8.3.8 Spectrum Management (Fixed Frequency and WIMAX)

The PTP 600 Series Bridge software allows a user to optionally fix transmit and receive frequencies for a wireless link. Once configured, the spectrum management software will not attempt to move the wireless link to a channel with lower co and adjacent channel interference. Therefore this mode of operation is only recommended for deployments where the installer has a good understanding the prevailing interference environment. (See Section 8.3.4.4). Care must also be taken to ensure that the frequency allocations at each end of the link are compatible. To help the user when identifying the mode of operation Spectrum Management uses two visual cues. See Figure 78. The main page title identifies the mode of operation using the “Fixed Frequency Mode” postfix and the selected channels are identified by a red capital ‘F’.

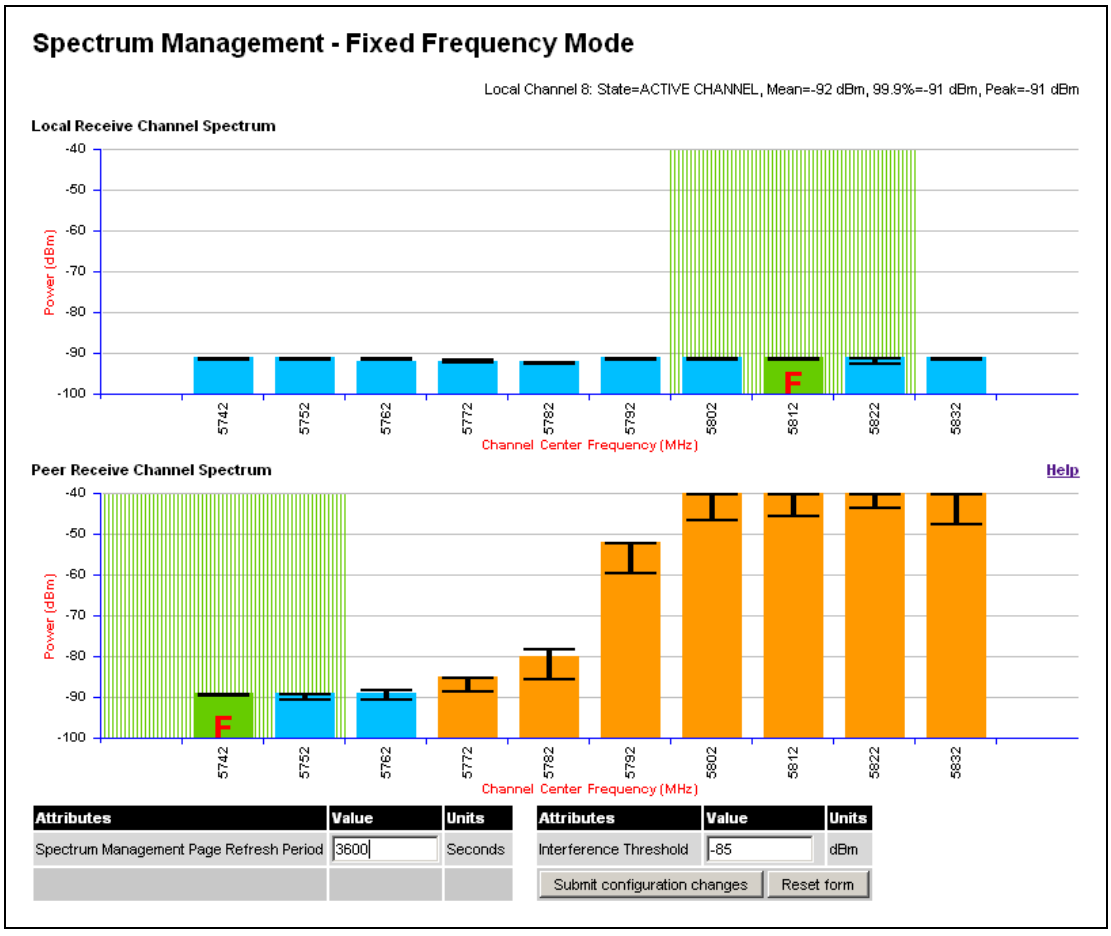


Figure 78 - Spectrum Management Fixed Frequency Screen

Channel barring is disabled in fixed frequency mode; it is not required as dynamic channel hopping is prohibited in this mode.

The only controls available to the master are the Statistics Window and Interference Threshold attributes. They will have no effect on the operation of the wireless link and will only effect the generation of the channel spectrum graphics.

The active channel history menu is removed in this mode of operation as channel hopping is prohibited.

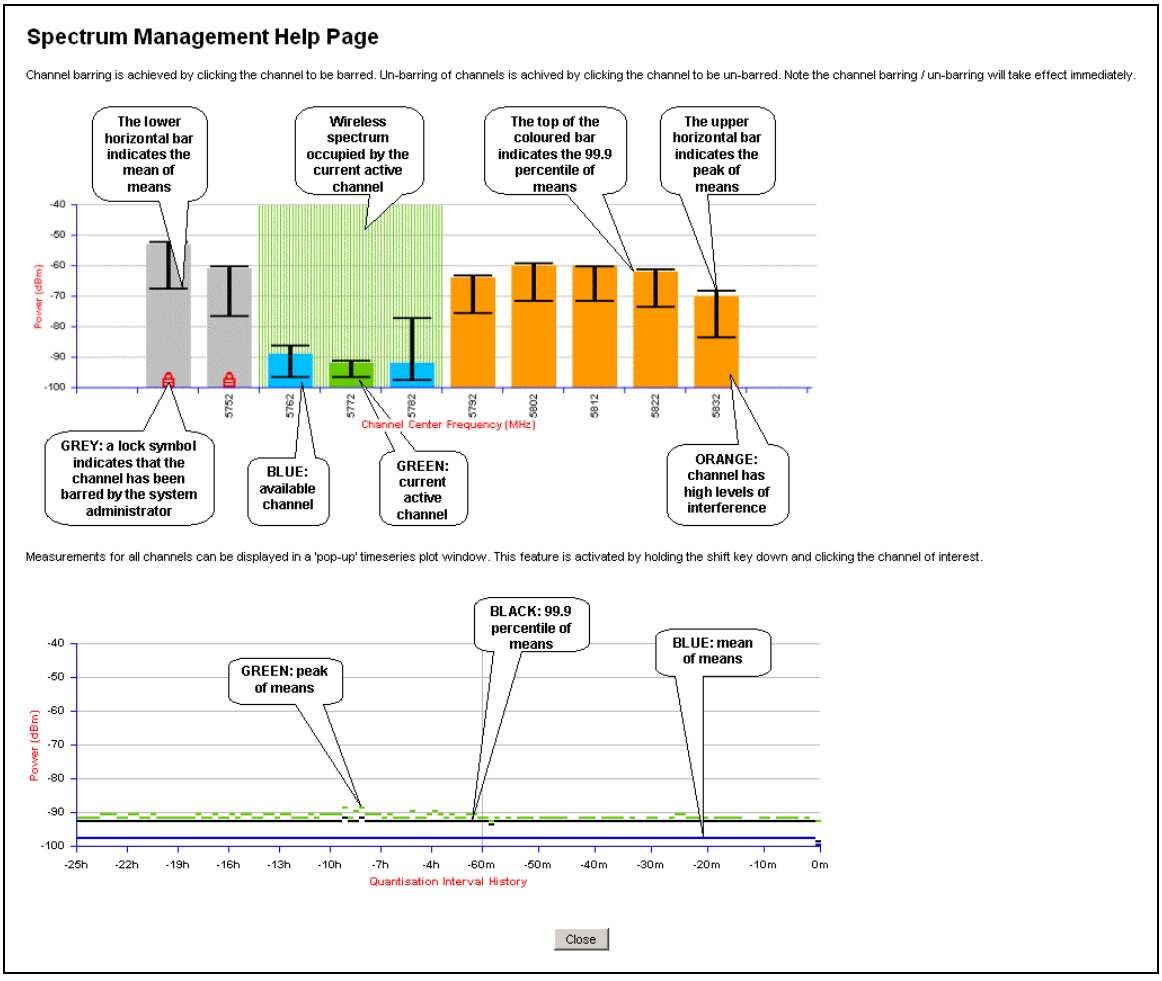


Figure 79 - Spectrum Management Help Page (Fixed Frequency)

8.3.9 Spectrum Management Control - With Operational Restrictions

When operating with Radar Avoidance enabled the following variances in operation apply:

- The words “Radar Avoidance” are appended to the “Spectrum Management” title at the top of the screen. See Figure 80 and Figure 81.

- The only controls available to the master are the Interference Threshold attribute. This has no effect on the operation of the wireless link and will only affect the generation of the channel spectrum graphics. See Figure 80.
- Extra color coding of the interference histogram is provided. See Table 20.

When operating with RTTT Avoidance enabled or other regulatory restrictions on channel usage the following variances apply:

- All channels marked with a 'no entry' symbol with their associated statistics colored black are the prohibited channels. See Figure 80 and Figure 81. These channels are never used to host the wireless link, but CAC measurements are still taken so that adjacent channel biases can be calculated correctly and so the user can see if other equipment is in use.

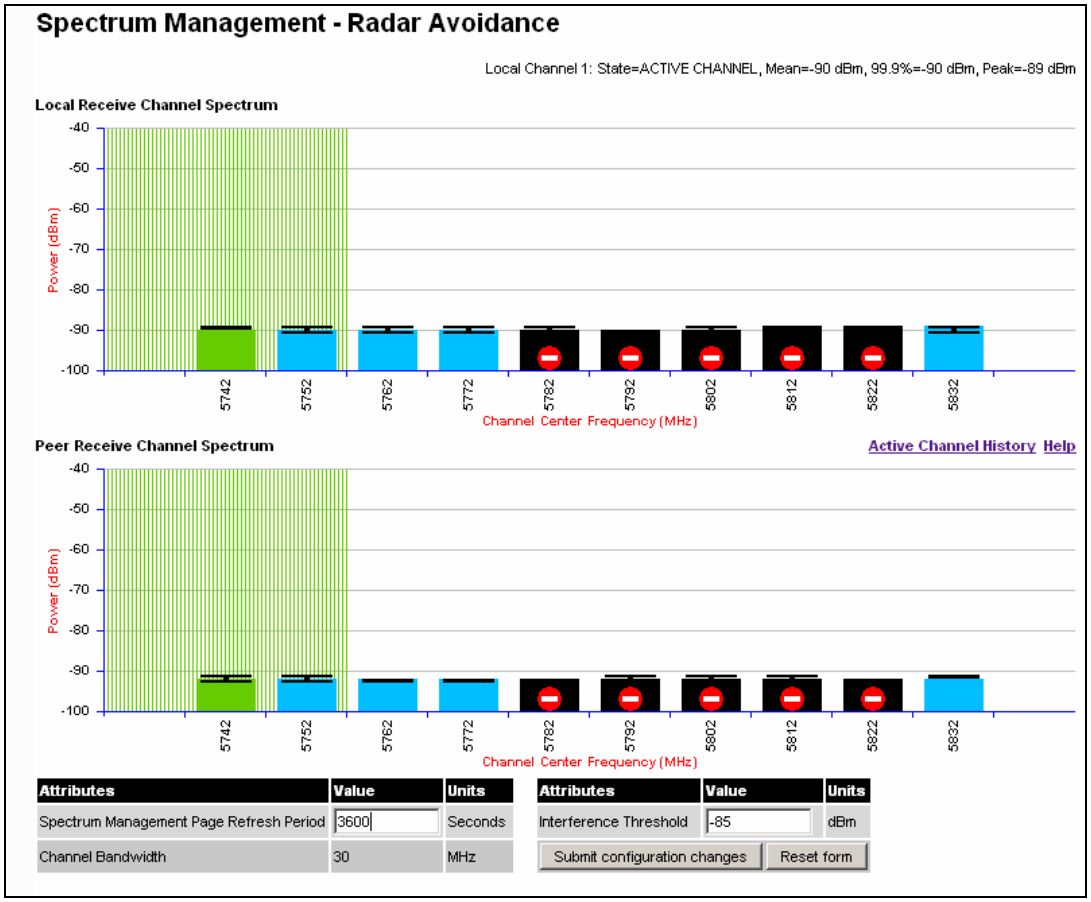


Figure 80 - Spectrum Management Master Screen With Operational Restrictions

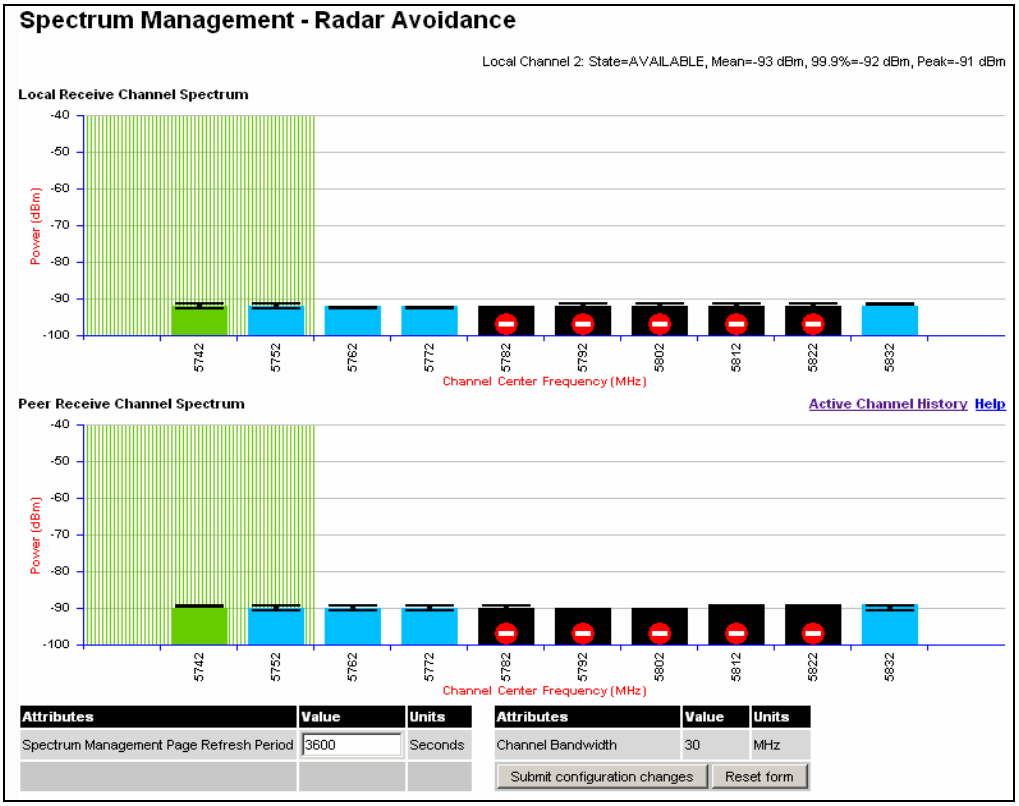


Figure 81 - Spectrum Management Slave Screen With Operational Restrictions

The colored bar represents the following channel state:

Green	Active	The channel is currently in use hosting the Point-to-Point wireless link
Orange	Interference	The channel has interference above the interference threshold
Blue	Available	The channel has an interference level below the interference threshold and is considered by the Spectrum Management algorithm suitable for hosting the Point-to-Point link
Grey	Barred	The system administrator has barred this channel from use. Because the low signal levels encountered when a unit is powered up in a laboratory environment prior to installation (which makes the grey of the channel bar difficult to see). An additional red 'lock' symbol is used to indicate that a channel is barred.
Red	Radar Detected	Impulsive Radar Interference has been detected on this channel.
Region Bar	Region Bar	This channel has been barred from use by the local region regulator

Table 20 - Spectrum Management Change State Key With Operational Restrictions

8.3.10 Spectrum Management – Example of 2.5 GHz Product variant

As described in Section 49, the 2.5 GHz product variant can operate in three frequency bands. Figure 82 shows an example of a Lower Band with a 30 MHz channel bandwidth.

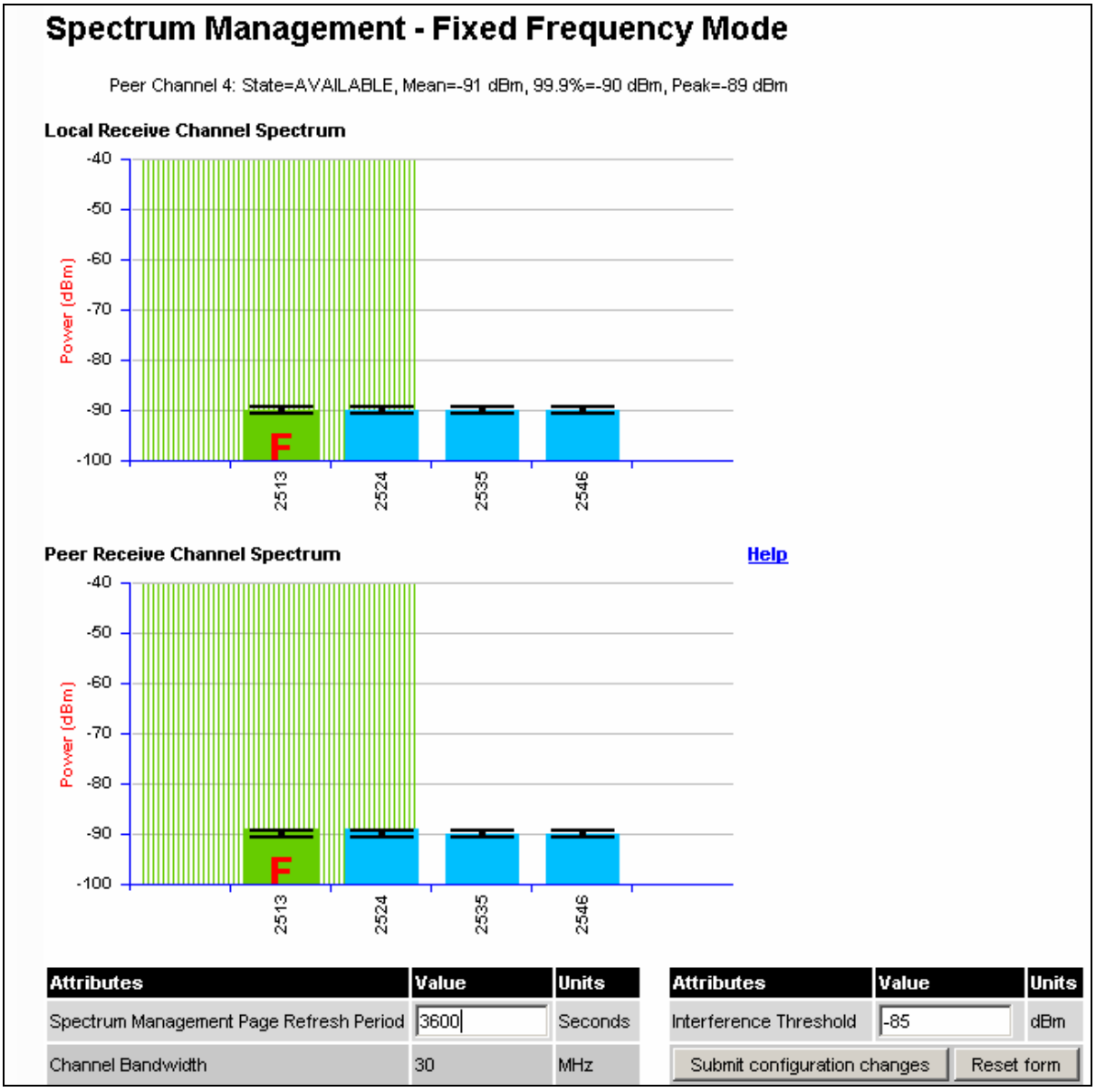


Figure 82 - 2.5 GHz Example of Spectrum Management Page

8.3.11 Remote Management Page

The Remote Management page (Figure 83) allows the system administrator to configure the remote management of the PTP 600 Series Bridge.

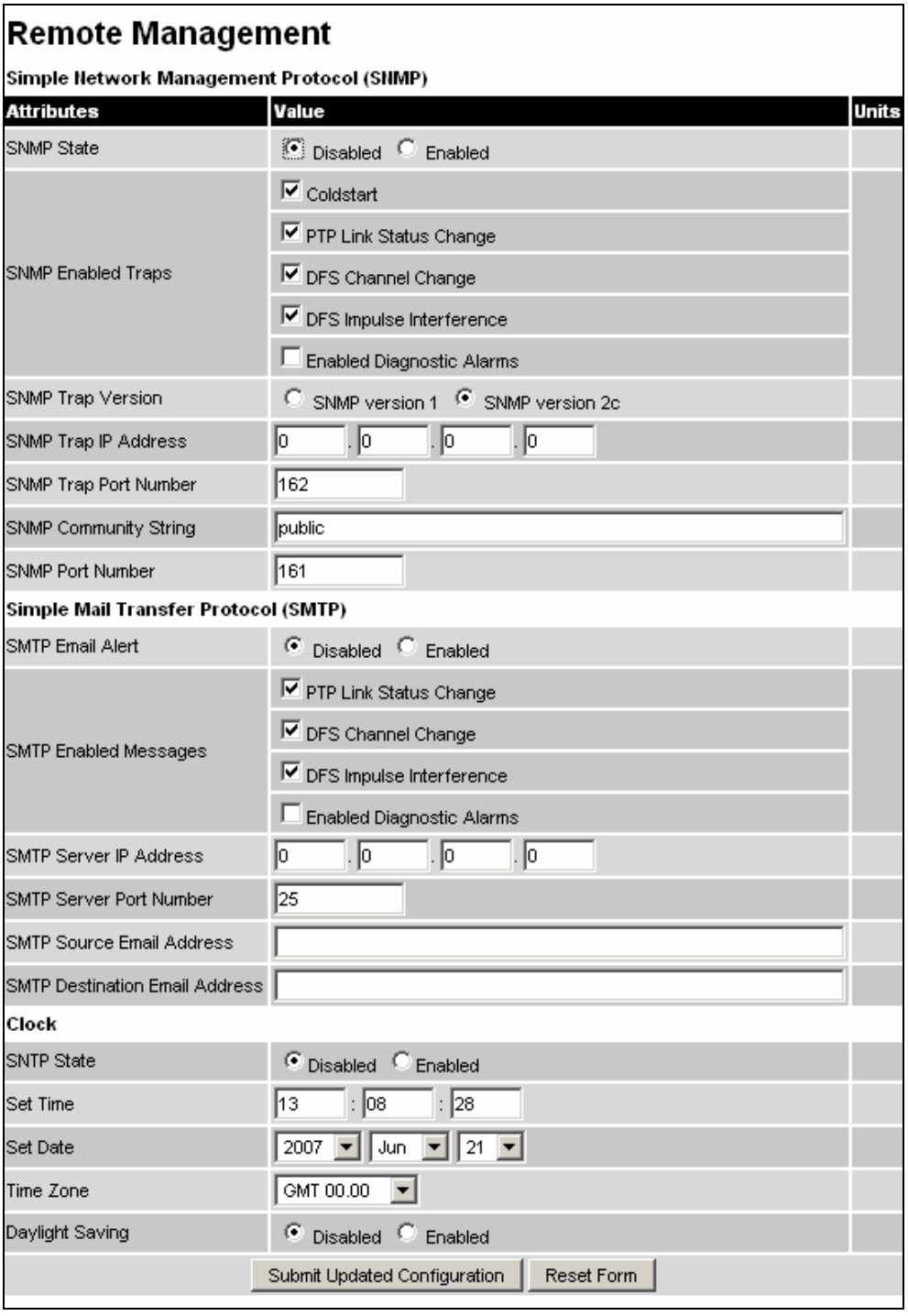


Figure 83 - Remote Management

8.3.11.1 SNMP (Simple Network Management Protocol)

The industry standard remote management technique is SNMP (Simple Network Management Protocol). The PTP 600 Series Bridge supports version 1 and version 2c of the SNMP protocol.

8.3.11.2 Supported Management Information Bases (MIBS)

The PTP 600 Series Bridge SNMP stack currently supports three distinct MIBs:

- MIB-II, RFC-1213, The PTP 600 Series Bridge supports the 'System Group' and 'Interfaces Group'.
- Bridge MIB, RFC-1493, The PTP 600 Series Bridge supports the 'dot1dBase Group' and the 'dot1dBasePortTable Group'.
- PTP 600 Series Bridge proprietary MIB
- RFC-2233 (High capacity counter) MIB
- WiMAX MIB

SNMP TRAPs supported:

- Cold Start
- Link Up
- Link Down
- DFS Channel Change
- DFS Impulsive Interference

8.3.11.3 Diagnostics Alarms

A number of diagnostics alarms have been added to allow SNMP agents to receive traps and emails if required. Refer to Section 8.1.1 for a description of all these alarms. Checking the control “Enabled Diagnostic Alarms” in SNMP and/or SNTP selects all the alarms shown in Figure 84. Users can access the sub-menu “Diagnostic Alarms” to modify the alarms selected.

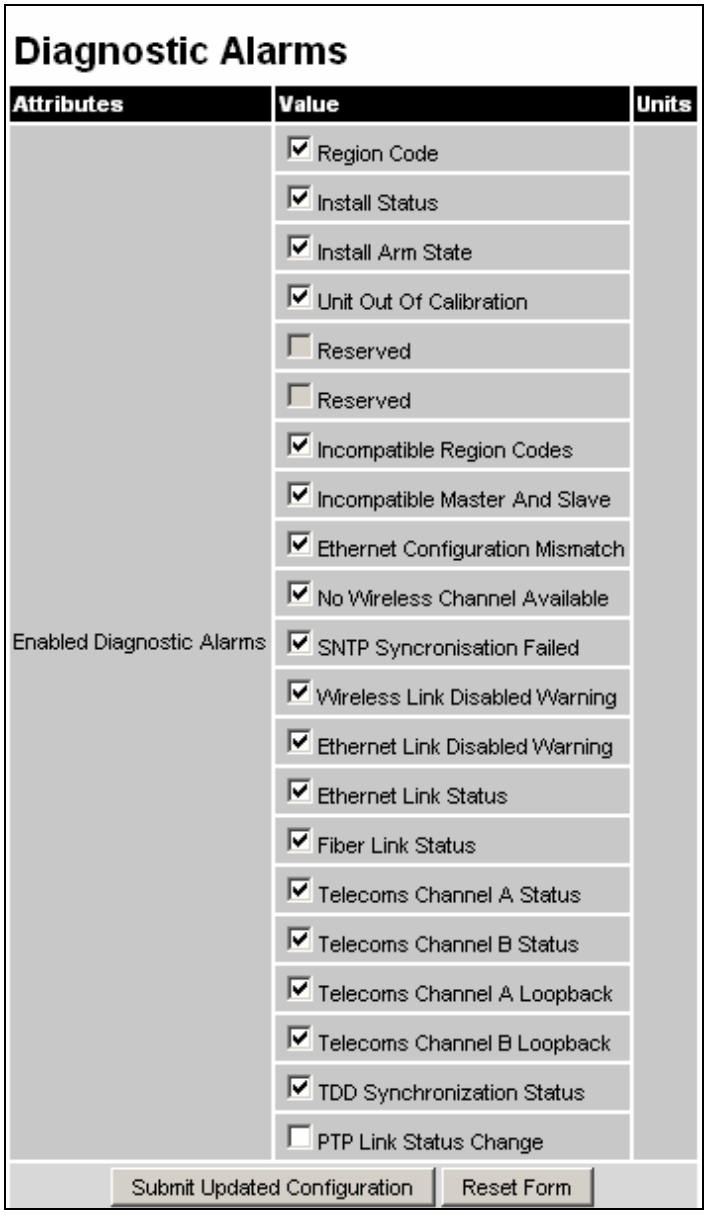


Figure 84 - Remote Management - Diagnostic Alarms

For a copy of the Motorola proprietary version 1 and version 2 MIB RFCs please consult the installation CD

8.3.11.4 SNMP Configuration

SNMP State: The SNMP state attribute controls the creation of the SNMP features. Changing the SNMP state attribute requires a mandatory reboot of the unit. Only when the SNMP state is enabled at system start-up will the SNMP processor task be created.

SNMP Enabled Traps: The SNMP Enabled Traps attribute controls which SNMP Traps the unit will send.

SNMP Community String: The SNMP community string acts like a password between the networks SNMP management entity and the distributed SNMP clients (600 Series bridge). Only if the community string is configured correctly on all SNMP entities can the flow of management information take place. By convention the default value is set to 'public'. When the community string is changed the system requires a mandatory reboot before the new string or phrase is adopted.

SNMP Port Number: Is the port the SNMP management agent is listening to for commands from an SNMP manager. The default value for this port number is 161.

SNMP Trap IP Address: Is the address of either the network SNMP manager or Trap receiver. When asynchronous events (traps in SNMP terminology) are generated, the client unicasts these to this IP Address. When the address is changed the system requires a mandatory reboot before the setting is adopted

SNMP Trap Port Number: The SNMP Trap Port Number is the port number of either the networked SNMP manager or Trap receiver. By convention the default value for the port number is 162. When the port number is changed the system requires a mandatory reboot before the setting is adopted.

WiMAX Control: Enables and Disables the WiMAX (802.16) MIB. This control is only displayed when 'Fixed Frequency' is selected during installation.

8.3.11.5 SMTP (Simple Mail Transport Protocol)

The SMTP client is an alternative method for the 600 Series bridge to alert a system administrator when there are or have been system errors

SMTP Email Alert: This attribute controls the activation of the SMTP client.

SMTP Enabled Messages: The SMTP Enabled Messages attribute controls which email alerts the unit will send.

SMTP IP Address: The IP address of the networked SMTP server.

SMTP Port Number: The SMTP Port Number is the port number used by the networked SMTP server. By convention the default value for the port number is 25.

SMTP Source Email Address: The email address used by the 600 Series bridge to log into the SMTP server with. This must be a valid email address that will be accepted by your SMTP Server

SMTP Destination Email Address: The email address to which the 600 Series bridge will send the alert messages.

8.3.11.6 SNTP (Simple Network Time Protocol)

The SNTP client allows the 600 Series bridge to obtain accurate date and time updates from a networked timeserver. The system time is used for SNMP and event logging.

SNTP State: When enabled, the Remote Management web page permits the following attributes to be set:

SNTP IP Address: The IP address of the networked SNTP server.

SNTP Port Number: The port number of the networked SNTP server. By convention the default value for the port number is 123.

SNTP Poll Interval: The period at which the SNTP client polls the server for time correction updates. Default 1 hour. If for any reason an SNTP poll fails, the client will automatically perform 3 retries before waiting for the user defined poll period.

Time Zone: The time zone is a fixed offset from GMT that is added to the SNTP time to allow the expression of time in all geographic time zones.

Daylight Saving: Allows a fixed offset of one hour to be added to the SNTP time in order to reflect the local daylight saving time.

8.3.11.7 Setting the clock

The PTP 600 Series bridge has a system clock which can be used to supply accurate date and time information in the absence of a SNTP server. The system clock is battery backed and will continue to operate for several days if the 600 Series bridge has been switched off.

SNTP State: If the SNTP State is set to “Disabled”, see Figure 83, then the Remote Management web page allows the following attributes to be set:

Set Time: Shows the current time in 24 hour mode. The three editable fields display hours minutes and seconds.

Set Date: Displays the current date. The year, month and day can be set using the drop-down selection boxes.

Time Zone: See Section 8.3.11.7.

Daylight Saving: See Section 8.3.11.7.

8.3.12 Diagnostics

To further enhance the diagnostic capabilities of the PTP 600 Series, the storage of link performance histograms has been extended to 31. To optimize RAM (volatile memory) usage a cascading histogram approach has been adopted. The root histogram is identical to the histograms in 58100 that is data is stored for one hour at a resolution of one second. In 58100 the histograms were simple cyclic buffers which never stored more that the last one hour of data. The new cascading histogram approach daisy chains multiple histograms together. When the first histogram fills up the overflow from the first is used as an input to the next histogram in line. To optimize memory utilization a statistical analysis is performed on the overflow to reduce the amount of data to be stored. In the case of the PTP 600 Series the cascading histograms are defined as:

- Histogram 1: 1 hour at a resolution of 1 second
- Histogram 2: 24 hours at a resolution of 1 minute
- Histogram 3: 30 Days at a resolution of 1 hour

For example, when histogram 1 fills up and starts to overflow the first minute of overflow is analyzed and the maximum, minimum and mean over that minute are computed and inserted into histogram 2. When histogram 2 fills up and starts to overflow the first hour of overflow is analyzed and the maximum, minimum and mean over that hour is computed and inserted into histogram 3. When histogram 3 starts to overflow, the overflow data is simply discarded.

8.3.12.1 Diagnostic Plotter

New for the PTP 600 Series is the system administration diagnostic plotter facility see Figure 85.

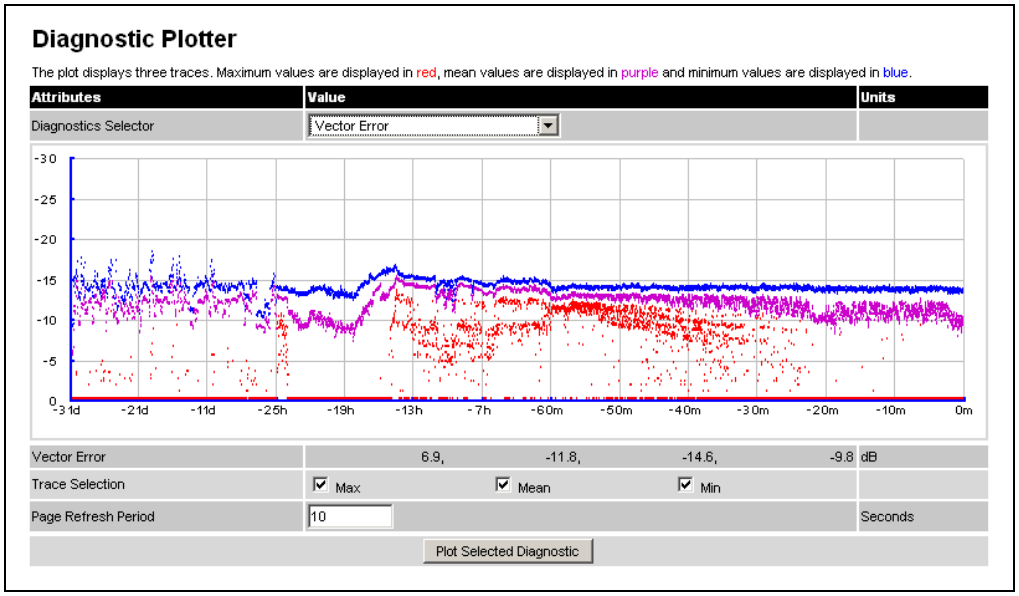


Figure 85 - Diagnostic Plotter

The diagnostic plotter allows the system administrator to view the cascading histogram data in an easily accessible graphical form. The plot always displays three traces, maximum, minimum and mean by default. The diagnostic selector allows the user to select the various categories of histogram.

The histograms that are available are:

- Vector Error
- Rx Power
- Tx Power
- Signal Strength Ratio
- Link Loss
- Rx Data Rate
- Tx Data Rate
- Aggregate Data Rate

The diagnostic plotter uses a novel time representation in the x-axis which compresses the timeline of the plot without sacrificing resolution.

The trace selection allows the user to control which traces are plotted.

As with other management pages the page refresh period can be used to interactively monitor the wireless link.

8.3.12.2 Diagnostics Download

The diagnostics Download page allows the system administrator to download snapshots of system diagnostics.

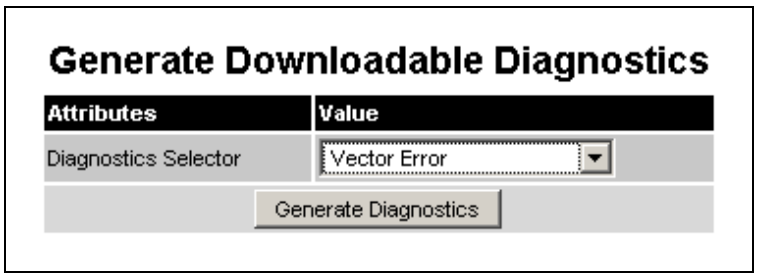


Figure 86 - CSV Download

The following diagnostics are available:

- Vector Error
- Rx Power
- Tx Power
- Signal Strength Ratio V/H
- Link Loss
- Rx Data Rate
- Tx Data Rate
- Aggregate Data Rate
- Receive SNR
- Rx Gain

All diagnostics are extracted from the associated status and statistics web page histograms. They are translated in a CSV file containing at most 5784[24] entries.

[24] 5784 entries comprises 3600 entries for the first hour, 1440 entries for the next 24 hours and 744 entries for the next 31 days.

8.3.13 Change System Administration Password

This page (Figure 87) is used to change the password for the system administration (The factory default is blank).

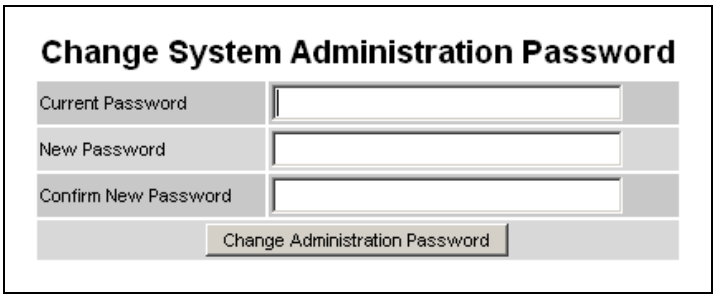


Figure 87 - Password Change

To change the password any combination of alphanumeric characters, up to 31 characters in length, can be used.

8.3.14 License Key

The License Key data entry page allows the system administrator to update the 600 Series bridge license key. Figure 88 shows a sample license key data entry page.

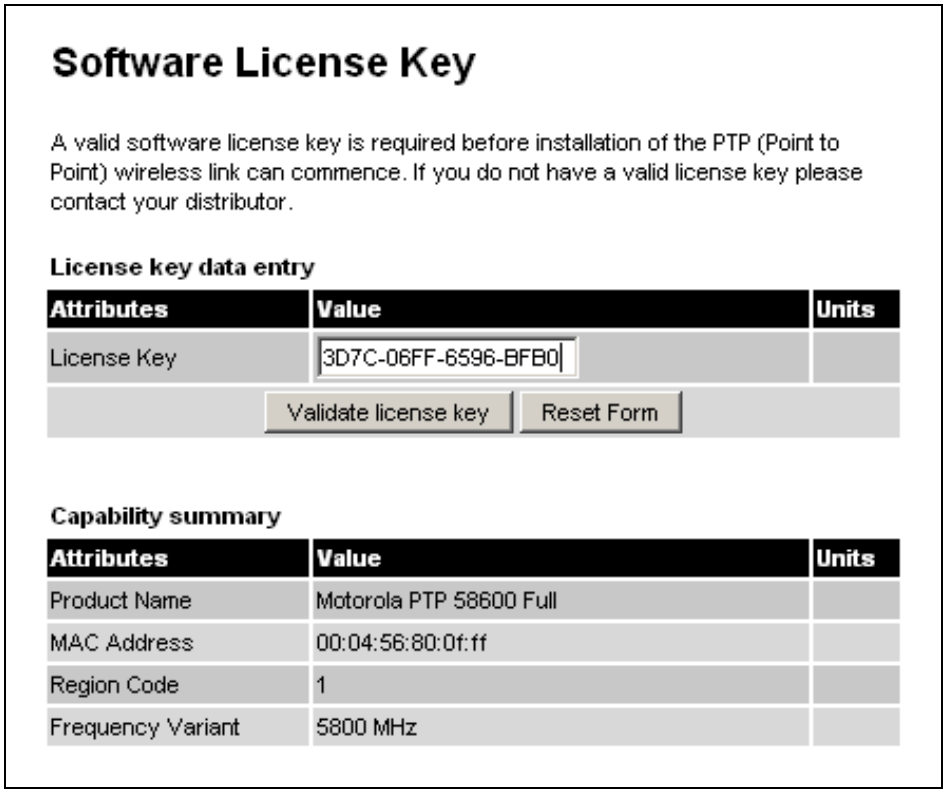


Figure 88 - Software License Key Data Entry

The user must enter the license key and click the 'Validate License Key' button to check that the key is valid and program it to non-volatile memory.

If a valid license key is detected then the user will be presented by a system reboot screen.

Figure 89: License Key reboot Screen

The user will then be asked to confirm the reboot (Figure 90).

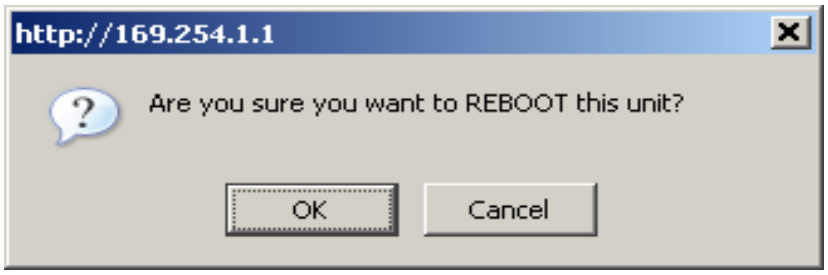


Figure 90 - Reboot Confirmation Pop Up

8.3.15 Properties

The web page properties screen allows the user to configure the web page interface.

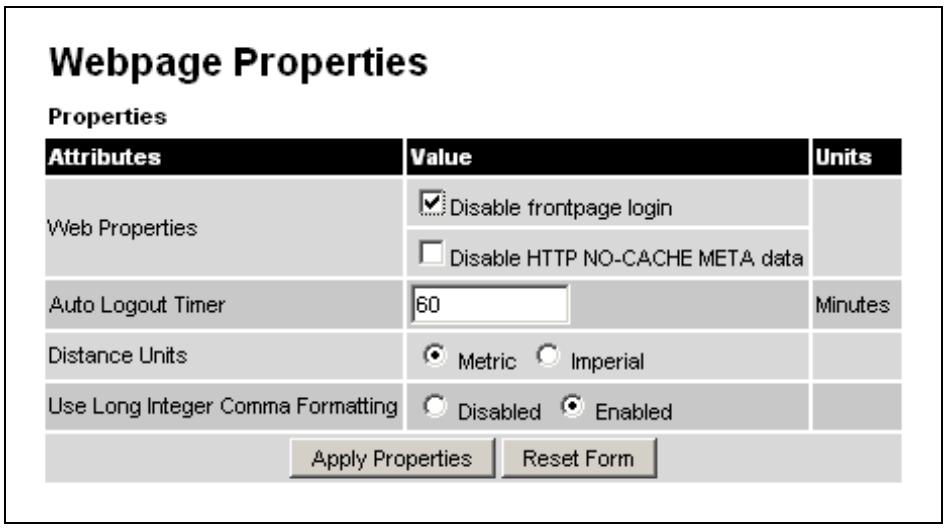


Figure 91 – Properties

WEB Properties: Disable Front Page Login Allows access to homepage and status page web pages without forcing a login as the system administrator.

WEB Properties: Disable HP NO-CACHE META data: Removes the HTTP NO-CACHE META clause from all dynamically created web pages.

Auto Logout Timer Configures the time, in minutes, when the system administrator is automatically logged out if no web page activity is detected.

Distance Units Swaps the default metric display of distance in to imperial units, for example km to Miles.

Use Long Integer Comma Formatting Changes the format of long integers from 1000000 to 1,000,000.

8.3.16 Reboot

The reboot page allows the system administrator to perform commanded reboots of the wireless unit. The reboot page also allows the system administrator to view a list of past reboot reasons. The “Previous Reasons For Reset/Reboot” field has been implemented as a drop down selection box, where the latest reason for reboot is located at the top of the list.

If the SNTP service from the remote management section above is active, or the system time has been set, then the command reboot reason will be accompanied by the date and time at which the reboot occurred.

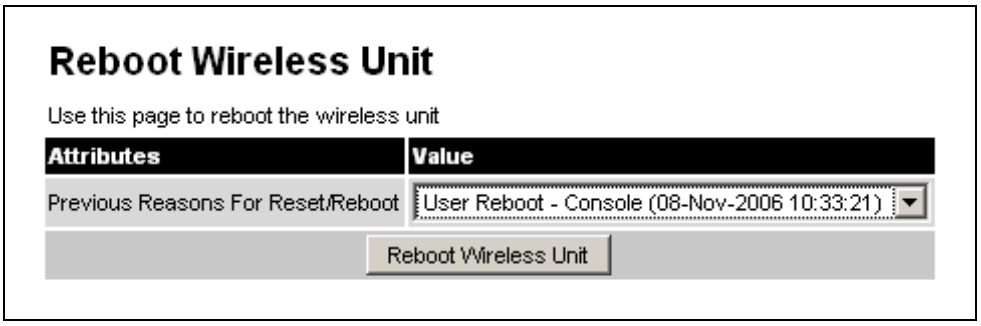


Figure 92 - System Reboot

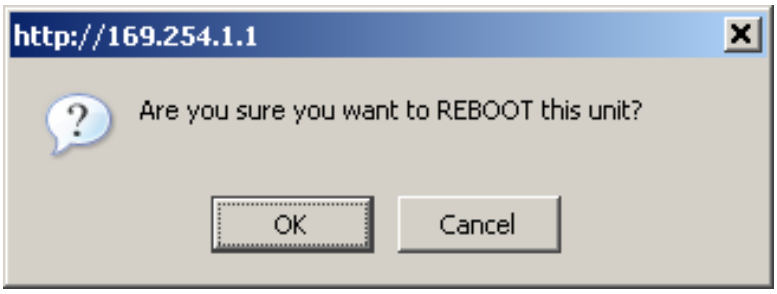


Figure 93 - Reboot Confirmation Pop Up

9 Recovery Mode

The Motorola PTP 600 point-to-point wireless Ethernet bridges have a special mode of operation that allows the user to recover a unit from configuration errors or software image corruption.

Recovery mode is entered by depressing the Recovery Switch located on the underside of the PIDU Plus while applying mains power, as shown in Section 3.3.2. The Recovery Switch should be held in the depressed state for between 10 and 20 seconds after the application of mains power. The Ethernet LED will flash with 10 double flashes at power up.

When in recovery mode the user will be able to access the unit via the Ethernet interface. The Ethernet interface will have its IP address set to 169.254.1.1 (or 10.10.10.10). On connection to a unit in recovery mode the following screen is displayed (Figure 94):

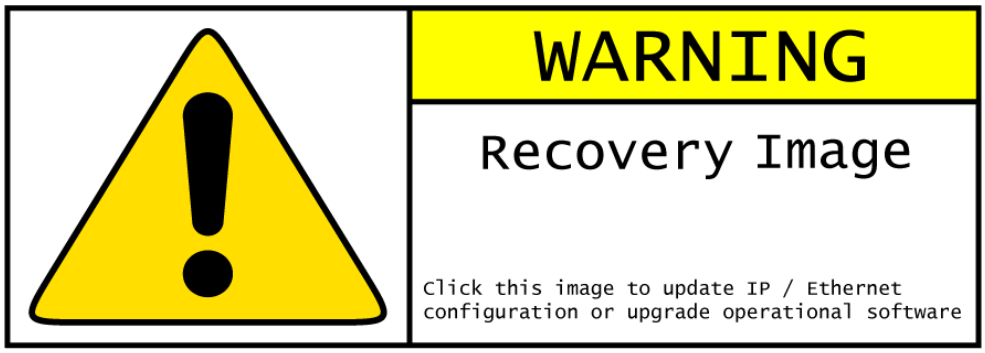


Figure 94 - Recovery Mode Warning Page

Clicking on the warning page image will take the user on to the Recovery Option Page (Figure 95).

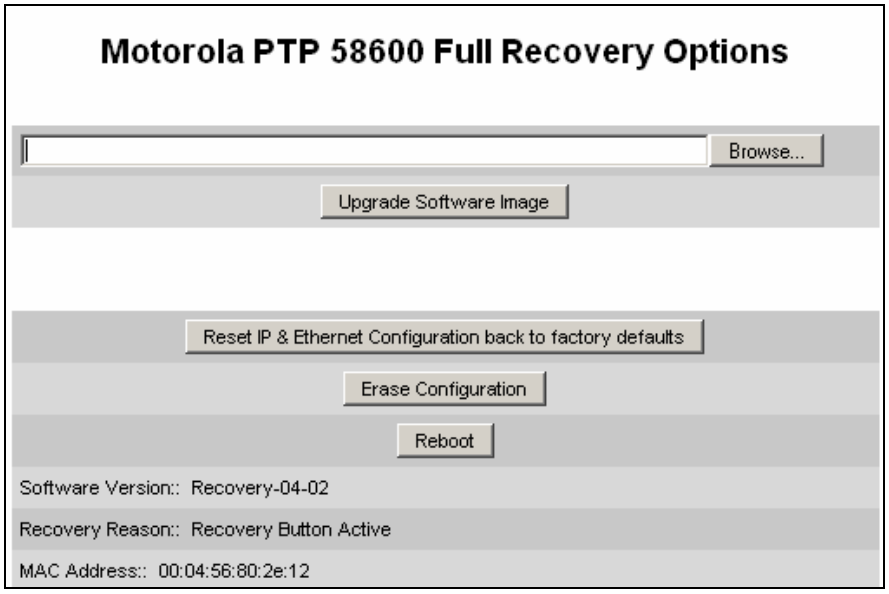


Figure 95 - Recovery Options Page

The recovery options available are:

Upgrade Software Image: This allows the user to reload a software image. This may be the original image if software corruption is suspected or a step back to an old image if an incorrect image has just been loaded.

Reset IP & Ethernet Configuration back to factory defaults: This allows the user to reset the unit back to the factory defaults:

- IP Address 169.254.1.1 (or 10.10.10.10)
- Netmask 255.255.0.0
- Gateway 169.254.1.0
- Ethernet Interface Auto-negotiate, Auto-MDI/MDIX

Erase Configuration: This allows the user to erase the unit's entire configuration. Executing this option will also erase factory settings such as target MAC address, range setting, license key, etc.

Reboot: This allows the user to reboot the unit. This option must be executed after resetting the IP & Ethernet configuration or erasing the configuration detailed above.

Software Version: This is the software version of the recovery operating system permanently installed during manufacture.

Recovery Reason: Indicates the reason the unit is operating in Recovery mode. Possible reasons are “Recovery button active” or “Invalid or corrupt image”

MAC Address: The MAC address shown here is the MAC address of the unit programmed during manufacture.

9.1 Upgrade Software Image

The first step (Figure 95) is to use the ‘Browse’ button to locate the software image to be downloaded. Once located the user should press the “Upgrade Software Image” button to start the software download process.

During software download, progress is indicated by a pair of progress bars (Figure 96).

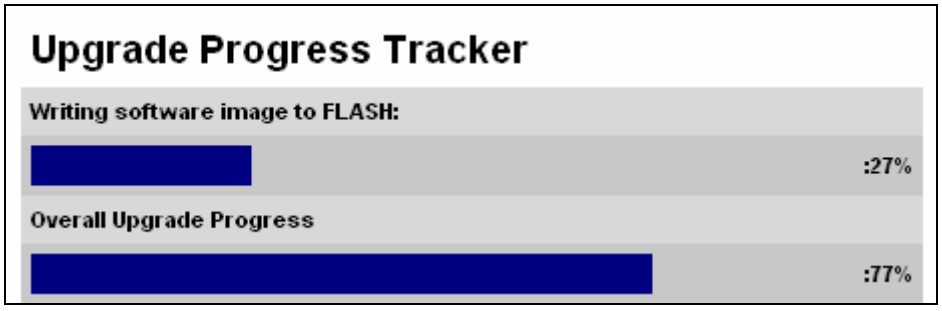


Figure 96 - Software Download Progress Indicator Page

When the download is complete a page is displayed indicating the status of the software download (Figure 97).

Figure 97 - Software Download Complete Page

After carefully checking that correct image has been downloaded the user should reboot the unit by pressing the “Reboot Wireless Unit” button. The user will then be presented with a pop up box asking them to confirm the action (Figure 98)

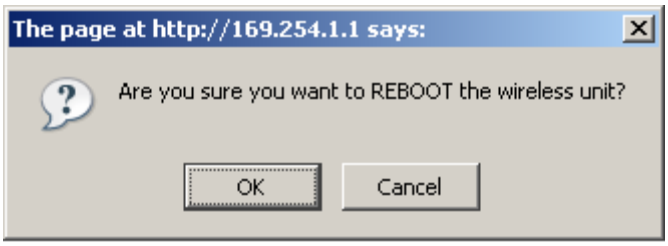


Figure 98 - Reboot Confirmation Pop Up

The unit will now reboot. Providing the unit configuration is still intact the unit should restart in normal operational mode and the link should recover. Should the unit or link fail to recover the user should refer to Section 10.

9.2 Reset IP & Ethernet Configuration

To reset IP & Ethernet configuration back to factory defaults the user should press the “Reset IP & Ethernet Configuration back to factory defaults” button on the “Recovery Options” page (Figure 95). The user will now be presented with a pop up box asking them to confirm the action (Figure 99).

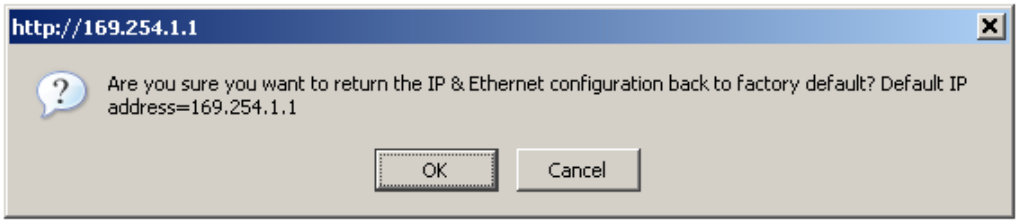


Figure 99 - Confirm Reset to Factory Default Pop Up

On confirmation the following page will be displayed (Figure 100). The user should now reboot the unit by pressing the “Reboot” button.

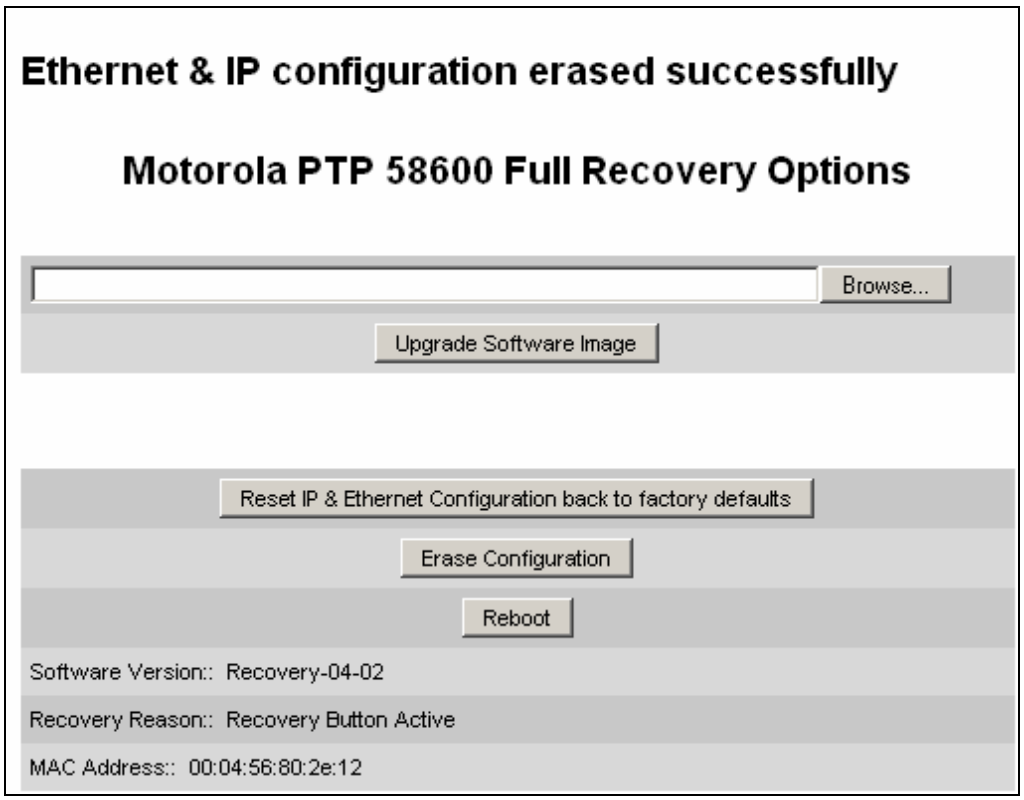


Figure 100 - IP and Ethernet Erased Successfully page

The user will now be presented with a pop up box asking them to confirm the action (Figure 101)

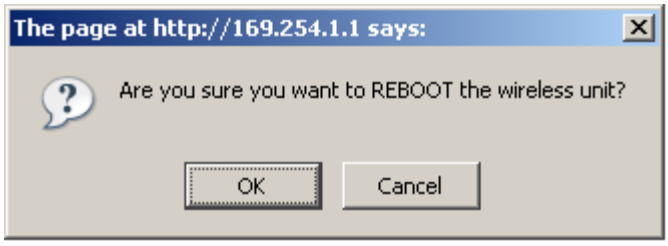


Figure 101 - Reboot Confirmation Pop Up

The unit will now reboot. The unit should now start up in normal mode but with the IP address set to 169.254.1.1 and the Ethernet interface set to auto-negotiate and auto-MDI/MDIX. Should the unit fail to start up the user should refer to Section 10.

9.3 Erase Configuration

To erase the unit's configuration the user should press the "Erase Configuration" button on the "Recovery Options" page (Figure 95). The user will now be presented with a pop up box asking them to confirm the action (Figure 102).

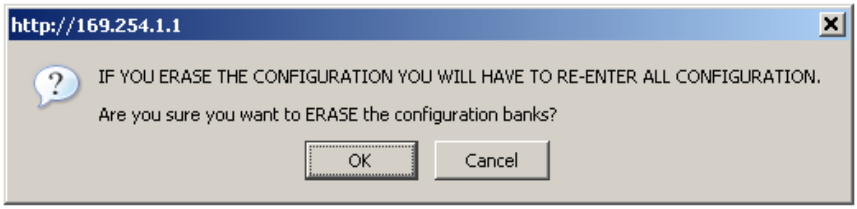


Figure 102 - Confirm Erase Configuration Pop Up

On confirmation the following page will be displayed (Figure 103). The user should now reboot the unit by pressing the “Reboot” button.

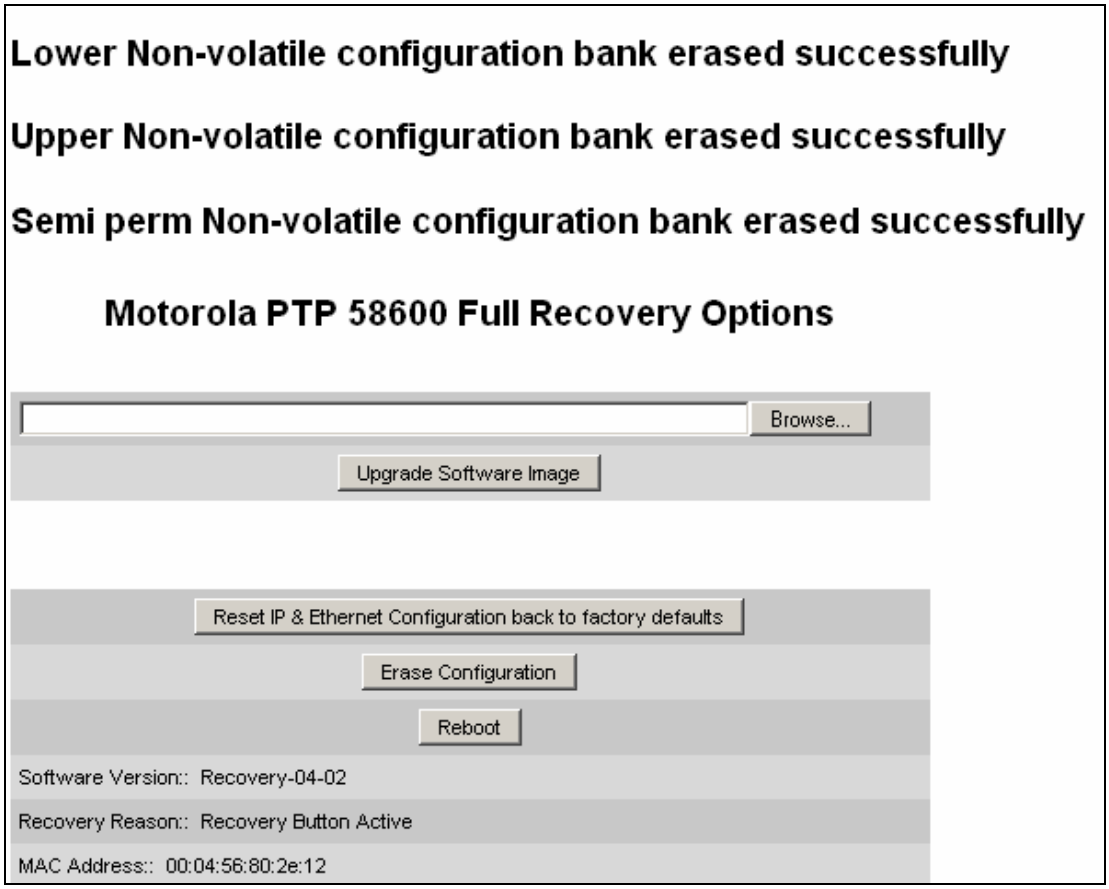


Figure 103 - Erase Configuration Successful Page

The user will now be presented with a pop up box asking them to confirm the action (Figure 104)

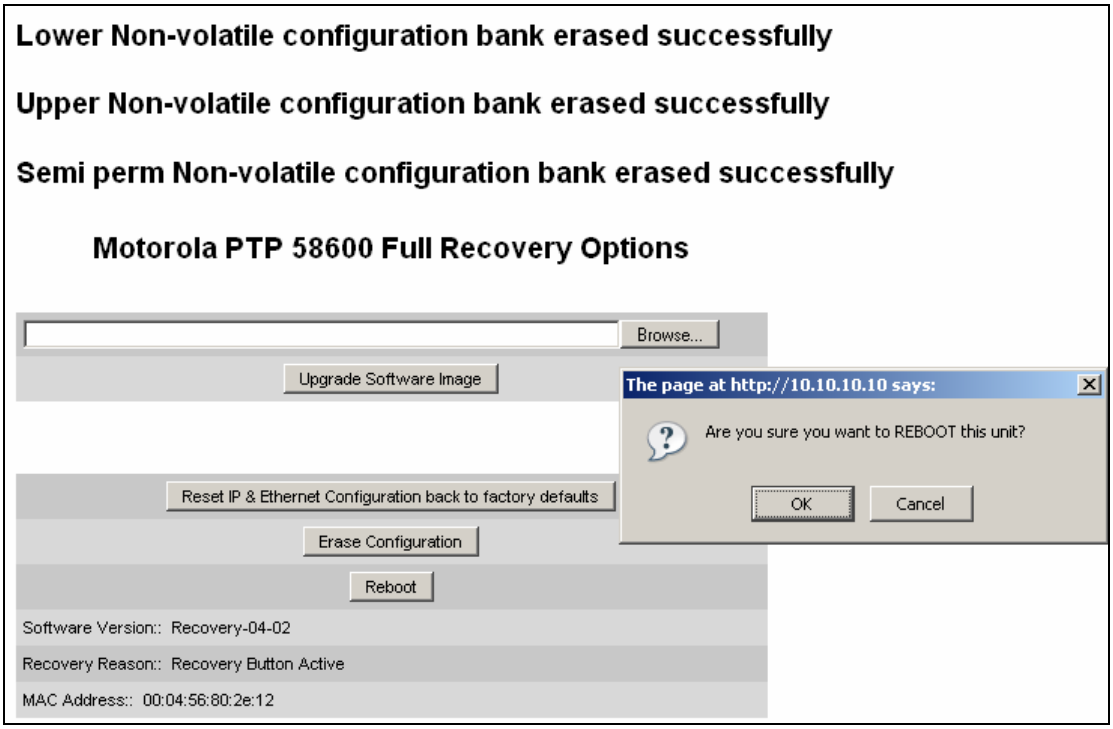


Figure 104 – Erase Configuration - Reboot Confirmation Pop Up

The unit will now reboot. The unit should now start up in normal mode but with all configuration erased. Should the unit fail to start up the user should refer to Section 10.

9.4 Reboot

To erase the unit's configuration the user should press the "Reboot" button on the "Recovery Options" page (Figure 95). The user will now be presented with a pop up box asking them to confirm the action (Figure 105).

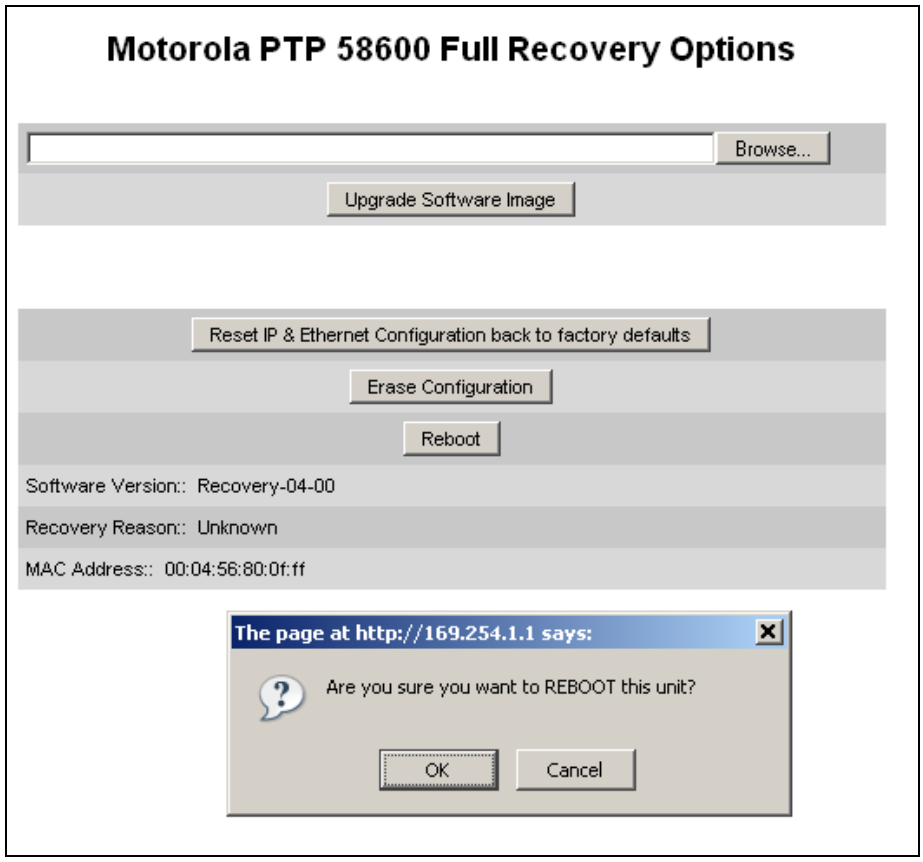


Figure 105 – Recovery - Reboot Confirmation Pop Up

The unit will now reboot. The unit should now start up in normal operational mode. Should the unit fail to start up the user should refer to Section 10.

10 Fault Finding

If communication has been lost with the unit at the near end of the link then there may be a hardware fault with the wiring, network or hardware. Go to the hardware section below. If communication with the far end of the link is lost then go to the radio section below.

10.1 Hardware

If there are problems suspected with the link hardware the following procedure is recommended.

The following diagram illustrates the main system connections:

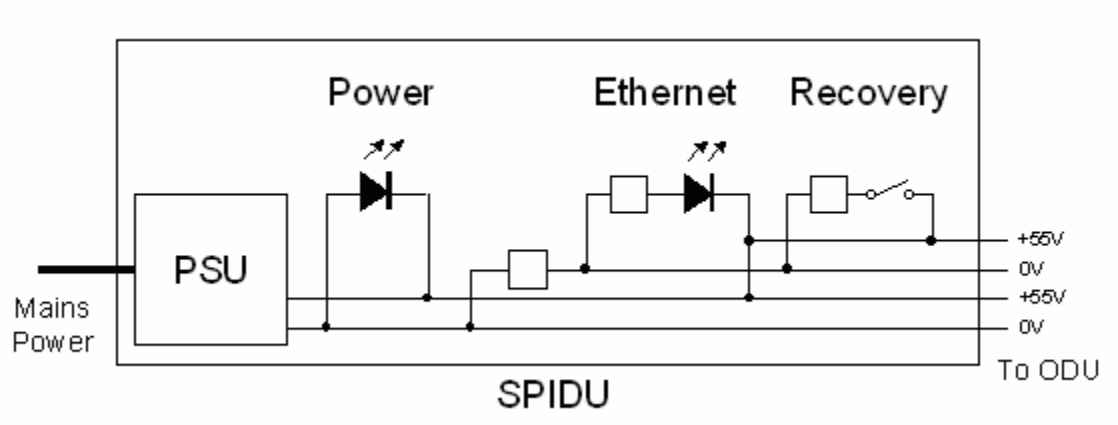


Figure 106 - Main System Connections

10.1.1 Power

Check the power LED at each end of the link. If the power lights are illuminated go to the Ethernet section below. If at either end they are not illuminated then[25] check the Ethernet LED.

If neither is illuminated then there is no voltage on the power wires to the ODU.

- Check that the mains power is connected and switched on.
- Check that the lamp illuminates if the ODU connector is disconnected at the PIDU Plus (Remove the PIDU Plus cover).

[25] The power indicator LED should be continually illuminated.

If it does illuminate then either the ODU is drawing too much current, or the power wiring to the ODU is short circuit or the PSU is supplying insufficient power. The likely fault can be determined by removing the jumper (J906), found inside the removable cover of the PIDU Plus, and measuring the current taken with an ammeter placed across the 2 jumper pins. This is normally 10mA without the ODU connected and 300mA to 1A when the ODU is connected.

If it does not illuminate then recheck that power is applied to the PIDU Plus by measuring the voltage across +55V and 0V pads inside the removable cover in the PIDU Plus. Check that the PIDU Plus is not short circuit by measuring the impedance across the Power connector. Is the lamp faulty?

10.1.2 Ethernet

The Ethernet LED is driven from the ODU processor and thus is capable of informing you of many conditions using different flash sequences. If the Ethernet indicator does not illuminate at all there are four possible conditions.

- There is no power reaching the ODU because of a wiring fault
- The ODU is faulty
- The PIDU Plus is faulty
- The Ethernet network side is faulty

Look at the following table to check the LED response for power up, disconnect the power and reapply and note what happens.

Differentiating between 1-3 and 4 can be achieved by removing the power for 1 second. Watch the Ethernet indicator for 1 minute, if it never flashes then the problem is 1-3. Take the jumper (J906) out of the PIDU Plus and check the current taken by the ODU. This should be 300mA to 1A when starting to run normally.

If the Ethernet indicator flashes to begin with but then stops flashing, the ODU is powered and software loaded but Ethernet connectivity has been lost between the ODU and the users connected equipment. All Ethernet connections should be rechecked.

Power Indoor Unit LED check chart:

Mode	Green LED	Yellow LED No Ethernet Cable Connected	Yellow LED Ethernet Cable Connected between PIDU Plus and NIC/Switch/Hub
No Power Applied	Off	Off	Off
Power Applied	On	Will flash once per second regularly approximately 30 seconds after power applied for 10 seconds then will go out and stay out	Will flash once per second regularly approximately 30 seconds after power applied for 10 seconds then operate as Ethernet Link/Activity LED
Valid Ethernet Link and no traffic	On	N/A	Will be on solid for a valid link.
Valid Ethernet Link with traffic	On	N/A	Will be on solid, but will blink randomly as traffic passes through
Recovery Switch Pressed and held for >10 seconds from power on (Recovery is pressed while power is applied)	On	Off while switch pressed. Approximately 30 seconds after releasing the switch, flashes twice per second regularly for 10 seconds, then boots in “Recovery Mode” While in “Recovery Mode” the unit will only be accessible via the IP address 10.10.10.10 or 169.254.1.1.	

10.1.3 Checking your wiring

If the above procedures fail to diagnose the issue you may have a wiring fault. Unplug the RJ45 from the PIDU+ and check the following resistances at the RJ45:

1. Check the cable resistance between pins 1 & 2, 3 & 6, 4 & 5 and 7 & 8 at the RJ45. Check against column 2 in Table 21. Resistances for each pair should be within 1 ohm of each other.

2. Check the cable resistance between pins 1 & 3 at the RJ45. Check against column 3 in Table 21.

3. Check the cable resistance between pins 4 & 7 at the RJ45. Check against column 4 in Table 21.

4. Ensure that there is greater than 100K ohms between pins 1 & 8 for all cable lengths.

5. Ensure that there is greater than 100K ohms between pin 1 and ODU ground for all cable lengths.

6. Ensure that there is greater than 100K ohms between pin 8 and ODU ground for all cable lengths

CAT-5 Length (Meters)	Resistance between pins 1 & 2, 3 & 6 , 4 & 5 and pins 7 & 8 (ohms)	Resistance between pins 1 & 3 (ohms)	Resistance between pins 4 & 7 (ohms)
0	0.8	1.0	1.6
10	2.5	2.7	3.3
20	4.2	4.4	5.0
30	5.9	6.1	6.7
40	7.6	7.8	8.4
50	9.3	9.5	10.1
60	11.0	11.2	11.8
70	12.7	12.9	13.5
80	14.4	14.6	15.2
90	16.1	16.3	16.9
100	17.8	18.0	18.6

Table 21 - Resistance Table Referenced To The RJ45 at the PIDU+

10.2 Radio

10.2.1 No Activity

If communication over the radio link has been lost and the unit at the other end of the link can be managed on its local network, the following procedure should be adopted:

If there is no wireless activity then the configuration should be checked. It is essential that the following items are correct:

- Check for Alarm conditions on Home page
- Check that the software at each end of the link is the same version
- Check that the Target Mac address has not been mis-configured at each end of the link.
- Check Range
- Check Tx Power

- Check License key
- Check Master Slave
- Check that the link has not been further obscured or the ODU misaligned.
- Check the DFS page at each end of the link and establish that there is a quiet wireless channel to use.

If there are no faults found in the configuration and there is absolutely no wireless signal retry the installation procedure. If this doesn't work then the ODU may be faulty.

10.2.2 Some Activity

If there is some activity but the link is unreliable or doesn't achieve the data rates required then:

- Check that the interference has not increased using the i-DFS measurements
- If a quieter channel is available check that it is not barred
- Check that the path loss is low enough for the communication rates required
- Check that the ODU has not become misaligned

11 Lightning Protection

EMD (Lightning) damage is not covered under warranty

The recommendations in this user manual when installed correctly give the user the best protection from the harmful effects of EMD

However 100% protection is neither implied nor possible

11.1 Overview

The idea of lightning protection is to protect structures, equipment and people against lightning by conducting the lightning current to ground via a separate preferential solid path and by reducing the electromagnetic field.

The following should be treated as a guide only, the actual degree of lightning protection required depends on local conditions and weather patterns and applicable local regulations. Full details of lightning protection methods and requirements can be found in the international standards IEC 61024-1 and IEC 61312-1, the U.S. National Electric Code ANSI/NFPA No. 70-1984 or section 54 of the Canadian Electric Code.

11.1.1 Lightning Protection Zones

The installation of the ODU can be classified into two different lightning protection zones.

Zone A — In this zone a direct lighting strike is possible.

Zone B — In this zone a direct lightning strike is unusual, but the un-attenuated electromagnetic field is still present.

The zones are determined using the ‘rolling sphere method’, an imaginary sphere, typically 50 meter in radius is rolled over the structure. All structure points that contact the sphere, (Zone A) indicate the zone where a direct strike is possible. Similarly points that do not contact the sphere indicate a zone (zone B) where a direct strike is less likely.

The following diagrams (Figure 107 & Figure 108) show this zoning pictorially:

Equipment mounted in Zone A should be capable of carrying the full lightning current. Mounting of the ODU in Zone A is not recommended. Mounting in Zone A should only be carried out observing the rules governing installations in Zone A[26] Failure to do so may put structures, equipment and life at risk.

Equipment mounted in Zone B should be grounded using grounding wire of at least 10 AWG. This grounding wire should be connected to a grounding rod or the building grounding system before entry in to building.

The 600 Series bridge ODU grounding point can be found on the bottom of the unit. The 600 Series Bridge is supplied with an appropriate grounding lug for attachment to the ODU.

11.2 Detailed Installation

The recommended components for an installation protected for nearby strikes are:

- Grounding Kits — Andrew Type 223158-2 (http://www.andrew.com .)
- Screened CAT 5e Cable also known as Shielded CAT 5e or CAT 5e STP (Shielded Twisted Pair)
- NB: Only use Outdoor rated, gel filled CAT5e if it contains a shield.
- Surge Arrestor: Transtector Type ALPU-ORT - 4 per link (www.transtector.com)
- Grounding Stake
- RJ45 screened connectors
- 8 AWG Grounding Cable – Minimum size, preferably 6 or 4

NOTE: There may be a local regulatory requirement to cross bond the CAT 5e cable at regular intervals to the mast. This may be as frequent as every 10 meters (33 feet)

[26] Local regulations may also require the fitting of the 8 AWG ground wire referred below.

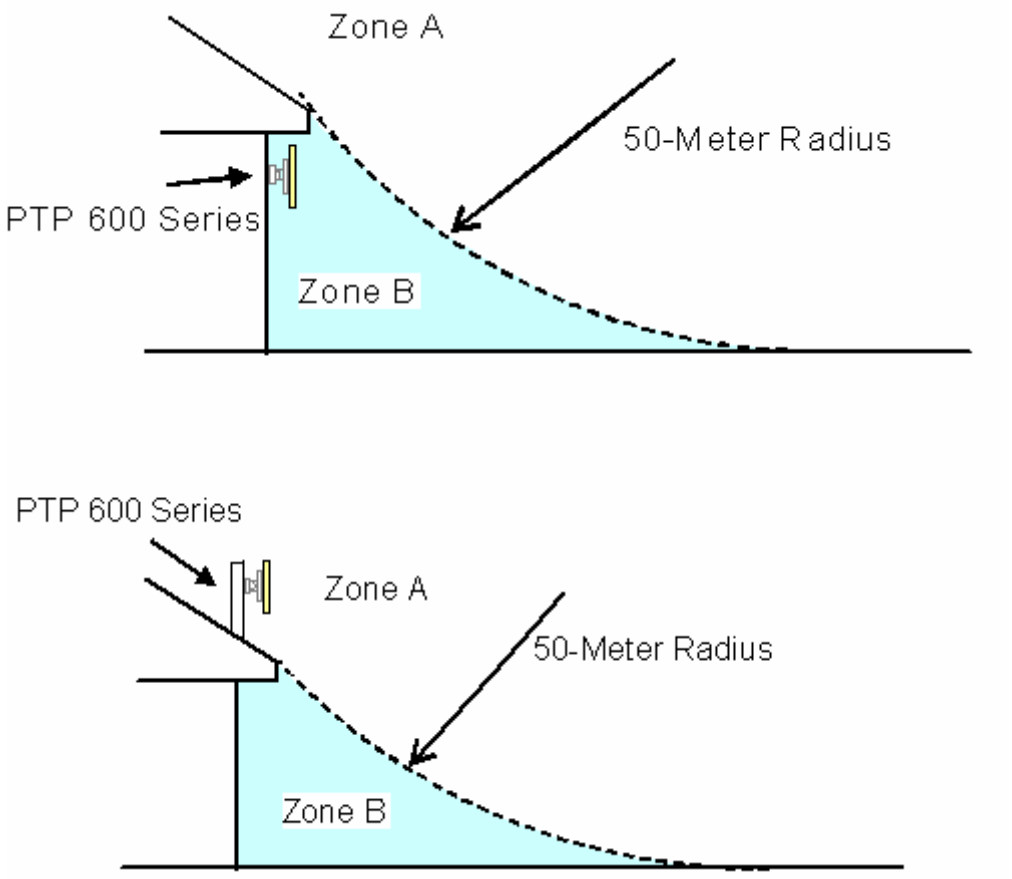


Figure 107 - ODU mounted in Zones A & B

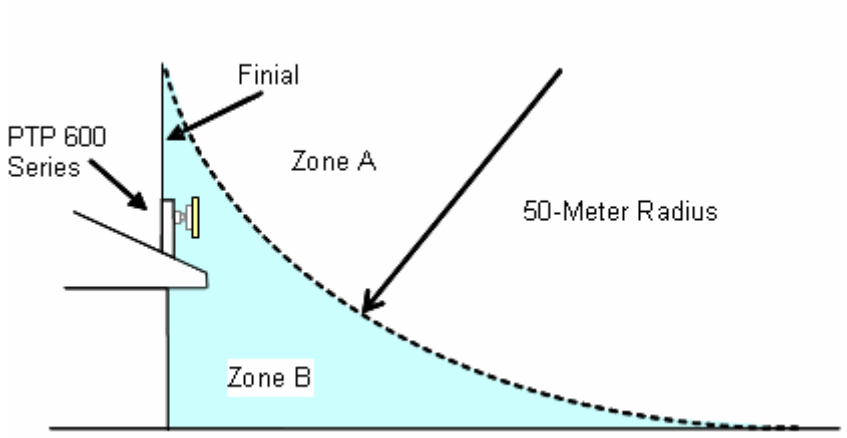


Figure 108 - Showing how the use of a Finial enables the ODU to be mounted inside Zone B

	Zone A	Zone B
Earth ODU	Mandatory	Mandatory
Screen Cable	Mandatory	Mandatory
Surge Arrestor Unit at ODU – ALPU-ORT	Mandatory	Mandatory
Earth Cable at Building Entry	Mandatory	Mandatory
Surge Arrestor Unit at Building Entry – ALPU-ORT	Mandatory	Mandatory

Table 22 - Protection Requirements

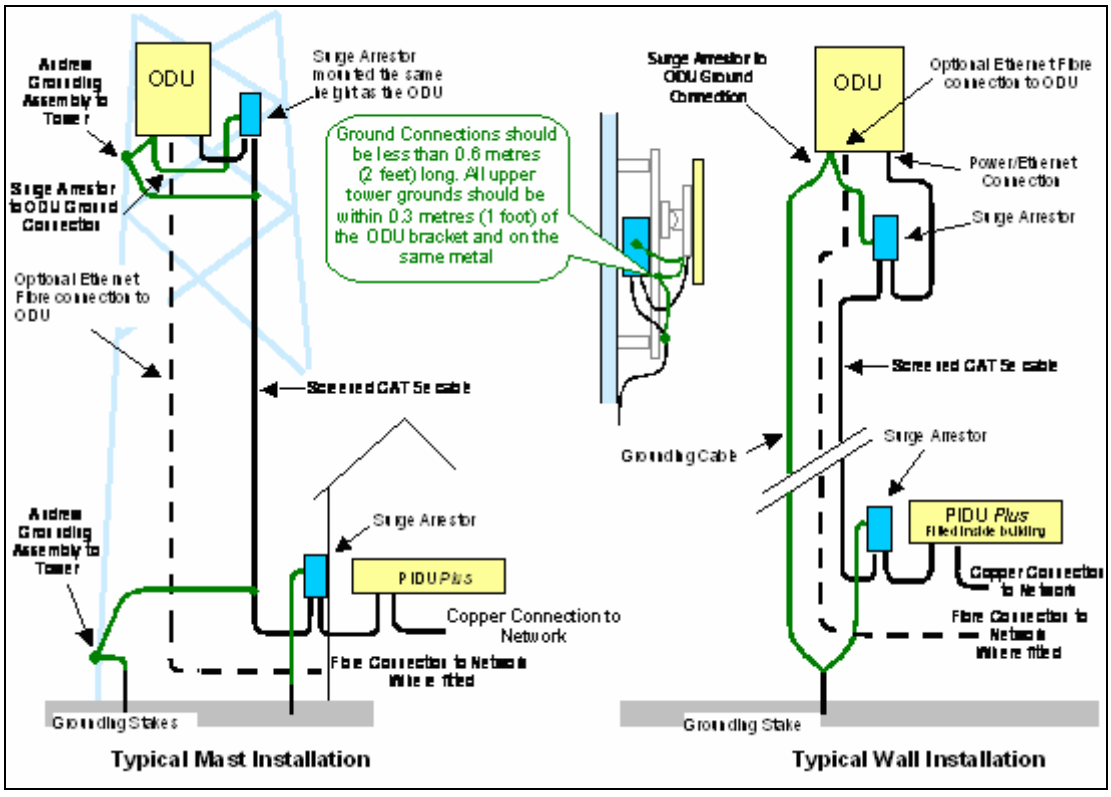


Figure 109 - Diagrammatically showing typical wall and mast installations

A typical installation is shown in Figure 110 and Figure 111.

Note: Grounding Points are shown unprotected for clarity. Grounding points should be adequately weatherproofed to prevent corrosion and possible loss of ground continuity.

Figure 110 - Upper Grounding Configuration

Figure 111 - Lower Grounding Configuration

An Andrew Grounding Kit and Surge Arrestor Unit must be located at the ODU and reliably grounded as shown in Figure 95. There may also be a regulatory requirement to crossbond the screened CAT-5 at regular intervals up the mast. Refer to local regulatory requirements for further details.

A second Surge Arrestor Unit should be mounted at the building entry point and must be grounded.

The termination of the CAT-5 Cable into the Surge Arrestor Unit is illustrated in Table, Table 24 and Figure 112. The screen from the cable must be terminated into the ground terminal within the unit to ensure the continuity of the screen. Earth Sleeving should be used to cover the shield ground connection to prevent internal shorting within the unit.

Terminal Identification	Conductor	RJ45 Pin
CON3 Pin 1	Orange/White	1
CON3 Pin 2	Orange	2
CON3 Pin 3	Green/White	3
CON3 Pin 6	Green	6
CON1 Pin 4	Blue	4
CON1 Pin 5	Blue/White	5
CON1 Pin 7	Brown/White	7
CON1 Pin 8	Brown	8

Table 23 - Surge Arrestor ALPU-ORT Cable 1 Termination

Terminal Identification	Conductor	RJ45 Pin
CON4 Pin 1	Orange/White	1
CON4 Pin 2	Orange	2
CON4 Pin 3	Green/White	3
CON4 Pin 6	Green	6
CON2 Pin 4	Blue	4
CON2 Pin 5	Blue/White	5
CON2 Pin 7	Brown/White	7
CON2 Pin 8	Brown	8

Table 24 - Surge Arrestor ALPU-ORT Cable 2 Termination

Figure 112 - Surge Arrestor ALPU-ORT Connection Illustration

Note: Cable screens have been sleeved.

11.3 Testing Your Installation

If you have followed the above instructions you will have wired your system to the following diagram:

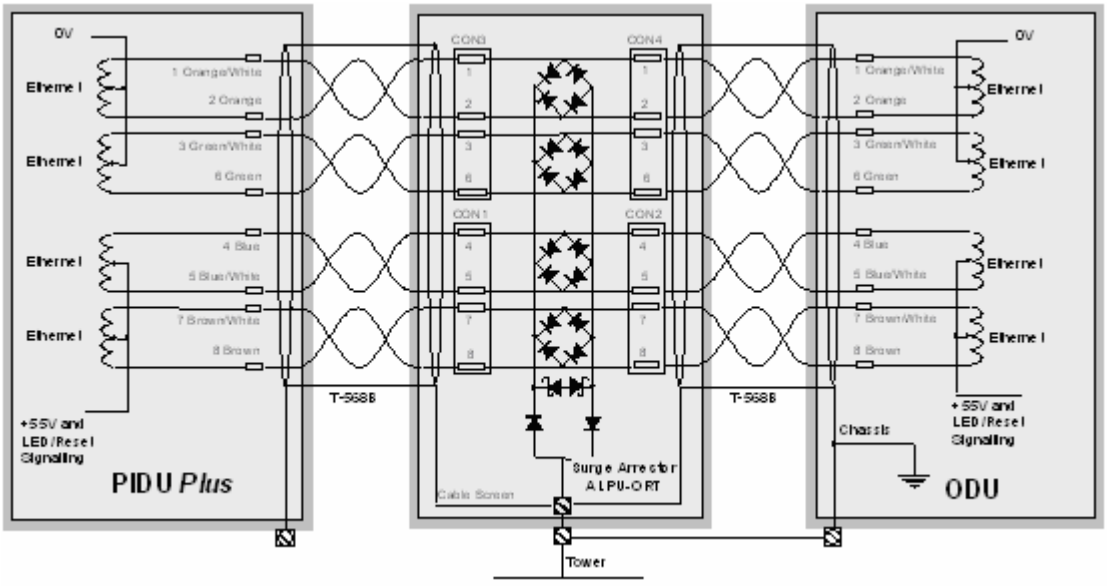


Figure 113 - Simplified Circuit Diagram (Only One Transtector Shown For Clarity)

11.3.1 Pre-Power Testing

Before plugging in the RJ45 to the PIDU check the impedances at the RJ45 as described in 10.1.3.

11.3.2 Post-Power Testing

The Correct Operation is as follows

1. Connect the RJ45 to the PIDU and apply power to the PIDU, the power LED should illuminate continuously.

2. 45 seconds after powering, the Ethernet LED should be observed starting with 10 slow flashes.

3. If there is a network connection the Ethernet LED will then show Ethernet activity.

The Ethernet LED does not flash 10 times

Failure of the Ethernet LED to illuminate can be due to wiring to pins 4&5 and 7&8 being incorrect, for example if the wiring to pins 4 and 7 are crossed.

The Ethernet LED flashes ten times but irregularly

Irregularly flashing, seen as a short gap followed by a long gap, indicates that the ODU has booted in recovery mode. This may be due to either the installation wiring or a corrupted main code image in the ODU.

The Ethernet LED flashes ten times but does not show Ethernet activity

Failure of the Ethernet LED to show Ethernet activity can be due to wiring to pins 1&2 and 3&6 being incorrect, for example if the wiring to pins 1 and 3 are crossed.

The Ethernet connection to the network is only 10/100 BaseT, when 1000 BaseT was expected

It is likely there is a fault with the wiring to pins 4&5 and 7&8.

12 Wind Loading

12.1 General

Antennas and electronic equipment mounted on towers or pole mounted on buildings will subject the mounting structure to lateral forces when there is appreciable wind. Antennas are normally specified by the amount of force (in pounds) for specific wind strengths.

The magnitude of the force depends on both the wind strength and size of the antenna.

12.2 Calculation of Lateral Force

The 600 Series bridge with or without the integral antenna is essentially a flat structure and so the magnitude of the lateral force can be estimated from:

$$\text{Force (in pounds)} = 0.0042 \cdot A \cdot v^2$$

Where A is the surface area in square feet and v is the wind speed in miles per hour.

The lateral force produced by a single 600 Series bridge (integrated or connectorized model) at different wind speeds is shown in Table 25 and Table 26.

	Largest Surface Area (sq ft)	Lateral Force (Pound) at wind speed (mph)				
		80	100	120	140	150
PTP 600 Series Bridge - Integrated	1.36	37	57	82	112	129
PTP 600 Series Bridge - Connectorized	1.00	27	42	60	82	95

Table 25 - Lateral Force – Imperial

	Largest Surface Area (sq m)	Lateral Force (kg) at wind speed (m/s)				
		30	40	50	60	70
PTP 600 Series Bridge - Integrated	0.130	12	22	34	49	66
PTP 600 Series Bridge - Connectorized	0.093	9	16	24	35	48

Table 26 - Lateral Force – Metric

Note: When the connectorized version of 600 Series bridge is used with external antennas, the figures from the antenna manufacturer for lateral force should be included to calculate to total loading on the mounting structure.

12.3 Capabilities of the PTP 600 Series Bridges

The structure and mounting brackets of the PTP Series systems are capable of withstanding wind speeds up to 151mph (242 kph). The installer should ensure that the structure to which the 600 Series Bridge is fixed to is also capable of withstanding the prevalent wind speeds and loads.

12.4 Wind Speed Statistics

Installers are recommended to contact the national meteorological office for the country concerned to identify the likely wind speeds prevalent at the proposed location. This will enable the installer to estimate the total wind loading on the support structures.

Examples of the sort of statistics that are available are:

USA - Reported Fastest Single Wind Velocities for Selected U.S. Cities

(Source: National Weather Service)

City, State	**Wind Velocity (mph)**
Bismarck, North Dakota	72
Buffalo, New York	91

Chicago, Illinois	87
Hatteras, North Carolina	110
Miami, Florida	132
New York, New York	99
Pensacola, Florida	114

UK Meteorological Office, www.meto.gov.uk

Peak wind speed contour maps can be found as Fig 3a/3b at:

http://www.meto.gov.uk/education/historic/1987.html

13 PTP 600 Series Bridge – Connectorized Model

13.1 Scope

This section details the changes and additional features relevant to the connectorized version of the PTP 600 Series systems, OS 58C.

13.2 Product Description

13.2.1 Hardware

The Connectorized PTP 600 Series Bridge is a variant designed to provide the system integrator and installer with the ability to provide extra capability to cope with very difficult radio links compared to the PTP 600 Series Integrated model. The variant allows the use of a variety of externally mounted antennas, either Flat Plate or Dish, which have higher gains than provided by the integrated antenna that is normally used.

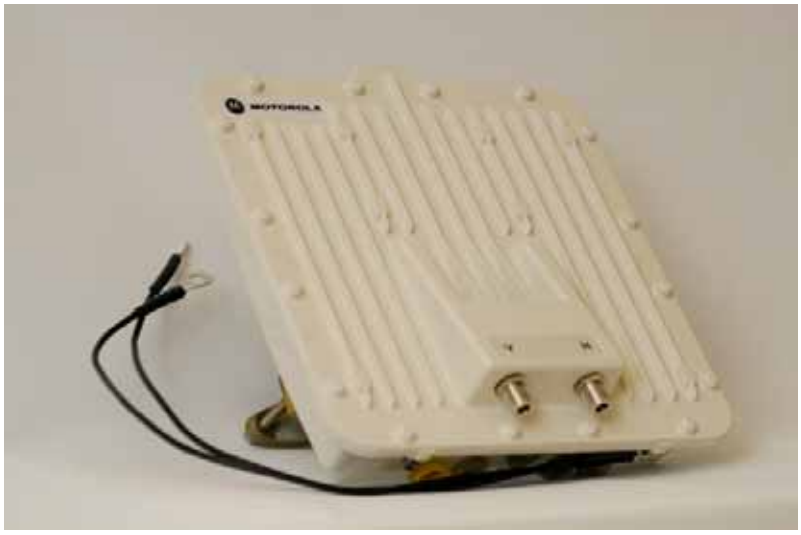


Figure 114 – Connectorized 600 Series Bridge Outdoor Unit

13.2.2 Antenna Choices – 5.8 GHz

The integrated antenna has a gain of 23 dBi.

In non-FCC regions antenna choice is not restricted but any region specific EIRP limit should be obeyed, see Table 6 in Section 5.2 “Region Codes”

In FCC regions external antennas from the list in Section 13.7 “Antennas for USA / Canada – 5.8 GHz” can be used with the Connectorized version of the 600 Series Bridge. These are approved by the FCC for use with the product and are basically constrained by the following limits:

- Single Polarization Flat Plate Antennas – up to 28dBi per antenna.
- Single/Dual Polarization Parabolic Dish Antennas – up to 37.7dBi per polarization or antenna.

In FCC regions when using external antennas – cable loss between the connectorized version of the 600 Series Bridge and the antenna ports must not be less than 1.2dB

13.2.3 Antenna Choices – 5.4 GHz

The integrated antenna has a gain of 23 dBi.

In FCC regions external antennas from the list in Section 13.8 “Antennas for USA / Canada – 5.4GHz” can be used with the Connectorized version of the 600 Series Bridge. These are approved by the FCC for use with the product and are basically constrained by the following limits:

- Single/Dual Polarization Parabolic Dish Antennas – up to 34.6dBi per polarization or antenna.

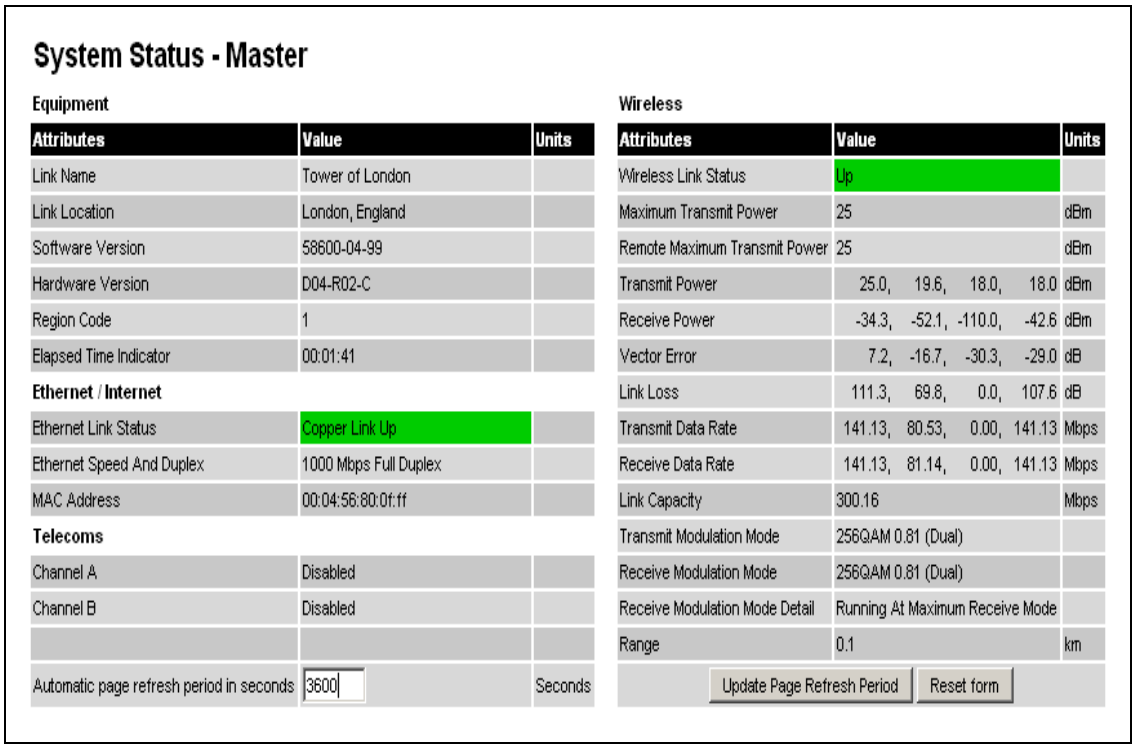
In FCC regions when using external antennas – cable loss between the connectorized version of the 600 Series Bridge and the antenna ports must not be less than 1.2dB

13.3 Software/Features

The variant operates in the same way as the basic 600 Series bridge and is released initially with the feature set of the Connectorized 600 Series bridge. The areas where the functionality is modified are:

13.3.1 Status Page

The link loss calculation presented on the Status Page of the management interface has to be modified to allow for the increased antenna gains at each end of the link. The manufacturing process of the Connectorized 600 Series Bridge configures the standard hardware of the unit for use with external antennas. The installer is prompted, as part of the installation process, to enter the gain of the external antenna(s) and cable losses at each end of the link. Peer-to-peer messaging is used to pass the effective antenna gain to each end of the link so that the link loss calculations can be correctly computed.



System Status - Master

Equipment

Attributes	Value	Units
Link Name	Tower of London	
Link Location	London, England	
Software Version	58600-04-99	
Hardware Version	D04-R02-C	
Region Code	1	
Elapsed Time Indicator	00:01:41	
Ethernet / Internet		
Ethernet Link Status	Copper Link Up	
Ethernet Speed And Duplex	1000 Mbps Full Duplex	
MAC Address	00:04:56:80:0f:ff	
Telecoms		
Channel A	Disabled	
Channel B	Disabled	
Automatic page refresh period in seconds	3600	Seconds

Wireless

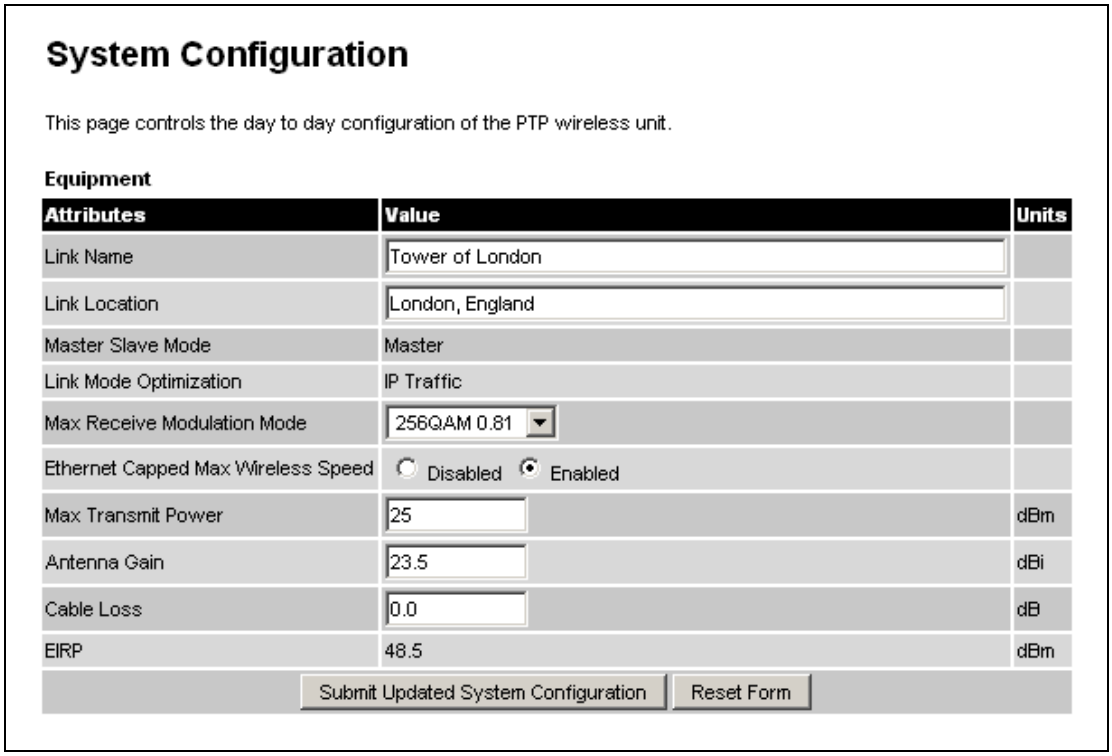
Attributes	Value	Units
Wireless Link Status	Up	
Maximum Transmit Power	25	dBm
Remote Maximum Transmit Power	25	dBm
Transmit Power	25.0, 19.6, 18.0, 18.0	dBm
Receive Power	-34.3, -52.1, -110.0, -42.6	dBm
Vector Error	7.2, -16.7, -30.3, -29.0	dB
Link Loss	111.3, 69.8, 0.0, 107.6	dB
Transmit Data Rate	141.13, 80.53, 0.00, 141.13	Mbps
Receive Data Rate	141.13, 81.14, 0.00, 141.13	Mbps
Link Capacity	300.16	Mbps
Transmit Modulation Mode	256QAM 0.81 (Dual)	
Receive Modulation Mode	256QAM 0.81 (Dual)	
Receive Modulation Mode Detail	Running At Maximum Receive Mode	
Range	0.1	km

Update Page Refresh Period | Reset form

Figure 115 - Connectorized 600 Series bridge Status Page

13.3.2 Configuration Pages

The amended Configuration web page is shown below as Figure 116.



System Configuration

This page controls the day to day configuration of the PTP wireless unit.

Equipment

Attributes	Value	Units
Link Name	Tower of London	
Link Location	London, England	
Master Slave Mode	Master	
Link Mode Optimization	IP Traffic	
Max Receive Modulation Mode	256QAM 0.81	
Ethernet Capped Max Wireless Speed	Disabled / Enabled	
Max Transmit Power	25	dBm
Antenna Gain	23.5	dBi
Cable Loss	0.0	dB
EIRP	48.5	dBm

Submit Updated System Configuration | Reset Form

Figure 116 - Connectorized 600 Series bridge 'System Configuration' Page

13.3.3 Installation Pages

The installer is prompted to enter the Antenna Gain and Cable Loss (Connectorized PTP 600 Series Bridge to antenna) at each end of the link. The Installation Page(s) is shown as Figure 117 to Figure 119.

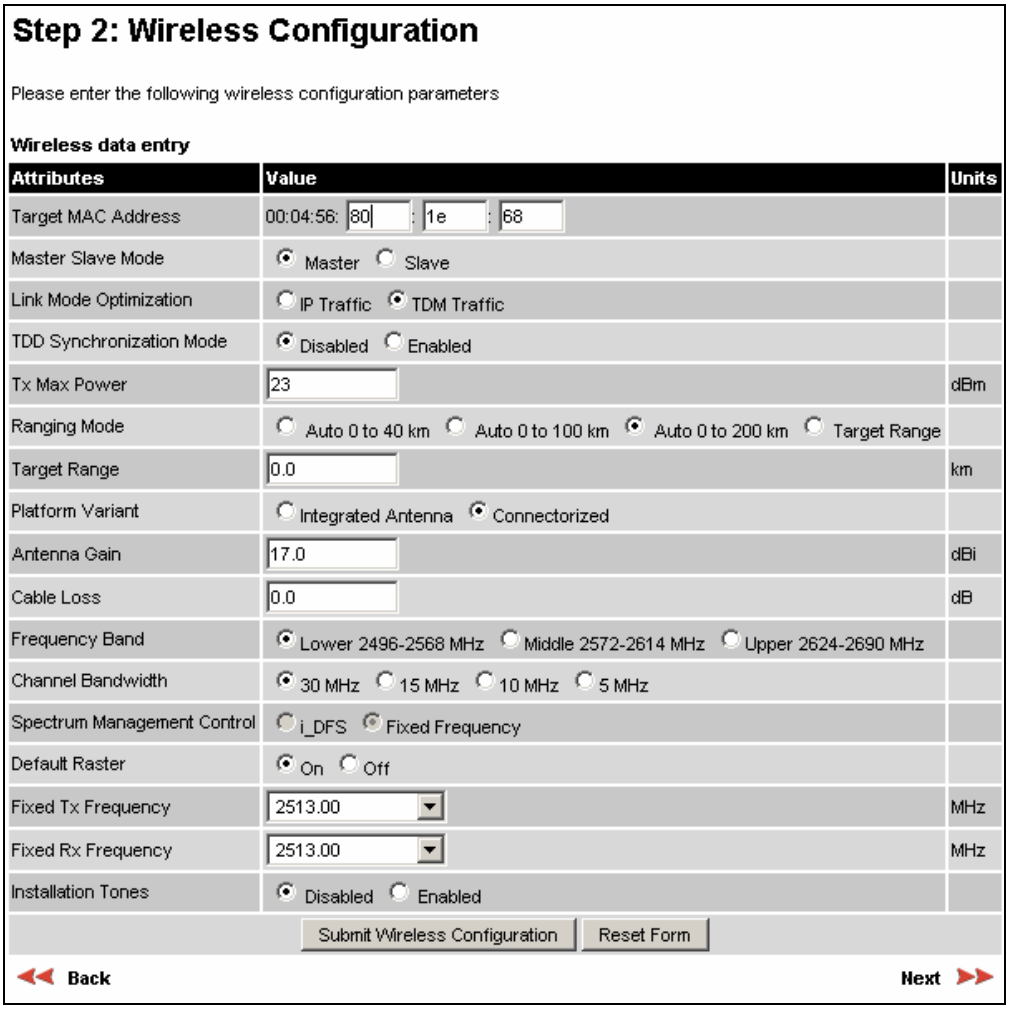
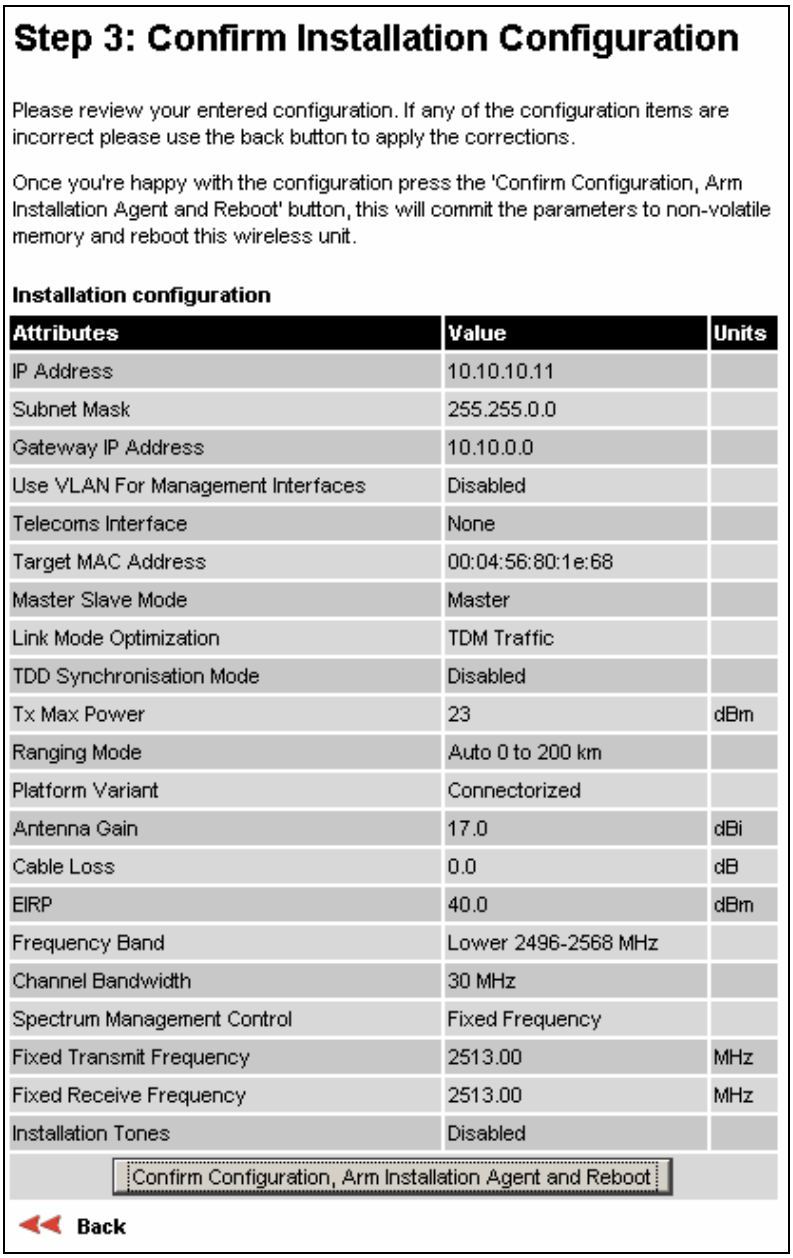


Figure 117 - Connectorized PTP 600 Series Bridge 'Installation Wizard' Page

Antenna Gain: Gain of the antenna you are connecting to the unit, see Table 28.

Cable Loss: Loss in the cable between the ODU and the antenna. Note: In the event that there is a significant difference in length of the antenna cables for the two antenna ports, then the average value should be entered.

Spectrum Management Control: Is used to configure the 600 Series Bridge Spectrum Management features, see Section 8.3.7 for more details. iDFS is the abbreviation for intelligent Dynamic Frequency Selection, which continually monitors the 5.8 GHz spectrum looking for the channel with the lowest level of on channel and co-channel interference. Fixed frequency mode allows the installer to fix the Transmit and receive frequencies on the units. The frequencies may be configured symmetrically or asymmetrically.



Step 3: Confirm Installation Configuration

Please review your entered configuration. If any of the configuration items are incorrect please use the back button to apply the corrections.

Once you're happy with the configuration press the 'Confirm Configuration, Arm Installation Agent and Reboot' button, this will commit the parameters to non-volatile memory and reboot this wireless unit.

Installation configuration

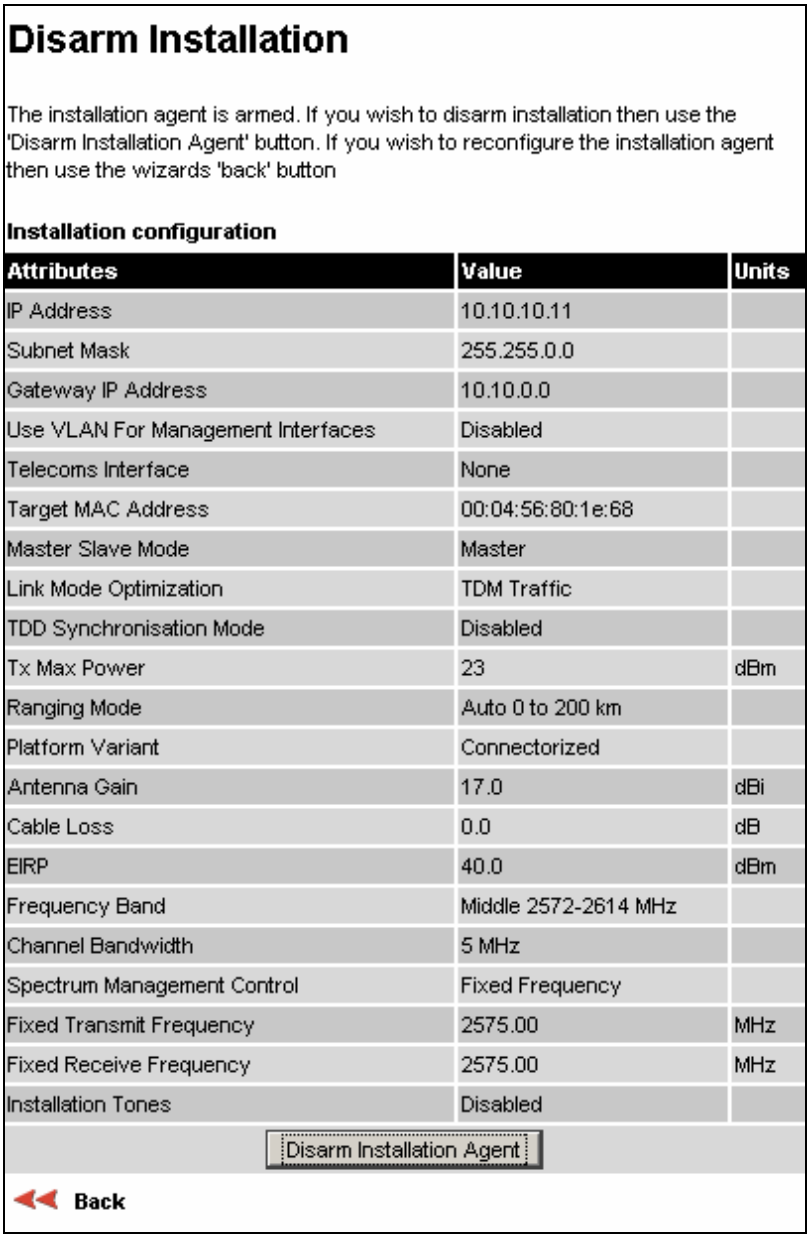
Attributes	Value	Units
IP Address	10.10.10.11	
Subnet Mask	255.255.0.0	
Gateway IP Address	10.10.0.0	
Use VLAN For Management Interfaces	Disabled	
Telecoms Interface	None	
Target MAC Address	00:04:56:80:1e:68	
Master Slave Mode	Master	
Link Mode Optimization	TDM Traffic	
TDD Synchronisation Mode	Disabled	
Tx Max Power	23	dBm
Ranging Mode	Auto 0 to 200 km	
Platform Variant	Connectorized	
Antenna Gain	17.0	dBi
Cable Loss	0.0	dB
EIRP	40.0	dBm
Frequency Band	Lower 2496-2568 MHz	
Channel Bandwidth	30 MHz	
Spectrum Management Control	Fixed Frequency	
Fixed Transmit Frequency	2513.00	MHz
Fixed Receive Frequency	2513.00	MHz
Installation Tones	Disabled	

Confirm Configuration, Arm Installation Agent and Reboot

Back

Figure 118 - Connectorized 600 Series bridge 'Confirm Installation' Page

EIRP The Confirm Installation Page displays the EIRP (Effective Isotropic Radiated Power), which describes the strength of the radio signal leaving the wireless unit. This allows the operator to verify that their link configuration (Max Transmit Power, Antenna Gain and Cable Loss) do not cause the link to exceed any applicable regulatory limit.



Disarm Installation

The installation agent is armed. If you wish to disarm installation then use the 'Disarm Installation Agent' button. If you wish to reconfigure the installation agent then use the wizards 'back' button

Installation configuration

Attributes	Value	Units
IP Address	10.10.10.11	
Subnet Mask	255.255.0.0	
Gateway IP Address	10.10.0.0	
Use VLAN For Management Interfaces	Disabled	
Telecoms Interface	None	
Target MAC Address	00:04:56:80:1e:68	
Master Slave Mode	Master	
Link Mode Optimization	TDM Traffic	
TDD Synchronisation Mode	Disabled	
Tx Max Power	23	dBm
Ranging Mode	Auto 0 to 200 km	
Platform Variant	Connectorized	
Antenna Gain	17.0	dBi
Cable Loss	0.0	dB
EIRP	40.0	dBm
Frequency Band	Middle 2572-2614 MHz	
Channel Bandwidth	5 MHz	
Spectrum Management Control	Fixed Frequency	
Fixed Transmit Frequency	2575.00	MHz
Fixed Receive Frequency	2575.00	MHz
Installation Tones	Disabled	

Disarm Installation Agent

Back

Figure 119 - Connectorized 600 Series bridge 'Disarm Installation' Page

13.4 Deployment Considerations

The majority of radio links can be successfully deployed with the 600 Series bridge. It should only be necessary to use external antennas where the Link Budget Calculator indicates marginal performance for a specific link – for example when the link is heavily obscured by dense woodland on an NLOS link or extremely long LOS links (>80km or > 50 miles) over water.

The external antennas can be either dual-polarization (as the integrated antenna) or two single polarized antennas can be used in a spatially diverse configuration. It is expected that the dual-polarization antennas would normally be used to simplify the installation process; spatially diverse antennas may provide additional fade margin on very long LOS links where there is evidence of correlation of the fading characteristics on Vertical and Horizontal polarizations.

Dual polarization antennas (with a gain greater than the integrated antenna) are currently only available in parabolic dish form.

13.5 Link Budget

An estimate of the link budget for a specific application can be obtained by using the Motorola Systems link estimation tools. For more information see the Motorola web site.

13.6 Regulatory Issues

In countries where FCC regulations are not relevant, installations should conform to any applicable local regulations for the Equivalent Isotropic Radiated Power (EIRP).

Ensuring compliance becomes more complex when the connectorized unit is used with external antennas which may be locally sourced. With higher gain external antennas fitted, the Maximum Transmit power may need to be reduced for operation in specific countries.

See Table 6 in Section 5.2 for any EIRP restrictions that may apply in your region.

13.6.1 Antenna Choice (FCC Regions Only)

The antennas which can be deployed with the Connectorized 600 Series Bridge are shown in Table 28.

13.6.2 Cable Losses (FCC Regions Only)

The FCC approval for the product is based on tests with a cable loss between the units of approximately 1.2dB at 5.8GHz. The use of lower cable losses would result in the installation being outside the FCC rules.

As an indication, 1.2dB of cable loss corresponds to the following cable lengths excluding connector losses (source: Times Microwave).

Cable	Length for 1.2dB Cable Loss at 5.8GHz	
	(ft)	(m)
LMR100	1.9	0.6
LMR200	4.6	1.4
LMR300	7.25	2.2
LMR400	11.1	3.4
LMR600	16.5	5.0

Table 27 - Cable Losses per Length

13.7 Antennas for USA / Canada – 5.8 GHz

Manufacturer	Antenna Type	Gain (dBi)	Flat Plate	Parabolic Dish
Andrew	Andrew 1-foot Flat Panel, FPA5250D12-N (23.6dBi)	23.6	Y	
Andrew	Andrew 2-foot Flat Panel, FPA5250D24-N (28dBi)	28	Y	
Gabriel	Gabriel 1-foot Flat Panel, DFPD1-52 (23.5dBi)	23.5	Y	
Gabriel	Gabriel 2-foot Flat Panel, DFPD2-52 (28dBi)	28	Y	
MTI	MTI 17 inch Diamond Flat Panel, MT-485009 (23dBi)	23	Y	
MTI	MTI 15 inch Dual-Pol Flat Panel, MT-485025/NVH (23dBi)	23	Y	
MTI	MTI 2 ft Directional Flat Panel, MT-20004 (28dBi)	28	Y	
MTI	MTI 2 ft Flat Panel, MT-486001 (28dBi)	28	Y	
RFS	RFS 1-foot Flat Panel, MA0528-23AN (23dBi)	23	Y	
RFS	RFS 2-foot Flat Panel, MA0528-28AN (28dBi)	28	Y	
Telectronics	Teletronics 2-foot Flat Plate Antenna, ANT-P5828 (28dBi)	28	Y	
Andrew	Andrew 2-foot Parabolic, P2F-52 (29.4dBi)	29.4		Y
Andrew	Andrew 2-foot Dual-Pol Parabolic, PX2F-52 (29.4dBi)	29.4		Y

Manufacturer	Antenna Type	Gain (dBi)	Flat Plate	Paraboli c Dish
Andrew	Andrew 3-foot Parabolic, P3F-52 (33.4dBi)	33.4		Y
Andrew	Andrew 3-foot Dual-Pol Parabolic, PX3F-52 (33.4dBi)	33.4		Y
Andrew	Andrew 4-foot Parabolic, P4F-52 (34.9dBi)	34.9		Y
Andrew	Andrew 4-foot Dual-Pol Parabolic, PX4F-52 (34.9dBi)	34.9		Y
Andrew	Andrew 6-foot Parabolic, P6F-52 (37.6dBi)	37.6		Y
Andrew	Andrew 6-foot Dual-Pol Parabolic, PX6F-52 (37.6dBi)	37.6		Y
Gabriel	Gabriel 2-foot High Performance QuickFire Parabolic, HQF2-52-N	28.2		Y
Gabriel	Gabriel 4-foot High Performance QuickFire Parabolic, HQF4-52-N	34.4		Y
Gabriel	Gabriel 6-foot High Performance QuickFire Parabolic, HQF6-52-N	37.4		Y
Gabriel	Gabriel 2-foot High Performance Dual QuickFire Parabolic, HQFD2-52-N	28.1		Y
Gabriel	Gabriel 4-foot High Performance Dual QuickFire Parabolic, HQFD4-52-N	34.3		Y
Gabriel	Gabriel 6-foot High Performance Dual QuickFire Parabolic, HQFD6-52-N	37.3		Y
Gabriel	Gabriel 2-foot Standard QuickFire Parabolic, QF2-52-N	28.5		Y
Gabriel	Gabriel 2-foot Standard QuickFire Parabolic, QF2-52-N-RK	28.5		Y
Gabriel	Gabriel 2.5-foot Standard QuickFire Parabolic, QF2.5-52-N	31.2		Y
Gabriel	Gabriel 4-foot Standard QuickFire Parabolic, QF4-52-N	34.8		Y
Gabriel	Gabriel 4-foot Standard QuickFire Parabolic, QF4-52-N-RK	34.8		Y
Gabriel	Gabriel 6-foot Standard QuickFire Parabolic, QF6-52-N	37.7		Y
Gabriel	Gabriel 2-foot Standard Dual QuickFire Parabolic, QFD2-52-N	28.4		Y
Gabriel	Gabriel 2.5-foot Standard Dual QuickFire Parabolic, QFD2.5-52-N	31.1		Y
Gabriel	Gabriel 2-foot Standard Dual QuickFire Parabolic, QFD2-52-N-RK	28.4		Y
Gabriel	Gabriel 4-foot Standard Dual QuickFire Parabolic, QFD4-52-N	34.7		Y
Gabriel	Gabriel 4-foot Standard Dual QuickFire Parabolic, QFD4-52-N-RK	34.7		Y
Gabriel	Gabriel 6-foot Standard Dual QuickFire Parabolic, QFD6-52-N	37.7		Y
RadioWaves	Radio Waves 2-foot Dual-Pol Parabolic, SPD2-5.2 (28.1dBi)	28.1		Y

Manufacturer	Antenna Type	Gain (dBi)	Flat Plate	Paraboli c Dish
RadioWaves	Radio Waves 2-foot Parabolic, SP2-5.2 (29.0dBi)	29		Y
RadioWaves	Radio Waves 3-foot Dual-Pol Parabolic, SPD3-5.2 (31.1dBi)	31.1		Y
RadioWaves	Radio Waves 3-foot Parabolic, SP3-5.2 (31.4dBi)	31.4		Y
RadioWaves	Radio Waves 4-foot Dual-Pol Parabolic, SPD4-5.2 (34.4dBi)	34.4		Y
RadioWaves	Radio Waves 4-foot Parabolic, SP4-5.2 (34.8dBi)	34.8		Y
RadioWaves	Radio Waves 6-foot Dual-Pol Parabolic, SPD6-5.2 (37.5dBi)	37.5		Y
RadioWaves	Radio Waves 6-foot Parabolic, SP6-5.2 (37.7dBi)	37.7		Y
RadioWaves	Radio Waves 2-foot Parabolic, SP2-2/5 (28.3dBi)	28.3		Y
RadioWaves	Radio Waves 3-foot Parabolic, SP3-2/5 (31.4dBi)	31.4		Y
RadioWaves	Radio Waves 4-foot Parabolic, SP4-2/5 (34.6dBi)	34.6		Y
RadioWaves	Radio Waves 6-foot Parabolic, SP6-2/5 (37.7dBi)	37.7		Y
RFS	RFS 2-foot Parabolic, SPF2-52AN or SPFX2-52AN (27.9dBi)	27.9		Y
RFS	RFS 3-foot Parabolic, SPF3-52AN or SPFX3-52AN(31.4dBi)	31.4		Y
RFS	RFS 4-foot Parabolic, SPF4-52AN or SPFX4-52AN(33.9dBi)	33.9		Y
RFS	RFS 6-foot Parabolic, SPF6-52AN or SPFX6-52AN (37.4dBi)	37.4		Y
RFS	RFS 2-foot HP Parabolic, SDF2-52AN or SDFX2-52AN (31.4dBi)	31.4		Y
RFS	RFS 4-foot HP Parabolic, SDF4-52AN or SDFX4-52AN (33.9dBi)	33.9		Y
RFS	RFS 6-foot HP Parabolic, SDF6-52AN or SDFX6-52AN (37.4dBi)	37.4		Y
StellaDoradus	StellaDoradus 45 inch Parabolic Antenna, 58PSD113	33.8		Y

Table 28 - Allowed Antennas for Deployment in USA/Canada – 5.8 GHz

13.8 Antennas for USA - 5.4 GHz

Manufacturer	Antenna Type	Gain (dBi)	Parabolic Dish
Andrew	Andrew 2-foot Parabolic, P2F-52 (29.4dBi)	29.4	Y
Andrew	Andrew 2-foot Dual-Pol Parabolic, PX2F-52 (29.4dBi)	29.4	Y
Andrew	Andrew 3-foot Parabolic, P3F-52 (33.4dBi)	33.4	Y
Andrew	Andrew 3-foot Dual-Pol Parabolic, PX3F-52 (33.4dBi)	33.4	Y
Andrew	Andrew 4-foot Parabolic, P4F-52 (34.9dBi)	34.9	Y
Andrew	Andrew 4-foot Dual-Pol Parabolic, PX4F-52 (34.9dBi)	34.9	Y
Gabriel	Gabriel 2-foot High Performance QuickFire Parabolic, HQF2-52-N	28.2	Y
Gabriel	Gabriel 4-foot High Performance QuickFire Parabolic, HQF4-52-N	34.4	Y
Gabriel	Gabriel 2-foot High Performance Dual QuickFire Parabolic, HQFD2-52-N	28.1	Y
Gabriel	Gabriel 4-foot High Performance Dual QuickFire Parabolic, HQFD4-52-N	34.3	Y
Gabriel	Gabriel 2-foot Standard QuickFire Parabolic, QF2-52-N	28.5	Y
Gabriel	Gabriel 2-foot Standard QuickFire Parabolic, QF2-52-N-RK	28.5	Y
Gabriel	Gabriel 2.5-foot Standard QuickFire Parabolic, QF2.5-52-N	31.2	Y
Gabriel	Gabriel 4-foot Standard QuickFire Parabolic, QF4-52-N	34.8	Y
Gabriel	Gabriel 4-foot Standard QuickFire Parabolic, QF4-52-N-RK	34.8	Y
Gabriel	Gabriel 2-foot Standard Dual QuickFire Parabolic, QFD2-52-N	28.4	Y
Gabriel	Gabriel 2.5-foot Standard Dual QuickFire Parabolic, QFD2.5-52-N	31.1	Y
Gabriel	Gabriel 2-foot Standard Dual QuickFire Parabolic, QFD2-52-N-RK	28.4	Y
Gabriel	Gabriel 4-foot Standard Dual QuickFire Parabolic, QFD4-52-N	34.7	Y
Gabriel	Gabriel 4-foot Standard Dual QuickFire Parabolic, QFD4-52-N-RK	34.7	Y
RadioWaves	Radio Waves 2-foot Dual-Pol Parabolic, SPD2-5.2 (28.1dBi)	28.1	Y
RadioWaves	Radio Waves 2-foot Parabolic, SP2-5.2 (29.0dBi)	29	Y
RadioWaves	Radio Waves 3-foot Dual-Pol Parabolic, SPD3-5.2 (31.1dBi)	31.1	Y
RadioWaves	Radio Waves 3-foot Parabolic, SP3-5.2 (31.4dBi)	31.4	Y
RadioWaves	Radio Waves 4-foot Dual-Pol Parabolic, SPD4-5.2 (34.4dBi)	34.4	Y
RadioWaves	Radio Waves 4-foot Parabolic, SP4-5.2 (34.8dBi)	34.8	Y
RadioWaves	Radio Waves 2-foot Parabolic, SP2-2/5 (28.3dBi)	28.3	Y

Manufacturer	Antenna Type	Gain (dBi)	Parabolic Dish
RadioWaves	Radio Waves 3-foot Parabolic, SP3-2/5 (31.4dBi)	31.4	Y
RadioWaves	Radio Waves 4-foot Parabolic, SP4-2/5 (34.6dBi)	34.6	Y
RFS	RFS 2-foot Parabolic, SPF2-52AN or SPFX2-52AN (27.9dBi)	27.9	Y
RFS	RFS 3-foot Parabolic, SPF3-52AN or SPFX3-52AN(31.4dBi)	31.4	Y
RFS	RFS 4-foot Parabolic, SPF4-52AN or SPFX4-52AN(33.9dBi)	33.9	Y
RFS	RFS 2-foot HP Parabolic, SDF2-52AN or SDFX2-52AN (31.4dBi)	31.4	Y
RFS	RFS 4-foot HP Parabolic, SDF4-52AN or SDFX4-52AN (33.9dBi)	33.9	Y

Table 29 - Allowed Antennas for Deployment in USA/Canada – 5.4 GHz

13.9 Installation

The section covers the generic installation instructions for the Connectorized versions of the PTP 600 Series point-to-point wireless Ethernet bridges. The actual installation procedure will depend on antenna choice, cable choice, required antenna separation etc.

13.9.1 Antenna Choice

Table 28 shows a wide variety of antennas that can be used with the Connectorized 600 Series bridge. The main selection criteria will be the required antenna gain. The secondary criteria should be the ease of mounting and alignment. For example the Radio Waves Parabolic dishes are supplied with a mount that allows adjustment for alignment independent of the actual antenna mounting. This type of antenna is much easier to align than those that have to be rotated around the mounting pole for alignment.

13.9.2 Cables and Connectors

Cables should be selected using the above criteria. However it should be noted that a cable of a type similar to LMR400 is a lot more difficult to handle and route than a cable of a type similar to LMR100.

Motorola recommends the use of weatherproof connectors -- preferably, ones that come supplied with adhesive lined heat shrink sleeve that is fitted over the cable/connector interface.

The connectors required at the Connectorized 600 Series bridge end of the antenna cables are N-Type Male.

The connectors required at the antenna end of the antenna cables is dependant on the antenna type chosen.

13.9.3 Tools

The tools required for mounting a Connectorized 600 Series bridge unit are the same as those required for an Integrated 600 Series bridge detailed in Section 7.3. The tools required for mounting the antennas are specific to the antenna chosen. The installer should refer to the antenna manufacturer’s instructions.

13.9.4 Miscellaneous supplies

The following miscellaneous supplies will be required:

- Cable ties, cable cleats – for securing cables
- Self-amalgamating tape – to weatherproof the RF connectors
- PVC tape – for additional protection of the RF connectors and securing cables

13.9.5 Mounting the Connectorized 600 Series Bridge

A Connectorized 600 Series bridge is shipped with the same bracket as supplied with an Integrated unit. Details on the use of this bracket can be found in Section 3.3.7. The 600 Series Bridge should be mounted in a position that gives it maximum protection from the elements, but still allows easy access for making off the various connections and applying the recommended weatherproofing.

When using dual polar antennas the Connectorized 600 Series bridge should be mounted in such a position as to minimize the cable length, keeping losses to a minimum (taking into account the minimum cable lengths required by the FCC regulations, see Section 13.7).

When using separate antennas the Connectorized 600 Series Bridge should be mounted in such a position as to minimize both cable runs between the unit and the antennas. It is not necessary to mount the Connectorized 600 Series Bridge at the mid point between the antennas.

13.9.6 Mounting the antennas

The Antennas should be mounted according to the manufacturer's instructions. Actual antenna position will depend on the available mounting positions and link requirements. It may be necessary to mount the antennas 20m apart or at a certain distance from the ground to get the desired results.

13.9.7 Alignment Process

When aligning antennas deployed with a Connectorized 600 Series bridge unit it may not be possible to hear the alignment tone emanating from the unit. In this case it may be necessary for a second installer to assist in the operation. Alternatively, it may be possible to extend the tube on the supplied stethoscope to give a longer reach.

Tip: Fine antenna alignment can sometimes be achieved by tightening and loosening the bolts on either side of the antenna mounting bracket, rather than trying to turn the whole bracket on the mounting pole.

13.9.8 Aligning Dual Polar Antennas

The process for aligning a dual polar antenna is the same as aligning an Integrated unit with an integrated antenna. This procedure is detailed in Section 7.7.11.

13.9.9 Aligning Separate Antennas

When using separate antennas to achieve spatial diversity, one should be mounted with Horizontal polarization and the other with Vertical polarization.

The following steps should be followed:

Step 1: Mount the Antennas

Step 2: Mount the connectorized version of the PTP 600 Series Bridge unit

Step 3: Route and make off the ends of the Antenna cables

Step 4: Connect the antenna cables at the antennas

Step 5: Connect one of the antenna cables at the Connectorized version of the 600 Series bridge unit.

Step 6: Connect the Connectorized 600 Series Bridge ODU to PIDU Plus cable and configure the unit as described in Section 7.7.

Step 7: Align the connected antenna using the tones as described in Section 7.7.11.

Step 8: Connect the other antenna to the Connectorized 600 Series bridge.

Step 9: Disconnect the cable to the already aligned antenna.

Step 10: Align the second antenna using the tones as described in Section 7.7.11.

Step 11: Re-connect the second antenna to the Connectorized 600 Series bridge (Note: you will notice the tone pitch increase as you re-connect the second antenna due to the additional received signal).

Step 12: Use the relevant status web pages to check that you are getting the results you expect from your link planning.

Step 13: Complete the installation as detailed below.

13.9.10 Completing the Installation

The installation should be completed by checking all mounting nuts bolts and screws, securing all cables and weatherproofing the installation.

Warning: Finally tightening the antenna mountings may cause the antenna alignment to be altered, due to distortion in the mounting bracket caused by action of tightening. It is recommended that the installation tone be left turned on (armed) during this process so that any movement can be noticed and counteracted by tightening the other side of the bracket.

13.9.11 Antenna Cable Fixing

Cables should be secured in place using cable ties, cleats or PVC tape. Care should be taken to ensure that no undue strain is placed on the connectors on both the Connectorized 600 Series bridge and the Antennas and also to ensure that the cables do not flap in the wind. Flapping cables are prone to damage and induce unwanted vibrations in the mast to which the units are attached.

13.9.12 Antenna Connection Weatherproofing

Where a cable connects to an antenna or unit from above, a drip loop should be left to ensure that water is not constantly channeled towards the connector.

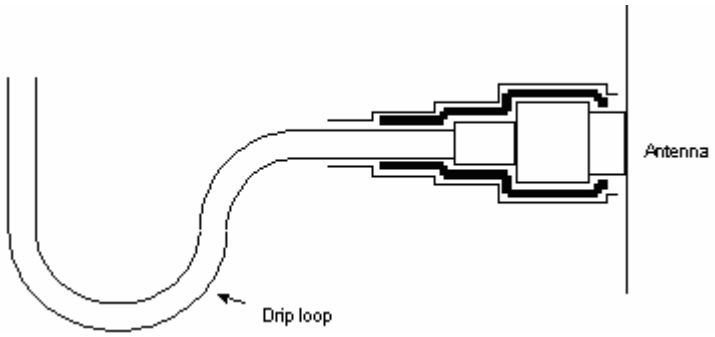


Figure 120 - Forming a Drip Loop

All joints should be weatherproofed using self-amalgamating tape. It is recommended that a layer of PVC tape be placed over the self-amalgamating tape to protect the joint while the self-amalgamating tape cures and gives additional protection. Figure 121 shows this diagrammatically for the 600 Series bridge end of the antenna cables. If the antenna manufacturer has not supplied guidance on this matter, the same technique should be employed at the antenna end of the cable.

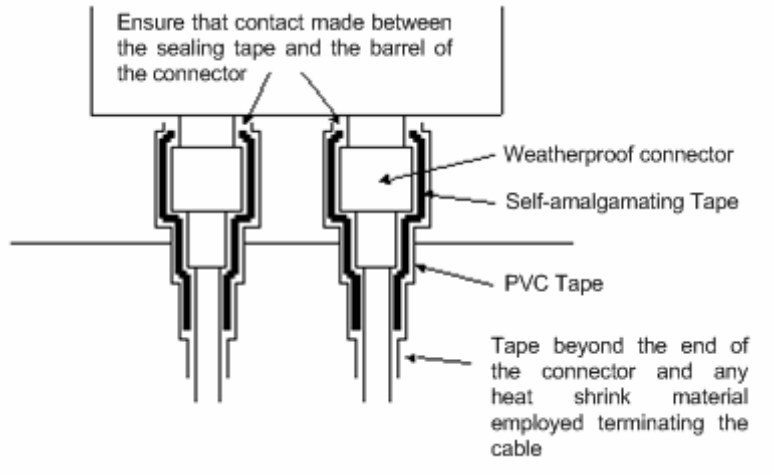


Figure 121 - Weatherproofing the Antenna Connections

13.10 Additional Lightning Protection

The following guidelines should be applied in addition to those described in Section 11 ”Lightning Protection”.

13.10.1 ODU Mounted Outdoors

Where the ODU is mounted outdoors and is mounted some distance from the antenna, it is advisable to add additional grounding by utilizing Andrew Assemblies (such as Andrew Type 223158 www.andrew.com) as shown in Figure 122.

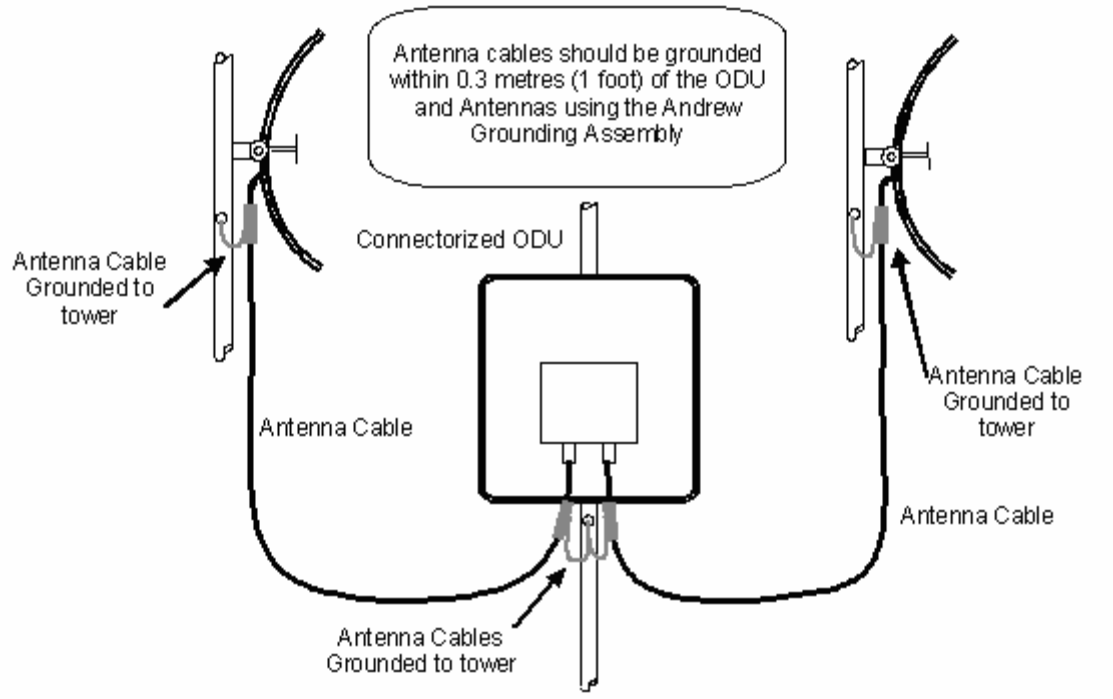


Figure 122- Additional Grounding When Using Connectorized Units

13.10.2 ODU Mounted Indoors

Where the ODU is mounted indoors, lightning arrestors should be deployed where the antenna cables enter the building as shown in Figure 123.

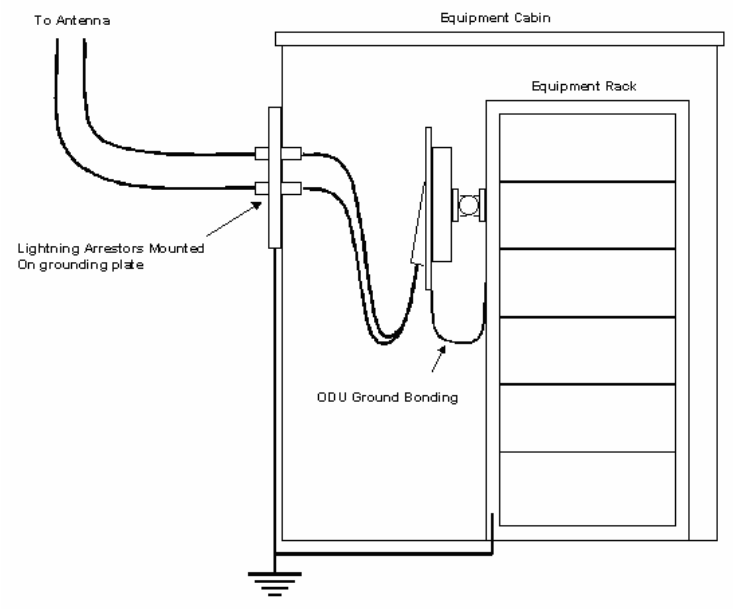


Figure 123 - Lightning Arrestor Mounting

The lighting arrestors should be ground bonded to the building ground at the point of entry. Motorola recommends Polyphaser LSXL-ME or LSXL lighting arrestors. These should be assembled as show in Figure 124.

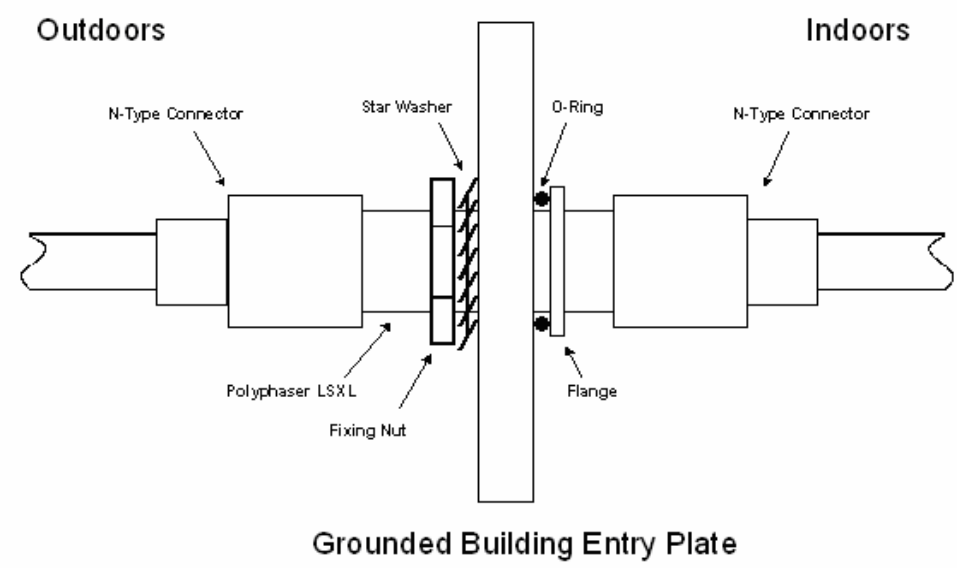


Figure 124 - Polyphaser Assembly

14 TDD Synchronization Configuration and Installation Guide

14.1 Introduction

This Section gives instructions for installing and configuring the TDD (Time Division Duplex) Synchronization feature for Motorola PTP600 Series bridges. This has many advantages such as:

- Minimising interference between multiple links on a single mast.
- Improving frequency re-use
- Reducing spatial / angular separation between PTP links when installed on the same mast
- Improving Link Budgets (when using higher Tx power)

This section includes also:

- Wiring Diagrams
- Step-by-Step configuration using web interface.
- Illustrations showing the placement of the GPS box and the recommended components for installation

14.2 TDD Synchronization Installation and Wiring Guidelines

As mentioned in Section 5.8.4, enabling the TDD Synchronization[27] feature is a two-stage process:

1. Install GPS Synchronization unit
2. Use web interface to enable and configure parameters

14.2.1 Installing the Recommended GPS Synchronization Kit

The recommended GPS Sync installation kit includes the following:

- GPS Sync Box unit from MemoryLink (see Figure 125), with two attached terminated Ethernet and Sync cables and cable glands (2) which connect directly to a PTP 600 Series ODU, and an attached un-terminated Ethernet cable.
- Mounting bracket and mounting bracket screws
- Outdoor rated UV resistant cable tie
- GPS Sync Box User Manual.

In addition to the hardware mentioned above, it is recommended to have an appropriate lightning protection (ALPU-ORT in Section 16).

[27] TDD Synchronization assumes that the user is familiar with network planning issues. For simple networks, it is advisable not to use the “Expert Mode” and rely on the configuration wizard.

Figure 125 - GPS Synchronization Unit

NOTE: Refer to GPS Sync Box User manual for al the details on the lengths of all the cables used to connect the GPS Sync Box to the ODU.

Figure 126 shows the connections in the GPS Sync Box unit and Figure 127 is a diagram that shows how to connect the GPS Sync box to the ODU and the Lightning protection unit.

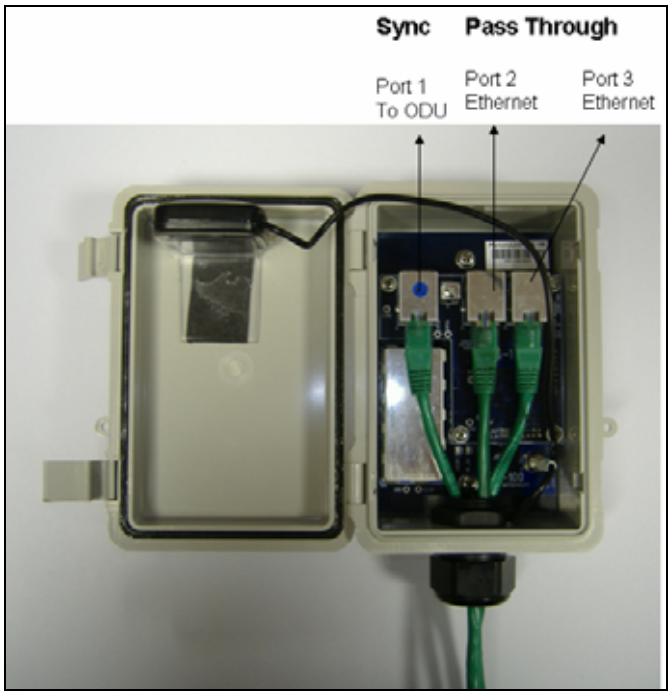


Figure 126 - GPS Synchronization Unit Connections

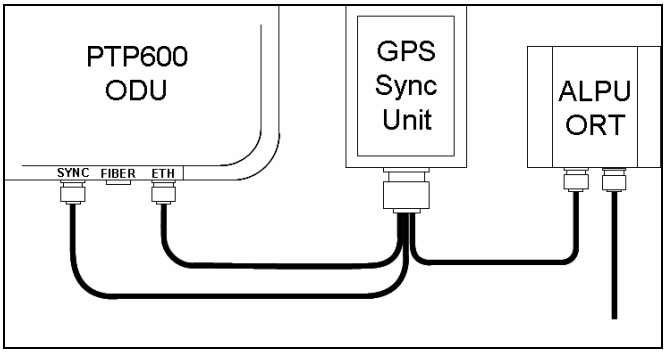


Figure 127 - TDD Sync - PTP600 Deployment Diagram

NOTE: Installation details of the GPS Sync Box are described in the GPS Sync Box User Manual.

Figure 128 shows an example of mast installation using lightning protection and a GPS Sync Box unit.

Figure 128- GPS Synchronization Unit Complete Installation

14.3 Configuring the TDD Synchronization Feature

TDD synchronization is enabled and configured using the install wizard during the installation process of the link[28].

14.3.1 TDD Synchronization Enable

Figure 129 shows how to enable TDD Synchronization.

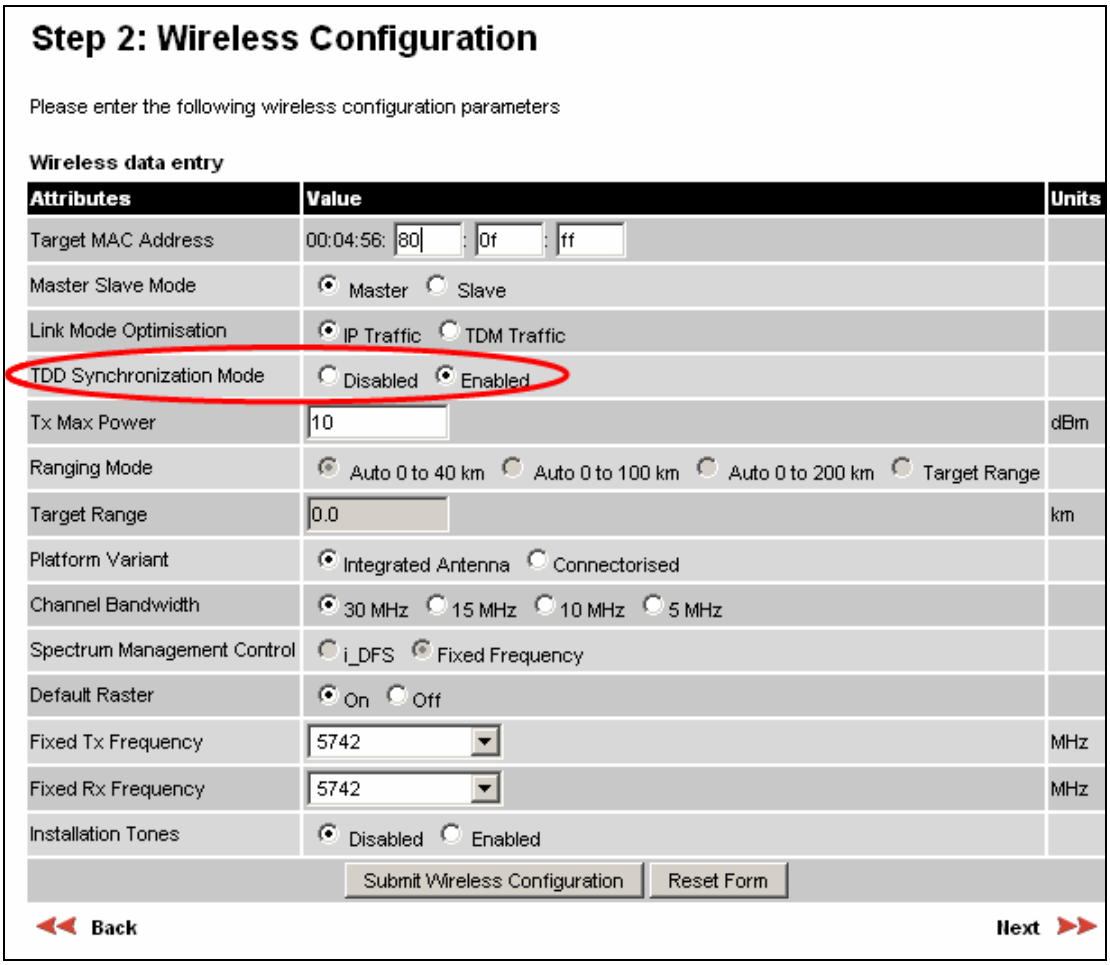


Figure 129 - Enabling TDD Synchronization Feature

[28] TDD synchronisation is not available in regions where radar avoidance is enabled.

When TDD Synchronization is enabled, note that:

- ‘Ranging Mode’ and ‘Target Range’ controls are disabled on the wireless configuration page.
- ‘Spectrum Management’ Control is forced to ‘Fixed Frequency’ operation only.

14.3.2 TDD Synchronization Configuration Menu

14.3.2.1 TDD Synchronization Configuration - Standard Mode

When TDD Synchronization is enabled, there is an extra installation screen (“TDD Synchronization”) as shown in Figure 130.

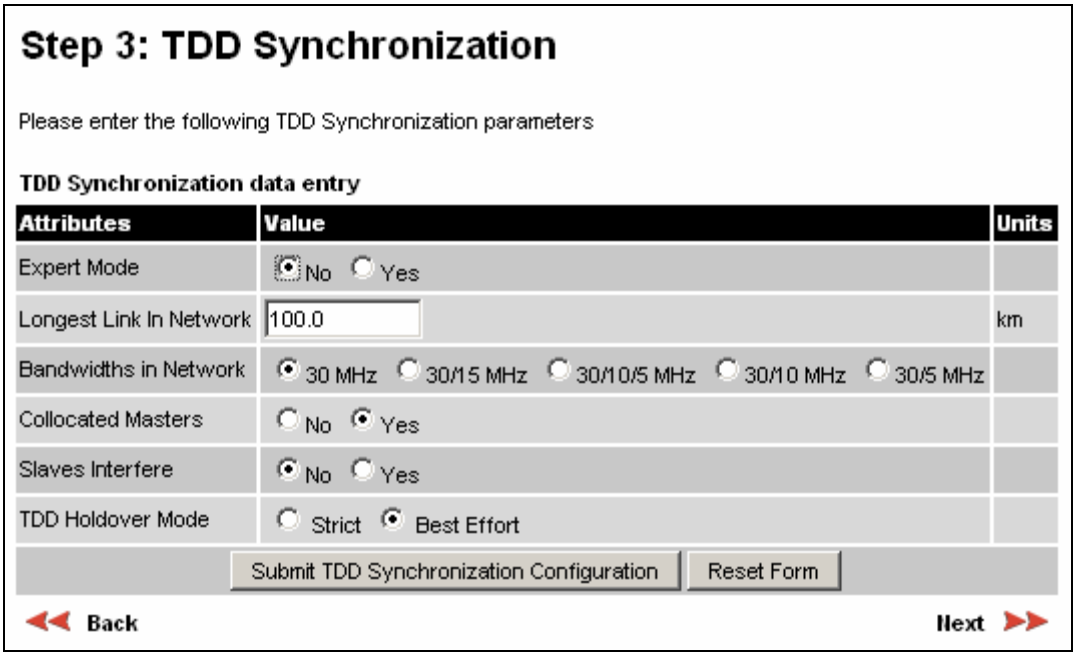


Figure 130 - Configuring TDD Synchronization – Screen 1

The TDD Synchronization screen provides the following controls:

Expert Mode: Select “Yes” to use “Expert Mode”. This is an option recommended only for experienced network and cell planners and is outside the scope of this document (see Figure 132 for parameters required to configure in this mode). If “Expert Mode” is not selected, then the user is required to enter some basic information to allow the software to calculate the best values for Frame Duration and Burst Duration.

Longest Link in Network: Default value is 100 kms (60 miles). It is the distance of the longest link in the network (maximum is 200 kms or 120 miles).

Bandwidths in Network: It is very likely that there will be several different channel bandwidths in a given network. Table 30 gives a list of bandwidth combinations that permit synchronization without gross loss of efficiency. Note that depending on the channel bandwidth size, only subsets of Table 30 will be shown in the configuration wizard screen.

Bandwidth Combination (MHz)
30
30/5
30/10
5/10/30
15/30
15
10/15
5/10
10
5

Table 30 - Common Burst Durations

Collocated Masters: choose “Yes” to indicate that ODUs are collocated on the same mast. If the option “No” is selected, then the control below is displayed (see Figure 131):

> **Master to Master Range:** Maximum range is 200 Kms (120 miles). It is the longest distance over which two masters can interfere.

Slave Interfere: Select “Yes” to indicate that a Slave ODU interferes. If the option “No” is selected, then the control below is displayed (see Figure 131):

> **Slave to Slave Range**: Maximum range is 200 Kms (120 miles). It is the longest distance over which two slaves can interfere.

Configure Link Range: Choose “yes” to enter the range of the link in control below: Note that Link Range MUST be less or equal to “Longest Link in Network”. In some networks, throughput can be increased by entering the exact range of each link in the wizard.

TDD Holdover Mode: Two values: “Strict” and “Best Effort”. If a PTP 600 master ODU is configured for a TDD Holdover Mode set to “Strict”, then it will not transmit when synchronization is lost. On the other hand, a link configured for TDD Holdover Mode set to “Best Effort” will synchronize when a reference signal is available, but will otherwise use best efforts to operate in unsynchronized fashion.

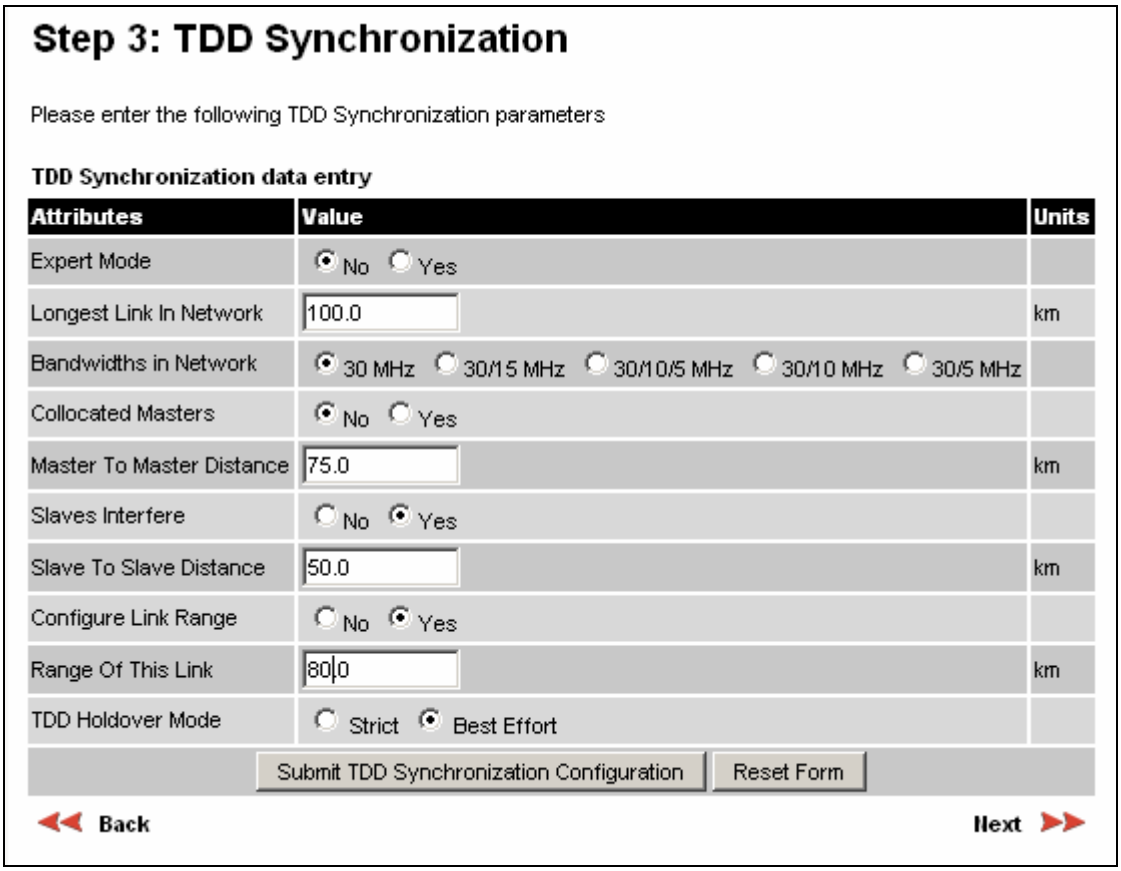


Figure 131 - Configuring TDD Synchronization Feature - Screen 2

WARNING: the values entered for the controls in Figure 131 MUST be the same for all the links in the network, except for the attribute “Range of This Link” which can be entered exactly for better performance.

14.3.2.2 TDD Synchronization Configuration – Expert Mode

When “Expert Mode” is selected, the user is required to configure the parameters[29] shown in Figure 132. As mentioned previously, this is outside the score of this document. However, this mode can be used as informative to ensure that the values of the parameters are the same for all the links in the network.

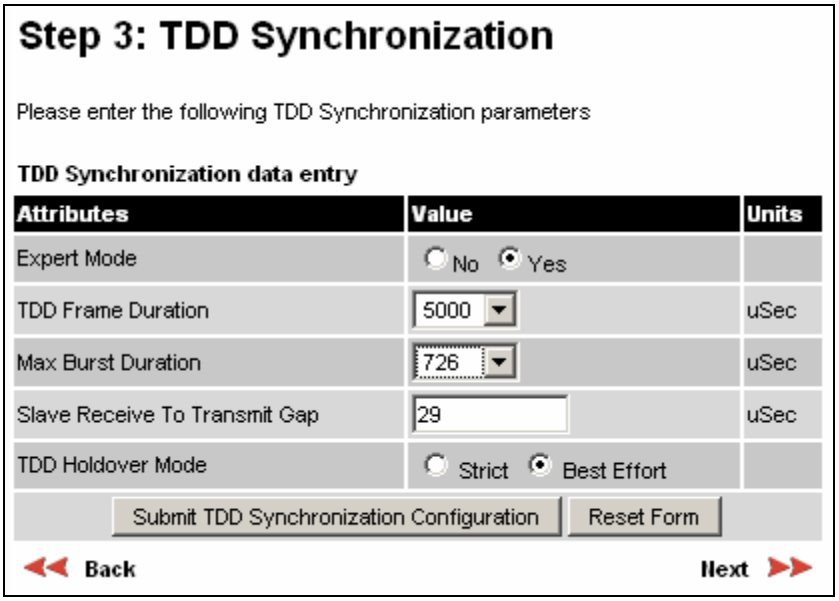
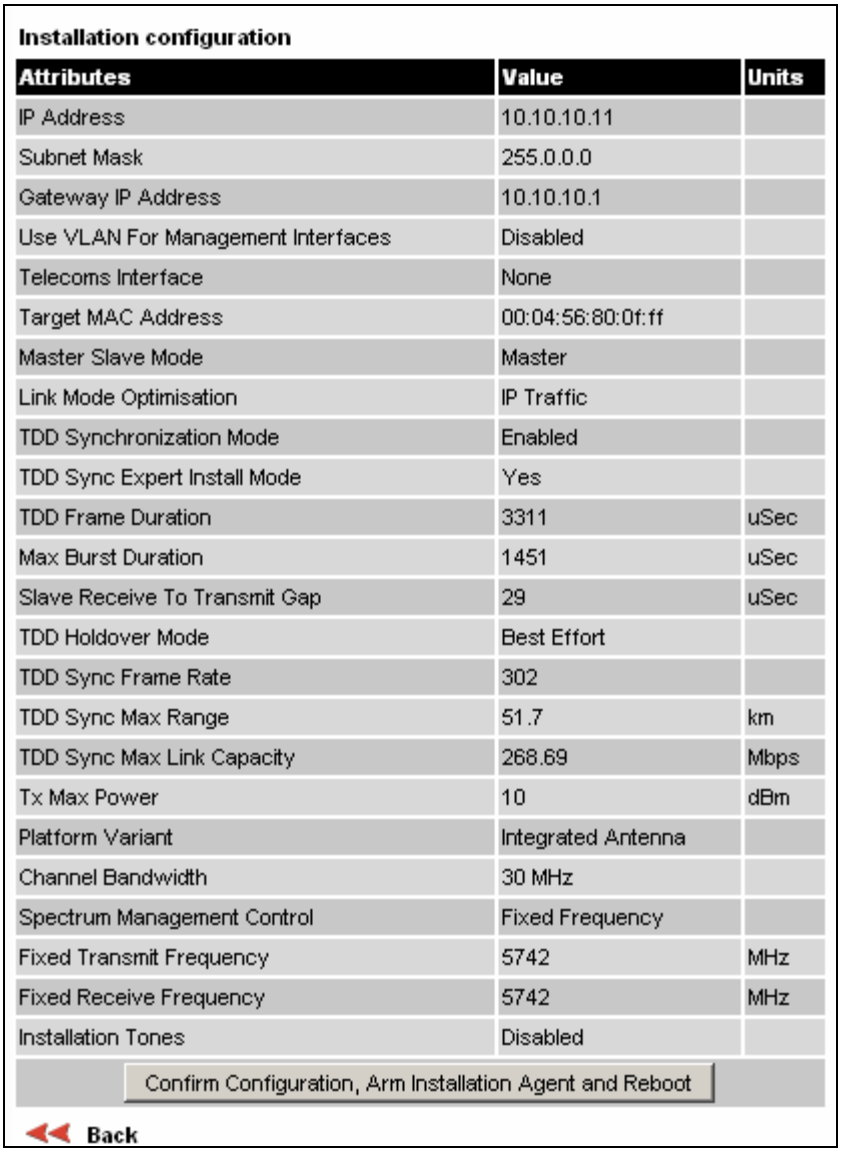


Figure 132 - Configure TDD Synchronization Expert Mode

[29] For the non-expert mode, the controls in Figure 132 are automatically filled by the software

14.3.2.3 Confirm Settings and Reboot ODU

When all the parameters have been entered, then the user can commit the values to the unit and reboot. Figure 133 shows the list of the installation parameters.



Installation configuration

Attributes	Value	Units
IP Address	10.10.10.11	
Subnet Mask	255.0.0.0	
Gateway IP Address	10.10.10.1	
Use VLAN For Management Interfaces	Disabled	
Telecoms Interface	None	
Target MAC Address	00:04:56:80:0f:ff	
Master Slave Mode	Master	
Link Mode Optimisation	IP Traffic	
TDD Synchronization Mode	Enabled	
TDD Sync Expert Install Mode	Yes	
TDD Frame Duration	3311	uSec
Max Burst Duration	1451	uSec
Slave Receive To Transmit Gap	29	uSec
TDD Holdover Mode	Best Effort	
TDD Sync Frame Rate	302	
TDD Sync Max Range	51.7	km
TDD Sync Max Link Capacity	268.69	Mbps
Tx Max Power	10	dBm
Platform Variant	Integrated Antenna	
Channel Bandwidth	30 MHz	
Spectrum Management Control	Fixed Frequency	
Fixed Transmit Frequency	5742	MHz
Fixed Receive Frequency	5742	MHz
Installation Tones	Disabled	

Confirm Configuration, Arm Installation Agent and Reboot

Back

Figure 133 - Confirm TDD Synchronization Configuration Parameters

Following the reboot and provided the GPS has synchronized, an additional control is displayed in the Status Page as shown in Figure 134 (Sync) or Figure 135 (Not Sync).

System Status - Master

Equipment

Attributes	Value	Units
Link Name		
Link Location		
Software Version	25600-B1236+ wdog	
Hardware Version	D05-R00-C	
Region Code	Region Code 16	
Elapsed Time Indicator	4 Days 01:28:25	
Ethernet / Internet		
Ethernet Link Status	Copper Link Up	
Ethernet Speed And Duplex	100 Mbps Full Duplex	
MAC Address	00:04:56:80:2e:80	
Remote IP Address	10.10.10.10	
Telecoms		
Channel A	Disabled	
Channel B	Disabled	
TDD Syncronization		
TDD Synchronization Status	Synchronized	

Wireless

Attributes	Value	Units
Wireless Link Status	Up	
Maximum Transmit Power	15	dBm
Remote Maximum Transmit Power	15	dBm
Transmit Power	15.0, 15.0, 15.0, 15.0	dBm
Receive Power	-45.2, -45.2, -45.4, -45.3	dBm
Vector Error	-32.9, -35.8, -38.7, -36.2	dB
Link Loss	96.3, 96.2, 96.2, 96.2	dB
Transmit Data Rate	18.46, 18.46, 18.46, 18.46	Mbps
Receive Data Rate	18.46, 18.46, 18.46, 18.46	Mbps
Link Capacity	36.92	Mbps
Transmit Modulation Mode	256QAM 0.81 (Dual) (5 MHz)	
Receive Modulation Mode	256QAM 0.81 (Dual) (5 MHz)	
Receive Modulation Mode Detail	Running At Maximum Receive Mode	
Range	1.0	km

Figure 134 - Status Page - TDD Enabled and Synchronized

System Status - Master

Equipment

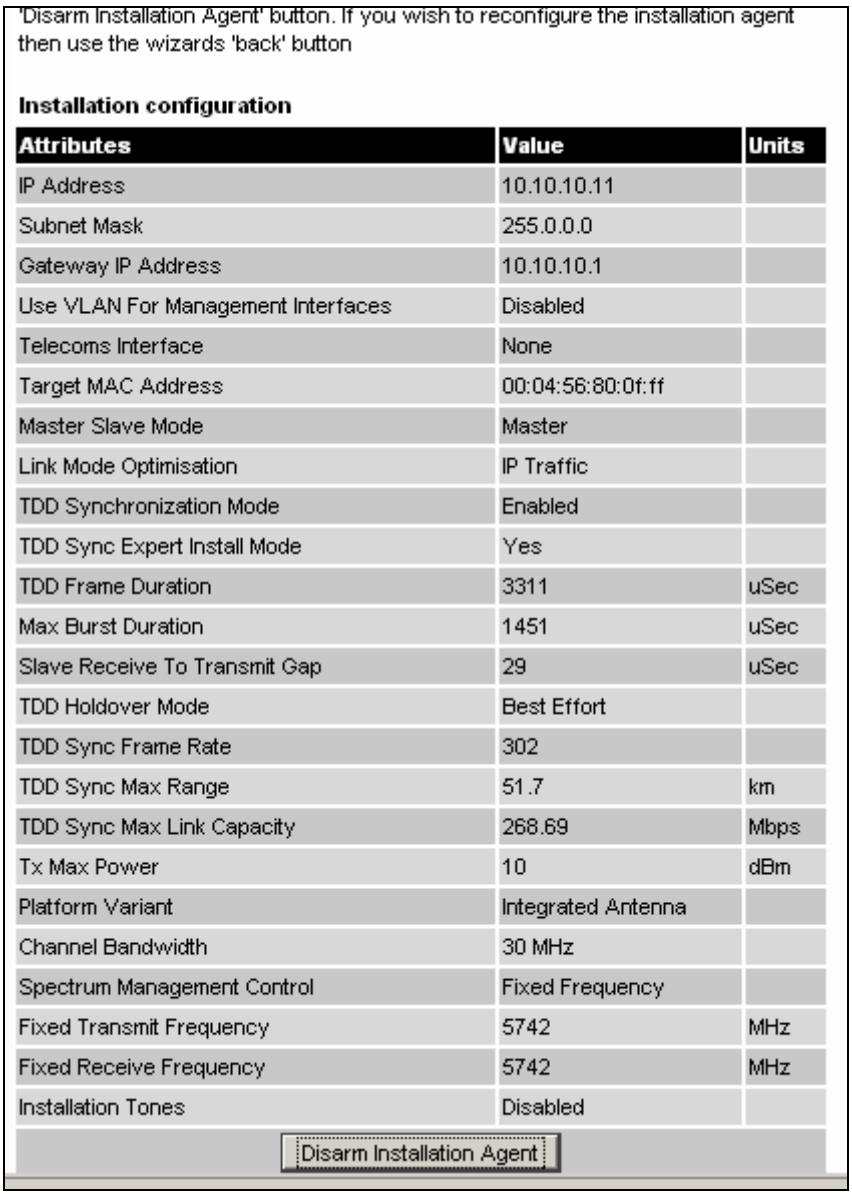
Attributes	Value	Units
Link Name		
Link Location		
Software Version	25600-B1236+ wdog	
Hardware Version	D05-R00-C	
Region Code	Region Code 16	
Elapsed Time Indicator	4 Days 01:30:26	
Ethernet / Internet		
Ethernet Link Status	Copper Link Up	
Ethernet Speed And Duplex	100 Mbps Full Duplex	
MAC Address	00:04:56:80:2e:80	
Remote IP Address	10.10.10.10	
Telecoms		
Channel A	Disabled	
Channel B	Disabled	
TDD Syncronization		
TDD Synchronization Status	Timing System Not Connected	

Wireless

Attributes	Value	Units
Wireless Link Status	Up	
Maximum Transmit Power	15	dBm
Remote Maximum Transmit Power	15	dBm
Transmit Power	15.0, 15.0, 15.0, 15.0	dBm
Receive Power	-45.2, -45.2, -45.4, -45.2	dBm
Vector Error	-32.9, -35.8, -38.7, -35.7	dB
Link Loss	96.3, 96.2, 96.2, 96.2	dB
Transmit Data Rate	18.46, 18.46, 18.46, 18.46	Mbps
Receive Data Rate	18.46, 18.46, 18.46, 18.46	Mbps
Link Capacity	36.92	Mbps
Transmit Modulation Mode	256QAM 0.81 (Dual) (5 MHz)	
Receive Modulation Mode	256QAM 0.81 (Dual) (5 MHz)	
Receive Modulation Mode Detail	Running At Maximum Receive Mode	
Range	1.0	km

Figure 135 - Status Page - TDD Enabled and Not Synchronized

14.3.2.4 Disarm ODU Following TDD Sync Configuration



'Disarm Installation Agent' button. If you wish to reconfigure the installation agent then use the wizards 'back' button

Installation configuration

Attributes	Value	Units
IP Address	10.10.10.11	
Subnet Mask	255.0.0.0	
Gateway IP Address	10.10.10.1	
Use VLAN For Management Interfaces	Disabled	
Telecoms Interface	None	
Target MAC Address	00:04:56:80:0f:ff	
Master Slave Mode	Master	
Link Mode Optimisation	IP Traffic	
TDD Synchronization Mode	Enabled	
TDD Sync Expert Install Mode	Yes	
TDD Frame Duration	3311	uSec
Max Burst Duration	1451	uSec
Slave Receive To Transmit Gap	29	uSec
TDD Holdover Mode	Best Effort	
TDD Sync Frame Rate	302	
TDD Sync Max Range	51.7	km
TDD Sync Max Link Capacity	268.69	Mbps
Tx Max Power	10	dBm
Platform Variant	Integrated Antenna	
Channel Bandwidth	30 MHz	
Spectrum Management Control	Fixed Frequency	
Fixed Transmit Frequency	5742	MHz
Fixed Receive Frequency	5742	MHz
Installation Tones	Disabled	

Disarm Installation Agent

Figure 136 - Disarm Following TDD Synchronization

WARNING: In a synchronized network, links MUST be configured separately before bringing the whole network up.

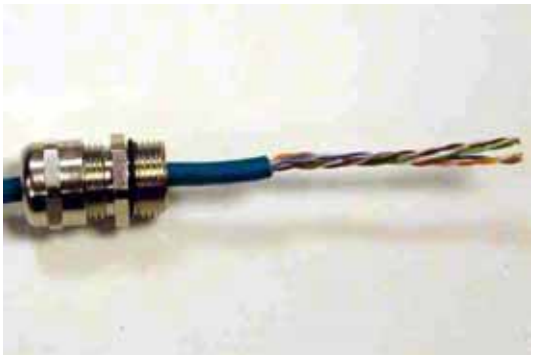
15 E1/T1 Installation Guide

15.1 Preparing the PTP 600 Series Bridge E1/T1 Cable

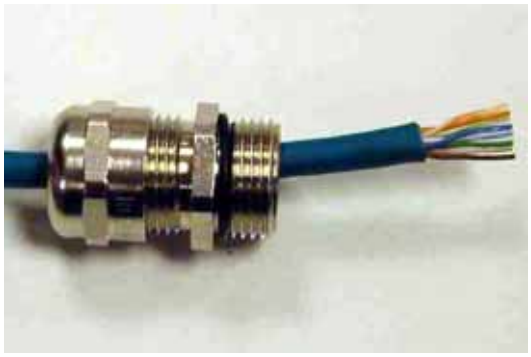
Note: The maximum cable length between the ODU and the customers terminating equipment is 200m (656 feet) for T1.

The E1/T1 cable should be assembled to the following instructions:

Step 1: Assemble gland on cable as shown



Step 2: Strip the outer insulation



Step 3: Arrange conductors as shown in fig. A2 and cut to length

Step 4: Insert conductors and crimp

Figure 137 - Completed ODU Connector

This procedure applies to the ODU termination. The above procedure should be repeated for the customer equipment end of the cable when the cable is terminated with a RJ45.

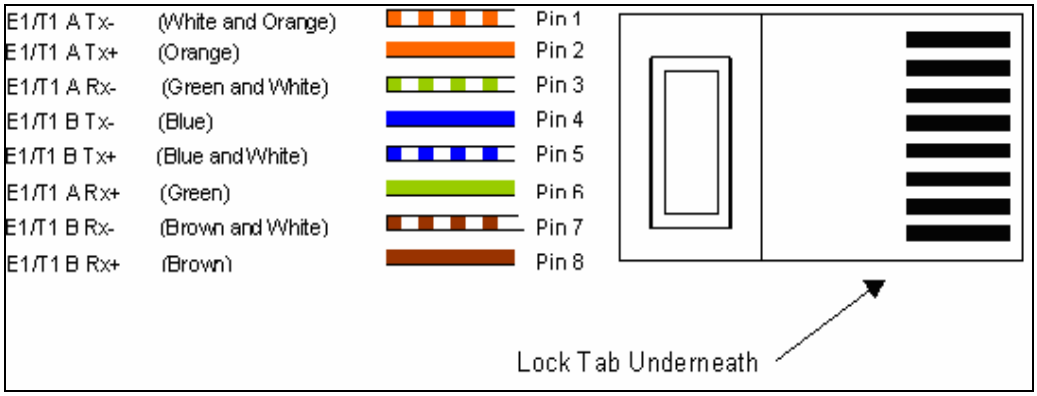


Figure 138 - RJ45 Pin Connection (T568B Color Coding)

15.2 Making the Connection at the ODU

Looking at the back of the unit with the cable entry at the bottom, the PTP 600 Series Bridge E1/T1 connection is the first hole on the left (Figure 139) and is labeled E1/T1.

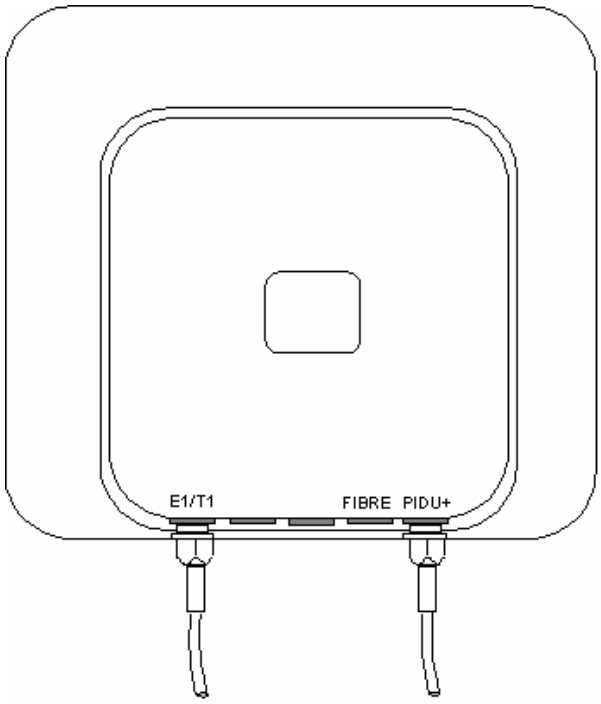


Figure 139 - PIDU Plus and E1-T1 Connection

The following procedure describes how connection is made at the ODU. It is often easier to carry out this procedure on the ground or a suitable surface prior to mounting the ODU.

Ensure no power is connected to the PIDU Plus.

Step 1: Assemble the cable as described in above

Step 2: Insert the RJ45 connector making sure that the locking tab snaps home

Step 3: Screw in the body of the weather proofing gland and tighten

Step 4: Screw on the clamping nut and tighten

Should it be necessary to disconnect the E1/T1 cable at the ODU this can be achieved by removing the weatherproofing gland and depressing the RJ45 locking tab with a small screwdriver as shown in the opposite photograph.

Figure 140 - Disconnecting the ODU

15.3 Routing the Cable

After connecting the cable to the ODU it can be routed and secured using standard cable routing and securing techniques. When the cable is in place it can then be cut to the desired length.

15.4 Fitting a Surge Arrestor

If you have opted to fit a Surge Arrestor, it should be installed as described in Section A1.5 “Lightning Protection”

15.5 Customer Cable Termination

The two channels can be separated by means of a patch panel which may include Baluns for transmission over 75 Ohm co-axial unbalanced lines. Such equipment should conform to the requirements of C.C.I.T.T. G703. An example of a Balun is shown below. It allows the transmit and receive data carried over a 75 Ohm cable to be converted to a balanced form for transmission over a 120 Ohm signal balanced twisted pair.

Figure 141 - Example of a Balun

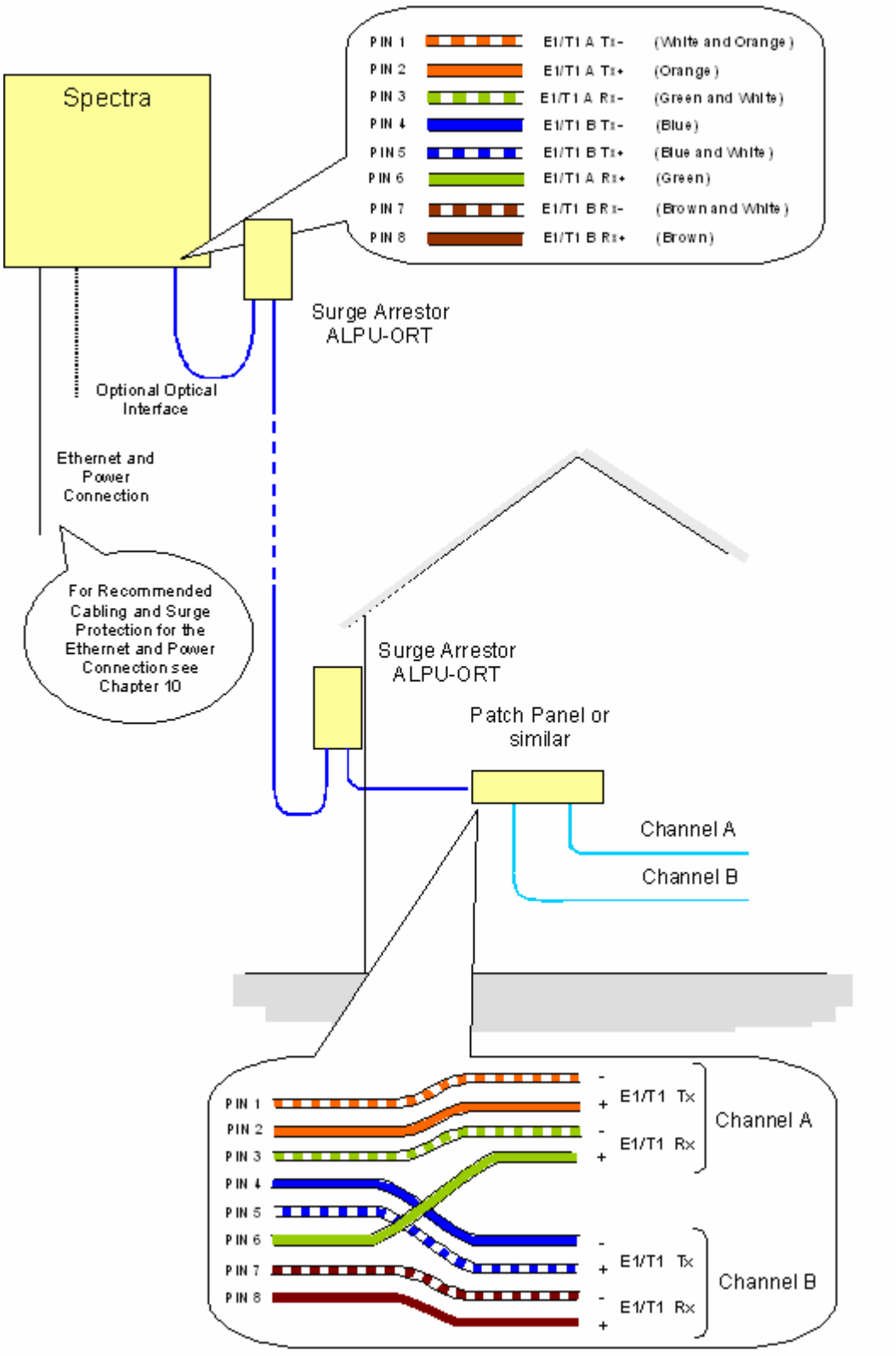


Figure 142 - Diagrammatically Showing the E1-T1 Connections

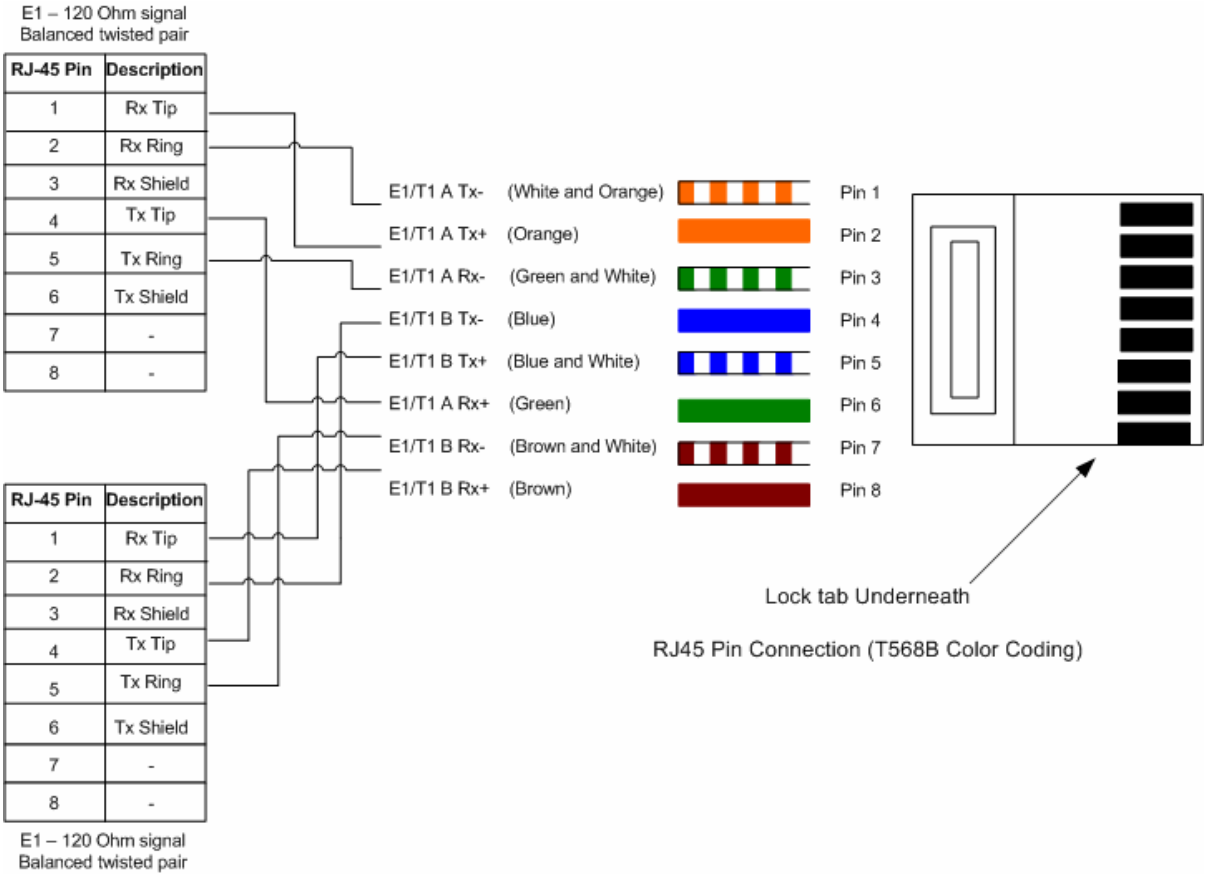


Figure 143 - Two E1-T1-120 Ohms signal Balanced to PTP600 Interface

16 Lightning Protection

16.1 Overview

Section 11 in the main body of this manual contains the requirements for the Motorola PTP 600 Series deployment. This section details the additional requirements for the deployment of E1/T1.

16.2 Recommended Additional Components for E1/T1 Installation.

The recommended components below are in addition to those listed in Section 11, the extra components required for the E1/T1 installation are:

- Screened Cat 5 Cable
- Surge Arrestor Units — Transtector type ALPU-ORT, 4 required per link. (www.transtector.com)
- RJ45 screened connectors
- 8 AWG Grounding Cable

For a description of Zone A and Zone B refer to Section 11.

	Zone A	Zone B
Earth ODU	Mandatory	Mandatory
Screen Cable	Mandatory	Mandatory
Surge Arrestor Unit ALPU-ORT at ODU	Mandatory	Mandatory
Earth Cable at Building Entry	Mandatory	Mandatory
Surge Arrestor Unit ALPU-ORT at Building Entry	Mandatory	Mandatory

Table 31 - Protection Requirements

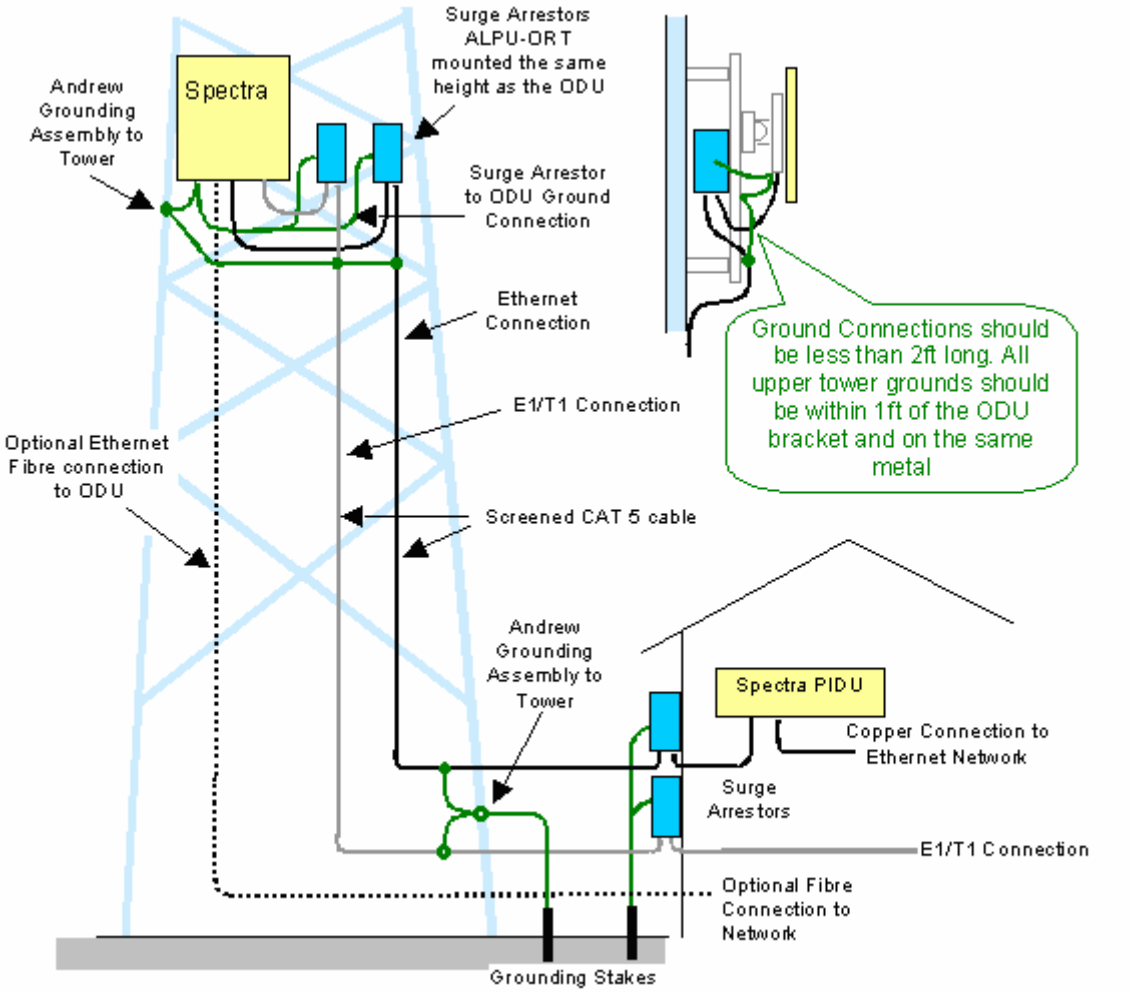


Figure 144 - Typical Mast Installation with the addition of the E1-T1 cable

Note: There may be a local regulatory requirement to cross bond the CAT 5 drop cable at regular intervals to the mast. This may be as frequent as every 10 meters (33 feet).

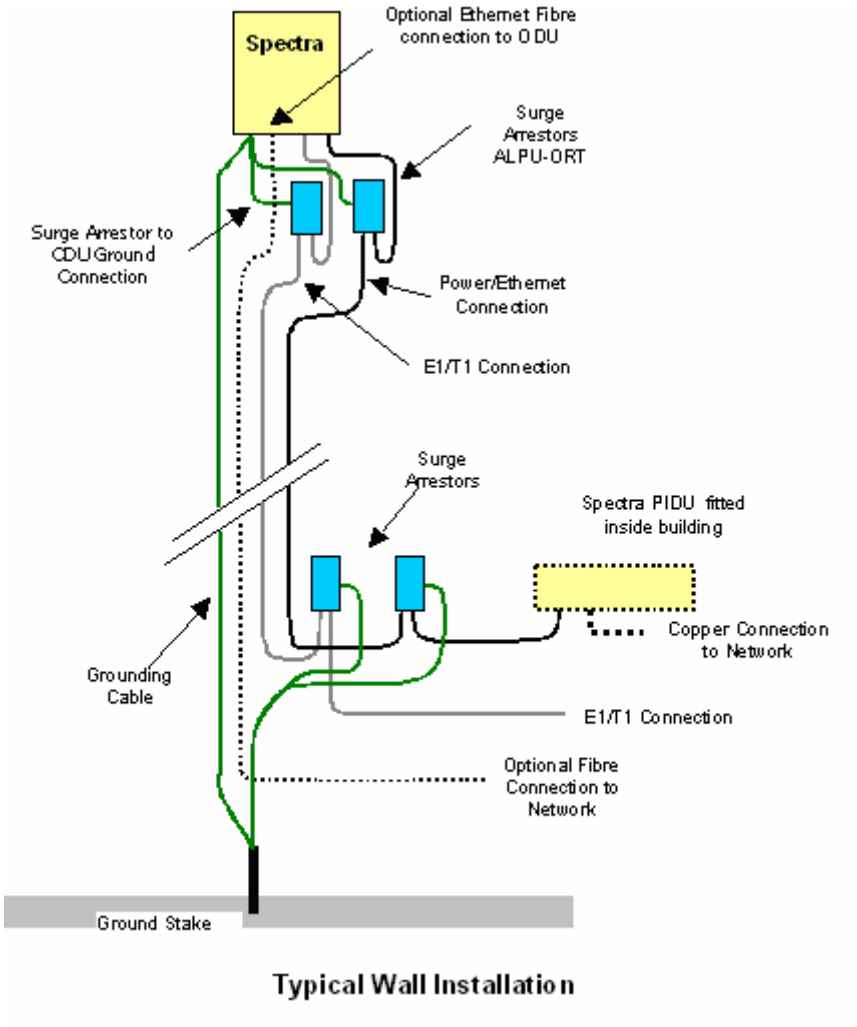


Figure 145 - Wall Installation with the addition of E1-T1 cable

16.3 Surge Arrestor Wiring

An Andrew Grounding Kit and Surge Arrestor Unit must be located at the ODU and reliably grounded as shown in Figure 109. There may also be a regulatory requirement to crossbond the screened CAT-5 at regular intervals up the mast. Refer to local regulatory requirements for further details.

A second Surge Arrestor Unit should be mounted at the building entry point and must be grounded.

The termination of the CAT-5 Cable into the Surge Arrestor Unit is illustrated in Table 32, Table 33 and Figure 146. The screen from the cable must be terminated into the ground terminal within the unit to ensure the continuity of the screen. Earth Sleeving should be used to cover the shield ground connection to prevent internal shorting within the unit.

Terminal Identification	Conductor	RJ45 Pin
CON3 Pin 1	Orange/White	1
CON3 Pin 2	Orange	2
CON3 Pin 3	Green/White	3
CON3 Pin 6	Green	6
CON1 Pin 4	Blue	4
CON1 Pin 5	Blue/White	5
CON1 Pin 7	Brown/White	7
CON1 Pin 8	Brown	8

Table 32 - Surge Arrestor ALPU-ORT Cable 1 Termination

Terminal Identification	Conductor	RJ45 Pin
CON4 Pin 1	Orange/White	1
CON4 Pin 2	Orange	2
CON4 Pin 3	Green/White	3
CON4 Pin 6	Green	6
CON2 Pin 4	Blue	4
CON2 Pin 5	Blue/White	5
CON2 Pin 7	Brown/White	7
CON2 Pin 8	Brown	8

Table 33 - Surge Arrestor ALPU-ORT Cable 2 Termination

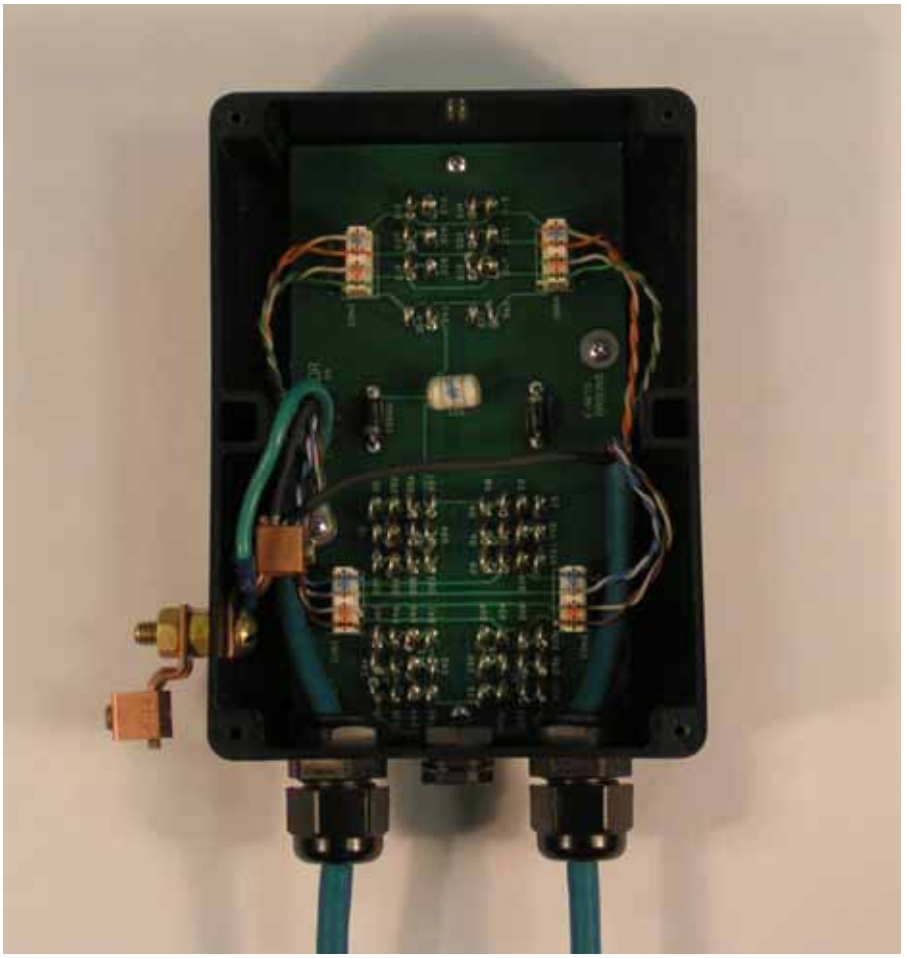


Figure 146 - Surge Arrestor ALPU-ORT Connection Illustration

16.4 Testing Your Installation

If you have followed the above instructions you will have wired your systems to the following diagram:

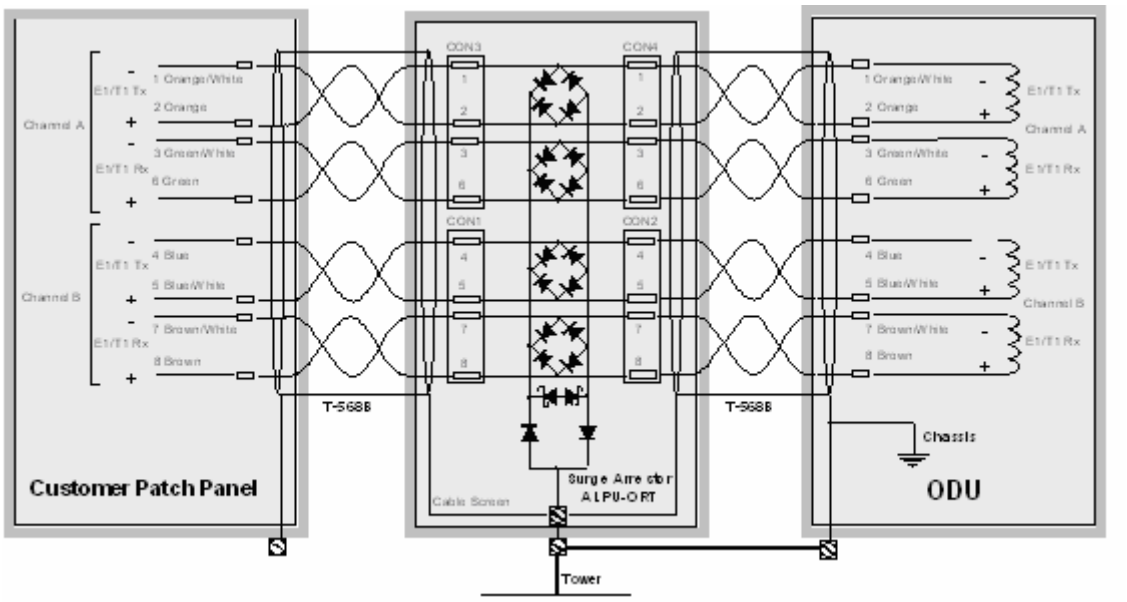


Figure 147 - Simplified Circuit Diagram (Only One Transtector Shown For Clarity)

16.4.1 Pre-Power Testing

Before connecting your E1/T1 source, check the following resistances:

1. Check the cable resistance between pins 3 & 6 (Green/White & Green) and 7 & 8 (Brown/White & Brown). Check against Table 34 column 2.
2. Check the cable resistance between pins 1 & 2 (Orange/White & Orange) and 4 & 5 (Blue & Blue/White). Check against Table 34 column 3.

CAT-5 Length (Meters)	Resistance between pins 3 & 6 and pins 7 & 8 (ohms)	Resistance between pins 1 & 2 and pins 4 & 5 (ohms)
0	0.8	1.3
10	2.5	3.0
20	4.2	4.7
30	5.9	6.4
40	7.6	8.2
50	9.3	9.8
60	11.0	11.5
70	12.7	13.2
80	14.4	14.9
90	16.1	18.2
100	17.8	18.3

Table 34 - Resistance Table Referenced To the E1/T1 Source

17 Data Rate Calculations

To aid the calculation of data rate throughput, the following plots of throughput verses link range have been produced for all the PTP 600 Series modulation modes, assuming the units are connected using Gigabit Ethernet.

Aggregate data rate capacity can be calculated using four key system parameters:

- Receive modulation mode
- Transmit modulation mode
- Range Between the two wireless units
- Wireless link mode (IP or TDM)

Using these parameters the Receive and Transmit data rates can be looked up using the plots Figure 148 through Figure 160.

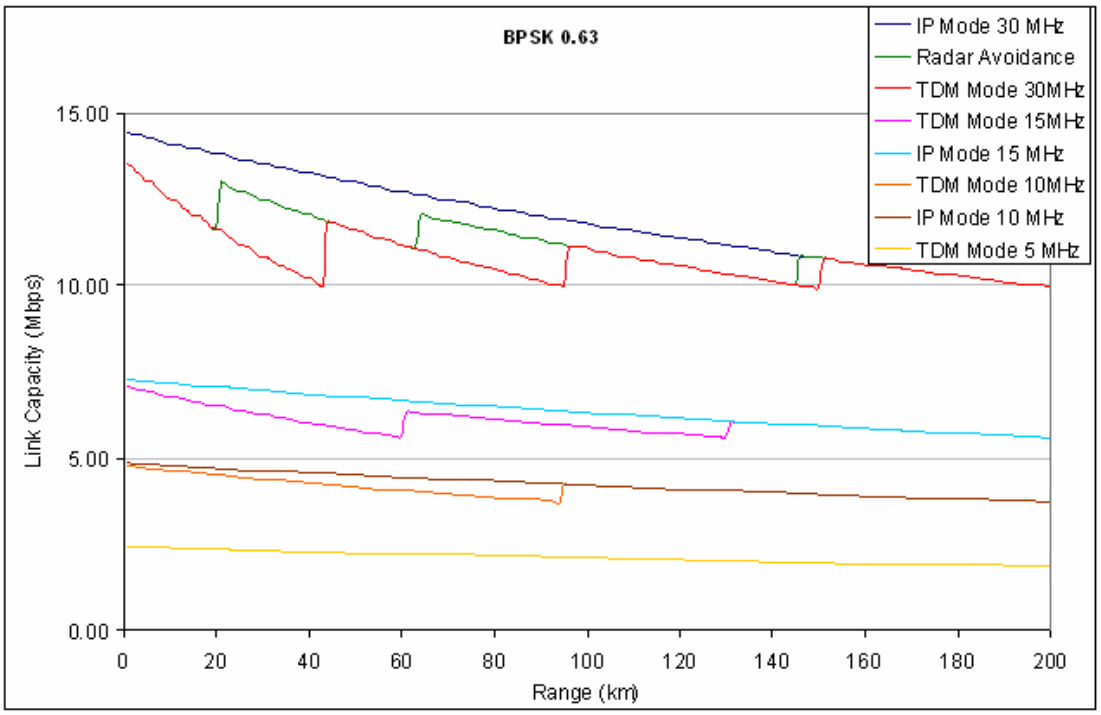


Figure 148 - BPSK 0.63 Single Payload

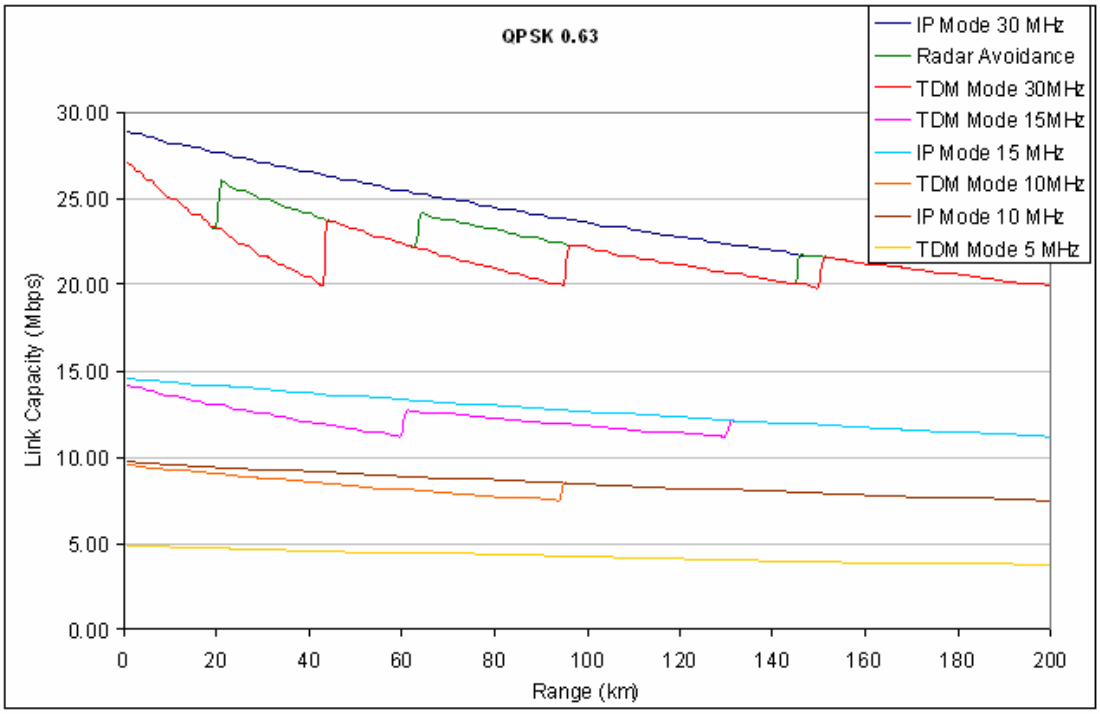


Figure 149 - QPSK 0.63 Single Payload

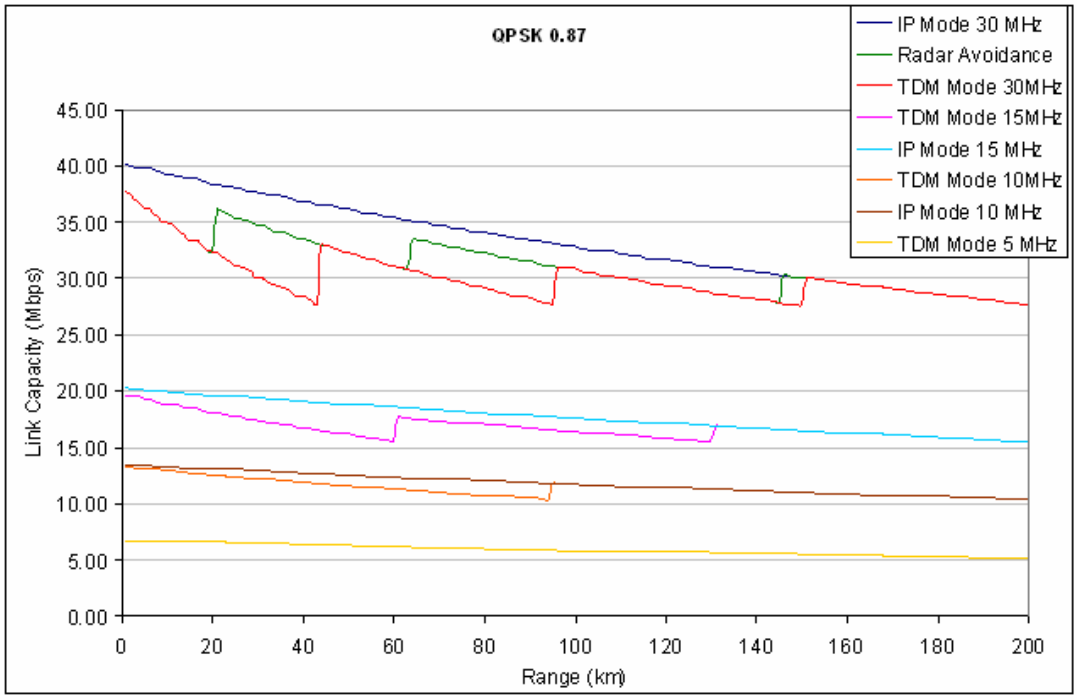


Figure 150 - QPSK 0.87 Single Payload

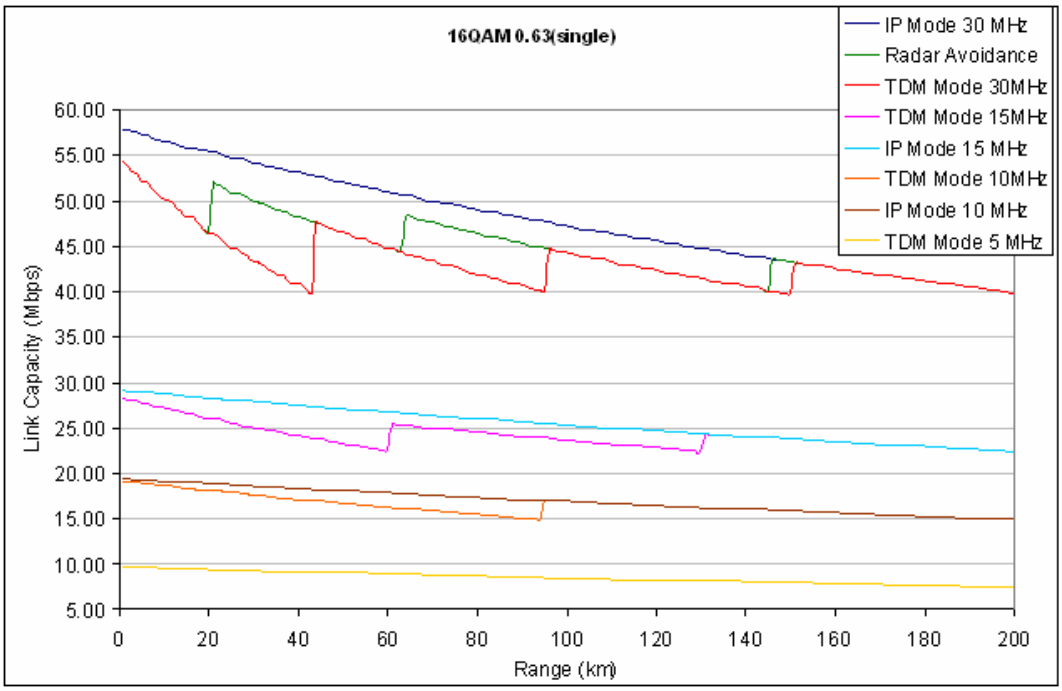


Figure 151 - 16 QAM 0.63 Single Payload

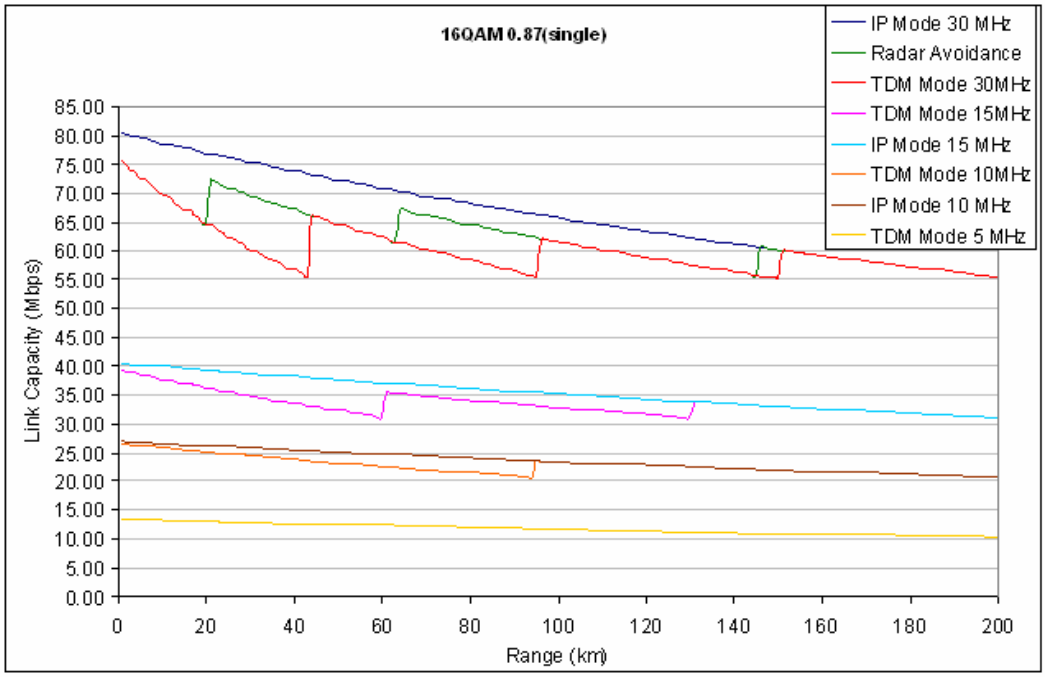


Figure 152 - 16 QAM 0.87 Single Payload

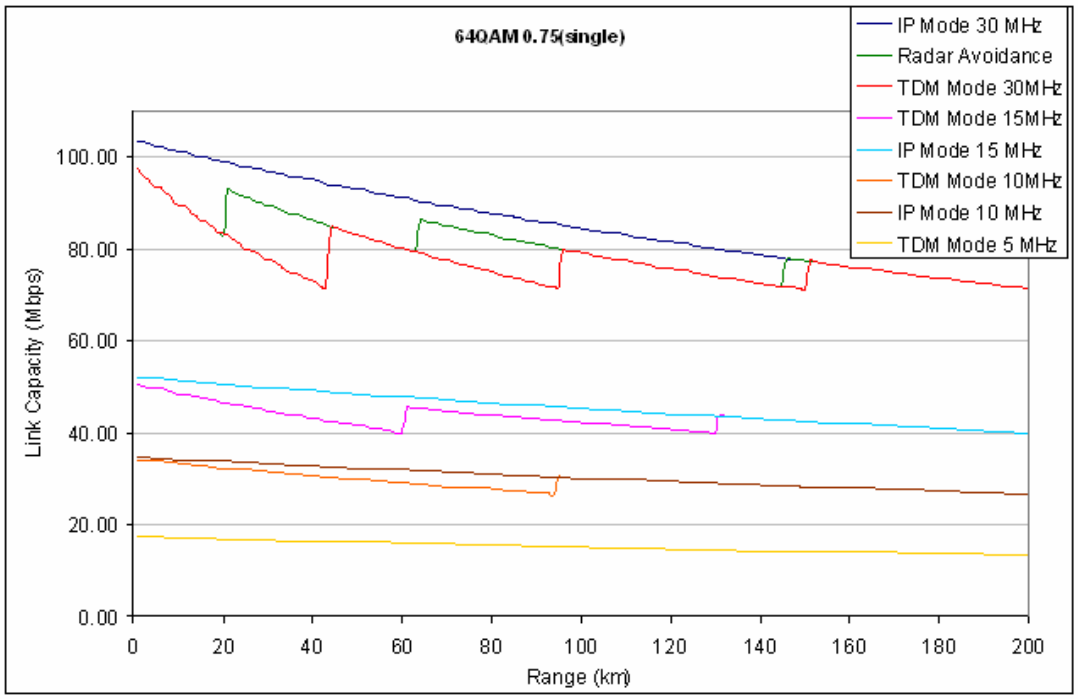


Figure 153 - 64 QAM 0.75 Single Payload

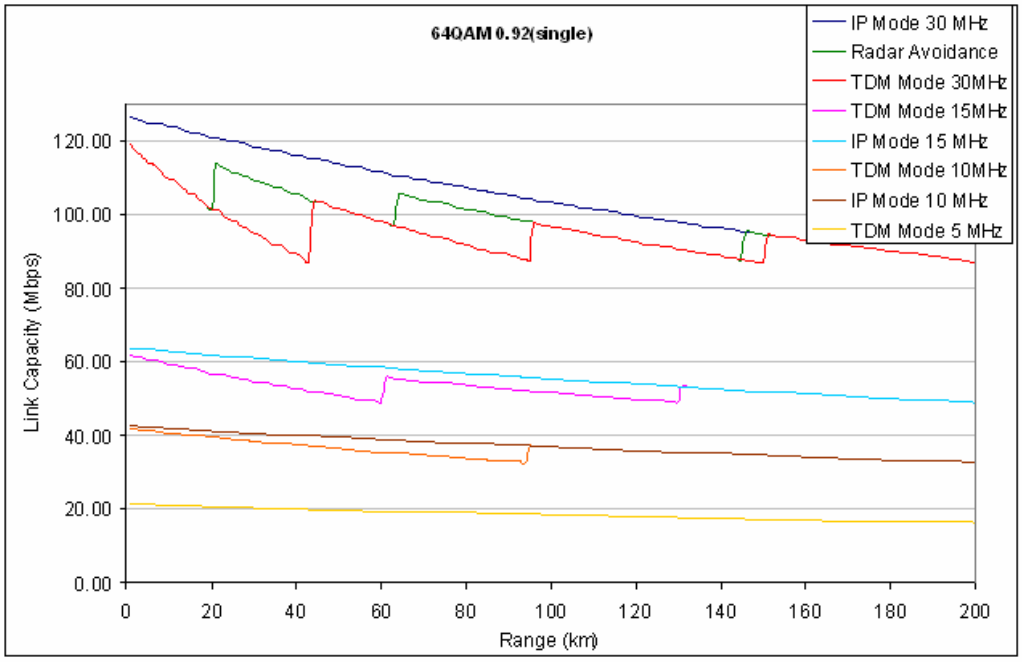


Figure 154 - 64 QAM 0.92 Single Payload

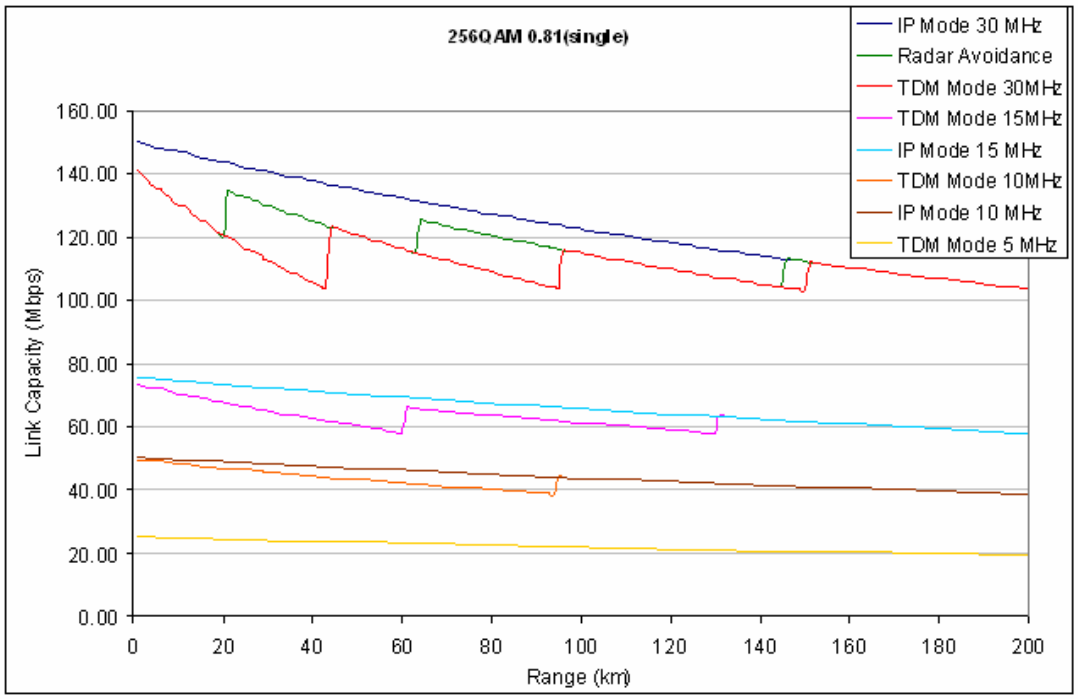


Figure 155 - 256 QAM 0.81 Single Payload

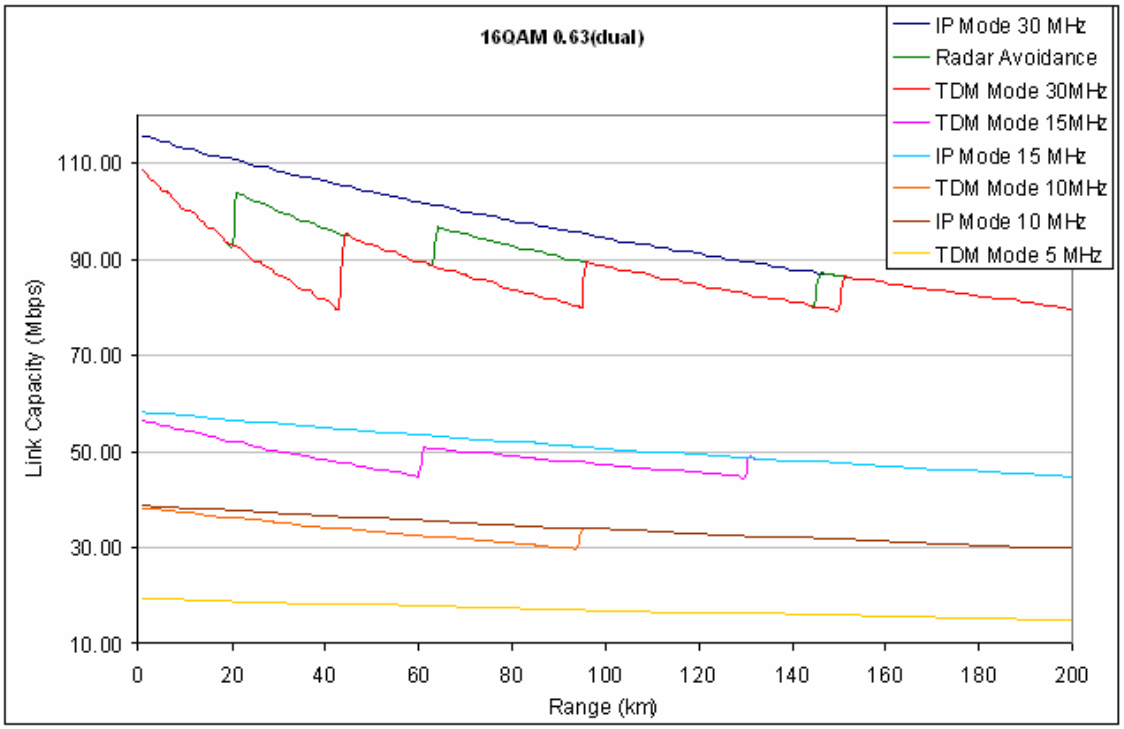


Figure 156 - 16 QAM 0.63 Dual Payload

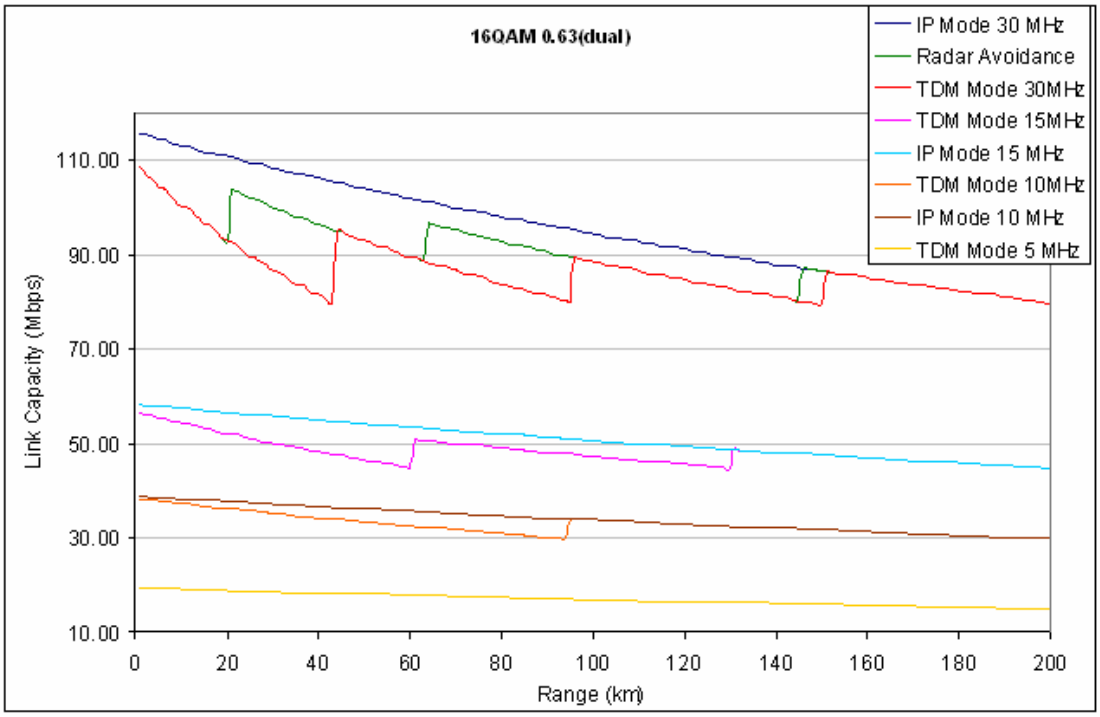


Figure 157 - 16 QAM 0.87 Dual Payload

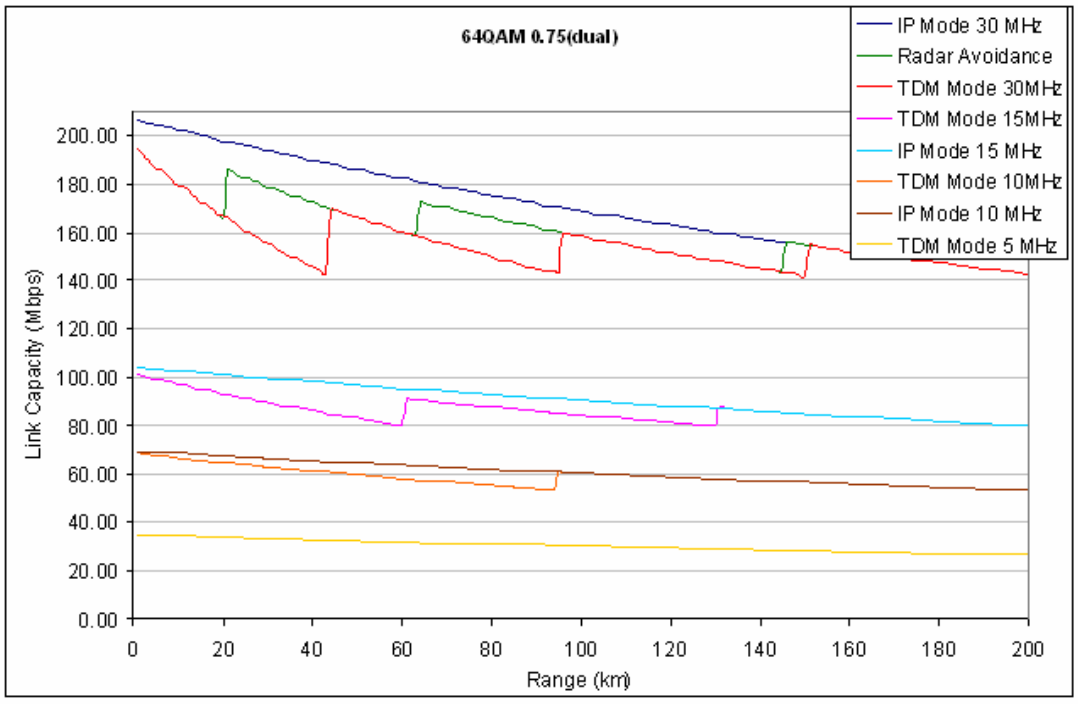


Figure 158 - 64 QAM 0.75 Dual Payload

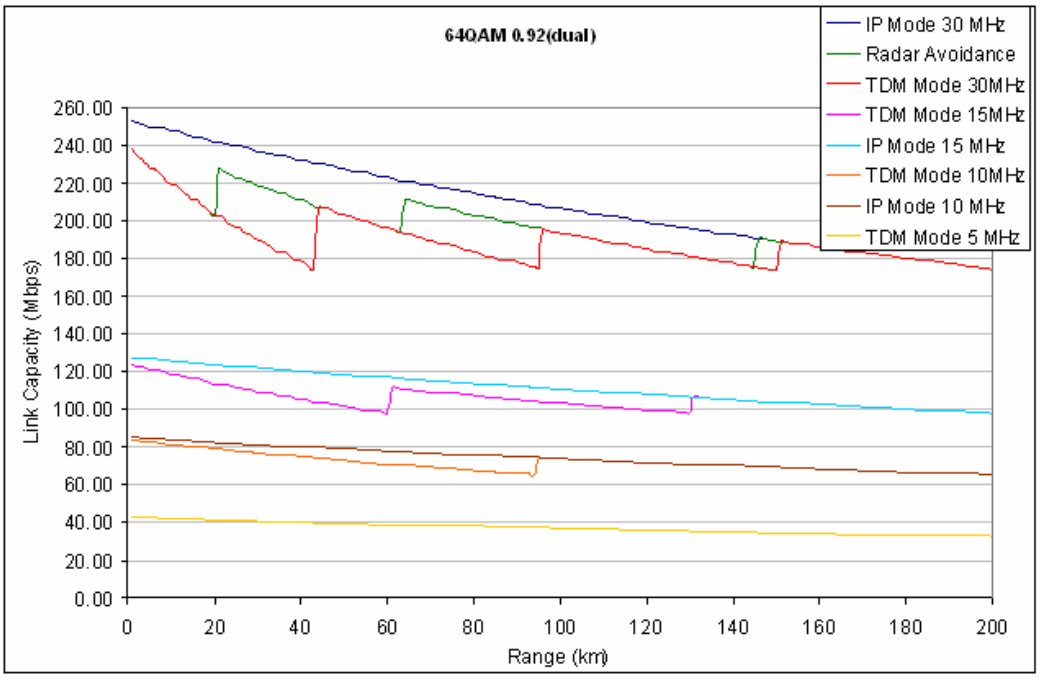


Figure 159 - 64 QAM 0.92 Dual Payload

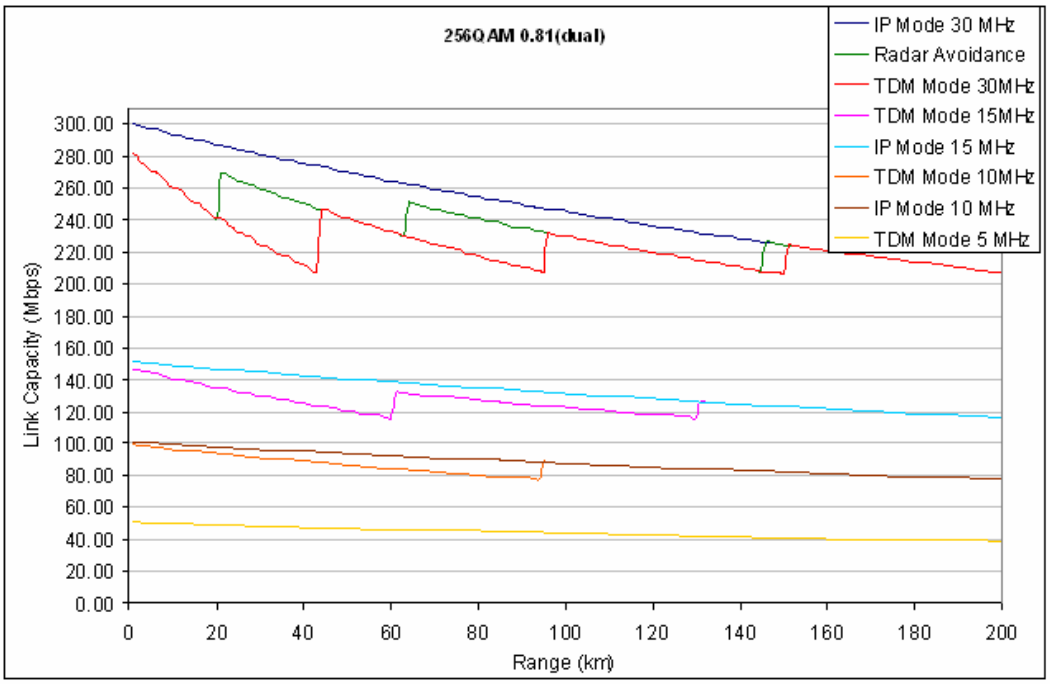


Figure 160 - 256 QAM 0.81 Dual Payload

18 AES Encryption Upgrade

The Motorola PTP 600 Series bridges support link encryption using the NIST approved Advanced Encryption Standard, HFIPS-197H. This standard specifies AES (Rijndael) as a FIPS-approved symmetric encryption algorithm that may be used by U.S. Government organizations (and others) to protect sensitive information.

Link Encryption is not available in the standard PTP 600 Series system. A license key to enable link encryption can be purchased from your Motorola Point-to-Point Distributor or Solutions Provider. AES can be activated on receipt of the activation on the Motorola Systems Support Page.

There are two levels of encryption that are available to purchase:

- 128-bit
- 128 and 256-bit

Option 1 allows the user to encrypt all traffic sent over the wireless link using 128-bit encryption. Option 2 allows the user to encrypt traffic using either 128 or 256-bit encryption. The configuration process for both encryption variants is identical except for the selection of algorithm. The following configuration example is for a 256-bit encryption key.

18.1 Configuring Link Encryption

After purchasing AES encryption for the PTP 600 Series wireless link, two new license keys will be issued, one for each end of the wireless link. The following configuration process gives a step by step guide to enabling AES link encryption on a PTP 600 Series bridge.

18.2 Configuring Link Encryption

After purchasing AES encryption for the PTP 600 Series wireless link, two new license keys will be issued, one for each end of the wireless link. The following configuration process gives a step by step guide to enabling AES link encryption on a PTP 600 Series bridge.

18.2.1 License Keys

The first step when configuring link encryption is to enter the new license keys in both 600 Series wireless units.

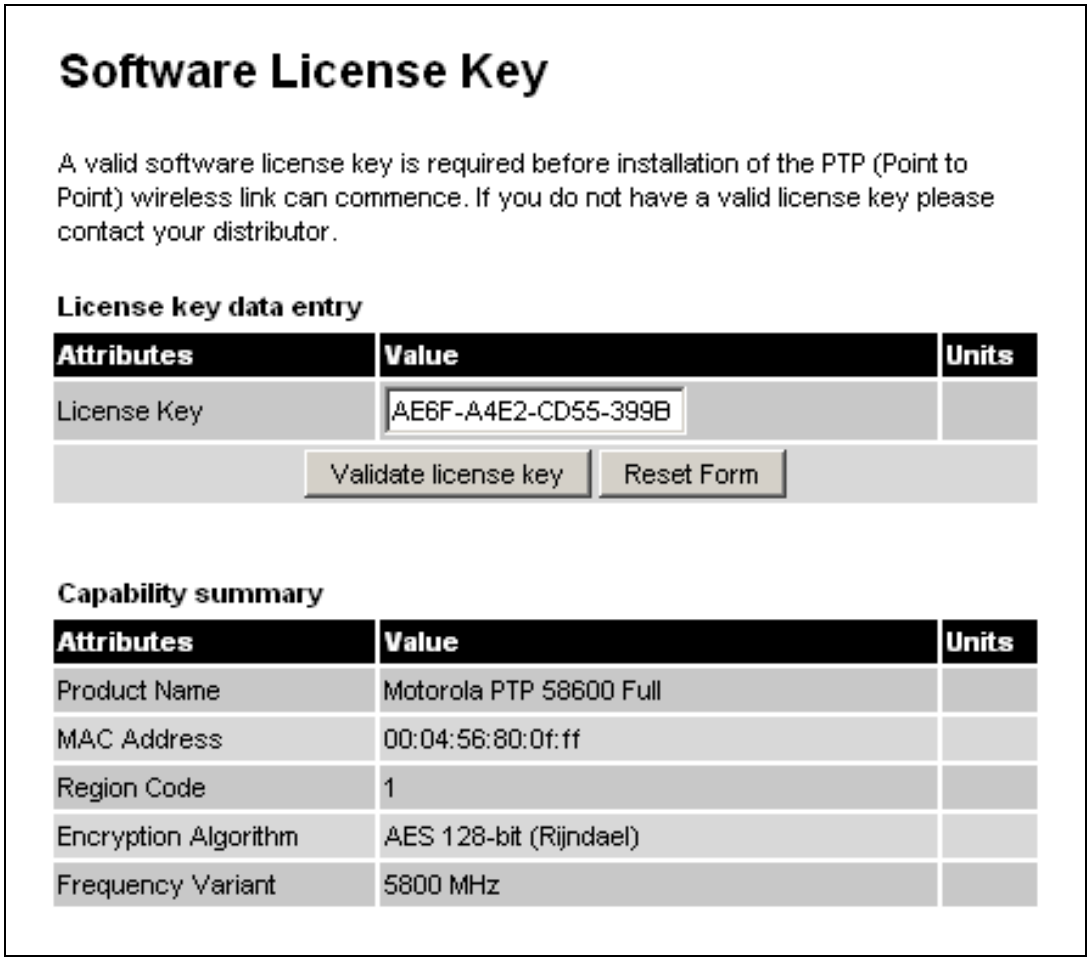


Figure 161 – AES Software License Key Data Entry

Figure 161 shows the license key data entry screen. This screen can only be accessed by the system administrator. If you do not have access to the PTP 600 Series system administration pages then please contact your designated system administrator.

It must be noted that configuring link encryption will necessitate a 600 Series bridge service outage. Therefore it is recommended that the configuration process be scheduled during an appropriate period of low link utilization. Motorola recommends the following process for entering new license keys and minimizing service outage.

1. Open two browsers, one for each end of the link
2. Navigate to the ‘License Key’ data entry page for each end of the link

3. Enter the license keys and click the 'Validate license key' button at each end of the link. This will allow the software to validate the license key prior to the system reset. (DO NOT CLICK ARE YOU SURE POPUP DIALOG)

4. When both license keys have been successfully validated confirm the reboot for both ends of the link. The software is designed to allow five seconds so that a user can command both ends of the link to reset before the wireless link drops.

5. The link will automatically re-establish.

18.2.2 Encryption Mode and Key

Entering the license keys only does not initialize AES link encryption. Link encryption can only be enabled via the Configuration or Installation Wizard pages. Motorola recommends that the Configuration page Figure 162 be used to configure AES link encryption.

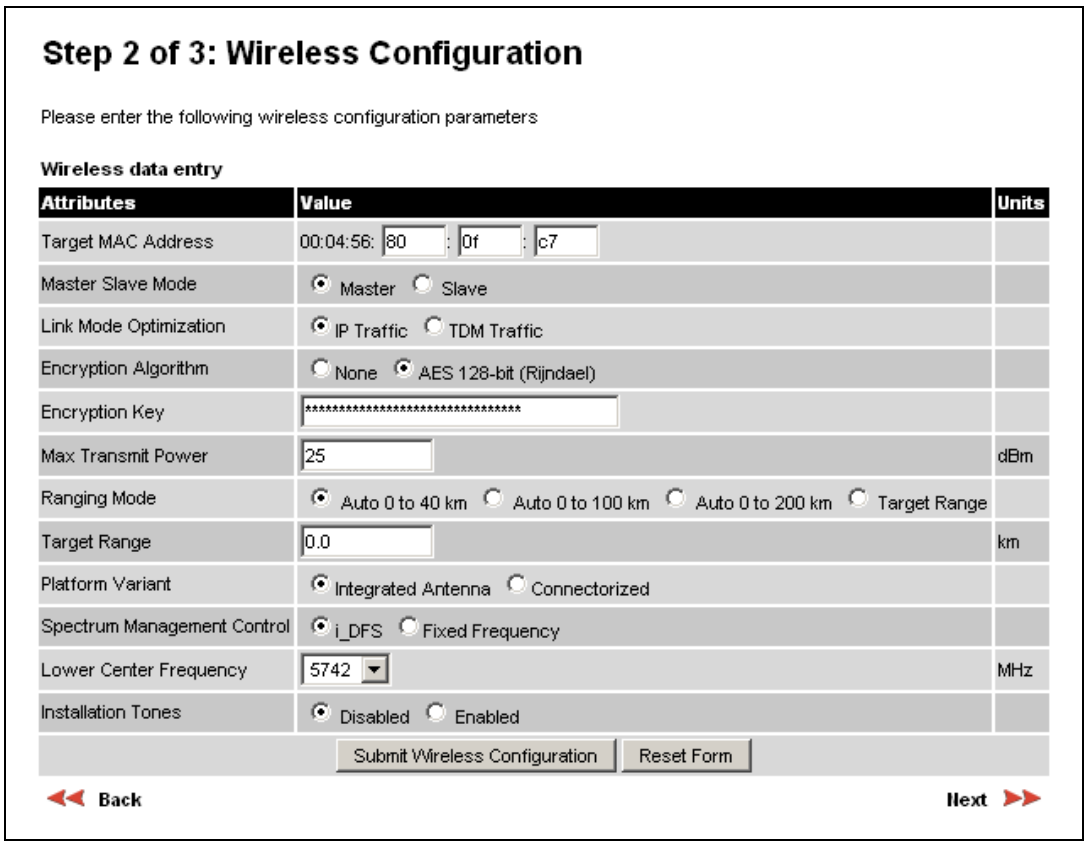


Figure 162 – AES Configuration Data Entry Page

Motorola recommends the following process for entering AES link encryption configuration:-

1. Open two browsers, one for each end of the link
2. Navigate to the ‘Configuration’ data entry page for each end of the link
3. At both ends of the link select the ‘AES (Rijndael)’ Encryption Algorithm required.
4. At both ends of the link enter ether an 128-bit or 256-bit encryption key. Note the key consists of 32/64 case insensitive hexadecimal characters. The same Key must be entered at both ends of the link. Failure to enter the same key will cause the link to fail.
5. Submit configuration on both ends of the link, but do not reboot.
6. Reboot both ends of the link Figure 163. The software is designed to allow five seconds so that a user can command both ends of the link to reboot before the wireless link drops.

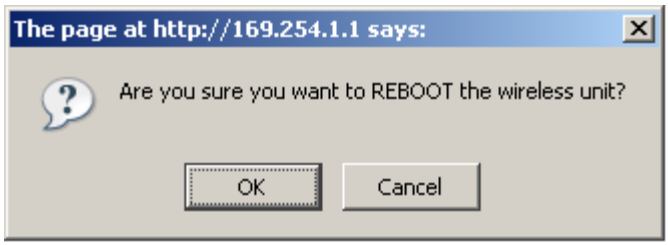


Figure 163 - Configuration Reboot Screen

18.3 Wireless Link Encryption FAQ

18.3.1 Encryption data entry fields are not available

Check that the correct license key has been inserted into the unit. The current license key is displayed on the ‘License Key’ data entry page.

18.3.2 Link fails to bridge packets after enabling link encryption

If the wireless link status on the status web page indicates that the link is ‘Searching’, and you can browse to the local end of the link but not to the remote end, then check that the same encryption algorithm and key have been entered at both ends of the link. Failure to enter the same algorithm and key will result in received packets not being decrypted correctly.

18.3.3 Loss of AES following downgrade

When downgrading (using Recovery software image 05-01 onwards) to an earlier version of software that does not support AES, the unit will indicate that the region code is invalid. The user will be required to re-install correct software (supplied when AES key was activated) and reboot the unit.

19 Legal and Regulatory Notices

19.1 Important Note on Modifications

Intentional or unintentional changes or modifications to the equipment must not be made unless under the express consent of the party responsible for compliance. Any such modifications could void the user's authority to operate the equipment and will void the manufacturer's warranty.

19.2 National and Regional Regulatory Notices – 5.8 GHz variant

19.2.1 U.S. Federal Communication Commission (FCC) and Industry Canada (IC) Notification

This system has achieved Type Approval in various countries around the world. This means that the system has been tested against various local technical regulations and found to comply. The frequency band in which the system operates is 'unlicensed' and the system is allowed to be used provided it does not cause interference. Further, it is not guaranteed protection against interference from other products and installations.

This device complies with part 15 of the US FCC Rules and Regulations and with RSS-210 of Industry Canada. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation. In Canada, users should be cautioned to take note that high power radars are allocated as primary users (meaning they have priority) of 5250 – 5350 MHz and 5650 – 5850 MHz and these radars could cause interference and/or damage to license-exempt local area networks (LELAN).

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the US FCC Rules and with RSS-210 of Industry Canada. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio-frequency energy and, if not installed and used in accordance with these instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to correct the interference by one or more of the following measures:

- Increase the separation between the affected equipment and the unit;
- Connect the affected equipment to a power outlet on a different circuit from that which the receiver is connected to;
- Consult the dealer and/or experienced radio/TV technician for help.
- FCC IDs and Industry Canada Certification Numbers are listed in Table 35

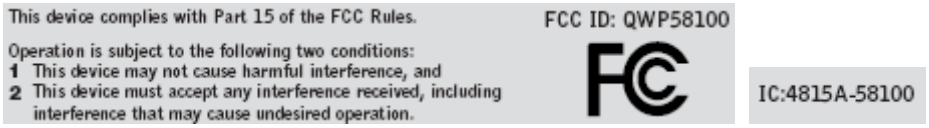


Table 35 - US FCC IDs and Industry Canada certification numbers

Where necessary, the end user is responsible for obtaining any National licenses required to operate this product and these must be obtained before using the product in any particular country. Contact the appropriate national administrations for details on the conditions of use for the bands in question and any exceptions that might apply. Also see www.ero.dk for further information.

19.2.2 European Union Notification

The 5.8 GHz connectorized product is a two-way radio transceiver suitable for use in Broadband Wireless Access System (WAS), Radio Local Area Network (RLAN), or Fixed Wireless Access (FWA) systems. It is a Class 2 device and uses operating frequencies that are not harmonized throughout the EU member states. The operator is responsible for obtaining any national licenses required to operate this product and these must be obtained before using the product in any particular country.

This equipment complies with the essential requirements for the EU R&TTE Directive 1999/5/EC.

The use of 5.8GHz for Point to Point radio links is not harmonized across the EU and currently the product may only be deployed in the UK and Eire (IRL). However, the regulatory situation in Europe is changing and the radio spectrum may become available in other countries in the near future.

This equipment is marked

to show compliance with the European R&TTE directive 1999/5/EC.

The relevant Declaration of Conformity can be found at www.motorola.com/ptp

European Union (EU) Waste of Electrical and Electronic Equipment (WEEE) directive

The European Union's WEEE directive requires that products sold into EU countries must have the crossed out trash bin label on the product (or the package in some cases). As defined by the WEEE directive, this cross-out trash bin label means that customers and end-users in EU countries should not dispose of electronic and electrical equipment or accessories in household waste. Customers or end-users in EU countries should contact their local equipment supplier representative or service center for information about the waste collection system in their country.

19.2.3 UK Notification

The 5.8 GHz connectorized product has been notified for operation in the UK, and when operated in accordance with instructions for use it is compliant with UK Interface Requirement IR2007. For UK use, installations must conform to the requirements of IR2007 in terms of EIRP spectral density against elevation profile above the local horizon in order to protect Fixed Satellite Services. The frequency range 5795-5815 MHz is assigned to Road Transport & Traffic Telematics (RTTT) in the U.K. and shall not be used by FWA systems in order to protect RTTT devices. UK Interface Requirement IR2007 specifies that radiolocation services shall be protected by a Dynamic Frequency Selection (DFS) mechanism to prevent co-channel operation in the presence of radar signals.

Important Note

This equipment operates as a secondary application, so it has no rights against harmful interference, even if generated by similar equipment, and cannot cause harmful interference on systems operating as primary applications.

19.3 National and Regional Regulatory Notices – 5.4 GHz Variant

19.3.1 U.S. Federal Communication Commission (FCC) and Industry Canada (IC) Notification[30]

This device complies with part 15.407 of the US FCC Rules and Regulations and with RSS-210 Issue 7 of Industry Canada. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation. In Canada, users should be cautioned to take note that high power radars are allocated as primary users (meaning they have priority) of 5250 – 5350 MHz and 5650 – 5850 MHz and these radars could cause interference and/or damage to license-exempt local area networks (LELAN).

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15E of the US FCC Rules and with RSS-210 Issue 7 of Industry Canada. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio-frequency energy and, if not installed and used in accordance with these instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to correct the interference by one or more of the following measures:

- Increase the separation between the affected equipment and the unit;
- Connect the affected equipment to a power outlet on a different circuit from that which the receiver is connected to;
- Consult the dealer and/or experienced radio/TV technician for help.
- FCC IDs and Industry Canada Certification Numbers are listed in Table 36

Table 36 - US FCC IDs and Industry Canada certification numbers

[30] FCC and IC certification approval applies ONLY to INTEGRATED variant.

Where necessary, the end user is responsible for obtaining any National licenses required to operate this product and these must be obtained before using the product in any particular country. Contact the appropriate national administrations for details on the conditions of use for the bands in question and any exceptions that might apply. Also see www.eor.dk for further information.

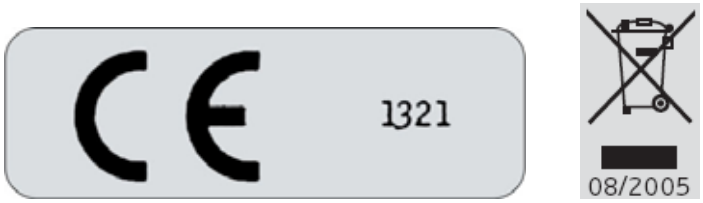
19.3.2 European Union Notification

The 5.4 GHz product is a two-way radio transceiver suitable for use in Broadband Wireless Access System (WAS), Radio Local Area Network (RLAN), or Fixed Wireless Access (FWA) systems. It is a Class 2 device and uses operating frequencies that are not harmonized throughout the EU member states. The operator is responsible for obtaining any national licenses required to operate this product and these must be obtained before using the product in any particular country.

This equipment complies with the essential requirements for the EU R&TTE Directive 1999/5/EC.

The use of 5.4GHz for Point to Point radio links is harmonized across the EU.

This equipment is marked



to show compliance with the European R&TTE directive 1999/5/EC.

The relevant Declaration of Conformity can be found at www.motorola.com

European Union (EU) Waste of Electrical and Electronic Equipment (WEEE) directive

The European Union's WEEE directive requires that products sold into EU countries must have the crossed out trash bin label on the product (or the package in some cases). As defined by the WEEE directive, this cross-out trash bin label means that customers and end-users in EU countries should not dispose of electronic and electrical equipment or accessories in household waste. Customers or end-users in EU countries should contact their local equipment supplier representative or service center for information about the waste collection system in their country.

19.4 National and Regional Regulatory Notices – 2.5 GHz Variant

19.4.1 U.S. Federal Communication Commission (FCC) Notification

This device complies with Part 27 of the US FCC Rules and Regulations. Use of this product is limited to operators holding Licenses for the specific operating channels.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15E of the US FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio-frequency energy and, if not installed and used in accordance with these instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to correct the interference by one or more of the following measures:

- Increase the separation between the affected equipment and the unit;
- Connect the affected equipment to a power outlet on a different circuit from that which the receiver is connected to;
- Consult the dealer and/or experienced radio/TV technician for help.
- FCC IDs Certification Numbers are listed in Table 36

Table 37 - US FCC IDs and Industry Canada certification numbers

Where necessary, the end user is responsible for obtaining any National licenses required to operate this product and these must be obtained before using the product in any particular country. Contact the appropriate national administrations for details on the conditions of use for the bands in question and any exceptions that might apply.

19.5 Exposure

See **Preventing Overexposure to RF** on Page 26.

19.6 Legal Notices

19.6.1 Software License Terms and Conditions

ONLY OPEN THE PACKAGE, OR USE THE SOFTWARE AND RELATED PRODUCT IF YOU ACCEPT THE TERMS OF THIS LICENSE. BY BREAKING THE SEAL ON THIS DISK KIT / CDROM, OR IF YOU USE THE SOFTWARE OR RELATED PRODUCT, YOU ACCEPT THE TERMS OF THIS LICENSE AGREEMENT. IF YOU DO NOT AGREE TO THESE TERMS, DO NOT USE THE SOFTWARE OR RELATED PRODUCT; INSTEAD, RETURN THE SOFTWARE TO PLACE OF PURCHASE FOR A FULL REFUND. THE FOLLOWING AGREEMENT IS A LEGAL AGREEMENT BETWEEN YOU (EITHER AN INDIVIDUAL OR ENTITY), AND MOTOROLA, INC. (FOR ITSELF AND ITS LICENSORS). THE RIGHT TO USE THIS PRODUCT IS LICENSED ONLY ON THE CONDITION THAT YOU AGREE TO THE FOLLOWING TERMS.

Now, therefore, in consideration of the promises and mutual obligations contained herein, and for other good and valuable consideration, the receipt and sufficiency of which are hereby mutually acknowledged, you and Motorola agree as follows:

Grant of License. Subject to the following terms and conditions, Motorola, Inc., grants to you a personal, revocable, non-assignable, non-transferable, non-exclusive and limited license to use on a single piece of equipment only one copy of the software contained on this disk (which may have been pre-loaded on the equipment)(Software). You may make two copies of the Software, but only for backup, archival, or disaster recovery purposes. On any copy you make of the Software, you must reproduce and include the copyright and other proprietary rights notice contained on the copy we have furnished you of the Software.

Ownership. Motorola (or its supplier) retains all title, ownership and intellectual property rights to the Software and any copies, including translations, compilations, derivative works (including images) partial copies and portions of updated works. The Software is Motorola's (or its supplier's) confidential proprietary information. This Software License Agreement does not convey to you any interest in or to the Software, but only a limited right of use. You agree not to disclose it or make it available to anyone without Motorola's written authorization. You will exercise no less than reasonable care to protect the Software from unauthorized disclosure. You agree not to disassemble, decompile or reverse engineer, or create derivative works of the Software, except and only to the extent that such activity is expressly permitted by applicable law.

Termination. This License is effective until terminated. This License will terminate immediately without notice from Motorola or judicial resolution if you fail to comply with any provision of this License. Upon such termination you must destroy the Software, all accompanying written materials and all copies thereof, and the sections entitled Limited Warranty, Limitation of Remedies and Damages, and General will survive any termination.

Limited Warranty. Motorola warrants for a period of ninety (90) days from Motorola's or its customer's shipment of the Software to you that (i) the disk(s) on which the Software is recorded will be free from defects in materials and workmanship under normal use and (ii) the Software, under normal use, will perform substantially in accordance with Motorola's published specifications for that release level of the Software. The written materials are provided "AS IS" and without warranty of any kind. Motorola's entire liability and your sole and exclusive remedy for any breach of the foregoing limited warranty will be, at Motorola's option, replacement of the disk(s), provision of downloadable patch or replacement code, or refund of the unused portion of your bargained for contractual benefit up to the amount paid for this Software License.

THIS LIMITED WARRANTY IS THE ONLY WARRANTY PROVIDED BY MOTOROLA, AND MOTOROLA AND ITS LICENSORS EXPRESSLY DISCLAIM ALL OTHER WARRANTIES, EITHER EXPRESS OF IMPLIED, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. MOTOROLA DOES NOT WARRANT THAT THE OPERATION OF THE SOFTWARE WILL BE UNINTERRUPTED OR ERROR-FREE, OR THAT DEFECTS IN THE SOFTWARE WILL BE CORRECTED. NO ORAL OR WRITTEN REPRESENTATIONS MADE BY MOTOROLA OR AN AGENT THEREOF SHALL CREATE A WARRANTY OR IN ANY WAY INCREASE THE SCOPE OF THIS WARRANTY. MOTOROLA DOES NOT WARRANT ANY SOFTWARE THAT HAS BEEN OPERATED IN EXCESS OF SPECIFICATIONS, DAMAGED, MISUSED, NEGLECTED, OR IMPROPERLY INSTALLED. BECAUSE SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF IMPLIED WARRANTIES, THE ABOVE LIMITATIONS MAY NOT APPLY TO YOU.

Limitation of Remedies and Damages. Regardless of whether any remedy set forth herein fails of its essential purpose, IN NO EVENT SHALL MOTOROLA OR ANY OF THE LICENSORS, DIRECTORS, OFFICERS, EMPLOYEES OR AFFILIATES OF THE FOREGOING BE LIABLE TO YOU FOR ANY CONSEQUENTIAL, INCIDENTAL, INDIRECT, SPECIAL OR SIMILAR DAMAGES WHATSOEVER (including, without limitation, damages for loss of business profits, business interruption, loss of business information and the like), whether foreseeable or unforeseeable, arising out of the use or inability to use the Software or accompanying written materials, regardless of the basis of the claim and even if Motorola or a Motorola representative has been advised of the possibility of such damage. Motorola's liability to you for direct damages for any cause whatsoever, regardless of the basis of the form of the action, will be limited to the price paid for the Software that caused the damages. THIS LIMITATION WILL NOT APPLY IN CASE OF PERSONAL INJURY ONLY WHERE AND TO THE EXTENT THAT APPLICABLE LAW REQUIRES SUCH LIABILITY. BECAUSE SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES, THE ABOVE LIMITATION MAY NOT APPLY TO YOU.

Maintenance and Support. Motorola shall not be responsible for maintenance or support of the software. By accepting the license granted under this agreement, you agree that Motorola will be under no obligation to provide any support, maintenance or service in connection with the Software or any application developed by you. Any maintenance and support of the Related Product will be provided under the terms of the agreement for the Related Product.

Transfer. In the case of software designed to operate on Motorola equipment, you may not transfer the Software to another party except: (1) if you are an end-user, when you are transferring the Software together with the Motorola equipment on which it operates; or 2) if you are a Motorola licensed distributor, when you are transferring the Software either together with such Motorola equipment or are transferring the Software as a licensed duly paid for upgrade, update, patch, new release, enhancement or replacement of a prior version of the Software. If you are a Motorola licensed distributor, when you are transferring the Software as permitted herein, you agree to transfer the Software with a license agreement having terms and conditions no less restrictive than those contained herein. You may transfer all other Software, not otherwise having an agreed restriction on transfer, to another party. However, all such transfers of Software are strictly subject to the conditions precedent that the other party agrees to accept the terms and conditions of this License, and you destroy any copy of the Software you do not transfer to that party. You may not sublicense or otherwise transfer, rent or lease the Software without our written consent. You may not transfer the Software in violation of any laws, regulations, export controls or economic sanctions imposed by the US Government.

Right to Audit. Motorola shall have the right to audit annually, upon reasonable advance notice and during normal business hours, your records and accounts to determine compliance with the terms of this Agreement.

Export Controls. You specifically acknowledge that the software may be subject to United States and other country export control laws. You shall comply strictly with all requirements of all applicable export control laws and regulations with respect to all such software and materials.

US Government Users. If you are a US Government user, then the Software is provided with "RESTRICTED RIGHTS" as set forth in subparagraphs (c)(1) and (2) of the Commercial Computer Software-Restricted Rights clause at FAR 52 227-19 or subparagraph (c)(1)(ii) of the Rights in Technical Data and Computer Software clause at DFARS 252.227-7013, as applicable.

Disputes. You and Motorola hereby agree that any dispute, controversy or claim, except for any dispute, controversy or claim involving intellectual property, prior to initiation of any formal legal process, will be submitted for non-binding mediation, prior to initiation of any formal legal process. Cost of mediation will be shared equally. Nothing in this Section will prevent either party from resorting to judicial proceedings, if (i) good faith efforts to resolve the dispute under these procedures have been unsuccessful, (ii) the dispute, claim or controversy involves intellectual property, or (iii) interim relief from a court is necessary to prevent serious and irreparable injury to that party or to others.

General. Illinois law governs this license. The terms of this license are supplemental to any written agreement executed by both parties regarding this subject and the Software Motorola is to license you under it, and supersedes all previous oral or written communications between us regarding the subject except for such executed agreement. It may not be modified or waived except in writing and signed by an officer or other authorized representative of each party. If any provision is held invalid, all other provisions shall remain valid, unless such invalidity would frustrate the purpose of our agreement. The failure of either party to enforce any rights granted hereunder or to take action against the other party in the event of any breach hereunder shall not be deemed a waiver by that party as to subsequent enforcement of rights or subsequent action in the event of future breaches.

19.6.2 Hardware Warranty in U.S.

Motorola U.S. offers a warranty covering a period of one year from the date of purchase by the customer. If a product is found defective during the warranty period, Motorola will repair or replace the product with the same or a similar model, which may be a reconditioned unit, without charge for parts or labor.

19.6.3 Limit of Liability

IN NO EVENT SHALL MOTOROLA BE LIABLE TO YOU OR ANY OTHER PARTY FOR ANY DIRECT, INDIRECT, GENERAL, SPECIAL, INCIDENTAL, CONSEQUENTIAL, EXEMPLARY OR OTHER DAMAGE ARISING OUT OF THE USE OR INABILITY TO USE THE PRODUCT (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF BUSINESS PROFITS, BUSINESS INTERRUPTION, LOSS OF BUSINESS INFORMATION OR ANY OTHER PECUNIARY LOSS, OR FROM ANY BREACH OF WARRANTY, EVEN IF MOTOROLA HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. (Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusion or limitation may not apply to you.) IN NO CASE SHALL MOTOROLA'S LIABILITY EXCEED THE AMOUNT YOU PAID FOR THE PRODUCT.

20 Glossary

ARP	Address Resolution Protocol
ARQ	Automatic Repeat reQuest
BPSK	Binary Phase Shift Keying
DC	Direct Current
DFS	Dynamic Frequency Selection
ETSI	European Telecommunications Standards Institute
FAQ	Frequently Asked Question
GPS	Global Positioning System
HP	Hypertext Transfer Protocol
ID	Identity
IEEE	Institute of Electrical and Electronic Engineers
IP	Internet Protocol
IQ	In phase / Quadrature
ISM	Industrial Scientific and Medical
I	International Telecommunications Union
LAN	Local Area Network
MAC	Medium Access Control Layer
MDI	Medium Dependent Interface
MDIX	Medium Dependent Interface Crossover
NLOS	non-Line-of-Sight
ODU	Outdoor Unit
OFDM	Orthogonal Frequency Division Multiplex
PC	IBM Compatible Personal Computer
PIDU +	Power Indoor Unit
PING	Packet Internet Groper
POE	Power over Ethernet
PSU	Power Supply Unit
PTP	Point-to-Point
QAM	Quadrature Amplitude Modulation
RAM	Random Access Memory
STC	Space Time Coding
STP	Shielded Twisted Pair
TCP	Transmission Control Protocol
TPC	Transmit Power Control
URL	Universal Resource Location
USA	United States of America
UTP	Unshielded Twisted Pair
UV	Ultraviolet
VLAN	Virtual Local Area Network

21 FAQs

Can I source and use my own PoE adaptor with the 600 Series bridge? No. The 600 Series bridge uses a non-standard PoE configuration. Failure to use the Motorola supplied Power Indoor Unit could result in equipment damage and will invalidate the safety certification and may cause a safety hazard.

Why has Motorola launched the 600 Series bridge? The 600 Series bridge is the first product in this band to feature Multiple-Input Multiple-Output (MIMO). The PTP 600 Series solutions allow wireless connections of up to 200km (124 miles) in near line-of-sight conditions and up to 10km (6 miles) in deep non-line-of-sight conditions.

What is Multiple-Input Multiple-Output (MIMO)? The 600 Series bridge radiates multiple beams from the antenna - the effect of which is to significantly protect against fading and to radically increase the probability that the receiver will decode a usable signal. When the effects of MIMO are combined with those of OFDM techniques and a best in class link budget, there is a significant improvement to the probability of a robust connection over a non-line-of-sight path.

What do you mean by "non-line-of-sight"? A wireless connection between two points without optical line-of-sight, i.e., with obstructions between the antennas the transmitted signal is still able to reach the receiver and produce a good quality link.

What else is special about the 600 Series bridge ? There are many special features built-in to the hardware of the 600 Series bridge. The product offers the highest system gain in its class through high sensitivity antennas for improved signal recovery. It also features a Software Defined Radio system that operates on ultra fast digital signal processors but is controlled by firmware giving the ability to download new firmware when enhancements become available. The 600 Series bridge has a built-in web server for advanced management capabilities including detailed radio signal diagnosis.

In which frequency bands does the 600 Series bridge operate? The Motorola point-to-point 600 Series bridge operates in the licensed 2.5 GHz , unlicensed 5.4 GHz (ETSI Band B) and 5.8 GHz (ETSI Band C and FCC ISM band). This means no license is required to operate the 600 Series bridge.

Why does the 600 Series bridge operate in the 5GHz band? The 5 GHz band offers the dual benefits of high data throughput and good radio propagation characteristics. The wide band of spectrum available is subdivided into several channels such that multiple systems can operate in the vicinity without causing interference to one another.

Is the 600 Series bridge an 802.11a device? No, although similar, the 600 Series bridge uses different encoding and radio transmission systems from 802.11a. In areas where 802.11a systems are operating, the 600 Series bridge will detect the 802.11a radio signals and choose a clear channel away from any interference.

How much power does the 600 Series bridge transmit? At all times the 600 Series bridge operates within country / region specific regulations for radio power emissions. In addition, the 600 Series bridge uses a technique known as Transmit Power Control (TPC) to ensure that it only transmits sufficient radio power such that the other antenna can receive a high quality signal.

How does the PTP 600 Series Bridge avoid interference from other devices nearby? At initialization, the 600 Series bridge monitors the available frequency channels to find a channel that is clear of interference. In operation 600 Series bridge continuously monitors the spectrum to ensure it is operating on the cleanest channel.

How does the 600 Series bridge integrate into my data network? The 600 Series bridge acts as a transparent bridge between two segments of your network. In this sense, it can be treated like a virtual wired connection between the two buildings. The 600 Series bridge forwards 802.3 Ethernet packets destined for the other part of the network and filters packets it does not need to forward. The system is transparent to higher-level management systems such as VLANs and Spanning Tree.

How does the 600 Series bridge provide security for data traffic? The 600 Series bridge has a range of security features. At installation time each link must be programmed with the serial ID of its partner. The two ends of the link will only communicate with one another, eliminating any chance of "man in the middle" attacks. Over the air security is achieved through a proprietary scrambling mechanism that cannot be disabled, spoofed or snooped by commercial tools.

Can I use Apple Macintosh OS X to control and monitor my 600 Series bridge? Yes, but there are some restrictions. Mozilla 1.6 or higher is recommended. There are some issues with Internet Explorer 5.2(IE) and Safari, which could mislead the user.

How will my investment be protected as new features are developed? Future enhancements can be downloaded to the unit, meaning advances in technology or changes in regulations can quickly be applied to the system without any further hardware investment.

22 Index

23 Specifications

23.1 System Specifications

23.1.1 Wireless 2.5 GHz Variant

Radio Technology	Specification
RF Band	Lower: 2496-2568 MHz Middle: 2572-2614 MHz Upper: 2618-2690 MHz
Channel Selection	Manual selection.
Dynamic Frequency Control	N/A
Channel size	5, 10, 15 and 30 MHz
Manual Power Control	Maximum power can be controlled lower than the power limits shown above in order to control interference to other users of the band.
Receiver Noise Figure	Typically 5 dB

Antenna	
Antenna Type	Integrated flat plate antenna
Antenna Gain	18 dBi typical
Antenna Beamwidth	8 Degrees

Wireless PHY	
Max Path Loss	161 dB
Duplex Scheme	TDD, Symmetric (1:1)
Range	125 miles (200km) optical Line-of-Sight 6 miles (10km) non-Line-of-Sight

Over-the-Air Encryption	Proprietary scrambling mechanism.
Weather Sensitivity	Sensitivity at higher modes may be reduced during high winds through trees due to Adaptive Modulation Threshold changes
Error Correction	FEC

23.1.2 Wireless 5.4GHz Variant

Radio Technology	Specification
RF Band	5.470-5.725GHz
Channel Selection	By dynamic frequency control and manual intervention Automatic detection on start-up and continual adaptation to avoid interference.
Dynamic Frequency Control	Initial capture 10-15 sec. Out of service on interference 100 ms.
Channel size	5, 10, 15 and 30 MHz
Manual Power Control	Maximum power can be controlled lower than the power limits shown above in order to control interference to other users of the band.
Receiver Noise Figure	Typically 6 dB

Antenna	
Antenna Type	Integrated flat plate antenna
Antenna Gain	23 dBi typical
Antenna Beamwidth	8 Degrees

Wireless PHY	
Max Path Loss	161 dB
Duplex Scheme	TDD, Symmetric (1:1)
Range	125 miles (200km) optical Line-of-Sight 6 miles (10km) non-Line-of-Sight
Over-the-Air Encryption	Proprietary scrambling mechanism.
Weather Sensitivity	Sensitivity at higher modes may be reduced during high winds through trees due to Adaptive Modulation Threshold changes
Error Correction	FEC

23.1.3 Wireless 5.8GHz Variant

Radio Technology	Specification
RF Band	5.725-5.850GHz
Channel Selection	By dynamic frequency control and manual intervention Automatic detection on start-up and continual adaptation to avoid interference.
Dynamic Frequency Control	Initial capture 10-15 sec. Out of service on interference 100 ms.
Channel size	5, 10, 15 and 30 MHz
Manual Power Control	Maximum power can be controlled lower than the power limits shown above in order to control interference to other users of the band.
Receiver Noise Figure	Typically 6 dB

Antenna	
Antenna Type	Integrated flat plate antenna
Antenna Gain	23 dBi typical
Antenna Beamwidth	8 Degrees

Wireless PHY	
Max Path Loss	161 dB
Duplex Scheme	TDD, Symmetric (1:1)
Range	125 miles (200km) optical line-of-sight 6 miles (10km) non-line-of-sight
Over-the-Air Encryption	Proprietary scrambling mechanism.
Weather Sensitivity	Sensitivity at higher modes may be reduced during high winds through trees due to Adaptive Modulation Threshold changes
Error Correction	FEC

23.1.4 Management

Management	
Status Indication	Power status Ethernet Link Status Data activity
Installation	Web server and browser for setup Audio tone feedback during installation , plus graphical installation tool suitable for laptop and PDA computing devices Web server for confirmation
Radio Performance and Management	Via web server and browser, SNMP
Alarms	Via configurable email alerts, SNMP

Ethernet Bridging	
Protocol	IEEE802.1; IEEE802.1p; IEEE802.3 compatible
Interface	10/100/1000BaseT (RJ-45), Supports MDI/MDIX Auto Crossover
Data Rates	See Section 17

Note: Practical Ethernet rates will depend on network configuration, higher layer protocols and platforms used.

Warning: Over the air throughput will be capped to the rate of the Ethernet interface at the receiving end of the link.

23.1.5 Physical

Physical Integrated	
Dimensions	Width 14.5” (370mm), Height 14.5” (370mm), Depth 3.75” (95mm)
Weight	12.1 lbs (5.5 Kg) including bracket

Physical Connectorized	
Dimensions	Width 12” (305mm), Height 12” (305mm), Depth 4.01” (105mm)
Weight	9.1 lbs (4.3 Kg) including bracket

23.1.6 Powering

Power Supply	**Separate power supply unit (included)**
Dimensions	Width 9.75” (250mm), Height 1.5” (40mm), Depth 3” (80mm)
Weight	1.9 lbs (0.864 Kg)
Power source	90 – 264 VAC, 50 – 60 Hz / 36 – 60 VDC
Power consumption	55 W max

23.1.7 Telecoms Interface

Telecoms	
Interfaces	2 E1 balanced 120R or 2 T1 balanced 100R over a CAT5 screened twisted pair cable
Jitter and Wander	Compliant with G.823/ G.824.
Surge Protection and Power Cross	Compliant with GR1089, EN60950, K20, K21).

23.2 Safety Compliance

Region	Specification
USA	UL 60950
Canada	CSA C22.2 No.60950
International	CB certified & certificate to IEC 60950

23.3 EMC Emissions Compliance

23.3.1 2.5GHz Variant

Region	Specification
USA	FCC Part 27 and FCC Part 15 (Class B)

23.3.2 5.4GHz Variant

Region	Specification
USA	FCC Part 15 Class B
Canada	CSA Std C108.8, 1993 Class B
Europe	EN55022 CISPR 22

23.3.3 5.8GHz Variant

Region	Specification
USA	FCC Part 15 Class B
Canada	CSA Std C108.8, 1993 Class B
Europe	EN55022 CISPR 22

23.4 EMC Immunity Compliance

Top-level Specification ETSI 301-489.

Specification	Comment
EN 55082-1 Generic EMC and EMI requirements for Europe	
EN 61000-4-2: 1995 Electro Static Discharge (ESD), Class 2, 8 kV air, 4 kV contact discharge	Testing will be carried to ensure immunity to 15kV air and 8kV contact
EN 61000-4-3: 1995 ENV50140: 1993 (radiated immunity) 3 V/m	
EN 61000-4-4: 1995 (Bursts/Transients), Class 4, 4 kV level (power lines AC & DC)	Signal lines @ 0.5 kV open circuit voltage.
EN 6100045:1995, (Surge Immunity)	Requires screened connection to users network
EN 61000-4-6: 1996 (Injected RF), power line, Class 3 @ 10 V/m	Signal lines, Class 3 @ 3 V RMS un-modulated.

23.5 Radio Certifications

23.5.1 2.5 GHz Variant

Region	Specification (Type Approvals)
USA	FCC Part 27

23.5.2 5.4GHz Variant

Region	Specification (Type Approvals)
USA	FCC Part 15.407
EU	EN301 893 V1.2.3/V1.3.1
CANADA	RSS 210 Issue 7

23.5.3 5.8GHz Variant

Region	Specification (Type Approvals)
USA	FCC Part 15.247
CANADA	RSS 210 Issue 7
UK	IR 2007
Eire	ComReg 03/42

23.6 Environmental Specifications

Category	Specification
Temperature	ODU: -40°F (-40°C) to 140°F (+60°C) PIDU Plus: 32°F (0°C) to 104°F(+40°C) PIDU Plus: -40°F (-40°C) to 140°F (+60°C)
Wind Loading	150mph Max (242kph). See Section 12 for a full description.
Humidity	100% Condensing
Waterproof	IP65 (ODU), IP53 (PIDU Plus)
UV Exposure	10 year operational life (UL746C test evidence)

23.7 System Connections

23.7.1 PIDU Plus to ODU and ODU to Network Equipment Connections

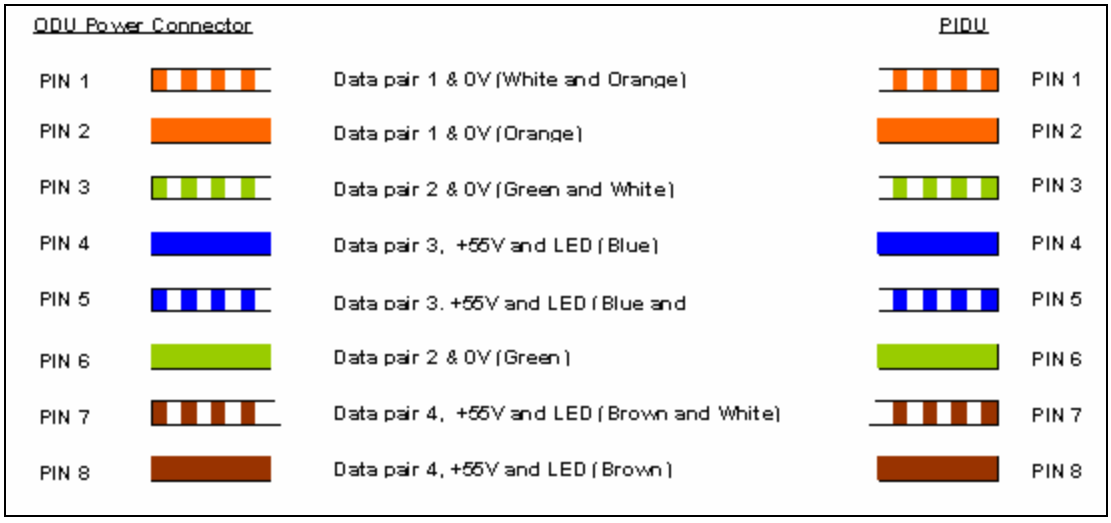


Figure 164 - Cable Connection Diagram (T568B Color Coding)

Telecoms	Connector Pinout Signal Name
Pin 1	E1T1A_TX-
Pin 2	E1T1A_TX+
Pin 3	E1T1A_RX-
Pin 4	E1T1B_TX-
Pin 5	E1T1B_TX+
Pin 6	E1T1A_RX+
Pin 7	E1T1B_RX-
Pin 8	E1T1B_RX+

Table 38 - Telecoms Connection Pin Out

Unit A1, Linhay Business Park
Eastern Road, Ashburton
Devon, TQ 13 7UP, UK
Telephone Support: +1 877 515-0400 (Worldwide)
+44 808 234 4640 (UK)
www.motorola.com/ptp