NOTE: A raster limits the selection of the Rx frequency based upon the setting of the Tx frequency.

Tx Color Code, Rx Color Code: When co-channel interference is from another PTP 600, co-channel performance is improved by selecting different values for a new colour code attribute at the victim and interfering links. Improvement may be up to 7dB. It will also allow the units to operate at levels of C to I below 14dB, which is currently not possible.

Figure 68 – PTP 59600, PTP 58600 and PTP 54600 Variants - Fixed Frequency Operation

Figure 69 - PTP 25600 Variant - Fixed Frequency Operation

Installation Tones: Where the use of audio installation tones is not required, this control allows the installer to optionally disable the tone generator during the installation process.

Once the installer is satisfied with the wireless configuration options then the "Submit Wireless Configuration" button or the "Next" link should be clicked.

Figure 70 – PTP 59600, PTP 58600 and PTP 54600 Variants - Installation Wizard Confirm Configuration

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	169.254.0.0	
Use VLAN For Management Interfaces	No VLAN Tagging	
Telecoms Interface	None	
Target MAC Address	00:04:56:80:27:cb	
Master Slave Mode	Master	
Link Mode Optimization	IP Traffic	
TDD Synchronization Mode	Disabled	
Tx Max Power	25	dBm
Ranging Mode	Auto 0 to 40 km	
Platform Variant	Integrated Antenna	
Channel Bandwidth	15 MHz	
Link Symmetry	1:1	
Spectrum Management Control	Fixed Frequency	
Fixed Transmit Frequency	5736	MHz
Tx Color Code	B	
Fixed Receive Frequency	5736	MHz
Rx Color Code	A	
Installation Tones	Enabled	

[Confirm Configuration, Arm Installation Agent and Reboot]

◄◄ **Back**

Figure 71 - PTP 25600 Variant - Installation Wizard Confirm Configuration

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	169.254.0.0	
Use VLAN For Management Interfaces	No VLAN Tagging	
Telecoms Interface	None	
Target MAC Address	00:04:56:80:1e:59	
Master Slave Mode	Master	
Link Mode Optimization	IP Traffic	
TDD Synchronisation Mode	Disabled	
Tx Max Power	25	dBm
Ranging Mode	Auto 0 to 40 km	
Platform Variant	Integrated Antenna	
Frequency Band	Lower 2496-2568 MHz	
Channel Bandwidth	30 MHz	
Spectrum Management Control	i_DFS	
Lower Center Frequency	2513.00	MHz
Installation Tones	Disabled	

Confirm Configuration, Arm Installation Agent and Reboot

◄◄ Back

If the settings are correct and appropriate, click the "Confirm Configuration, Arm Installation and Reboot" button. The user will now be prompted to confirm the action (Figure 72).

Figure 72 - Reboot Confirmation Pop Up

http://169.254.1.1

? Are you sure you want to REBOOT this unit?

OK   Cancel
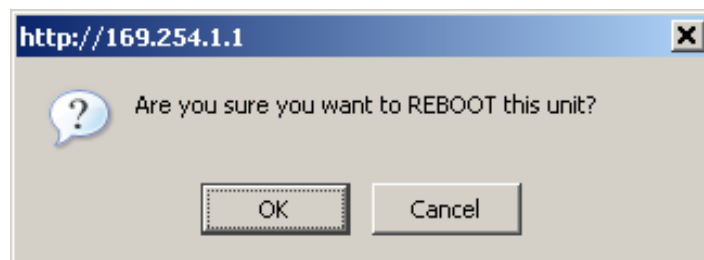
All the attributes are committed to non-volatile memory. Immediately following the write to nonvolatile memory the unit is reset.

NOTE: If you have changed the Ethernet parameters you must reconnect using the correct network and address settings.

8.3.4.5   Disarm

Step 5 of the installation wizard is the disarm phase.

Figure 73 – PTP 59600, PTP 58600 and PTP 54600 Variant - Disarm Installation

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	255.0.0.0	
Gateway IP Address	10.10.10.1	
Use VLAN For Management Interfaces	No VLAN Tagging	
Telecoms Interface	None	
Target MAC Address	00:04:56:80:4b:ae	
Master Slave Mode	Master	
Link Mode Optimisation	IP Traffic	
TDD Synchronization Mode	Disabled	
Tx Max Power	25	dBm
Ranging Mode	Auto 0 to 40 km	
Platform Variant	Connectorised	
Antenna Gain	23.0	dBi
Cable Loss	0.0	dB
EIRP	48.0	dBm
Channel Bandwidth	15 MHz	
Spectrum Management Control	i_DFS	
Lower Center Frequency	5838	MHz
Installation Tones	Disabled	

[Disarm Installation Agent]

◀◀ Back

Figure 74 - PTP 25600 Variant - Disarm Installation

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	169.254.0.0	
Use VLAN For Management Interfaces	No VLAN Tagging	
Telecoms Interface	None	
Target MAC Address	00:04:56:80:1e:59	
Master Slave Mode	Master	
Link Mode Optimization	IP Traffic	
TDD Synchronisation Mode	Disabled	
Tx Max Power	25	dBm
Ranging Mode	Auto 0 to 40 km	
Platform Variant	Integrated Antenna	
Frequency Band	Lower 2496-2568 MHz	
Channel Bandwidth	30 MHz	
Spectrum Management Control	i_DFS	
Lower Center Frequency	2513.00	MHz
Installation Tones	Disabled	

Disarm Installation Agent

◀◀ Back

Once Section 8.3.4.4 "Wireless Configuration" is complete pressing the "Disarm Installation Agent" button completes the installation process[19] and the audible installation tone will be switched off. If the installer wishes to modify the installation configuration then the 'Back' link can be used to access the installation wizard steps described above.

After disarming the wireless link the user is presented with one of two possible configuration pages, see Figure 75 and

Figure 76. The screen presents hyperlinks to the main configuration and spectrum management pages.

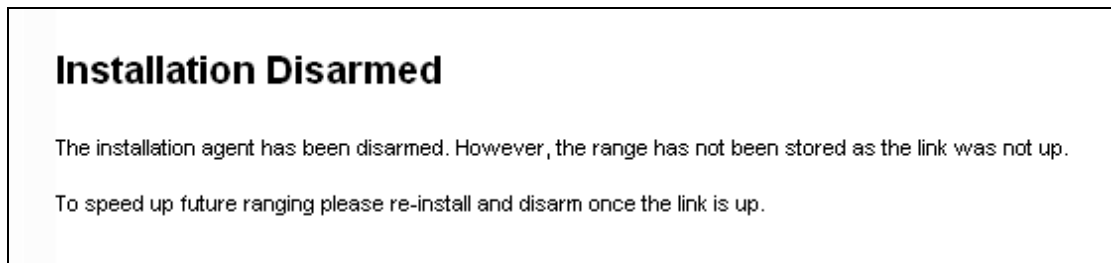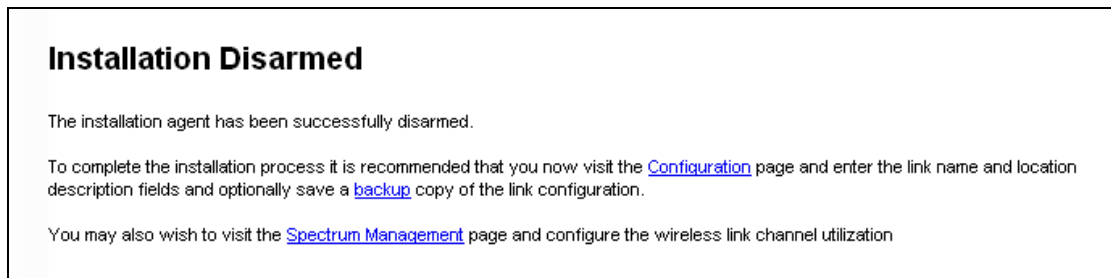**Figure 75 - Optional Post Disarm Configuration 1**

Figure 76 - Optional Post Disarm Configuration 2

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[19] The installation process is completed when both ends of the link are 'disarmed'.

After installation the system administrator may wish to modify the wireless units descriptive configuration (link name and link location). In addition the system administrator may wish to change the spectrum management configuration of the wireless unit, or look at the analysis of the 5.8 GHz spectrum to see if the automatic channel selection is appropriate for the system administrator's network. It is also recommended that a backup copy of the wireless units configuration is taken. Hyperlinks are provided on the post disarm page for ease of use.

8.3.5 Graphical Install

To aid the installation of wireless links two graphical installation aids have been introduced in this 600 Series system version.

- A PDA installation screen
- A larger installation screen available from the main HTTP management interface.

The design of the installation screen has been deliberately kept simple and uncluttered. An example of the installation screen is shown in Figure 77. Both the PDA and the large format installation screen have the same content and only differ in size. The PDA installation screen is 232 by 220 pixels to be compatible with the typical size of a PDA screen.

Figure 77 – Graphical Installation Screen
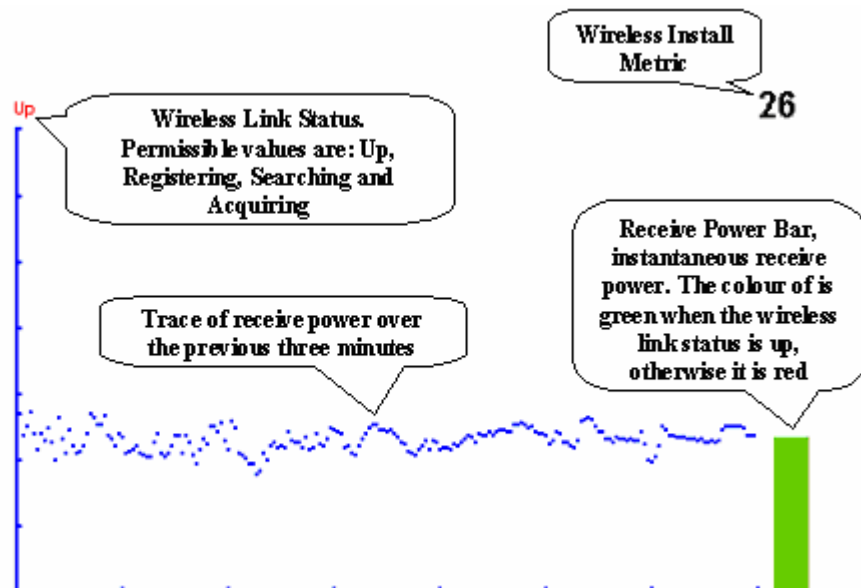
The screen displays the receive power over the last three minutes. This will allow the installer to slowly sweep the antenna during installation and monitor the variation in signal strength with angular position. The screen automatically refreshes every three seconds.

The screen also displays the current state of the wireless link in two ways. First, the actual state of the wireless link is written in the top left corner of the screen. The instantaneous receive power bar also encodes the state of the wireless link using green to signify that the wireless link is up and red for all other states.

For the more technically, aware the installation metric is simply the instantaneous receive power in dBm + 100.
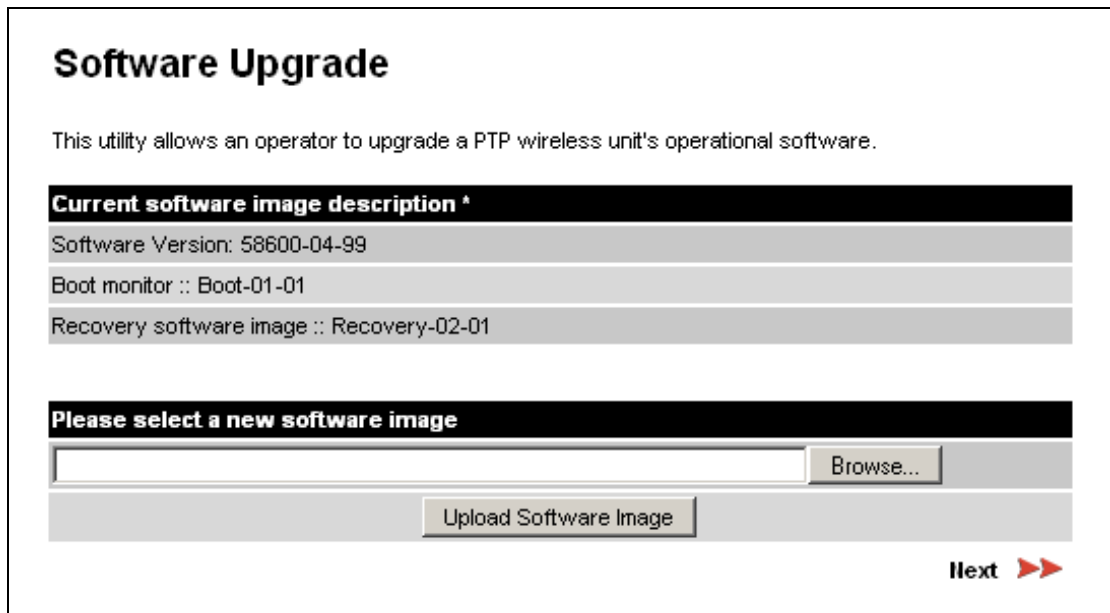
The PDA installation tool is accessed via a hidden URL http://<ip-address>/pda.cgi. It should be noted that this link is only available after the user has logged in as system administrator.

The large screen version of the graphical user interface is available as a submenu option of the installation wizard.

8.3.6   Software Upgrade

The 600 Series system has two software image banks; one is a fixed image which is stored in protected non-volatile memory and cannot be modified by the user. The second bank is used by the system administrator to upgrade the firmware when necessary. Figure 78 shows the main software upgrade web page.

Figure 78 - Software Upgrade

The 'Fixed' or 'Recovery' image is used by the System Administrator to:

- Reset Ethernet configuration to default settings
- Erase Configuration
- Upgrade software

For a full description of the Recovery image see Section 9 "Recovery Mode".

The software upgrade pages are used to update a unit's operational software. The software image to be uploaded should be downloaded to local storage from the Motorola web site. The software image is delivered by Motorola as a compressed zip file. Once the zip file has been downloaded, the user should extract the PTP 600 Series Software image, identifiable by its '.dld' file extension.

The first step (Figure 78) is to use the "Browse" button to locate the software image previously downloaded to local storage from the Motorola web site. Once the image is located, the user should press the "Upload image to wireless unit" button to start the software upgrade process[20].

The software image will now be uploaded to the unit. This upload should only take a few seconds. Once complete the image is verified and validated to ensure that no errors occurred during transfer and that the image is valid to run on the current platform. If there are any problems a warning screen will appear.

The unit being upgraded will now display information about the build it currently has stored in the image bank and the one that's just been uploaded. If the image is not the right one, the user has the option to go back and reload a new image. (See Figure 79)

Figure 79 - Software Upgrade Image Check
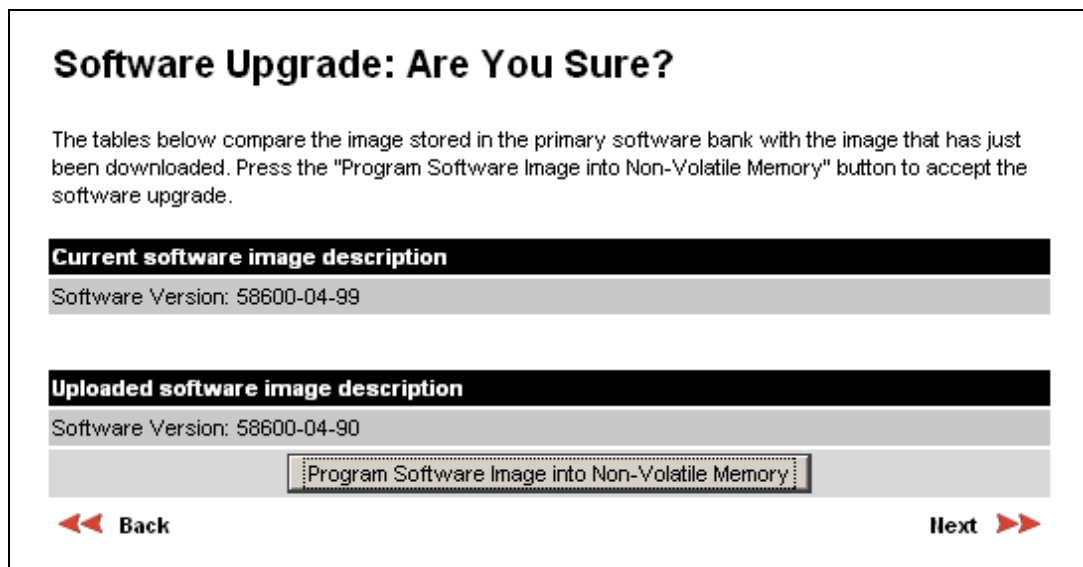
The user should ensure that the correct image is shown before pressing the "Program Software Image into Non-Volatile Memory" button. Once this button has been pressed the image is stored into non-volatile memory, this process can take up to 60 seconds and must not be interrupted.

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[20] During the software upgrade process, ensure that the remote end is upgraded first using the wireless connection and then the local end can be upgraded.

⚠️ **CAUTION:** If the upgrade process is interrupted during the erasure of the image bank, or during the reprogramming of the image bank, the image bank will be left in a corrupt state. If this occurs the software must be reloaded. All software images that are stored in non-volatile memory are protected via the use of CRCs. If the software detects an invalid CRC the image bank is marked as 'corrupt' and the 600 Series bridge boot code will boot the fixed software image. If this occurs the user must attempt to reload the correct version of software.

During the write process the progress of the upgrade is displayed on the progress tracking page (Figure 80). The upgrade process should not be interrupted. Interruption of this process can result in a corrupt main software image, which will result in the recovery image been booted at the next reset cycle.

Figure 80 - Software Download Progress Indicator
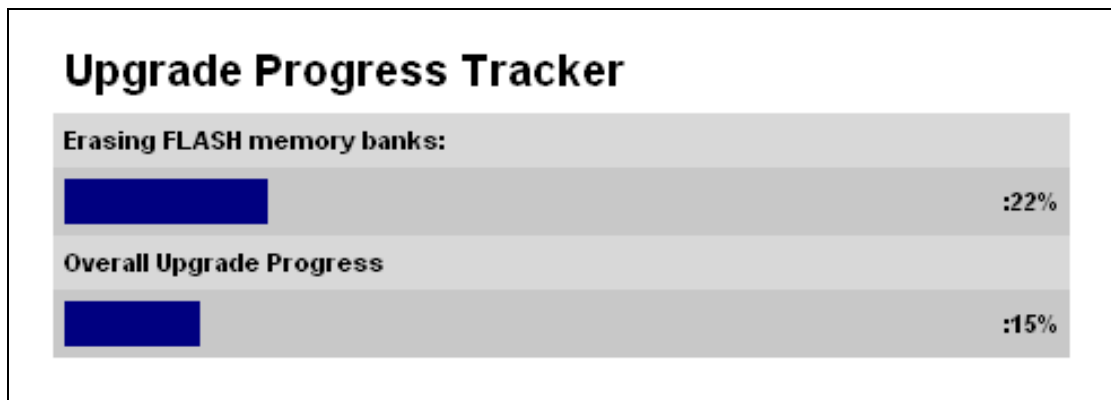
Figure 81 - Software Upgrade Complete
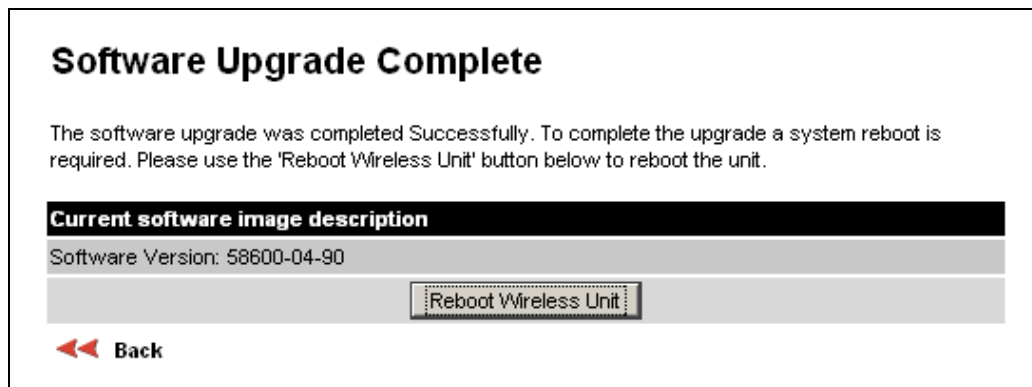
When the software image has been written to non-volatile memory Figure 81 will be displayed showing the status of the software upload.

Reboot the unit by clicking the "Reboot Wireless Unit" button. You will be asked to confirm this action as shown in Figure 82.

Figure 82 - Reboot Confirmation Pop Up
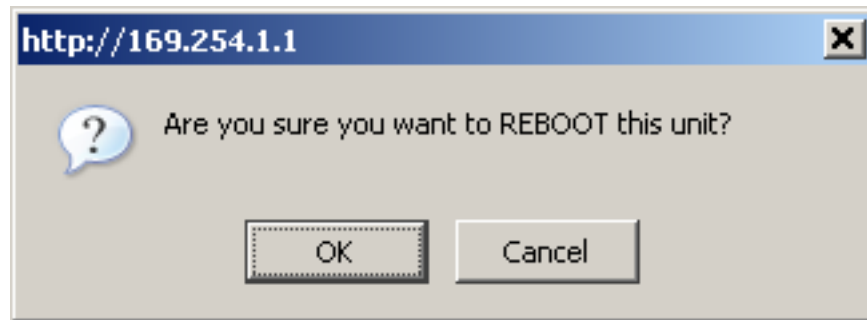
This will reboot the unit, taking up to 120 seconds. During this time you will not be able to communicate with the unit.

If you cannot communicate with the unit after 120 seconds, this could indicate a problem with the memory update process. Under these circumstances the user should enter "Recovery Mode", see Section 9 "Recovery Mode".

After the reboot the user should check that the required software image is loaded and running.

NOTE: Please ensure that you are upgrading the correct units. Units cannot be downgraded.

8.3.7 Spectrum Management

Spectrum Management Selection is the PTP 600 Series Bridge feature that monitors the available wireless spectrum and directs both ends of the wireless link to operate on a channel with a minimum level of co-channel and adjacent channel interference.

8.3.7.1 Wireless Channels

The PTP 600 Series Bridge operates using a set of predefined overlapping channels. There are a different number of channels, depending on the raster mode selected. Each channel occupies 30 MHz, 15 MHz, 10 MHz or 5 MHz of wireless spectrum and is offset in center frequency from its neighboring channel by 10 MHz or 6 MHz. It is important to note that adjacent channels on the Spectrum management display have a 10 MHz or 6 MHz overlap to the adjacent channel.

The default channelization can be modified by varying the lower center frequency attribute in the installation wizard - see Section 8.3.4.4 "Wireless Configuration". See Section 5.4 "Variable Channel Bandwidth Operation" and 5.9 "PTP 58600 Specific Frequency Planning Considerations" for more detail.

8.3.7.2 Spectrum Management Measurements

The 600 Series Bridge performs two mean signal measurements per TDD cycle, per channel. This mean measurement represents the mean received signal power for the 40 microseconds measurement period.

The Spectrum Management algorithm collects measurements equally from all channels. This process is called the Channel Availability Check (hereafter referred to by the acronym CAC). The CAC uses a round-robin channel selection process to collect an equal amount of measurements from each channel. It is important to note that the CAC measurement process is not altered by the channel barring process. Measurements are still collected for all channels irrespective of the number of barred channels.

8.3.7.3 Measurement Analysis

Spectrum Management uses statistical analysis to process the received peak and mean measurement. The statistical analysis is based on a fixed, one minute, measurement quantization period. Spectrum Management collects data for the specified quantization period and only at the end of the period is the statistical analysis performed.

The analysis produces three key metrics for each channel:

- Peak of Means
- 99.9% Percentile of the Means
- Mean of Means

Peak of Means is the largest mean interference measurement encountered during the quantization period. The peak of means is similar to the peak of peaks and is useful for detecting slightly longer duration spikes in the interference environment.

99.9% Percentile of the Means is the value of mean interference measurement which 99.9% of all mean measurements fall below, during the quantization period. The 99.9% percentile metric is useful for detecting short duration repetitive interference that by its very nature has a minimal effect of the mean of means.

Mean of Means is the arithmetic mean[21] of the measured means during a quantization period. The mean of means is a coarse measure of signal interference and gives an indication of the average interference level measured during the quantization period. The metric is not very good at predicting intermittent interference and is included to show the spread between the mean of means, the 99.9% percentile and the peak of means.

NOTE: Spectrum Management uses the 99.9% percentile as the prime interference measurement. All subsequent references to interference level refer to this percentile measurement.

The display of statistical measurement on the spectrum management page always shows a statistical summary of all channel measurement. The statistical summary is controlled by the Statistics Window attribute. This attribute defaults to a value of twenty minutes, which means that the mean and percentile values displayed for each channel are calculated over the 20 minute period. All channel decisions are made using the values computed over the statistics window period.

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[21] The arithmetic mean is the true power mean and not the mean of the values expressed in dBm.

8.3.7.4 The Spectrum Management Master / Slave Relationship

The Spectrum Management operates in a master / slave relationship. The master is assumed to be the link master configured during installation. All Spectrum Management configuration changes MUST be performed from the master. To enforce this, the Spectrum Management web page has a different appearance depending if you are viewing the data from the master or slave.

All configuration changes are applied at the master only. These changes are then messaged from the master to the slave. Any Spectrum Management configuration messages received at the slave are stored in non-volatile memory. This enables both master and slave to keep identical copies of Spectrum Management configuration data in their non-volatile memories. It is therefore possible to swap master and slave roles on an active Point-to-Point link without modifying Spectrum Management configuration.

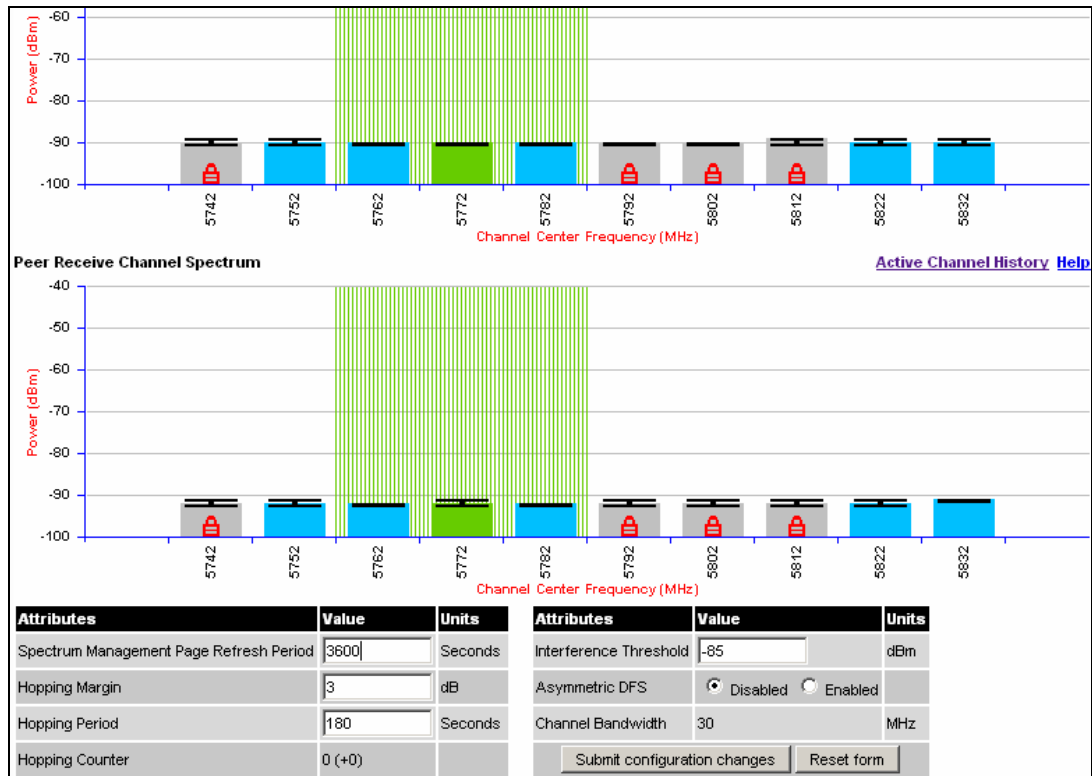**Figure 83 - Spectrum Management as seen from the Master**

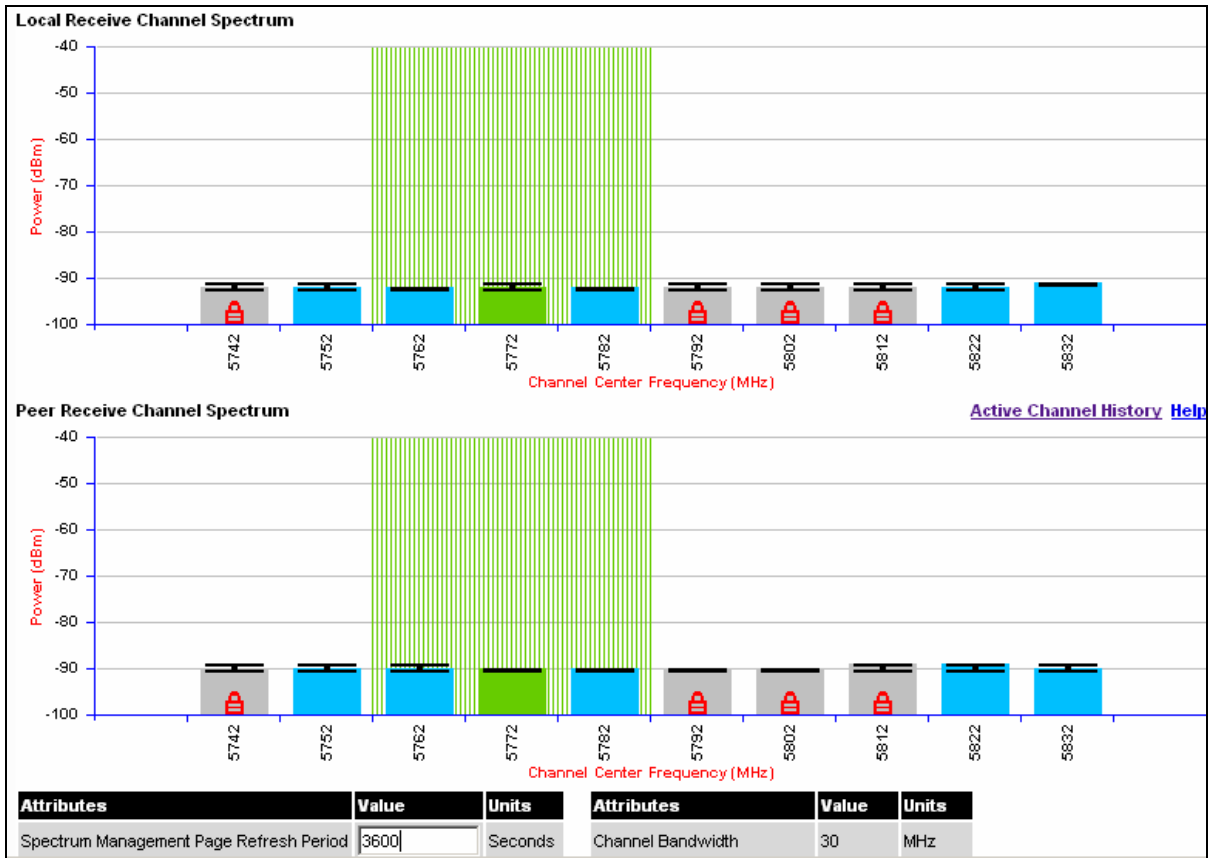**Figure 84 - Spectrum Management as seen from the Slave**

Figure 83 shows an example Spectrum Management webpage as seen from the master.

Figure 84 shows an example Spectrum Management webpage as seen from the slave. It should be noted that the key configuration attributes are not available on the slave web page.

8.3.7.5 Spectrum Management Configuration

The following section describes the user modifiable configuration accessible from the Spectrum Management webpage. It is recommended that the default values are maintained. If the user believes that the performance of the Spectrum Management algorithm requires some modifications this should only be done after consulting your Motorola Point-to-Point distributor or one of the system field support engineers.

Page Refresh Period: The page refreshes automatically according to the setting entered here (in seconds).

Hopping Margin: Spectrum Management uses this margin when making a channel hop decision. The target channel has to have an interference level 3 dB (default) better than the current active channel.

Hopping Period (not configurable): The Spectrum Management algorithm evaluates the metrics every 'Hopping Period' seconds (180 seconds by default) looking for a channel with lower levels of interference. If a better channel is located, Spectrum Management performs an automated channel hop. If SNMP or SMTP alerts are enabled an SNMP TRAP or an email alert is sent warning the system administrator of the channel change.

Hopping Counter: is used to record the number of channel hops. The number in the "(+)" brackets indicates the number of channel changes since the last screen refresh.

Interference Threshold: Spectrum Management uses the interference threshold to perform instantaneous channel hops. If the measured interference on a channel exceeds the specified threshold, then iDFS will instruct the wireless to immediately move to a better channel. If a better channel cannot be found the 600 Series Bridge will continue to use the current active channel. (Default –85 dBm)

Asymmetric DFS: The default configuration of symmetric operation constrains the link to operate symmetrically, using the same transmit and receive channels. When in symmetric mode the slave unit will always follow the master. If the master moves to a new channel the slave will hop to the same channel. When the Point-to-Point link is configured as an asymmetric link both the master and slave are free to select the best channel from their own set of local interference metrics.

Channel Bandwidth (not configurable): shows the value of the variable channel bandwidth selected.

8.3.7.6   Barring Channels

Channels can only be barred / unbarred by the system administrator from the master Spectrum Management web page. The barring / unbarring operations are disabled on the slave web page. If an attempt to bar / unbar a channel is made at the slave, a warning dialog is generated.

Barring/Unbarring of channels is performed by clicking the appropriate channel on the local or peer channel spectrum plots on the master web page. Each bar / unbar attempt will be proceeded by a confirmation dialog. It should be noted that the channel bar will take effect immediately and is not related to the measurement quantization period.

8.3.7.7   Master and Slave Channel Spectrum Graphics

Spectrum Management presents its computed statistical measurements in a graphical display on both the master and slave Spectrum Management web page.

Figure 85 - Example Spectrum Management Graphic
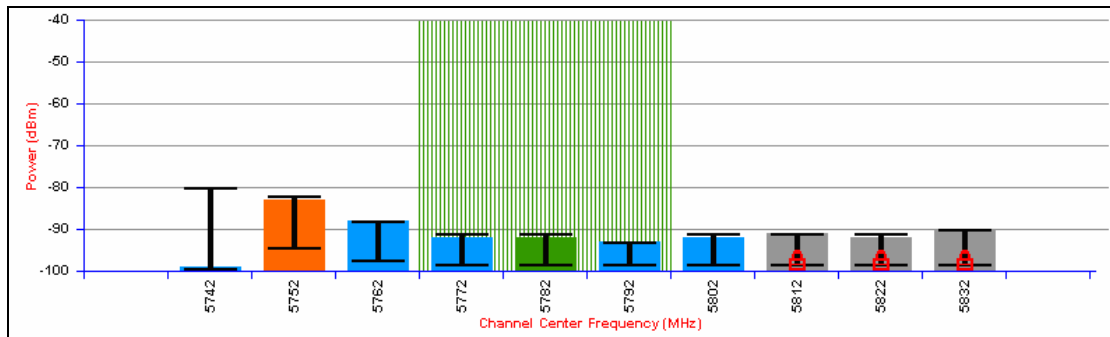
The X-axis shows a stylized view of the 9 or 10 selectable wireless channels. It is important to note that adjacent channels on the display have a 10 MHz overlap. The display separates the display of channels to help the clarity of the resultant display. The axis is labeled using the channel center frequencies in MHz.

The Y-axis shows the interference power levels from –100 to –40 dBm.

The active channel (channel 5 in Figure 85) is always marked using hatched green and white lines. The width of the hatching is directly proportional the channel bandwidth spectral occupancy of the channel.

The individual channel metrics are displayed using a colored bar and an 'I' bar.

The colored bar represents the following channel state:

Table 28 - Spectrum Management change state key

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. For improved visibility, an additional red 'lock' symbol is used to indicate that a channel is barred.

The top of the colored bar represents the 99.9% percentile metric for specific channel.

The 'I' Bar is used to display the mean of means and peak of means metrics. The lower horizontal bar represents the mean of means and the upper horizontal bar represents the peak of means. The vertical bar is used as a visual cue to highlight the statistical spread between the peak and the mean of the statistical distribution.

8.3.7.8   Active Channel History

The active channel history is a time series display of the channels used by the PTP 600 Series Bridge over the last 25 hours. The active channel history is activated from the main Spectrum Management page using the 'Active Channel History' hyperlink. An example of the active channel history display is shown in Figure 86. Where there are parallel entries on the display this signifies that the wireless link occupied this channel during the measurement period. The measurement periods are one minute (from zero to sixty minutes) and twenty minutes from (60 minutes to twenty five hours).

Figure 86 - Active Channel History Screen
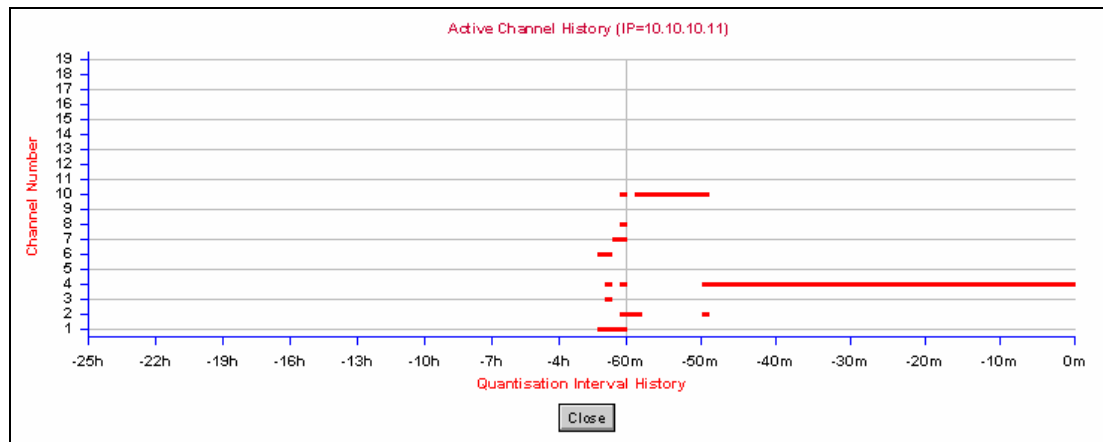
8.3.7.9 Viewing Historic Spectrum Management Metrics

Spectrum Management allows the system administrator to view the results of previous measurement quantization periods. Holding down the shift key and clicking the appropriate channel on the local channel spectrum plots activates this feature. This feature is available on both the master and slave web page.

Figure 87 - Spectrum Management Time Series Plot
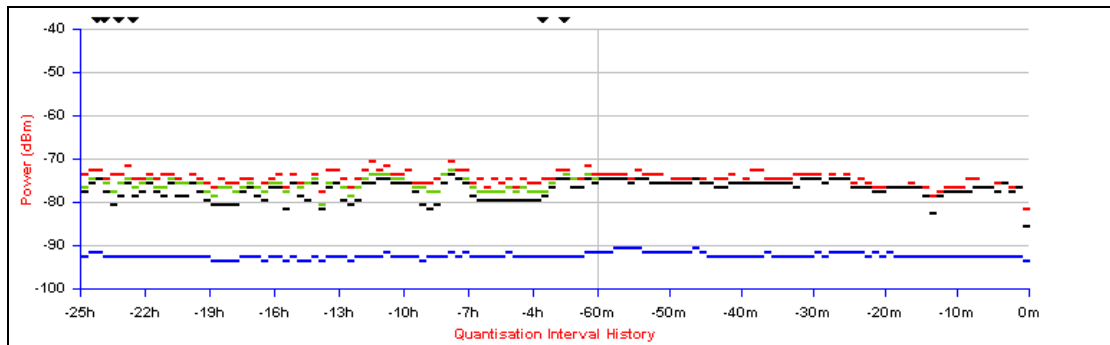
Figure 87 shows an example time series plot. A time series plot displays the previous 132 measurement quantization periods. If the PTP 600 Series Bridge has not been running for 132 quantization periods then only the number of measurement quantization periods that are available are displayed.

Table 29 - Spectrum Management Time Series Key

GREEN	Peak of Means interference measurement
BLACK	99.9% percentile of means interference measurement
BLUE	Mean of Means interference measurement

8.3.8   Spectrum Management (Fixed Frequency)

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 "Wireless Configuration"). 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 88. 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 88 - Spectrum Management Fixed Frequency Screen
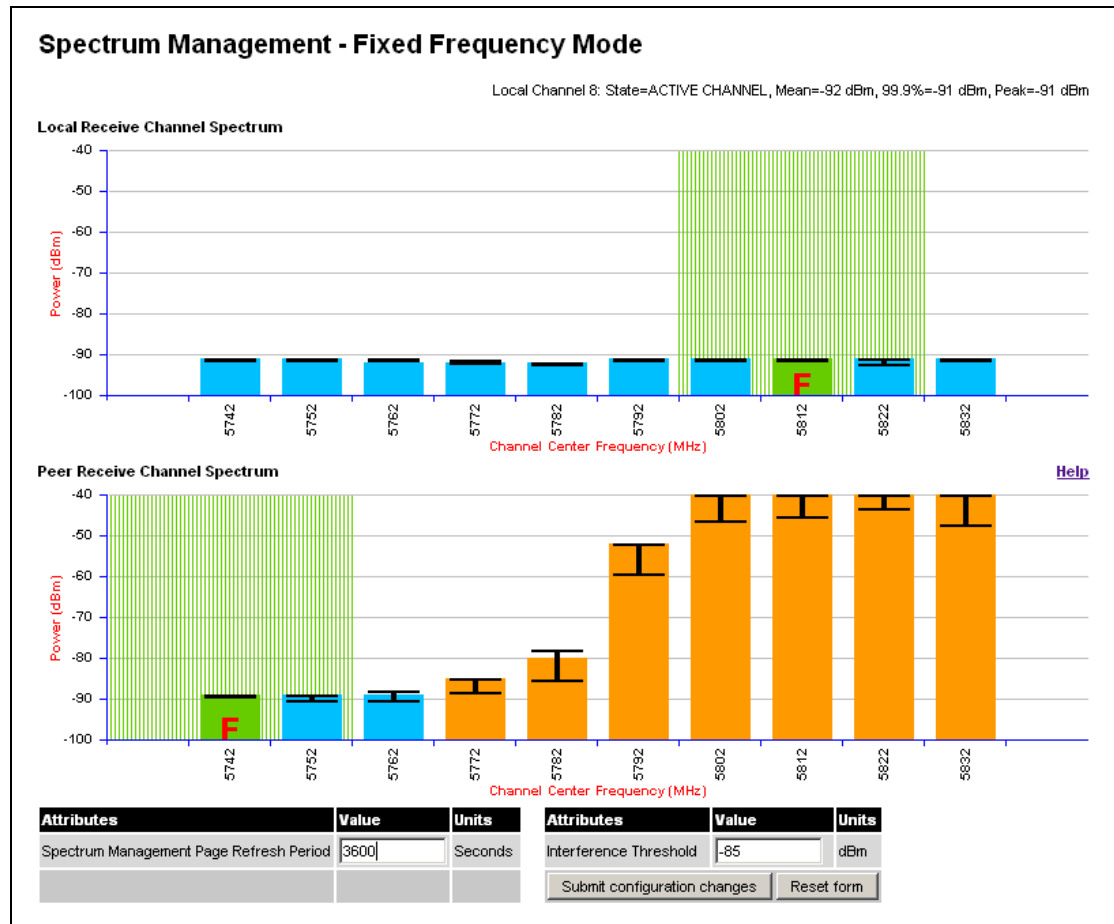

Channel barring is disabled in fixed frequency mode; it is not required as dynamic channel hopping is prohibited in this mode.

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 89 - Spectrum Management Help Page (Fixed Frequency)
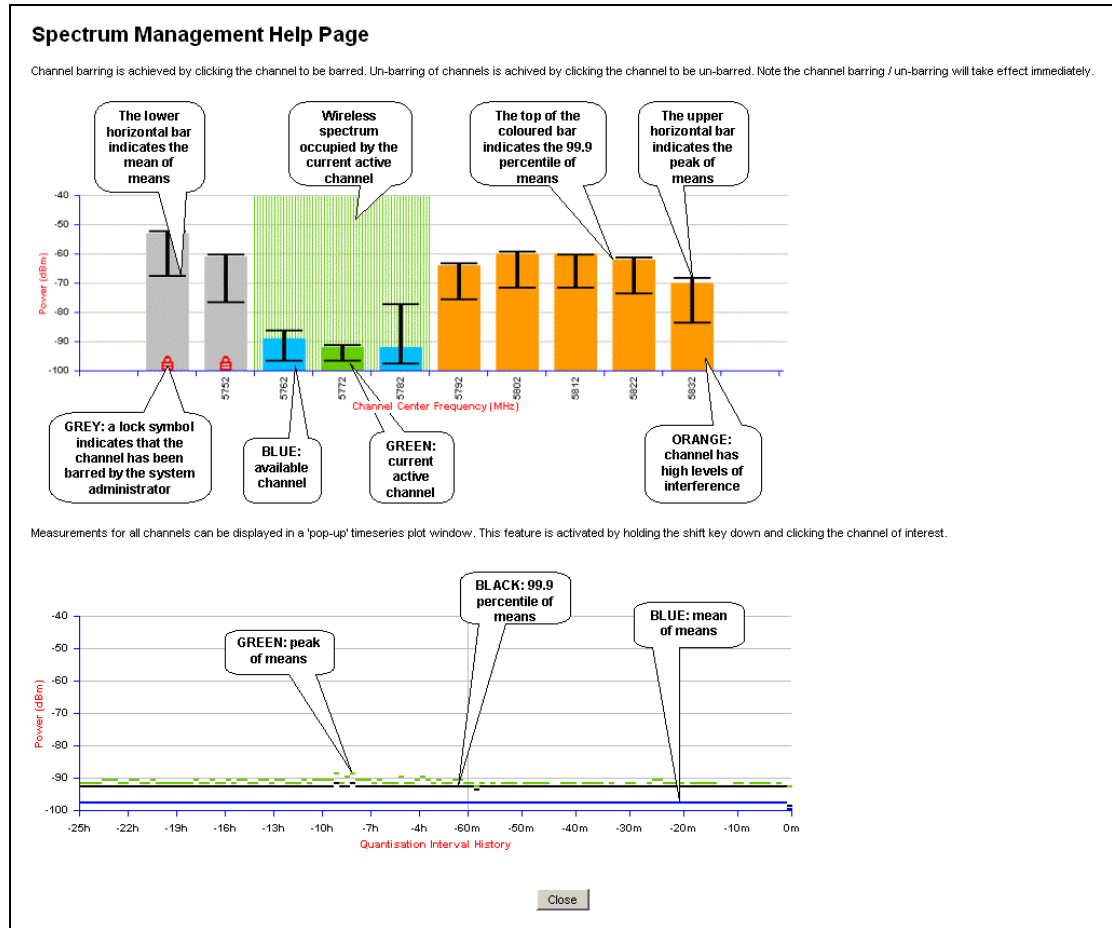
8.3.9 Spectrum Management Control - With Operational Restrictions

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 90 and Figure 91.
- 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 90.

- Extra color coding of the interference histogram is provided. See Table 30.

When operating with RTTT (Road transport and Traffic Telematics) 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 90 and Figure 91. 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 90 - Spectrum Management Master Screen With Operational Restrictions
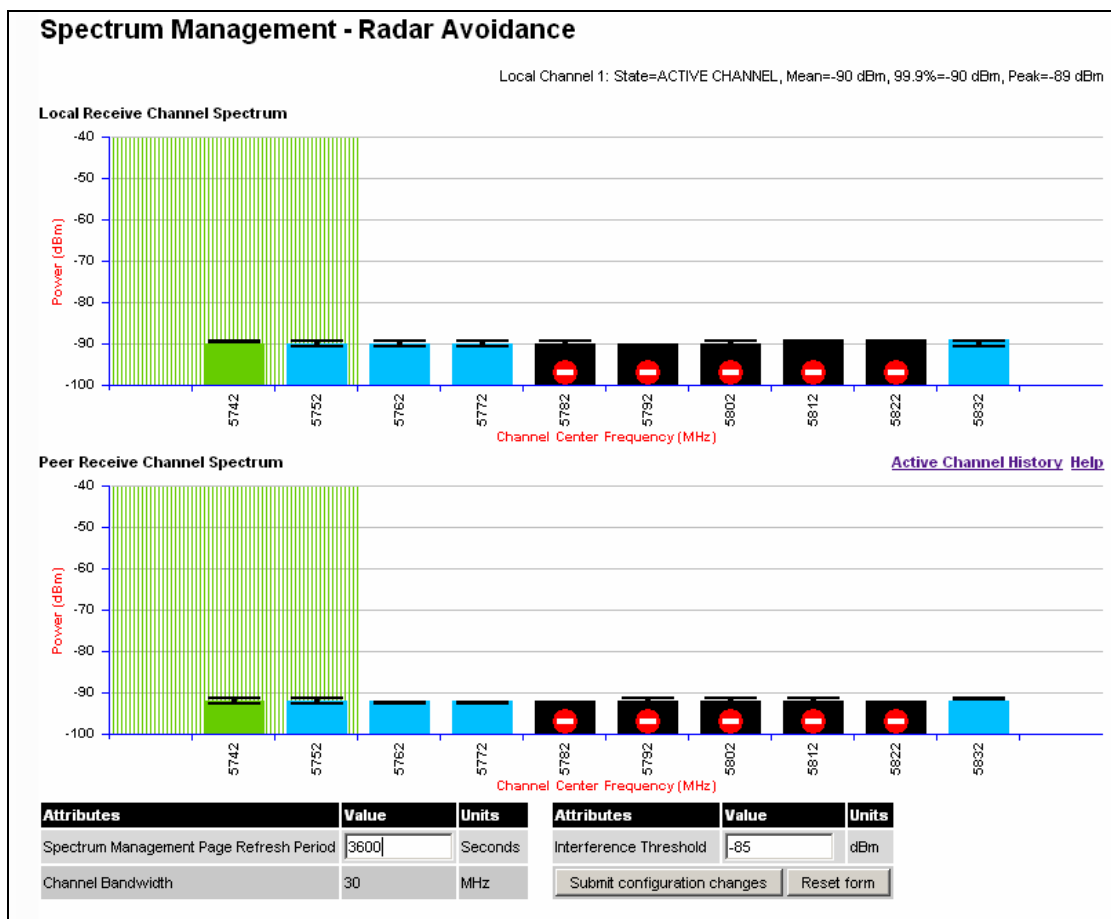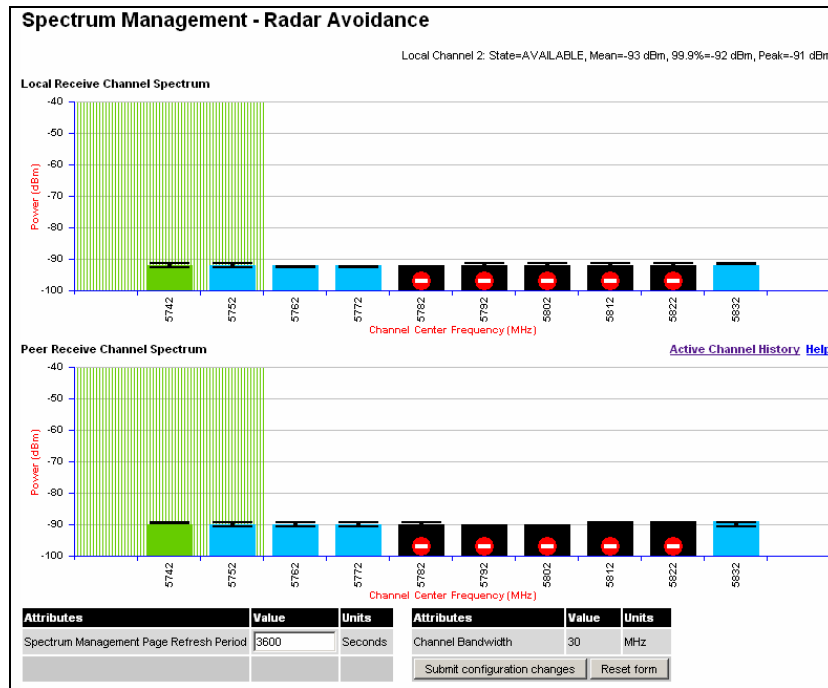
Figure 91 - Spectrum Management Slave Screen With Operational Restrictions

The colored bar represents the following channel state:

Table 30 - Spectrum Management Change State Key With Operational Restrictions

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 and the channel is unavailable for 30 minutes. At the end of the 30 minute period a Channel Availability Check is required to demonstrate no radar signals remain on this channel before it can be used for the radio link.

Region Bar	Region Bar	This channel has been barred from use by the local region regulator

8.3.10 Spectrum Management – Example of PTP 25600 Product variant

As described in Section 5.5 "PTP 25600 Specific Frequency Planning Considerations", the PTP 25600 product variant can operate in three frequency bands. Figure 92 shows an example of a Lower Band with a 30 MHz channel bandwidth.

Figure 92 - PTP 25600 Example of Spectrum Management Page
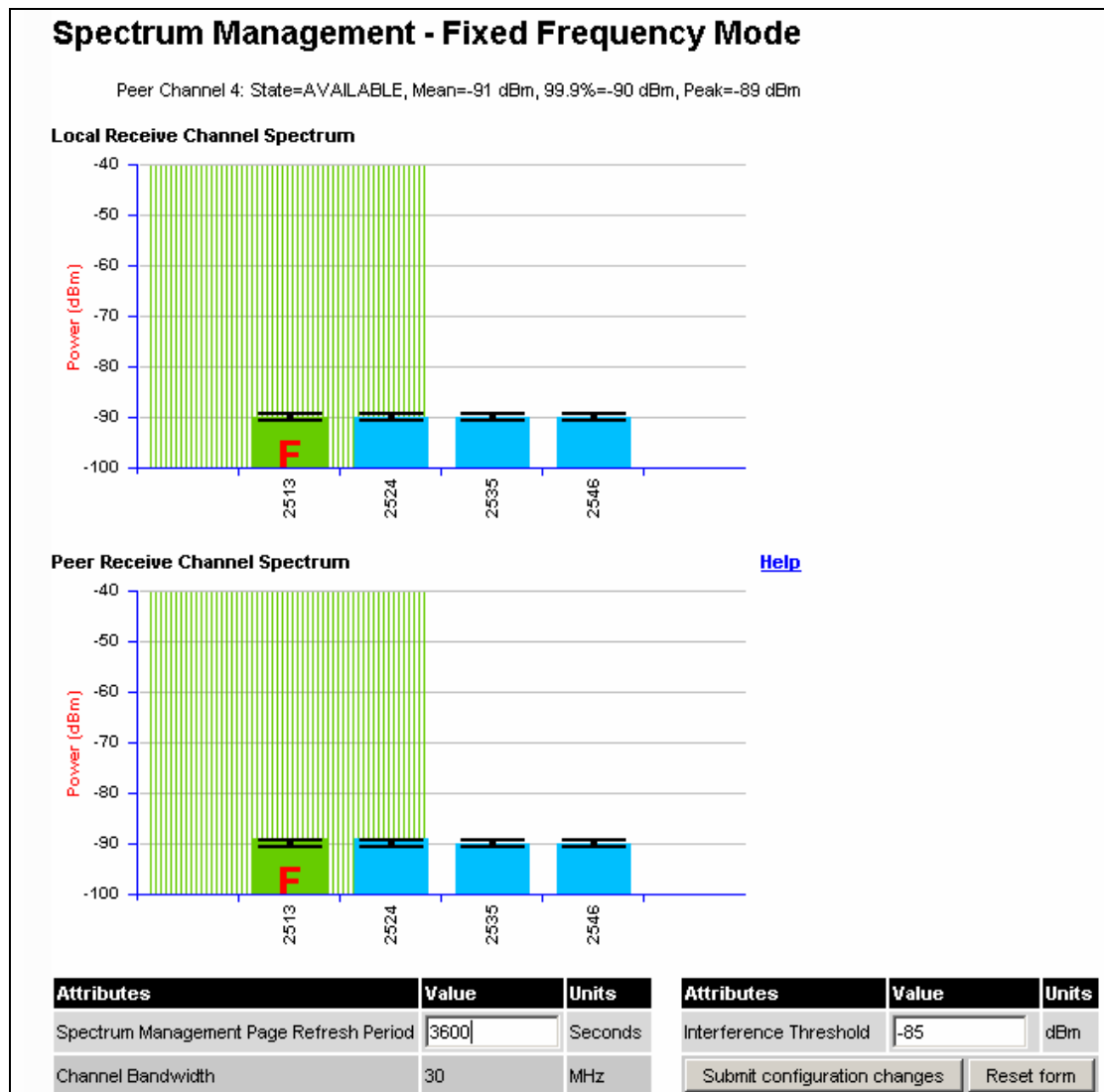
8.3.11 Remote Management Page

The Remote Management page (Figure 93) allows the system administrator to configure the remote management of the PTP 600 Series Bridge.

Figure 93 - Remote Management

8.3.11.1 Control Access to HTTP Interface

The attribute **HTTP Access Enabled** allows a user to stop any access to a unit via the web interface. The default value for this control is set to "yes", which means that the unit can be accessed using the web interface. If the option "No" is selected, then a warning is displayed as shown in Figure 94.

8.3.11.2 Control Access to Telnet Interface

The attribute **HTTP Telnet Enabled** allows a user to stop any access to a unit via the telnet interface. The default value for this control is set to "yes", which means that the unit can be accessed using the telnet interface[22].

8.3.11.3 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.

8.3.11.4 Supported Management Information Bases (MIBS)

The PTP 600 Series Bridge SNMP stack currently supports the following 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

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[22] If HTTP, Telnet and SNMP interfaces have been disabled, then the user needs to use the Recovery image to reset IP & Ethernet Configuration back to factory defaults to re-enable the HTTP-Telnet interfaces. SNMP can also be used to re-enable the other interfaces if SNMP is enabled.

SNMP TRAPs supported:

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

Figure 94 – Warning when disabling HTTP interface
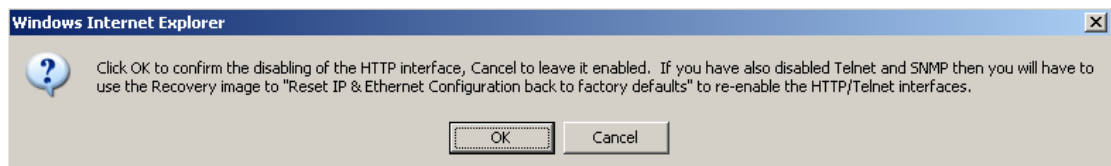
8.3.11.5 Diagnostics Alarms

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 "Home Page Alarm Display" 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 95. Users can access the sub-menu "Diagnostic Alarms" to modify the alarms selected.

Figure 95 - Remote Management - Diagnostic Alarms

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

8.3.11.6 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.

8.3.11.7 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 to log into the SMTP server. 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.

8.3.11.8 SNTP (Simple Network Time Protocol)

The SNTP client allows the 600 Series 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.

8.3.11.9 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 93, 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.8.3.11.9 "Setting the clock".

Daylight Saving: See Section 8.3.11.9 "Setting the clock"

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 earlier releases of the software, that is data is stored for one hour at a resolution of one second. Previously, 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 96.

Figure 96 - Diagnostic Plotter
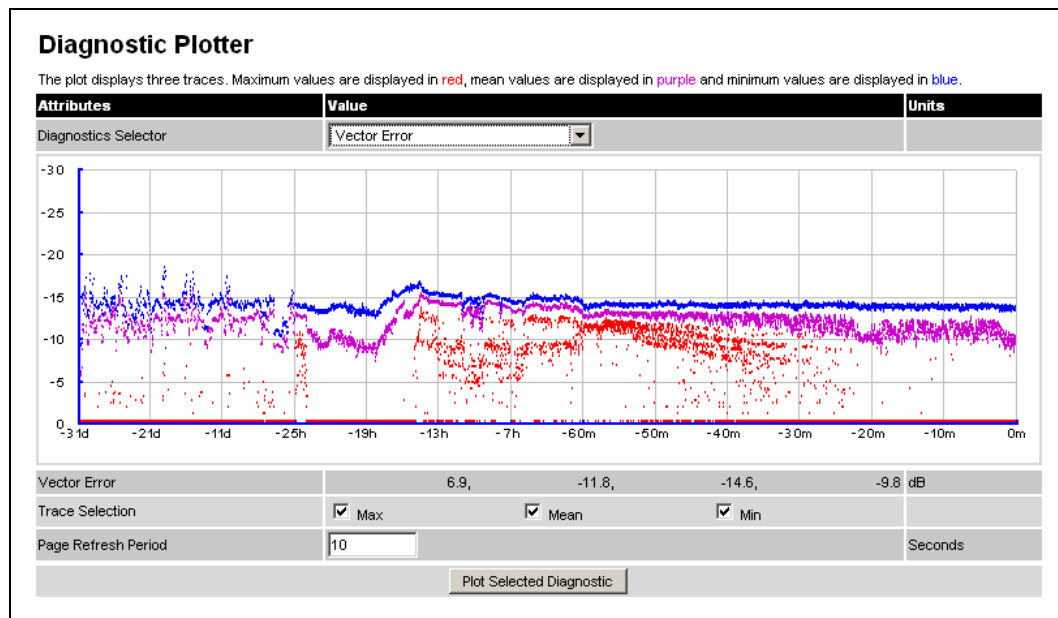
The diagnostic plotter allows the system administrator to view the cascading histogram data in an easily accessible graphical form. The plot always displays three traces, maximum, minimum and mean by default. The diagnostic selector allows the user to select the various categories of histogram.

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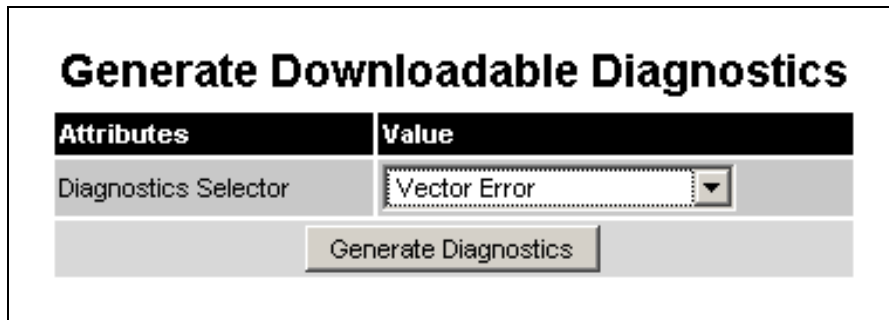
The trace selection allows the user to control which traces are plotted.

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 97 - 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 entries. These 5784 entries comprise 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 98) is used to change the password for the system administration (The factory default is blank).

Figure 98 - 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 99 shows a sample license key data entry page.

Figure 99 - 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 100: License Key reboot Screen

The user will then be asked to confirm the reboot (Figure 101).

Figure 101 - Reboot Confirmation Pop Up
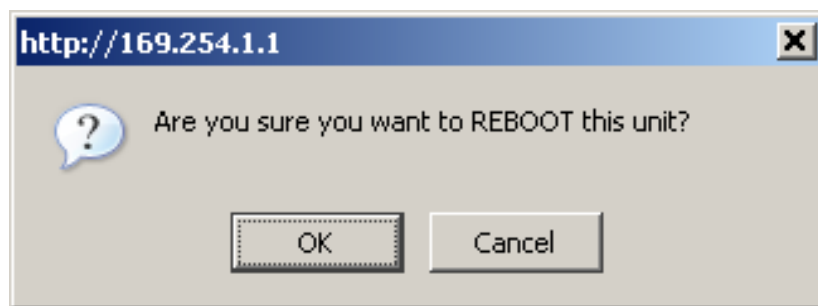
8.3.15 Properties

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

Figure 102 – 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 HTTP 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.
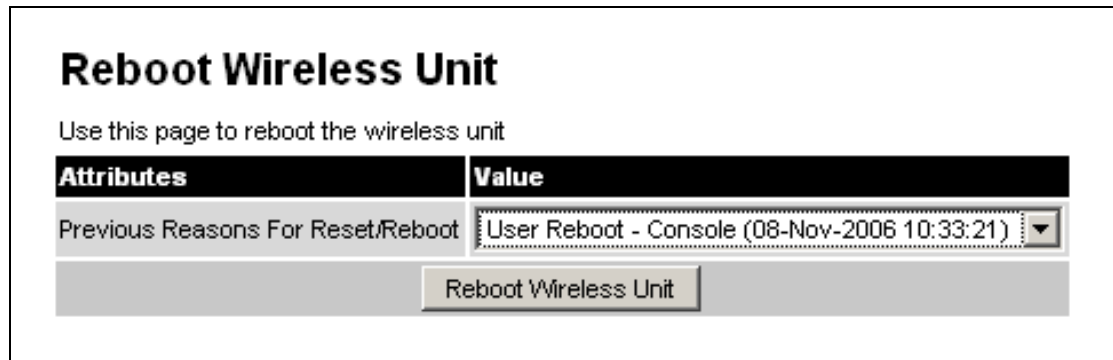
Use Long Integer Comma Formatting Changes the format of long integers from 1000000 to 1,000,000.

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 103 - System Reboot

Figure 104 - Reboot Confirmation Pop Up
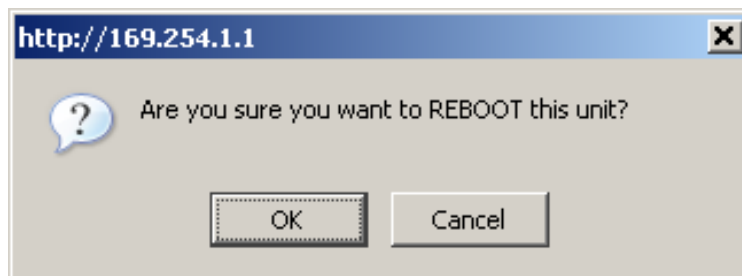
9   Recovery Mode

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 "PIDU Plus – PTP 600 Series Bridge" 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 (following the release of the Recovery switch).
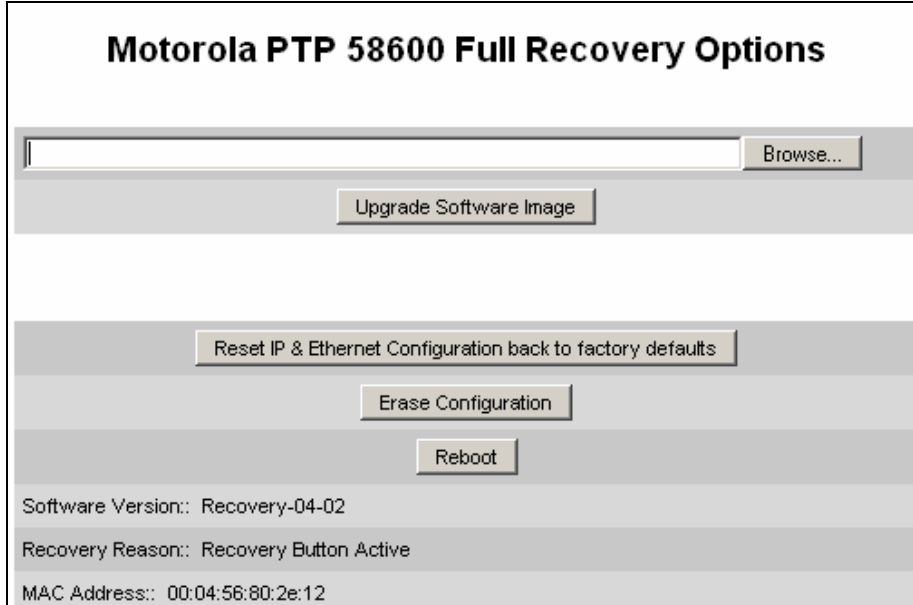
When in recovery mode the user will be able to access the unit via the Ethernet interface. The Ethernet interface will have its IP address set to 169.254.1.1 (or 10.10.10.10 see section 7.7.10 "Powering Up"). On connection to a unit in recovery mode the following screen is displayed (Figure 105):

Figure 105 - Recovery Mode Warning Page
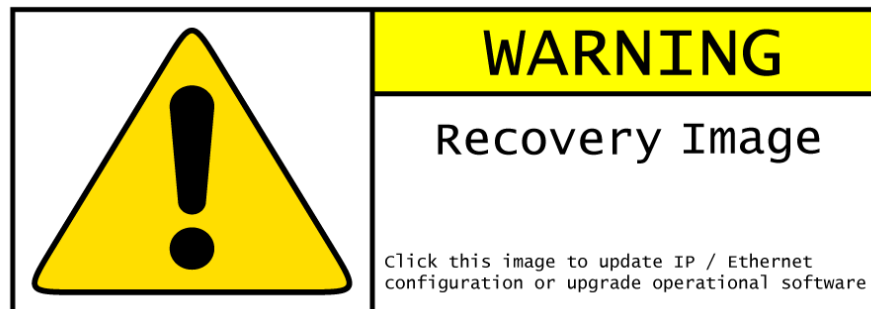
Clicking on the warning page image will take the user on to the Recovery Option Page (Figure 106).

Figure 106 - 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 106) 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 107).

Figure 107 - Software Download Progress Indicator Page
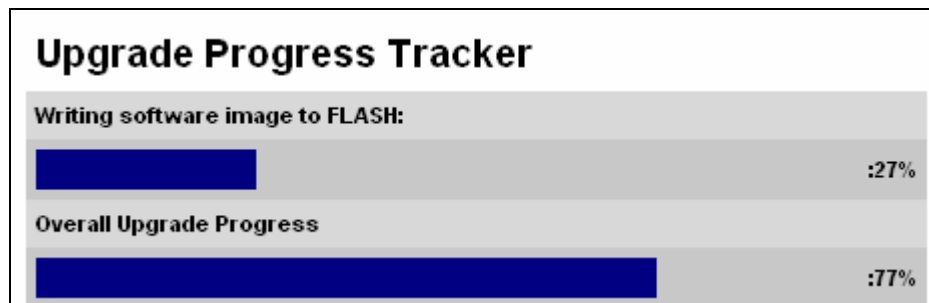
When the download is complete a page is displayed indicating the status of the software download (Figure 108).

Figure 108 - 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 109).

Figure 109 - Reboot Confirmation Pop Up
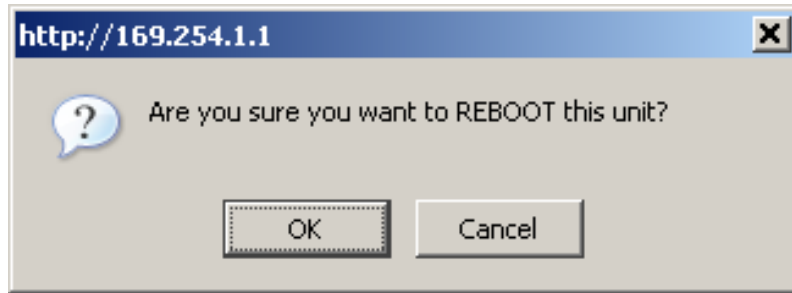
The unit will now reboot. Providing the unit configuration is still intact the unit should restart in normal operational mode and the link should recover. Should the unit or link fail to recover the user should refer to Section 10 "Fault Finding".

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 106). The user will now be presented with a pop up box asking them to confirm the action (Figure 110).

Figure 110 - Confirm Reset to Factory Default Pop Up
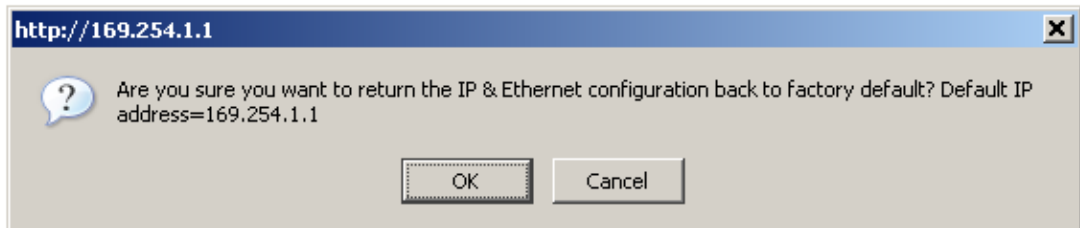
On confirmation the following page will be displayed (Figure 111). The user should now reboot the unit by pressing the "Reboot" button.

Figure 111 - IP and Ethernet Erased Successfully page
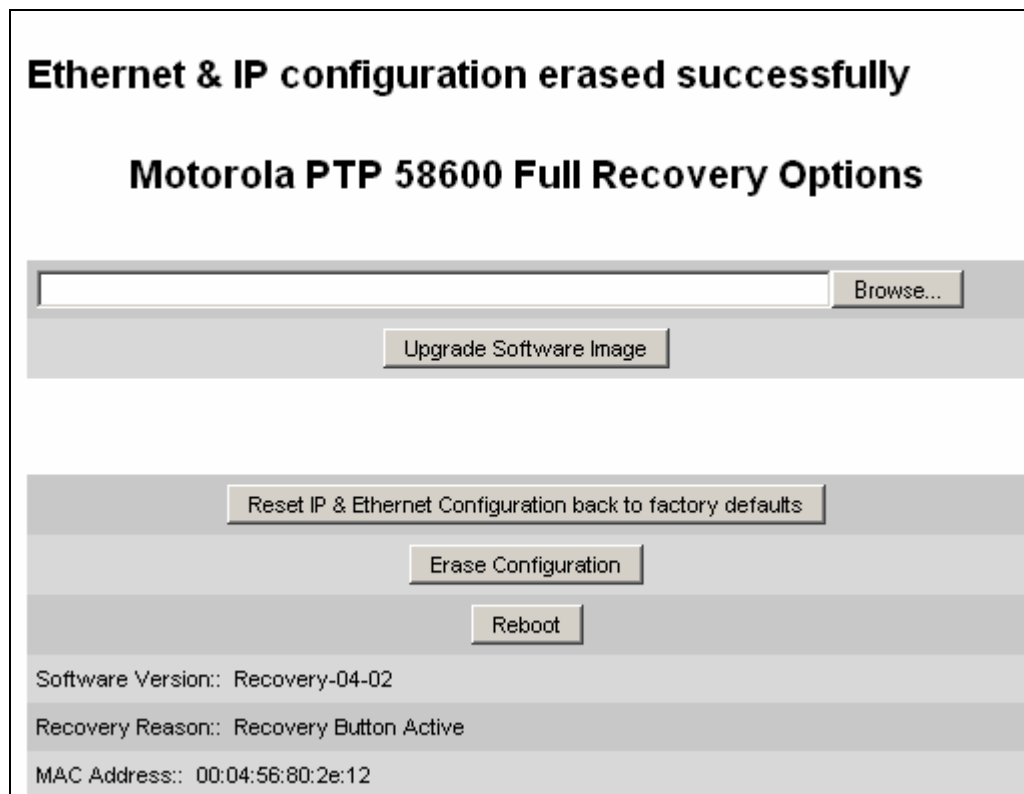
The user will now be presented with a pop up box asking them to confirm the action (Figure 112).

Figure 112 - Reboot Confirmation Pop Up
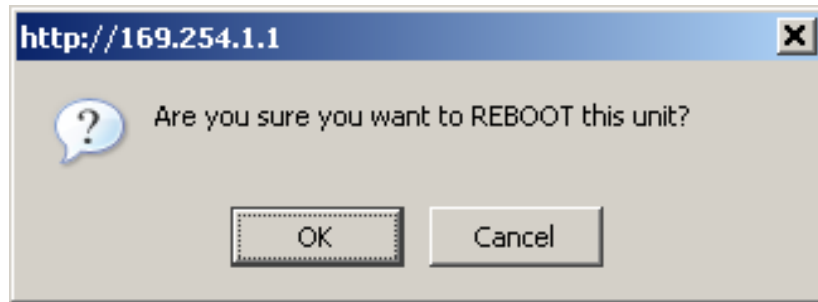
The unit will now reboot. The unit should now start up in normal mode but with the IP address set to 169.254.1.1 and the Ethernet interface set to auto-negotiate and auto-MDI/MDIX. Should the unit fail to start up the user should refer to Section 10 "Fault Finding".

9.3   Erase Configuration
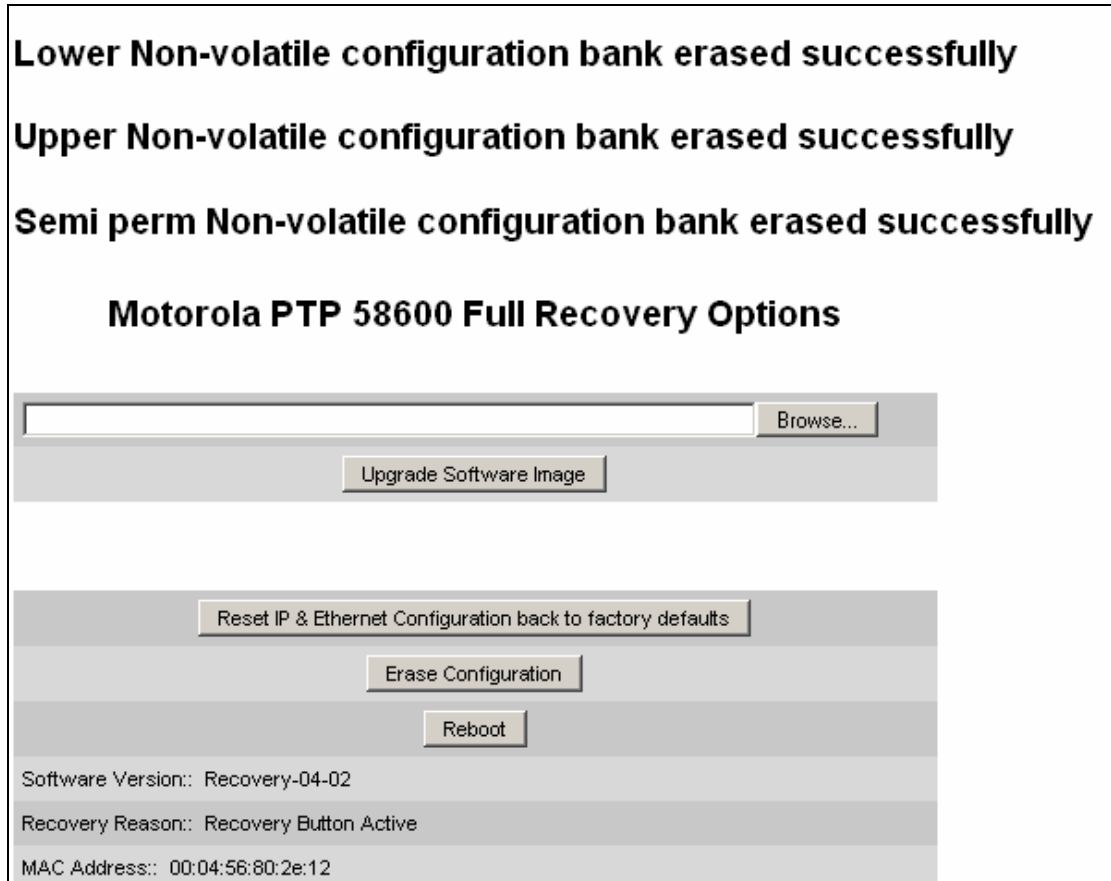
To erase the unit's configuration the user should press the "Erase Configuration" button on the "Recovery Options" page (Figure 106). The user will now be presented with a pop up box asking them to confirm the action (Figure 113).

Figure 113 - Confirm Erase Configuration Pop Up
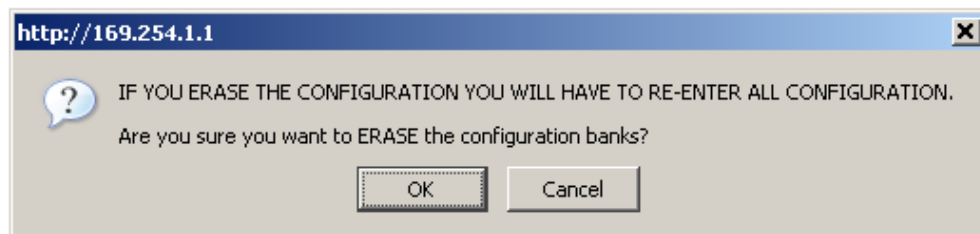
On confirmation the following page will be displayed (Figure 114). The user should now reboot the unit by pressing the "Reboot" button.

Figure 114 - Erase Configuration Successful Page

The user will now be presented with a pop up box asking them to confirm the action (Figure 115)

Figure 115 – Erase Configuration - Reboot Confirmation Pop Up
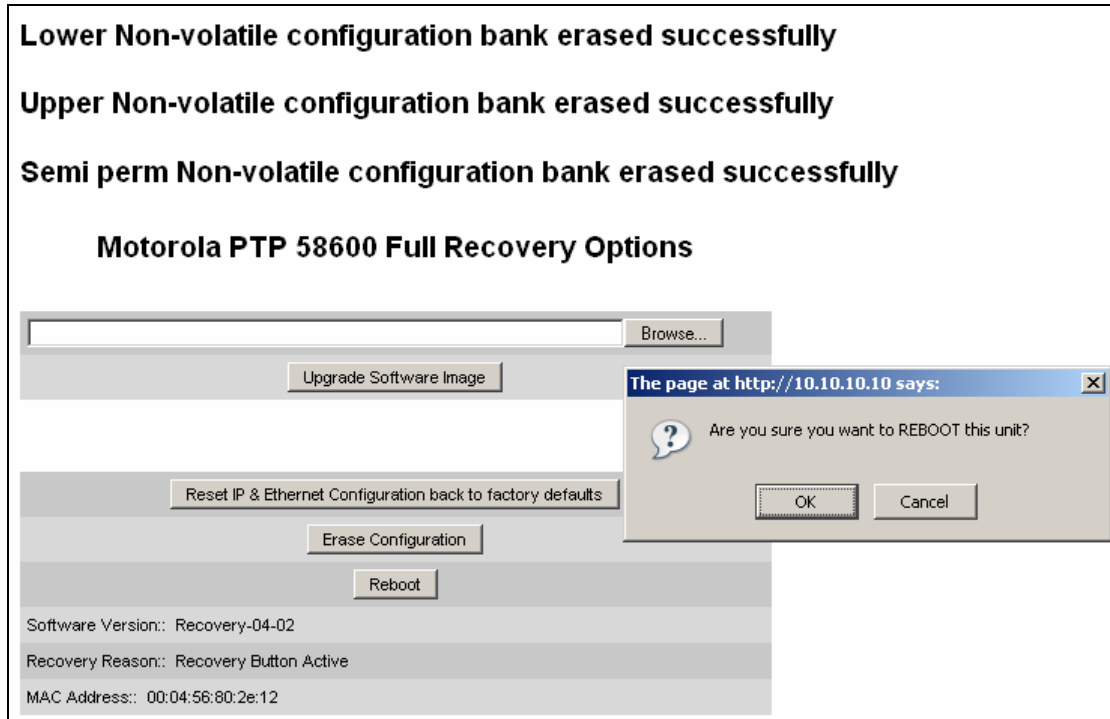
The unit will now reboot. The unit should now start up in normal mode but with all configuration erased. Should the unit fail to start up the user should refer to Section 10 "Fault Finding".

9.4   Reboot

This option can be used to reboot the unit. The user will now be presented with a pop up box asking them to confirm the action (Figure 116).

Figure 116 – Recovery - Reboot Confirmation Pop Up
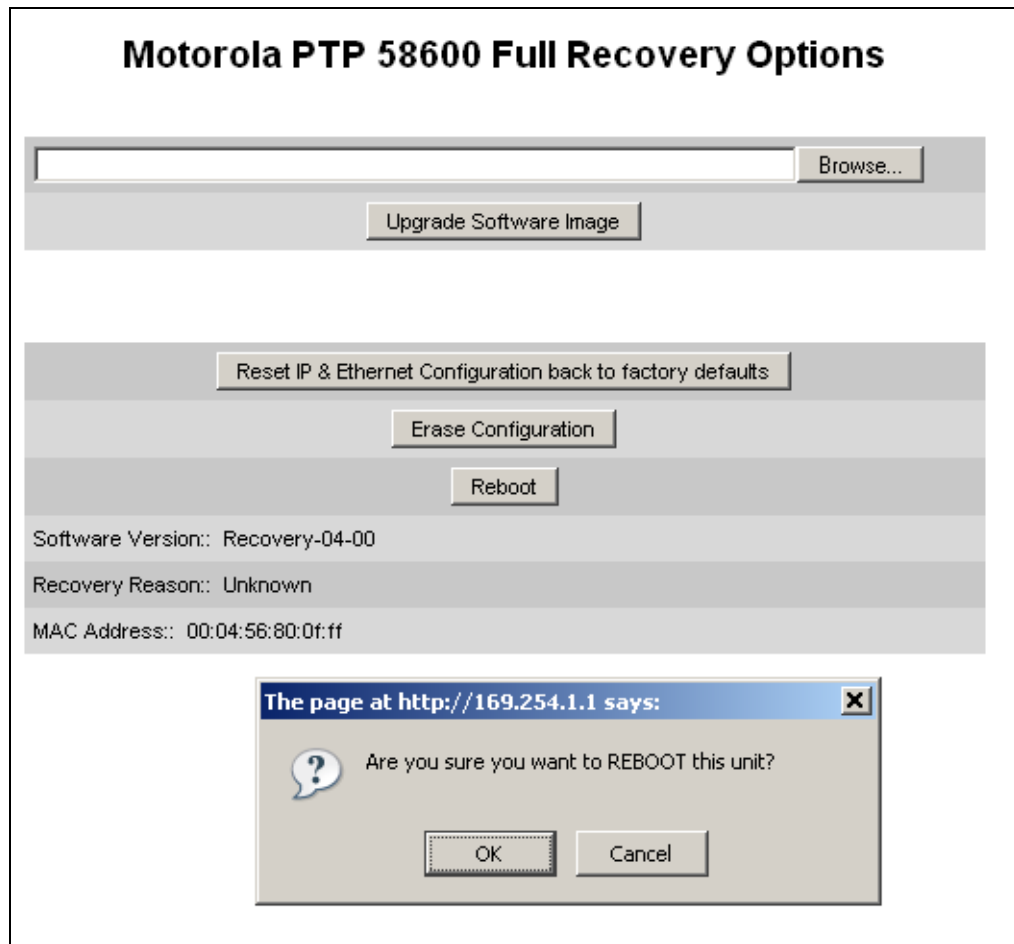
The unit will now reboot. The unit should now start up in normal operational mode. Should the unit fail to start up the user should refer to Section 10 "Fault Finding".

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:

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[23] check the power source.

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 power LED illuminates if the ODU connector is disconnected at the PIDU Plus (Remove the PIDU Plus flap on the left hand side).

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 led faulty?

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

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 while power is removed, if it never flashes then the problem is 1-3. Take the jumper (J905) 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.

Table 31 - 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.

2. Check against column 2 in Table 33. Resistances for each pair should be within 1 ohm of each other.

3. Check the cable resistance between pins 1 & 3 at the RJ45. Check against column 3 in Table 33.

4. Check the cable resistance between pins 4 & 7 at the RJ45. Check against column 4 in Table 33.

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

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

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

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 keys to ensure that both units are the same product variant
*   Check Master/Slave status for each unit and ensure that one unit is Master and the other unit is 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 does not 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

CAUTION: EMD (Lightning) damage is not covered under standard warranty. The recommendations in this user manual, when implemented 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.

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 117 & Figure 118) 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[24] 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 PTP 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.

Figure 117 - ODU mounted in Zones A & B

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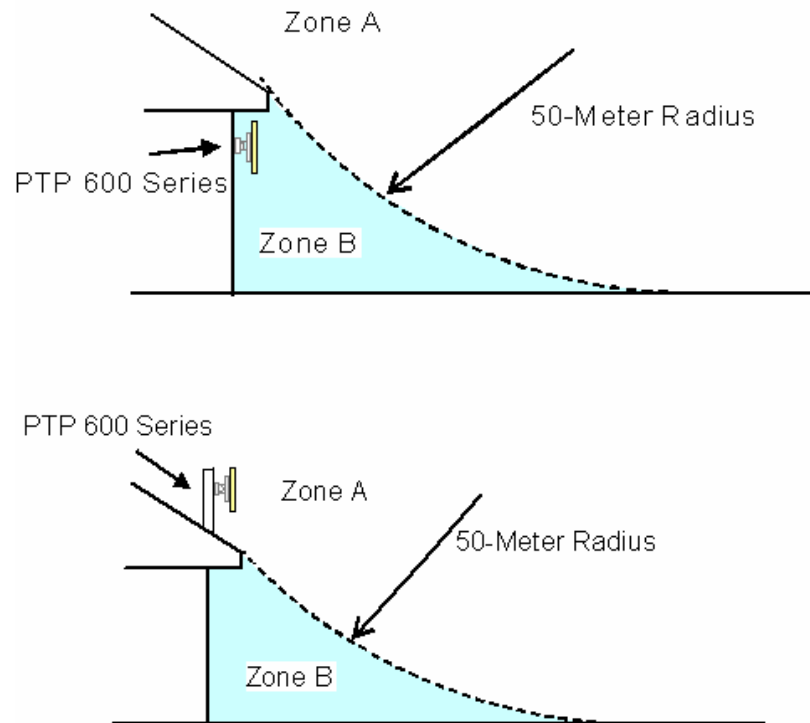
[24] Local regulations may also require the fitting of the 8 AWG ground wire referred below.

Figure 118 - Showing how the use of a Finial enables the ODU to be mounted inside Zone B
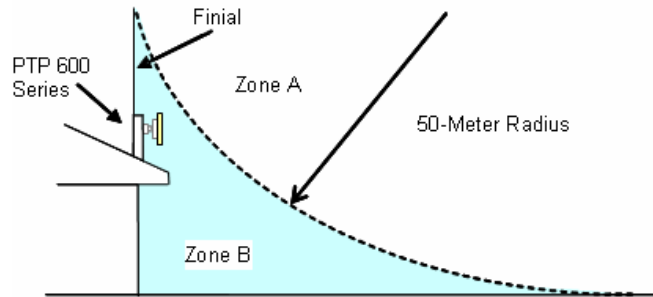
Table 32 - Protection Requirements

Component	Zone A	Zone B
Earth ODU	Mandatory	Mandatory
Screen Cable	Mandatory	Mandatory
Lightning Protection Unit at ODU – PTP-LPU	Mandatory	Mandatory
Earth Cable at Building Entry	Mandatory	Mandatory
Lightning Protection Unit at Building Entry – PTP-LPU	Mandatory	Mandatory

11.2   Detailed Installation

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

- Recommended cables as described in Section 3.3.5 "Cables and connectors".
- Lightning protection: Motorola PTP-LPUT - 4 per link (2 Motorola Kits, part number 2907)
- Grounding Stake
- RJ45 screened connectors

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).

Figure 119 includes illustrations showing the placement of the PTP lightning protection units and the recommended components for typical Mast/Tower or Wall installations.

Figure 119 - Diagrammatically Showing Typical Mast and Wall Installations
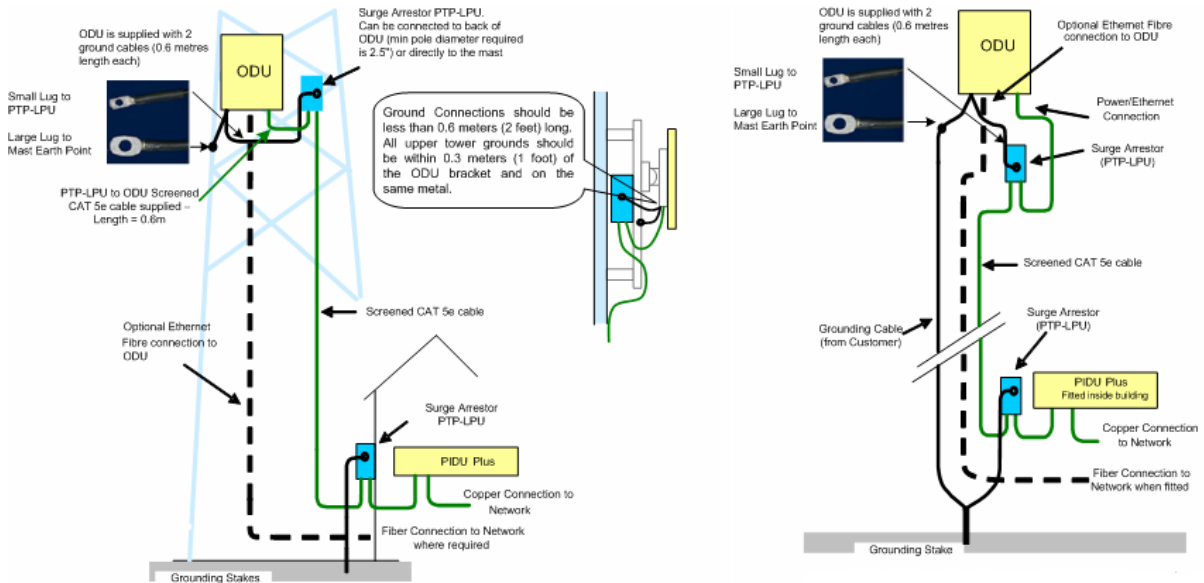
The PTP LPU can be installed in one of the following configurations:

- Option 1: Back-to-Back with the ODU using the supplied brackets delivered part of the installation of a link. This is the configuration recommended by Motorola.

- Option 2: using the U-Bolt bracket supplied with the PTP LPU Kit.

Typical examples of these two configurations are shown in Figure 120 and Figure 121.

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

Figure 120 – Example of PTP-LPU Configuration – Option 1 (Back-to-Back Recommended)
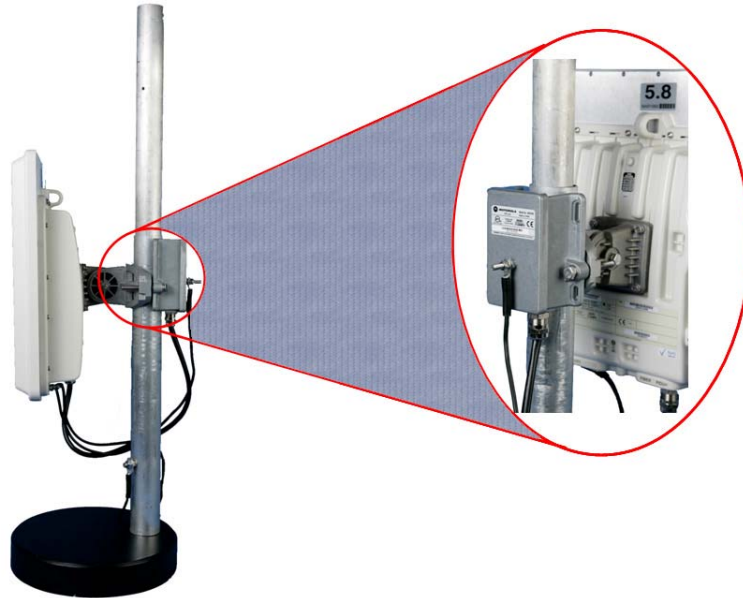
Figure 121 - PTP-LPU - Installation Option 2 (Using U-Bolt)
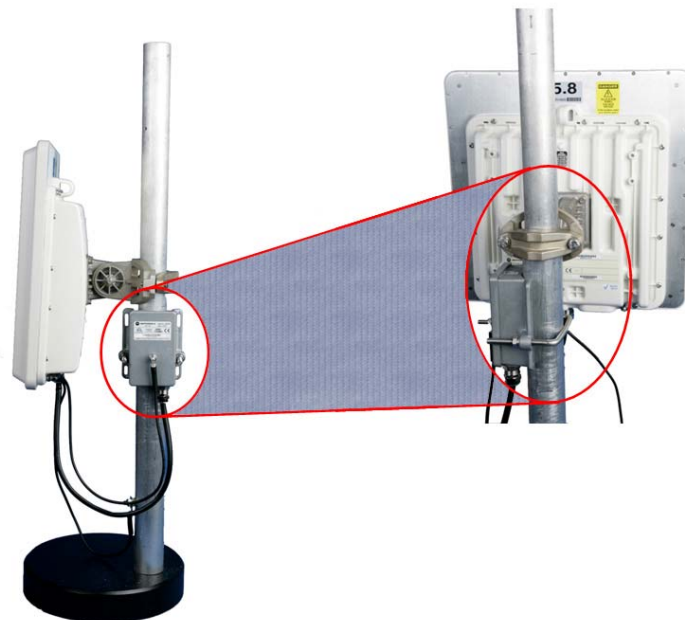
A second Lightning protection Unit should be mounted at the building entry point and must be grounded.

The PTP-LPU Kit is supplied with a 600mm ODU to PTP-LPU cable pre-fitted with glands. Figure 122 shows all the components that are supplied with the Motorola Kit 2907.

Figure 122 - PTP LPU Full Kit
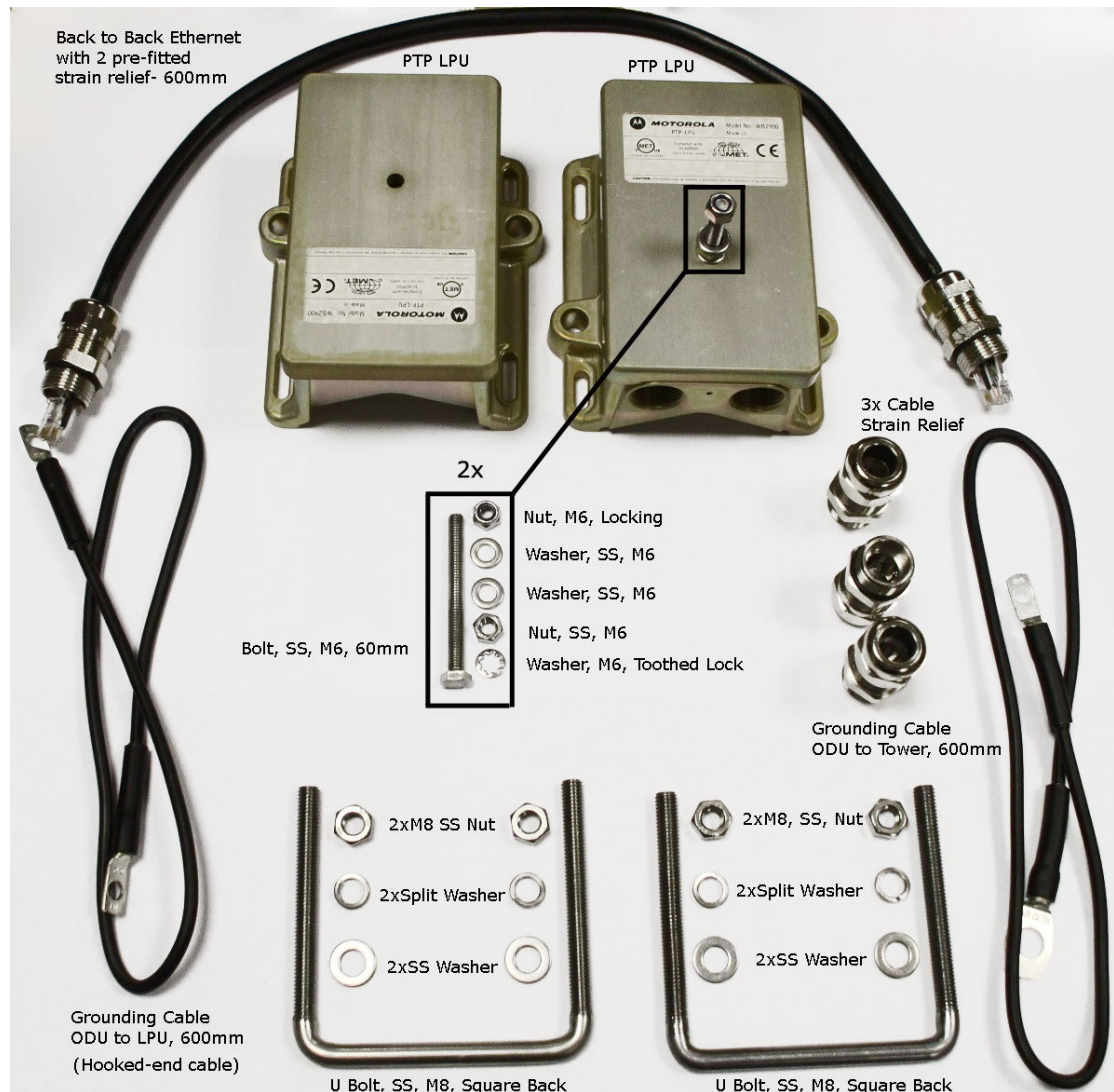
The cable between the two lightning protection units (top and bottom) should be of the type recommended by Motorola (Section 3.3.5 "Cables and connectors") and terminated as shown in Figure 35.

11.3 Testing Your Installation

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

Figure 123 - Simplified Circuit Diagram

11.3.1 Pre-Power Testing

Before plugging the RJ45 from the lower LPU (or if not fitted the ODU) into the PIDU, 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 33. Resistances for each pair should be within 1 ohm of each other.

2. Check the cable resistance between pins 1&3 and 4&7 at the RJ45. Check against columns 3 and 4 respectively in Table 33.

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

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

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

Table 33 - Resistance Table Referenced To The RJ45 at the PIDU+

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
150	26.3	26.5	27.1
200	34.8	35.0	35.6
250	43.3	43.5	44.1

| 300 | 51.8 | 52.0 | 52.6 |

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 PIDU Green power LED does not illuminate

Unplug the ODU connection from the PIDU and check the power LED illumination. If the power LED still does not light then check the power source.

The PIDU Green power LED flashes

A flashing power LED indicates that there is a short circuit on the output of the PIDU. Check that pins 4&5 and 7&8 are not crossed with pins 1&2 and 3&6 on the RJ45, and also greater than 100K ohms between pins 1&8

The PIDU 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. An indication that power is available on the cable to the ODU is available in the LPU as shown Figure 124.

The PIDU 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.

11.4   Locating the Fault

Having identified which of the wiring cores are likely to be connected incorrectly, the location of the faulty cable can be narrowed by disconnecting sections of the drop cable and by unplugging the relevant RJ45 connectors from the LPUs.

As a further aid to locating the fault the Ethernet connections are also available inside the LPU. The connections can be accessed by rotating the LPU lid as shown in Figure 124 The Lid nut only needs to be slacken, **do not remove.** Test point P1 on the LPU PCB corresponds to pin 1 on the RJ45 etc.

An indication of power on the Ethernet cable is also provided inside the LPU, LED PWR1 will illuminate in the case of the PTP600 series, LED PWR2 should not.

Figure 124 - PTP LPU test Points
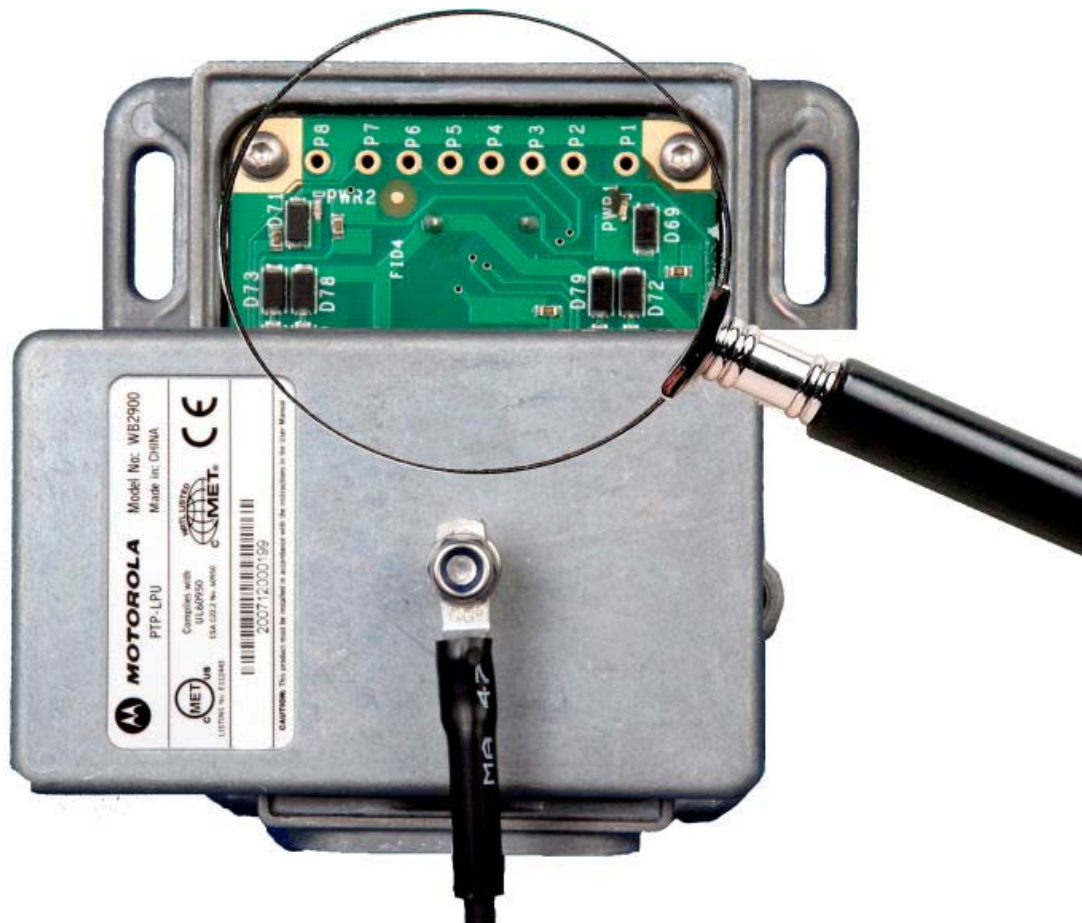
12 Wind Loading

12.1 General

Antennas and electronic equipment mounted on towers or pole mounted on buildings will subject the mounting structure to significant 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:

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 34 and Table 35.

Table 34 - Lateral Force – Imperial

	Largest Surface Area (sq ft)	Lateral Force (Pound) at wind speed (mph)				
		80	100	120	140	150
PTP 600 Series Bridge - Integrated	1.36	36.6	57.1	82.3	146.2	228.5
PTP 600 Series Connectorized	1.00	26.9	42	60.5	107.5	168.0

Table 35 - Lateral Force – Metric

	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- Connectorized	0.093	9	16	24	35	48

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 products..

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 125 – Connectorized 600 Series Bridge Outdoor Unit

13.2.2 Antenna Choices – 5.9 GHz

N/A.

13.2.3 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 must be obeyed by reducing the maximum Transmit power[25], see Section 5.2 "Licenses and Region Codes".

In FCC regions external antennas from the list in Section 13.6.3 "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.

NOTE: When operating PTP 58600 with a 5 MHz channel bandwidth and with dish antennas larger than 4 ft (1.2 metres) diameter, the maximum operating power must be reduced to 24 dBm (3 dB reduction) to ensure that FCC requirements are met.

13.2.4 Antenna Choices – 5.4 GHz

The integrated antenna has a gain of 23 dBi.

The PTP 54600 Series Bridge has been designed to operate with the antennas listed in Section 13.6.4 "Antennas for USA/Canada - 5.4 GHz", and having a maximum gain of 34.9 dB for the 30, 15 and 10 MHz channel bandwidth (32.3dBi for the 5MHz channel bandwidth) variant.

However, the Maximum Transmit Power must be reduced to avoid exceeding the EIRP limits[25].

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 1.2 dB.

---

[25] Maximum Transmit Power Allowed = EIRP Limit – Antenna Gain + Cable Losses; set the power to the 1dB value lower than the actual value calculated.

13.2.5 Antenna Choices – 2.5 GHz

N/A.

13.3   Software/Features

The connectorized variant operates in the same way as the basic 600 Series and is released initially with the feature set to the Connectorized 600 Series variant. 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.

Figure 126 - Connectorized 600 Series bridge Status Page

System Status - Master

Equipment

Attributes	Value	Units
Link Name	Master	
Link Location		
Software Version	58600-B1385+ wdog	
Hardware Version	D05-R02-C	
Region Code	Region Code 1	
Elapsed Time Indicator	00:34:45	

Ethernet / Internet

Attributes	Value	Units
Ethernet Link Status	Copper Link Up	
Ethernet Speed And Duplex	100 Mbps Full Duplex	
MAC Address	00:04:56:80:36:ba	
Remote IP Address	10.10.10.10	

Telecoms

Attributes	Value	Units
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	10				dBm
Transmit Power	25.0,	22.6,	18.0,	18.0	dBm
Receive Power	-22.6,	-58.7,	-110.0,	-49.4	dBm
Vector Error	7.2,	2.5,	-39.0,	-31.3	dB
Link Loss	105.3,	6.8,	0.0,	105.3	dB
Transmit Data Rate	63.50,	16.16,	0.00,	63.50	Mbps
Receive Data Rate	63.50,	17.69,	0.00,	63.50	Mbps
Link Capacity	127.00				Mbps
Transmit Modulation Mode	64QAM 0.92 (Dual) (15 MHz)				
Receive Modulation Mode	64QAM 0.92 (Dual) (15 MHz)				
Link Symmetry	1:1				
Receive Modulation Mode Detail	Running At Maximum Receive Mode				
Range	0.1				km

Update Page Refresh Period   Reset form

13.3.2 Configuration Pages

The amended Configuration web page is shown below as Figure 127.

Figure 127 - 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 128 to Figure 130.

Figure 128 - Connectorized PTP 600 Series Bridge 'Installation Wizard' Page

Antenna Gain: Gain of the antenna you are connecting to the unit, see table in Section 13.6.4 "Antennas for USA/Canada - 5.4 GHz"

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 "Spectrum Management" for more details. iDFS is the abbreviation for intelligent Dynamic Frequency Selection, which continually monitors the 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.

Figure 129 - Connectorized 600 Series bridge 'Confirm Installation' Page

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	169.254.0.0	
Use VLAN For Management Interfaces	No VLAN Tagging	
Telecoms Interface	None	
Target MAC Address	00:04:56:80:27:cb	
Master Slave Mode	Master	
Link Mode Optimization	IP Traffic	
TDD Synchronization Mode	Disabled	
Tx Max Power	25	dBm
Ranging Mode	Auto 0 to 40 km	
Platform Variant	Connectorized	
Antenna Gain	23.0	dBi
Cable Loss	0.0	dB
EIRP	48.0	dBm
Channel Bandwidth	15 MHz	
Link Symmetry	1:1	
Spectrum Management Control	Fixed Frequency	
Fixed Transmit Frequency	5736	MHz
Tx Color Code	B	
Fixed Receive Frequency	5736	MHz
Rx Color Code	A	
Installation Tones	Disabled	

Confirm Configuration, Arm Installation Agent and Reboot

◄◄ Back

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.

Figure 130 - Connectorized 600 Series bridge 'Disarm Installation' Page

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]

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13.4   Deployment Considerations

The majority of radio links can be successfully deployed with the 600 Series. It should only be necessary to use external antennas where the LINKPlanner 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

Installations must 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 Section 5.2 "Licenses and Region Codes" for any EIRP restrictions that may apply in your region.

In some regions, operation of the PTP 54600 products is constrained by an EIRP limit. The normal constraint is that the EIRP does not exceed 30 dBm (33 dBm for PTP 58600) for radio signals with a bandwidth of >=20 MHz. As the PTP 54600 operating bandwidth is approximately 27 MHz, then the limit is 30 dBm EIRP (33 dBm for PTP 58600).

When operating with external antennas, the installer/operator has to set the maximum transmit power to ensure that the EIRP limit is not exceeded. The Set_Max_Transmit_Power is calculated as below:

Set_Max_Transmit_Power = [Max_Transmit_Power] rounded down to nearest lower dB.

13.6.1 Antenna Choice (FCC and Industry Canada Regions Only)

For FCC and Industry Canada, the PTP 58600 Series Bridge has been designed to operate with the antennas listed Section 13.6.3 "Antennas for USA / Canada – 5.8 GHz", and having a maximum gain of 37.7 dB.

The PTP 54600 Series Bridge has been designed to operate with the antennas listed in Section 13.6.4 "Antennas for USA/Canada - 5.4 GHz", and having a maximum gain of 34.9 dB for the 30, 15 and 10 MHz channel bandwidth (32.3dBi for the 5MHz channel bandwidth) variant.

Antennas not included in these tables or having greater gains are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

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).

Table 36 - Cable Losses per Length

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

13.6.3 Antennas for USA / Canada – 5.8 GHz

Table 37 - Allowed Antennas for Deployment in 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
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

Manufacturer	Antenna Type	Gain (dBi)	Flat Plate	Parabolic Dish
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

Manufacturer	Antenna Type	Gain (dBi)	Flat Plate	Parabolic Dish
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
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

Manufacturer	Antenna Type	Gain (dBi)	Flat Plate	Parabolic Dish
StellaDoradus	StellaDoradus 45 inch Parabolic Antenna, 58PSD113	33.8		Y

13.6.4 Antennas for USA/Canada - 5.4 GHz

Table 38 - Allowed Antennas for Deployment in USA/Canada – 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

Manufacturer	Antenna Type	Gain (dBi)	Parabolic Dish
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
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

13.7   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.

13.7.1   Antenna Choice

Section 13.6.3 "Antennas for USA / Canada – 5.8 GHz" and Section 13.6.4 "Antennas for USA/Canada - 5.4 GHz" show a wide variety of antennas that can be used with the Connectorized PTP 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.

13.7.2   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.

13.7.3   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 "Tools Required". The tools required for mounting the antennas are specific to the antenna chosen. The installer should refer to the antenna manufacturer's instructions.

13.7.4 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

13.7.5 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 "Mounting Brackets". 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 13.6.3 "Antennas for USA / Canada – 5.8 GHz".

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.

13.7.6 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.

13.7.7 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.

Recommendation: 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.

13.7.8 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 "Aligning the PTP 600 Series Bridge ODUs".

13.7.9 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 "Connecting Up".

Step 7: Align the connected antenna using the tones as described in Section 7.7.11 "Aligning the PTP 600 Series Bridge ODUs".

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 "Aligning the PTP 600 Series Bridge ODUs".

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.

13.7.10 Completing the Installation

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

CAUTION: 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.

13.7.11 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.

13.7.12 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 131 - Forming a Drip Loop
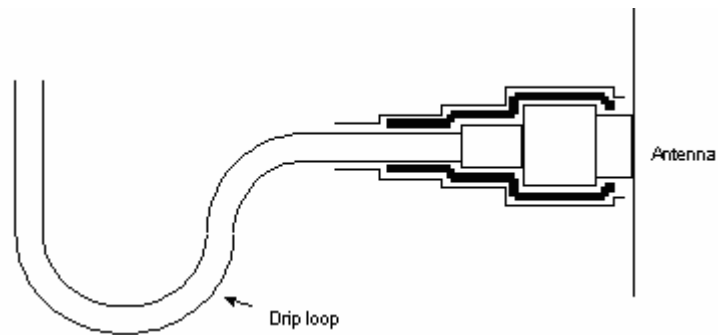
All joints should be weatherproofed using self-amalgamating tape. It is recommended that a layer of PVC tape be placed over the self-amalgamating tape to protect the joint while the self-amalgamating tape cures and gives additional protection. Figure 132 shows this diagrammatically for the 600 Series 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 132 - Weatherproofing the Antenna Connections
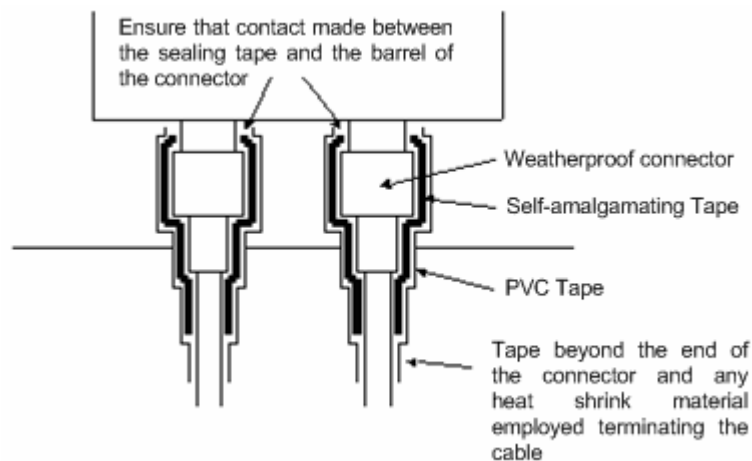
13.8 Additional Lightning Protection

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

13.8.1 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 133.

Figure 133- Additional Grounding When Using Connectorized Units
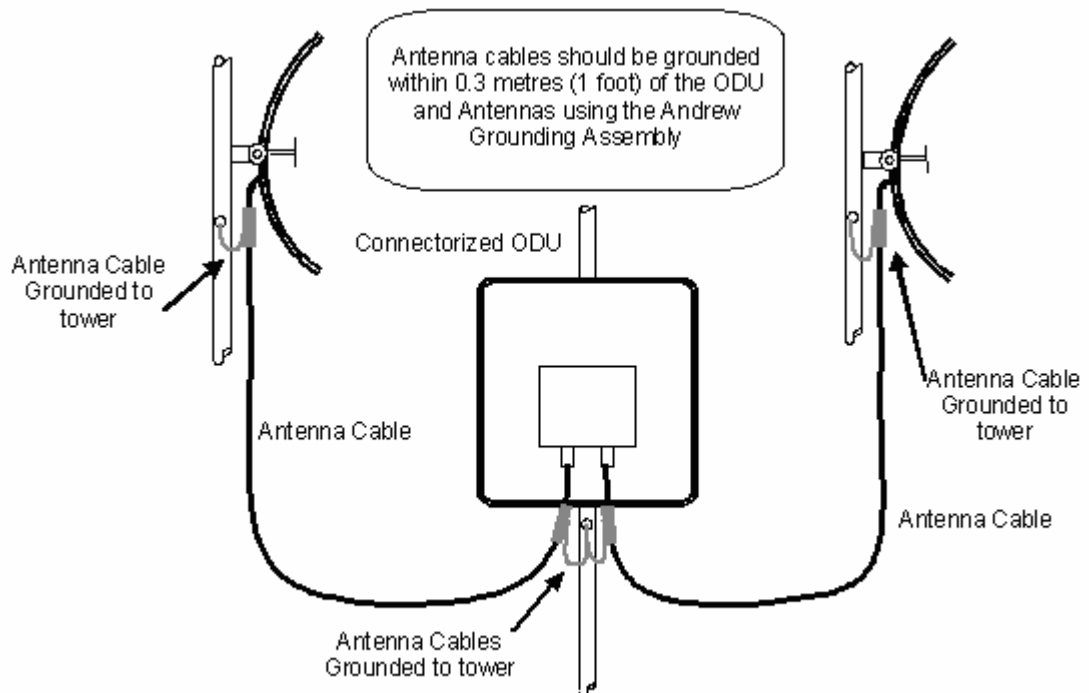
13.8.2 ODU Mounted Indoors

Where the ODU is mounted indoors, lightning arrestors should be deployed where the antenna cables enter the building as shown in Figure 134.

Figure 134 - Lightning Arrestor Mounting
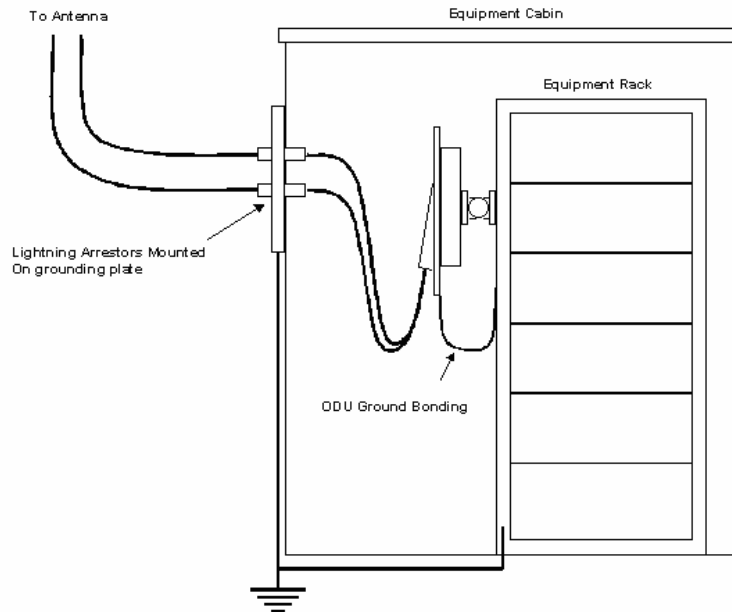
The lighting arrestors should be ground bonded to the building ground at the point of entry. Motorola recommends Polyphaser LSXL-ME or LSXL lighting arrestors. These should be assembled as show in Figure 135.

Figure 135 - Polyphaser Assembly
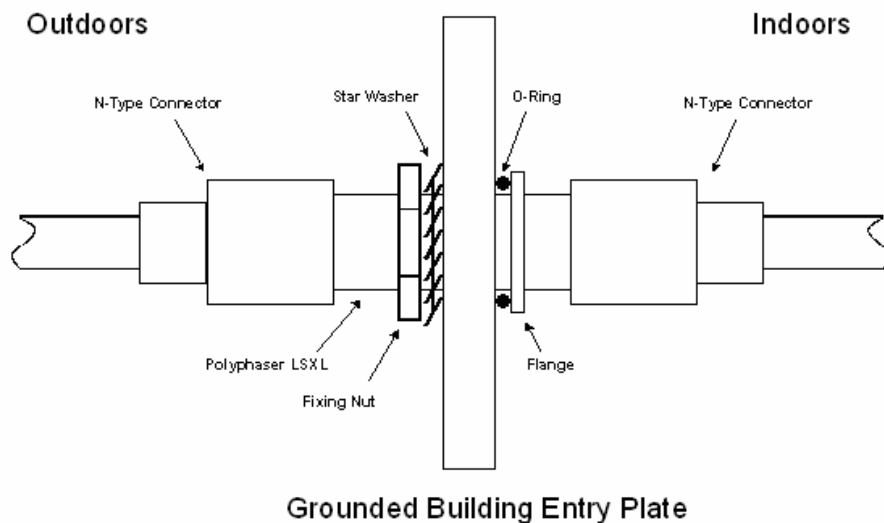
14 TDD Synchronization Configuration and Installation Guide

14.1 Introduction

When planning a network of links, a key consideration is the interference that exists between the links. TDD synchronization is a feature which eliminates two specific interference mechanisms, namely interference between Master and Master and interference between Slave and Slave.

One example which highlights the need for TDD synchronization is the case where a number of links are required from a single mast. Without TDD synchronization, high levels of interference will occur between the units on the mast due to their close proximity. By enabling TDD synchronization, interference between these units is eliminated if all are of the same type. The recommendation is for all units on a mast to be configured as Masters. The maximum number of links on a mast depends on the customer requirements such as required throughput, link availability, available spectrum, maximum EIRP, bandwidth, channel separation and the longest link. However, in some cases, it may even be possible to re-use radio channels on the same mast which would not be possible without TDD synchronization. In summary, by eliminating interference between units of a like type, TDD synchronization increases network capacity by increasing frequency re-use and increasing the density of links across the network.

This section will cover the two steps required to enable TDD synchronization:

- Physical installation of the GPS Synchronisation Unit. This will include wiring diagrams, illustrations showing the placement of the GPS box and the recommended components for installation.
- The latter will describe the step by step configuration process using the Web interface.

14.1.1 Installing the Recommended GPS Synchronization Kit

The recommended GPS Sync installation kit includes the following:

- GPS Sync Unit from MemoryLink (see Figure 136), with three attached terminated Ethernet and Sync cables and cable glands (2) which connect directly to a PTP 600 Series ODU.

- Mounting bracket and mounting bracket bolts

- Outdoor rated UV resistant cable tie

- GPS Sync Unit User Manual.

In addition to the hardware mentioned above, it is recommended to have an appropriate lightning protection (PTP LPU as described in Section 15.6 "Lightning Protection and E1/T1").

NOTE: Refer to GPS Sync Unit User manual for details on the lengths of cables used to connect the GPS Sync Unit to the ODU and PTP LPU.

Figure 136 - GPS Synchronization Unit

Figure 137 shows the inside of the GPS Sync Unit and Figure 138 is a diagram that shows how to connect the GPS Sync Unit to the ODU and the Lightning protection unit.

Figure 137 - GPS Synchronization Unit Connections

Figure 138 - TDD Sync - PTP600 Deployment Diagram
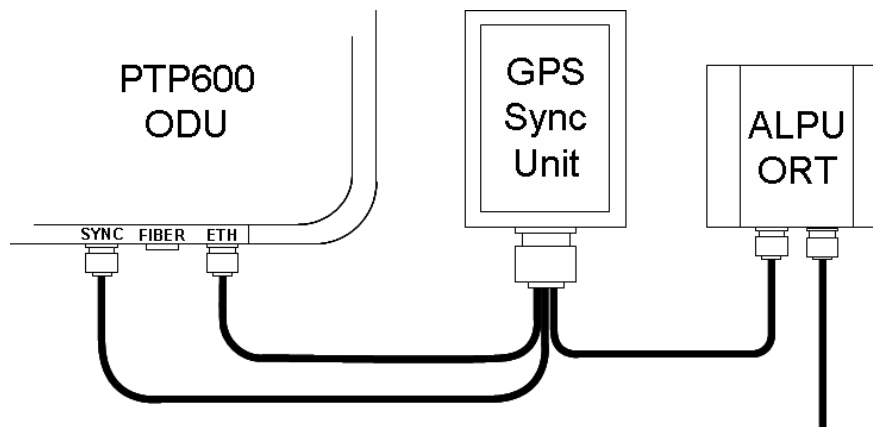
NOTE: Installation details of the GPS Sync Unit are described in the GPS Sync Unit User Manual.

Figure 139 shows an example of mast installation using lightning protection and a GPS Sync Unit.

Figure 139- GPS Synchronization Unit Complete Installation

14.2   TDD Synchronization Configuration – Standard Mode

TDD synchronization is enabled and configured using the install wizard during the installation process of the link[26].

14.2.1   TDD Synchronization Enable

Figure 140 shows how to enable TDD Synchronization.

Figure 140 - Enabling TDD Synchronization Feature

When TDD Synchronization is enabled, note that:

---

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

- Ranging Mode and Target Range are disabled on the wireless configuration page.

- Link Symmetry is forced to '1:1' operation only.

- Spectrum Management Control is forced to 'Fixed Frequency' operation only.

14.2.2 TDD Synchronization Configuration Menu

14.2.2.1 TDD Synchronization Configuration - Standard Mode

When TDD Synchronization is enabled, there is an extra installation screen ("TDD Synchronization") as shown in Figure 141.

Figure 141 - 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 143 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 39 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 39 will be shown in the configuration wizard screen.

Table 39 - Common Burst Durations

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

Collocated Masters: The network needs to be configured differently depending on whether all masters for which interference can potentially occur are collocated or whether interference needs to be considered for masters which are not collocated. Answer "Yes" to this question if master to master interference only occurs between collocated masters, otherwise answer "No". If "No" is selected, the maximum distance between masters which can potentially interfere is required. This is the subject of the next bullet.

Master to Master Range: This is only displayed (see Figure 138.) if the answer to the above question was "No". In this case, the longest distance over which two masters can interfere must be entered here. Maximum range is 200 km (120 miles).

Slave Interfere: Select "No" if there is no potential of a slave interfering with another slave. Select "Yes" if there is potential for one slave to interfere with another slave. If the option "Yes" is selected, then the maximum distance between slaves which can potentially interfere is required. This is the subject of the next bullet.

Slave to Slave Range: This is only displayed (see Figure 138.) if the answer to the above question was "Yes". In this case, the longest distance over which two slaves can interfere must be entered here. Maximum range is 200 km (120 miles).

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 142 - Configuring TDD Synchronization Feature - Screen 2

CAUTION: the values entered for the controls in Figure 142 MUST be the same for master/slave pairs for all the links in the network, except for the attribute "Range of This Link" which can be entered exactly for better performance.

14.2.2.2 TDD Synchronization Configuration – Expert Mode

When "Expert Mode" is selected, the user is required to configure the parameters[27] shown in Figure 143. As mentioned previously, this is outside the scope 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 143 - Configure TDD Synchronisation Expert Mode

14.2.2.3 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 144 shows the list of the installation parameters.

Figure 144 - Confirm TDD Synchronization Configuration Parameters

Installation configuration		
Attributes	**Value**	**Units**
IP Address	10.10.10.11	
Subnet Mask	255.255.0.0	
Gateway IP Address	169.254.0.0	
Use VLAN For Management Interfaces	No VLAN Tagging	
Telecoms Interface	None	
Target MAC Address	00:04:56:80:27:cb	
Master Slave Mode	Master	
Link Mode Optimization	IP Traffic	
TDD Synchronization Mode	Enabled	
TDD Sync Expert Install Mode	Yes	
TDD Frame Duration	3817	uSec
Max Burst Duration	1451	uSec
Slave Receive To Transmit Gap	105	uSec
TDD Holdover Mode	Best Effort	
TDD Sync Frame Rate	262	
TDD Sync Max Range	116.4	km
TDD Sync Max Link Capacity	233.10	Mbps
Tx Max Power	25	dBm
Platform Variant	Integrated Antenna	
Channel Bandwidth	30 MHz	
Link Symmetry	1:1	
Spectrum Management Control	Fixed Frequency	
Fixed Transmit Frequency	5742	MHz
Tx Color Code	B	
Fixed Receive Frequency	5742	MHz
Rx Color Code	A	
Installation Tones	Disabled	

Confirm Configuration, Arm Installation Agent and Reboot

◄◄ Back

Following the reboot and provided the GPS has synchronized, an additional control is displayed in the Status Page as shown in Figure 145 (Sync) or Figure 146 (Not Sync).

Figure 145 - Status Page - TDD Enabled and Synchronized

Figure 146 - Status Page - TDD Enabled and Not Synchronized

14.2.2.4 Disarm ODU Following TDD Sync Configuration

Figure 147 - Disarm Following TDD Synchronization

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	169.254.0.0	
Use VLAN For Management Interfaces	No VLAN Tagging	
Telecoms Interface	None	
Target MAC Address	00:04:56:80:27:cb	
Master Slave Mode	Master	
Link Mode Optimization	IP Traffic	
TDD Synchronization Mode	Enabled	
TDD Sync Expert Install Mode	No	
Longest Link In Network	100.0	km
Bandwidths In Network	15 MHz	
All Masters Collocated	No	
Master To Master Distance	75.0	km
Slaves Interfere	Yes	
Slave To Slave Distance	50.0	km
Configure Link Range	Yes	
Range Of This Link	80.0	km
TDD Holdover Mode	Best Effort	
TDD Sync Frame Rate	262	
TDD Sync Max Link Capacity	98.19	Mbps
Tx Max Power	25	dBm
Platform Variant	Connectorized	
Antenna Gain	23.0	dBi
Cable Loss	0.0	dB
EIRP	48.0	dBm
Channel Bandwidth	15 MHz	
Link Symmetry	1:1	
Spectrum Management Control	Fixed Frequency	
Fixed Transmit Frequency	5736	MHz
Tx Color Code	B	
Fixed Receive Frequency	5736	MHz
Rx Color Code	A	
Installation Tones	Disabled	

[Disarm Installation Agent]

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CAUTION: 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 E1/T1.

The E1/T1 cable should be assembled as described in Section 3.3.5 "Cables and connectors". 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 148 - RJ45 Pin Connection (T568B Color Coding)

Wire Color	Pin
White/Orange	Pin 1
Orange	Pin 2
White/Green	Pin 3
Blue	Pin 4
White/Blue	Pin 5
Green	Pin 6
White/Brown	Pin 7
Brown	Pin 8

Lock tab underneath
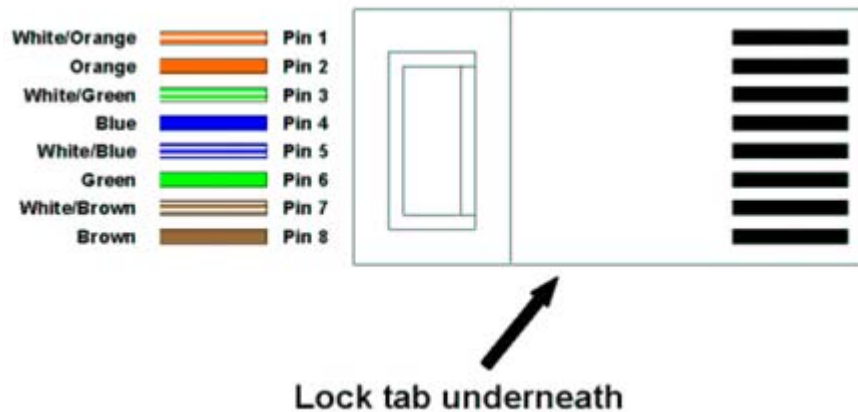
15.2 Making the Connection at the ODU

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 149) and is labeled E1/T1.

Figure 149 - PIDU Plus and E1-T1 Connexion
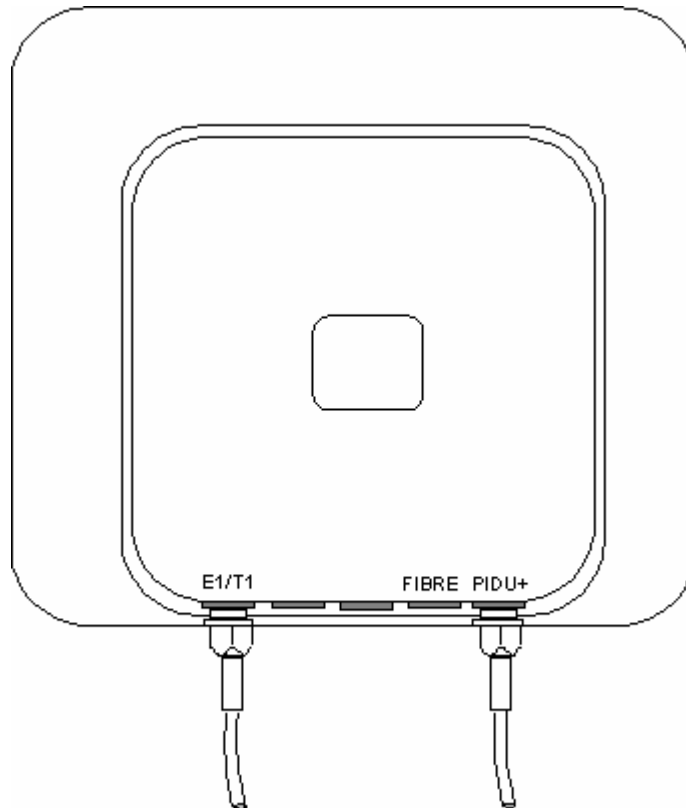
The following procedure describes how connection is made at the ODU. It is often easier to carry out this procedure on the ground or a suitable surface prior to mounting the ODU. Ensure no power is connected to the PIDU Plus.

Figure 150 - Disconnecting the ODU

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.

CAUTION: Do not over tighten the glands as the internal seal and structure may be damaged. See Figure 37 for an example of an over tightened cable gland.

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 Lightning Protection Unit

If you have opted to fit a Lightning Protection Unit, it should be installed as described in Section 11 "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 151 - Example of a Balun

Figure 152 - Diagrammatically Showing the E1-T1 Connections
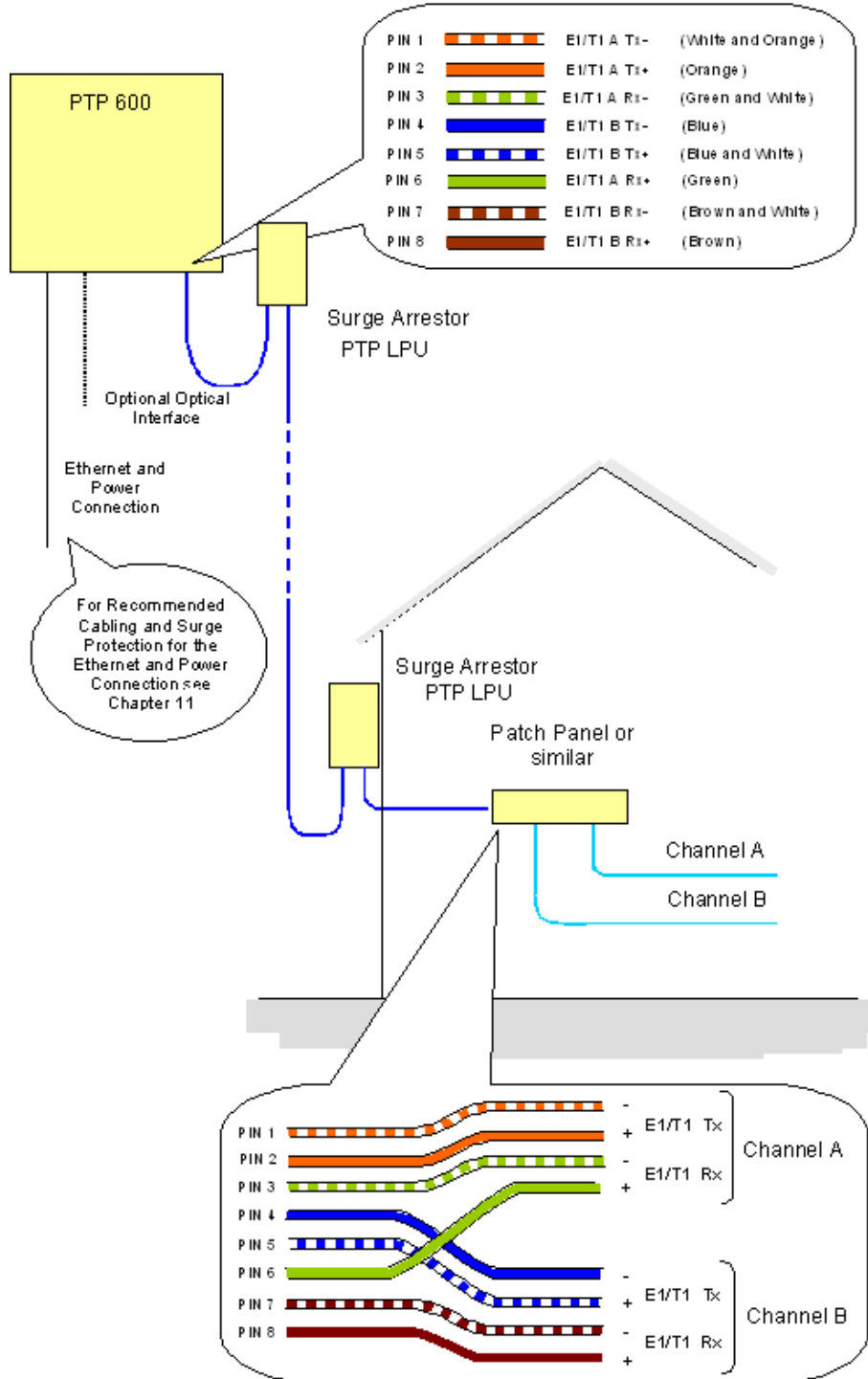
Figure 153 - Two E1-T1-120 Ohms signal Balanced to PTP600 Interface

E1 – 120 Ohm signal
Balanced twisted pair

RJ-45 Pin	Description
1	Rx Tip
2	Rx Ring
3	Rx Shield
4	Tx Tip
5	Tx Ring
6	Tx Shield
7	-
8	-

RJ-45 Pin	Description
1	Rx Tip
2	Rx Ring
3	Rx Shield
4	Tx Tip
5	Tx Ring
6	Tx Shield
7	-
8	-

E1 – 120 Ohm signal
Balanced twisted pair

E1/T1 A Tx-   (White and Orange)   Pin 1
E1/T1 A Tx+   (Orange)   Pin 2
E1/T1 A Rx-   (Green and White)   Pin 3
E1/T1 B Tx-   (Blue)   Pin 4
E1/T1 B Tx+   (Blue and White)   Pin 5
E1/T1 A Rx+   (Green)   Pin 6
E1/T1 B Rx-   (Brown and White)   Pin 7
E1/T1 B Rx+   (Brown)   Pin 8

Lock tab Underneath

RJ45 Pin Connection (T568B Color Coding)

15.6   Lightning Protection and E1/T1

15.6.1   Overview

Section 11 "Lightning Protection" contains the requirements for the Motorola PTP 600 Series deployment. For E1/T1, an extra Earthing cable is supplied to connect the other PTP-LPU to the ODU ground. This section details the additional requirements for the deployment of E1/T1.

15.6.2   Recommended Additional Components for E1/T1 Installation.

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

Table 40 - Protection Requirements

Component	Zone A	Zone B
Earth ODU	Mandatory	Mandatory
Screen Cable	Mandatory	Mandatory
Lightning Protection Unit PTP LPU at ODU	Mandatory	Mandatory
Earth Cable at Building Entry	Mandatory	Mandatory
Lightning Protection Unit PTP LPU at Building Entry	Mandatory	Mandatory

Figure 154 - Typical Mast Installation with the addition of the E1-T1 cable
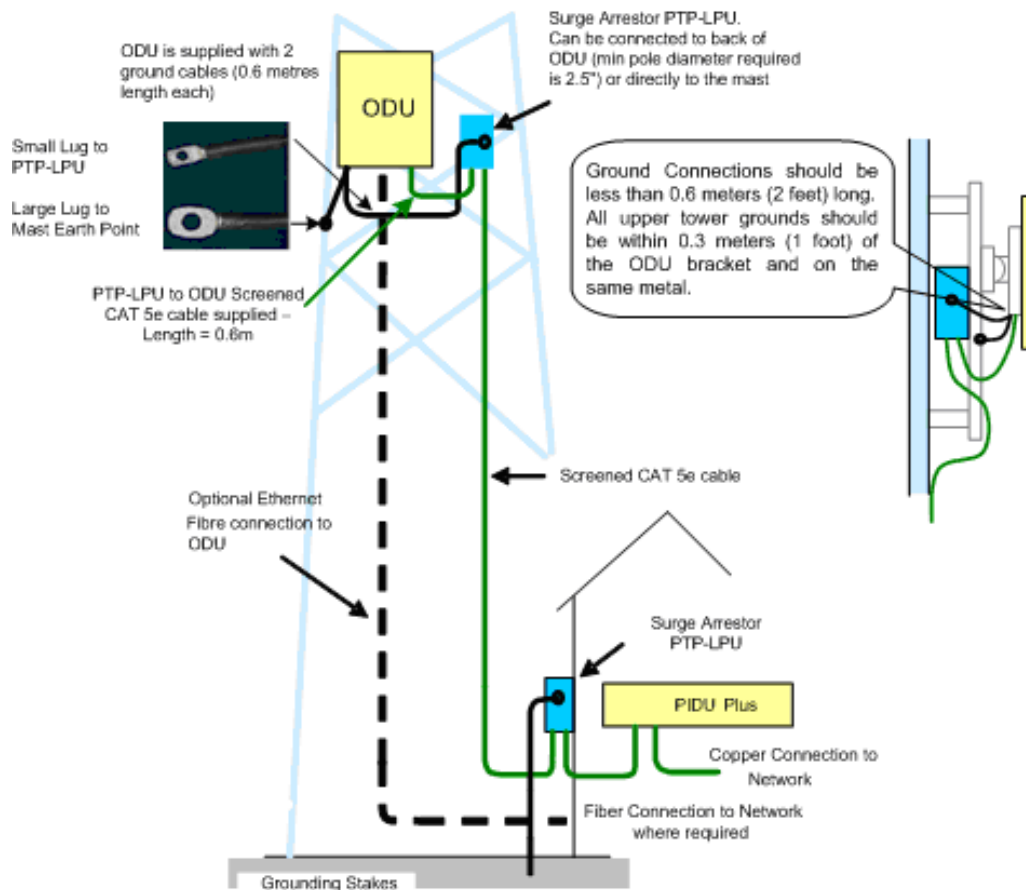
600 Series Typical Mast/Tower Installation

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

- Lightning Protection: Motorola PTP- LPU - 4 per link (2 Motorola Kits Part Number 2907).
- Grounding Stake
- RJ45 screened connectors.

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 155 - Wall Installation with the addition of E1-T1 cable

PTP 600 Series Wall Installation – E1/T1 Configuration
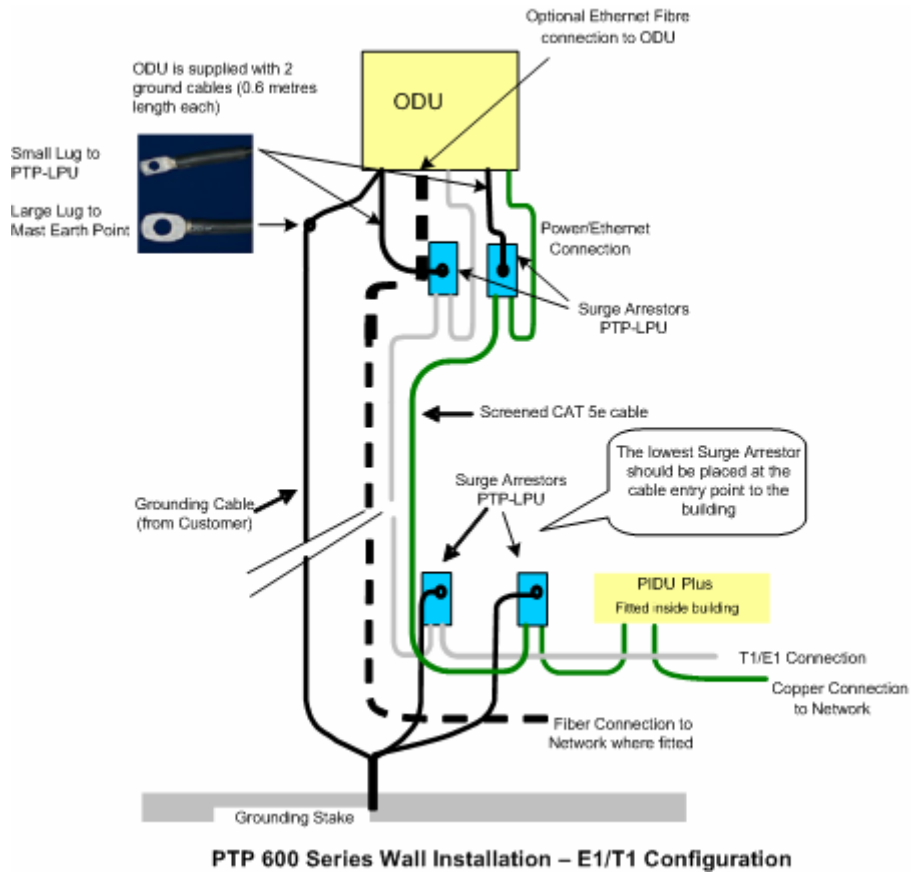
15.6.3 Lightning Protection Wiring

Please refer to Section 3.3.5 "Cables and connectors" for recommended cables.

15.7 Testing the E1/T1 Installation

If you have opted to fit a Lightning Protection Unit, it should be tested as described in Section 11.3 "Testing Your Installation".

Test the telecoms links by performing loopback connections as described in Section 8.3.1.6 "Telecoms Configuration Page".

15.7.1 Pre-Power Testing

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

Check the cable resistance between pins 3 & 6 (Green/White & Green) and 7 & 8 (Brown/White & Brown). Check against Table 41 column 2.

Check the cable resistance between pins 1 & 2 (Orange/White & Orange) and 4 & 5 (Blue & Blue/White). Check against Table 41 column 3.

Table 41 - Resistance Table Referenced To the E1/T1 Source

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

16 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 156 through Figure 168.

Figure 156 - BPSK 0.63 Single Payload
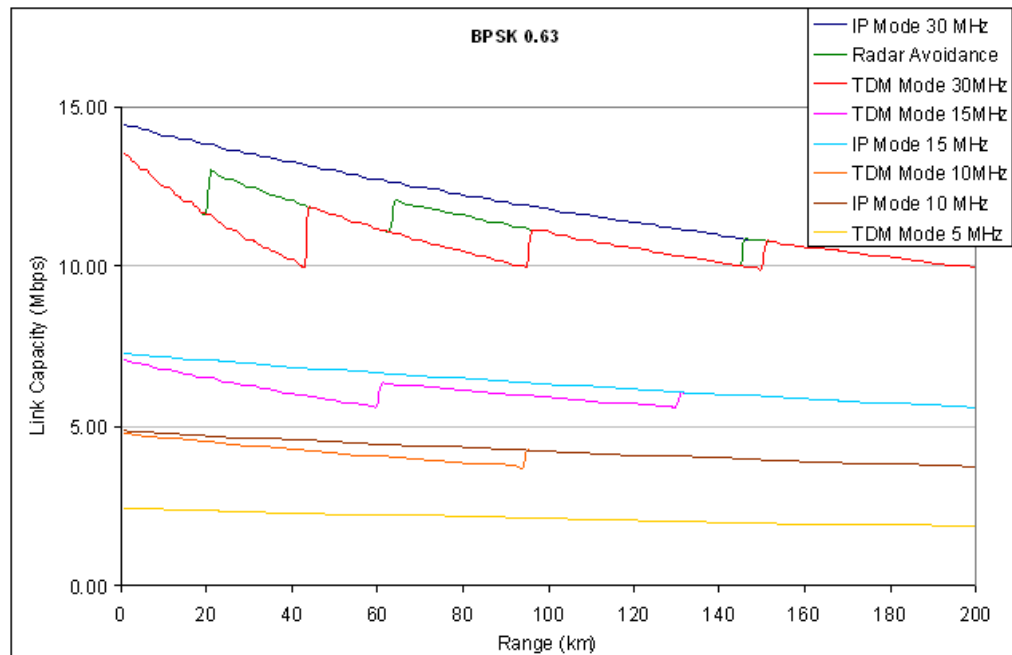
Figure 157 - QPSK 0.63 Single Payload
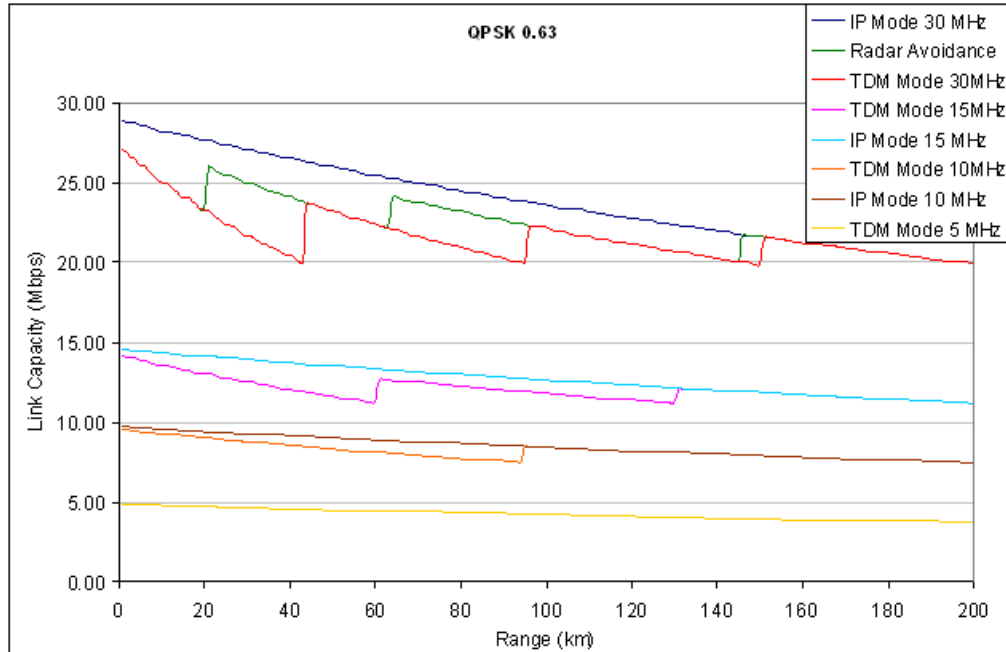
Figure 158 - QPSK 0.87 Single Payload
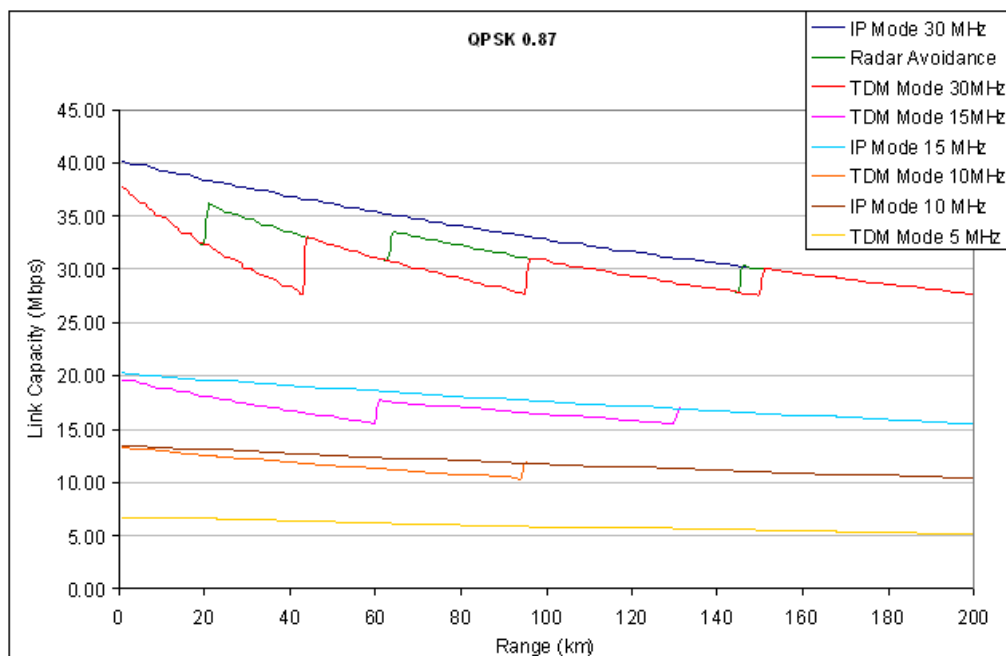
Figure 159 - 16 QAM 0.63 Single Payload
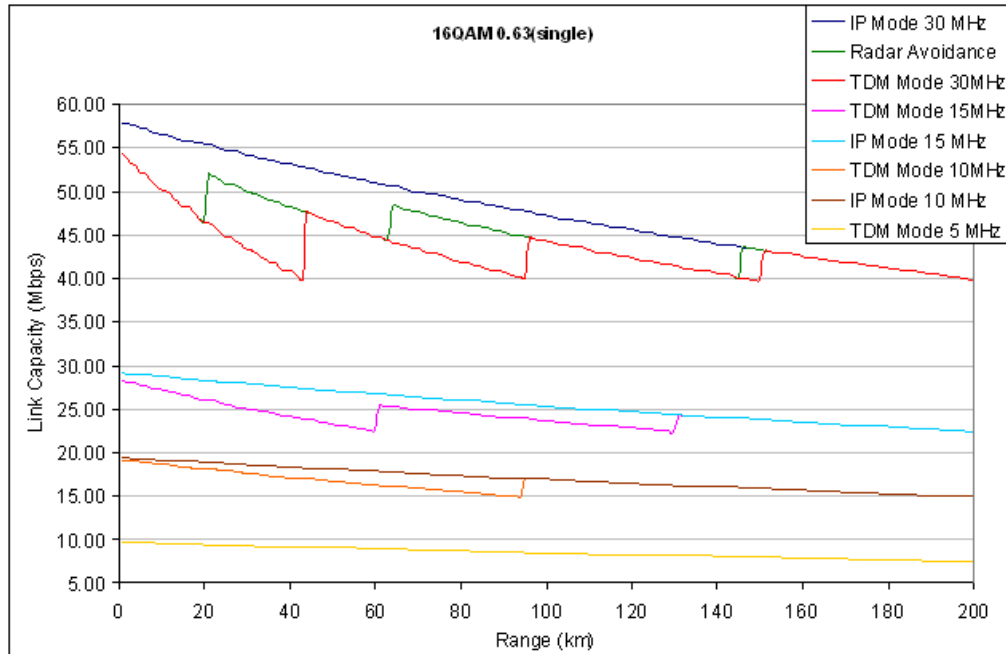
Figure 160 - 16 QAM 0.87 Single Payload
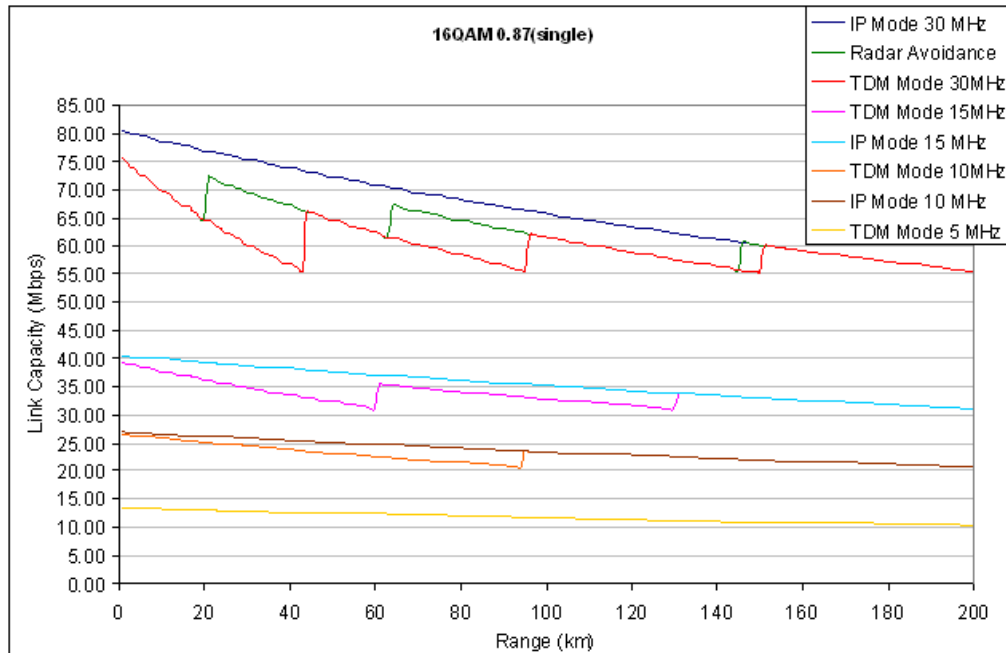
Figure 161 - 64 QAM 0.75 Single Payload
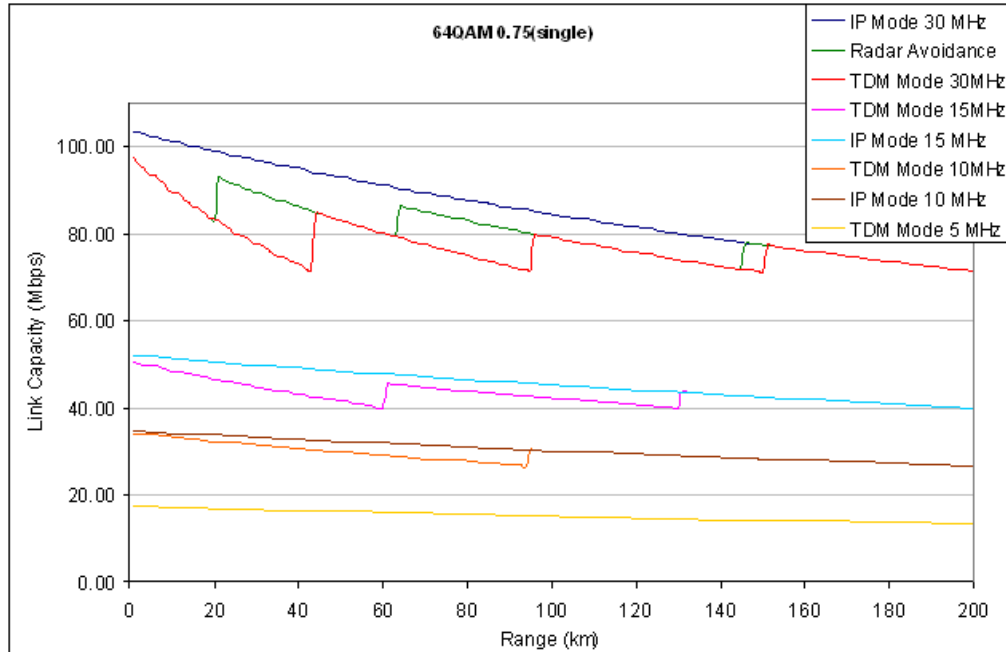
Figure 162 - 64 QAM 0.92 Single Payload
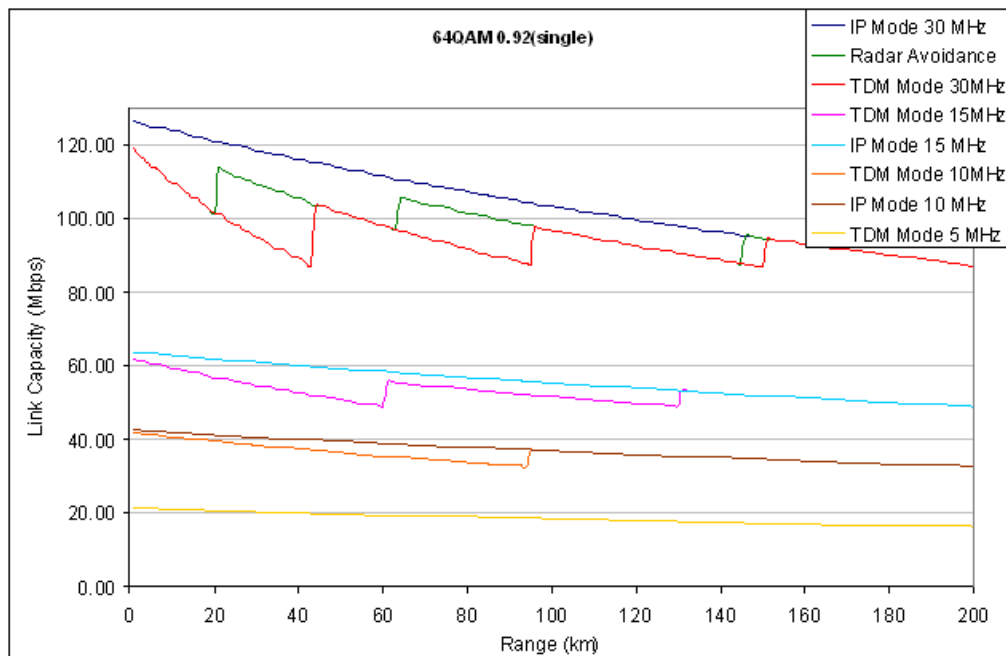
Figure 163 - 256 QAM 0.81 Single Payload
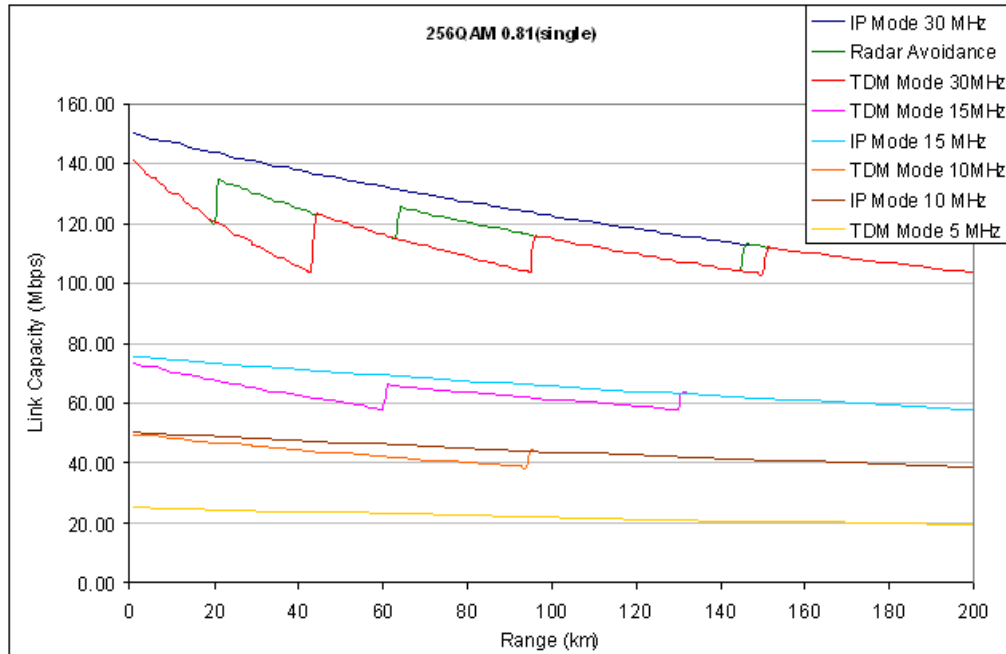
Figure 164 - 16 QAM 0.63 Dual Payload
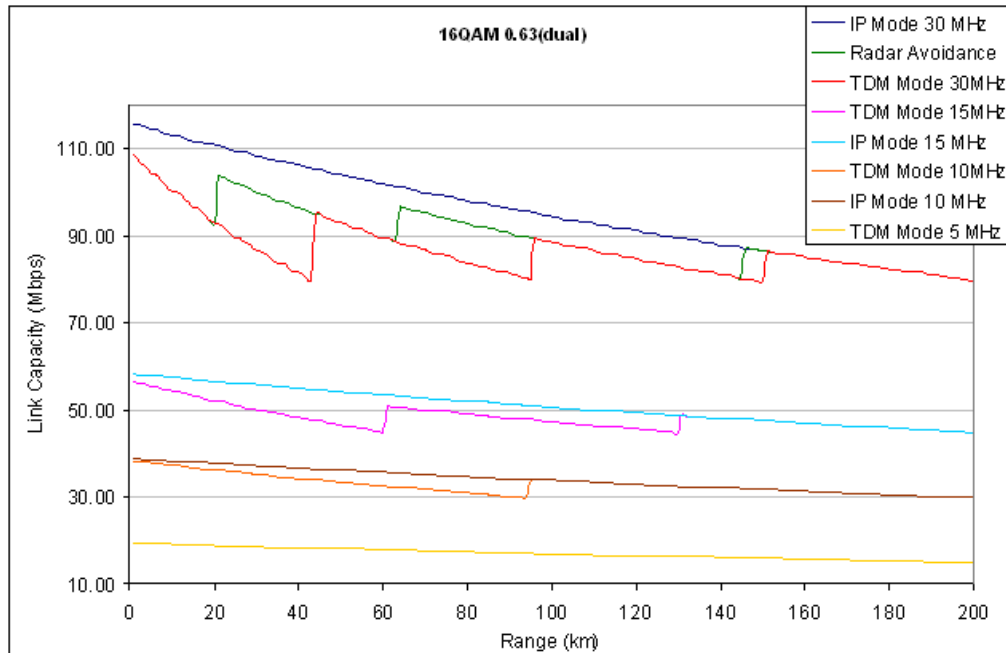
Figure 165 - 16 QAM 0.87 Dual Payload
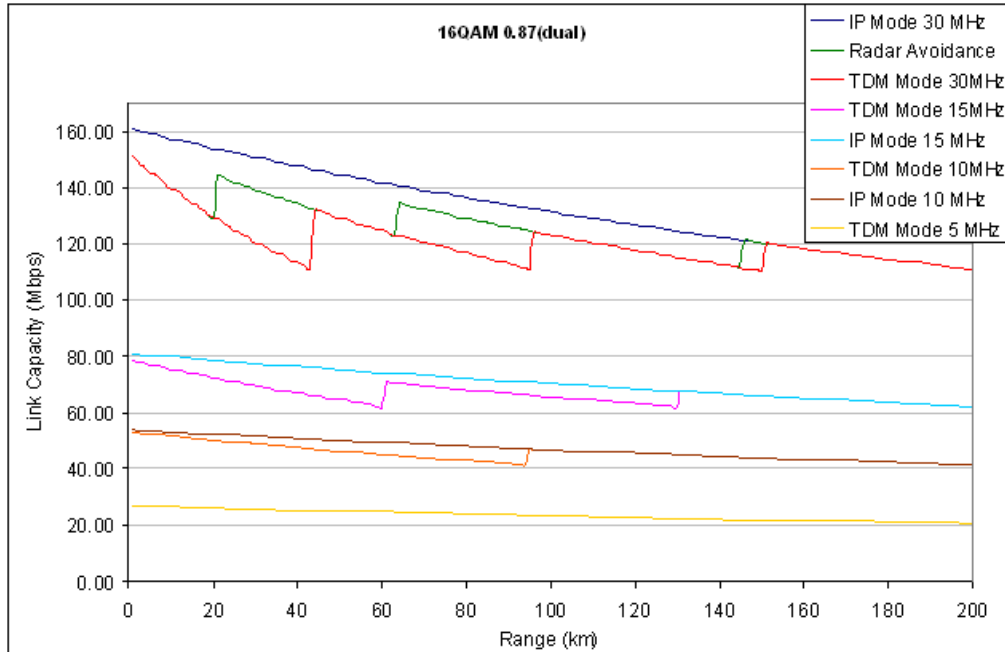
Figure 166 - 64 QAM 0.75 Dual Payload
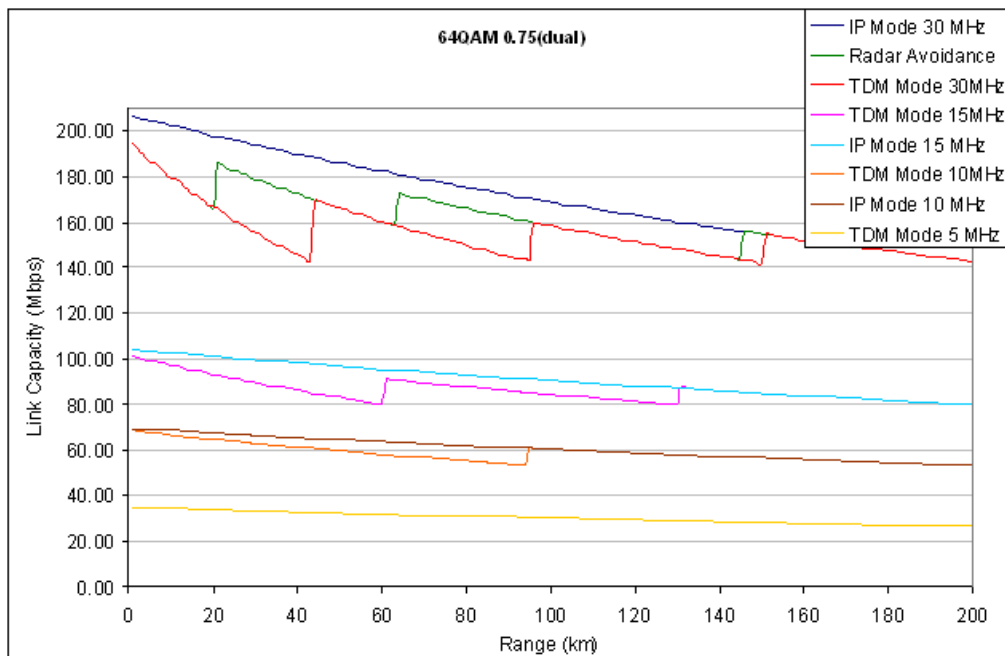
Figure 167 - 64 QAM 0.92 Dual Payload
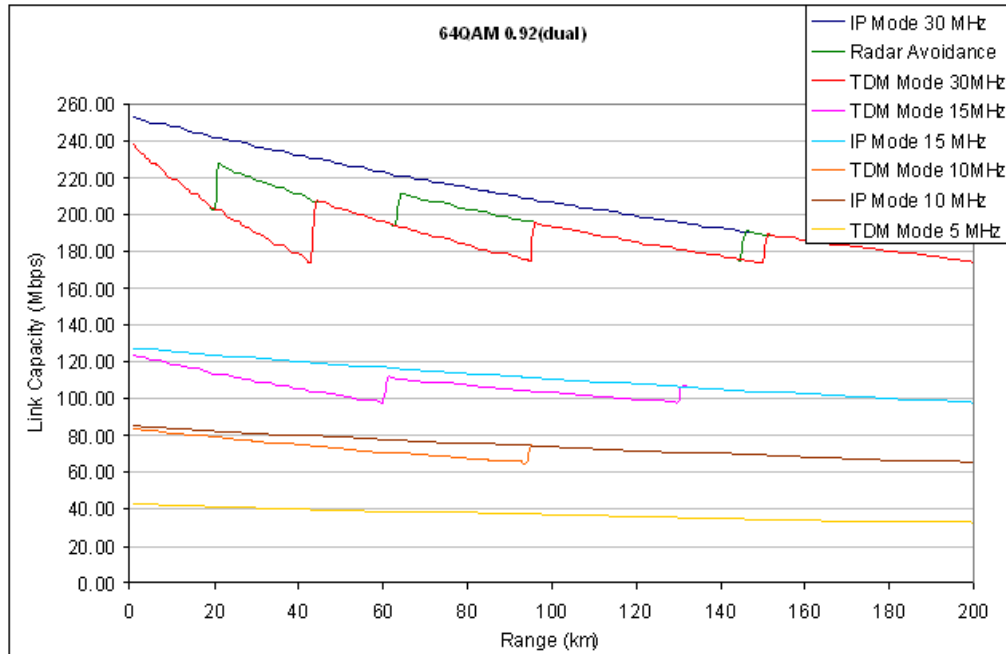
Figure 168 - 256 QAM 0.81 Dual Payload
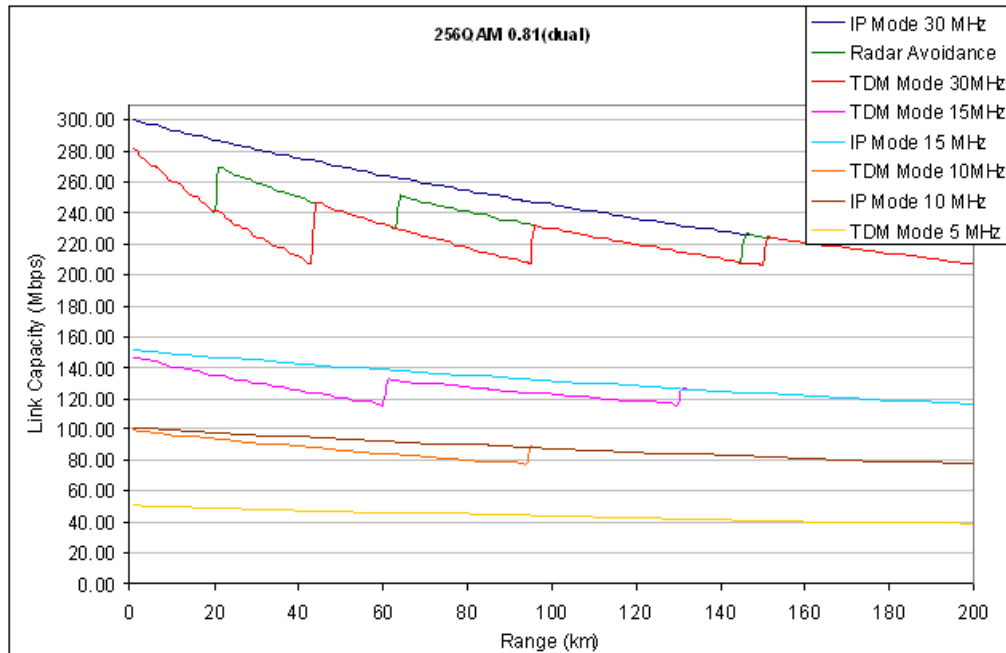
17 AES Encryption Upgrade

The Motorola PTP 600 Series bridges support link encryption using the NIST approved Advanced Encryption Standard, HFIPS-197.H. 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.

17.1 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.

17.1.1 License Keys

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

Figure 169 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.

Figure 169 – AES Software License Key Data Entry

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.

17.1.2 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 170 be used to configure AES link encryption.

Figure 170 – 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 171. 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 171 - Configuration Reboot Screen

The Configuration Changes Require a System Reboot

The configuration changes you requested can only be activated via a system reboot. Would you like to reboot the wireless unit now?

Reboot Wireless Unit

◀◀ Back
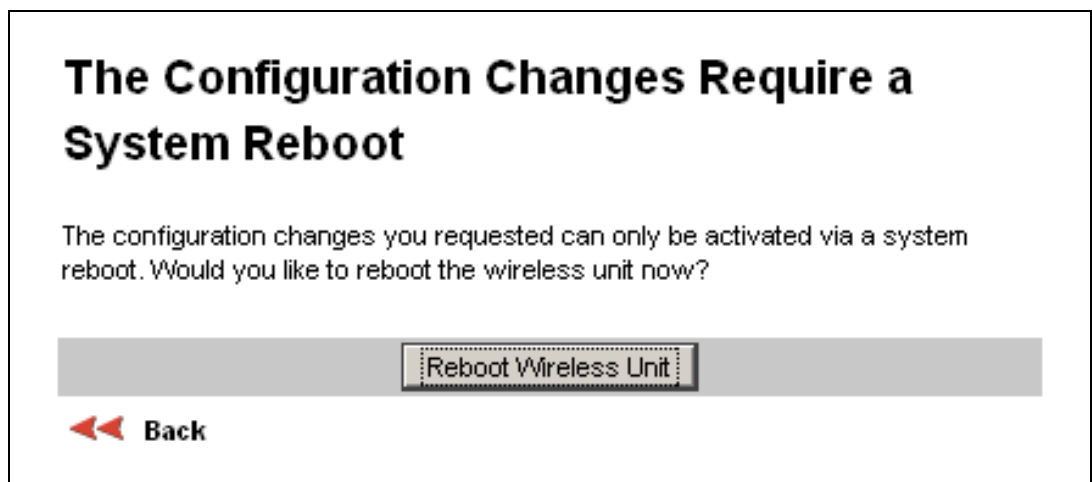
17.2 Wireless Link Encryption FAQ

17.2.1 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.

17.2.2 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.

17.2.3 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.

18 Remote Software Upgrade by TFTP

The ODU software can be upgraded remotely using Trivial FTP (TFTP) triggered by SNMP.

To perform a remote software upgrade, follow this procedure:

1. Set the following tFTP attributes:

tFTPServerIPAddress: The IP address of the TFTP server from which the TFTP software upgrade file Name will be retrieved. For example, to set the TFTP server IP address for unit 10.10.10.10 to 10.10.10.1:

```
snmpset_d.exe -v 2c -c public 10.10.10.10 .iso.3.6.1.4.1.17713.1.9.5.0 a
10.10.10.1
```

tFTPServerPortNumber: This setting is optional. The port number of the TFTP server from which the TFTP software upgrade file name will be retrieved (default=69).

tFTPSoftwareUpgradeFileName: The filename of the software upgrade to be loaded from the TFTP server. For example, to set the TFTP software upgrade filename on 10.10.10.10 to "B1095.dld":

```
snmpset_d.exe -v 2c -c public 10.10.10.10 .iso.3.6.1.4.1.17713.1.9.7.0 s
B1095.dld
```

tFTPStartSoftwareUpgrade: Write '1' to this attribute to start the TFTP software upgrade process. The attribute will be reset to 0 when the upgrade process has finished. Example:

```
snmpset_d.exe -v 2c -c public 10.10.10.10 .iso.3.6.1.4.1.17713.1.9.8.0 i
1
```

2. Monitor the values of the following tFTP attributes:

tFTPSoftwareUpgradeStatus: The current status of the TFTP software upgrade process. Values:

- o idle(0)
- o uploadinprogress(1)
- o uploadsuccessfulprogrammingFLASH(2)
- o upgradesuccessfulreboottorunthenewsoftwareimage(3)
- o upgradefailed(4).

Example:

```
snmpget_d.exe -v 2c -c public 10.10.10.10 .iso.3.6.1.4.1.17713.1.9.9.0
```

tFTPSoftwareUpgradeStatusText: This describes the status of the TFTP software upgrade process, including any error details. Example:

```
snmpget_d.exe -v 2c -c public 10.10.10.10 .iso.3.6.1.4.1.17713.1.9.10.0
```

tFTPSoftwareUpgradeStatusAdditionalText: Used if tFTPSoftwareUpgradeStatusText is full and there are more than 255 characters to report. Additional text describing the status of the TFTP software upgrade process, including any error details. Example:

```
snmpget_d.exe -v 2c -c public 10.10.10.10 .iso.3.6.1.4.1.17713.1.9.11.0
```

3. When the upgrade is complete, reboot the ODU to run the newly loaded software image. See Section 9.4"Reboot".

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 – PTP 59600 variant

19.2.1 Russia

This system has been tested for type approval in Russia of fixed link equipment under the heading of BPD TZS 12.

19.3 National and Regional Regulatory Notices – PTP 58600 variant

19.3.1 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 'license exempt' and the system is allowed to be used provided it does not cause interference. Further, the licensing authority does 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).

For the connectorized version of the product and in order to reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the Effective Isotropically Radiated Power (EIRP) is not more than that permitted for successful communication.

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 below:

This device complies with Part 15 of the FCC Rules.

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.

FCC ID: QWP58100

FC

IC:4815A-58100

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.

19.3.2 European Union Notification

The PTP 58600 connectorized product is a two-way radio transceiver suitable for use in Broadband Wireless Access System (BWAS), 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.

19.3.3 UK Notification

The PTP 58600 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: This equipment operates as a secondary application, so it has no rights against harmful interference, even if generated by similar equipment, and must not cause harmful interference on systems operating as primary applications.

19.4 National and Regional Regulatory Notices – PTP 54600 Variant

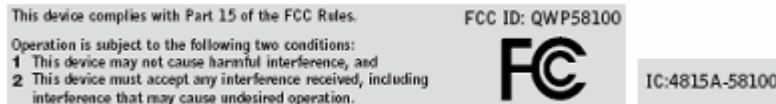### 19.4.1 U.S. Federal Communication Commission (FCC) and Industry Canada (IC) Notification[28]

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).

For the connectorized version of the product and in order to reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that permitted by the regulations. The transmitted power must be reduced to achieve this requirement.

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 below:

---

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

This device complies with Part 15 of the FCC Rules.

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.

FCC ID: QWP54XX

IC:109AO-54XX

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.

19.4.2 European Union Notification

The PTP 54600 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 1 device and uses operating frequencies that are 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 and has been tested compliant with EuroNorm EN 301 893.

This equipment is marked to show compliance with the European R&TTE directive 1999/5/EC.

$C\varepsilon$ 1321

08/2005
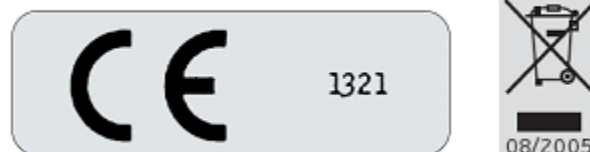
The relevant Declaration of Conformity can be found at www.motorola.com

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.

19.5 National and Regional Regulatory Notices – PTP 25600 Variant

19.5.1 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 below:
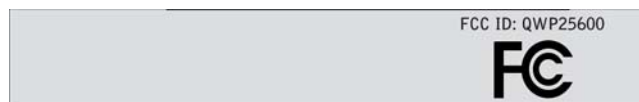
FCC ID: QWP25600

FC

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.

19.6 Exposure

See Section 2 "Avoiding Hazards".

19.7   Legal Notices

19.7.1 Motorola Inc. End User License Agreement

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IF YOU DO NOT AGREE TO THE TERMS OF THIS AGREEMENT, DO NOT USE THE PRODUCT OR INSTALL THE SOFTWARE. INSTEAD, YOU MAY, FOR A FULL REFUND, RETURN THIS PRODUCT TO THE LOCATION WHERE YOU ACQUIRED IT OR PROVIDE WRITTEN VERIFICATION OF DELETION OF ALL COPIES OF THE SOFTWARE. ANY USE OF THE SOFTWARE, INCLUDING BUT NOT LIMITED TO USE ON THE PRODUCT, WILL CONSTITUTE YOUR ACCEPTANCE TO THE TERMS OF THIS AGREEMENT.

19.7.1.1 Definitions

In this Agreement, the word "Software" refers to the set of instructions for computers, in executable form and in any media, (which may include diskette, CD-ROM, downloadable internet, hardware, or firmware) licensed to you. The word "Documentation" refers to electronic or printed manuals and accompanying instructional aids licensed to you. The word "Product" refers to Motorola's MOTOwi4™ fixed wireless broadband devices for which the Software and Documentation is licensed for use.

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Any use of the Software and Documentation outside of the conditions set forth in this Agreement is strictly prohibited and will be deemed a breach of this Agreement.

Only you, your employees or agents may use the Software and Documentation. You will take all necessary steps to insure that your employees and agents abide by the terms of this Agreement.

You will use the Software and Documentation (i) only for your internal business purposes; (ii) only as described in the Software and Documentation; and (iii) in strict accordance with this Agreement.

You may use the Software and Documentation, provided that the use is in conformance with the terms set forth in this Agreement.

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20 Specifications

20.1 System Specifications

20.1.1 Wireless PTP 25600 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 Type	Integrated flat plate antenna
Antenna Gain	18 dBi typical
Antenna Beamwidth	18 Degrees
Max Path Loss (5 MHz channel)	157 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

20.1.2 Wireless PTP 45600 Variant

Radio Technology	Specification
RF Band	4400-4600 MHz
Channel Selection	Manual selection.
Dynamic Frequency Control	By intelligent Dynamic Frequency Selection (i-DFS) or manual intervention; automatic selection on start-up and continual adaptation to avoid interference.
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 Type	Integrated flat plate antenna
Antenna Gain	21.5 dBi typical
Antenna Beamwidth	11 Degrees
Max Path Loss (5 MHz channel)	157 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

20.1.3 Wireless PTP 54600 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 Type	Integrated flat plate antenna
Antenna Gain	23 dBi typical
Antenna Beamwidth	8 Degrees
Max Path Loss (5 MHz channel)	169 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

20.1.4 Wireless PTP 58600 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 Type	Integrated flat plate antenna
Antenna Gain	23 dBi typical
Antenna Beamwidth	8 Degrees
Max Path Loss (5 MHz Channel)	166 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

20.1.5 Wireless PTP 59600 Variant

Radio Technology	Specification
RF Band	5.825-5.925GHz
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 Type	Integrated flat plate antenna
Antenna Gain	23 dBi typical
Antenna Beamwidth	8 Degrees
Max Path Loss (5 MHz Channel)	166 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

20.1.6 Management

Management	Specification
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

20.1.7 Ethernet Bridging

Ethernet Bridging	Specification
Protocol	IEEE802.1; IEEE802.1p; IEEE802.3 compatible
Interface	10/100/1000BaseT (RJ-45), Supports MDI/MDIX Auto Crossover
Data Rates	See Section 16 "Data Rate Calculations"
Maximum Ethernet Frame Size	2000 bytes

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

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

20.1.8 Physical

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

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

20.1.9 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

20.1.10 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.

20.2 Safety Compliance

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

20.3 EMC Emissions Compliance

20.3.1 PTP 25600 Variant

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

20.3.2 PTP 45600 Variant

Region	Specification
USA - Military	NTIA JF 12

20.3.3 PTP 54600 Variant

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

20.3.4 PTP 58600 Variant

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

20.4 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.

20.5   Radio Certifications

20.5.1 PTP 25600 Variant

Region	Specification (Type Approvals)
USA	FCC Part 27

20.5.2 PTP 54600 Variant

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

20.5.3 PTP 58600 Variant

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

20.6 Environmental Specifications

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

20.7 System Connections

20.7.1 PIDU Plus to ODU and ODU to Network Equipment Connections

Figure 172 - Cable Connection Diagram (T568B Color Coding)

Table 42 - Telecoms Connection Pin Out

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+

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 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, that is, 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 bands 2.5 GHz and 4.5 GHz, and in the unlicensed bands 5.4 GHz (ETSI Band B), 5.8 GHz (ETSI Band C and FCC ISM band) and 5.9 GHz. Users must ensure that the PTP 600 Series bridge complies with local operating regulations.

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.

22 Glossary

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

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