PTP 600 Series User Guide

MOTOROLA POINT-TO-POINT WIRELESS SOLUTIONS

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MOTOROLA, Inc.

Point-to-Point Wireless Bridges – PTP 600 Series

Software Release PTP 600-08-xx

System User Guide

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Copyright Information

http://www.motorola.com/ptp

Compliance

General

Changes or modifications not expressly approved by Motorola could void the user's authority to operate the system.

NOTE: 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 bands in which the system operates may be 'unlicensed' and, in these bands, the system can be used provided it does not cause interference. Further, it is not guaranteed protection against interference from other products and installations.

The system has been tested for compliance to both US (FCC) and European (ETSI) specifications. It has been shown to comply with the limits for emitted spurious radiation for a Class B digital device, pursuant to Part 15 of the FCC Rules in the USA and appropriate European ENs. These limits have been designed to provide reasonable protection against harmful interference. However the equipment can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to other radio communications. There is no guarantee that interference will not occur in a particular installation.

NOTE: A Class B Digital Device is a device that is marketed for use in a residential environment, notwithstanding use in commercial, business and industrial environments.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the Outdoor Unit (ODU).
- Increase the separation between the affected equipment and ODU.
- Connect the ODU/PIDU into a power outlet on a circuit different from that to which the receiver is connected.
- Consult your installer or supplier for help.

Deployment and Operation

The Radio Regulations of various countries' limits constrain the operation of radio products generally. In particular the local regulator may limit the amount of conducted or radiated transmitter power and may require registration of the radio link.

The power transmitted by the PTP 600 Series Bridge is controlled by the use of Region-specific License Keys.

The following examples show how the regulatory limits apply in some specific countries at the current time. Operators should note that regulations are subject to change.

Contact your supplier/installer to ensure that your product is set for the correct License Key for your Country/Region and to ensure that you have fulfilled all the local regulatory requirements, especially if you are intending to use a link with external antennas. Footnotes to the table below indicate countries where registration of the link is currently mandatory.

The system has been tested for compliance to both US (FCC) and European (ETSI) specifications. It has been shown to comply with the limits for emitted spurious radiation for a Class B digital device, pursuant to Part 15 of the FCC Rules in the USA and appropriate European ENs. These limits have been designed to provide reasonable protection against harmful interference. However the equipment can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to other radio communications. There is no guarantee that interference will not occur in a particular installation.

CAUTION: When planning a link that will use Connectorized PTP 600 Series bridges (with external antennas), ensure that regulatory requirements are met for the installation, as described in Section 13.6 "Regulatory Issues with Connectorized Units".

Regulations applicable to PTP 25600 variant

	Examples of Regulatory Limits at 2.5GHz
FCC	Under FCC Regulations, operation of this product is only allowed with a License Key for Region 16 which ensures that the product will meet the requirements of FCC part 27. **Note**: Spectrum in this band (2496MHz to 2690MHz) is allocated on a licensed basis in USA.

Regulations applicable to PTP 45600 variant

	Examples of Regulatory Limits at 4.5GHz
	Operation of this product is only allowed with a License Key for Region 23 (USA Military).

Regulations applicable to PTP 48600 variant

	Examples of Regulatory Limits at 4.8GHz
	Operation of this product is only allowed with a License Key for Regions 15 or 23 (USA Military).

Regulations applicable to PTP 49600 variant

	Examples of Regulatory Limits at 4.9GHz
	Operation of this product is only allowed with a License Key for Region 14 (USA/Canada Public Safety) or Region 18 (Hong Kong Public Safety).

Regulations applicable to PTP 54600 variant

	Examples of Regulatory Limits at 5.4GHz
FCC	Operation of this product is only allowed with a License Key for Region 12. This implements Radar Detection in accordance with FCC Regulations and limits the EIRP to the regulatory limits below: EIRP ≤ Max of [(17 +10 x Log(Channel BW)) and 30] dBm.
ETSI	Operation of this product is only allowed with a License Key for Region 26. This implements Radar Detection, including barring of the band from 5600 MHz to 5650 MHz and limits the EIRP to the regulatory limits below: EIRP ≤ Max of [(17 +10 x Log(Channel BW)) and 30] dBm
Australia, Canada	Operation of this product is only allowed with a License Key for Region 13. This implements Radar Detection, including barring of the band from 5600 MHz to 5650 MHz and limits the EIRP to the regulatory limits below: EIRP ≤ Max of [(17 +10 x Log(Channel BW)) and 30] dBm
Thailand	Operation of this product is only allowed with a License Key for Region 20 (30 dBm or 1W EIRP)
Korea	Operation of this product is only allowed with a License Key for Region 21 (28 dBm EIRP (15 MHz), 27 dBm EIRP (10 MHz), 24 dBm EIRP (5 MHz)).

General Notice Applicable to Europe
This equipment complies with the essential requirements for the EU R&E Directive 1999/5/EC.

CE 1321

NOTE: In regions other than EU/USA, specific local regulations may apply. It is the responsibility of the installer/user to check that the equipment as deployed meets local regulatory requirements.

Regulations applicable to PTP 58600 variant

	Examples of Regulatory Limits
USA/ Canada/ Taiwan/ Brazil	Equipment can be operated in any mode, best results will be obtained using Region 1 settings. There are some limitations on the use of antennas above 4ft diameter plus a band edge power reduction.
China	Operation of this product is only allowed with a License Key for Region 2 (33 dBm or 2W EIRP).
Australia	Operation of this product is only allowed with a License Key for Region 3 (36 dBm or 4W EIRP).
Hong Kong	Operation of this product is only allowed with a License Key for Region 3 (36 dBm or 4W EIRP).
UK	Operation of this product is allowed with a License Key for Region 4 . This implements Radar Detection with barring of the band from 5795 MHz to 5815 MHz and above 5850 MHz. It limits the EIRP to the Regulatory Limits below: EIRP ≤ Max of [(23 +10 x Log(Channel BW)) and 36] dBm
Singapore	Operation of this product is only allowed with a License Key for Region 5 (20 dBm or 100mW EIRP).
Eire	Operation of this product is only allowed with a License Key for Region 6 (33 dBm or 2W EIRP). The lower power limits are lower in narrower bandwidths.
Korea	Operation of this product is only allowed with a License Key for Region 11 (43 dBm or 20W EIRP).
India	Operation of this product is only allowed with a License Key for Region 19 (36 dBm or 4W EIRP at 15 MHz and 10 MHz and 33 dBm or 2 W EIRP at 5 MHz channel bandwidth).
Thailand	Operation of this product is only allowed with a License Key for Region 20 (30 dBm or 1W EIRP).
Germany	Operation of this product is only allowed with a License Key for Region 22. This limits the band of operation to 5755 MHz to 5850 MHz and limits the EIRP to the Regulatory Limits below: EIRP ≤ Max of [(23 +10 x Log(Channel BW)) and 36] dBm
Bahrain	Operation of this product is allowed with a License Key for Region 24 . This limits the EIRP to the Regulatory Limits below: EIRP ≤ Max of [(20 +10 x Log(Channel BW)) and 33] dBm
Norway	Under Norway Regulations, operation of this product is only allowed with a License Key for Region 7. This implements Radar Detection and limits the EIRP to the Regulatory Limits below: EIRP ≤ Max of [(40 +10 x Log(Channel BW)) and 53] dBm Spectral density at border between Norway and neighboring countries shall not exceed -122,5 dBW/m2 measured with a reference bandwidth of 1 MHz.

General Notice Applicable to Europe
This equipment complies with the essential requirements for the EU R&E 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, Eire (IRL), Germany, Denmark and Norway.
However, the regulatory situation in Europe is changing and the radio spectrum may become available in other countries in the near future. Please contact Motorola for the latest situation.

CE ! 0889 DK, DE, IE, NO, UK

Regulations applicable to PTP 59600 variant

	Examples of Regulatory Limits
Russia	Operation of this product is only allowed with a License Key for Region 16 (no power limit)
India	Operation of this product is only allowed with a License Key for Regions 17 or 19 (36 dBm or 4W EIRP at 30 MHz, 15 MHz and 10 MHz; and 33 dBm or 2 W EIRP at 5 MHz channel bandwidth).

NOTES:

UK Registration of Links – OfCom, The application form may be found at:

http://www.ofcom.org.uk/radiocomms/isu

Eire Registration of Links – Commission for Communication Regulation, The application form may be found at:

http://www.comreg.ie/licensing_and_services

Disclaimer

The parameters quoted in this document must be specifically confirmed in writing before they become applicable to any particular order or contract. The company reserves the right to make alterations or amendments to the detail specification at its discretion. The publication of information in this document does not imply freedom from patent or other rights of Motorola, Inc. or others.

Contents

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List of Figures

List of Tables

List of Equations

1 About This User Guide

This guide covers the installation, commissioning, operation and fault finding of the Motorola PTP 600 Series of Point-to-Point Wireless Ethernet Bridges.

1.1 Interpreting Typeface and Other Conventions

This document employs distinctive fonts to indicate the type of information, as described in Table 1.

Table 1 - Font types

Font	Type of Information
variable width bold	Selectable option in a graphical user interface or settable parameter in a web-based interface.
`constant width regular`	Literal system response in a command-line interface.
`constant width italic`	Variable system response in a command-line interface.
`constant width bold`	Literal user input in a command-line interface.
`constant width bold italic`	Variable user input in a command-line interface.

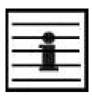
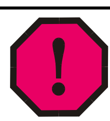
This document employs specific imperative terminology as follows:

- Type means press the following characters.
- Enter means type the following characters and then press Enter.
- Highlight means click anywhere in a row of data to highlight the entire row.
- Select means use the mouse to click on or branch to the menu item that follows.

Use this table and the Glossary to aid in interpreting the technical acronyms used throughout this User Guide.

This document also employs a set of consistently used admonitions. Each type of admonition has a general purpose that underlies the specific information in the box. These purposes are indicated in Table 2.

Table 2 - Admonition types

Admonition Label	General Message
	**Note** Informative content that may: • Defy common or cursory logic. • Describe a peculiarity of the 600 Series solutions implementation. • Add a conditional caveat. • Provide a reference. • Explain the reason for a preceding statement or provide background for what immediately follows. **Recommendation** Suggestion for an easier, quicker, or safer action or practice.
	**Important** Informative content that may: • Identify an indication that you should watch for. • Advise that your action can disturb something that you may not want disturbed. • Reiterate something that you presumably know but should always keep in mind.
	**Caution!** A notice that the risk of harm to equipment or service exists.
	**Warning!** A notice that the risk of harm to person exists.

1.2 Getting Additional Help

To get information or assistance as soon as possible for problems that you encounter, follow this procedure:

1. Search this document, the user manuals that support the modules, and the software release notes of supported releases:

   a. In the Table of Contents for the topic.

   b. In the Adobe Reader® search capability for keywords that apply (Reader is a registered trademark of Adobe Systems, Incorporated).

2. Visit the Motorola website at www.motorola.com/ptp

3. Ask your Motorola products supplier to help.

4. Gather information from affected units such as:

   a. the IP addresses and MAC addresses

   b. the software releases

   c. the configuration of software features

   d. any available diagnostic downloads

5. Escalate the problem to Motorola Technical Support as follows. You may either:

   a. Send e-mail to support.ptp@motorola.com

   b. Call our 24x7 Technical Support Center on +1 (0) 877 515 0400 (Worldwide) or +44 (0) 808 234 4640 (UK Customers).

For warranty assistance, contact your reseller or distributor for the process.

1.3 Sending Feedback

We welcome your feedback on the PTP 600 Series Bridge system documentation. This includes feedback on the structure, content, accuracy, or completeness of our documents, and any other comments you have. Send feedback to support.ptp@motorola.com.

2 Avoiding Hazards

2.1 Preventing Overexposure to RF Energy

WARNING: To protect from overexposure to RF energy, install the radios for the 600 family of PTP wireless solutions so as to provide and maintain the minimum separation distances from all persons as shown in Table 3.

When the system is operational, avoid standing directly in front of the antenna. Strong RF fields are present when the transmitter is on. The Outdoor Unit (ODU) must not be deployed in a location where it is possible for people to stand or walk inadvertently in front of the antenna.

At these and greater separation distances, the power density from the RF field is below generally accepted limits for the general population.

NOTE: These are conservative distances that include compliance margins.

2.1.1 Calculations for Separation Distances and Power Compliance Margins

Limits and guidelines for RF exposure come from:

- US FCC limits for the general population. See the FCC web site at http://www.fcc.gov, and the policies, guidelines, and requirements in Part 1 of Title 47 of the Code of Federal Regulations, as well as the guidelines and suggestions for evaluating compliance in FCC OET Bulletin 65.
- Health Canada limits for the general population. See the Health Canada web site at http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/99ehd-dhm237/limits-limites_e.html and Safety Code 6.
- EN 50383:2002 Basic standard for the calculation and measurement of electromagnetic field strength and SAR related to human exposure from radio base stations and fixed terminal stations for wireless telecommunication systems (110 MHz - 40 GHz).
- ICNIRP (International Commission on Non-Ionizing Radiation Protection) guidelines for the general public. See the ICNIRP web site at http://www.icnirp.de/ and Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields.

The applicable power density exposure limit from the documents referenced above is:

- 10 W/m^2 for RF energy in the 2.4-, 5.2-, 5.4-, 5.8- and 5.9 GHz frequency bands.

Peak power density in the far field of a radio frequency point source is calculated as follows:

Equation 1 - Peak power density in the far field

$$S = \frac{P.G}{4\pi d^2}$$

Where

S = power density in W/m^2

P= Maximum Average transmit power capability of the radio, in W

G= total Tx gain as a factor, converted from dB

d = distance from point source, in m

Rearranging terms to solve for distance yields:

$$d = \sqrt{\frac{P.G}{4\pi.S}}$$

2.1.1.1 Calculated Distances and Power Compliance Margins

Table 3 shows calculated minimum separation distances d, recommended distances and resulting power compliance margins for each frequency band and antenna combination.

Table 3 - Power Compliance Margins

Band	Antenna	Max Average Transmit Power in Burst (Watt)	Variable			d (m)	Recom-mended Distance (m)	Power Compliance Margin
			P (Watt)	G	S (W/m^2)			
2.5 GHz	Integrated	0.25	0.125	63 (18dBi)	10	0.25	2	8.0
4.5 GHz	Integrated	0.5	0.4	63 (22dBi)	10	0.71	5	7.0
4.8 GHz	Integrated	0.5	0.4	63 (22dBi)	10	0.71	5	7.0
	Connectorized	0.5	0.4	(26 dBi)	10	1.1	5	4.5
4.9 GHz	Integrated	0.25	0.2	63 (22dBi)	10	0.5	2	4.0
	Connectorized	0.25	0.2	(26 dBi)	10	0.8	5	6.25

Band	Antenna	Max Average Transmit Power in Burst (Watt)	Variable			d (m)	Recom-mended Distance (m)	Power Compliance Margin
			P (Watt)	G	S (W/m^2)			
5.4 GHz	Integrated	0.005 (7dBm)	0.00250	200 (23dBi)	10	0.06	1	15.9
	External 4ft Dish	0.00035 (-4.6dBm)	0.00017	2884 (34.6dBi)	10	0.06		
5.8 GHz	Integrated	0.32 (25dBm)	0.16	200 (23dBi)	10	0.5	2	4.0
	External 2ft Flat Plate	0.32 (25dBm)	0.16	631 (28dBi)	10	0.9	4	4.5
	External 6ft Dish	0.32 (25dBm)	0.16	6310 (38dbi)	10	2.83	10	3.5
5.9 GHz	Integrated	0.32 (25dBm)	0.16	200 (23dBi)	10	0.5	2	4.0
	External 2ft Flat Plate	0.32 (25dBm)	0.16	631 (28dBi)	10	0.9	4	4.5
	External 6ft Dish	0.32 (25dBm)	0.16	6310 (38dbi)	10	2.83	10	3.5

NOTES:

- The regulations require that the power used for the calculations is the maximum power in the transmit burst subject to allowance for source-based time-averaging.
- At 5.4 GHz and EU 5.8 GHz, the products are generally limited to a fixed EIRP which can be achieved with the Integrated Antenna. The calculations above assume that the maximum EIRP allowed by the regulations is being transmitted.
- If there are no EIRP limits in the country of deployment, use the distance calculations for FCC 5.8 GHz for all frequency bands.
- At FCC 5.8 GHz, for antennas between 0.6m (2ft) and 1.8m (6ft), alter the distance proportionally to the antenna gain.
- At 2.5 GHz, for antennas between 1.2m (4ft) and 3.6m (12ft) the safe distance is increased to between 0.8m (2.6 ft) and 2.4m (7.8 ft).

3 Getting Started

3.1 For Your Safety

WARNING: Use extreme care when installing antennas near power lines.

WARNING: Use extreme care when working at heights.

WARNING: The Outdoor Unit (ODU) for the PTP 600 Series Bridge must be properly grounded to protect against lightning. In the USA and Canada it is the user's responsibility to install the equipment in accordance with Section 810 of the National Electric Code, ANSI/NFPA No.70-1984 or Section 54 of the Canadian Electrical Code. These codes describe correct installation procedures for grounding the outdoor unit, mast, lead-in wire and discharge unit, size of grounding conductors and connection requirements for grounding electrodes. Other regulations may apply in different countries and therefore it is recommended that installation of the outdoor unit be contracted to a professional installer.

WARNING: The ODU for the PTP 600 Series Bridge must be grounded to a Protective Earth in accordance with the Local Electrical Regulations.

WARNING: It is recommended that the supplied Power Indoor Plus (PIDU Plus) – PTP 600 Series is used to power the PTP 600 Series Bridge ODU. The use of other power sources may invalidate safety approval and affect your warranty.

WARNING: A cable measuring card must NEVER be used at the ODU end connected to power from the PIDU. It must only be used at the bottom of the mast with a multimeter. This is because the PIDU voltage exceeds the limit allowed in some countries for safe handling in wet conditions and therefore may create a safety hazard.

WARNING: When using alternative DC supplies (via the PIDU Plus DC in terminals as described in Section 3.3.3 "Redundancy and Alternative Powering Configurations"), such as battery-backed DC power source, the supply MUST comply with the following requirements:

- The voltage and polarity is correct and is applied to the correct terminals in the PIDU Plus
- The power source is rated as SELV
- The power source is rated to supply at least 1A continuously
- The power source cannot provide more than the Energy Hazard Limit as defined by IEC/EN/UL6090, Clause 2.5, Limited Power (The Energy Hazard Limit is 240VA)

WARNING: Users and installers should note that the main power supply is the primary disconnect device.

WARNING: Safety will be compromised if external quality cables are not used for connections that will be exposed to the weather.

WARNING: Safety will be compromised if a different power supply is used than the one supplied by Motorola as part of the system.

3.2 Welcome

Congratulations on the purchase of the PTP 600 Series Bridge from Motorola. The PTP 600 Series Bridge is the latest innovation in high-speed wireless networking that lets you deploy wireless networks in areas previously unattainable.

3.2.1 Who Should Use This Guide

The guide is for use by the system installer and the end user IT professional. The system installer will require expertise in the following areas:

- Outdoor radio equipment installation
- Network configuration
- Use of web browser for system configuration, monitoring and fault finding

3.2.2 Contact Information

Table 4 - Contact Information

Postal Address:	Motorola, Inc. Unit A1, Linhay Business Park, Eastern Road, Ashburton, Devon. TQ13 7UP United Kingdom
Web Site:	http://www.motorola.com/ptp
Sales Enquiries:	sales.ptp@motorola.com
Web Support:	http://www.motorola.com/ptp/support
Email Support:	support.ptp@motorola.com
All Other Enquiries:	info.ptp@motorola.com
Telephone Enquiries and Global Support:	+1 (0) 877 515 0400 (Toll Free in the USA) and +44 (0) 808 234 4640 (Toll Free in the UK).

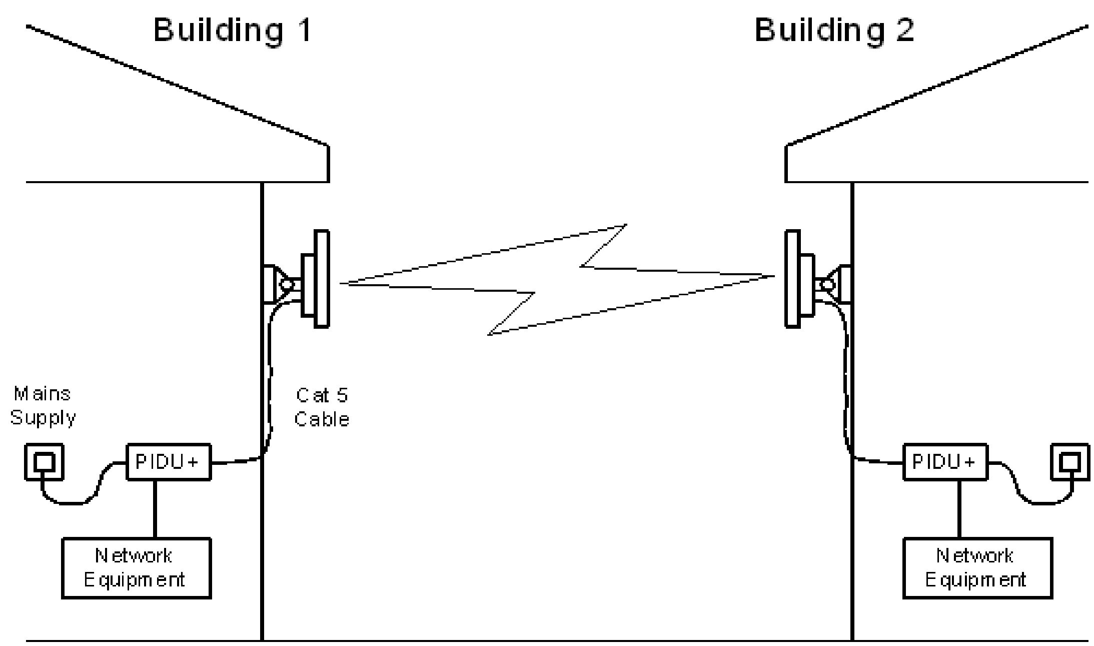
3.2.3 Repair and Service

For unit repair or service, contact your service provider or an authorized Motorola Point-to-Point Distributor for Return Material Authorization (RMA) and shipping instructions. Alternatively, contact the PTP Global Technical Support Center to process an RMA.

3.3 Product Description

This User Manual is specifically written for the 600 family of point-to-point broadband wireless solutions. The PTP 600 Series Bridge has been developed to provide Point-to-Point data connectivity via a 2.5 GHz, 4.5 GHz, 4.8 GHz, 4.9 GHz, 5.4 GHz, 5.8 GHz or 5.9 GHz wireless Ethernet bridge operating at broadband data rates. The PTP 600 Series Bridge is aimed at a wide range of applications. An example application is an enterprise that has a requirement to connect together the Local Area Network (LAN) of two or more buildings as shown in Figure 1.

Figure 1 - Typical PTP 600 Series Bridge Deployment



The PTP 600 Series Bridge offers true non-line-of-sight (NLOS) operation by using a combination of Orthogonal Frequency Division Multiplexing (OFDM) modulation and Multiple-Input Multiple-Output (MIMO) techniques. These technologies enable the PTP 600 Series Bridge to drive through foliage and around buildings to such an extent that almost universal coverage can be expected at short range.

A PTP 600 Series Bridge system consists of a pair of identical devices that are deployed one at each end of the link. At installation, the user sets up one unit as the Master and the other as the Slave. Either unit can be configured as Master or Slave.

Each end of the link consists of:

- An integrated (or connectorized -see section 13) outdoor transceiver unit containing all the radio and networking electronics hereafter referred to as the Outdoor Unit (ODU).
- An indoor connection box containing a mains power supply, status indicators and network connection port. Hereafter referred to as the Power Indoor Unit Plus (PIDU Plus).

A pair of units is normally supplied pre-configured as a link.

The network connection to a PTP 600 Series Bridge is made via a 1000BaseT Ethernet connection. Power is provided to the ODU over the 1000BaseT Ethernet connection using a patented non-standard powering technique.

Previous releases of the PTP 600 Series Bridge platform used different powering and connection arrangements. Users of equipment prior to “Mod Record 1” should refer to the User Guide shipped with the original equipment. The “Mod Record” label can be found on the back of the ODU as shown in Figure 2.

Figure 2 - Mod Record Label

Alternatively, the network connection to a PTP 600 Series Bridge can be made using a 1000BaseSX Fiber Optic cable connected directly to the ODU. In this case power is still provided over the 1000BaseT Ethernet connection. In the case of Fiber Optic cable failure the PTP 600 Series Bridge will automatically fall back to the copper Ethernet connection (provided the cable length <=100m [330 ft]). “PTP 600 Series Optical Interface Upgrade Kits” can be obtained from your distributor, reseller or system integrator.

Power is fed into the PTP 600 Series Bridge PIDU Plus from the mains via a standard "figure of eight" mains plug. Connection between the ODU and PIDU Plus is made using standard CAT5e outdoor UV resistant cable. Connection between the PIDU Plus and the Network Equipment is made using standard CAT5e cable.

3.3.1 The Outdoor Unit (ODU)

The ODU is a self-contained unit. It houses both radio and networking electronics. The ODU for the PTP 600 Series Bridge should only be deployed using the supplied PTP 600 Series Bridge PIDU Plus. Figure 3 shows an installation example of a PTP 600 Series ODU with a Motorola lightning protection unit (PTP-LPU).

Figure 3 – PTP 600 Series Bridge Outdoor Unit (ODU) with PTP-LPU

3.3.2 PIDU Plus – PTP 600 Series Bridge

The PTP 600 Series Bridge PIDU Plus is used to generate the ODU supply voltage from the mains supply and inject this supply voltage into the 1000BaseT Ethernet connection to the ODU. Connection uses a CAT5e cable using standard RJ45 wiring.

CAUTION: Care should be taken not to connect equipment other than an ODU for the PTP 600 Series Bridge to a PIDU Plus ODU port as equipment damage may occur. The PTP 600 Series Bridge PIDU Plus is not interchangeable with the PTP 400 Series PIDU Plus.

Figure 4 - Power Indoor Unit (PIDU Plus) – PTP 300/500/600 Series

The front panel contains indicators showing the status of the power and Ethernet connections.

The power indicator is illuminated when the PIDU Plus is receiving mains power.

The Ethernet indicator normally illuminates when the Ethernet link is working, flashing when there is Ethernet activity. The fact that it lights also indicates that the ODU is powered. At power up the LED will flash 10 times to indicate that a correct start up sequence has occurred. See Section 11 “Fault Finding” for further fault finding information.

At the bottom of the PIDU Plus is an entry point for the PIDU Plus to ODU cable, the 1000BaseT Ethernet network port and the Recovery switch.

Figure 5 – PIDU Plus Recovery Switch Location

The Recovery switch is used to recover the unit from configuration errors or software image corruption. To put a PTP 600 Series Bridge into Recovery mode the Recovery switch should be pressed then the power applied. The Recovery switch should be kept pressed for at least 20 seconds after the power has been applied. Full instruction on the recovery mode can be found in Section 9 “Recovery Mode”.

A simple reboot can be performed by removing and re-applying the mains power to the PTP 600 Series Bridge PIDU Plus.

On the left hand side of the PIDU Plus, 48V DC input and output connections can be found. These are used to power the PTP 600 Series Bridge from an external DC source or to provide a level of power supply redundancy, as shown in Section 3.3.3 “Redundancy and Alternative Powering Configurations”.

WARNING: When using alternative DC supplies the supply MUST comply with the following requirements:

- The voltage and polarity is correct and is applied to the correct terminals in the PIDU Plus
- The power source is rated as SELV
- The power source is rated to supply at least 1A continuously
- The power source cannot provide more than the Energy Hazard Limit as defined by IEC/EN/UL6090, Clause 2.5, Limited Power (The Energy Hazard Limit is 240VA)

Also on the left hand side of the PTP 600 Series Bridge PIDU Plus, connectors and jumpers can be found that allow the remote connection of power LED, Ethernet LED and Recovery switch. The connection instructions can be found in Section 3.3.4 “Remote LEDs and Recovery Switch”.

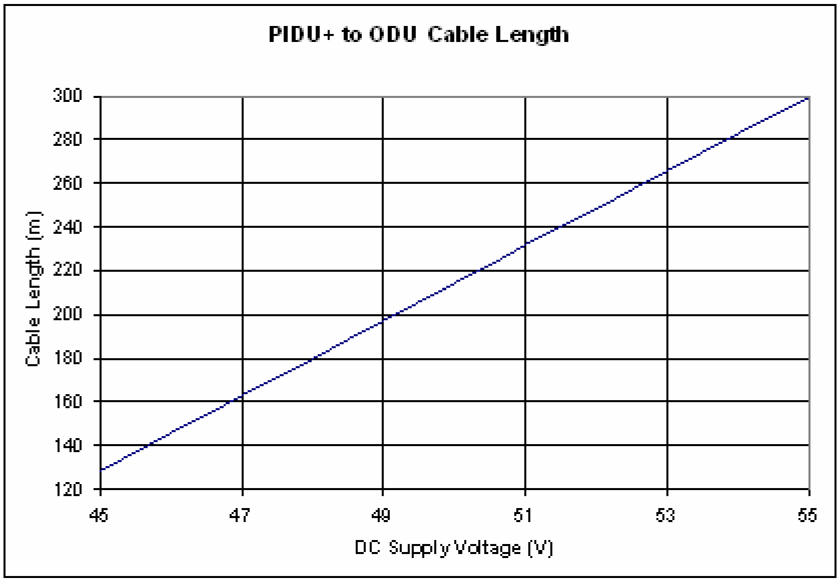
The input supply range for the 600 Series PIDU Plus is 90V-264V AC, 47-63Hz. Mains connection to the PIDU Plus is made using a standard “figure of eight” mains lead as shown in Figure 6.

Figure 6 –PTP 300/500/600 Series Bridge PIDU Plus Power Input

3.3.3 Redundancy and Alternative Powering Configurations

NOTE: The use of DC supplies of less than 55v will reduce the usable distance between the PIDU Plus and ODU see Figure 7.

Figure 7 – PTP 600 Series Bridge PIDU Plus to ODU Cable Length Graph

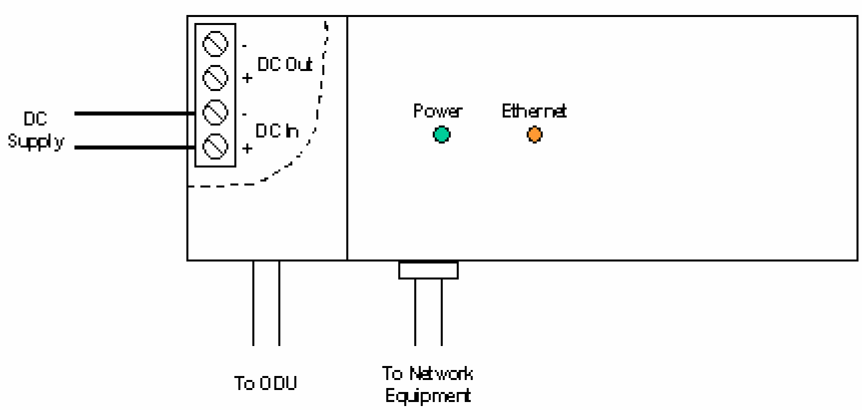


CAUTION: The maximum distance from the ODU to the connected network equipment is 100m (330 ft) when using 1000BaseT. Powering distances over 100m (330 ft) are only applicable when using a 1000BaseSX (Fiber Optic) connection.

3.3.3.1 External DC Supply Only

This configuration is for use where there is no mains supply.

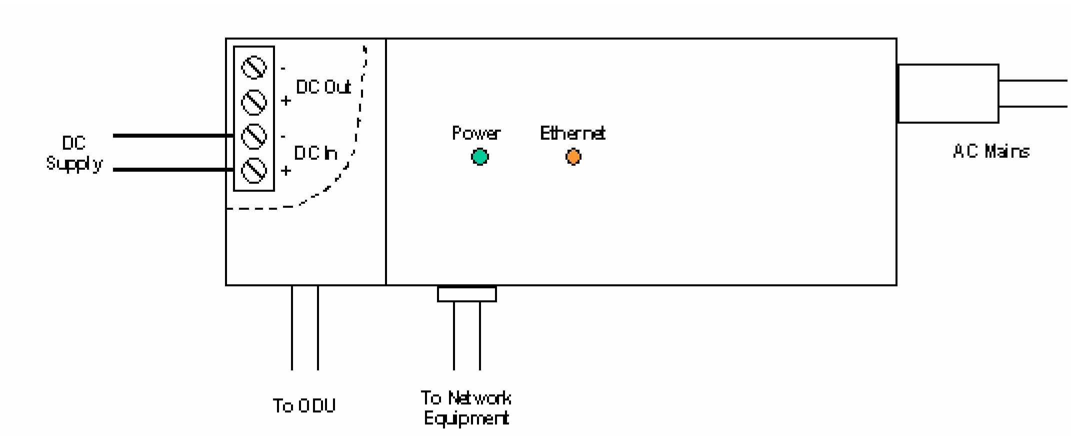
Figure 8 - External DC Supply Only



3.3.3.2 External DC Supply and AC Supply

This configuration provides redundancy through the use of mains and DC supply.

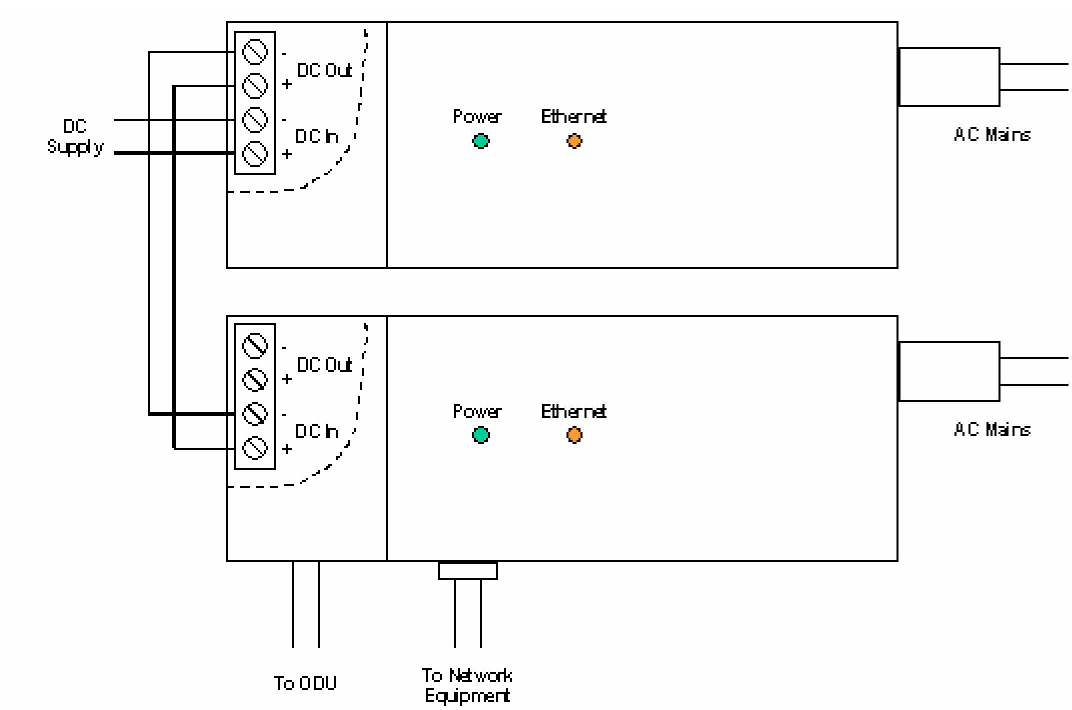
Figure 9 - External DC Supply and AC Supply



3.3.3.3 External DC Supply and Redundant AC Supply

This configuration guards against mains failure and failure of the DC output of single PTP 300/500/600 PIDU Plus.

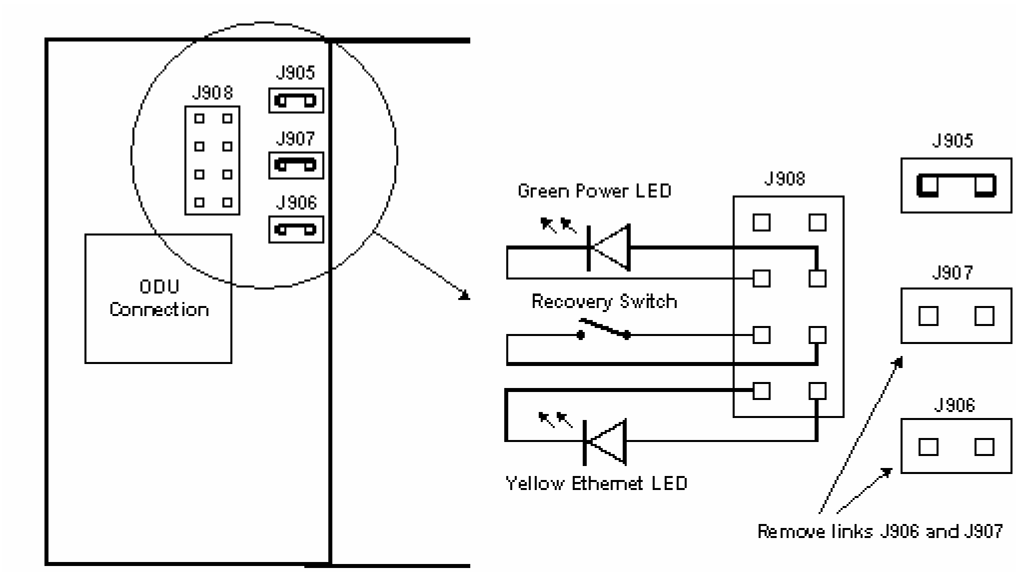
Figure 10 - External DC Supply and Redundant AC Supply



3.3.4 Remote LEDs and Recovery Switch

The PTP 600 Series Bridge PIDU Plus provides a facility to connect remote LEDs and Recovery switch allowing the PIDU Plus to be mounted inside an enclosure. At the left hand end of the PIDU Plus under the ODU connection cover can be found a PCB header and three jumpers. Jumpers J906 and J907 should be removed and connection to the remote LEDs and Recovery switch made to J908 as shown in Figure 11.

Figure 11 - Remote LED and Recovery Switch Wiring



3.3.5 Cables and connectors

The cable used to connect the PTP 600 Series Bridge PIDU Plus to the ODU can be any standard CAT5e type provided that it is suitable for outdoor deployment. Motorola recommends that cables to the specification below be used:

Cable:	**Superior Essex BBDGE CAT 5e**
Connector Type:	**Tyco, 5-569278**
Gland:	**Motorola WB1811**

CAUTION: Failure to use the recommended (or equivalent) standard of cable may invalidate the system's safety certification.

The cable used to connect the PTP 600 Series Bridge PIDU Plus to the users Network Equipment can be any standard CAT5e Cable.

The PIDU Plus to ODU and the PIDU Plus to Network Equipment cables may be unscreened (UTP) or screened (STP). However, unscreened cables reduce the system's ability to cope with nearby lightning strikes. If lightning activity is common in the area of deployment, the use of screened cable is highly recommended. See Section 10 "Lightning Protection".

The PIDU Plus provides screen continuity between the ODU and Network Equipment connections.

NOTE: The ODU network connection implements automatic MDI/MDI-X sensing and pair swapping allowing connection to networking equipment that require cross-over cables (MDI-X networks) or straight-through cables (MDI Networks).

3.3.6 PTP and Lightning Protection

The PTP 600 Series Bridge PIDU Plus meets the low level static discharge specifications identified in Section 20 "Specifications", but does not provide lightning or surge suppression. Installations will generally require lightning or surge suppression, a separate Ethernet surge suppressor must be used and appropriately earthed. Suitable surge suppressors can be sourced from your Motorola Point-to-Point Distributor or Solutions Provider. See Section 10 "Lightning Protection".

3.3.7 Mounting Brackets

The PTP 600 Series Bridge is supplied with a mounting bracket suitable for mounting the ODU to a pole of 50mm (2") to 75mm (3") in diameter. For more details on mounting, see Section 7 "Installation".

The bracket allows for adjustment in both azimuth and elevation. The bracket may be split allowing the pole mount section of the bracket to be mounted to the pole first. This allows the installer to take the weight of the unit and secure it, one handed, with a single mounting bolt.

The PIDU Plus can either be desk or wall mounted. The preference is wall mounted with the cables dressed to a cable channel. Wall mounting is achieved by screwing through the mounting lugs on either side of the unit. Remember to leave space for access to the Recovery button. See Section 3.3.2 "PIDU Plus – PTP 600 Series Bridge".

3.3.8 Configuration and Management

Configuration and Management of the PTP 600 Series Bridge is implemented using an inbuilt web server hosting a number of Configuration and Management web pages. This approach allows Configuration and Management to be carried out on any standard web browsing technology. The PTP 600 Series Bridge can also be managed remotely using the SNMP management protocol. Connection to the bridge is via the Ethernet connection carrying the bridge network traffic. Connection to the unit is via a preset IP address. This address can be changed via the Network Interface Configuration web page. A full explanation of the available web pages and their use can be found in Section 8 “Web Page Reference”.

3.4 Warranty

Motorola’s standard hardware warranty is for one (1) year from date of shipment from Motorola or a Motorola Point-to-Point Distributor. Motorola warrants that hardware will conform to the current relevant published specifications and will be free from material defects in material and workmanship under normal use and service. Motorola shall within this time, at its own option, either repair or replace the defective product within thirty (30) days of receipt of the defective product. Repaired or replaced product will be subject to the original warranty period but not less than thirty (30) days.

Motorola warranty for software is described in details in 19.8.1 “Motorola Inc. End User License Agreement”.

4 Product Architecture

4.1 Radio Link

The PTP 600 Series Bridge consists of an identical pair of units deployed one at each end of the link. The radio link operates on a single frequency channel in each direction using Time Division Duplex (TDD). One unit is deployed as a master and the other as a slave. The master unit takes responsibility for controlling the link in both directions.

The non-line-of-sight (NLOS) aspects of the product are provided by Multiple-Input Multiple-Output (MIMO), coupled with Orthogonal Frequency Division Multiplexing (OFDM) modulation.

4.2 Frequency Bands

The PTP 600 Series Bridge has been developed to operate within license exempt frequency bands as well as the licensed 2.5GHz band in the USA. The current product range supports:

- USA BRS-EBS Post-Transition band 2.5 GHz (2496 – 2690 GHz)
- ETSI 5.4 GHz band B (5.470-5.725 GHz)
- ETSI 5.8 GHz band C (5.725–5.850 GHz) and the USA 5 GHz ISM band (5.725-5.850 GHz)
- US Federal 4.5 GHz band (4.404-4.596 GHz)
- USA and Canada Public Safety 4.9 GHz band
- Military 4.8 GHz band
- 5.9 GHz band (5.825-5.925 GHz)

The PTP 600 Series Bridge has been designed to coexist with other users of the band in an optimal fashion using a combination of Transmit Power Control (TPC), Spectrum Management functionality and Antenna beam shape. In order to maintain link availability, the product employs adaptive modulation techniques that dynamically reduce the data rate in severe or adverse conditions.

4.3 Ethernet Frames

The PTP 600 series provides wireless Ethernet bridging between two fixed locations. To be more precise, it forwards Ethernet frames as a two-port transparent heterogeneous encapsulation bridge, meaning that each bridge forwards frames between two dissimilar interfaces (Ethernet and wireless), encapsulating Ethernet MAC frames within a PTP MAC frames for transmission at the wireless interface. A link consisting of a pair of back to back bridges appears to the data network to be very similar to a standard two-port Ethernet bridge.

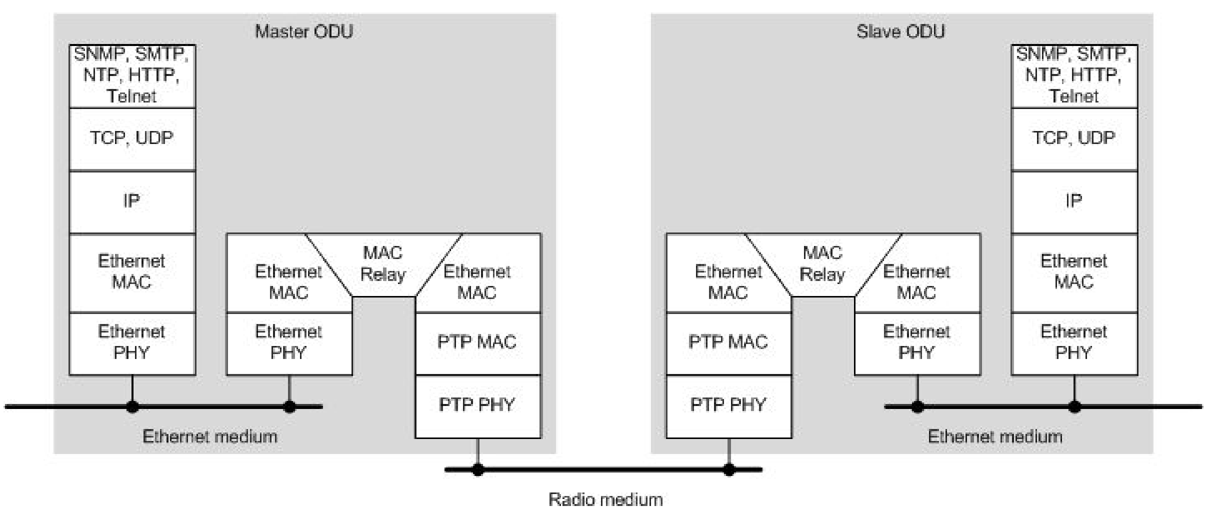
The PTP600 series provides two egress queues in each direction, classifying Ethernet frames into one of the two prioritized queues based on inspection of the user priority field (802.1p) in a customer (IEEE802.1Q) VLAN tag or provider (IEEE802.1ad) VLAN tag. Untagged frames receive a default priority. The queuing method is strict priority. The bridge does not implement any VLAN functions for bridged frames apart from inspection of the priority field, and consequently the bridge forwards tagged and untagged Ethernet frames regardless of VLAN ID and without modification of any protocol header fields.

The PTP 600 series supports a maximum Ethernet frame size of 2000 bytes for bridged traffic.

4.4 Management Function

The management function of the PTP 600 Series Bridge is logically equivalent to a separate protocol stack with virtual point of attachment at the Ethernet interface. This is illustrated in Figure 12.

Figure 12 – PTP 600 Series Bridge Layer Diagram



Each unit in the link is manageable through an IP connection. Standard IP protocols are utilized for all management functions, for example, HP, SNMP, etc. The unit can be configured to use a VLAN with a single C-tag or S-tag on the management interfaces.

4.5 Channel Bandwidth and Link Symmetry Control

The PTP 600 series provides configurable channel bandwidth in the radio link (5 MHz, 10 MHz, 15 MHz, 20 MHz and 30 MHz depending on the frequency band for the bandwidth choice, see Table 5), and configurable fixed and adaptive link symmetry. Fixed link symmetry supports:

- 2:1
- 1:1
- 1:2

Channel bandwidth 5 MHz supports link symmetry 1:1 only.

4.6 Upgradeable Software

The PTP 600 Series Bridge is fully software upgradeable. New software images are first downloaded from the Motorola website http://www.motorola.com/ptp to a convenient computer. The image is then uploaded to the ODU via the web management page described in Section 8.3.6 “Software Upgrade”. The compressed image is first loaded into RAM and check-summed. If the compressed image transfer has completed successfully the image is decompressed and written to flash memory. On completion of this process the unit can be rebooted to use the newly uploaded image. Should this process fail, the unit will revert to a protected compressed image installed during manufacturing to allow the unit to be recovered.

5 Radio Link Planning and Regulations

5.1 Spectrum Planning

The PTP 600 Series Bridge has seven frequency variants in its product range.

Table 5 - PTP 600 Series Bridge Frequency Variants

Variant	Definition	Frequency Coverage	Variable Channel Width	Channel Raster
PTP 25600	FCC BRS-EBS Post-Transition Band	2496-2568 MHz	5, 10, 15 and 30 MHz	5.5 MHz
		2572-2614 MHz	5, 10, 15 and 30 MHz	6 MHz
		2618-2690 MHz	5, 10, 15 and 30 MHz	5.5 MHz
PTP 45600	Military	4404-4596 MHz	5, 10, 15 MHz	6 MHz
		4404-4596 MHz	30 MHz	10 MHz
PTP 48600	Military	4710-4940 MHz	5, 10, 20 MHz	5 MHz
	Military Extended	4710-5000 MHz	5, 10, 20 MHz	5 MHz
PTP 49600	USA/Canada Public Safety	4940-4990 MHz	5, 10, 20 MHz	5 MHz
	Hong Kong Public Safety	4900-4950 MHz	5, 10, 20 MHz	5 MHz
PTP 54600	ETSI 5 GHz Band B FCC UNII Band	5470-5725 MHz	5,10,15 MHz	6 MHz
		5470-5725 MHz	30 MHz	10 MHz
PTP 58600	ETSI 5 GHz Band C FCC ISM Band	5725-5850 MHz	5,10,15 MHz	6 MHz
		5725-5850 MHz	30 MHz	10 MHz
PTP 59600	Russia	5825-5925 MHz	5, 10, 15 MHz	6 MHz
			30 MHz	10 MHz
	India	5875-5925 MHz	5, 10, 15 MHz	6 MHz
			30 MHz	10 MHz

NOTE: For PTP 25600, channel widths of 30 MHz are available where allowed by local regulations and subject to some restrictions on channel choice.

NOTE: For PTP 54600, PTP 58600 and PTP 59600, use of the product is allowed according to local regulations.

There are two alternative methods of spectrum planning:

- First an operator can utilize the default spectrum management mode i-DFS (intelligent Dynamic Frequency Selection). This mode uses the PTP 600 Series Bridge ability to measure the interference levels in all channels to build up a picture of the interference / noise levels in all channels. The PTP 600 Series Bridge uses statistical techniques to select the most appropriate transmit and receive channels. The i-DFS mode can be influenced in its channel decision process by selectively barring channels from use. The use of this functionality is described in detail in Section 8.3.7 “Spectrum Management”.
- Second, when detailed control of the spectrum allocation is required, it is recommended that the fixed frequency mode is used to statically allocate transmit and receive channels.

CAUTION: These methods are not allowed when Radar Detection is enabled.

5.2 Licenses and Region Codes

The PTP 600 Series Bridge uses a system of Region Codes to control the operation of the radio link. The user must ensure the product is configured to conform to local regulatory requirements by installing a License Key for the correct Region Code.

CAUTION: For the connectorized model, when using external antennas of higher gain than the appropriate integrated antenna, the regulations may require the maximum Tx power to be reduced. To ensure that regulatory requirements are met for connectorized installations, refer to Section 13.6 “Regulatory Issues with Connectorized Units”.

5.2.1 PTP 25600 Licenses and Region Codes

PTP 25600 units may be operated in any of the regions listed in Table 6.

When shipped, PTP 25600 units are configured with a license key for Region Code 16. An alternative license key is provided in the Deployment Guide for Region Code 18.

NOTE: For a PTP 25600 in Region Code 16, the EIRP limit is approximately 63 dBm + 10 x Log(360/Antenna Azimuth BW). PTP25600 products are not able to exceed this EIRP limit with any available antenna.

Table 6 – PTP 25600 Licenses and Region Codes

Region Code	License / Regulation	Frequencies	DFS	Channel Bandwidth	Max Power	Notes
16	FCC Upper	2624 - 2690 MHz		15, 30 MHz	63 dBm EIRP	The 30MHz bandwidth is not approved in FCC regions.
				10 MHz	63 dBm EIRP	
				5 MHz	63 dBm EIRP	
	FCC Middle	2572 - 2614 MHz		5, 10, 15 MHz	63 dBm EIRP	
	FCC Lower	2496 - 2568 MHz		5, 10, 15, 30 MHz	63 dBm EIRP	
18	Taiwan Upper	2660 - 2690 MHz		15 MHz	23 dBm	
				10 MHz	22 dBm	
				5 MHz	21 dBm	
	Taiwan Middle	2595 - 2625 MHz		5, 10, 15 MHz	23 dBm	
	Taiwan Lower	2565 - 2595 MHz		5, 10, 15 MHz	23 dBm	

5.2.2 PTP 45600 Licenses and Region Codes

PTP 45600 units may be operated in any of the regions listed in Table 7.

When shipped, PTP 45600 units are configured with a license key for Region Code 23.

Table 7 – PTP 45600 Licenses and Region Codes

Region Code	License / Regulation	Frequencies	DFS	Channel Bandwidth	Max Power	Notes

23	USA Military	4400 - 4600 MHz		5, 10, 15, 30 MHz	25 dBm	

5.2.3 PTP 48600 Licenses and Region Codes

PTP 48600 units may be operated in any of the regions listed in Table 8.

When shipped, PTP 48600 units are configured with a license key for Region Code 23. An alternative license key is provided in the Deployment Guide for Region Code 14. If the link is to be installed in any other permitted region, the user must obtain a new license key from the reseller or distributor.

Table 8 – PTP 48600 Licenses and Region Codes

Region Code	License / Regulation	Frequencies	DFS	Channel Bandwidth	Max Power	Notes
14	USA/Canada Public Safety	4940 - 4990 MHz		5, 10, 20 MHz	25 dBm	See note below.
15	USA Military Extended	4710 - 5000 MHz		5, 10, 20 MHz	27 dBm	
23	USA Military	4710 - 4940 MHz		5, 10, 20 MHz	27 dBm	

NOTE: Region Code 14 Max Power depends upon Antenna Gain:

- If Antenna Gain < 26 dBi then Max Power = 25 dBm
- If Antenna Gain >= 26 dBi then Max Power = (51 – Antenna Gain) dBm

5.2.4 PTP 49600 Licenses and Region Codes

PTP 49600 units may be operated in any of the regions listed in Table 9.

When shipped, PTP 49600 units are configured with a license key for Region Code 14. An alternative license key is provided in the Deployment Guide for Region Code 18.

Table 9 – PTP 49600 Licenses and Region Codes

Region Code	License / Regulation	Frequencies	DFS	Channel Bandwidth	Max Power	Notes
14	USA/Canada Public Safety	4940 - 4990 MHz		5, 10, 20 MHz	25 dBm	See note below.
18	Hong Kong Public Safety	4900 - 4950 MHz		5, 10, 20 MHz	25 dBm	See note below.

NOTE: Region Codes 14 and 18 Max Power depends upon Antenna Gain:

- If Antenna Gain < 26 dBi then Max Power = 25 dBm
- If Antenna Gain >= 26 dBi then Max Power = (51 – Antenna Gain) dBm

5.2.5 PTP 54600 Licenses and Region Codes

PTP 54600 units may be operated in any of the regions listed in Table 10.

When shipped, PTP 54600 units are configured with a license key for Region Code 26. Alternative license keys are provided in the Deployment Guide for Region Codes 12 and 13. If the link is to be installed in any other permitted region, the user must obtain a new license key from the reseller or distributor.

Table 10 – PTP 54600 Licenses and Region Codes

Region Code	License / Regulation	Frequencies	DFS	Channel Bandwidth	Max Power	Notes
7	Full Power + Radar	5470 - 5725 MHz	Yes	5, 10, 15, 30 MHz	25 dBm	
8	Full Power	5470 - 5725 MHz		5, 10, 15, 30 MHz	25 dBm	
12	FCC	5470 - 5725 MHz	Yes	30 MHz	30 dBm EIRP	
				15 MHz	27 dBm EIRP	
				10 MHz	25 dBm EIRP	
				5 MHz	22 dBm EIRP	
13	Australia, Canada	5470 - 5600 MHz 5650 - 5725 MHz	Yes	30 MHz	30 dBm EIRP	
				15 MHz	27 dBm EIRP	
				10 MHz	25 dBm EIRP	
				5 MHz	22 dBm EIRP	
20	Thailand	5470 - 5725 MHz		5, 10, 15, 30 MHz	30 dBm EIRP	
21	Korea	5470 - 5650 MHz		15 MHz	28 dBm EIRP	
				10 MHz	27 dBm EIRP	
				5 MHz	24 dBm EIRP	
26	ETSI	5470 - 5600 MHz 5650 - 5725 MHz	Yes	30 MHz	30 dBm EIRP	The band 5600 MHz to 5650 MHz is reserved for the use of weather radars
				15 MHz	27 dBm EIRP	
				10 MHz	25 dBm EIRP	
				5 MHz	22 dBm EIRP	

5.2.6 PTP 58600 Licenses and Region Codes

PTP 58600 units may be operated in any of the regions listed in Table 11.

When shipped, PTP 58600 units are configured with a license key for Region Code 1. An alternative license key is provided in the Deployment Guide for Region Code 25. If the link is to be installed in any other permitted region, the user must obtain a new license key from the reseller or distributor.

Table 11 – PTP 58600 Licenses and Region Codes

Region Code	License / Regulation	Frequencies	DFS	Channel Bandwidth	Max Power	Notes
1	FCC USA, Canada, Taiwan, Brazil	5725 - 5850 MHz		5, 10, 15, 30 MHz	25 dBm	Reduced TX power at band edges
2	China	5725 - 5850 MHz		5, 10, 15, 30 MHz	33 dBm EIRP	
3	Australia, Hong Kong	5725 - 5850 MHz		5, 10, 15, 30 MHz	36 dBm EIRP	
4	UK	5725 - 5795 MHz 5815 - 5850 MHz	Yes	30 MHz	35 dBm EIRP	5795 MHz to 5815 MHz is assigned for Road Transport and Traffic Telematics (RTTT).
				15 MHz	34 dBm EIRP	
				10 MHz	32 dBm EIRP	
				5 MHz	29 dBm EIRP	
5	Singapore	5725 - 5850 MHz		5, 10, 15, 30 MHz	20 dBm EIRP	
6	Eire	5725 - 5850 MHz		30 MHz	33 dBm EIRP	
				15 MHz	31 dBm EIRP	
				10 MHz	30 dBm EIRP	
				5 MHz	27 dBm EIRP	
7	Norway	5725 - 5795 MHz 5815 - 5850 MHz	Yes	30 MHz	53 dBm EIRP	
				15 MHz	51 dBm EIRP	
				10 MHz	50 dBm EIRP	
				5 MHz	47 dBm EIRP	

Region Code	License / Regulation	Frequencies	DFS	Channel Bandwidth	Max Power	Notes
8	Full Power	5725 - 5850 MHz		5, 10, 15, 30 MHz	25 dBm	
11	Korea	5725 - 5825 MHz		30 MHz	44 dBm EIRP	
				15 MHz	41 dBm EIRP	
				10 MHz	40 dBm EIRP	
				5 MHz	37 dBm EIRP	
19	India	5825 - 5850 MHz		10, 15 MHz	36 dBm EIRP	
				5 MHz	33 dBm EIRP	
20	Thailand	5725 - 5850 MHz		5, 10, 15, 30 MHz	30 dBm EIRP	
22	Germany	5755 - 5850 MHz	Yes	30 MHz	35 dBm EIRP	
				15 MHz	34 dBm EIRP	
				10 MHz	32 dBm EIRP	
				5 MHz	29 dBm EIRP	
24	Bahrain	5725 - 5850 MHz	Yes	30 MHz	33 dBm EIRP	
				15 MHz	31 dBm EIRP	
				10 MHz	30 dBm EIRP	
				5 MHz	27 dBm EIRP	
25	ETSI	5725 - 5850 MHz	Yes	30 MHz	35 dBm EIRP	1dB reduction required to achieve adjacent channel emissions
				15 MHz	34 dBm EIRP	
				10 MHz	32 dBm EIRP	
				5 MHz	29 dBm EIRP	
27	Denmark	5725 - 5795 5815 - 5850 MHz	Yes	30 MHz	35 dBm EIRP	5795 MHz to 5815 MHz is assigned for Road Transport and Traffic Telematics (RTTT)
				15 MHz	34 dBm EIRP	
				10 MHz	32 dBm EIRP	
				5 MHz	29 dBm EIRP	

5.2.7 PTP 59600 Licenses and Region Codes

PTP 59600 units may be operated in any of the regions listed in Table 12.

When shipped, PTP 59600 units are configured with a license key for Region Code 16. An alternative license key is provided in the Deployment Guide for Region Code 17. If the link is to be installed in any other permitted region, the user must obtain a new license key from the reseller or distributor.

Table 12 – PTP 59600 Licenses and Region Codes

Region Code	License / Regulation	Frequencies	DFS	Channel Bandwidth	Max Power	Notes
15	Unrestricted	5825 - 5925 MHz		5, 10, 15, 30 MHz	25 dBm	
16	Russia	5825 - 5925 MHz		5, 10, 15, 30 MHz	25 dBm	
17	India	5875 - 5925 MHz		10, 15, 30 MHz	36 dBm EIRP	
				5 MHz	33 dBm EIRP	
19	India	5825 - 5875 MHz		10, 15, 30 MHz	36 dBm EIRP	
				5 MHz	33 dBm EIRP	

NOTE: The 5.8 GHz license for India is addressed using both PTP 58600 and PTP 59600 frequency variants.

5.3 Operational Restrictions

5.3.1 Radar Avoidance

Radar Avoidance requires that equipment used in the region:

- Detects interference from other systems and avoids co-channel operation with these systems, notably radar systems.
- Provide on aggregate a uniform loading of the spectrum across all devices, that is, Fixed Frequency operation is not allowed.

Radar avoidance is not applicable to the PTP 25600 product or the PTP 45600 product.

To address the primary aims, the Spectrum Management algorithm implements a radar detection function which looks for impulsive interference on the operating channel only. If impulsive interference is detected, Spectrum Management will mark the current operating channel as having detected radar (unavailable channel) and initiate a channel hop to an available channel. The previous operating channel will remain in the unavailable state for thirty minutes after the last impulsive interference pulse was detected. After the thirty minutes have expired the channel will be returned to the usable channel pool.

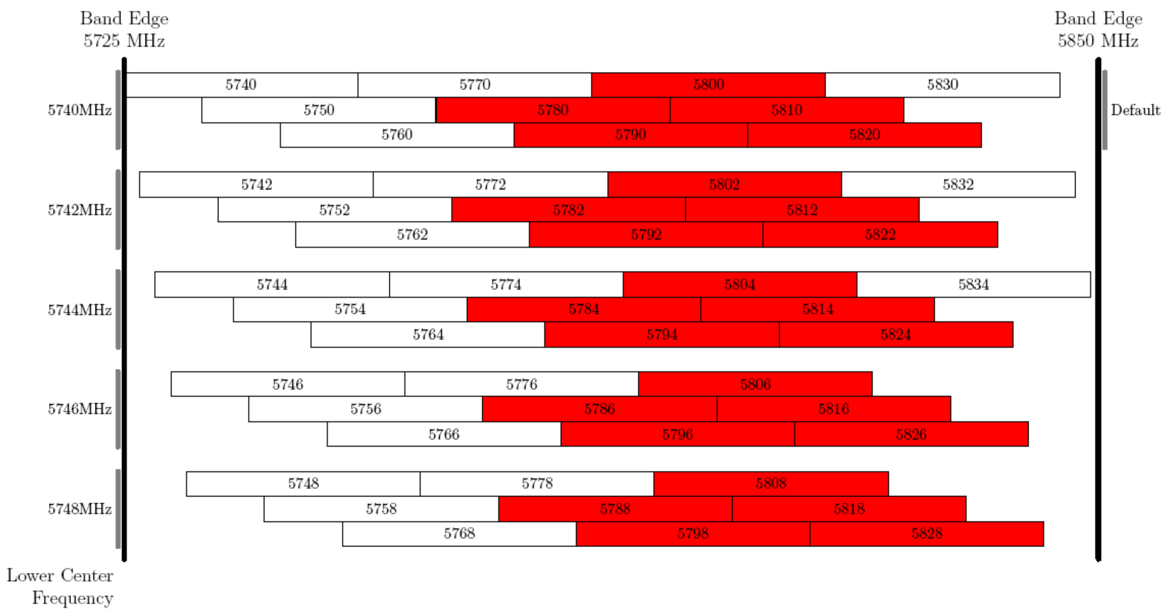
The equipment can only transmit on available channels, of which there are none at initial power up. The radar detection algorithm will always scan a usable channel for 60 seconds for radar interference before making the channel an available channel. This compulsory channel scan will mean that there is a 60 seconds service outage every time radar is detected and that the installation time is extended by 60 seconds even if there is found to be no radar on the channel.

NOTE: On system installation or start-up this extends the initial scan time of the Master unit by 60 seconds. To address the "provide aggregate uniform loading of the spectrum across all devices" requirement, the channel selection algorithm will choose a channel at random from a list of useable channels. The channel selection algorithm is initiated at link initialization and when radar interference is detected.

5.3.2 RTTT Avoidance and Other Channel Use Restrictions

Where regulatory restrictions apply to certain channels these channels are barred. RTTT avoidance may be necessary in all channel bandwidths. The number of channels barred is dependant on the channel raster selected. For example see the effect of the UK RTTT channel restrictions in the 30 MHz bandwidth (Figure 13), where blocks in red indicate channels that are barred. Barred channels are indicated by a “No Entry” symbol displayed on the “Spectrum Management” web page, see Section 8.3.9 “Spectrum Management Control - With Operational Restrictions”.

Figure 13 - 5.8 GHz UK RTTT Channel Avoidance – 30 MHz Channel Bandwidth (Example)



5.3.3 Radar Avoidance, i-DFS and Variable (Narrow) Bandwidth Operation

PTP 600 Series bridges do not support operation with 5, 10 or 15 MHz channel bandwidth in regions where radar avoidance is enabled.

NOTE: Radar avoidance requirements in the 5.4GHz band in the EU is detailed in specification EN 301-893 version 1.4.1 and in the US in the specification FCC part 15.437. Radar avoidance at 5.8GHz is applicable to EU operation and the requirements are currently as defined in EN 302 502.

5.4 Variable Channel Bandwidth Operation

The selection of Channel Bandwidth depends upon the PTP bridge variant:

- For PTP 25600, PTP 54600, PTP 58600 and PTP 59600, Channel Bandwidth may be 30, 15, 10 or 5 MHz.
- For PTP 48600 and PTP 49600, Channel Bandwidth may be 20, 10 or 5 MHz.

The 30MHz channel widths are available where allowed by local regulations and subject to some restrictions on channel choice.

Lite versions of the PTP 600 products do not support a Channel Bandwidths of 5 MHz.

Configuration of the variable bandwidth operation must be symmetric, that is, the Transmit and receive channels must use identical Channel Bandwidths.

5.5 PTP 25600 Specific Frequency Planning Considerations

The supported 2.5GHz frequency range is split into three bands, according to the bands specified in the FCC BRS-EBS Post-Transition Band plan (only for PTP 25600 and Region Code 16):

- Lower: 2496 MHz to 2572 MHz with a 5.5MHz channel raster (76 MHz total).
- Middle: 2572 MHz to 2614 MHz with a 6 MHz channel raster (42 MHz total).
- Upper: 2618 MHz to 2690 MHz with a 5.5 MHz channel raster (76 MHz total).

NOTE: For the PTP 25600 product variant, the unit will only operate in Fixed Frequency mode, and the user is unable to select i-DFS.

The PTP 25600 product variant support channel centre frequencies as specified in Table 13.

Table 13 - PTP 25600 Product Variant Channel Plan - FCC BRS-EBS Post-Transition Band

Block	Channel Bandwidth (MHz)	Channel Centre Frequencies (MHz)
Lower Band Segment	5	2499.25, 2504.75, 2510.25, 2515.75, 2521.25, 2526.75, 2532.25, 2537.75, 2543.25, 2548.75, 2554.25, 2559.75, 2565.25
	10	2502, 2507.5, 2513, 2518.5, 2524, 2529.5, 2535, 2540.5, 2546, 2551.5, 2557, 2562.5
	15	2504.75, 2510.25, 2515.75, 2521.25, 2526.75, 2532.25, 2537.75, 2543.25, 2548.75, 2554.25, 2559.75
	30	2513, 2524, 2535, 2546
Middle Band Segment	5	2575, 2581, 2587, 2593, 2599, 2605, 2611
	10	2578, 2584, 2590, 2596, 2602, 2608
	15	2581, 2587, 2593, 2599, 2605
	30	Not supported
Upper Band Segment	5	2626.75, 2632.25, 2637.75, 2643.25, 2648.75, 2654.25, 2659.75, 2665.25, 2670.75, 2676.25, 2681.75, 2687.25
	10	2629.5, 2635, 2640.5, 2646, 2651.5, 2657, 2662.5, 2668, 2673.5, 2679, 2684.5
	15	2632.25, 2637.75, 2643.25, 2648.75, 2654.25, 2659.75, 2665.25, 2670.75, 2676.25, 2681.75
	30	2640.5, 2651.5, 2662.5, 2673.5

The channel centre frequencies listed above have been selected to align with the so-called post-transition BRS channels as shown in Figure 14.

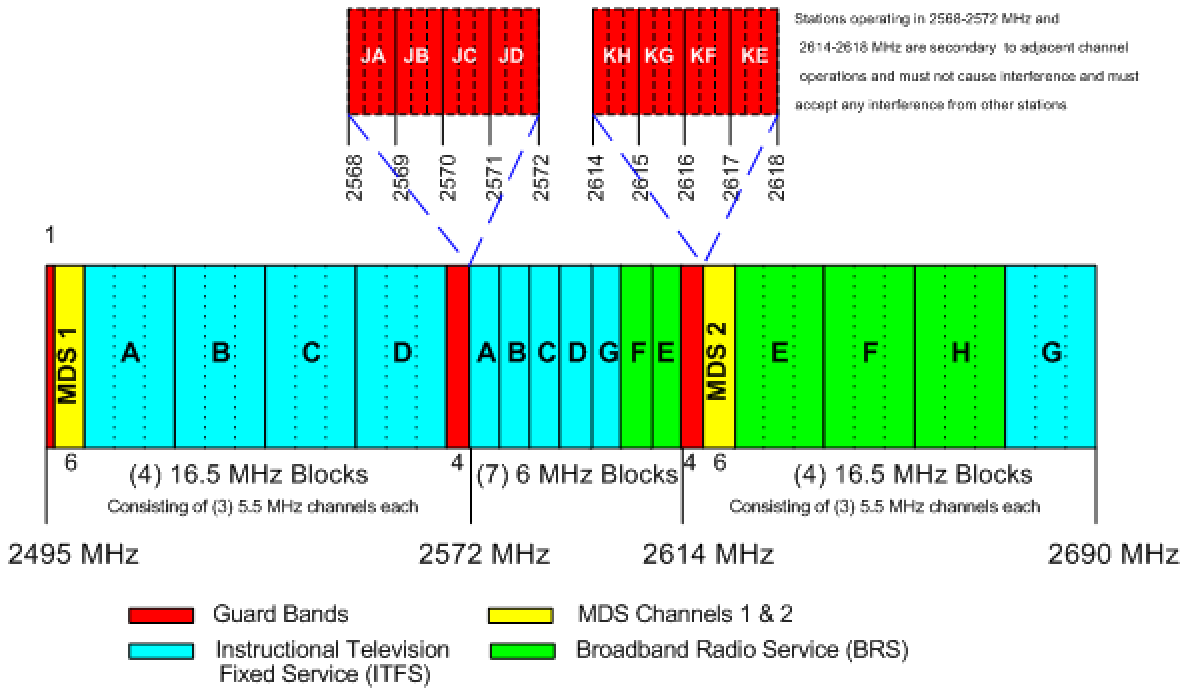
NOTE: The PTP 25600 frequency variant supports three portions of the BRS spectrum allocation. These are configurable at installation and constrain the wireless to operate in a limited portion of the Spectrum. The three frequency bands are as shown in Figure 14:

Band 1: channels A, B, C and D (16.5 MHz blocks)

Band 2: channels A through G (6 MHz blocks)

Band 3: channels E, F, G and H (16.5 MHz blocks)

Figure 14 - 2.5 GHz BRS Band Channel Assignments



5.6 PTP 45600 Specific Frequency Planning Considerations

Adjustment of the lower centre frequency allows the operator to slide the available frequency settings up and down the 4.5 GHz band. Figure 15 to Figure 18 show the available spectrum settings for the 30 MHz, 15 MHz, 10 MHz and 5 MHz channel bandwidths All channel centre frequencies may not be available for all Region Codes.

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Figure 15 - 4.5 GHz Available Spectrum Settings – 30 MHz Channel Bandwidth

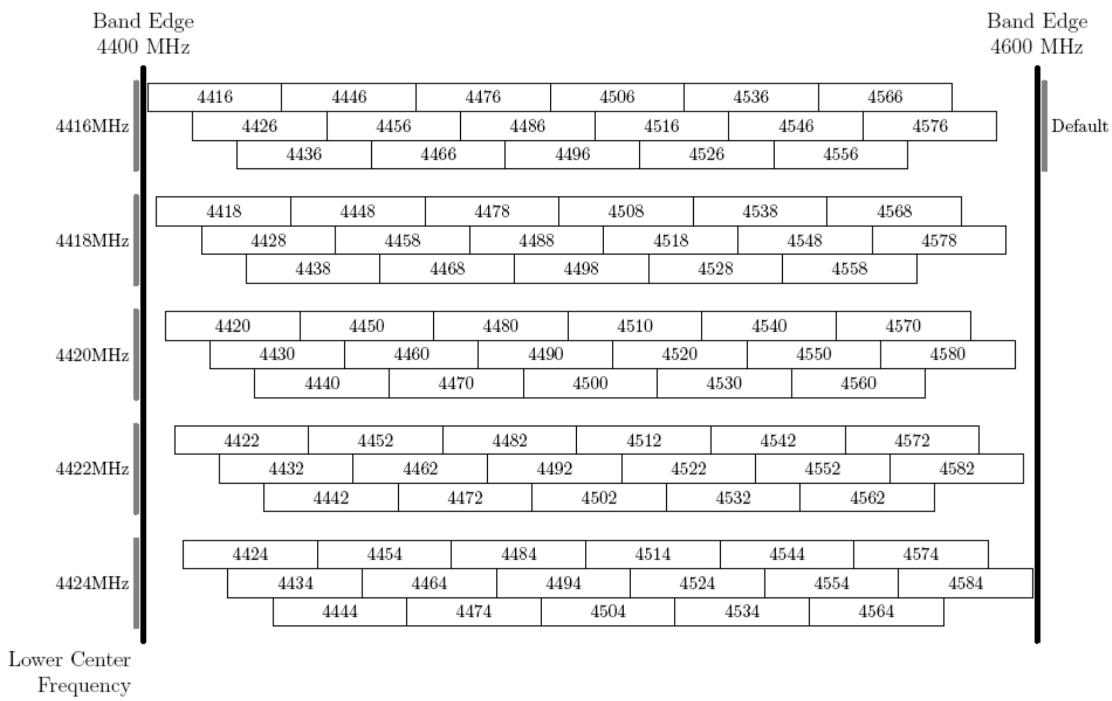


Figure 16 - 4.5 GHz Available Spectrum Settings – 15 MHz Channel Bandwidth

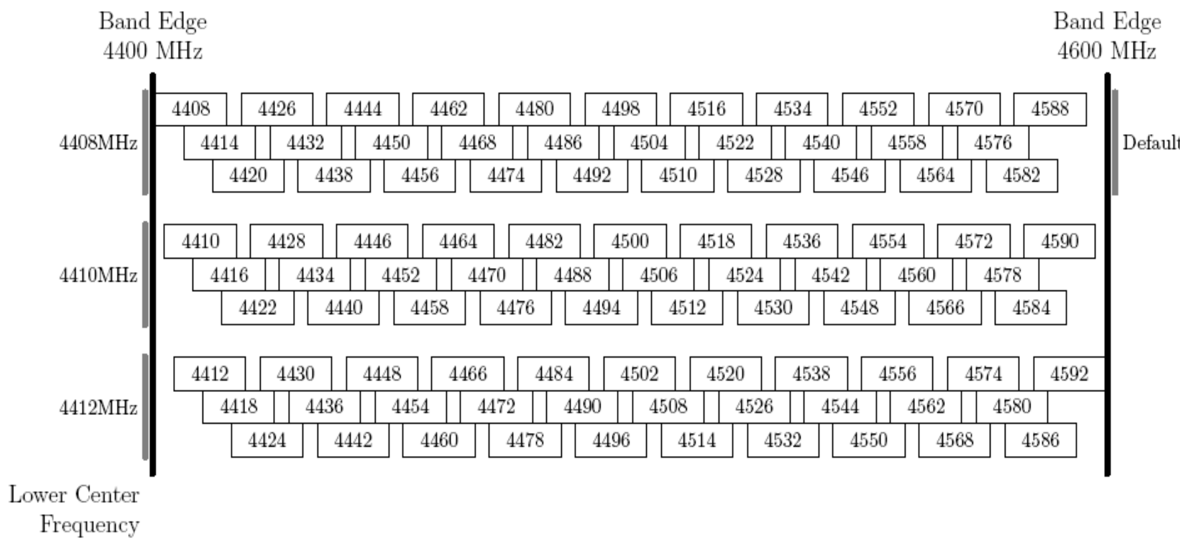


Figure 17 - 4.5 GHz Available Spectrum Settings – 10 MHz Channel Bandwidth

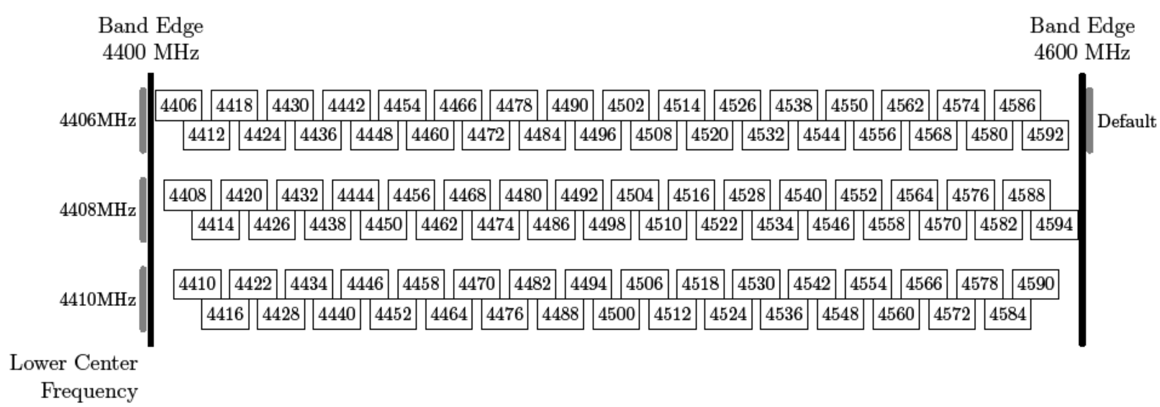
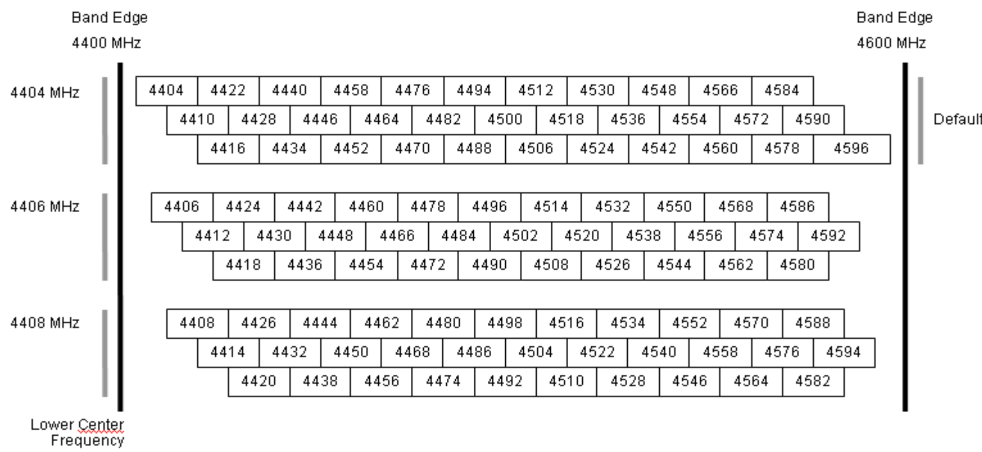


Figure 18 - 4.5 GHz Available Spectrum Settings – 5 MHz Channel Bandwidth



5.6.1 PTP 45600 Raster Considerations

The PTP 45600 variant operates on a 10 MHz channel raster (for 30 MHz channel bandwidth) and 6 MHz for the variant channel bandwidths 5, 10 and 15 MHz. The channel raster is set to even centre frequencies. See Figure 15 to Figure 18.

5.7 PTP 48600 Specific Frequency Planning Considerations

Adjustment of the lower centre frequency allows the operator to slide the available frequency settings up and down the 4.8 GHz band in steps of 1 MHz. Table 14 shows the available Channel Center Frequencies for each Channel Bandwidth.

Table 14 – PTP 48600 Channel Center Frequencies

Region Code	Channel Bandwidth	Available Channel Center Frequencies
15	20 MHz	4720 MHz – 4990 MHz
	10 MHz	4715 MHz – 4995 MHz
	5 MHz	4715 MHz – 4997 MHz
23	20 MHz	4720 MHz – 4930 MHz
	10 MHz	4715 MHz – 4935 MHz
	5 MHz	4715 MHz – 4937 MHz

5.8 PTP 49600 Specific Frequency Planning Considerations

Figure 19 to Figure 21 show the available spectrum settings for the 20 MHz, 10 MHz and 5 MHz channel bandwidths All channel centre frequencies may not be available for all Region Codes.

Figure 19 - 4.9 GHz Available Spectrum Settings - 20 MHz Channel Bandwidth

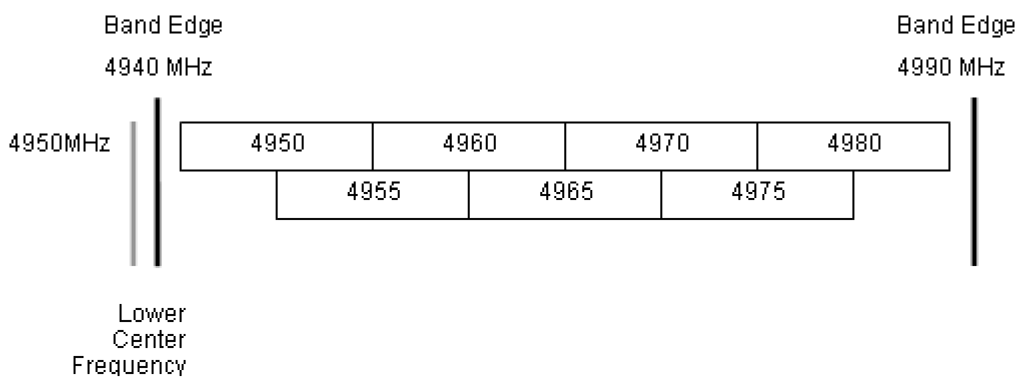


Figure 20 - 4.9 GHz Available Spectrum Settings - 10 MHz Channel Bandwidth

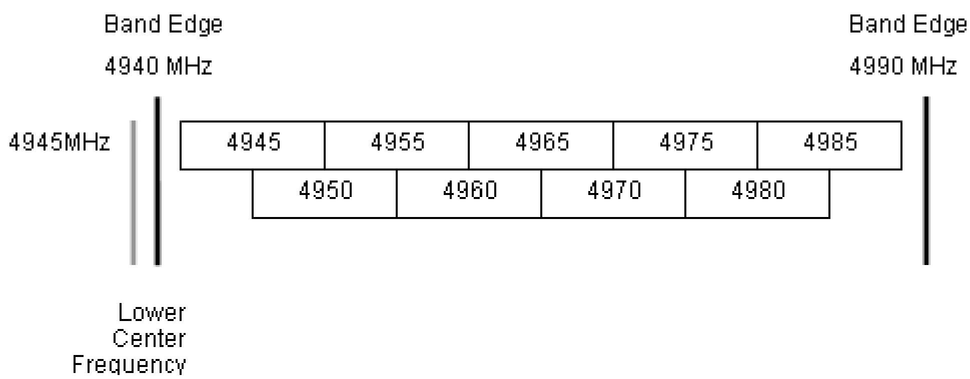
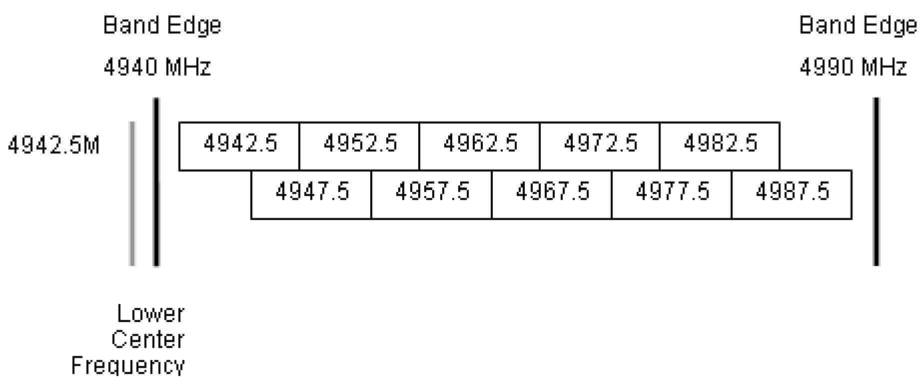


Figure 21 - 4.9 GHz Available Spectrum Settings - 5 MHz Channel Bandwidth



5.9 PTP 54600 Specific Frequency Planning Considerations

Adjustment of the lower centre frequency allows the operator to slide the available frequency settings up and down the 5.4 GHz band. Figure 22 to Figure 25 show the available spectrum settings for the 30 MHz, 15 MHz, 10 MHz and 5 MHz channel bandwidths All channel centre frequencies may not be available for all Region Codes.

Figure 22 - 5.4 GHz Available Spectrum Settings - 30 MHz Channel Bandwidth

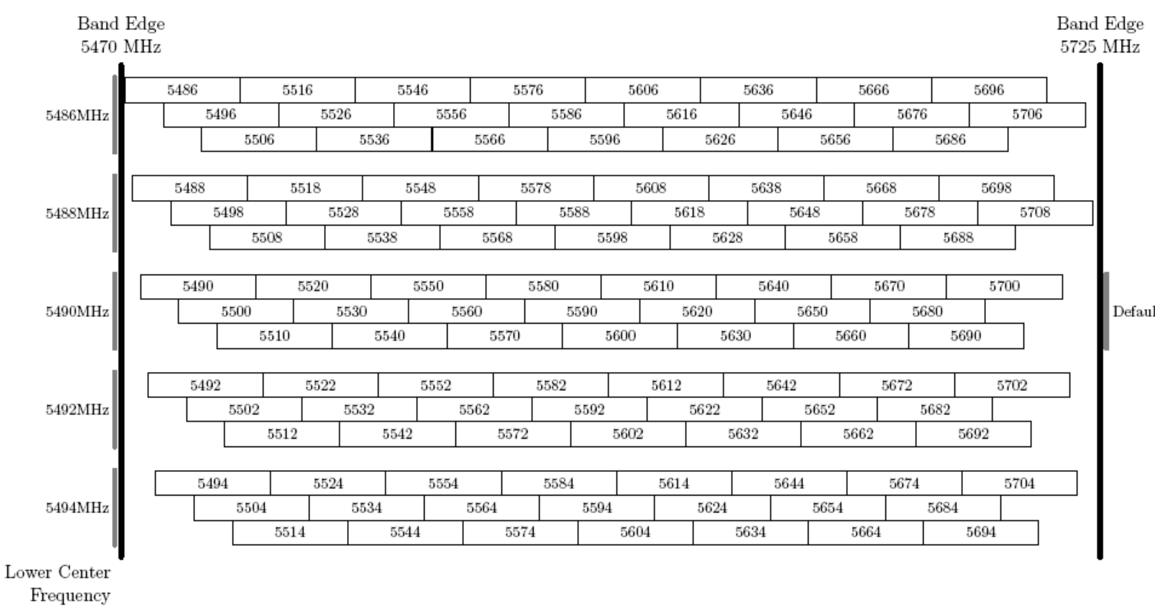


Figure 23 - 5.4 GHz Available Spectrum Settings - 15 MHz Channel Bandwidth

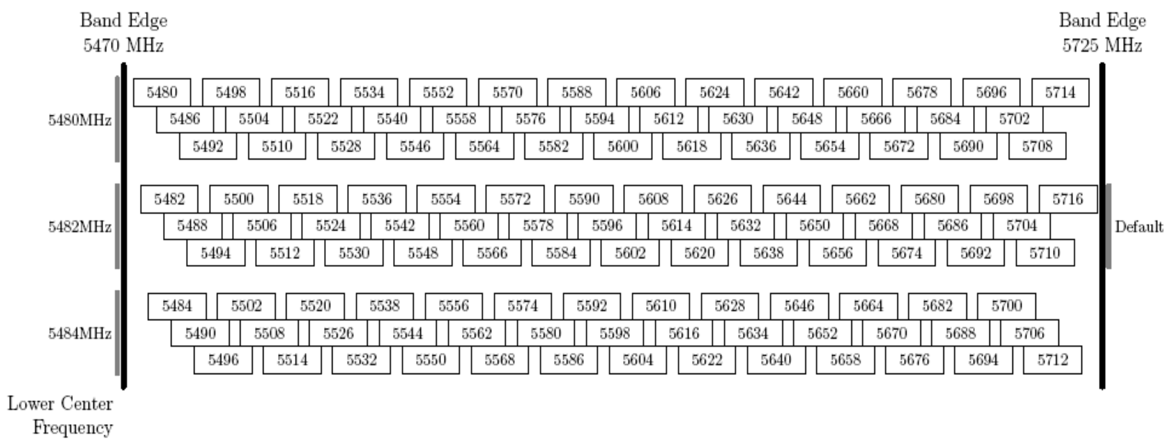


Figure 24 - 5.4 GHz Available Spectrum Settings - 10 MHz Channel Bandwidth

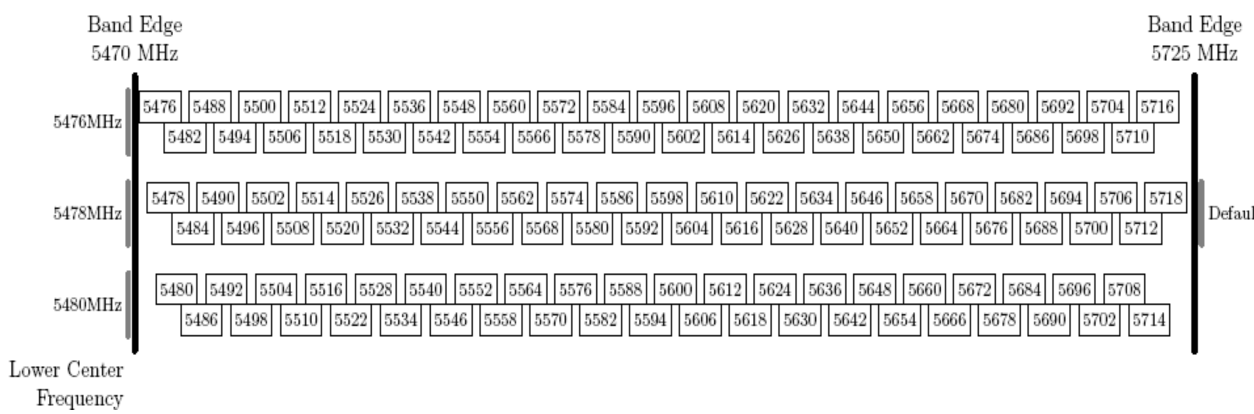
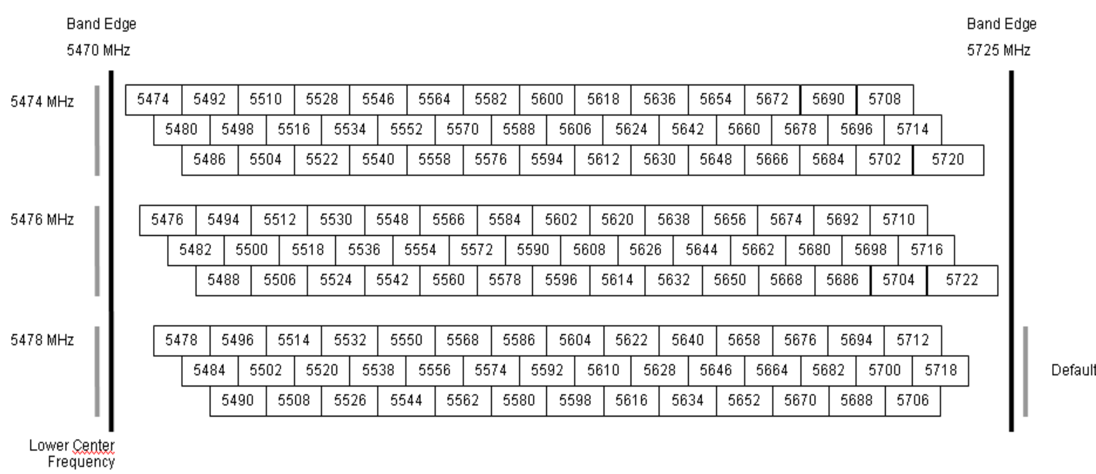


Figure 25 - 5.4 GHz Available Spectrum Settings - 5 MHz Channel Bandwidth



5.9.1 PTP 54600 Raster Considerations:

The PTP 54600 variant operates on a 10 MHz channel raster (for 30 MHz channel bandwidth) and 6 MHz for the variant channel bandwidths 5, 10 and 15 MHz. The channel raster is set to even centre frequencies. See Figure 22 to Figure 25.

5.9.2 Transmit Power Reduction at the Band Edges

The PTP 54600 product variant does not apply any band edge power reduction.

5.10 PTP 58600 Specific Frequency Planning Considerations

Adjustment of the lower center frequency allows the operator to slide the available frequency settings up and down the 5.8 GHz bands. Figure 26 to Figure 29 show the available spectrum settings for the 30 MHz, 15 MHz, 10 MHz and 5 MHz channel bandwidths in those regions where the band edge is 5850 MHz (for example FCC). All channel centre frequencies may not be available for all Region Codes.

Figure 26 - 5.8 GHz Available Spectrum Settings – 30 MHz Channel Bandwidth

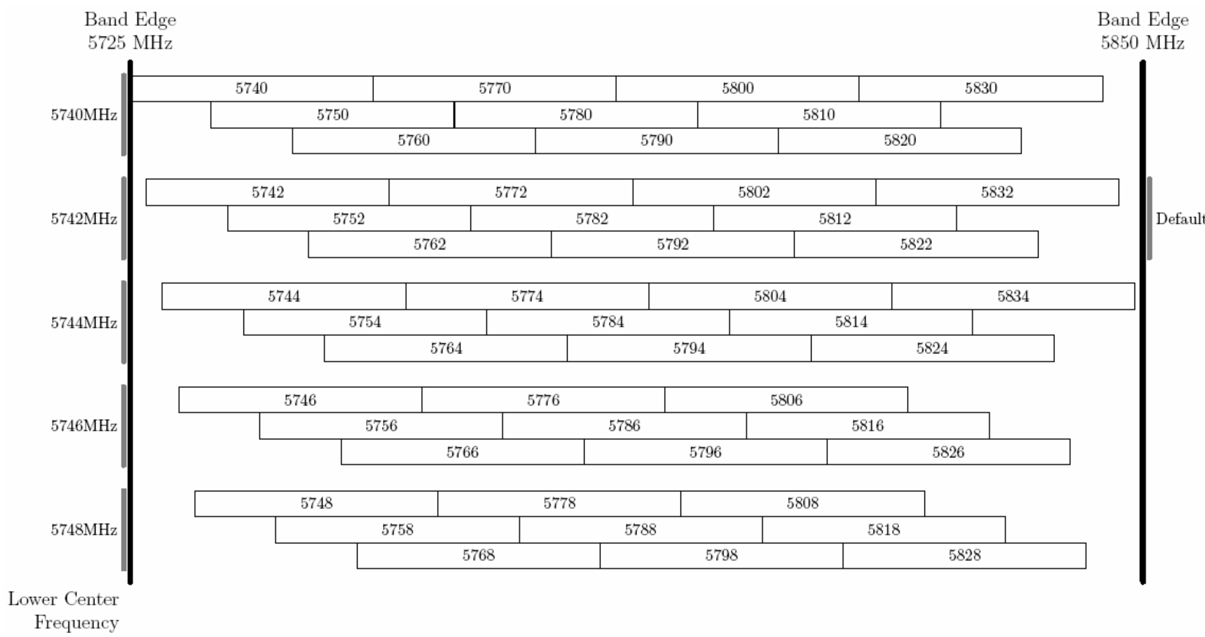


Figure 27 - 5.8 GHz Available Spectrum Settings - 15 MHz Channel Bandwidth

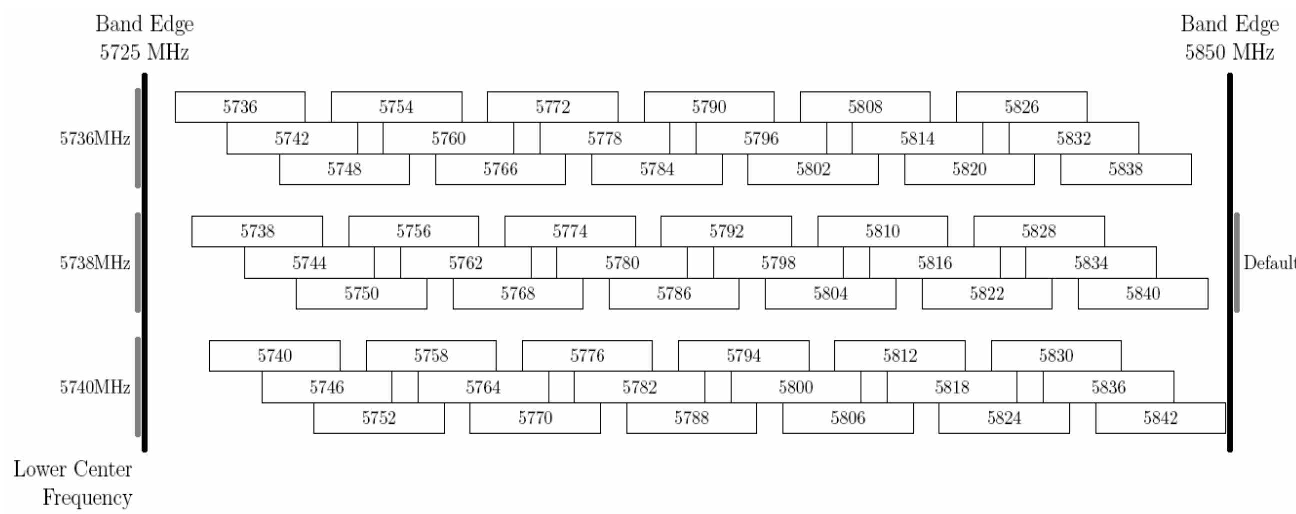


Figure 28 - 5.8 GHz Available Spectrum Settings - 10 MHz Channel Bandwidth

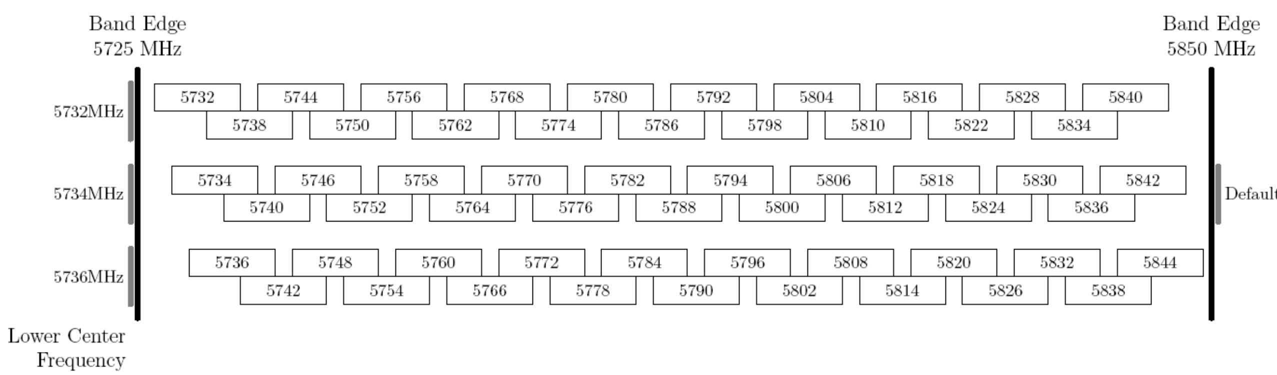
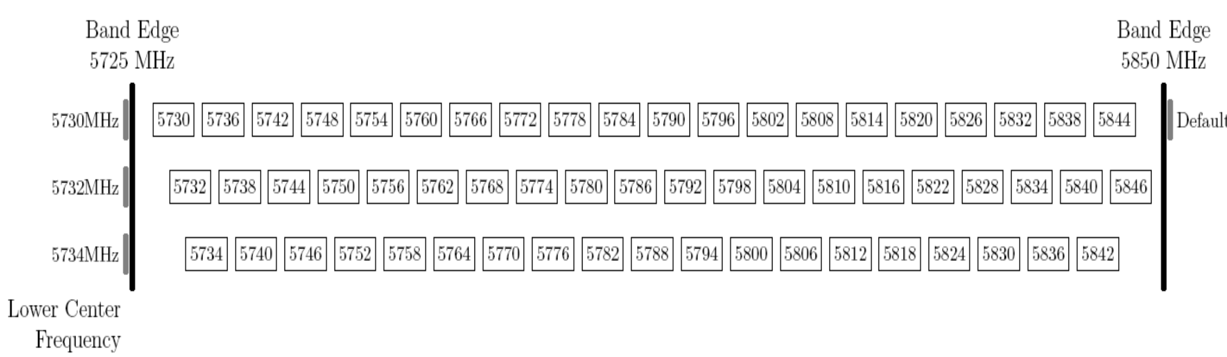


Figure 29 - 5.8 GHz Available Spectrum Settings - 5 MHz Channel Bandwidth



5.10.1 PTP 58600 Raster Considerations

The PTP 58600 variant operates on a 10 MHz channel raster (for 30 MHz channel bandwidth) and 6 MHz for the variant channel bandwidths 5, 10 and 15 MHz. The channel raster is set to even center frequencies. See Figure 26 to Figure 29.

5.10.2 PTP 58600 Transmit Power Reduction at the Band Edges

Operation at or near the 5.8 GHz band edges can results in a lower maximum transmit power. In some configurations the PTP 600 Series Bridge solution reduces the power when operating at the edge channels. The amount of reduction, if any, is dependant on the region code of the region of operation. This currently only affects systems configured with Region Code 1. The power reductions in the edge channels for 5 MHz, 10 MHz, 15 MHz and 30 MHz are presented in Table 15 (for region code 1 ONLY).

Table 15 – PTP 58600 Band Edge Tx Power Reduction

Power Levels for Channel Centre	Channel Width (MHz)			
	5	**10**	**15**	**30**
5730	25	N/A	N/A	N/A
5732	25	23	N/A	N/A
5734	25	25	N/A	N/A
5736	25	25	23	N/A
5738	25	25	25	N/A
5740	25	25	25	17
5742 - 5750	25	25	25	21
5752 - 5822	25	25	25	25
5824 - 5832	25	25	25	21
5834	25	25	25	17
5840	25	25	23	N/A
5842	25	23	19	N/A
5844	25	19	N/A	N/A
5846	23	N/A	N/A	N/A

5.11 PTP 59600 Specific Frequency Planning Considerations

Adjustment of the lower center frequency allows the operator to slide the available frequency settings up and down the 5.9 GHz bands. Figure 30 to Figure 33 show the available spectrum depending on the channel width (30 MHz, 15 MHz, 10 MHz and 5 MHz respectively).

Figure 30 - 5.9 GHz Available Spectrum Settings – 30 MHz Channel Bandwidth

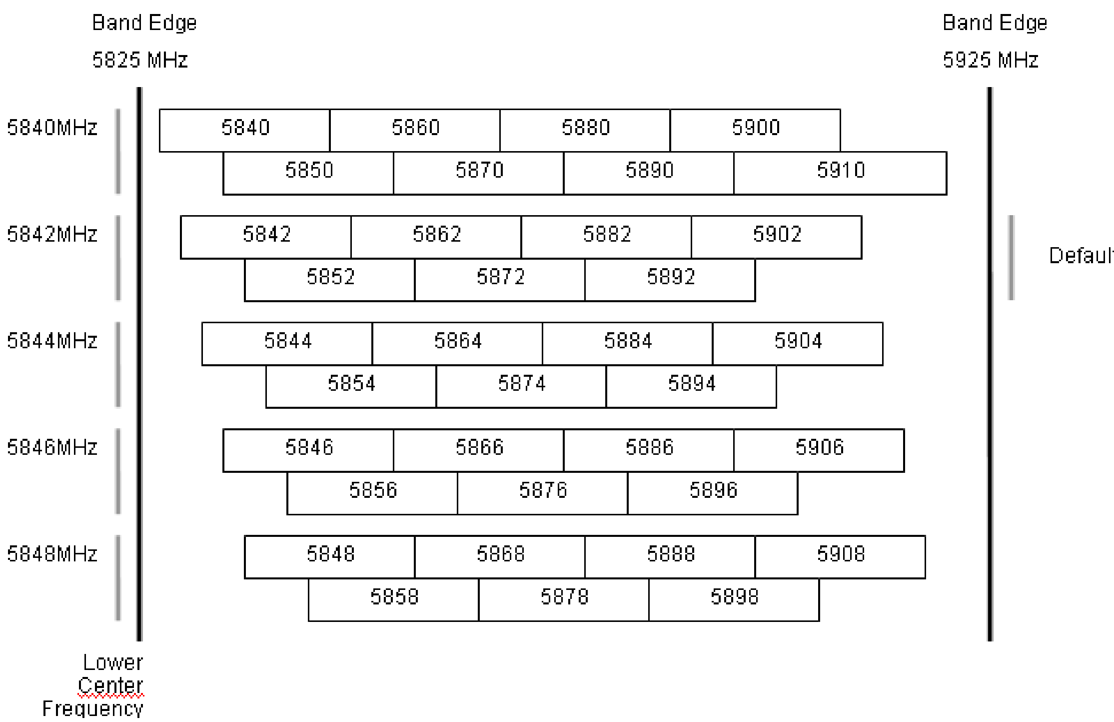


Figure 31 - 5.9 GHz Available Spectrum Settings - 15 MHz Channel Bandwidth

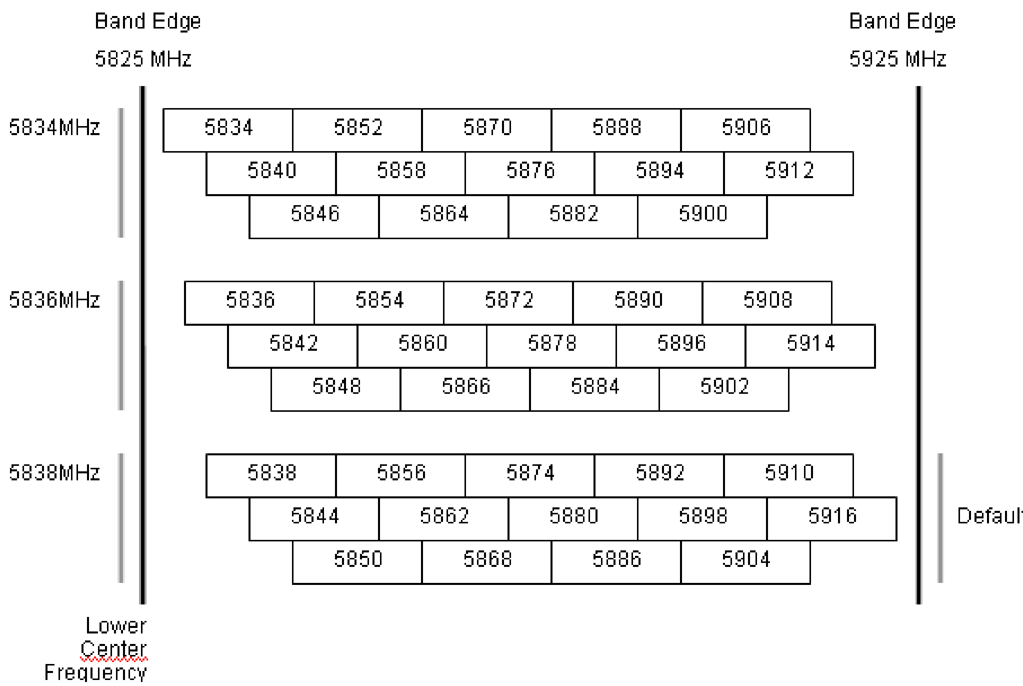


Figure 32 - 5.9 GHz Available Spectrum Settings - 10 MHz Channel Bandwidth

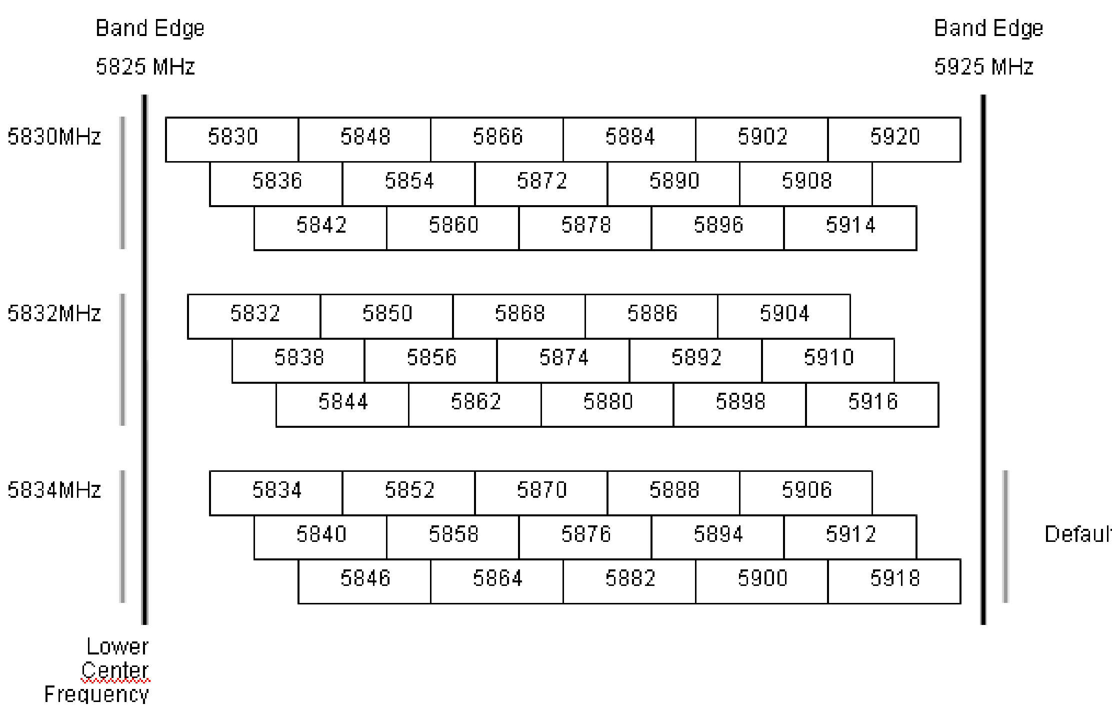
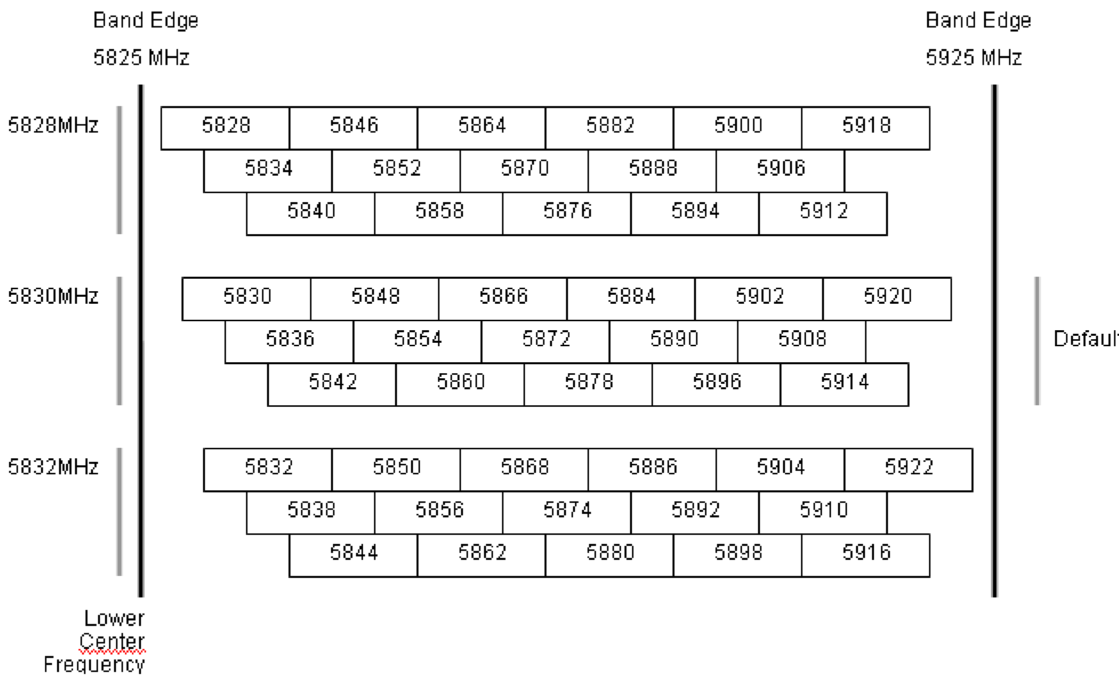


Figure 33 - 5.9 GHz Available Spectrum Settings - 5 MHz Channel Bandwidth



5.11.1 PTP 59600 Raster Considerations

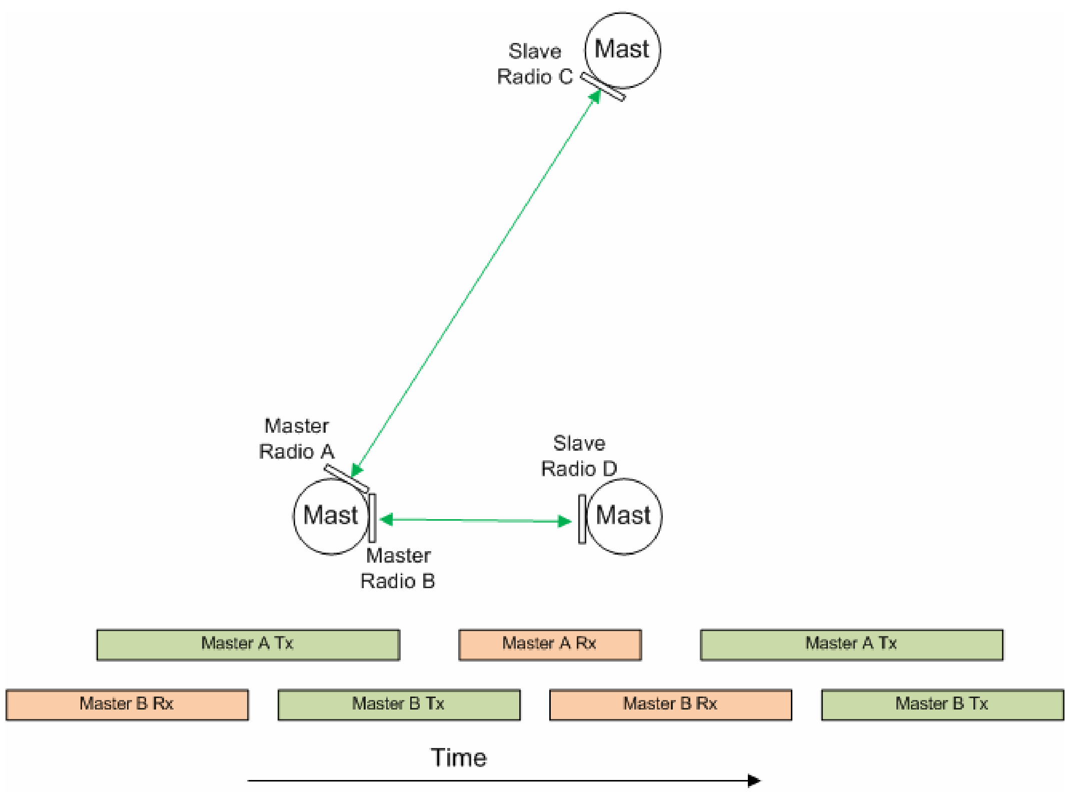
The PTP 59600 variant operates on a 10 MHz channel raster (for 30 MHz channel bandwidth) and 6 MHz for the variant channel bandwidths 5, 10 and 15 MHz. The channel raster is set to even center frequencies. See Figure 30 to Figure 33.

5.12 Time Division Duplex (TDD) Synchronization

5.12.1 Introduction

In a TDD system, a radio transmits for a portion of the radio frame and receives in a different portion of the frame. Motorola PTP600 links consist of a Master unit and a Slave unit with the Master transmitting for the first part of the radio frame (Slave receiving) and the Slave transmitting in the remainder of the radio frame (Master receiving). The portion of the frame apportioned to each period can be dynamic, for example in IP optimization mode where the split is a function of the offered traffic in each direction. However, if the frames of the two links are not aligned in time, then an interference mechanism exists where one Master unit may be transmitting when the Master unit from the other link is receiving. A similar mechanism exists for Slave units. The level of interference becomes very significant when the units are located in close proximity, for example when units are located on the same mast. This problem is illustrated in Figure 34 where it can be seen that transmissions from Master unit A overlap with the receive portion of Master unit B and vice versa.

Figure 34 - Co-location of Links Interference Problem - A Simple Example

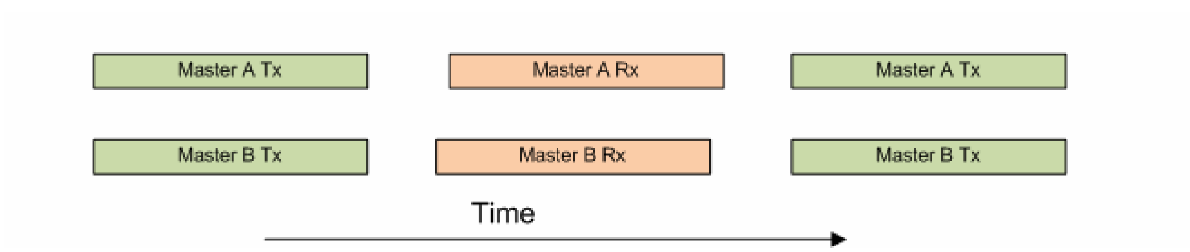


Interference can be minimized by increasing the radio channel separation between units which are in close proximity, for example for units on the same mast. This may not always be possible if the mast is hosting a large number of links and if spectrum is limited. Also, the achieved reduction may not always be sufficient. Another way to reduce interference is to reduce the transmit power of an interfering radio. Again, this may not always be possible if the link causing the interference does not itself have sufficient radio gain margin to allow the power of its radios to be reduced.

5.12.2 TDD Synchronization

TDD synchronization overcomes these issues by aligning the radio frame of all links in the network such that all Master units transmit at the same time and receive at the same time. This eliminates interference between units on the same mast if the units on the mast are configured as Master units. This illustrated in Figure 28 where the frames of the two links are aligned in time.

Figure 35 TDD Synchronization And Co location Example



Due to propagation delay, a mechanism exists where an interfering signal from a remote Master unit arrives at a victim Master delayed in time. This would occur when Master units are installed on different masts. Similarly, an interfering signal from a remote Slave unit will arrive at a victim Slave unit delayed in time. Correct configuration of TDD synchronization ensures that the delayed signals do not overlap with the receive portion of the victim frame. In order to eliminate the interference from delayed signals, the configuration and the resulting TDD frame structure will actually depend upon characteristics of the overall network such as the longest link and the maximum distance between interfering Master units and interfering Slave units. The installation wizard requests that these parameters are entered when TDD synchronization is enabled. This is covered in detail in Section 14 “TDD Synchronization Configuration and Installation Guide”.

5.12.3 Implementation of TDD Synchronization

TDD synchronization is achieved by connecting each Master unit to a GPS Synchronization Unit. Installation details are covered in Section 14 "TDD Synchronization Configuration and Installation Guide". The GPS unit provides the Master unit with a precise 1Hz signal where the leading edge occurs at the same point in time for all units in the network which have been locked to the GPS Satellite system. The Master radio then aligns its radio frame to start on the leading edge of the 1Hz signal.

TDD synchronization is not available in the PTP 48600 and PTP 49600 product variants.

5.12.4 System Constraints with TDD Synchronization Enabled

The following constraints apply when TDD synchronization is enabled:

- As the radio frame needs to be aligned across the network, the apportioning of the frame between the two link directions can no longer be dynamic. The split is fixed at 50:50.
- In order that the start of the radio frame can always align with the leading edge of the 1Hz signal, the radio frame duration must be an integer fraction of 1s. The exact frame length is calculated by the installation wizard as a function of the network characteristics such as longest link, and longest distance between interfering masters and interfering slaves.

5.13 Link Mode Optimization

Link Mode Optimization allows the PTP 600 link to be optimized according to the type of traffic that will be bridged. There are two modes to choose from: IP and TDM.

5.13.1 IP Link Mode Optimization

In IP Mode, the PTP 600 product runs an adaptive TDD scheme. This means that an unloaded link runs 10:10 mode (10 OFDM bursts alternately in each direction). If there is a sustained increase in traffic load in one direction, a threshold is reached where the TDD mode automatically adapts to 20:10. If the load continues to increase, then the TDD structure adapts even further through 30:10 to 40:10. This is the state of maximum link asymmetry (40 OFDM bursts in one direction compared with 10 in the other). If the load increases in BOTH directions, then the TDD structure adapts from 10:10, through 20:20, 30:30 to 40:40. This is a state of maximum aggregate throughput.

Three of these modes (10:10, 40:10 and 40:40) have the following characteristics:

- In **10:10** mode, throughput performance is equal in each direction. Aggregate throughput and latency are minimized.
- In **40:10** mode, throughput performance is maximized in one direction, to the detriment of both latency and throughput in the opposite direction.
- In **40:40** mode, throughput performance is maximized in both directions. Aggregate throughput and latency are maximized.

NOTE: There is an engineering trade-off between the flexibility of adaptive TDD and latency. When the TDD structure changes, there is a brief impact on latency for a few frames. This does not affect the steady state long term average latency, but may be recorded as a maximum latency. This affect may be amplified for short latency tests or if the traffic loading is oscillating either side of a boundary condition. As the TDD burst length increases, traffic in each direction has to wait longer before a transmit window is available, but more data can be sent during the burst. There is an impact on latency but it varies depending upon installation range, frame size and modulation mode.

5.13.2 TDM Link Mode Optimization

In TDM mode, two major differences in link behavior occur compared with IP mode. First, if E1/T1 services are enabled, the TDD structure is fixed symmetrically. Either 10:10, 20:20, 30:30 or 40:40 based upon the installed range, as shown in Table 16.

Table 16 – TDD Structure in TDM Mode

OFDM Bursts	Radar Avoidance Range (km)	30 MHz Band Range (km)	15 MHz Band Range (km)	10 MHz Band Range (km)	5 MHz Band Range (km)
10:10	1-20	1-43	1-60	1-94	1 -200
20:20	21-63	44-95	61-130	95-200	N/A
30:30	64 -145	96 -150	131 -200	N/A	N/A
40:40	146 -200	151 -200	N/A	N/A	N/A

Secondly, the point at which a modulation mode changes for given RF conditions is more conservative. In practice, this means that the link will typically stay in a lower modulation mode, but with increased tolerance to RF variability.

Depending upon the link characteristic that the customer requires, this may very well be the best choice. It increases consistency of link performance and equality in each direction as a trade-off against maximum throughput.

CAUTION: In TDM mode, data errors may occur during channel changes on an operational link. To minimize channel change related data errors in TDM mode, it may be appropriate to prevent i-DFS initiated channel changes, either by barring all channels except the active channel, or by configuring for fixed frequency operation. These steps disable the interference avoidance mechanisms in i-DFS and should not be taken if the risk of errors due to interference is higher than that due to channel changes.

NOTE: In TDM mode it is recommended to set the Maximum Modulation Mode to 64QAM 0.75 at both ends of the link, but preferably to the minimum mode necessary to carry the required traffic.

5.14 Distance

The PTP 600 Series Bridge will operate at ranges from 100 m (330 ft) to 200 km (124 miles), within 3 modes: 0-40km (0-25 miles), 0-100km (0-62 miles) and 0-200km (0-124 miles). Operation of the system will depend on obstacles in the path between the units. Operation at 40 km (25 miles) or above will require a near line-of-sight path. Operation at 100m (330 ft) could be achieved with one unit totally obscured from the other unit, but with the penalty of transmitting at higher power in a non-optimal direction, thereby increasing interference in the band. This subject is covered in more detail in Section 6.2.3 “Path Loss Considerations“.

5.15 Networking Information

The PTP 600 Series Bridge operates as a transparent Ethernet bridge. Although each unit requires an IP address, this IP address is for management purposes only, and it plays no part in the forwarding of bridged Ethernet frames. IP addresses are assigned during initial configuration as described in Section 7.2 “Installation Procedure”.

5.16 Lightning Protection

The amount of lightning protection is dependent on regulatory requirements and the end user requirements. The standard ODU for the PTP 600 Series Bridge is fitted with surge limiting circuits and other features to minimize the risk of damage due to nearby lightning strikes. These standard features may require some additional equipment to be configured as part of the system installation to be fully effective.

CAUTION: Motorola recommends the use of screened cable and Lightning Protection units to protect connected equipment from nearby strikes.

NOTE: The PTP 600 Series Bridge is not designed to survive direct lightning strikes. For this reason the unit should not be installed as the highest point in a localized area, unless specific precautions are taken. See Section 10 “Lightning Protection”.

5.17 Electrical Requirements

The PTP 600 Series Bridge requires one mains supply outlet at each end of the link to plug in the PIDU Plus units. See Section 3.3.2 “PIDU Plus – PTP 600 Series Bridge”.

5.18 Latency

The latency of a PTP 600 link depends upon product variant, modulation mode, channel bandwidth, load, range and several other factors. Example latency figures for a PTP 49600 link, all modulation modes and all channel bandwidths are quoted in Table 17 (frame size 64 bytes), Table 18 (frame size 512 bytes) and Table 19 (frame size 1518 bytes). These figures assume that the other relevant variables are set to the following values:

- Load is 95%
- Range is 0 km
- Link Mode is TDM 1 to 1
- AES encryption is off
- VLAN is off

Table 17 – Latency of a PTP 49600 Link with Frame Size 64 bytes

Channel Bandwidth	Modulation Mode	Average Latency (microseconds)	Maximum Latency (microseconds)
5 MHz	BPSK 0.63	3592.3	7327.6
	QPSK 0.63 (Single)	2356.3	4547.2
	QPSK 0.87 (Single)	2219.9	3948.0
	16QAM 0.63 (Single)	1745.0	3111.9
	16QAM 0.63 (Dual)	1394.4	2240.0
	16QAM 0.87 (Single)	1694.7	2858.6
	16QAM 0.87 (Dual)	1371.7	2180.9
	64QAM 0.75 (Single)	1663.4	2670.2
	64QAM 0.75 (Dual)	1362.1	2112.0
	64QAM 0.92 (Single)	1643.1	2627.6
	64QAM 0.92 (Dual)	1359.0	2077.9
	256QAM 0.81 (Single)	1627.1	2574.1
	256QAM 0.81 (Dual)	1347.8	2054.7
10 MHz	BPSK 0.63	2095.5	4312.2
	QPSK 0.63 (Single)	1475.5	2860.0
	QPSK 0.87 (Single)	1419.1	2594.9
	16QAM 0.63 (Single)	1200.9	2144.6
	16QAM 0.63 (Dual)	1047.0	1764.1
	16QAM 0.87 (Single)	1188.7	1992.3
	16QAM 0.87 (Dual)	1038.5	1737.4
	64QAM 0.75 (Single)	1177.8	1932.5
	64QAM 0.75 (Dual)	1031.0	1697.8
	64QAM 0.92 (Single)	1175.7	1904.2
	64QAM 0.92 (Dual)	1031.2	1681.0
	256QAM 0.81 (Single)	1163.9	1886.4
	256QAM 0.81 (Dual)	1023.5	1682.4
20 MHz	BPSK 0.63	1459.9	2962.3
	QPSK 0.63 (Single)	1045.5	2003.7
	QPSK 0.87 (Single)	1005.8	1797.2
	16QAM 0.63 (Single)	861.2	1481.6
	16QAM 0.63 (Dual)	758.9	1240.6
	16QAM 0.87 (Single)	852.6	1393.6
	16QAM 0.87 (Dual)	752.8	1226.8
	64QAM 0.75 (Single)	847.3	1369.9
	64QAM 0.75 (Dual)	766.0	1228.3
	64QAM 0.92 (Single)	845.9	1341.5
	64QAM 0.92 (Dual)	766.6	1227.2
	256QAM 0.81 (Single)	863.4	1374.0
	256QAM 0.81 (Dual)	792.7	1245.4

Table 18 – Latency of a PTP 49600 Link with Frame Size 512 bytes

Channel Bandwidth	Modulation Mode	Average Latency (microseconds)	Maximum Latency (microseconds)
5 MHz	BPSK 0.63	6076.5	10258.9
	QPSK 0.63 (Single)	3495.9	5723.3
	QPSK 0.87 (Single)	3008.3	4859.9
	16QAM 0.63 (Single)	2188.9	3826.2
	16QAM 0.63 (Dual)	1631.6	2484.6
	16QAM 0.87 (Single)	2021.5	3417.4
	16QAM 0.87 (Dual)	1576.3	2339.7
	64QAM 0.75 (Single)	1942.4	3183.5
	64QAM 0.75 (Dual)	1485.5	2272.9
	64QAM 0.92 (Single)	1872.7	2846.4
	64QAM 0.92 (Dual)	1414.4	2249.0
	256QAM 0.81 (Single)	1841.6	2780.4
	256QAM 0.81 (Dual)	1436.1	2182.7
10 MHz	BPSK 0.63	3342.5	5685.8
	QPSK 0.63 (Single)	1959.7	3504.2
	QPSK 0.87 (Single)	1747.8	3039.0
	16QAM 0.63 (Single)	1376.5	2348.8
	16QAM 0.63 (Dual)	1181.2	1898.1
	16QAM 0.87 (Single)	1334.2	2203.2
	16QAM 0.87 (Dual)	1152.0	1817.0
	64QAM 0.75 (Single)	1279.9	2129.3
	64QAM 0.75 (Dual)	1117.6	1779.1
	64QAM 0.92 (Single)	1245.0	2066.8
	64QAM 0.92 (Dual)	1081.2	1769.8
	256QAM 0.81 (Single)	1237.4	2041.2
	256QAM 0.81 (Dual)	1077.9	1738.1
20 MHz	BPSK 0.63	2289.1	3848.1
	QPSK 0.63 (Single)	1380.1	2391.7
	QPSK 0.87 (Single)	1238.1	2132.3
	16QAM 0.63 (Single)	988.3	1642.0
	16QAM 0.63 (Dual)	853.0	1346.0
	16QAM 0.87 (Single)	958.9	1541.4
	16QAM 0.87 (Dual)	833.5	1293.2
	64QAM 0.75 (Single)	923.2	1511.3
	64QAM 0.75 (Dual)	828.5	1289.8
	64QAM 0.92 (Single)	901.2	1460.6
	64QAM 0.92 (Dual)	808.7	1269.5
	256QAM 0.81 (Single)	925.1	1466.0
	256QAM 0.81 (Dual)	801.8	1258.9

Table 19 – Latency of a PTP 49600 Link with Frame Size 1518 bytes

Channel Bandwidth	Modulation Mode	Average Latency (microseconds)	Maximum Latency (microseconds)
5 MHz	BPSK 0.63	12764.9	16872.2
	QPSK 0.63 (Single)	6730.1	9026.8
	QPSK 0.87 (Single)	5140.4	7324.2
	16QAM 0.63 (Single)	3988.9	5372.4
	16QAM 0.63 (Dual)	2555.3	3437.4
	16QAM 0.87 (Single)	3140.4	4207.4
	16QAM 0.87 (Dual)	2137.2	2961.6
	64QAM 0.75 (Single)	2758.7	4037.1
	64QAM 0.75 (Dual)	1762.1	2832.9
	64QAM 0.92 (Single)	2717.0	3588.2
	64QAM 0.92 (Dual)	1889.8	2534.8
	256QAM 0.81 (Single)	2347.8	3267.5
	256QAM 0.81 (Dual)	1695.4	2490.1
10 MHz	BPSK 0.63	6427.3	8666.7
	QPSK 0.63 (Single)	3681.6	5077.5
	QPSK 0.87 (Single)	2875.0	3875.1
	16QAM 0.63 (Single)	2298.3	3321.2
	16QAM 0.63 (Dual)	1588.4	2245.8
	16QAM 0.87 (Single)	1942.6	2717.5
	16QAM 0.87 (Dual)	1443.8	2161.1
	64QAM 0.75 (Single)	1587.0	2696.7
	64QAM 0.75 (Dual)	1283.6	1947.9
	64QAM 0.92 (Single)	1684.1	2381.1
	64QAM 0.92 (Dual)	1274.3	1943.8
	256QAM 0.81 (Single)	1509.4	2314.6
	256QAM 0.81 (Dual)	1243.7	1911.5
20 MHz	BPSK 0.63	4399.4	5917.4
	QPSK 0.63 (Single)	2561.8	3527.0
	QPSK 0.87 (Single)	2018.2	2701.7
	16QAM 0.63 (Single)	1628.5	2339.4
	16QAM 0.63 (Dual)	1148.4	1641.5
	16QAM 0.87 (Single)	1390.3	1919.7
	16QAM 0.87 (Dual)	1054.7	1531.3
	64QAM 0.75 (Single)	1151.5	1885.4
	64QAM 0.75 (Dual)	966.0	1412.9
	64QAM 0.92 (Single)	1215.6	1705.5
	64QAM 0.92 (Dual)	957.6	1409.5
	256QAM 0.81 (Single)	1128.6	1667.4
	256QAM 0.81 (Dual)	965.5	1423.3

6 Site Planning

6.1 Site Survey and Link Planning

A site survey must be performed to identify all the obstructions (such as trees or buildings) in the path and to assess the risk of interference. This information is important if you are to achieve an accurate link feasibility assessment.

The PTP 600 Series are designed to operate in Non-Line-of-Sight (NLoS) and Line-of-Sight (LoS) environments. Link planning enables a link of known quality to be installed. This involves the acquisition of path profile data (using Motorola's free LINKPlanner utility). The LINKPlanner predicts data rates and reliability over the path. It allows the user to try different antenna heights and RF power settings. When the link is installed, the mean path loss can be checked to confirm that the predicted data rate and link reliability is achievable. Motorola LINKPlanner is available to download from http://www.motorola.com/ptp/support.

6.2 Site Selection Criteria

The following are guidelines for selecting the installation location of the ODU and PIDU Plus for a PTP 600 Series Bridge.

6.2.1 ODU Site Selection

When selecting a site for the ODU the following should be taken into consideration:

- It is not possible for people to stand or walk inadvertently in front of the antenna
- Height and location to achieve the best radio path
- Height in relation to other objects with regard to lightning strikes
- Aesthetics and planning permission issues
- Distance from the ODU and connected Network equipment (Maximum cable run from the ODU to the connected equipment is 100m [330 ft])
- Distance from the PIDU Plus to the ODU (Maximum cable run from the PIDU Plus to the ODU is 300m [990 ft] when using the Fiber interface)
- If using the GPS Sync Unit, ensure that it is exposed to an unobstructed path to the sky. Please refer to the "GPS Synchronization Unit Kit" User Manual delivered with the kit.

6.2.2 PTP 600 Series Bridge PIDU Plus Site Selection

When selecting a site for the PIDU Plus the following should be taken into consideration:

- Availability of a mains electricity supply
- Accessibility for viewing status indicators and pressing Recovery switch.

6.2.3 Path Loss Considerations

The path loss is the amount of attenuation the radio signal undergoes between the two ends of the link. The path loss is the sum of the attenuation of the path if there were no obstacles in the way (Free Space Path Loss), the attenuation caused by obstacles (Excess Path Loss) and a margin to allow for possible fading of the radio signal (Fade Margin).

Equation 2 - Path Loss

$$L_{free\_space} + L_{excess} + L_{fade} + L_{seasonal} < L_{capability}$$

Where

L_{free_space}	Free Space Path Loss (dB)
L_{excess}	Excess Path Loss (dB)
L_{fade}	Fade Margin Required (dB)
$L_{seasonal}$	Seasonal Fading (dB)
$L_{capability}$	Equipment Capability (dB)

6.2.4 Definitions

The equipment capability is given in Table 20 to Table 33. Each table gives Link Loss, Output Power and System Thresholds for PTP 600 Series Bridge in all modulation modes for all available channel bandwidths. Adaptive Modulation will ensure that the highest throughput that can be achieved instantaneously will be obtained taking account of propagation and interference. The calculation of Equation 1 needs to be performed to judge whether a particular link can be installed. When the link has been installed, web pages provide information about the link loss currently measured by the equipment both instantaneously and averaged. The averaged value will require maximum seasonal fading to be added, and then the radio reliability of the link can be computed.

For minimum error rates on TDM links the maximum modulation mode should be limited to 64QAM 0.75.

The values for (BPSK) are static receive sensitivity measurements. The other values are static receive sensitivity measurements with an AMOD threshold applied. The AMOD threshold applied is for a benign radio channel.

Sensitivity: Sensitivity is defined as the combined receive input signal level on both horizontal and vertical inputs that produces a Null BER Error ratio of $3x10^{-7}$.

Output Power: The output power is for a centre channel in Region 1. The output power will be reduced on the edge channels and may vary if different region codes are selected.

AMOD Threshold: The AMOD threshold is the combined receive input signal level on both horizontal and vertical inputs that results in the link consistently entering the receive modulation mode under consideration as the signal level is increased.

System Threshold: Thresholds for all modes except BPSK are for the relevant link optimization AMOD thresholds. System threshold for BPSK is the RPSK receive sensitivity.

Max Link Loss: The maximum link loss for each modulation mode is derived from the AMOD threshold for that mode (sensitivity threshold for BPSK) and the maximum Region 1 centre channel output power. The figures assume integral antennas are used, with gain depending upon frequency band as follows:

- 23 dBi (5.9 GHz, 5.8 GHz and 5.4 GHz)
- 22 dBi (4.8 GHz and 4.9 GHz)
- 21.5 dBi (4.5 GHz)
- 18 dBi (2.5 GHz)

6.2.5 PTP 25600 System Threshold, Output Power and Link Loss

PTP 25600 system threshold figures are given in the following tables:

- Table 20 - IP Mode.
- Table 21 - TDM Mode.

These figures assume that antenna gain is 23 dBi.

Table 20 - PTP 25600 - IP Mode - Threshold, Power and Loss per Modulation Mode

Modulation Mode	Threshold Value (dBm)				Output Power (dBm)	Maximum Link Loss (dB)			
	Channel Bandwidth (MHz)								
	5 MHz	10 MHz	15 MHz	30 MHz	All Bands	5 MHz	10 MHz	15 MHz	30 MHz
BPSK 0.63 single	-97.57	-95.14	-92.95	-90.39	+23	156.6	154.1	152.0	149.4
QPSK 0.63 single	-93.87	-90.66	-90.49	-86.65	+23	152.9	149.7	146.6	145.7
QPSK 0.87 single	-90.72	-87.60	-87.45	-83.94	+23	149.7	146.6	146.5	142.9
16QAM 0.63 single	-89.06	-85.98	-86.02	-82.11	+23	148.0	145.5	145.0	140.4
16QAM 0.63 dual	-86.71	-83.93	-83.96	-79.43	+23	145.7	142.9	143.0	138.4
16QAM 0.87 single	-84.21	-82.45	-80.52	-76.50	+23	143.2	141.4	139.5	135.5
16QAM 0.87 dual	-80.97	-77.65	-77.44	-72.92	+23	140.0	136.6	136.4	131.9
64QAM 0.75 single	-81.61	-79.24	-77.42	-73.45	+23	140.6	138.2	136.4	132.4
64QAM 0.75 dual	-77.83	-74.71	-74.34	-69.81	+23	136.8	133.7	133.3	128.8
64QAM 0.92 single	-78.80	-76.25	-74.42	-70.27	+23	137.8	135.2	133.4	129.3
64QAM 0.92 dual	-75.46	-71.32	-71.88	-66.51	+23	134.5	130.3	130.9	125.5
256QAM 0.81 single	-77.17	-74.94	-72.92	-68.81	+23	136.2	133.9	131.9	127.8
256QAM 0.81 dual	-73.53	-70.07	-69.68	-65.14	+23	132.5	129.1	128.7	124.1

Table 21 - PTP 25600 - TDM Mode - Threshold, Power and Loss per Modulation Mode

Modulation Mode	Threshold Value (dBm)				Output Power (dBm)	Maximum Link Loss (dB)			
	Channel Bandwidth (MHz)								
	5 MHz	10 MHz	15 MHz	30 MHz	All Bands	5 MHz	10 MHz	15 MHz	30 MHz
BPSK 0.63 single	-97.57	-95.14	-92.95	-90.39	+23	156.6	154.1	152.0	149.4
QPSK 0.63 single	-91.55	-89.12	-88.20	-85.19	+23	150.6	148.1	147.2	144.2
QPSK 0.87 single	-88.28	-85.58	-85.12	-81.51	+23	147.3	144.6	144.1	140.5
16QAM 0.63 single	-86.37	-83.86	-83.45	-79.36	+23	145.4	142.9	142.5	138.4
16QAM 0.63 dual	-84.18	-80.79	-80.73	-76.62	+23	143.2	139.8	139.7	135.6
16QAM 0.87 single	-81.68	-78.11	-77.27	-73.64	+23	140.7	137.1	136.3	132.6
16QAM 0.87 dual	-78.64	-74.42	-74.30	-70.03	+23	137.6	133.4	133.3	129.0
64QAM 0.75 single	-78.76	-75.24	-74.19	-70.55	+23	137.8	134.2	133.2	129.6
64QAM 0.75 dual	-75.39	-70.99	-70.86	-66.72	+23	134.4	130.0	129.9	125.7
64QAM 0.92 single	-76.04	-73.44	-72.15	-68.64	+23	135.0	132.4	131.2	127.6
64QAM 0.92 dual	-73.49	-69.25	-68.92	-64.84	+23	132.5	128.2	127.9	123.8
256QAM 0.81 single	-73.39	-71.63	-69.11	-65.41	+23	132.4	130.6	128.1	124.4
256QAM 0.81 dual	-70.44	-67.58	-65.89	-61.62	+23	129.4	126.6	124.9	120.6

6.2.6 PTP 45600 System Threshold, Output Power and Link Loss

PTP 45600 system threshold figures are given in the following tables:

- Table 22 - IP Mode.
- Table 23 - TDM Mode.

These figures assume that antenna gain is 23 dBi.

Table 22 - PTP 45600 - IP Mode - Threshold, Power and Loss per Modulation Mode

Modulation Mode	Threshold Value (dBm)				Output Power (dBm)	Maximum Link Loss (dB)			
	Channel Bandwidth (MHz)								
	5 MHz	10 MHz	15 MHz	30 MHz	All Bands	5 MHz	10 MHz	15 MHz	30 MHz
BPSK 0.63 single	-97.86	-95.25	-93.00	-89.56	+25	165.9	163.3	161.0	157.6
QPSK 0.63 single	-93.13	-90.51	-88.91	-84.62	+25	161.1	158.5	156.9	152.6
QPSK 0.87 single	-89.69	-86.28	-84.17	-81.34	+25	157.7	154.3	152.2	149.3
16QAM 0.63 single	-87.58	-84.00	-81.85	-79.06	+25	155.6	152.0	149.9	147.1
16QAM 0.63 dual	-84.34	-80.96	-79.19	-76.33	+25	152.3	149.0	147.2	144.3
16QAM 0.87 single	-81.26	-77.89	-75.92	-72.45	+25	149.3	145.9	143.9	140.5
16QAM 0.87 dual	-77.69	-73.70	-71.96	-69.10	+25	145.7	141.7	140.0	137.1
64QAM 0.75 single	-78.02	-74.28	-72.47	-69.24	+25	146.0	142.3	140.5	137.2
64QAM 0.75 dual	-74.18	-70.29	-68.62	-65.93	+25	142.2	138.3	136.6	133.9
64QAM 0.92 single	-74.27	-71.62	-69.63	-66.51	+25	142.3	139.6	137.6	134.5
64QAM 0.92 dual	-71.69	-68.04	-66.47	-63.27	+25	139.7	136.0	134.5	131.3
256QAM 0.81 single	N/A	N/A	N/A	-64.50	+25	N/A	N/A	N/A	132.5
256QAM 0.81 dual	N/A	N/A	N/A	-60.48	+25	N/A	N/A	NA	128.5

Table 23 - PTP 45600 - TDM Mode - Threshold, Power and Loss per Modulation Mode

Modulation Mode	Threshold Value (dBm)				Output Power (dBm)	Maximum Link Loss (dB)			
	Channel Bandwidth (MHz)								
	5 MHz	10 MHz	15 MHz	30 MHz	All Bands	5 MHz	10 MHz	15 MHz	30 MHz
BPSK 0.63 single	-97.86	-95.25	-93.00	-89.56	+25	165.9	163.3	161.0	157.6
QPSK 0.63 single	-90.42	-88.78	-85.56	-82.82	+25	158.4	156.8	153.6	150.8
QPSK 0.87 single	-86.07	-84.02	-80.83	-78.67	+25	154.1	152.0	148.8	146.7
16QAM 0.63 single	-83.53	-81.83	-78.74	-76.39	+25	151.5	149.8	146.7	144.4
16QAM 0.63 dual	-80.70	-78.86	-75.74	-73.35	+25	148.7	146.9	143.7	141.4
16QAM 0.87 single	-77.12	-73.86	-72.03	-69.25	+25	145.1	141.9	140.0	137.2
16QAM 0.87 dual	-73.48	-71.50	-68.68	-66.77	+25	141.5	139.5	136.7	134.8
64QAM 0.75 single	-73.07	-70.39	-68.65	-66.06	+25	141.1	138.4	136.7	134.1
64QAM 0.75 dual	-69.60	-68.30	-65.37	-63.38	+25	137.6	136.3	133.4	131.4
64QAM 0.92 single	-70.51	-68.26	-66.52	-63.93	+25	138.5	136.3	134.5	131.9
64QAM 0.92 dual	-67.27	-66.03	-63.11	-60.04	+25	135.3	134.0	131.1	128.0
256QAM 0.81 single	N/A	N/A	N/A	-63.93	+25	N/A	N/A	N/A	131.9
256QAM 0.81 dual	N/A	N/A	N/A	-60.04	+25	N/A	N/A	N/A	128.0

6.2.7 PTP 48600 System Threshold, Output Power and Link Loss

PTP 48600 system threshold figures are given in the following tables:

- Table 24 - IP Mode.
- Table 25 - TDM Mode.

These figures assume that antenna gain is 22 dBi.

Table 24 - PTP 48600 - IP Mode - Threshold, Power and Loss per Modulation Mode

Modulation Mode	Threshold Value (dBm)			Output Power (dBm)	Maximum Link Loss (dB)		
	Channel Bandwidth (MHz)						
	5 MHz	10 MHz	20 MHz	All Bands	5 MHz	10 MHz	20 MHz
BPSK 0.63 single	-98.04	-96.12	-93.90	+27.0	169.0	167.1	164.9
QPSK 0.63 single	-94.60	-91.12	-89.37	+27.0	165.6	162.1	160.4
QPSK 0.87 single	-90.88	-87.24	-85.14	+27.0	161.9	158.2	156.1
16QAM 0.63 single	-89.34	-85.85	-83.92	+26.0	159.3	155.9	153.9
16QAM 0.63 dual	-85.66	-82.32	-80.22	+26.0	155.7	152.3	150.2
16QAM 0.87 single	-82.47	-78.86	-76.65	+26.0	152.5	148.9	146.7
16QAM 0.87 dual	-78.92	-75.44	-73.56	+26.0	148.9	145.4	143.6
64QAM 0.75 single	-81.29	-77.93	-75.88	+23.0	148.3	144.9	142.9
64QAM 0.75 dual	-78.29	-74.83	-73.01	+23.0	145.3	141.8	140.0
64QAM 0.92 single	-75.41	-72.62	-71.50	+23.0	142.4	139.6	138.5
64QAM 0.92 dual	-72.55	-69.68	-68.75	+23.0	139.5	136.7	135.7
256QAM 0.81 single	-74.48	-71.47	-69.64	+22.0	140.5	137.5	135.6
256QAM 0.81 dual	-71.63	-68.44	-66.68	+22.0	137.6	134.4	132.7

Table 25 - PTP 48600 - TDM Mode - Threshold, Power and Loss per Modulation Mode

Modulation Mode	Threshold Value (dBm)			Output Power (dBm)	Maximum Link Loss (dB)		
	Channel Bandwidth (MHz)						
	5 MHz	10 MHz	20 MHz	All Bands	5 MHz	10 MHz	20 MHz
BPSK 0.63 single	-98.04	-96.12	-93.90	+27.0	169.0	167.1	164.9
QPSK 0.63 single	-91.81	-88.65	-87.04	+27.0	162.8	159.6	158.0
QPSK 0.87 single	-87.68	-84.59	-82.61	+27.0	158.7	155.6	153.6
16QAM 0.63 single	-86.26	-83.21	-81.22	+26.0	156.3	153.2	151.2
16QAM 0.63 dual	-82.66	-79.42	-77.35	+26.0	152.7	149.4	147.4
16QAM 0.87 single	-79.18	-76.09	-74.22	+26.0	149.2	146.1	144.2
16QAM 0.87 dual	-75.75	-72.93	-71.22	+26.0	145.8	142.9	141.2
64QAM 0.75 single	-77.80	-74.84	-73.12	+23.0	144.8	141.8	140.1
64QAM 0.75 dual	-74.82	-71.97	-70.34	+23.0	141.8	139.0	137.3
64QAM 0.92 single	-73.95	-71.29	-69.54	+23.0	140.9	138.3	136.5
64QAM 0.92 dual	-70.80	-68.01	-66.13	+23.0	137.8	135.0	133.1
256QAM 0.81 single	-70.45	-67.57	-65.40	+22.0	136.4	133.6	131.4
256QAM 0.81 dual	-66.44	-63.87	TBD	+22.0	132.4	129.9	TBD

6.2.8 PTP 49600 System Threshold, Output Power and Link Loss

PTP 49600 system threshold figures are given in the following tables:

- Table 26 - IP Mode.
- Table 27 - TDM Mode.

These figures assume that antenna gain is 22 dBi.

Table 26 - PTP 49600 - IP Mode - Threshold, Power and Loss per Modulation Mode

Modulation Mode	Threshold Value (dBm)			Output Power (dBm)	Maximum Link Loss (dB)		
	Channel Bandwidth (MHz)						
	5 MHz	10 MHz	20 MHz	All Bands	5 MHz	10 MHz	20 MHz
BPSK 0.63 single	-98.04	-96.12	-93.90	+25.0	167.0	165.1	162.9
QPSK 0.63 single	-94.60	-91.12	-89.37	+25.0	163.6	160.1	158.4
QPSK 0.87 single	-90.88	-87.24	-85.14	+25.0	159.9	156.2	154.1
16QAM 0.63 single	-89.34	-85.85	-83.92	+25.0	158.3	154.9	152.9
16QAM 0.63 dual	-85.66	-82.32	-80.22	+25.0	154.7	151.3	149.2
16QAM 0.87 single	-82.47	-78.86	-76.65	+25.0	151.5	147.9	145.7
16QAM 0.87 dual	-78.92	-75.44	-73.56	+25.0	147.9	144.4	142.6
64QAM 0.75 single	-81.29	-77.93	-75.88	+23.0	148.3	144.9	142.9
64QAM 0.75 dual	-78.29	-74.83	-73.01	+23.0	145.3	141.8	140.0
64QAM 0.92 single	-75.41	-72.62	-71.50	+23.0	142.4	139.6	138.5
64QAM 0.92 dual	-72.55	-69.68	-68.75	+23.0	139.5	136.7	135.7
256QAM 0.81 single	-74.48	-71.47	-69.64	+22.0	140.5	137.5	135.6
256QAM 0.81 dual	-71.63	-68.44	-66.68	+22.0	137.6	134.4	132.7

Table 27 - PTP 49600 - TDM Mode - Threshold, Power and Loss per Modulation Mode

Modulation Mode	Threshold Value (dBm)			Output Power (dBm)	Maximum Link Loss (dB)		
	Channel Bandwidth (MHz)						
	5 MHz	10 MHz	20 MHz	All Bands	5 MHz	10 MHz	20 MHz
BPSK 0.63 single	-98.04	-96.12	-93.90	+25.0	167.0	165.1	162.9
QPSK 0.63 single	-91.81	-88.65	-87.04	+25.0	160.8	157.6	156.0
QPSK 0.87 single	-87.68	-84.59	-82.61	+25.0	156.7	153.6	151.6
16QAM 0.63 single	-86.26	-83.21	-81.22	+25.0	155.3	152.2	150.2
16QAM 0.63 dual	-82.66	-79.42	-77.35	+25.0	151.7	148.4	146.4
16QAM 0.87 single	-79.18	-76.09	-74.22	+25.0	148.2	145.1	143.2
16QAM 0.87 dual	-75.75	-72.93	-71.22	+25.0	144.8	141.9	140.2
64QAM 0.75 single	-77.80	-74.84	-73.12	+23.0	144.8	141.8	140.1
64QAM 0.75 dual	-74.82	-71.97	-70.34	+23.0	141.8	139.0	137.3
64QAM 0.92 single	-73.95	-71.29	-69.54	+23.0	140.9	138.3	136.5
64QAM 0.92 dual	-70.80	-68.01	-66.13	+23.0	137.8	135.0	133.1
256QAM 0.81 single	-70.45	-67.57	-65.40	+22.0	136.4	133.6	131.4
256QAM 0.81 dual	-66.44	-63.87	TBD	+22.0	132.4	129.9	TBD

6.2.9 PTP 54600 System Threshold, Output Power and Link Loss

PTP 54600 system threshold figures are given in the following tables:

- Table 28 - IP Mode.
- Table 29 - TDM Mode.

These figures assume that antenna gain is 23 dBi.

Table 28 – PTP 54600 - IP Mode - Threshold, Power and Loss per Modulation Mode

Modulation Mode	Threshold Value (dBm)				Output Power (dBm)	Maximum Link Loss (dB)			
	Channel Bandwidth (MHz)								
	5 MHz	10 MHz	15 MHz	30 MHz	All Bands	5 MHz	10 MHz	15 MHz	30 MHz
BPSK 0.63 single	-98.24	-94.58	-92.26	-88.90	+25	169.2	165.6	163.3	159.9
QPSK 0.63 single	-93.02	-89.99	-88.50	-82.86	+24	163.0	160.0	158.5	152.9
QPSK 0.87 single	-90.23	-86.68	-85.25	-80.10	+23	159.2	155.7	154.3	149.1
16QAM 0.63 single	-87.98	-83.75	-82.82	-78.33	+22	156.0	151.8	150.8	146.3
16QAM 0.63 dual	-84.29	-80.68	-79.32	-74.64	+22	152.3	148.7	147.3	142.6
16QAM 0.87 single	-82.44	-79.10	-78.20	-72.98	+20	148.4	145.1	144.2	139.0
16QAM 0.87 dual	-79.65	-75.74	-74.67	-70.58	+20	145.7	141.7	140.7	136.6
64QAM 0.75 single	-78.93	-76.44	-74.93	-70.28	+18	142.9	140.4	138.9	134.3
64QAM 0.75 dual	-76.45	-72.74	-71.55	-67.69	+18	140.5	136.7	135.6	131.7
64QAM 0.92 single	-74.40	-71.66	-70.42	-64.96	+18	138.4	135.7	134.4	129.0
64 QAM 0.92 dual	-70.65	-68.51	-66.88	-62.33	+18	134.7	132.5	130.9	126.3
256QAM 0.81 single	N/A	N/A	N/A	-63.63	+18	N/A	N/A	N/A	127.6
256QAM 0.81 dual	N/A	N/A	N/A	-60.46	+18	N/A	N/A	N/A	124.5

Table 29 – PTP 54600 - TDM Mode - Threshold, Power and Loss per Modulation Mode

Modulation Mode	Threshold Value (dBm)				Output Power (dBm)	Maximum Link Loss (dB)			
	Channel Bandwidth (MHz)								
	5 MHz	10 MHz	15 MHz	30 MHz	All Bands	5 MHz	10 MHz	15 MHz	30 MHz
BPSK 0.63 single	-98.24	-94.58	-92.26	-88.90	+25	169.2	165.6	163.3	159.9
QPSK 0.63 single	-89.70	-88.28	-86.35	-81.35	+24	159.7	158.3	156.4	151.4
QPSK 0.87 single	-86.70	-84.30	-82.34	-78.42	+23	155.6	153.3	151.3	147.4
16QAM 0.63 single	-86.56	-81.81	-79.91	-75.99	+22	151.7	149.8	147.9	144.0
16QAM 0.63 dual	-83.70	-78.23	-76.54	-72.41	+22	148.8	146.3	144.5	140.4
16QAM 0.87 single	-78.75	-76.61	-75.47	-69.76	+20	144.8	142.6	141.5	135.8
16QAM 0.87 dual	-76.92	-73.85	-72.19	-68.70	+20	142.9	139.9	138.2	134.7
64QAM 0.75 single	-74.66	-72.21	-71.77	-66.59	+18	138.7	136.2	135.8	130.6
64QAM 0.75 dual	-73.00	-70.41	-68.79	-65.63	+18	137.0	134.4	132.8	129.6
64QAM 0.92 single	-70.91	-68.59	-67.40	-62.94	+18	134.9	132.6	131.4	126.9
64 QAM 0.92 dual	-68.15	-65.62	-64.23	-60.50	+18	132.1	129.6	128.2	124.5
256QAM 0.81 single	N/A	N/A	N/A	-65.36	+18	N/A	N/A	N/A	126.9
256QAM 0.81 dual	N/A	N/A	N/A	-60.50	+18	N/A	N/A	N/A	124.5

6.2.10 PTP 58600 System Threshold, Output Power and Link Loss

PTP 58600 system threshold figures are given in the following tables:

- Table 30 - IP Mode.
- Table 31 - TDM Mode.

These figures assume that antenna gain is 23 dBi.

Table 30 - PTP 58600 - IP Mode - Threshold, Power and Loss per Modulation Mode

Modulation Mode	Threshold Value (dBm)				Output Power (dBm)	Maximum Link Loss (dB)			
	Channel Bandwidth (MHz)								
	5 MHz	10 MHz	15 MHz	30 MHz	All Bands	5 MHz	10 MHz	15 MHz	30 MHz
BPSK 0.63 single	-95.05	-92.51	-90.78	-86.33	+25	166.1	163.5	161.8	157.3
QPSK 0.63 single	-91.86	-90.04	-87.73	-83.00	+24	161.9	160.0	157.7	153.0
QPSK 0.87 single	-88.69	-86.64	-84.84	-80.26	+23	157.7	155.6	153.8	149.3
16QAM 0.63 single	-85.99	-84.31	-82.44	-78.34	+22	154.0	152.3	150.4	146.3
16QAM 0.63 dual	-83.46	-80.36	-78.51	-75.34	+22	151.5	148.4	146.5	143.3
16QAM 0.87 single	-82.12	-79.50	-78.13	-72.47	+20	148.1	145.5	144.1	138.5
16QAM 0.87 dual	-79.24	-76.21	-73.92	-71.49	+20	145.2	142.2	139.9	137.5
64QAM 0.75 single	-78.82	-76.70	-75.20	-69.16	+18	142.8	140.7	139.2	133.2
64QAM 0.75 dual	-76.14	-73.14	-70.99	-67.67	+18	140.1	137.1	135.0	131.7
64QAM 0.92 single	-74.40	-72.48	-66.24	-64.98	+18	138.4	136.5	134.6	129.0
64 QAM 0.92 dual	-70.23	-69.07	-70.69	-61.53	+18	134.2	133.1	130.2	125.5
256QAM 0.81 single	N/A	N/A	N/A	-64.03	+18	N/A	N/A	N/A	128.0
256QAM 0.81 dual	N/A	N/A	N/A	-59.59	+18	N/A	N/A	N/A	123.6

Table 31 - PTP 58600 - TDM Mode - Threshold, Power and Loss per Modulation Mode

Modulation Mode	Threshold Value (dBm)				Output Power (dBm)	Maximum Link Loss (dB)			
	Channel Bandwidth (MHz)								
	5 MHz	10 MHz	15 MHz	30 MHz	All Bands	5 MHz	10 MHz	15 MHz	30 MHz
BPSK 0.63 single	-95.05	-92.51	-90.78	-86.33	+25	166.1	163.5	161.8	157.3
QPSK 0.63 single	-88.70	-87.77	-85.95	-80.59	+24	158.7	157.8	155.9	150.6
QPSK 0.87 single	-85.51	-83.79	-81.56	-77.82	+23	154.5	152.8	150.6	146.8
16QAM 0.63 single	-81.98	-81.26	-79.06	-75.29	+22	150.0	149..3	147.1	143.3
16QAM 0.63 dual	-79.40	-77.58	-75.62	-71.72	+22	147.4	145.6	143.6	139.7
16QAM 0.87 single	-78.66	-76.32	-74.67	-71.21	+20	144.7	142.3	140.7	137.2
16QAM 0.87 dual	-75.05	-73.16	-71.03	-67.73	+20	141.0	139.2	137.0	133.7
64QAM 0.75 single	-74.44	-72.26	-70.64	-67.94	+18	138.4	136.3	134.6	131.9
64QAM 0.75 dual	-70.90	-69.52	-67.59	-64.02	+18	134.9	133.5	131.6	128.0
64QAM 0.92 single	-70.86	-68.01	-66.63	-63.07	+18	134.9	132.0	130.6	127.1
64 QAM 0.92 dual	-66.80	-64.62	-65.52	-58.65	+18	130.8	128.6	126.5	122.7
256QAM 0.81 single	N/A	N/A	N/A	-63.07	+18	N/A	N/A	N/A	127.1
256QAM 0.81 dual	N/A	N/A	N/A	-58.65	+18	N/A	N/A	N/A	122.7

6.2.11 PTP 59600 System Threshold, Output Power and Link Loss

PTP 59600 system threshold figures are given in the following tables:

- Table 32 - IP Mode.
- Table 33 - TDM Mode.

These figures assume that antenna gain is 23 dBi.

Table 32 - PTP 59600 - IP Mode - Threshold, Power and Loss per Modulation Mode

Modulation Mode	Threshold Value (dBm)				Output Power (dBm)	Maximum Link Loss (dB)			
	Channel Bandwidth (MHz)								
	5 MHz	10 MHz	15 MHz	30 MHz	All Bands	5 MHz	10 MHz	15 MHz	30 MHz
BPSK 0.63 single	-97.11	-94.07	-91.96	-88.66	+25.0	168.1	165.1	163.0	159.7
QPSK 0.63 single	-90.71	-88.06	-87.13	-82.53	+24.0	160.7	158.1	157.1	152.5
QPSK 0.87 single	-87.23	-84.38	-83.50	-79.29	+23.0	156.2	153.4	152.5	148.3
16QAM 0.63 single	-85.04	-81.89	-81.21	-77.10	+22.0	153.0	149.9	149.2	145.1
16QAM 0.63 dual	-81.90	-78.75	-77.47	-73.47	+22.0	149.9	146.8	145.5	141.5
16QAM 0.87 single	-80.90	-77.95	-76.72	-72.87	+20.0	146.9	143.9	142.7	138.9
16QAM 0.87 dual	-76.48	-73.92	-73.19	-70.03	+20.0	142.5	139.9	139.2	136.0
64QAM 0.75 single	-77.02	-74.56	-73.63	-70.28	+18.0	141.0	138.6	137.6	134.3
64QAM 0.75 dual	-73.14	-71.04	-70.40	-67.54	+18.0	137.1	135.0	134.4	131.5
64QAM 0.92 single	-72.09	-70.98	-68.90	-65.65	+18.0	136.1	135.0	132.9	129.7
64 QAM 0.92 dual	-70.20	-67.15	-66.11	-62.07	+18.0	134.2	131.1	130.1	126.1
256QAM 0.81 single	N/A	N/A	N/A	-63.91	+18.0	N/A	N/A	N/A	127.9
256QAM 0.81 dual	N/A	N/A	N/A	-59.88	+18.0	N/A	N/A	N/A	123.9

Table 33 - PTP 59600 - TDM Mode - Threshold, Power and Loss per Modulation Mode

Modulation Mode	Threshold Value (dBm)				Output Power (dBm)	Maximum Link Loss (dB)			
	Channel Bandwidth (MHz)								
	5 MHz	10 MHz	15 MHz	30 MHz	All Bands	5 MHz	10 MHz	15 MHz	30 MHz
BPSK 0.63 single	-97.11	-94.07	-91.96	-88.66	+25.0	168.1	165.1	163.0	159.7
QPSK 0.63 single	-88.47	-86.12	-84.37	-79.38	+24.0	158.5	156.1	154.4	149.4
QPSK 0.87 single	-84.64	-81.89	-80.09	-76.00	+23.0	153.6	150.9	149.1	145.0
16QAM 0.63 single	-82.45	-79.60	-77.75	-73.66	+22.0	150.4	147.6	145.8	141.7
16QAM 0.63 dual	-78.81	-75.96	-74.12	-70.42	+22.0	146.8	144.0	142.1	138.4
16QAM 0.87 single	-78.27	-75.07	-73.66	-70.19	+20.0	144.3	141.1	139.7	136.2
16QAM 0.87 dual	-74.23	-71.63	-70.18	-66.89	+20.0	140.2	137.6	134.2	132.9
64QAM 0.75 single	-74.69	-71.38	-70.23	-67.31	+18.0	138.7	135.4	134.2	131.3
64QAM 0.75 dual	-70.85	-68.25	-66.75	-63.60	+18.0	134.8	132.2	130.8	127.6
64QAM 0.92 single	-71.20	-68.05	-66.99	-63.27	+18.0	135.2	132.0	131.0	127.3
64 QAM 0.92 dual	-66.66	-64.17	-62.71	-58.72	+18.0	130.7	128.2	126.7	122.7
256QAM 0.81 single	N/A	N/A	N/A	-63.27	+18.0	N/A	N/A	N/A	127.3
256QAM 0.81 dual	N/A	N/A	N/A	-58.72	+18.0	N/A	N/A	N/A	122.7

7 Installation

IMPORTANT Motorola recommends that only qualified personnel undertake the installation of a PTP 600 Series Bridge solution.

We recommend that the practices and procedures detailed in the Motorola manual R56 "STANDARDS AND GUIDELINES FOR COMMUNICATION SITES" (68P81089E50) be applied to all new site build activities. This manual is provided on the PTP 600 CD-ROM.

7.1 Preparation

Before proceeding with the installation you should:

- Check the contents of all packages against the parts lists shown in the packing list.
- Ensure that you have the correct tools for the job.
- Ensure that you are qualified to undertake the work.
- Ensure that you have taken the correct safety precautions.
- Have completed the site planning as described in Section 6 “Site Planning”.

7.2 Installation Procedure

The 600 Series installation procedure consists of the following steps:

- Mounting the ODUs, Section 7.6 “Mounting the ODUs”
- Connecting up, Section 7.7 “Connecting Up”
- Mounting the PIDU Plus units, Section 7.7.9 “Mounting the PTP 600 Series Bridge PIDU Plus”
- Mounting the Lightning Protection Units, Section 10.2 “Detailed Installation”.
- Mounting the GPS Sync Unit (if required), Section 14 “TDD Synchronization Configuration and Installation Guide” and refer to the “GPS Sync Unit Kit” User Manual available in your installation CD for specific information related to the GPS Sync Unit.
- Powering Up, Section 7.7.10 “Powering Up”.
- Establishing a radio link between the two ODUs and aligning the units for the best signal strength, Section 7.8 “Establishing a Radio Link”.

7.3 Tools Required

The following specific tools are required to install a PTP 600 Series Bridge in addition to general tools:

- 13mm wrench and 22 mm wrench for use with the glands
- RJ45 crimp tool (it must be the correct tool for the type of RJ45 being used)
- Personal Computer (PC) with 10, 100 or 1000 BaseT Ethernet
- Either Internet Explorer version 6 or higher, or FireFox 2.0 or higher are recommended.
- Ethernet patch cables
- Motorola PTP LINKPlanner report for this link

7.4 Installation Support

Online installation support and contact details for your regional support can be found at http://www.motorola.com/ptp

A Frequently Asked Questions (FAQ) section can be found in Section 21 "FAQs".

7.5 Legal Disclaimer

IN NO EVENT SHALL MOTOROLA, INC. BE LIABLE FOR ANY INJURY TO ANY PERSONS OR ANY DAMAGE CAUSED DURING THE INSTALLATION OF THE MOTOROLA PTP 600 SERIES PRODUCT.

7.6 Mounting the ODUs

7.6.1 Mounting Bracket

The ODU is pre-fitted with a mounting bracket (designed to ease installation) and with earth bonding leads (Figure 36).

Figure 36 – ODU with Mounting Bracket and Earth Bonding Leads

WARNING: When mounting the ODU, observe the following precautions against failure of the assembly:

- Do not remove the pre-fitted mounting bracket from the ODU.
- Do not mount the ODU on poles with diameter less than 50mm (2”) or greater than 75mm (3”). The ODU mounting bracket is designed to work only with poles with diameter in the 50 mm (2”) to 75 mm (3”) range.
- Do not over-tighten the bolts.

The ODU must be mounted using the following steps, ensuring that the cable entry is at the bottom:

1. Attach the bracket strap to the pole using M8 x 70 mm bolts, M8 flat washers and M8 coil washers (Figure 37). Tighten to ensure the assembly grips but can be adjusted.

Figure 37 – ODU Bracket Strap

2. Offer the ODU (with pre-fitted mounting bracket) to the bracket strap and affix using the captive M8 bolt. Tighten to ensure the assembly grips, but can be adjusted on the pole (Figure 38 and Figure 39).

Figure 38 – ODU Mounting Bracket

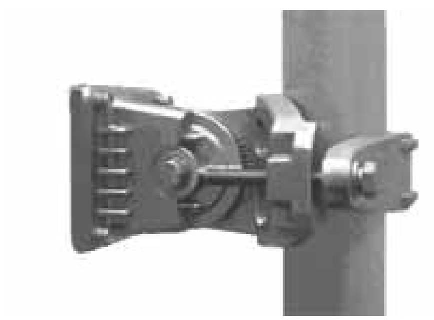


Figure 39 - ODU Mounted on Pole

3. Adjust the elevation and azimuth of the unit before tightening to the required torque settings of 14 Nm (11 lb ft) for both bolts.

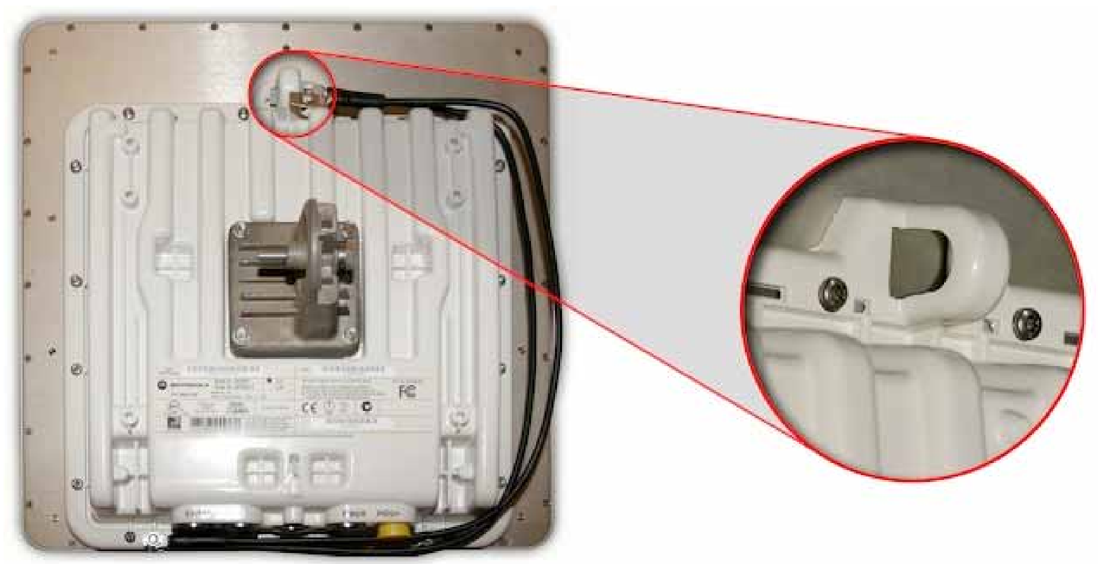
CAUTION: Attach the free end of one earth bonding lead (large tag M10) to the tower metal work. On no account must this be attached to the mounting bracket bolts.

The enclosure and mounting brackets of the PTP 600 Series Bridge product range are capable of withstanding wind speeds up to 151mph (242kph). The installer should ensure that the structure the bridge is fixed to is also capable of withstanding the prevalent wind speeds and loads. See Section 12 “Wind Loading”.

7.6.2 Hoist and Safety Loop

Use the integral safety loop (Figure 40) for hoisting the ODU up a mast, tower or building. When the ODU is in position, use the safety loop as a fixing point to secure a permanent lanyard from the mast, tower or building to the ODU, as a precaution against mounting failure.

Figure 40 - Integral Safety Loop



WARNING: The safety lanyard must not exceed 1m (approx 3 ft) in length. The lanyard must be made from a material that does not degrade in an outdoor environment.

WARNING: The safety lanyard must be fixed to a separate fixing point that is not part of the direct mounting system for the ODU.

WARNING: If the safety loop or its fixing is damaged in any way or has been exposed to a shock loading due to a fall, replace it with a new one before undertaking any further operations.

7.7 Connecting Up

7.7.1 Preparing the PIDU Plus To ODU Cable

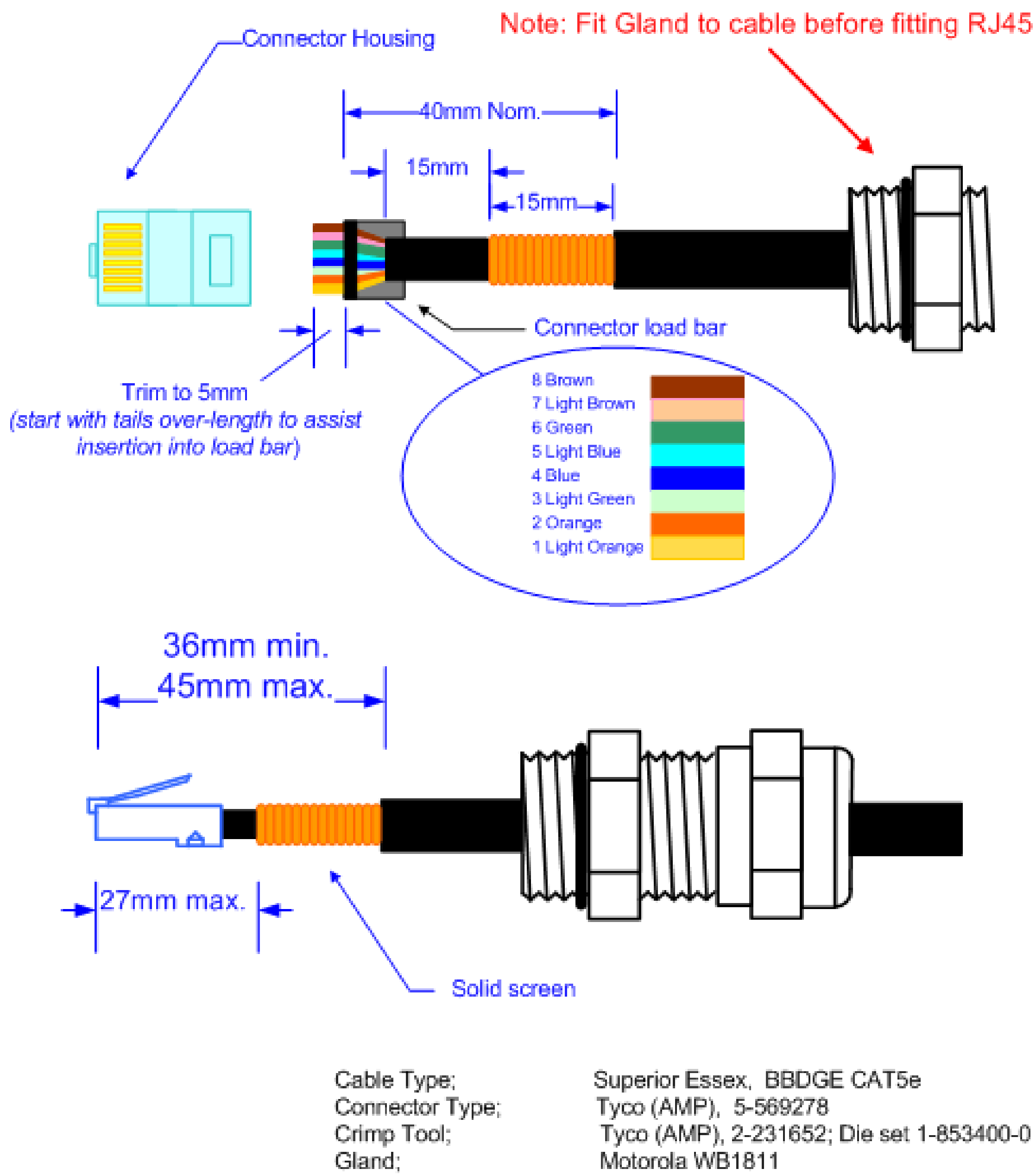
The maximum cable length between the ODU and the user's Network Equipment is 100m (330 ft). Cable lengths up to 300m (984 ft) can be used where the PIDU Plus to ODU cable is supplying power only, that is, when using the PTP 600 Series Bridge Optical Interface.

WARNING: The copper screen of the recommended Superior Essex cable is very sharp and may cause personal injury. When preparing this cable, take the following precautions:

- ALWAYS wear cut resistant gloves (check the label to ensure they are cut resistant).
- ALWAYS wear protective eyewear.
- ALWAYS use a rotary blade tool to strip the cable (DO NOT use a bladed knife). To use the rotary blade tool, fit it around the outer cable sheaf and rotate the cutter around the cable once or twice. The stripped outer section can then be removed.

The cable should be assembled as shown in Figure 41:

Figure 41 - Correct Cable Preparation for the Recommended Cable



CAUTION: Check that the crimp tool matches the RJ45 connector being used.

Both ends of the ODU cable are terminated in the same way. The above procedure should be repeated for the PIDU Plus end of the cable when the cable routing process is complete. This assumes that the installation uses PTP LPUs. If not, then the PIDU Plus end of the cable does not require a Gland, but just the RJ45.

NOTE: The PIDU Plus end of the cable does not employ a cable gland.

Figure 42 shows a completed ODU to PIDU Plus cable.

Figure 42 - Completed ODU Connector

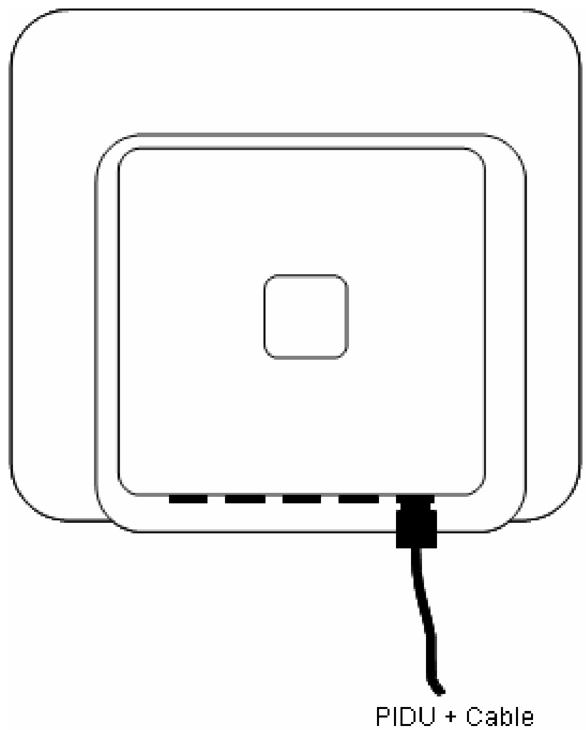
CAUTION: Do not over tighten the glands as the internal seal and structure may be damaged. See Figure 43 for an example of an over tightened cable gland.

Figure 43 - Correct and Incorrect Tightening of Cable Gland

7.7.2 Making the Connections at the ODU

Looking at the back of the unit with the cable entry at the bottom, the PTP 600 Series Bridge PIDU Plus connection is the first hole on the right (Figure 44) and is labeled “PIDU +”.

Figure 44 – PTP 600 Series Bridge PIDU Plus Connexion



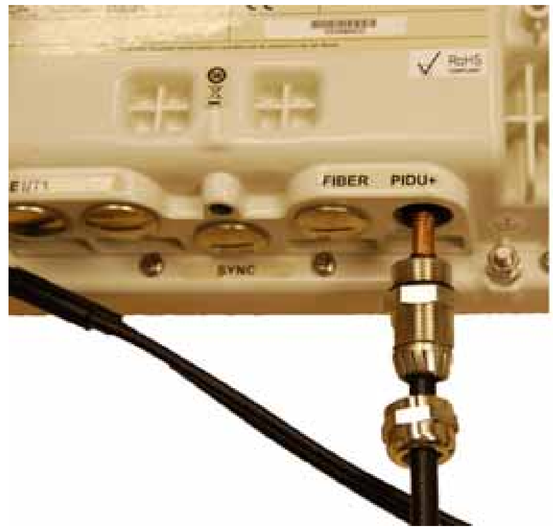
7.7.3 Making the PTP 600 Series Bridge PIDU Plus Connection At The ODU

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 that no power is connected to the PIDU Plus or present on the cable before connecting the ODU.

Figure 45 - Connecting the PIDU+ to the ODU

Step 1: Assemble the cable as described in 7.7.1 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 (Do not over tighten – see Figure 43)

Should it be necessary to disconnect the PIDU Plus to ODU cable at the ODU, this can be achieved by removing the weather proofing gland and depressing the RJ45 locking tab with a small screwdriver as shown below.

Figure 46 - Disconnecting the ODU

CAUTION: Ensure that power is removed from the system at the PIDU Plus to prevent damage to the ODU while making or breaking the connection.

7.7.4 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 at the PIDU Plus prior to connection to the PIDU Plus.

7.7.5 Fitting a Lightning Protection Unit

If you have opted to fit a Lightning Protection unit, this should be installed by following the manufacturer's instruction. For recommended types see Section 10 "Lightning Protection".

7.7.6 Grounding the Installation

The Outdoor Unit (ODU) must be properly grounded to protect against power surges. It is the user's responsibility to install the equipment in accordance with Section 810 of the National Electric Code, ANSI/NFPA No.70-1984 or Section 54 of the National Electrical Code in the country of installation. These codes describe correct installation procedures for grounding the outdoor unit, mast, lead-in wire and discharge unit, size of grounding conductors and connection requirements for grounding electrodes. It is recommended that installation of the outdoor unit be contracted to a professional installer.

7.7.7 Making the ODU Connection at the PTP 600 Series Bridge PIDU Plus

The ODU is connected to the PIDU Plus by means of a concealed RJ45 connector. The RJ45 connection has been placed inside the PIDU Plus hinged cover to prevent the user from inadvertently plugging other equipment into the ODU RJ45 socket.

CAUTION: Plugging other equipment into the ODU RJ45 socket may damage the equipment due to the non-standard techniques employed to inject DC power into the 1000BaseT connection between the PIDU Plus and the ODU. Plugging the ODU into other equipment may damage the ODU and/or the other equipment.

Step 1: Undo the retaining screw and hinge back the cover.

Step 2: Plug in the ODU into the PIDU Plus Cable ensuring that it snaps home

Step 3: Replace the cover and secure with the retaining screw

7.7.8 Making the Network Connection at The PIDU Plus – PTP 600 Series Bridge

The Network connection is made by connecting the user's Network Equipment directly to the PIDU Plus LAN port as shown in Figure 47.

Figure 47 - Making the Network Connection at the PIDU Plus

7.7.9 Mounting the PTP 600 Series Bridge PIDU Plus

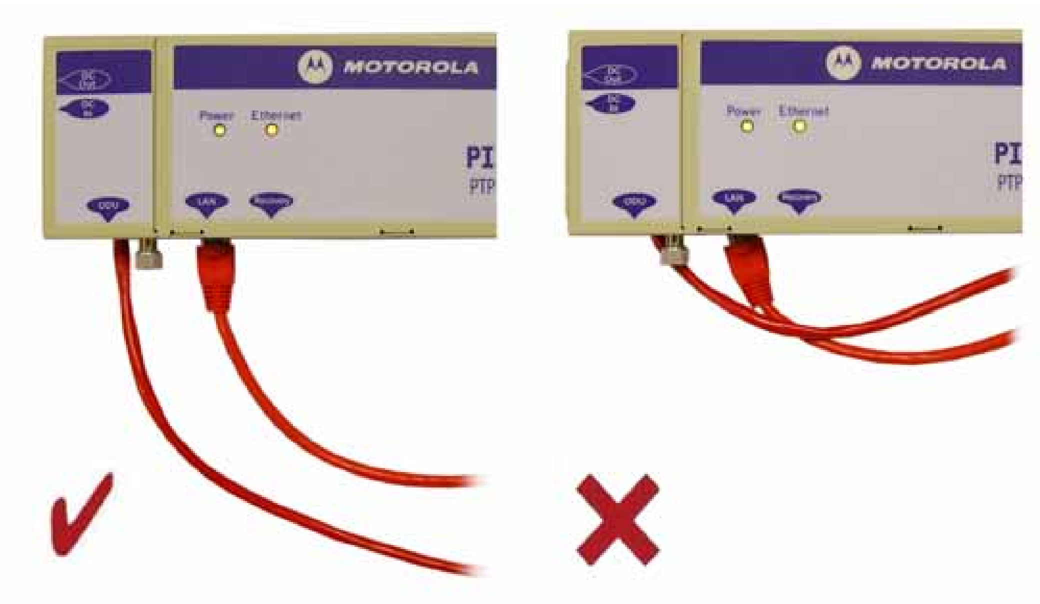
This step is optional. Motorola recommends that you mount the PIDU Plus on a wall or other suitable mounting surface. This prevents the unit from being knocked or kicked and can help maintain link availability. Ensure that the Recovery switch can be accessed when mounting the unit.

Step 1: Fix the PIDU Plus to the wall using the lugs provided.

Step 2: Make connections as per Section 7.7.7 “Making the ODU Connection at the PTP 600 Series Bridge PIDU Plus”

CAUTION: Do not dress the RJ45 cables too tightly, as this may make the connections unreliable. Figure 48 shoes the correct and incorrect ways to dress RJ45 cables when connected to the PIDU.

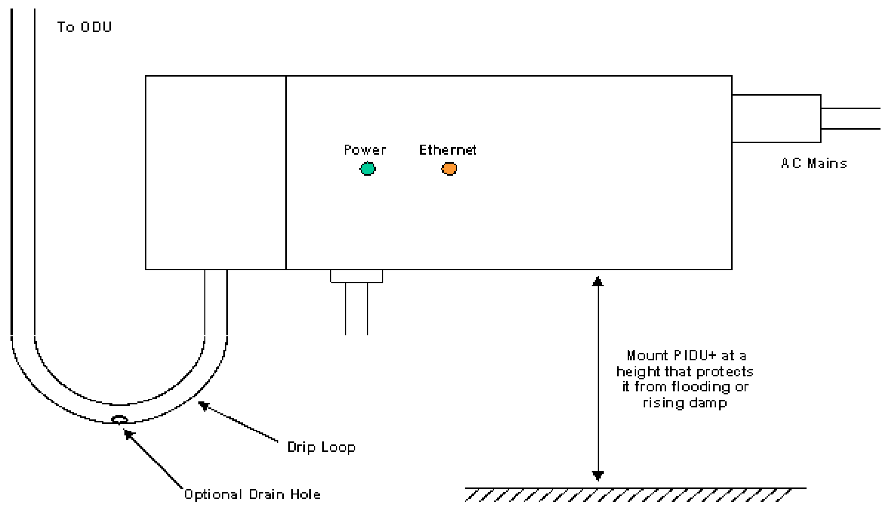
Figure 48 - Correct and Incorrect RJ45 Cable Dressing



CAUTION: The PIDU Plus is not waterproof and should be mounted away from sources of moisture. If mounted outdoors, the unit should be mounted in a rain proof enclosure, preferably ventilated.

It is also recommended that you fit a drip loop on the PIDU Plus to ODU cable to ensure that any moisture that runs down the cable into the cabinet or enclosure cannot enter the PIDU Plus. This is shown in Figure 49. The network connection and mains cable should be treated in the same way if there is a risk that they can carry moisture to the PIDU Plus.

Figure 49 – PTP 600 Series PIDU Plus Drip Loop Configuration



CAUTION: It is possible for moisture to enter the cable due to damage to the outer protective layer. This moisture can track down the inside of the cable, filling up the drip loop and eventually finding its way into the PIDU Plus. To protect against this the outer protective layer of the cable can be opened up at the bottom of the drip loop to allow this moisture to escape.

7.7.10 Powering Up

The PTP 600 Series Bridge is supplied as a pair of matched Master/Slave units. The Master unit can now be powered up and accessed using the default URL http://169.254.1.2/; the Slave unit can be accessed using http://169.254.1.1/.

Prior to powering up the PTP 600 Series Bridge, a computer with web browsing capabilities should be configured with an IP address of 169.254.n.n and subnet mask of 255.255.0.0 where n is any value between 1 and 254 but excluding 1.1 or 1.2. If the default addresses of the unit 169.254.1.1/2 clashes with an address you are already using on your LAN, or you are not sure, you should set up an isolated LAN. As the LAN connection presented at the PIDU Plus has a default configuration as a hub/switch (and auto-sensing MDI/MDIX cross over is employed), connection can be made directly to the computer using a standard CAT 5 patch cable.

Before physical installation takes place the units to be installed should be set up as described in the Section 8.3.4 “Install Pages”. It is recommended that this procedure be carried out on the bench before physical installation commences. Providing it is safe to do so, the installer should take the process to the point where a radio link is established before proceeding to the installation site.

NOTE: It is possible that some units may not be accessed using the above default URL. This is because these units may have been previously configured with IP addresses 10.10.10.11 (Master) and 10.10.10.10 (Slave). Therefore, users must use the URL http://10.10.10.10/ and/or URL http://10.10.10.11/ to configure the units. Please ensure that a computer with web browsing capabilities is configured with an IP address of 10.10.10.n, where n is any value between 2 and 254 but excluding 10 and 11, to configure these units.

7.8 Establishing a Radio Link

The following is a description of the steps taken to establish a radio link between the two units forming the bridge and align the units for the best signal strength.

7.8.1 Aligning the PTP 600 Series Bridge ODUs

The PTP 600 Series Bridge uses audible tones during installation to assist the installer with alignment. The installer should adjust the alignment of the ODU in both azimuth and elevation until highest pitch tone is achieved.

The pitch of the alignment tone is proportional to the received power of the wireless signals. The best results are usually achieved by making small incremental movement in angular alignment.

The tones and their meanings are as follows:

Table 34 - Audio indications from the ODU

State Name	Tone Description	State Description	Pitch Indication (Higher pitch = higher power)
Free Channel Search	Regular beep	Executing band scan	N/A
Scanning	Slow broken tone	Not demodulating the wanted signal	Rx Power
Synchronized	Fast broken tone	Demodulating the wanted signal	Rx Power
Registered	Solid tone	Both Master and Slave units exchanging Radio layer MAC management messages	Rx Power

The term 'wanted signal' refers to that of the peer unit being installed.

In each of the states detailed above, the unit should be aligned to give the highest pitch tone. It should be noted that if, when in the Synchronized or Registered state, the tone varies wildly, you may be suffering from interference or a fast fading link. Installing in this situation may not give a reliable link. The cause of the problem should be investigated.

For the ease of alignment, both Master and Slave units use the install tones in the same way but with some small behavioral differences. This allows the installer to install the Slave unit first and carry out the initial alignment with the Master unit if desired. However, due to the behavioral differences of Master and Slave units, it is recommended that the Master unit is installed first and the initial alignment carried out at the Slave unit.

Once the optimum performance has been achieved by directing the Slave unit (indicated by highest frequency of tone) then adjustment of the direction of the Master unit should be done without moving the Slave. Repeat if necessary at the Slave and then the Master until optimum alignment has been obtained.

There is a graphical installation screen (section 8.3.5 “Graphical Install”) available using the web interface that displays the state of the link during the alignment process (up = green, down = red).

7.8.2 Behaviour During Installation

The following behavior should be noted:

- **Band scan:** When first started up and from time to time, the Master unit will carry out a band scan to determine which channels are not in use. During this time, between 10 and 15 seconds, the Master unit will not transmit and as a consequence of this neither will the Slave unit. During this time the installation tone on the master unit will drop back to the band scan state, and the Slave unit will drop back to the Scanning state with the pitch of the tone set to the background noise level. Alignment of the unit should cease during this time.
- **Radar detection:** If the unit is operating where mandatory radar avoidance algorithms are implemented, the ranging behaviour for the PTP 600 Series Bridge may be affected. The Master has to monitor the initially chosen channel for 60 seconds to make sure it is clear of radar signals before transmitting. If a radar is detected during any of the installation phases, a further compulsory 60 seconds channel scan will take place as the master unit attempts to locate a new channel that is free of radar interference.
- **Ranging:** The Master unit can take up to 60 seconds in 0-40km (0-25 miles) mode, 90 seconds in 0-130km (0-81 miles) mode and 120 seconds in 0-200km (0-124 miles) mode to determine the range of the link being installed. The Master unit will remain in the Scanning state until the range of the link has been established. The Master unit will only move to the Synchronized state when the range of the link has been established.

- **Retrying same channel:** If, at the end of the ranging period, the Registered state is not achieved due to interference or other reasons, the Master unit will retry twice more on the same channel before moving to another available channel. Should this occur it might take a number of minutes to establish a link in the Registered state.
- **Slave unit:** The Slave unit does not have a ranging process. The slave unit will change to the Synchronized state as soon as the wanted signal is demodulated.

7.8.3 Adjust Power Settings

The transmit power levels of the installed units must be adjusted to ensure they are not too high. Excessive power levels may cause saturation of the receivers or false radar detection (in radar enabled regions), leading to degradation of link performance and link failure.

To adjust power levels, follow this procedure:

1. Consult the report generated by the LINKPlanner tool and note the Transmit power recommended levels.
2. Set the local unit power equal to the “LOCAL - Max Transmit Power setting while pointing” value from the LINKPlanner report.
3. Set the remote unit power equal to the “REMOTE - Max Transmit Power setting while pointing” value from the LINKPlanner report.
4. Access each unit separately.
5. Align the units.
6. Repeat Step 2 and 3 using the values “LOCAL - Max Transmit Power setting before disarm” and “REMOTE - Max Transmit Power setting before disarm” , if different than the corresponding “while pointing” values.
7. Reboot the local unit then reboot the remote unit.
8. Disarm the units.

7.8.4 Disarm on Completion

When the alignment process is complete, the installer MUST REMEMBER TO DISARM BOTH UNITS in the link, as described in Section 8.3.4 "Install Pages". This is necessary in order to:

- Turn off the audible alignment aid (section 8.3.4.6 "Disarm")
- Enable Adaptive Modulation
- Fully enable Advanced Spectrum Management with i-DFS
- Clear unwanted installation information from the various systems statistics
- Store the link range for fast link acquisition on link drop
- Enable higher data rates

NOTE: After 24 hours, the units will be disarmed automatically, provided that they are armed and that the link is UP.

8 Web Page Reference

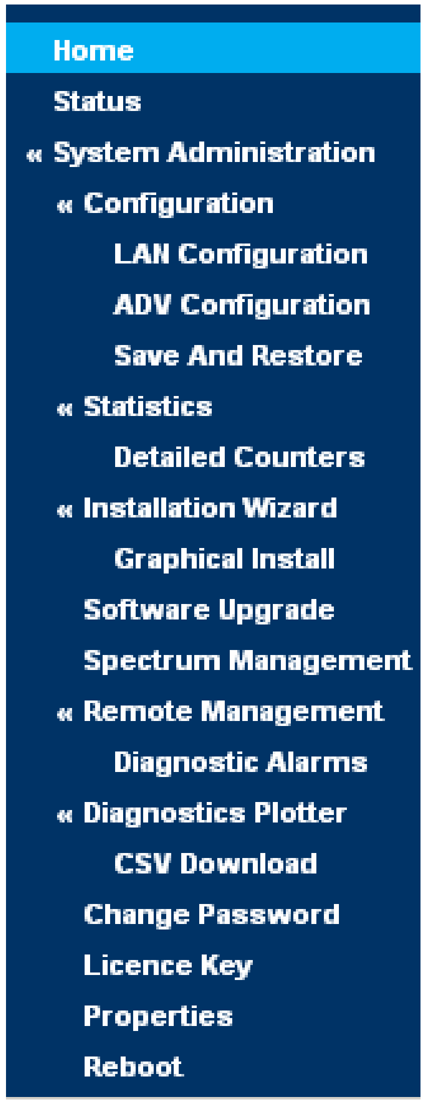
The web user interface has three main sections. The home page presents to the operator a high level summary of the PTP 600 Series Bridge point-to-point wireless link. The status page presents a more detailed set of system parameters describing the performance of the wireless link together with other key system performance metrics. The final section is the system administration section. This section is password protected and allows the system administrator to perform all the day-to-day administrative procedures, for example software upgrade and configuration changes.

The following subsections give a detailed usage guide for all the web user interfaces. The web pages are best viewed using a screen resolution of at least 1024 x 768 pixels on a PC using Microsoft Internet Explorer Version 6 or 7.

NOTE: The web pages have also been tested with Firefox 2.0.0.12. Other browsers have not been tested.

The navigation bar on the left hand side of the web page is used to move between the various management pages. The currently selected page is always highlighted with a light blue background. The menu is hierarchical. Selecting a menu item which has associated submenu options will automatically display all sub options. A sample web page with the navigation menu is shown in Figure 50 when the ‘Home’ Link is highlighted as the current page.

Figure 50 - Menu Navigation Bar



8.1 Home Page – PTP 600 Series Bridge

The home page for the PTP 600 Series Bridge has been designed to display a high level summary of the status of the wireless link and associated equipment. The home page (Figure 51) normally displays four key system attributes:

Wireless Link Status: The Wireless Link Status attribute displays the current status of the PTP 600 Series Bridge wireless link. A state of 'Up' on a green background indicates that a point-to-point link is established. A state of 'Down' on a red background indicates that the wireless link is not established. If the link is down for an unknown reason the system administrator should first consult the status web page for a more detailed summary of up to date system diagnostics.

Link Name: The link name attribute is a name and/or handle allocated by the system administrator to aid the identification of the unit, network or building.

Figure 51 - System Summary Page

System Summary

Attributes	Value	Units
Wireless Link Status	Up	
Link Name	Tower of London	
Elapsed Time Indicator	00:08:13	
System Clock	08-Nov-2006 10:42:08	

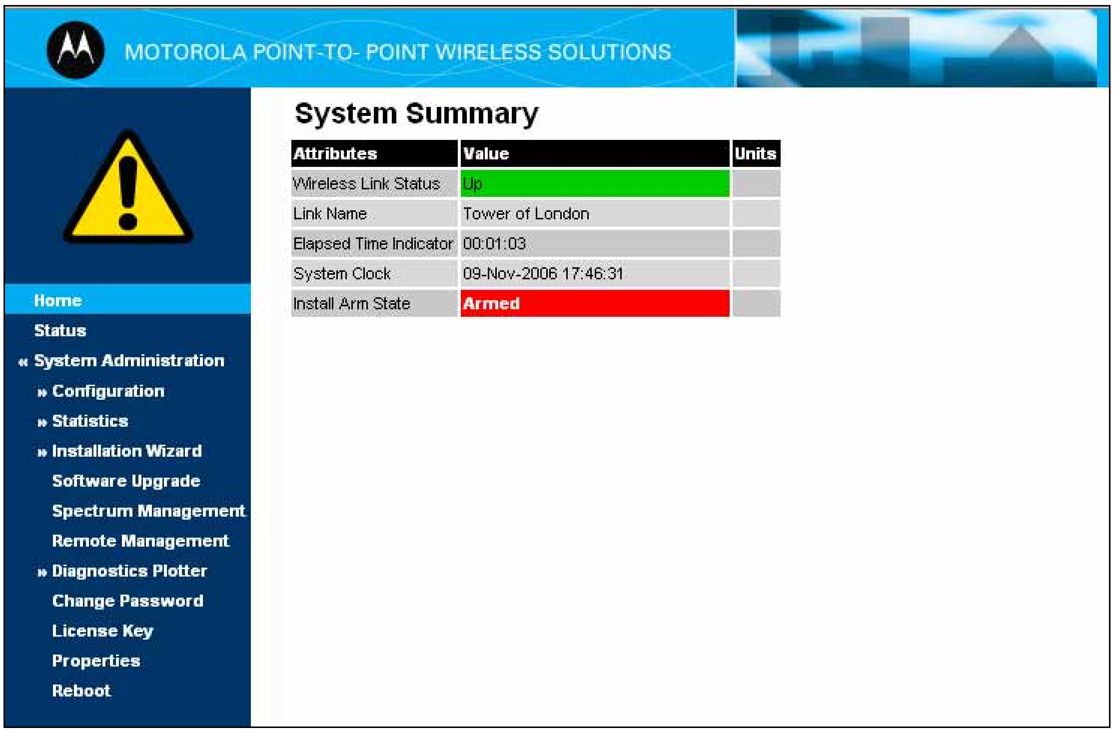
Elapsed Time Indicator: The elapsed time indicator attribute presents the total time in days, hours, minutes and seconds since the last system restart. The system can restart for several reasons, for example, commanded reboot from the system reboot webpage, or a power cycle of the equipment.

System Clock: If SNTP (Simple Network Time Protocol) is enabled, or the clock has been set, then a system clock attribute is displayed giving the date and time of the last page refresh. Section 8.3.11.8 "SNTP (Simple Network Time Protocol)" explains how to enable SNTP and Section 8.3.11.9 "Setting the clock" explains how to set the clock.

8.1.1 Home Page Alarm Display

The home page is also used to display all outstanding major system alarms. Whenever system alarms are asserted, a yellow warning triangle is displayed on web page navigation bar. The warning triangle will be visible from all web pages. Clicking the warning triangle will cause the web page to jump back to the system homepage. Figure 52 shows a sample alarm screen.

Figure 52 - Alarm Warning Triangle



The following system alarms are defined:

Ethernet Link Status: Current status of the Ethernet link. If there are any problems with the Ethernet interface, this alarm will be asserted. This alarm will most likely be seen if the unit has no Ethernet cable plugged into its Ethernet socket. Note that a change of state may generate an SNMP trap and/or SMTP email alert.

Telecoms Channel Status (see section 8.3.4.3 “Telecoms Interface” for a description of the Telecoms Interface): Indicates an alarm condition on a telecoms channel. Alarms include:

- "No Signal (Local)": there is no telecoms signal present at the connection to the ODU at the local end.
- "No Signal (Remote)": indicates that an absence of telecoms data across the wireless link.
- "No Signal (Local and Remote)": both alarms occur at the same time.
- "Remote Timing": there is insufficient wireless capacity available to carry telecoms data. Under these conditions telecoms timing information is still sent to keep the telecoms clocks synchronized.
- "No Signal (Local) and Remote Timing", indicates both no local signal and remote timing.

In remote timing mode the ODU will transmit an Alarm Indication Signal (AIS), consisting of all-ones, from the associated telecoms interface. A change of state may generate an SNMP trap and/or SMTP email alert.

Telecoms Interface A Loopback (see section 8.3.4.3 for a description of the Telecoms Interface): The loopback status of telecoms channel A. This is intended for installation testing and should be set to 'None' for normal operation. The wire connections to a unit can be tested by applying a 'Copper' loopback to the local unit. The wireless connection to the remote unit can be tested by applying a 'Wireless' loopback to the remote unit with no loopback on the local unit. Note that a change of state may generate an SNMP trap and/or SMTP email alert. The loopback can be disabled from the telecoms configuration sub menu (see Section 8.3.1.6).

Telecoms Interface B Loopback (see section 8.3.4.3 for a description of the Telecoms Interface): The loopback status of telecoms channel B. This is intended for installation testing and should be set to 'None' for normal operation. The wire connections to a unit can be tested by applying a 'Copper' loopback to the local unit. The wireless connection to the remote unit can be tested by applying a 'Wireless' loopback to the remote unit with no loopback on the local unit. Note that a change of state may generate an SNMP trap and/or SMTP email alert. The loopback can be disabled from the telecoms configuration sub menu (see Section 8.3.1.6 “Telecoms Configuration Page”).

Region Code: The region code prohibits the wireless unit from operating outside the regulated limits. An invalid region code indicates a corrupted license key. Note that a change of state may generate an SNMP trap and/or SMTP email alert.

Install Status: A non-OK value indicates that signaling was received with the wrong MAC address. Note that it is very unusual to detect this, because units with wrongly configured Target MAC Address will normally fail to establish a wireless link. However, rare circumstances may establish a partial wireless link and detect this situation. NB: A non-OK value on start-up, or a change of value during operation, may generate an SNMP trap and/or SMTP email alert.

Install Arm State: This alarm warns when a wireless unit is in installation mode. After installation the wireless unit should be disarmed. This will increase the wireless link’s data-carrying capacity and stop the installation tone generator. The wireless link is disarmed from the ‘Installation Wizard’ see Section 8.3.4.6 “Disarm”. A change of state may generate an SNMP trap and/or SMTP email alert.

Unit Out Of Calibration: The unit is out of calibration and must be returned to the factory using the RMA process for re-calibration.

Encryption Enable Mismatch (see section 17 “AES Encryption Upgrade**”):** Encryption has been enabled on one end of the wireless link but not the other.

Incompatible Region Codes: The PTP 600 Series Bridge uses region codes to comply with local regulatory requirements governing the transmission of wireless signals in the 5.9 GHz, 5.8 GHz, 5.4 GHz, 4.5 GHz and 2.5 GHz bands. Region codes can only be changed by obtaining a new PTP600. Note that a change of state may generate an SNMP trap and/or SMTP email alert.

Series license key: If this alarm is encountered the appropriate license keys from the country of operation should be obtained from your distributor. Applying license keys containing the same region codes to both ends of the link will remove the alarm.

No Wireless Channel Available: Spectrum Management was unable to locate a suitable wireless channel to operate on. Note that a change of state may generate an SNMP trap and/or SMTP email alert.

Wireless Link Disable Warning: This warning is displayed if the Wireless link has been administratively disabled via the SNMP Interface (see Section 8.3.11 “Remote Management Page”). The Wireless Interface MIB-II ifAdminStatus attribute has been set to DOWN. To enable the Ethernet interface, set the ifAdminStatus attribute to UP. Note that a change of state may generate an SNMP trap and/or SMTP email alert.

Ethernet Link Disable Warning: This warning is displayed if the Ethernet link has been administratively disabled via the SNMP Interface (see section 8.3.11 “Remote Management Page”). The Ethernet Interface MIB-II ifAdminStatus attribute has been set to DOWN. To enable the Ethernet interface, set the ifAdminStatus attribute to UP. Note that a change of state may generate an SNMP trap and/or SMTP email alert.

Fiber Link Status: If the fiber link is not OK, there are two possible causes: Either the fiber link has been installed but disabled (because the license key does not include fiber support), or the link could not be established even though an optical carrier was detected (due perhaps to a broken TX fiber, or the link is disabled at the fiber link partner). Note that a change of status may generate an SNMP trap and/or SMTP email alert.

Ethernet Configuration Mismatch Alarm: The detection of Ethernet fragments (runt packets) when the link is in full duplex is an indication of an auto-negotiation or forced configuration mismatch. Note that a change of state may generate an SNMP trap and/or SMTP email alert.

Incompatible Master and Slave: A non-zero value indicates that the master and slave ends of the wireless link are different hardware products, or have different software versions. Note that it is very unusual to detect this because incompatible units will normally fail to establish a wireless link. However, some combinations may establish a partial wireless link and detect this situation. Note that a non-zero value may generate an SNMP trap and/or SMTP email alert.

TDD Synchronization Status: Current status of the TDD Synchronization (acquiring synchronization, no timing reference and timing system not connected). Note that a change of state may generate an SNMP trap and/or SMTP email alert.

SNTP Synchronization failed: This warning indicates that SNTP has been enabled but that the unit is unable to synchronize with the specified SNTP server. Section 8.3.11.8 “SNTP (Simple Network Time Protocol)” explains how to configure SNTP. Note that a change of state may generate an SNMP trap and/or SMTP email alert.

8.2 Systems Status Page

The status page has been designed to give the system administrator a detailed view of the operation of the 600 Series Bridge from both the wireless and network perspectives.

The page is subdivided into four main categories Equipment, Wireless, Telecoms and Ethernet/Internet. The 'Equipment' section contains the unit's inventory and identification information. The 'Wireless' section presents the key wireless metrics, which are displayed as a series of measurements. The 'Ethernet/Internet' section describes the unit's network identity and connectivity. "Telecoms" controls the unit's E1/T1 telecoms interfaces.

The status page can be configured to refresh itself at an operator defined rate (if the user is logged in as system administrator). The refresh period defaults to 3600 seconds and can easily be changed to refresh at any period between 2 seconds and 3600 seconds. Pressing the 'Update Page Refresh Period' button causes a new page refresh period to be adopted by the system. The page refresh mechanism uses a HTML Meta refresh command. Therefore the refresh is always initiated by the local browser and not by the 600 Series Bridge at this interval.

The two PTP 600 Series bridges units are arranged in a master and slave relationship. The roles of the units in this relationship are displayed in the page title. The master unit will always have the title '- Master', and the slave will always have '- Slave' appended to the 'Systems Status' page title.

Figure 53 - Status Page

System Status - Master

Equipment

Attributes	Value	Units
Link Name	Master	
Link Location		
Software Version	58600-08-00	
Hardware Version	D04-R02-C	
Region Code	Region Code 1	
Elapsed Time Indicator	00:04:19	
Ethernet / Internet		
Ethernet Link Status	Down	
Ethernet Speed And Duplex		
MAC Address	00:04:56:80:0a:97	
Remote IP Address	169.254.1.3	
Telecoms		
Channel A	Up	
Channel B	Up	
Telecoms Latency	1653	µs
Telecoms Single Payload Lock	Enabled	
Automatic page refresh period in seconds	3600	Seconds

Wireless

Attributes	Value	Units
Wireless Link Status	Up	
Maximum Transmit Power	25	dBm
Remote Maximum Transmit Power	25	dBm
Transmit Power	25.0, 18.3, 18.0, 18.0	dBm
Receive Power	-38.3, -45.3, -110.0, -41.9	dBm
Vector Error	7.2, -26.2, -30.2, -29.0	dB
Link Loss	106.0, 95.3, 0.0, 104.3	dB
Transmit Data Rate	140.87, 140.87, 140.87, 140.87	Mbps
Receive Data Rate	140.87, 140.31, 67.09, 140.87	Mbps
Link Capacity	281.74	Mbps
Transmit Modulation Mode	256QAM 0.81 (Dual) (30 MHz)	
Receive Modulation Mode	256QAM 0.81 (Dual) (30 MHz)	
Link Symmetry	1 to 1	
Receive Modulation Mode Detail	Running At Maximum Receive Mode	
Range	0.1	km
TDD Synchronization		
TDD Synchronization Inactive	Timing System Not Connected	
Update Page Refresh Period	Reset form	

The following section details all the attributes displayed on the status page:

Link Name: The link name is allocated by the system administrator and is used to identify the equipment on the network. The link name attribute is limited to a maximum size of 63 ASCII characters.

Link Location: The link location is allocated by the system administrator and can be used as a generic scratch pad to describe the location of the equipment or any other equipment related notes. The link location attribute is limited to a maximum size of 63 ASCII characters.

Software Version: The attribute describes the version of software installed on the equipment. The format of the attributes is *FFSSS*-XX-*YY* where *FF* is the frequency variant (2.5, 4.5, 5.4, 5.8 or 5.9 GHz), *SSS* is the System Release, *XX* is the major release version and *YY* is the minor release version.

Hardware Version: The hardware version attribute contains all the combined hardware version information. The attribute is formatted as D*XX*-R*YY*-*Z* where D*XX* contain the version of the digital card, R*YY* contains the version of the RF (radio frequency) card and *Z* describes the antenna type which can be I (integrated) or C (connectorized).

Region Code: The region code is used by the system to constrain the wireless to operate within regulatory regime of the particular country. The region code is encoded in the product license key. If the operator wishes to change region code, a new license key must be obtained from Motorola or the local point-to-point distributor / system integrator.

Elapsed Time Indicator: The elapsed time indicator attribute presents the total time in years, days, hours, minutes and seconds since the last system restart. The system can restart for several reasons, for example commanded reboot from the system reboot web page, or a power cycle of the equipment.

Ethernet Link Status: Current status of the Ethernet link. A state of ‘Up’ with a green background indicates that an Ethernet link is established. A state of ‘Down’ with a red background indicates that the Ethernet link is not established.

Ethernet Speed and Duplex: The negotiated speed and duplex setting of the Ethernet interface. The speed setting is specified in Mbps. Full Duplex data transmission means that data can be transmitted in both directions on a signal carrier at the same time. For example, on a local area network with a technology that has full duplex transmission; one workstation can be sending data on the line while another workstation is receiving data. Half Duplex data transmission means that data can be transmitted in both directions on a signal carrier, but not at the same time. For example, on a local area network using a technology that has half duplex transmission, one workstation can send data on the line and then immediately receive data on the line from the same direction in which data was just transmitted.

Remote IP Address: Hyperlink to the other side of the Link. The IP address of the peer link is displayed if the Link is UP, otherwise “unavailable” is displayed.

Telecoms Channel A and B: Indicate the current status of the telecoms channels. Channels which are disabled during installation are marked as such. Correctly operating channels display "Up" on a green background, but alarm conditions (described in Section 8.1.1 “Home Page Alarm Display”) have a red background.

The Telecoms Latency value, displayed in microseconds, is determined when the wireless link starts and will remain the same for a given wireless configuration. Section 8.3.4.3 “Telecoms Interface” describes methods for reducing telecoms latency on links which support high data rate modulation modes.

Under normal circumstances the unit will freely transition between modulation modes to suit the wireless conditions. The "Single Payload Lock" indicates that the ODU will prevent transitions from Single Payload modes to the higher Dual Payload modes in order to avoid loss of telecoms data. This field appears where such a transition would pass through modes which cannot carry telecoms data. This may be because, in order to control latency, the lowest modulation mode has been set to a higher Single Payload mode. In the absence of the Single Payload Lock the wireless will transition to the faster Dual Payload modes as soon as the conditions are appropriate. With the lock enabled, the wireless will dwell in slower Single Payload modes whenever there are operational telecoms links (operational links are shown as "Up" in the telecoms channel field described above). When the lock is actively preventing transitions, the value displayed changes from "Enabled" to "Applied".

Refresh Page Period: The Status page refreshes automatically according to the setting entered here (in seconds). This attribute is only displayed when the user is logged on as System Administrator.

Wireless Link Status: As the attribute name suggests it displays the current status of the wireless link. A state of ‘Up’ on a green background indicates that a point-to-point link is established. A state of ‘Down’ on a red background indicates that the wireless link is not established.

Maximum Transmit Power: The maximum transmit power that the local wireless unit is permitted to use to sustain a link.

Remote Maximum Transmit Power: The maximum transmit power that the remote wireless unit is permitted to use to sustain a link.

Transmit Power: Transmit power histogram is expressed in dBm and presented as: max, mean, min, and latest. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means. See Section 8.2.1 “Histogram Data”.

Receive Power: Receive power histogram is expressed in dBm and presented as: max, mean, min, and latest. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means. See Section 8.2.1 “Histogram Data”.

Vector Error: The vector error measurement compares the received signal's In phase / Quadrature (IQ) modulation characteristics to an ideal signal to determine the composite error vector magnitude. The results are stored in an histogram and expressed in dB and presented as: max, mean, min and latest. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means. The expected range for Vector Error would be approximately -2dB (NLOS link operating at sensitivity limit on BPSK 0.67) to –33dB (short LOS link running 256 QAM 0.83). See Section 8.2.1 "Histogram Data".

Link Loss: The link loss is the total attenuation of the wireless signal between the two point-to-point units. See Section 8.2.1 "Histogram Data"..

The link loss calculation presented below:

Equation 3 - Link Loss

$$P_{ll} = P_{T_x} - P_{R_x} + g_{T_x} + g_{R_x}$$

Where	**is**
P_{ll}	Link Loss (dB)
P_{T_x}	Transmit power of the remote wireless unit (dBm)
P_{R_x}	Received signal power at the local unit (dBm)
g_{T_x}, g_{R_x}	Antenna gain at the remote and local units respectively (dBi). The antenna gain of the 600 Series bridge (23.5 dBi) is used unless one or both of the units is a Connectorized version.

Transmit Data Rate: The data rate in the transmit direction, expressed in Mbps and presented as: max, mean, min, and latest in an histogram format. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means. See Section 8.2.1 "Histogram Data". Expected data rates can be found in Section 16 "Data Rate Calculations".

Receive Data Rate: The data rate in the receive direction, expressed in Mbps and presented as: max, mean, min, and latest in an histogram format. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means. See Section 8.2.1 "Histogram Data". Expected data rates can be found in Section 16 "Data Rate Calculations".

Link Capacity: The maximum aggregate data rate capacity available for user traffic, assuming the units have been connected using Gigabit Ethernet. The link capacity is variable and depends of the prevailing wireless conditions as well as the distance (range) between the two wireless units..

Transmit Modulation Mode: The modulation mode currently being used on the transmit channel. List of all the modulation modes can be found in Section 16 “Data Rate Calculations” where data rate calculations plots are given for each available modulation mode..

Receive Modulation Mode: The modulation mode currently being used on the receive channel. List of all the modulation modes can be found in Section 16 “Data Rate Calculations” where data rate calculations plots are given for each available modulation mode.

Link Symmetry: Link Symmetry: A ratio that expresses the division between transmit and receive time in the TDD frame. The first number in the ratio represents the time allowed for the transmit direction and the second number represents the time allowed for the receive direction.

NOTE: Link Symmetry is configured at the master ODU only. The appropriate matching Link Symmetry is set at the slave ODU automatically. For example, if Link Symmetry is configured as “2 to 1” at the master ODU, then the slave ODU will be set automatically as “1 to 2”. In this example, the master-slave direction has double the capacity of the slave-master direction.

Receive Modulation Mode Detail: This supplies the user with information regarding the receive modulation mode in use. Possible values are:

- Running at maximum receive mode
- Running at user-configured Max Modulation Mode
- Restricted due to byte errors on the wireless link or local Ethernet Tx Fifo Drops
- Restricted because a DFS channel change is in progress
- Restricted due to telecoms acquisition mode
- Restricted due to the low Ethernet link speed
- Limited by the wireless conditions

Range: The range between the 600 Series bridge ODUs. The PTP 600 Series Bridge displays range in km by default, but if the user would prefer to display range using Miles, the ‘Distance Units’ attribute should be set to imperial, as described in Section 8.3.15 “Properties”.

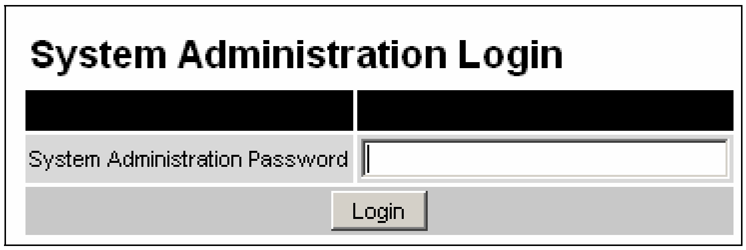
8.2.1 Histogram Data

The histogram is calculated over a one hour period. If the equipment has been running for less than one hour, then the histogram is calculated over the current elapsed time. The data used to compute the histogram statistics can be downloaded in an ASCII comma separated value (CSV) format via the diagnostics CSV Download page, see Section 8.3.12.2 “Diagnostics Download”.

8.3 System Administration Pages

The following menu options are available for the system administrator and can be password protected. Figure 54 shows the system administration login page. By default a system administrator password is not set. Simply click the login button to access the system administration features.

Figure 54 - System Administration Login Page



Once the password has been set using the 'Change Password' menu item the system administration pages will only be available after the user has entered the correct password.

The features that are only available to the system administrator are:

- Configuration
- Statistics
- The Installation Wizard
- Software Upgrade
- Spectrum Management including DFS
- Remote management
- Diagnostics Plotter
- Password Management
- License Key Management
- Properties
- System Reboot

8.3.1 System Configuration

The configuration of the 600 Series Bridge is organized into three sections:

- General configuration
- LAN configuration
- Telecoms Configuration
- Save and Restore

The general configuration allows modification of high level administrative (descriptive) attributes and high level wireless configuration.

The LAN configuration sub menu allows the system administrator to modify the Ethernet and IP configuration of the 600 Series Bridge.

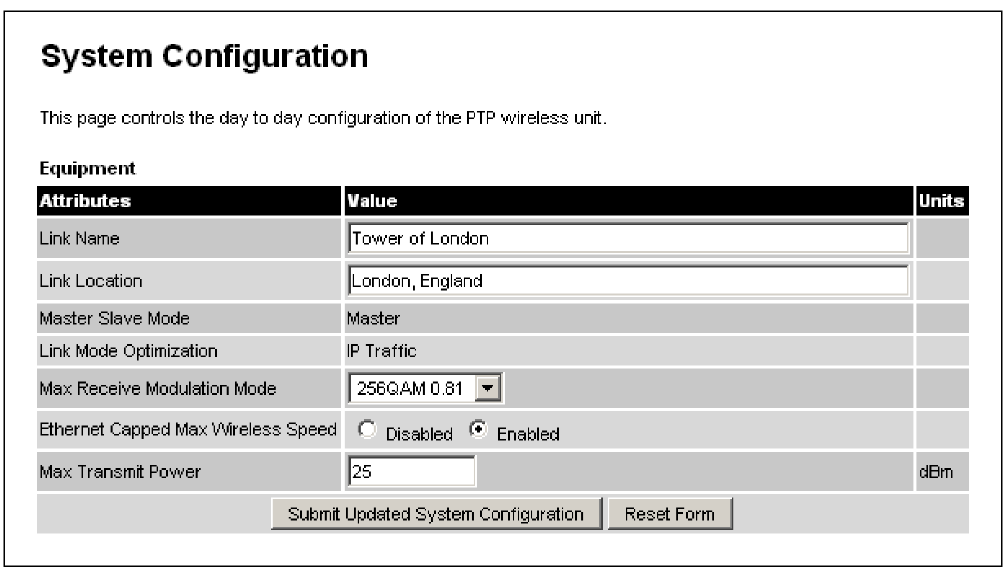
The telecoms submenu displays the current status of the telecoms interface and allows the configuration of interface loopbacks.

The save and restore submenu allows the system administrator to backup and restore the bridge configuration. It is recommended after a unit has been successfully installed; a copy of the active configuration is taken and archived by the system administrator.

8.3.1.1 General Configuration Page

The general configuration page (Figure 55) is used by the system administrator to configure the 600 Series Bridge's high level administrative (descriptive) attributes and high level wireless configuration.

Figure 55 - System Configuration Page



System Configuration

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

Equipment

Attributes	Value	Units
Link Name	Tower of London	
Link Location	London, England	
Master Slave Mode	Master	
Link Mode Optimization	IP Traffic	
Max Receive Modulation Mode	256QAM 0.81	
Ethernet Capped Max Wireless Speed	Disabled Enabled	
Max Transmit Power	25	dBm

Submit Updated System Configuration | Reset Form

While the majority of the system configuration is entered during installation and should never require changing, this page offers the system administrator the ability to change the basic system parameters for both the wireless and Ethernet components.

Link Name: User defined identity for the unit (max 63 characters).

Link Location: Can be used as a generic scratch pad to describe the location of the equipment.

Master Slave Mode and Link Mode Optimization: Current settings are displayed and can be modified using the Installation Wizard pages 8.3.4 “Install Pages”.

Max Receive Modulation Mode: This is the maximum mode the unit will use as its adaptive modulation. By default the Max Receive Modulation Mode is the highest mode available.

For minimum error rates, set the maximum modulation mode to the minimum necessary to carry the required traffic.

Ethernet Capped Max Wireless Speed: When enabled this option will cap the wireless speed to a mode that the connected Ethernet connection can sustain.

Maximum Transmit Power: This specifies the maximum transmit power in dBm of the system. It is country dependent and although the user can change this in 1dB steps, it will be limited to that country’s regulations.

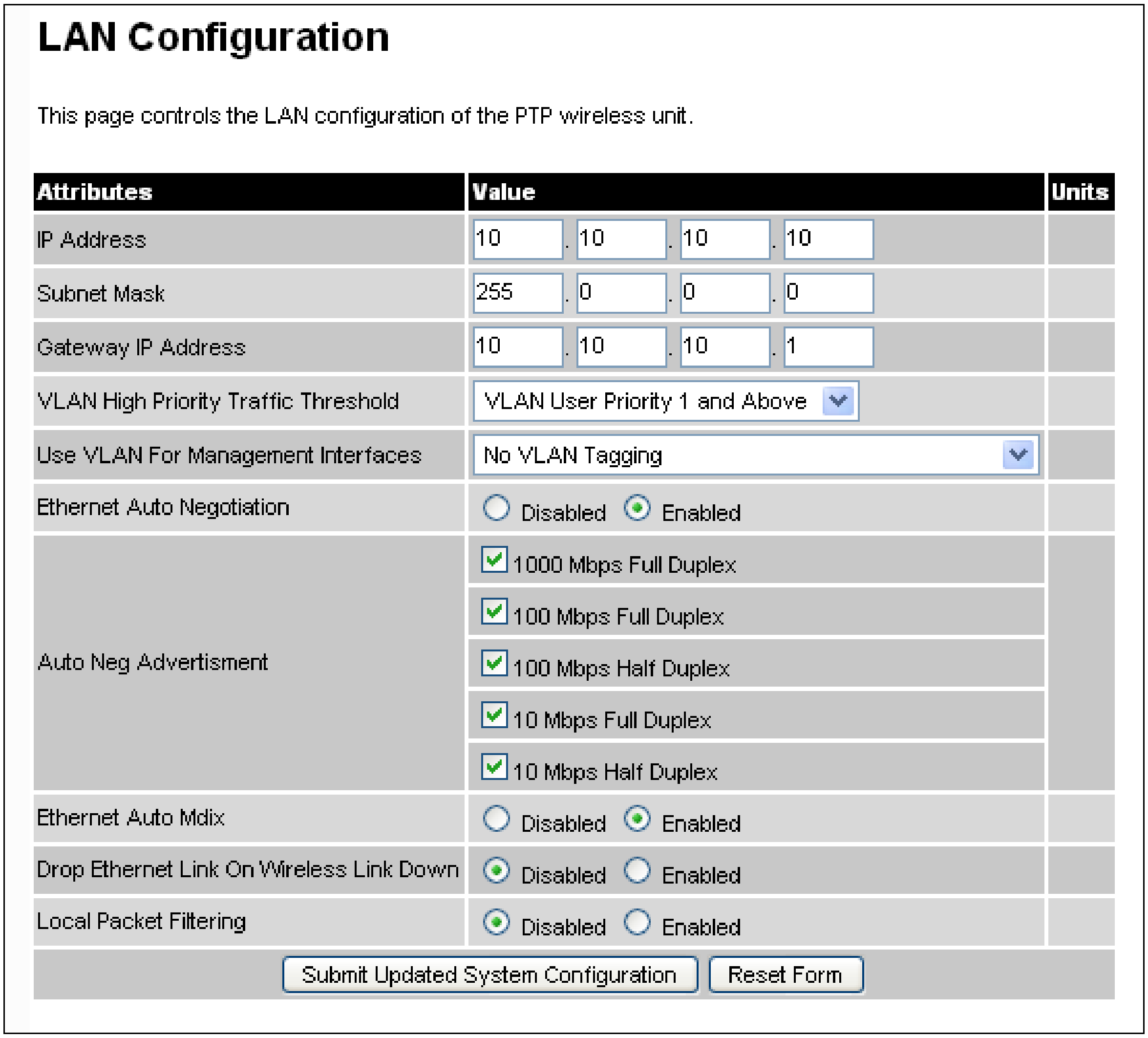
NOTE: In the UK there is a legal requirement to provide a minimum of 19 dB of transmit power control range. When the equipment is operating with a UK License Key, an additional facility is provided on the configuration page that allows the transmitted power to be reduced by 19 dB compared to the maximum allowed with a simple single step control..

NOTE: Why Reduce Transmit Power? If the link losses are low and the link data rate and availability targets are being easily achieved, the transmitted power level may be reduced with a consequent benefit to other users of the band, such as fixed satellite links.

8.3.1.2 LAN Configuration Page

The LAN configuration page (Figure 56) is used by the system administrator to configure the 600 Series Bridge's LAN interface.

Figure 56 - LAN Configuration Page



IP Address: Internet protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network.

Subnet Mask: A subnet allows the flow of network traffic between hosts to be segregated based on a network configuration.

Gateway IP Address: The IP address of a computer / router on the current network that acts as a gateway.

VLAN High Priority Traffic Threshold: All packets with an 802.1P priority tag greater than or equal to the indicated value will be treated as a high priority packet for transmission over the wireless link.

Use VLAN For Management Interfaces: This controls use of VLAN tags at the management interfaces (WWW/SNMP/SMTP/SNTP). See Section 8.3.1.3 "LAN Configuration Page – Use VLAN For Management Interfaces".

Ethernet Auto Negotiation This enables the Ethernet configuration to be forced rather than auto negotiated.

CAUTION: The configuration should only be forced if you are having problems with auto negotiation. You must ensure that you configure both this unit and the Ethernet port to which it is connected identically. If you force a fixed Ethernet Configuration on the 600 Series bridge then you MUST also force the same fixed configuration on the equipment to which it is connected. If you fail to force the configuration of the connected equipment, its automatic configuration mechanisms will normally cause a duplex mismatch, and you will receive greatly reduced throughput!

When Ethernet Auto Negotiation is Disabled the format of the LAN configuration page will change see Section 8.3.1.4 "LAN Configuration Page – Manual Ethernet Configuration".

Auto Neg Advertisement: This controls the rates that the auto negotiation mechanism will advertise as available.

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

Ethernet Auto Mdix: This enables/disables the Auto Medium Dependent Interface (MDI)/Medium Dependent Interface Crossover (MDIX) capability. Default is "Enabled".

Drop Ethernet Link On Wireless Link Down: When this option is enabled the Ethernet link is momentarily dropped when the wireless link goes down. This feature is used to indicate to the connected network equipment that this Ethernet link is no longer available, thus causing STP (Spanning Tree Protocol) to re-route packets through an alternative link.

Local Packet Filtering: When Local Packet Filtering is “Enabled”, the bridge learns the source MAC addresses of devices transmitting Ethernet packets on the local Ethernet network, and only bridges packets to the remote unit if the destination MAC address has not been learned as a 'local' device. When Local Packet Filtering is ‘Disabled’ the bridge does not learn the source MAC addresses of devices transmitting Ethernet packets on the local Ethernet network, and bridges ALL Ethernet packets received to the remote unit. Local Packet Filtering should be disabled when external Ethernet switching hardware or a router is present. The default setting for Local Packet Filtering is disabled.

All of the above attributes are non-volatile, once set they will be used by the unit even after a power on reboot. A number of attributes, such as IP Address, Subnet Mask and Gateway IP Address and VLAN settings will require a reboot before they are used. If any of these attributes are changed a reboot screen appears asking the user to verify the reboot (Figure 57 or Figure 58).

Figure 57 - Configuration Reboot Page

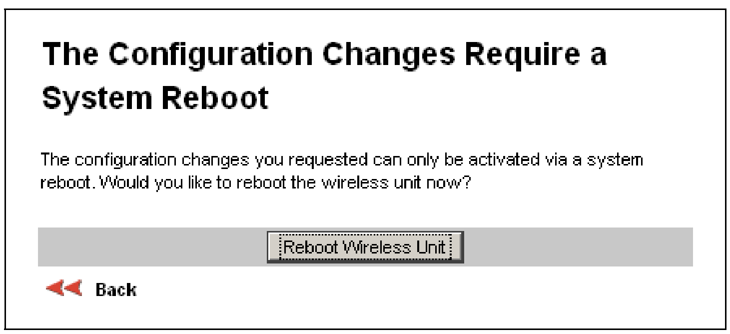
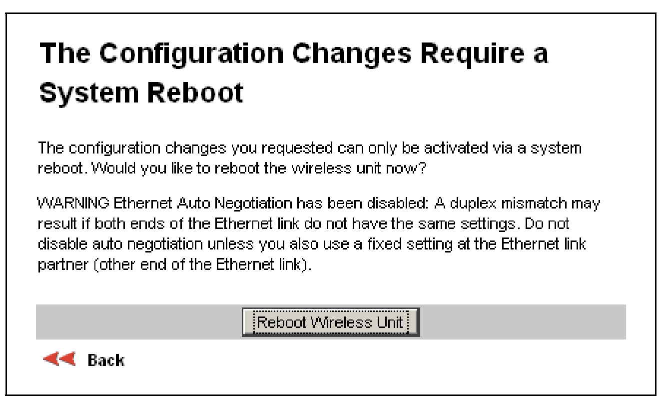


Figure 58 - Configuration Reboot Page - Ethernet Auto Negotiation Disabled



This will be followed by a pop-up dialogue box asking to confirm the action.

NOTE: At this point you will lose connection to the unit. If you have just changed the IP Address you now have to reconnect to the unit using the address just set.

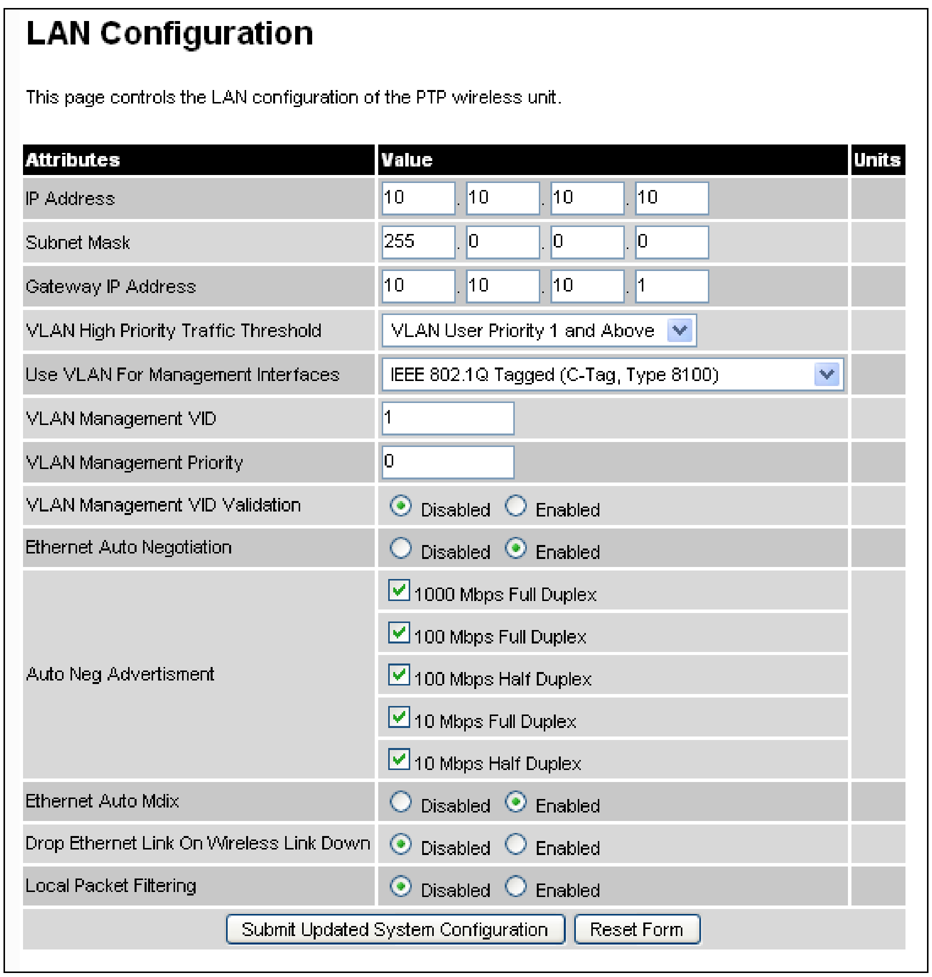
8.3.1.3 LAN Configuration Page – Use VLAN For Management Interfaces

The layout of the LAN Configuration page changes if this attribute is enabled in order to allow the VLAN VID and VLAN Priority to be set, see Figure 59. The VLAN settings are applied only after the unit is rebooted.

CAUTION: You must ensure that you can access the VLAN which you configure here, otherwise you will be unable to access the unit following the next reboot.

CAUTION: The PTP 600 management function is only compatible with single VLAN tagged packets. Any management packet with two or more packets will be ignored.

Figure 59 - VLAN Configuration Fields



Use VLAN For Management Interfaces: This control can be configured with one of the following three values:

- No VLAN Tagging
- IEEE 802.1Q Tagged (C-Tag, Type 8100)
- IEEE 802.1ad Tagged (S-Tag or B-Tag, Type 88a8)

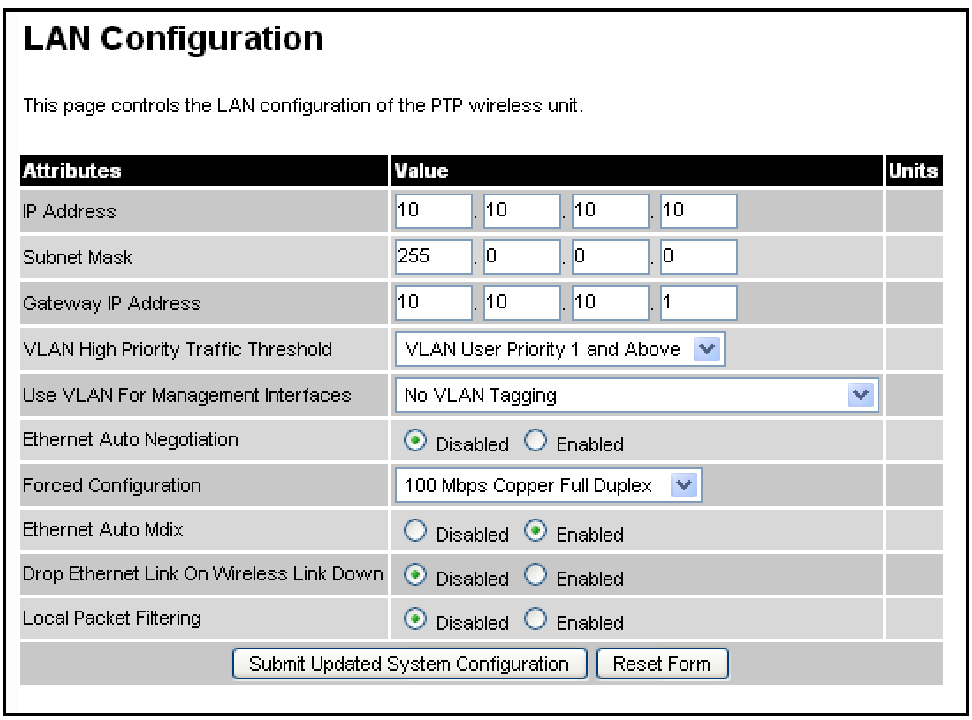
VLAN Management VID: This 802.1Q or 802.1ad VLAN ID (VID) will be included in packets generated by the management interfaces. Valid settings are in the range 0 to 4094.

VLAN Management Priority: This 802.1Q or 802.1ad VLAN Priority will be included in packets generated by the management interfaces. Valid settings are in the range 0 to 7.

VLAN Management VID Validation: If enabled, the management interfaces will only respond to Ethernet packets tagged with the configured Management VID; otherwise packets with any VID will be accepted.

8.3.1.4 LAN Configuration Page – Manual Ethernet Configuration

Figure 60 - LAN Configuration Page - Manual Ethernet Configuration



Force Configuration: This option allows the user to force the speed and duplex setting of the Ethernet interface.

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

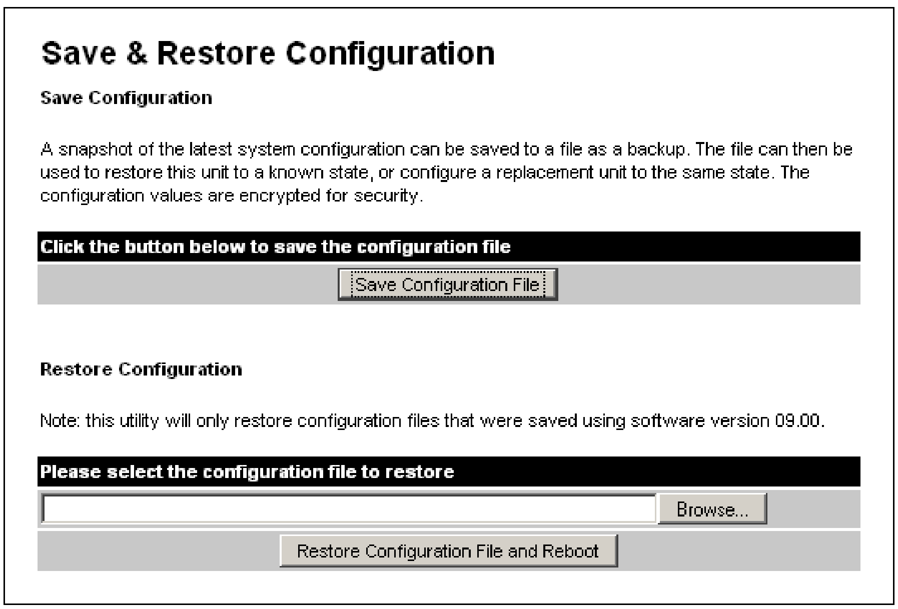
8.3.1.5 Save and Restore Configuration File

The save and restore feature of a PTP 600 Series Bridge allows the system administrator to backup the operation configuration of the wireless unit. It is recommended that this facility is used immediately after a successful PTP 600 Series Bridge installation or prior to any software upgrade. In the unlikely event that a unit has to be replaced in the field, the replacement unit can be reconfigured by simply playing back the saved configuration file.

8.3.1.5.1 Save Configuration File

To save the configuration file click on the 'Save Configuration File' button (Figure 61) and save the configuration file (.cfg) to the hard drive of your computer.

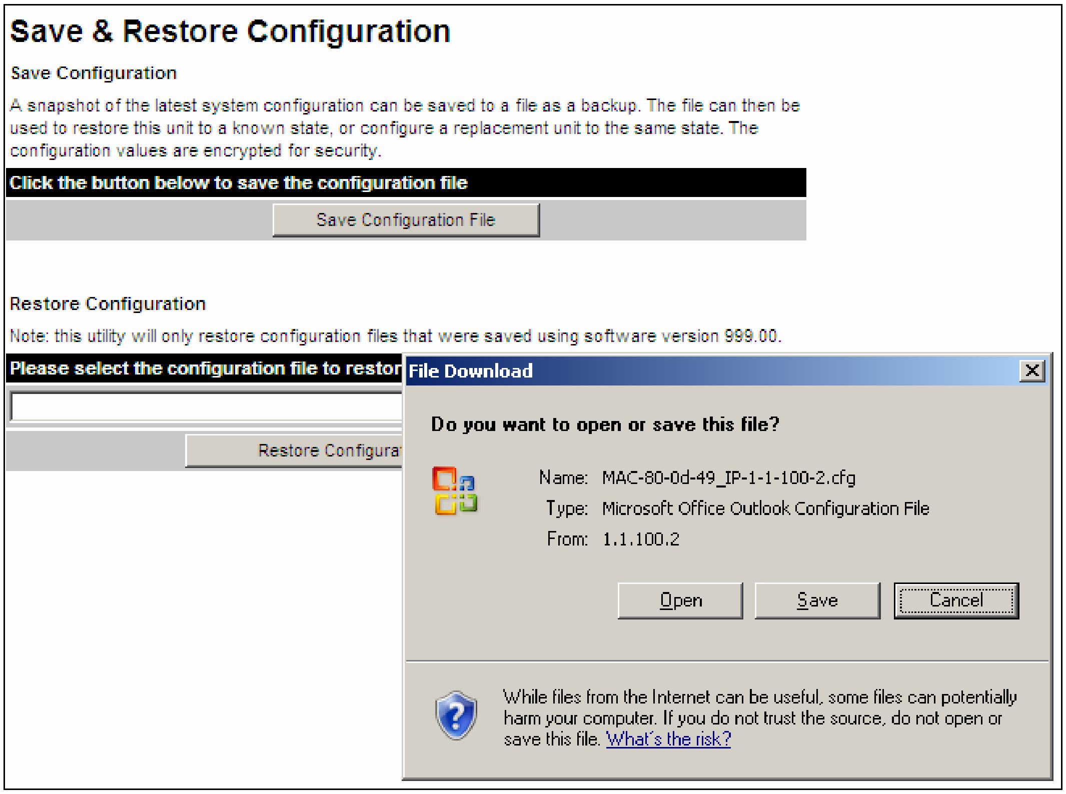
Figure 61 - Save and Restore Configuration Page



The configuration file format is **MAC-mm-mm-mm_IP-iii-iii-iii-iii.cfg**, where **mm** and **iii** are the lower 3 bytes of the MAC address and the unit IP address respectively.

NOTE: There is a feature of Internet Explorer (all versions) that looks at the content of any downloadable file and decides whether to treat the file as ASCII or binary. As a result of this feature, Internet Explorer always treats the configuration file as ASCII and attempts to display it instead of downloading it. Firefox (all versions) makes no such assumption.

Figure 62 - Save Configuration File Screen



The configuration file is encoded using an ASCII encoding scheme. An example is show in Figure 63.

Figure 63 – PTP 600 Example Configuration File

Motorola PTP 600 Series Configuration file
#
MAC Address :- 00:04:56:80:0f:ff
IP Address :- 169.254.1.1
License Key :- DCBD-A7AA-6851-4679
Software Version :- 09-01
Creation Date :- 07-Mar-07 20:03:23
#
To playback this configuration file into the unit, use the Save and Restore configuration webpage:
#
<config>+.BP9)7HC;O)DS.UNPAGUTLIHJ:",\K.]"3F6'0*XR14+>) !3-MZ-VF
...
</config>

CAUTION: The configuration file is currently restricted to a single software version and can only be restored into a wireless unit operating the software version indicated in the configuration file header.

8.3.1.5.2 Restore Configuration File

The configuration file can also be used when swapping out a faulty wireless unit. If one of the wireless units is replaced on a wireless link a configuration file captured from the faulty unit can be uploaded into the new unit to speed up replacement.

NOTE: The license key of the faulty unit should be setup on the replacement unit before the configuration file is loaded. This can be obtained either from the Quick Start Guide supplied with the faulty wireless unit or directly from Motorola. The target MAC address at the other end needs to be changed to ensure that it is using the MAC address of the replaced unit.

The restoration of configuration files can be performed using the Restore configuration tool. Using the browser button to locate the configuration file you wish to restore then click the 'Restore Configuration File and Reboot' button (Figure 64). The user will then be prompted to confirm the action (Figure 65)

Figure 64 - Restore Configuration File Pop Up Screen

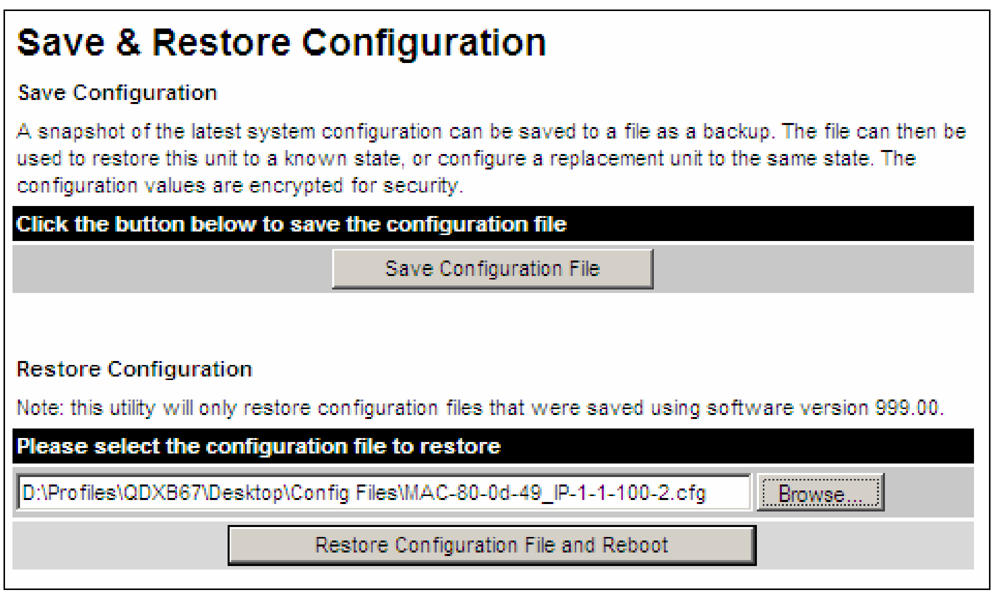
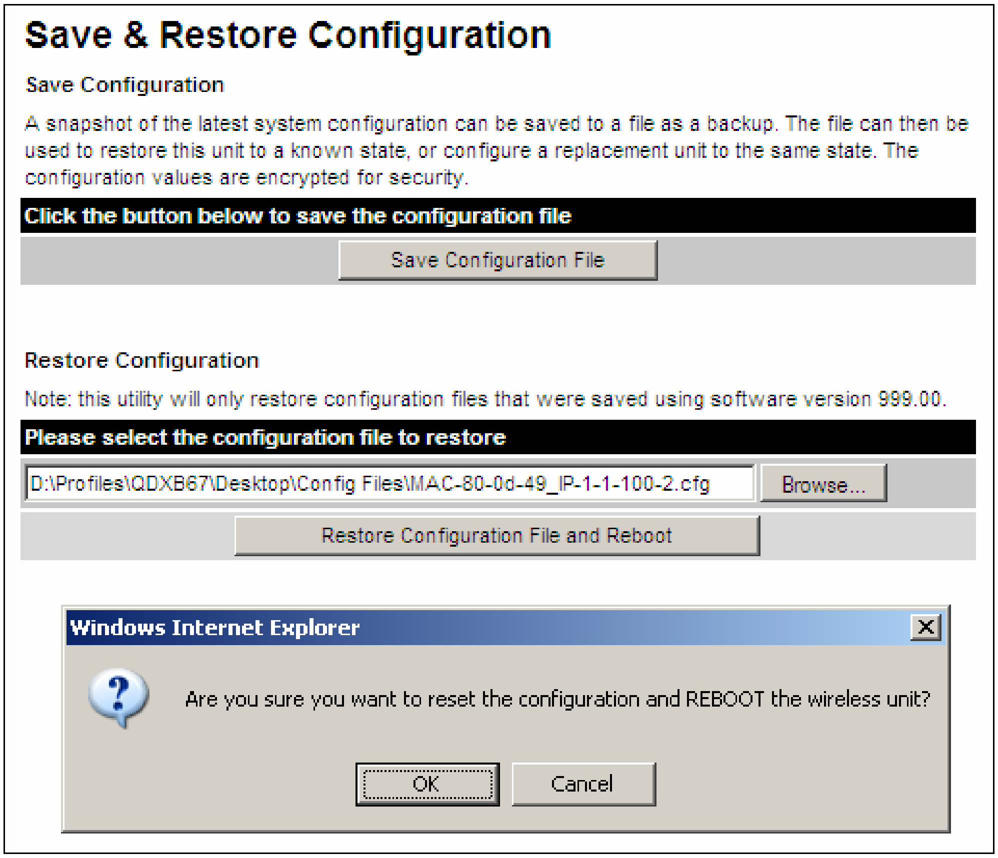


Figure 65 - Reset Configuration and Reboot Confirmation Pop-up



On confirmation the PTP 600 Series Bridge will:

- Upload the configuration file
- Perform data integrity checking
- Erase previous configuration
- Apply the new configuration
- Restart

After the unit has restarted the entire configuration from the configuration file will now be active. Note: The IP address of the unit may have also been changed. The user can check the new IP address by reading the header of the configuration file, Figure 63.

CAUTION: A reboot is always required to restore a configuration file.

8.3.1.6 Telecoms Configuration Page

The PTP600 is capable of carrying up to two T1 or E1 channels when there is sufficient wireless capacity. When there is insufficient capacity the wireless carries timing information which maintains clock synchronization. When operating in timing only mode, no telecoms data is sent.

When a wireless link is established the unit calculates a suitable telecoms latency for reliable link operation. Links which are able to operate consistently in a high modulation mode can take advantage of lower link latency. This is controlled by setting the "Lowest Telecoms Modulation Mode" during installation. Appropriate settings for this control may be determined by using the LINKPlanner tool.

The user may select the lowest telecoms modulation mode from a full range of modes in the Installation Wizard. However, the unit may override the user setting if the selected mode has insufficient capacity to carry the telecoms data. Other modes may also be excluded if they demand very high latency and require more buffering than the wireless can provide. Given these constraints, the unit will display the effective "Lowest Modulation Mode". When the effective mode differs for Single and Dual Payload operation two modes will be displayed: "Lowest Dual Payload Modulation Mode" and "Lowest Single Payload Modulation Mode".

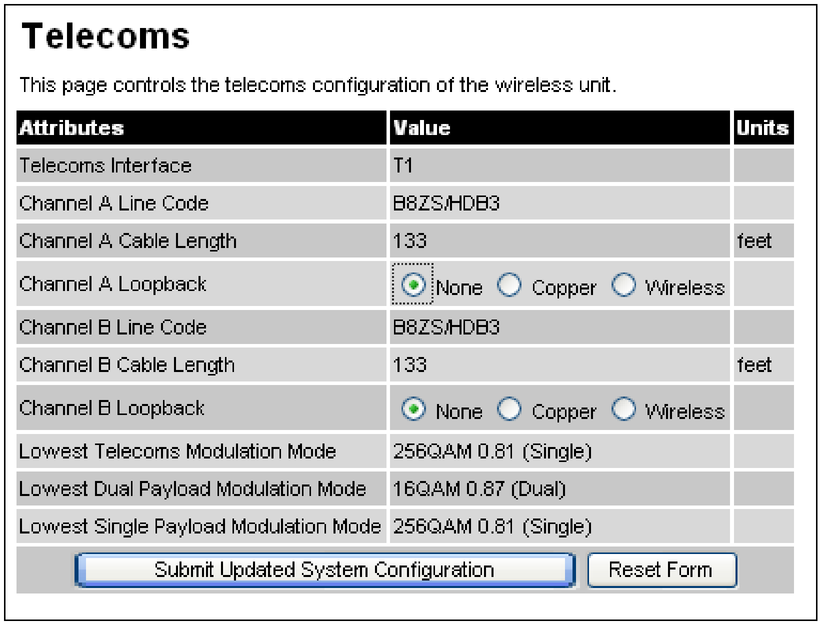
Configuration

The Telecoms page (Figure 66) is available when the Telecoms Interface has been set to either T1 or E1 in the Installation Wizard.

The unit displays the interface setting and line code for the available telecoms channels. The PTP 600 Series Bridge is able to support two T1 or E1 channels. These channels are referred to as "Channel A" and "Channel B".

The "Channel B" configuration and controls will be displayed only when the second channel is enabled.

Figure 66 - Telecoms Data Entry



Telecoms

This page controls the telecoms configuration of the wireless unit.

Attributes	Value	Units
Telecoms Interface	T1	
Channel A Line Code	B8ZS/HDB3	
Channel A Cable Length	133	feet
Channel A Loopback	◉ None ○ Copper ○ Wireless	
Channel B Line Code	B8ZS/HDB3	
Channel B Cable Length	133	feet
Channel B Loopback	◉ None ○ Copper ○ Wireless	
Lowest Telecoms Modulation Mode	256QAM 0.81 (Single)	
Lowest Dual Payload Modulation Mode	16QAM 0.87 (Dual)	
Lowest Single Payload Modulation Mode	256QAM 0.81 (Single)	

Submit Updated System Configuration | Reset Form

Telecoms Interface: May be either T1 or E1, reflecting the Installation Wizard setting.

Line Code: Displays the Line Code setting for each channel. The Line Code configuration must match the configuration of the connected equipment and may be set using the Installation Wizard.

Cable Length: The Cable Length setting is applicable in T1 mode only and shows the cable length specified in the installation wizard.

Loopback: Allows the T1 or E1 data stream to be looped back at the copper or wireless interface. During normal operation the loopback must be set to "None". It may be helpful during installation to test the telecoms links by performing loopback connections.

A "Copper" loopback connects the received data on a given telecoms interface to the transmit interface. A "Copper" loopback may be used, in conjunction with a Bit Error Rate Tester, to confirm that the correct connections have been made to the ODU. This mode cannot be used for resistance tests as it is only capable of looping back valid telecoms signals.

A "Wireless" loopback sends the telecoms data received across the wireless link back across the link on the same Telecom channel. The link may be checked using, for example, a Bit Error Rate Tester to ensure that no errors are detected.

A typical T1 or E1 installation might include a "Copper" loopback on the local unit followed by a "Wireless" loopback on the remote unit.

It is important to remove all loopbacks on channels for normal operation. Alarms on the Home Page indicate the presence of loopbacks on either channel.

Lowest Telecoms Modulation Mode: The user defined lowest modulation mode at which telcoms data can be sent. If the link cannot sustain telecoms data in this mode then the effective lowest modulation mode may differ

Lowest Dual Payload Modulation Mode; Lowest Single Payload Modulation Mode: Indicate the effective lowest modulation mode at which telecoms data can be sent, subject to wireless capacity and latency limitations. Under some circumstances, these settings may differ from the user defined Lowest Telecoms Modulation Mode described above.

8.3.2 Statistics Page

The 600 Series bridge statistics page is designed to display some key statistics of the Ethernet Bridge and the underlying wireless performance.

The numbers in brackets display the number of packets received since the last page refresh.

Figure 67 - System Statistics

System Statistics

Attributes	Value	Units
Wireless Tx Packets	1,718 (+1,718)	
Wireless Rx Packets	51 (+51)	
Ethernet Tx Packets	1,684 (+1,684)	
Ethernet Rx Packets	1,243 (+1,243)	
Packets To Internal Stack	1,174 (+1,174)	
Packets From Internal Stack	1,637 (+1,637)	
Transmit Data Rate	141.13, 128.61, 0.00, 141.13	Mbps
Receive Data Rate	141.13, 128.65, 0.00, 141.13	Mbps
Aggregate Data Rate	282.26, 257.26, 0.00, 282.26	Mbps
Link Capacity	300.16	Mbps
Transmit Modulation Mode	256QAM 0.81 (Dual)	
Receive Modulation Mode	256QAM 0.81 (Dual)	
Receive Modulation Mode Detail	Running At Maximum Receive Mode	
Signal Strength Ratio	0.8, 0.6, -1.0, 0.7	dB
Wireless Link Availability	100.0000	%
Byte Error Ratio	1.724e-9	
Elapsed Time Indicator	00:08:14	
Statistics Page Refresh Period	3600	Seconds
Link Symmetry	1:1	

Submit Updated Values | Reset Form

Reset system counters

Reset system histograms

Wireless Tx Packets: This displays the total number of good packets the bridge has sent for transmission by the wireless interface.

Wireless Rx Packets: This displays the total number of good packets the bridge has received from the wireless interface.

Ethernet Tx Packets: This displays the total number of good packets the bridge has sent for transmission by the local Ethernet interface.

Ethernet Rx Packets: This displays the total number of good packets the bridge has received from the local Ethernet interface.

Packets To Internal Stack: This displays the total number of good packets the bridge has transmitted to the internal stack (for example, ARP requests, PING requests, HTTP requests).

Packets From Internal Stack: This displays the total number of good packets the bridge has received from the internal stack (for example ARP responses, PING replies, HTTP responses).

Link Symmetry: Link Symmetry: A ratio that expresses the division between transmit and receive time in the TDD frame. The first number in the ratio represents the time allowed for the transmit direction and the second number represents the time allowed for the receive direction.

Transmit Data Rate: The data rate in the transmit direction, expressed in Mbps and presented as: max, mean, min, and latest in an histogram format. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means. See Section 8.2.1 “Histogram Data”. Expected data rates can be found in Section 16 “Data Rate Calculations”.

Receive Data Rate: The data rate in the receive direction, expressed in Mbps and presented as: max, mean, min, and latest in an histogram format. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means. See Section 8.2.1 “Histogram Data”. Expected data rates can be found in Section 16 “Data Rate Calculations”.

Aggregate Data Rate: The sum of the data rate in the directions expressed in Mbps and presented as: max, mean, min, and latest in an histogram format. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means. See Section 8.2.1 “Histogram Data”. Expected data rates can be found in Section 16 “Data Rate Calculations”.

Link Capacity: The maximum aggregate data capacity available for user traffic under the current radio link conditions, assuming the units have been connected using Gigabit Ethernet. The sum of the displayed Transmit and Receive data rates may be lower than this figure if the link isn't fully loaded by the current traffic profile.

Transmit Modulation Mode: The modulation mode currently being used on the transmit channel. The number in brackets after the modulation mode and coding rate string is the effective data rate available to all MAC layer protocols. List of all the modulation modes can be found in Section 16 “Data Rate Calculations” where data rate calculations plots are given for each available modulation mode.

Receive Modulation Mode: The modulation mode currently being used on the receive channel. The number in brackets after the modulation mode and coding rate string is the effective data rate available to all MAC layer protocols. List of all the modulation modes can be found in Section 16 “Data Rate Calculations” where data rate calculations plots are given for each available modulation mode.

Receive Modulation Mode Detail: This supplies the user with information regarding the receive modulation mode in use. Possible values are:

- Running at maximum receive mode
- Running at user-configured Target Modulation Mode
- Restricted because Installation is armed
- Restricted because of byte errors on the wireless link
- Restricted because a DFS channel change is in progress
- Restricted due to the low Ethernet link speed
- Limited by the radio conditions

Signal Strength Ratio: The Signal Strength Ratio is the ratio of the power received by the Vertical / Horizontal receivers and presented as: max, mean, min, and latest in an histogram format. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means. See Section 8.2.1 “Histogram Data”.

Wireless Link Availability: Expresses the link availability as a percentage of time since the first successful registration after a system restart, expressed as a percentage to four decimal places.

Byte Error Ratio: The ratio of detected Byte errors to the total number of bytes since the last system reboot. This is a true measure of link quality as this measurement is made continually using null frames when there is no user data to transport.

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

Reset System Counters: By pressing this button all counters in the system are reset to zero.

Reset System Histograms: All histograms are reset, and the calculation period is restarted.

8.3.3 Detailed Counters Page

Figure 68 - Detailed Counters Page

Detailed Counters

Ethernet

Attributes	Value	Units
Ethernet Rx Octets	99,368 (+99,368)	
Ethernet Tx Octets	420,808 (+420,808)	
Ethernet Rx Drops	0 (+0)	
Ethernet Rx Packets	1,066 (+1,066)	
Ethernet Rx Broadcasts	395 (+395)	
Ethernet Rx Multicasts	32 (+32)	
Ethernet Rx Crc And Align	0 (+0)	
Ethernet Rx Undersize	0 (+0)	
Ethernet Rx Oversize	0 (+0)	
Ethernet Rx Fragments	0 (+0)	
Ethernet Rx Jabbers	0 (+0)	
Ethernet Rx 64 Bytes	841 (+841)	
Ethernet Rx 65 To 127 Bytes	143 (+143)	
Ethernet Rx 128 To 255 Bytes	17 (+17)	
Ethernet Rx 256 To 511 Bytes	49 (+49)	
Ethernet Rx 512 To 1023 Bytes	20 (+20)	
Ethernet Rx 1024 To Max Bytes	0 (+0)	
Ethernet Tx Drops	0 (+0)	
Ethernet Tx Packets	973 (+973)	
Ethernet Tx Broadcasts	1 (+1)	
Ethernet Tx Multicasts	0 (+0)	
Ethernet Tx Collisions	0 (+0)	
Ethernet Tx 64 Bytes	327 (+327)	
Ethernet Tx 65 To 127 Bytes	191 (+191)	
Ethernet Tx 128 To 255 Bytes	100 (+100)	
Ethernet Tx 256 To 511 Bytes	49 (+49)	
Ethernet Tx 512 To 1023 Bytes	97 (+97)	
Ethernet Tx 1024 To Max Bytes	217 (+217)	
Ethernet Tx Fifo Drops	0 (+0)	
Ethernet Rx Frames	1,087 (+1,087)	
Ethernet Tx Frames	996 (+996)	
Ethernet Rx Pause Frames	0 (+0)	
Ethernet Tx Pause Frames	0 (+0)	
Ethernet Rx Classified Drops	0 (+0)	

Wireless

Attributes	Value	Units
Wireless Rx Octets	0 (+0)	
Wireless Tx Octets	5,925 (+5,925)	
Wireless Rx Drops	0 (+0)	
Wireless Rx Packets	0 (+0)	
Wireless Rx Broadcasts	0 (+0)	
Wireless Rx Multicasts	0 (+0)	
Wireless Rx Crc And Align	0 (+0)	
Wireless Rx Undersize	0 (+0)	
Wireless Rx Oversize	0 (+0)	
Wireless Rx Fragments	0 (+0)	
Wireless Rx Jabbers	0 (+0)	
Wireless Rx 64 Bytes	0 (+0)	
Wireless Rx 65 To 127 Bytes	0 (+0)	
Wireless Rx 128 To 255 Bytes	0 (+0)	
Wireless Rx 256 To 511 Bytes	0 (+0)	
Wireless Rx 512 To 1023 Bytes	0 (+0)	
Wireless Rx 1024 To Max Bytes	0 (+0)	
Wireless Tx Drops	940 (+940)	
Wireless Tx Packets	36 (+36)	
Wireless Tx Broadcasts	3 (+3)	
Wireless Tx Multicasts	0 (+0)	
Wireless Tx Collisions	0 (+0)	
Wireless Tx 64 Bytes	8 (+8)	
Wireless Tx 65 To 127 Bytes	6 (+6)	
Wireless Tx 128 To 255 Bytes	4 (+4)	
Wireless Tx 256 To 511 Bytes	8 (+8)	
Wireless Tx 512 To 1023 Bytes	7 (+7)	
Wireless Tx 1024 To Max Bytes	17 (+17)	
Wireless Tx Fifo Drops	0 (+0)	
Wireless Rx High Priority Frames	0 (+0)	
Wireless Rx Low Priority Frames	0 (+0)	
Wireless Tx High Priority Frames	0 (+0)	
Wireless Tx Low Priority Frames	60 (+60)	
Wireless Rx Pause Frames	0 (+0)	
Wireless Tx Pause Frames	0 (+0)	
Wireless Rx Classified Drops	0 (+0)	

Internal Stack

Packets To Internal Stack	976 (+976)	
Packets From Internal Stack	1,009 (+1,009)	
Packets Ignored By Internal Stack	0 (+0)	
Detailed Counters Page Refresh Period	3600	Seconds

Update Page Refresh Period | Reset System Counters

The detailed counters page is subdivided into two columns. Column one presents the detailed statistics for the bridge's Ethernet interface. Column two relates to the wireless interface.

The Counters have the following definitions:

Tx & Rx Octets: Total number of octets (bytes) transmitted or received over the interface.

Rx Drops: Total number of frames dropped due to the lack of sufficient capacity in the receive buffer.

Rx Packets: Total number of packets received by the interface. This includes both good and bad packets.

Rx Broadcasts: Total number of good broadcast packets.

Rx Multicasts: Total number of good multicast packets.

Rx CRC and Align: Total number of packets with CRC or frame alignment errors.

Rx Undersize: Total number of packets received that are less than 64 bytes and have a valid CRC.

Rx Oversize: Total number of packets received that are greater than the maximum number of bytes with a valid CRC.

Rx Fragments: Total number of packets that are less than 64 bytes with an invalid CRC (these packet types are also known as runts).

Rx Jabbers: Total number of packets received that are greater than the maximum number of bytes with an invalid CRC.

Rx 64 Bytes: Total number 64 byte frames received

Rx 65 to 127 Bytes: Total number of frames received in the size range 65 to 127 bytes.

Rx 128 to 255 Bytes: Total number of frames received in the size range 128 to 255 bytes.

Rx 256 to 511 Bytes: Total number of frames received in the size range 256 to 511 bytes.

Rx 512 to 1023 Bytes: Total number of frames received in the size range 512 to 1023 bytes.

Rx 1024 to Max: Total number of frames received in the size range 1024 to Maximum bytes.

Tx Drops: Total number of frames dropped due excessive collisions, late collision and frame ageing.

Tx Packets: Total number of packets received by the interface. This includes both good and bad packets.

Tx Broadcasts: Total number of good broadcast packets.

Tx Multicasts: Total number of good multicast packets.

Tx Collisions: Total number frames experiencing collisions.

Tx 64 Bytes: Total number 64 byte frames transmitted

Tx 65 to 127 Bytes: Total number frames transmitted in the size range 65 to 127 bytes.

Tx 128 to 255 Bytes: Total number frames transmitted in the size range 128 to 255 bytes.

Tx 256 to 511 Bytes: Total number frames transmitted in the size range 256 to 511 bytes.

Tx 512 to 1023 Bytes: Total number frames transmitted in the size range 512 to 1023 bytes.

Tx 1024 to Max: Total number frames transmitted in the size range 1024 to Maximum bytes.

Tx FIFO Drops: Total number frames dropped due to lack of capacity in the transmit buffer, for example when the 600 Series bridge is connected to the local Ethernet at a connection speed of less than 1 Gbps.

Rx & Tx High Priority: Total number of received or transmitted frames marked as high priority.

Rx & Tx Low Priority: Total number of received or transmitted frames marked as low priority.

Rx & Tx Pause Frames: Total number of received or transmitted pause frames.

Rx Classifier Drops: Total number of received frames dropped due to the application of classifier rules.

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

8.3.4 Install Pages

These pages are used during system installation. There follows a description of the install pages along with their use during the installation configuration process. The actual installation process is described in Section 8.3.4.1 “Manually Configuring The Wireless Units”.

NOTE: This section assumes that the integrated PTP 600 is being installed. If the connectorized variant is being installed, refer to Section 13.3 “Software/Features” for details of the additional functionality that must be configured.

All wireless links are shipped as paired units. They are pre-configured at the factory so that they can be installed without the user supplying any configuration. Each wireless link is shipped with a quick start guide. Attached to the quick start guide is a summary of the pre-configured configuration data. Table 35 shows a sample link configuration. The values in red type have been committed to the wireless unit’s non-volatile storage.

Table 35 – 600 Series Bridge Factory Configuration Values

Example PTP 600 Series Configuration Data	
For your convenience these two units have been pre-configured as a link	
Units:	
ODU serial number	ODU serial number
016780000FFF	016780000FC7
Ethernet MAC address	Ethernet MAC address
00:04:56:80:0F:FF	00:04:56:80:0F:C7
Configured as:	
Master	Slave
Target MAC address	Target MAC address

00:04:56:80:0F:C7	00:04:56:80:0F:FF
License Key	License Key
A471-FE88-428D-E1F3	534F-4F54-D1B0-E2DA
IP Address	IP Address
169.254.1.2	169.254.1.1

CAUTION: The factory default configuration is limited in range to 40 Km (25 miles). If you wish to install a wireless link with a range of > 40 Km (> 25 miles) and < 200 Km (< 124 miles) or < 5 Km (< 3 miles) you must follow the 'Manually Configuring The Wireless Units' in Section 8.3.4.1.

CAUTION: The factory default configuration is set to Region 1. Region 1 allows the 600 Series bridge a maximum transmit power of 25 dBm. If the local regulatory regime limits the maximum transmit power (EIRP) to less than 25 dBm you should obtain a new license key containing the correct region code from your local distributor or direct from Motorola. Alternatively in the short term, you should reduce the maximum transmit power by following the procedures in 'Manually Configuring The Wireless Units' in Section 8.3.4.1.

8.3.4.1 Manually Configuring The Wireless Units

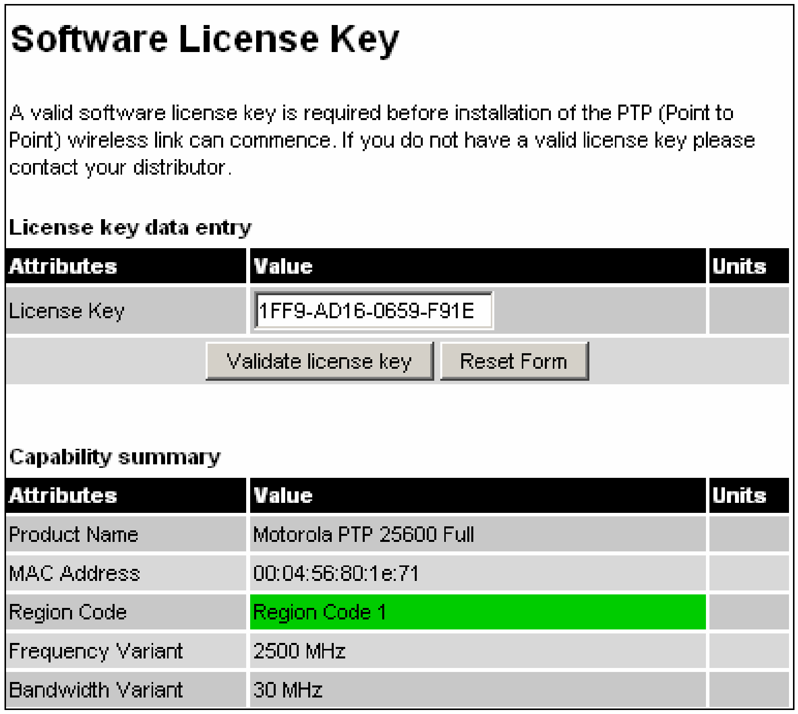
If the installer / system administrator wishes, they may modify the default installation configuration. If only the IP addresses (network configuration) are incorrect it is recommended that the values are changed via the configuration menu (Section 8.3.1.2 "LAN Configuration Page").

CAUTION: If any other parameters (for example Region Code) require modification, then it is recommended that the system administrator use the Installation Wizard.

A detailed description of the Installation Wizard follows:

The 600 Series bridge operational software requires a license key to enable the wireless bridging capability and programs region code specific parameters in to the unit.

Figure 69 - License Key Data Entry



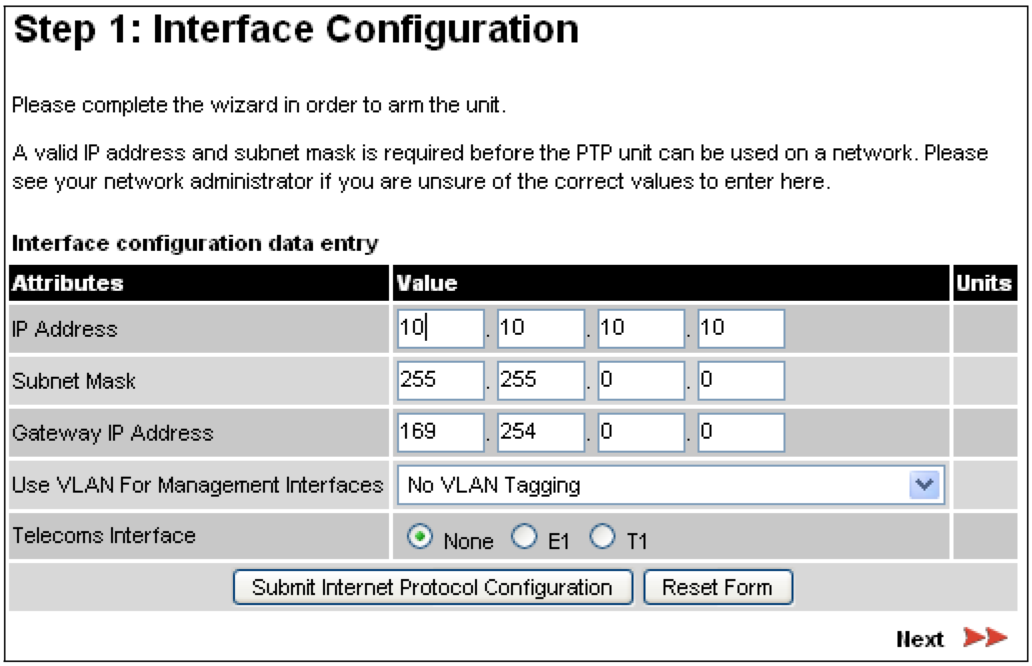
A license key is programmed into each unit during production and can be found written on the Configuration Data Summary Label which is attached to the Quick Install Guide. If subsequently the license key has been mislaid, replacement keys can be applied for online or via your distributor.

If a valid license key is not detected in the unit's non-volatile memory then the user is prompted to enter a valid key. It should be noted that 600 Series bridge units are shipped as link pairs and, as such, valid license keys are entered during the production process. To enter a license key simply type or paste the license key into the data entry box (Figure 69) and click the 'validate license key' button.

8.3.4.2 Internet Protocol Configuration

Step 1 of the installation wizard requires the installer to enter the Internet Protocol (IP) configuration.

Figure 70 - Installation Wizard Internet Protocol Configuration



Step 1: Interface Configuration

Please complete the wizard in order to arm the unit.

A valid IP address and subnet mask is required before the PTP unit can be used on a network. Please see your network administrator if you are unsure of the correct values to enter here.

Interface configuration data entry

Attributes	Value	Units
IP Address	10 . 10 . 10 . 10	
Subnet Mask	255 . 255 . 0 . 0	
Gateway IP Address	169 . 254 . 0 . 0	
Use VLAN For Management Interfaces	No VLAN Tagging	
Telecoms Interface	None E1 T1	

Submit Internet Protocol Configuration | Reset Form

Next

IP Address: Internet protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network.

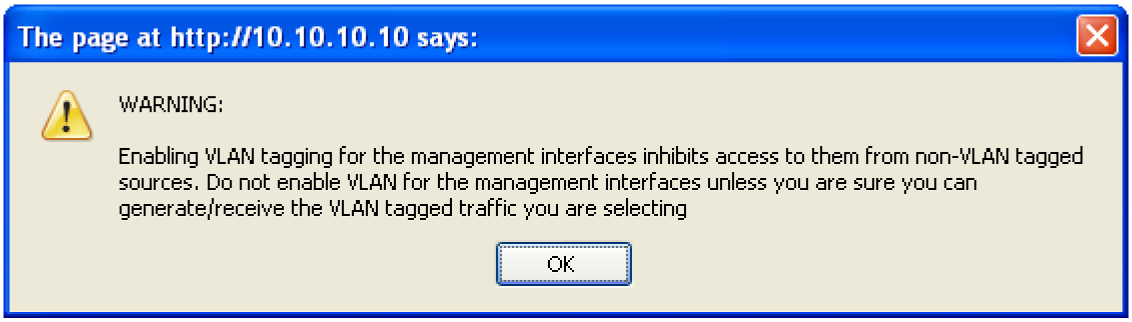
Subnet Mask: A subnet allows the flow of network traffic between hosts to be segregated based on a network configuration. By organizing hosts into logical groups, subnetting can improve network security and performance.

Gateway IP Address: The IP address of a computer / router on the current network that acts as a gateway. A gateway acts as an entrance / exit to packets from / to other networks.

Use VLAN Management Interface: Controls whether the management interfaces (HTTP/SNMP/SMTP/SNTP) use a VLAN. Selecting this option presents the user with extra fields in which to enter the Management VLAN ID, Priority and whether to validate the VLAN ID. If the user modifies this control, a warning dialog is displayed see Figure 71.

Telecoms Interface This allows the activation of the 600 Series bridge telecoms interface. The selection options are None, E1 or T1. Mixed T1/E1 configurations are not permitted.

Figure 71 - VLAN Warning

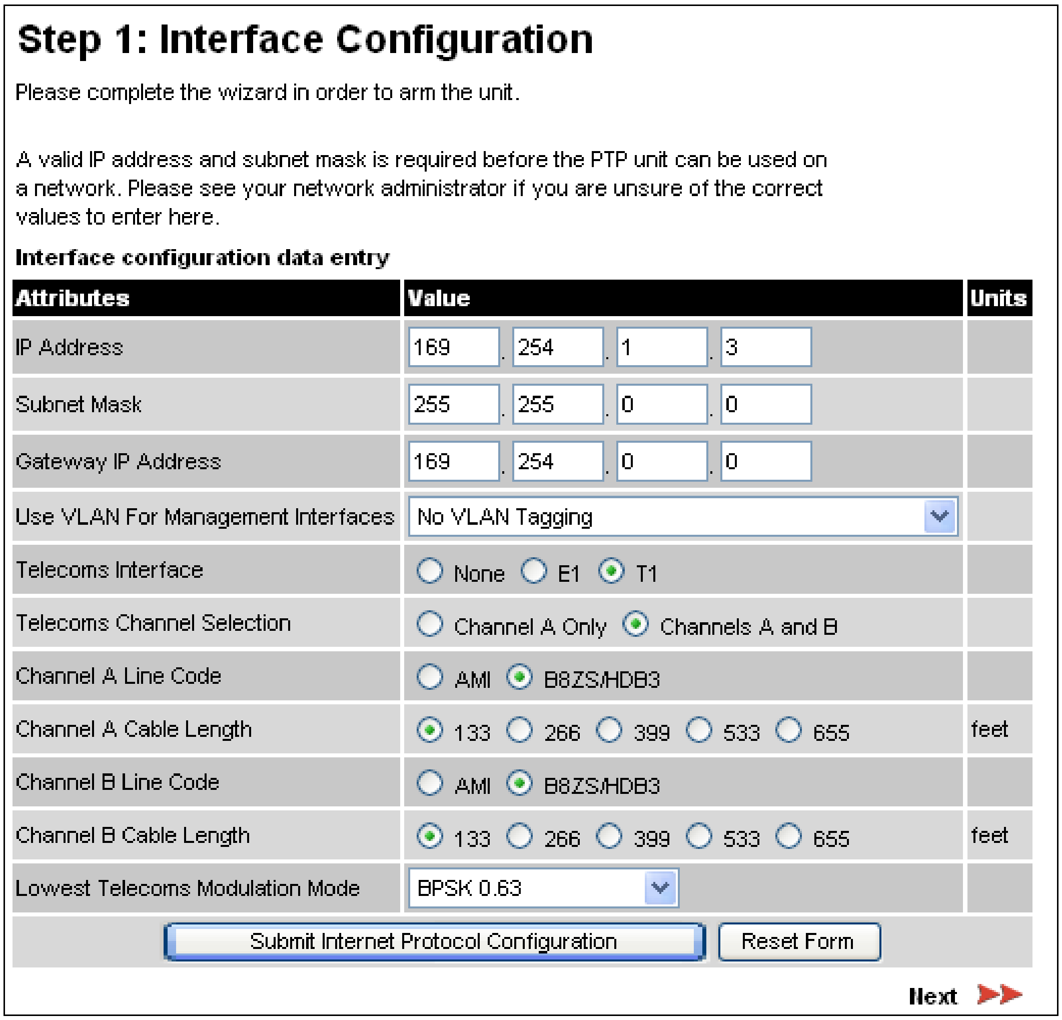


Once complete, click the ‘Submit Internet Protocol Configuration’ button or the ‘Next’ link.

8.3.4.3 Telecoms Interface

If the telecoms interface is configured to either T1 or E1 then Step 1 of the installation wizard contains additional configuration fields.

Figure 72 - Telecoms Configuration Interface



Step 1: Interface Configuration

Please complete the wizard in order to arm the unit.

A valid IP address and subnet mask is required before the PTP unit can be used on a network. Please see your network administrator if you are unsure of the correct values to enter here.

Interface configuration data entry

Attributes	Value	Units
IP Address	169 . 254 . 1 . 3	
Subnet Mask	255 . 255 . 0 . 0	
Gateway IP Address	169 . 254 . 0 . 0	
Use VLAN For Management Interfaces	No VLAN Tagging	
Telecoms Interface	None E1 T1	
Telecoms Channel Selection	Channel A Only Channels A and B	
Channel A Line Code	AMI B8ZS/HDB3	
Channel A Cable Length	133 266 399 533 655	feet
Channel B Line Code	AMI B8ZS/HDB3	
Channel B Cable Length	133 266 399 533 655	feet
Lowest Telecoms Modulation Mode	BPSK 0.63	

Submit Internet Protocol Configuration   Reset Form

Next

The additional E1 or T1 fields are:

Telecoms Channel Selection: This controls the selection of the telecoms interface standard supported options or T1 and E1.

Channel A Line Code: The line code setting of the telecoms interface. This must match the setting of the device connected to this interface.

Channel B Line Code: The line code setting of the telecoms interface. This must match the setting of the device connected to this interface.

Channel A/B Cable Length: This field is applicable to the T1 operating mode only. It configures the T1 transceiver to output a signal suitable for driving a cable of the specified length. This should be set to reflect the length of cable between the wireless unit and the connected equipment.

Lowest Telecoms Modulation Mode: The lowest modulation mode at which telecoms data will be sent, if there is sufficient link capacity.

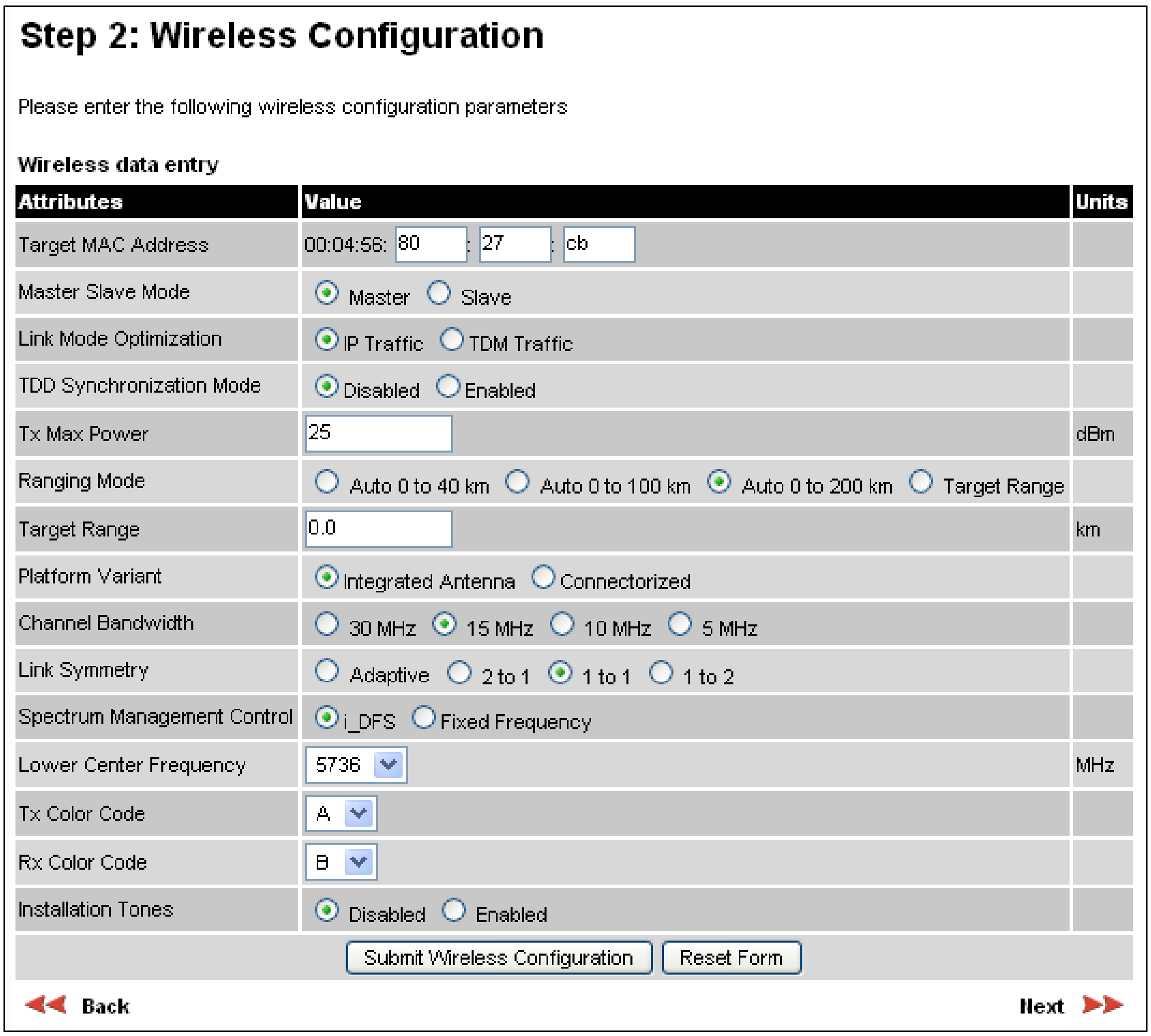
In conjunction with the LINKPlanner tool, this setting may be used to optimize the latency for links which operate in consistently high modulation modes. High data rate links are able to support lower latencies.

The lowest telecoms modulation mode is selected from a rate ordered drop-down list. If this selected mode has insufficient capacity to support the telecoms data then the effective lowest modulation mode, determined when the wireless link starts, will be higher. The effective lowest modulation mode is displayed on the Telecoms Configuration page.

8.3.4.4 Wireless Configuration

Step 2 of the installation wizard requires the installer to enter the wireless configuration parameters. Figure 73 is an example of the Wireless Configuration screen.

Figure 73 –Wireless Configuration



Step 2: Wireless Configuration

Please enter the following wireless configuration parameters

Wireless data entry

Attributes	Value	Units
Target MAC Address	00:04:56: 80 : 27 : cb	
Master Slave Mode	(•) Master ( ) Slave	
Link Mode Optimization	(•) IP Traffic ( ) TDM Traffic	
TDD Synchronization Mode	(•) Disabled ( ) Enabled	
Tx Max Power	25	dBm
Ranging Mode	( ) Auto 0 to 40 km ( ) Auto 0 to 100 km (•) Auto 0 to 200 km ( ) Target Range	
Target Range	0.0	km
Platform Variant	(•) Integrated Antenna ( ) Connectorized	
Channel Bandwidth	( ) 30 MHz (•) 15 MHz ( ) 10 MHz ( ) 5 MHz	
Link Symmetry	( ) Adaptive ( ) 2 to 1 (•) 1 to 1 ( ) 1 to 2	
Spectrum Management Control	(•) i_DFS ( ) Fixed Frequency	
Lower Center Frequency	5736	MHz
Tx Color Code	A	
Rx Color Code	B	
Installation Tones	(•) Disabled ( ) Enabled	

Submit Wireless Configuration | Reset Form

Back | Next

The contents of the Wireless Configuration screen vary depending upon the PTP 600 variant as follows:

- PTP 25600: Frequency Band field is also displayed.
- PTP 48600 and PTP 49600: Channel Bandwidth options are 20, 10 and 5 MHz.
- PTP 49600: Lower Center Frequency is not displayed.

Screen contents also vary depending upon the options selected as follows:

- If Spectrum Management Control is set to “Fixed Frequency”, the Lower Center Frequency field is replaced by Fixed Tx Frequency and Fixed Rx Frequency.
- If Platform Variant is set to “Connectorized”, Antenna Gain and Cable Loss are also displayed. For more information about the configuration of connectorized PTP 600 units, refer to Section 13.3 “Software/Features”.

See the field definitions below for more details.

Target MAC Address: This is the MAC Address of the peer unit that will be at the other end of the wireless link. This is used by the system to ensure the unit establishes a wireless link to the correct peer. The MAC Address can be found embedded within the serial number of the unit. The last six characters of the serial number are the last three bytes of the unit’s MAC address.

NOTE: A PTP 600 Series system is shipped as a pair of units with pre-loaded correct MAC addresses. Target MAC addresses will only need to be entered if an existing unit has to be replaced in the field or the units configuration has been erased.

Master Slave Mode: At this point it is necessary to decide which end will designate a Master. The Master unit is the controlling unit with respect to the point-to-point link and its maintenance. The master transmits until the link is made, while the Slave listens for its peer and only transmits when the peer has been identified.

Link Mode Optimization: Optimizes the link behavior according to the type of traffic that will be bridged. There are two modes to choose from: IP and TDM. For more information, see 5.13 “Link Mode Optimization”.

TDD Synchronization Mode: Enables the TDD Synchronization feature (see Section 5.12 “Time Division Duplex (TDD) Synchronization” for basic description and Section 14 “TDD Synchronization Configuration and Installation Guide” for installation and configuration details).

Tx Max Power: This attribute controls the maximum transmit power the unit is permitted to use when installing and executing the wireless link. The maximum setting for a particular region or country is controlled by the License Key.

Ranging Mode: During installation, the wireless units perform "Automatic Ranging". The ranging mode allows the installer to control the behavior of the system's automatic ranging algorithms. The default value is 0 to 40 km (0 to 25 miles). If the installer is required to install a link of greater than 40 km (25 miles) then the ranging mode attribute MUST be configured to '0 to 100km' (0 to 62 miles) or '0 to 200km' (0 to 124 miles) mode depending on the range of the link.

NOTE: If preferred, PTP 600 Series Bridge range functions can be configured to operate in miles, as described in Section 8.3.15 "Properties".

Target Range: Installers that know the range between the two wireless units to within ± 1 km can use the target range mode. The main advantage of the target range mode is that it reduces the time taken by the units to range. To use the target range mode the installer MUST select Target Range as the ranging mode and enter the approximate range in km in the Target range data entry field at both ends of the link.

Platform Variant: Chooses between an integrated unit or a connectorized unit that requires an external antenna.

Frequency Band: Only displayed for the PTP 25600 product variant, which operates in one of three bands as described in Section 5.4 “Variable Channel Bandwidth Operation”:

- Lower: 2496 MHz to 2568 MHz
- Middle: 2572 MHz to 2614 MHz
- Upper: 2624 MHz to 2690 MHz

Channel Bandwidth: Users can choose a variable channel bandwidth for the available spectrum. The selection depends upon the PTP bridge variant:

- For PTP 25600, PTP 45600, PTP 54600, PTP 58600 and PTP 59600, Channel Bandwidth may be 30, 15, 10 or 5 MHz.
- For PTP 48600 and PTP 49600, Channel Bandwidth may be 20, 10 or 5 MHz.

Link Symmetry: (Master only) Values of "Adaptive", "2 to 1", "1 to 1" and "1 to 2" can be selected. The adaptive setting allows link symmetry to vary dynamically in response to offered traffic load. The remaining values select three options for fixed division between transmit and receive time in the TDD frame of the master ODU. The first number in the ratio represents the time allowed for the transmit direction and the second number represents the time allowed for the receive direction. The appropriate matching Link Symmetry is set at the slave ODU automatically. For example, if Link Symmetry is configured as “2 to 1” at the master ODU, then the slave ODU will be set automatically as “1 to 2”. In this example, the master-slave direction has double the capacity of the slave-master direction.

NOTE: (a) "Adaptive" is not supported in regions where radar avoidance is in use, (b) "Adaptive" is not supported when link optimization is set to "TDM", (c) "Adaptive" is not supported in 5 MHz channel bandwidth, (d) "2 to 1" and "1 to 2" are not supported in 5 MHz channel bandwidth, (e) “2 to 1” and “1 to 2” are not supported when E1/T1 services are enabled.

Spectrum Management Control: Is used to configure the PTP 600 Series Bridge’s Spectrum Management features, see Section 8.3.7 “Spectrum Management” for more details. i-DFS is the abbreviation for intelligent Dynamic Frequency Selection. This feature 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 transmit and receive frequencies on the units. The frequencies may be configured symmetrically or asymmetrically. Only 30MHz channels are available in regions that mandate DFS (Radar Detection), and the Spectrum Management Control may not be available because the regulations for some regions force DFS, others force fixed frequency (for example 2.5 GHz).

Lower Center Frequency: Not displayed for the PTP 49600. Not displayed when Spectrum Management Control is set to “i-DFS”. The software for the PTP 600 Series Bridge allows a user to optionally adjust the channel center frequencies. Changing the Lower Center Frequency attribute causes all channel center frequencies to be offset. It effectively slides the channelization up or down. See Sections 5.5 to 5.11, depending on the frequency variant.

NOTE: Because the 4.9 GHz spectrum is restricted by license, the Lower Center Frequency is fixed for the PTP 49600 and is therefore not displayed.

CAUTION: The lower center frequency attribute must be configured to the same value for both the master and slave. Failure to do so will cause the wireless link to fail reestablishment. The only way to recover from this situation is to modify the Lower Center Frequency attribute so that they are identical on both the master and slave unit.

Default Raster: If this is set to “On”, the list of options presented in the fixed Tx frequency box is limited by the default raster.

Fixed Tx Frequency, Fixed Rx Frequency: Only displayed when Spectrum Management Control is set to “Fixed Frequency”. The software for the PTP 600 Series Bridge allows a user to optionally fix the Transmit and the Receive frequencies for a wireless link. The settings must be compatible at each end of the link. Once configured, the spectrum management software will not attempt to move the wireless link to a channel with lower co-channel or adjacent channel interference. Therefore this mode of operation is only recommended for deployments where the installer has a good understanding of the prevailing interference environment. Figure 74 shows an example fixed frequency configuration for a 30 MHz channel bandwidth. In this example, the Fixed Transmit Frequency is set to 5742 MHz and the Fixed Receive Frequency is set to 5742 MHz. Care must be taken when configuring the Fixed Transmit and Receive Frequencies to ensure that both frequencies are on the same channel raster as the Lower Center Frequency. For example, if the channel raster is 10 MHz, both the Fixed Transmit and Receive Frequencies must be a multiple of 10 MHz from the Lower Center Frequency (5752 = 5742 + 10 MHz) and (5782 = 5742 + 10 MHz × 3).

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

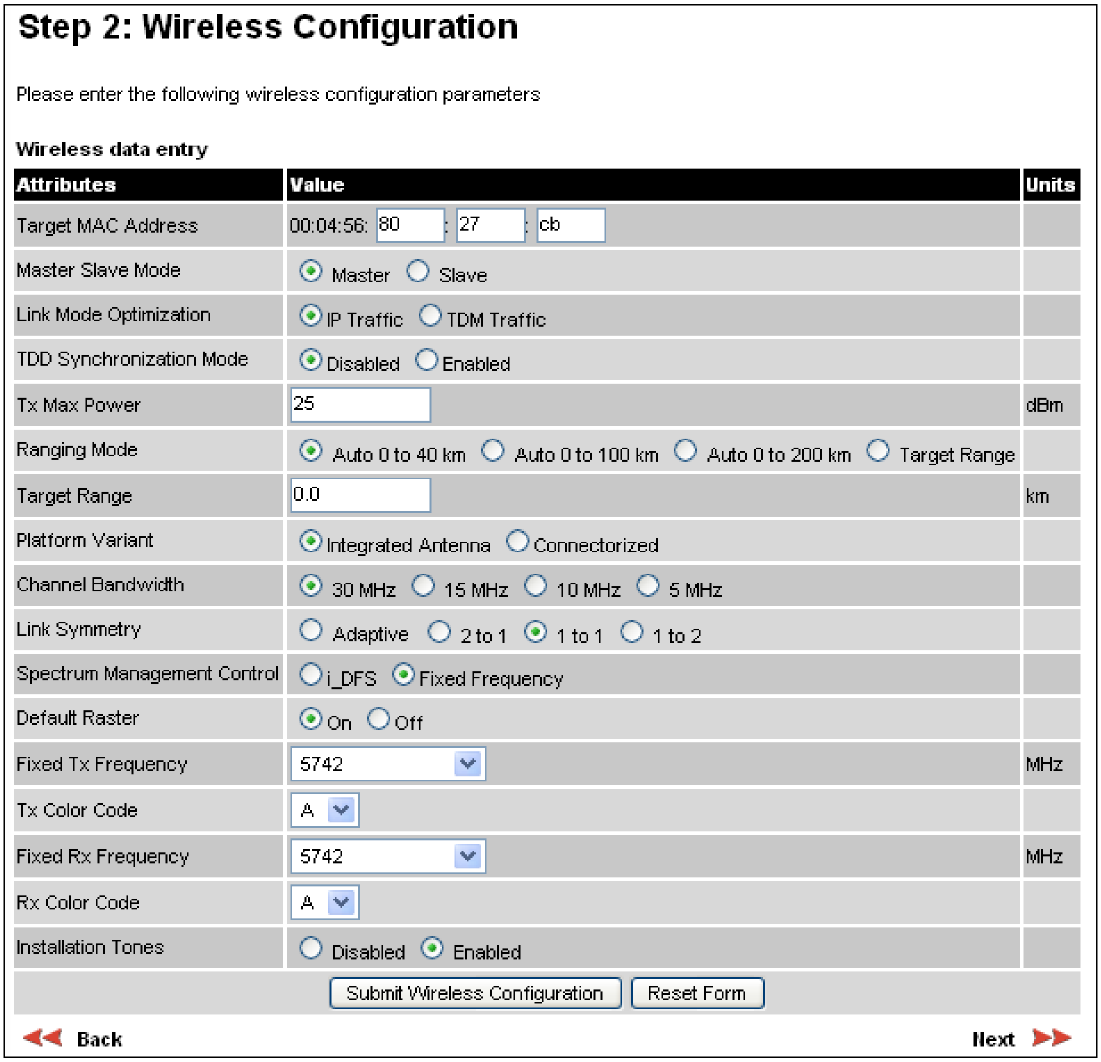
Tx Color Code, Rx Color Code: The Tx Color Code and Rx Color Code attributes need only be considered when the unit is installed in a dense network of synchronized PTP 600 units and where some of the PTP 600 units are operating on the same frequency. In this case, the value would normally be derived by a network radio planner. In all other cases, it is strongly recommended that this attribute is left at the default value of "A". Tx and Rx Color Code are not available in the PTP 48600 and PTP 49600 product variants.

NOTE: The value of Tx Color Code MUST always match the value of Rx Color Code at the other end of the link.

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 74 – Fixed Frequency Configuration Example



Step 2: Wireless Configuration

Please enter the following wireless configuration parameters

Wireless data entry

Attributes	Value	Units
Target MAC Address	00:04:56: 80 : 27 : cb	
Master Slave Mode	◉ Master ○ Slave	
Link Mode Optimization	◉ IP Traffic ○ TDM Traffic	
TDD Synchronization Mode	◉ Disabled ○ Enabled	
Tx Max Power	25	dBm
Ranging Mode	◉ Auto 0 to 40 km ○ Auto 0 to 100 km ○ Auto 0 to 200 km ○ Target Range	
Target Range	0.0	km
Platform Variant	◉ Integrated Antenna ○ Connectorized	
Channel Bandwidth	◉ 30 MHz ○ 15 MHz ○ 10 MHz ○ 5 MHz	
Link Symmetry	○ Adaptive ○ 2 to 1 ◉ 1 to 1 ○ 1 to 2	
Spectrum Management Control	○ i_DFS ◉ Fixed Frequency	
Default Raster	◉ On ○ Off	
Fixed Tx Frequency	5742	MHz
Tx Color Code	A	
Fixed Rx Frequency	5742	MHz
Rx Color Code	A	
Installation Tones	○ Disabled ◉ Enabled	

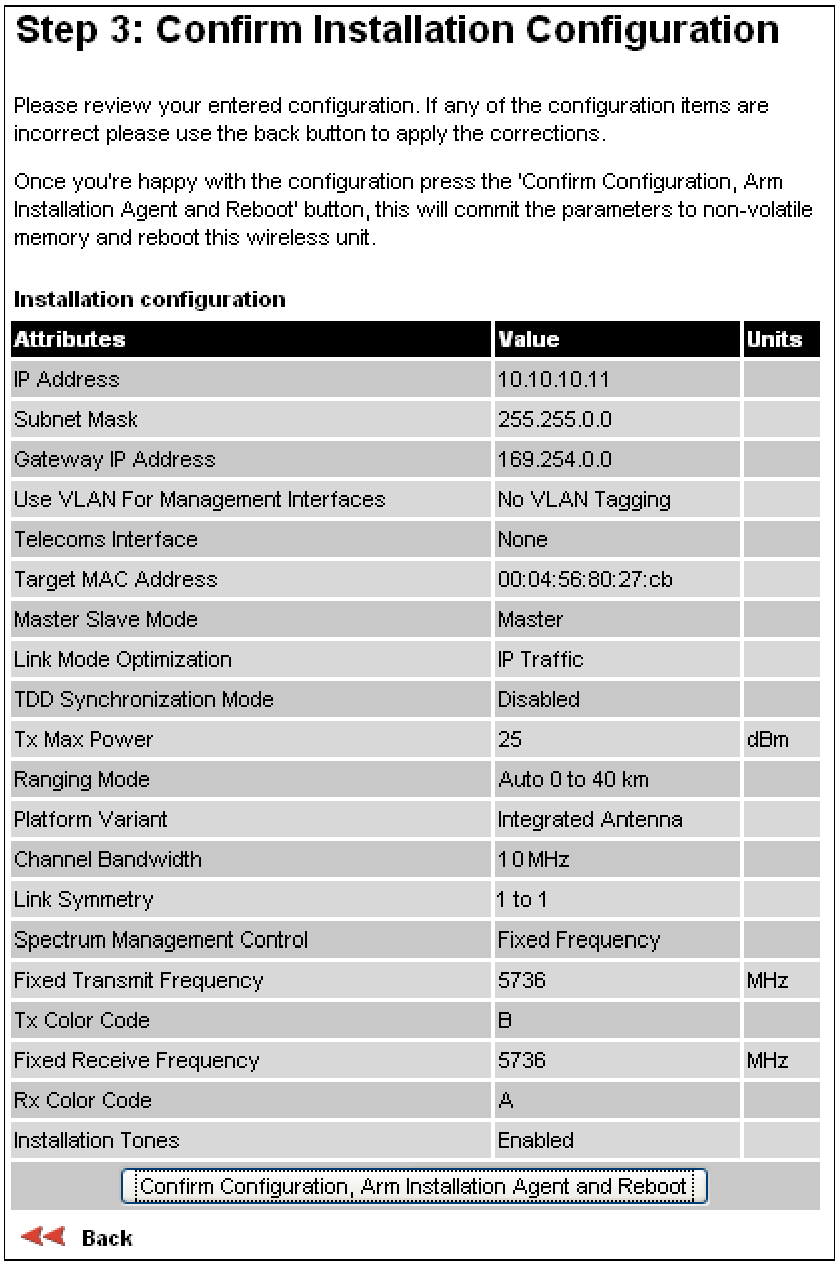
Submit Wireless Configuration | Reset Form

Back | Next

8.3.4.5 Confirm Configuration

Step 3 of the installation wizard requires the installer to confirm the wireless configuration parameters. Figure 75 is an example of the Confirm Configuration screen. The screen contents vary depending upon the product variant and configuration options selected.

Figure 75 – 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

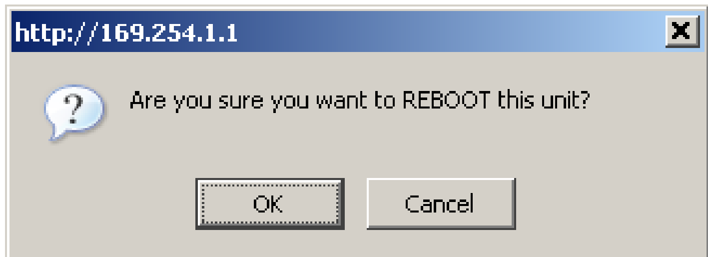
Attributes	Value	Units
IP Address	10.10.10.11	
Subnet Mask	255.255.0.0	
Gateway IP Address	169.254.0.0	
Use VLAN For Management Interfaces	No VLAN Tagging	
Telecoms Interface	None	
Target MAC Address	00:04:56:80:27:cb	
Master Slave Mode	Master	
Link Mode Optimization	IP Traffic	
TDD Synchronization Mode	Disabled	
Tx Max Power	25	dBm
Ranging Mode	Auto 0 to 40 km	
Platform Variant	Integrated Antenna	
Channel Bandwidth	10 MHz	
Link Symmetry	1 to 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

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 76).

Figure 76 - Reboot Confirmation Pop Up



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

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

8.3.4.6 Disarm

Figure 77 is an example of the Disarm Installation screen. The screen contents vary depending upon the product variant and configuration options selected.

Figure 77 – 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	00:04:56:80:27:cb	
Master Slave Mode	Master	
Link Mode Optimization	IP Traffic	
TDD Synchronization Mode	Disabled	
Tx Max Power	25	dBm
Ranging Mode	Auto 0 to 200 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 to 1	
Spectrum Management Control	i_DFS	
Lower Center Frequency	5736	MHz
Tx Color Code	A	
Rx Color Code	B	
Installation Tones	Disabled	

Disarm Installation Agent

Back

When Section 8.3.4.5 “Confirm Configuration” is complete, the installation is armed and rebooted. Pressing the “Disarm Installation Agent” button completes the installation process 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.

The installation process is completed when both ends of the link are ‘disarmed’.

After disarming the wireless link the user is presented with one of two possible configuration pages, see Figure 78 and Figure 79. The screen presents hyperlinks to the main configuration and spectrum management pages.

Figure 78 - Optional Post Disarm Configuration 1

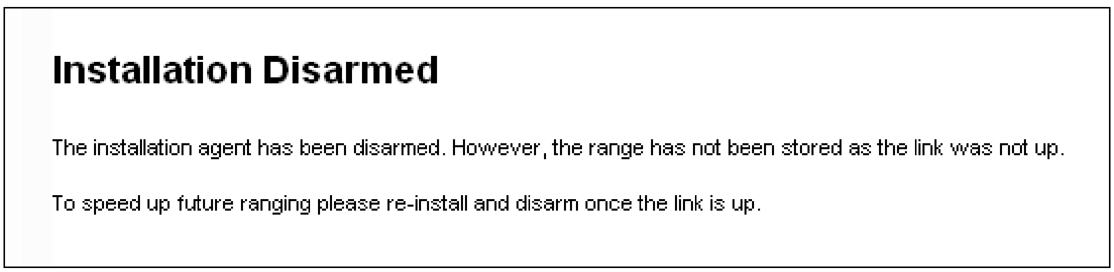
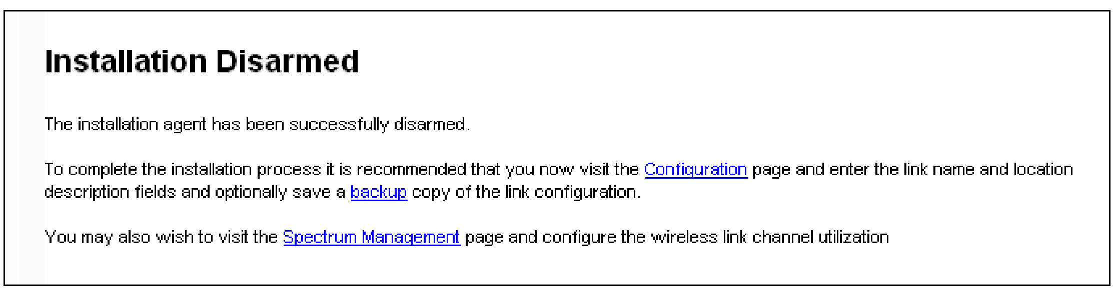


Figure 79 - Optional Post Disarm Configuration 2



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.

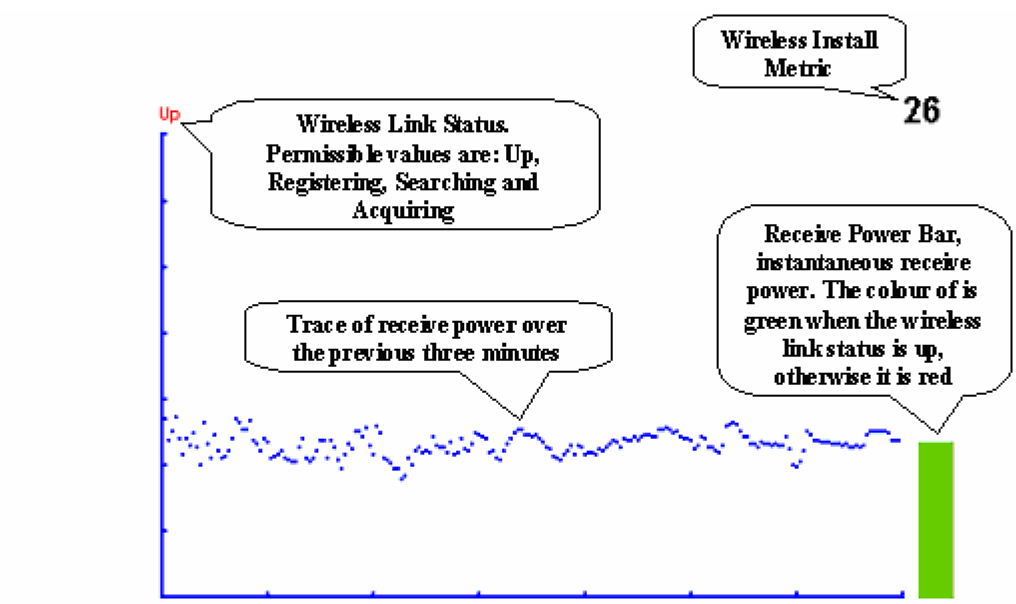
8.3.5 Graphical Install

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 80. 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 80 – 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.

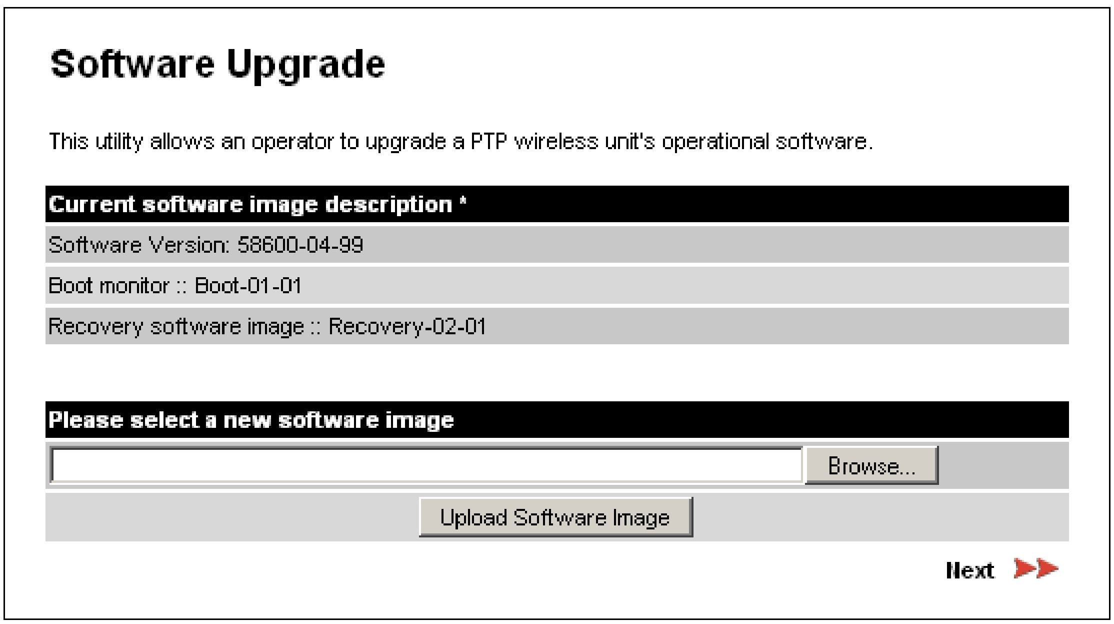
The PDA installation tool is accessed via a hidden URL http://<ip-address>/pda.cgi. It should be noted that this link is only available after the user has logged in as system administrator.

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 81 shows the main software upgrade web page.

Figure 81 - 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.

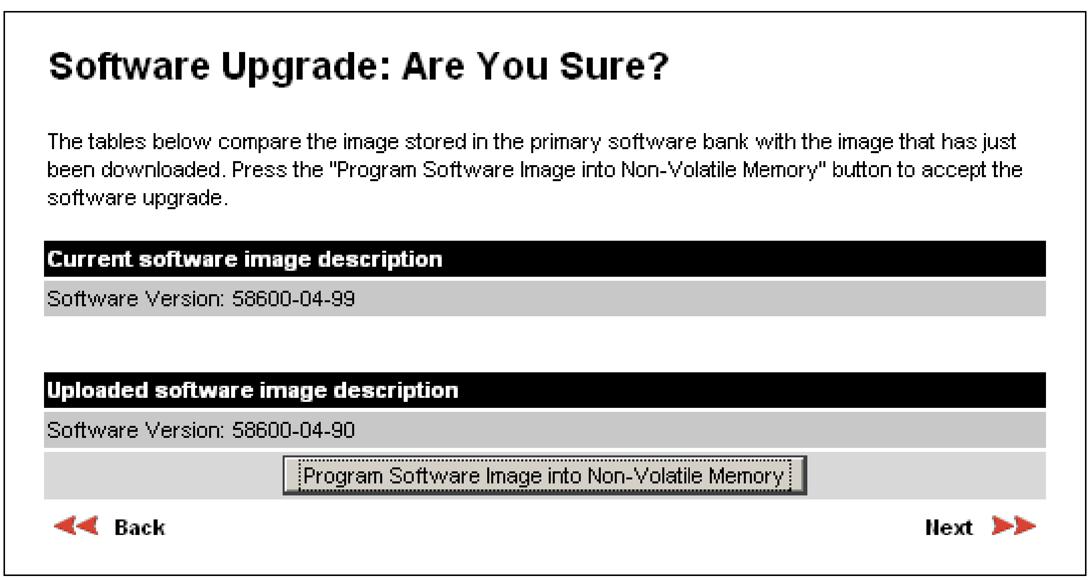
The first step (Figure 81) is to use the "Browse" button to locate the software image previously downloaded to local storage from the Motorola web site. Once the image is located, the user should press the **Upload Software Image** button to start the software upgrade process.

RECOMMENDATION: 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.

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 82)

Figure 82 - 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.

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 83). 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 83 - Software Download Progress Indicator

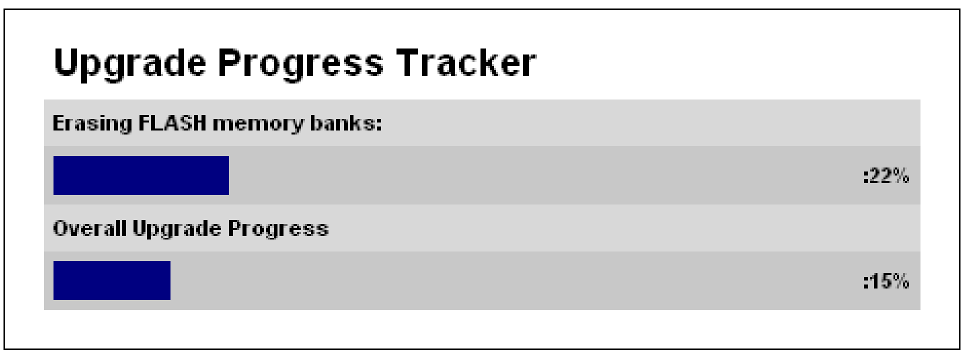
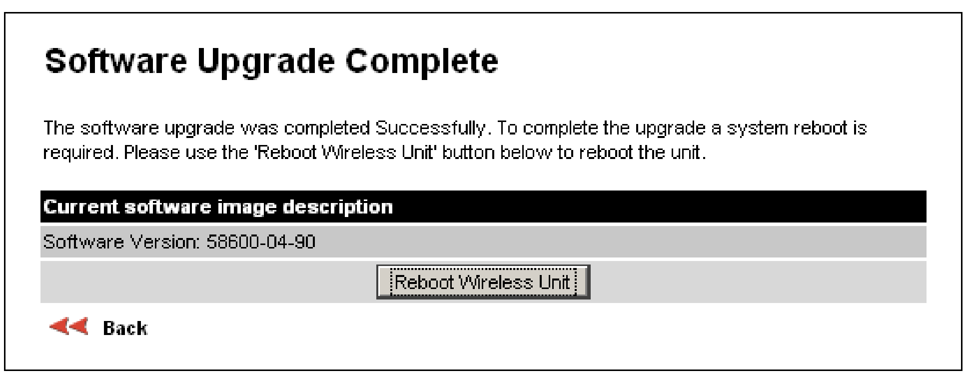


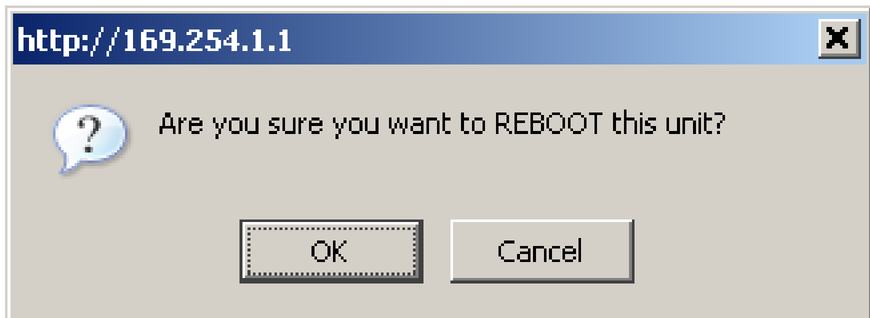
Figure 84 - Software Upgrade Complete



When the software image has been written to non-volatile memory Figure 84 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 85.

Figure 85 - 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, 20 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 5.10 “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 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: The arithmetic mean is the true power mean and not the mean of the values expressed in dBm.

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

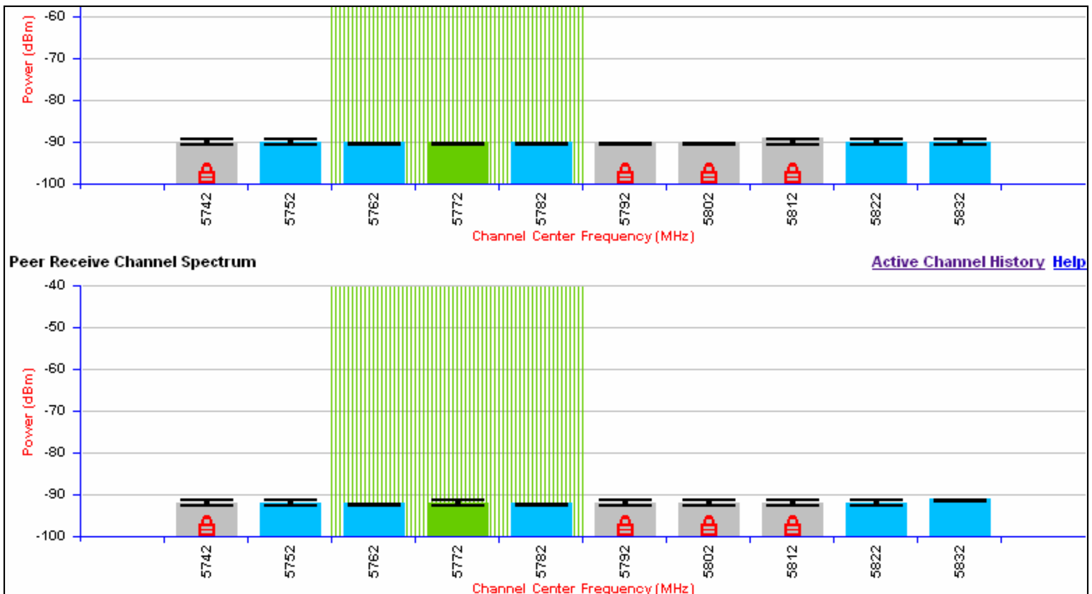
The display of statistical measurement on the spectrum management page always shows a statistical summary of all channel measurement. The statistical summary is controlled by the Statistics Window attribute. This attribute defaults to a value of twenty minutes, which means that the mean and percentile 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.

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.

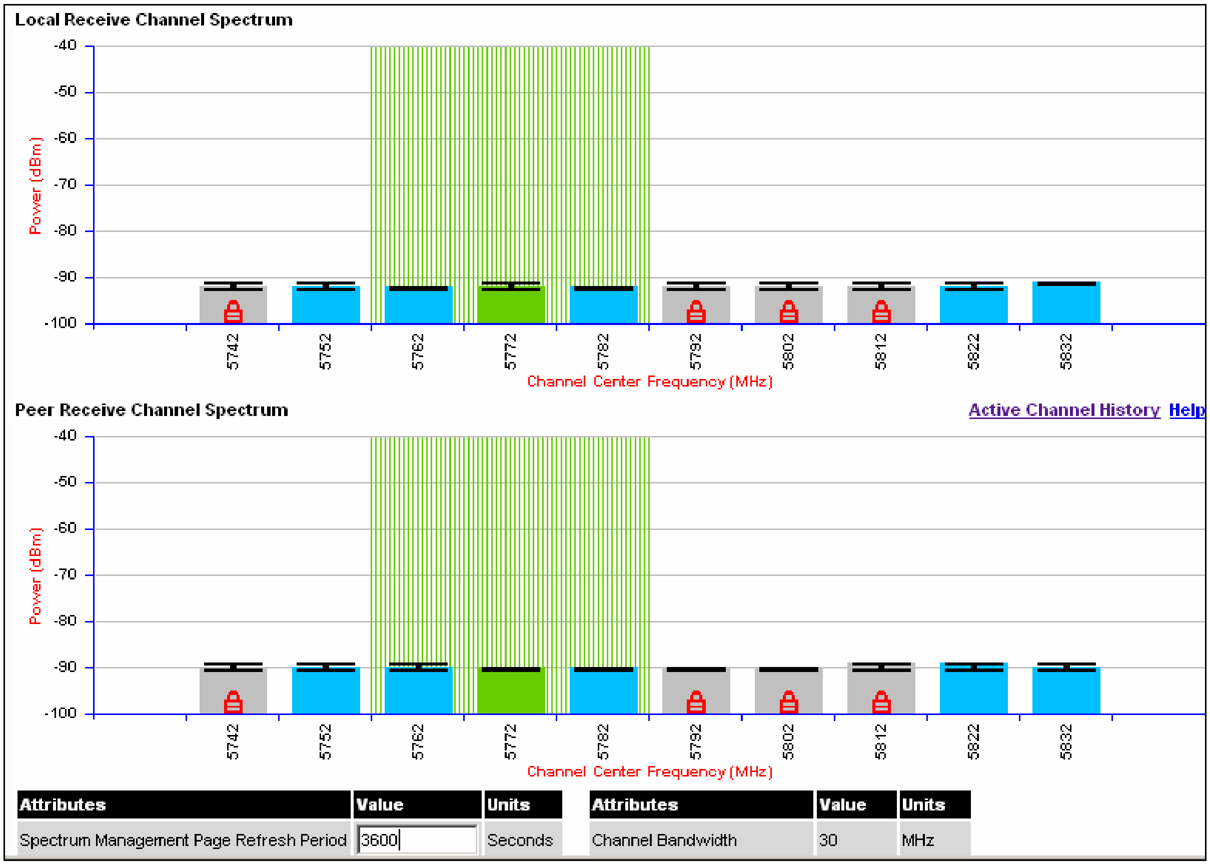
All configuration changes are applied at the master only. These changes are then messaged from the master to the slave. Any Spectrum Management configuration messages received at the slave are stored in non-volatile memory. This enables both master and slave to keep identical copies of Spectrum Management 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 86 - Spectrum Management as seen from the Master



Attributes	Value	Units	Attributes	Value	Units
Spectrum Management Page Refresh Period	3600	Seconds	Interference Threshold	-85	dBm
Hopping Margin	3	dB	Asymmetric DFS	Disabled Enabled	
Hopping Period	180	Seconds	Channel Bandwidth	30	MHz
Hopping Counter	0 (+0)		Submit configuration changes	Reset form	

Figure 87 - Spectrum Management as seen from the Slave



NOTE: These plots are for 30 MHz operation; 5/10/15/20 MHz operation is similar - the width of the vertical green bar represents the channel width.

Figure 86 shows an example Spectrum Management webpage as seen from the master.

Figure 87 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

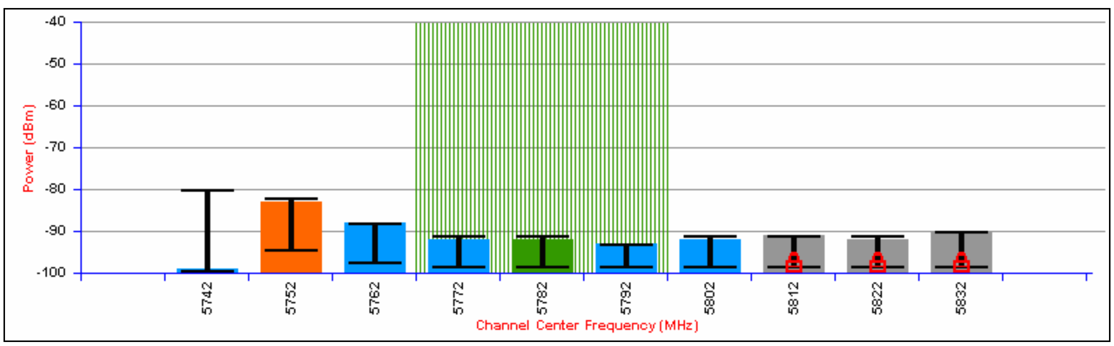
Channels can only be barred / unbarred by the system administrator from the master Spectrum Management web page. The barring / unbarring operations are disabled on the slave web page. If an attempt to bar / unbar a channel is made at the slave, a warning dialog is generated.

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 88 - 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 88) 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 36 - 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.

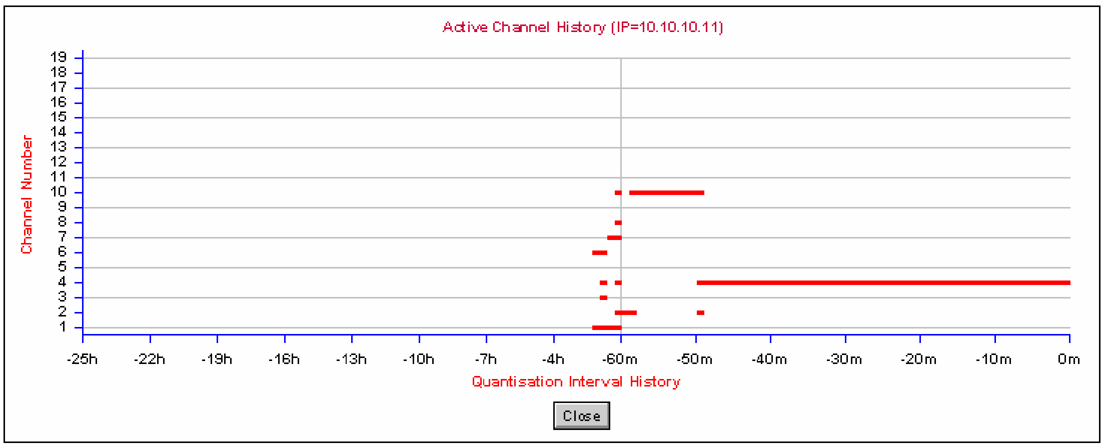
The top of the colored bar represents the 99.9% percentile metric for specific channel.

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 89. 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 89 - 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 90 - Spectrum Management Time Series Plot

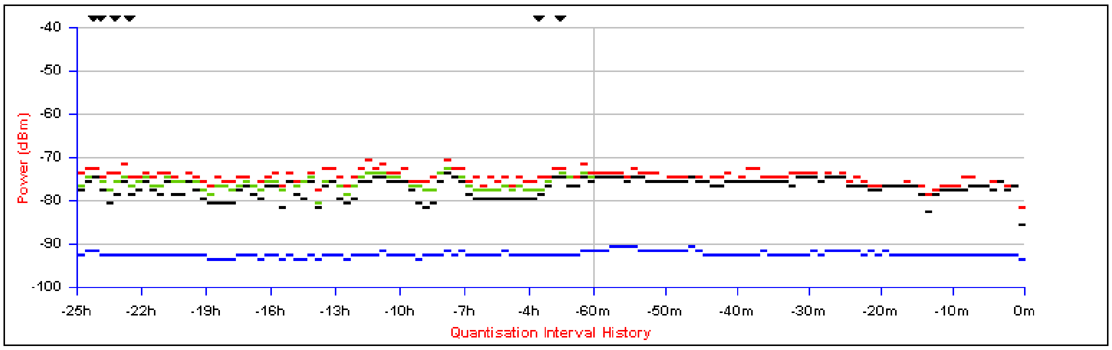


Figure 90 shows an example time series plot. A time series plot displays the previous 132 measurement quantization periods. If the PTP 600 Series Bridge has not been running for 132 quantization periods then only the number of measurement quantization periods that are available are displayed.

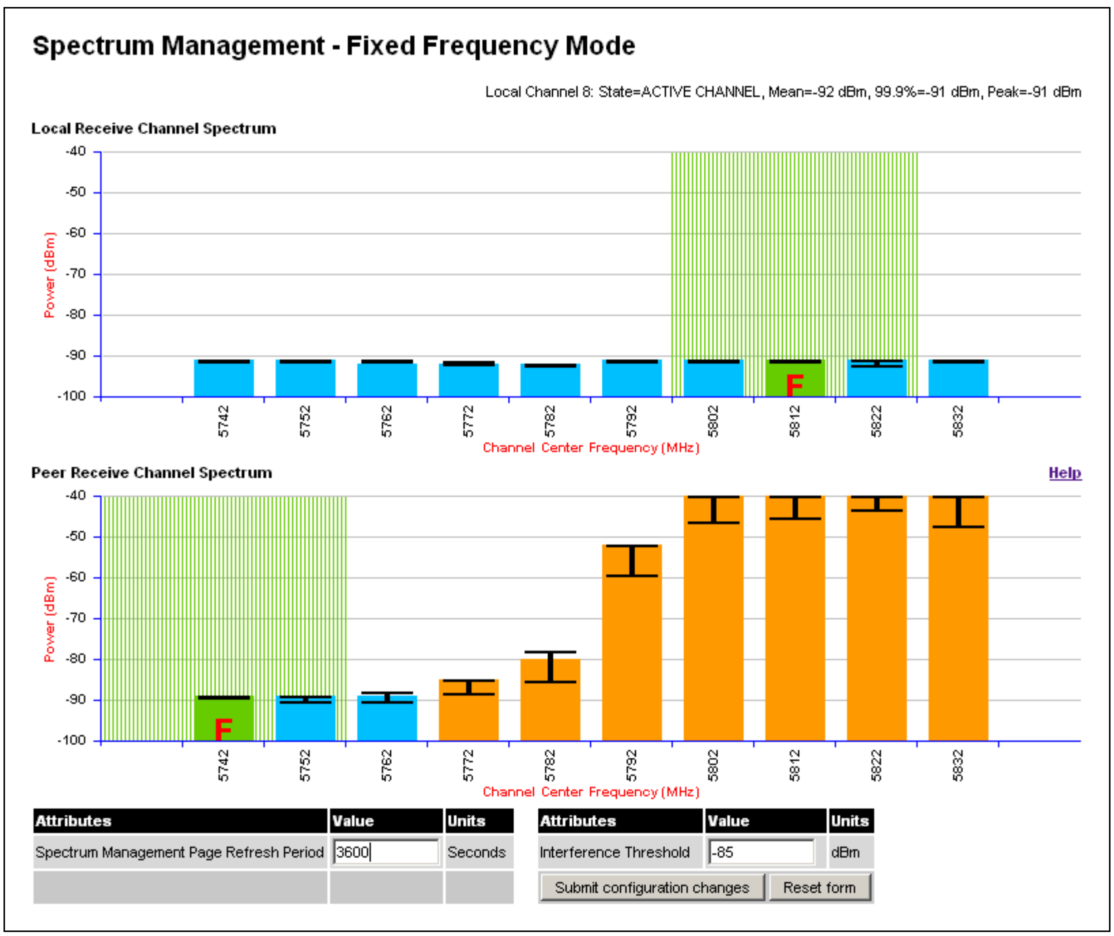
Table 37 - Spectrum Management Time Series Key

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 91. 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 91 - Spectrum Management Fixed Frequency Screen

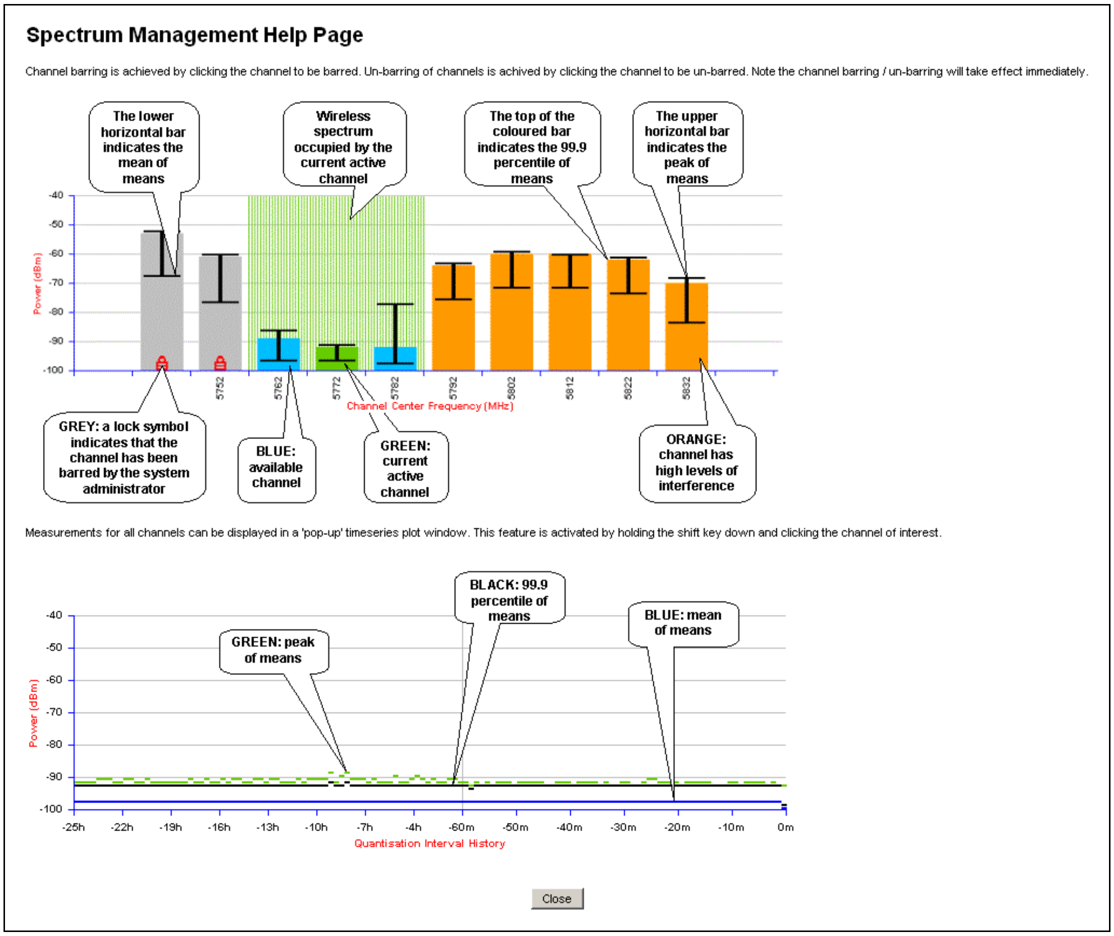


Channel barring is disabled in fixed frequency mode; it is not required as dynamic channel hopping is prohibited in this mode.

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 92 - 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 93 and Figure 94.
- 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 93.

- Extra color coding of the interference histogram is provided. See Table 38.

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 93 and Figure 94. 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 93 - Spectrum Management Master Screen With Operational Restrictions

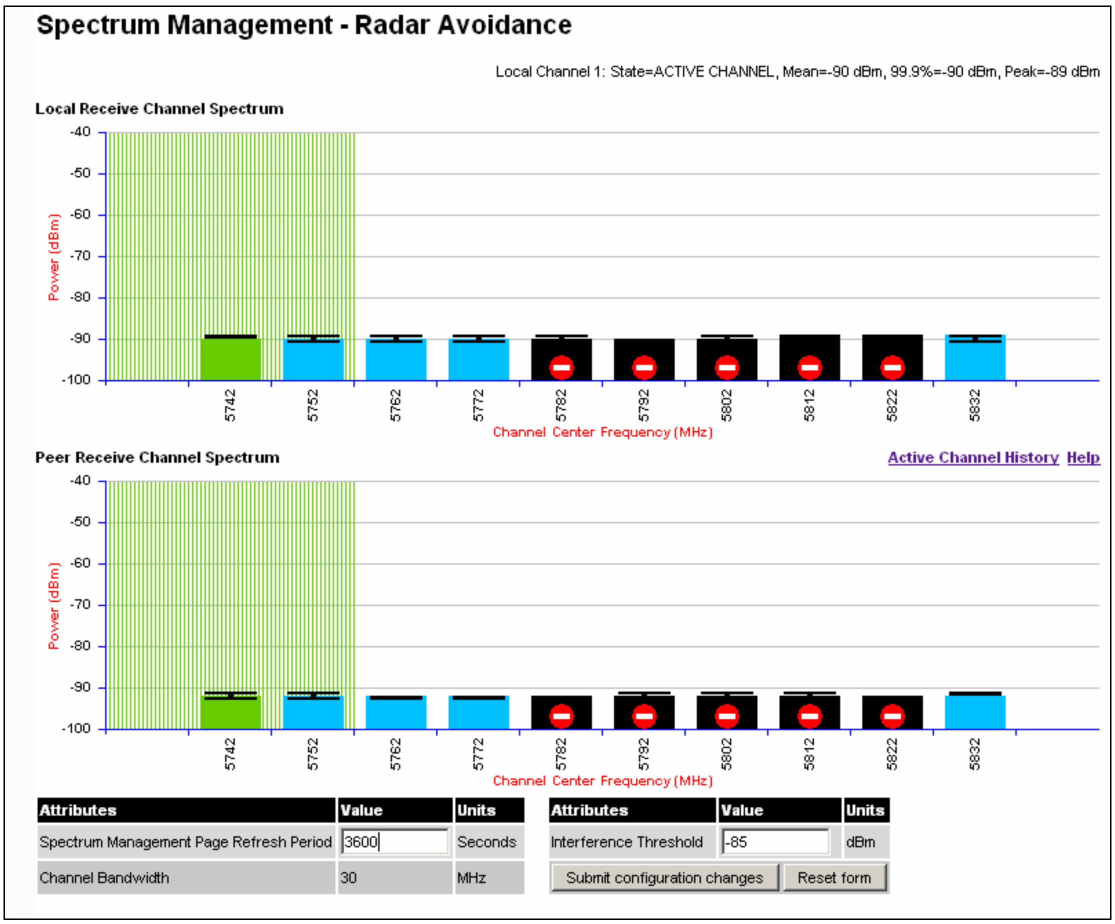
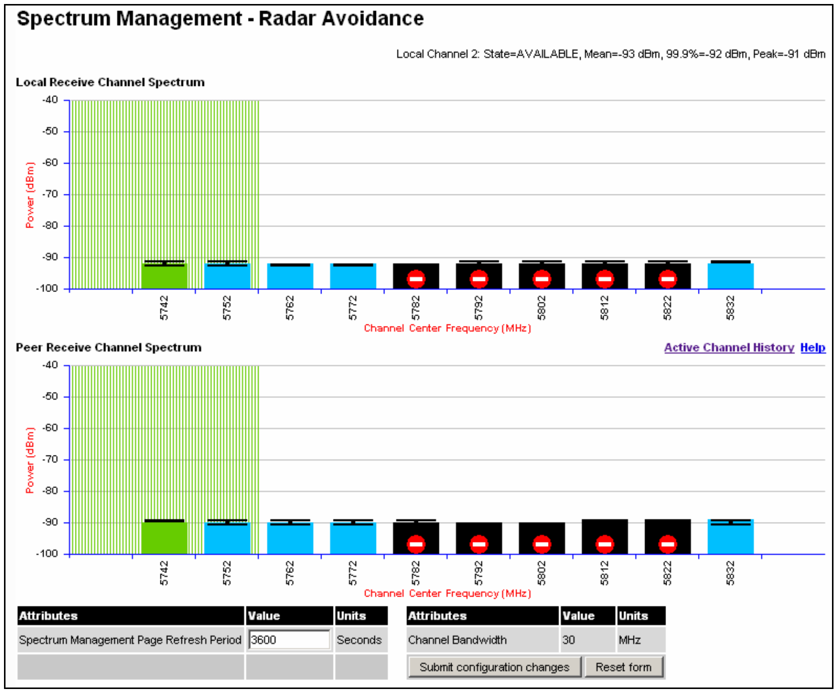


Figure 94 - Spectrum Management Slave Screen With Operational Restrictions



The colored bar represents the following channel state:

Table 38 - Spectrum Management Change State Key With Operational Restrictions

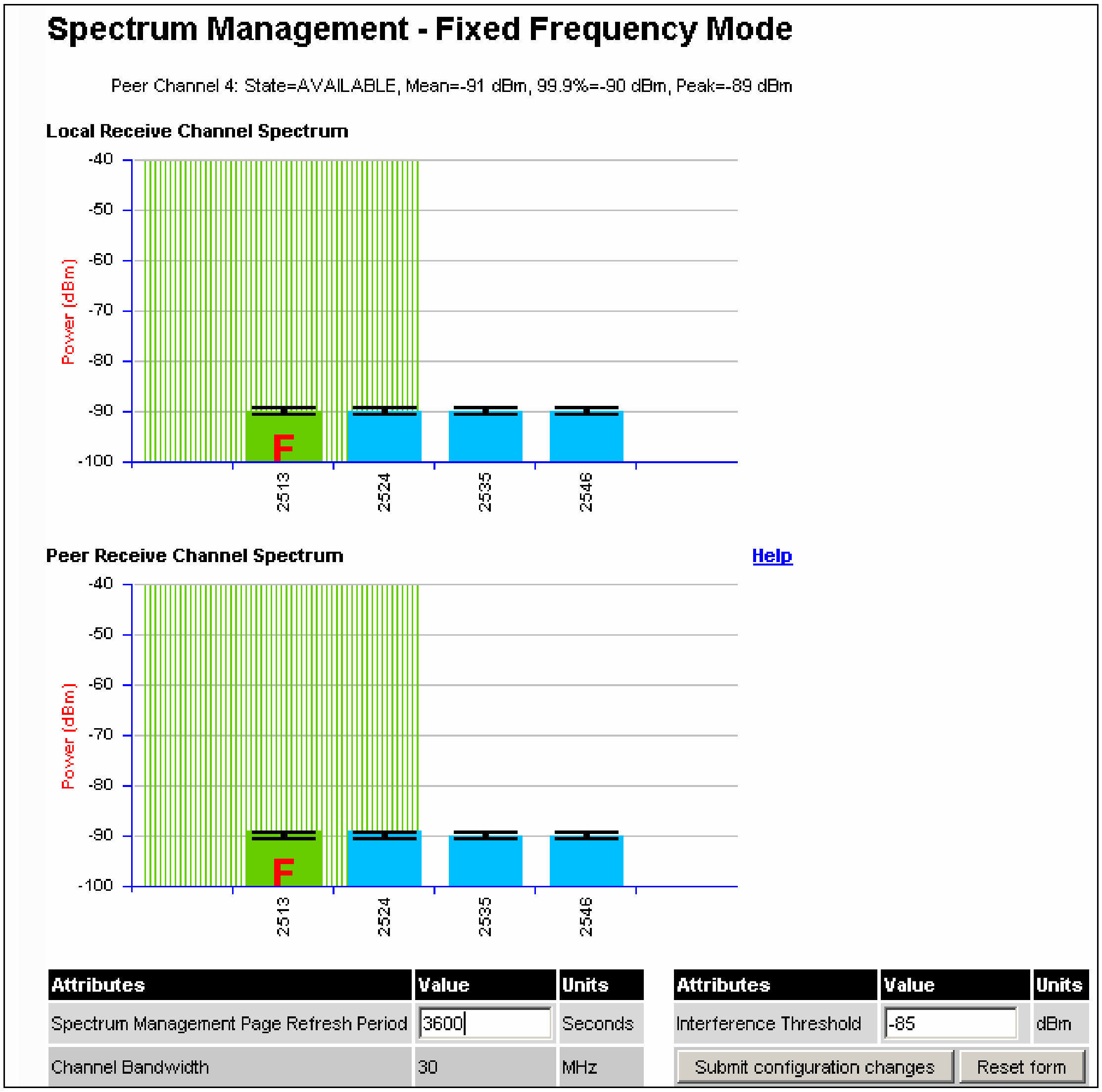
Green	Active	The channel is currently in use hosting the Point-to-Point wireless link
Orange	Interference	The channel has interference above the interference threshold
Blue	Available	The channel has an interference level below the interference threshold and is considered by the Spectrum Management algorithm 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 95 shows an example of a Lower Band with a 30 MHz channel bandwidth.

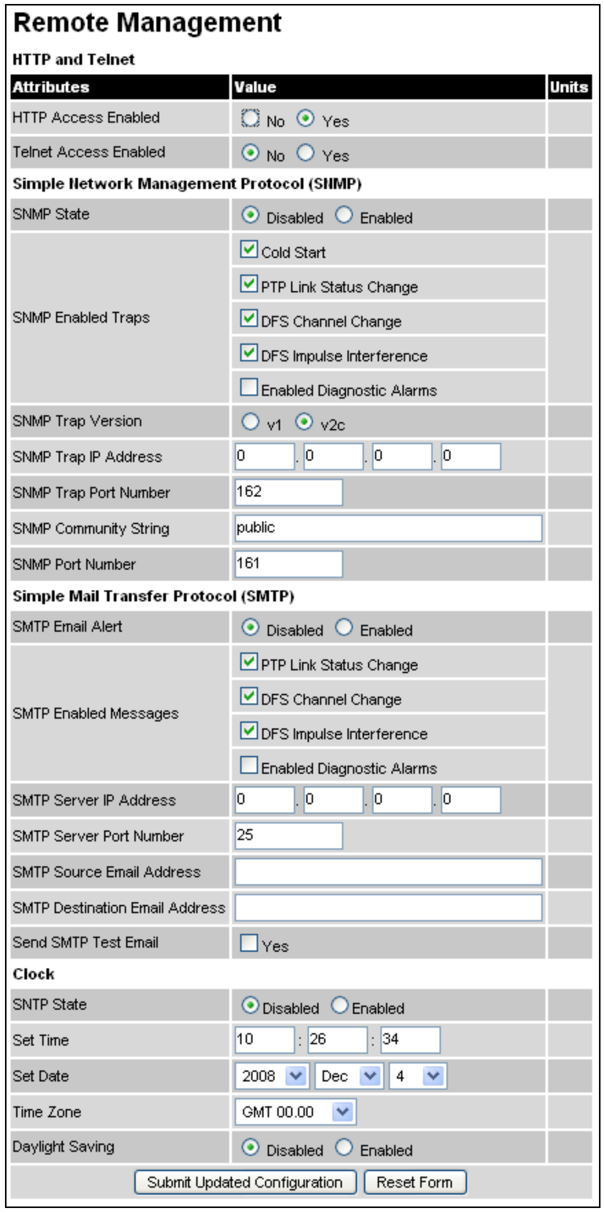
Figure 95 - PTP 25600 Example of Spectrum Management Page



8.3.11 Remote Management Page

The Remote Management page (Figure 96) allows the system administrator to configure the remote management of the PTP 600 Series Bridge.

Figure 96 - Remote Management



Remote Management

HTTP and Telnet

Attributes	Value	Units
HTTP Access Enabled	No / Yes (selected)	
Telnet Access Enabled	No (selected) / Yes	
Simple Network Management Protocol (SNMP)		
SNMP State	Disabled (selected) / Enabled	
SNMP Enabled Traps	☑ Cold Start	
	☑ PTP Link Status Change	
	☑ DFS Channel Change	
	☑ DFS Impulse Interference	
	☐ Enabled Diagnostic Alarms	
SNMP Trap Version	v1 / v2c (selected)	
SNMP Trap IP Address	0 . 0 . 0 . 0	
SNMP Trap Port Number	162	
SNMP Community String	public	
SNMP Port Number	161	
Simple Mail Transfer Protocol (SMTP)		
SMTP Email Alert	Disabled (selected) / Enabled	
SMTP Enabled Messages	☑ PTP Link Status Change	
	☑ DFS Channel Change	
	☑ DFS Impulse Interference	
	☐ Enabled Diagnostic Alarms	
SMTP Server IP Address	0 . 0 . 0 . 0	
SMTP Server Port Number	25	
SMTP Source Email Address		
SMTP Destination Email Address		
Send SMTP Test Email	☐ Yes	
Clock		
SNTP State	Disabled (selected) / Enabled	
Set Time	10 : 26 : 34	
Set Date	2008 / Dec / 4	
Time Zone	GMT 00.00	
Daylight Saving	Disabled (selected) / Enabled	

Submit Updated Configuration | Reset Form

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 97.

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.

NOTE: 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.

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)

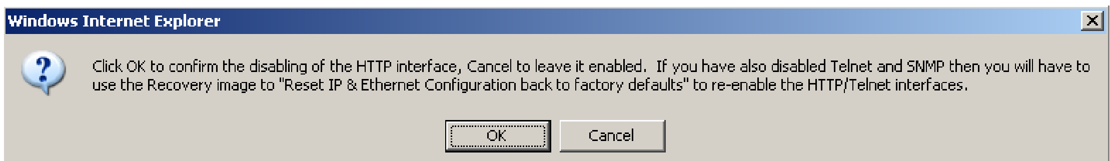
The PTP 600 Series Bridge SNMP stack currently supports the following MIBs:

- 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

SNMP TRAPs supported:

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

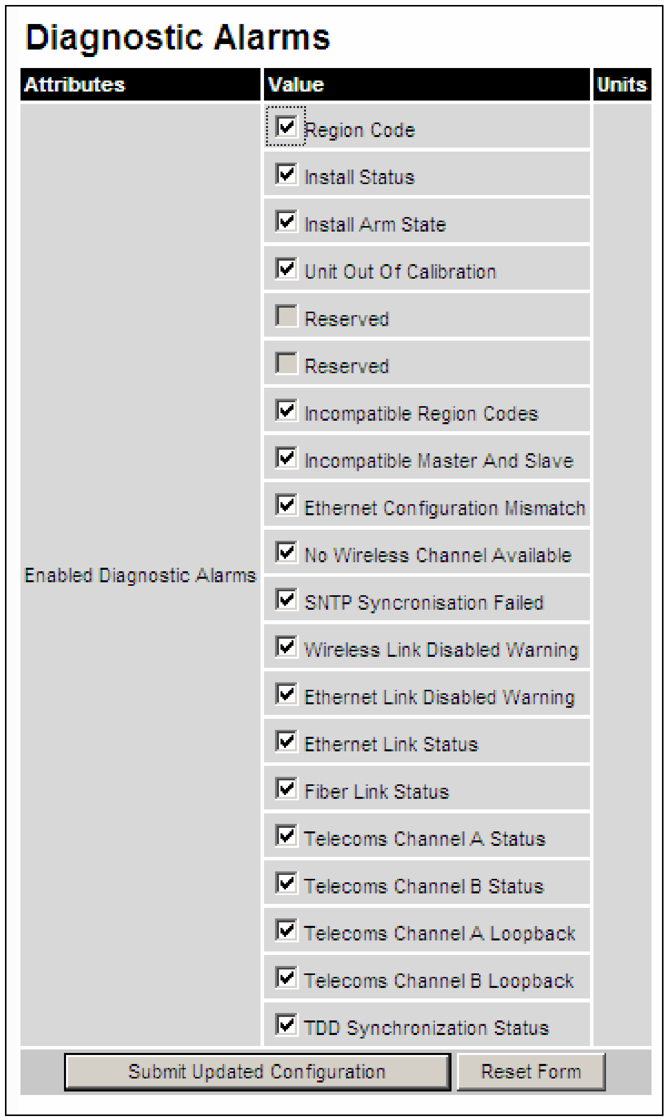
Figure 97 – Warning when disabling HTTP interface



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 98. Users can access the sub-menu “Diagnostic Alarms” to modify the alarms selected.

Figure 98 - 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 96, 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:

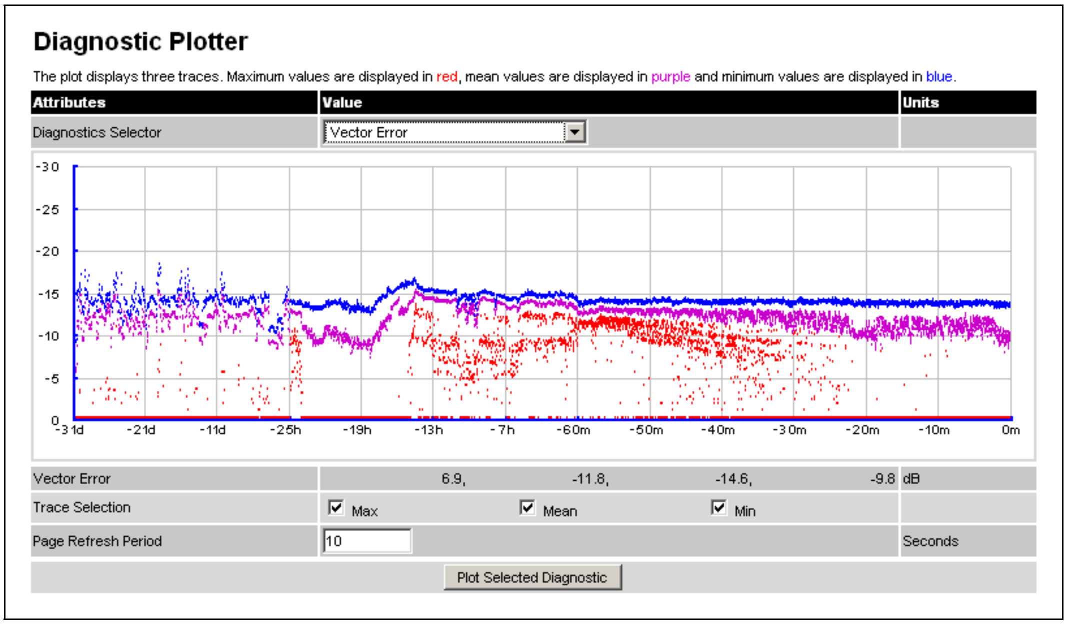
- Histogram 1: 1 hour at a resolution of 1 second
- Histogram 2: 24 hours at a resolution of 1 minute
- Histogram 3: 30 Days at a resolution of 1 hour

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 99.

Figure 99 - 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.

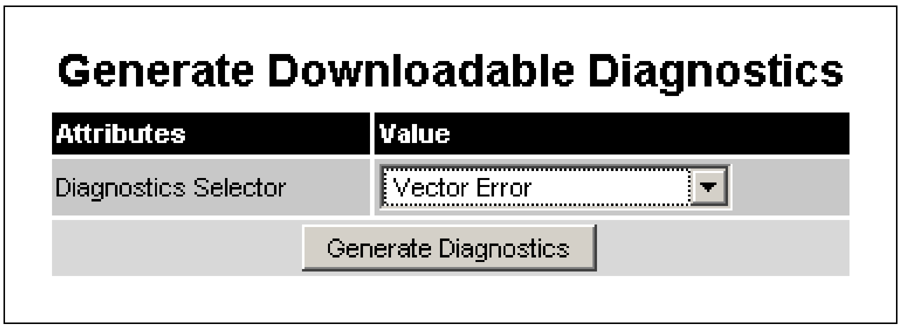
The trace selection allows the user to control which traces are plotted.

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 100 - CSV Download



The following diagnostics are available:

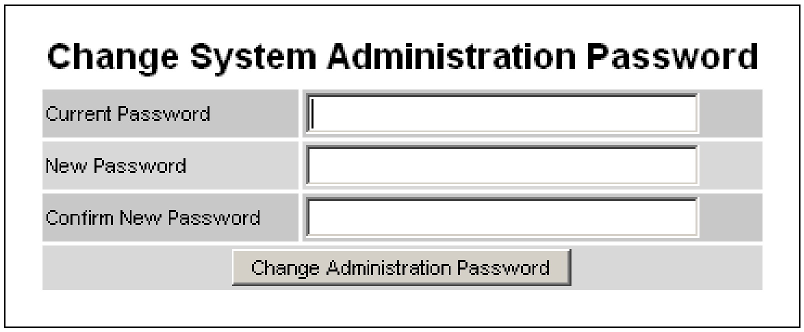
- Vector Error
- Rx Power
- Tx Power
- Signal Strength Ratio V/H
- Link Loss
- Rx Data Rate
- Tx Data Rate
- Aggregate Data Rate
- Receive SNR
- Rx Gain

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 101) is used to change the password for the system administration (The factory default is blank).

Figure 101 - Password Change

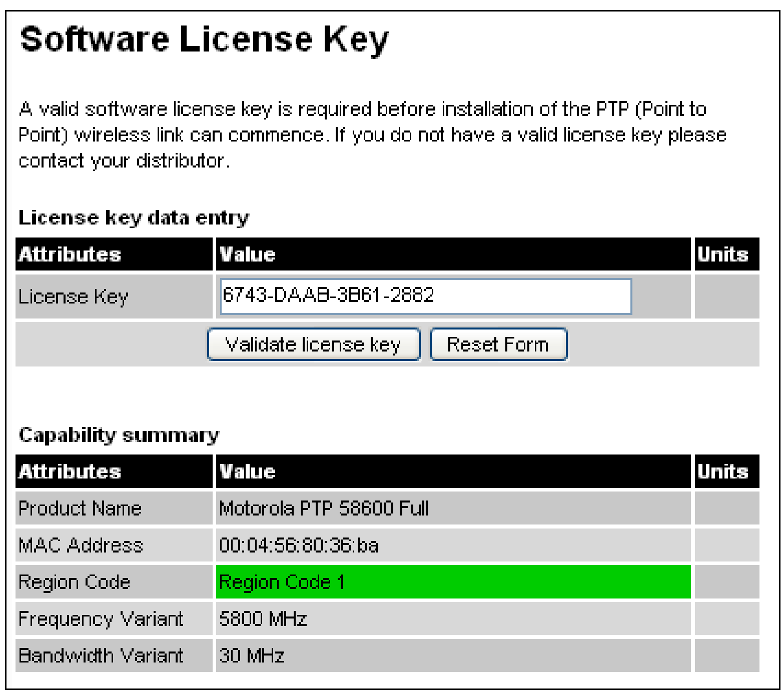


The password may contain any combination of characters, up to 31 characters in length.

8.3.14 License Key

The License Key data entry page allows the system administrator to update the 600 Series bridge license key. Figure 102 shows a sample license key data entry page.

Figure 102 - Software License Key Data Entry



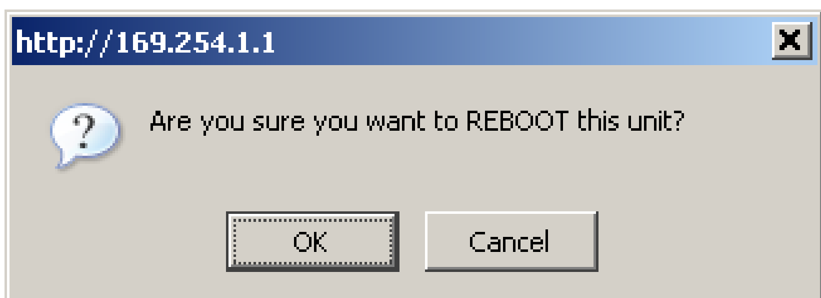
The user must enter the license key and click the 'Validate License Key' button to check that the key is valid and program it to non-volatile memory.

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

Figure 103: License Key reboot Screen

The user will then be asked to confirm the reboot (Figure 104).

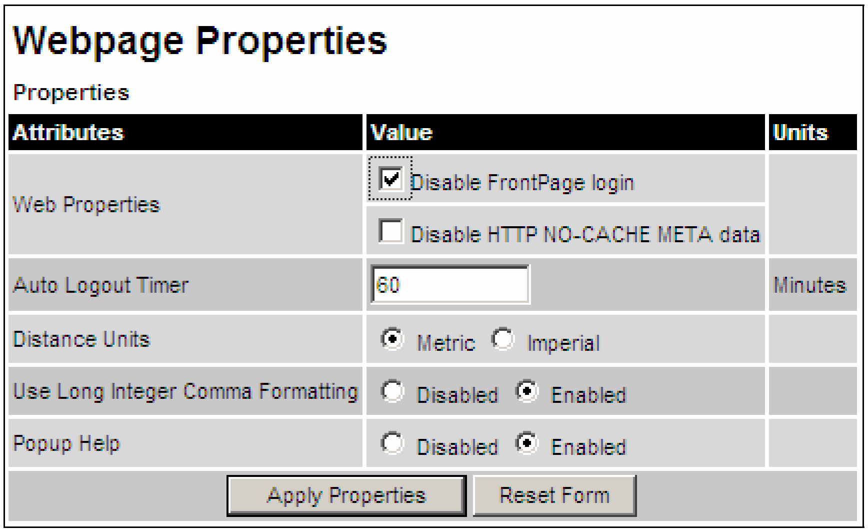
Figure 104 - Reboot Confirmation Pop Up



8.3.15 Properties

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

Figure 105 – 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 106 - System Reboot

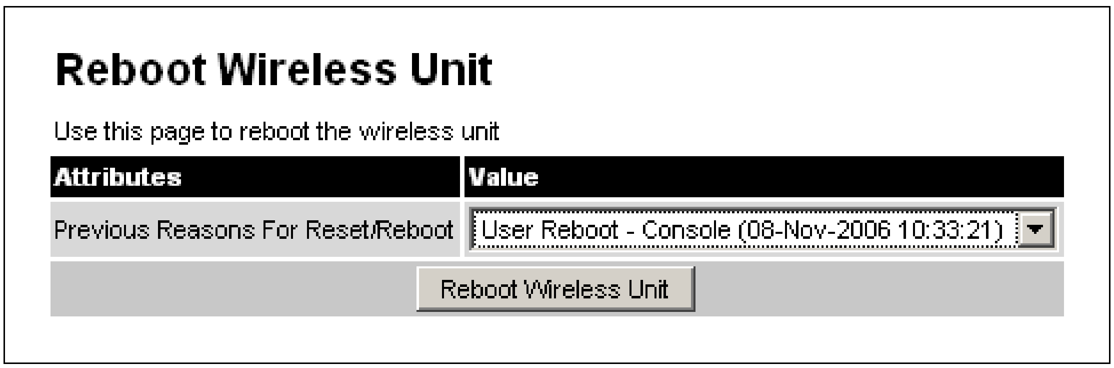
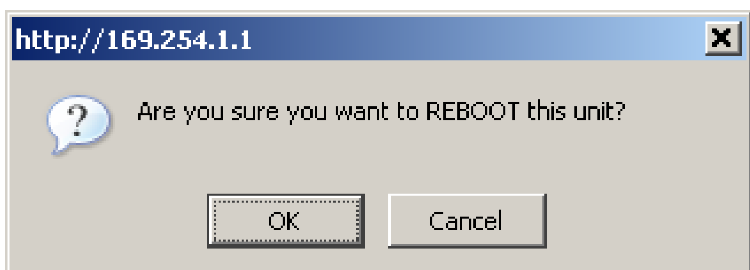


Figure 107 - Reboot Confirmation Pop Up



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.

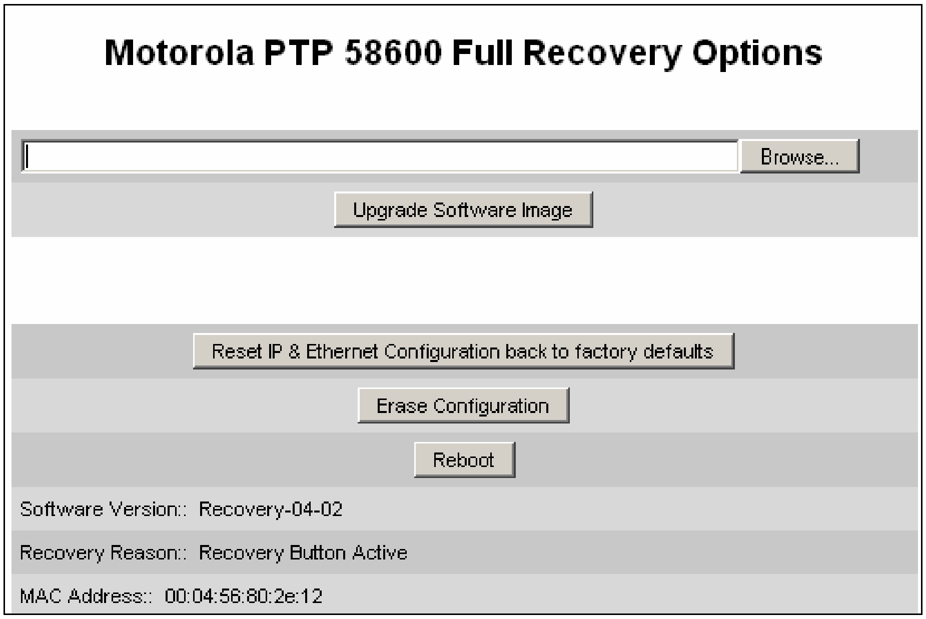
Recovery mode is entered by depressing the Recovery Switch located on the underside of the PIDU Plus while applying mains power, as shown in Section 3.3.2 "PIDU Plus – PTP 600 Series Bridge" The Recovery Switch should be held in the depressed state for between 10 and 20 seconds after the application 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 108):

Figure 108 - Recovery Mode Warning Page

Clicking on the warning page image will take the user on to the Recovery Option Page (Figure 109).

Figure 109 - 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”

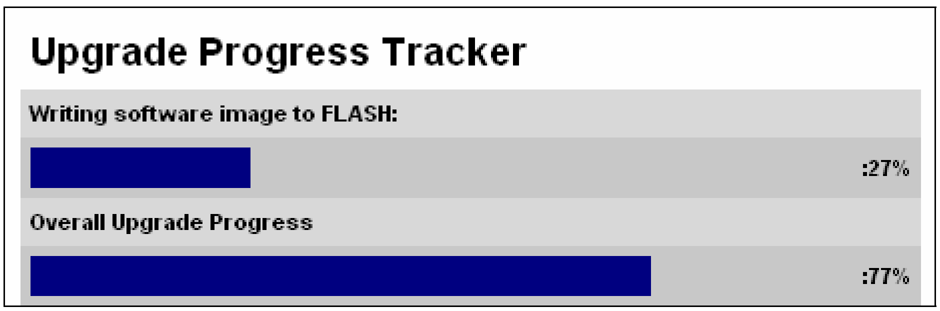
MAC Address: The MAC address shown here is the MAC address of the unit programmed during manufacture.

9.1 Upgrade Software Image

The first step (Figure 109) 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.

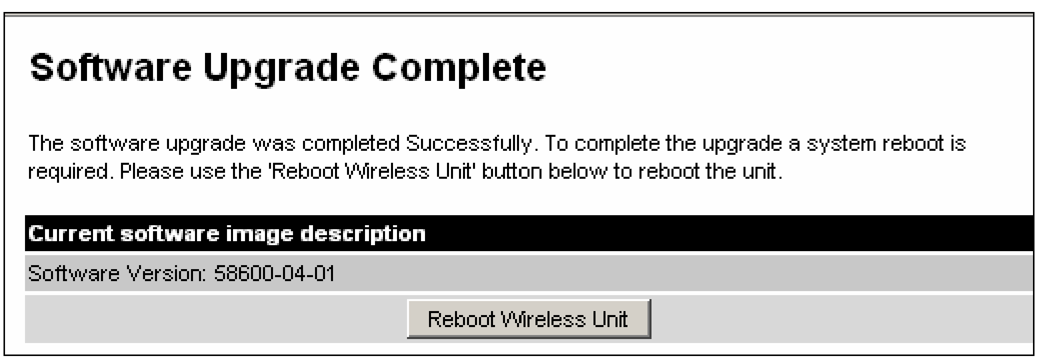
During software download, progress is indicated by a pair of progress bars (Figure 110).

Figure 110 - Software Download Progress Indicator Page



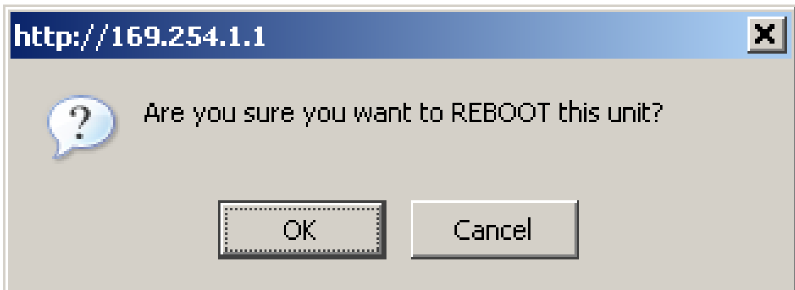
When the download is complete a page is displayed indicating the status of the software download (Figure 111).

Figure 111 - 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 112).

Figure 112 - 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 11 “ (Fault Finding”.

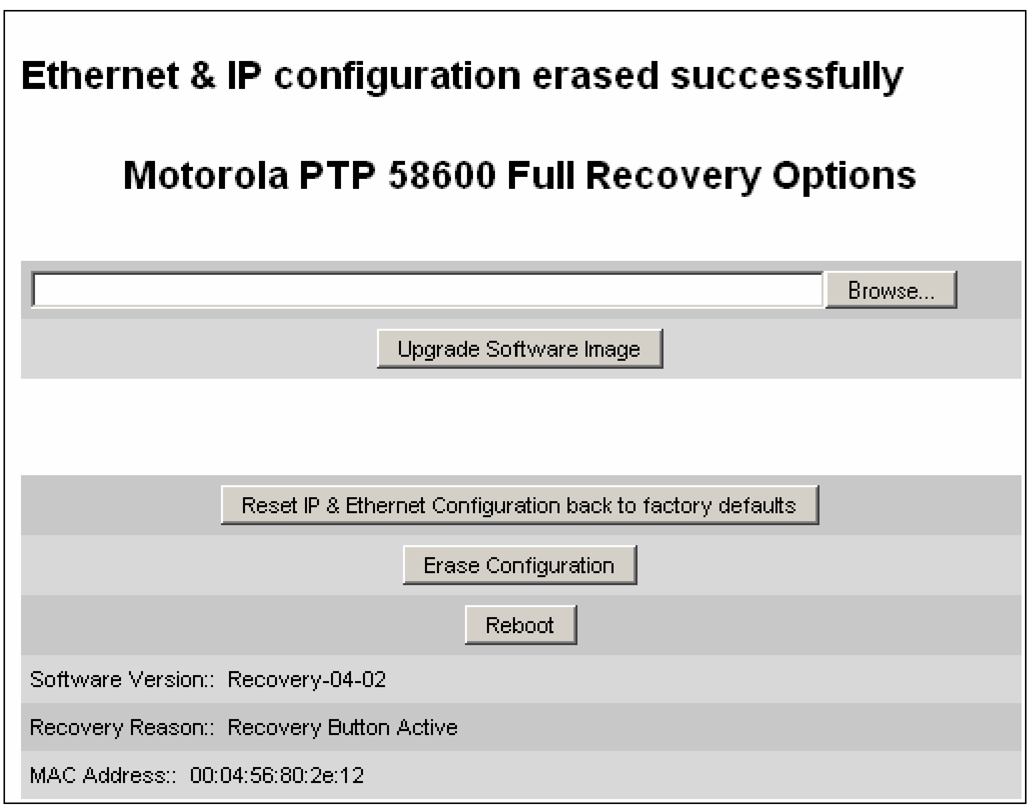
9.2 Reset IP & Ethernet Configuration

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 109). The user will now be presented with a pop up box asking them to confirm the action (Figure 113).

Figure 113 - Confirm Reset to Factory Default Pop Up

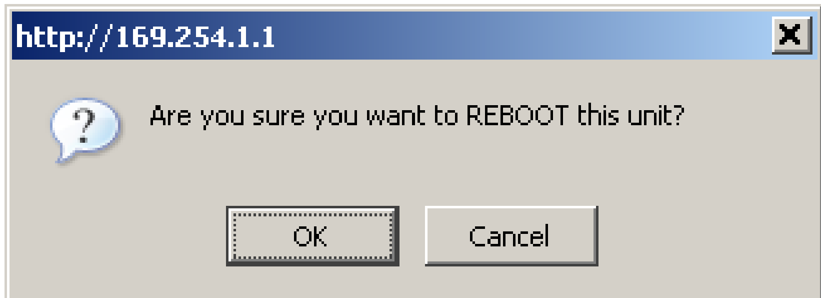
On confirmation the following page will be displayed (Figure 114). The user should now reboot the unit by pressing the “Reboot” button.

Figure 114 - IP and Ethernet Erased Successfully page



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

Figure 115 - Reboot Confirmation Pop Up

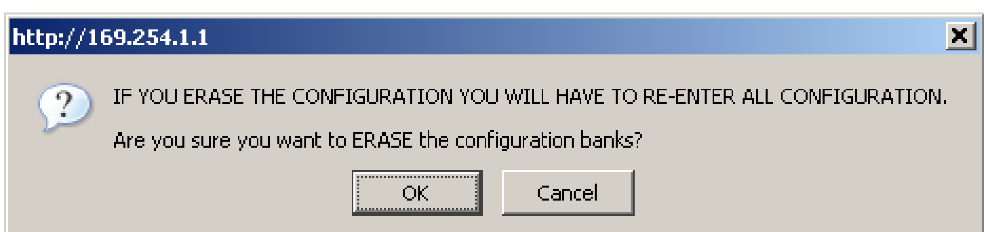


The unit will now reboot. The unit should now start up in normal mode but with the IP address set to 169.254.1.1 and the Ethernet interface set to auto-negotiate and auto-MDI/MDIX. Should the unit fail to start up the user should refer to Section 11 " (Fault Finding".

9.3 Erase Configuration

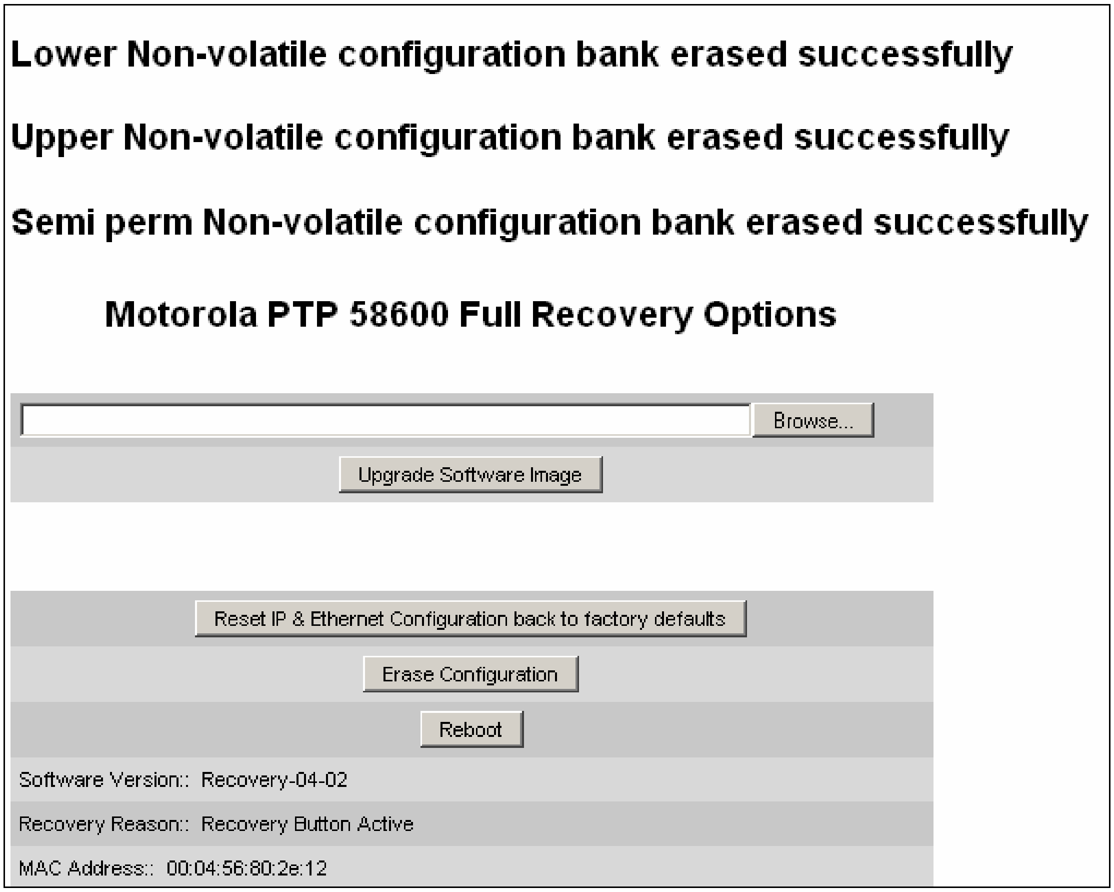
To erase the unit's configuration the user should press the "Erase Configuration" button on the "Recovery Options" page (Figure 109). The user will now be presented with a pop up box asking them to confirm the action (Figure 116).

Figure 116 - Confirm Erase Configuration Pop Up



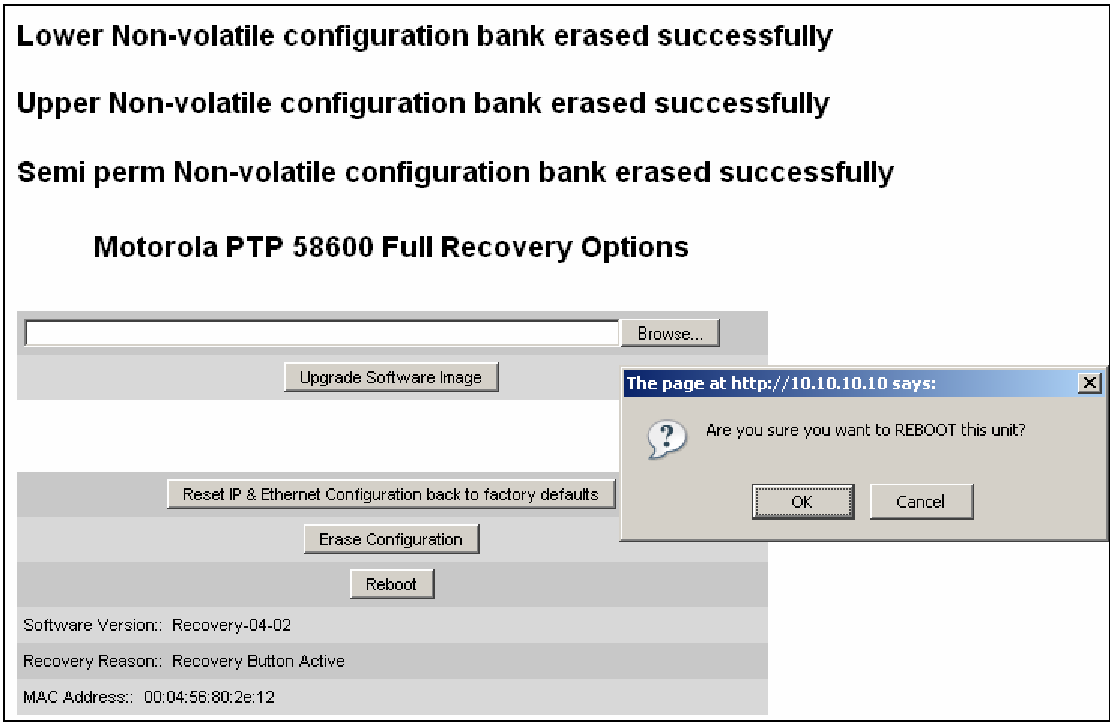
On confirmation the following page will be displayed (Figure 117). The user should now reboot the unit by pressing the “Reboot” button.

Figure 117 - Erase Configuration Successful Page



The user will now be presented with a pop up box asking them to confirm the action (Figure 118)

Figure 118 – Erase Configuration - Reboot Confirmation Pop Up

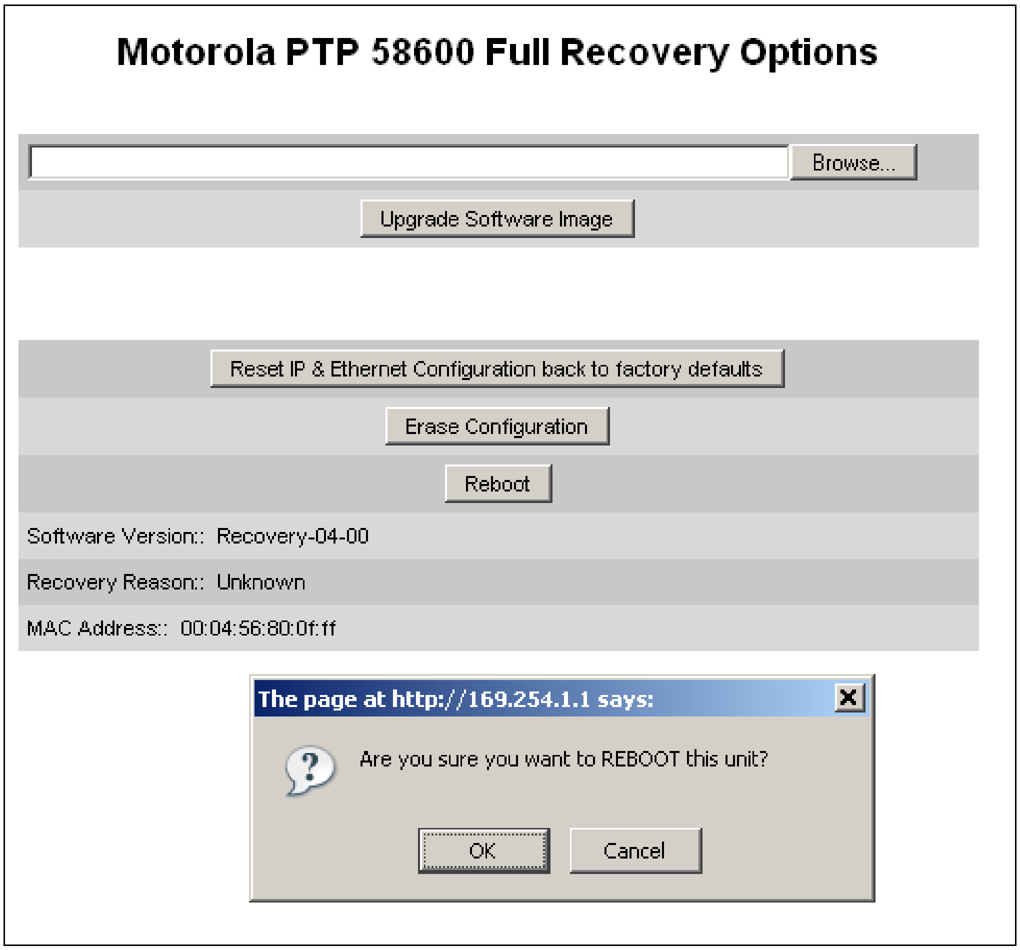


The unit will now reboot. The unit should now start up in normal mode but with all configuration erased. Should the unit fail to start up the user should refer to Section 11 “(Fault Finding”.

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 119).

Figure 119 – 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 11 “Troubleshooting (Fault Finding)”.

10 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.

10.1 Overview

The purpose 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.

10.1.1 Lightning Protection Zones

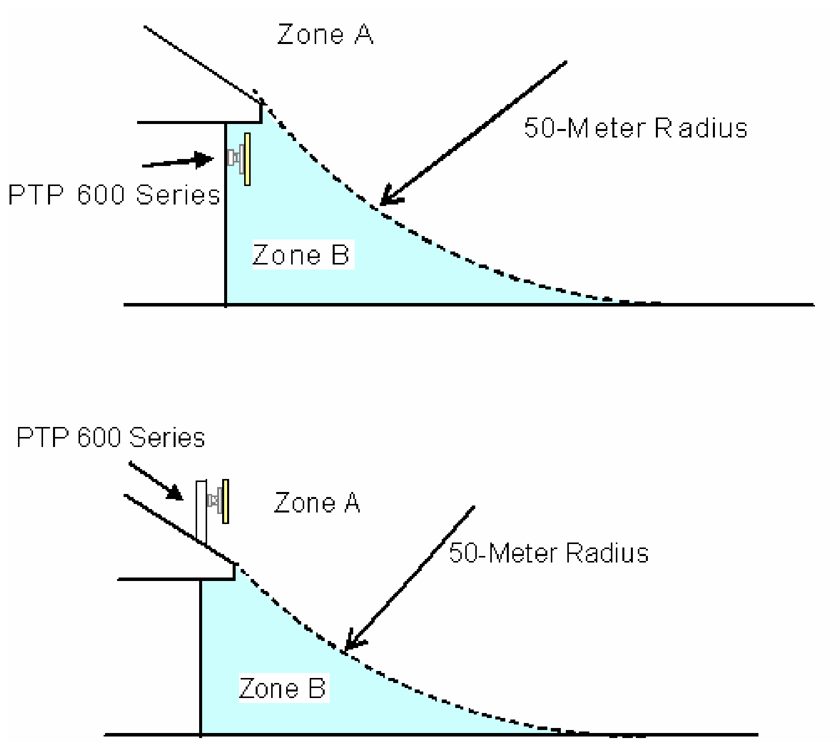
When the ODU is installed on a mast, tower or wall, it may be in one of two possible lightning protection zones :

- Zone A: In this zone a direct lighting strike is possible. Do not mount the ODU in this zone.
- Zone B: In this zone, direct EMD (Lightning) effects are still possible, but mounting in this zone significantly reduces the possibility of a direct strike. Mount the ODU in this zone.

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 indicate the zone (A) where a direct strike is possible. Similarly points that do not contact the sphere indicate a zone (B) where a direct strike is less likely.

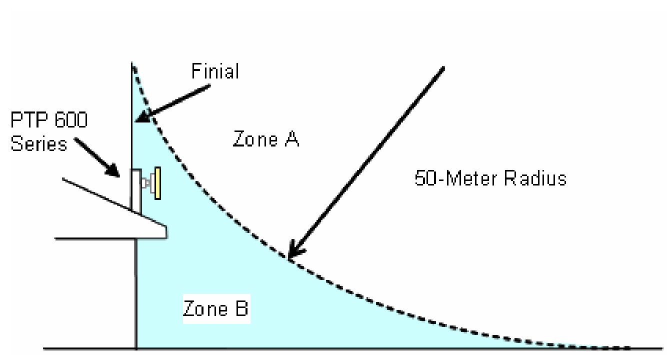
Zones A and B are shown in Figure 120.

Figure 120 - ODU mounted in Zones A & B



It may be possible to extend Zone B by installing a finial above the ODU (Figure 121).

Figure 121 – Using a Finial to extend Zone B



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

NOTE: Local regulations may also require the fitting of the 8 AWG grounding wire.

WARNING: Equipment mounted in Zone A must 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. Failure to do so may put structures, equipment and life at risk.

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.

The following protection requirements are mandatory in both Zones A and B:

- The ODU must be earthed
- Screened CAT 5e cable must be used
- Surge arrestors of type PTP-LPU must be installed at both the ODU and building entry
- There must be an earth connection at building entry

The recommended standard components for protecting installations are listed in 10.4 “LPU Recommended Configurations”.

10.2 Detailed Installation

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 122 and Figure 123.

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

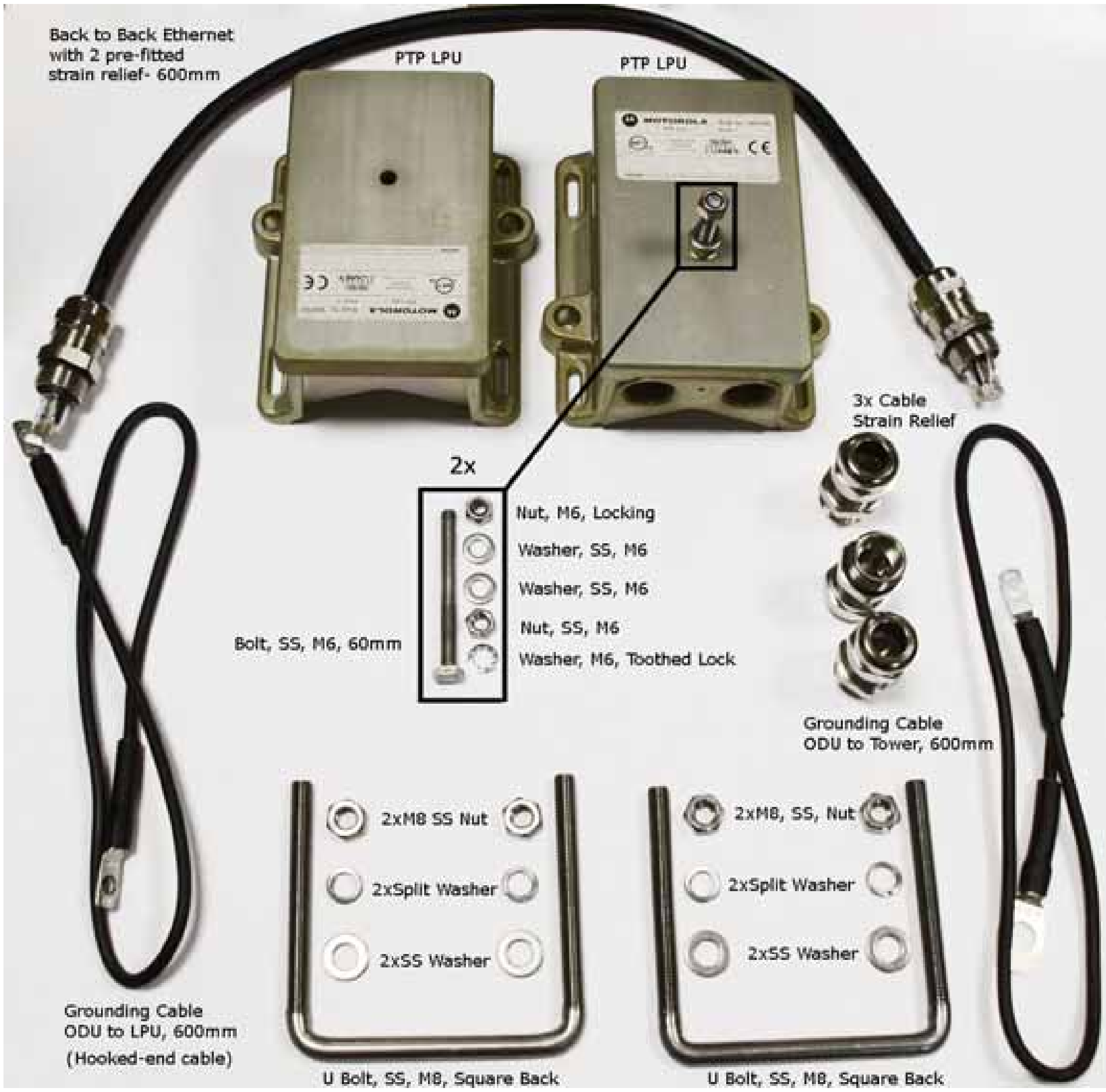
Figure 122 – Example of PTP-LPU Configuration – Option 1 (Back-to-Back Recommended)

Figure 123 - 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 124 shows all the components that are supplied with the Motorola Kit WB2907AA.

Figure 124 - PTP LPU Full Kit

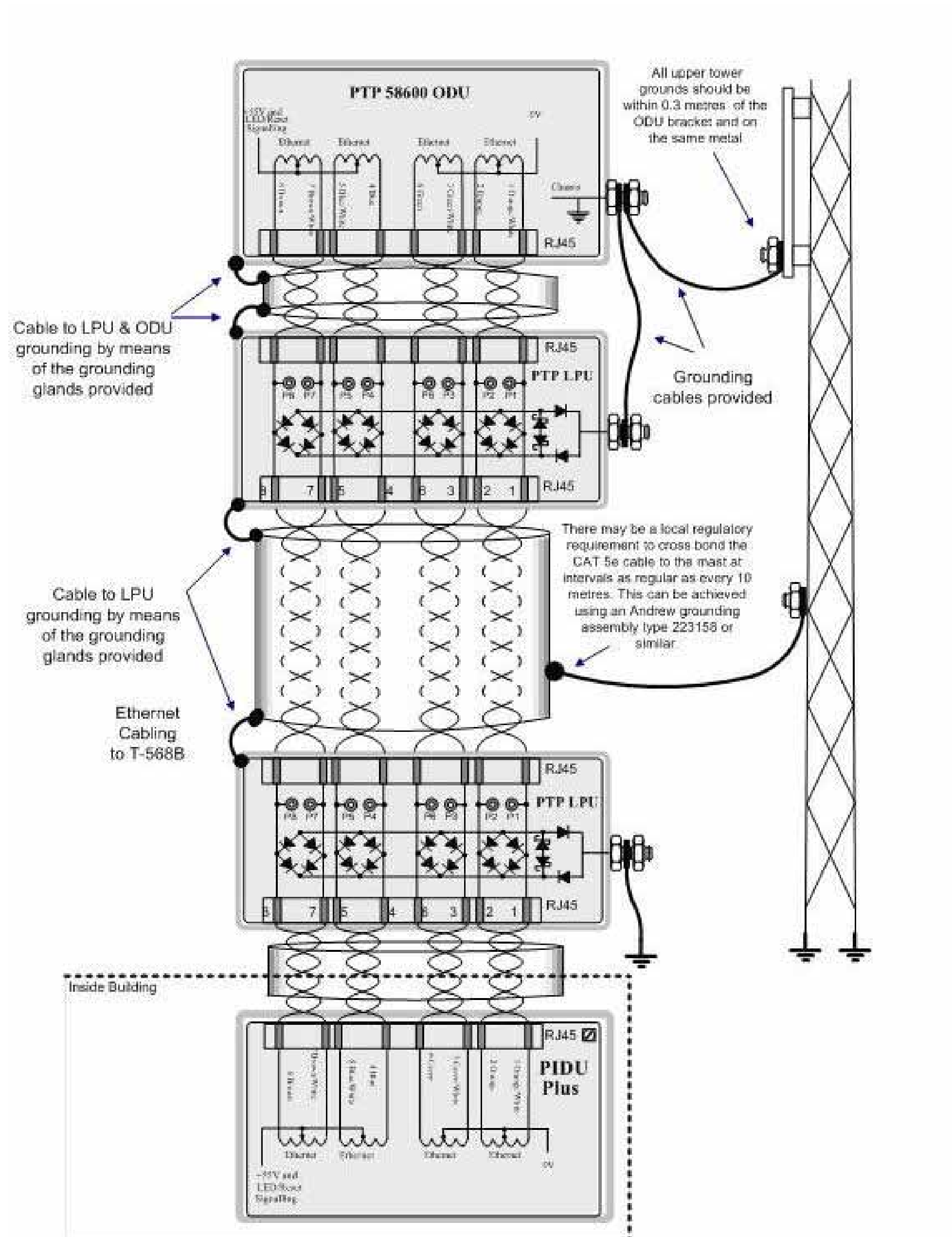


The cable between the two lightning protection units (top and bottom) should be of the type recommended by Motorola (Section 3.3.5 “Cables and connectors”) and terminated as shown in Figure 41.

10.3 Installation Wiring

Figure 125 shows the correct installation wiring for a PTP 600 with lightning protection.

Figure 125 - Simplified Circuit Diagram



10.4 LPU Recommended Configurations

This section contains diagrams to show how the components of PTP 600 sites are installed and connected. The diagrams cover the following configurations:

- Typical mast or tower installation
- Typical wall installation
- Mast or tower installation with E1/T1
- Wall installation with E1/T1
- Mast or tower installation with GPS Sync Box
- Wall installation with GPS Sync Box
- Mast or tower installation with GPS Sync Box and E1/T1
- Wall installation with GPS Sync Box and E1/T1

The recommended standard components for protecting installations are:

- Screened CAT 5e cable, also known as Shielded CAT 5e or CAT 5e STP (Shielded Twisted Pair)
- Surge arrestor, type PTP-LPU: 4 or 8 per link (2 or 4 Motorola Kits Part Number WB2907AA)
- Grounding stake
- Grounding cable: minimum size 8 AWG, preferably 6 or 4 AWG
- RJ45 screened connectors

There may be a local regulatory requirement to cross bond the CAT 5e cable to the mast or tower at intervals as regular as every 10 metres (33 feet). This can be achieved using an Andrew grounding assembly type 223158 or similar.

Where an installation already has, or requires the use of a Master Ground Bar then the requirements of Motorola Specification R56 "STANDARDS AND GUIDELINES FOR COMMUNICATION SITES" (68P81089E50) take precedence over those in this guide.

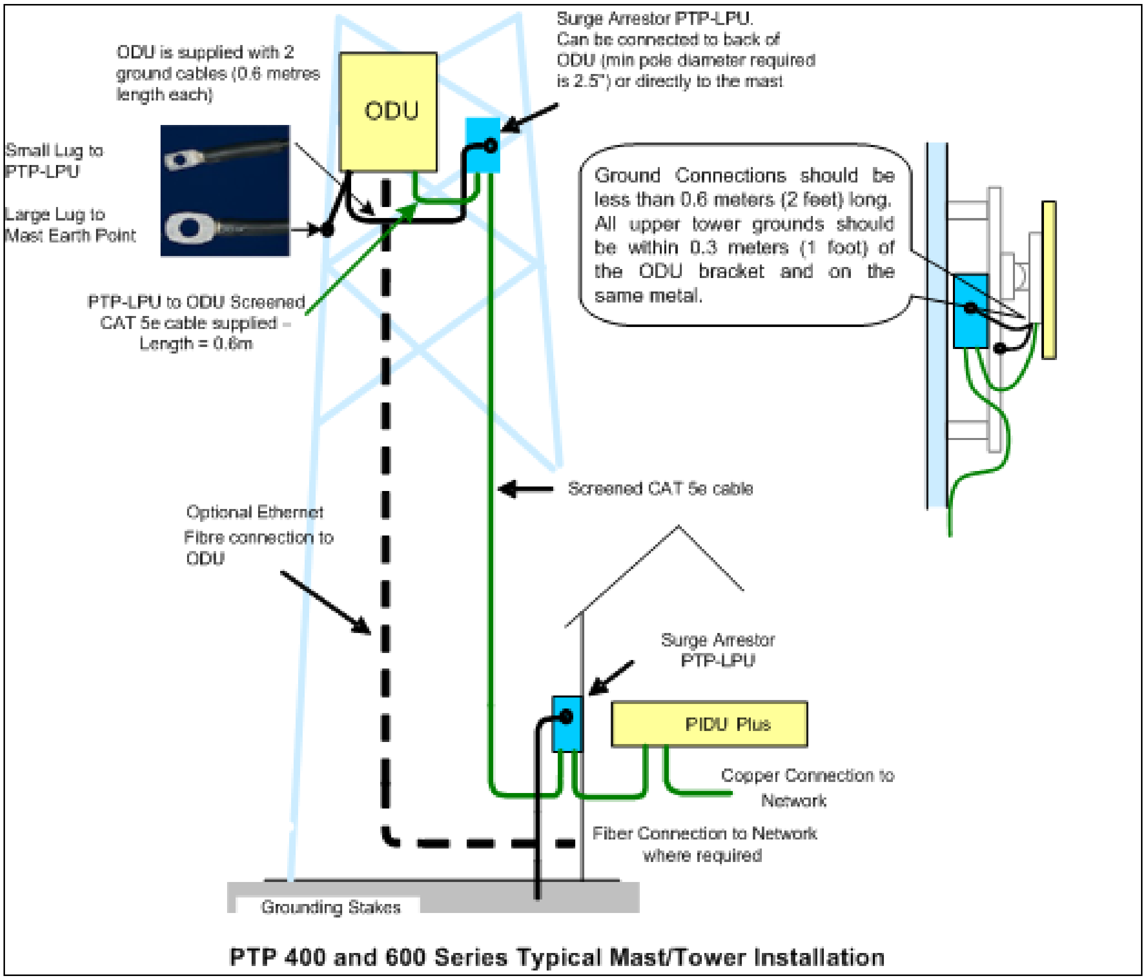
NOTE: If a coaxial (or other) cable is already cross-bonded to the mast or tower, the same cross bonding points on the mast or tower must be used for the CAT 5e cable.

Additional components are listed under each diagram where required. The recommended cables are specified in Section 3.3.5 “Cables and connectors”.

10.4.1 Typical Mast or Tower Installation

Figure 126 shows a typical PTP 600 Series Mast or Tower installation using PTP-LPU Surge protection for a configuration without a GPS Sync box or E1/T1 ports.

Figure 126 - Typical Mast or Tower Installation

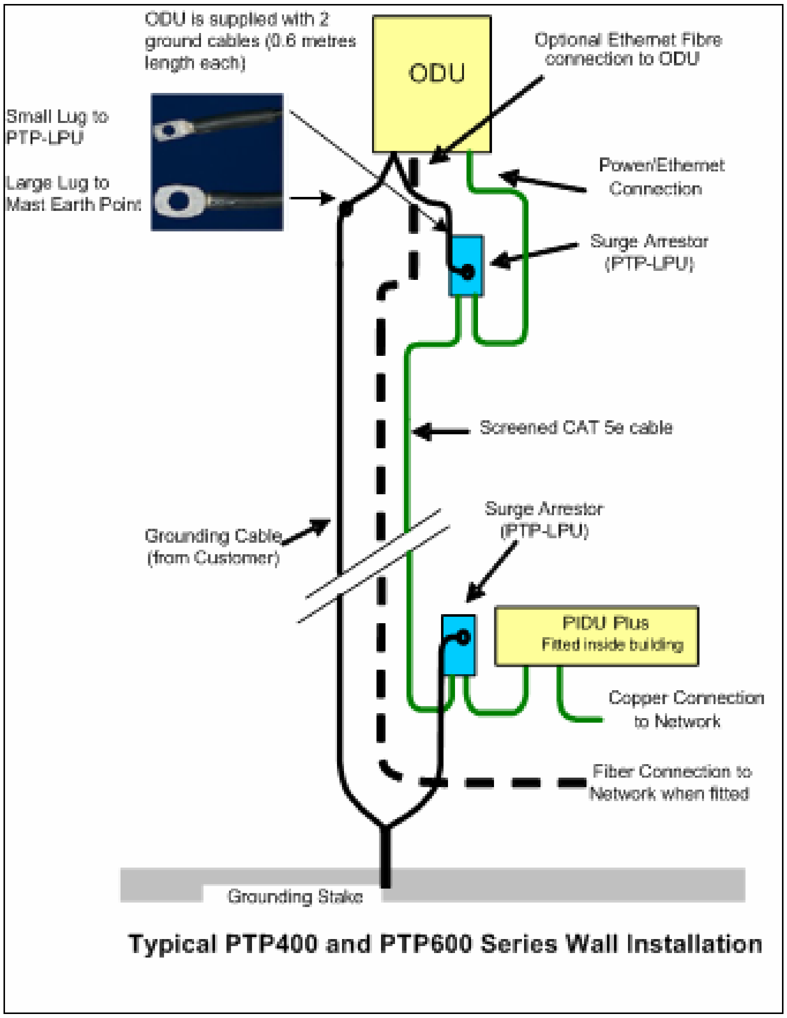


The recommended standard components for this installation are listed in 10.4 "LPU Recommended Configurations". This installation requires 4 Motorola PTP-LPU Surge Arrestors (2 kits).

10.4.2 Typical Wall Installation

Figure 127 shows a typical PTP 600 Series Wall installation using PTP-LPU Surge protection for a configuration without a GPS Sync box or E1/T1 ports.

Figure 127 - Typical Wall Installation

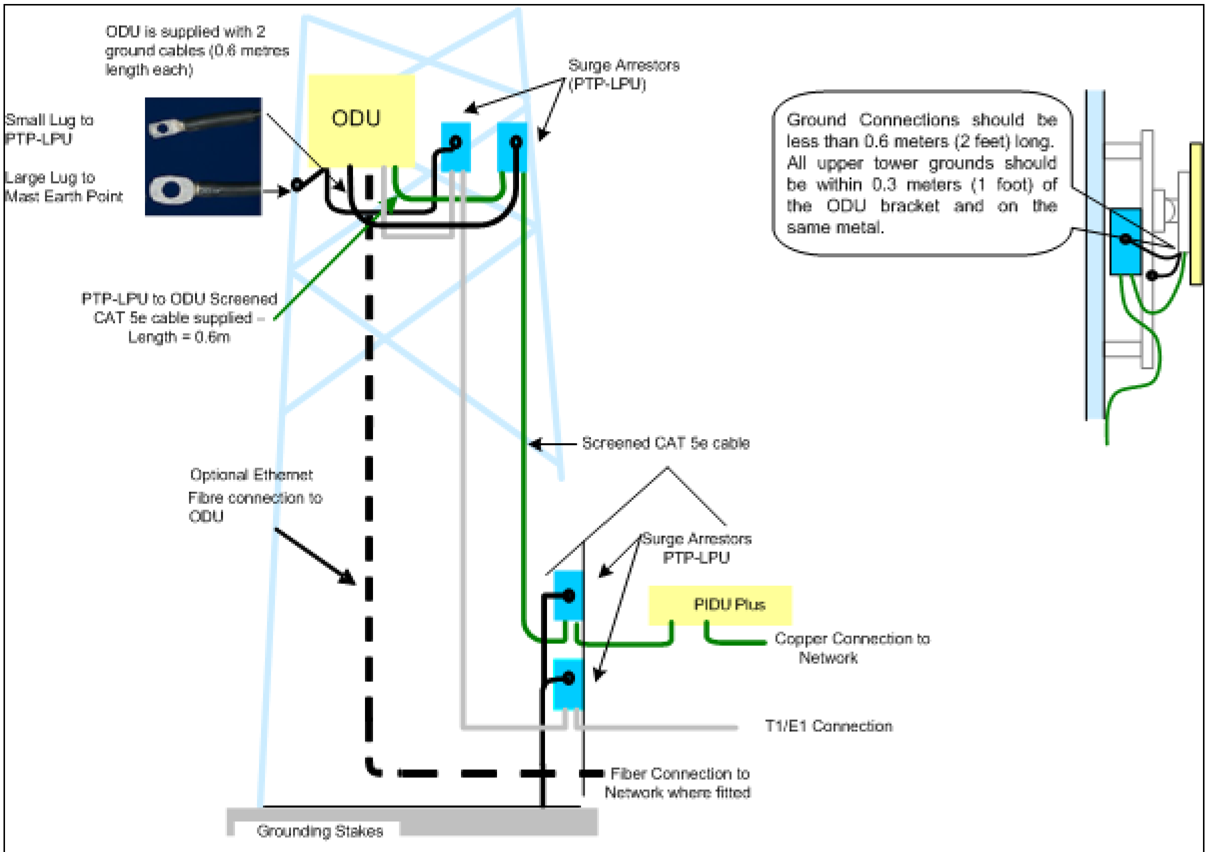


The recommended standard components for this installation are listed in 10.4 "LPU Recommended Configurations". This installation requires 4 Motorola PTP-LPU Surge Arrestors (2 kits).

10.4.3 Mast or Tower Installation with E1/T1

Figure 128 shows a typical PTP 600 Series Mast or Tower installation using PTP-LPU Surge protection for a configuration that includes E1/T1 ports.

Figure 128 – Mast or Tower Installation with E1/T1



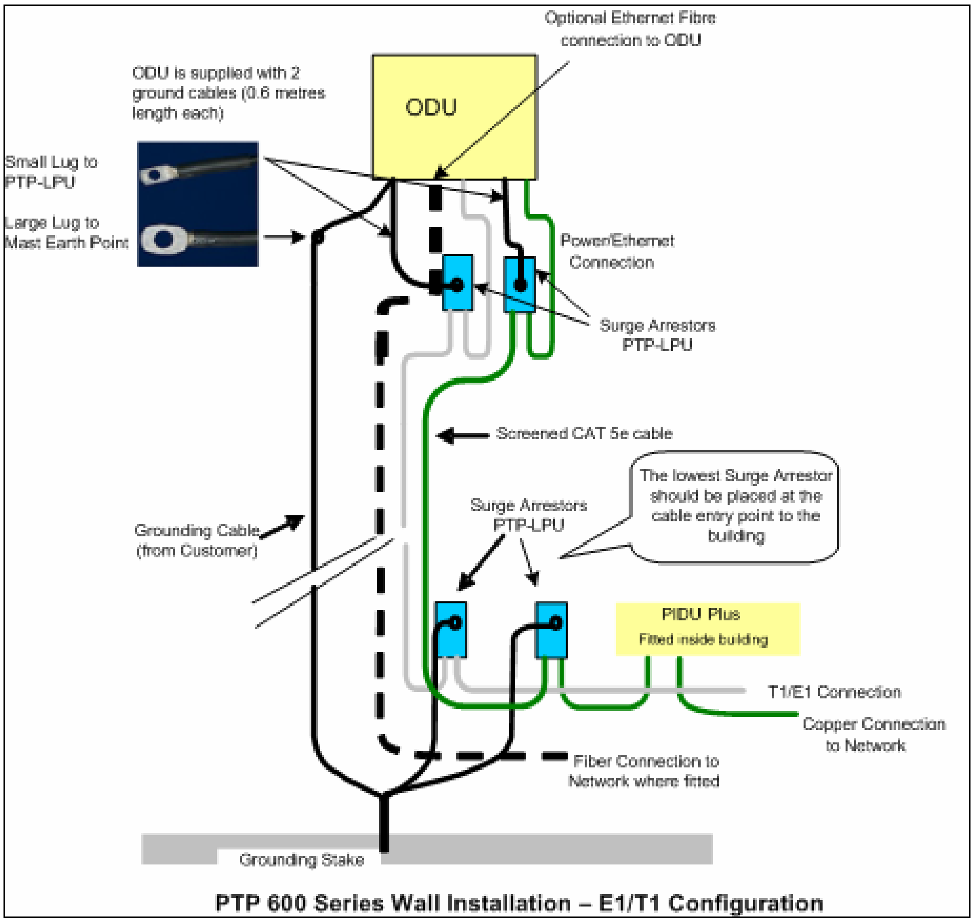
PTP600 Mast/Tower Installation – E1/T1 Configuration

The recommended standard components for this installation are listed in 10.4 "LPU Recommended Configurations". This installation requires 8 Motorola PTP-LPU Surge Arrestors (4 kits).

10.4.4 Wall Installation with E1/T1

Figure 129 shows a PTP 600 Series Wall installation using PTP-LPU Surge protection for a configuration that includes E1/T1 ports.

Figure 129 - Wall Installation with E1/T1

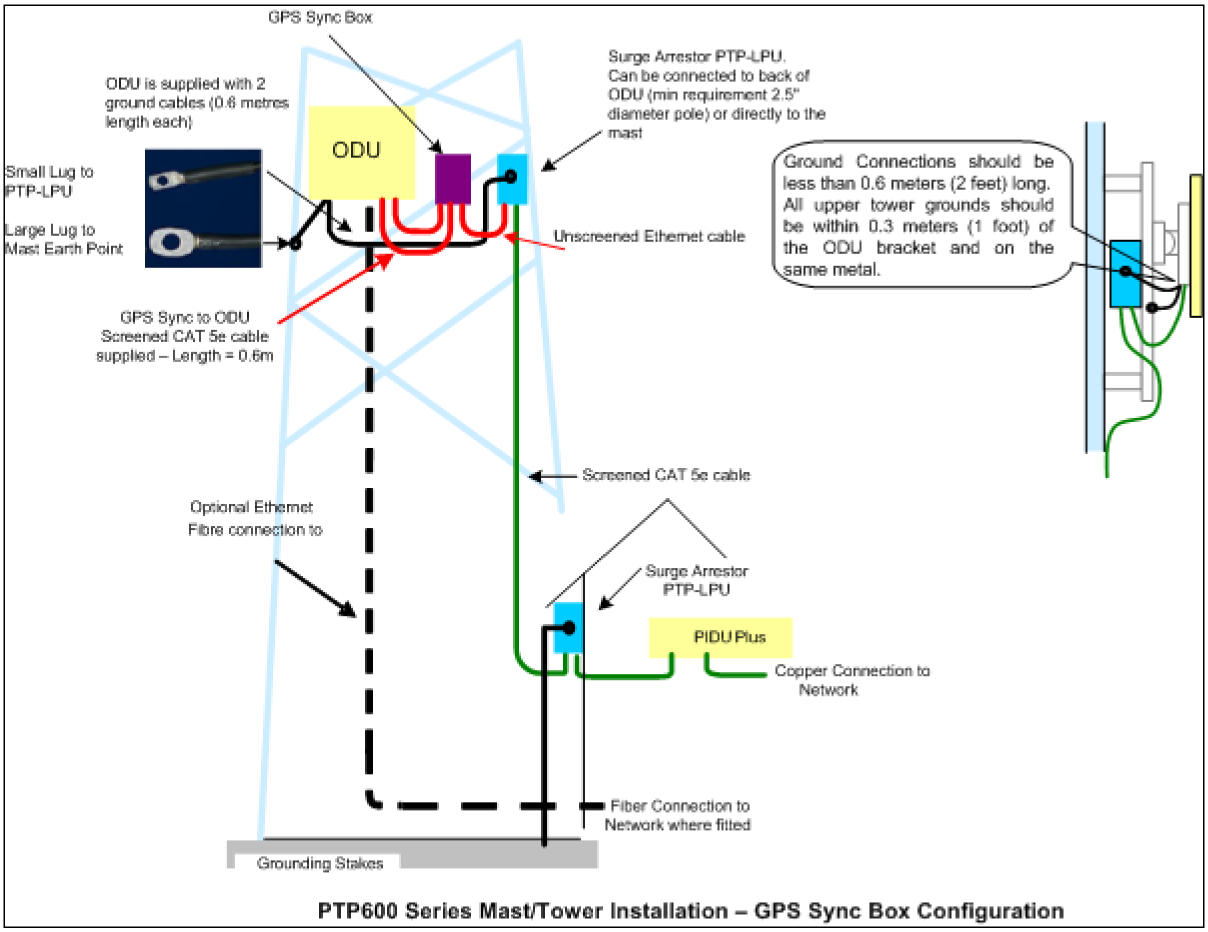


The recommended standard components for this installation are listed in 10.4 "LPU Recommended Configurations". This installation requires 8 Motorola PTP-LPU Surge Arrestors (4 kits).

10.4.5 Mast or Tower Installation with GPS Sync Box

Figure 130 shows a PTP 600 Series Mast or Tower installation using PTP-LPU Surge protection for a configuration that includes a GPS Sync box.

Figure 130 – Mast or Tower Installation with GPS Sync Box



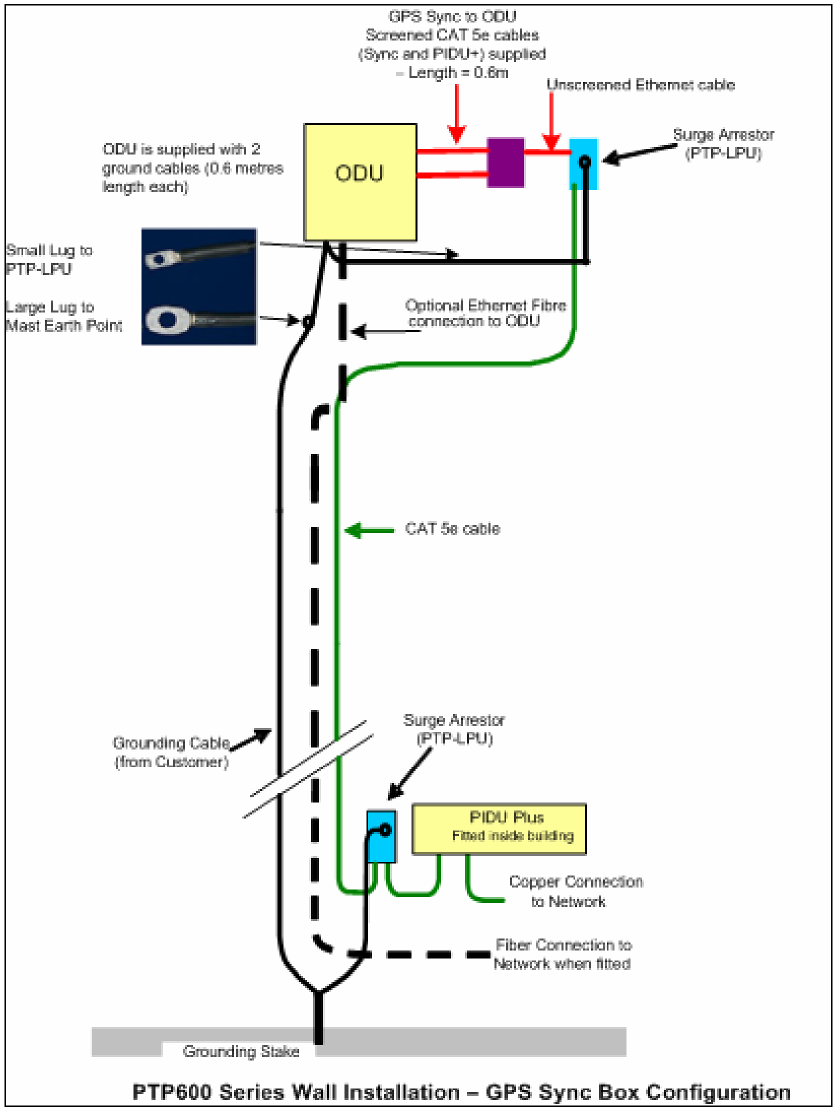
The recommended standard components for this installation are listed in 10.4 "LPU Recommended Configurations". This installation requires 4 Motorola PTP-LPU Surge Arrestors (2 kits).

This installation also requires: GPS Sync Box from MemoryLinkl – 1 per link (1 Motorola kit).

10.4.6 Wall Installation with GPS Sync Box

Figure 131 shows a PTP 600 Series Wall installation using PTP-LPU Surge protection for a configuration that includes a GPS Sync box.

Figure 131 –Wall Installation with GPS Sync Box



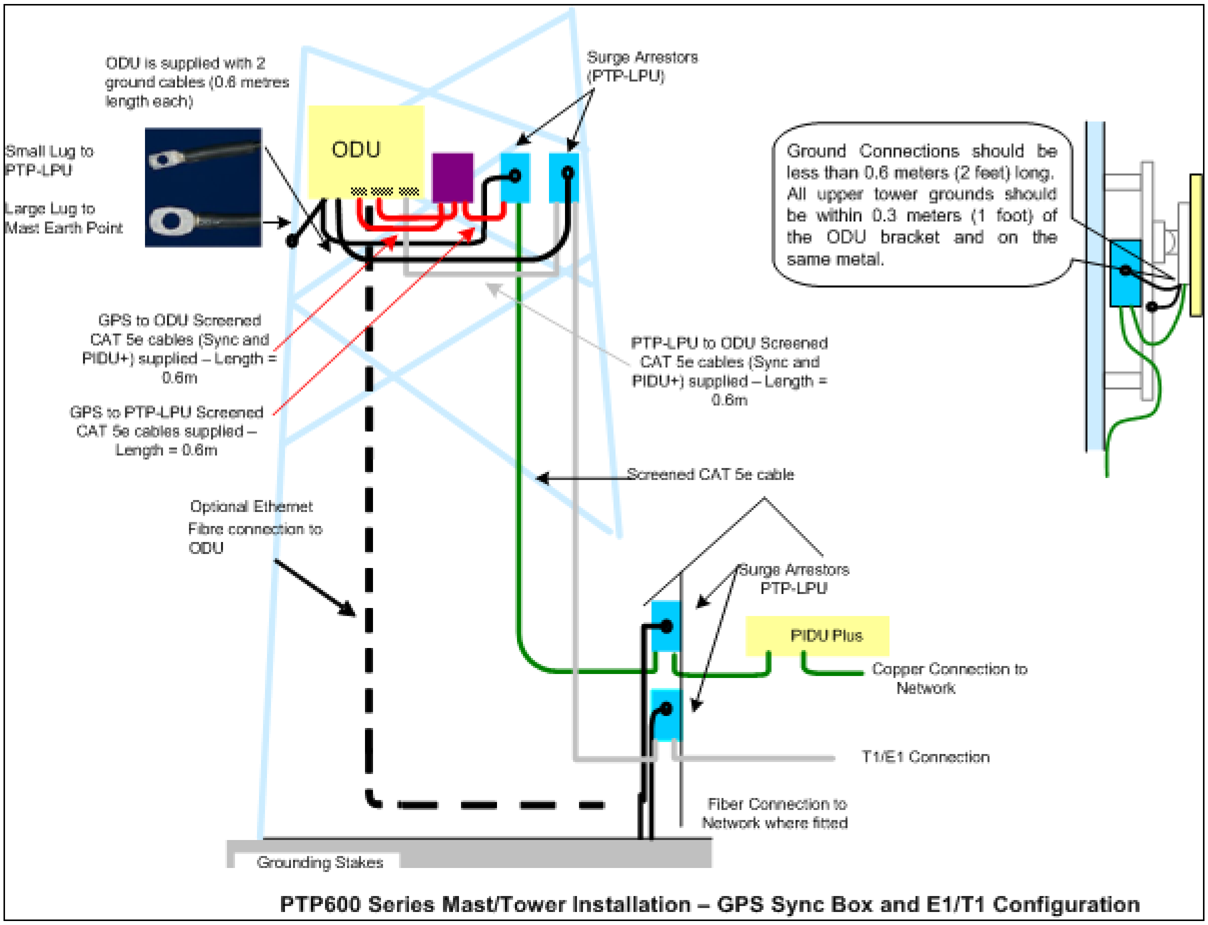
The recommended standard components for this installation are listed in 10.4 "LPU Recommended Configurations". This installation requires 4 Motorola PTP-LPU Surge Arrestors (2 kits).

This installation also requires: GPS Sync Box from MemoryLinkl – 1 per link (1 Motorola kit).

10.4.7 Mast or Tower Installation with GPS Sync Box and E1/T1

Figure 132 shows a PTP 600 Series Mast or Tower installation using PTP-LPU Surge protection for a configuration that includes a GPS Sync box and E1/T1 ports.

Figure 132 - Mast or Tower Installation with GPS Sync Box and E1/T1



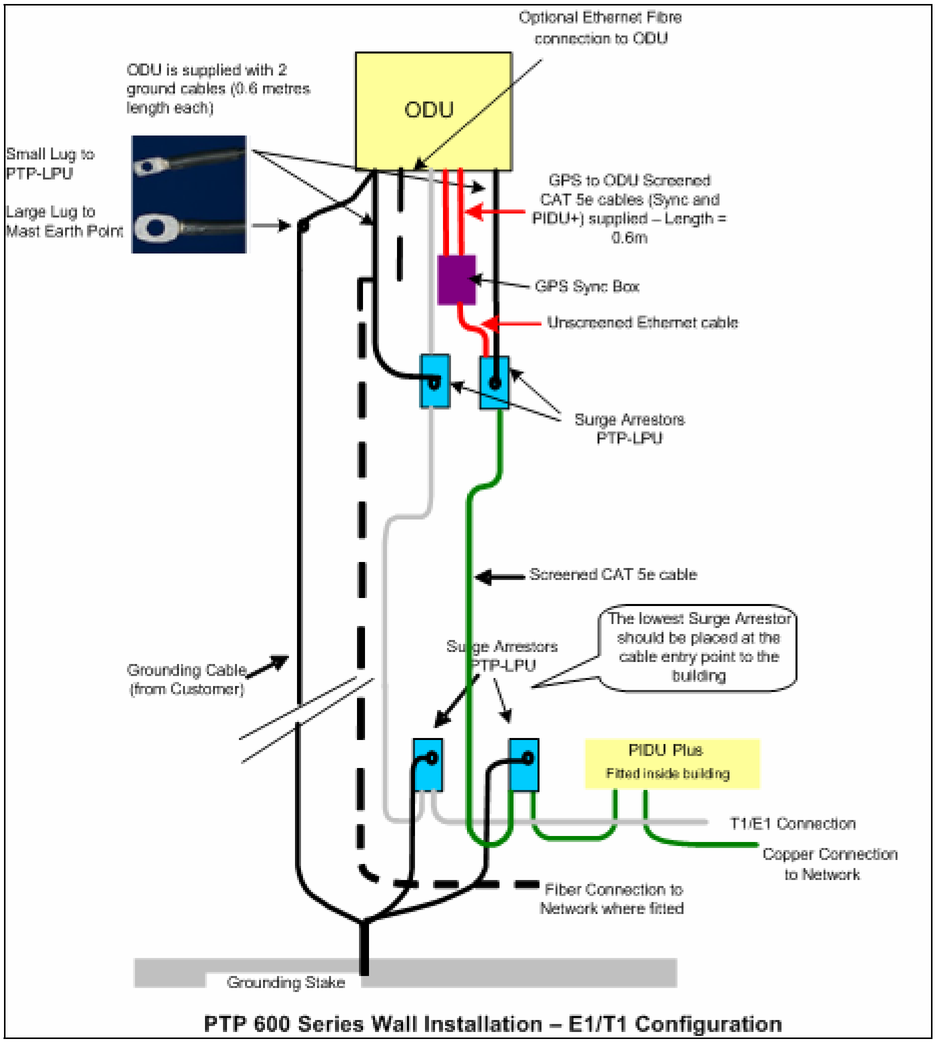
The recommended standard components for this installation are listed in 10.4 "LPU Recommended Configurations". This installation requires 8 Motorola PTP-LPU Surge Arrestors (4 kits).

This installation also requires: GPS Sync Box from MemoryLinkl – 1 per link (1 Motorola kit).

10.4.8 Wall Installation with GPS Sync Box and E1/T1

Figure 133 shows a PTP 600 Series Wall installation using PTP-LPU Surge protection for a configuration that includes a GPS Sync box and E1/T1 ports.

Figure 133 - Wall Installation with GPS Sync Box and E1/T1



The recommended standard components for this installation are listed in 10.4 "LPU Recommended Configurations". This installation requires 8 Motorola PTP-LPU Surge Arrestors (4 kits).

This installation also requires: GPS Sync Box from MemoryLinkl – 1 per link (1 Motorola kit).

11 Troubleshooting (Fault Finding)

Perform troubleshooting (fault finding) procedures either on a newly installed link, or on an operational link if communication is lost:

1. Test the hardware at one end of the link, as described in Section 11.1 “Test Link End Hardware”.

2. Test the hardware at the other end of the link, as described in Section 11.1 “Test Link End Hardware”.

3. Test the radio link, as described in Section 11.2 ”Test Radio Link”.

4. If an installation has been struck by lightning, see Section 11.3 “Lightning Strike”.

11.1 Test Link End Hardware

When the link end hardware (PIDU, LPU, ODU and cabling) has been installed, start it by following this procedure:

1. Connect the RJ45 from the ODU (or LPU if fitted) to the PIDU and apply mains or battery power to the PIDU. The green Power LED should illuminate continuously.

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

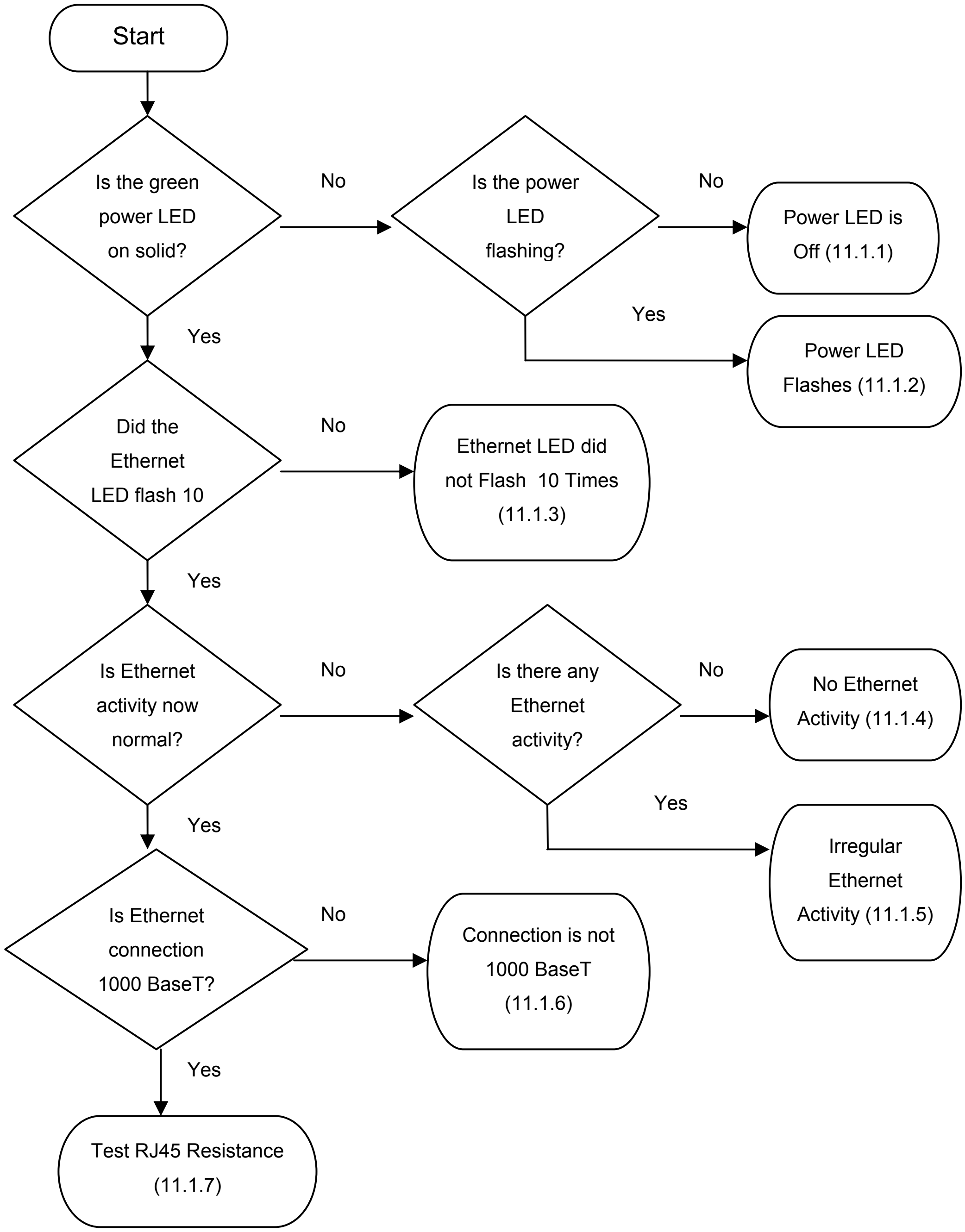
3. Connect the RJ45 from the LAN port of the PIDU to the network. The yellow Ethernet LED should blink randomly as traffic passes through.

If the Power and Ethernet LEDs do not illuminate correctly, test the link end as described in the flowchart (Figure 134).

NOTE: The flowchart contains references to the detailed test procedures in Sections 11.1.1 to 11.1.7.

If a GPS synchronization unit has been installed, but one or more of its status LEDs are not illuminated, refer to Section 11.1.8 “Test GPS Synchronization Unit”.

Figure 134 – Link End Hardware Test Flowchart



11.1.1 Power LED is Off

If the green Power LED does not light up at all, perform the following tests:

1. Remove the power lead from the PIDU and test that the power source (mains or 56 V battery) is working.

2. If the main or battery power supply is working, open the flap on the left hand side of the PIDU and remove the RJ45 ODU cable from the PIDU.

3. If the Power LED does not illuminate when the RJ45 ODU cable is removed:
   i. Measure the voltage across the +55 V and 0 V pads inside the PIDU flap. An incorrect reading indicates that the PIDU is short-circuited.
   ii. Measure the impedance across the Power connector. An incorrect reading indicates that the PIDU is short-circuited.
   iii. If both of the above tests are successful, it is likely that the PIDU Power LED is faulty.

4. If the Power LED does illuminate when the RJ45 ODU cable is removed:
   i. Remove the jumper (J906) found inside the PIDU flap.
   ii. Measure the current with an ammeter placed across the two jumper pins. It should be 10 mA with the ODU disconnected. An incorrect ammeter reading indicates that the PIDU is faulty.

5. If all tests so far have succeeded:
   i. Reconnect the RJ45 ODU cable to the PIDU.
   ii. Measure the current with an ammeter placed across the two jumper pins. It should be in the range 300 mA to 1 A with the ODU connected.
   iii. If the ammeter reading is too high, the ODU may be drawing too much power, or the ODU may be short-circuited.
   iv. If the ammeter reading is too low, the PIDU may be supplying too little power.

11.1.2 Power LED is Flashing

If the green Power LED flashes, perform the following tests on the RJ45 cable that connects the PIDU to the LPU or ODU:

1. Check that pins 4&5 and 7&8 are not crossed with pins 1&2 and 3&6.

2. Check that the resistance between pins 1&8 is greater than 100K ohms.

3. If either test fails, replace or repair the RJ45 cable.

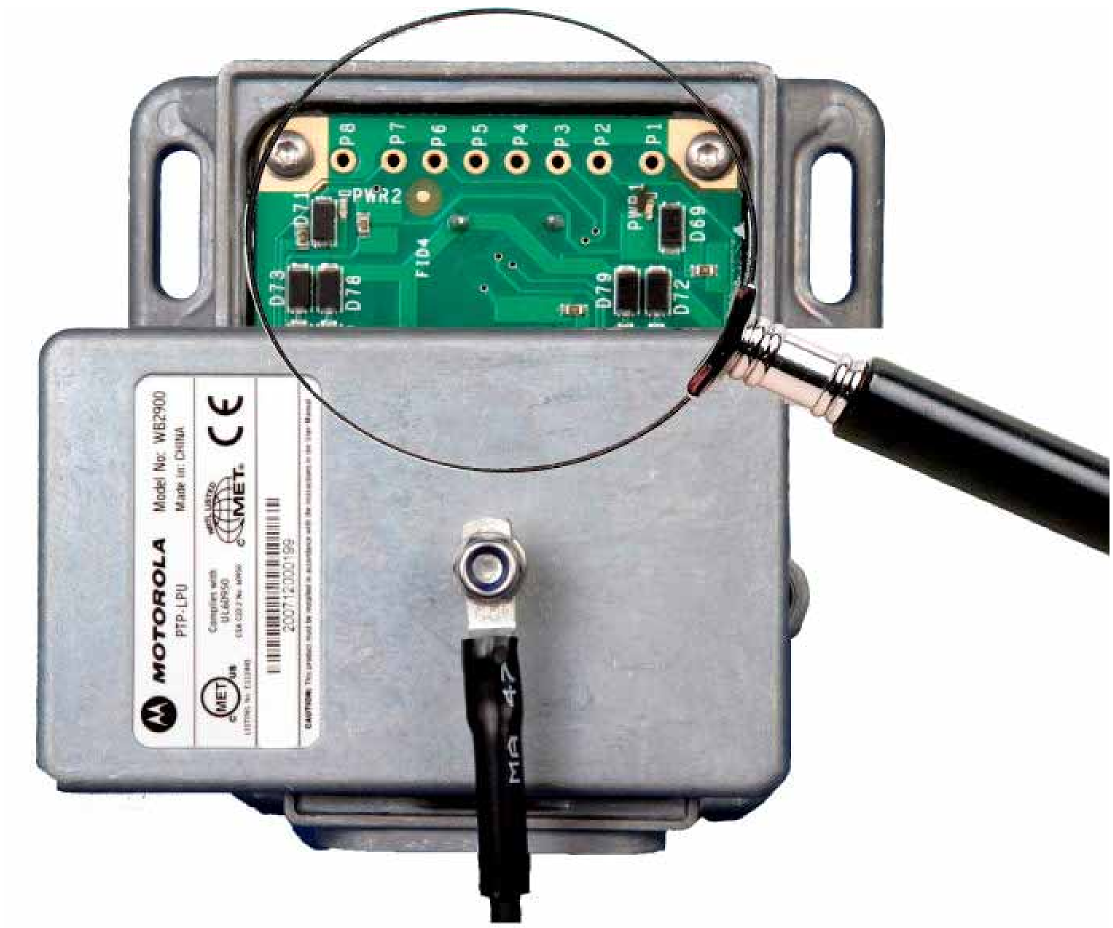
11.1.3 Ethernet LED did not Flash 10 Times

When the PIDU is connected to the power supply and the green Power LED illuminates, there should be a 45 second delay, following which the yellow Ethernet LED should flash 10 times. If the Ethernet LED did not flash 10 times, perform the following tests on the RJ45 cable that connects the PIDU to the LPU or ODU:

1. Check that the wiring to pins 4&5 and 7&8 is correct. For example, the wiring to pins 4 and 7 may be crossed.

2. If an LPU is installed, it can be used to check that power is available on the cable to the ODU. The connections can be accessed by rotating the LPU lid as shown in Figure 135 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: the LED PWR1 should illuminate but LED PWR2 should not.

Figure 135 - PTP LPU Test Points



3. If either test fails, replace or repair the RJ45 cable.

11.1.4 No Ethernet Activity

If the Ethernet LED did flash 10 times but then went off, check that the RJ45 connection from the LAN port of the PIDU to the PC is working. If the PC connection is working, perform the following tests on the RJ45 cable that connects the PIDU to the LPU or ODU:

1. Check that the wiring to pins 1&2 and 4&6 is correct. For example, the wiring to pins 1 and 3 may be crossed.

2. If this test fails, replace or repair the RJ45 cable.

11.1.5 Irregular Ethernet Activity

The yellow Ethernet LED should blink randomly as normal traffic passes through. If the Ethernet LED flashes irregularly, for example there is a short flash followed by a long flash, this indicates that the ODU has booted in recovery mode. The causes may be installation wiring or a corrupt ODU software load. For more information, see Section 9 “Recovery Mode”.

11.1.6 Connection is not 1000 BaseT

If the Ethernet connection to the network is only 10/100 BaseT, when 1000 BaseT is expected, perform the following tests on the RJ45 cable that connects the PIDU to the LPU or ODU:

1. Check that the wiring to pins 4&5 and 7&8 is correct. For example, the wiring to pins 4 and 7 may be crossed.

2. If this test fails, replace or repair the RJ45 cable.

11.1.7 Test RJ45 Resistance

If the above procedures fail to diagnose the issue, there may be a fault in the wiring of the RJ45 cable that connects the ODU (or LPU) to the PIDU. Unplug this cable from the PIDU, then perform the following test procedure:

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 39. 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 39.

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

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

5. If GPS is not fitted, ensure that there is greater than 100K ohms between pin 1 and pin 8 for all cable lengths. If GPS is fitted, ensure there is greater than 2K ohms between pin 1 and pin 8.

Table 39 - Resistance Table Referenced To The RJ45 at the PIDU+

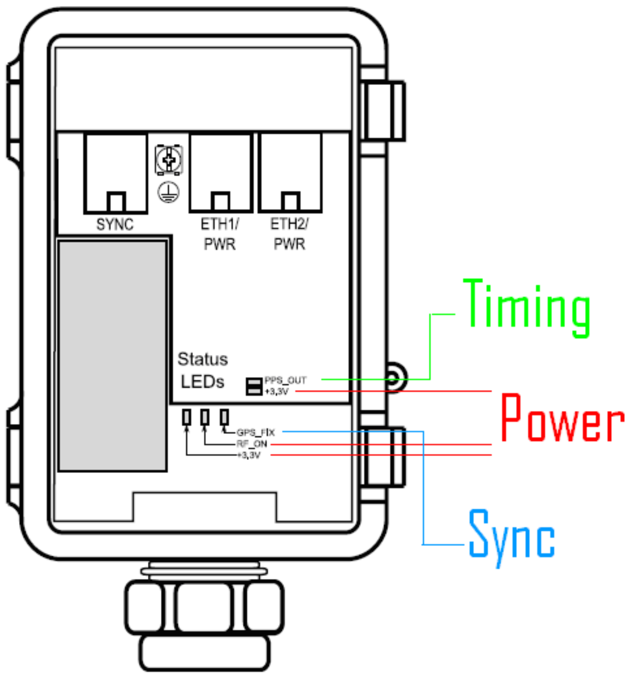
Resistances should fall within + or -10% of the stated values.

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	2.7	2.7	3.3
20	4.6	4.4	5.0
30	6.5	6.1	6.7
40	8.3	7.8	8.4
50	10.2	9.5	10.1
60	12.1	11.2	11.8
70	14.0	12.9	13.5
80	15.8	14.6	15.2
90	17.7	16.3	16.9
100	19.6	18.0	18.6
150	29.0	26.5	27.1
200	38.4	35.0	35.6
250	47.7	43.5	44.1
300	57.1	52.0	52.6

11.1.8 Test GPS Synchronization Unit

The GPS synchronization unit, if installed, is located between the ODU and the LPU (Figure 131 and Figure 132). Use the status LEDs (Figure 136) to test the GPS unit.

Figure 136 - GPS Synchronization Box



To troubleshoot the GPS synchronization unit, perform the following test procedure:

1. **Power supply**: Check that the **+3.3V** and **RF_ON** LEDs are lit, indicating that the GPS is receiving power. If they are not lit, confirm that all link end hardware (PIDU, LPU, ODU and cabling) tests have been performed.

2. **Synchronization**: Approximately 2 minutes after powering on, the **GPS_FIX** LED should be lit. If it is not, ensure the GPS is at a height of at least 1.8m above the ground, where there is an unobstructed path to the sky.

3. **Timing**: When the GPS_FIX LED lights up, the **PPS_OUT** LED should begin blinking faintly at one pulse per second, indicating that sync is being generated. If does not, replace or repair the GPS synchronization unit.

11.2 Test Radio Link

11.2.1 No Activity

If there is no communication over the radio link 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:

1. Check for Alarm conditions on Home page.
2. Check that the software at each end of the link is the same version.
3. Check that the Target Mac address has not been mis-configured at each end of the link.
4. Check Range.
5. Check Tx Power.
6. Check License keys to ensure that both units are the same product variant.
7. Check Master/Slave status for each unit and ensure that one unit is Master and the other unit is slave.
8. Check that the link has not been further obscured or the ODU misaligned.
9. 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.

11.2.2 Some Activity

If there is some activity but the link is unreliable or does not achieve the data rates required then:

1. Check that the interference has not increased using the i-DFS measurements.

2. If a quieter channel is available check that it is not barred.

3. Check that the path loss is low enough for the communication rates required.

4. Check that the ODU has not become misaligned.

11.3 Lightning Strike

If a link end installation is struck by lightning, perform the following diagnostic procedure:

1. Perform the tests specified in Section 11.1 “Test Link End Hardware”. Ensure that the PIDU is working and that the resistances are correct as specified in 11.1.7 “Test RJ45 Resistance”.

2. If the ODU is not working, power off the ODU and both LPUs and return them to Motorola.

3. If the ODU is working but there is suspicion of damage to the LPU, then take the LPUs down and take the covers off, inspect for damage, test the big diode for short circuit and test all other diodes for forward voltage.

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:

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

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 40 and Table 41.

Table 40 - 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 41 - 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 Connectorized PTP 600 Series Bridge

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 137 – Connectorized 600 Series Bridge Outdoor Unit

13.2.2 Antenna

The antenna choices for the Connectorized PTP 58600 and 54600 are described in 13.6.2 “Antenna Choices”.

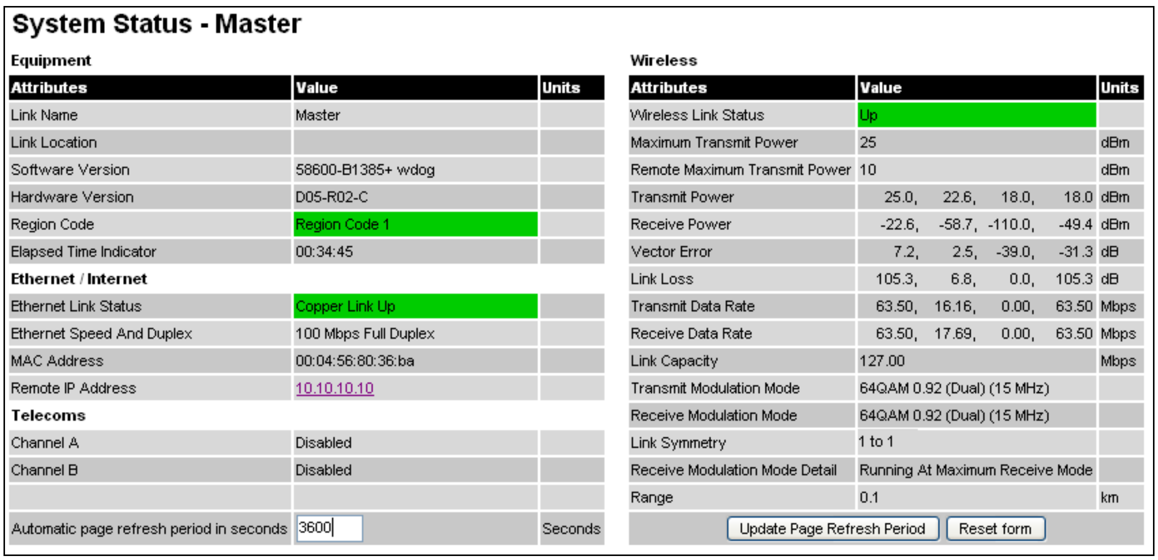
13.3 Software/Features

This section only describes the areas where functionality is modified for the connectorized variant. For details of the functionality that is common to the integrated and connectorized variants, see Section 8 "Web Page Reference".

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 138 - 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		
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		
Channel A	Disabled	
Channel B	Disabled	
Automatic page refresh period in seconds	3600	Seconds

Wireless

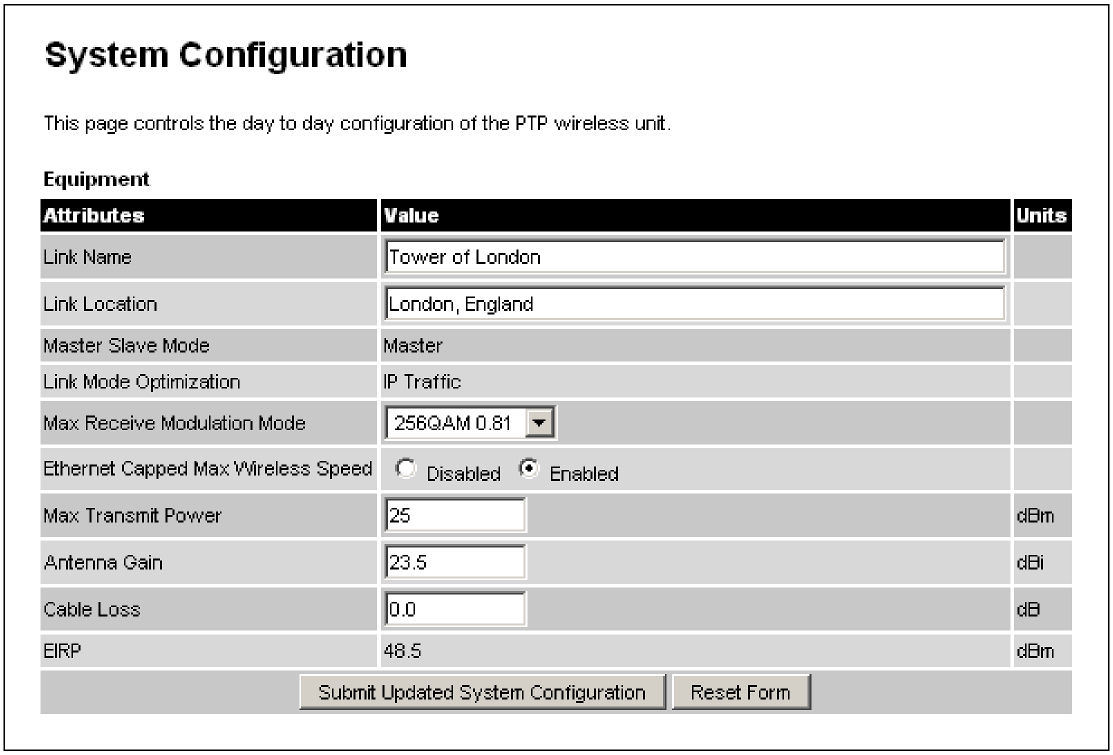
Attributes	Value	Units
Wireless Link Status	Up	
Maximum Transmit Power	25	dBm
Remote Maximum Transmit Power	10	dBm
Transmit Power	25.0, 22.6, 18.0, 18.0	dBm
Receive Power	-22.6, -58.7, -110.0, -49.4	dBm
Vector Error	7.2, 2.5, -39.0, -31.3	dB
Link Loss	105.3, 6.8, 0.0, 105.3	dB
Transmit Data Rate	63.50, 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 to 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 Configuration web page for the connectorized variant is shown in Figure 139. The parameters Antenna Gain, Cable Loss and EIRP are specific to the connectorized variant.

Figure 139 - Connectorized 600 Series bridge 'System Configuration' Page



System Configuration

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

Equipment

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

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 Pages for the connectorized version are shown as Figure 140 to Figure 142.

Figure 140 - Connectorized PTP 600 Series Bridge 'Installation Wizard' Page

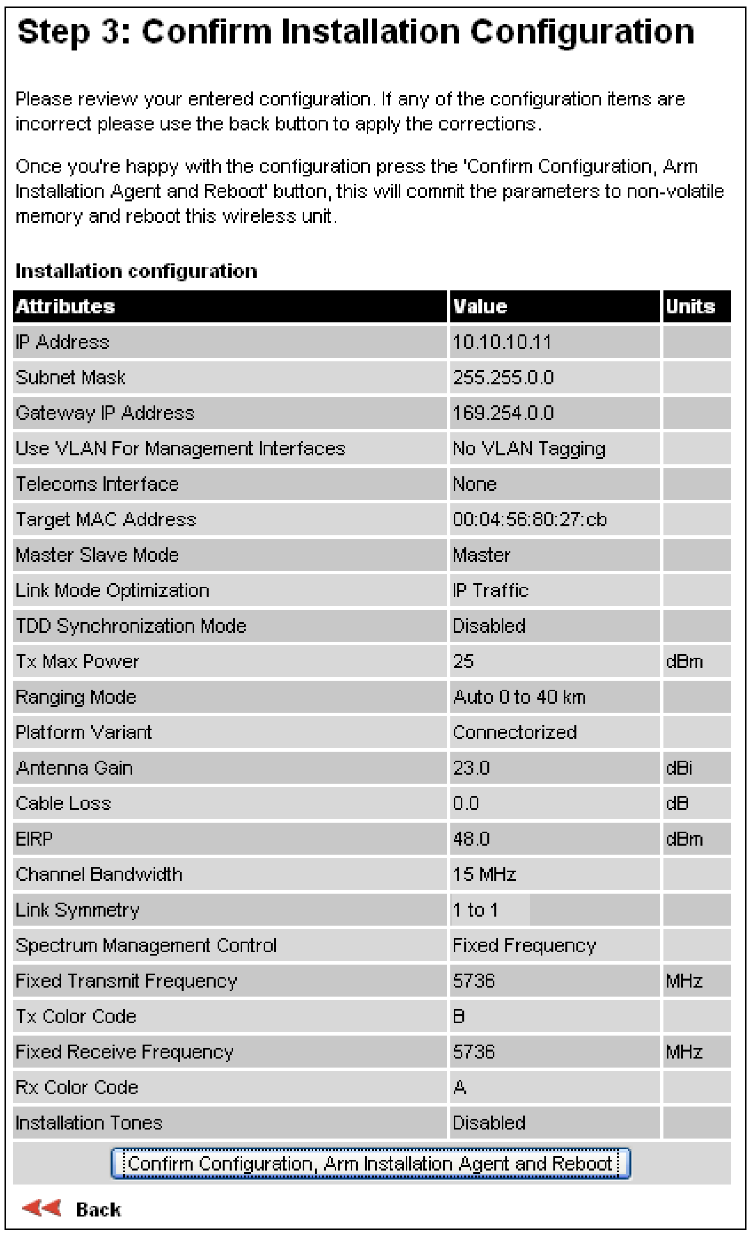
Antenna Gain: Gain of the antenna you are connecting to the unit, see Section 13.6.2 "Antenna Choices".

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 141 - 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

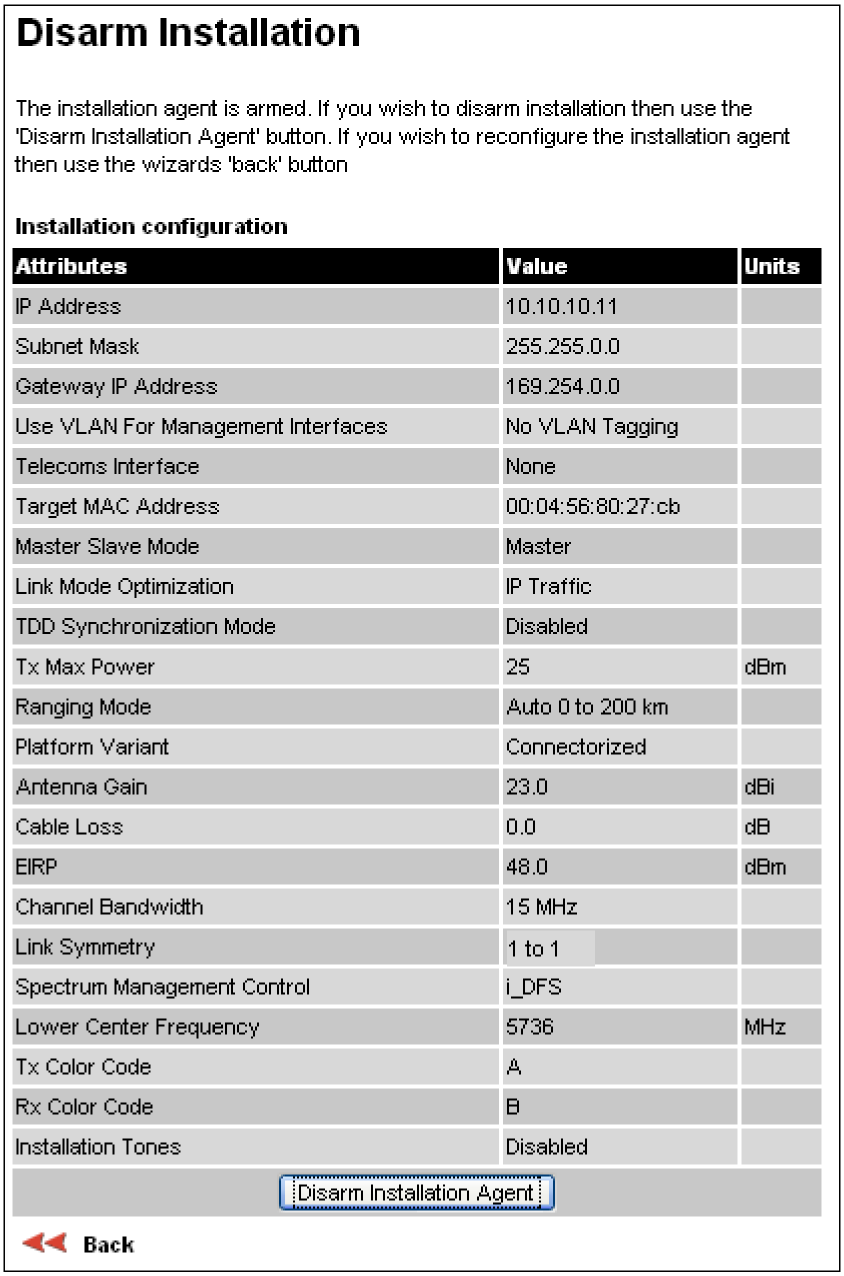
Attributes	Value	Units
IP Address	10.10.10.11	
Subnet Mask	255.255.0.0	
Gateway IP Address	169.254.0.0	
Use VLAN For Management Interfaces	No VLAN Tagging	
Telecoms Interface	None	
Target MAC Address	00:04:56:80:27:cb	
Master Slave Mode	Master	
Link Mode Optimization	IP Traffic	
TDD Synchronization Mode	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 to 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 142 - 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	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 200 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 to 1	
Spectrum Management Control	i_DFS	
Lower Center Frequency	5736	MHz
Tx Color Code	A	
Rx Color Code	B	
Installation Tones	Disabled	

Disarm Installation Agent

Back

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.

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 with Connectorized Units

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.

In some regions, operation of the PTP 600 products is constrained by EIRP limits. For more information on these limits, see Section 5.2 “Licenses and Region Codes”.

When operating with external antennas, the installer/operator has to set the maximum transmit power to ensure that the EIRP limit is not exceeded. Use this formula:

Maximum Transmit Power Allowed = EIRP Limit – Antenna Gain + Cable Losses

Set the power to the 1dB value lower than the actual value calculated.

13.6.1 Cable Losses (FCC Regions Only)

The FCC approval for the product is based on tests with a cable loss between the units of not less than 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 42 - 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

13.6.2 Antenna Choices

In non-FCC regions, antenna choice is not restricted, but any region specific EIRP limit must be obeyed by reducing the maximum Transmit power, see Section 5.2 “Licenses and Region Codes”.

In FCC regions, antenna choice is restricted as described in Section 13.6.3 “FCC Antenna Restrictions on the PTP 58600” and Section 13.6.4 “FCC Antenna Restrictions on the PTP 54600”.

The maximum permitted antenna gain depends upon product variant and channel bandwidth as follows:

- PTP 49600: 26 dBi
- PTP 58600: 37.7 dBi
- PTP 54600 at channel bandwidth 30, 15 or 10 MHz: 34.9 dBi
- PTP 54600 at channel bandwidth 5 MHz: 33.4dBi

13.6.3 FCC Antenna Restrictions on the PTP 58600

In FCC regions, external antennas from the list in Table 43 can be used with the Connectorized version of the PTP 600 Series Bridge. These are approved by the FCC for use with the product and are constrained by the following limit for Single/Dual Polarization Parabolic Dish Antennas: up to 37.7 dBi per polarization or antenna.

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

CAUTION: Antennas not included in this table, or those having a gain greater than the specified maximum, are strictly prohibited for use with the PTP 58600. The required antenna impedance is 50 ohms.

Table 43 - 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

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

Manufacturer	Antenna Type	Gain (dBi)	Flat Plate	Parabolic Dish
Gabriel	Gabriel 2-foot Standard Dual QuickFire Parabolic, QFD2-52-N	28.4		Y
Gabriel	Gabriel 2.5-foot Standard Dual QuickFire Parabolic, QFD2.5-52-N	31.1		Y
Gabriel	Gabriel 2-foot Standard Dual QuickFire Parabolic, QFD2-52-N-RK	28.4		Y
Gabriel	Gabriel 4-foot Standard Dual QuickFire Parabolic, QFD4-52-N	34.7		Y
Gabriel	Gabriel 4-foot Standard Dual QuickFire Parabolic, QFD4-52-N-RK	34.7		Y
Gabriel	Gabriel 6-foot Standard Dual QuickFire Parabolic, QFD6-52-N	37.7		Y
RadioWaves	Radio Waves 2-foot Dual-Pol Parabolic, SPD2-5.2 (28.1dBi)	28.1		Y
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

Manufacturer	Antenna Type	Gain (dBi)	Flat Plate	Parabolic Dish
RFS	RFS 4-foot Parabolic, SPF4-52AN or SPFX4-52AN(33.9dBi)	33.9		Y
RFS	RFS 6-foot Parabolic, SPF6-52AN or SPFX6-52AN (37.4dBi)	37.4		Y
RFS	RFS 2-foot HP Parabolic, SDF2-52AN or SDFX2-52AN (31.4dBi)	31.4		Y
RFS	RFS 4-foot HP Parabolic, SDF4-52AN or SDFX4-52AN (33.9dBi)	33.9		Y
RFS	RFS 6-foot HP Parabolic, SDF6-52AN or SDFX6-52AN (37.4dBi)	37.4		Y
StellaDoradus	StellaDoradus 45 inch Parabolic Antenna, 58PSD113	33.8		Y

13.6.4 FCC Antenna Restrictions on the PTP 54600

In FCC regions, external antennas from the list in Table 44 can be used with the Connectorized version of the PTP 54600. These are approved by the FCC for use with the product and are constrained by the following limit for Single/Dual Polarization Parabolic Dish Antennas: up to 34.9 dBi (33.4 dBi for 5 MHz bandwidth) per polarization or antenna.

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

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

CAUTION: Antennas not included in this table, or those having a gain greater than the specified maximum, are strictly prohibited for use with the PTP 54600. The required antenna impedance is 50 ohms.

Table 44 - 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

Manufacturer	Antenna Type	Gain (dBi)	Parabolic Dish
Gabriel	Gabriel 2-foot Standard QuickFire Parabolic, QF2-52-N-RK	28.5	Y
Gabriel	Gabriel 2.5-foot Standard QuickFire Parabolic, QF2.5-52-N	31.2	Y
Gabriel	Gabriel 4-foot Standard QuickFire Parabolic, QF4-52-N	34.8	Y
Gabriel	Gabriel 4-foot Standard QuickFire Parabolic, QF4-52-N-RK	34.8	Y
Gabriel	Gabriel 2-foot Standard Dual QuickFire Parabolic, QFD2-52-N	28.4	Y
Gabriel	Gabriel 2.5-foot Standard Dual QuickFire Parabolic, QFD2.5-52-N	31.1	Y
Gabriel	Gabriel 2-foot Standard Dual QuickFire Parabolic, QFD2-52-N-RK	28.4	Y
Gabriel	Gabriel 4-foot Standard Dual QuickFire Parabolic, QFD4-52-N	34.7	Y
Gabriel	Gabriel 4-foot Standard Dual QuickFire Parabolic, QFD4-52-N-RK	34.7	Y
RadioWaves	Radio Waves 2-foot Dual-Pol Parabolic, SPD2-5.2 (28.1dBi)	28.1	Y
RadioWaves	Radio Waves 2-foot Parabolic, SP2-5.2 (29.0dBi)	29	Y
RadioWaves	Radio Waves 3-foot Dual-Pol Parabolic, SPD3-5.2 (31.1dBi)	31.1	Y
RadioWaves	Radio Waves 3-foot Parabolic, SP3-5.2 (31.4dBi)	31.4	Y
RadioWaves	Radio Waves 4-foot Dual-Pol Parabolic, SPD4-5.2 (34.4dBi)	34.4	Y
RadioWaves	Radio Waves 4-foot Parabolic, SP4-5.2 (34.8dBi)	34.8	Y
RadioWaves	Radio Waves 2-foot Parabolic, SP2-2/5 (28.3dBi)	28.3	Y
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

Manufacturer	Antenna Type	Gain (dBi)	Parabolic Dish
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 “FCC Antenna Restrictions on the PTP 58600” and Section 13.6.4 “FCC Antenna Restrictions on the PTP 54600” 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 "FCC Antenna Restrictions on the PTP 58600".

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 7.8.1 "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 7.8.1 "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 7.8.1 “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.

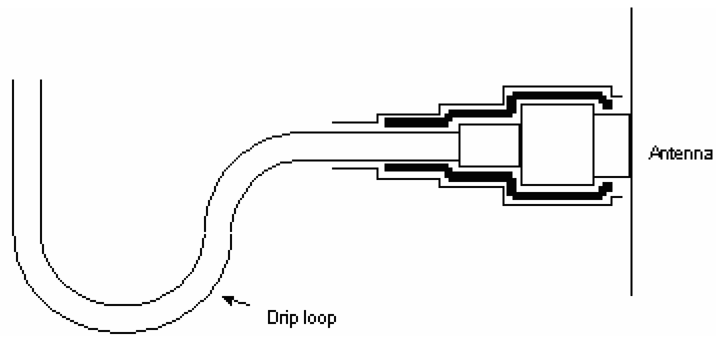
13.7.11 Antenna Cable Fixing

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

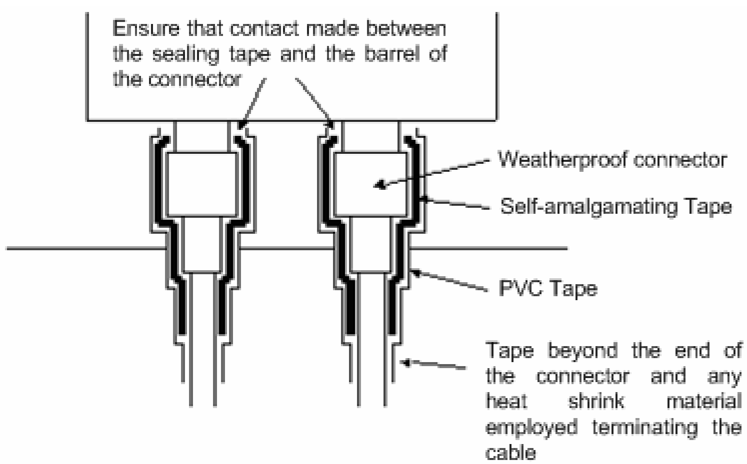
Where a cable connects to an antenna or unit from above, a drip loop should be left to ensure that water is not constantly channeled towards the connector.

Figure 143 - 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 144 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 144 - Weatherproofing the Antenna Connections



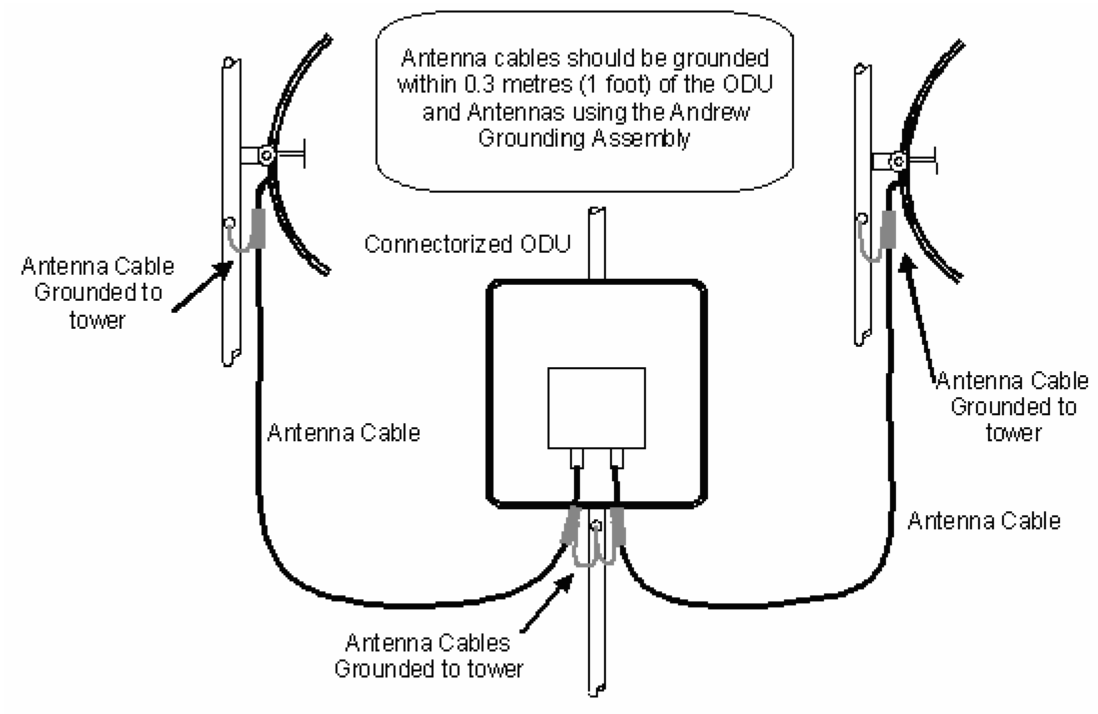
13.8 Additional Lightning Protection

The following guidelines should be applied in addition to those described in Section 10 ”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 145.

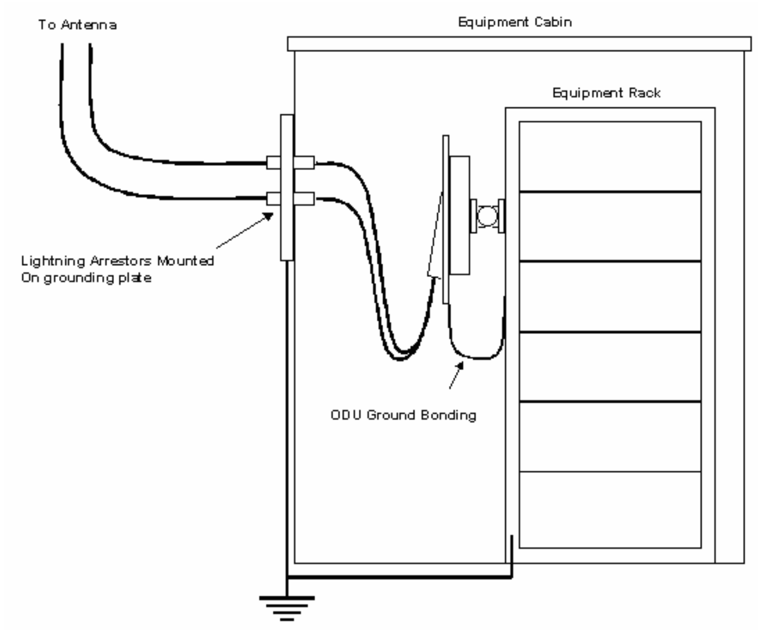
Figure 145- Additional Grounding When Using Connectorized Units



13.8.2 ODU Mounted Indoors

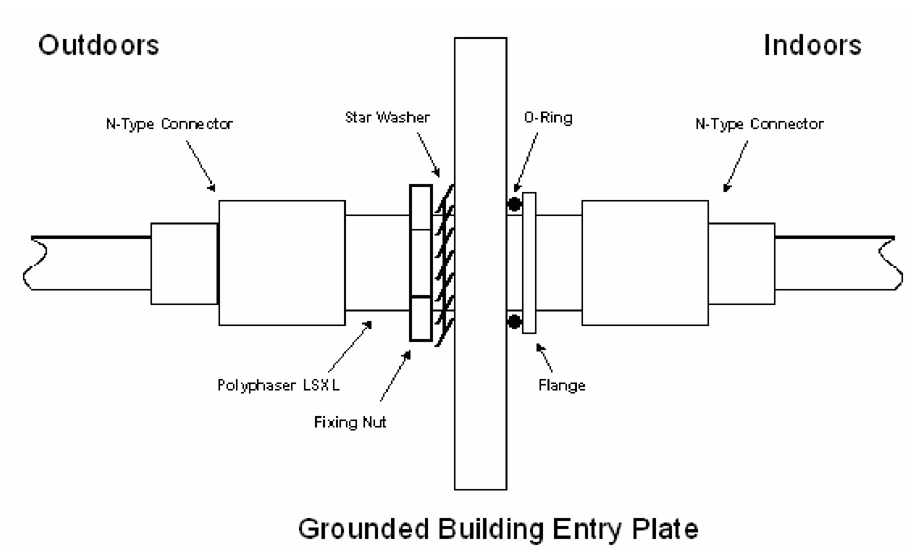
Where the ODU is mounted indoors, lightning arrestors should be deployed where the antenna cables enter the building as shown in Figure 146.

Figure 146 - 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 147.

Figure 147 - 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.

TDD synchronization is not available in the PTP 48600 and PTP 49600 product variants.

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 148), 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”).

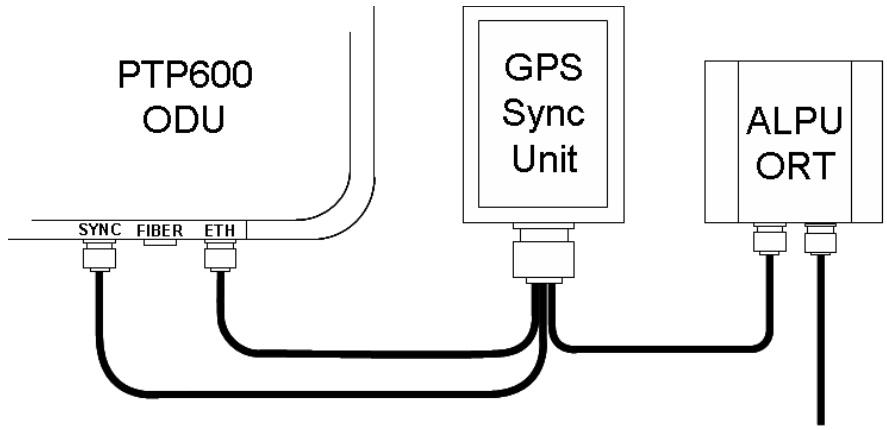
NOTE: Refer to GPS Sync Unit User manual for details on the lengths of cables used to connect the GPS Sync Unit to the ODU and PTP LPU.

Figure 148 - GPS Synchronization Unit

Figure 149 shows the inside of the GPS Sync Unit and Figure 150 is a diagram that shows how to connect the GPS Sync Unit to the ODU and the Lightning protection unit.

Figure 149 - GPS Synchronization Unit Connections

Figure 150 - TDD Sync - PTP600 Deployment Diagram



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

Figure 151 shows an example of mast installation using lightning protection and a GPS Sync Unit.

Figure 151- GPS Synchronization Unit Complete Installation

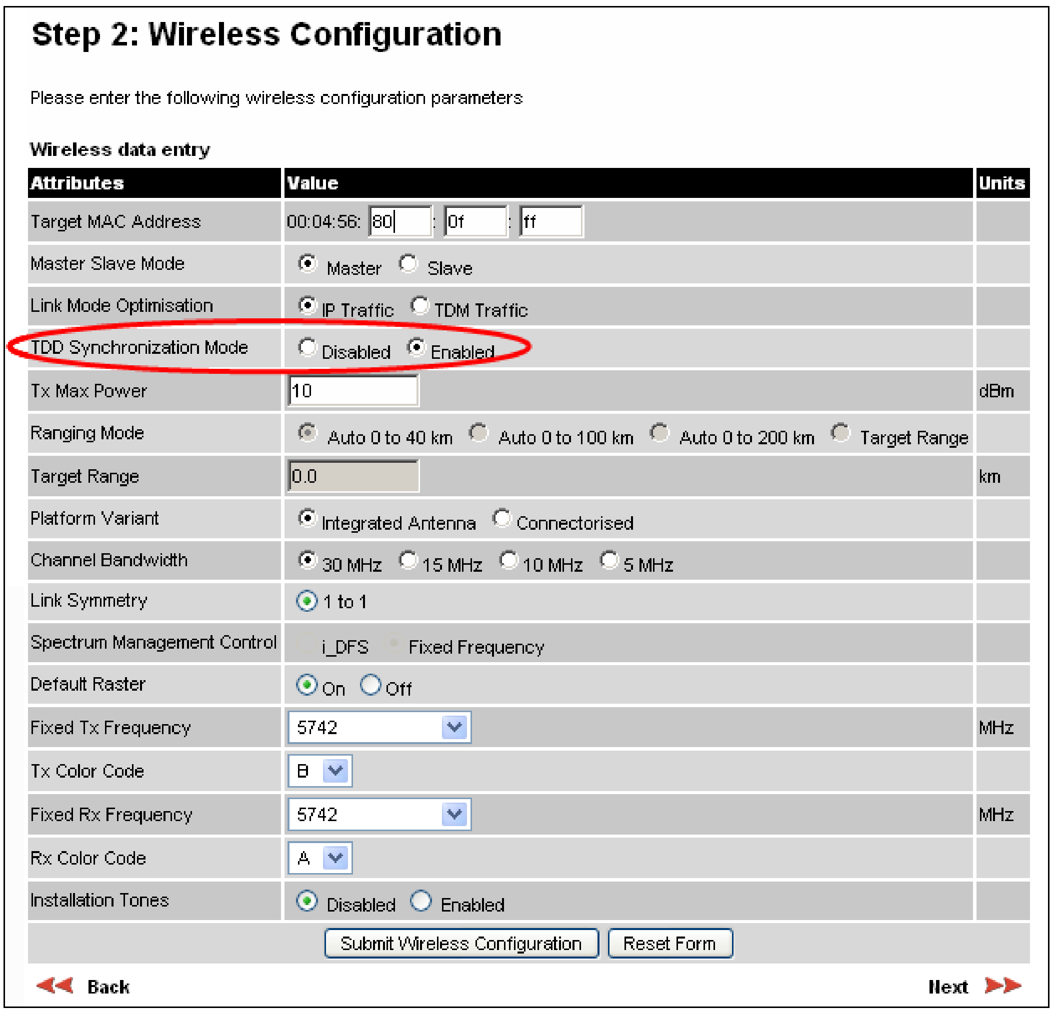
14.2 TDD Synchronization Configuration

TDD synchronization is enabled and configured using the install wizard during the installation process of the link. TDD synchronization is not available in regions where radar avoidance is enabled.

14.2.1 TDD Synchronization Enable

Figure 152 shows how to enable TDD Synchronization.

Figure 152 - Enabling TDD Synchronization Feature



When TDD Synchronization is enabled, note that:

- 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 - Standard Mode

When TDD Synchronization is enabled, there is an extra installation screen (“TDD Synchronization”):

- Figure 153 shows the default screen when All Masters Collocated is set to ‘Yes’ and Slave Interference is set to ‘No’.
- Figure 154 shows the extra fields displayed when All Masters Collocated is set to ‘No’, Slave Interference is set to ‘Yes’ and Configure Link Range is set to ‘Yes’.

Figure 153 - Configuring TDD Synchronization – Screen 1

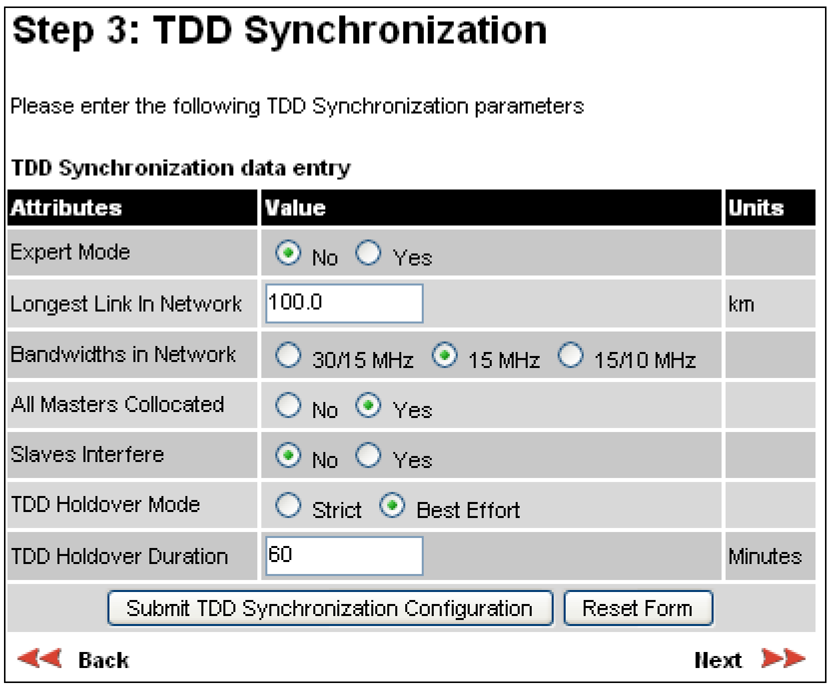
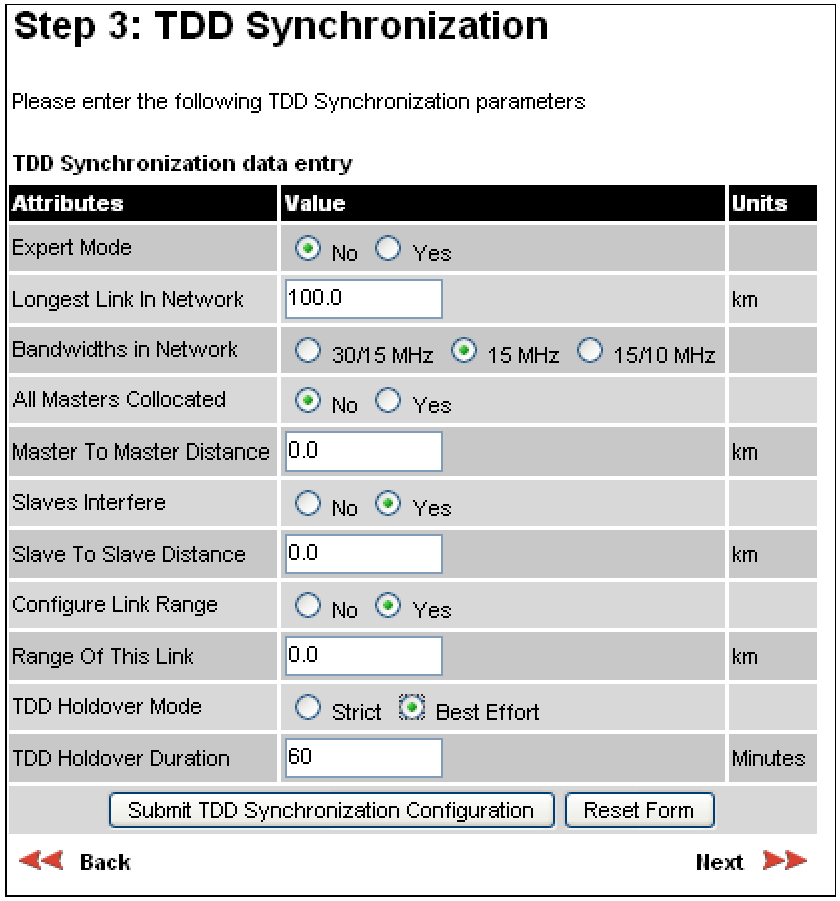


Figure 154 - Configuring TDD Synchronization Feature - Screen 2



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 155 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 km (60 miles). It is the distance of the longest link in the network (maximum is 200 km or 120 miles).

Bandwidths in Network: It is very likely that there will be several different channel bandwidths in a given network. Table 45 gives a list of bandwidth combinations that permit synchronization without gross loss of efficiency. Depending on the channel bandwidth size, only subsets of Table 45 will be shown in the configuration wizard screen.

Table 45 - Common Burst Durations

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

All Masters Collocated: 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 Distance: This is only displayed (see Figure 154) if All Masters Collocated is set to “No”. In this case, the longest distance over which two masters can interfere must be entered here. Maximum distance 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 Distance: This is only displayed (see Figure 154) if Slave Interference is set to “Yes”. In this case, the longest distance over which two slaves can interfere must be entered here. Maximum distance is 200 km (120 miles).

Configure Link Range: This is only displayed (see Figure 154) if All Masters Collocated is set to "No". Choose "Yes" to enter the range of the link in control below.

Range of This Link: This is only displayed (see Figure 154) if Configure Link Range is set to "Yes". Link Range MUST be less than 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.

TDD Holdover Duration: (Master only). Default value is 60 minutes. Specifies duration of holdover period following loss of TDD synchronization.

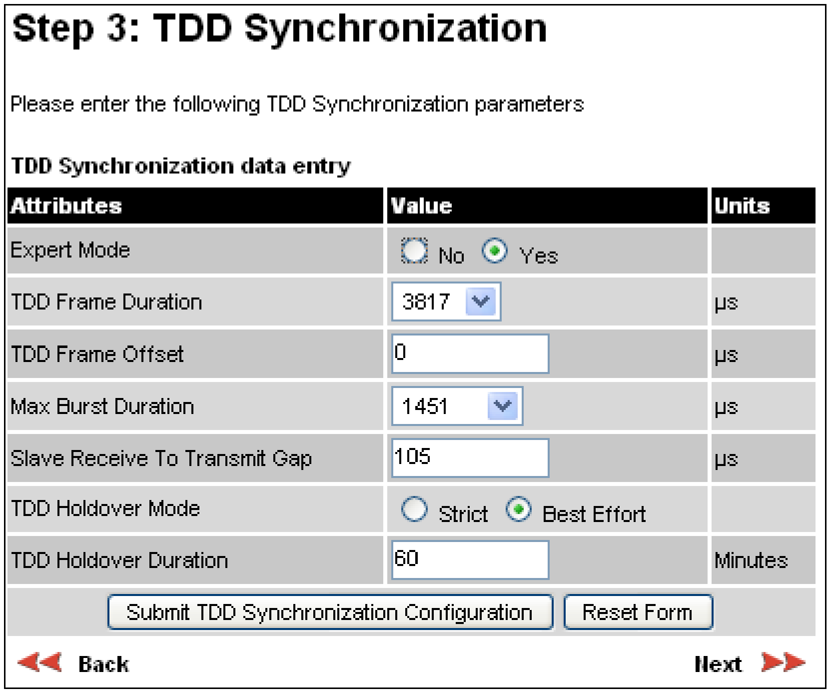
CAUTION: the values entered for the controls in Figure 154 MUST be the same for master/slave pairs for all the links in the network, except for the attribute "Range of This Link" which can be entered exactly for better performance.

14.2.3 TDD Synchronization Configuration – Expert Mode

When "Expert Mode" is selected, the user is required to configure the parameters shown in Figure 155. 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.

When "Expert Mode" is not selected, the controls in Figure 155 are automatically filled by the software.

Figure 155 - Configure TDD Synchronisation Expert Mode



14.2.4 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 156 shows the list of the installation parameters.

Figure 156 - 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	
Telecoms Lowest Single Modulation Mode	BPSK 0.63	
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	0.0	km
Slaves Interfere	Yes	
Slave To Slave Distance	0.0	km
Configure Link Range	No	
TDD Holdover Mode	Best Effort	
TDD Holdover Duration	60	Minutes
TDD Sync Frame Rate	262	
TDD Sync Max Link Capacity	98.19	Mbps
Tx Max Power	25	dBm
Platform Variant	Integrated Antenna	
Channel Bandwidth	15 MHz	
Link Symmetry	1:1	
Spectrum Management Control	i_DFS	
Lower Center Frequency	5736	MHz
Tx Color Code	A	
Rx Color Code	B	
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 157 (Sync) or Figure 158 (Not Sync).

Figure 157 - Status Page - TDD Enabled and Synchronized

System Status - Master

Equipment

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

Wireless

Attributes	Value	Units
Wireless Link Status	Up	
Maximum Transmit Power	15	dBm
Remote Maximum Transmit Power	15	dBm
Transmit Power	15.0, 15.0, 15.0, 15.0	dBm
Receive Power	-45.2, -45.2, -45.4, -45.3	dBm
Vector Error	-32.9, -35.8, -38.7, -36.2	dB
Link Loss	96.3, 96.2, 96.2, 96.2	dB
Transmit Data Rate	18.46, 18.46, 18.46, 18.46	Mbps
Receive Data Rate	18.46, 18.46, 18.46, 18.46	Mbps
Link Capacity	36.92	Mbps
Transmit Modulation Mode	256QAM 0.81 (Dual) (5 MHz)	
Receive Modulation Mode	256QAM 0.81 (Dual) (5 MHz)	
Link Symmetry	1 to 1	
Receive Modulation Mode Detail	Running At Maximum Receive Mode	
Range	0.1	km

Figure 158 - Status Page - TDD Enabled and Not Synchronized

System Status - Master

Equipment

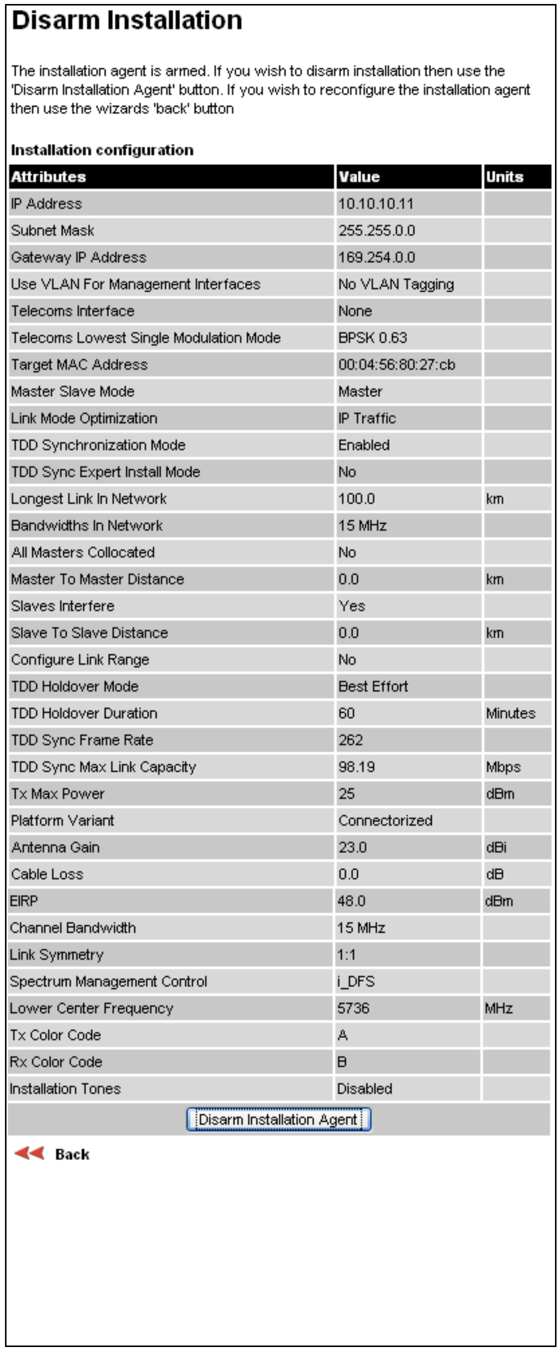
Attributes	Value	Units
Link Name		
Link Location		
Software Version	25600-B1236+ wdog	
Hardware Version	D05-R00-C	
Region Code	Region Code 16	
Elapsed Time Indicator	4 Days 01:30:26	
Ethernet / Internet		
Ethernet Link Status	Copper Link Up	
Ethernet Speed And Duplex	100 Mbps Full Duplex	
MAC Address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

Wireless

Attributes	Value	Units
Wireless Link Status	Up	
Maximum Transmit Power	15	dBm
Remote Maximum Transmit Power	15	dBm
Transmit Power	15.0, 15.0, 15.0, 15.0	dBm
Receive Power	-45.2, -45.2, -45.4, -45.2	dBm
Vector Error	-32.9, -35.8, -38.7, -35.7	dB
Link Loss	96.3, 96.2, 96.2, 96.2	dB
Transmit Data Rate	18.46, 18.46, 18.46, 18.46	Mbps
Receive Data Rate	18.46, 18.46, 18.46, 18.46	Mbps
Link Capacity	36.92	Mbps
Transmit Modulation Mode	256QAM 0.81 (Dual) (5 MHz)	
Receive Modulation Mode	256QAM 0.81 (Dual) (5 MHz)	
Link Symmetry	1 to 1	
Receive Modulation Mode Detail	Running At Maximum Receive Mode	
Range	0.1	km

14.2.5 Disarm ODU Following TDD Sync Configuration

Figure 159 - 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	
Telecoms Lowest Single Modulation Mode	BPSK 0.63	
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	0.0	km
Slaves Interfere	Yes	
Slave To Slave Distance	0.0	km
Configure Link Range	No	
TDD Holdover Mode	Best Effort	
TDD Holdover Duration	60	Minutes
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	i_DFS	
Lower Center Frequency	5736	MHz
Tx Color Code	A	
Rx Color Code	B	
Installation Tones	Disabled	

Disarm Installation Agent

Back

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

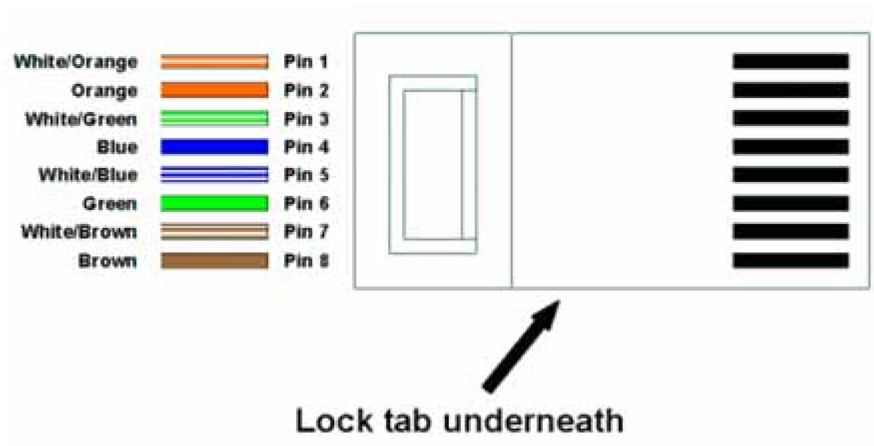
15 E1/T1 Installation Guide

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.

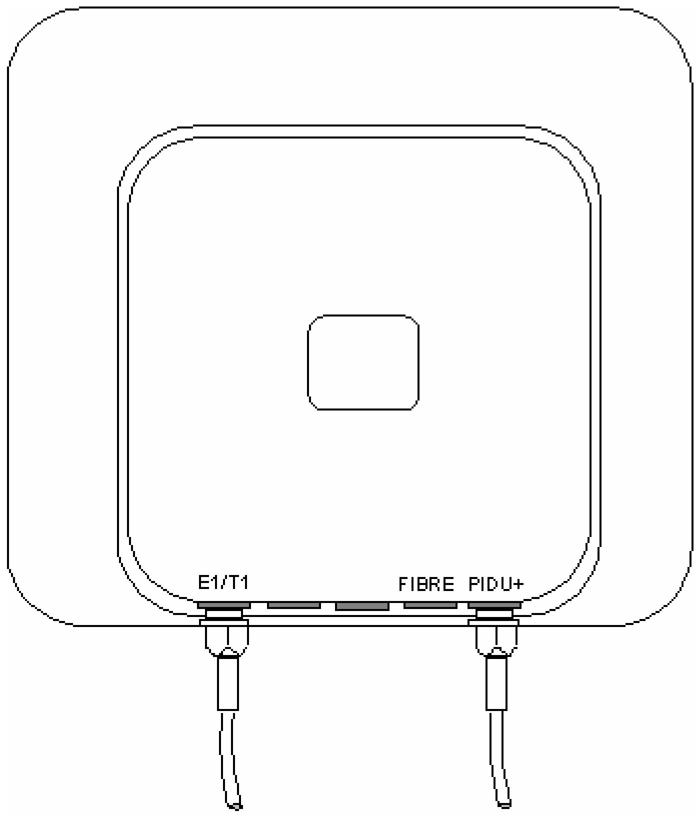
Figure 160 - RJ45 Pin Connection (T568B Color Coding)



15.2 Making the Connection at the ODU

Looking at the back of the unit with the cable entry at the bottom, the PTP 600 Series Bridge E1/T1 connection is the first hole on the left (Figure 161) and is labeled E1/T1.

Figure 161 - 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 162 - 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 43 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 10 “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 163 - Example of a Balun

Figure 164 - Diagrammatically Showing the E1-T1 Connections

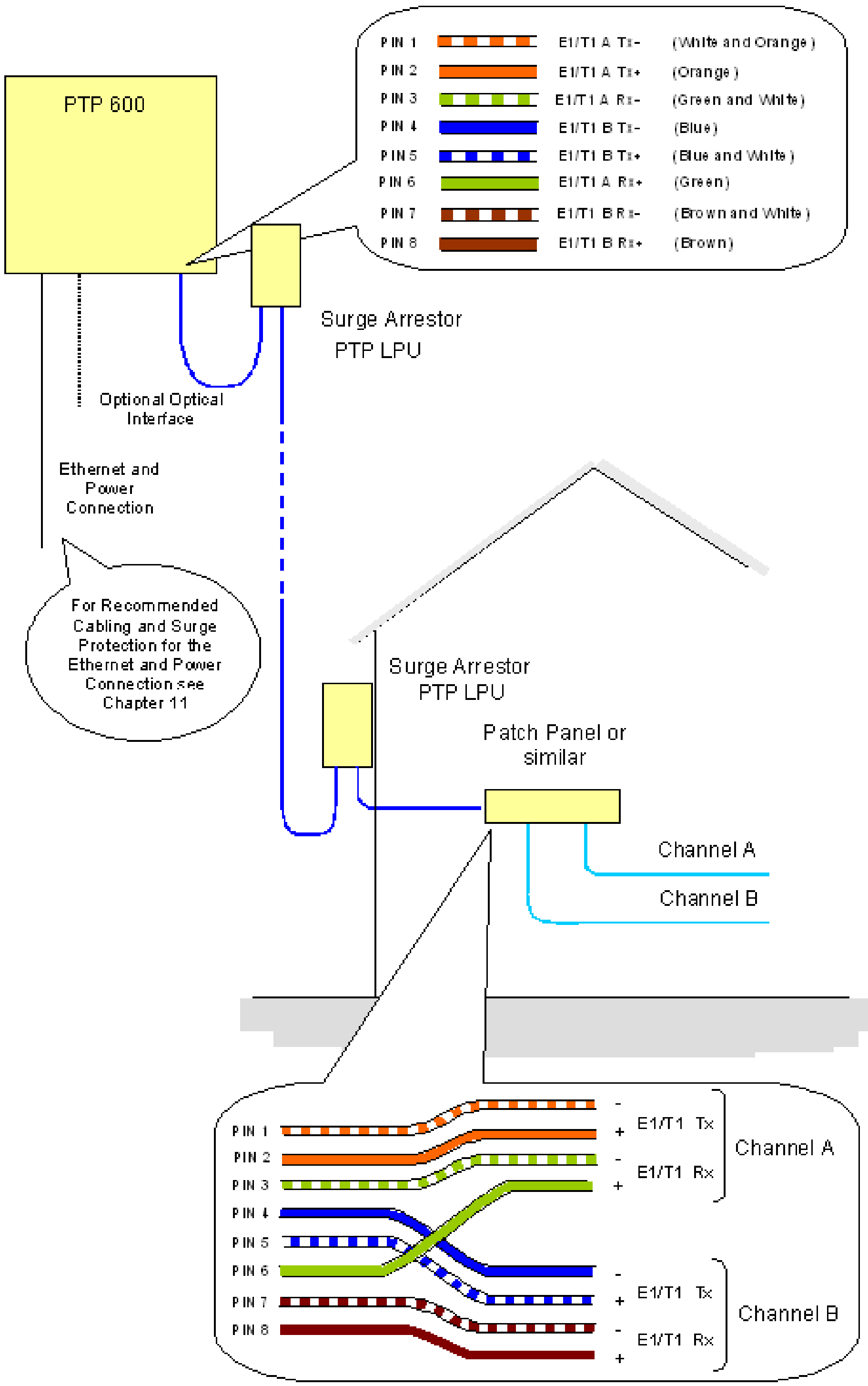
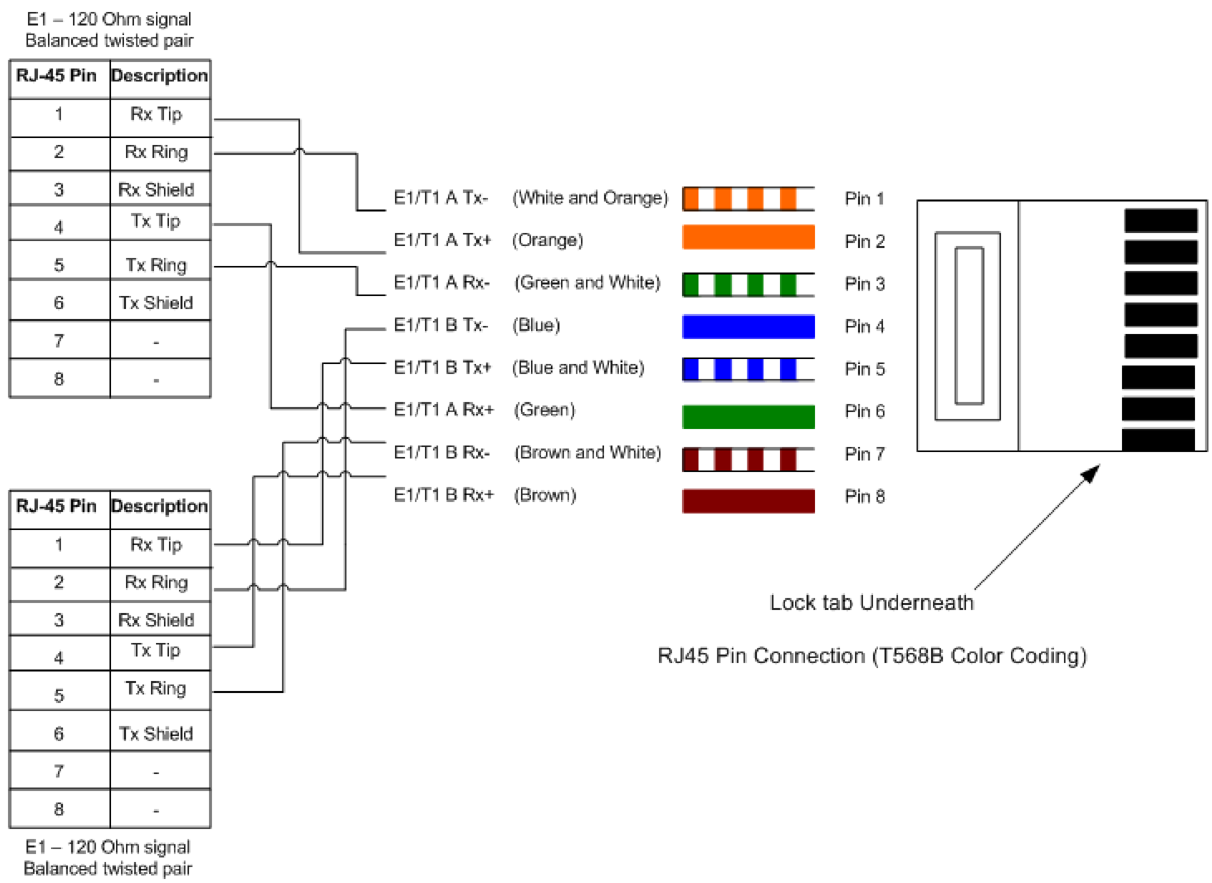


Figure 165 - Two E1-T1-120 Ohms signal Balanced to PTP600 Interface



15.6 Lightning Protection and E1/T1

15.6.1 Overview

Section 10 “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 10 “Lightning Protection”.

Table 46 - 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

Refer to Section 10.4 “LPU Recommended Configurations” to see how the components of PTP 600 sites with E1/T1 are installed and connected. This section also lists the recommended components for each type of installation.

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 10.3 “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 47 column 2.

Check the cable resistance between pins 1 & 2 (Orange/White & Orange) and 4 & 5 (Blue & Blue/White). Check against Table 47 column 3.

Table 47 - 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

The data rate capacity of a PTP link is defined as the maximum end-to-end Ethernet throughput (including Ethernet headers) that it can support. Use the tables and graph in this section to calculate the data rate capacity that can be provided by alternative PTP 600 configurations. It is assumed that Ethernet frames are 1500 octet.

Data rate capacity is determined by the following factors:

- Product variant (PTP 600 Full or Lite)
- Link Symmetry
- Link Mode Optimization (IP or TDM)
- Modulation Mode
- Channel Bandwidth
- Link Range

16.1 Calculation Procedure and Example

16.1.1 Procedure

To calculate the data rate capacity of a PTP 600 link, follow this procedure:

1. Use the tables in Section 16.2 to look up the data throughput capacity rates (Tx, Rx and Both) for the required combination of:
    - Link Symmetry
    - Link Mode Optimization
    - Modulation Mode
    - Channel Bandwidth

2. The tables in Section 16.2 contain data rates for PTP 600 Full only. If the ODUs are PTP 600 Lite, divide the data rates in Section 16.2 by 2.

3. The tables in Section 16.2 contain data rates for links of zero range. Use the curves in Section 16.3 to look up the Throughput Factor that must be applied to adjust the data rates for the actual range of the link.

4. Multiply the data rates by the Throughput Factor to give the throughput capacity of the link.

NOTE: There is a small difference between the rates for IP and TDM because there is fragmentation in TDM (for low priority traffic) which causes the throughput to be reduced buy approximately 1% compared to the IP mode.

16.1.2 Example

Suppose that the link characteristics are:

- Product variant = PTP 600 Lite
- Link Symmetry = 1:1
- Link Mode Optimization = TDM
- Modulation Mode = 64QAM 0.92 Dual
- Channel Bandwidth = 10 MHz
- Link Range = 60 km

Applying the calculation procedure:

1. Use Table 49 to look up the data throughput capacity rates:
   - Tx = 41.41 Mbits/s
   - Rx = 41.41 Mbits/s
   - Both = 82.81 Mbits/s

2. Divide these rates by 2 to give PTP 600 Lite rates:
   - Tx = 20.70 Mbits/s
   - Rx = 20.70 Mbits/s
   - Both = 41.40 Mbits/s

3. Use Figure 176 to look up the Throughput Factor for 1:1, TDM and Link Range 60 km. The factor is 0.86.

4. Multiply the rates from Step 2 by the Throughput Factor from Step 3 to give the throughput capacity of the link:
   - Tx = 17.80 Mbits/s
   - Rx = 17.80 Mbits/s
   - Both = 35.60 Mbits/s

16.2 Data Throughput Capacity

Table 48, Table 49, Table 50, Table 51 and Table 52 show the data throughput rates (Mbits/s) that are achieved when two PTP 600 Full ODUs are linked and the link distance (range) is 0 km. Use the curves in Section 16.3 to adjust these figures to allow for link range.

NOTE: When using these tables, be aware of the following points:

- PTP 600 Lite data rates are half the PTP 600 Full rates given in this section.
- Modulation Mode “256QAM 0.81 dual” is not available in all product variants and channel bandwidths.
- Throughput for Link Symmetry 2:1 is the same as that for 1:2, but the Tx and Rx data rates are swapped.
- The data rates for Adaptive symmetry apply to the most asymmetric case where the link has significant offered traffic in one direction only. The data rates for Adaptive symmetry with bidirectional offered traffic are the same as those for Link Symmetry = 1:1 with Link Optimization = IP.

Table 48 – Data Throughput for PTP 600 Full, Link Symmetry = 1:1, Link Optimization = IP

(Mbit/s)

Modulation Mode	30 MHz			20 MHz and 15 MHz			10 MHz		
	Tx	Rx	Both	Tx	Rx	Both	Tx	Rx	Both
256QAM 0.81 dual	150.01	150.01	300.02	75.37	75.37	150.74	50.11	50.11	100.21
64QAM 0.92 dual	126.39	126.39	252.78	63.50	63.50	127.01	42.22	42.22	84.43
64QAM 0.75 dual	103.28	103.28	206.57	51.89	51.89	103.79	34.50	34.50	69.00
16QAM 0.87 dual	80.35	80.35	160.70	40.37	40.37	80.74	26.84	26.84	53.68
16QAM 0.63 dual	57.76	57.76	115.52	29.02	29.02	58.04	19.29	19.29	38.59
256QAM 0.81 single	75.00	75.00	150.01	37.69	37.69	75.37	25.05	25.05	50.11
64QAM 0.92 single	63.19	63.19	126.39	31.75	31.75	63.50	21.11	21.11	42.21
64QAM 0.75 single	51.64	51.64	103.28	25.95	25.95	51.89	17.25	17.25	34.50
16QAM 0.87 single	40.17	40.17	80.35	20.18	20.18	40.37	13.42	13.42	26.84
16QAM 0.63 single	28.88	28.88	57.76	14.51	14.51	29.02	9.65	9.65	19.29
QPSK 0.87 single	20.09	20.09	40.17	10.09	10.09	20.18	6.71	6.71	13.42
QPSK 0.63 single	14.44	14.44	28.88	7.25	7.25	14.51	4.82	4.82	9.64
BPSK 0.63 single	7.22	7.22	14.44	3.63	3.63	7.25	2.41	2.41	4.82

Modulation Mode	5 MHz		
	Tx	Rx	Both
256QAM 0.81 dual	24.22	24.22	48.43
64QAM 0.92 dual	20.40	20.40	40.80
64QAM 0.75 dual	16.67	16.67	33.34
16QAM 0.87 dual	12.97	12.97	25.94
16QAM 0.63 dual	9.32	9.32	18.65
256QAM 0.81 single	12.11	12.11	24.21
64QAM 0.92 single	10.20	10.20	20.40
64QAM 0.75 single	8.34	8.34	16.67
16QAM 0.87 single	6.48	6.48	12.97
16QAM 0.63 single	4.66	4.66	9.32
QPSK 0.87 single	3.24	3.24	6.48
QPSK 0.63 single	2.33	2.33	4.66
BPSK 0.63 single	1.16	1.16	2.33

Table 49 – Data Throughput for PTP 600 Full, Link Symmetry = 1:1, Link Optimization = TDM

(Mbit/s)

Modulation Mode	30 MHz			20 MHz and 15 MHz			10 MHz		
	Tx	Rx	Both	Tx	Rx	Both	Tx	Rx	Both
256QAM 0.81 dual	140.87	140.87	281.74	72.92	72.92	145.83	49.14	49.14	98.29
64QAM 0.92 dual	118.69	118.69	237.38	61.43	61.43	122.87	41.41	41.41	82.81
64QAM 0.75 dual	96.99	96.99	193.98	50.20	50.20	100.41	33.84	33.84	67.67
16QAM 0.87 dual	75.45	75.45	150.91	39.06	39.06	78.11	26.32	26.32	52.64
16QAM 0.63 dual	54.24	54.24	108.48	28.08	28.08	56.15	18.92	18.92	37.84
256QAM 0.81 single	70.43	70.43	140.87	36.46	36.46	72.91	24.57	24.57	49.14
64QAM 0.92 single	59.34	59.34	118.69	30.72	30.72	61.43	20.70	20.70	41.40
64QAM 0.75 single	48.49	48.49	96.99	25.10	25.10	50.20	16.92	16.92	33.83
16QAM 0.87 single	37.73	37.73	75.45	19.53	19.53	39.05	13.16	13.16	26.32
16QAM 0.63 single	27.12	27.12	54.24	14.04	14.04	28.07	9.46	9.46	18.92
QPSK 0.87 single	18.86	18.86	37.72	9.76	9.76	19.52	6.58	6.58	13.16
QPSK 0.63 single	13.56	13.56	27.12	7.02	7.02	14.03	4.73	4.73	9.46
BPSK 0.63 single	6.78	6.78	13.56	3.51	3.51	7.02	2.36	2.36	4.73

Modulation Mode	5 MHz		
	Tx	Rx	Both
256QAM 0.81 dual	24.22	24.22	48.43
64QAM 0.92 dual	20.40	20.40	40.80
64QAM 0.75 dual	16.67	16.67	33.34
16QAM 0.87 dual	12.97	12.97	25.94
16QAM 0.63 dual	9.32	9.32	18.65
256QAM 0.81 single	12.11	12.11	24.21
64QAM 0.92 single	10.20	10.20	20.40
64QAM 0.75 single	8.34	8.34	16.67
16QAM 0.87 single	6.48	6.48	12.97
16QAM 0.63 single	4.66	4.66	9.32
QPSK 0.87 single	3.24	3.24	6.48
QPSK 0.63 single	2.33	2.33	4.66
BPSK 0.63 single	1.16	1.16	2.33

Table 50 – Data Throughput for PTP 600 Full, Link Symmetry = 2:1, Link Optimization = IP

(Mbit/s)

(This combination is not available with Channel Bandwidth 5 MHz)

Modulation Mode	30 MHz			20 MHz and 15 MHz			10 MHz		
	Tx	Rx	Both	Tx	Rx	Both	Tx	Rx	Both
256QAM 0.81 dual	198.58	99.29	297.88	100.50	50.25	150.74	66.38	33.19	99.56
64QAM 0.92 dual	167.31	83.66	250.97	84.67	42.33	127.01	55.92	27.96	83.88
64QAM 0.75 dual	136.73	68.36	205.09	69.19	34.59	103.79	45.70	22.85	68.55
16QAM 0.87 dual	106.37	53.18	159.55	53.83	26.91	80.74	35.55	17.78	53.33
16QAM 0.63 dual	76.47	38.23	114.70	38.70	19.35	58.04	25.56	12.78	38.34
256QAM 0.81 single	99.29	49.64	148.94	50.25	25.12	75.37	33.19	16.59	49.78
64QAM 0.92 single	83.66	41.83	125.48	42.33	21.17	63.50	27.96	13.98	41.94
64QAM 0.75 single	68.36	34.18	102.54	34.59	17.30	51.89	22.85	11.42	34.27
16QAM 0.87 single	53.18	26.59	79.77	26.91	13.46	40.37	17.78	8.89	26.66
16QAM 0.63 single	38.23	19.11	57.35	19.35	9.67	29.02	12.78	6.39	19.17
QPSK 0.87 single	26.59	13.29	39.88	13.46	6.73	20.18	8.89	4.44	13.33
QPSK 0.63 single	19.11	9.56	28.67	9.67	4.84	14.51	6.39	3.19	9.58
BPSK 0.63 single	9.56	4.78	14.33	4.84	2.42	7.25	3.19	1.60	4.79

Table 51 – Data Throughput for PTP 600 Full, Link Symmetry = 2:1, Link Optimization = TDM

(Mbit/s)

(This combination is not available with Channel Bandwidth 5 MHz)

Modulation Mode	30 MHz			20 MHz and 15 MHz			10 MHz		
	Tx	Rx	Both	Tx	Rx	Both	Tx	Rx	Both
256QAM 0.81 dual	193.06	96.53	289.58	98.83	49.42	148.25	66.38	33.19	99.56
64QAM 0.92 dual	162.66	81.33	243.98	83.27	41.63	124.90	55.92	27.96	83.88
64QAM 0.75 dual	132.92	66.46	199.38	68.05	34.02	102.07	45.70	22.85	68.55
16QAM 0.87 dual	103.41	51.70	155.11	52.94	26.47	79.40	35.55	17.78	53.33
16QAM 0.63 dual	74.34	37.17	111.50	38.05	19.03	57.08	25.56	12.78	38.34
256QAM 0.81 single	96.53	48.26	144.79	49.42	24.71	74.12	33.19	16.59	49.78
64QAM 0.92 single	81.33	40.66	121.99	41.63	20.82	62.45	27.96	13.98	41.94
64QAM 0.75 single	66.46	33.23	99.69	34.02	17.01	51.03	22.85	11.42	34.27
16QAM 0.87 single	51.70	25.85	77.55	26.47	13.23	39.70	17.78	8.89	26.66
16QAM 0.63 single	37.17	18.58	55.75	19.03	9.51	28.54	12.78	6.39	19.17
QPSK 0.87 single	25.85	12.92	38.77	13.23	6.62	19.85	8.89	4.44	13.33
QPSK 0.63 single	18.58	9.29	27.87	9.51	4.76	14.27	6.39	3.19	9.58
BPSK 0.63 single	9.29	4.64	13.93	4.76	2.38	7.13	3.19	1.60	4.79

Table 52 – Data Throughput for PTP 600 Full, Link Symmetry = Adaptive Link Optimization = IP

(Mbit/s)

(This combination is not available with Channel Bandwidth 5 MHz)

Modulation Mode	30 MHz			20 MHz and 15 MHz			10 MHz		
	Tx	Rx	Both	Tx	Rx	Both	Tx	Rx	Both
256QAM 0.81 dual	236.95	59.23	296.18	112.12	37.37	149.49	66.38	33.19	99.56
64QAM 0.92 dual	199.63	49.91	249.54	94.46	31.49	125.95	55.92	27.96	83.88
64QAM 0.75 dual	163.14	40.78	203.92	77.19	25.73	102.92	45.70	22.85	68.55
16QAM 0.87 dual	126.91	31.73	158.64	60.05	20.02	80.07	35.55	17.78	53.33
16QAM 0.63 dual	91.24	22.81	114.04	43.17	14.39	57.56	25.56	12.78	38.34
256QAM 0.81 single	118.47	29.62	148.09	56.06	18.68	74.74	33.19	16.59	49.78
64QAM 0.92 single	99.82	24.95	124.77	47.23	15.74	62.97	27.96	13.98	41.94
64QAM 0.75 single	81.57	20.39	101.96	38.59	12.86	51.46	22.85	11.42	34.27
16QAM 0.87 single	63.46	15.86	79.32	30.02	10.01	40.03	17.78	8.89	26.66
16QAM 0.63 single	45.62	11.40	57.02	21.58	7.19	28.78	12.78	6.39	19.17
QPSK 0.87 single	31.73	7.93	39.66	15.01	5.00	20.01	8.89	4.44	13.33
QPSK 0.63 single	22.81	5.70	28.51	10.79	3.60	14.39	6.39	3.19	9.58
BPSK 0.63 single	11.40	2.85	14.25	5.39	1.80	7.19	3.19	1.60	4.79

16.3 Range Adjustment Curves

Use these curves to look up the link Range and find the Throughput Factor that must be applied to adjust the 0 km data throughput rates for the required combination of Channel Bandwidth, Link Symmetry, Link Optimization, DFS and Link Range (km).

Table 53 – Range Adjustment Characteristics

Channel Bandwidth	Link Symmetry	Link Optimisation	DFS	Range Adjustment Curve	See Figure
30 MHz	1:1	IP		A	Figure 166
		TDM		B	Figure 167
	2:1	IP		C	Figure 168
		TDM		D	Figure 169
	Adaptive	IP		E	Figure 170
20 MHz or 15 MHz	1:1	IP		F	Figure 171
		TDM		G	Figure 172
	2:1	IP		F	Figure 171
		TDM	None	H	Figure 173
			FCC or ETSI	C	Figure 168
	Adaptive	IP		I	Figure 174
10 MHz	1:1	IP		J	Figure 175
		TDM		K	Figure 176
	2:1	IP		L	Figure 177
		TDM		L	Figure 177
	Adaptive	IP		L	Figure 177
5 MHz	1:1	Don't Care		M	Figure 178

Figure 166 – PTP 600 Range Adjustment for Data Rates, Curve A

Channel Bandwidth = 30 MHz, Link Symmetry = 1:1, Link Optimization = IP.

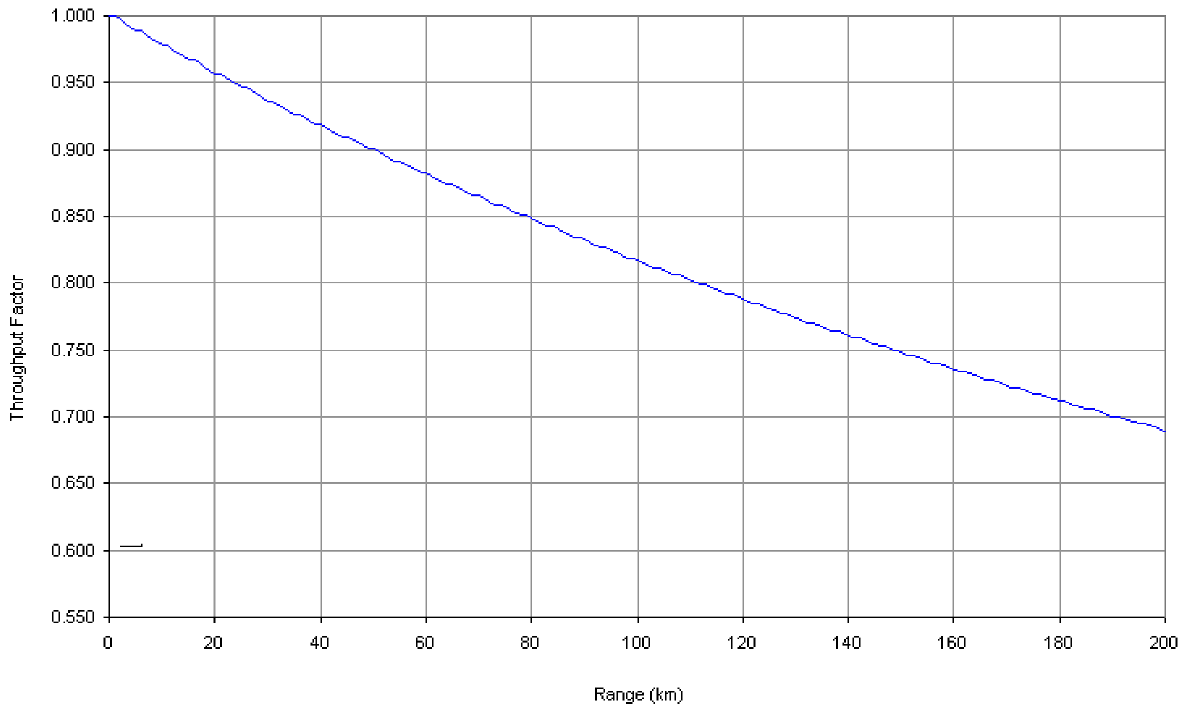


Figure 167 – PTP 600 Range Adjustment for Data Rates, Curve B

Channel Bandwidth = 30 MHz, Link Symmetry = 1:1, Link Optimization = TDM.

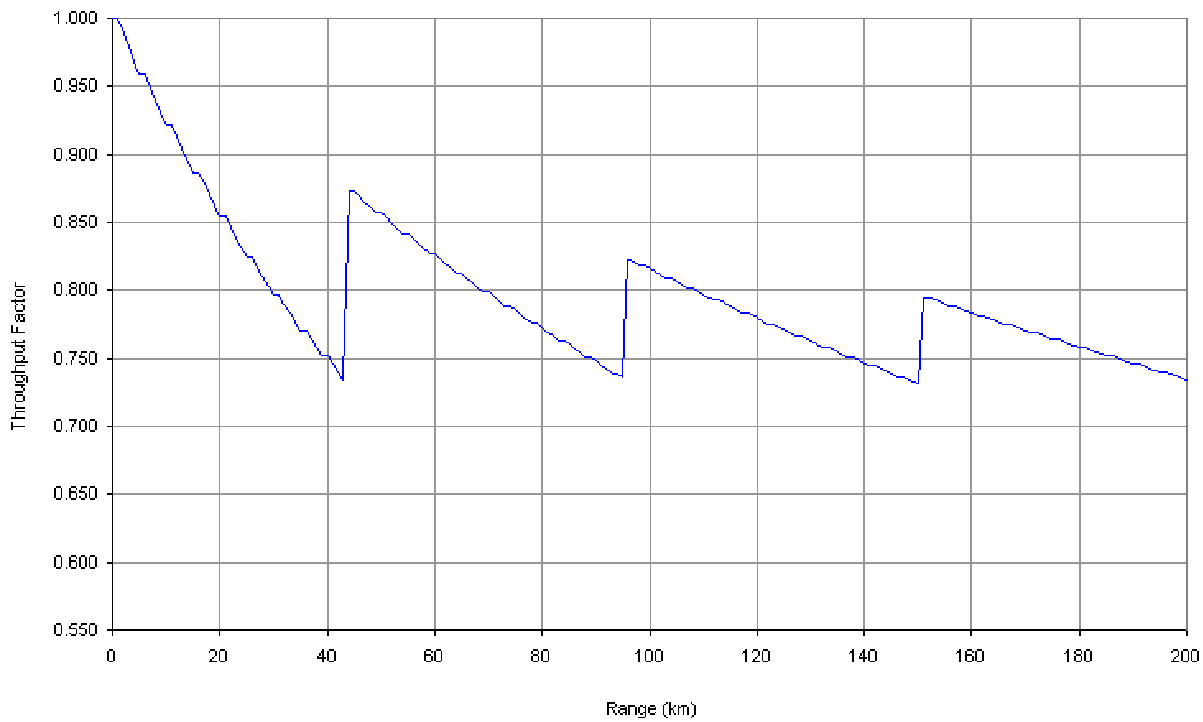


Figure 168 – PTP 600 Range Adjustment for Data Rates, Curve C

Channel Bandwidth = 30 MHz, Link Symmetry = 2:1, Link Optimization = IP.

Channel Bandwidth = 20 or 15 MHz, Link Symmetry = 2:1, Link Optimization = TDM, DFS = FCC or ETSI.

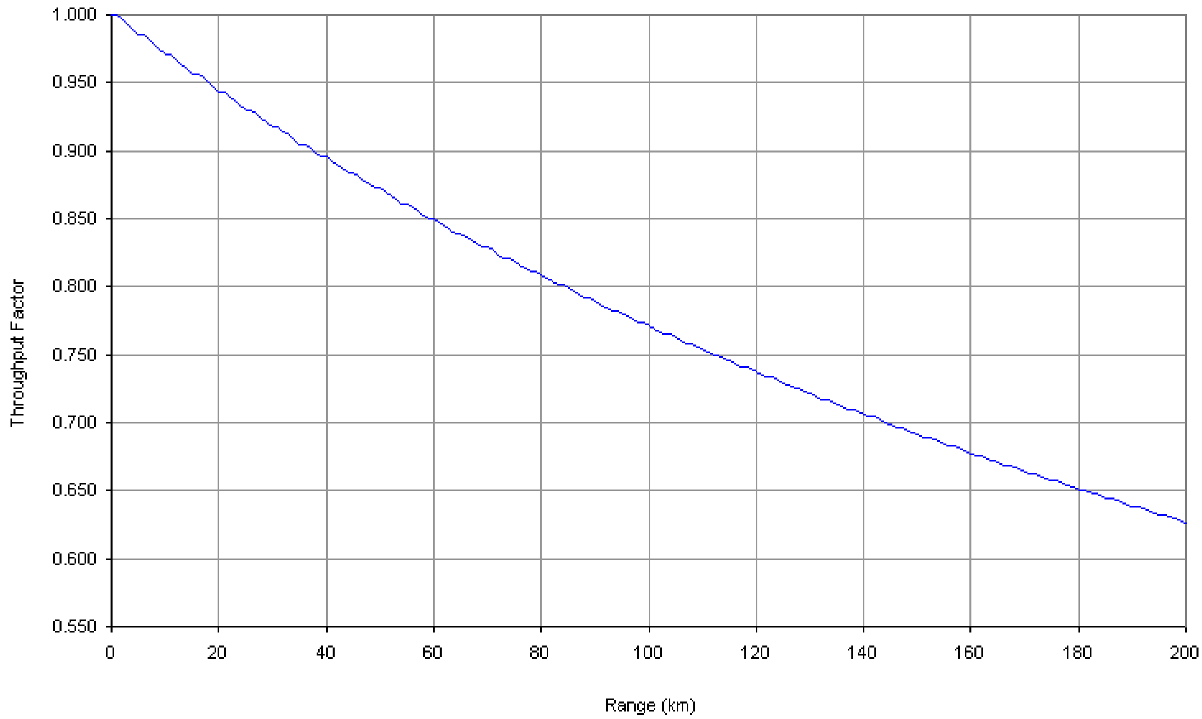


Figure 169 – PTP 600 Range Adjustment for Data Rates, Curve D

Channel Bandwidth = 30 MHz, Link Symmetry = 2:1, Link Optimization = TDM.

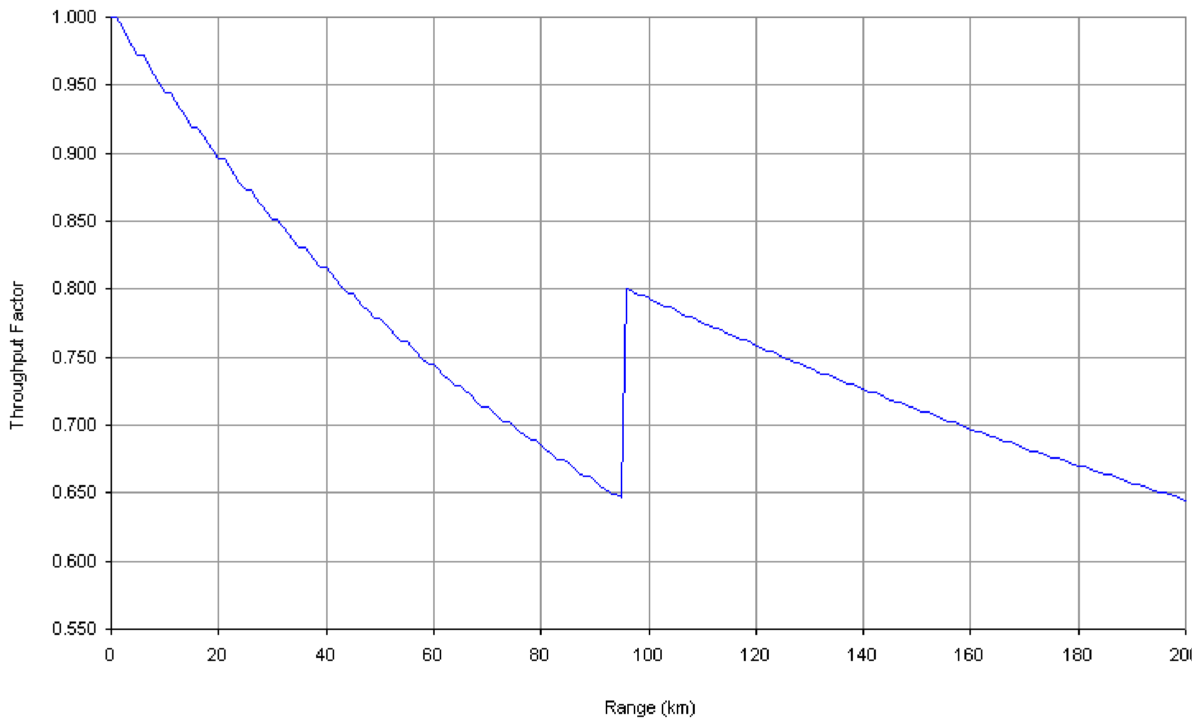


Figure 170 – PTP 600 Range Adjustment for Data Rates, Curve E

Channel Bandwidth = 30 MHz, Link Symmetry = Adaptive, Link Optimization = IP.

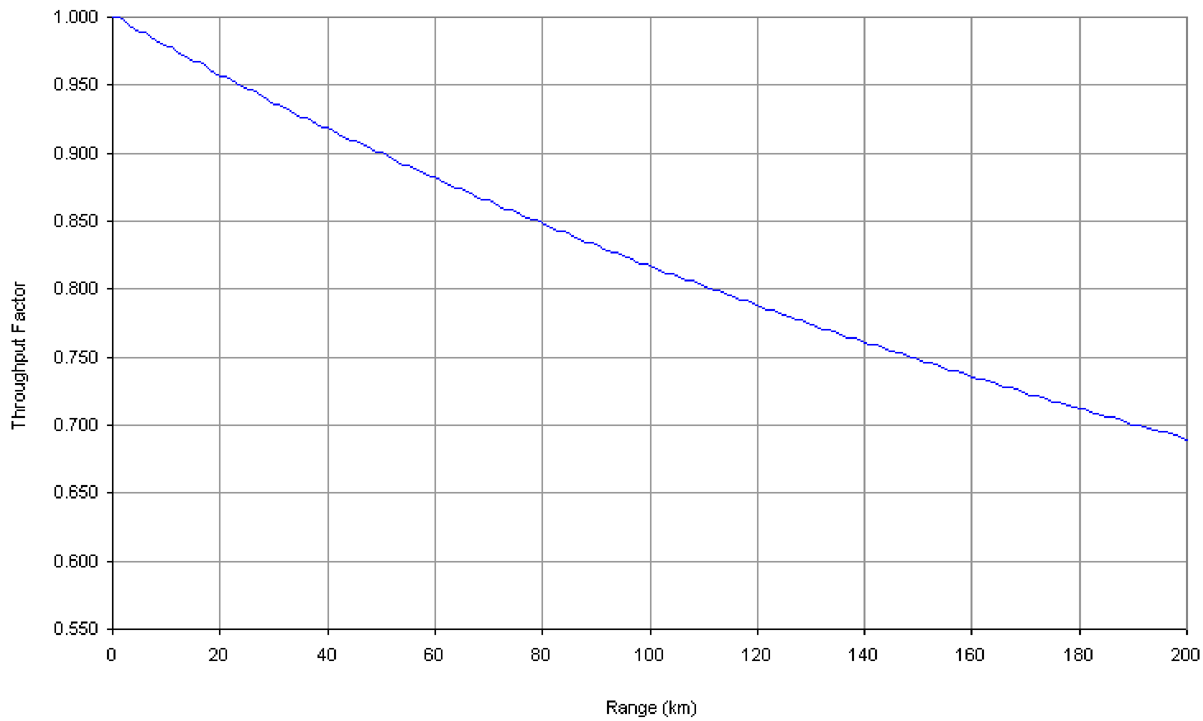


Figure 171 – PTP 600 Range Adjustment for Data Rates, Curve F

Channel Bandwidth = 20 or 15 MHz, Link Symmetry = 1:1 or 2:1, Link Optimization = IP.

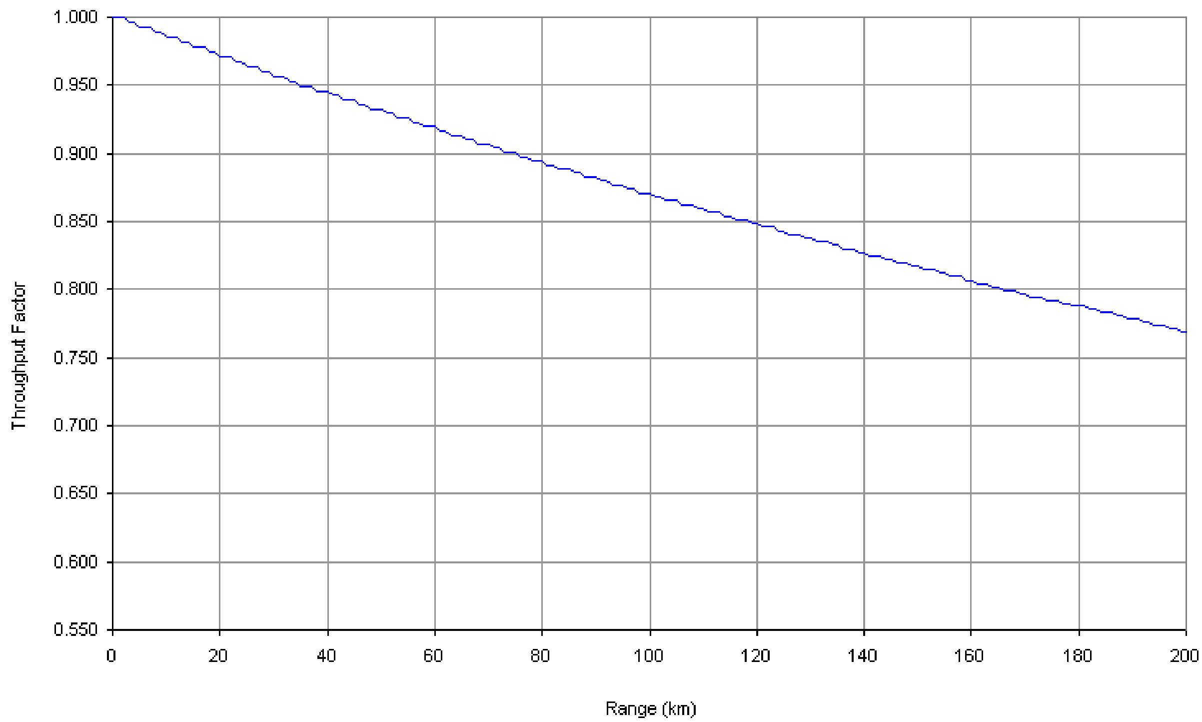


Figure 172 – PTP 600 Range Adjustment for Data Rates, Curve G

Channel Bandwidth = 20 or 15 MHz, Link Symmetry = 1:1, Link Optimization = TDM.

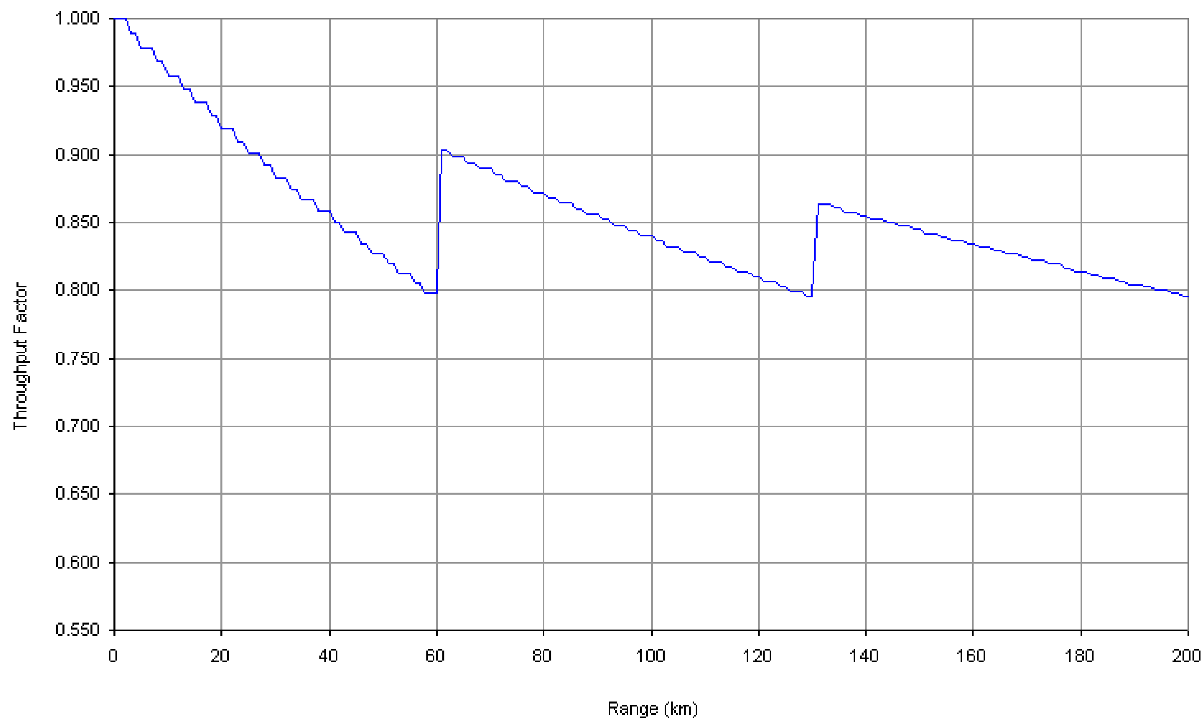


Figure 173 – PTP 600 Range Adjustment for Data Rates, Curve H

Channel Bandwidth = 20 or 15 MHz, Link Symmetry = 2:1, Link Optimization = TDM, DFS = None.

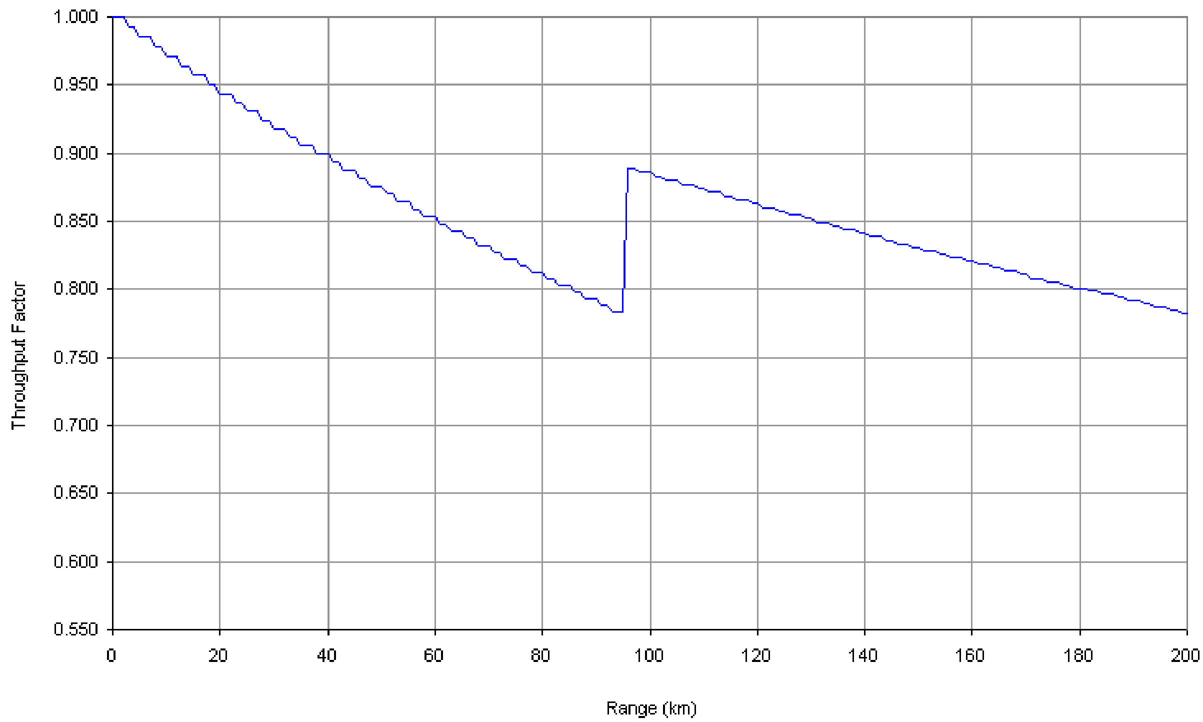


Figure 174 – PTP 600 Range Adjustment for Data Rates, Curve I

Channel Bandwidth = 20 or 15 MHz, Link Symmetry = Adaptive, Link Optimization = IP.

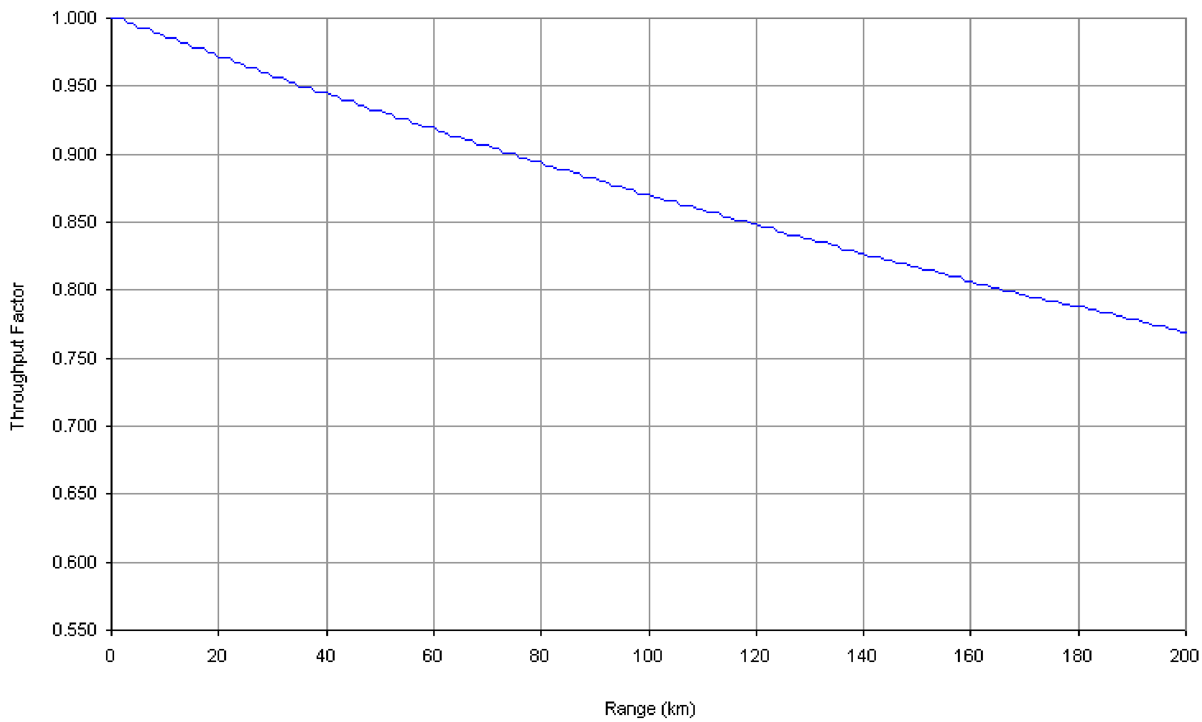


Figure 175 – PTP 600 Range Adjustment for Data Rates, Curve J

Channel Bandwidth = 10 MHz, Link Symmetry = 1:1, Link Optimization = IP.

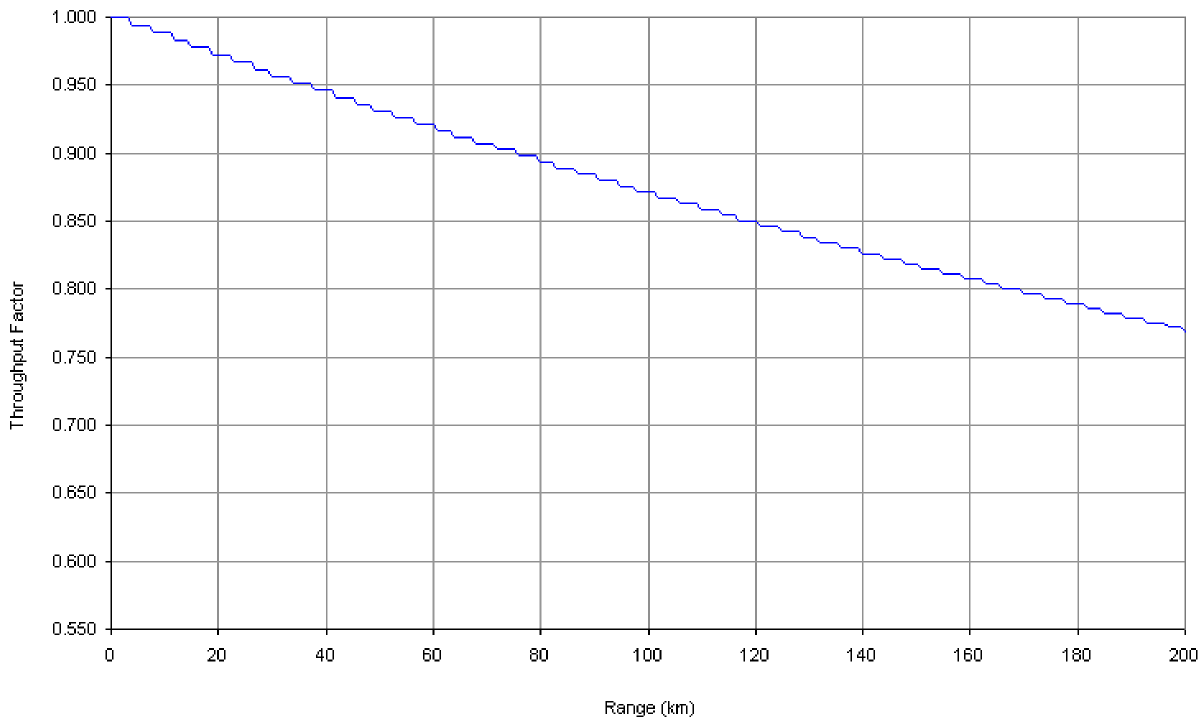


Figure 176 – PTP 600 Range Adjustment for Data Rates, Curve K

Channel Bandwidth = 10 MHz, Link Symmetry = 1:1, Link Optimization = TDM.

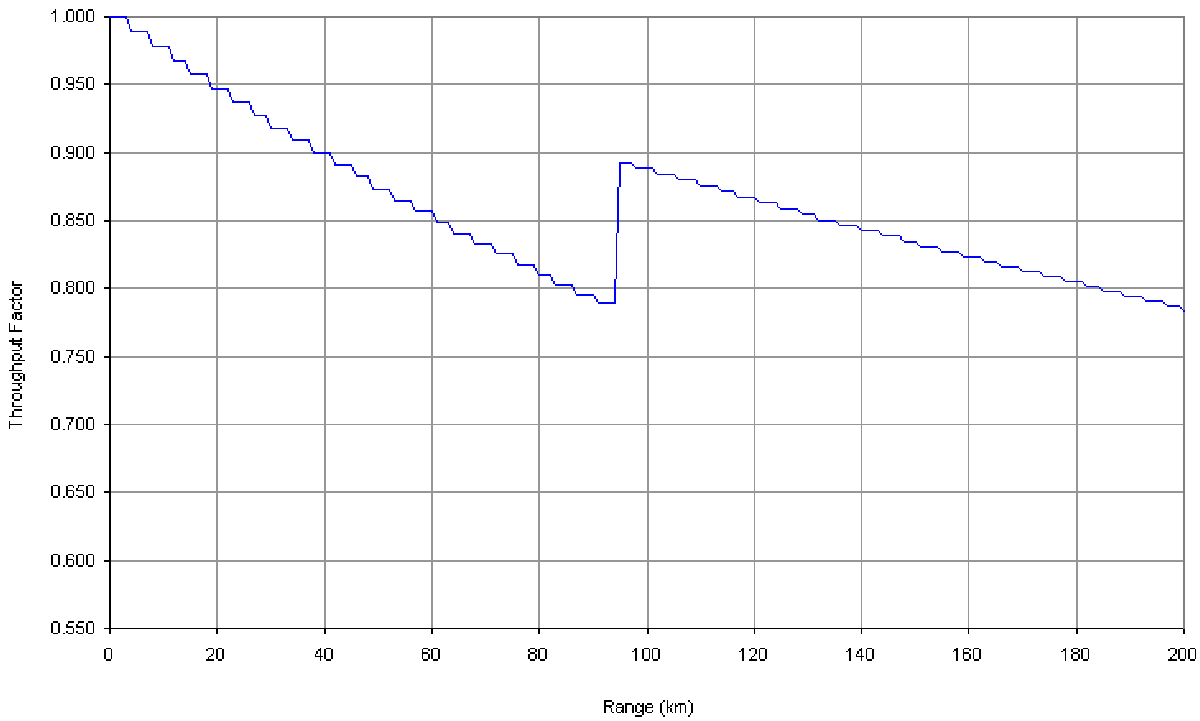


Figure 177 – PTP 600 Range Adjustment for Data Rates, Curve L

Channel Bandwidth = 10 MHz, Link Symmetry = 2:1 or Adaptive.

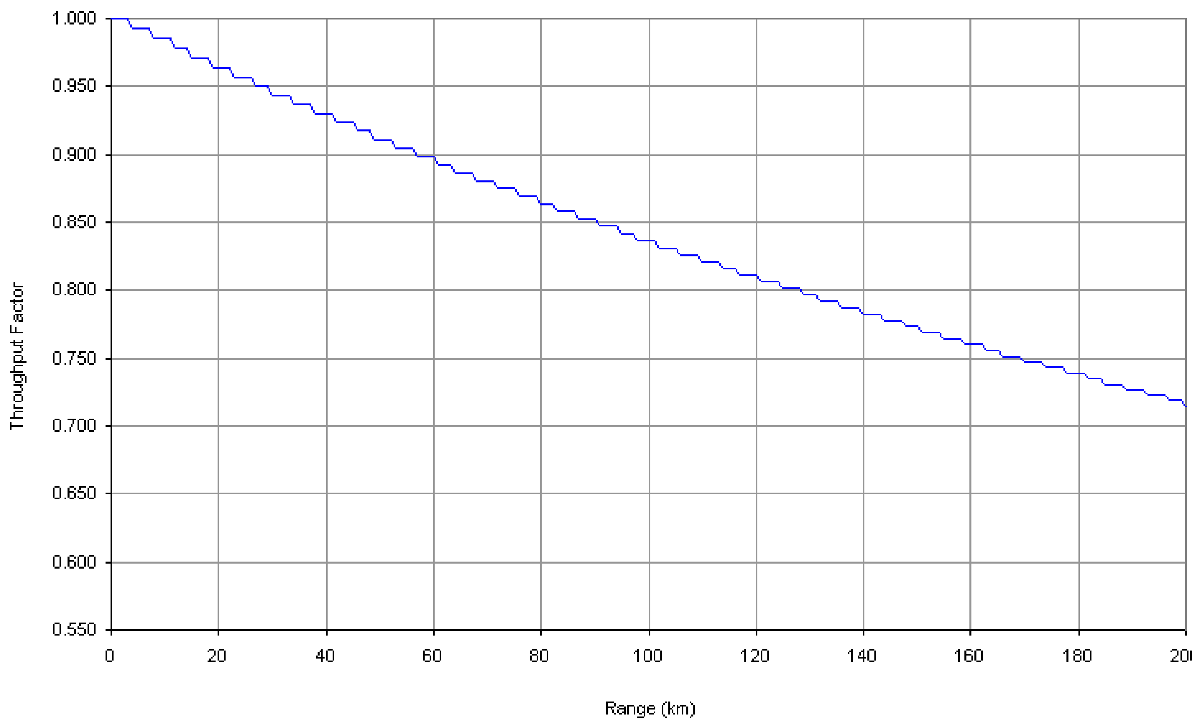
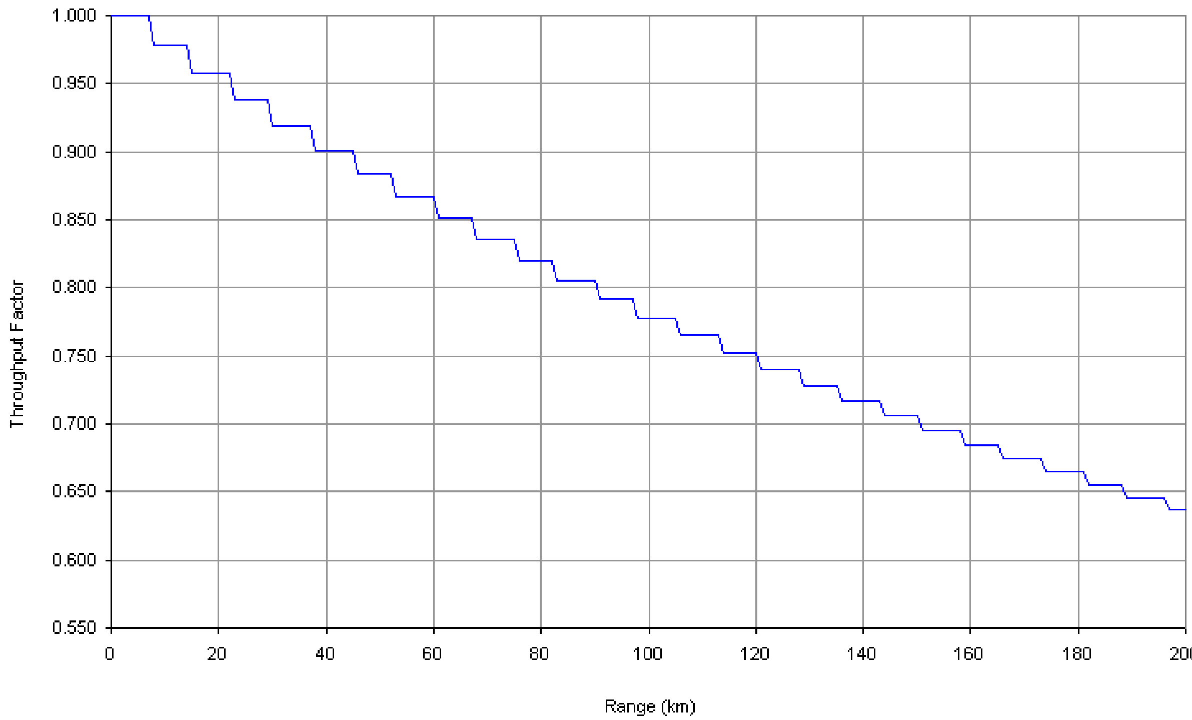


Figure 178 – PTP 600 Range Adjustment for Data Rates, Curve M

Channel Bandwidth = 5 MHz, Link Symmetry = 1:1.



17 AES Encryption Upgrade

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

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

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

- 128-bit
- 128 and 256-bit

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

17.1 Configuring Link Encryption

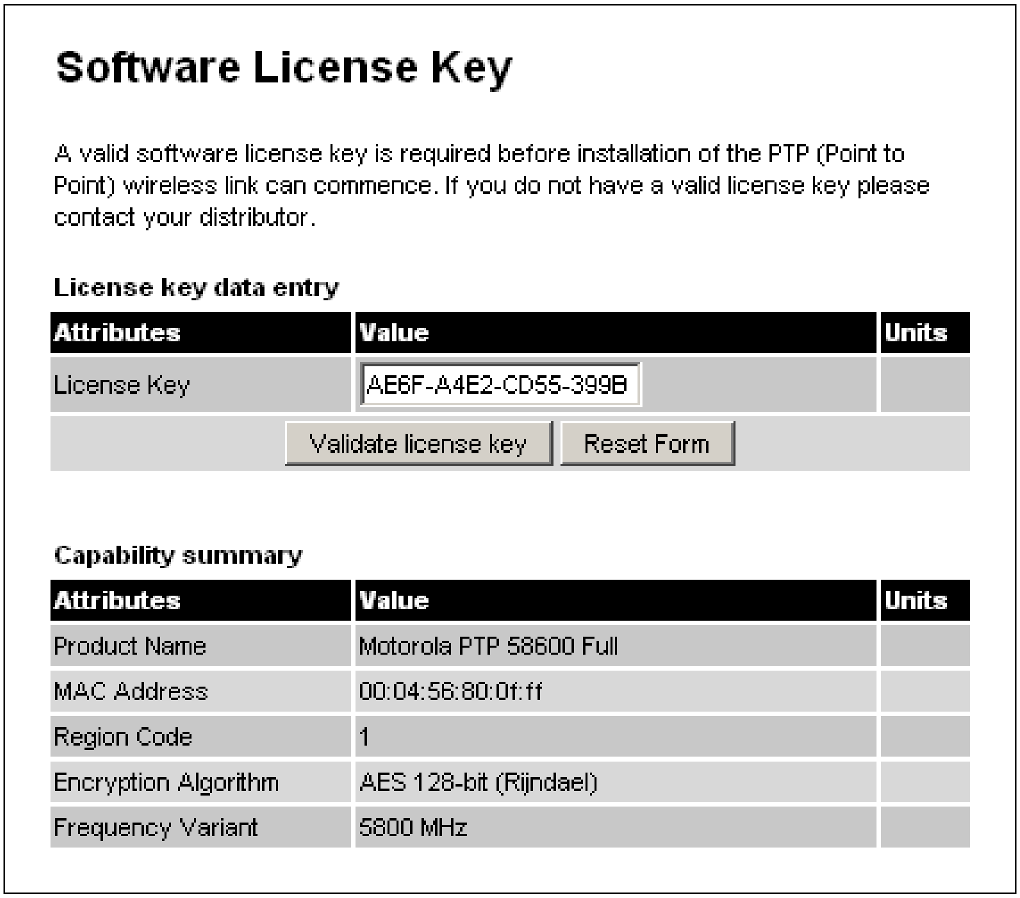
After purchasing AES encryption for the PTP 600 Series wireless link, two new license keys will be issued, one for each end of the wireless link. The following configuration process gives a step by step guide to enabling AES link encryption on a PTP 600 Series bridge.

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 179 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 179 – 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)

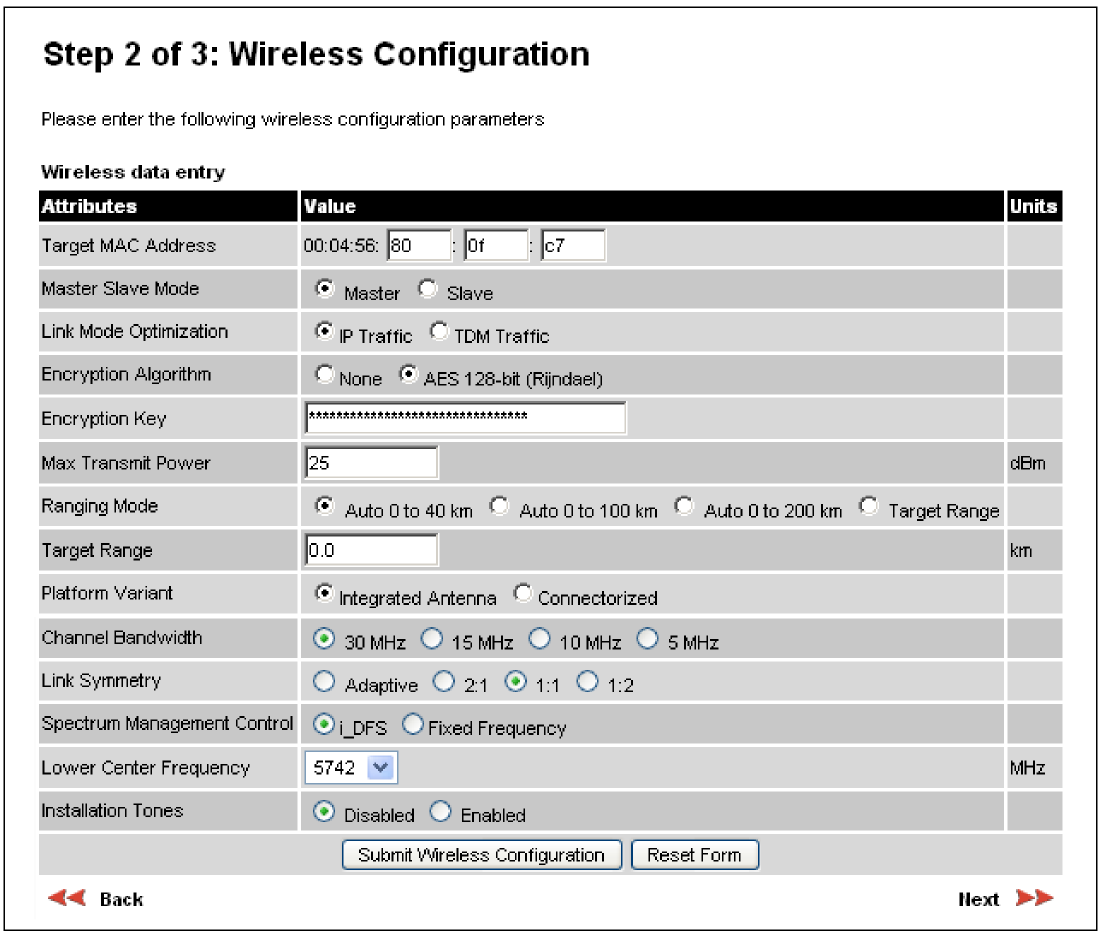
4. When both license keys have been successfully validated confirm the reboot for both ends of the link. The software is designed to allow five seconds so that a user can command both ends of the link to reset before the wireless link drops.

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 180 be used to configure AES link encryption.

Figure 180 – AES Configuration Data Entry Page



Step 2 of 3: Wireless Configuration

Please enter the following wireless configuration parameters

Wireless data entry

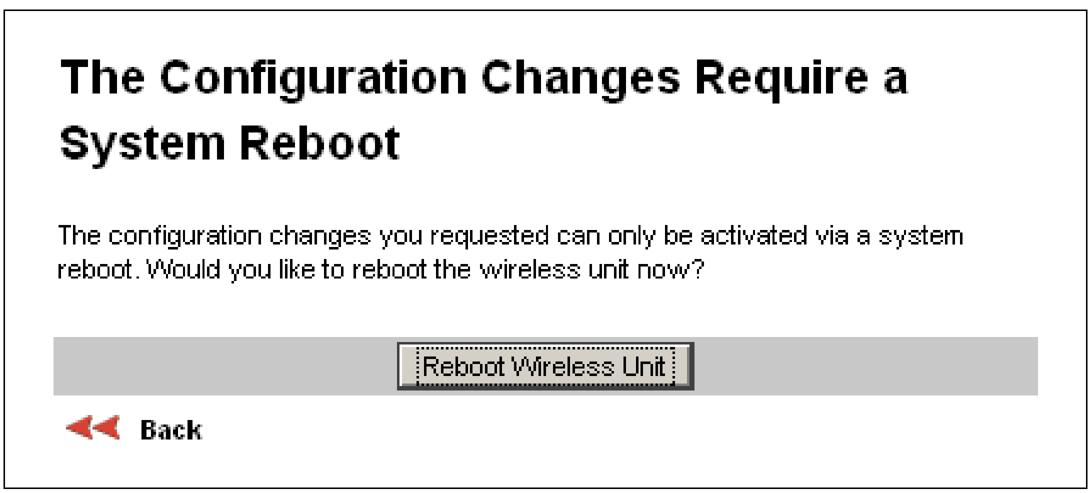
Attributes	Value	Units
Target MAC Address	00:04:56: 80 : 0f : c7	
Master Slave Mode	Master Slave	
Link Mode Optimization	IP Traffic TDM Traffic	
Encryption Algorithm	None AES 128-bit (Rijndael)	
Encryption Key	********************************	
Max Transmit Power	25	dBm
Ranging Mode	Auto 0 to 40 km Auto 0 to 100 km Auto 0 to 200 km Target Range	
Target Range	0.0	km
Platform Variant	Integrated Antenna Connectorized	
Channel Bandwidth	30 MHz 15 MHz 10 MHz 5 MHz	
Link Symmetry	Adaptive 2:1 1:1 1:2	
Spectrum Management Control	i_DFS Fixed Frequency	
Lower Center Frequency	5742	MHz
Installation Tones	Disabled Enabled	
	Submit Wireless Configuration Reset Form	

Back Next

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 181. 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 181 - Configuration Reboot Screen



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 49600 variant

The system has been approved under FCC Part 90 and Industry Canada RSS-111 for Public Safety Agency usage. The installer or operator is responsible for obtaining the appropriate site licenses before installing or using the system.

FCC IDs and Industry Canada Certification Numbers are listed below:

FCC ID: QWP49100

IC:109A0-49100

19.3 National and Regional Regulatory Notices – PTP 59600 variant

19.3.1 Russia

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

Сертификат соответствия	Срок действия
ОС-1-РД-0241	с 28 октября 2008 г.

19.4 National and Regional Regulatory Notices – PTP 58600 variant

19.4.1 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.

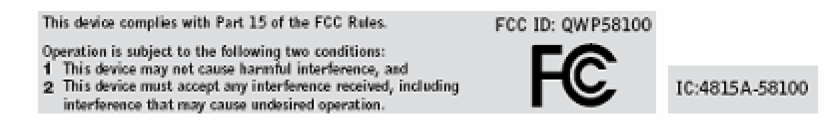
This device complies with part 15 of the US FCC Rules and Regulations and with RSS-210 of Industry Canada. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may 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 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:



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.

19.4.2 European Union Notification

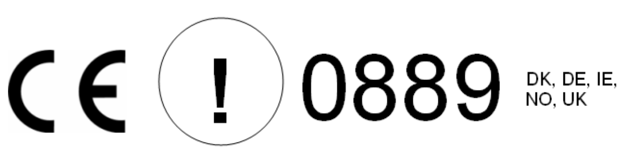
The PTP 58600 connectorized product is a two-way radio transceiver suitable for use in Broadband Wireless Access System (BWAS), Radio Local Area Network (RLAN), or Fixed Wireless Access (FWA) systems. It is a Class 2 device and uses operating frequencies that are not harmonized throughout the EU member 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, Eire (IRL), Germany, Norway and Denmark. However, the regulatory situation in Europe is changing and the radio spectrum may become available in other countries in the near future. Also see www.ero.dk for further information.

Motorola declares that the PTP 58600 product complies with the essential requirements and other relevant provisions of Directive 1999/5/EC. The declaration of conformity may be consulted at http://motorola.canopywireless.com/doc.php.

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



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

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

19.4.3 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.

19.5 National and Regional Regulatory Notices – PTP 54600 Variant

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

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:

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

19.5.2 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. Also see www.ero.dk for further information.

Motorola declares that the PTP 58600 product complies with the essential requirements and other relevant provisions of Directive 1999/5/EC. The declaration of conformity may be consulted at http://motorola.canopywireless.com/doc.php.

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

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.

19.6 National and Regional Regulatory Notices – PTP 25600 Variant

19.6.1 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:

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.

19.7 Exposure

See Section 2 “Avoiding Hazards”.

19.8 Legal Notices

19.8.1 Motorola Inc. End User License Agreement

In connection with Motorola's delivery of certain proprietary software or products containing embedded or pre-loaded proprietary software, or both, Motorola is willing to license this certain proprietary software and the accompanying documentation to you only on the condition that you accept all the terms in this End User License Agreement ("Agreement").

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.

19.8.1.1 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.

19.8.1.2 Grant of License

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20 Specifications

20.1 System Specifications

20.1.1 Wireless PTP 25600 Variant

Radio Technology	Specification
RF Band	Lower: 2.496-2.568 GHz Middle: 2.572-2.614 GHz Upper: 2.618-2.690 GHz
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	Symmetric fixed, asymmetric fixed or adaptive TDD
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	4.400-4.600 GHz
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	Symmetric fixed, asymmetric fixed or adaptive TDD
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 48600 Variant

Radio Technology	Specification
RF Band	4.710-5.000 GHz
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 and 20 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	22 dBi typical
Antenna Beamwidth	11 Degrees
Max Path Loss (5 MHz channel)	157 dB
Duplex Scheme	Symmetric fixed, asymmetric fixed or adaptive TDD
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 49600 Variant

Radio Technology	Specification
RF Band	4.900-4.990 GHz
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 and 20 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	22 dBi typical
Antenna Beamwidth	11 Degrees
Max Path Loss (5 MHz channel)	157 dB
Duplex Scheme	Symmetric fixed, asymmetric fixed or adaptive TDD
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 54600 Variant

Radio Technology	Specification
RF Band	5.470-5.725 GHz
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	Symmetric fixed, asymmetric fixed or adaptive TDD
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 Wireless PTP 58600 Variant

Radio Technology	Specification
RF Band	5.725-5.850 GHz
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	Symmetric fixed, asymmetric fixed or adaptive TDD
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

20.1.7 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	Symmetric fixed, asymmetric fixed or adaptive TDD
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

20.1.8 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

20.1.9 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.

20.1.10 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

20.1.11 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

20.1.12 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 15 (Class B)

20.3.2 PTP 45600 Variant

Region	Specification
USA - Military	

20.3.3 PTP 48600 Variant

Region	Specification
USA - Military	

20.3.4 PTP 49600 Variant

Region	Specification
USA	FCC Part 15B

20.3.5 PTP 54600 Variant

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

20.3.6 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 45600 Variant

Region	Specification (Type Approvals)
USA	FCC Part 27, NTIA Red Book, TBC

20.5.3 PTP 48600 Variant

Region	Specification (Type Approvals)
USA	FCC Part 27, NTIA Red Book, TBC

20.5.4 PTP 49600 Variant

Region	Specification (Type Approvals)
USA	FCC Part 90
Canada	RSS-111

20.5.5 PTP 54600 Variant

Region	Specification (Type Approvals)
USA	FCC Part 15 E
EU	EN301 893 V1.4.1 with DFS testing using radar parameters as defined in V1.5.1
CANADA	RSS 210 Issue 7, Annex 9

20.5.6 PTP 58600 Variant

Region	Specification (Type Approvals)
USA	FCC Part 15.247
CANADA	RSS 210 Issue 7, Annex 8
UK	IR 2007
Eire	ComReg 02/71R1
EU	EN302 502 v 1.2.1

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 182 - Cable Connection Diagram (T568B Color Coding)

Table 54 - 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
ARQ	Automatic Repeat reQuest
BPSK	Binary Phase Shift Keying
DC	Direct Current
DFS	Dynamic Frequency Selection
ETSI	European Telecommunications Standards Institute
FAQ	Frequently Asked Question
GPS	Global Positioning System
HP	Hypertext Transfer Protocol
ID	Identity
IEEE	Institute of Electrical and Electronic Engineers
IP	Internet Protocol
IQ	In phase / Quadrature
ISM	Industrial Scientific and Medical
I	International Telecommunications Union
LAN	Local Area Network
MAC	Medium Access Control Layer
MDI	Medium Dependent Interface
MDIX	Medium Dependent Interface Crossover
NLOS	non-Line-of-Sight
ODU	Outdoor Unit
OFDM	Orthogonal Frequency Division Multiplex
PC	IBM Compatible Personal Computer
PIDU +	Power Indoor Unit Plus
PING	Packet Internet Groper
POE	Power over Ethernet
PSU	Power Supply Unit
PTP	Point-to-Point
QAM	Quadrature Amplitude Modulation
RAM	Random Access Memory
STC	Space Time Coding
STP	Shielded Twisted Pair
TCP	Transmission Control Protocol
TPC	Transmit Power Control
URL	Universal Resource Location
USA	United States of America
UTP	Unshielded Twisted Pair
UV	Ultraviolet
VLAN	Virtual Local Area Network

23 Index

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