



# PTP 600 Series User Guide



MOTOROLA POINT-TO-POINT WIRELESS SOLUTIONS

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# Important safety information

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This section describes important safety guidelines that must be observed by personnel installing or operating PTP 600 equipment.

**⚠ WARNING**

**To prevent loss of life or physical injury, observe the safety guidelines in this section.**

## Power lines

Exercise extreme care when installing antennas near power lines.

## Working at heights

Exercise extreme care when working at heights.

## Grounding and protective earth

The Outdoor Unit (ODU) 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.

## Grounding PTP-SYNC

In order to meet the safety requirements for deployment in Australia and New Zealand (AS/NZS 60950-1), the PTP Sync unit, if deployed, must be grounded to a Protective Earth in accordance with Local Electrical Regulations.

## PIDU Plus

It is recommended that the supplied Power Indoor Plus (PIDU Plus PTP 300/500/600 Series) is used to power the ODU. The use of other power sources may invalidate safety approval and affect your warranty.

## Powering down before servicing

Always power down and unplug the equipment before servicing.

## Cable measuring card

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.

## Non-Motorola power supply

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

## Alternative DC supplies

When using alternative DC supplies (via the PIDU Plus DC in terminals), 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).

## Primary disconnect device

The main power supply is the primary disconnect device.

## External cables

Safety may be compromised if outdoor rated cables are not used for connections that will be exposed to the weather.

## RF exposure near the antenna

Strong radio frequency (RF) fields will be present close to the antenna when the transmitter is on. Always mute the transmitter before undertaking maintenance activities in front of the antenna.

## Minimum separation distances

Install the PTP 600 ODUs so as to provide and maintain the minimum separation distances from all persons. The minimum separation distances for each frequency variant are specified in [Calculated distances and power compliance margins](#) on page 4-12.

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# About This User Guide

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This guide describes the planning, installation and operation of the Motorola PTP 600 Series of Point-to-Point Wireless Ethernet Bridges. It is intended for use by the link planner, system installer and the end user IT professional. The users of this guide will require expertise in the following areas:

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

## Revision history

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### Version information

The following shows the issue status of this document since it was first released.

Document issue	Date of issue	Remarks
008v000	Dec 2008	System release 600-08-00
008v004	Apr 2009	System release 600-08-01
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(\*) AUTHOR NOTE: Will be published as document issue 010v000.



## General information

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### Purpose

Motorola Point-To-Point documents are intended to instruct and assist personnel in the operation, installation and maintenance of the Motorola Point-To-Point equipment and ancillary devices. It is recommended that all personnel engaged in such activities be properly trained by Motorola.

Motorola disclaims all liability whatsoever, implied or express, for any risk of damage, loss or reduction in system performance arising directly or indirectly out of the failure of the customer, or anyone acting on the customer's behalf, to abide by the instructions, system parameters, or recommendations made in this document.

### Cross references

References to external publications are shown in italics. Other cross references, emphasized in blue text in electronic versions, are active links to the references.

This document is divided into numbered chapters that are divided into sections. Sections are not numbered, but are individually named at the top of each page, and are listed in the table of contents.

## Text conventions

The following conventions are used in the Motorola Point-To-Point documents to represent keyboard input text, screen output text and special key sequences.

### Input

Characters typed in at the keyboard are shown like this.

### Output

Messages, prompts, file listings, directories, utilities, and environmental variables that appear on the screen are shown like this.

### Special key sequences

Special key sequences are represented as follows:

<b>CTRL-c</b> or <b>CTRL+C</b>	Press the <b>Ctrl</b> and <b>C</b> keys at the same time.
<b>CTRL-SHIFT-c</b> or <b>CTRL+SHIFT+C</b>	Press the <b>Ctrl</b> , <b>Shift</b> , and <b>C</b> keys at the same time.
<b>ALT-f</b> or <b>ALT+F</b>	Press the <b>Alt</b> and <b>F</b> keys at the same time.
<b>ALT+SHIFT+F11</b>	Press the <b>Alt</b> , <b>Shift</b> , and <b>F11</b> keys at the same time.
	Press the pipe symbol key.
<b>RETURN</b> or <b>ENTER</b>	Press the <b>Return</b> or <b>Enter</b> key.

## Contacting Motorola

---

### Feedback

We appreciate feedback from the users of our documents. This includes feedback on the structure, content, accuracy, or completeness of our documents. Send feedback to [support.ptp@motorola.com](mailto:support.ptp@motorola.com).

### Motorola Point-to-Point

Postal Address:	Motorola, Inc., 1303 E. Algonquin Road, Schaumburg, Illinois 60196 U.S.A.
Web Site:	<a href="http://www.motorola.com/ptp">http://www.motorola.com/ptp</a>
Sales Enquiries:	<a href="mailto:sales.ptp@motorola.com">sales.ptp@motorola.com</a>
Web Support:	<a href="http://www.motorola.com/ptp/support">http://www.motorola.com/ptp/support</a>
Email Support:	<a href="mailto:support.ptp@motorola.com">support.ptp@motorola.com</a>
All Other Enquiries:	<a href="mailto:info.ptp@motorola.com">info.ptp@motorola.com</a>

## WiBB Technical Support telephone numbers

Region and country	Support telephone number
<b>North America:</b>	
USA and Canada	866-961-9288
<b>Europe, Middle East and Africa:</b>	
Denmark	043682114
France	0157323434
Germany	06950070204
Italy	0291483230
Lithuania	800 030 828
Netherlands	0202061404
Norway	24159815
Portugal	0217616160
Spain	912754787
Russia	810 800 228 41044
Saudi Arabia	800 844 5345
South Africa	0800981900
United Kingdom	0203 0277499
All other countries	+44 203 0277499
<b>Latin and Central America:</b>	
Argentina	0800-666-2789
Brazil	0800-891-4360

Region and country	Support telephone number
Chile	800-225-288
Columbia	01-800-912-0557
Mexico	001-800-942-7721
Peru	0800-70-086
All other countries	+420 533 336 946
<b>Asia, Pacific and China:</b>	
Australia	800 457 439
Singapore	64 155 110
All other countries	+420 533 336 946

## Reporting problems

If any problems are encountered when installing or operating this equipment, follow this procedure to investigate and report:

1. Search this document and the software release notes of supported releases.
2. Visit the Motorola website at <http://ww.motorola.com/ptp>.
3. Ask for assistance from the Motorola products supplier.
4. Gather information from affected units such as:
  - o The IP addresses and MAC addresses
  - o The software releases
  - o The configuration of software features
  - o Any available diagnostic downloads
5. Escalate the problem to Motorola as follows:
  - o Either: send e-mail to [support.ptp@motorola.com](mailto:support.ptp@motorola.com)
  - o Or: call WiBB Technical Support.

For warranty assistance, contact the reseller or distributor.

## Repair and service

For unit repair or service, contact the PTP Global Technical Support Center for Return Material Authorization (RMA) and shipping instructions. The Global Technical Support Center is contacted at:

<http://www.motorola.com/ptp/support>

Further details of the RMA process are available at:

<http://www.motorola.com/ptp/support>

## 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 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.

Details of Motorola's Extended Warranty Program are available at:

<http://www.motorola.com/ptp/support>

Please register your PTP products at:

<http://www.motorola.com/ptp/support>

### CAUTION

Using non-Motorola parts for repair could damage the equipment or void warranty. Contact Motorola Warranty and Repair for service and repair instructions.

### CAUTION

Portions of Motorola equipment may be damaged from exposure to electrostatic discharge. Use precautions to prevent damage.

## Security advice

---

Motorola systems and equipment provide security parameters that can be configured by the operator based on their particular operating environment. Motorola recommends setting and using these parameters following industry recognized security practices. Security aspects to be considered are protecting the confidentiality, integrity, and availability of information and assets. Assets include the ability to communicate, information about the nature of the communications, and information about the parties involved.

In certain instances Motorola makes specific recommendations regarding security practices, however the implementation of these recommendations and final responsibility for the security of the system lies with the operator of the system.

## Warnings, cautions, and notes

---

The following describes how warnings and cautions are used in this document and in all documents of this Motorola document set.

### Warnings

Warnings precede instructions that contain potentially hazardous situations. Warnings are used to alert the reader to possible hazards that could cause loss of life or physical injury. A warning has the following format:



**Warning text and consequence for not following the instructions in the warning.**

### Cautions

Cautions precede instructions and are used when there is a possibility of damage to systems, software, or individual items of equipment within a system. However, this damage presents no danger to personnel. A caution has the following format:



Caution text and consequence for not following the instructions in the caution.

### Notes

A note means that there is a possibility of an undesirable situation or provides additional information to help the reader understand a topic or concept. A note has the following format:



Note text.



## Caring for the environment

---

The following information describes national or regional requirements for the disposal of Motorola supplied equipment and for the approved disposal of surplus packaging.

### In EU countries

The following information is provided to enable regulatory compliance with the European Union (EU) directives identified and any amendments made to these directives when using Motorola equipment in EU countries.



### Disposal of Motorola equipment

*European Union (EU) Directive 2002/96/EC Waste Electrical and Electronic Equipment (WEEE)*

Do not dispose of Motorola equipment in landfill sites. In the EU, Motorola in conjunction with a recycling partner ensures that equipment is collected and recycled according to the requirements of EU environmental law.

### Disposal of surplus packaging

Do not dispose of surplus packaging in landfill sites. In the EU, it is the individual recipient's responsibility to ensure that packaging materials are collected and recycled according to the requirements of EU environmental law.

### In non-EU countries

In non-EU countries, dispose of Motorola Networks equipment and all surplus packaging in accordance with national and regional regulations.



# Chapter 1 Product description

---

This chapter provides a high level description of the PTP 600 product. It describes in general terms the function of the product, the main product variants and typical deployment. It also describes the main hardware components.

The following topics are described in this chapter:

- [Product function](#) on page 1-2
- [Typical deployment](#) on page 1-3
- [Product variants](#) on page 1-4
- [Outdoor unit \(ODU\)](#) on page 1-6
- [PIDU Plus PTP 300/500/600 Series](#) on page 1-9
- [Cables and connectors](#) on page 1-15
- [PTP and lightning protection](#) on page 1-18
- [Wireless operation](#) on page 1-19
- [Ethernet bridging](#) on page 1-33
- [Telecoms circuits](#) on page 1-36
- [System management](#) on page 1-38
- [FIPS 140-2](#) on page 1-52

## Product function

---

The PTP 600 Series Bridge has been developed to provide Point-to-Point data connectivity via a wireless Ethernet bridge operating at broadband data rates.

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.

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.

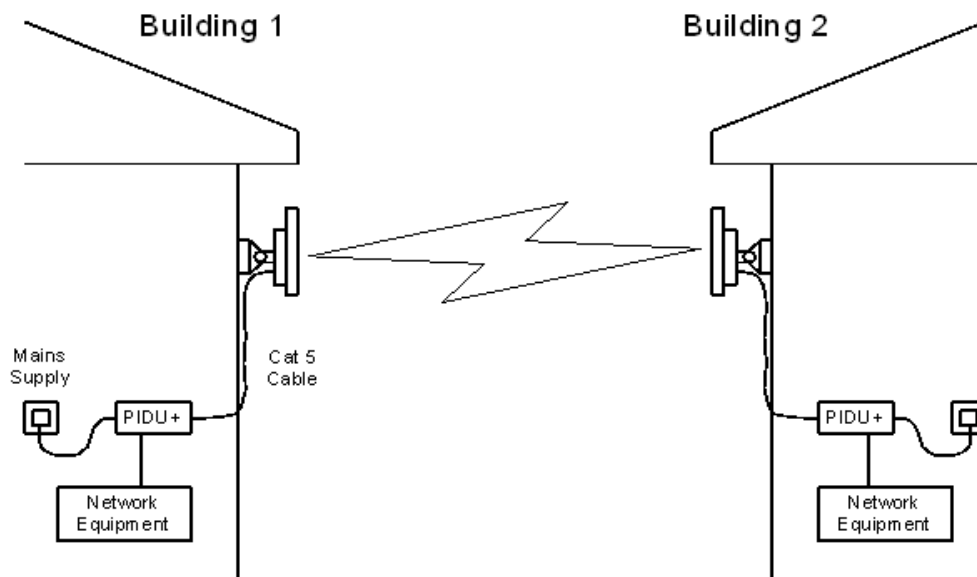
## Typical deployment

---

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 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 1-1](#).

**Figure 1-1** Typical PTP 600 Series bridge deployment



Each end of the link consists of:

- **Outdoor Unit (ODU):** An integrated (or connectorized - see [Chapter 8 Connectorized PTP 600 series](#)) outdoor transceiver unit containing all the radio and networking electronics.
- **PIDU Plus:** An indoor connection box containing a mains power supply, status indicators and network connection port.

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

## Product variants

---

### Frequency variants

The PTP 600 Series has been developed to operate within license exempt frequency bands as well as the licensed 2.5 GHz band in the USA. The frequency variants are listed in [Table 1-1](#).

**Table 1-1** PTP 600 Series frequency variants

Variant	Region	Frequency Coverage	Variable Channel Bandwidth	Channel Raster
PTP 25600	FCC BRS-EBS Post-Transition Band	2496-2568 MHz	5, 10, 15, 30 MHz	5.5 MHz
		2572-2614 MHz	5, 10, 15, 30 MHz	6 MHz
		2618-2690 MHz	5, 10, 15, 30 MHz	5.5 MHz
PTP 45600	US Federal	4404-4596 MHz	5, 10, 15, 20 MHz	6 MHz
		4404-4596 MHz	30 MHz	10 MHz
	NTIA	4400-4600 MHz	10, 20 MHz	6 MHz
PTP 48600	US Federal	4710-4940 MHz	5, 10, 15, 20, MHz	5 MHz
	US Federal Extended	4710-5000 MHz	5, 10, 15, 20, MHz	5 MHz
	NTIA	4700-4940 MHz	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	5470-5725 MHz	5, 10, 15 MHz	6 MHz
	FCC UNII Band	5470-5725 MHz	30 MHz	10 MHz
PTP	ETSI 5 GHz Band C	5725-5850 MHz	5, 10, 15 MHz	6 MHz

Variant	Region	Frequency Coverage	Variable Channel Bandwidth	Channel Raster
58600	FCC ISM Band	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.

For PTP 58600 ETSI 5 GHz Band C, use of the product is only allowed where permitted by country-specific regulations.

## Other product variants

The Lite versions have lower data throughput rates than the Full versions.

The PTP 600 outdoor unit (ODU) may be integrated (with its own antenna) or connectorized (with a separate antenna).

## Outdoor unit (ODU)

---

The ODU is a self-contained unit. It houses both radio and networking electronics. The ODU for the PTP 600 Series should only be deployed using the supplied PIDU PTP 300/500/600 Series. [Figure 1-2](#) shows an installation example of a PTP 600 Series ODU with a Motorola lightning protection unit (PTP-LPU).

**Figure 1-2** PTP 600 Series outdoor unit (ODU) with PTP-LPU





## Mounting brackets

The ODU is supplied with a bracket for mounting it to a pole of 50mm (2") to 75mm (3") in diameter. For more details on mounting, see [Chapter 3](#)

The bracket allows for adjustment in both azimuth and elevation. The bracket may be split to allow 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 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 [PIDU Plus PTP 300/500/600 Series](#) on page 1-9.

## Network connection

The network connection to a PTP 600 Series 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 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 1-3](#).

**Figure 1-3** Mod record label



Alternatively, the network connection to a PTP 600 Series 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 will automatically fall back to the copper Ethernet connection (provided the cable length  $\leq 100\text{m}$  [330 ft]). "PTP 600 Series Optical Interface Upgrade Kits" can be obtained from your distributor, reseller or system integrator.

## PIDU Plus PTP 300/500/600 Series

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The PIDU Plus PTP 300/500/600 Series ([Figure 1-4](#)) is used to generate the ODU supply voltage from the mains supply (or from an external DC source) and inject this supply voltage into the 1000BaseT Ethernet connection to the ODU. The PIDU is connected to the ODU and network equipment using CAT5e cable with standard RJ45 connectors.

### CAUTION

Care should be taken not to connect equipment other than an ODU or LPU for the PTP 600 Series to a PIDU ODU port, as equipment damage may occur. The PIDU Plus PTP 300/500/600 Series is not interchangeable with the PIDU Plus PTP 400 Series.

**Figure 1-4** Power indoor unit (PIDU Plus PTP 300/500/600 Series)



## Power and Ethernet LEDs

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

- The Power indicator is illuminated when the PIDU 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 [Chapter 7 Troubleshooting](#) for further fault finding information.

## ODU, LAN and recovery

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

**Figure 1-5** PIDU Plus recovery switch location



The Recovery switch is used to recover the unit from configuration errors or software image corruption. To put an ODU 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 [Using recovery mode](#) on page 7-20.

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

## DC In and Out

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 from an external DC source or to provide a level of power supply redundancy, as shown in [Redundancy and alternative powering configurations](#) on page 1-11.

## Remote connectors and jumpers

Also on the left hand side of the 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 [Remote LEDs and recovery switch](#) on page 1-14.

## Mains connection

The input supply range for the 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 1-6** PIDU Plus power input



## Redundancy and alternative powering configurations

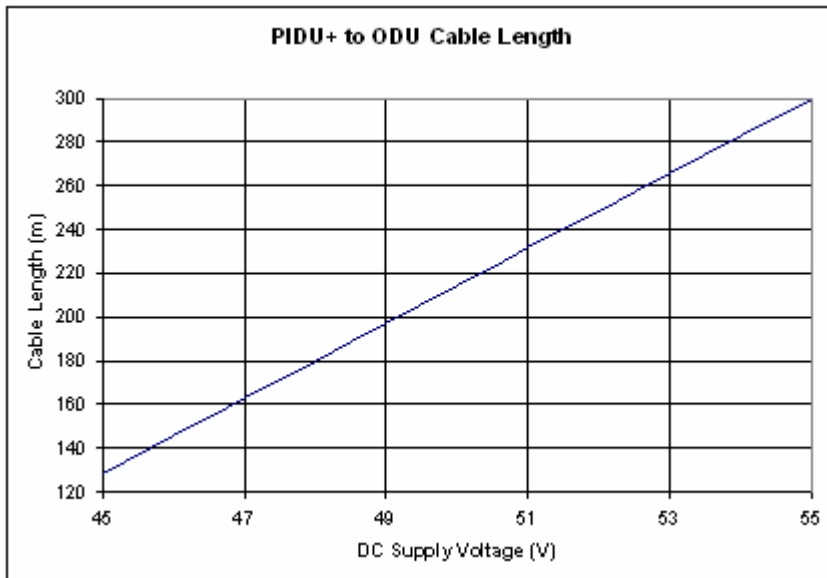
The PTP 600 Series can be powered from an external DC source and can be provided with power supply redundancy as follows:

- External DC supply only ([Figure 1-8](#)): This configuration is for use where there is no mains supply.
- External DC supply and AC supply ([Figure 1-9](#)): This configuration provides redundancy through the use of mains and DC supply.
- External DC supply and redundant AC Supply ([Figure 1-10](#)): This configuration guards against mains failure and failure of the DC output of single PTP 300/500/600 PIDU Plus.

### NOTE

The use of DC supplies of less than 55v will reduce the usable distance between the PIDU Plus and ODU ([Figure 1-7](#)).

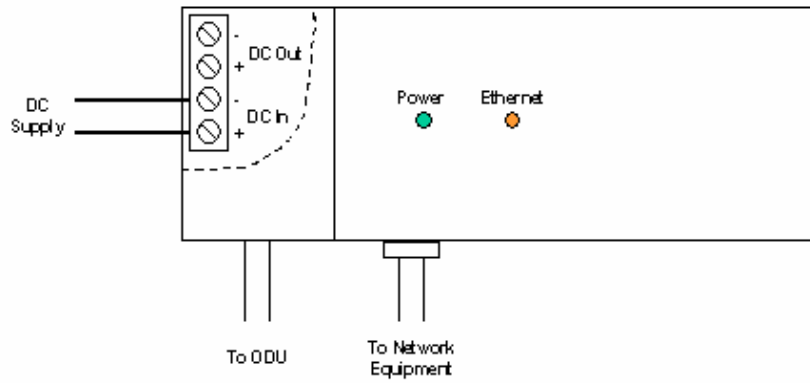
**Figure 1-7** Relationship between DC voltage and cable length



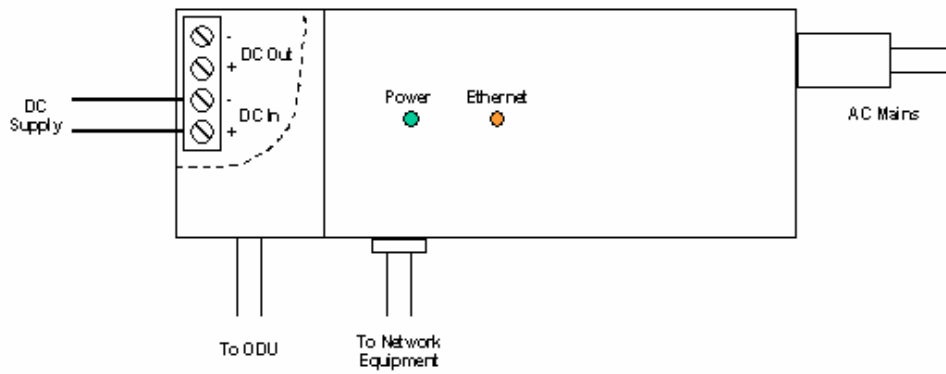
**CAUTION**

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.

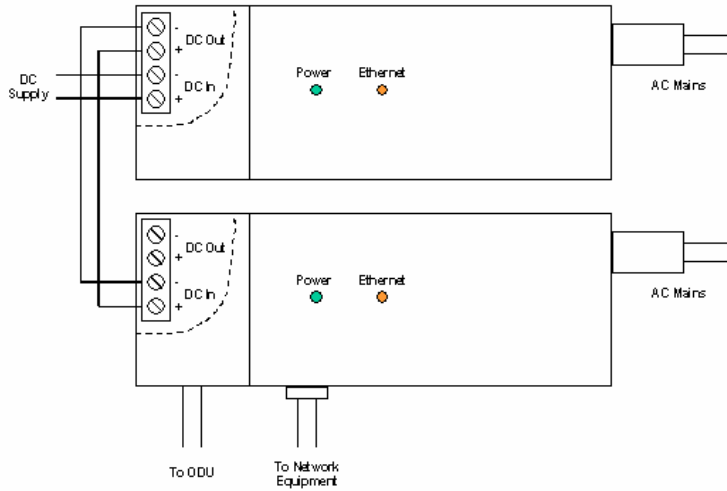
**Figure 1-8** External DC supply only



**Figure 1-9** External DC supply and AC supply



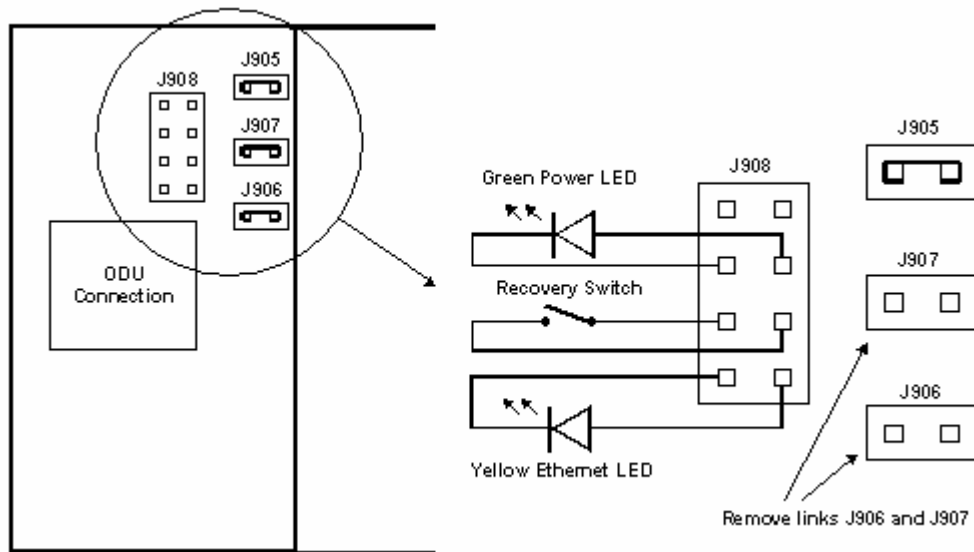
**Figure 1-10** External DC supply and redundant AC supply



## Remote LEDs and recovery switch

The 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 1-11](#).

**Figure 1-11** Remote LED and recovery switch wiring





## Cables and connectors

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### Outdoor connections

The term 'drop cable' refers to the cable that is used for all connections that terminate outside the building, that is for connections between the ODU, LPUs (if installed), GPS receiver (if installed) and the ODU port of the PIDU Plus.

#### Supported Superior Essex cable

The only type of outdoor drop cable supported by Motorola is Superior Essex CAT5e, which is UV resistant and has a screened shield. The available lengths and part numbers are specified in [Table 1-2](#).

#### CAUTION

Alternative types of drop cable are not supported by Motorola, as they may increase the risk of lightning damage to the installation. See [Lightning protection](#) on page [2-18](#).

**Table 1-2** Supported Superior Essex cable - available lengths and part numbers

Length	Part number
1000 ft	BBDGe 04-001-55
2500 ft	BBDGe 04-002-55
5000 ft	BBDGe 04-003-55
Cut to length	BBDGe 04-601-55

## Connectors and glands for outdoor use

The recommended connectors and glands to be used for connecting the supported Superior Essex cable to the ODU or LPU are specified in [Table 1-5](#).

**Table 1-3** Recommended outdoor connectors for ODU and LPU

Item	Manufacturer	Part number
Connector	Tyco (AMP)	5-569278
Crimp tool	Tyco (AMP)	2-231652
Die set	Tyco (AMP)	1-8534400-0
Gland	Motorola	WB1811

The recommended connectors and glands to be used for connecting the supported Superior Essex cable to the Trimble GPS receiver are specified in [Table 1-4](#).

**Table 1-4** Recommended outdoor connectors for Trimble GPS receiver

Item	Manufacturer	Part number
12 way circular connector	Deutsch	IMC26-2212X
Size 22 crimp socket	Deutsch	6862-201-22278
Crimp tool	Daniels Manufacturing Corp	MH860
Positioner	Daniels Manufacturing Corp	86-5
Insertion / extraction tool	Deutsch	6757-201-2201
Adaptor	Deutsch	IMC2AD
Self amalgamating tape		

## Indoor connections

The cable used for indoor connections, for example from the PIDU Plus to the network, can be any standard screened or unscreened CAT5e cable. The recommended connectors and glands to be used for indoor cables are specified in [Table 1-5](#).

**Table 1-5** Recommended indoor CAT5e connectors

Item	Manufacturer	Part number
Connector	Tyco (AMP)	336330-1
Crimp tool	Tyco (AMP)	790163-1 (includes die set)

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 requires cross-over cables (MDI-X networks) or straight-through cables (MDI Networks).

## PTP and lightning protection

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The PIDU Plus meets the low level static discharge specifications identified in [European EMC immunity compliance](#) on page 4-9 but does not provide lightning or surge suppression.

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

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 [Lightning protection](#) on page 2-18.

### CAUTION

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

The PTP 600 Series 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 [Lightning protection](#) on page 2-18.

## Wireless operation

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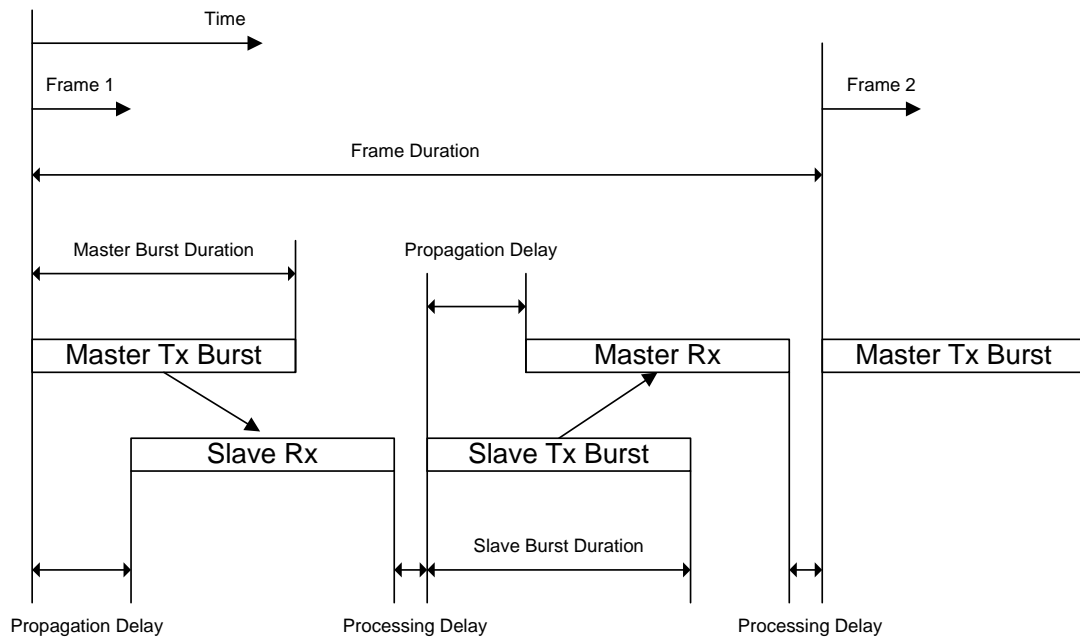
### Time division duplex

PTP 600 series links use a duplexing scheme known as Time Division Duplex (TDD). TDD operates by only allowing one end of the link to transmit at any one time. This allows both link directions to operate on the same radio frequency, although this is not mandatory. This differs from Frequency Division Duplex (FDD), where each end can transmit and receive simultaneously but this does require the two directions to operate on different frequencies, thereby increasing the demand for spectrum. TDD operates cyclically, with the transmissions alternating between the two ends. The cycle of events is illustrated in [Figure 1-12](#), with the sequence being described as follows:

1. Master transmits a burst to the Slave.
2. A delay occurs as the Master burst propagates over the air.
3. Slave receives the burst from the Master.
4. A delay as the Slave processes the burst.
5. The slave transmits a burst to the Master.
6. A delay as the slave burst propagates over the air.
7. Master receives the burst from the Slave.
8. A delay as the Master processes the burst.
9. Master transmits the next burst to the Slave.

A transmission from either end is called a burst. The length of the burst is called the Burst Duration. One cycle is called a TDD Frame. The cycle period is called the Frame Duration. To make the illustration more clear, the duration of the processing delays and propagation delays have been exaggerated compared to the Burst Durations.

**Figure 1-12** The TDD cycle of events



The Master PTP 600 automatically controls the structure of the TDD Frame, optimizing Burst Duration and Frame Duration for either maximum capacity or minimum latency depending on the setting of Link Mode Optimization and Link Symmetry.

When TDD synchronization is enabled (see [TDD synchronization configuration](#) on page 6-66), the user must configure the TDD Frame which includes configuration of Burst Duration and Frame Duration.

## Link mode optimization

Link mode optimization allows the PTP 600 link to be optimized according to the type of traffic that will be bridged. The link supports two modes, IP Traffic and TDM Traffic.

### IP traffic

IP Traffic mode is optimized to provide the maximum possible link capacity. IP Traffic mode is an appropriate choice where applications in the bridged networks provide some measure of reliable transmission, and where very low latency is not critical. IP mode supports both fixed and adaptive link symmetry (see [Link symmetry](#) on page 1-21).

## TDM traffic

TDM Traffic mode is optimized to provide the lowest possible latency. TDM Traffic mode additionally implements a more conservative approach to adaptive modulation, leading to lower error rates in fading channels at the expense of slightly lower link capacity. TDM Traffic mode is an appropriate choice for delay intolerant data without reliable transmission (for example voice over IP data). TDM mode is selected automatically when Telecom interfaces are enabled.

## Link symmetry

The PTP 600 series provides four configuration options for apportioning the available capacity between the two link directions.

- **Symmetric:** The Master and Slave have equal capacity. The PTP 600 series achieves this by allocating an equal Burst Duration for the Master and the Slave.
- **2:1** The capacity in the direction Master to Slave is twice that of the direction Slave to Master. The PTP 600 series achieves this by setting the Burst Duration of the Master to twice that of the Slave. Note that this mode is not available when TDD synchronization is enabled (see section *TDD Synchronization*)
- **1:2** The capacity in the direction Slave to Master is twice that of the direction Master to Slave. The PTP 600 series achieves this by setting the Burst Duration of the Slave to twice that of the Master.

### NOTE

This mode is not available when TDD synchronization is enabled (see [Time division duplex synchronization](#) on page 1-25).

- **Adaptive:** The capacity allocated to a given link direction is dependant on the offered level of network traffic in both link directions. If the level of offered traffic in both directions is equally high or equally low, the PTP 600 will allocate equal capacity to both directions. If however the offered level of traffic is greater in one direction, it is allocated a greater proportion of the overall link capacity. The PTP 600 series achieves this by increasing (or decreasing) the duration of the Transmit Burst in a given link direction as the offered level of network traffic increases (or decreases) in this same direction. This is done independently for the two directions.

### NOTE

This mode is not available in the following configurations :

- When link mode optimization is set to TDM Traffic see [Link mode optimization](#) on page 1-20).
- When TDD synchronization is enabled (see [Time division duplex synchronization](#) on page 1-25).
- In regions where radar avoidance is operational (see [Radar avoidance](#) on page 1-24).

## OFDM and channel bandwidth

The PTP 600 series transmits using Orthogonal Frequency Division Multiplexing (OFDM). This wideband signal consists of many equally spaced sub-carriers. Although each sub carrier is modulated at a low rate using conventional modulation schemes, the resultant data rate from all the sub-carriers is high. OFDM works exceptionally over a Non-Line-of-Sight (NLoS) channel.

The channel bandwidth of the OFDM signal is configurable to one of five values: 5 MHz, 10 MHz, 15 MHz, 20 MHz and 30 MHz. Higher bandwidths provide greater link capacity at the expense of using more spectrum. Systems configured for a narrower channel bandwidth provide better receiver sensitivity and can also be an appropriate choice in deployments where the amount of free spectrum is limited.

### NOTE

The Channel Bandwidth must be configured to the same value at both ends of the link.

Not all channel bandwidths are available in all regions or all frequency variants.

## Adaptive modulation

The PTP 600 series can transport data over the wireless link using a number of different modulation modes ranging from 256QAM 0.81 to BPSK 0.63. For a given channel bandwidth and TDD frame structure, each modulation mode transports data at a fixed rate. Also, the receiver requires a given signal to noise ratio in order to successfully demodulate a given modulation mode. Although the more complex modulations such as 256QAM 0.81 will transport data at a much higher rate than the less complex modulation modes, the receiver requires a much higher signal to noise ratio.



The PTP 600 series provides an adaptive modulation scheme where the receiver constantly monitors the quality of the received signal and notifies the far end of the link of the optimum modulation mode with which to transmit. In this way, optimum capacity is achieved at all times. This is one of a number of features which allows the PTP 600 to operate in challenging none line of sight radio channels.

Specifications of capacity for all channel bandwidths, modulation modes and configurations are provided in [Data throughput capacity](#) on page 4-102.

Specifications of receive level thresholds for each modulation mode (assuming no interference) are provided in the various system threshold tables in [Chapter 4 Reference information](#).

### NOTE

Link Planner should be used to estimate the performance of a given link. Link Planner includes an estimate of mean data rate, the data rate provided by each modulation and the percentage of time spent in each modulation mode.

## MIMO

The PTP 600 transmits two signals on the same radio frequency, one which is vertically polarized, the other which is horizontally polarized. The PTP 600 also has the ability to adapt between two modes of operation:

- **Dual Payload:** When the radio channel conditions allow, the PTP 600 will transmit two different and parallel data streams, one on the vertical channel and one on the horizontal channel. This doubles the capacity of the PTP 600.
- **Single Payload:** As the radio channel becomes more challenging, the PTP 600 has the ability to detect this and switch to a mode which transmits the same data stream on both vertical and horizontal channels. This provides polar diversity and is another key feature which allows the PTP 600 to operate in challenging none line of sight radio channels.

The two modes have been implemented by the introduction of two sets of modulation modes. The lower order modulations (BPSK 0.63 up to QPSK 0.87) are only available as single payload modes. Each of the higher order modulations (16QAM 0.63 to 256QAM 0.81) are available in single payload mode and dual payload mode. The switching between modes is automatically controlled by the adaptive modulation feature described in [Adaptive modulation](#) on page 1-22.

## Intelligent dynamic frequency selection

The PTP 600 series uses an interference mitigation technique known as Intelligent Dynamic Frequency Selection (i-DFS). Both the PTP 600 Master and PTP 600 Slave continually monitor for interference on all channels and then select the best frequency of operation. This is a dynamic process where the PTP 600 can continually move channels in response to changes in interference. Two modes of operation are available, one where the two link directions are forced to select the same frequency. This is determined by the Master. The second mode is where the frequency of operation can be determined independently for each direction. This is a key feature which enables the PTP 600 to operate successfully in areas where other radio equipments are operating within the same band.

### NOTE

i-DFS is not available in the 2.5 GHz band.

## Radar avoidance

Similar to current description except that we need some words to cover the option of hopping channels in response to interference other than Radar.

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.
- Provides a uniform loading of the spectrum across all devices, that is, fixed frequency operation is not allowed.

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.

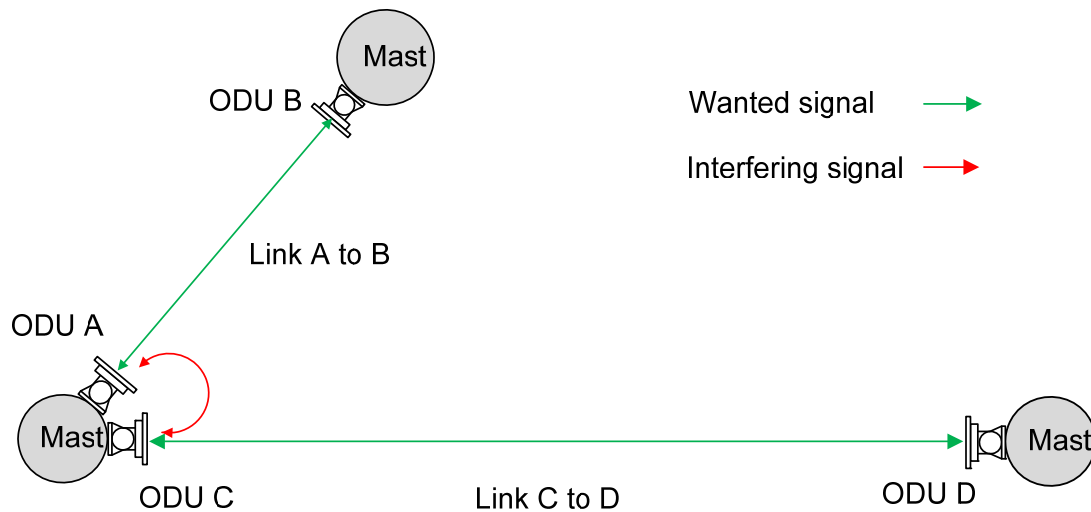
**NOTE**

On system installation or start-up, this extends the initial scan time of the Master unit by 60 seconds. To address the requirement to provide aggregate uniform loading of the spectrum across all devices, 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.

### Time division duplex synchronization

The performance of any radio system is dependent on the level of electromagnetic interference to which it is subjected. This is also true for the PTP 600 ODUs. In an ideal environment, any individual ODU will only receive transmissions from the paired ODU at the other end of the link. However, when multiple PTP 600 links are installed, an ODU may also be subjected to interference from the transmission of an ODU which is part of another link. The levels of interference become very significant when ODUs are installed in close proximity, for example on the same mast. In this case, one ODU may be transmitting a burst at the same time as an ODU sharing the same mast is receiving a burst from its paired ODU. This is shown in [Figure 1-13](#), where ODU A is seen to be interfering with ODU C and vice versa. This can adversely affect link performance.

**Figure 1-13** Interference between two ODUs on the same mast



This type of interference may be eliminated if the TDD frames of the two links are synchronized such that ODUs which share a mast are configured to always transmit together and always receive together. An ODU will never be transmitting when an ODU sharing the same mast is receiving. Similarly, the paired ODUs installed at the remote ends from the common mast will also transmit together and receive together but in the opposite half (or opposite phase) of the TDD cycle. Synchronization can be extended beyond the single mast case where the TDD frames of all links in a network can be synchronized. The benefit is that interference between any pair of units in the network will be eliminated if they are configured to transmit in the same half of the TDD frame, that is, with the same phase. In summary, TDD synchronization eliminates half of the network interference mechanisms.

## Network timing reference

For links to be synchronized, they must have access to a common network timing reference. This is achieved by connecting each Master PTP 600 to a synchronization unit. One synchronization unit is required for each Master. Two alternative synchronization units are available:

- **MemoryLink UltraSync GPS receiver:** This unit contains a GPS receiver which produces the common network timing reference. For more information, refer to [UltraSync](#) on page 1-27.
- **PTP-SYNC:** This option is the preferred solution. For simple networks centred on a single common mast, the common network timing reference may be derived from one of the PTP 600 ODUs installed at the common mast. The timing signal is then daisy chained to the other collocated ODUs. For larger distributed networks, sites which consist of one or more Master PTP 600 units will require a single GPS receiver. For more information, refer to [PTP-SYNC](#) on page 1-27.

## Configuring the TDD frame

The Master PTP 600 automatically configures the TDD frame by optimizing parameters such as the Frame Duration and Burst Duration (see [Time division duplex synchronization](#) on page 1-25). When TDD synchronization is enabled, this is no longer the case and it is up to the user to configure the frame parameters appropriately. This should be done with the aid of LINKPlanner. Please refer to the *Link Planner User Guide* for guidance on configuring TDD synchronization.

## Performance considerations when enabling TDD synchronization

In certain configurations, the TDD frame can adapt to allocate more of the frame to a particular link direction. This is called adaptive TDD. It works by the PTP 600 automatically and independently adjusting the Burst Duration in each link direction as the level of offered traffic in each direction changes. This was discussed in more detail in [Link symmetry](#) on page 1-21. As TDD synchronization requires TDD frames to be constantly aligned in time, a varying TDD frame is not an option when TDD synchronization is enabled. Only the symmetric mode is available when TDD synchronization is enabled.

When TDD synchronization is enabled, the capacity of an “ideal” link is generally a few percent lower than the case where TDD synchronization is disabled. The term “ideal” is important as this is the capacity assuming that there is no interference. The benefit of eliminating half of the network interference mechanisms generally outweighs this small reduction in capacity. The exact reduction can be examined using Link Planner.

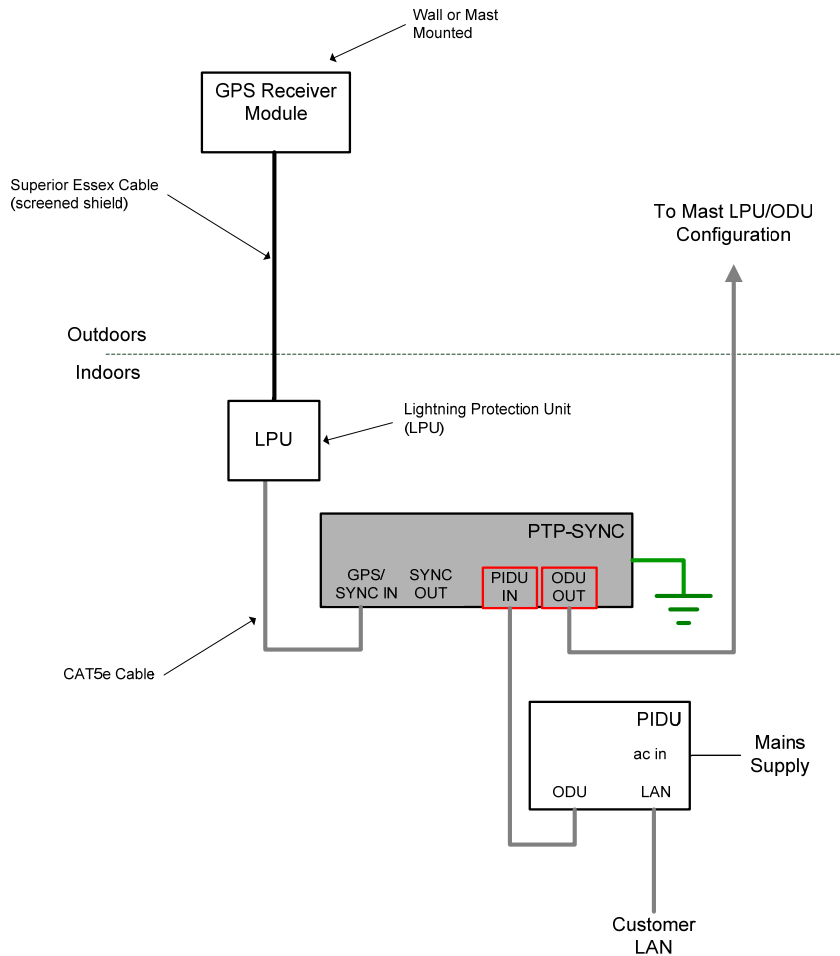
## UltraSync

PTP 600 application software supports the synchronization method based on the MemoryLink UltraSync GPS receiver. An additional control in the web-based management interface allows a user to configure the ODU for operation with UltraSync or for PTP-SYNC. If the installation is converted from UltraSync to PTP-SYNC, the UltraSync unit must be disconnected.

## PTP-SYNC

TDD synchronization using PTP-SYNC is an improved method for synchronizing TDD transmission in a network of PTP 600 links. This method is based on the PTP-SYNC hardware platform connected in-line between the PIDU and the master ODU. [Figure 1-14](#) shows a single PTP-SYNC within a system. In this example, the chosen system configuration requires an LPU between the GPS receiver module and the PTP-SYNC.

**Figure 1-14** PTP-SYNC application



The PTP-SYNC is a compact indoor unit mounted on a wall or a shelf or (using an optional rack mounting adaptor) in a standard 19 inch rack. The PTP-SYNC is powered using standard PTP 600 power-over-Ethernet from the PIDU. One PTP-SYNC unit is required for each synchronized link.

### How PTP-SYNC works

TDD synchronization using the PTP-SYNC operates as follows:

1. The timing reference generates a precise 1 Hz signal that is synchronised in both frequency and phase with a network-wide master,
2. The PTP 600 ODU generates a timing signal locked to its TDD frame timing,

3. The PTP-SYNC unit measures the difference between the TDD frame timing and the 1 Hz time reference,
4. The PTP-SYNC signals this time difference to the ODU,
5. The ODU uses the measured time difference as an input to a control loop that synchronizes TDD timing with the timing reference and thus indirectly with the network-wide master.

## Timing reference

PTP-SYNC requires a 1 Hz timing reference signal. One timing reference signal is required at each site that contains PTP-SYNC units.

### NOTE

One timing reference signal can be used to synchronize up to ten PTP-SYNC. If more than ten PTP-SYNC must be synchronized on a single site, then additional timing reference signals are required.

The timing source may be one of the following:

- A separate timing source (typically a GPS receiver) connected directly to the PTP-SYNC, or through another PTP-SYNC in a daisy-chain arrangement (as shown in [Figure 1-14](#)).
- In networks where all master ODUs are collocated (for example a network consisting of a single hub), it is possible to use PTP-SYNCS in the standard scheme but omitting the external timing source. In this case, one ODU must be configured as the local timing master.

## Advantages of PTP-SYNC over UltraSync

PTP-SYNC has several advantages over the UltraSync solution:

- PTP-SYNC does not require individual GPS receivers located close to the ODUs, and this reduces the complexity and the cost of the installation on the mast,
- The GPS receiver can be located anywhere with a clear view of the sky, offering additional flexibility in the installation,
- The PTP-SYNC solution is compatible with standard 1 Hz interfaces, allowing an operator to take advantage of alternative timing references that may be already present at the site,

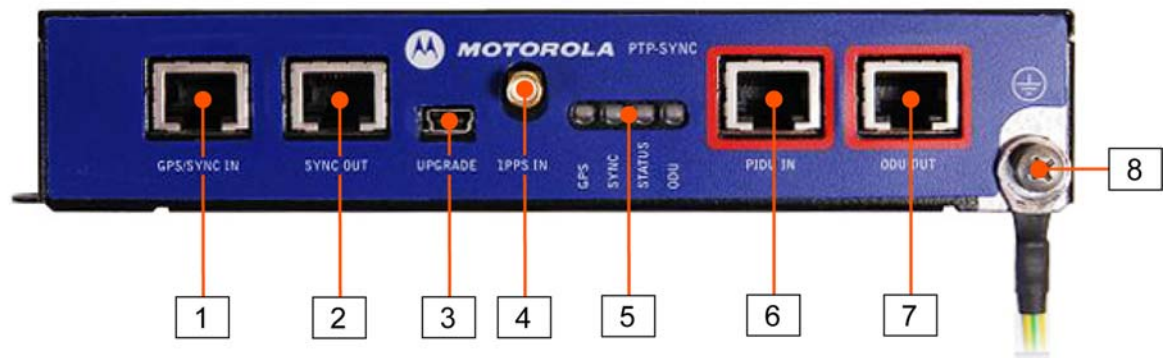
- The recommended GPS receiver continues to provide accurate timing even after the number of received satellite has dropped down to one, leading to significantly better availability of the reference signal,
- The PTP-SYNC offers the possibility of creating synchronised single-hub networks where no GPS receiver is required.



## PTP-SYNC front panel

The PTP-SYNC front panel is illustrated in [Figure 1-15](#). The annotated interfaces are described in [Table 1-6](#).

**Figure 1-15** PTP-SYNC front panel



**Table 1-6** PTP-SYNC front panel interfaces

Number	Description	Function
1	GPS/SYNC IN	Input from GPS receiver module.
2	SYNC OUT	Output to cascaded GPS-SYNC units.
3	USB	Input for software upgrades. Contact Motorola for instructions.
4	1PPS IN	Coaxial alternative to GPS/SYNC IN. Peak input supply must not exceed 5V.
5	LED bank	LEDs and their functions are described in <a href="#">Table 1-7</a> .
6	PIDU IN	Input from PIDU.
7	ODU	Output to ODU.
8	Ground stud	For connecting to a ground point.

**Table 1-7** PTP-SYNC indicator LEDs

Indicator	Function	Description
GPS	Off	No GPS satellite data being received at either the GPS/SYNC IN or 1PPS IN port.
	On steady or blink	GPS satellite data being received.
SYNC	Off	No data being received at the SYNC OUT port.
	On steady or blink	Data being received at the SYNC OUT port.
STATUS	Off	No power.
	On steady	Power but no satellite lock.
	Blink	Power and satellite lock at either the GPS/SYNC IN or 1PPS IN port.
ODU	Off	No signal being received from the ODU.
	On	Communication with the ODU is established.

## Security

### Encryption standard used

The Motorola PTP 600 Series supports link encryption using the NIST approved Advanced Encryption Standard, [FIPS-197](#). 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.

## Ethernet bridging

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### 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.

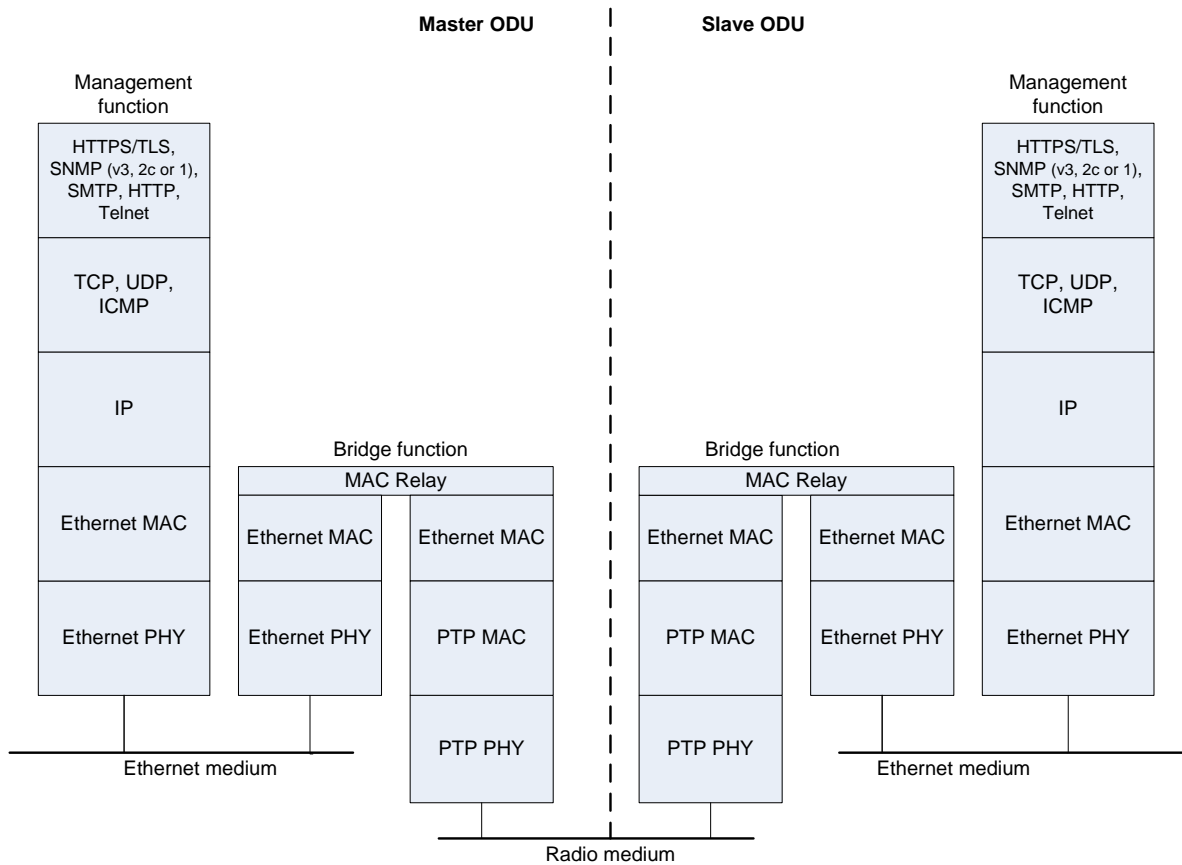
The PTP 600 series provides eight traffic classes, classifying Ethernet frames into one of eight prioritized queues based on inspection of the user priority field (802.1p) in a customer (IEEE802.1Q) VLAN tag or provider (IEEE802.1ad) VLAN tag. Untagged frames receive a default priority. The scheduling 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 field.

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

## Management function

The management function of the PTP 600 Series is logically equivalent to a separate protocol stack with virtual point of attachment at the Ethernet interface. This is illustrated in [Figure 1-16](#).

**Figure 1-16** PTP 600 protocol layers



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

## Networking information

The PTP 600 Series 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.

## Telecoms circuits

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The PTP 600 link provides native support for one or two E1 links, or one or two T1 links. The link relays unstructured E1 or T1 data and provides accurate timing transfer.

### Lowest telecoms modulation mode

In narrow channel bandwidth and lower modulation modes, the link may have insufficient capacity to relay the E1/T1 payload; in this case, the wireless link continues to carry timing information in order to maintain accurate clock synchronization. The relay of telecoms data resumes automatically when the link reaches a suitable modulation mode.

Links that are able to operate consistently in a high modulation mode can take advantage of lower link latency. This option is configured by setting the "Lowest Telecoms Modulation Mode" during installation. Appropriate settings for this control may be determined by using the LINKPlanner tool. The reduction in latency is achieved by disabling the relay of telecoms data in lower modulation modes, and this necessarily results in somewhat lower availability for the telecoms circuit. The loss of availability can be estimated using the LINKPlanner.

The unit will override the user setting of Lowest Telecoms Modulation Mode if the selected mode has insufficient capacity to carry the telecoms data, or if the mode demands very high latency and requires more buffering than the link can provide. 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".

### Fixed frequency operation

In the PTP 600 link, data errors may occur during channel changes on an operational link. It may be appropriate to minimize channel-change-related errors in a link carrying Telecoms traffic by preventing channel changes initiated by i-DFS. This can be achieved by barring all channels except one in the Spectrum Management page, or alternately by selecting Fixed Frequency mode. These steps unavoidably disable interference avoidance mechanisms, and should not be taken if the risk of errors due to interference is more severe than the risk due to channel changes.

Fixed frequency operation is not available when radar detection requirements exist in the frequency band.

## Further reading

Installation details are provided in [Installing E1 and T1](#) on page 5-50.

E1/T1 circuits are configured using the web pages described in Section [Configuring the telecoms circuits](#) on page 6-49 and [Telecoms interface](#) on page 6-57.

## System management

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### Management agent

PTP 600 equipment is managed through an embedded management agent. Management workstations, network management systems or PCs can be connected to this agent using standard management protocols multiplexed with user traffic at the Ethernet data port.

### Web interface

The PTP 600 management agent contains a web server. The management agent provides comprehensive web-based fault, configuration, performance and security management functions. Web-based management offers a convenient way to manage the PTP 600 equipment from a locally connected computer or from a network management workstation connected through a management network, without requiring any special management software. The web-based interface is the only interface supported for installation of PTP 600, and for the majority of PTP 600 configuration management tasks.

There are two servers, HTTP and HTTPS which, depending on prevailing licence key, can be independently controlled

Management tasks using the web-based management interface are described in detail in [Chapter 6: Operation](#).

### Installation wizard

The web-based interface includes an Installation wizard. This feature simplifies the process of entering initial configuration details and arming the PTP 600 ready for installation.

### Configuration pages

The web-based interface includes a number of configuration pages. These pages allow for modification of the system configuration of an installed link. Configuration pages include controls relating to the management agent IP interface, the Ethernet interfaces, quality of service at the wireless interface, security passwords and AES keys.



## Transport layer security

The PTP 600 management agent allows HTTP traffic at the web interface to be encrypted using Transport Layer Security (TLS). PTP 600 uses AES to encrypt HTTP traffic. Operation of HTTPS/TLS is enabled by purchase of an optional AES upgrade as described in [Upgrading the PTP 600](#) on page 6-77.

TLS operation requires installation of a key of keys, a private key, a related public key certificate, and an entropy value. The subject of the public key certificate will be the IP address or hostname of the ODU. If the subject of the certificate is the hostname, then the network must include a DNS service capable of resolving the hostname to the IP address of the ODU.

The private key and public key certificate must be installed as standard DER files.

The PTP 600 has no default public key certificate, and Motorola is not able to generate public key certificates for specific network applications.

## Security wizard

The web-based interface includes a Security Wizard. The Security Wizard is used to enter configuration for TLS, including the key or keys, private key, public key certificate and entropy value.

The Security Wizard additionally allows HTTP and Telnet interfaces to be disabled, and encryption keys to be entered or updated for AES encryption at the wireless interface.

The Security Wizard is disabled until AES encryption or FIPS are enabled by license key.

Management tasks using the Security Wizard are described in [Configuring HTTPS/TLS using the Security Wizard](#) on page 6-98.

## Identity-based user accounts

The PTP 600 web-based interface provides two methods of authenticating users:

- Role-based user authentication allows the user, on entry of a valid password, to access all configuration capabilities and controls. This is the default method.
- Identify-based user authentication supports up to 10 users with individual usernames and passwords.

When identity-based user accounts are enabled, a security officer can define from one to ten user accounts, each of which may have one of the three possible roles:

- Security officer.
- System administrator.

- Read only.

Identity-based user accounts are enabled in the User Accounts page of the web-based interface.

## Best-practice passwords

PTP 600 allows passwords to be checked for compliance with password best practice. When checking is enabled, passwords must comply with the following:

- Passwords are case sensitive
- Passwords must contain at least:
  - One uppercase letter.
  - One lowercase letter.
  - One numeral.
  - One special character.
- When the password is changed, the new password must differ from the previous password by at least four characters.

Special characters are any of the following:

! \ " # \$ % & ' ( ) \* + , - . / : ; < = > ? @ [ \ ] ^ \_ ` { | } ~

Best-practice passwords can be checked in role-based and identity-based authentication methods.

## SNMP

The management agent supports fault and performance management by means of an SNMP interface. The management agent is compatible with SNMP v1, SNMP v2c, and SNMPv3 using the following MIBs:

- PTP 600 enterprise MIB
- The system group and the interfaces group from MIB-II, RFC-1213
- The interfaces group and the ifXTable from RFC-2233
- The dot1dBase group and the dot1dBasePortTable group from the Bridge MIB, RFC-1493.

## Supported notifications

The supported notifications are as follows:

- Cold start
- Wireless Link Up/Down
- DFS Channel Change
- DFS Impulse Interference
- Authentication Failure
- Ethernet Link Up/Down

## Supported alarms

PTP 600 supports the following diagnostic alarms:

- Region Code
- Install Status
- Install Arm State
- Unit Out Of Calibration
- Incompatible Region Codes
- Incompatible Master And Slave
- Ethernet Configuration Mismatch
- No Wireless Channel Available
- SNTP Synchronisation Failed
- Wireless Link Disabled Warning
- Ethernet Link Disabled Warning
- Ethernet Link Status
- Fiber Link Status
- Telecoms Channel A Status
- Telecoms Channel B Status
- Telecoms Channel A Loopback
- Telecoms Channel B Loopback
- TDD Synchronization Alarm

- Link Mode Optimization Mismatch

The web-based interface may be used to enable or disable generation of each supported SNMP notification or diagnostic alarm.

## Enabling SNMP

The SNMP interface must be enabled for use by configuring the following attributes in the Remote Management page:

- SNMP State (default disabled)
- SNMP Version (default SNMPv1/2c)
- SNMP Port Number (default 161)

When the SNMP Version is set to SNMPv1/2c the interface must be additionally configured by entering the following attributes:

- SNMP Trap IP Address
- SNMP Trap Port Number
- SNMP Community String

## SNMPv3 security

### Secure configuration

PTP 600 provides a default SNMPv3 configuration. This initial configuration is not secure, but it provides the means by which a secure configuration can be created.

The secure configuration should be configured in a controlled environment to prevent disclosure of the initial security keys necessarily sent as plaintext, or sent as encrypted data using a predictable key. The initial security information should not be configured over an insecure network.

### User-based security model

PTP 600 supports the SNMPv3 user-based security model (USM) for up to 10 users, with MD5, SHA-1, DES and (subject to the license key) AES protocols in the following combinations:

- No authentication, no privacy,
- MD5, no privacy,
- SHA-1, no privacy,
- MD5, DES,

- SHA-1, DES,
- MD5, AES,
- SHA-1, AES.

Use of AES privacy requires the PTP 600 AES upgrade described in [AES license](#) on page 1-48. The ODU will allow the creation of users configured with AES privacy protocol, regardless of license key. However, a user configured to use AES privacy protocol will not be able to transmit and receive encrypted messages unless the license key enables the AES capability.

### Default configuration

The default configuration is restored when all PTP 600 configuration data is erased using [Erase configuration](#) on page 7-25, or when all SNMP users are deleted using the SNMP management interface.

Default configuration for the usmUserTable table is based on one initial user and four template users as listed in [Table 1-8](#).

**Table 1-8** Default SNMPv3 users

Object	Entry 1
Name	initial
SecurityName	initial
AuthProtocol	usmHMACMD5AuthProtocol
PrivProtocol	usmDESPrivProtocol
StorageType	nonVolatile

Object	Entry 2	Entry 3
Name	templateMD5_DES	templateSHA_DES
SecurityName	templateMD5_DES	templateSHA_DES
AuthProtocol	usmHMACMD5AuthProtocol	usmHMCSAAuthProtocol
PrivProtocol	usmDESPrivProtocol	usmDESPrivProtocol
StorageType	nonVolatile	nonVolatile

Object	Entry 4	Entry 5
--------	---------	---------

Name	templ ateMD5_AES	templ ateSHA_AES
Securi tyName	templ ateMD5_AES	templ ateSHA_AES
AuthProtocol	usmHMACMD5AuthProtocol	usmHMACSHAAuthProtocol
Pri vProtocol	usmAESPri vProtocol	usmAESPri vProtocol
StorageType	nonVol ati le	nonVol ati le

PTP 600 creates the initial user and template users with localised authentication and privacy keys derived from the passphrase string “123456789”. Authentication keys for the templates users are fixed and cannot be changed.

Any or all of the template users can be deleted.

The default user `i ni ti al` will have read/write access to the whole of the MIB. This is described in further detail in [View-based access control model](#) on page 1-44 below. The template users have no access to the MIB in the default configuration.

User `i ni ti al` will normally be used to create one or more additional users with secret authentication and privacy keys, and with appropriate access to the whole of the MIB or to particular views of the MIB according to the operator’s security policy. New users must be created by cloning template users. The user `i ni ti al` may then be deleted to prevent access using the well-known user name and keys. Alternatively, the keys associated with `i ni ti al` may be set to some new secret value.

## View-based access control model

PTP 600 supports the SNMPv3 view-based access control model (VACM) with a single context. The context name is the empty string. The context table is read-only, and cannot be modified by users. The default user `i ni ti al` is created with a view of the entire MIB, requiring authentication for SET operations. There is no access for template users.

### NOTE

VACM grants access for requests sent with more than the configured security level.

The default user `i ni ti al` is assigned to VACM group `i ni ti al` in the `vacmSecuri tyToGroupTabl e` table. The template users are not assigned to a group.

PTP 600 creates default view trees and access as shown in [Table 1-9](#) and [Table 1-10](#).

**Table 1-9** Default view trees

Object	Entry 1	Entry 2
--------	---------	---------

ViewName	internet	restricted
Subtree	1.3.6.1	1.3.6.1
Mask	""	""
Type	included	included
StorageType	nonVolatile	nonVolatile

**Table 1-10** Default data fill for access table

Object	Entry 1	Entry 2
GroupName	i n i t i a l	i n i t i a l
ContextPrefix	" "	" "
SecurityLevel	authNoPriv	noAuthNoPriv
ContextMatch	exact	exact
ReadViewName	i n t e r n e t	r e s t r i c t e d
WriteViewName	i n t e r n e t	" "
NotifyViewName	i n t e r n e t	r e s t r i c t e d
StorageType	n o n V o l a t i l e	n o n V o l a t i l e

## Access to critical security parameters

The SNMPv3 management interface does not provide access to critical security parameters (CSPs) of PTP 600. It is not possible to read or modify AES keys used to encrypt data transmitted at the wireless interface. Neither is it possible to read or modify security parameters associated with TLS protection of the web-based management interface. The recovery mode option to zeroise CSPs does not affect SNMPv3 configuration.

## Downgrade of the license key

A possible lockout condition exists if a user downgrades the PTP 600 license key so as to disable the AES capability when SNMPv3 users are configured with AES privacy and VACM is configured to require privacy. In this case, recovery is by either (a) restoring the correct license key, or (b) using recovery mode to erase all configuration and entering new configuration.

Option (b) will cause default users and access configuration to be re-created.

### CAUTION

Care should be taken to avoid exposing the ODU to an insecure network when configuration data is erased.



## Email alerts

The management agent can be configured to generate alerts by electronic mail when any of the following events occur:

- Wireless Link Up/Down
- DFS Channel Change
- DFS Impulse Interference
- Ethernet Link Up/Down
- Region Code
- Install Status
- Install Arm State
- Unit Out Of Calibration
- Incompatible Region Codes
- Incompatible Master And Slave
- Ethernet Configuration Mismatch
- No Wireless Channel Available
- SNTP Synchronisation Failed
- Wireless Link Disabled Warning
- Ethernet Link Disabled Warning
- Ethernet Link Status
- Fiber Link Status
- Telecoms Channel A Status
- Telecoms Channel B Status
- Telecoms Channel A Loopback
- Telecoms Channel B Loopback
- TDD Synchronization Alarm
- Link Mode Optimization Mismatch

## AES license

PTP 600 provides optional encryption using the Advanced Encryption Standard (AES). Encryption is not available in the standard PTP 600 system.

AES upgrades are supplied as an access key purchased from your Motorola Point-to-Point distributor or solutions provider. The access key authorizes AES operation for one ODU. Two access keys are needed to operate AES on a link. The upgrade is applied by entering an access key together with the MAC address of the target ODU into the PTP License Key Generator web page, which may be accessed from <http://www.motorola.com/ptp/support>.

The License Key Generator creates a new license key that is delivered by email. The license key must be installed on the ODU. When the license key is installed, the ODU must be rebooted before AES can be enabled. Once applied, the AES upgrade is bound to a single ODU and is not transferrable.

AES encryption may be used in the following ways:

- At the wireless port to encrypt data transmitted over the wireless link.
- At the SNMP management interface in the SNMPv3 mode.
- At the HTTP management interface in the TLS mode.

Two levels of encryption are available to purchase:

- 128-bit: This allows an operator to encrypt all traffic sent over the wireless link using 128-bit encryption.
- 256-bit: This allows an operator to encrypt traffic using either 128-bit or 256-bit encryption.

Encryption must be configured with the same size key in each direction.

AES encryption at the PTP 600 wireless port is based on pre-shared keys. An identical key must be entered at each end of the link.

AES encryption for SNMPv3 or TLS is always based on a 128-bit key, regardless of level enabled in the PTP 600 license key.

For more information, see:

- [Upgrading the PTP 600](#) on page 6-77.
- [Enabling AES encryption at the wireless interface](#) on page 6-96.

## Critical security parameters

Critical security parameters (CSPs) are as follows:

- Key of keys.
- AES encryption keys for the wireless interface.
- Private key for the HTTPS/TLS interface.
- Entropy value for the HTTPS/TLS interface.
- User account passwords for the web-based interface.

CSPs can be erased (zeroised) using the Zeroise CSPs page of the web-based interface or by selecting the Zeroise CSPs option in Recovery mode.

## Capacity upgrades

Capacity upgrades are supplied as an access key purchased from your Motorola Point-to-Point distributor or solutions provider. The upgrade is applied by entering an access key together with the MAC address of the target ODU into the PTP License Key Generator web page, which may be accessed from <http://www.motorola.com/ptp/support>.

The License Key Generator creates a new license key delivered by email. The license key must be installed on the ODU as described in reference to [Upgrading the PTP 600](#) on page 6-77. Once applied, the capacity upgrade is bound to a single ODU and is not transferrable.

## Software upgrade

The management agent supports application software upgrade using either the web-based interface or the SNMP interface.

PTP 600 software images are digitally signed, and the ODU will accept only images that contain a valid Motorola PTP digital signature. The ODU always requires a reboot to complete a software upgrade.

### NOTE

Obtain the application software and this user guide from the support website BEFORE warranty expires.

### NOTE

ODU software version must be the same at both ends of the link. Limited operation may sometimes be possible with dissimilar software version, but such operation is not supported by Motorola.

The management process for software upgrade is described in detail in [Upgrading the PTP 600](#) on page 6-77.

Software can be downgraded using Recovery mode as described in [Recovery mode](#) on page 1-50.

## Recovery mode

The PTP 600 recovery mode provides a means to recover from serious configuration errors including lost or forgotten passwords and unknown IP addresses.

Recovery mode also allows new main application software to be loaded even when the integrity of the existing main application software image has been compromised. The most likely cause of an integrity problem with the installed main application software is where the power supply has been interrupted during an earlier software upgrade.

The ODU operates in recovery mode in the following circumstances:

- When a checksum error occurs for the main application software image.
- When the PIDU recovery button is pressed at the same time as the ODU is rebooted or power cycled.

## Recovery mode options

Options in recovery mode are as follows:

- Load new main application software.
- Reset all configuration data to factory default. This option resets IP and Ethernet configuration, and erases (zeroizes) critical security parameters.
- Reset IP and Ethernet configuration to factory default.
- Erase (zeroize) critical security parameters.
- Reboot with existing software and configuration.

### NOTE

If recovery mode has been entered either because of a checksum error, by default the ODU will reboot with existing software and configuration following a 30 second wait.

The recovery software image is installed during manufacture of the ODU and cannot be upgraded by operators.

For detailed instructions on using the recovery mode, see [Using recovery mode](#) on page 7-20.

## FIPS 140-2

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PTP 600 provides an optional secure cryptographic mode of operation validated to Level 2 of Federal Information Processing Standards Publication 140-2.

PTP 600 operates in the FIPS mode when all of the following are true:

- The ODU software image is validated for FIPS operation.
- The ODU license key has AES encryption enabled.
- The ODU license key has FIPS operation enabled.
- The hardware security of the ODU is compatible with operation in the FIPS 140-2 mode.
- The HTTPS/TLS management interface is enabled.
- The HTTP management interface is disabled.
- The Telnet management interface is disabled.

### Validated software image

FIPS validated software images are indicated by a FIPS- prefix to the file name, for example: FIPS-PTP600-08-50.DLD2. The general features of a FIPS validated software image are identical to those of the standard image with the same version number. For example, FIPS-PTP600-08-50.DLD2 is equivalent to PTP600-08-50.DLD2 apart from the ability of the FIPS image to operate in FIPS mode.

## Hardware security

The ODU has compatible hardware security if the part number suffix is no earlier than the minimum listed in [Table 1-11](#).

**Table 1-11** Minimum part number suffix for FIPS 140-2 mode

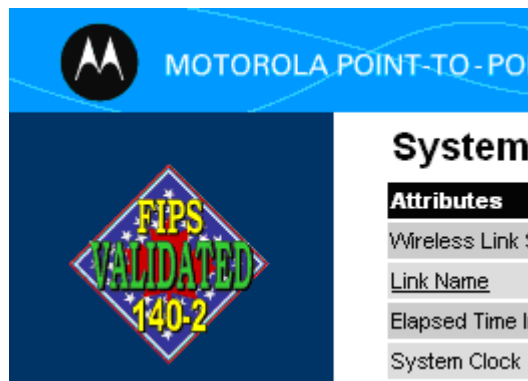
Frequency variant	Part number suffix
PTP 25600	BB
PTP 45600	BB
PTP 48600	AA
PTP 49600	AA
PTP 54600	EE
PTP 58600	DD
PTP 59600	BB

The ODU will also have compatible hardware security if the part number suffix is earlier and PTP 600 Hardware Security Upgrade has been applied. The Hardware Security Upgrade Kit is available as Motorola part number WB3593AA.

## FIPS 140-2 mode indication

The FIPS 140-2 mode is indicated by a distinctive symbol displayed at the top of the navigation bar in the web-based interface, as shown in [Figure 1-17](#).

**Figure 1-17** FIPS 140-2 mode



## Configuring HTTPS/TLS

The HTTPS/TLS interface is configured using the Security Wizard. See [Configuring FIPS 140-2 mode](#) on page 6-108 for further details of using the Security Wizard.

## Exiting from the FIPS 140-2 mode

To exit from the FIPS 140-2 mode, do any of the following:

- Load a PTP 600 license key that has FIPS operation disabled and reboot.
- Load PTP 600 software that is not FIPS-validated and reboot.
- Zeroise CSPs and reboot.

The critical security parameters (CSPs) are always erased (zeroised) on exit from FIPS 140-2 mode.

## Prerequisites

### CAUTION

To operate in FIPS-140-2 mode ensure that you use:

- A FIPS-approved cryptographic key generator
- A FIPS-approved X509 RSA public/private key pair generator with the DER output format.
- A FIPS-approved random number generator
- A HTTPS-enabled web browser supporting FIPS approved cipher specifications.



## Chapter 2 Planning considerations

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This chapter provides information to help the user to plan a PTP 600 link.

Each frequency variant has specific licensing restrictions that affect frequency range, channel bandwidth, maximum power and radar avoidance. Link planning must take account of obstructions, site selection, path loss and wind loading.

The following topics are described in this chapter:

- [Spectrum planning](#) on page 2-2
- [Licenses and region codes](#) on page 2-3
- [Radar avoidance and bandwidth operation](#) on page 2-4
- [Variable channel bandwidth operation](#) on page 2-5
- [Site planning](#) on page 2-6
- [Link planning](#) on page 2-9
- [Path loss considerations](#) on page 2-10
- [Planning synchronized networks](#) on page 2-12
- [System threshold, output power and link loss](#) on page 2-17
- [Lightning protection](#) on page 2-18

To calculate the data throughput capacity of a planned PTP 600 link, see [Data rate calculations](#) on page 4-99.

## Spectrum planning

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The PTP 600 may use one of four alternative methods of spectrum planning. The choice of methods depends upon whether or not the region mandates radar detection.

### Regions without mandatory radar detection

In regions that do not mandate DFS (Radar Detection), the frequencies may be configured symmetrically or asymmetrically (different transmit and receive frequencies). The Spectrum Management Control options are:

- **Intelligent Dynamic Frequency Selection (i-DFS):** This method continually monitors the spectrum looking for the channel with the lowest level of on channel and co-channel interference. Statistical techniques are used 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.
- **Fixed Frequency:** This method allows the installer to allocate fixed transmit and receive frequencies on the units.

### Regions with mandatory radar detection

In regions that mandate DFS (Radar Detection), the frequency must always be symmetrical (transmit and receive on the same frequency). The Spectrum Management Control options are:

- **Dynamic Frequency Selection (DFS):** This method detects interference from other systems and avoids co-channel operation with these systems, notably radar systems.
- **DFS with i-DFS:** This method is similar to i-DFS. It differs in the event that several alternative channels are equally the best within the 1 dB measurement resolution. In **i-DFS**, the ODU selects the lowest channel number out of the set of best channels. In **DFS with i-DFS**, the ODU monitors the interference level on all the available channels and then randomly selects one channel from all that are within 3dB of the lowest interference channel.

## Licenses and region codes

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The PTP 600 Series 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 [Regulatory issues with connectorized units](#) on page 8-10.

The license and region codes for each frequency variant are listed in:

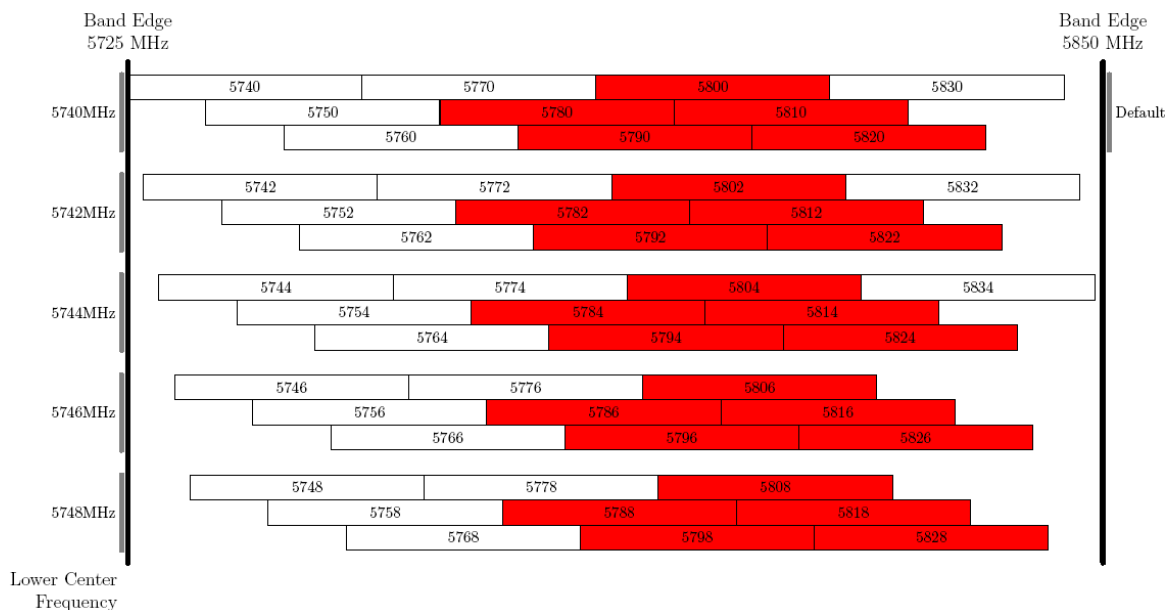
- [PTP 25600 licenses and region codes](#) on page 4-17
- [PTP 45600 licenses and region codes](#) on page 4-26
- [PTP 48600 licenses and region codes](#) on page 4-36
- [PTP 49600 licenses and region codes](#) on page 4-45
- [PTP 54600 licenses and region codes](#) on page 4-54
- [PTP 58600 licenses and region codes](#) on page 4-70
- [PTP 59600 licenses and region codes](#) on page 4-91

# Radar avoidance and bandwidth operation

## Channel barring

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 2-1), 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 [Spectrum management control with radar avoidance](#) on page 6-34.

**Figure 2-1** RTTT channel avoidance example (5.8 GHz UK)



**NOTE**

Radar avoidance requirements in the 5.4GHz band in the EU is detailed in specification EN 301-893 version V1.4.1 (from July 2010, this becomes V1.5.1) plus additional requirements shown in the OJ of the EC and in the US in the specification FCC part 15.407. Radar avoidance at 5.8 GHz is applicable to EU operation and the requirements are currently as defined in EN 302 502.

## Variable channel bandwidth operation

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The selection of Channel Bandwidth depends upon the PTP frequency 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.

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.

For details of the spectrum settings that are available to each frequency variant, refer to:

- [PTP 25600 available spectrum settings](#) on page 4-21
- [PTP 45600 available spectrum settings](#) on page 4-29
- [PTP 48600 available spectrum settings](#) on page 4-39
- [PTP 49600 available spectrum settings](#) on page 4-49
- [PTP 54600 available spectrum settings](#) on page 4-60
- [PTP 58600 available spectrum settings](#) on page 4-80
- [PTP 59600 available spectrum settings](#) on page 4-93

## Site planning

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### Site selection criteria

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

#### ODU site selection

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

- It should not be possible for people to stand or walk 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.
- The effect of strong winds on the installation – see Section [Wind loading](#) on page 2-7.

#### 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.

## Wind loading

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.

### Calculation of lateral force

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

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

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

The lateral force produced by a single 600 Series (integrated or connectorized model) at different wind speeds is shown in [Table 2-1](#) and [Table 2-2](#).

**Table 2-1** Lateral force – imperial

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

**Table 2-2** Lateral force – metric

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

 **NOTE**

When the connectorized version of 600 Series 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.

**Capabilities of the PTP 600 Series**

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 PTP 600 Series is fixed to is also capable of withstanding the prevalent wind speeds and loads.

**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. Sources of information:

- US National Weather Service, <http://www.nws.noaa.gov/>
- UK Meteorological Office, [www.metoffice.gov.uk](http://www.metoffice.gov.uk)



## Link planning

---

### Range and obstacles

The PTP 600 Series are designed to operate in Non-Line-of-Sight (NLoS) and Line-of-Sight (LoS) environments.

The PTP 600 Series 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.

A 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.

### PTP LINKPlanner

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>.

## Path loss considerations

---

Path loss is the amount of attenuation the radio signal undergoes between the two ends of the link.

### Calculating path loss

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). The calculation of [Equation 2-1](#) needs to be performed to judge whether a particular link can be installed.

**Equation 2-1** 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)

### Adaptive modulation

Adaptive modulation ensures that the highest throughput that can be achieved instantaneously will be obtained, taking account of propagation and interference. 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.

Modulation mode affects the following:

### **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  $3 \times 10^{-7}$ .

### **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)

## Planning synchronized networks

---

### Using PTP LINKPlanner for synchronized networks

TDD synchronization should be planned using LINKPlanner. This will provide the necessary TDD Frame parameter values which are required to complete a synchronized installation. Please refer to the *Link Planner User Guide*.

### TDD synchronization configuration options

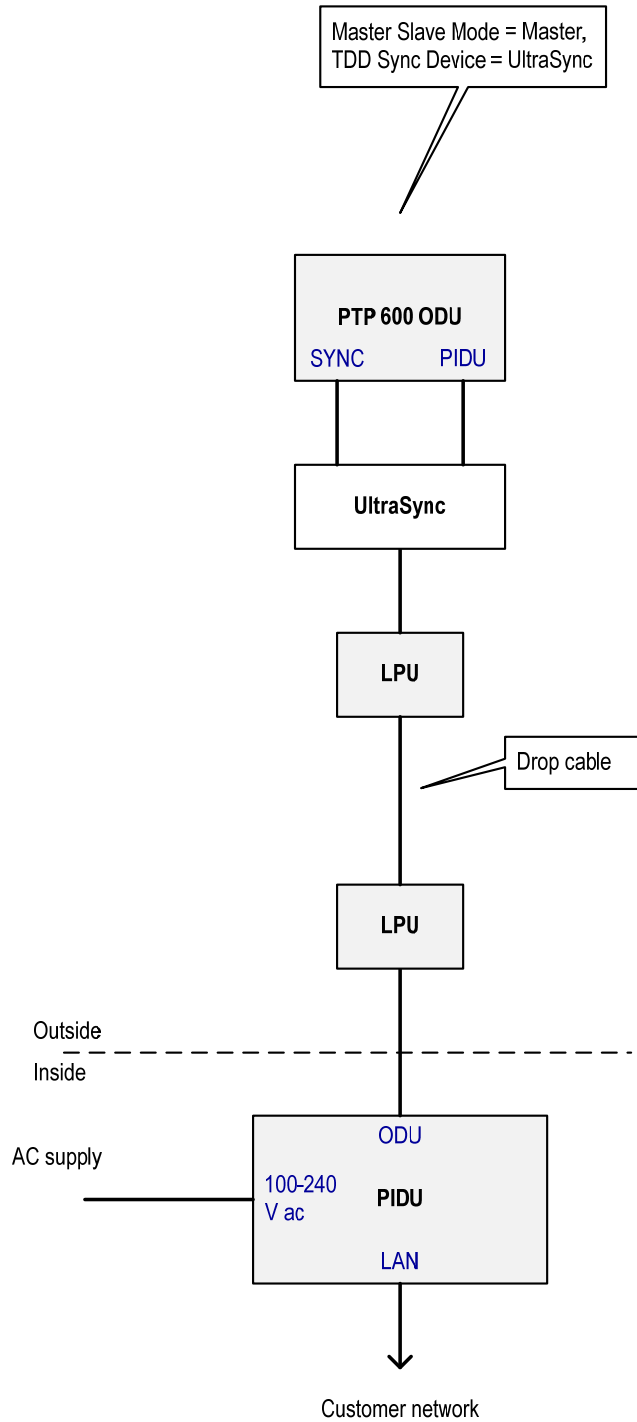
The PTP 600 supports the following TDD synchronization configurations:

- Standalone with UltraSync (Figure 2-2): Each link requires an Ultrasync GPS receiver connected at the master ODU. Use this configuration only for legacy applications.
- Standalone with PTP SYNC (Figure 2-3): Each link requires one PTP-SYNC unit connected to the master ODU and one compatible GPS receiver. Use this configuration where a site contains only one TDD master ODU. The GPS Receiver and LPU can be replaced by an alternative compatible 1 Hz timing reference.
- Cluster with PTP SYNC and GPS receiver (Figure 2-4): Each link requires one PTP SYNC unit. Each site requires one compatible GPS receiver. Collocated PTP SYNC units are connected together in a daisy-chain. Use this configuration where a site contains collocated TDD master ODUs in an extended network where TDD master ODUs are located at multiple sites.
- Cluster with PTP SYNC and no GPS receiver (Figure 2-5): Each link requires one PTP SYNC unit. PTP SYNC units are connected together in a daisy-chain. One ODU is designated as a cluster timing master. Use this configuration where all master ODUs are collocated at a single site. As this configuration does not require a GPS receiver, it provides additional flexibility, particularly in applications requiring rapid deployment.

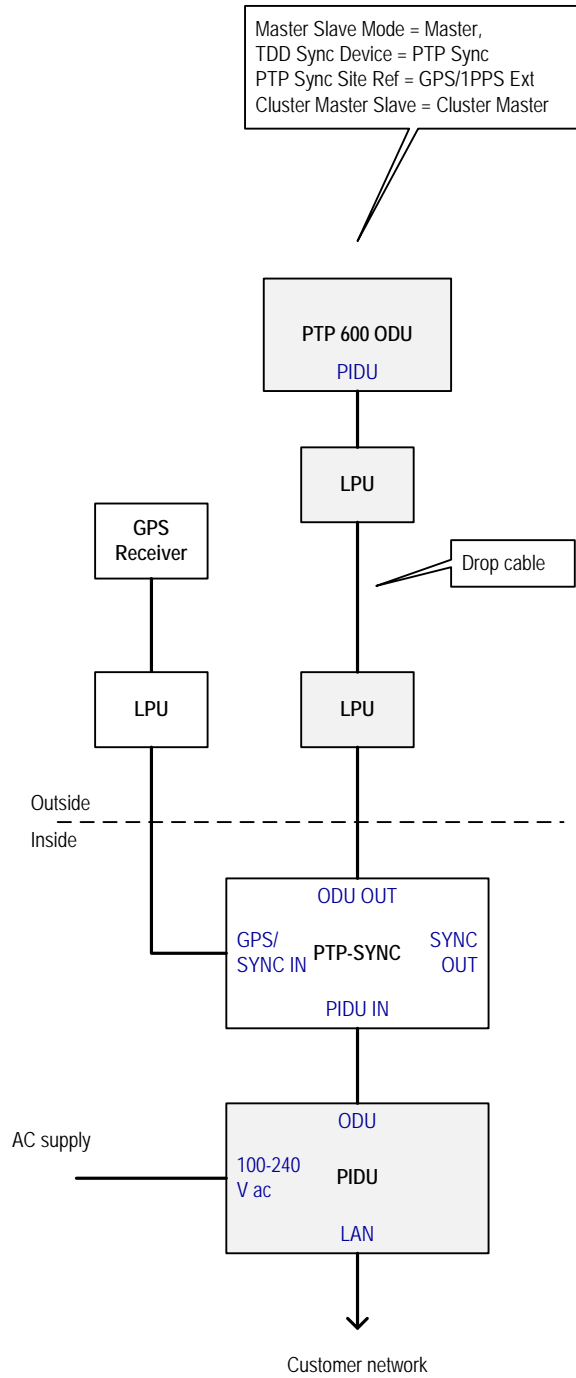
#### NOTE

If PTP-SYNC is the selected TDD synchronization method, select a 1 Hz timing reference for the system. This will normally be a GPS receiver module.

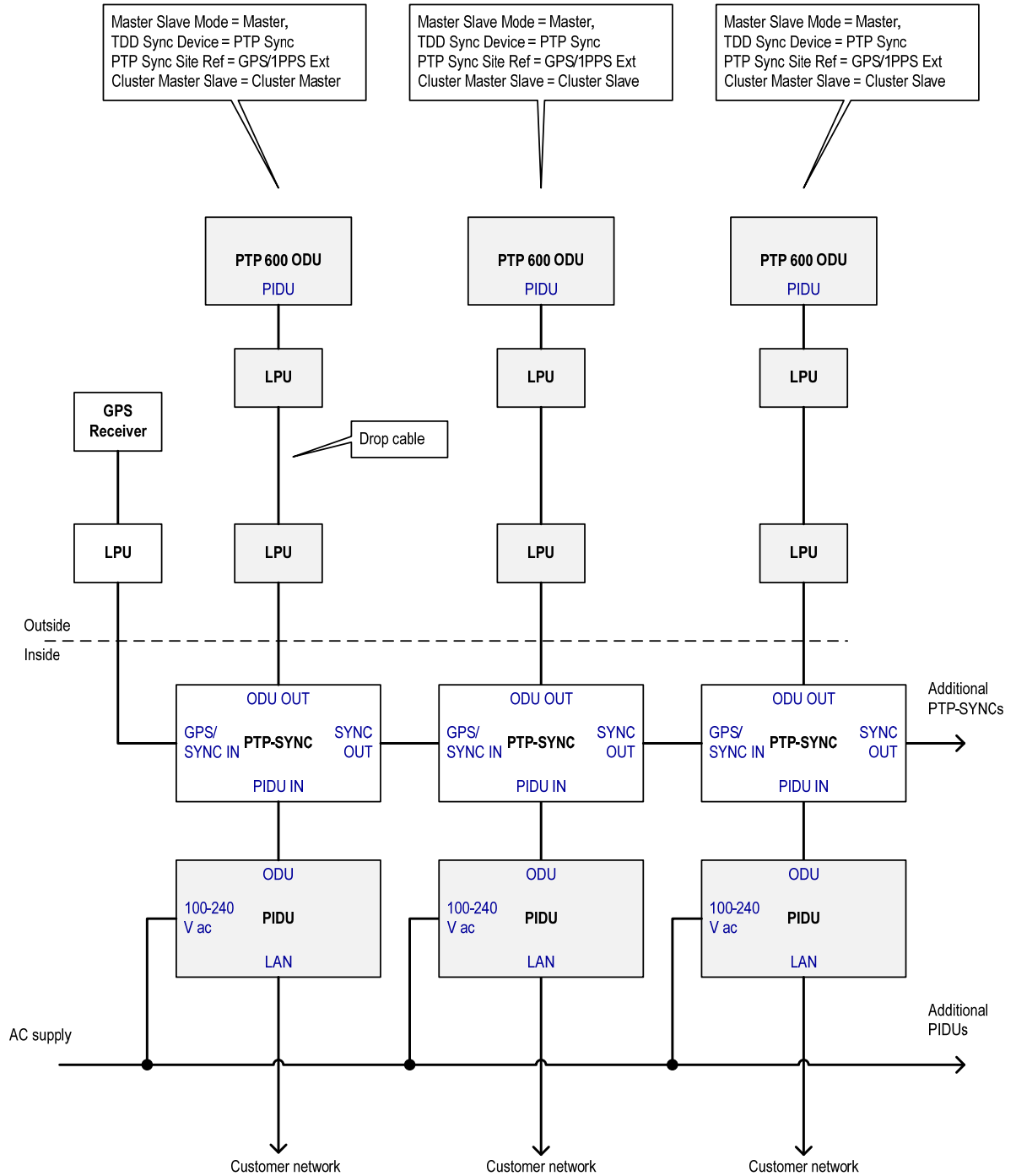
**Figure 2-2** TDD synchronization configuration – standalone with UltraSync



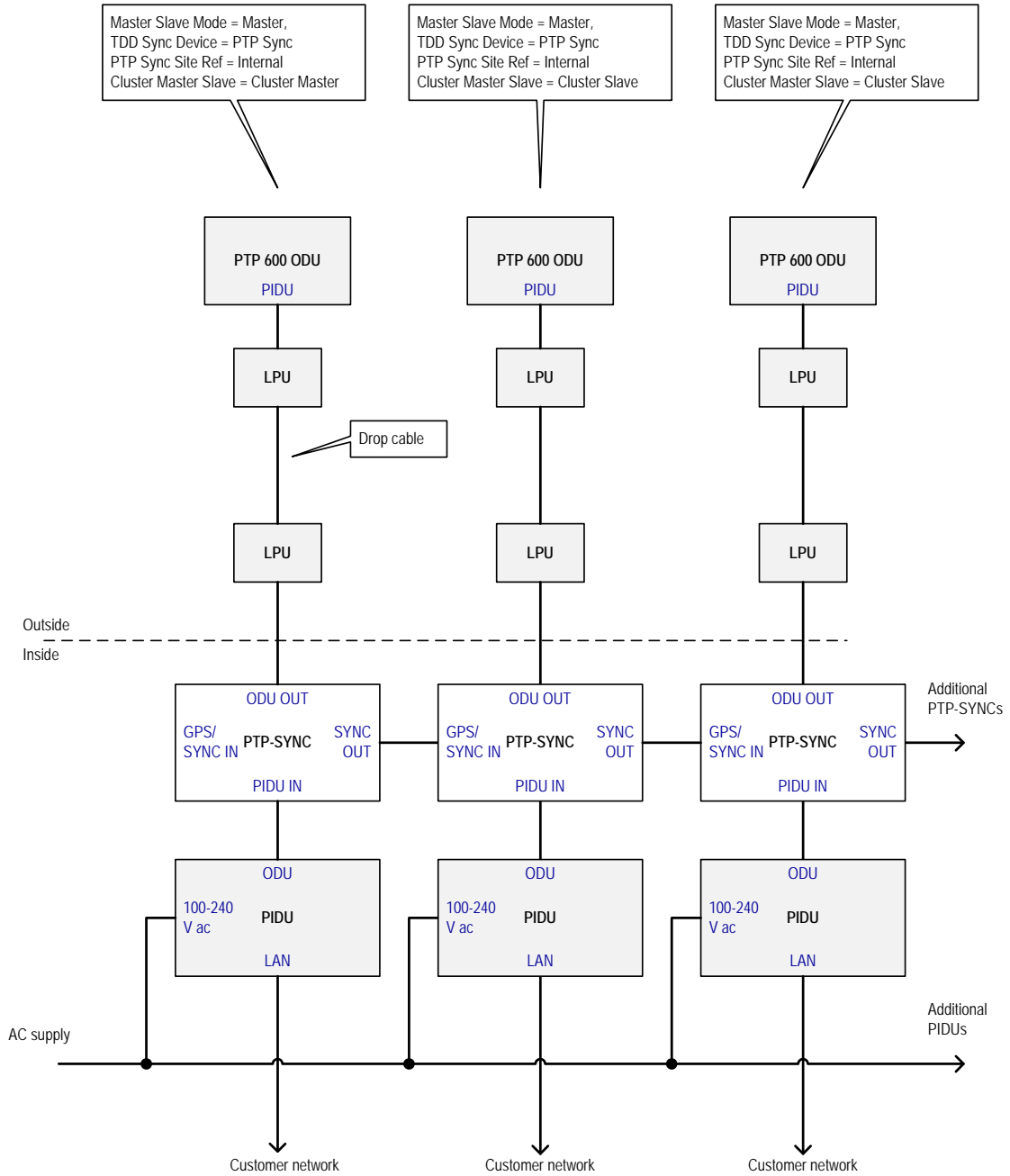
**Figure 2-3** TDD synchronization configuration – standalone with PTP SYNC



**Figure 2-4** TDD synchronization configuration – cluster with PTP SYNC and GPS



**Figure 2-5** TDD synchronization configuration – cluster with PTP SYNC and no GPS





## System threshold, output power and link loss

---

For details of the system threshold, output power and link loss for each frequency variant in all modulation modes for all available channel bandwidths, refer to:

- [PTP 25600 system threshold, output power and link loss](#) on page 4-24
- [PTP 45600 system threshold, output power and link loss](#) on page 4-33
- [PTP 48600 system threshold, output power and link loss](#) on page 4-43
- [PTP 49600 system threshold, output power and link loss](#) on page 4-51
- [PTP 54600 system threshold, output power and link loss](#) on page 4-62
- [PTP 58600 system threshold, output power and link loss](#) on page 4-83
- [PTP 59600 system threshold, output power and link loss](#) on page 4-97

## Lightning protection

---

This section provides instructions for protecting PTP 600 installations against lightning strike. 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 topics are described in this section:

- [Lightning protection zones](#) on page 2-19
- [Grounding considerations](#) on page 2-20
- [LPU configuration options](#) on page 2-21
- [LPU kit](#) on page 2-22
- [LPU installation wiring](#) on page 2-24
- [Site installation diagrams](#) on page 2-26

This section 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.

### 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.

## Lightning protection zones

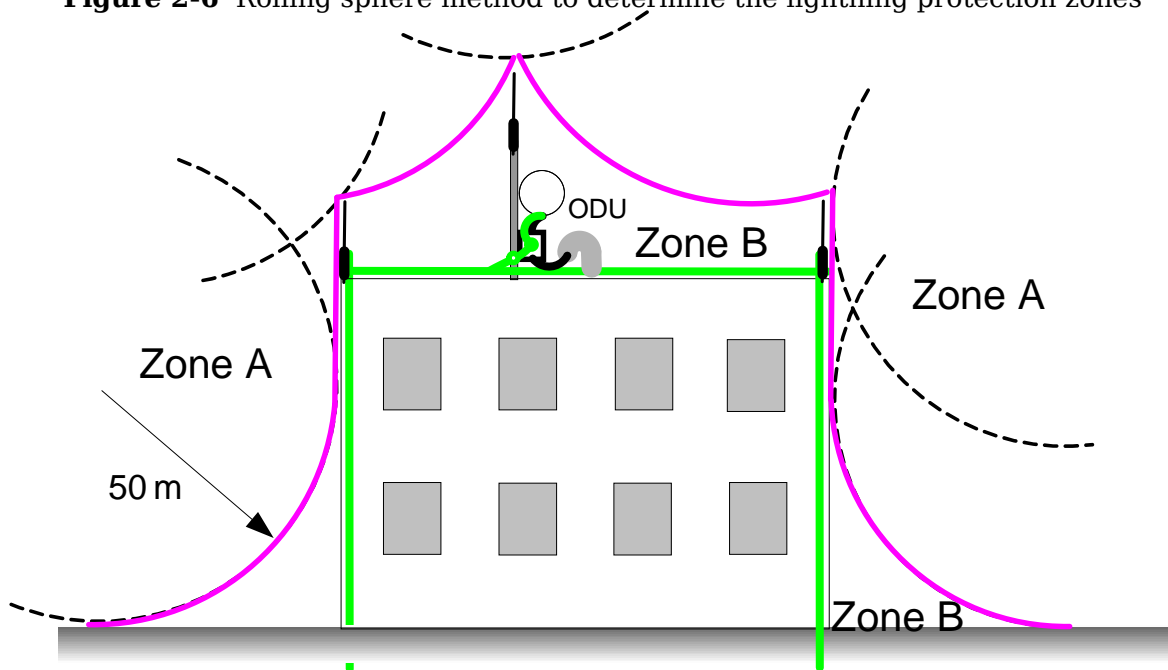
Lightning protection zones are determined by using the 'rolling sphere method' (Figure 2-6). Assess locations on masts, towers and buildings to determine if the location is in Zone A or Zone B:

- Zone A: In this zone a direct lightning strike is possible. Do not mount the ODU and antenna 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 and antenna in this zone.

### **⚠ WARNING**

**Never mount the ODU in Zone A. Mounting in Zone A may put equipment, structures and life at risk.**

**Figure 2-6** Rolling sphere method to determine the lightning protection zones



## The rolling sphere method

An imaginary sphere, typically 50 meters in radius, is rolled over the structure ([Figure 2-6](#)). Where the sphere rests against the ground and a strike termination device (such as a finial or ground bar) all the space under the sphere is considered to be in the zone of protection (Zone B). Similarly, where the sphere rests on two finials the space under the sphere is considered in the zone of protection.

## Grounding considerations

The PTP 600 Series ODU grounding point can be found on the bottom of the unit. The ODU is supplied with an appropriate grounding lug.

The following protection requirements are mandatory:

- 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 [Site installation diagrams](#) on page 2-26.

## LPU configuration options

The PTP LPU can be installed in one of the following configurations:

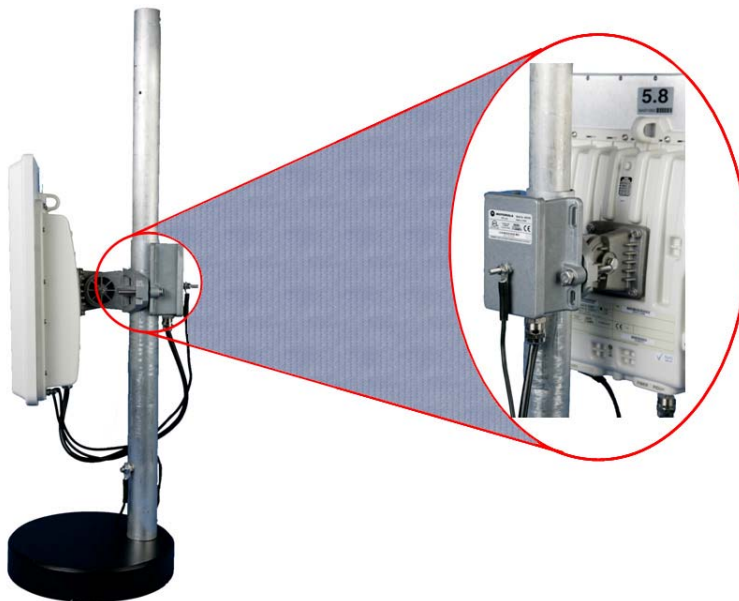
- **Option 1:** Back-to-back with the ODU using the supplied brackets delivered part of the installation of a link. This is the configuration recommended by Motorola.
- **Option 2:** Using the U-Bolt bracket supplied with the PTP LPU Kit.

Typical examples of these two configurations are shown in [Figure 2-7](#) and [Figure 2-8](#).

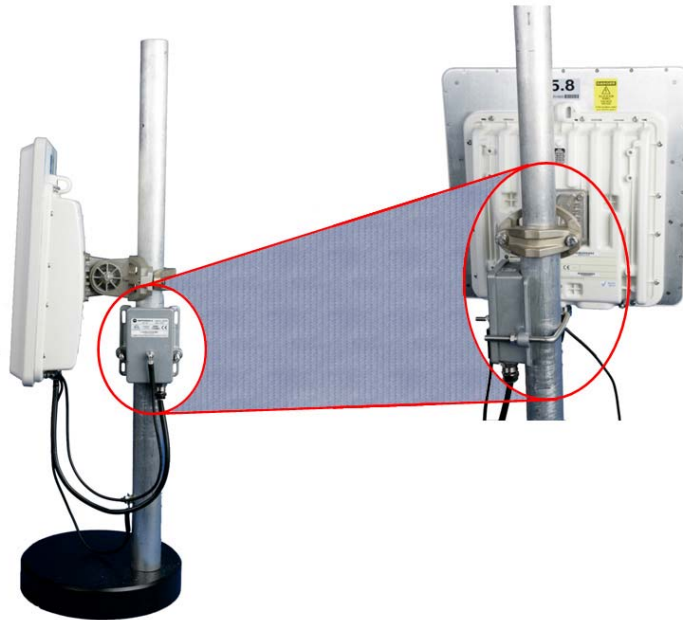
### CAUTION

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

**Figure 2-7** Example of PTP-LPU configuration option 1 (back-to-back)



**Figure 2-8** Example of PTP-LPU configuration option 2 (U-bolt)



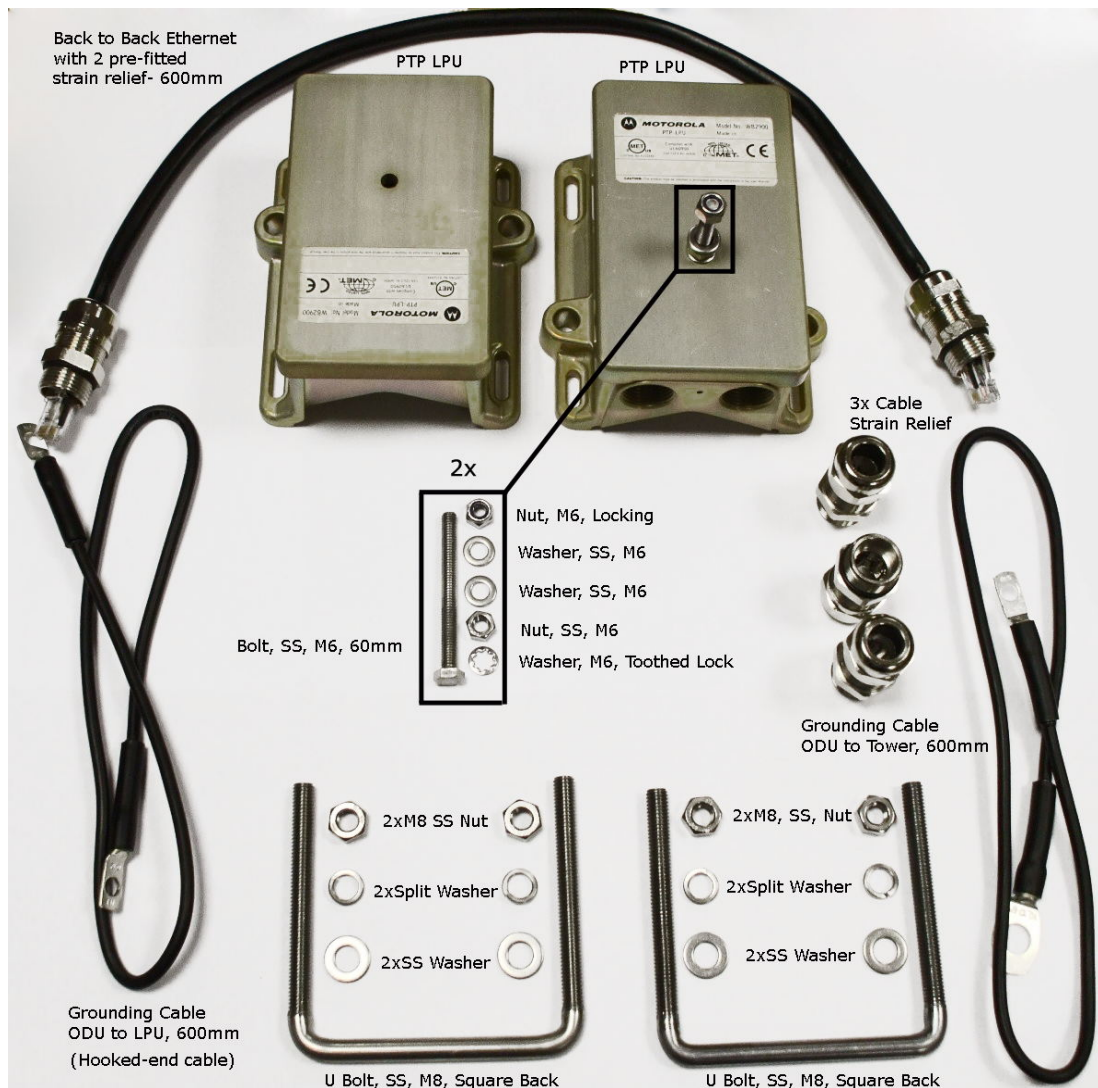
A second Lightning protection Unit should be mounted at the building entry point and must be grounded.

## LPU kit

### Standard kit with two LPUs

The standard PTP-LPU kit ([Figure 2-9](#)) contains two LPUs, grounding cables and a 600mm ODU to LPU cable pre-fitted with glands. The Motorola part number for this kit is WB2907AA.

**Figure 2-9** PTP LPU full kit

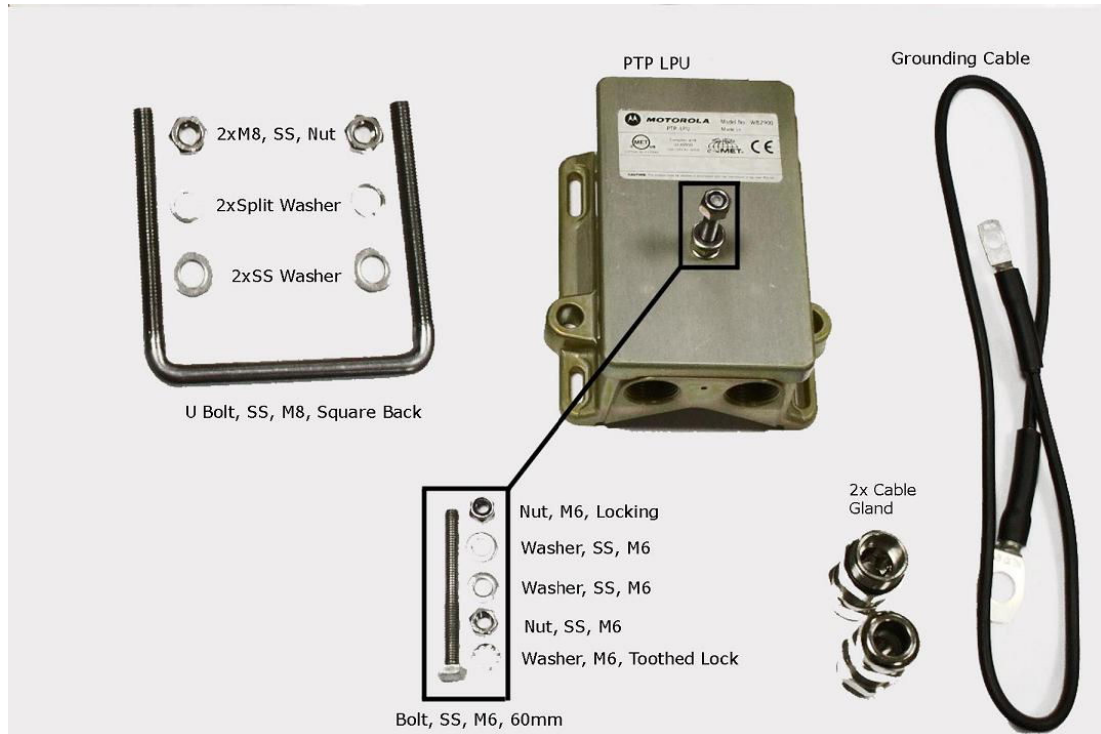


The cable between the two LPUs (top and bottom) should be of the recommended type (see [Cables and connectors](#) on page 1-15) and terminated as shown in [Figure 5-1](#).

### Additional kit with one LPU

Some installation options, for example PTP-SYNC with Trimble GPS receiver, may require an additional single LPU kit (Figure 2-10).

**Figure 2-10** PTP-LPU additional kit

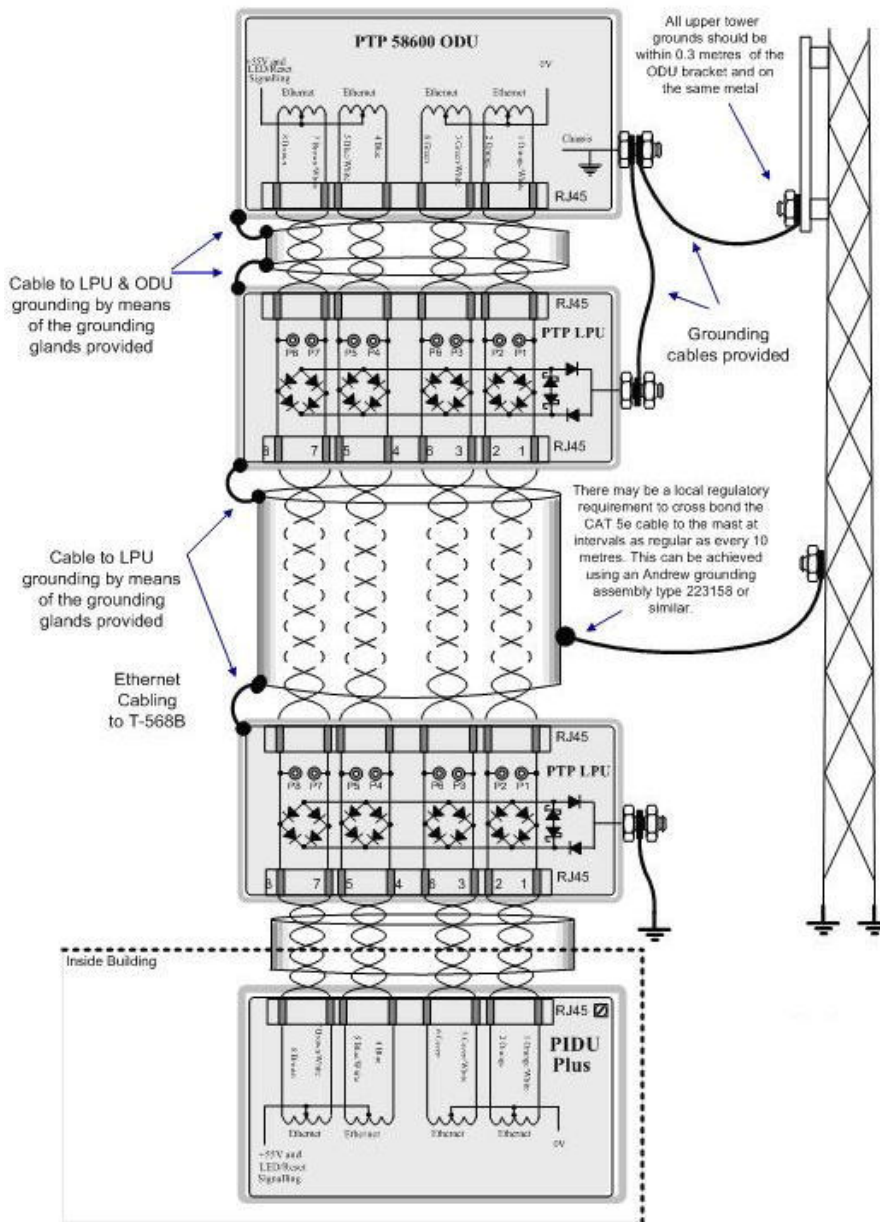


### LPU installation wiring

Figure 2-11 shows the correct installation wiring for a PTP 600 with lightning protection.



**Figure 2-11** Simplified circuit diagram



## Site installation diagrams

---

This section contains diagrams to show how the components of PTP 600 sites are installed and connected with LPU. 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 Unit
- Wall installation with GPS Sync Unit
- Mast or tower installation with GPS Sync Unit and E1/T1
- Wall installation with GPS Sync Unit and E1/T1

The recommended standard components for protecting installations are:

- The supported Superior Essex cable
- 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

Additional components are listed under each diagram where required. The recommended cables are specified in [Cables and connectors](#) on page 1-15.

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.

### NOTE

Refer to instructions contained in the Andrew grounding kit for correct installation, or if instructions are missing, refer to:

[http://awapps.commscope.com/catalog/product\\_details.aspx?id=15832&tab=2](http://awapps.commscope.com/catalog/product_details.aspx?id=15832&tab=2)

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.

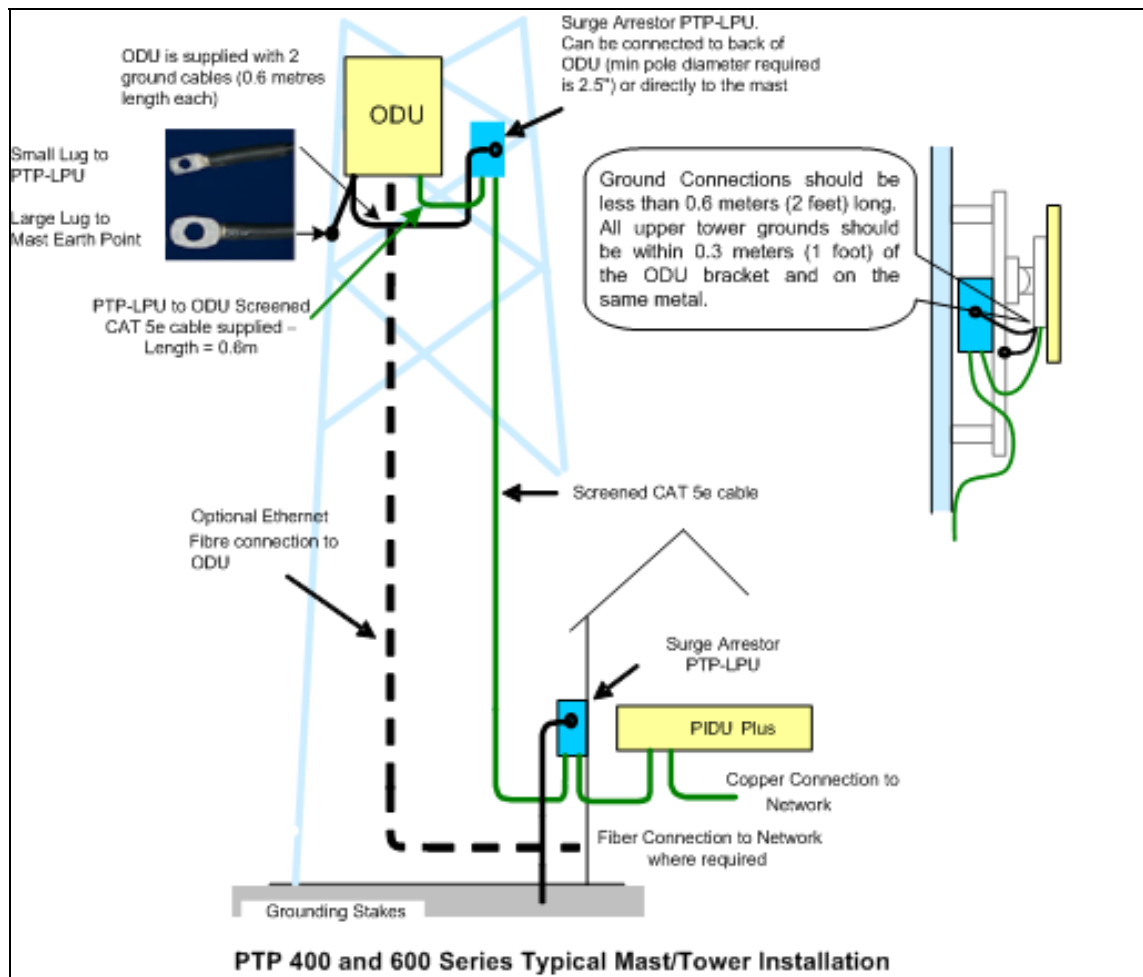
 **NOTE**

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.

## Typical mast or tower installation

Figure 2-12 shows a typical PTP 600 Series mast or tower installation using PTP-LPU Surge protection for a configuration without a GPS sync unit or E1/T1 ports. This installation requires 4 Motorola PTP-LPU surge arrestors (2 kits).

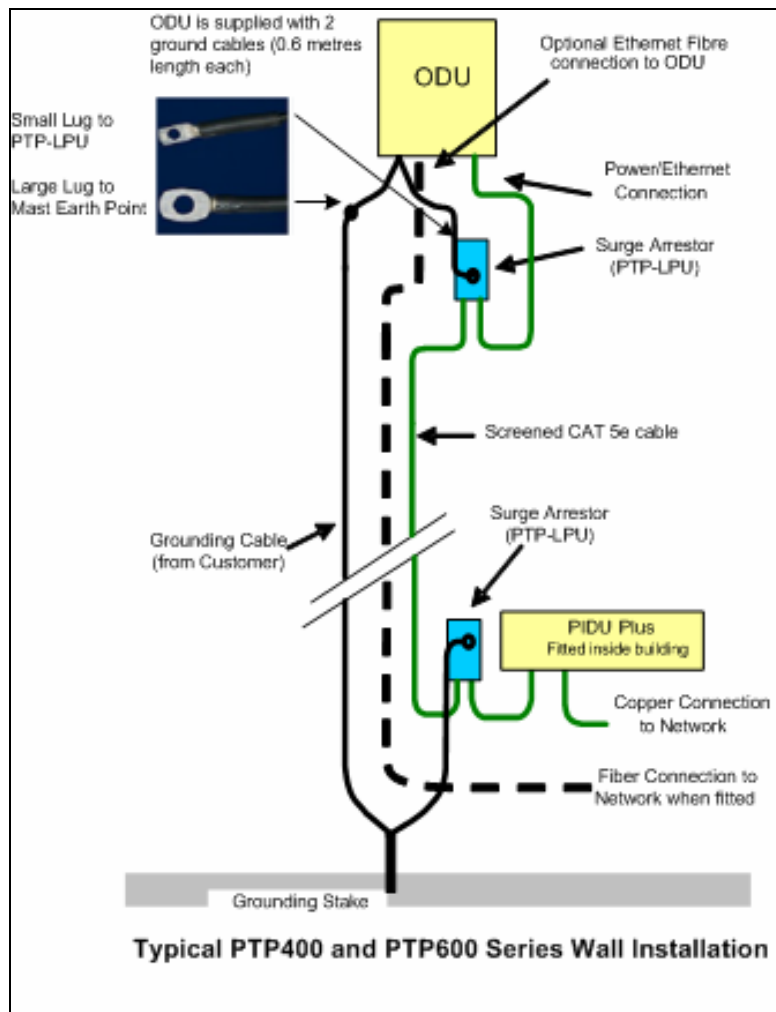
**Figure 2-12** Typical mast or tower installation



## Typical wall installation

Figure 2-13 shows a typical PTP 600 Series wall installation using PTP-LPU surge protection for a configuration without a GPS sync unit or E1/T1 ports. This installation requires 4 Motorola PTP-LPU surge arrestors (2 kits).

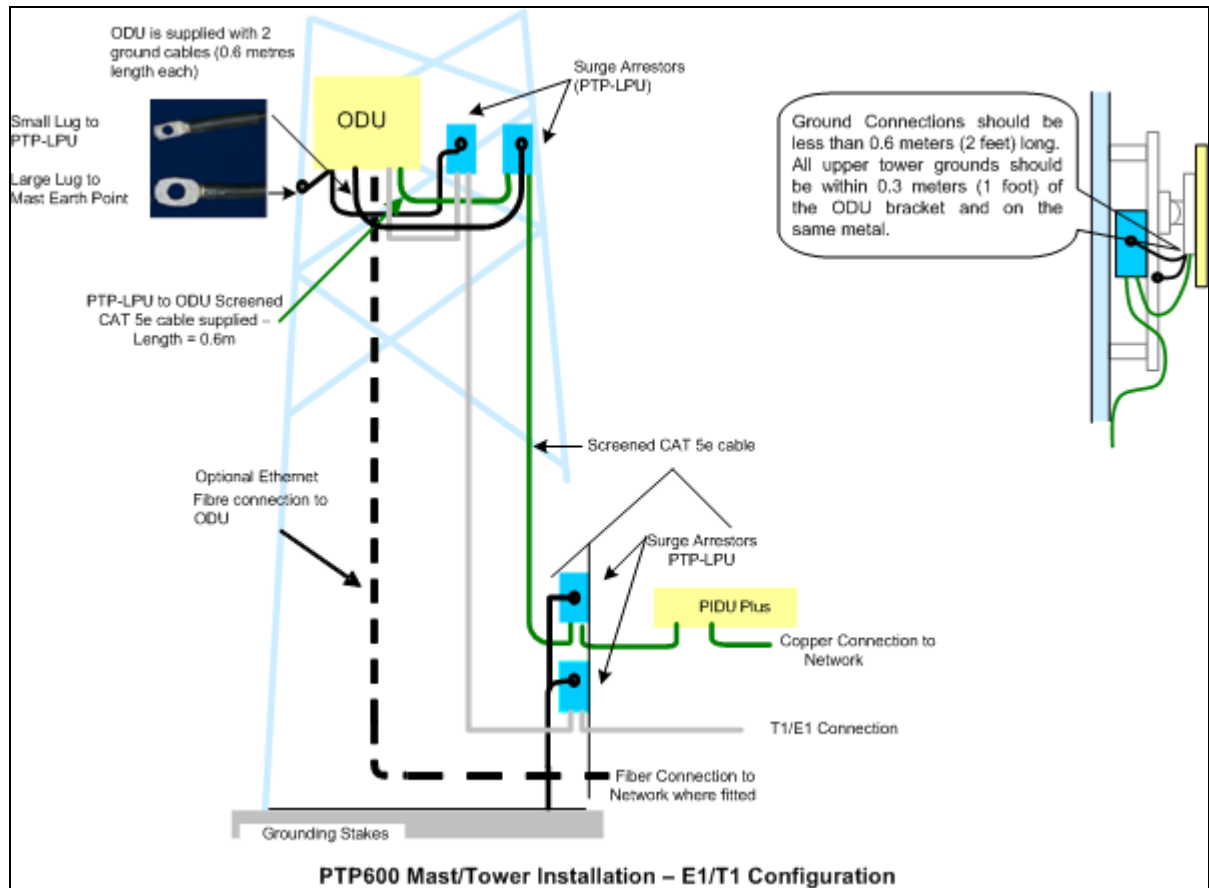
**Figure 2-13** Typical wall installation



## Mast or tower installation with E1/T1

Figure 2-14 shows a typical PTP 600 Series mast or tower installation using PTP-LPU surge protection for a configuration that includes E1/T1 ports. This installation requires 8 Motorola PTP-LPU surge arrestors (4 kits).

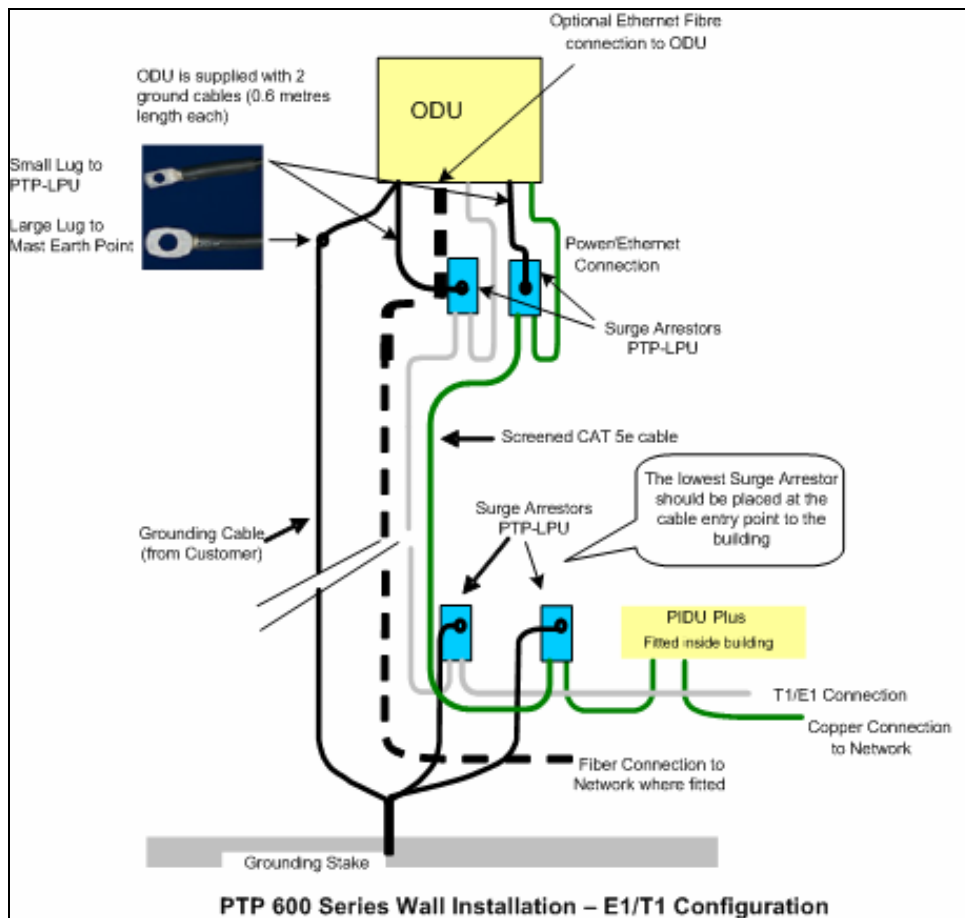
**Figure 2-14** Mast or tower installation with E1/T1



## Wall installation with E1/T1

Figure 2-15 shows a PTP 600 Series wall installation using PTP-LPU surge protection for a configuration that includes E1/T1 ports. This installation requires 8 Motorola PTP-LPU surge arrestors (4 kits).

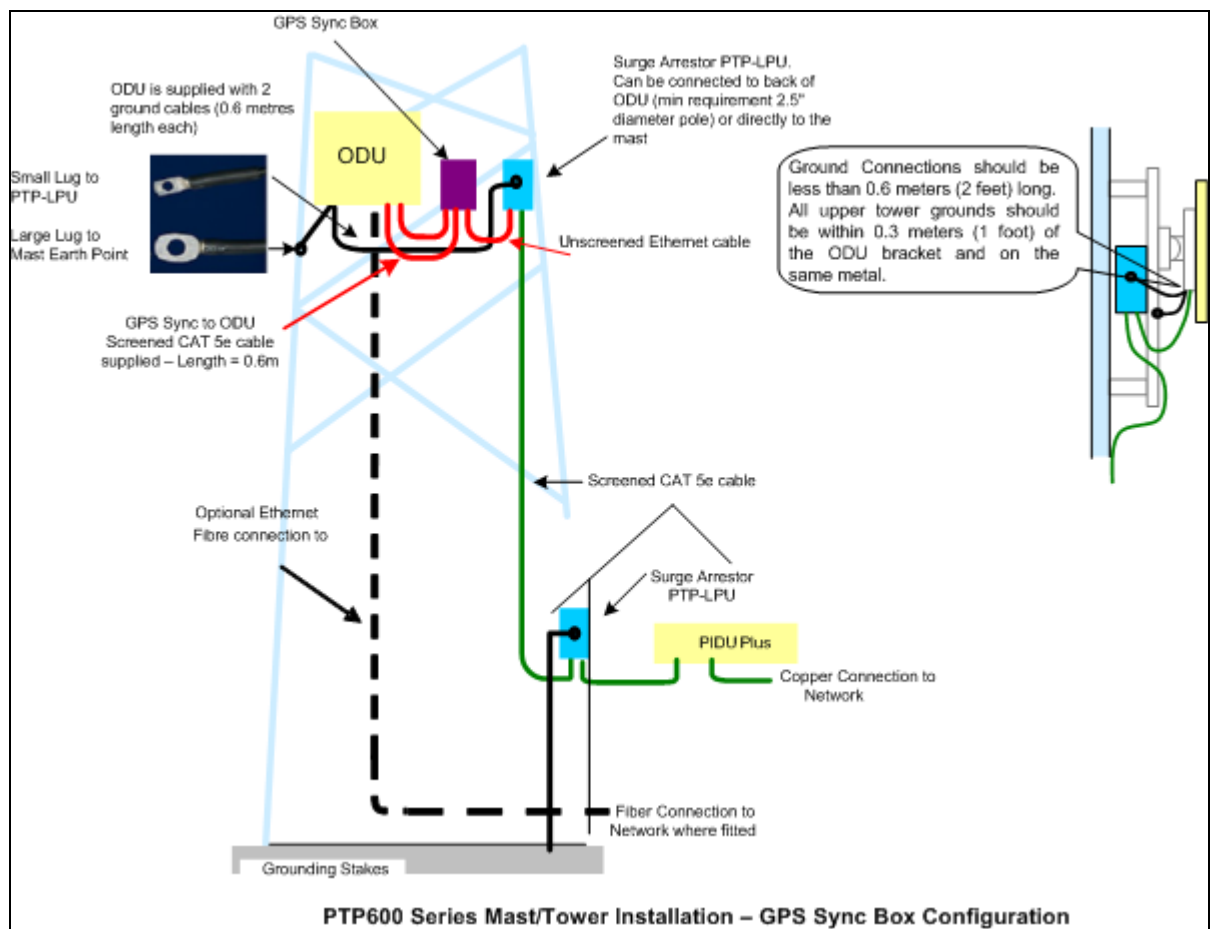
Figure 2-15 Wall installation with E1/T1



## Mast or tower installation with UltraSync GPS unit

Figure 2-16 shows a PTP 600 Series mast or tower installation using PTP-LPU surge protection for a configuration that includes an UltraSync GPS sync unit. This installation requires 4 Motorola PTP-LPU surge arrestors (2 kits). This installation also requires: UltraSync GPS sync unit from MemoryLinkl – 1 per link (1 Motorola kit).

**Figure 2-16** Mast or tower installation with UltraSync GPS sync unit

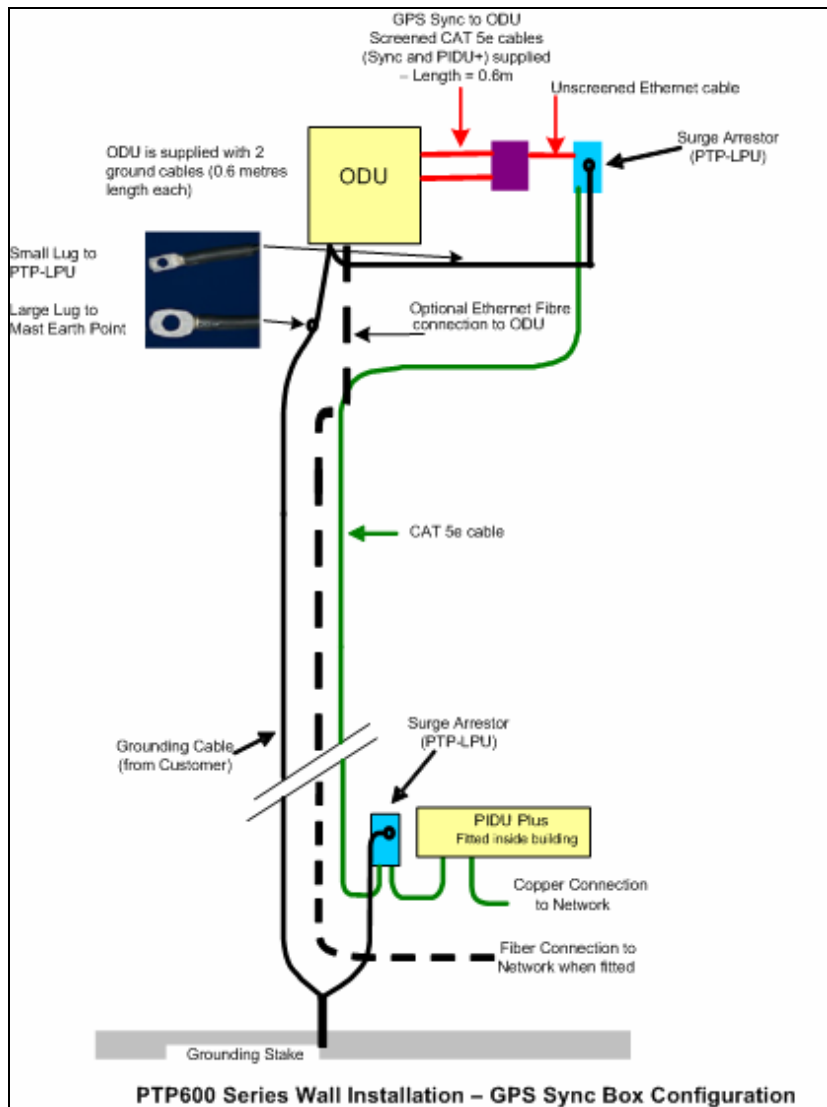




## Wall installation with UltraSync GPS unit

Figure 2-17 shows a PTP 600 Series wall installation using PTP-LPU surge protection for a configuration that includes an UltraSync GPS sync unit. This installation requires 4 Motorola PTP-LPU surge arrestors (2 kits). This installation also requires one UltraSync GPS sync unit from MemoryLink per link (1 Motorola kit).

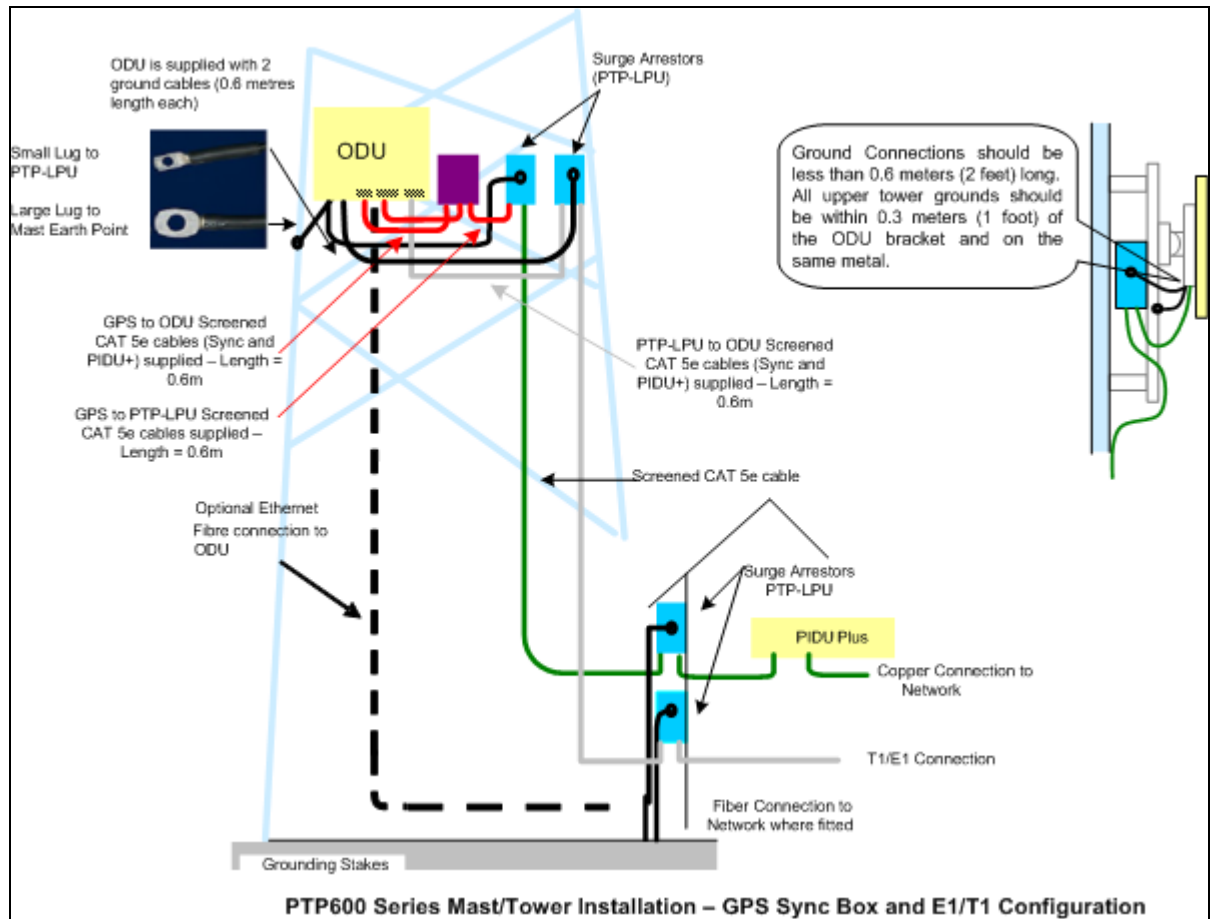
**Figure 2-17** Wall installation with UltraSync GPS sync unit



## Mast or tower installation with UltraSync GPS unit and E1/T1

Figure 2-18 shows a PTP 600 Series mast or tower installation using PTP-LPU surge protection for a configuration that includes an UltraSync GPS sync unit and E1/T1 ports. This installation requires 8 Motorola PTP-LPU surge arrestors (4 kits). This installation also requires: UltraSync GPS sync unit from MemoryLink1 – 1 per link (1 Motorola kit).

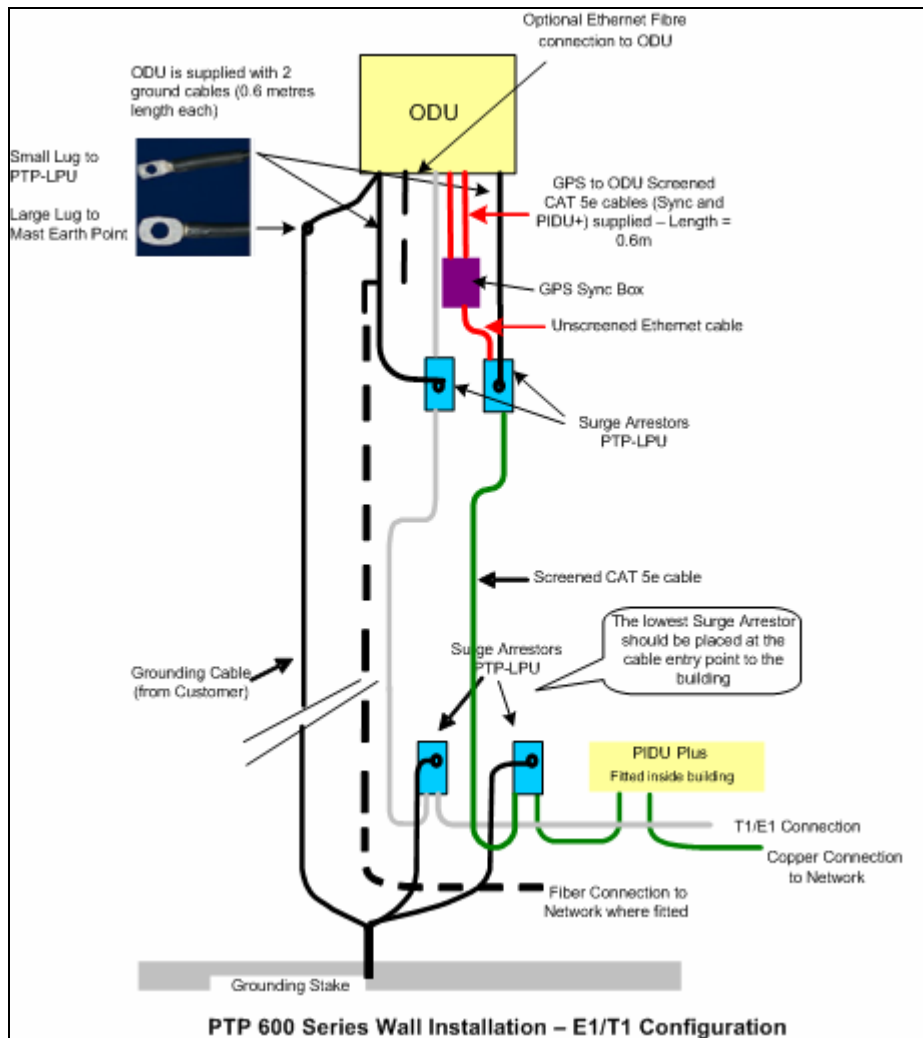
**Figure 2-18** Mast or tower installation with UltraSync GPS sync unit and E1/T1



## Wall installation with UltraSync GPS unit and E1/T1

Figure 2-19 shows a PTP 600 Series wall installation using PTP-LPU surge protection for a configuration that includes an UltraSync GPS sync unit and E1/T1 ports. This installation requires 8 Motorola PTP-LPU surge arrestors (4 kits). This installation also requires: UltraSync GPS sync unit from MemoryLink1 – 1 per link (1 Motorola kit).

**Figure 2-19** Wall installation with UltraSync GPS sync unit and E1/T1



## Protection of the GPS receiver for PTP-SYNC

---

If PTP-SYNC is the selected TDD synchronization method, with a GPS receiver as the timing reference source, then the GPS receiver must be protected as described in this section.

### CAUTION

Ensure that the GPS receiver module is mounted in a position where all lightning protection requirements can be met.

### GPS receiver mounting options

The options for mounting the GPS receiver module are as follows:

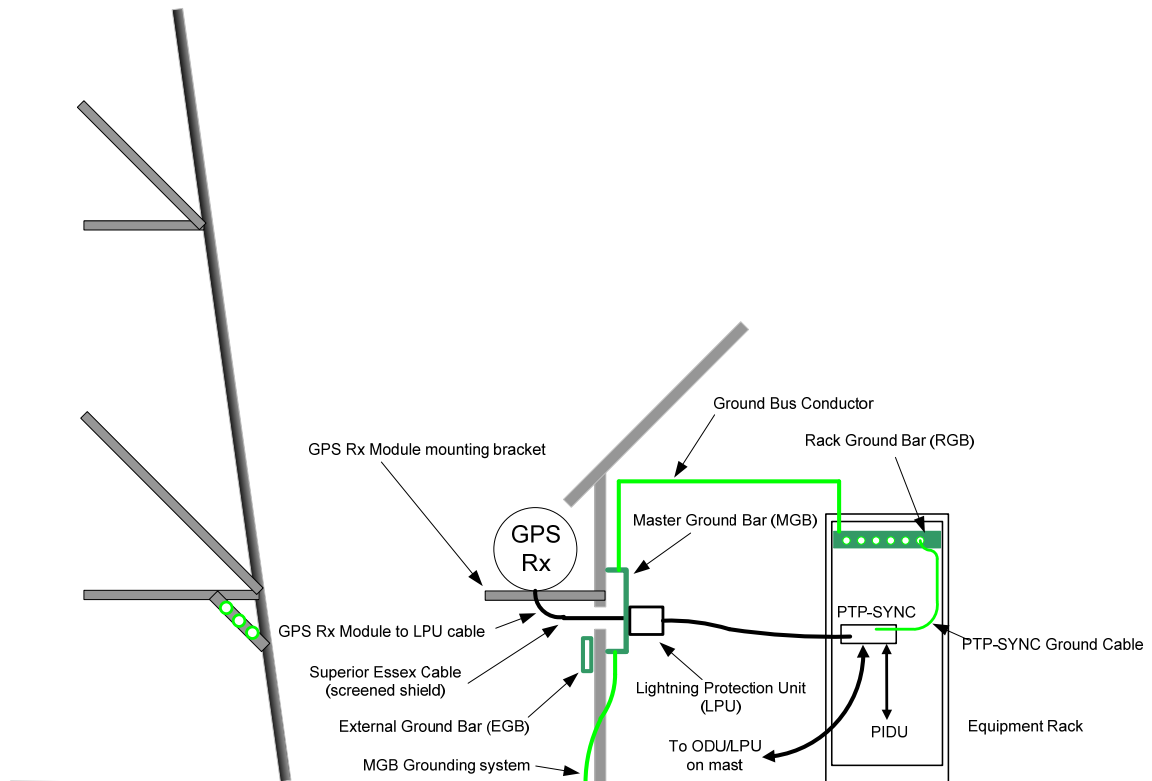
- Mount it on the wall of the equipment building, if there is a suitable position from which it can receive an adequate satellite signal.
- Failing that, mount it on a metal tower or mast.

### Mounting the GPS receiver module on the equipment building

If mounting the GPS receiver module on the equipment building ([Figure 2-20](#)), select a position on the wall that meets the following requirements:

- It must have an un-interrupted view of the sky.
- It must receive an adequate signal from at least one GPS satellite.
- It must be in 'Zone B' (refer to [Lightning protection zones](#) on page 2-19).
- It must be below the roof height of the equipment building or below the height of any roof-mounted equipment (such as air conditioning plant).
- It must be below the lightning terminals and finials.
- It must not project more than 600mm (24 inches) from the wall of the building.
- It must be possible to wire it to the PTP-SYNC unit via an LPU with Superior Essex screened 4-pair cable.

If these requirements cannot all be met, then the module must be mounted on a metal tower or mast.

**Figure 2-20** GPS receiver mounted on equipment building

## Mounting the GPS receiver module on a metal tower or mast

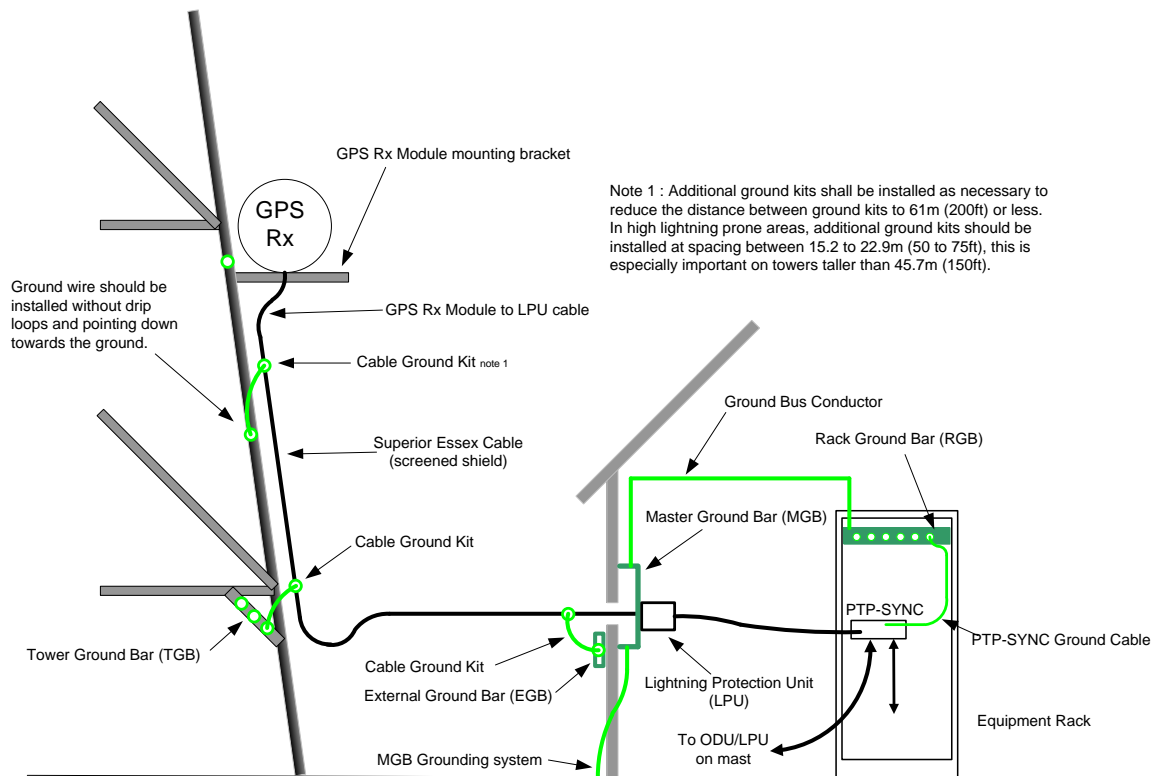
If mounting the GPS receiver module on a metal tower or mast ([Figure 2-21](#)), select a position that meets the following requirements:

- It must have an un-interrupted view of the sky.
- It must not be mounted any higher than is necessary to receive an adequate signal from a GPS satellite.
- It must be lower than the top of the tower or its lightning terminal and finial.
- It must be protected by a nearby lightning terminal or finial that projects further out from the tower than the GPS receiver module.
- It must be possible to wire it to the PTP-SYNC unit via an LPU with Superior Essex screened 4-pair cable.

The grounding requirements of a tower or mast mounted GPS receiver module are:

- The metal tower or mast must be correctly grounded.
- The cable screen must be bonded to the tower at the top and bottom ends.
- Additional grounding at intermediate points of the cable may be required if the cable is longer than 15m (50 feet).

**Figure 2-21** GPS receiver mounted on tower or mast



PIDU

## Chapter 3 Legal information

---

This chapter provides legal notices including software license agreements.

### CAUTION

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.

The following topics are described in this chapter:

- [Motorola Inc. end user license agreement](#) on page 3-2
- [Hardware warranty](#) on page 3-12
- [Limit of liability](#) on page 3-13

## Motorola Inc. end user license agreement

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Jean-loup Gailly [jloup@gzip.org](mailto:jloup@gzip.org)

Mark Adler [madler@alumni.caltech.edu](mailto:madler@alumni.caltech.edu)

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## Chapter 4 Reference information

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This chapter describes the reference information and regulatory notices that are common to all PTP 600 products and those that are specific to each frequency variant.

The following topics are described in this chapter:

- [PTP 600 general reference information](#) on page 4-2
- [PTP 25600 reference information](#) on page 4-16
- [PTP 45600 reference information](#) on page 4-26
- [PTP 48600 reference information](#) on page 4-35
- [PTP 49600 reference information](#) on page 4-45
- [PTP 54600 reference information](#) on page 4-53
- [PTP 58600 reference information](#) on page 4-67
- [PTP 59600 reference information](#) on page 4-90
- [Data rate calculations](#) on page 4-99

## PTP 600 general reference information

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### Compliance with regulations

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

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.

#### CAUTION

When planning a link that will use Connectorized PTP 600 Series (with external antennas), ensure that regulatory requirements are met for the installation, as described in [Regulatory issues with connectorized units](#) on page 8-10.

### FCC and ETSI compliance testing

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.

When the system is used with PTP-SYNC, then it meets the requirements for a Class A digital device.

#### 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.

A Class A Digital Device is a device that is marketed for use in a commercial, industrial or business environment, exclusive of a device which is marketed for use by the general public or is intended to be used in the home.

## Radio and television interference

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 and PIDU Plus 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 is controlled by the use of Region-specific License Keys. 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.

## Examples of regulatory limits

For examples of how the regulatory limits apply to each frequency variant in specific countries, refer to:

- [PTP 25600 examples of regulatory limits](#) on page 4-16
- [PTP 45600 examples of regulatory limits](#) on page 4-26
- [PTP 48600 examples of regulatory limits](#) on page 4-35
- [PTP 49600 examples of regulatory limits](#) on page 4-45
- [PTP 54600 examples of regulatory limits](#) on page 4-53
- [PTP 58600 examples of regulatory limits](#) on page 4-67
- [PTP 59600 examples of regulatory limits](#) on page 4-90

## Registration of links

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](http://www.comreg.ie/licensing_and_services)



## System specifications

**Table 4-1** PTP 600 management specifications

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

**Table 4-2** PTP 600 Ethernet bridging specifications

Ethernet Bridging	Specification
Protocol	IEEE802.1; IEEE802.1p; IEEE802.3 compatible
QoS	IEEE 802.1p (eight levels), IEEE 802.1Q, IEEE 802.1ad
Interface	10/100/1000BaseT (RJ-45), Supports MDI/MDIX Auto Crossover
Data Rates	See <a href="#">Data rate calculations</a> on page 4-99.
Maximum Ethernet Frame Size	2000 bytes

 **NOTE**

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

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

**Table 4-3** PTP 600 physical specifications

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

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

**Table 4-4** PTP 600 power supply specifications

<b>Power Supply</b>	<b>Separate power supply unit (included)</b>
Dimensions	Width 9.75" (250mm), Height 1.5" (40mm), Depth 3" (80mm)
Weight	1.9 lbs (0.864 Kg)
Power source	90 – 264 V ac, 50 – 60 Hz / 36 – 60 V dc
Power consumption	55 W max

**Table 4-5** PTP 600 telecoms interface specifications

Telecoms	Specification
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.

**Table 4-6** PTP 600 PTP-SYNC physical specifications

PTP-SYNC	Specification
Dimensions	Width excluding ears 6.69in (174mm) Width including ears 7.54in (196mm) Height 1.21in (31.5mm) Depth 3.04in (79mm)
Weight	485 gm
Power supply	Integrated with PIDU
Power source	+39 V dc to +60 V dc
Power consumption	1.5 W max

## Safety compliance

**Table 4-7** PTP 600 safety compliance specifications

Region	Specification
USA	UL 60950
Canada	CSA C22.2 No.60950

International	CB certified & certificate to IEC 60950
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## European EMC immunity compliance

Complies with European EMC Specification EN301 489-1 with testing carried out to the detailed requirements of EN301 489-4.

### NOTE

For EN 61000-4-2: 1995 Electro Static Discharge (ESD), Class 2, 8 kV air, 4 kV contact discharge, the PTP 600 has been tested to ensure immunity to 15kV air and 8kV contact.

## Electromagnetic energy

### Standards

Relevant standards (USA and EC) applicable when working with RF equipment are:

- *ANSI IEEE C95.1-1991, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.*
- Council recommendation of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) (1999/519/EC) and respective national regulations.
- *Directive 2004/40/EC of the European Parliament and of the Council of 29 April 2004 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields) (18th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC).*
- 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-limités\\_e.html](http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/99ehd-dhm237/limits-limités_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).
- BS EN 50385:2002 Product standard to demonstrate the compliances of radio base stations and fixed terminal stations for wireless telecommunication systems with the basic restrictions or the reference levels related to human exposure to radio frequency electromagnetic fields (110 MHz – 40 GHz) – general public.
- 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.

## Power density exposure limit

Install the radios for the PTP 600 family of PTP wireless solutions so as to provide and maintain the minimum separation distances from all persons.

The applicable power density exposure limit from the standards (see [Electromagnetic energy](#) on page 4-10 ) is:

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

## Calculation of power density

### NOTE

The following calculation is based on the ANSI IEEE C95.1-1991 method, as that provides a worst case analysis. Details of the assessment to EN50383:2002 can be provided, if required.

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

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

**Where:**

S

P

G

d

**Is:**

power density in W/m<sup>2</sup>

maximum average transmit power capability of the radio, in W

total Tx gain as a factor, converted from dB

distance from point source, in m

Rearranging terms to solve for distance yields:

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

### Calculated distances and power compliance margins

Table 4-8 shows calculated minimum separation distances *d*, recommended distances and resulting margins for each frequency band and antenna combination. These are conservative distances that include compliance margins. At these and greater separation distances, the power density from the RF field is below generally accepted limits for the general population.

**Table 4-8** Power compliance margins

Band	Antenna	Max Average Transmit Power in Burst (Watt)	Equation Variables				Recommended Distance (m)	Compliance Margin
			P (Watt)	G (factor)	S (W/m <sup>2</sup> )	d (m)		
2.5 GHz	Integrated	0.25	0.2	63	10	0.32	2	6.0
4.5 GHz	Integrated	0.5	0.4	158	10	0.71	5	7.0
4.8 GHz	Integrated	0.5	0.4	158	10	0.71	5	7.0
	Connectorized	0.5	0.4	398	10	1.1	5	4.5
4.9 GHz	Integrated	0.25	0.2	158	10	0.5	2	4.0
	Connectorized	0.25	0.2	398	10	0.8	5	6.25
5.4 GHz	Integrated	0.005	0.004	200	10	0.08	1	12.5
	External 4ft Dish	0.00035	0.00028	2884	10	0.08		
5.8 GHz	Integrated	0.32	0.26	200	10	0.63	2	3.2
	External 2ft Flat Plate	0.32	0.26	631	10	1.0	5	5.0



Band	Antenna	Max Average Transmit Power in Burst (Watt)	Equation Variables				Recommended Distance (m)	Compliance Margin
			P (Watt)	G (factor)	S (W/m <sup>2</sup> )	d (m)		
	External 6ft Dish	0.32	0.26	6310	10	3.07	10	3.25
	External sectored antenna (60°)	0.32	0.26	50.1	10	0.28	1	3.6
5.9 GHz	Integrated	0.32	0.16	200	10	0.63	2	4.0
	External 2ft Flat Plate	0.32	0.16	631	10	1.0	5	5.0
	External 6ft Dish	0.32	0.16	6310	10	3.07	10	3.25

 **NOTE**

Gain of antenna in dBi = 10\*log(G).

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.

 **NOTE**

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).



## Environmental specifications

**Table 4-9** PTP 600 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) PTP-SYNC: -40°F (-40°C) to 140°F (+60°C)
Wind Loading	150mph Max (242kph). See <a href="#">Wind loading</a> on page 2-7 for a full description.
Humidity	100% Condensing (ODU only)
Waterproof	IP65 (ODU only)
UV Exposure	10 year operational life (UL746C test evidence)

## PTP 25600 reference information

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This section contains reference information that is specific to the PTP 25600 frequency variant.

### PTP 25600 examples of regulatory limits

Table 4-10 shows how the regulatory limits currently apply in specific countries. Operators should note that regulations are subject to change.

**Table 4-10** PTP 25600 examples of regulatory limits

Region	Examples of Regulatory Limits at 2.5 GHz
FCC	<p>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.</p> <p>Spectrum in this band (2496MHz to 2690MHz) is allocated on a licensed basis in USA.</p>

## PTP 25600 licenses and region codes

PTP 25600 units may be operated in any of the regions listed in [Table 4-11](#).

When shipped, PTP 25600 units are configured with a license key for region code 16. An alternative license key is provided in the *PTP 600 Installation 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.

The 30MHz bandwidth is not approved in FCC regions.

**Table 4-11** PTP 25600 licenses and region codes

Region Code	License / Regulation	Frequencies	DFS	Channel Bandwidth	Max Power
16	FCC Upper	2624 - 2690 MHz		5, 10, 15, 30 MHz	63 dBm EIRP
	FCC Middle	2572 - 2614 MHz		5, 10, 15, 30 MHz	63 dBm EIRP
	FCC Lower	2496 - 2568 MHz		5, 10, 15, 30 MHz	63 dBm EIRP
18	Taiwan Upper	2660 - 2690 MHz		5, 10, 15 MHz	23 dBm
	Taiwan Middle	2595 - 2625 MHz		5, 10, 15 MHz	23 dBm
	Taiwan Lower	2565 - 2595 MHz		5, 10, 15 MHz	23 dBm

## PTP 25600 regulatory compliance

The PTP 25600 complies with the regulations that are in force in the USA. The relevant notifications are specified in this section.

### 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.

## PTP 25600 radio system specifications

Table 4-12 contains radio system specifications for the PTP 25600.

**Table 4-12** PTP 25600 RF specifications

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.

Radio Technology	Specification
Weather Sensitivity	Sensitivity at higher modes may be reduced during high winds through trees due to Adaptive Modulation Threshold changes.
Error Correction	FEC

## PTP 25600 emissions and radio certifications

Table 4-13 lists the EMC emissions specifications under which the PTP 25600 has received type approval. Table 4-14 lists the radio specifications under which the PTP 25600 has received type approval.

**Table 4-13** PTP 25600 EMC emissions compliance

Region	Specification (Type Approvals)
USA	FCC Part 15 (Class B)

**Table 4-14** PTP 25600 radio certifications

Region	Certification



## PTP 25600 available spectrum settings

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 4-15](#). The 30MHz Channel Bandwidth is not supported in the FCC region.

**Table 4-15** PTP 25600 channel plan - FCC BRS-EBS Post-Transition Band

<b>Block</b>	<b>Channel Bandwidth (MHz)</b>	<b>Channel Centre Frequencies (MHz)</b>
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	2587, 2599
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 4-1](#).



## PTP 25600 system threshold, output power and link loss

PTP 25600 system threshold, output power and maximum link loss are given in [Table 4-16](#) (IP mode) and [Table 4-17](#) (TDM mode). These figures assume that antenna gain is 23 dBi.

**Table 4-16** PTP 25600 - IP mode - threshold, power and link loss

Channel Bandwidth	Threshold Value (dBm)				Output Power (dBm)	Maximum Link Loss (dB)			
	5 MHz	10 MHz	15 MHz	20 MHz		All Bands	5 MHz	10 MHz	15 MHz
BPSK 0.63 single	-97.6	-95.1	-93.0	-90.4	+23	156.6	154.1	152.0	149.4
QPSK 0.63 single	-93.9	-90.7	-90.5	-86.7	+23	152.9	149.7	146.6	145.7
QPSK 0.87 single	-90.7	-87.6	-87.5	-83.9	+23	149.7	146.6	146.5	142.9
16QAM 0.63 single	-89.1	-86.0	-86.0	-82.1	+23	148.0	145.5	145.0	140.4
16QAM 0.63 dual	-86.7	-83.9	-84.0	-79.4	+23	145.7	142.9	143.0	138.4
16QAM 0.87 single	-84.2	-82.5	-80.5	-76.5	+23	143.2	141.4	139.5	135.5
16QAM 0.87 dual	-81.0	-77.7	-77.4	-72.9	+23	140.0	136.6	136.4	131.9
64QAM 0.75 single	-81.6	-79.2	-77.4	-73.5	+23	140.6	138.2	136.4	132.4
64QAM 0.75 dual	-77.8	-74.7	-74.3	-69.8	+23	136.8	133.7	133.3	128.8
64QAM 0.92 single	-78.8	-76.3	-74.4	-70.3	+23	137.8	135.2	133.4	129.3
64QAM 0.92 dual	-75.5	-71.3	-71.9	-66.5	+23	134.5	130.3	130.9	125.5
256QAM 0.81 single	-77.2	-74.9	-72.9	-68.8	+23	136.2	133.9	131.9	127.8
256QAM 0.81 dual	-73.5	-70.1	-69.7	-65.1	+23	132.5	129.1	128.7	124.1

**Table 4-17** PTP 25600 - TDM mode - threshold, power and link loss

Channel Bandwidth	Threshold Value (dBm)				Output Power (dBm)	Maximum Link Loss (dB)			
	5 MHz	10 MHz	15 MHz	20 MHz		5 MHz	10 MHz	15 MHz	20 MHz
BPSK 0.63 single	-97.6	-95.1	-93.0	-90.4	+23	156.6	154.1	152.0	149.4
QPSK 0.63 single	-91.6	-89.1	-88.2	-85.2	+23	150.6	148.1	147.2	144.2
QPSK 0.87 single	-88.3	-85.6	-85.1	-81.5	+23	147.3	144.6	144.1	140.5
16QAM 0.63 single	-86.4	-83.9	-83.5	-79.4	+23	145.4	142.9	142.5	138.4
16QAM 0.63 dual	-84.2	-80.8	-80.7	-76.6	+23	143.2	139.8	139.7	135.6
16QAM 0.87 single	-81.7	-78.1	-77.3	-73.6	+23	140.7	137.1	136.3	132.6
16QAM 0.87 dual	-78.6	-74.4	-74.3	-70.0	+23	137.6	133.4	133.3	129.0
64QAM 0.75 single	-78.8	-75.2	-74.2	-70.6	+23	137.8	134.2	133.2	129.6
64QAM 0.75 dual	-75.4	-71.0	-70.9	-66.7	+23	134.4	130.0	129.9	125.7
64QAM 0.92 single	-76.0	-73.4	-72.2	-68.6	+23	135.0	132.4	131.2	127.6
64QAM 0.92 dual	-73.5	-69.3	-68.9	-64.8	+23	132.5	128.2	127.9	123.8
256QAM 0.81 single	-73.4	-71.6	-69.1	-65.4	+23	132.4	130.6	128.1	124.4
256QAM 0.81 dual	-70.4	-67.6	-65.9	-61.6	+23	129.4	126.6	124.9	120.6

## PTP 45600 reference information

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This section contains reference information for the PTP 45600 frequency variant.

### PTP 45600 examples of regulatory limits

Table 4-18 shows how the regulatory limits currently apply in specific countries. Operators should note that regulations are subject to change.

**Table 4-18** PTP 45600 examples of regulatory limits

Region	Examples of Regulatory Limits at 4.5 GHz
US Federal	Operation of this product is only allowed with a License Key for Region 23 (US Federal).
NTIA	Operation of this product is only allowed with a License Key for Region 24.

### PTP 45600 licenses and region codes

PTP 45600 units may be operated in any of the regions listed in Table 4-19.

When shipped, PTP 45600 units are configured with a license key for region code 23.

**Table 4-19** PTP 45600 licenses and region codes

Region Code	License / Regulation	Frequencies	DFS	Channel Bandwidth	Max Power
23	US Federal	4400 - 4600 MHz		5, 10, 15, 20, 30 MHz	27 dBm
24	NTIA	4400 - 4600 MHz		10, 20 MHz	27 dBm

## PTP 45600 radio system specifications

Table 4-20 contains radio system specifications for the PTP 45600.

**Table 4-20** PTP 45600 RF specifications

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, 20 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.

Radio Technology	Specification
Weather Sensitivity	Sensitivity at higher modes may be reduced during high winds through trees due to Adaptive Modulation Threshold changes
Error Correction	FEC

## PTP 45600 emissions and radio certifications

Table 4-21 lists the EMC emissions specifications under which the PTP 45600 has received type approval. Table 4-22 lists the radio specifications under which the PTP 45600 has received type approval.

**Table 4-21** PTP 45600 EMC emissions compliance

Region	Specification (Type Approvals)
US Federal	

**Table 4-22** PTP 45600 radio certifications

Region	Certification



## PTP 45600 available spectrum settings

The available spectrum settings for the PTP 45600 are illustrated in this section.

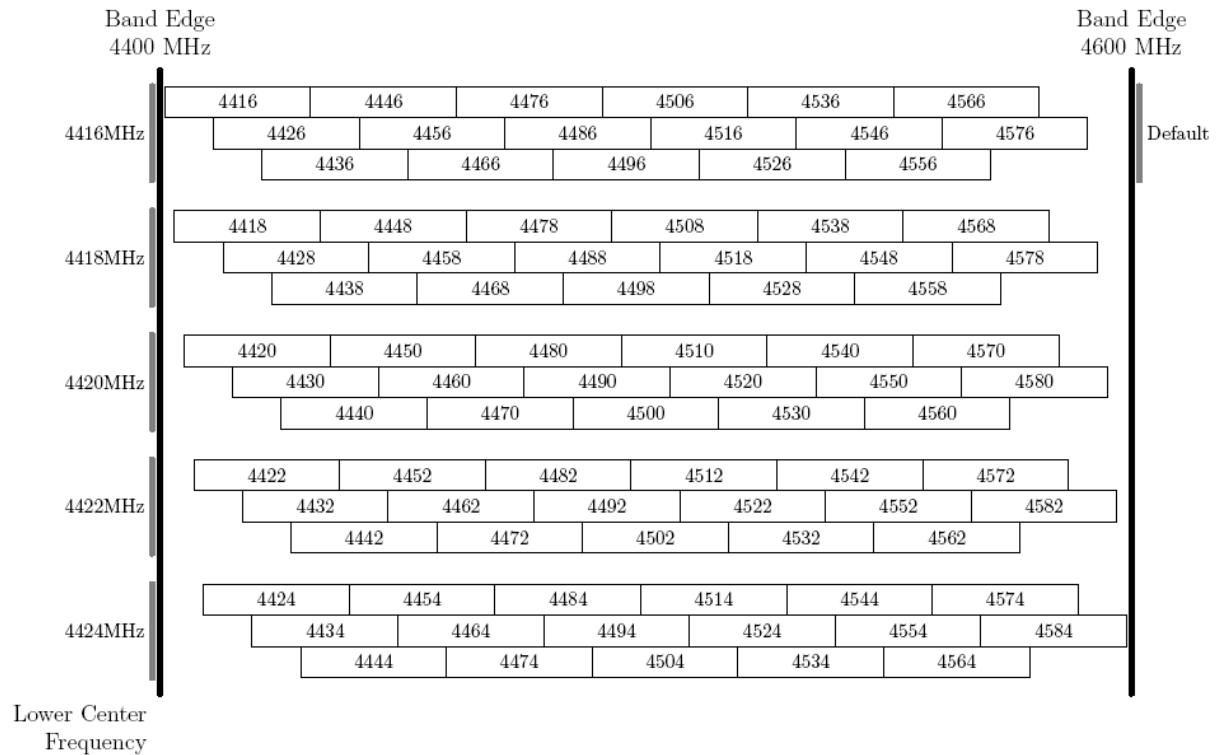
The PTP 45600 product variant does not apply any band edge power reduction.

### Region code 23

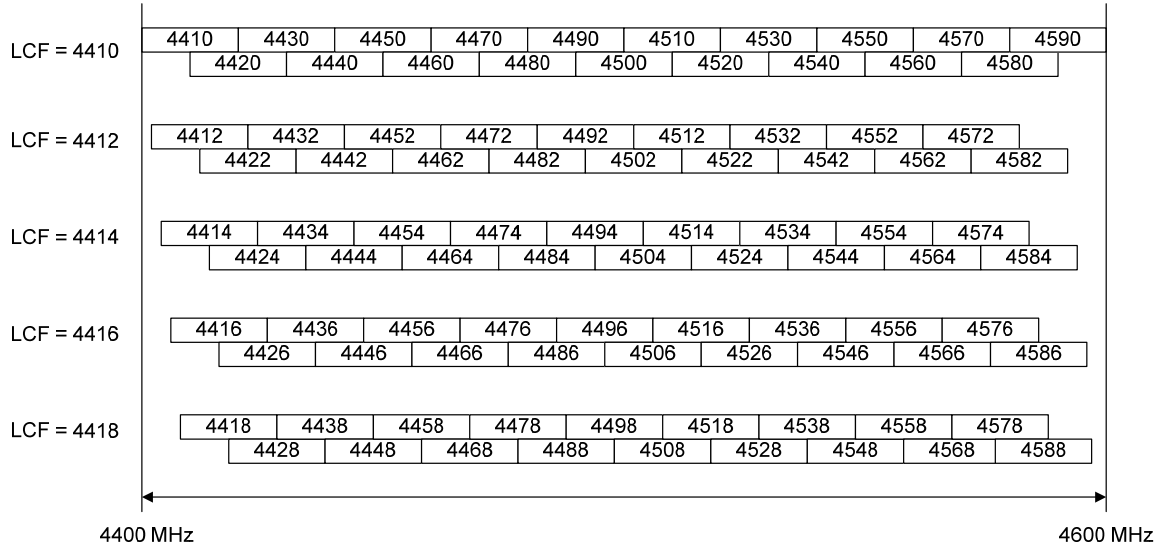
Adjustment of the lower centre frequency allows the operator to slide the available frequency settings up and down the 4.5 GHz band in steps of 2 MHz.

In the 30 MHz (Figure 4-2) and 20 MHz (Figure 4-3) channel bandwidths, the PTP 45600 variant operates on a 10 MHz channel raster. In the 15 MHz (Figure 4-4), 10 MHz (Figure 4-5) and 5 MHz (Figure 4-6) channel bandwidths, the PTP 45600 variant operates on a 6 MHz channel raster. The channel raster is set to even centre frequencies.

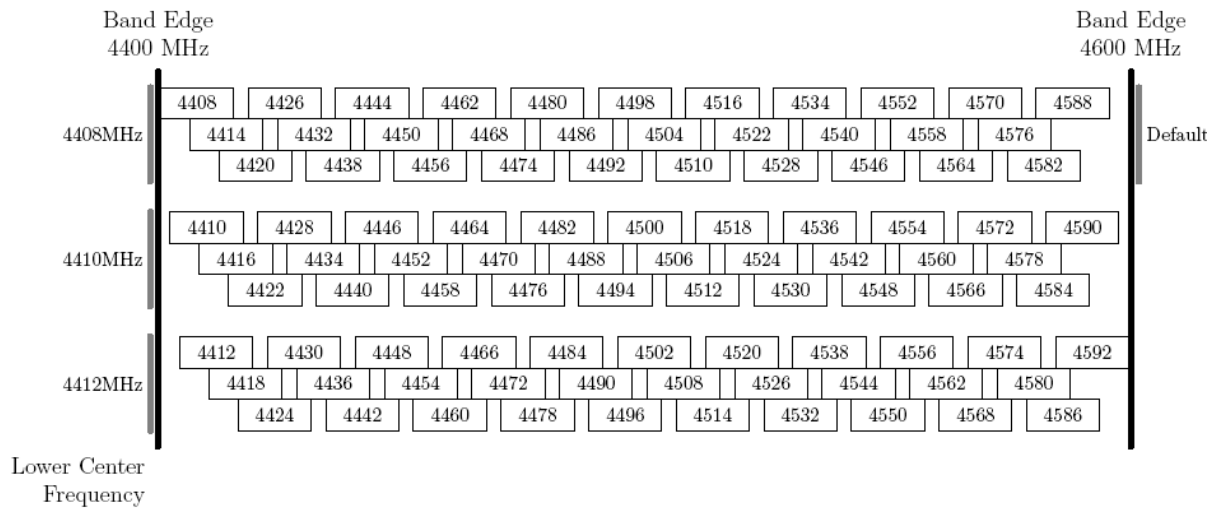
**Figure 4-2** PTP 45600 available spectrum in 30 MHz channel bandwidth (RC 23)



**Figure 4-3** PTP 45600 available spectrum in 20 MHz channel bandwidth (RC 23)

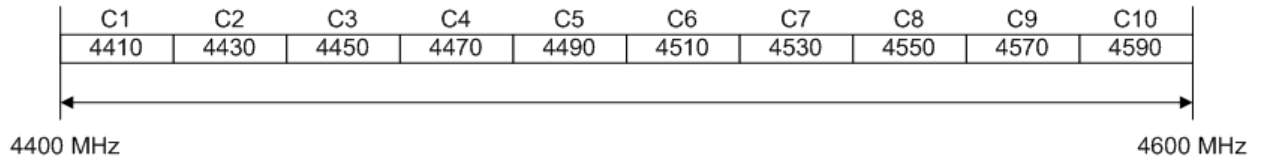


**Figure 4-4** PTP 45600 available spectrum in 15 MHz channel bandwidth (RC 23)

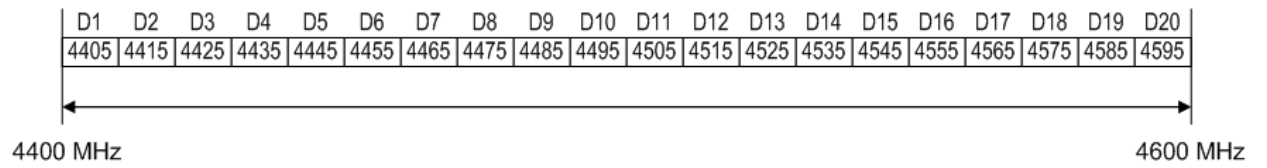




**Figure 4-7** PTP 45600 available spectrum in 20 MHz channel bandwidth (RC 24)



**Figure 4-8** PTP 45600 available spectrum in 10 MHz channel bandwidth (RC 24)



## PTP 45600 system threshold, output power and link loss

PTP 45600 system threshold figures are given in [Table 4-23](#) (IP mode) and [Table 4-24](#) (TDM mode). These figures assume that antenna gain is 23 dBi.

**Table 4-23** PTP 45600 - IP mode - threshold, power and loss per modulation mode

Channel Bandwidth	Threshold Value (dBm)					Output Power (dBm)	Maximum Link Loss (dB)				
	5 MHz	10 MHz	15 MHz	20 MHz	30 MHz		All Bands	5 MHz	10 MHz	15 MHz	20 MHz
BPSK 0.63 single	-96.6	-93.7	-92.0	-90.4	-88.0	+27	166.6	163.7	162.0	160.4	158.0
QPSK 0.63 single	-92.0	-91.4	-89.3	-88.5	-85.8	+27	160.5	159.9	159.3	158.5	155.8
QPSK 0.87 single	-90.0	-87.6	-85.7	-84.9	-82.2	+27	160.0	157.6	155.7	154.9	152.2
16QAM 0.63 single	-88.3	-85.5	-83.3	-82.5	-80.1	+27	158.3	155.5	153.3	152.5	150.1
16QAM 0.63 dual	-85.5	-81.9	-79.5	-78.9	-77.1	+27	155.5	151.9	149.5	148.9	147.1
16QAM 0.87 single	-84.6	-80.7	-78.6	-77.8	-75.5	+27	154.6	150.7	148.6	147.8	145.5
16QAM 0.87 dual	-81.3	-77.3	-75.0	-74.3	-72.3	+27	151.3	147.3	145.0	144.3	142.3
64QAM 0.75 single	-81.2	-77.6	-75.5	-74.7	-72.4	+25	149.2	145.6	143.5	142.7	140.4
64QAM 0.75 dual	-78.2	-74.2	-71.8	-71.1	-69.3	+25	146.2	142.2	139.8	139.1	137.3
64QAM 0.92 single	-76.8	-73.1	-71.3	-70.0	-67.7	+25	144.8	141.1	139.3	138.0	135.7
64QAM 0.92 dual	-73.2	-69.4	-67.6	-66.9	-65.0	+25	141.2	137.4	135.6	134.9	133.0
256QAM 0.81 single	Not supported										
256QAM 0.81 dual											

**Table 4-24** PTP 45600 - TDM mode - threshold, power and loss per modulation mode

Channel Bandwidth	Threshold Value (dBm)					Output Power (dBm)	Maximum Link Loss (dB)				
	5 MHz	10 MHz	15 MHz	20 MHz	30 MHz		All Bands	5 MHz	10 MHz	15 MHz	20 MHz
BPSK 0.63 single	-96.6	-93.7	-92.0	-90.4	-88.0	+27	166.6	163.7	162.0	160.4	158.0
QPSK 0.63 single	-90.4	-89.1	-87.8	-86.0	-83.1	+27	158.1	155.4	153.3	151.6	149.5
QPSK 0.87 single	-88.1	-85.4	-83.3	-81.6	-79.5	+27	160.3	159.1	157.8	156.0	153.1
16QAM 0.63 single	-86.1	-82.8	-80.7	-79.2	-77.2	+27	156.1	152.8	150.7	149.2	147.2
16QAM 0.63 dual	-82.5	-79.1	-77.2	-75.6	-73.9	+27	152.5	149.1	147.2	145.6	143.9
16QAM 0.87 single	-81.2	-78.2	-76.1	-74.4	-72.0	+27	151.2	148.2	146.1	144.4	142.0
16QAM 0.87 dual	-77.7	-74.4	-72.4	-70.8	-69.2	+27	147.7	144.4	142.4	140.8	139.2
64QAM 0.75 single	-77.7	-74.5	-72.4	-70.7	-68.6	+25	145.7	142.5	140.4	138.7	136.6
64QAM 0.75 dual	-74.2	-70.9	-69.1	-67.5	-65.9	+25	142.2	138.9	137.1	135.5	133.9
64QAM 0.92 single	-75.9	-72.2	-70.2	-68.6	-66.5	+25	143.9	140.2	138.2	136.6	134.5
64QAM 0.92 dual	-71.7	-68.5	-66.8	-65.4	-63.7	+25	139.7	136.5	134.8	133.4	131.7
256QAM 0.81 single	Not supported										
256QAM 0.81 dual											

## PTP 48600 reference information

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This section contains reference information for the PTP 48600 frequency variant.

### PTP 48600 examples of regulatory limits

Table 4-25 shows how the regulatory limits currently apply in specific countries. Operators should note that regulations are subject to change.

**Table 4-25** PTP 48600 examples of regulatory limits

Region	Examples of Regulatory Limits at 5.4GHz
US Federal	Operation of this product is only allowed with a License Key for Regions 15 or 23 (US Federal).
NTIA	Operation of this product is only allowed with a License Key for Region 24.

## PTP 48600 licenses and region codes

PTP 48600 units may be operated in any of the regions listed in [Table 4-26](#).

When shipped, PTP 48600 units are configured with a license key for region code 15. An alternative license key is provided in the *PTP 600 Installation Guide* for region code 23. 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 4-26** PTP 48600 licenses and region codes

Region Code	License / Regulation	Frequencies	DFS	Channel Bandwidth	Max Power
14	USA/Canada Public Safety	4940 - 4990 MHz		5, 10, 20 MHz	24 dBm
15	US Federal Extended	4710 - 5000 MHz		5, 10, 15, 20 MHz	27 dBm
23	US Federal	4710 - 4940 MHz		5, 10, 15, 20 MHz	27 dBm
24	NTIA	4700 - 4940 MHz		10, 20 MHz	27 dBm

### NOTE

region code 14 Max Power depends upon Antenna Gain:

If Antenna Gain < 26 dBi then Max Power = 24 dBm

If Antenna Gain >= 26 dBi then Max Power = (50 – Antenna Gain) dBm



## PTP 48600 radio system specifications

Table 4-27 contains radio system specifications for the PTP 48600.

**Table 4-27** PTP 48600 RF specifications

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, 15, 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.

Radio Technology	Specification
Weather Sensitivity	Sensitivity at higher modes may be reduced during high winds through trees due to Adaptive Modulation Threshold changes
Error Correction	FEC

## PTP 48600 emissions and radio certifications

Table 4-28 lists the EMC emissions specifications under which the PTP 48600 has received type approval. Table 4-29 lists the radio specifications under which the PTP 48600 has received type approval.

**Table 4-28** PTP 48600 EMC emissions compliance

Region	Specification (type approvals)
US Federal	

**Table 4-29** PTP 48600 radio certifications

Region	Certification

## PTP 48600 available spectrum settings

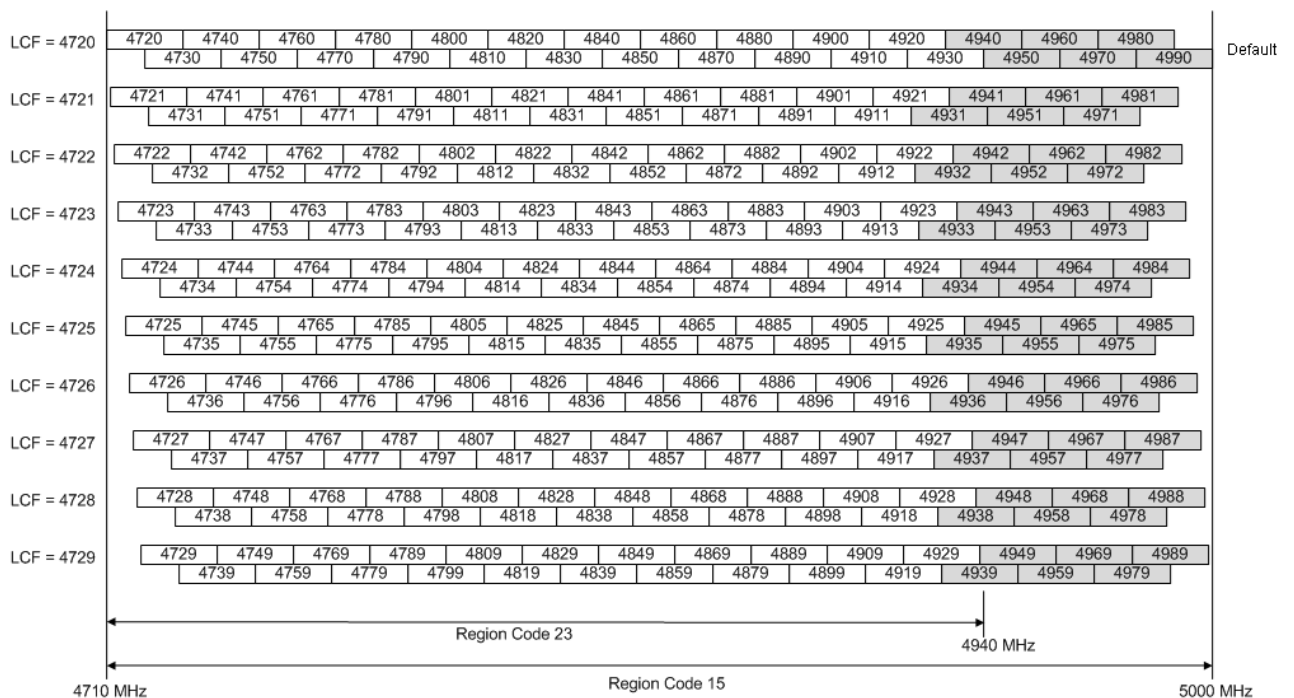
The available spectrum settings for the PTP 48600 are illustrated in this section.

### Region codes 15 and 23

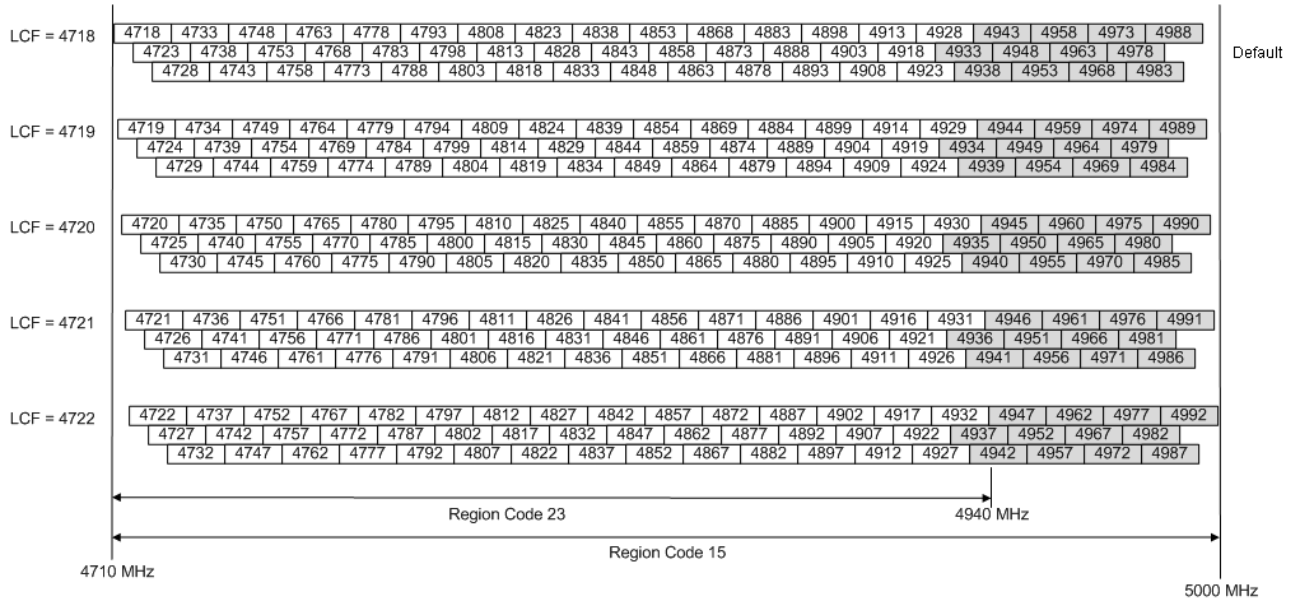
Adjustment of the lower centre frequency allows the operator to slide the available frequency settings up and down the 4.8 GHz band in steps of 1 MHz.

In the 20 MHz (Figure 4-9) channel bandwidth, the PTP 48600 variant operates on a 10 MHz channel raster. In the 15 MHz (Figure 4-10), 10 MHz (Figure 4-11) and 5 MHz (Figure 4-12) channel bandwidths, the PTP 48600 variant operates on a 5 MHz channel raster. The channel raster is set to even centre frequencies.

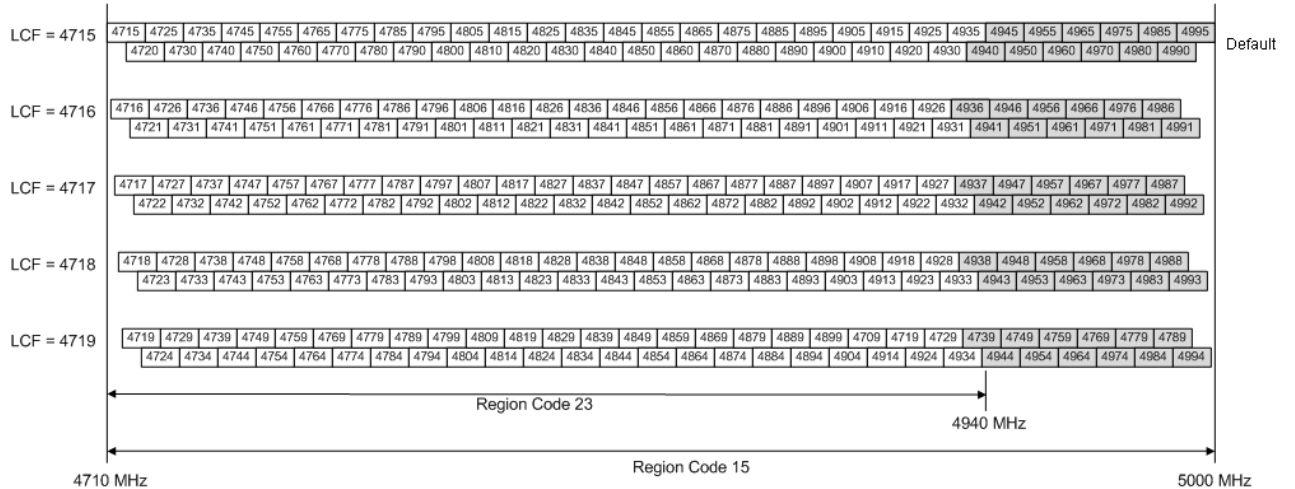
**Figure 4-9** PTP 48600 available spectrum in 20 MHz channel bandwidth (RC 15 and 23)



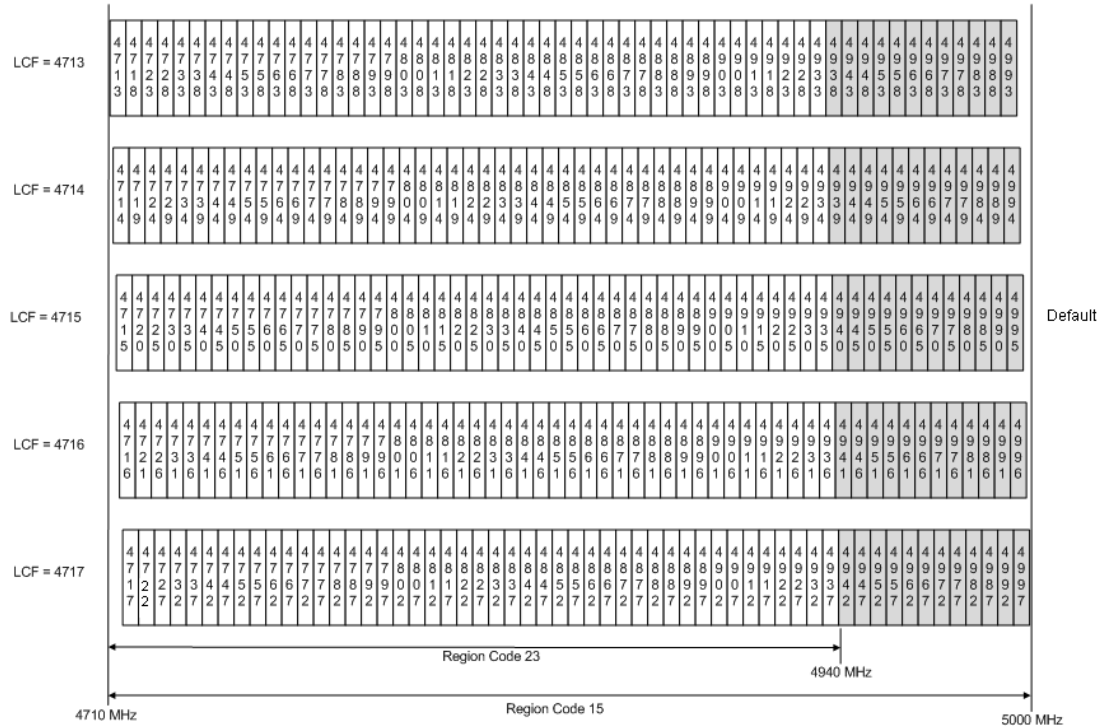
**Figure 4-10** PTP 48600 available spectrum in 15 MHz channel bandwidth (RC 15 and 23)



**Figure 4-11** PTP 48600 available spectrum in the 10 MHz channel bandwidth (RC 15 and 23)



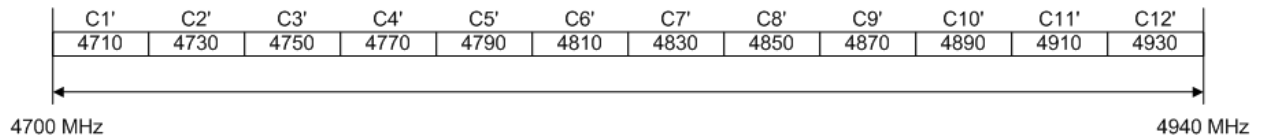
**Figure 4-12** PTP 48600 available spectrum in 5 MHz channel bandwidth (RC 15 and 23)



**Region code 24 (NTIA)**

In the 20 MHz (Figure 4-13) channel bandwidth, the PTP 48600 variant operates on a 20 MHz channel raster. In the 10 MHz (Figure 4-14) channel bandwidth, the PTP 48600 variant operates on a 10 MHz channel raster. The channel raster is set to even centre frequencies.

**Figure 4-13** PTP 48600 available spectrum in the 20 MHz channel bandwidth (RC 24)





## PTP 48600 system threshold, output power and link loss

PTP 48600 system threshold figures are given in [Table 4-30](#) (IP mode) and [Table 4-31](#) (TDM mode). These figures assume that antenna gain is 22 dBi.

**Table 4-30** PTP 48600 - IP mode - threshold, power and loss per modulation mode

Channel Bandwidth	System Threshold (dBm)				Output Power (dBm)		Maximum Link Loss (dB)			
	5 MHz	10 MHz	15 MHz	20 MHz	5, 10, 15 MHz	20 MHz	5 MHz	10 MHz	15 MHz	20 MHz
BPSK 0.63 single	-98.6	-95.5	-93.3	-91.9	+27	+27	169.6	166.5	164.3	162.9
QPSK 0.63 single	-94.3	-90.7	-89.6	-87.5	+27	+27	165.3	161.7	160.6	158.5
QPSK 0.87 single	-90.8	-87.3	-85.9	-84.0	+27	+26	161.8	158.3	156.9	154.0
16QAM 0.63 single	-88.7	-85.2	-83.6	-81.8	+25	+25	157.7	154.2	152.6	150.8
16QAM 0.63 dual	-85.3	-81.6	-80.0	-78.5	+25	+25	154.3	150.6	149.0	147.5
16QAM 0.87 single	-84.4	-80.6	-78.8	-77.3	+25	+25	153.4	149.6	147.8	146.3
16QAM 0.87 dual	-81.0	-77.2	-75.9	-74.5	+25	+25	150.0	146.2	144.9	143.5
64QAM 0.75 single	-81.2	-77.7	-76.1	-74.7	+23	+23	148.2	144.7	143.1	141.7
64QAM 0.75 dual	-78.2	-74.7	-73.4	-71.9	+23	+23	145.2	141.7	140.4	138.9
64QAM 0.92 single	-77.0	-73.9	-72.7	-71.0	+21	+21	142.0	138.9	137.7	136.0
64QAM 0.92 dual	-74.0	-70.9	-69.7	-67.6	+21	+21	139.0	135.9	134.7	132.6
256QAM 0.81 single	-75.2	-71.9	-70.1	-68.0	+20	+20	139.2	135.9	134.1	132.0
256QAM 0.81 dual	-72.1	-68.4	-66.9	-64.5	+20	+20	136.1	132.4	130.9	128.5

**Table 4-31** PTP 48600 - TDM Mode - threshold, power and loss per modulation mode

Channel Bandwidth	System Threshold (dBm)				Output Power (dBm)		Maximum Link Loss (dB)			
	5 MHz	10 MHz	15 MHz	20 MHz	5, 10, 15 MHz	20 MHz	5 MHz	10 MHz	15 MHz	20 MHz
BPSK 0.63 single	-98.6	-95.5	-93.3	-91.9	+27	+27	169.6	166.5	164.3	162.9
QPSK 0.63 single	-91.4	-88.8	-87.8	-85.7	+27	+27	162.4	159.8	158.8	156.7
QPSK 0.87 single	-87.9	-85.2	-83.5	-81.9	+27	+26	158.9	156.2	154.5	151.9
16QAM 0.63 single	-85.4	-82.7	-81.1	-79.6	+25	+25	154.4	151.7	150.1	148.6
16QAM 0.63 dual	-81.9	-79.5	-77.8	-76.5	+25	+25	150.9	148.5	146.8	145.5
16QAM 0.87 single	-81.0	-78.2	-76.8	-75.5	+25	+25	150.0	147.2	145.8	144.5
16QAM 0.87 dual	-77.8	-75.4	-74.0	-72.5	+25	+25	146.8	144.4	143.0	141.5
64QAM 0.75 single	-77.9	-75.2	-73.9	-72.6	+23	+23	144.9	142.2	140.9	139.6
64QAM 0.75 dual	-75.0	-72.6	-71.1	-69.3	+23	+23	142.0	139.6	138.1	136.3
64QAM 0.92 single	-76.5	-73.9	-72.3	-70.7	+21	+21	141.5	138.9	137.3	135.7
64QAM 0.92 dual	-73.3	-71.0	-69.0	-67.2	+21	+21	138.3	136.0	134.0	132.2
256QAM 0.81 single	-75.1	-72.3	-70.8	-69.3	+20	+20	139.1	136.3	134.8	133.3
256QAM 0.81 dual	-71.7	-69.3	-67.3	-65.4	+20	+20	135.7	133.3	131.3	129.4



## PTP 49600 reference information

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This section contains reference information for the PTP 49600 frequency variant.

### PTP 49600 examples of regulatory limits

[Table 4-32](#) shows how the regulatory limits currently apply in specific countries. Operators should note that regulations are subject to change.

**Table 4-32** PTP 49600 examples of regulatory limits

Region	Examples of Regulatory Limits at 5.4GHz
USA, Canada and Hong Kong Public Safety	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).

### PTP 49600 licenses and region codes

PTP 49600 units may be operated in any of the regions listed in [Table 4-33](#).

When shipped, PTP 49600 units are configured with a license key for region code 14. An alternative license key is provided in the *PTP 600 Installation Guide* for region code 18.

**Table 4-33** 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	24 dBm	See note below.
18	Hong Kong Public Safety	4900 - 4950 MHz		5, 10, 20 MHz	24 dBm	See note below.

**NOTE**

Region codes 14 and 18 Max Power depends upon Antenna Gain:  
If Antenna Gain < 26 dBi then Max Power = 24 dBm  
If Antenna Gain >= 26 dBi then Max Power = (50 – Antenna Gain) dBm

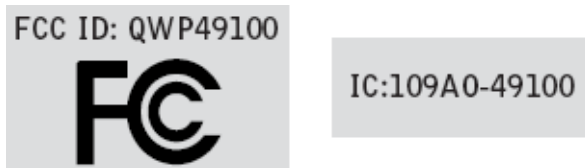
## PTP 49600 regulatory compliance

The PTP 49600 complies with the regulations that are in force in the USA and Canada. The relevant notifications are specified in this section.

### PTP 49600 FCC and IC notification

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:



## PTP 49600 radio system specifications

Table 4-34 contains radio system specifications for the PTP 49600.

**Table 4-34** PTP 49600 RF specifications

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	Typical: 22 dBi Maximum permitted: 26 dBi
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.

Radio Technology	Specification
Weather Sensitivity	Sensitivity at higher modes may be reduced during high winds through trees due to Adaptive Modulation Threshold changes
Error Correction	FEC

## PTP 49600 emissions and radio certifications

Table 4-35 lists the EMC emissions specifications under which the PTP 49600 has received type approval. Table 4-36 lists the radio specifications under which the PTP 49600 has received type approval.

**Table 4-35** PTP 49600 EMC emissions compliance

Region	Specification (Type Approvals)
USA	FCC Part 15B

**Table 4-36** PTP 49600 radio certifications

Region	Specification (Type Approvals)
USA	FCC Part 90
Canada	RSS-111

## PTP 49600 available spectrum settings

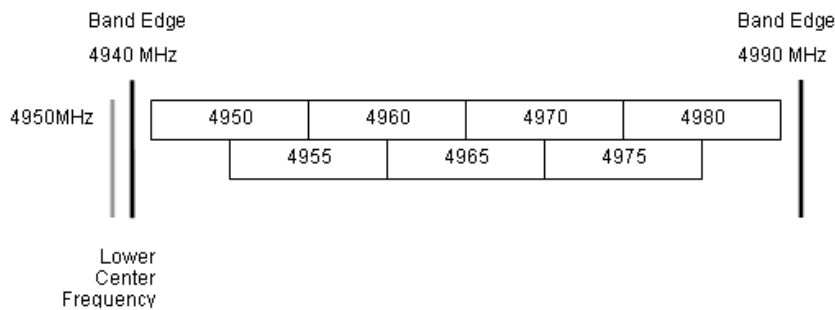
The available spectrum settings for the PTP 49600 are illustrated in this section. In the 20 MHz (Figure 4-15), 10 MHz (Figure 4-16) and 5 MHz (Figure 4-17) channel bandwidths, the PTP 49600 variant operates on a 5 MHz channel raster. The channel raster is set to even centre frequencies.

### NOTE

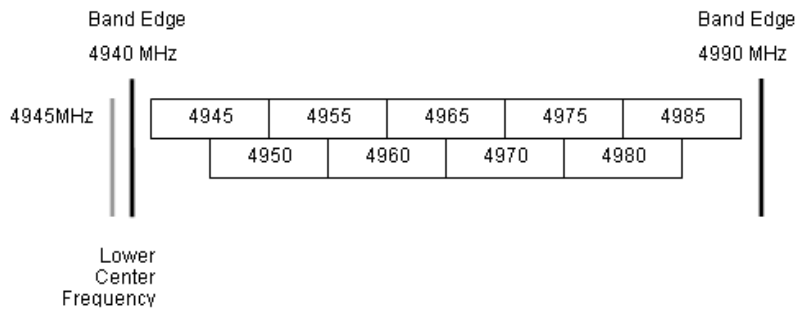
These tables contain data for one typical region code. The specified channel centre frequencies may not be available in other region codes.

The PTP 49600 product variant does not apply any band edge power reduction.

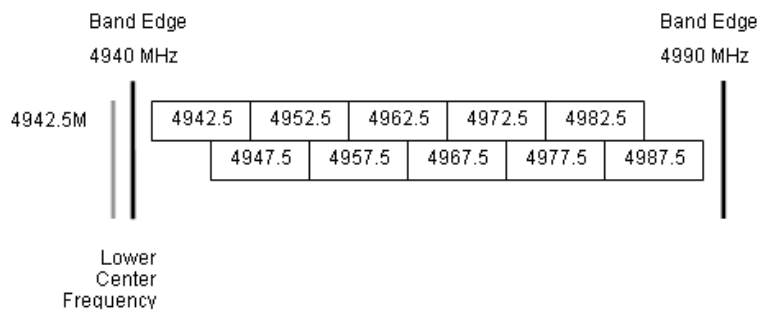
**Figure 4-15** PTP 49600 available spectrum in 20 MHz channel bandwidth



**Figure 4-16** PTP 49600 available spectrum in the 10 MHz channel bandwidth



**Figure 4-17** PTP 49600 available spectrum in the 5 MHz channel bandwidth



## PTP 49600 system threshold, output power and link loss

PTP 49600 system threshold figures are given in [Table 4-37](#) (IP mode) and [Table 4-38](#) (TDM mode). These figures assume that antenna gain is 22 dBi.

**Table 4-37** PTP 49600 - IP mode - threshold, power and loss per modulation mode

Channel Bandwidth	Threshold Value (dBm)			Output Power (dBm)	Maximum Link Loss (dB)		
	5 MHz	10 MHz	20 MHz		All Bands	5 MHz	10 MHz
BPSK 0.63 single	-98.6	-95.5	-91.9	+24	166.6	163.5	159.9
QPSK 0.63 single	-94.3	-90.7	-87.5	+24	162.3	158.7	155.5
QPSK 0.87 single	-90.8	-87.3	-84.0	+24	158.8	155.3	152.0
16QAM 0.63 single	-88.7	-85.2	-81.8	+24	156.7	153.2	149.8
16QAM 0.63 dual	-85.3	-81.6	-78.5	+24	153.3	149.6	146.5
16QAM 0.87 single	-84.4	-80.6	-77.3	+24	152.4	148.6	145.3
16QAM 0.87 dual	-81.0	-77.2	-74.5	+24	149.0	145.2	142.5
64QAM 0.75 single	-81.2	-77.7	-74.7	+23	148.2	144.7	141.7
64QAM 0.75 dual	-78.2	-74.7	-71.9	+23	145.2	141.7	138.9
64QAM 0.92 single	-77.0	-73.9	-71.0	+21	142.0	138.9	136.0
64QAM 0.92 dual	-74.0	-70.9	-67.6	+21	139.0	135.9	132.6
256QAM 0.81 single	-75.2	-71.9	-68.0	+20	139.2	135.9	132.0
256QAM 0.81 dual	-72.1	-68.4	-64.5	+20	136.1	132.4	128.5

**Table 4-38** PTP 49600 - TDM mode - threshold, power and loss per modulation mode

Channel Bandwidth	Threshold Value (dBm)			Output Power (dBm)	Maximum Link Loss (dB)		
	5 MHz	10 MHz	20 MHz		All Bands	5 MHz	10 MHz
Modulation Mode							
BPSK 0.63 single	-98.6	-95.5	-91.9	+24	166.6	163.5	159.9
QPSK 0.63 single	-91.4	-88.8	-85.7	+24	159.4	156.8	153.7
QPSK 0.87 single	-87.9	-85.2	-81.9	+24	155.9	153.2	149.9
16QAM 0.63 single	-85.4	-82.7	-79.6	+24	153.4	150.7	147.6
16QAM 0.63 dual	-81.9	-79.5	-76.5	+24	149.9	147.5	144.5
16QAM 0.87 single	-81.0	-78.2	-75.5	+24	149.0	146.2	143.5
16QAM 0.87 dual	-77.8	-75.4	-72.5	+24	145.8	143.4	140.5
64QAM 0.75 single	-77.9	-75.2	-72.6	+23	144.9	142.2	139.6
64QAM 0.75 dual	-75.0	-72.6	-69.3	+23	142.0	139.6	136.3
64QAM 0.92 single	-76.5	-73.9	-70.7	+21	141.5	138.9	135.7
64QAM 0.92 dual	-73.3	-71.0	-67.2	+21	138.3	136.0	132.2
256QAM 0.81 single	-75.1	-72.3	-69.3	+20	139.1	136.3	133.3
256QAM 0.81 dual	-71.7	-69.3	-65.4	+20	135.7	133.3	129.4



## PTP 54600 reference information

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This section contains reference information for the PTP 54600 frequency variant.

### PTP 54600 examples of regulatory limits

Table 4-39 shows how the regulatory limits currently apply in specific countries. Operators should note that regulations are subject to change.

**Table 4-39** PTP 54600 examples of regulatory limits

Region	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 - 5.4 GHz
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.

## PTP 54600 licenses and region codes

PTP 54600 units may be operated in any of the regions listed in [Table 4-40](#). When shipped, PTP 54600 units are configured with a license key for region code 26. Alternative license keys are provided in the *PTP 600 Installation 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 4-40** 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	Yes	30 MHz	30 dBm EIRP	The band 5600 MHz to

Region code	License / Regulation	Frequencies	DFS	Channel Bandwidth	Max Power	Notes
		5650 - 5725 MHz		15 MHz	27 dBm EIRP	5650 MHz is reserved for the use of weather radars.
				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	

## PTP 54600 regulatory compliance

The PTP 54600 complies with the regulations that are in force in the USA, Canada and Europe. The relevant notifications are specified in this section.

### PTP 54600 FCC and IC notification

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.

## PTP 54600 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.

Hereby, Motorola declares that the PTP 54600 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.

## PTP 54600 radio system specifications

Table 4-41 contains radio system specifications for the PTP 54600.

**Table 4-41** PTP 54600 RF specifications

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
Integrated Antenna Type/Gain	Integrated flat plate antenna; 23dBi
External Antenna Gain	Depends on feeder losses, see <a href="#">Regulatory issues with connectorized units</a> on page 8-10.
Antenna Beamwidth	8 Degrees
Max Path Loss (5 MHz channel, integrated antenna)	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

Radio Technology	Specification
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

## PTP 54600 emissions and radio certifications

Table 4-42 lists the EMC emissions specifications under which the PTP 54600 has received type approval. Table 4-43 lists the radio specifications under which the PTP 54600 has received type approval.

**Table 4-42** PTP 54600 EMC emissions compliance

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

**Table 4-43** PTP 54600 radio certifications

Region	Specification (Type Approvals)
USA	FCC Part 15 E
Canada	RSS 210 Issue 7, Annex 9
Europe	EN301 893 V1.4.1 with DFS testing using radar parameters as defined in V1.5.1

## PTP 54600 available spectrum settings

The available spectrum settings for the PTP 54600 are illustrated in this section.

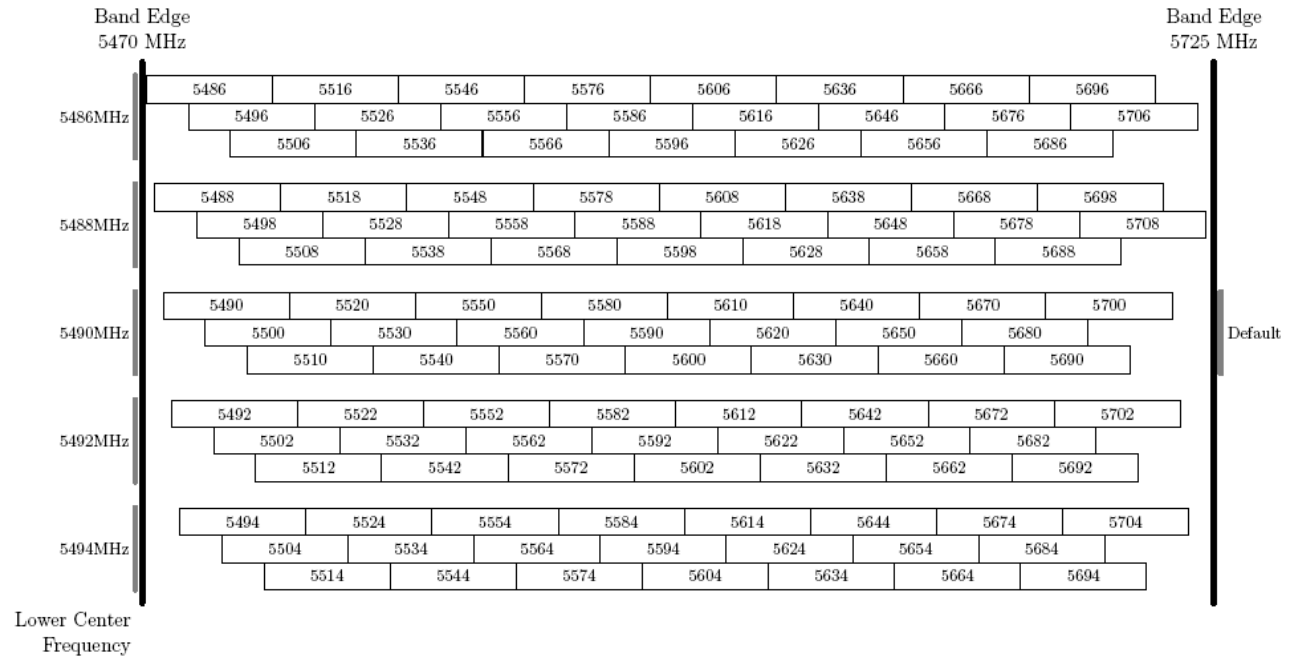
Adjustment of the lower centre frequency allows the operator to slide the available frequency settings up and down the 5.4 GHz band in steps of 2 MHz.

In the 30 MHz channel bandwidth (Figure 4-18), the PTP 54600 variant operates on a 10 MHz channel raster. In the 15 MHz (Figure 4-19), 10 MHz (Figure 4-20) and 5 MHz (Figure 4-21) channel bandwidths, the PTP 54600 variant operates on a 6 MHz channel raster. The channel raster is set to even centre frequencies. The PTP 54600 product variant does not apply any band edge power reduction.

### NOTE

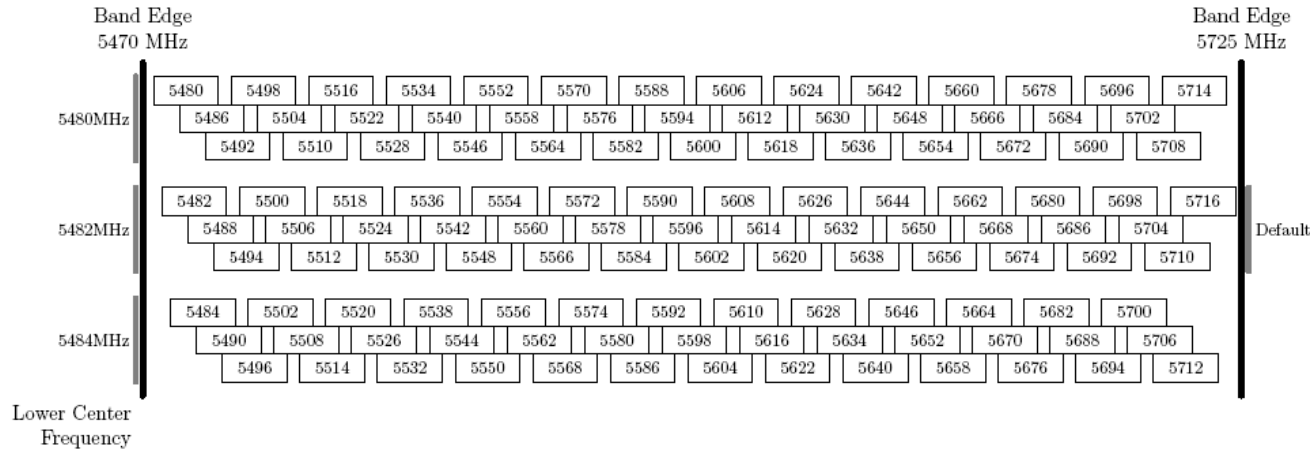
These tables contain data for one typical region code. The specified channel centre frequencies may not be available in other region codes.

**Figure 4-18** PTP 54600 available spectrum in 30 MHz channel bandwidth

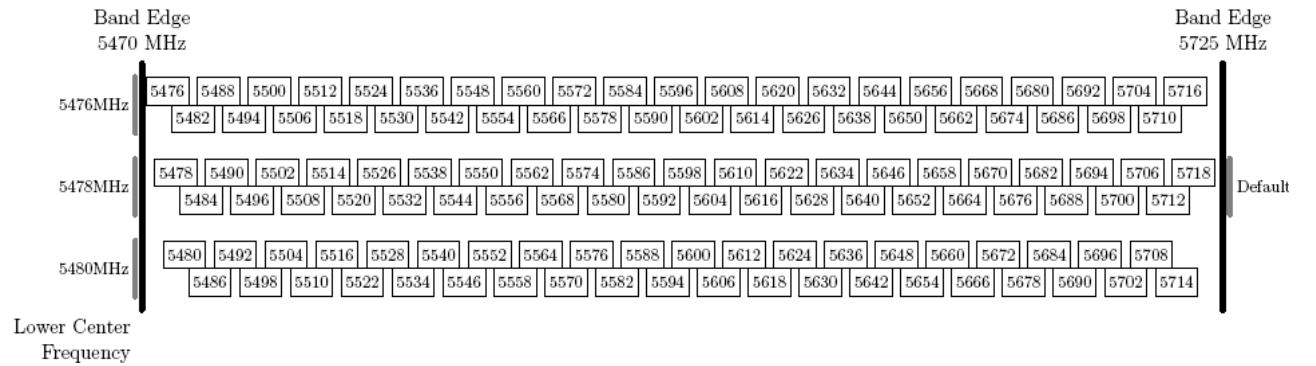




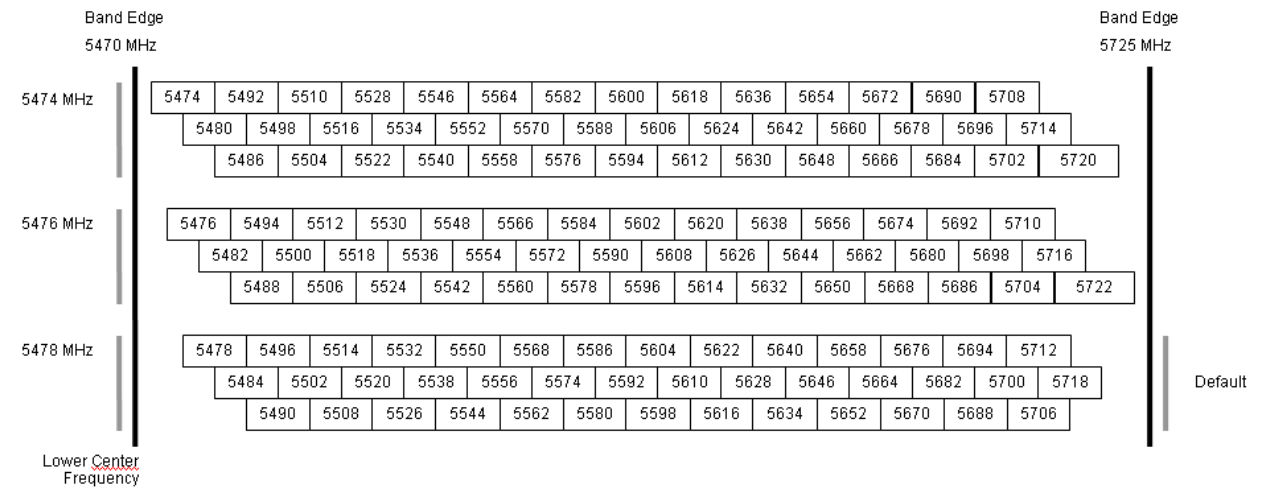
**Figure 4-19** PTP 54600 available spectrum in 15 MHz channel bandwidth



**Figure 4-20** PTP 54600 available spectrum in 10 MHz channel bandwidth



**Figure 4-21** PTP 54600 available spectrum in 5 MHz channel bandwidth



## PTP 54600 system threshold, output power and link loss

PTP 54600 system threshold, output power and maximum link loss are given in [Table 4-44](#) (IP mode) and [Table 4-45](#) (TDM mode). These figures assume that antenna gain is 23 dBi.

**Table 4-44** PTP 54600 - IP mode - threshold, power and loss per modulation mode

Channel Bandwidth	Threshold Value (dBm)				Output Power (dBm)	Maximum Link Loss (dB)			
	5 MHz	10 MHz	15 MHz	30 MHz		5 MHz	10 MHz	15 MHz	30 MHz
Modulation Mode					All Bands				
BPSK 0.63 single	-98.2	-94.6	-92.3	-88.9	+25	169.2	165.6	163.3	159.9
QPSK 0.63 single	-93.0	-90.0	-88.5	-82.9	+24	163.0	160.0	158.5	152.9
QPSK 0.87 single	-90.2	-86.7	-85.3	-80.1	+23	159.2	155.7	154.3	149.1
16QAM 0.63 single	-88.0	-83.8	-82.8	-78.3	+22	156.0	151.8	150.8	146.3
16QAM 0.63 dual	-84.3	-80.7	-79.3	-74.6	+22	152.3	148.7	147.3	142.6
16QAM 0.87 single	-82.4	-79.1	-78.2	-73.0	+20	148.4	145.1	144.2	139.0
16QAM 0.87 dual	-79.7	-75.7	-74.7	-70.6	+20	145.7	141.7	140.7	136.6
64QAM 0.75 single	-78.9	-76.4	-74.9	-70.3	+18	142.9	140.4	138.9	134.3
64QAM 0.75 dual	-76.5	-72.7	-71.6	-67.7	+18	140.5	136.7	135.6	131.7
64QAM 0.92 single	-74.4	-71.7	-70.4	-65.0	+18	138.4	135.7	134.4	129.0
64 QAM 0.92 dual	-70.7	-68.5	-66.9	-62.3	+18	134.7	132.5	130.9	126.3
256QAM 0.81 single	N/A	N/A	N/A	-63.6	+18	N/A	N/A	N/A	127.6
256QAM 0.81 dual	N/A	N/A	N/A	-60.5	+18	N/A	N/A	N/A	124.5

**Table 4-45** PTP 54600 - TDM mode - threshold, power and loss per modulation mode

Channel Bandwidth	Threshold Value (dBm)				Output Power (dBm)	Maximum Link Loss (dB)			
	5 MHz	10 MHz	15 MHz	30 MHz		5 MHz	10 MHz	15 MHz	30 MHz
BPSK 0.63 single	-98.2	-94.6	-92.3	-88.9	+25	169.2	165.6	163.3	159.9
QPSK 0.63 single	-89.7	-88.3	-86.4	-81.4	+24	159.7	158.3	156.4	151.4
QPSK 0.87 single	-86.7	-84.3	-82.3	-78.4	+23	155.6	153.3	151.3	147.4
16QAM 0.63 single	-86.6	-81.8	-79.9	-76.0	+22	151.7	149.8	147.9	144.0
16QAM 0.63 dual	-83.7	-78.2	-76.5	-72.4	+22	148.8	146.3	144.5	140.4
16QAM 0.87 single	-78.8	-76.6	-75.5	-69.8	+20	144.8	142.6	141.5	135.8
16QAM 0.87 dual	-76.9	-73.9	-72.2	-68.7	+20	142.9	139.9	138.2	134.7
64QAM 0.75 single	-74.7	-72.2	-71.8	-66.6	+18	138.7	136.2	135.8	130.6
64QAM 0.75 dual	-73.0	-70.4	-68.8	-65.6	+18	137.0	134.4	132.8	129.6
64QAM 0.92 single	-70.9	-68.6	-67.4	-62.9	+18	134.9	132.6	131.4	126.9
64 QAM 0.92 dual	-68.2	-65.6	-64.2	-60.5	+18	132.1	129.6	128.2	124.5
256QAM 0.81 single	N/A	N/A	N/A	-65.4	+18	N/A	N/A	N/A	126.9
256QAM 0.81 dual	N/A	N/A	N/A	-60.5	+18	N/A	N/A	N/A	124.5

## PTP 54600 FCC antenna restrictions

In FCC regions, external antennas from the list in [Table 4-46](#) 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 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 4-46** 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

<b>Manufacturer</b>	<b>Antenna Type</b>	<b>Gain (dBi)</b>	<b>Parabolic Dish</b>
Gabriel	Gabriel 2-foot High Performance Dual QuickFire Parabolic, HQFD2-52-N	28.1	Y
Gabriel	Gabriel 4-foot High Performance Dual QuickFire Parabolic, HQFD4-52-N	34.3	Y
Gabriel	Gabriel 2-foot Standard QuickFire Parabolic, QF2-52-N	28.5	Y
Gabriel	Gabriel 2-foot Standard QuickFire Parabolic, QF2-52-N-RK	28.5	Y
Gabriel	Gabriel 2.5-foot Standard QuickFire Parabolic, QF2.5-52-N	31.2	Y
Gabriel	Gabriel 4-foot Standard QuickFire Parabolic, QF4-52-N	34.8	Y
Gabriel	Gabriel 4-foot Standard QuickFire Parabolic, QF4-52-N-RK	34.8	Y
Gabriel	Gabriel 2-foot Standard Dual QuickFire Parabolic, QFD2-52-N	28.4	Y
Gabriel	Gabriel 2.5-foot Standard Dual QuickFire Parabolic, QFD2.5-52-N	31.1	Y
Gabriel	Gabriel 2-foot Standard Dual QuickFire Parabolic, QFD2-52-N-RK	28.4	Y
Gabriel	Gabriel 4-foot Standard Dual QuickFire Parabolic, QFD4-52-N	34.7	Y
Gabriel	Gabriel 4-foot Standard Dual QuickFire Parabolic, QFD4-52-N-RK	34.7	Y
RadioWaves	Radio Waves 2-foot Dual-Pol Parabolic, SPD2-5.2 (28.1dBi)	28.1	Y
RadioWaves	Radio Waves 2-foot Parabolic, SP2-5.2 (29.0dBi)	29	Y
RadioWaves	Radio Waves 3-foot Dual-Pol Parabolic, SPD3-5.2 (31.1dBi)	31.1	Y
RadioWaves	Radio Waves 3-foot Parabolic, SP3-5.2 (31.4dBi)	31.4	Y

<b>Manufacturer</b>	<b>Antenna Type</b>	<b>Gain (dBi)</b>	<b>Parabolic Dish</b>
RadioWaves	Radio Waves 4-foot Dual-Pol Parabolic, SPD4-5.2 (34.4dBi)	34.4	Y
RadioWaves	Radio Waves 4-foot Parabolic, SP4-5.2 (34.8dBi)	34.8	Y
RadioWaves	Radio Waves 2-foot Parabolic, SP2-2/5 (28.3dBi)	28.3	Y
RadioWaves	Radio Waves 3-foot Parabolic, SP3-2/5 (31.4dBi)	31.4	Y
RadioWaves	Radio Waves 4-foot Parabolic, SP4-2/5 (34.6dBi)	34.6	Y
RFS	RFS 2-foot Parabolic, SPF2-52AN or SPFX2-52AN (27.9dBi)	27.9	Y
RFS	RFS 3-foot Parabolic, SPF3-52AN or SPFX3-52AN(31.4dBi)	31.4	Y
RFS	RFS 4-foot Parabolic, SPF4-52AN or SPFX4-52AN(33.9dBi)	33.9	Y
RFS	RFS 2-foot HP Parabolic, SDF2-52AN or SDFX2-52AN (31.4dBi)	31.4	Y
RFS	RFS 4-foot HP Parabolic, SDF4-52AN or SDFX4-52AN (33.9dBi)	33.9	Y

## PTP 58600 reference information

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This section contains reference information that is specific to the PTP 58600 frequency variant.

### PTP 58600 examples of regulatory limits

Table 4-47 shows how the regulatory limits currently apply in specific countries. Operators should note that regulations are subject to change.

**Table 4-47** PTP 58600 examples of regulatory limits

Region	Examples of Regulatory Limits at 5.8GHz
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).

<b>Region</b>	<b>Examples of Regulatory Limits at 5.8GHz</b>
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 $\leq$ 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 $\leq$ 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 $\leq$ 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.

<b>General Notice Applicable to Europe - 5.8 GHz</b>
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.





## PTP 58600 licenses and region codes

PTP 58600 units may be operated in any of the regions listed in [Table 4-48](#).

PTP 58600 units are configured with a license key for region code 1. An alternative license key is provided in the *PTP 600 Installation Guide* for region code 25. For any other permitted region, obtain a new license key from the reseller or distributor.

**Table 4-48** 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		30 MHz	33 dBm EIRP	
				15 MHz	31 dBm EIRP	
				10 MHz	30 dBm EIRP	
				5 MHz	27 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	

Region code	License / Regulation	Frequencies	DFS	Channel Bandwidth	Max Power	Notes
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	5795 MHz to 5815 MHz is assigned for Road Transport and Traffic Telematics (RTTT).
				15 MHz	51 dBm EIRP	
				10 MHz	50 dBm EIRP	
				5 MHz	47 dBm EIRP	
8	Full Power	5725 - 5850 MHz		5, 10, 15, 30 MHz	25 dBm	
11	Korea	5725 - 5825 MHz		30 MHz	43 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	

Region code	License / Regulation	Frequencies	DFS	Channel Bandwidth	Max Power	Notes
20	Thailand	5725 - 5850 MHz		5, 10, 15, 30 MHz	30 dBm EIRP	
22	Germany	5755 - 5850 MHz	Yes	30 MHz	35 dBm EIRP	1dB reduction required in 30 MHz to achieve adjacent channel emissions
				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 in 30 MHz to achieve adjacent channel emissions
				15 MHz	34 dBm EIRP	
				10 MHz	32 dBm EIRP	
				5 MHz	29 dBm EIRP	
27	Denmark	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
				15 MHz	34 dBm EIRP	
				10 MHz	32 dBm EIRP	

<b>Region code</b>	<b>License / Regulation</b>	<b>Frequencies</b>	<b>DFS</b>	<b>Channel Bandwidth</b>	<b>Max Power</b>	<b>Notes</b>
				5 MHz	29 dBm EIRP	(RTTT)

## PTP 58600 regulatory compliance

The PTP 58600 complies with the regulations that are in force in the USA, Canada and Europe. The relevant notifications are specified in this section.

### PTP 58600 FCC and IC notification

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 the 5650 – 5850 MHz spectrum 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:



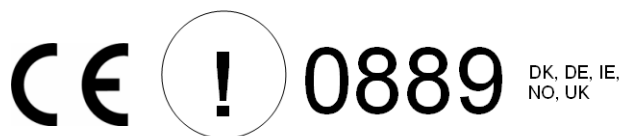
Where necessary, the end user is responsible for obtaining any National licenses required to operate this product and these must be obtained before using the product in any particular country. Contact the appropriate national administrations for details on the conditions of use for the bands in question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

### PTP 58600 European Union notification

The PTP 58600 is a Class 2 device as it operates on frequencies that are not harmonized across the EU. Currently the product may only be operated 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 future. See [www.ero.dk](http://www.ero.dk) for further information. 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.

Hereby, 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.

## 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.

### CAUTION

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.



## PTP 58600 radio system specifications

Table 4-49 contains radio system specifications for the PTP 58600.

**Table 4-49** PTP 58600 RF specifications

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; 23 dBi
Antenna Type (External)	Parabolic dish, maximum permitted gain: 37.7 dBi Flat plate; maximum permitted gain: 28.0 dBi
Antenna Beamwidth (Integrated)	8 degrees
Max Path Loss (5 MHz Channel)	166 dB
Duplex Scheme	Symmetric fixed, asymmetric fixed or adaptive TDD

Radio Technology	Specification
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

## PTP 58600 emissions and radio certifications

[Table 4-50](#) lists the EMC emissions specifications under which the PTP 58600 has received type approval. [Table 4-51](#) lists the radio specifications under which the PTP 58600 has received type approval.

**Table 4-50** PTP 58600 EMC emissions compliance

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

**Table 4-51** PTP 58600 radio certifications

<b>Region</b>	<b>Specification (Type Approvals)</b>
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

## PTP 58600 available spectrum settings

The available spectrum settings for the PTP 58600 are illustrated in this section.

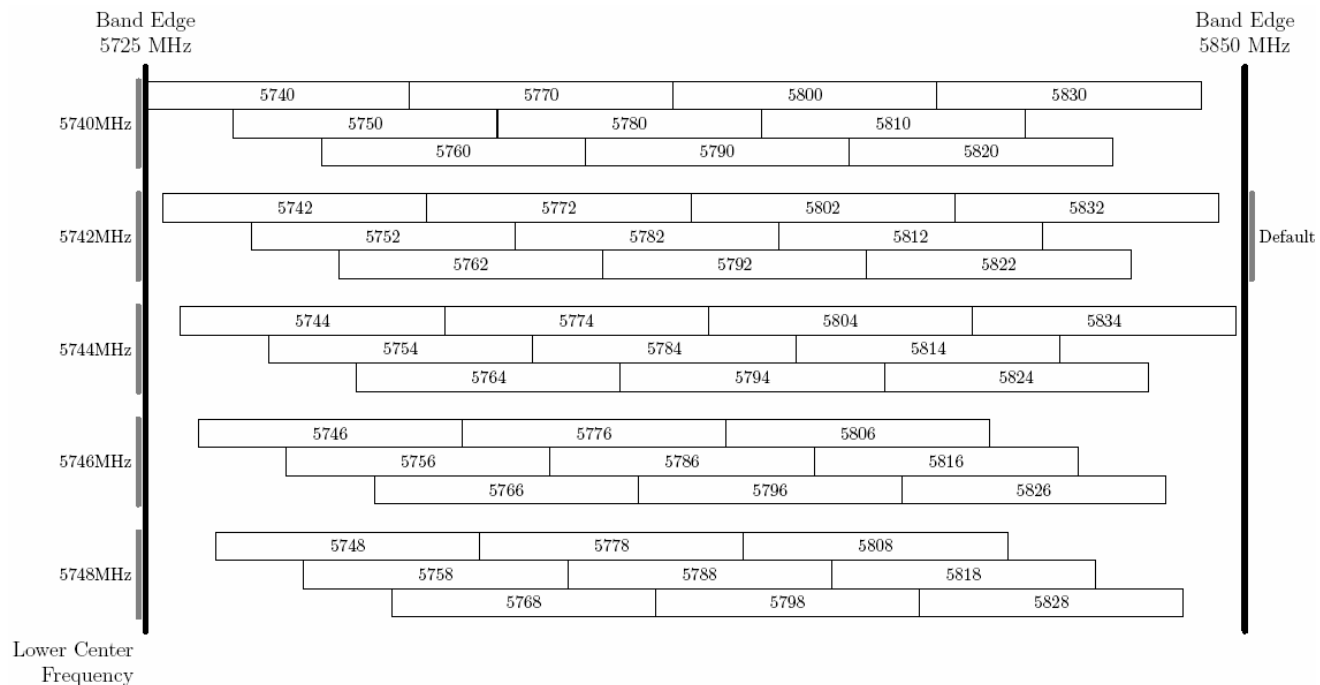
Adjustment of the lower centre frequency allows the operator to slide the available frequency settings up and down the 5.8 GHz band in steps of 2 MHz.

In the 30 MHz channel bandwidth (Figure 4-22), the PTP 58600 variant operates on a 10 MHz channel raster. In the 15 MHz (Figure 4-23), 10 MHz (Figure 4-24) and 5 MHz (Figure 4-25) channel bandwidths, the PTP 58600 variant operates on a 6 MHz channel raster. The channel raster is set to even centre frequencies.

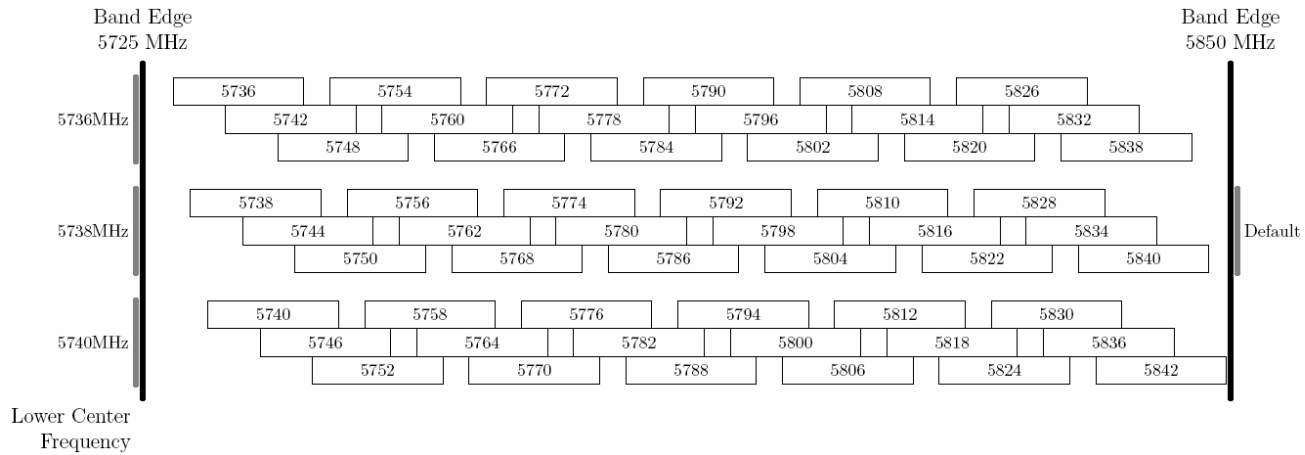
**NOTE**

These tables contain data for one typical region code. The specified channel centre frequencies may not be available in other region codes.

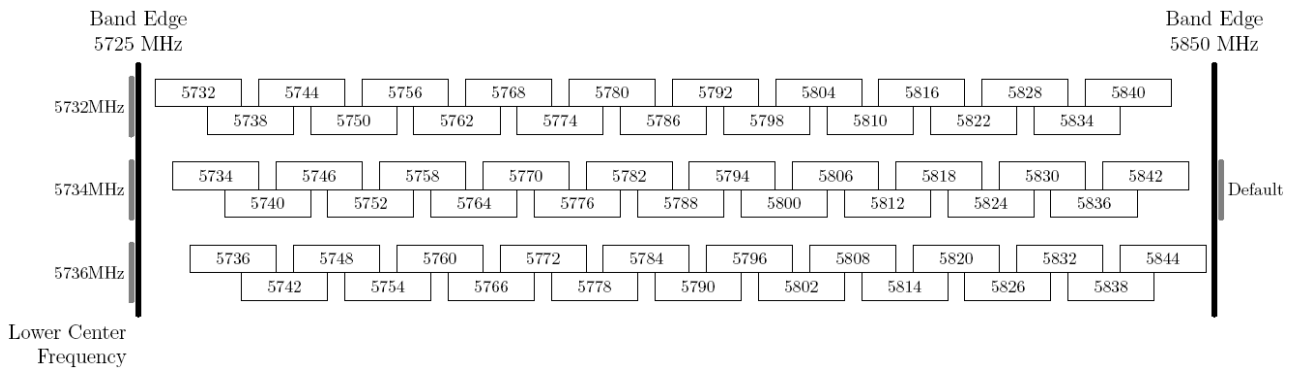
**Figure 4-22** PTP 58600 available spectrum in 30 MHz channel bandwidth



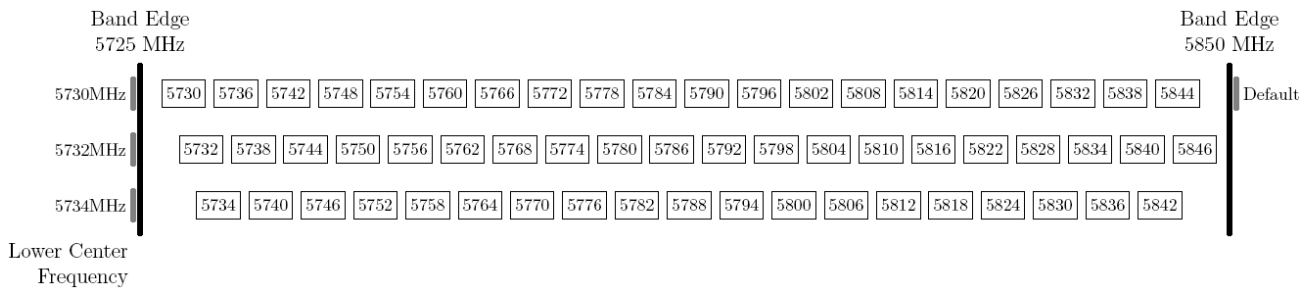
**Figure 4-23** PTP 58600 available spectrum in 15 MHz channel bandwidth



**Figure 4-24** PTP 58600 available spectrum in the 10 MHz channel bandwidth



**Figure 4-25** PTP 58600 available spectrum in 5 MHz channel bandwidth



### PTP 58600 Transmit Power Reduction at the Band Edges

Operation at or near the 5.8 GHz band edges can result in a lower maximum transmit power. In some configurations the PTP 600 Series 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 4-52](#) (for region code 1 ONLY).

**Table 4-52** 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

## PTP 58600 system threshold, output power and link loss

PTP 58600 system threshold figures are given in [Table 4-53](#) (IP mode) and [Table 4-54](#) (TDM mode). These figures assume that antenna gain is 23 dBi.

**Table 4-53** PTP 58600 - IP mode - threshold, power and loss per modulation mode

Channel Bandwidth	Threshold Value (dBm)				Output Power (dBm)	Maximum Link Loss (dB)			
	5 MHz	10 MHz	15 MHz	30 MHz		All Bands	5 MHz	10 MHz	15 MHz
BPSK 0.63 single	-95.1	-92.5	-90.8	-86.3	+25	166.1	163.5	161.8	157.3
QPSK 0.63 single	-91.9	-90.0	-87.7	-83.0	+24	161.9	160.0	157.7	153.0
QPSK 0.87 single	-88.7	-86.6	-84.8	-80.3	+23	157.7	155.6	153.8	149.3
16QAM 0.63 single	-86.0	-84.3	-82.4	-78.3	+22	154.0	152.3	150.4	146.3
16QAM 0.63 dual	-83.5	-80.4	-78.5	-75.3	+22	151.5	148.4	146.5	143.3
16QAM 0.87 single	-82.1	-79.5	-78.1	-72.5	+20	148.1	145.5	144.1	138.5
16QAM 0.87 dual	-79.2	-76.2	-73.9	-71.5	+20	145.2	142.2	139.9	137.5
64QAM 0.75 single	-78.8	-76.7	-75.2	-69.2	+18	142.8	140.7	139.2	133.2
64QAM 0.75 dual	-76.1	-73.1	-71.0	-67.7	+18	140.1	137.1	135.0	131.7
64QAM 0.92 single	-74.4	-72.5	-66.2	-65.0	+18	138.4	136.5	134.6	129.0
64 QAM 0.92 dual	-70.2	-69.1	-70.7	-61.5	+18	134.2	133.1	130.2	125.5
256QAM 0.81 single	N/A	N/A	N/A	-64.0	+18	N/A	N/A	N/A	128.0
256QAM 0.81 dual	N/A	N/A	N/A	-59.6	+18	N/A	N/A	N/A	123.6

**Table 4-54** PTP 58600 - TDM mode - threshold, power and loss per modulation mode

	Threshold Value (dBm)				Output Power (dBm)	Maximum Link Loss (dB)			
Channel Bandwidth	5 MHz	10 MHz	15 MHz	30 MHz	All Bands	5 MHz	10 MHz	15 MHz	30 MHz
Modulation Mode									
BPSK 0.63 single	-95.1	-92.5	-90.8	-86.3	+25	166.1	163.5	161.8	157.3
QPSK 0.63 single	-88.7	-87.8	-86.0	-80.6	+24	158.7	157.8	155.9	150.6
QPSK 0.87 single	-85.5	-83.8	-81.6	-77.8	+23	154.5	152.8	150.6	146.8
16QAM 0.63 single	-82.0	-81.3	-79.1	-75.3	+22	150.0	149.3	147.1	143.3
16QAM 0.63 dual	-79.4	-77.6	-75.6	-71.7	+22	147.4	145.6	143.6	139.7
16QAM 0.87 single	-78.7	-76.3	-74.7	-71.2	+20	144.7	142.3	140.7	137.2
16QAM 0.87 dual	-75.1	-73.2	-71.0	-67.7	+20	141.0	139.2	137.0	133.7
64QAM 0.75 single	-74.4	-72.3	-70.6	-67.9	+18	138.4	136.3	134.6	131.9
64QAM 0.75 dual	-70.9	-69.5	-67.6	-64.0	+18	134.9	133.5	131.6	128.0
64QAM 0.92 single	-70.9	-68.0	-66.6	-63.1	+18	134.9	132.0	130.6	127.1
64 QAM 0.92 dual	-66.8	-64.6	-65.5	-58.7	+18	130.8	128.6	126.5	122.7
256QAM 0.81 single	N/A	N/A	N/A	-63.1	+18	N/A	N/A	N/A	127.1
256QAM 0.81 dual	N/A	N/A	N/A	-58.7	+18	N/A	N/A	N/A	122.7



## PTP 58600 FCC antenna restrictions

In FCC regions, external antennas from the lists in [Table 4-55](#) and [Table 4-56](#) can be used with the Connectorized version of the PTP 58600. 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 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 4-55** 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	

<b>Manufacturer</b>	<b>Antenna Type</b>	<b>Gain (dBi)</b>	<b>Flat Plate</b>	<b>Parabolic Dish</b>
RFS	RFS 1-foot Flat Panel, MA0528-23AN (23dBi)	23	Y	
RFS	RFS 2-foot Flat Panel, MA0528-28AN (28dBi)	28	Y	
Telectronics	Telectronics 2-foot Flat Plate Antenna, ANT-P5828 (28dBi)	28	Y	
Andrew	Andrew 2-foot Parabolic, P2F-52 (29.4dBi)	29.4		Y
Andrew	Andrew 2-foot Dual-Pol Parabolic, PX2F-52 (29.4dBi)	29.4		Y
Andrew	Andrew 3-foot Parabolic, P3F-52 (33.4dBi)	33.4		Y
Andrew	Andrew 3-foot Dual-Pol Parabolic, PX3F-52 (33.4dBi)	33.4		Y
Andrew	Andrew 4-foot Parabolic, P4F-52 (34.9dBi)	34.9		Y
Andrew	Andrew 4-foot Dual-Pol Parabolic, PX4F-52 (34.9dBi)	34.9		Y
Andrew	Andrew 6-foot Parabolic, P6F-52 (37.6dBi)	37.6		Y
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

<b>Manufacturer</b>	<b>Antenna Type</b>	<b>Gain (dBi)</b>	<b>Flat Plate</b>	<b>Parabolic Dish</b>
Gabriel	Gabriel 2-foot Standard QuickFire Parabolic, QF2-52-N	28.5		Y
Gabriel	Gabriel 2-foot Standard QuickFire Parabolic, QF2-52-N-RK	28.5		Y
Gabriel	Gabriel 2.5-foot Standard QuickFire Parabolic, QF2.5-52-N	31.2		Y
Gabriel	Gabriel 4-foot Standard QuickFire Parabolic, QF4-52-N	34.8		Y
Gabriel	Gabriel 4-foot Standard QuickFire Parabolic, QF4-52-N-RK	34.8		Y
Gabriel	Gabriel 6-foot Standard QuickFire Parabolic, QF6-52-N	37.7		Y
Gabriel	Gabriel 2-foot Standard Dual QuickFire Parabolic, QFD2-52-N	28.4		Y
Gabriel	Gabriel 2.5-foot Standard Dual QuickFire Parabolic, QFD2.5-52-N	31.1		Y
Gabriel	Gabriel 2-foot Standard Dual QuickFire Parabolic, QFD2-52-N-RK	28.4		Y
Gabriel	Gabriel 4-foot Standard Dual QuickFire Parabolic, QFD4-52-N	34.7		Y
Gabriel	Gabriel 4-foot Standard Dual QuickFire Parabolic, QFD4-52-N-RK	34.7		Y
Gabriel	Gabriel 6-foot Standard Dual QuickFire Parabolic, QFD6-52-N	37.7		Y
RadioWaves	Radio Waves 2-foot Dual-Pol Parabolic, SPD2-5.2 (28.1dBi)	28.1		Y
RadioWaves	Radio Waves 2-foot Parabolic, SP2-5.2 (29.0dBi)	29		Y

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

Manufacturer	Antenna Type	Gain (dBi)	Flat Plate	Parabolic Dish
RFS	RFS 6-foot HP Parabolic, SDF6-52AN or SDFX6-52AN (37.4dBi)	37.4		Y
StellaDoradus	StellaDoradus 45 inch Parabolic Antenna, 58PSD113	33.8		Y

**Table 4-56** Sectored antennas for deployment in USA/Canada – 5.8 GHz

Manufacturer	Antenna Type	Gain (dBi)	Beamwidth
RadioWaves	SEC-55V-60-17 SEC-55H-60-17 SEC-55D-60-17	17	60°
RadioWaves	SEC-55V-90-16 SEC-55H-90-16 SEC-55D-90-16	16	90°