as fiber optics through the use of SFP ports.

The TrangoLINK® Apex is a Frequency Division Duplex (FDD) radio which provides low latency of less than 150 μs, over 1 million packets per second, and up to 730+ Mbps of data. The TrangoLINK® Apex uses VLAN and Quality of Service (QoS) prioritization to offer great flexibility in offering high value added services.

Contents

Each TrangoLINK® Apex kit comes equipped with two ODUs.

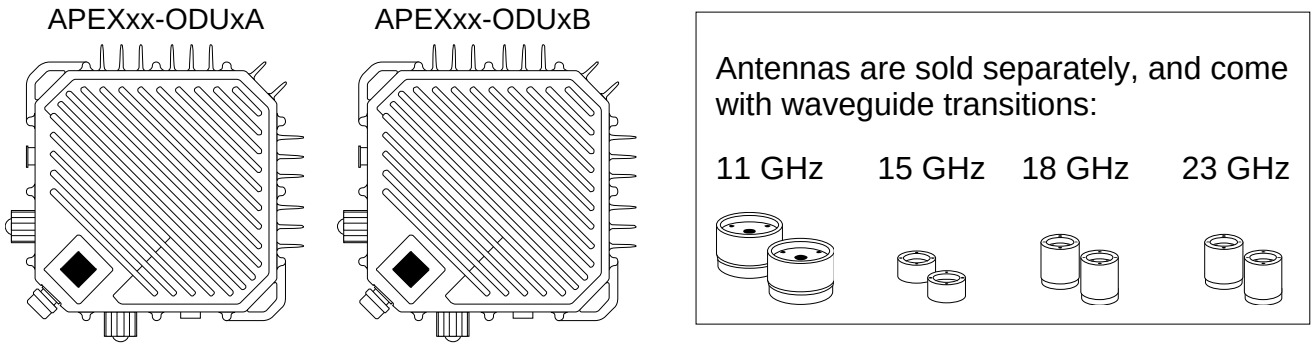


Figure 1: Contents of a TrangoLINK® Apex kit

> ⚠ Additional accessories are required to complete installation of the TrangoLINK® Apex, such as power supplies, PoE devices, fiber kits, and antennas. See Appendix E for a complete list of accessories.

Ports & Features

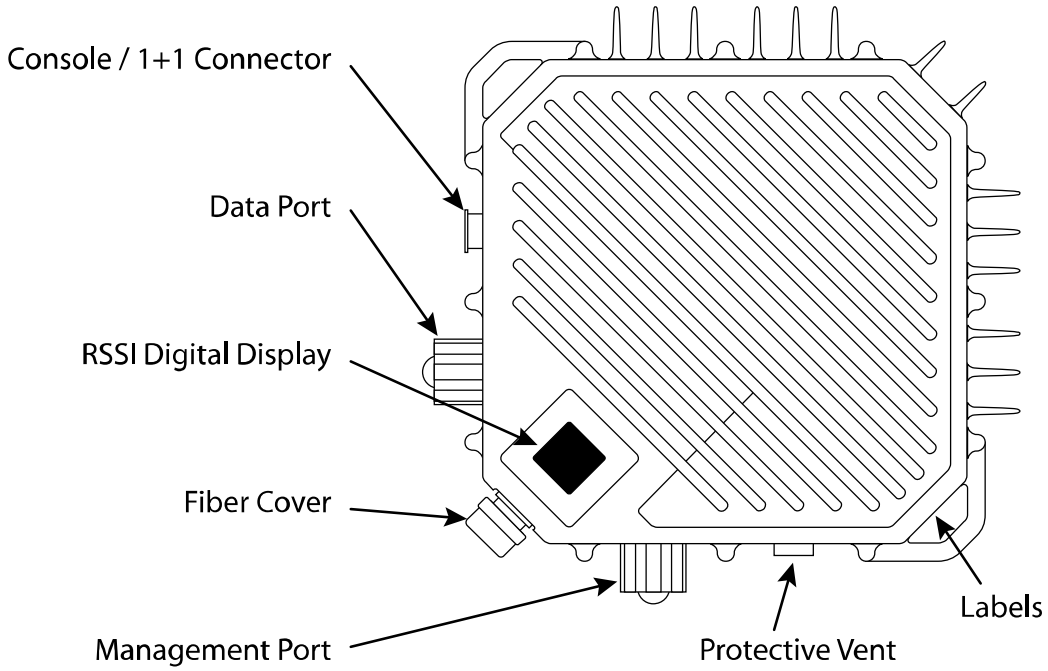


Figure 2: Apex ports and features

Console/1+1 Connector: Serial cable connection for 1+1 redundancy configuration.

Data Port: RJ-45 connector allows Ethernet 10/100/1000 data rates (also PoE capable).

RSSI LED: Displays real-time RSSI value of the link in a 2-digit LED display.

Fiber Cover: Contains the SFP fiber optic port and MOLEX™ direct DC power connector.

Management Port: Dedicated to out-of-band management (also PoE capable). No data pass through is allowed on this port.

Protective Vent: Equalizes air pressure while keeping moisture out.

Labels: Location of serial number and MAC address.

> ⚠ DO NOT TAMPER with the Protective Vent. It should not be twisted or removed. Tampering with or damaging the Protective Vent will void the factory warranty.

Mount Latches & Waveguide Connections

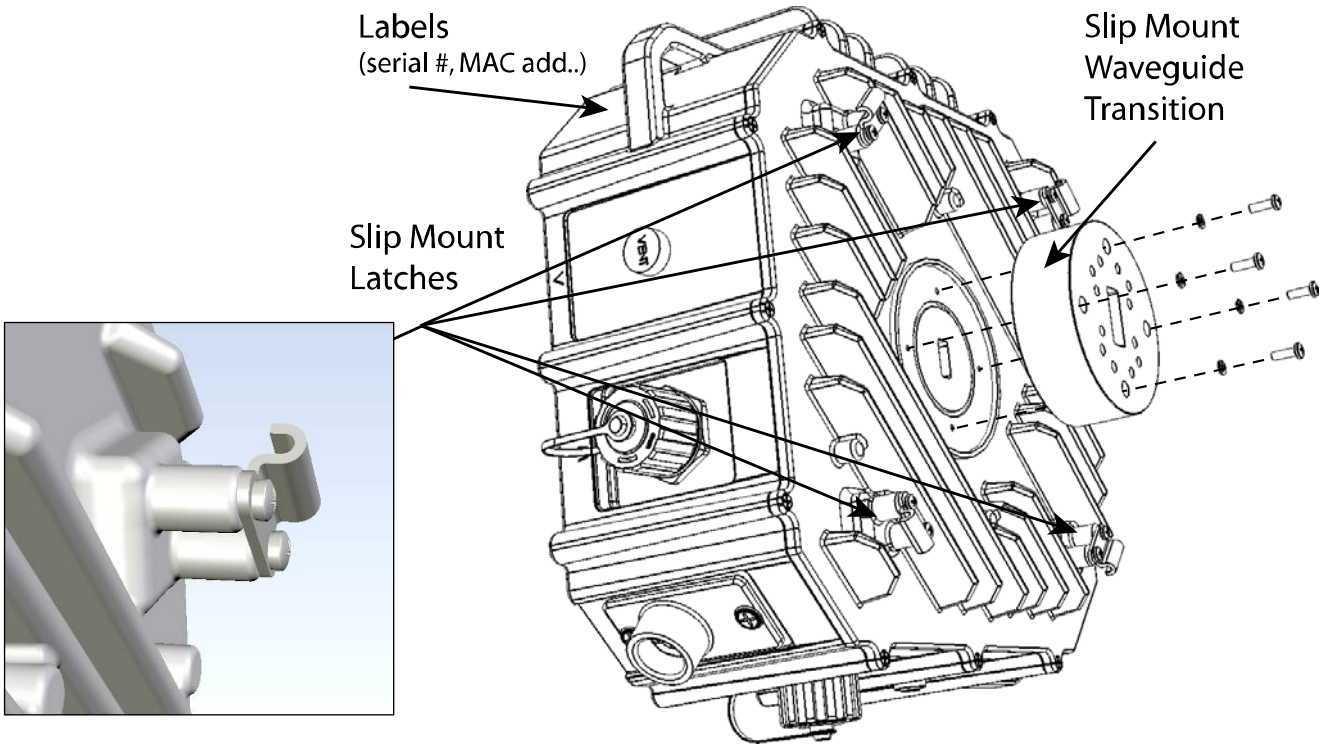


Figure 3: Labels, mount latches and waveguide connection

Slip Mount Latches: Slip-mount installation secures the ODU to the Antenna Assembly or mounting bracket and allows easy removal during maintenance.

Slip Mount Waveguide Transition: Connects the ODU transmit signal to the antenna waveguide port.

Labels: Location of serial number and MAC address.

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:

- Power and Connections
- Basic Configuration Concepts
- Management

It is recommended that you first test and configure the radios on the bench before deploying them in the field. Bench testing is a particularly important exercise for the novice user.

Please see Chapter 7 for details and the importance of bench testing.

Additional accessories are required to complete installation of the TrangoLINK® Apex, such as power supplies, PoE devices, fiber kits, cables, and antennas. Accessories are sold separately. See Appendix E for a complete list of accessories.

Power and Connections

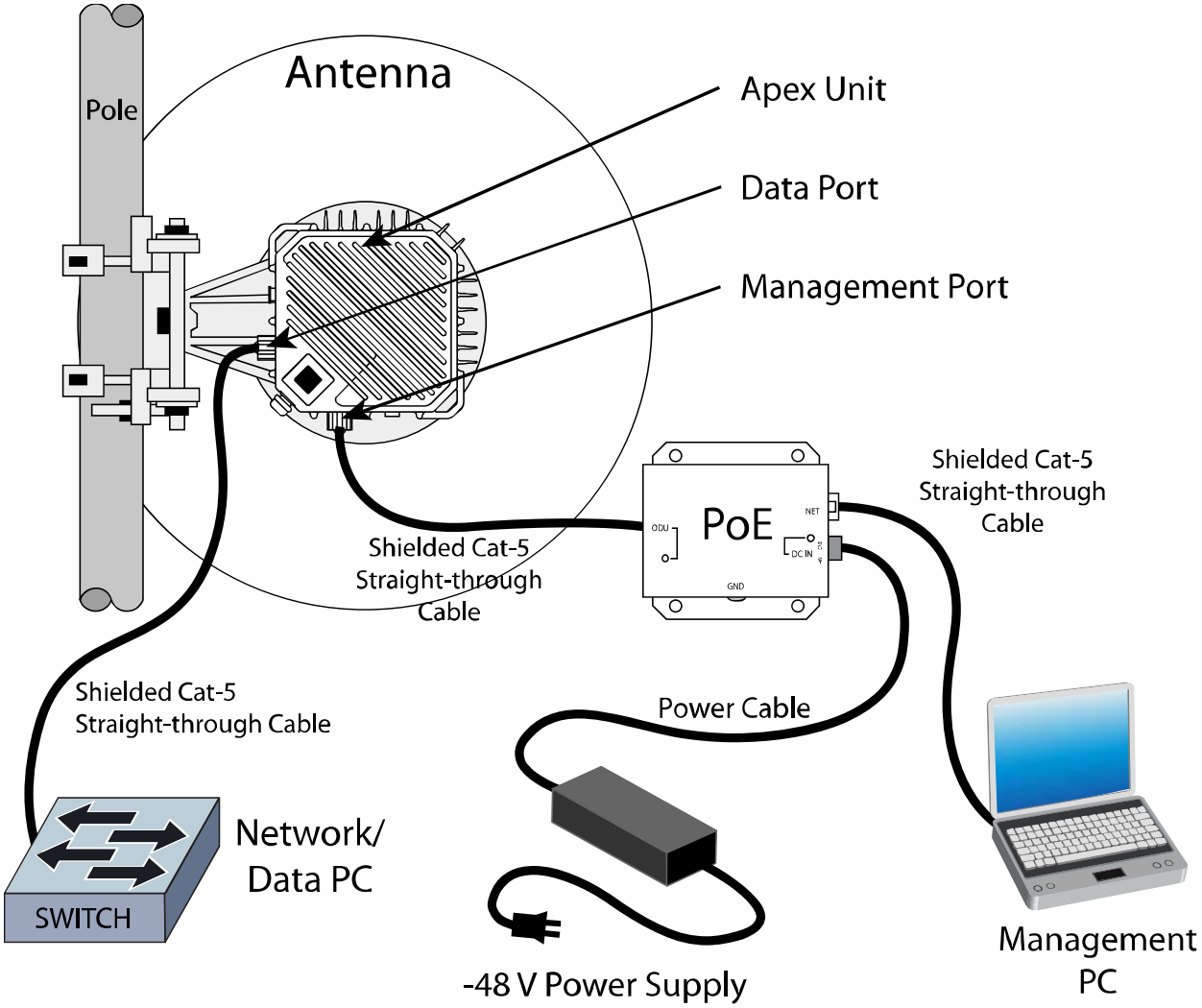


Figure 4: Power and Ethernet wiring diagram (proportions not to scale)

Power Supply

The Apex requires a -48 Volt power supply. Trango Systems recommends two power supplies (see Appendix E for a complete listing of accessories):

1. -48 VDC, 1U rack mount power supply (part# P-SUPPLY-1U-48)
2. -48 VDC universal desktop power supply, 1.5 A (part# P-SUPPLY-DT-48)

Power can be connected in two ways, **Power-over-Ethernet** or **Direct DC Power**:

Connecting Power Using Power-over-Ethernet

The **PoE Power Injector** can be connected to either of the two copper Ethernet ports:

1. **Out-of-Band Management Port**: Always use a shielded *Cross-Over* Ethernet cable when connecting the out-of-band Management Port to a COMPUTER (see Figure 6).
2. **Data Port**: Always use a shielded *Straight-Through* cable when connecting the Data Port to a HUB, SWITCH, or ROUTER (see Figure 6).

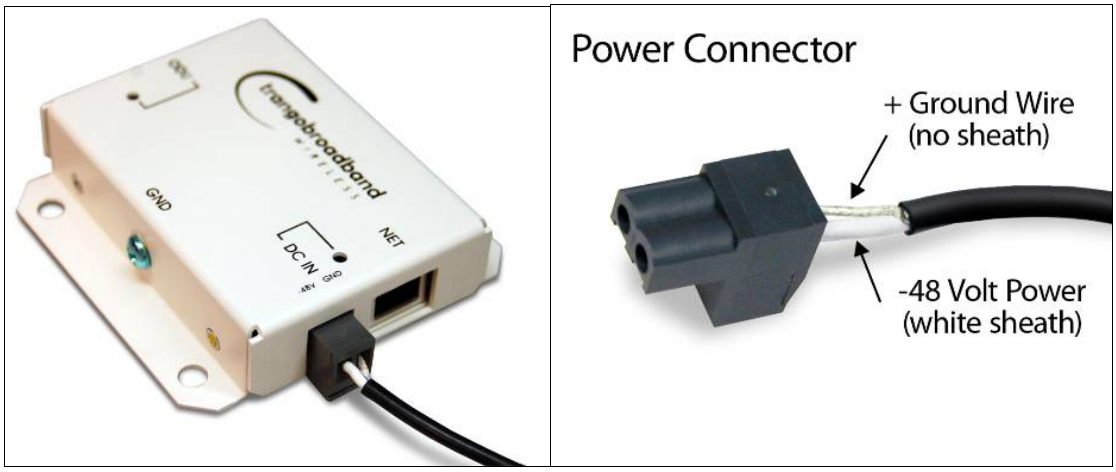


Figure 5: PoE injector power connections

Connecting Power Using Direct DC Power

Direct DC Power to the 2 pin MOLEX™ connector is located under the fiber cover. Please note that when the pins are facing up, the -48v (White) is on the left.

⚠	If you cannot access radio management functions via the Management Port, it is possible that your PC is not properly set up with a routable subnet. In this case you must use the proprietary Console Programming Cable to connect to the Console Port for management. The proprietary Console Programming Cable can be purchased from your sales manager. Settings and connection steps are found later in this chapter.
⚠	It is recommended to always use a shielded **crossover cable** for the Data Port. When auto-negotiate is disabled, a crossover cable is required for the Data Port, otherwise you will experience limited Ethernet connectivity for management. When auto-negotiate is enabled is will auto sense the cable type.

Basic Configuration Concepts

The TrangoLINK® Apex 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. The Apex can be in one of two operational modes, *Opmode* "On" or *Opmode* "Off."

Opmode "Off"

- Radio is NOT transmitting and is NOT attempting to make a wireless connection
- Radio can be managed when *Opmode* is "Off"

Opmode "On"

Radio is transmitting and attempting to make a wireless connection

- Radio cannot be managed when *Opmode* is "On"

Default Opmode Settings

There are two important related settings: **Opmode** and **Default Opmode.** The factory default setting for *Default Opmode* is "Off." The *Default Opmode* setting controls whether *Opmode* will be turned on or off after a power up or reboot process. If *Default Opmode* is "Off" and *Opmode* is "On" the radio will not transmit upon rebooting. The default setting is *Opmode* "Off" to ensure that nothing is transmitted until the installation is complete and so that during bench testing the risk of unintentional RF radiation is mitigated.

Why is Opmode Important?

If *Opmode* is not configured correctly the radio will not transmit to establish a link. Certain functions can only be performed while the radio is in *Opmode* "Off":

- Setting / Changing Transmit Frequency
- Enabling Loopback

IMPORTANT — BEFORE YOU DEPLOY: Factory *Default Opmode* is "Off." *Default Opmode* should be set to "On" before radios are deployed in the field. 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 it accounts for **distortion** and **interference** in addition to noise power.

Distortion may come from several sources such as bad Ethernet cables (poor shield, damaged, or low quality), path degradations such as multipath, or Fresnel zone encroachment.

Interference can come from other transmitters on the tower, as well as from sources inside an indoor shelter. High power transmitters inside a shelter can cause interference when near the PoE device or when located very close to the cabling.

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 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

ACM: Adaptive Coding & Modulation

The ACM feature works in conjunction with the Mean Square Error (MSE) values. The ACM command is an on/off setting. When ACM is enabled (on) and the link becomes degraded, the radio will automatically shift down in modulation and speed based on the MSE threshold setting specified of the ACM table (Table 4).

Speed Setting QAM256					
Profile #	Modulation	Improve	Next	Degrade	Next
0	QAM256	-32.1	0	-27.2	1
1	QAM64	-29.2	0	-24.3	2
2	QAM16	-26.3	1	-21.3	3
3	QPSK	-23.3	2	-18.5	3
Speed Setting QAM128					
Profile #	Modulation	Improve	Next	Degrade	Next
0	QAM128	-32.1	0	-27.2	1
1	QAM64	-29.2	0	-24.3	2
2	QAM32	-26.3	1	- 21.3	3
3	QAM16	-23.3	2	-18.5	4
4	QPSK	-20.3	3	17.1	4
Speed Setting QAM64					
Profile #	Modulation	Improve	Next	Degrade	Next
0	QAM64	-29.2	0	-24.3	1
1	QAM32	-26.3	0	- 21.3	2
2	QAM16	-23.3	1	-18.5	3
3	QPSK	-20.3	2	17.1	3
Speed Setting QAM32					
Profile #	Modulation	Improve	Next	Degrade	Next
0	QAM32	-26.3	0	- 21.3	1
1	QAM16	-23.3	0	-18.5	2
2	QPSK	-20.3	1	17.1	2
Speed Setting QAM16					
Profile #	Modulation	Improve	Next	Degrade	Next
0	QAM16	-23.3	0	-18.5	1
1	QPSK	-20.3	0	17.1	1

Table 4: ACM threshold table

The ACM feature will automatically shift the modulation up or down based on the MSE value and the above specified thresholds. If you do not want the radio to change speed settings then disable ACM.

ATPC & TargetRSSI

ATPC and *TargetRSSI* work together to control the remote side power output in order to achieve optimal signal strength. ATPC is an enable/disable setting. When 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 its output power 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 license.

> ⚠ The power setting cannot be changed once ATPC is enabled. To manually change the power setting, ATPC needs to be disabled.

ATPC Max Power & Step Size

Settings for *ATPC Max Power* and the *ATPC Step Size* control how the ATPC function will behave when 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. 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 is a fixed setting and provides an additional amount of data security since traffic on the Ethernet port is segmented and isolated from traffic on the fiber port. The *Port Priority* feature allows for an individual data port to have priority over the remaining data port. This means that you can run both copper Gig-E as well as the fiber SFP ports simultaneously. The priority groups are 0-7 and can be applied to GigE port as well as the fiber port.

> ⚠ Port mapping is enabled by default through the smart_mode command. Should your network require Q in Q or other unique protocol you may need to disable smart_mode. In-band management will not work with smart_mode disabled.

Class of Service (802.1p)

TrangoLINK® Apex has Class of Service capabilities that provide priority for different types of traffic across the link. The traffic can be classified into 8 priorities (0-7) which can then be assigned to 4 queues.

Management

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

Access mode	Username	Password
CLI View Mode	admin	trango
CLI Config Mode	N/A	trango
CLI Debug Mode	N/A	N/A
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 6).

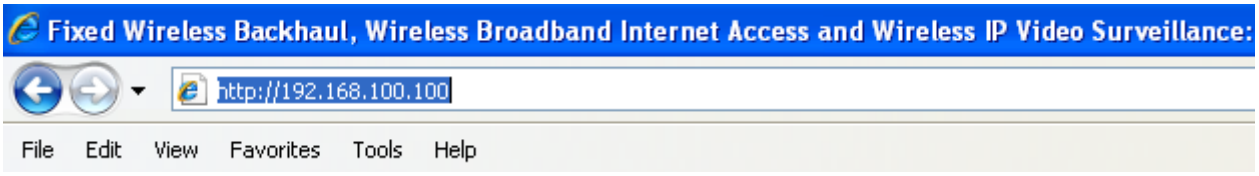


Figure 6: HTTP login

A login window will pop up, requiring a user name and password (Figure 7).

Enter the assigned user name and password then press OK.

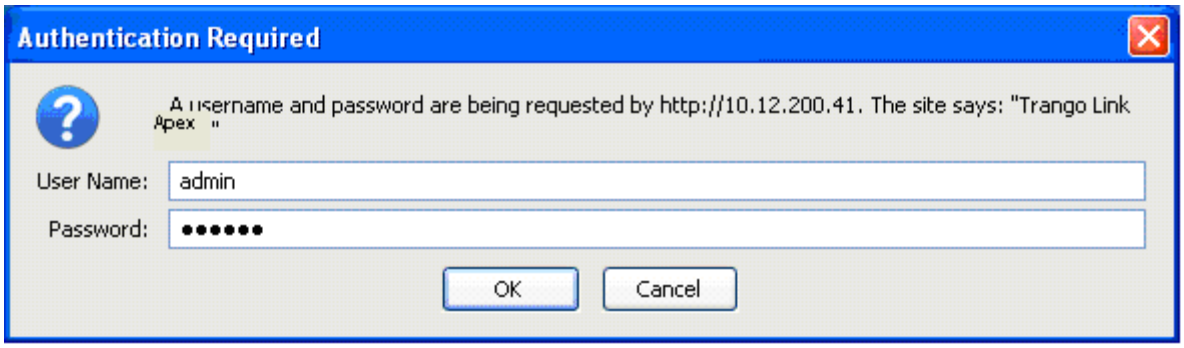


Figure 7: Web browser login

A valid combination of user name and password will open the SysInfo page (Figure 8).

Figure 8: 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 link to the following pages:

- **Settings:** The essential parameters, such as IP address, Frequency, RF output power, Speed, and Cable Loss are set here.
- **System Information** (Sysinfo)**:** Shows most of the basic configuration parameters of the radio. It is the first page shown after login.
- **Statistics:** Counter information on all interfaces RF, Fiber, and GigE is displayed. These statistics are used to determine the error rate of traffic
- **Password:** User can change the "config" password and enter the license upgrade key for higher capacity.

Command Line Interface (CLI)

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" and type command inside the "***open:***" box and click "***OK***"). Open a Telnet session by typing:

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

Example:

```
C:>telnet 192.168.100.100

trango login:
Password:
```

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

Example:
`trango login: admin` ← Enter username
`Password:` ← login password is "`trango`"

```
Trango Broadband Wireless: TrangoLink APEX Command Line Interface v1.0

(trango-view)#
```

To terminate a CLI session (Telnet or Console) simply close the session window. There is no exit or quit command. This is an intentional security feature.

The Command Line Interface has 3 levels of access.

- **View Mode:** Read-only. For viewing current settings.
- **Config Mode:** Read/Write. For changing configuration settings.
- **Debug Mode**: Only available through Config mode.

Config Mode: to enter this mode, type the command "*config*" from View Mode. It will prompt for a password and after successful authentication it enters Config Mode. All configuration settings can be changed while in Config Mode.

Any command entered without parameters will return the current configured values — similar to "view" mode.

Configuration changes are applied immediately and do not require reboot, with one exception. The only configuration change that requires a reboot is changing the *Channel Width*. If you change the channel width, save your settings and then reboot. Changing the modulation but leaving the channel width alone does not require a reboot.

All configuration changes have to be saved in order to be persistent across reboot. A single "save" command in the CLI will save all configuration changes.

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

Example:

```
trango login: admin
Password:
Trango Broadband Wireless: TrangoLink APEX Command Line Interface v1.0
(trango-view)# config
Password:
(trango-config)# exit
(trango-view)#
```

To terminate a telnet session, simply click on the **X** to close the telnet window or enter Debug Mode and type "*exit*".

The Command Line Interfaces (CLI) 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

Debug and Config Modes share the same password, and View Mode has a separate password.

To change the Config Mode password you must be in Config Mode. Use the CLI command password to change the Config Mode password. The example below demonstrates changing the password for the Config Mode to “control”

Syntax: `passwd <newpassword> <newpassword>`

Example:

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

 success
(trango-config)#_
```

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

Chapter 3: Configuration

About this Chapter

This section describes how to establish a wireless link with the TrangoLINK® Apex, using the Browser (HTTP) Interface. It addresses the basic steps to establish a link in a controlled lab environment.

Trango strongly recommends that that you read this manual thoroughly to gain an understanding and mastery of all important configuration parameters and procedures prior to deploying any wireless equipment in the field.

In this section:

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

Basic Configuration Screens & Parameters

The TrangoLINK® Apex has 4 main Web pages:

- Sysinfo
- Settings
- Statistics
- Password

System Information (Sysinfo) Page

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:

- Radio Configuration
- System Configuration
- IP Configuration / Model
- System Version

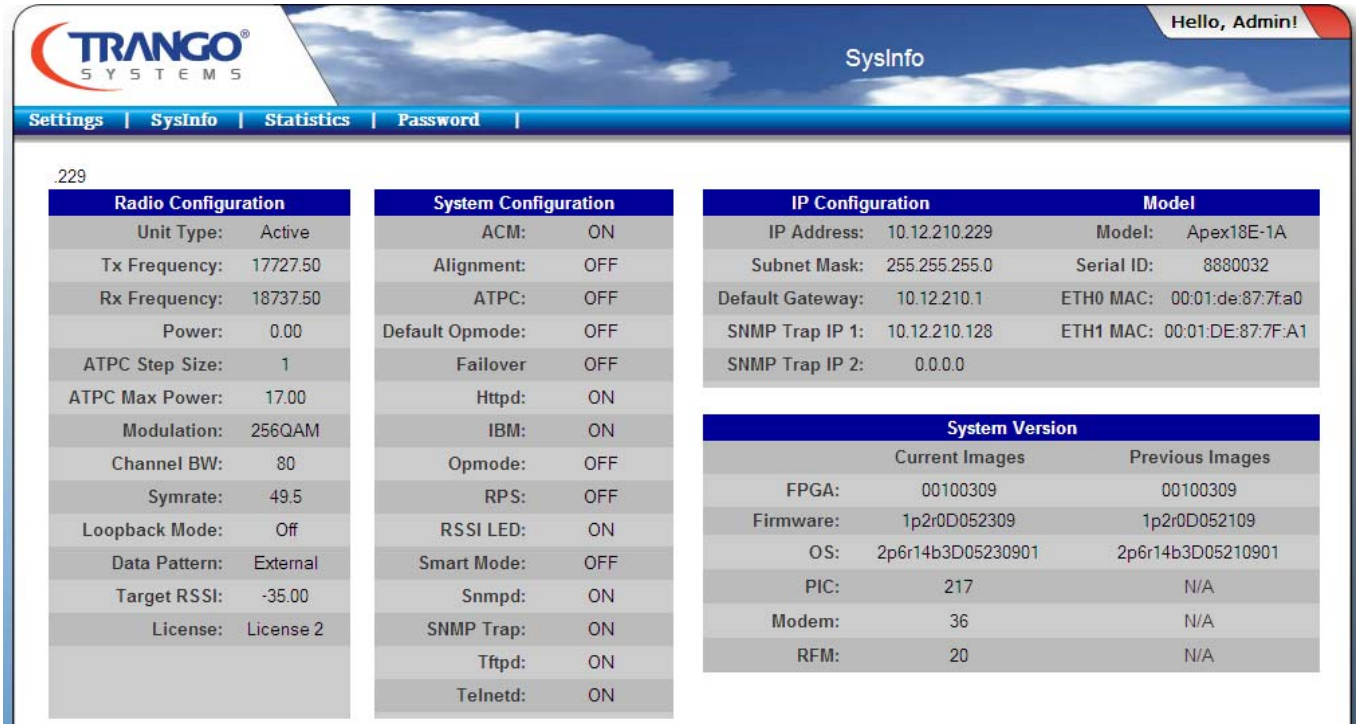


Figure 9: System Information Web page

Radio Configuration

ATPC Max Power: The maximum output power threshold (in dBm) that the Apex unit will deliver and not exceed (as determined by the granted regulatory license.)

ATPC Step Size: This is the amount in dBm that the Transmitter will alter the output power per command from the far end radio. ATPC 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.

Channel_bw: Displays the current channel bandwidth.

Datapattern: Displays current datapattern setting. The settings could be either External / Internal. Normal operation mode is External. Internal traffic is used to generate random data to measure BER, All user data from GigE and Fiber ports will be dropped when the datapath is set to internal mode.

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

Power: Transmit power of the unit in dBm. Please note that there is no internal checking of maximum power. Please check the datasheet for your frequency for maximum power for a specific modulation. Setting the unit at a power higher than allowed by your regulatory license, is strictly forbidden.

Loopback Mode: Displays the current Loopback settings.

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

Target RSSI: This is the RSSI value programmed as the nominal receive signal level (in dB determined during the path design). This is used by ATPC.

Temp: Internal temperature displayed in Celsius. Please Note: the temperature displayed could be 10° C more than the outside temp. Temperature ratings listed on product datasheets are outside ratings, not internal temperature ratings.

UTYPE: Displays the current Unit type.

System Configuration

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

ACM: Controls whether Adaptive Coding & Modulation (ACM) is enabled.

Alignment: Controls whether Alignment mode is

- Disabled (“Off”): The RSSI LED on the ODU will update once every 4 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.

ATPC: Controls whether ATPC is

- Disabled (“Off”): the ODU delivers the maximum transmit power as configured. (a function of your regulatory license limitations for bandwidth and transmit power, and equipment design limitations determined by data modulation.
- Enabled (“On”): the ODU will vary the output power under control of the far end radio to maintain Target RSSI. ATPC must be enabled on both sides of the link to be functional.

Default Opmode: Default Operation Mode is

- Disabled (“Off”): The unit will be in Opmode “Off” upon startup or reboot.
- Enabled (“On”): The unit will go into Opmode “On” upon startup or reboot.

Failover: When the Failover setting 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. Failover needs to be enabled on both sides of the link to be functional.

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.

IBM: In-Band Management feature

- 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.
- The default IBM port is copper. This setting can be changed to the fiber port and requires a reboot for settings to take effect. Current IBM port settings/status is only available via CLI and will be added to the HTML interface in a future release.

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.

RPS: Rapid Port Shutdown is

- Disabled (“Off”): The unit will not shut down the GigE/SFP ports when the wireless link is lost.
- Enabled (“On”): The unit will shut down the GigE/SFP ports when the wireless link is lost. The remote end will also be notified of the port shutdown.

RSSI LED: Receive Signal Strength Indicator is

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

Smart Mode: Internal VLAN port mapping is

- Disabled (“Off”): There is no internal VLAN port mapping
- Enabled (“On”): Internal VLAN port mapping between GE1 and SFP ports keep traffic separate. Smart Mode must be enabled to support IBM.

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.

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 it can be upgraded.

Telnetd: Telnet daemon is

- Disabled (“Off”): The unit will not accept Telnet session requests.
- Enabled (“On”): The unit will accept Telnet session requests so that it can be managed via Telnet.

IP Configuration and Model

The following information is displayed in the IP configuration and model section of the "Sysinfo page". These settings affect the OUT-OF-BAND MANAGEMENT port only.

IP Address: Displays the current configured Internet Protocol Address of the unit.

Subnet Mask: Displays the current configured Subnet Mask the unit is using.

Default Gateway: Shows the current Default Gateway for the unit.

SNMP Trap IP 1: SNMP traps will be sent the Internet Protocol Address shown.

SNMP Trap IP 2: SNMP traps will be sent the Internet Protocol Address shown.

Model: The model of the unit is shown.

Serial ID: The unique serial ID of the unit is shown.

ETH0 MAC: The Ethernet Media Access Control Address of the management port of the unit. (Required for license upgrade keys).

ETH1 MAC: The Ethernet Media Access Control Address of the data Ethernet port of the unit. This is used by the IBM feature.

System Version

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

FPGA: Displays the current unit Field Programmable Gate Array (FPGA) version.

Firmware: The current version of firmware the unit is displayed.

OS: The current version of the operating system the unit is shown.

PIC: Displays the current version of firmware for the microcontrollers of the unit.

MODEM: Displays the current version of the modem firmware for the unit.

RFM: Displays the current RF Module (Band) of the unit.

Settings Page

Configuration of the unit is performed under the “Settings” page, which includes:

- Radio Configuration
- Ethernet Configuration
- IP Configuration
- System Configuration

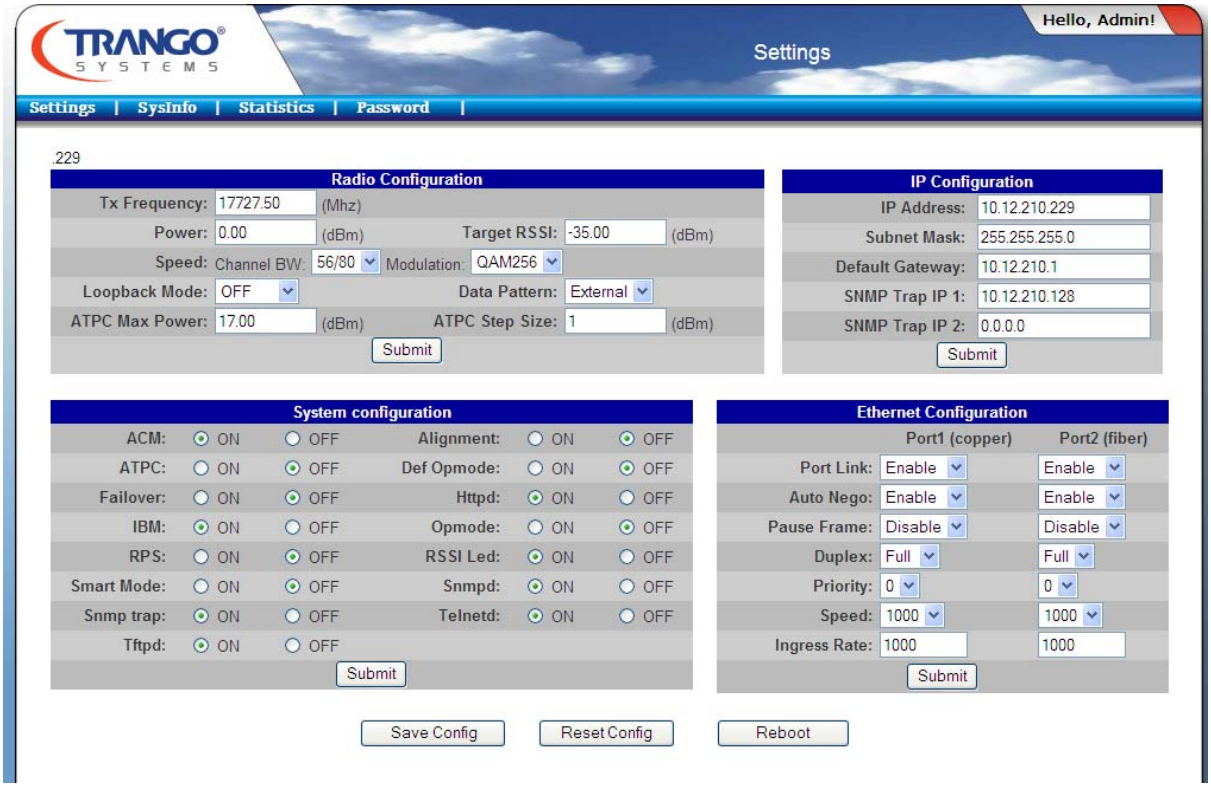


Figure 10: Settings Web page

Radio Configuration

System Model: Displays the current system model of the unit.

TX Frequency: Set the Center Frequency in MHz in accordance with the license grant.

> ⚠ Radio Configurations for Center Frequency, Bandwidth, and Maximum Transmit Power must be set in compliance with the regulatory license granted for the link. The TrangoLINK® Apex user is responsible for configuring the radio correctly.

Power: Transmit power (dBm). Transmit power is controlled by two settings. First, the TrangoLINK® Apex has equipment specifications (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 license grant may constrain power below what the TrangoLINK® Apex can deliver as to ensure there is no interference with an existing user. The Power should be set to the lower of these two values (equipment limitations and license grant).

Target RSSI: This is the RSSI value the unit will try to achieve if ATPC is enabled on both sides of the link. It is recommended to use the expected RSSI value calculated during the design phase of the project.

Speed: Set the channel bandwidth (in MHz) in accordance with the 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.

The TrangoLINK® Apex is shipped with default values

- Speed - 16 QAM and 10 MHz bandwidth which protect the user from inadvertently violating constraints set by the regulating entity
- ACM - Disabled

When the user enables the ACM feature, the default threshold values are used. Please refer to Table 4 for threshold values. This setting is not user adjustable.

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 for digital loopback only. Opmode must be on for IF loopback modes. rf_gen and rf_refl are not available currently and will be added in a future release.

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. Normal operation mode is External. Internal traffic is used to generate random data to measure BER. All user data from GigE ports will be dropped when the datapath is set to internal mode.

ATPC Max Power: This setting will limit the maximum output power to be used if ATPC is enabled.

ATPC Step Size: This setting will limit the amount of increase or decrease in a single “step” of power adjustment.

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

SNMP Trap IP 2: The IP address of the device that will receive SNMP traps.

System Configuration

ACM (Adaptive Coding & Modulation): ACM will allow the unit to adjust modulation seamlessly as the RF signal quality degrades and improves. If this feature is enabled and modulation decreases, there will be a noticeable reduction in link throughput based on modulation. The modulation change is hitless for this feature.

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

Failover: Enable or disabled 1+1 protection.

IBM: Enable or disable In-Band Management.

RPS: Enable or disable Rapid Port Shutdown.

Smart Mode: Enable or disable Smart Mode feature.

SNMP Trap: Enable or disable the sending of SNMP traps. This must be enabled to have the unit send SNMP traps.

Tftpd: Enable or disable Trivial File Transfer Protocol Daemon. This must be enabled to upload new firmware images.

Alignment: Enable or disable alignment mode. Increases refresh rate of LED panel.

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.

Httpd: Enable or disable the HTML daemon—must be enabled to have Web access.

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.

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

Telnetd: Enable or disable the Telnet daemon. This must be enabled for telnet access.

> ⚠ NOTE: SSH access to the unit can not be enabled or disabled. This is intentional in the product design.

Ethernet Configuration

Port Link: The option of enabling or disabling the specified port.

Auto Nego: Enable or disable auto negotiation of the specified port.

Pause Frame: Enable or disable the use of pause frames on the specified port.

Duplex: Set the duplex setting of the specified port. Auto Negotiation must be disabled and speed setting must be specified. Only Full duplex is allowed on the Fiber port.

Priority: Set the priority of the specified port over remaining ports.

Speed: Set the negotiation speed of the specified port. Auto Negotiation must be disabled and duplex setting must be specified. Only 1000Mbps is allowed for Fiber port.

Ingress Rate: Sets the maximum bandwidth of traffic that can pass through the specified port.

Statistics Page

This page displays statistics and status under the following groupings (Figure 11):

- System Status
- Link Status
- Ethernet Status
- RF

Figure 11: Statistics Web page

System Status

System Status show which GigE and Fiber ports are active. This section also provides the RSSI, MSE, BER, Radio Temp, Modulation, ACM Profile, and if the link has lock.

Link Status

Link Status 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.

Modem Lock

- **Timing**: The RF signal from the far end has been detected and the symbol timing loop is locked.
- **Preamble**: Must be locked to pass traffic.
- **LDPC** (Low Density Parity Check): An efficient form of forward error correction coding. Must be locked to pass traffic.

PLL Lock (Phase Lock Loop)

- **RFM RF**: Unit RF Local PLL - Normally green.
- **RFM IF**: Unit RF Module Intermediate Frequency PLL - Normally green.
- **Transmit PLL**: Unit transmit IF PLL - Normally green.
- **Receive PLL**: Unit receive IF PLL - Normally green.

Ethernet Status

Ethernet Status provides the configuration information of each data port along with the following counters.

GigE Status

- **Enabled**: The specified port can be either ON or OFF.
- **Auto Nego**: Displays either ON or OFF for setting selection.
- **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 7.
- **Speed**: Displays 10, 100, or 1000.
- **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

RF Status section displays the following counters for RF traffic in both directions (IN and OUT).

- **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.
- **Ethernet Drop Packets**: total number of received Ethernet packets that were dropped.
- **Total Drop Packets**: The total number of packets that were dropped.
- **Port Utilization**: Current link utilization as a percentage of the total RF capacity.

Password Web Page

This page allows the user to change the Web access password. The only password that can be changed on this page is the Web access password.

The Password page also allows you to upgrade to the radio to higher capacity by entering the software License Key.

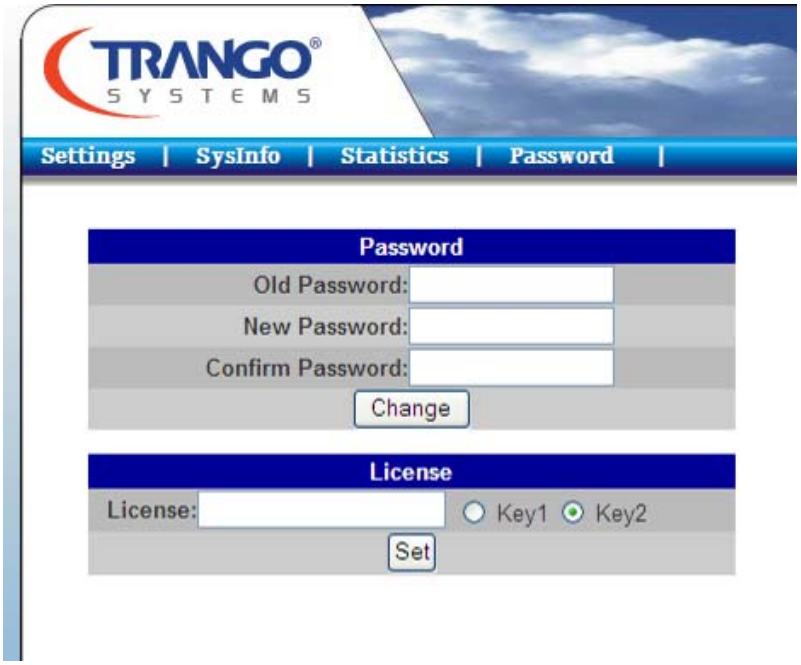


Figure 12: Password Web page

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 setting must be configured correctly on both sides of the link. 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. This is a list of MINIMUM requirements to establish a link.

Transmit Frequency

- The transmit frequency in MHz is required. The receive frequency is automatically set based on the transmit frequency.

Transmit Power

- This is the maximum output power the unit will transmit.

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. Be sure to enable Default Opmode before deployment in the field.

Save and Reboot

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

Evaluate Link Quality

Link Test

A link test can only be performed on a link that is carrying traffic and will not impact customers. linktest can be used 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 only displays information for the local side of the link.

The fields displayed are LOCK, RSSI, MSE, BER (TX and RX are displayed if ACM is enabled.)

LOCK: 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 *Received Signal Strength Indicator* level measured in dBm. This value should be compared to the expected signal level determined during the design phase of the project. Signal levels that are 20 dBm lower than expected are typically associated with antenna misalignment (i.e. one antenna is aligned to a side lobe). Signal levels that are more than a few dB lower than expected may indicate obstructions in the Fresnel zone. Make sure that your target RSSI is set correctly when evaluating RSSI readings.

The RSSI should not exceed -25dB. 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* is only used when the datapattern is set to Internal on both sides of the link. When the datapattern is set to External the BER will always display 0.00E+00 and is not to be considered error free. 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 of times to display results.

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

TX/RX: If ACM is enabled, the TX/RX will display the current modulation the radio is transmitting and receiving. From time to time, the TX/RX may change due to interference or atmospheric conditions. If it is disabled, the TX/RX will display N/A.

Example:

```
(trango-view)# datapattern
 Data pattern: external

(trango-view)# linktest ?
[1-99] Duration in seconds



(trango-view)# linktest 5
  LOCK  RSSI  MSE  BER           TX         RX
 1>  1 -42.00 dBm -33.00 dBm 0.00E+00 QAM256 QAM256
 2>  1 -42.00 dBm -33.04 dBm 0.00E+00 QAM256 QAM256
```

```
 3>  1 -42.00 dBm -33.05 dBm 0.00E+00 QAM256 QAM256
 4>  1 -42.00 dBm -32.86 dBm 0.00E+00 QAM256 QAM256
 5>  1 -42.00 dBm -33.00 dBm 0.00E+00 QAM256 QAM256
(trango-view)#
```

If ACM is disabled, the TX and RX will not change. Therefore, it is not necessary to demonstrate if the TX is different from the RX which results on the TX/RX value displaying N/A.

Example:

```
(trango-config)# acm

ACM: on  Bandwidth = 80

<-------------------- ACM Status ---------------------->
ACM mod  MSE(improve) MSE(degrade) Enable
QPSK  -20.30  -17.10  disabled
16QAM   -25.30  -18.50  disabled
64QAM   -29.20  -24.30  disabled
256QAM  -32.10  -27.20  disabled

(trango-config)# acm enable off
ACM: off

SUCCESS

(trango-config)# linktest 5
  LOCK  RSSI  MSE  BER   TX  RX
 1>  1 -52.10 dBm -33.30 dB  0.00E+00  N/A  N/A
 2>  1 -52.10 dBm -33.30 dB  0.00E+00  N/A  N/A
 3>  1 -52.10 dBm -33.30 dB  0.00E+00  N/A  N/A
 4>  1 -52.10 dBm -33.50 dB  0.00E+00  N/A  N/A
 5>  1 -52.10 dBm -33.40 dB  0.00E+00  N/A  N/A
(trango-config)#
```

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 TrangoLINK® Apex features a unique slip-mount design which allows for the waveguide output to be coupled into the antenna input with a minimum of loss and ease of installation. The Apex unit is easily secured to the antenna assembly using 4 slip-mount latches.

> ⚠ For proper antenna installation, please refer to instructions that come with your antenna.

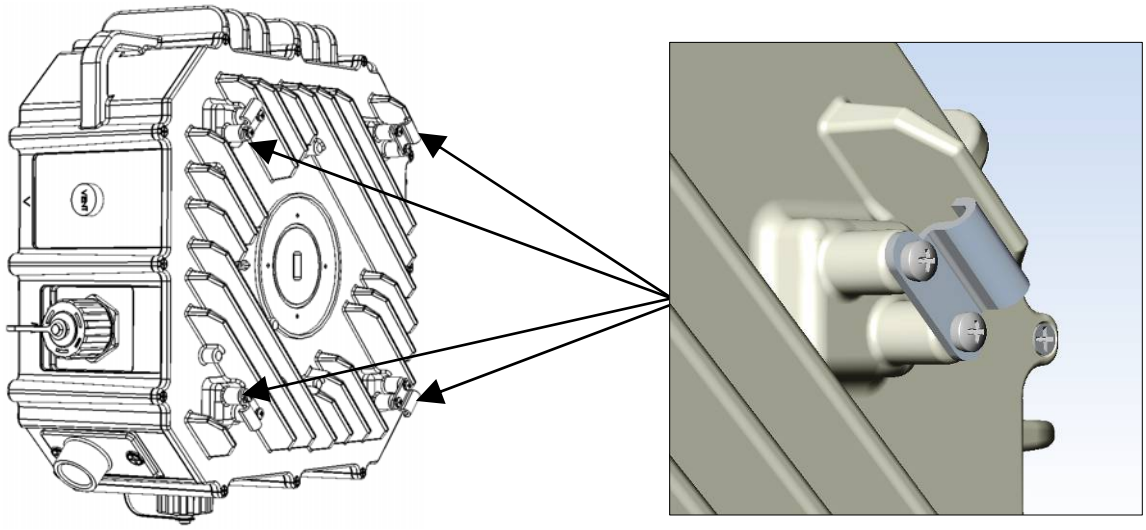


Figure 13: Mounting assembly latches

To discourage theft, the unit can be secured to the tower/pole with high strength cable strung through the clasp hole. Trango recommends using combination locks so that maintenance is not frustrated by lost keys.

> ⚠ 18 - 22 AWG type wire is recommend from the power supply to the Apex unit.

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

Installation & Polarity Considerations

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

1. Installation of the waveguide.
2. Mounting the Apex Unit to the antenna.

IT IS IMPORTANT that the waveguide transition and the Apex unit are installed correctly. The results of improper installation will result in transmitting an incorrect polarity in violation of the license and possible link failure.

Waveguide Adapter Installation

1. Remove the protective tape that covers the waveguide port on the Apex unit.
2. Lubricate the O-Ring using the supplied silicone lubricant, then place the O-Ring into the grove on the radio unit.
3. Place the Waveguide Adapter into the bore on the radio making sure to align the waveguide opening to the same orientation as the waveguide opening on the Apex unit. Take care not to disturb the O-Ring position.
4. Attach the waveguide using a Phillips screw driver and tighten securely.

> ⚠ Installing the Waveguide Adapter requires a small Phillips head screwdriver to reach into the narrow hole. It needs to be 2 ½ inches long, with a maximum diameter of .225 inches.

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

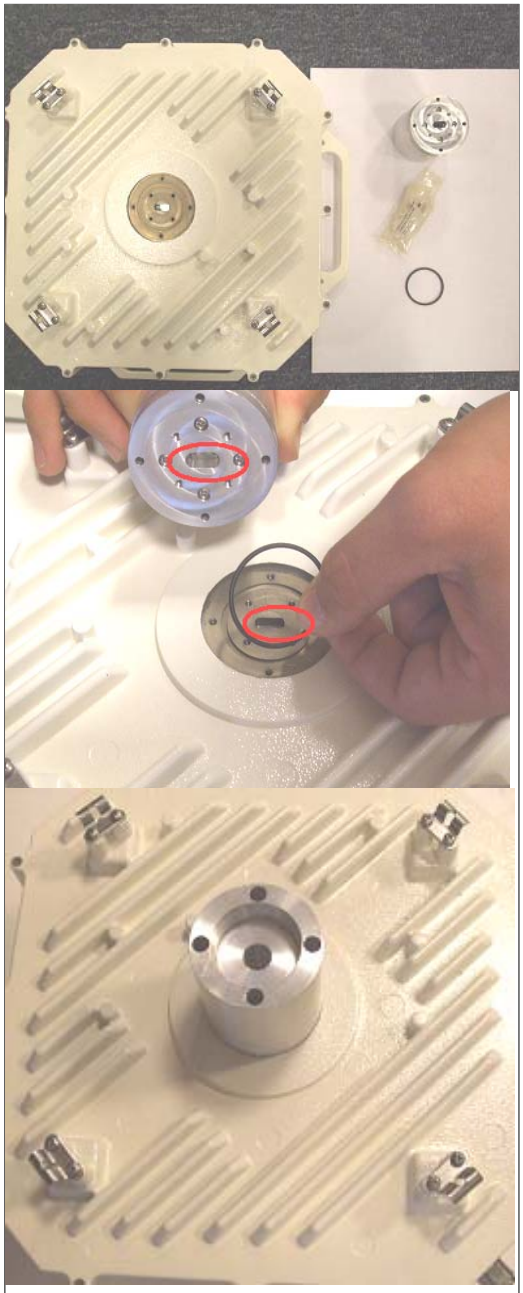


Figure 14: Waveguide adapter installation

SFP Installation

Installation of the SFP module is easily accomplished by removing the Fiber plate using a Philips screwdriver. Remove the silicone seal located directly under the Fiber plate. Using the SFP module purchased from Trango, simply slide the module into the SFP receptacle until it locks into place. The Apex unit will auto detect the module and allow use of the interface. Properly install and connect the fiber optic cable (described later in this chapter) and Gigabit Fiber interface is ready to begin passing traffic.

Figure 15: SFP Module installation

⚠ Note that SFP modules that are not approved by Trango Systems may not function in this unit or may not display current link status on the Sysinfo screens of the system.

Direct DC Power Connection

To use a direct DC connection to power up your TrangoLINK® Apex, remove the fiber cover and locate the 2 pin MOLEX receptacle. Terminate your DC cable (AWG 16 or smaller) to the MOLEX connector which is included with your fiber kit (sold separately). Connect the MOLEX connector to the receptacle and properly install the DC power cable through the Fiber plate (described later in this chapter).

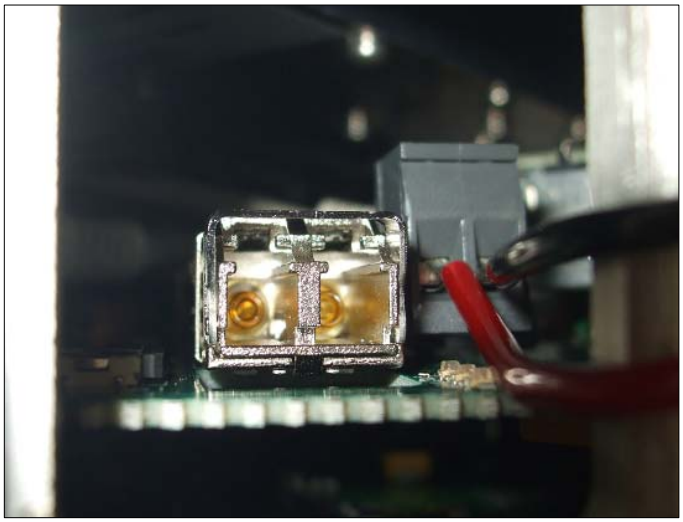
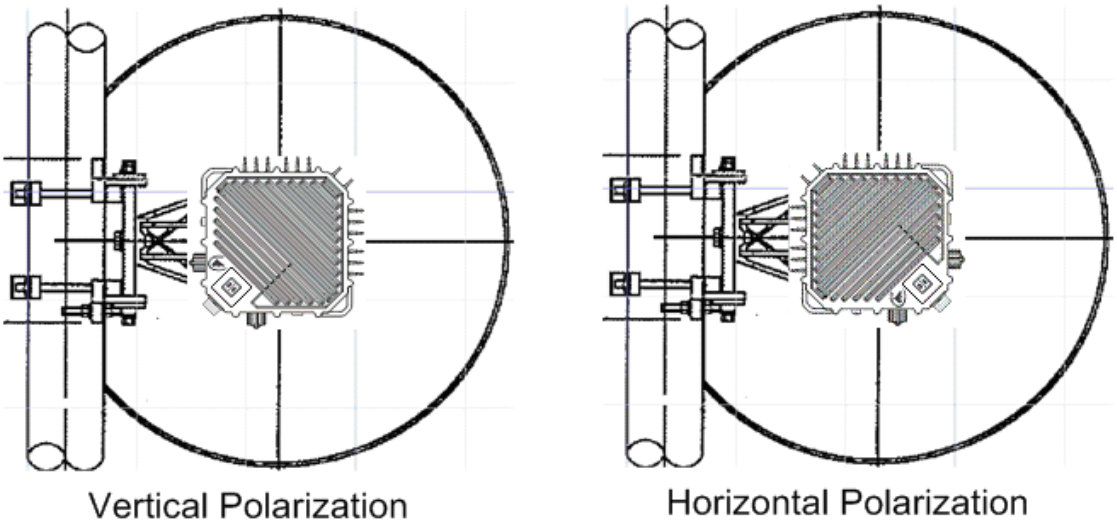


Figure 16: Direct DC power connection

Polarization

Apex mounting determines if the transmit signal polarity as vertical or horizontal. Changing polarity from vertical to horizontal is easy. Simply unlatch the Apex Unit from the antenna and rotate counter-clockwise and reattach the Apex Unit to the antenna. Note the position of the LED panel. **Figure 17** displays an example of a left side mount and an example of a right side mount on a three feet or higher diameter size antenna.

Left Side Mount



Right Side Mount

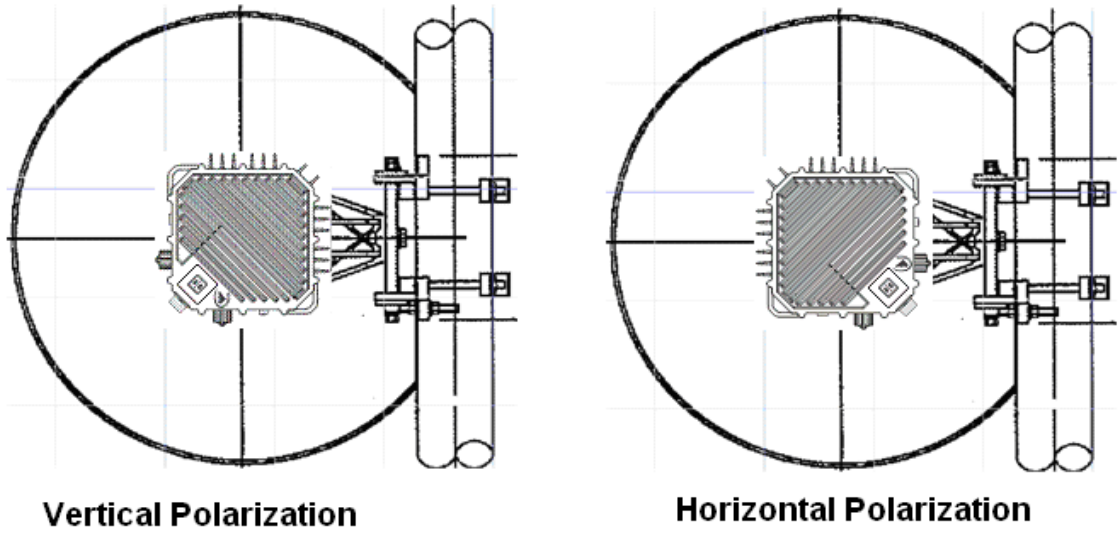
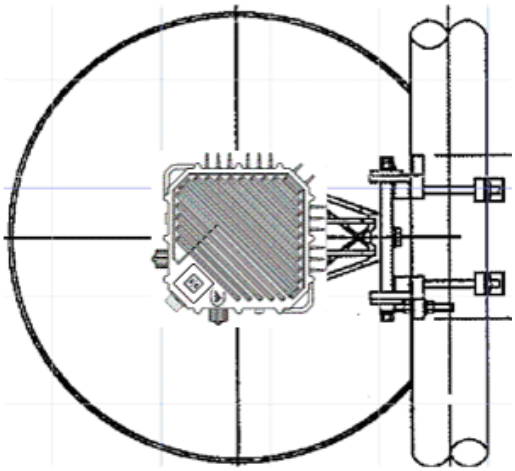


Figure 17: Proper right/left mounting and polarization adjustment

Special Consideration for Smaller Antennas (1 ft and 2 ft antennas only)

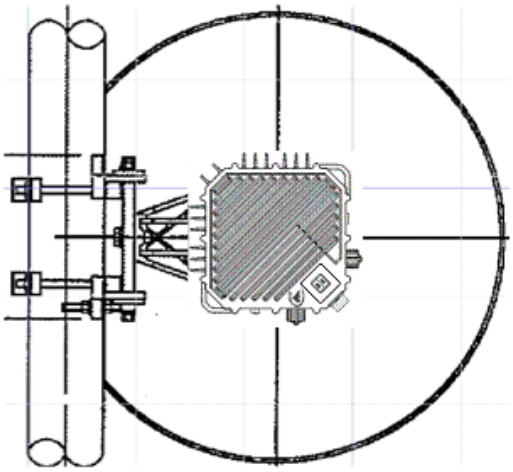
In order to have ample space for the ports, the radio must be mounted with the ports facing away from the mast/pole as described by Figure 18.



Vertical Polarization

For **vertical polarization** installations, the antenna must be mounted to the **left of the mast/pole**

For **horizontal polarization** installations, the antenna must be mounted to the **right of the mast/pole**



Horizontal Polarization

Figure 18: Mounting smaller antennas (2 ft. and smaller)

1+1 Coupler Installation

The 1 +1 coupler is needed to install two Apex Units to a single antenna. The mount has a single coupler centered on one side (Figure 19) while there are 2 evenly spaced on the second side.

Figure 19: 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 20. Remember to use the supplied silicone lubricant as mentioned in the standard installation steps.

Figure 20: 1+1 coupler and latches

Once the 1+1 coupler has been securely installed onto the antenna assembly (Figure 21) the radios can be mounted on the opposite side. The polarization for the 1+1 mount is determined by the transition between the mount and the antenna. The Apex radios needs to be mounted in the H-Pol position on the 1+1 mount as the coupler determines polarity.

Please order your correct polarity.

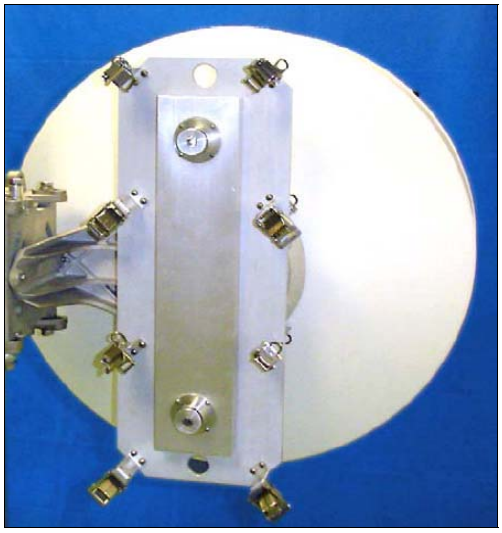


Figure 21: 1+1 coupler installed on antenna

Both Apex units must be mounted in the same position with the LED Panel on the bottom right side as shown in Figure 22 regardless of desired RF polarization.

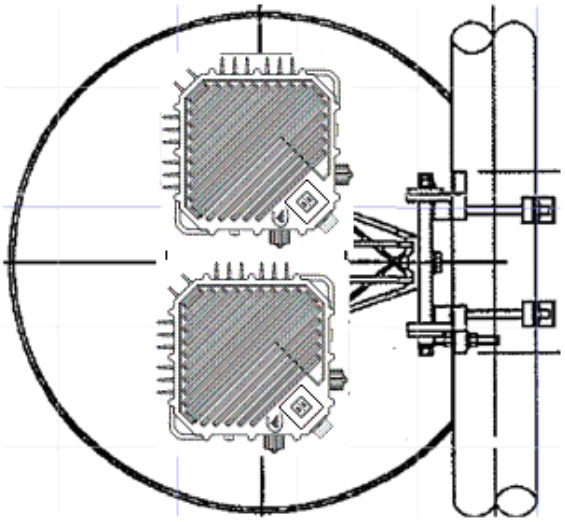


Figure 22: 1+1 Apex mounting

⚠ The Apex units need to be mounted in the same positions to the 1+1 MOUNT, as polarization 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 23) This coupler has a “twist” transition so it will look slightly different than the coupler that connects to the Apex. The 1+1 coupler also has 2 slightly offset screw holes to ensure proper installation orientation.

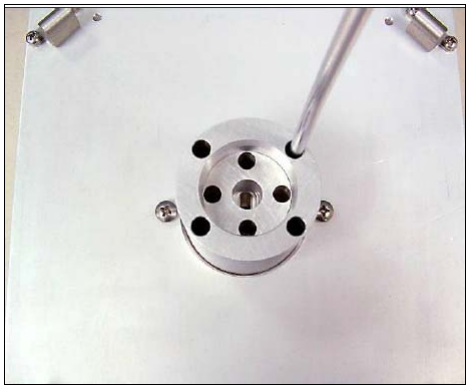


Figure 23: Installing twist transition on 1+1 coupler

The vertical and horizontal couplers have differences in the waveguide as shown in Figure 24.

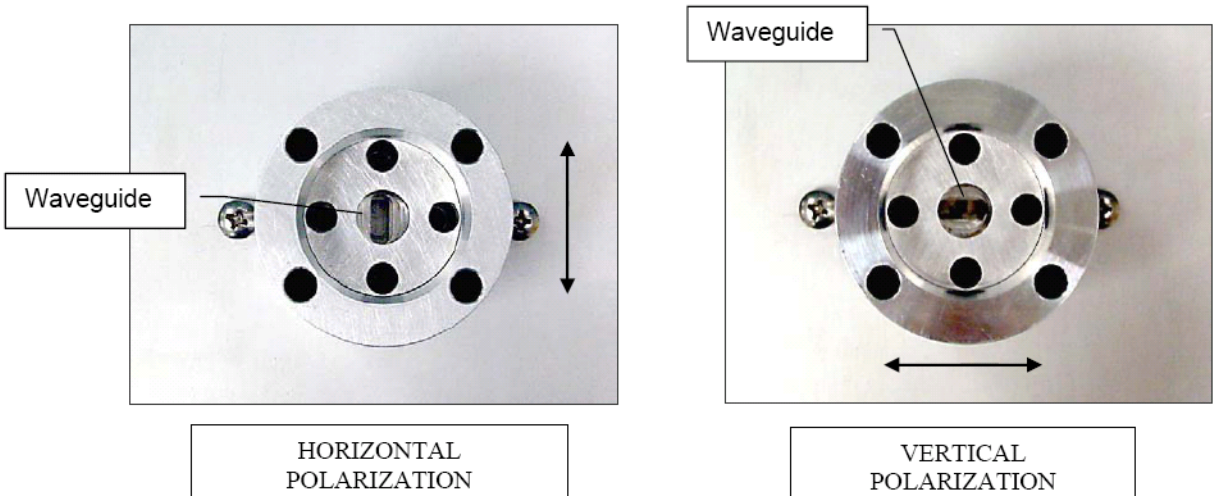


Figure 24: H and V transitions

⚠ Once the 1+1 coupler is properly mounted the 12” redundancy cable must be installed between units and set the failover CLI command to “on”.

Grounding Recommendations

The Apex unit does not require any additional grounding since it is attached directly to the antenna and thus shares the antenna's ground. Please note that if the antenna is attached to a metal pole that is earth-grounded, no other grounding is necessary.

The PoE includes a grounding screw located on the side of the panel and should be connected to a low resistance path to earth ground (typically through the rack frame (Figure 25).

Figure 25: PoE ground screw

> ⚠ If the antenna support structure is not earth-grounded through a low resistance, high current path, do not proceed with the installation.

Weather Proofing Cabling

It is important to properly seal each cable connection to protect against moisture and corrosion. Trango LINK Apex uses special connectors which provide this protection and is included with your purchase. Please note that proper strain relief and installation is mandatory to prevent moisture intrusion. Damage to the unit from moisture intrusion through the Ethernet caps or Fiber plates are not covered under warranty.

To properly install the Ethernet weatherized connectors first remove the cap from the unit and pass the bare end of the CAT5/6 cable through the cap as shown in Figure 26:

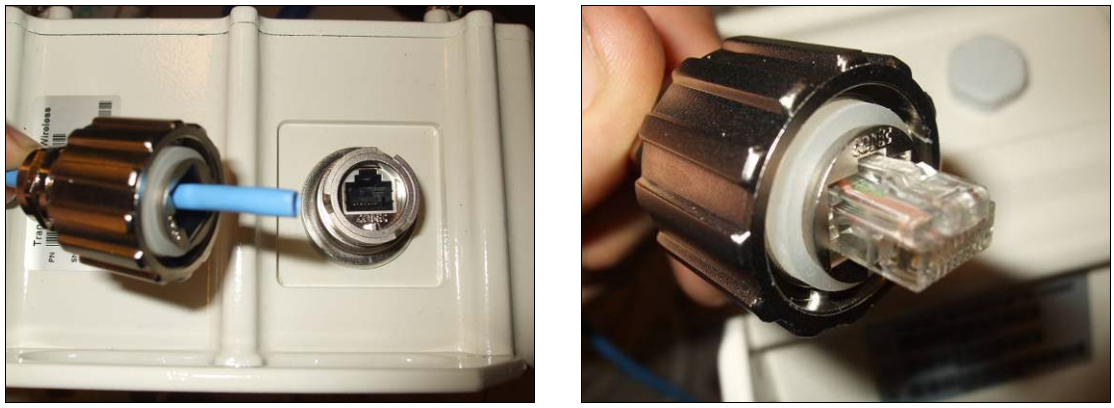


Figure 26: Ethernet cap installation

Second, Terminate the Cat5/6 cable to a RJ-45 connector. To complete installation, connect the RJ-45 connector into the Apex radio and properly adjust the Ethernet cap over the RJ-45 connector as shown in Figure 27.

Figure 27: Complete Ethernet cap installation

⚠ IT IS IMPORTANT that the orientation is correct to prevent water intrusion

To properly weatherize the Fiber cable and direct DC power first remove the fiber plate and silicone seal from the unit and pass the Fiber and power cables through the fiber plate as shown in Figure 28: The silicone seal has a slit that will allow the cables through. Please note that the Fiber plate must be connected to a properly installed conduit which will prevent moisture from entering the Apex unit.

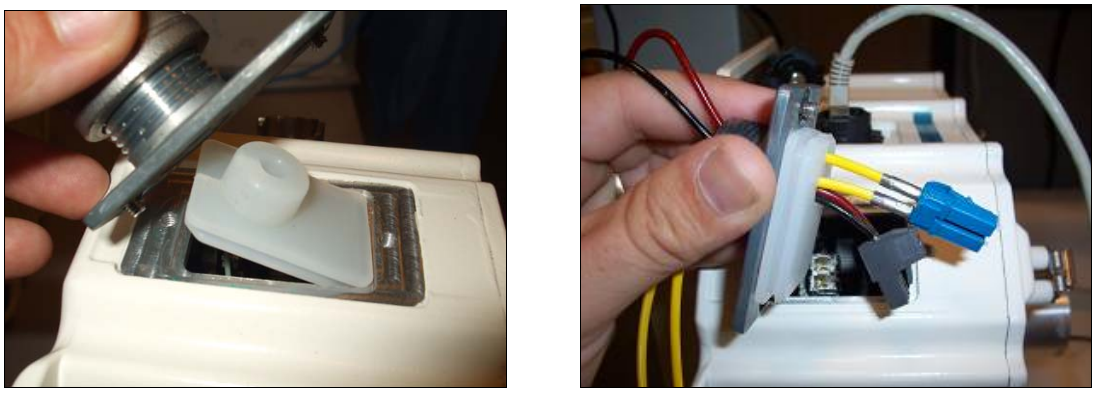


Figure 28: Fiber plate installation

Second, terminate fiber and DC wires and connect to the SFP module and MOLEX connector.

Complete installation by re-seating the silicone seal into the Apex unit and screw the Fiber plate back to the unit as shown in Figure 29.

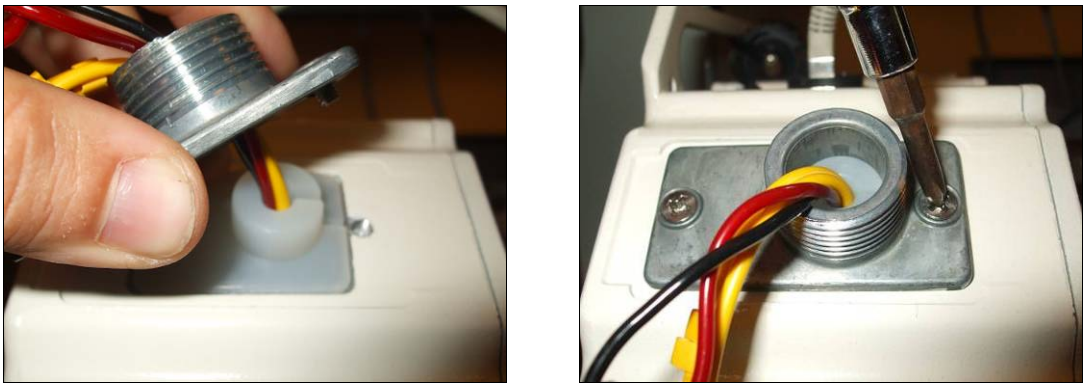


Figure 29: Complete fiber plate installation (conduit not shown)

⚠ It is important that the silicone seal is properly installed to prevent moisture intrusion. Trango also insists that the fiber plate be connected to properly installed conduit to ensure no moisture penetration into the apex unit.

⚠ Make sure to remove any cable constraint from your fiber cables. Failure to do so will result in possible moisture penetration through the silicone seal

Antenna Alignment

Aligning narrow beam width (< 2º) 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, begin the fine alignment process 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 Apex Unit.

Antenna Alignment Procedure

1. Ensure that the radios on both sides of the link are configured correctly.
2. Connect to the Management Port or via the Console Port.
3. Login to config mode. Once in config mode, enable the “alignment_mode”

   Example:

```
trango login: admin
Password:

Trango Broadband Wireless: TrangoLink APEX Command Line Interface
v1.1.0
(trango-view)# config
Password:

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

4. Once alignment mode is enabled the digital RSSI panel will update 5 times every second.
5. Once the desired RSSI is reached, tighten down the antenna in the optimum position.
6. Disable the alignment mode

The LED display reads in negative dBm, so “80” equals to -80 dBm whereas “40” equals -40 dBm. When aligning the antenna the closer to zero the better the RSSI (a -40 dBm signal is more powerful than a -80 dBm).

Upgrading Firmware

The firmware on the TrangoLINK® Apex can be upgraded through the management Ethernet port. A firmware release can consist of up to 5 files:

System FPGA Image Firmware File	<sys_fpga_xxyy>
System OS Image Firmware File	<sys_os_xxyy>
System Firmware File	<sys_fw_xxyy>
System PIC Firmware File	<sys_pic_xxyy>
System RFM Firmware File	<sys_rfm.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 the local hard drive.

Upgrade Procedures

Once all files have been properly extracted and placed on an easily accessible directory on the local hard drive, proceed with as follow:

Telnet into the radio by Clicking on Start menu, RUN. On the "*open*" box enter telnet and the IP address of the unit. The example below uses the default IP address.

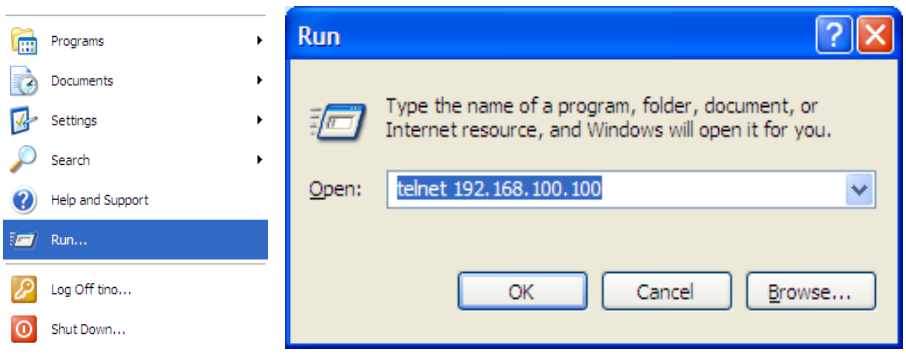


Figure 30: Windows Start & Telnet

1. At the login enter your username and password. Default login is
   Username = "*admin*"
   Password = "*trango*"

2. Enter Config mode by typing "*config*" and entering config password. The default config mode password is *"trango"*

3. Enable tftp daemon by using the TFTPD command as shown below.
   `trango login: admin`

```
Password:
Trango Broadband Wireless: TrangoLink APEX Command Line Interface
v1.1.0

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

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

4. Open a MS-DOS prompt window and access the directory with the extracted firmware files.

   Example:
   ```
   C:\CD Firmware
   C:\Firmware>
   ```

5. Using windows TFTP command line tool, upload the firmware files one at a time. (See tftp syntax example below)

   ```
   tftp -i <ip address> put <file name>

   C:\firmware>tftp -i 192.168.100.100 put sys_fpga_v10.bin
   Transfer successful: 1951744 bytes in 15 seconds, 130116 bytes/s
   ```

If upgrading multiple images at a time. Repeat Step 5 with the correct file name.

6. After successful transfer of all the files, log into the unit and apply the updates using the "*bootimage*" command from the config mode. Each file requires a separate "*bootimage*" upgrade command.

   Example:
   ```
   (trango-config)#
   (trango-config)# bootimage upgrade 0
   This will apply the fpga upgrade only. Please note the following
   options for the "bootimage" command:

   (trango-config)# bootimage upgrade ?
   <0-4> <0-sys_fpga, 1-sys_os, 2-sys_fw, 3-sys_pic, 4-sys_rfm.bin
   0: System's FPGA
   1: System's OS
   2: System's Firmware
   3: System's PIC
   4: System's RFM
   ```

7. A reboot of the radio is required to load the new image after upgrade. If upgrading multiple images at one 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 CLI and with the use of the "*version*" command or Web browser sysinfo at the bottom right corner (see Figure 31).

   The "*version*" command has two sections, Current Image Version and Previous Image Version.

   Example:

   ```
   (trango-config)# version
   Current Image Version
   FPGA version:   01270608
   OS version:   2p6r14b3D07230801
   FW version:   1p0r0D072308
   PIC version:  215
   Modem version:  35
   RFM version:  1C

   Previous Image Version:
   FPGA version:   01270608
   OS version:   2p6r14b3D07230801
   FW version:   1p0r0D072308
   PIC version:  214
   RFM version:  1C
   ```

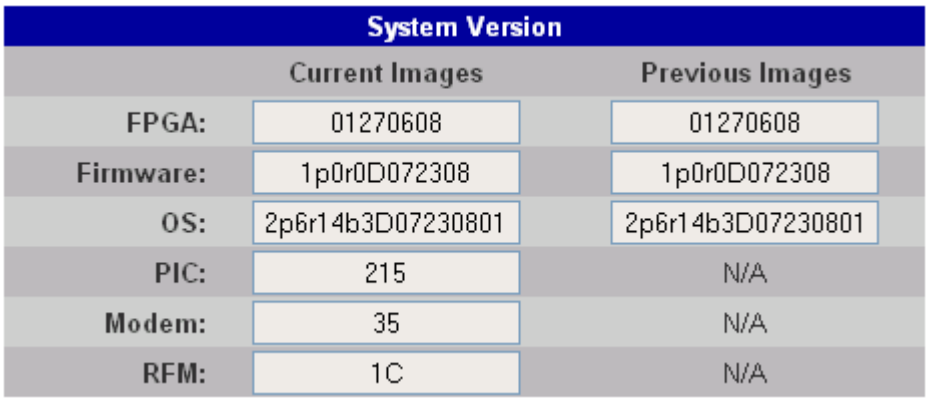


Figure 31: Verify Firmware Upgrade

Chapter 5: Management

About this Chapter

The TrangoLINK® Apex system can be managed though a number of methods.

This chapter will focus on SNMP management. Please review Chapter 3 for HTTP configuration and Appendix A for CLI configuration commands and procedures.

Management Options

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 chapter.

Understanding SNMP

Understanding and familiarization of SNMP concepts and software platforms are required to utilize SNMP management of the TrangoLINK® Apex system. Due to the large number of programs available for SNMP, Trango does not provide support of SNMP software packages or NMS systems. Some common items to try while having issues monitoring specific OIDs are:

- Properly load the MIBs into your software
- Try adding a " .0 " at the end of your OID string

If this does not resolve your issues, please contact technical support.

SNMP – Simple Network Management Protocol

TrangoLINK® Apex supports Simple Network Management Protocol (SNMP) for network management. Network management consists of 4 categories:

1. Configuration
2. Accounting
3. Alarm
4. Monitoring/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 or SNMP 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® Apex MIB for a complete understanding of its features.

The following is an overview of some of the more commonly used SNMP objects in the TrangoLINK® Apex system.

A copy of the MIB files for the current firmware version can be obtained by contacting Trango Technical Support.

Objects for Monitoring and Control

GigE Bandwidth Monitoring

- **gigeEth1InOctets**: Number of octets of payload received on GigE port 1 (copper).
- **gigeEth2InOctets**: Number of octets of payload received on GigE port 2 (fiber).
- **gigeEth1OutOctets**: Number of octets of payload transmitted on GigE port 1 (copper).
- **gigeEth2OutOctets**: Number of octets of payload transmitted on GigE port 2 (fiber).

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.
- **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.
- **trapModemLock -** This trap will inform you when there is a change to the link lock.
- **trapDownShift -** This trap will inform you when the modulation of the radio has shifted downed.

Trango recommends monitoring RSSI, MSE, Ethernet Traffic (gigeEthOctets), Temp, and modem lock as a minimum for thorough monitoring of the link. Additional objects and traps can be added to the monitoring software as required. Please review Appendix D MIB for a complete listing of MIB Objects and Traps.

Chapter 6: Troubleshooting

About this Chapter

This chapter will cover some of the more common steps to take when encountering difficulties with the TrangoLINK® Apex.

- No Link
- High BER
- Ethernet Port
- Fiber Port
- Web Management Interface

No Link

- Ensure that Opmode is enabled or “ON” for both sides of the link.
- Verify the Transmit frequency is configured correctly for each side of the link.
- Ensure the Apex units for the link are paired correctly. The pair consists of 1A and 1B.
- Both sides of the link must be configured for the same speed, channel bandwidth and modulation.
- Reissue Speed commands to both sides of the link and ensure the settings have been saved.
- Incorrect configuration of the TargetRSSI can prevent a link. 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.
- Check to make sure Loopback is disabled.
- Antennas are misaligned, verify RSSI values.
- Look at troubleshooting tips for other issues.
- If initial installation, set the speed to QPSK modulation, channel to 10MHz and power to 21dBm.

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 and ensure the TargetRSSI is set correctly or reduce the power of the remote side manually.
- Ensure the Apex unit is properly grounded.
- Verify that shielded CAT5 cable is being used and the cable does not run parallel to power lines.

GigE Port

No traffic is passing

- Ensure cables are connected into correct ports. Data will not pass through the management port of the Apex system.
- Check the Ethernet cables to ensure they work properly.
- Ensure that the GigE port is enabled.
- Ensure the switch or device's port is properly working or negotiating speed correctly.

Errors on GigE port

- Ensure there is no duplex mismatch.
- The TrangoLINK® Apex 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® Apex should match the setting of the connecting device.
- Verify correct Ethernet cable type is being used for GigE setting. Once Auto-negotiate is disabled, the correct cable type most by use when attaching to the device.
- Verify proper crimped on the Ethernet cable connector.

Fiber Port (SFP)

Not passing traffic

- Ensure the SFP module is properly installed.
- Ensure the port is enabled.
- Verify the correct type of fiber is being used.
- Verify the SFP module is approved by Trango.

Not showing link status

- Verify the SFP module is approved by Trango.
- Ensure the SFP module is properly installed.
- Ensure the port is enabled.
- Check cable for damage and proper termination of connectors.

Management

If you cannot 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 there are still issues please contact Technical Support at 858-391-0010 or E-mail at techsupport@trangosys.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 side of the Apex unit (See figure 2, Chapter 1).

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

Bench 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 ensure 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. Below is a basic diagram of a bench test setup.

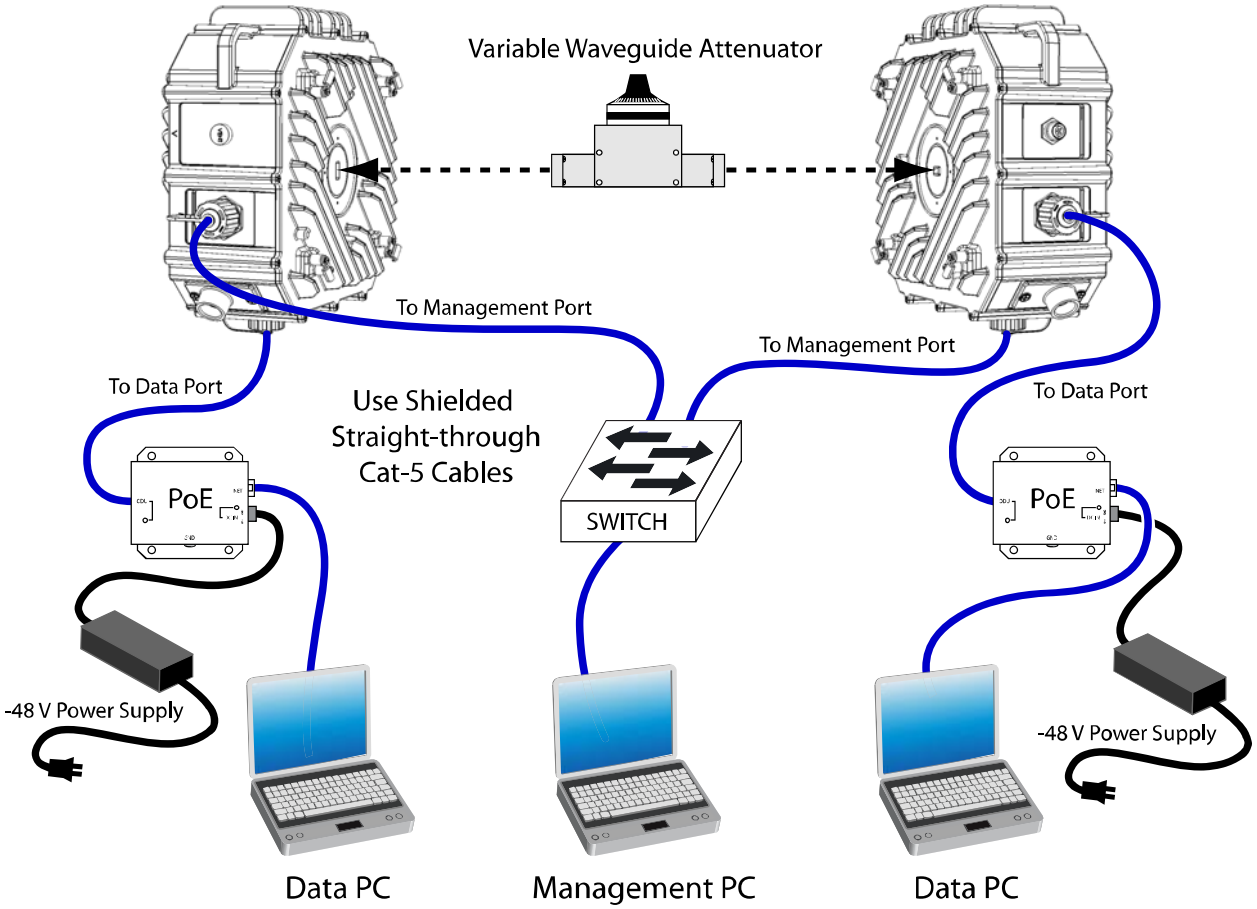


Figure 32: Bench Test Setup diagram

> ⚠ NOTE: Variable Waveguide Attenuator: at least 45 dB of attenuation at the Transmit Frequency to ensure that the Receive level is less than -25 dBm

The following are tips to ensure the bench test setup is properly done.

1. Ensure proper connection of the DC power to the PoE injector

2. Have at least 45 db of attenuation between Apex Units.
3. Connect the attenuator directly to the unit without a waveguide adapter. (Figure 33)

Figure 33: Waveguide Attenuator

4. Configure the Apex units with the configuration that will be used in the field. More information on the setup process can be found in Chapter 3: Configuration.
5. Adjust the amount of attenuation to ensure the RSSI is less than -25dBm (-30 to -35 is optimal)
6. Perform throughput testing by connecting PCs to the data ports and passing FTP or other IP traffic across the link.
7. Confirm proper SNMP setup by enabling traps and monitoring. By turning the opmode off or increasing attenuation, the link will lose lock and trigger a trap to be sent to the monitoring software.

⚠ NOTE: If waveguide attenuators are not available for the bench test, DO NOT connect the Apex units to the antennas. Using antennas at very close range tests will damage the radios. Instead, lay the radios on the bench with the waveguide pointed at the ceiling. Even though the radios are not pointed at each other, it is usually possible to create a link “over the air” with no waveguide, transition, antennas, or attenuators present.

For any issues during the setup or the testing process, please contact Trango Technical Support at (858) 391-0010 for assistance.

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 BS

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

View mode is the default mode after logging in. It is strictly a read-only view of the current configuration and statistics. Configuration changes can be made while in View Mode.

Command List in View Mode

acm	Display ACM feature status
alignment_mode	Display alignment mode status
atpc	Display ATPC feature status
atpc_max_power	Display current ATPC max power
atpc_step	Display ATPC power level step size
ber	Display ber test parameters
config	Enable Trango configuration mode
cos	Display current status for class of service
datapattern	Display data source for data pattern
date	Display time of Day
default_opmode	Display default opmode status
failover	Display failover mode status
freq	Display RF Tx/Rx frequency
help	Display help command
httpd	Display Web server (httpd) status
ibm	Display current status of inband management feature
ipconfig	Display radio management port configuration
license	Check if the license is enable or disable
linktest	Display link test parameters (RSSI, MSE, BER)
loglevel	Display current syslog level
loopback	Display loopback Mode
model	Display system model and serial number
mse	Display MSE (Mean Square Errors) value
opmode	Display operation mode status
power	Display Tx power in dBm
remark	Display product remarks
rps_enable	Display current status of rapid port shutdown
rssi	Display RSSI value
rssiled	Display rssiled status
smart_mode	Display current status of Smart Mode feature
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
sync_state	Display current synchronization state
sysinfo	Display system information
syslog	Display system event log

targetrssi	Display target rssi value
telnetd	Display telnet daemon (telnetd) status
temp	Display current system temperature
tftpd	Display tftp server (tftpd) status
trapip	Display SNMP Trap IP configuration
uptime	Display system uptime
utype	Display unit type
version	Display system software version

Config Mode

To enter Config Mode you must first be in View Mode. Once in View Mode, type the command “config” and you will be prompted for a password. After successful authentication the systems enters Config Mode, from which all configuration settings can be changed.

- All commands entered without parameters will return the current configured values — this is similar to View Mode.
- All configuration changes are applied immediately and do not require reboot (except the command “speed” in which the settings are applied immediately, but requires a 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
acm	<mod>	N/A
enable	on/off	Off
mse_de	<mse value>	Depending on modulation
mse_im	<mse value>	Depending on modulation
alignment_mode	on/off	Off
atpc	on/off	Off
atpc_max_power	0-20	17
atpc_step	<1-4> dB	1dB
ber	duration <1-99>	1
bootimage	<0-5>	N/A
config	< export | import | remove | view >	N/A

cos	<pri> <queue>	<0,1,2,4,5,6,7> <0, 0, 1, 1, 2, 2, 3, 3>
date	<0-99><1-12><1-31><0-23><0-60>	Linux System Date (TBD)
debug	N/A	N/A
default_opmode	on/off	Off
exit	N/A	N/A
freq	<17705-19695>	0 (this is exception to the valid range)
help / ?	N/A	N/A
httpd	<on/off>	On
ibm		
enable	on/off	off
ip	<ip address>	172.16.1.1
vlanid	<1-4090>	100
ipconfig	<ip address><netmask><gateway>	ip 192.168.100.100 netmask: 255.255.255.0 gateway: 192.168.100.100
datapatten	<external | internal>	External
license	Key# = 1 or 2 License Key : 20byte Hex Key	User needs to reenter license keys after reset
linktest	duration <1-99>	Default 1 (if duration not entered by user)
loglevel	<0> | <0 1> | <0 1 2>	0 1
loopback	<dig | if | rf_gen | rf_refl | off>	Off
model	N/A	No defaults, read directly from the system
mse	duration <1-99>	Default 1 (if duration not entered by user)

opmode	<on/off>	Off
passwd	<passwd> <confirm_passwd> (8char)	trango
port	<eth > <port#> <autonegotiate | duplex | enable | pause | | maxrate | priority | speed >	both ports configured in the Auto-Neg Mode
auto negotiate	<on | off >	On
duplex	<half | full>	Full
enable	on/off	on (for both GigE copper and fiber)
ingress_rate	0-1000 Mbps	0 (0 = 1000Mbps)
pause	<on | off>	Off
priority	0-3	0
speed	<10 | 100 | 1000>	1000
power	0-20	10
reboot	N/A	N/A
remark	<string 1-100bytes>	Trango Broadband Wireless
remove	<license>	N/A
reset	N/A	N/A
rps	<on/off>	Off
rssi	Duration <1-99>	Default 1 (if duration not entered by user)
rssiled	on/off	On
save	NA	No Auto Save
show		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>	<5> <qpsk>
channel_bw	0-5 (10,20,30,40,50)	5
modulation	qpsk, qam16, qam64,qam128,qam256	Qpsk
status	<modem | fifo | pll | port | all | clear>	N/A
sysinfo	<0-6>	0 (if command executed without any param)
syslog	<clear>	N/A
targetrssi	<-88 - 25>	-40
temp	N/A	N/A
telnetd	on/off	On
tftpd	on/off	Off
threshold	<param> <min | max> <value> <action> param : 0 rssi, 1 mse, 2 ber, 3 fer, 4 temp, 5 in port util, 6 out port util min|max: param dependent action: 0 none, 1 alaram1, 2 alarm2 ,3 snmptrap	Default action is None.
trapip	<Manger 1 | 2 > <valid ipv4 address>	0.0.0.0 Reset will change the prev configured trapip
uptime	N/A	N/A
utype	N/A	active
version	N/A	N/A

Debug Mode

Debug Mode has additional management port related settings. Debug Mode can only be entered while in Config Mode. Debug and Config modes share the same password. The password can be changed from the Config mode only.

To enter Debug Mode, type the command “exit” from Config Mode. To return to View Mode, enter the command “*cli*”.

Command List in Debug Mode

Cli		Used to Enter the CLI (trango-view) node
Exit		Logout of the system
Help		Display list of commands in the debug node
tg_reboot		Reboot the system
tg_powercycle		Power cycle the system
Ping	<ip address>	ping network hosts
Route	N/A	Display the current system routing table
ssh	<ip address>	ssh into another host
Syslog		Display current system log
telnet	<ip address>	telnet into another host

CLI Command Description

acm

SYNTAX	acm enable <on | off> acm mod <modulation> enable <on | off> acm mod <modulation> mse_de <value> acm mod <modulation> mse_im <value>
DEFAULT VALUE	acm enable: Off acm mod <modulation> enable: on acm_mod <modulation> mse_de: see table below acm_mod <modulation> mse_im: see table below
DESCRIPTION	acm is used to turn on the adaptive modulation feature. When enabled, the current speed may shift to different profile (modulation based) based on the current MSE value. And predefined MSE degrade and improve thresholds ACM is not symmetric and each end can have different profiles at a given time depending upon the MSE values on each end. acm mod is used to enable/disable certain profiles. It could also be used for changing the value for mse degrade table or mse improve. When the threshold of the MSE reaches certain value from the table, the profile will change thus, the modulation for rx will be changed. **Note: This feature is not supported in current release**
EXAMPLE	*(trango-config)# acm* *ACM: on Bandwidth = 80* *<---------- ACM Status ---------->* *ACM mod MSE(improve) MSE(degrade) Enable* *QPSK -20.00 -1.00 enabled* *16QAM -21.00 -17.00 enabled* *32QAM -22.30 -20.00 enabled* *64QAM -28.20 -23.30 enabled* *128QAM -31.10 -27.20 enabled*
RELATED	acm

Default ACM Threshold Values

QAM256					
Profile #	**Modulation**	**Improve**	**Next**	**Degrade**	**Next**
0	QAM256	-32.1	0	-27.2	1
1	QAM64	-29.2	0	-24.3	2
2	QAM16	-26.3	1	-21.3	3

3	QPSK	-23.3	2	-18.5	3
QAM128					
Profile #	**Modulation**	**Improve**	**Next**	**Degrade**	**Next**
0	QAM128	-32.1	0	-27.2	1
1	QAM64	-29.2	0	-24.3	2
2	QAM32	-26.3	1	-21.3	3
3	QAM16	-23.3	2	-18.5	4
4	QPSK	-20.3	3	-17.1	4
QAM64					
Profile #	**Modulation**	**Improve**	**Next**	**Degrade**	**Next**
0	QAM64	-29.2	0	-24.3	1
1	QAM32	-26.3	0	-21.3	2
2	QAM16	-23.3	1	-18.5	3
3	QPSK	-20.3	2	-17.1	3
QAM32					
Profile #	**Modulation**	**Improve**	**Next**	**Degrade**	**Next**
0	QAM32	-26.3	0	-21.3	1
1	QAM16	-23.3	0	-18.5	2
2	QPSK	-20.3	1	-17.1	2
QAM16					
Profile #	**Modulation**	**Improve**	**Next**	**Degrade**	**Next**
0	QAM16	-23.3	0	-18.5	1
1	QPSK	-20.3	0	-17.1	1

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 Apex Unit Led at a higher rate (5/sec) than during normal operation. ATPC is disabled during alignment_mode. RSSILED 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	rssiled, targetrssi

atpc

SYNTAX	atpc <on | off>
DEFAULT VALUE	Off
DESCRIPTION	Used to enable/disable ATPC ATPC is used to automatically adjust the remote end Apex 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 Apex power change size during ATPC operation. The transmit power is changed in step size on the Apex, 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, atpc_max_power

ber

SYNTAX	ber <duration> Duration = 1-99sec
DEFAULT VALUE	Duration = 1
DESCRIPTION	ber command is similar to the ”linktest” with internal data source ONLY. It can be 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 ber 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) Txprofile: The current Tx modulation Rx profile: The current Rx modulation

bootimage

SYNTAX	bootimage <upgrade | toggle> bootimage upgrade <0-4> 0: fpga 1: os 2: fimware 3. pic 4. rfm 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 Apex 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. The progress of the upgrade is indicated to dots …..and the result is indicated by SUCCESS/FAILURE. Make sure the file names of the images to be transferred (via tftp) are in the following format. 0: fpga sys_fpga_xxx 1: os sys_os_xxx 2: firmware sys_fw_xxx 3. pic sys_pic_xxx 4. rfm sys_rfm.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 sys_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

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	

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 (CHANGE THIS) *(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

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

debug

SYNTAX	debug
DEFAULT VALUE	N/A
DESCRIPTION	debug command is used to logout from the current node to the debug prompt. This is only allowed in the configuration node, not view node
EXAMPLE	To switch from “trango-config” to debug prompt *(trango-config)# debug* *debug>*
RELATED	cli, config, exit

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

exit

SYNTAX	exit
DEFAULT VALUE	N/A
DESCRIPTION	Exit command is used to logout from the current mode to the lower mode. Typing exit from the debug> mode will close the current session.
EXAMPLE	To Switch back to “trango-view” node from trango-config *(trango-config)# exit*

	(trango-view)# To Switch to debug> node from “trango-view” mode *(trango-view)# exit* *debug>* To logout from the system *debug>exit*
RELATED	clii, config

failover

SYNTAX	failover <on | off>
DEFAULT VALUE	**Off**
DESCRIPTION	This command is to enable failover (1+1) feature and 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. 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 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 status is 1.

EXAMPLE	To Enable failover *(trango-config)# failover on* *Failover mode: on*
RELATED	sync, sync_state, utype,

freq

SYNTAX	freq <17705-19695>
DEFAULT VALUE	None
DESCRIPTION	This command is used to set the transmit freq, this CLI will also return the corresponding receive frequency Only frequency specific to the system model can be set. The Apex needs to be powered ON for setting the freq.
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	opmode

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> Ibm port <0:copper | 1: fiber>
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 port” command will take effect only after reboot. 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

datapattern

SYNTAX	datapattern <external | internal>
DEFAULT VALUE	external
DESCRIPTION	Sets datasource for the modem.

	datapattern can be generated from external source or the internal data The datapattern should be set to “external” during normal mode of operation, otherwise no user data from GigE or the T1 ports will be transmitted.
EXAMPLE	To set data pattern source: *(trango-config)# datapattern external* *Data pattern: External* *SUCCESS* *(trango-config)# datapattern* *Data pattern: External*
RELATED	Loopback, ber

license

SYNTAX	License <key#> <key> Key# is 1 | 2 1 for Speed up to 200Mbps 2 for MAX speed Key: 20byte hex string
DEFAULT VALUE	No key, Preconfigured for speed < 107Mbps
DESCRIPTION	License key command is used to set the license required for using higher speed (> 100Mbps, > 200Mbps) on the radio. The license key is specific to each unit (management port Ethernet mac address) and is not transferable.
EXAMPLE	Set the license key for speed > 107Mbps *(trango-config)# license1 XXXXX* *SUCCESS*
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-config)# linktest 3 LOCK RSSI MSE BER txProfile rxProfile 1> 1 -21.20 dBm -34.10 dB 0.00E+00 128QAM 128QAM 2> 1 -21.20 dBm -34.10 dB 0.00E+00 128QAM 128QAM 3> 1 -21.20 dBm -34.20 dB 0.00E+00 128QAM 128QAM
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 doesn't require a link. It is used to isolate problems on the RFM/IF only. Opmode ON is required for the IF loopback mode. 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	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, datapattern

model

SYNTAX	Model
DEFAULT VALUE	N/A
DESCRIPTION	Display system model and serial numbers
EXAMPLE	To display the current model/serial of the system *(trango-config)# model* *SYS Model: Apex18-1B* *SYS serial ID: 2*
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 *1> -33.81* *2> -33.86*
RELATED	Linktest, rssi

opmode

SYNTAX	opmode <on | off>
DEFAULT VALUE	Off
DESCRIPTION	Opmode command is used to enable the transmitter on the system. Opmode settings are not persistent across reboot. See default_opmode command Freq needs to be set, before opmode can be turned ON
EXAMPLE	Set Opmode on *(trango-config)# opmode on* *opmode: on*
RELATED	Default_opmode, 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 “apex” *(trango-config)# passwd apex apex* *SUCCESS*
RELATED	Show passwords, config

Port (ge1 = Copper / ge2 = Fiber)

SYNTAX	port <eth > <port#> <settings> <value> For Ethernet Port the following commands are valid port eth <ge1|ge2> <autonegotiate> <on|off> port eth <ge1|ge2> <duplex> <on|off> port eth <ge1|ge2> <enable> <on|off>

	port eth <ge1|ge2> <rate> <0-1000Mbps> port eth <ge1|ge2> <pause> <on| off> port eth <ge1|ge2> <priority> <0-3> port eth <ge1|ge2> <speed> <10 | 100 |1000>
DEFAULT VALUE	For GigE copper and fiber Ports the default settings are Autonegotiate: ON 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 copper and fiber ports
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*
RELATED	sysinfo 4

power

SYNTAX	Power <value> Value = 0-20dBm
DEFAULT VALUE	10dBm
DESCRIPTION	Power command is used to set the transmit power level. 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 transmit power to 12dBm *(trango-config)# power 12*

	Power: 12.0 dBm *SUCCESS*
RELATED	atpc

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 Apex" *(trango-config)# remark TrangoLINK Apex* *Remark: TrangoLINK Apex* *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
DEFAULT VALUE	N/A
DESCRIPTION	Reset is used to restore factory default settings. All currently configured settings will be lost. Reboot of the radio is required for the new settings to take effect. 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, failover

rssi

SYNTAX	rssi <duration> Duration = 1-99sec
DEFAULT VALUE	Duration = 1sec
DESCRIPTION	rssi command is used to monitor the received signal level. It is used to monitor the link, based on the specified duration. CLI prompt will not be accessible while rssi command is running. RSSI value will display LO if below –90 and display HI if above -30
EXAMPLE	To monitor the RSSI for 2sec *(trango-view)# rssi 2* *1> -48.00* *2> -33.86*
RELATED	Linktest, mse

rssiled

SYNTAX	rssiled < on | off>
DEFAULT VALUE	On
DESCRIPTION	Turn ON/OFF led for display RSSI value
EXAMPLE	To set rssi led status (trango-config)# rssiled on Rssiled: on SUCCESS To view rssiled status: (trango-config)# rssiled Rssiled: on
RELATED	Rssi, alignment_mode

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

smart_mode

SYNTAX	smart_mode <on/off>
DEFAULT VALUE	ON
DESCRIPTION	This command will enable/disable all port mapping and port vlan, priority, ibm, etc from the Apex unit. This configuration will require a reboot command to take effect.
EXAMPLE	Disable smart mode *(trango-config)# smart_mode off* *smart_mode: on* *SUCCESS*
RELATED	ibm

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

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 = 5 Modulation = qpsk
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 5 qam256* *symrate: 46.00* *modulation: 256QAM* *speed: 312.20* *bpf: 56* *fcc_bw: 80* SUCCESS
RELATED	Freq, license

status

SYNTAX	Status <modem | 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: -34.60 dB* *BER: 0.00E+00* *FER: 0.00E+00* *BER(cumulative): 0.00E+00* *FER(cumulative): 0.00E+00* *RSSI: -40.40 dBm* *Acquire Lock: 1* *<---------- PLL Status ---------->* *RFM RF PLL: 1* *RFM IF PLL: 1* *Transmit PLL: 1* *Receive PLL: 1* *<---------- Ethernet Port Status ---------->* *Port: ge1 ge2* *Status: on on* *In Octets: 3072 0* *In Ucast Pkt: 0 0* *In NUcast Pkt: 12 0* *Out Octets: 2834 0* *Out Ucast Pkt: 0 0* *Out NUcast Pkt: 14 0* *CRC Errors: 0 0* *Collision: 0 0* *<---------- RF Status ---------->* *IN OUT* *Total Data Octets: 0 0* *Total Data Pkt: 0 0* *Total Drop Pkt: 0 N/A* *Port Rate(Mbps): 0 0* *Port Util(percent): 0 0*
RELATED	Sysinfo

sysinfo

SYNTAX	Sysinfo <0-6> 0=All, 1=Management, 2=Radio Config, 3=System Config, 4=Ethernet, 5= Threshold 6= ACM
DEFAULT VALUE	0
DESCRIPTION	Sysinfo command is used to display the current settings.
EXAMPLE	To display current radio settings *(trango-config)# sysinfo*

	<----------1. Management----------> *Remark: TrangoLink Apex* *IP addres: 10.14.0.191* *Subnet Mask: 255.255.255.0* *Gateway IP: 10.14.0.1* *Trap IP Address 1: 0.0.0.0* *Trap IP Address 2: 0.0.0.0* *ETH0 MAC: 00:01:DE:00:00:02* *SYS FPGA version: 01050508* *SYS OS version: 2p6r14b3D05150801* *SYS FW version: 1p0r0D05150801* *SYS PIC version: 198* *SYS Modem version: 35* *SYS RFM version: 14* *SYS Model: Apex18-1B* *SYS serial ID: 2* *<----------2. Radio Configuration---------->* *Freq (TX): 19480.00 (MHz)* *Freq (RX): 17920.00 (MHz)* *Data pattern: fpga* *Loopback mode: off* *Power: 10.0 (dBm)* *ATPC step size: 1 (dB)* *ATPC max power: 17.0 (dBm)* *Target RSSI: -40.00 (dBm)* *Symbol Rate: 46.00* *Modulation: 128QAM* *Speed: 289.90 (Mbps)* *FCC BW: 80* *<----------3. System Configuration---------->* *Alignment Mode: off* *ATPC: on* *ACM: on* *Rssiled: on* *Opmode: on* *Default opmode: on* *Rapid port shutdown: on* *tftpd: off* *httpd: on* *snmpd: on* *SNMP trap: on* *<----------4. Ethernet Configuration---------->* *Port: ge1 ge2(fiber)* *Enable: enabled enabled* *Status: off off* *Pause Frame: off off* *Auto Nego: on on* *Speed(Mbps): 1000 1000* *Duplex: full full* *Priority: 0 0* *Max Rate(Mbps): 1000 1000* *<----------5. 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* *Temp (Celsius): -40.0 58.0 none* *IN Port util: 0.0 100.0 none* *OUT Port util: 0.0 100.0 none* *<---------- 6. ACM Status ---------->* *ACM mod MSE(improve) MSE(degrade) Enable* *QPSK -20.00 -1.00 enabled* *16QAM -21.00 -17.00 enabled* *32QAM -22.30 -20.00 enabled* *64QAM -28.20 -23.30 enabled* *128QAM -31.10 -27.20 enabled*
RELATED	Status

sync

SYNTAX	sync
DEFAULT VALUE	**N/A**
DESCRIPTION	This command is allowed only on the active unit to initiate synchronization process with the standby unit. On detecting the Standby unit the Active unit synchronized the current system setting with the Standby unit.
EXAMPLE	To synchronize with the standby unit *(trango-config)# sync* *success*
RELATED	Failover, sync_state

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, sync

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 tragetrssi.
EXAMPLE	Set the targetrssi at –45dBm *(trango-config)# targetrssi -45* *target rssi: -45.00 dBm* *SUCCESS*
RELATED	atpc, rssi

temp

SYNTAX	temp
DEFAULT VALUE	N/A
DESCRIPTION	Temp command is used to display the current system temperature in Celsius.
EXAMPLE	To display current temp *(trango-config)# temp* *System temperature: 45 celsius*
RELATED	N/A

telnetd

SYNTAX	telnetd <on | off>
DEFAULT VALUE	ON
DESCRIPTION	Turn on telnetd daemon. Used to enable or disable telnet access.
EXAMPLE	Enable tftp server *(trango-config)# telnetd on* *Telnetd: on* *SUCCESS*
RELATED	

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-temp 5-in port util 6-out port util action: <0-1> 0-none, 1-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.
EXAMPLE	Set RSSI min threshold to –80 and action to send a snmptrap. *(trango-config)# threshold 0 min -80 3* *min = -80* *SUCCESS*
RELATED	Snmptrap, snmpd, trapip,

trapip

SYNTAX	Trapip < manager 1 | 2 ><ipv4 address>
DEFAULT VALUE	0.0.0.0
DESCRIPTION	Trapip is used to set the ip address of the snmptrap manager destination. 2 trapip (snmp managers) can be configured.
EXAMPLE	Set manager 1 trapip to 10.8.1.32 *(trango-config)# trapip 1 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 <standby>
DEFAULT VALUE	Main
DESCRIPTION	Utype command identifies the current system role. The valid type in the current release is main. Only the active unit may use this command to switch the role type. The command is prohibited when the standby unit is not in a good condition.
EXAMPLE	To display current system type *(trango-config)# utype* *utype: main* To switch to standby role: *(trango-config)# utype standby* *utype: main*
RELATED	failover, sync_state, sync

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 *FPGA version: 02150708* *OS version: 2p6r14b3D07250801* *FW version: 1p0r0D072508*

	PIC version: 215 *Modem version: 35* *RFM version: 1D* *Previous Image Version:* *FPGA version: 02150708* *OS version: 2p6r14b3D07200801* *FW version: 1p0r0D072108* *PIC version: 215* *RFM version: 1C*
RELATED	bootimage

Appendix B: Specifications

Apex 18 ANSI Data Sheet

RADIO PARAMETERS						
Frequency of Operation	**Band 1A Apex**: 17.700 to 18.140 GHz **Band 1B Apex**: 19.265 to 19.700 GHz					
Channel Size	10 MHz / 20 MHz / 30 MHz / 40 MHz / 50 MHz / 80 MHz					
RF Power Output (max per modulation)	**QPSK**	**16QAM**	**32QAM**	**64QAM**	**128QAM**	**256QAM**
	+20 dbm	+20 dbm	+20 dbm	+19 dbm	+18 dbm	+17 dbm
Modulation Format	Selectable from QPSK, 16QAM, 32QAM, 64QAM, 128QAM, 256QAM					
Receiver Sensitivity	-64 dBm (256 QAM maximum speed); -90 dBm (QPSK minimum speed)					
Compliance	FCC Part 101, Part 15 Class A Unintentional Radiator and Canada SRSP-317.8 Issue 2					
Features	ATPC (Automatic Transmit Power Control), Modulation Shifting, LDPC (Low Density Parity Check) Forward Error Correction					

Data

Data Throughput/ RSSI (1E10-6 BER)

Speeds are uni-directional. For aggregate full duplex speeds, multiply numbers below by 2.

Channel Size	QPSK / RSSI	16QAM / RSSI	32QAM / RSSI	64QAM / RSSI	128QAM / RSSI	256QAM / RSSI
10 MHz	15 Mbps / -90	30 Mbps / -84	37 Mbps / -80	45 Mbps / -78	52 Mbps / -74	60 Mbps / -72
20 MHz	30 Mbps / -89	63 Mbps / -82	79 Mbps / -78	95 Mbps / -76	110 Mbps / -72	126 Mbps / -70
30 MHz	46 Mbps / -87	94 Mbps / -80	117 Mbps / -77	142 Mbps / -74	165 Mbps / -71	188 Mbps / -68
40 MHz	64 Mbps / -86	128 Mbps / -79	159 Mbps / -75	194 Mbps / -73	226 Mbps / -69	258 Mbps / -67
50 MHz	77 Mbps / -84	156 Mbps / -77	195 Mbps / -74	236 Mbps / -71	275 Mbps / -68	314 Mbps / -65
56/80 MHz	88 Mbps / -83	179 Mbps / -76	227 Mbps / -72	272 Mbps / -70	315 Mbps / -66	366 Mbps / -64

Legend

- Basic Package (no License Key) = 110 Mbps max.
- License Key 1 = 226 Mbps maximum *
- License Key 2 = 366 Mbps maximum *

Packet Size	64-9600 bytes
Flow Control	Yes, via Ethernet pause frames (GigE mode only)
Security	Authentication uses 2 level password
Configuration & Management	SSH, HTTPS, Ethernet, SNMPV2
Remote firmware update	TFTP client in radio unit

Antenna

Antenna options

Model/Description	Gain	3 dB Beamwidth
AD18G-2 / 2-foot antenna with slip-fit mount	38.6 dBi	2.0°
AD18G-3 / 3-foot antenna with slip-fit mount	42 dBi	1.3°
AD18G-4 / 4-foot antenna with slip-fit mount	44.5 dBi	1°

Power

Input	-40.5 to –57 VDC
Power Consumption	48 Watts

Mechanical & Environmental	
Enclosure	Cast Aluminum with RSSI window
Indicators	2-digit LED “in dBm” RSSI indicator for alignment
Dimensions	12 × 12 × 6.8 inches (height × width × length)
Weight	18 lbs
Temperature Range	-40° to 122° F (-40° to +50° C)
Humidity	100% condensing
Interfaces	1 GigaEthernet port, RJ45 (10/100/1000 BaseT) 1 Fiber Optic port (SFP Module required) 1 Ethernet management port, RJ45 (10/100 BaseT)
Power connector	Power-over-Ethernet / 2 pin Molex connector
Redundancy (1+1)	6 pin circular
Antenna Connector	Optional waveguide adapter: WR42 / UBR 220
* Based on purchasable Option Key. Contact sales for more information.	

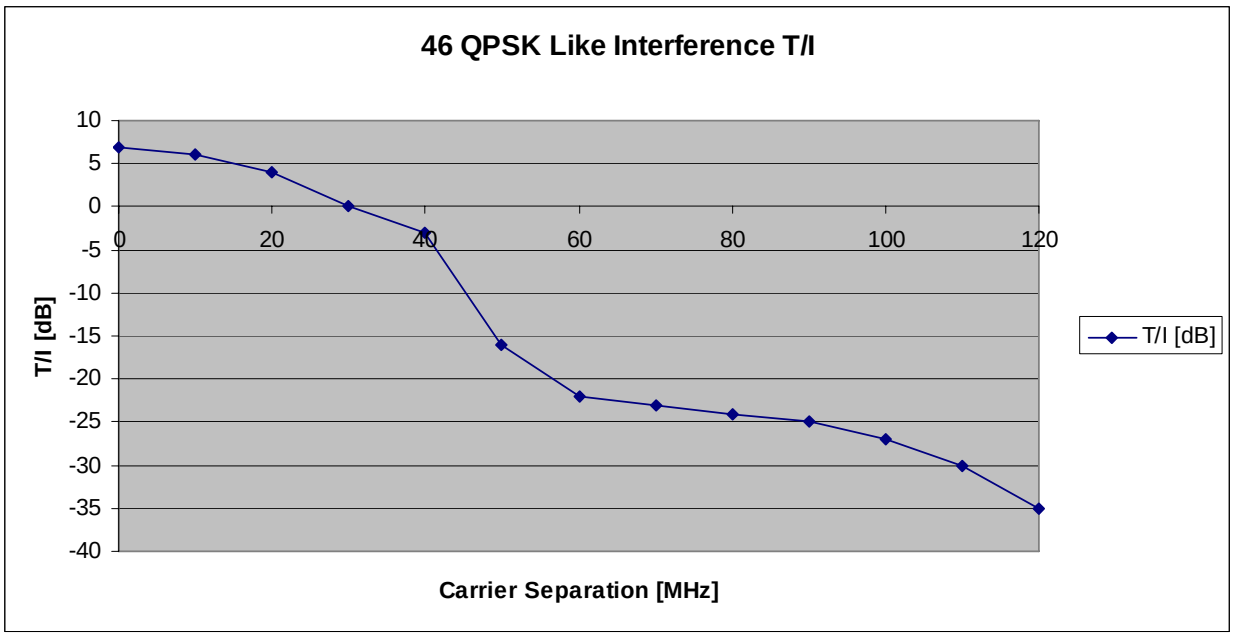
Interface Specifications

	Physical Interface	Bit rate	Impedance	Line Code	Standard	Jitter transfer and jitter tolerance requirement Compliance
Fiber MM	Optical	1Gb/s	N/A	Multi Mode	IEEE 802.3	IEEE 802.3
Fiber SM	Optical	1Gb/s	N/A	Single Mode	IEEE 802.3	IEEE 802.3
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

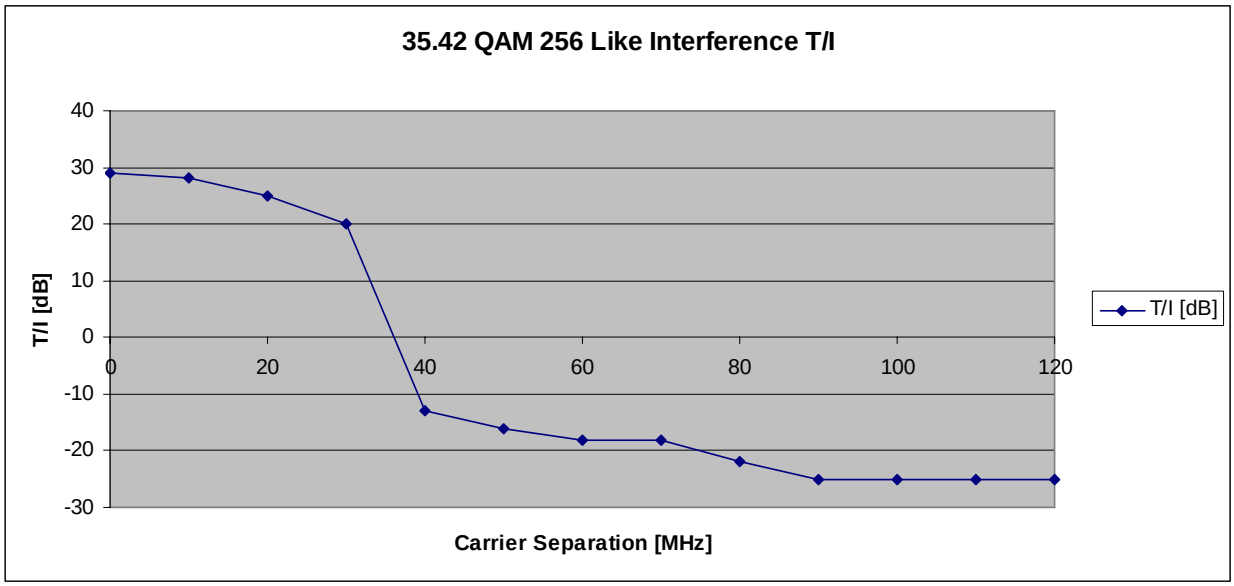
T/I Curves

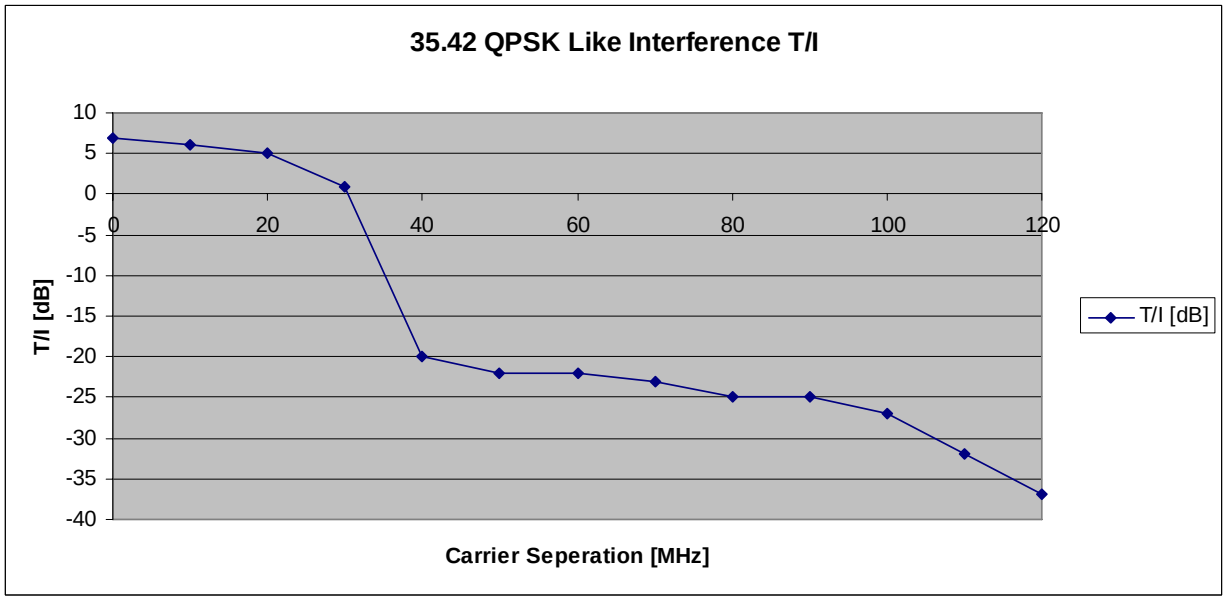
The Interference test measures the performance of the receiver under co-channel and adjacent channel interferers.

80 MHz channel (46 Symbol Rate)

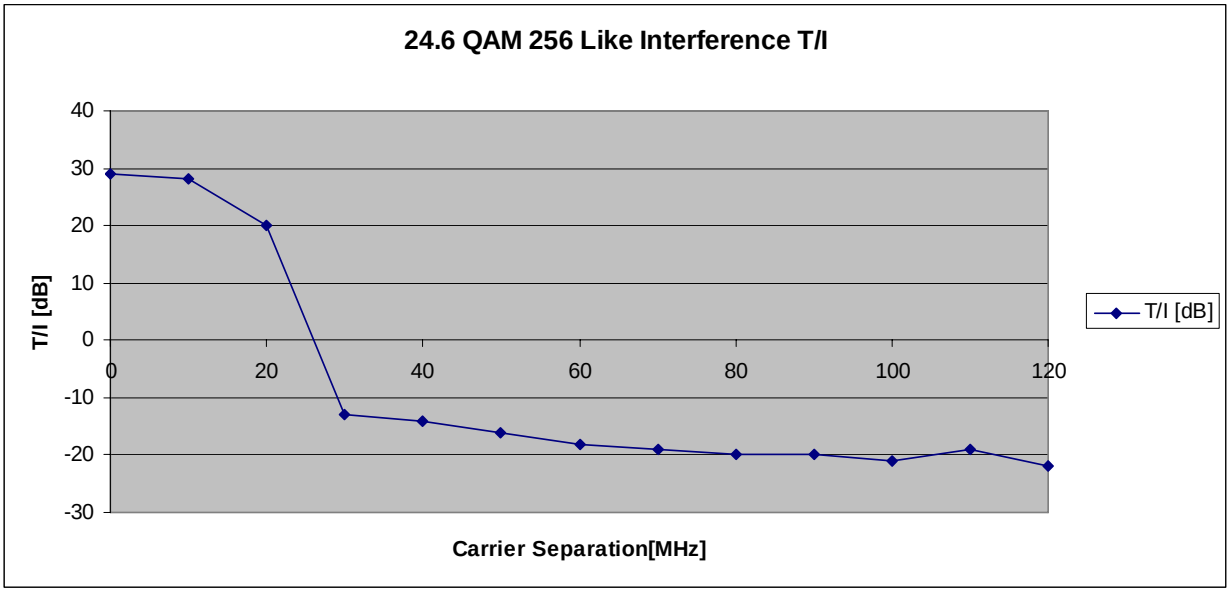


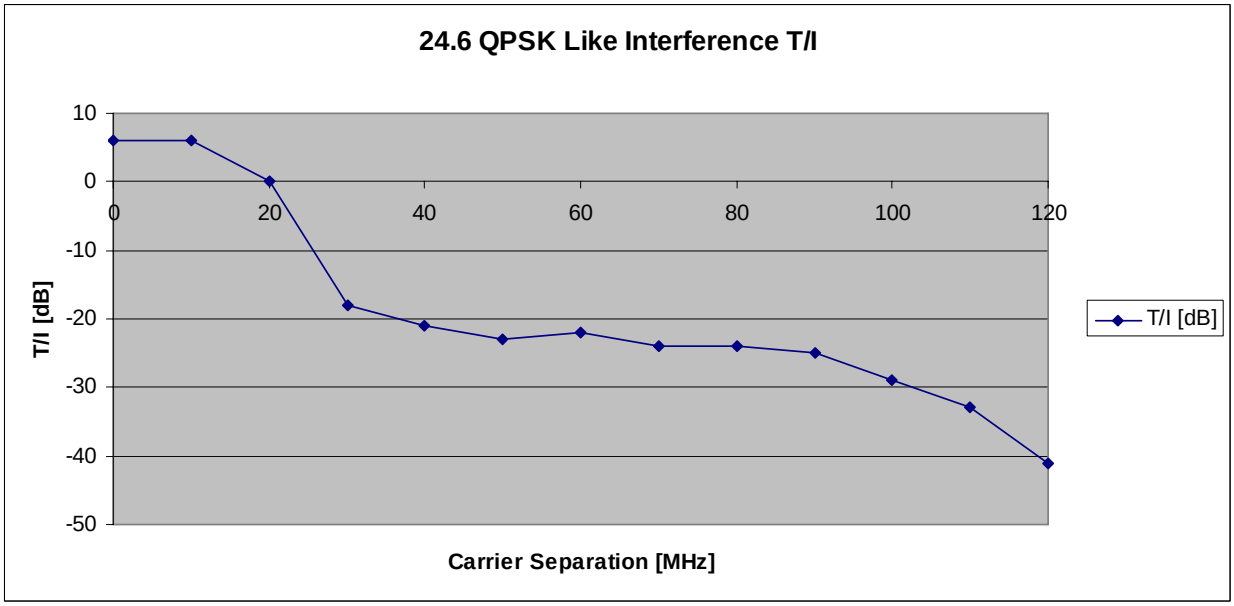
40 MHz channel (35.42 Symbol Rate)



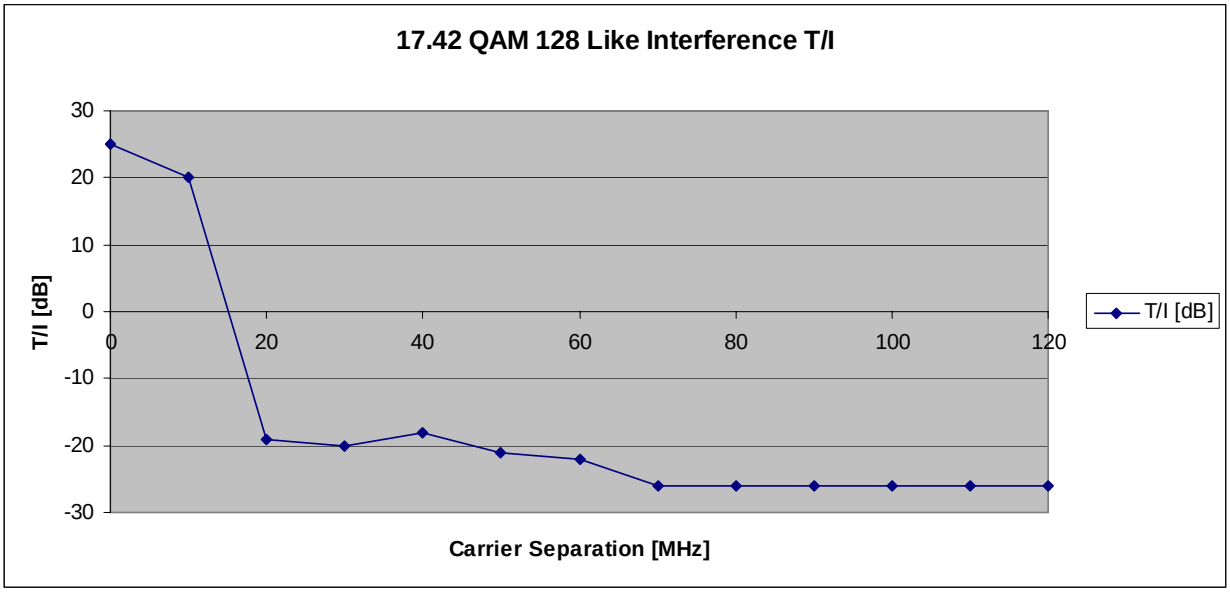


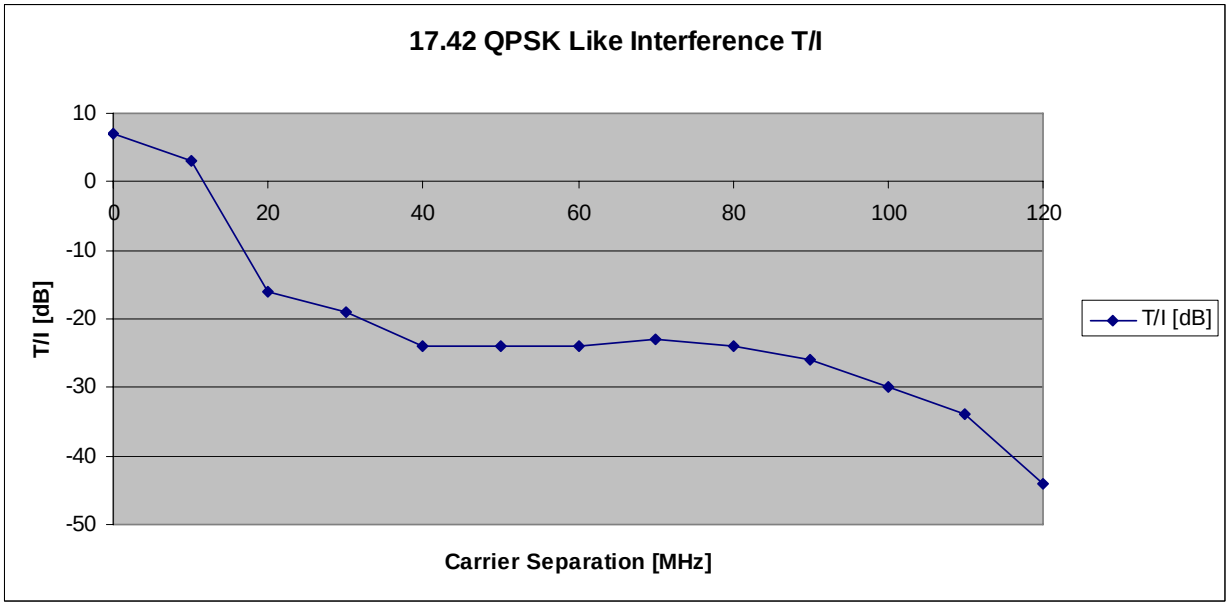
30 MHz channel (24.6 Symbol Rate)



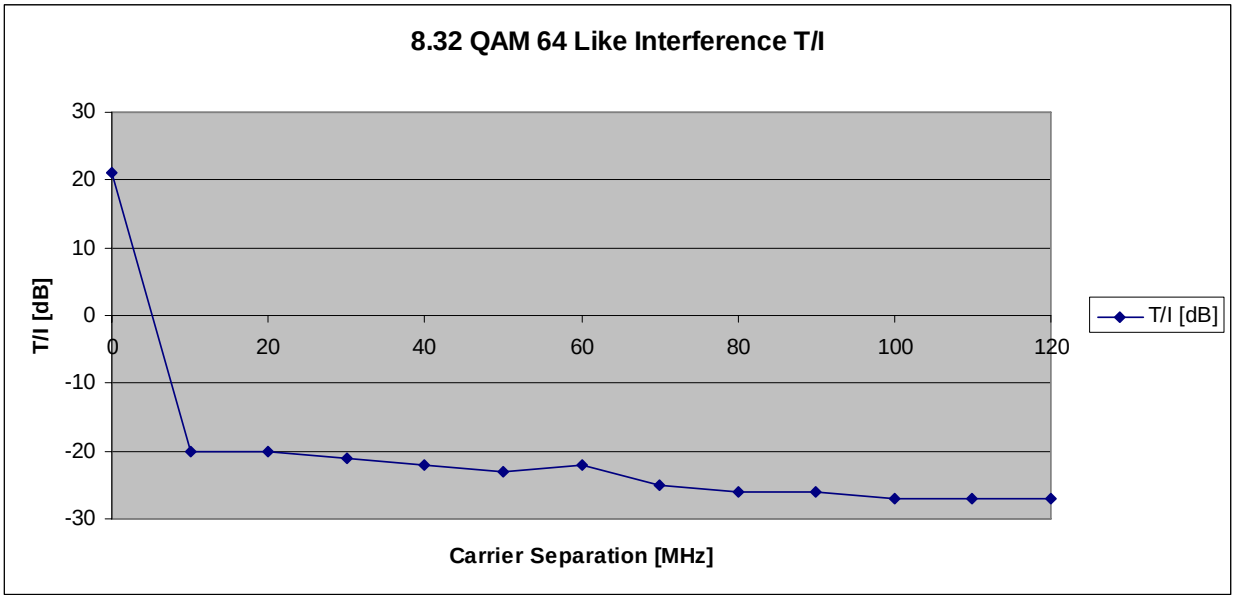


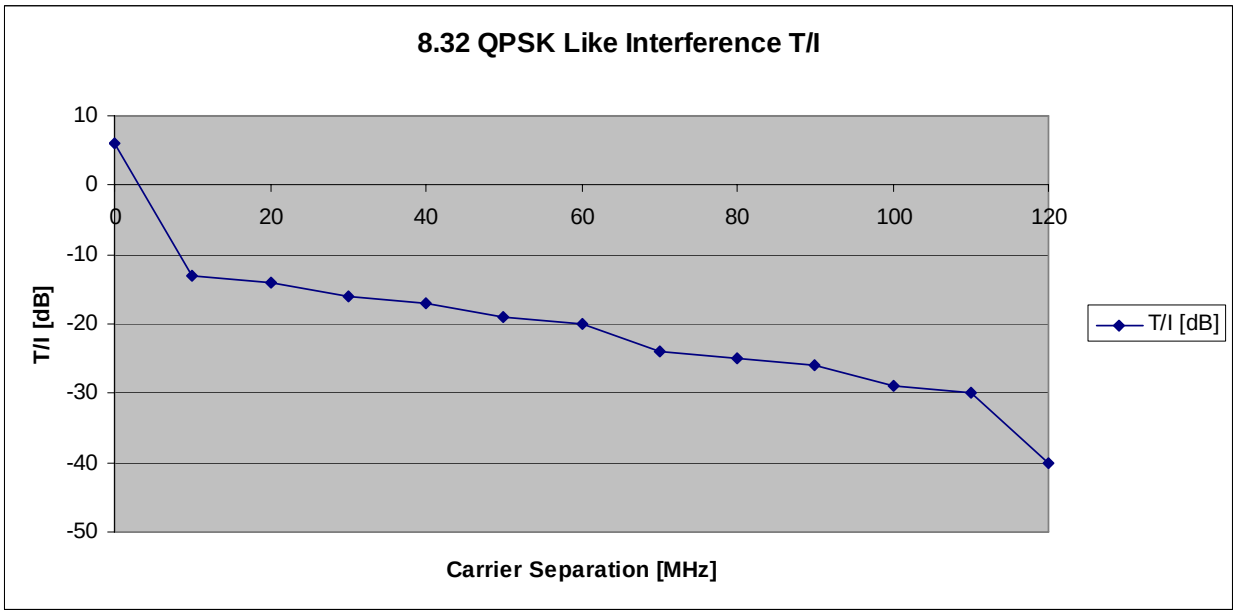
20 MHz channel (17.42 Symbol Rate)





10 MHz channel (8.32 Symbol Rate)





Supported Frequencies by Model

APEX11 models:

FCC Part 101								
10 MHz Channels								
ODU	Channel	RF TX freq	RF RX freq	Duplex	ODU	Channel	RF TX freq	RF RX freq
Model	Number	in MHz	in MHz	in MHz	Model	Number	in MHz	in MHz
Apex11- 1A	1	10735	11225	490	Apex11-1B	1	11225	10735
Apex11- 1A	2	10745	11235	490	Apex11-1B	2	11235	10745
Apex11- 1A	3	10755	11245	490	Apex11-1B	3	11245	10755
Apex11- 1A	4	10765	11255	490	Apex11-1B	4	11255	10765
Apex11- 1A	5	10775	11265	490	Apex11-1B	5	11265	10775
Apex11- 1A	6	10785	11275	490	Apex11-1B	6	11275	10785
Apex11- 1A	7	10795	11285	490	Apex11-1B	7	11285	10795
Apex11- 1A	8	10805	11295	490	Apex11-1B	8	11295	10805
Apex11- 1A	9	10815	11305	490	Apex11-1B	9	11305	10815
Apex11- 1A	10	10825	11315	490	Apex11-1B	10	11315	10825
Apex11- 1A	11	10835	11325	490	Apex11-1B	11	11325	10835
Apex11- 1A	12	10845	11335	490	Apex11-1B	12	11335	10845
Apex11- 1A	13	10855	11345	490	Apex11-1B	13	11345	10855
Apex11- 1A	14	10865	11355	490	Apex11-1B	14	11355	10865
Apex11- 1A	15	10875	11365	490	Apex11-1B	15	11365	10875
Apex11- 1A	16	10885	11375	490	Apex11-1B	16	11375	10885
Apex11- 1A	17	10895	11385	490	Apex11-1B	17	11385	10895
Apex11- 1A	18	10905	11395	490	Apex11-1B	18	11395	10905
Apex11- 1A	19	10915	11405	490	Apex11-1B	19	11405	10915
Apex11- 1A	20	10925	11415	490	Apex11-1B	20	11415	10925
Apex11- 1A	21	10935	11425	490	Apex11-1B	21	11425	10935
Apex11- 1A	22	10945	11435	490	Apex11-1B	22	11435	10945
Apex11- 2A	23	10955	11445	490	Apex11-2B	23	11445	10955
Apex11- 2A	24	10965	11455	490	Apex11-2B	24	11455	10965
Apex11- 2A	25	10975	11465	490	Apex11-2B	25	11465	10975
Apex11- 2A	26	10985	11475	490	Apex11-2B	26	11475	10985
Apex11- 2A	27	10995	11485	490	Apex11-2B	27	11485	10995
Apex11- 2A	28	11005	11495	490	Apex11-2B	28	11495	11005
Apex11- 2A	29	11015	11505	490	Apex11-2B	29	11505	11015
Apex11- 2A	30	11025	11515	490	Apex11-2B	30	11515	11025
Apex11- 2A	31	11035	11525	490	Apex11-2B	31	11525	11035
Apex11- 2A	32	11045	11535	490	Apex11-2B	32	11535	11045
Apex11- 2A	33	11055	11545	490	Apex11-2B	33	11545	11055
Apex11- 2A	34	11065	11555	490	Apex11-2B	34	11555	11065
Apex11- 2A	35	11075	11565	490	Apex11-2B	35	11565	11075
Apex11- 2A	36	11085	11575	490	Apex11-2B	36	11575	11085
Apex11- 2A	37	11095	11585	490	Apex11-2B	37	11585	11095
Apex11- 2A	38	11105	11595	490	Apex11-2B	38	11595	11105
Apex11- 2A	39	11115	11605	490	Apex11-2B	39	11605	11115
Apex11- 2A	40	11125	11615	490	Apex11-2B	40	11615	11125
Apex11- 2A	41	11135	11625	490	Apex11-2B	41	11625	11135

Apex11- 2A	42	11145	11635	490	Apex11-2B	42	11635	11145
Apex11- 2A	43	11155	11645	490	Apex11-2B	43	11645	11155
Apex11- 2A	44	11165	11655	490	Apex11-2B	44	11655	11165
Apex11- 2A	45	11175	11665	490	Apex11-2B	45	11665	11175
FCC Part 101								
30 MHz Channels								
ODU	**Channel**	**RF TX freq**	**RF RX freq**	**Duplex**	**ODU**	**Channel**	**RF TX freq**	**RF RX freq**
Model	**Number**	**in MHz**	**in MHz**	**in MHz**	**Model**	**Number**	**in MHz**	**in MHz**
Apex11- 1A	1	10755	11245	490	Apex11-1B	1	11245	10755
Apex11- 1A	2	10795	11285	490	Apex11-1B	2	11285	10795
Apex11- 1A	3	10835	11325	490	Apex11-1B	3	11325	10835
Apex11- 1A	4	10875	11365	490	Apex11-1B	4	11365	10875
Apex11- 1A	5	10915	11405	490	Apex11-1B	5	11405	10915
Apex11- 2A	6	10955	11445	490	Apex11-2B	6	11445	10955
Apex11- 2A	7	10995	11485	490	Apex11-2B	7	11485	10995
Apex11- 2A	8	11035	11525	490	Apex11-2B	8	11525	11035
Apex11- 2A	9	11075	11565	490	Apex11-2B	9	11565	11075
Apex11- 2A	10	11115	11605	490	Apex11-2B	10	11605	11115
Apex11- 2A	11	11155	11645	490	Apex11-2B	11	11645	11155
FCC Part 101								
40 MHz Channels								
ODU	**Channel**	**RF TX freq**	**RF RX freq**	**Duplex**	**ODU**	**Channel**	**RF TX freq**	**RF RX freq**
Model	**Number**	**in MHz**	**in MHz**	**in MHz**	**Model**	**Number**	**in MHz**	**in MHz**
Apex11- 1A	1	10735	11225	490	Apex11-1B	1	11225	10735
Apex11- 1A	2	10775	11265	490	Apex11-1B	2	11265	10775
Apex11- 1A	3	10815	11305	490	Apex11-1B	3	11305	10815
Apex11- 1A	4	10855	11345	490	Apex11-1B	4	11345	10855
Apex11- 1A	5	10895	11385	490	Apex11-1B	5	11385	10895
Apex11- 2A	6	10935	11425	490	Apex11-2B	6	11425	10935
Apex11- 2A	7	10975	11465	490	Apex11-2B	7	11465	10975
Apex11- 2A	8	11015	11505	490	Apex11-2B	8	11505	11015
Apex11- 2A	9	11055	11545	490	Apex11-2B	9	11545	11055
Apex11- 2A	10	11095	11585	490	Apex11-2B	10	11585	11095
Apex11- 2A	11	11135	11625	490	Apex11-2B	11	11625	11135
Apex11- 2A	12	11175	11665	490	Apex11-2B	12	11665	11175
Canada SRSP-310.7								
10 MHz Channels								
ODU	**Channel**	**RF TX freq**	**RF RX freq**	**Duplex**	**ODU**	**Channel**	**RF TX freq**	**RF RX freq**
Model	**Number**	**in MHz**	**in MHz**	**in MHz**	**Model**	**Number**	**in MHz**	**in MHz**
Apex11- 1A	1	10715	11205	490	Apex11-1B	1	11205	10715
Apex11- 1A	2	10725	11215	490	Apex11-1B	2	11215	10725
Apex11- 1A	3	10735	11225	490	Apex11-1B	3	11225	10735
Apex11- 1A	4	10745	11235	490	Apex11-1B	4	11235	10745
Apex11- 1A	5	10755	11245	490	Apex11-1B	5	11245	10755
Apex11- 2A	6	10765	11255	490	Apex11-2B	6	11255	10765
Apex11- 1A	7	10775	11265	490	Apex11-1B	7	11265	10775

Apex11- 1A	8	10785	11275	490	Apex11-1B	8	11275	10785
Apex11- 1A	9	10795	11285	490	Apex11-1B	9	11285	10795
Apex11- 1A	10	10805	11295	490	Apex11-1B	10	11295	10805
Apex11- 1A	11	10815	11305	490	Apex11-1B	11	11305	10815
Apex11- 2A	12	10825	11315	490	Apex11-2B	12	11315	10825
Apex11- 1A	13	10835	11325	490	Apex11-1B	13	11325	10835
Apex11- 1A	14	10845	11335	490	Apex11-1B	14	11335	10845
Apex11- 1A	15	10855	11345	490	Apex11-1B	15	11345	10855
Apex11- 1A	16	10865	11355	490	Apex11-1B	16	11355	10865
Apex11- 1A	17	10875	11365	490	Apex11-1B	17	11365	10875
Apex11- 2A	18	10885	11375	490	Apex11-2B	18	11375	10885
Apex11- 1A	19	10895	11385	490	Apex11-1B	19	11385	10895
Apex11- 1A	20	10905	11395	490	Apex11-1B	20	11395	10905
Apex11- 1A	21	10915	11405	490	Apex11-1B	21	11405	10915
Apex11- 1A	22	10925	11415	490	Apex11-1B	22	11415	10925
Apex11- 1A	23	10935	11425	490	Apex11-1B	23	11425	10935
Apex11- 2A	24	10945	11435	490	Apex11-2B	24	11435	10945
Apex11- 2A	25	10955	11445	490	Apex11-2B	25	11445	10955
Apex11- 2A	26	10965	11455	490	Apex11-2B	26	11455	10965
Apex11- 2A	27	10975	11465	490	Apex11-2B	27	11465	10975
Apex11- 2A	28	10985	11475	490	Apex11-2B	28	11475	10985
Apex11- 2A	29	10995	11485	490	Apex11-2B	29	11485	10995
Apex11- 2A	30	11005	11495	490	Apex11-2B	30	11495	11005
Apex11- 2A	31	11015	11505	490	Apex11-2B	31	11505	11015
Apex11- 2A	32	11025	11515	490	Apex11-2B	32	11515	11025
Apex11- 2A	33	11035	11525	490	Apex11-2B	33	11525	11035
Apex11- 2A	34	11045	11535	490	Apex11-2B	34	11535	11045
Apex11- 2A	35	11055	11545	490	Apex11-2B	35	11545	11055
Apex11- 2A	36	11065	11555	490	Apex11-2B	36	11555	11065
Apex11- 2A	37	11075	11565	490	Apex11-2B	37	11565	11075
Apex11- 2A	38	11085	11575	490	Apex11-2B	38	11575	11085
Apex11- 2A	39	11095	11585	490	Apex11-2B	39	11585	11095
Apex11- 2A	40	11105	11595	490	Apex11-2B	40	11595	11105
Apex11- 2A	41	11115	11605	490	Apex11-2B	41	11605	11115
Apex11- 2A	42	11125	11615	490	Apex11-2B	42	11615	11125
Apex11- 2A	43	11135	11625	490	Apex11-2B	43	11625	11135
Apex11- 2A	44	11145	11635	490	Apex11-2B	44	11635	11145
Apex11- 2A	45	11155	11645	490	Apex11-2B	45	11645	11155
Apex11- 2A	46	11165	11655	490	Apex11-2B	46	11655	11165
Apex11- 2A	47	11175	11665	490	Apex11-2B	47	11665	11175
Apex11- 2A	48	11185	11675	490	Apex11-2B	48	11675	11185
Apex11- 2A	49	11195	11685	490	Apex11-2B	49	11685	11195
Canada SRSP-310.7								
20 MHz Channels								
ODU Model	**Channel Number**	**RF TX freq in MHz**	**RF RX freq in MHz**	**Duplex in MHz**	**ODU Model**	**Channel Number**	**RF TX freq in MHz**	**RF RX freq in MHz**
Apex11- 1A	1	10720	11210	490	Apex11-1B	1	11210	10720
Apex11- 1A	2	10740	11230	490	Apex11-2B	2	11230	10740
Apex11- 1A	3	10760	11250	490	Apex11-1B	3	11250	10760
Apex11- 1A	4	10780	11270	490	Apex11-2B	4	11270	10780

Apex11- 1A	5	10800	11290	490	Apex11-1B	5	11290	10800
Apex11- 1A	6	10820	11310	490	Apex11-2B	6	11310	10820
Apex11- 1A	7	10840	11330	490	Apex11-1B	7	11330	10840
Apex11- 1A	8	10860	11350	490	Apex11-2B	8	11350	10860
Apex11- 1A	9	10880	11370	490	Apex11-1B	9	11370	10880
Apex11- 1A	10	10900	11390	490	Apex11-2B	10	11390	10900
Apex11- 1A	11	10920	11410	490	Apex11-1B	11	11410	10920
Apex11- 1A	12	10940	11430	490	Apex11-2B	12	11430	10940
Apex11- 2A	13	10960	11450	490	Apex11-2B	13	11450	10960
Apex11- 2A	14	10980	11470	490	Apex11-2B	14	11470	10980
Apex11- 2A	15	11000	11490	490	Apex11-2B	15	11490	11000
Apex11- 2A	16	11020	11510	490	Apex11-2B	16	11510	11020
Apex11- 2A	17	11040	11530	490	Apex11-2B	17	11530	11040
Apex11- 2A	18	11060	11550	490	Apex11-2B	18	11550	11060
Apex11- 2A	19	11080	11570	490	Apex11-2B	19	11570	11080
Apex11- 2A	20	11100	11590	490	Apex11-2B	20	11590	11100
Apex11- 2A	21	11120	11610	490	Apex11-2B	21	11610	11120
Apex11- 2A	22	11140	11630	490	Apex11-2B	22	11630	11140
Apex11- 2A	23	11160	11650	490	Apex11-2B	23	11650	11160
Apex11- 2A	24	11180	11670	490	Apex11-2B	24	11670	11180
Canada SRSP-310.7								
30 MHz Channels								
ODU	**Channel**	**RF TX freq**	**RF RX freq**	**Duplex**	**ODU**	**Channel**	**RF TX freq**	**RF RX freq**
Model	**Number**	**in MHz**	**in MHz**	**in MHz**	**Model**	**Number**	**in MHz**	**in MHz**
Apex11- 1A	1	10725	11215	490	Apex11-1B	1	11215	10725
Apex11- 1A	2	10755	11245	490	Apex11-2B	2	11245	10755
Apex11- 1A	3	10785	11275	490	Apex11-1B	3	11275	10785
Apex11- 1A	4	10815	11305	490	Apex11-2B	4	11305	10815
Apex11- 1A	5	10845	11335	490	Apex11-1B	5	11335	10845
Apex11- 1A	6	10875	11365	490	Apex11-2B	6	11365	10875
Apex11- 1A	7	10905	11395	490	Apex11-1B	7	11395	10905
Apex11- 1A	8	10935	11425	490	Apex11-2B	8	11425	10935
Apex11- 2A	9	10965	11455	490	Apex11-2B	9	11455	10965
Apex11- 2A	10	10995	11485	490	Apex11-2B	10	11485	10995
Apex11- 2A	11	11025	11515	490	Apex11-2B	11	11515	11025
Apex11- 2A	12	11055	11545	490	Apex11-2B	12	11545	11055
Apex11- 2A	13	11085	11575	490	Apex11-2B	13	11575	11085
Apex11- 2A	14	11115	11605	490	Apex11-2B	14	11605	11115
Apex11- 2A	15	11145	11635	490	Apex11-2B	15	11635	11145
Apex11- 2A	16	11175	11665	490	Apex11-2B	16	11665	11175
Canada SRSP-310.7								
40 MHz Channels								
ODU	**Channel**	**RF TX freq**	**RF RX freq**	**Duplex**	**ODU**	**Channel**	**RF TX freq**	**RF RX freq**
Model	**Number**	**in MHz**	**in MHz**	**in MHz**	**Model**	**Number**	**in MHz**	**in MHz**
Apex11- 1A	1	10735	11225	490	Apex11-1B	1	11225	10735
Apex11- 1A	2	10775	11265	490	Apex11-2B	2	11265	10775
Apex11- 1A	3	10815	11305	490	Apex11-1B	3	11305	10815
Apex11- 1A	4	10855	11345	490	Apex11-2B	4	11345	10855

Apex11- 1A	5	10895	11385	490	Apex11-1B	5	11385	10895
Apex11- 1A	6	10935	11425	490	Apex11-2B	6	11425	10935
Apex11- 2A	7	10975	11465	490	Apex11-2B	7	11465	10975
Apex11- 2A	8	11015	11505	490	Apex11-2B	8	11505	11015
Apex11- 2A	9	11055	11545	490	Apex11-2B	9	11545	11055
Apex11- 2A	10	11095	11585	490	Apex11-2B	10	11585	11095
Apex11- 2A	11	11135	11625	490	Apex11-2B	11	11625	11135
Apex11- 2A	12	11175	11665	490	Apex11-2B	12	11665	11175

APEX11E

CEPT 12-06E								
40 MHz Channels								
ODU Model	**Channel Number**	**RF TX freq in MHz**	**RF RX freq in MHz**	**Duplex in MHz**	**ODU Model**	**Channel Number**	**RF TX freq in MHz**	**RF RX freq in MHz**
Apex11E-1A	1	10735	11225	490	Apex11E-1B	1	11225	10735
Apex11E-1A	2	10775	11265	490	Apex11E-1B	2	11265	10775
Apex11E-1A	3	10815	11305	490	Apex11E-1B	3	11305	10815
Apex11E-1A	4	10855	11345	490	Apex11E-1B	4	11345	10855
Apex11E-1A	5	10895	11385	490	Apex11E-1B	5	11385	10895
Apex11E-1A	6	10935	11425	490	Apex11E-1B	6	11425	10935
Apex11E-2A	7	10975	11465	490	Apex11E-2B	7	11465	10975
Apex11E-2A	8	11015	11505	490	Apex11E-2B	8	11505	11015
Apex11E-2A	9	11055	11545	490	Apex11E-2B	9	11545	11055
Apex11E-2A	10	11095	11585	490	Apex11E-2B	10	11585	11095
Apex11E-2A	11	11135	11625	490	Apex11E-2B	11	11625	11135
ITU-R F.387-10								
40 MHz Channels								
ODU Model	**Channel Number**	**RF TX freq in MHz**	**RF RX freq in MHz**	**Duplex in MHz**	**ODU Model**	**Channel Number**	**RF TX freq in MHz**	**RF RX freq in MHz**
Apex11E-1A	1	10735	11225	490	Apex11E-1B	1	11225	10735
Apex11E-1A	2	10775	11265	490	Apex11E-1B	2	11265	10775
Apex11E-1A	3	10815	11305	490	Apex11E-1B	3	11305	10815
Apex11E-1A	4	10855	11345	490	Apex11E-1B	4	11345	10855
Apex11E-1A	5	10895	11385	490	Apex11E-1B	5	11385	10895
Apex11E-1A	6	10935	11425	490	Apex11E-1B	6	11425	10935
Apex11E-2A	7	10975	11465	490	Apex11E-2B	7	11465	10975
Apex11E-2A	8	11015	11505	490	Apex11E-2B	8	11505	11015
Apex11E-2A	9	11055	11545	490	Apex11E-2B	9	11545	11055
Apex11E-2A	10	11095	11585	490	Apex11E-2B	10	11585	11095
Apex11E-2A	11	11135	11625	490	Apex11E-2B	11	11625	11135
Apex11E-2A	12	11175	11665	490	Apex11E-2B	12	11665	11175

APEX18 ANSI Models:

FCC								
10 MHz Channels								
ODU	Channel	RF TX freq	RF RX freq	Duplex	ODU	Channel	RF TX freq	RF RX freq
Model	Number	in MHz	in MHz	in MHz	Model	Number	in MHz	in MHz
Apex18-1A	1	17705	19265	1560	Apex18-1B	1	19265	17705
Apex18-1A	2	17715	19275	1560	Apex18-1B	2	19275	17715
Apex18-1A	3	17725	19285	1560	Apex18-1B	3	19285	17725
Apex18-1A	4	17735	19295	1560	Apex18-1B	4	19295	17735
Apex18-1A	5	17745	19305	1560	Apex18-1B	5	19305	17745
Apex18-1A	6	17755	19315	1560	Apex18-1B	6	19315	17755
Apex18-1A	7	17765	19325	1560	Apex18-1B	7	19325	17765
Apex18-1A	8	17775	19335	1560	Apex18-1B	8	19335	17775
Apex18-1A	9	17785	19345	1560	Apex18-1B	9	19345	17785
Apex18-1A	10	17795	19355	1560	Apex18-1B	10	19355	17795
Apex18-1A	11	17805	19365	1560	Apex18-1B	11	19365	17805
Apex18-1A	12	17815	19375	1560	Apex18-1B	12	19375	17815
Apex18-1A	13	17825	19385	1560	Apex18-1B	13	19385	17825
Apex18-1A	14	17835	19395	1560	Apex18-1B	14	19395	17835
Apex18-1A	15	17845	19405	1560	Apex18-1B	15	19405	17845
Apex18-1A	16	17855	19415	1560	Apex18-1B	16	19415	17855
Apex18-1A	17	17865	19425	1560	Apex18-1B	17	19425	17865
Apex18-1A	18	17875	19435	1560	Apex18-1B	18	19435	17875
Apex18-1A	19	17885	19445	1560	Apex18-1B	19	19445	17885
Apex18-1A	20	17895	19455	1560	Apex18-1B	20	19455	17895
Apex18-1A	21	17905	19465	1560	Apex18-1B	21	19465	17905
Apex18-1A	22	17915	19475	1560	Apex18-1B	22	19475	17915
Apex18-1A	23	17925	19485	1560	Apex18-1B	23	19485	17925
Apex18-1A	24	17935	19495	1560	Apex18-1B	24	19495	17935
Apex18-1A	25	17945	19505	1560	Apex18-1B	25	19505	17945
Apex18-1A	26	17955	19515	1560	Apex18-1B	26	19515	17955
Apex18-1A	27	17965	19525	1560	Apex18-1B	27	19525	17965
Apex18-1A	28	17975	19535	1560	Apex18-1B	28	19535	17975
Apex18-1A	29	17985	19545	1560	Apex18-1B	29	19545	17985
Apex18-1A	30	17995	19555	1560	Apex18-1B	30	19555	17995
Apex18-1A	31	18005	19565	1560	Apex18-1B	31	19565	18005
Apex18-1A	32	18015	19575	1560	Apex18-1B	32	19575	18015
Apex18-1A	33	18025	19585	1560	Apex18-1B	33	19585	18025
Apex18-1A	34	18035	19595	1560	Apex18-1B	34	19595	18035
Apex18-1A	35	18045	19605	1560	Apex18-1B	35	19605	18045
Apex18-1A	36	18055	19615	1560	Apex18-1B	36	19615	18055
Apex18-1A	37	18065	19625	1560	Apex18-1B	37	19625	18065
Apex18-1A	38	18075	19635	1560	Apex18-1B	38	19635	18075
Apex18-1A	39	18085	19645	1560	Apex18-1B	39	19645	18085
Apex18-1A	40	18095	19655	1560	Apex18-1B	40	19655	18095
Apex18-1A	41	18105	19665	1560	Apex18-1B	41	19665	18105
Apex18-1A	42	18115	19675	1560	Apex18-1B	42	19675	18115
Apex18-1A	43	18125	19685	1560	Apex18-1B	43	19685	18125
Apex18-1A	44	18135	19695	1560	Apex18-1B	44	19695	18135

FCC

20 MHz Channels

ODU	Channel	RF TX freq	RF RX freq	Duplex	ODU	Channel	RF TX freq	RF RX freq
Model	**Number**	**in MHz**	**in MHz**	**in MHz**	**Model**	**Number**	**in MHz**	**in MHz**
Apex18-1A	1	17710	19270	1560	Apex18-1B	1	19270	17710
Apex18-1A	2	17730	19290	1560	Apex18-1B	2	19290	17730
Apex18-1A	3	17750	19310	1560	Apex18-1B	3	19310	17750
Apex18-1A	4	17770	19330	1560	Apex18-1B	4	19330	17770
Apex18-1A	5	17790	19350	1560	Apex18-1B	5	19350	17790
Apex18-1A	6	17810	19370	1560	Apex18-1B	6	19370	17810
Apex18-1A	7	17830	19390	1560	Apex18-1B	7	19390	17830
Apex18-1A	8	17850	19410	1560	Apex18-1B	8	19410	17850
Apex18-1A	9	17870	19430	1560	Apex18-1B	9	19430	17870
Apex18-1A	10	17890	19450	1560	Apex18-1B	10	19450	17890
Apex18-1A	11	17910	19470	1560	Apex18-1B	11	19470	17910
Apex18-1A	12	17930	19490	1560	Apex18-1B	12	19490	17930
Apex18-1A	13	17950	19510	1560	Apex18-1B	13	19510	17950
Apex18-1A	14	17970	19530	1560	Apex18-1B	14	19530	17970
Apex18-1A	15	17990	19550	1560	Apex18-1B	15	19550	17990
Apex18-1A	16	18010	19570	1560	Apex18-1B	16	19570	18010
Apex18-1A	17	18030	19590	1560	Apex18-1B	17	19590	18030
Apex18-1A	18	18050	19610	1560	Apex18-1B	18	19610	18050
Apex18-1A	19	18070	19630	1560	Apex18-1B	19	19630	18070
Apex18-1A	20	18090	19650	1560	Apex18-1B	20	19650	18090
Apex18-1A	21	18110	19670	1560	Apex18-1B	21	19670	18110
Apex18-1A	22	18130	19690	1560	Apex18-1B	22	19690	18130

FCC

40 MHz Channels

ODU	Channel	RF TX freq	RF RX freq	Duplex	ODU	Channel	RF TX freq	RF RX freq
Model	**Number**	**in MHz**	**in MHz**	**in MHz**	**Model**	**Number**	**in MHz**	**in MHz**
Apex18-1A	1	17720	19280	1560	Apex18-1B	1	19280	17720
Apex18-1A	2	17760	19320	1560	Apex18-1B	2	19320	17760
Apex18-1A	3	17800	19360	1560	Apex18-1B	3	19360	17800
Apex18-1A	4	17840	19400	1560	Apex18-1B	4	19400	17840
Apex18-1A	5	17880	19440	1560	Apex18-1B	5	19440	17880
Apex18-1A	6	17920	19480	1560	Apex18-1B	6	19480	17920
Apex18-1A	7	17960	19520	1560	Apex18-1B	7	19520	17960
Apex18-1A	8	18000	19560	1560	Apex18-1B	8	19560	18000
Apex18-1A	9	18040	19600	1560	Apex18-1B	9	19600	18040
Apex18-1A	10	18080	19640	1560	Apex18-1B	10	19640	18080
Apex18-1A	11	18120	19680	1560	Apex18-1B	11	19680	18120

FCC

80 MHz Channels

ODU	Channel	RF TX freq	RF RX freq	Duplex	ODU	Channel	RF TX freq	RF RX freq
Model	**Number**	**in MHz**	**in MHz**	**in MHz**	**Model**	**Number**	**in MHz**	**in MHz**
Apex18-1A	1	17740	19300	1560	Apex18-1B	1	19300	17740
Apex18-1A	2	17820	19380	1560	Apex18-1B	2	19380	17820
Apex18-1A	3	17900	19460	1560	Apex18-1B	3	19460	17900

Apex18-1A	4	17980	19540	1560	Apex18-1B	4	19540	17980
Apex18-1A	5	18060	19620	1560	Apex18-1B	5	19620	18060
Canada								
10 MHz Channels								
ODU Model	**Channel Number**	**RF TX freq in MHz**	**RF RX freq in MHz**	**Duplex in MHz**	**ODU Model**	**Channel Number**	**RF TX freq in MHz**	**RF RX freq in MHz**
Apex18-1A	1	17805	19365	1560	Apex18-1B	1	19365	17805
Apex18-1A	2	17815	19375	1560	Apex18-1B	2	19375	17815
Apex18-1A	3	17825	19385	1560	Apex18-1B	3	19385	17825
Apex18-1A	4	17835	19395	1560	Apex18-1B	4	19395	17835
Apex18-1A	5	17845	19405	1560	Apex18-1B	5	19405	17845
Apex18-1A	6	17855	19415	1560	Apex18-1B	6	19415	17855
Apex18-1A	7	17865	19425	1560	Apex18-1B	7	19425	17865
Apex18-1A	8	17875	19435	1560	Apex18-1B	8	19435	17875
Apex18-1A	9	17885	19445	1560	Apex18-1B	9	19445	17885
Apex18-1A	10	17895	19455	1560	Apex18-1B	10	19455	17895
Apex18-1A	11	17905	19465	1560	Apex18-1B	11	19465	17905
Apex18-1A	12	17915	19475	1560	Apex18-1B	12	19475	17915
Apex18-1A	13	17925	19485	1560	Apex18-1B	13	19485	17925
Apex18-1A	14	17935	19495	1560	Apex18-1B	14	19495	17935
Apex18-1A	15	17945	19505	1560	Apex18-1B	15	19505	17945
Apex18-1A	16	17955	19515	1560	Apex18-1B	16	19515	17955
Apex18-1A	17	17965	19525	1560	Apex18-1B	17	19525	17965
Apex18-1A	18	17975	19535	1560	Apex18-1B	18	19535	17975
Apex18-1A	19	17985	19545	1560	Apex18-1B	19	19545	17985
Apex18-1A	20	17995	19555	1560	Apex18-1B	20	19555	17995
Apex18-1A	21	18005	19565	1560	Apex18-1B	21	19565	18005
Apex18-1A	22	18015	19575	1560	Apex18-1B	22	19575	18015
Apex18-1A	23	18025	19585	1560	Apex18-1B	23	19585	18025
Apex18-1A	24	18035	19595	1560	Apex18-1B	24	19595	18035
Apex18-1A	25	18045	19605	1560	Apex18-1B	25	19605	18045
Apex18-1A	26	18055	19615	1560	Apex18-1B	26	19615	18055
Apex18-1A	27	18065	19625	1560	Apex18-1B	27	19625	18065
Apex18-1A	28	18075	19635	1560	Apex18-1B	28	19635	18075
Apex18-1A	29	18085	19645	1560	Apex18-1B	29	19645	18085
Apex18-1A	30	18095	19655	1560	Apex18-1B	30	19655	18095
Apex18-1A	31	18105	19665	1560	Apex18-1B	31	19665	18105
Apex18-1A	32	18115	19675	1560	Apex18-1B	32	19675	18115
Apex18-1A	33	18125	19685	1560	Apex18-1B	33	19685	18125
Apex18-1A	34	18135	19695	1560	Apex18-1B	34	19695	18135
Canada								
20 MHz Channels								
ODU Model	**Channel Number**	**RF TX freq in MHz**	**RF RX freq in MHz**	**Duplex in MHz**	**ODU Model**	**Channel Number**	**RF TX freq in MHz**	**RF RX freq in MHz**
Apex18-1A	1	17810	19370	1560	Apex18-1B	1	19370	17810
Apex18-1A	2	17830	19390	1560	Apex18-1B	2	19390	17830
Apex18-1A	3	17850	19410	1560	Apex18-1B	3	19410	17850

Apex18-1A	4	17870	19430	1560	Apex18-1B	4	19430	17870
Apex18-1A	5	17890	19450	1560	Apex18-1B	5	19450	17890
Apex18-1A	6	17910	19470	1560	Apex18-1B	6	19470	17910
Apex18-1A	7	17930	19490	1560	Apex18-1B	7	19490	17930
Apex18-1A	8	17950	19510	1560	Apex18-1B	8	19510	17950
Apex18-1A	9	17970	19530	1560	Apex18-1B	9	19530	17970
Apex18-1A	10	17990	19550	1560	Apex18-1B	10	19550	17990
Apex18-1A	11	18010	19570	1560	Apex18-1B	11	19570	18010
Apex18-1A	12	18030	19590	1560	Apex18-1B	12	19590	18030
Apex18-1A	13	18050	19610	1560	Apex18-1B	13	19610	18050
Apex18-1A	14	18070	19630	1560	Apex18-1B	14	19630	18070
Apex18-1A	15	18090	19650	1560	Apex18-1B	15	19650	18090
Apex18-1A	16	18110	19670	1560	Apex18-1B	16	19670	18110
Apex18-1A	17	18130	19690	1560	Apex18-1B	17	19690	18130

Canada

30 MHz Channels

ODU	Channel	RF TX freq	RF RX freq	Duplex	ODU	Channel	RF TX freq	RF RX freq
Model	**Number**	**in MHz**	**in MHz**	**in MHz**	**Model**	**Number**	**in MHz**	**in MHz**
Apex18-1A	1	17815	19375	1560	Apex18-1B	1	19375	17815
Apex18-1A	2	17845	19405	1560	Apex18-1B	2	19405	17845
Apex18-1A	3	17875	19435	1560	Apex18-1B	3	19435	17875
Apex18-1A	4	17905	19465	1560	Apex18-1B	4	19465	17905
Apex18-1A	5	17935	19495	1560	Apex18-1B	5	19495	17935
Apex18-1A	6	17965	19525	1560	Apex18-1B	6	19525	17965
Apex18-1A	7	17995	19555	1560	Apex18-1B	7	19555	17995
Apex18-1A	8	18025	19585	1560	Apex18-1B	8	19585	18025
Apex18-1A	9	18055	19615	1560	Apex18-1B	9	19615	18055
Apex18-1A	10	18085	19645	1560	Apex18-1B	10	19645	18085
Apex18-1A	11	18115	19675	1560	Apex18-1B	11	19675	18115

Canada

40 MHz Channels

ODU	Channel	RF TX freq	RF RX freq	Duplex	ODU	Channel	RF TX freq	RF RX freq
Model	**Number**	**in MHz**	**in MHz**	**in MHz**	**Model**	**Number**	**in MHz**	**in MHz**
Apex18-1A	1	17840	19400	1560	Apex18-1B	1	19400	17840
Apex18-1A	2	17880	19440	1560	Apex18-1B	2	19440	17880
Apex18-1A	3	17920	19480	1560	Apex18-1B	3	19480	17920
Apex18-1A	4	17960	19520	1560	Apex18-1B	4	19520	17960
Apex18-1A	5	18000	19560	1560	Apex18-1B	5	19560	18000
Apex18-1A	6	18040	19600	1560	Apex18-1B	6	19600	18040
Apex18-1A	7	18080	19640	1560	Apex18-1B	7	19640	18080
Apex18-1A	8	18120	19680	1560	Apex18-1B	8	19680	18120

Canada								
50 MHz Channels								
ODU	**Channel**	**RF TX freq**	**RF RX freq**	**Duplex**	**ODU**	**Channel**	**RF TX freq**	**RF RX freq**
Model	**Number**	**in MHz**	**in MHz**	**in MHz**	**Model**	**Number**	**in MHz**	**in MHz**
Apex18-1A	1	17865	19425	1560	Apex18-1B	1	19425	17865
Apex18-1A	2	17915	19475	1560	Apex18-1B	2	19475	17915
Apex18-1A	3	17965	19525	1560	Apex18-1B	3	19525	17965
Apex18-1A	4	18015	19575	1560	Apex18-1B	4	19575	18015
Apex18-1A	5	18065	19625	1560	Apex18-1B	5	19625	18065
Apex18-1A	6	18115	19675	1560	Apex18-1B	6	19675	18115

APEX18E models:

Australia RALI FX3								
55 MHz Channels								
ODU	**Channel**	**RF TX freq**	**RF RX freq**	**Duplex**	**ODU**	**Channel**	**RF TX freq**	**RF RX freq**
Model	**Number**	**in MHz**	**in MHz**	**in MHz**	**Model**	**Number**	**in MHz**	**in MHz**
Apex18E-2A	1	18360	19370	1010	Apex18E-2B	1	19370	18360
Apex18E-2A	2	18415	19425	1010	Apex18E-2B	2	19425	18415
Apex18E-2A	3	18470	19480	1010	Apex18E-2B	3	19480	18470
Apex18E-2A	4	18525	19535	1010	Apex18E-2B	4	19535	18525
Apex18E-2A	5	18580	19590	1010	Apex18E-2B	5	19590	18580
Australia RALI FX3								
27.5 MHz Channels								
ODU	**Channel**	**RF TX freq**	**RF RX freq**	**Duplex**	**ODU**	**Channel**	**RF TX freq**	**RF RX freq**
Model	**Number**	**in MHz**	**in MHz**	**in MHz**	**Model**	**Number**	**in MHz**	**in MHz**
Apex18E-2A	1	18305	19315	1010	Apex18E-2B	1	19315	18305
Apex18E-2A	2	18332.5	19342.5	1010	Apex18E-2B	2	19342.5	18332.5
Apex18E-2A	3	18360	19370	1010	Apex18E-2B	3	19370	18360
Apex18E-2A	4	18387.5	19397.5	1010	Apex18E-2B	4	19397.5	18387.5
Apex18E-2A	5	18415	19425	1010	Apex18E-2B	5	19425	18415
Apex18E-2A	6	18442.5	19452.5	1010	Apex18E-2B	6	19452.5	18442.5
Apex18E-2A	7	18470	19480	1010	Apex18E-2B	7	19480	18470
Apex18E-2A	8	18497.5	19507.5	1010	Apex18E-2B	8	19507.5	18497.5
Apex18E-2A	9	18525	19535	1010	Apex18E-2B	9	19535	18525
Apex18E-2A	10	18552.5	19562.5	1010	Apex18E-2B	10	19562.5	18552.5

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55 MHz Channels

ODU Model	Channel Number	RF TX freq in MHz	RF RX freq in MHz	Duplex in MHz	ODU Model	Channel Number	RF TX freq in MHz	RF RX freq in MHz
Apex18E-1A	1	17755	18765	1010	Apex18E-1B	1	18765	17755
Apex18E-1A	2	17810	18820	1010	Apex18E-1B	2	18820	17810
Apex18E-1A	3	17865	18875	1010	Apex18E-1B	3	18875	17865
Apex18E-1A	4	17920	18930	1010	Apex18E-1B	4	18930	17920
Apex18E-1A	5	17975	18985	1010	Apex18E-1B	5	18985	17975
Apex18E-1A	6	18030	19040	1010	Apex18E-1B	6	19040	18030
Apex18E-1A	7	18085	19095	1010	Apex18E-1B	7	19095	18085
Apex18E-1A	8	18140	19150	1010	Apex18E-1B	8	19150	18140
Apex18E-2A	9	18195	19205	1010	Apex18E-2B	9	19205	18195
Apex18E-2A	10	18250	19260	1010	Apex18E-2B	10	19260	18250
Apex18E-2A	11	18305	19315	1010	Apex18E-2B	11	19315	18305
Apex18E-2A	12	18360	19370	1010	Apex18E-2B	12	19370	18360
Apex18E-2A	13	18415	19425	1010	Apex18E-2B	13	19425	18415
Apex18E-2A	14	18470	19480	1010	Apex18E-2B	14	19480	18470
Apex18E-2A	15	18525	19535	1010	Apex18E-2B	15	19535	18525
Apex18E-2A	16	18580	19590	1010	Apex18E-2B	16	19590	18580
Apex18E-2A	17	18635	19645	1010	Apex18E-2B	17	19645	18635

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27.5 MHz Channels

ODU Model	Channel Number	RF TX freq in MHz	RF RX freq in MHz	Duplex in MHz	ODU Model	Channel Number	RF TX freq in MHz	RF RX freq in MHz
Apex18E-1A	1	17727.5	18737.5	1010	Apex18E-1B	1	18737.5	17727.5
Apex18E-1A	2	17755	18765	1010	Apex18E-1B	2	18765	17755
Apex18E-1A	3	17782.5	18792.5	1010	Apex18E-1B	3	18792.5	17782.5
Apex18E-1A	4	17810	18820	1010	Apex18E-1B	4	18820	17810
Apex18E-1A	5	17837.5	18847.5	1010	Apex18E-1B	5	18847.5	17837.5
Apex18E-1A	6	17865	18875	1010	Apex18E-1B	6	18875	17865
Apex18E-1A	7	17892.5	18902.5	1010	Apex18E-1B	7	18902.5	17892.5
Apex18E-1A	8	17920	18930	1010	Apex18E-1B	8	18930	17920
Apex18E-1A	9	17947.5	18957.5	1010	Apex18E-1B	9	18957.5	17947.5
Apex18E-1A	10	17975	18985	1010	Apex18E-1B	10	18985	17975
Apex18E-1A	11	18002.5	19012.5	1010	Apex18E-1B	11	19012.5	18002.5
Apex18E-1A	12	18030	19040	1010	Apex18E-1B	12	19040	18030
Apex18E-1A	13	18057.5	19067.5	1010	Apex18E-1B	13	19067.5	18057.5
Apex18E-1A	14	18085	19095	1010	Apex18E-1B	14	19095	18085
Apex18E-1A	15	18112.5	19122.5	1010	Apex18E-1B	15	19122.5	18112.5
Apex18E-1A	16	18140	19150	1010	Apex18E-1B	16	19150	18140
Apex18E-1A	17	18167.5	19177.5	1010	Apex18E-1B	17	19177.5	18167.5
Apex18E-2A	18	18195	19205	1010	Apex18E-2B	18	19205	18195
Apex18E-2A	19	18222.5	19232.5	1010	Apex18E-2B	19	19232.5	18222.5
Apex18E-2A	20	18250	19260	1010	Apex18E-2B	20	19260	18250
Apex18E-2A	21	18277.5	19287.5	1010	Apex18E-2B	21	19287.5	18277.5

Apex18E-2A	22	18305	19315	1010	Apex18E-2B	22	19315	18305
Apex18E-2A	23	18332.5	19342.5	1010	Apex18E-2B	23	19342.5	18332.5
Apex18E-2A	24	18360	19370	1010	Apex18E-2B	24	19370	18360
Apex18E-2A	25	18387.5	19397.5	1010	Apex18E-2B	25	19397.5	18387.5
Apex18E-2A	26	18415	19425	1010	Apex18E-2B	26	19425	18415
Apex18E-2A	27	18442.5	19452.5	1010	Apex18E-2B	27	19452.5	18442.5
Apex18E-2A	28	18470	19480	1010	Apex18E-2B	28	19480	18470
Apex18E-2A	29	18497.5	19507.5	1010	Apex18E-2B	29	19507.5	18497.5
Apex18E-2A	30	18525	19535	1010	Apex18E-2B	30	19535	18525
Apex18E-2A	31	18552.5	19562.5	1010	Apex18E-2B	31	19562.5	18552.5
Apex18E-2A	32	18580	19590	1010	Apex18E-2B	32	19590	18580
Apex18E-2A	33	18607.5	19617.5	1010	Apex18E-2B	33	19617.5	18607.5
Apex18E-2A	34	18635	19645	1010	Apex18E-2B	34	19645	18635
Apex18E-2A	35	18662.5	19672.5	1010	Apex18E-2B	35	19672.5	18662.5

Appendix C: Cable Pin outs

Industry Standard CAT-5 Pin outs

Below are pictures depicting the cable pin-outs for *Straight-Through* and *Cross-Over* cables. These images conform to EIA/TIA industry standard for 568-A and 568-B.

- If the first and second pins are orange, the cable is 568-B.
- If the first and second pins are green, the cable is 568-A (Figure 35).
- If one end of the cable is A and the other end is B then it is a *Cross-Over* cable.

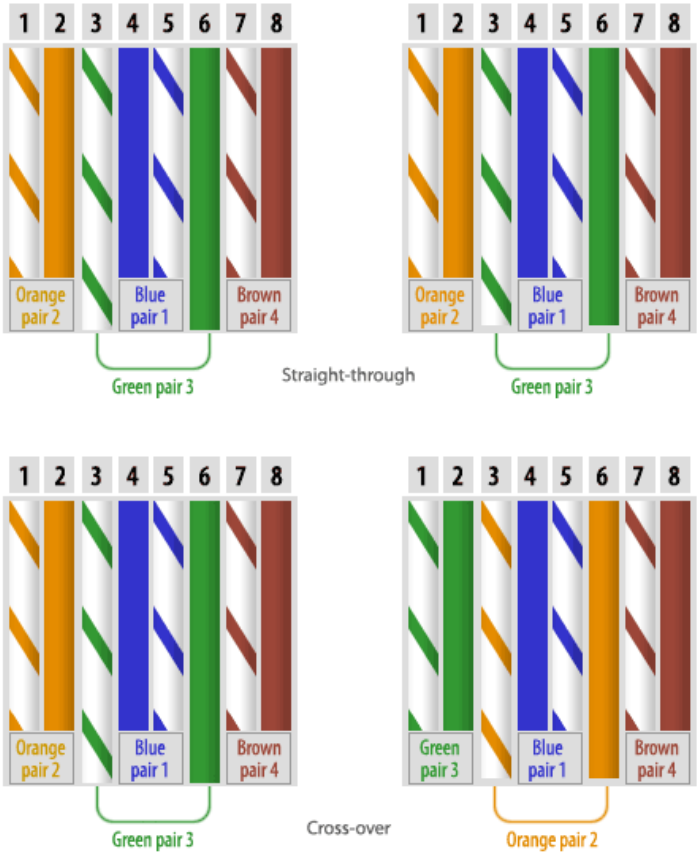

Figure 34: EIA/TIA 586-A & 586-B Pin-Outs

Apex Serial Cable Pin-out

The diagrams below depict TrangoLINK® Apex serial cable pin outs. Please note that Trango recommends purchasing this cable directly from Trango to ensure proper pin out and performance of the cable.

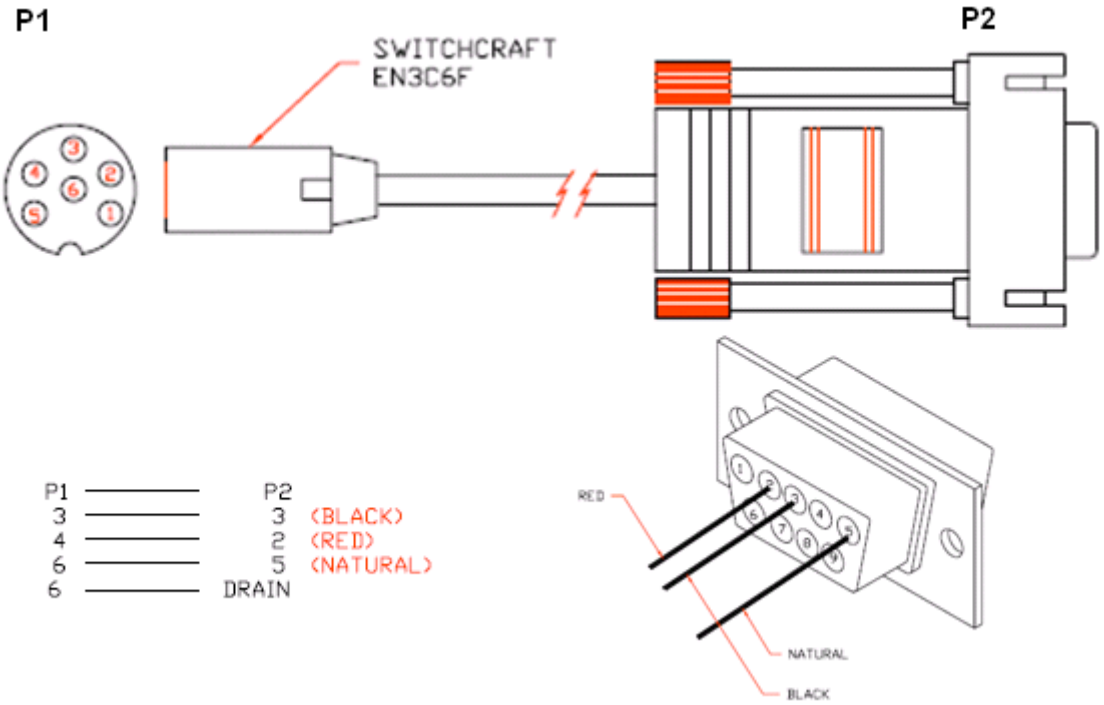

Figure 35: Apex Serial Cable Pin-Out

Appendix D: MIB

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

System OIDs

Object ID	Name	Type	Access	Range Limit	Default Value
.1.3.6.1.4.1.5454.1.60.1.1	sysUnitType	DisplayString	RW	0(NO_TYPE), 1(MAIN), 2(STANDBY)	1 (MAIN)
.1.3.6.1.4.1.5454.1.60.1.2.1	sysIFMVer	DisplayString	RO	0..80	N/A
.1.3.6.1.4.1.5454.1.60.1.2.2	sysFPGAVer	DisplayString	RO	0..80	N/A
.1.3.6.1.4.1.5454.1.60.1.2.3	sysFWVer	DisplayString	RO	0..80	N/A
.1.3.6.1.4.1.5454.1.60.1.2.4	sysOSVer	DisplayString	RO	0..80	N/A
.1.3.6.1.4.1.5454.1.60.1.2.5	sysPICVer	DisplayString	RO	0..80	N/A
.1.3.6.1.4.1.5454.1.60.1.2.6	sysModemVer	DisplayString	RO	0..80	N/A
.1.3.6.1.4.1.5454.1.60.1.3.1	sysFPGAPreVer	DisplayString	RO	0..80	N/A
.1.3.6.1.4.1.5454.1.60.1.3.2	sysFWPreVer	DisplayString	RO	0..80	N/A
.1.3.6.1.4.1.5454.1.60.1.3.3	sysOSPreVer	DisplayString	RO	0..80	N/A
.1.3.6.1.4.1.5454.1.60.1.4.1	sysModel	DisplayString	RO	0..80	N/A
.1.3.6.1.4.1.5454.1.60.1.4.2	sysSerialID	INTEGER	RO	0..127	N/A
.1.3.6.1.4.1.5454.1.60.1.5.1	sysMACFPGA	DisplayString	RO	12	N/A
.1.3.6.1.4.1.5454.1.60.1.5.2	sysMACeth1	DisplayString	RO	12	N/A
.1.3.6.1.4.1.5454.1.60.1.5.3	sysMACeth2	DisplayString	RO	12	N/A
.1.3.6.1.4.1.5454.1.60.1.6	sysBackupStatus	INTEGER	RO	0(OFF), 1(READY)	1(READY)
.1.3.6.1.4.1.5454.1.60.1.7.1	sysDefaultOpmode	INTEGER	RW	0(OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.60.1.7.2	sysOpmode	INTEGER	RW	deactivated(0), activate(1)	deactivated(0)
.1.3.6.1.4.1.5454.1.60.1.8.1	sysReadCommStr	DisplayString	RW	1..32	public
.1.3.6.1.4.1.5454.1.60.1.8.2	sysWriteCommStr	DisplayString	RW	1..32	private
.1.3.6.1.4.1.5454.1.60.1.9	sysSave	INTEGER	RW	1(Save)	N/A
.1.3.6.1.4.1.5454.1.60.1.10	sysReboot	INTEGER	RW	1(Reboot)	N/A
.1.3.6.1.4.1.5454.1.60.1.11	sysResetFactoryDefault	INTEGER	RW	1(Reset)	N/A
.1.3.6.1.4.1.5454.1.60.1.12.1	sysIPAddress	IpAddr	RW	16	192.168.100.100
.1.3.6.1.4.1.5454.1.60.1.12.2	sysSubnetMask	IpAddr	RW	16	255.255.255.0
.1.3.6.1.4.1.5454.1.60.1.12.3	sysDefaultGateway	IpAddr	RW	16	192.168.100.10

					0
.1.3.6.1.4.1.5454.1.60.1.13	sysRemarks	DisplayString	RW	0..100	TrangoLink Apex
.1.3.6.1.4.1.5454.1.60.1.14.1	sysTFTPD	INTEGER	RW	Disable(0), Enable(1)	Disable(0)
.1.3.6.1.4.1.5454.1.60.1.14.2	sysHTTPD	INTEGER	RW	Disable(0), Enable(1)	Enable(1)
.1.3.6.1.4.1.5454.1.60.1.14.3	sysTelnetD	INTEGER	RW	Disable(0), Enable(1)	Enable(1)
.1.3.6.1.4.1.5454.1.60.1.15	sysAlignmentMode	INTEGER	RW	0(OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.60.1.16	sysFailover	INTEGER	RO	0(OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.60.1.17.1	sysTrapIpEnable	INTEGER	RW	0(OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.60.1.17.2	sysTrapIpAddress1	IpAddr	RW	16	0.0.0.0
.1.3.6.1.4.1.5454.1.60.1.17.3	sysTrapIpAddress2	IpAddr	RW	16	0.0.0.0
.1.3.6.1.4.1.5454.1.60.1.17.4	sysTrapCommStr	DisplayString	RW	1..32	public
.1.3.6.1.4.1.5454.1.60.1.18.1	sysImageUpgrade	INTEGER	RW	0(FPGA), 1(LINUX), 2(ROOTFS),3(PIC), 4(RFM)	N/A
.1.3.6.1.4.1.5454.1.60.1.18.2	sysImageToggle	INTEGER	RW	0 (OFF), 1(TOGGLE)	0(OFF)
.1.3.6.1.4.1.5454.1.60.1.19	sysRPSEnable	INTEGER	RW	0(OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.60.1.20	sysSmartMode	INTEGER	RW	0(OFF), 1(ON)	1(ON)

Modem OIDs

Object ID	Name		Access	Range Limit	Default Value
.1.3.6.1.4.1.5454.1.60.2.1	modemLoopbackMode	INTEGER	RW	0(OFF), DIG(1), IF(2), RFGEN(3), RFREFL(4)	0(OFF)
.1.3.6.1.4.1.5454.1.60.2.2	modemDataPattern	INTEGER	RW	FPGA(0), MODEM(1)	0(FPGA)
.1.3.6.1.4.1.5454.1.60.2.3	modemBER	DisplayString	RO	N/A	N/A
.1.3.6.1.4.1.5454.1.60.2.4	modemMSE	INTEGER	RO	N/A	N/A
.1.3.6.1.4.1.5454.1.60.2.5	modemFER	DisplayString	RO	N/A	N/A
.1.3.6.1.4.1.5454.1.60.2.6.1	modemLockStatus	INTEGER	RO	0(NOACQUIRE), 1(INPROGRESS), 2(LOCKED)	N/A
.1.3.6.1.4.1.5454.1.60.2.6.2	modemTimingLock	INTEGER	RO	0(NORMAL), 1(LOCKED)	N/A
.1.3.6.1.4.1.5454.1.60.2.6.3	modemPreambleLock	INTEGER	RO	0(NORMAL), 1(LOCKED)	N/A

.1.3.6.1.4.1.5454.1.60.2.6.4	modemLDPCLock	INTEGER	RO	0(NORMAL), 1(LOCKED)	N/A
.1.3.6.1.4.1.5454.1.60.2.6.5	modemReserved	INTEGER	N/A	N/A	N/A
.1.3.6.1.4.1.5454.1.60.2.7.1	sysACMEnable	INTEGER	RW	0(OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.60.2.7.2.1	sysACMProfileQPSKEnable	INTEGER	RW	0(OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.60.2.7.2.2	sysACMProfileQAM16Enable	INTEGER	RW	0(OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.60.2.7.2.3	sysACMProfileQAM32Enable	INTEGER	RW	0(OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.60.2.7.2.4	sysACMProfileQAM64Enable	INTEGER	RW	0(OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.60.2.7.2.5	sysACMProfileQAM128Enable	INTEGER	RW	0(OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.60.2.7.2.6	sysACMProfileQAM256Enable	INTEGER	RW	0(OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.60.2.7.3.1	sysACMQPSKMSEImprove	Opaque(Float)	RW		
.1.3.6.1.4.1.5454.1.60.2.7.3.2	sysACMQAM16MSEImprove	Opaque(Float)	RW		
.1.3.6.1.4.1.5454.1.60.2.7.3.3	sysACMQAM32MSEImprove	Opaque(Float)	RW		
.1.3.6.1.4.1.5454.1.60.2.7.3.4	sysACMQAM64MSEImprove	Opaque(Float)	RW		
.1.3.6.1.4.1.5454.1.60.2.7.3.5	sysACMQAM128MSEImprove	Opaque(Float)	RW		
.1.3.6.1.4.1.5454.1.60.2.7.3.6	sysACMQAM256MSEImprove	Opaque(Float)	RW		
.1.3.6.1.4.1.5454.1.60.2.7.4.1	sysACMQPSKMSEDegrade	Opaque(Float)	RW		
.1.3.6.1.4.1.5454.1.60.2.7.4.2	sysACMQAM16MSEDegrade	Opaque(Float)	RW		
.1.3.6.1.4.1.5454.1.60.2.7.4.3	sysACMQAM42MSEDegrade	Opaque(Float)	RW		
.1.3.6.1.4.1.5454.1.60.2.7.4.4	sysACMQAM64MSEDegrade	Opaque(Float)	RW		
.1.3.6.1.4.1.5454.1.60.2.7.4.5	sysACMQAM128MSEDegrade	Opaque(Float)	RW		
.1.3.6.1.4.1.5454.1.60.2.7.4.6	sysACMQAM256MSEDegrade	Opaque(Float)	RW		

RF OIDs

Object ID	Name		Access	Range Limit	Default Value
.1.3.6.1.4.1.5454.1.60.3.1.1	rfATPCEnable	INTEGER	RW	0 (OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.60.3.1.2	rfATPCMaxPower	INTEGER	RW	0-17	10
.1.3.6.1.4.1.5454.1.60.3.1.3	rfATPCStepSize	INTEGER	RW	1~5	17
.1.3.6.1.4.1.5454.1.60.3.2	rfTxFrequency	Opaque(Float)	RW	17705~19695	0
.1.3.6.1.4.1.5454.1.60.3.3	rfRxFrequency	Opaque(Float)	RO	17705~19695	0
.1.3.6.1.4.1.5454.1.60.3.4.1	rfSymrate	INTEGER	RO	0(RATE8), 1(RATE17), 2(RATE26), 3(RATE35), 4(RATE43), 5(RATE49)	1
.1.3.6.1.4.1.5454.1.60.3.4.2	rfModulation	INTEGER	RW	0(QPSK), 1(16Q), 2(32Q), 3(64Q), 4(128Q),	0(QPSK)

				5(256Q)	
.1.3.6.1.4.1.5454.1.60.3.4.3	rfBPF	INTEGER	RO	14, 28, 56	56
.1.3.6.1.4.1.5454.1.60.3.4.4	rfChannelsWidth	INTEGER	RW	10(0), 20(1), 28(2), 40(3), 60(4), 80(5)	5(80)
.1.3.6.1.4.1.5454.1.60.3.5	rfPower	INTEGER	RW	0-17	10
.1.3.6.1.4.1.5454.1.60.3.6	rfRSSILEDEnable	INTEGER	RW	0 (OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.60.3.7	rfTemp	INTEGER	RO	-99 - 99	N/A
.1.3.6.1.4.1.5454.1.60.3.8	rfTargetRSSI	INTEGER	RW	(-25)~(-88)	-40
.1.3.6.1.4.1.5454.1.60.3.9	rfRSSI	INTEGER	RO	0-99	N/A
.1.3.6.1.4.1.5454.1.60.3.10.1	rfRFMRFpll	INTEGER	RO	0(NOLOCK), 1(LOCK)	N/A
.1.3.6.1.4.1.5454.1.60.3.10.2	rfRFMIFpll	INTEGER	RO	0(NOLOCK), 1(LOCK)	N/A
.1.3.6.1.4.1.5454.1.60.3.10.3	rfTransmitpll	INTEGER	RO	0(NOLOCK), 1(LOCK)	N/A
.1.3.6.1.4.1.5454.1.60.3.10.4	rfRecveiepll	INTEGER	RO	0(NOLOCK), 1(LOCK)	N/A
.1.3.6.1.4.1.5454.1.60.3.11.1	rfInDataOctet	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.3.11.2	rfInDataPackets	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.3.11.3	rfInDropPackets	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.3.11.5	rfInPortUtil	Counter32	RO	0-100	N/A
.1.3.6.1.4.1.5454.1.60.3.12.1	rfOutDataPackets	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.3.12.2	rfOutDataOctet	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.3.12.3	rfOutPortUtil	Counter32	RO	0-100	N/A

GigE OIDs

Object ID	Name		Access	Range Limit	Default Value
.1.3.6.1.4.1.5454.1.60.4.1.1	gigeIBMEnable	INTEGER	RW	0(OFF), 1(ON)	1(OFF)
.1.3.6.1.4.1.5454.1.60.4.1.2	gigeIBMIp	IpAddr	RW	16	172.168.1.1
.1.3.6.1.4.1.5454.1.60.4.1.3	gigeIBMVlanID	INTEGER	RW	Jan-90	1
.1.3.6.1.4.1.5454.1.60.4.1.4	gigeIBMPort	INTEGER	RW	0(copper), 1 (fiber)	0(copper)
.1.3.6.1.4.1.5454.1.60.4.2.1	gigeEth1Enable	INTEGER	RW	0(OFF), 1(ON)	1(ON)
.1.3.6.1.4.1.5454.1.60.4.2.2	gigeEth2Enable	INTEGER	RW	0(OFF), 1(ON)	1(ON)
.1.3.6.1.4.1.5454.1.60.4.3.1	gigeEth1Status	INTEGER	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.60.4.3.2	gigeEth2Status	INTEGER	RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.60.4.4.1	gigeEth1Speed	INTEGER	RW	10, 100,1000	1000
.1.3.6.1.4.1.5454.1.60.4.4.2	gigeEth2Speed	INTEGER	RO	1000	1000

.1.3.6.1.4.1.5454.1.60.4.5.1	gigeEth1Duplex	INTEGER	RW	0(HALF), 1(FULL)	1(FULL)
.1.3.6.1.4.1.5454.1.60.4.5.2	gigeEth2Duplex	INTEGER	RO	1(FULL)	1(FULL)
.1.3.6.1.4.1.5454.1.60.4.6.1	gigeEth1priority	INTEGER	RW	0-3	0
.1.3.6.1.4.1.5454.1.60.4.6.2	gigeEth2priority	INTEGER	RW	0-3	0
.1.3.6.1.4.1.5454.1.60.4.7.1	gigeEth1MaxRate	INTEGER	RW	0-1000	1000
.1.3.6.1.4.1.5454.1.60.4.7.2	gigeEth2MaxRate	INTEGER	RW	0-1000	1000
.1.3.6.1.4.1.5454.1.60.4.8.1	gigeEth1PauseFrame	INTEGER	RW	0(OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.60.4.8.2	gigeEth2PauseFrame	INTEGER	RW	0(OFF), 1(ON)	0(OFF)
.1.3.6.1.4.1.5454.1.60.4.9.1	gigeEth1InOctets	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.4.9.2	gigeEth2InOctets	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.4.10.1	gigeEth1InUcastPackets	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.4.10.2	gigeEth2InUcastPackets	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.4.11.1	gigeEth1InNUcastPackets	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.4.11.2	gigeEth2InNUcastPackets	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.4.12.1	gigeEth1InTotalPackets	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.4.12.2	gigeEth2InTotalPackets	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.4.13.1	gigeEth1OutOctets	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.4.13.2	gigeEth2OutOctets	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.4.14.1	gigeEth1OutUcastPackets	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.4.14.2	gigeEth2OutUcastPackets	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.4.15.1	gigeEth1OutNUcastPackets	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.4.15.2	gigeEth2OutNUcastPackets	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.4.16.1	gigeEth1OutTotalPackets	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.4.16.2	gigeEth2OutTotalPackets	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.4.17.1	gigeEth1CRCErrors	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.4.17.2	gigeEth2CRCErrors	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.4.18.1	gigeEth1CollisionErrors	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.4.18.2	gigeEth2CollisionErrors	Counter32	RO	0-4294967296	N/A
.1.3.6.1.4.1.5454.1.60.4.19.1	gigeEthPriority0COSQueue	INTEGER	RW	0-3	0
.1.3.6.1.4.1.5454.1.60.4.19.2	gigeEthPriority1COSQueue	INTEGER	RW	0-3	0
.1.3.6.1.4.1.5454.1.60.4.19.3	gigeEthPriority2COSQueue	INTEGER	RW	0-3	1
.1.3.6.1.4.1.5454.1.60.4.19.4	gigeEthPriority3COSQueue	INTEGER	RW	0-3	1
.1.3.6.1.4.1.5454.1.60.4.19.5	gigeEthPriority4COSQueue	INTEGER	RW	0-3	2
.1.3.6.1.4.1.5454.1.60.4.19.6	gigeEthPriority5COSQueue	INTEGER	RW	0-3	2
.1.3.6.1.4.1.5454.1.60.4.19.7	gigeEthPriority6COSQueue	INTEGER	RW	0-3	3
.1.3.6.1.4.1.5454.1.60.4.19.8	gigeEthPriority7COSQueue	INTEGER	RW	0-3	3

.1.3.6.1.4.1.5454.1.60.4.20.1	gigeEth1AutoNegotiate	INTEGER	RW	0(OFF), 1(ON)	1(ON)
.1.3.6.1.4.1.5454.1.60.4.20.2	gigeEth2AutoNegotiate	INTEGER	RW	0(OFF), 1(ON)	1(ON)

Trap OIDs

Object ID	Name		Access	Range Limit	Default Value
.1.3.6.1.4.1.5454.1.60.6.1	trapReboot		RO	N/A	N/A
.1.3.6.1.4.1.5454.1.60.6.2	trapStartUp		RO	N/A	N/A
.1.3.6.1.4.1.5454.1.60.6.3	trapModemLock		RO	0(NORMAL), 1(LOCKED)	N/A
.1.3.6.1.4.1.5454.1.60.6.4.1.1	trapMSEMinThreshold		RO	Current MSE value	N/A
.1.3.6.1.4.1.5454.1.60.6.4.1.2	trapMSEMaxThreshold		RO	Current MSE value	N/A
.1.3.6.1.4.1.5454.1.60.6.4.2.1	trapBERMinThreshold		RO	Current BER value	N/A
.1.3.6.1.4.1.5454.1.60.6.4.2.2	trapBERMaxThreshold		RO	Current BER value	N/A
.1.3.6.1.4.1.5454.1.60.6.4.3.1	trapFERMinThreshold		RO	Current FER value	N/A
.1.3.6.1.4.1.5454.1.60.6.4.3.2	trapFERMaxThreshold		RO	Current FER value	N/A
.1.3.6.1.4.1.5454.1.60.6.4.4.1	trapRSSIMinThreshold		RO	Current RSSI value	N/A
.1.3.6.1.4.1.5454.1.60.6.4.4.2	trapRSSIMaxThreshold		RO	Current RSSI value	N/A
.1.3.6.1.4.1.5454.1.60.6.4.6.1	trapODUTempMinThreshold		RO	Current ODU Temp	N/A
.1.3.6.1.4.1.5454.1.60.6.4.6.2	trapODUTempMaxThreshold		RO	Current ODU Temp	N/A
.1.3.6.1.4.1.5454.1.60.6.4.7.1	trapInPortUtilMaxThreshold		RO	Current In port untilization	N/A
.1.3.6.1.4.1.5454.1.60.6.4.7.2	trapInPortUtilMinThreshold		RO	Current In port untilization	N/A
.1.3.6.1.4.1.5454.1.60.6.4.8.1	trapOutPortUtilMaxThreshold		RO	Current Out port untilization	N/A
.1.3.6.1.4.1.5454.1.60.6.4.8.2	trapOutPortUtilMinThreshold		RO	Current Out port untilization	N/A
.1.3.6.1.4.1.5454.1.60.6.5.1	trapStandbyLinkDown		RO	N/A	N/A
.1.3.6.1.4.1.5454.1.60.6.5.2	trapStandbyLinkUp		RO	N/A	N/A
.1.3.6.1.4.1.5454.1.60.6.5.3	trapSwitchover		RO	N/A	N/A
.1.3.6.1.4.1.5454.1.60.6.6.1	trapEth1StatusUpdate		RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.60.6.6.2	trapEth2StatusUpdate		RO	0(OFF), 1(ON)	N/A
.1.3.6.1.4.1.5454.1.60.6.8	trapDownShift		RO	N/A	N/A
.1.3.6.1.4.1.5454.1.60.6.9	trapRapidPortShutdown		RO	N/A	N/A

Appendix E: Part Numbers

TrangoLINK Apex Radios	
Part #	Description
TLINK-APEX11-1 *	**TrangoLINK® Apex ANSI point-to-point system, 11GHz Band 1 ***
APEX11-1A	TrangoLINK® Apex, 11GHz, Band 1A, ANSI
APEX11-1B	TrangoLINK® Apex , 11GHz, Band 1B, ANSI
TLINK-APEX11-2 *	**TrangoLINK® Apex ANSI point-to-point system, 11GHz Band 2 ***
APEX11-2A	TrangoLINK® Apex, 11GHz, Band 2A, ANSI
APEX11-2B	TrangoLINK® Apex , 11GHz, Band 2B, ANSI
TLINK-APEX11E-1 *	**TrangoLINK® ApexETSI point-to-point system, 11GHz Band 1 ***
APEX11E-1A	TrangoLINK® Apex, 11GHz, Band 1A, ETSI
APEX11E-1B	TrangoLINK® Apex , 11GHz, Band 1B, ETSI
TLINK-APEX11E-2 *	**TrangoLINK® ApexETSI point-to-point system, 11GHz Band 2 ***
APEX11E-2A	TrangoLINK® Apex, 11GHz, Band 2A, ETSI
APEX11E-2B	TrangoLINK® Apex , 11GHz, Band 2B, ETSI
TLINK-APEX15E-1 *	**TrangoLINK® ApexETSI point-to-point system, 15GHz Band 1 ***
APEX15E-1A	TrangoLINK® Apex, 15GHz, Band 1A, ETSI
APEX15E-1B	TrangoLINK® Apex , 15GHz, Band 1B, ETSI
TLINK-APEX18-1 *	**TrangoLINK® ApexANSI point-to-point system, 18GHz Band 1 ***
APEX18-1A	TrangoLINK® Apex, 18GHz, Band 1A, ANSI
APEX18-1B	TrangoLINK® Apex , 18GHz, Band 1B, ANSI
TLINK-APEX18E-1 *	**TrangoLINK® ApexETSI point-to-point system, 18GHz Band 1 ***
APEX18E-1A	TrangoLINK® Apex, 18GHz, Band 1A, ETSI
APEX18E-1B	TrangoLINK® Apex , 18GHz, Band 1B, ETSI
TLINK-APEX18E-2 *	**TrangoLINK® ApexETSI point-to-point system, 18GHz Band 2 ***
APEX18E-2A	TrangoLINK® Apex, 18GHz, Band 2A, ETSI
APEX18E-2B	TrangoLINK® Apex , 18GHz, Band 2B, ETSI
TLINK-APEX23-2 *	**TrangoLINK® ApexANSI point-to-point system, 23GHz Band 2 ***
APEX23-2A	TrangoLINK® Apex, 23GHz, Band 2A, ANSI
APEX23-2B	TrangoLINK® Apex , 23GHz, Band 2B, ANSI
TLINK-APEX23E-2 *	**TrangoLINK® ApexETSI point-to-point system, 23GHz Band 2 ***
APEX23E-2A	TrangoLINK® Apex, 23GHz, Band 2A, ETSI
APEX23E-2B	TrangoLINK® Apex , 23GHz, Band 2B, ETSI
* - The basic package (2 radios) excluding antennas & accessories	

Accessories	
Part #	**Description**
Antennas	
AD11G-2	2 ft diameter, 11 GHz Dish Antenna for TrangoLINK® Apex
AD11G-3	3 ft diameter, 11 GHz Dish Antenna for TrangoLINK® Apex
AD11G-4	4 ft diameter, 11 GHz Dish Antenna for TrangoLINK® Apex
AD11G-6	6 ft diameter, 11 GHz Dish Antenna for TrangoLINK® Apex
AD18G-2	2 ft diameter, 18 GHz Dish Antenna for TrangoLINK® Apex
AD18G-3	3 ft diameter, 18 GHz Dish Antenna for TrangoLINK® Apex
AD18G-4	4 ft diameter, 18 GHz Dish Antenna for TrangoLINK® Apex
AD18G-6	6 ft diameter, 18 GHz Dish Antenna for TrangoLINK® Apex
AD23G-2	2 ft diameter, 23 GHz Dish Antenna for TrangoLINK® Apex
AD23G-3	3 ft diameter, 23 GHz Dish Antenna for TrangoLINK® Apex
AD23G-4	4 ft diameter, 23 GHz Dish Antenna for TrangoLINK® Apex
AD23G-6	6 ft diameter, 23 GHz Dish Antenna for TrangoLINK® Apex
Speed Upgrade Keys	
APEX18-Key-1	Software License Key, Upgrade to 200Mbps Full Duplex
APEX18-Key-2	Software License Key, Upgrade to 370Mbps Full Duplex
Power Supplies	
P-SUPPLY-1U-48	-48 VDC, 19” 1U Rack Mount Power Supply, 7.5 Amps
P-SUPPLY-DT-48	-48 VDC Universal Desktop Power Supply, 1.5 Amps
POE-APEX-48	Power Over Ethernet Injector box, 48v, Rev A
Other Accessories	
APEX18-PRT	1+1 Protection Kit, Data Cable, Vertical Polarized, for TrangoLINK® Apex 18
APEX18-VCMB	1+1 RF Combiner for TrangoLINK® Apex18 ODU, Vertical Polarized
APEX18-HCPL	Horizontal Polarization Transition for APEX18-PRT & APEX18-CPL
CBLDAT-RIU2	Data Cable for 1+ 1 Redundant TrangoLINK® Apex System
CBLDAT-3	Serial Console Cable for APEX
Giga-Srv-EW3	Service, Extended Warranty, 3 years
APEX-FIBERKIT-M	Multi-Mode SFP Fiber Module kit for APEX
APEX-FIBERKIT-S	Single-Mode SFP Fiber Module kit for APEX
APEX-ETHERKIT-1	Ethernet cable plug kit for APEX

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
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
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
PoE	Power-over-Ethernet
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
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