PTP 250

User Guide

System Release 250-01-00

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May 2011

Safety and regulatory information

This section describes important safety and regulatory guidelines that must be observed by personnel installing or operating PTP 250 equipment.

Important safety information

⚠ 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. It is the user's responsibility to install the equipment in accordance with national regulations. In the USA, follow Section 810 of the *National Electric Code, ANSI/NFPA No.70-1984* (USA). In Canada, follow 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.

Using the correct power supply

Always use the Motorola Power over Ethernet injector unit (PoE power supply) or Powered Indoor Unit (PIDU Plus) to power the ODU. Failure to use the correct power supply could result in equipment damage and will invalidate the safety certification and may cause a safety hazard.

Alternative DC supply

If the PTP 250 is to be powered from a DC supply (either as the primary power source or as a backup to the AC supply), the DC supply must be input to the ODU via a PIDU (not a PoE power supply). The DC supply must be connected to the PIDU DC IN terminals. The DC supply must comply with the following requirements:

- The voltage and polarity is correct and is applied to the correct terminals in the PIDU.
- The power source is rated as Safety Extra Low Voltage (SELV).
- The power source is rated to supply at least 1 A continuously.
- The power source cannot provide more than the Energy Hazard Limit as defined by IEC/EN/UL60950-1, Clause 2.5, Limited Power (The Energy Hazard Limit is 240VA).

Powering down before servicing

Always power down and unplug the equipment before servicing.

Lightning protection unit (LPU)

Do not remove the LPU printed circuit board when the LPU is connected to the power supply, as high voltages are present.

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.

Drop cable tester

The drop cable tester must NEVER be used at the ODU end connected to power from the PoE power supply. It must only be used at the bottom of the mast with a multimeter. This is because the PoE power supply voltage exceeds the limit allowed in some countries for safe handling in wet conditions and therefore may create a safety hazard.

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 outdoor environment.

RF exposure near the antenna

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

Minimum separation distances

Install the 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 4-25.

Important regulatory information

Operation of the PTP 250 product involves its use as an unlicensed device in frequency bands where it is not allowed to cause interference to licensed services (called primary users of the bands).

Radar avoidance

In some countries radar systems are the primary users and the regulators have devised special requirements to protect their operation from interference caused by unlicensed devices. The unlicensed devices are required to detect the presence of radar systems and avoid co-channel operation with the radar systems.

The PTP 250 system provides detection and avoidance functionality for countries and frequency bands requiring protection for radar systems.

Installers and users are reminded that they must follow local regulations with regard to any requirements for radar detection as well as transmitted power level. This can be achieved by using the correct country code for the product concerned. Failure to follow this could leave the installer and/or user liable to civil and/or criminal penalties.

Contact the Motorola helpdesk if you are unsure about any specific areas where you need guidance.

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About This User Guide

This guide describes the planning, installation and operation of the Motorola PTP 250 Point-to-Point Wireless Ethernet Bridge. It is intended for use by the system designer, system installer and system administrator.

Users of this guide should have knowledge of the following areas:

- Radio network design
- Outdoor radio equipment installation
- System installation, configuration, monitoring and fault finding

System designers should refer to the following chapters:

- Chapter 1 Product description
- Chapter 2 Planning considerations
- Chapter 3 Legal information
- Chapter 4 Reference information

Installers should refer to the following chapters:

- Chapter 5 Installation
- Chapter 6 Configuration and alignment
- Chapter 8 Troubleshooting

Operators should refer to the following chapters:

- Chapter 1 Product description
- Chapter 6 Configuration and alignment
- Chapter 7 Operation
- Chapter 8 Troubleshooting

Revision history

Version information

The following shows the issue status of this document:

Document issue	Date of issue	Remarks
001v000	Apr 2011	System release 250-01-00
002v000	May 2011	System release 250-01-00 (Revised)

General information

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.

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.

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@motorolasolutions.com.

Motorola Point-to-Point

Postal address:

Motorola Solutions, Inc.,
1303 E. Algonquin Road,
Schaumburg,
Illinois 60196
U.S.A.

URLs:

Main web site: http://www.motorola.com/ptp

Web support: http://www.motorola.com/ptp/support

Email addresses:

Sales enquiries: sales.ptp@motorolasolutions.com

Email support: support.ptp@motorolasolutions.com

Telephone numbers:

North America: +1 866-961-9288

Latin/Central America: +420 533 336 946

Europe, Middle East or Africa: +44 203 0277499

Asia/Pacific: +420 533 336 946

For full list of Motorola Wireless Broadband Support telephone numbers, see: http://www.motorola.com/ptp/support/contact

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://www.motorola.com/ptp.
3. Ask for assistance from the Motorola product supplier.
4. Gather information from affected units such as:
   - The IP addresses and MAC addresses
   - The software releases
   - The configuration of software features
   - Any available diagnostic downloads
5. Escalate the problem to Motorola as follows:
   - Either: send e-mail to support.ptp@motorolasolutions.com
   - Or: call Wireless Broadband Technical Support.

Repair and service

If unit failure is suspected, visit http://www.motorola.com/ptp/support for details of the Return Material Authorization (RMA) process.

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.

To register PTP products or activate warranties, visit http://www.motorola.com/ptp/support.

For warranty assistance, contact the reseller or distributor.

⚠ 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

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

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

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 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 250 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:

- Overview of the PTP 250 on page 1-2 introduces the key features, typical uses, product variants and components of the PTP 250.
- Outdoor unit (ODU) on page 1-5 describes the ODU and its interfaces.
- Power over Ethernet injector (PoE power supply) on page 1-9 describes the PoE power supply and its interfaces.
- Cabling and lightning protection on page 1-13 describes the cabling and lightning protection components of a PTP 250 installation.
- Wireless operation on page 1-17 describes how the PTP 250 wireless link is operated, including modulation modes, power control and security.
- Ethernet bridging on page 1-23 describes how the PTP 250 controls Ethernet data in the customer and management networks.
- System management on page 1-27 introduces the PTP 250 management system, including the web interface, installation, configuration, alerts and upgrades.

Overview of the PTP 250

This section introduces the key features, typical uses, product variants and components of the PTP 250.

Purpose

Motorola PTP 250 products are designed for Ethernet bridging over point-to-point microwave links in the unlicensed bands 5.4 GHz (ETSI Band B) and 5.8 GHz (ETSI Band C and FCC ISM band). Users must ensure that the links comply with local operating regulations.

The PTP 250 is used to create a transparent bridge between two segments of the operator's network. This bridge can be treated as a virtual wired connection between two points.

Key features

The key features of the PTP 250 include:

- Orthogonal Frequency Division Multiplexing (OFDM) modulation and Multiple-Input Multiple-Output (MIMO) techniques.
- Wireless connections of up to 54 km (34 miles) in near line-of-sight conditions.
- High link availability, through the use of adaptive modulation techniques that dynamically reduce the data rate in severe or adverse conditions.
- High-sensitivity antennas for improved signal recovery.
- A built-in web server for advanced management capabilities including detailed radio signal diagnosis.
- Password control and encryption.

Benefit of the chosen bands

The products operate in bands that offer the dual benefits of high data throughput and good radio propagation characteristics. The wide band of spectrum available is subdivided into several channels such that multiple systems can operate in the vicinity without causing interference to one another.

802.11n device

PTP250 uses 802.11n encoding and radio transmission. In areas where the PTP 250 co-exists with 802.11a and 802.11n devices, the PTP 250 detects the 802.11a and 802.11n radio signals and chooses a clear channel away from any interference.

Avoiding interference from nearby devices

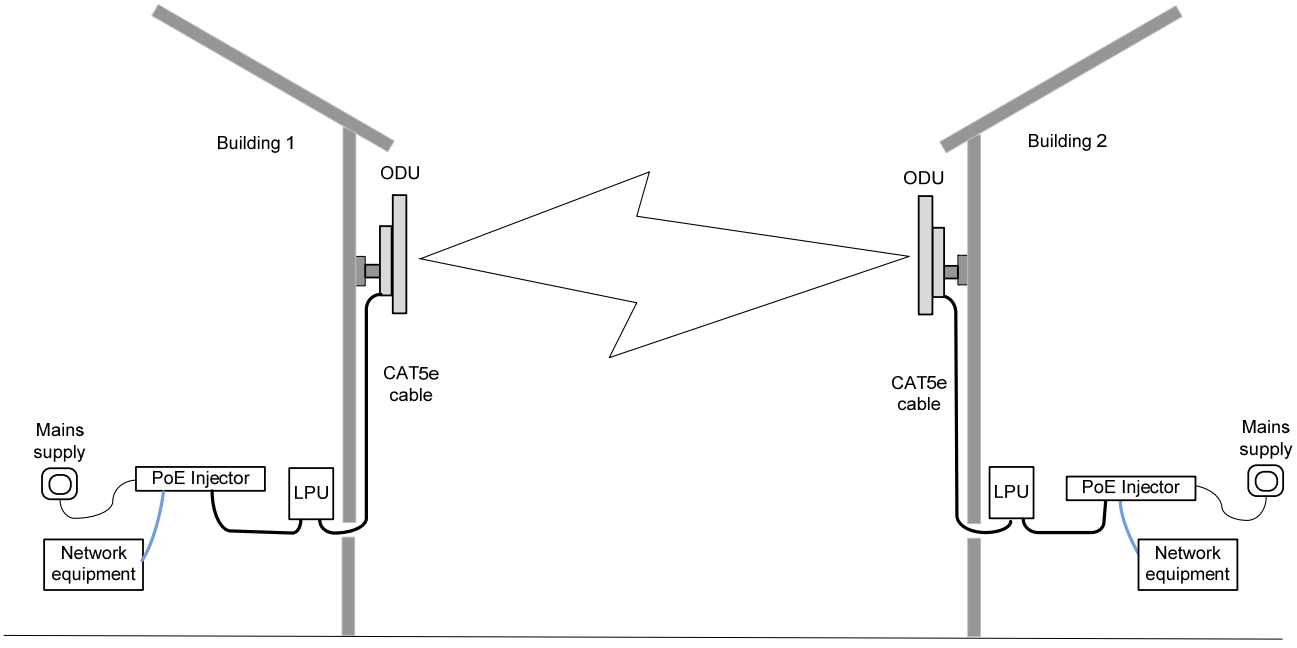
At initialization, the products monitor the available frequency channels to find a channel that is clear of interference.

Typical deployment

The PTP 250 bridge consists of a pair of identical units, one deployed at each end of the link. The radio link operates on a single frequency channel. One unit is configured as a master and the other as a slave. The master unit takes responsibility for controlling the link in both directions.

The bridge is aimed at a wide range of applications. One example is an enterprise that needs to connect together the Local Area Network (LAN) of two or more buildings as shown in Figure 1-1.

Figure 1-1 Typical PTP 250 bridge deployment (grounding not shown)



System components

Each end of the link consists of:

- **Outdoor Unit (ODU):** An integrated (or connectorized) outdoor transceiver unit containing all the radio and networking electronics.
- **PoE power supply:** An indoor connection box containing a mains power supply, status indicators and network connection port.
- **Cabling and lightning protection:** CAT5e cables, grounding cables, connectors and a lightning protection unit (LPU).

Product variants

The PTP 250 is available in the following product variants:

- **FCC/IC or ETSI/RoW**: The PTP 250 is available in two regional variants: one is for use in countries where FCC or IC licensing restrictions apply (FCC/IC), and the other is for use in ETSI countries or the rest of the world (ETSI/RoW). The regional variants may operate in the following bands:
  - ETSI/RoW: 5.4 GHz or 5.8 GHz.
  - FCC/IC: 5.8 GHz only.
- **Integrated or Connectorized**: Both products are available in either Integrated (with attached antenna) or Connectorized (without an antenna) variants.
- **Link Complete or End Complete**: The Link Complete kit consists of two ODUs and two PoE power supply units. The End Complete kit consists of one ODU and one PoE power supply unit.

To obtain part numbers for the above variants, refer to Installation inventories on page 4-2.

NOTE

The PTP 250 is not currently approved for 5.4 GHz operation in the USA or Canada.

Outdoor unit (ODU)

This section describes the PTP 250 ODU and its interfaces.

ODU description

The ODU is a self-contained unit that houses both radio and networking electronics. The ODU is supplied in two configurations: integrated (attached to its own flat plate antenna, Figure 1-2) or connectorized (without an antenna, Figure 1-3).

Figure 1-2 Integrated ODU (front and rear views)

Figure 1-3 Connectorized ODU (front and rear views)

Connectorized variant

The connectorized ODU is designed to work with externally mounted antennas that have higher gains than the integrated antenna. Connectorized units can cope with more difficult radio conditions, as described in When to install connectorized units on page 2-10.

ODU interfaces

The ODU interfaces are illustrated in Figure 1-4 and described in Table 1-1.

Figure 1-4 ODU interfaces

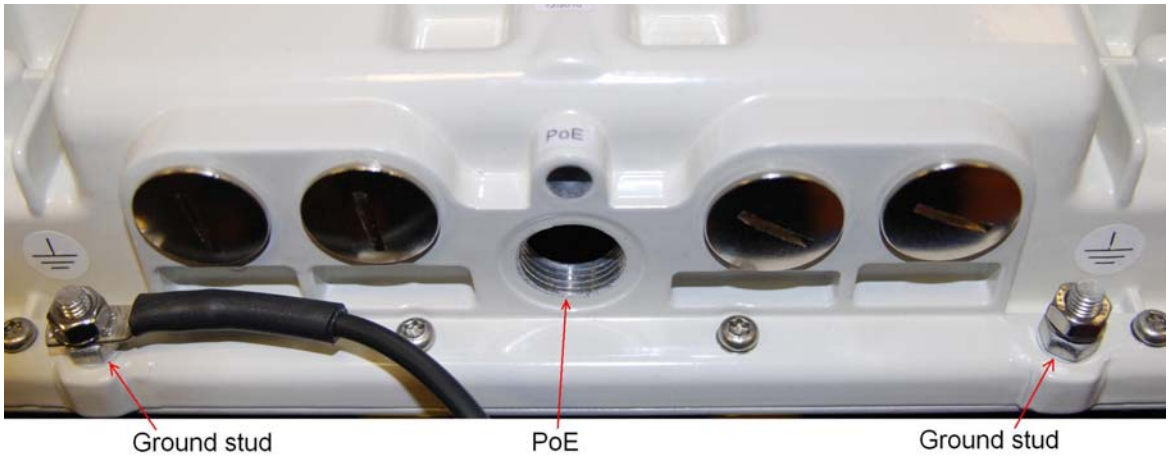


Table 1-1 ODU interface functions

Interface	Function
Ground studs	For grounding the ODU to the supporting structure. The ground cable (supplied with the ODU) may be connected to either ground stud.
PoE	RJ45 socket for connecting to power supply and network via the PoE power supply.

Connectorized ODU antenna interfaces

The connectorized ODU also has interfaces to connect to an external antenna (Figure 1-5) via an N type connector with RF cable of type LMR100, LMR200, LMR300, LMR400 or LMR600. The ‘V’ interface is for vertical polarization and the ‘H interface is for horizontal polarization.

Figure 1-5 Connectorized ODU antenna interfaces

Mounting brackets

The ODU is supplied with a bracket for mounting it to a pole of 50mm (2”) to 75mm (3”) in diameter.

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.

Network connection

The network connection to the ODU is made via a 1000BaseT (Gigabit) Ethernet connection. Power is provided to the ODU over the 1000BaseT Ethernet connection using a standard IEEE 802.3at power supply.

Further reading on the ODU

For more information on the ODU, refer to the following:

- ODU site selection on page 2-4 describes how to select a site for the ODU.
- When to install connectorized units on page 2-10 describes when to choose connectorized ODUs and external antennas rather than integrated ODUs.
- General protection requirements on page 2-12 describes the grounding and lightning protection requirements of a PTP 250 installation, including the ODU.
- Installation inventories on page 4-2 lists the components required for PTP 250 installations, including ODUs, with Motorola part numbers.
- ODU specifications on page 4-10 contains specifications of the ODU such as dimensions, weight and environmental requirements.
- Antenna specifications on page 4-14 contains specifications of the antennas that may be used with connectorized ODUs.
- Installing the ODU on page 5-5 describes how to install the ODU (integrated or connectorized) on the supporting structure.
- Installing connectorized antennas on page 5-9 describes how to install separate antenna(s) for a connectorized ODU.
- Aligning antennas on page 6-24 describes how to align the antennas for both integrated and connectorized ODUs.

Power over Ethernet injector (PoE power supply)

This section describes the PTP 250 Power over Ethernet injector (PoE power supply). One or two PoE power supply units are provided with every PTP 250 kit.

⚠ CAUTION

The ODU should only be deployed with either the PoE power supply or the PTP 300/500/600 Series PIDU. Do not use other power supply units, as they may damage the PTP 250. For guidance on choosing the most suitable power supply unit, refer to Power supply selection on page 2-4.

PoE power supply description

The Motorola High Power Gigabit PoE power supply (Motorola part number WB3727) (Figure 1-6) is a single-port Power over Ethernet injector combining low-voltage DC with Ethernet data in a single cable connecting to a PTP 250 ODU.

Figure 1-6 PoE power supply

PoE features

The PoE power supply has the following features:

- Independent power controller (SPEAR™), CPU controller and input (Data) and output (Data & Power) shielded RJ-45 connectors.
- Supports standard 10/100/1000BaseT Ethernet networks over a standard TIA/EIA-568 Category 5 (or higher) cabling.
- Universal AC Input: 110/220 V, 60/50 Hz.
- Maximum available output power 30 W (nominal output voltage 52 to 56 V DC).
- Underload, overload, short-circuit and under/over voltage port protection.
- Port and AC power LED indicators.
- Standalone or wall mount installation support.
- Coupling rail and slot to allow two or more PoE power supply units to be mounted together.

PoE power supply interfaces

The PoE power supply interfaces are illustrated in Figure 1-7 and described in Table 1-2 and Table 1-3.

Figure 1-7 PoE power supply interfaces

Table 1-2 PoE power supply interface functions

Interface	Function
IEC Power socket at rear	Mains power input (100 – 240 V AC).
DATA & POWER OUT	RJ45 socket for connecting CAT5e cable to ODU.
DATA IN	RJ45 socket for connecting CAT5e cable to network.

Table 1-3 PoE power supply indicator LEDs

Indicator	Function	Description
AC	Off	The PoE power supply is not receiving power.
	Green (steady)	The PoE power supply is receiving power from an AC outlet.
	Green (blinking)	The PoE power supply is receiving a voltage from the AC outlet that is out of the correct range (100 – 240 V AC).
Port	Off	There is no device connected to the DATA & POWER OUT port.
	Green (steady)	A device is connected to the DATA & POWER OUT port.
	Green (blinking)	The PoE power supply is overloaded or has a short circuit.

Further reading on the PoE power supply

For more information on the PoE power supply, refer to the following:

- Power supply selection on page 2-4 describes how to select a location for the PoE power supply.
- Installation inventories on page 4-2 lists the components required for PTP 250 installations, including PoE power supply units, with Motorola part numbers.
- Power supply unit specifications on page 4-12 contains specifications of the PoE power supply (and the PIDU) such as dimensions, weight, environmental and electrical requirements.
- Connecting to the unit on page 6-3 describes how to connect the PoE power supply to a management PC to allow configuration and alignment of the PTP 250.
- Installing the PoE power supply on page 5-27 describes how to install the PoE power supply, connect it to the ODU, and prepare the network cables.
- Connecting to the network on page 6-35 describes how to connect the PoE power supply to the network when configuration, installation and alignment are complete.
- Testing link end hardware on page 8-2 describes how the PoE power supply is used when testing the link end hardware for suspected faults.

Cabling and lightning protection

This section describes the cabling and lightning protection components of PTP 250 installations.

PTP and lightning protection

The PoE power supply meets the low level static discharge specifications identified in Electromagnetic compatibility (EMC) compliance on page 4-22 but does not provide lightning or surge suppression.

The amount of lightning protection is dependent on regulatory and end user requirements. The standard ODU 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.

⚠ WARNING

The units are not designed to survive direct lightning strike. For this reason they must not be installed in 'Zone A', as defined in Lightning protection zones on page 2-11. Mounting in Zone A may put equipment, structures and life at risk.

Outdoor connections

The term 'drop cable' refers to the cable that is used for all connections that terminate outside the building, for example, connections between the ODU, LPU and PoE power supply.

⚠ CAUTION

For outdoor connections, always use Cat5e cable that is gel-filled and shielded with copper-plated steel. This is the only type of outdoor drop cable supported in this application.

Indoor connections

The CAT5e cable that connects the PoE power supply to the network equipment must meet the following requirements:

- **Screening**: Must be either foil screen (FTP) or braided screen (STP) cable.
- **Connectors**: Must use screened RJ45 connectors with metal shells at both ends.
- **Electrical connection**: There must be a continuous electrical connection between both screened connectors.

⚠ CAUTION

The connected network equipment must feature screened RJ45 connectors and must be connected to ground, otherwise the PoE power supply will not be grounded, and this may increase the levels of unwanted radiation from the ODU - PoE power supply cables.

Cable grounding kits

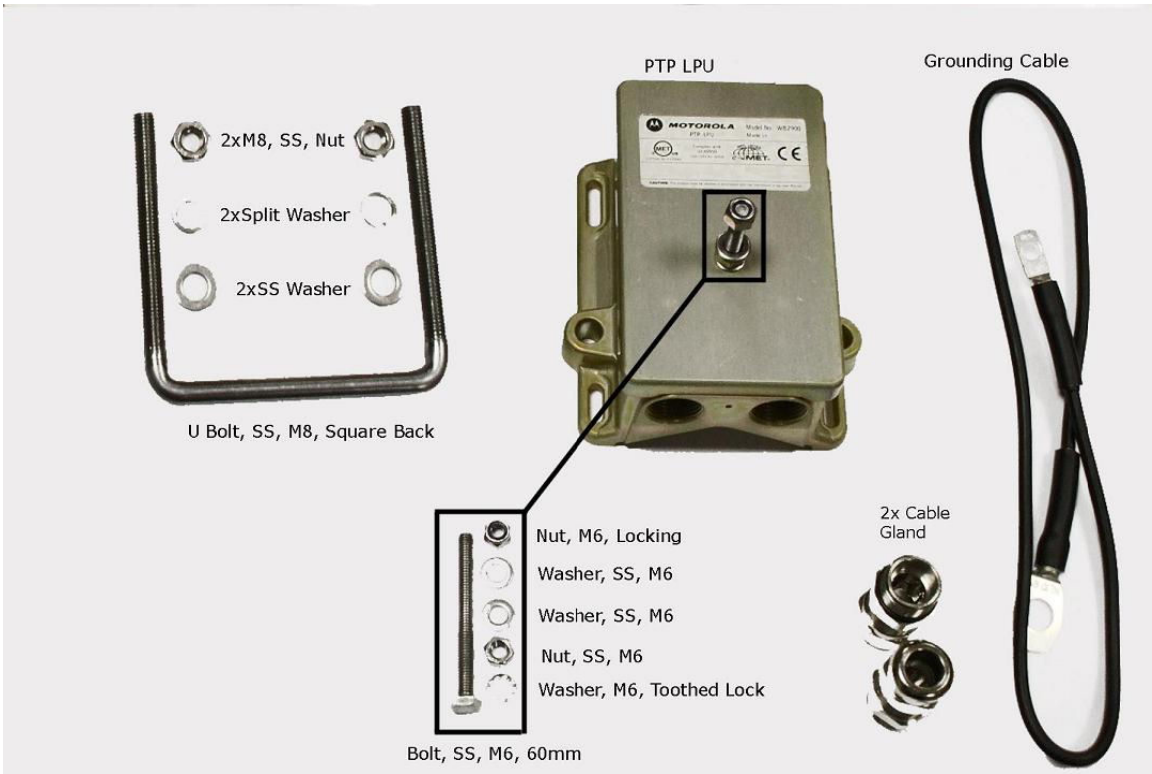
Drop cables must be grounded at the points specified in Grounding and lightning protection on page 2-11. One cable grounding kit (Figure 1-8) is required for each drop cable grounding point.

Figure 1-8 Cable grounding kit for 1/4” and 3/8” cable

Lightning protection units (LPUs)

One LPU kit (Figure 1-9) is required for each ODU drop cable. The LPU is installed at the building entry point.

Figure 1-9 LPU kit



Further reading on cabling and lightning protection

For more information on cabling and lightning protection, refer to the following:

- Maximum cable lengths on page 2-5 gives maximum permitted lengths of interface cables in PTP 250 installations.
- Grounding and lightning protection on page 2-11 describes the grounding and lightning protection requirements of a PTP 250 installation.
- Installation inventories on page 4-2 lists the components required for PTP 250 installations, including cables, connectors, grounding kits and LPUs.
- Installing the drop cable and LPU on page 5-14 describes how to install the drop cable from the ODU to the LPU and PoE power supply, and to provide grounding for the installation.
- Installing the PoE power supply on page 5-27 describes how to prepare the indoor cables to connect to the network.
- Testing after a lightning strike on page 8-2 describes testing to be performed after a PTP 250 installation is struck by lightning.

Wireless operation

This section describes how PTP 250 wireless links are operated, including modulation modes, power control and security.

Wireless Transmissions

The PTP 250 uses Time Division Duplexing (TDD) transmission, which means that a single frequency channel is used for both Transmit and Receive. This is handled automatically by the radio.

The PTP 250 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.

The channel width of the OFDM signal is configurable to one of two values: 20 MHz or 40 MHz. The higher channel width provides greater link capacity at the expense of using more spectrum. The lower channel width provides better receiver sensitivity and can also be appropriate where the amount of free spectrum is limited.

Each channel is offset in center frequency from its neighboring channel by 20 MHz.

Spectrum management

At system start-up, the spectrum management feature of the PTP 250 monitors the available wireless spectrum and directs both ends of the wireless link to operate on a channel with a minimum level of co-channel and adjacent channel interference.

Alternatively, the user can specify a single channel to use (or several to be chosen from) at the master unit.

Adaptive modulation

The PTP 250 can transport data over the wireless link using different modulation modes. For a given channel width, 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 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 system 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.

NOTE

PTP LINKPlanner 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

Multiple-Input Multiple-Output (MIMO) techniques provide protection against fading and increase the probability that the receiver will decode a usable signal. When the effects of MIMO are combined with those of OFDM techniques and a high link budget, there is a high probability of a robust connection.

The PTP 250 transmits two signals on the same radio frequency, one of which is vertically polarized and the other horizontally polarized. The system also has the ability to adapt between two modes of operation:

- **Dual Payload**: When the radio channel conditions allow, the system 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 system.
- **Single Payload**: As the radio channel becomes more challenging, the system 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 system to operate in challenging radio channels.

The switching between modes is automatically controlled by the adaptive modulation feature described in Adaptive modulation on page 1-17.

Radar avoidance

In regions where protection of radars is part of the local regulations, the PTP 250 must detect interference from radar-like systems and avoid co-channel operation with these systems.

To meet this requirement, the PTP 250 implements the following features:

ETSI regulations

The regulations have radar detection requirements for both master and slave devices.

The requirements for a master device are:

- The device 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 (channel availability check) for radar interference before making the channel an available channel.
- As a result of this compulsory channel scan, there is a service outage of at least 60 seconds every time radar is detected, and the installation time is extended by at least 60 seconds even if no radar is detected on the channel.
- When operating on a channel, the spectrum monitoring algorithm implements a radar detection function (in-service monitoring) which looks for impulsive interference on the operating channel. 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 30 minutes after the impulsive interference pulse was detected.
- After the 30 minutes have expired the channel will be returned to the usable channel pool.
- There is a secondary requirement for bands requiring radar avoidance. Regulators have mandated that products provide an approximately even loading of the spectrum across all devices. In general, this prevents operation with fixed frequency allocations. However, ETSI regulations do allow frequency planning of networks (as that has the effect of spreading the load across the spectrum).

NOTE

The Master device will not initiate any transmissions on channels which overlap the band 5600-5650 MHz as the radar detection requirements are more severe.

The requirements for a slave device are:

- The slave device can only transmit after receiving a transmission from its associated master to demonstrate that the channel is an available channel.
- The slave device is required to vacate the channel when the master device has detected a radar signal.
- The slave device is also required to perform in-service monitoring and will stop transmitting on a channel having detected a radar signal (having informed the master device) and will not re-use the channel for thirty minutes.
- Once the slave device has detected a radar on a channel, it will perform a channel availability check before transmitting again on the channel.
- The slave device is also required to perform Channel Availability Check (CAC) measurements before responding to a master transmission, but this requirement only applies after the slave has detected a radar signal on the channel.

Security

The PTP 250 supports 48-bit proprietary encryption for data transmitted over the wireless link.

Country of operation

Some aspects of wireless operation are controlled, enforced or restricted according to country of operation.

The Country Code must be set in the user interface by the user at first login. The Country Code setting affects the following aspects of wireless operation:

- Maximum transmit power
- Radar avoidance
- Transmit power reduction in edge channels
- Frequency range
- Channel plan

⚠ CAUTION

To avoid possible enforcement action by the country regulator, always operate links in accordance with local regulations.

NOTE

Equipment supplied to the USA can ONLY be set to operate with a Country Code which is fully compatible with FCC Rules.

Using frequency planning

Networks will benefit from the use of fixed channel allocations if (a) the network consists of multiple PTP links, and (b) RF interference predominantly arises from equipment in the same network.

Frequency planning is the exercise of assigning operating channels to PTP units so as to minimize RF interference between links. Frequency planning must consider interference from any PTP unit to any other PTP unit in the network. Low levels of interference normally allow for stable operation and high link capacity.

The frequency planning task is made more straightforward by use of the following techniques:

- Using several different channels
- Separating units located on the same mast
- Using high performance (directional) external antennas

For help with planning networks, refer to Chapter 2 Planning considerations, or contact a Motorola distributor or re-seller.

Further reading on wireless operation

For information on planning wireless operation, refer to the following:

- Spectrum planning on page 2-2 describes the regulatory restrictions that affect radio spectrum usage, such as frequency range and radar avoidance.
- Link planning on page 2-8 describes factors to be taken into account when planning links, such as range and path loss, and introduces PTP LINKPlanner.
- Wireless specifications on page 4-19 contains specifications of the PTP 250 wireless interface, such as RF bands, channel width, spectrum settings, maximum power and link loss.
- Compliance with safety standards on page 4-22 lists the safety specifications against which the PTP 250 has been tested, and describes how to keep RF exposure within safe limits.
- Compliance with radio regulations on page 4-27 describes how the PTP 250 complies with the radio regulations that are in force in various countries.
- Notifications on page 4-33 contains notifications of compliance with the radio regulations that are in force in various regions.

For information on configuring and operating the wireless link, refer to the following:

- Using the installation wizard on page 6-14 describes how to configure the wireless interface using the installation wizard.
- Comparing actual to predicted performance on page 6-34 describes how to check that a newly installed link is achieving predicted levels of performance.
- Managing performance on page 7-17 describes how to manage the performance of a PTP 250 link.
- Testing the radio link on page 8-12 describes what to do if the radio link is not working, or it is unreliable, or the data throughput rate is too low.

Ethernet bridging

This section describes how the PTP 250 controls Ethernet data in the customer and management networks.

Customer network

Transparent Ethernet service

The PTP 250 provides an Ethernet service between the Ethernet port at a local ODU and the Ethernet port at an associated remote ODU. The Ethernet service is based on conventional layer two transparent bridging, and is equivalent to the Ethernet Private Line (EPL) service defined by the Metro Ethernet Forum (MEF).

The service is transparent to untagged frames, standard VLAN frames, priority-tagged frames, provider bridged frames, and provider backbone bridged frames. In each case, the service preserves MAC addresses, VLAN ID, Ethernet priority and Ethernet payload in the forwarded frame. The maximum frame size for bridged frames is 2000 octets.

Layer two control protocols

The PTP 250 is transparent to layer two control protocols (L2CP) including:

- Spanning tree protocol (STP), rapid spanning tree protocol (RSTP)
- Multiple spanning tree protocol (MSTP)
- Link aggregation control protocol (LACP)
- Link OAM, IEEE 802.3ah
- Port authentication, IEEE 802.1X
- Ethernet local management interface (E-LMI), ITU-T Q.933.
- Link layer discovery protocol (LLDP)
- Multiple registration protocol (MRP)
- Generic attribute registration protocol (GARP)

The system does not generate or respond to any L2CP traffic.

Management network

IP interface

The PTP 250 ODU contains an embedded management agent with a single IP interface. Network management communication is exclusively based on IP and associated higher layer transport and application protocols. The factory default IP address of the management agent is 169.254.1.1. The products do not require use of supplementary serial interfaces.

MAC address

The MAC address is not configurable by the user.

VLAN membership

VLAN tagging is not supported for the management agent.

In-band management

In-band management is the only management mode offered (there is no out of band management).

In the in-band management mode, the management agent can be reached from the Ethernet port at the local ODU, and (assuming that the wireless link is established) the Ethernet port at the remote ODU.

Wireless link down alert

PTP 250 offers a configurable email alert which can be set to send the user an email message in the event of the wireless link going down.

Back-to-back links

PTP 250 will not operate correctly if a direct cabled connection is made between two PoE power supply units. Where two or more links are deployed in a chain, always use an Ethernet switch or router to interconnect the links at the relay points.

Protocol model

Ethernet bridging behavior at each end of the wireless link is equivalent to a two-port, managed, transparent MAC bridge where the two ports are:

- Ethernet Port
- Wireless Port

Frames are transmitted at the Wireless port over a proprietary point-to-point circuit-mode link layer between ends of the link. Ethernet frames received at the Ethernet port, or generated internally within the management agent, are encapsulated within a lightweight MAC layer for transmission over the wireless link.

Protocol layers involved in bridging between Ethernet and wireless interfaces are shown in Figure 1-10. Protocol layers involved in bridging between external interfaces and the management agent are shown in Figure 1-11. In these figures, the layers have the meanings defined in IEEE 802.1Q-2005.

Figure 1-10 Protocol layers between Ethernet and wireless interfaces

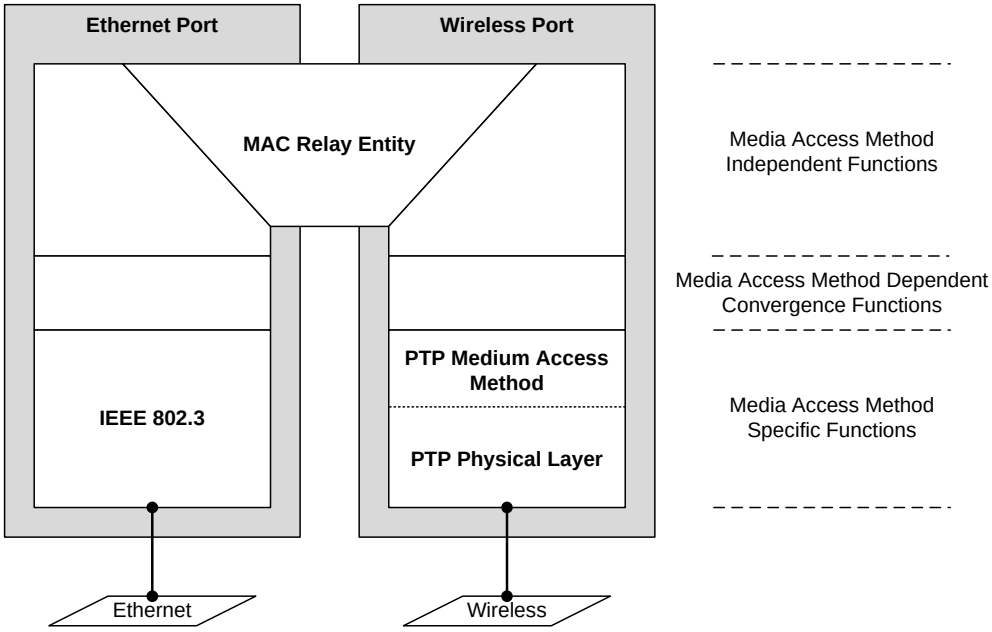
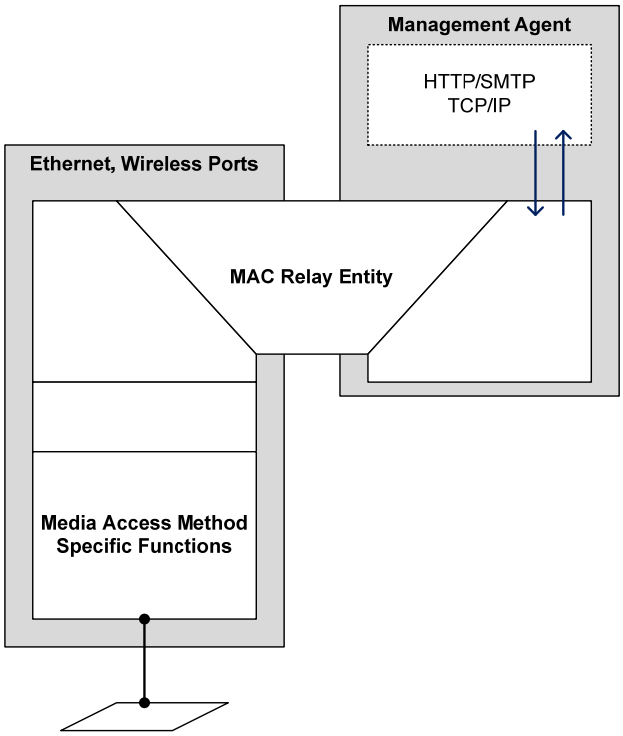


Figure 1-11 Protocol layers between external interfaces and the management agent



Further reading on Ethernet bridging

For more information on Ethernet bridging, refer to the following:

- Data network planning on page 2-21 describes factors to be considered when planning PTP 250 data networks.
- Data network specifications on page 4-21 contains specifications of the PTP 250 Ethernet interface.
- Using the installation wizard on page 6-14 describes how to configure the IP and Ethernet attributes of the PTP 250.
- Reviewing system configuration attributes on page 6-31 describes how to review the IP and Ethernet attributes of the PTP 250.

System management

This section introduces the PTP 250 management system, including the web interface, installation, configuration, alerts and upgrades.

Web server

The PTP 250 management agent contains a web server.

Web-based management offers a convenient way to manage the equipment from a locally connected computer or from a workstation connected through a management network, without requiring any special management software. The web-based interfaces are the only interfaces supported for system installation and configuration management.

The web-based management interfaces provide comprehensive web-based fault, configuration, performance and security management functions organized into the following menu options:

- **Home:** This page reports wireless link status and basic information needed to identify the link.
- **Status:** This page reports the detailed status of the system.
- **Configuration**: These pages are used to review the LAN, wireless, date and email settings. These settings are updated using the Installation Wizard.
- **Statistics**: This page contains performance management counters that are collected at the data, management and wireless ports.
- **Firmware Update**: This page is used to update the firmware in the unit.
- **Diagnostics Plotter**: This page provides diagnostic measurements over time, as an aid to performance management.
- **Installation Wizard:** These pages are used to complete the initial system configuration, including LAN, wireless, date and email settings.
- **Change Password**: The page is used to change the web-interface password.
- **Reboot:** This page is used to reboot the unit.
- **Logout:** This page is used to log out of the web-based interface.

Firmware upgrade

The management agent supports application firmware upgrade using the web-based interface.

PTP 250 firmware 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 firmware upgrade.

Obtain the application firmware and this user guide from the support website (http://www.motorola.com/ptp/support) BEFORE warranty expires.

⚠ CAUTION

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

The procedure for firmware upgrade is described in Upgrading firmware version on page 6-10.

Reset to factory defaults

The ‘reset to factory defaults’ feature provides a means to recover from serious configuration errors, such as lost or forgotten passwords.

Use the reset plug (supplied in each PTP 250 ‘Link Complete’ or ‘End Complete’ kit) to reset the unit to factory default configuration, including reset of the country that was selected at first login. Following the procedure in Resetting to default configuration (with country reset) on page 7-26

Use the Save & Restore page to reset the unit to factory default configuration, without resetting the country that was selected at first login. Follow the procedure in Resetting to default configuration (without country reset) on page 7-25.

Further reading on system management

For more information on system management, refer to the following:

- Chapter 6 Configuration and alignment describes all configuration and alignment tasks that are performed when a PTP 250 link is deployed.
- Chapter 7 Operation provides instructions for operators of the PTP 250 web user interface.

Chapter 2 Planning considerations

This chapter provides information to help the user to plan a PTP 250 link.

The following topics are described in this chapter:

- Spectrum planning on page 2-2 describes the regulatory restrictions that affect radio spectrum usage, such as frequency range and radar avoidance.
- Site planning on page 2-4 describes factors to be considered when choosing sites for the ODU and PoE power supply.
- Link planning on page 2-8 describes factors to be taken into account when planning links, such as range and path loss. Introduces the PTP LINKPlanner.
- Grounding and lightning protection on page 2-11 describes the grounding and lightning protection requirements of a PTP 250 installation.
- Data network planning on page 2-21 describes factors to be considered when planning PTP 250 data networks.

Spectrum planning

This section describes the regulatory restrictions that affect radio spectrum usage.

Each frequency variant has specific regulatory restrictions that affect frequency range, radar avoidance and channel width usage.

Available spectrum

Ensure the link is configured to conform to local regulatory requirements.

The available spectrum for operation depends on the country of operation:

- The 5.4 GHz band is available in all EU countries.
- The 5.8 GHz band is currently only available in a limited number of EU countries (UK, Eire, Norway, Denmark, Germany and Spain).

Certain regulations have allocated certain channels as unavailable for use:

- Europe has allocated part of the 5.4 GHz band to weather radar.
- The UK and some other European countries have allocated part of the 5.8 GHz band to Road Transport and Traffic Telematics (RTTT) systems.

For examples of these restrictions, refer to Examples of regulatory limits on page 4-32.

Where regulatory restrictions apply to certain channels, these channels are barred automatically by the use of the correct country setting. For example, at 5.8 GHz in the UK and some other European countries, the RTTT band 5795 MHz to 5815 MHz is barred. With the appropriate configuration for a country in this region, the PTP 250 will not operate on channels within this band.

The number and identity of channels barred by the country selection is dependent on the channel width selected.

NOTE

For the connectorized model, when using external antennas of higher gain than the appropriate integrated antenna, the regulations may require the maximum transmit power to be reduced. To ensure that regulatory requirements are met for connectorized installations, refer to Calculating EIRP for connectorized units on page 4-30.

Frequency selection

The PTP 250 fully conforms to regional regulatory requirements for radar avoidance.

In regions that mandate DFS, the unit first ensures that there is no radar activity on a given channel for a period of 60 seconds before radiating on that channel. Once a channel has been selected for operation, the unit will continually monitor for radar activity on the operating channel. If detected, it will immediately cease radiating and attempt to find a new channel.

Radar avoidance requirements in the 5.4 GHz band are defined as follows:

- For the EU: in specification EN 301-893 version V1.5.1.

Radar avoidance at 5.8 GHz is applicable to EU operation (not FCC/IC) and the requirements are defined in EN 302 502.

Channel width

Select the required channel width for the link (20 MHz or 40 MHz). The wider channel has the greater the capacity. As narrower channel widths take up less spectrum, selecting a narrow channel width may be a better choice when operating in locations where the spectrum is very busy.

Site planning

This section describes factors to be taken into account when choosing sites for the ODU and PoE power supply.

ODU site selection

When selecting a site for the ODU, consider the following factors:

- Height and location to ensure that people are kept away from the antenna; see Calculated distances and power compliance margins on page 4-25.
- Height and location to achieve the best radio path.
- Ability to meet the requirements specified in Grounding and lightning protection on page 2-11.
- Aesthetics and planning permission issues.
- Cable lengths; see Maximum cable lengths on page 2-5.
- The effect of strong winds on the installation; see Wind loading on page 2-5.

Power supply selection

Select a suitable power supply unit for the PTP 250. The only supported units are the PoE power supply (included in PTP 250 kits) or the PTP 300/500/600 Series PIDU. The PoE power supply is suitable for the majority of installations, but the PIDU is required in the following situations:

- When a -48 V DC power supply is required, either as the primary supply or as a backup to the AC mains.
- When an extended operating temperature range is required for the mains powering system, for example when the indoor equipment is in a building without temperature control or air conditioning.

For PIDU ordering information, see Alternative components on page 4-9.

The power supply unit must be installed in an indoor location with no possibility of condensation, with an ambient temperature within the specified operating range of the product; see Power supply unit specifications on page 4-12.

Maximum cable lengths

The maximum permitted lengths of interface cables in PTP 250 installations are specified in Table 2-1.

Table 2-1 Maximum cable lengths

Interface type	Interface	Maximum length
Ethernet power and data	ODU to network terminating equipment.	100 m (330 ft)

Wind loading

Ensure that the supporting structure will not be prone to excessive wind loading.

Antennas and equipment mounted on towers or 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.

The ODU, with or without the integral antenna, is essentially a flat structure. The magnitude of the lateral force can be estimated from surface area and wind speed.

Calculation of lateral force (metric)

The magnitude of the lateral force can be estimated from:

Force (in kilograms) = $0.1045aV^2$

Where:	Is:
a	surface area in square meters
V	wind speed in meters per second

The lateral force produced by a single PTP 250 ODU (integrated or connectorized model) at different wind speeds is shown in Table 2-2.

Table 2-2 Lateral force – metric

Type of ODU	Largest surface area (square meters)	Lateral force (Kg) at wind speed (meters per second)				
		30	40	50	60	70
Integrated	0.130	12	22	34	49	66
Connectorized	0.093	9	16	24	35	48

Calculation of lateral force (US)

The magnitude of the lateral force can be estimated from:

Force (in pounds) = $0.0042Av^2$

Where:	Is:
A	surface area in square feet
v	wind speed in miles per hour

The lateral force produced by a single PTP 250 ODU (integrated or connectorized model) at different wind speeds is shown in Table 2-3.

Table 2-3 Lateral force – US

Type of ODU	Largest surface area (square feet)	Lateral force (lb) at wind speed (miles per hour)				
		80	100	120	140	150
Integrated	1.36	36.6	57.1	82.3	146.2	228.5
Connectorized	1.00	26.9	42	60.5	107.5	168.0

NOTE

When the connectorized ODU is used with external antennas, the figures from the antenna manufacturer for lateral force should be included to calculate the total loading on the mounting structure.

Capabilities of the PTP 250

The structure and mounting brackets of the ODU are capable of withstanding wind speeds up to 242 kph (151 mph). Ensure that the structure to which the ODU is fixed is also capable of withstanding the prevalent wind speeds and loads.

Wind speed statistics

Contact the national meteorological office for the country concerned to identify the likely wind speeds prevalent at the proposed location. Use this data 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.meto.gov.uk

Link planning

This section describes factors to be taken into account when planning links, such as range, obstacles and path loss. PTP LINKPlanner is recommended.

Range and obstacles

Calculate the range of the link and identify any obstacles that may affect radio performance.

Perform a survey to identify all the obstructions (such as trees or buildings) in the path and to assess the risk of interference. This information is necessary in order to achieve an accurate link feasibility assessment.

NOTE

When higher gain connectorized antennas are used, reduce the transmit power to ensure that the receiver signal level does not exceed -20 dBm.

PTP LINKPlanner

The Motorola PTP LINKPlanner software and user guide may be downloaded from http://www.motorola.com/ptp/support.

PTP LINKPlanner imports path profiles and predicts data rates and reliability over the path. It allows the system designer to try different antenna heights and RF power settings. It outputs an installation report that defines the parameters to be used for configuration, alignment and operation. The installation report can be used to compare the predicted and actual performance of the link.

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 is

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.

When to install connectorized units

The majority of radio links can be successfully deployed with the integrated PTP 250. However the integrated units may not be sufficient in some areas, for example:

- Where the path is heavily obscured by dense woodland on an NLOS link.
- Where long LOS links (>23 km or >14 miles) are required.
- Where there are known to be high levels of interference.

PTP LINKPlanner can be used to identify these areas of marginal performance.

In these areas, connectorized ODUs and external antennas should be used.

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

Grounding and lightning protection

Structures, equipment and people must be protected against power surges (typically caused by lightning) by conducting the surge current to ground via a separate preferential solid path.

The actual degree of protection required depends on local conditions and applicable local regulations.

Motorola recommends that PTP 250 installation is contracted to a professional installer.

⚠ WARNING

Electro-magnetic discharge (lightning) damage is not covered under warranty. The recommendations in this guide, when followed correctly, give the user the best protection from the harmful effects of EMD. However 100% protection is neither implied nor possible.

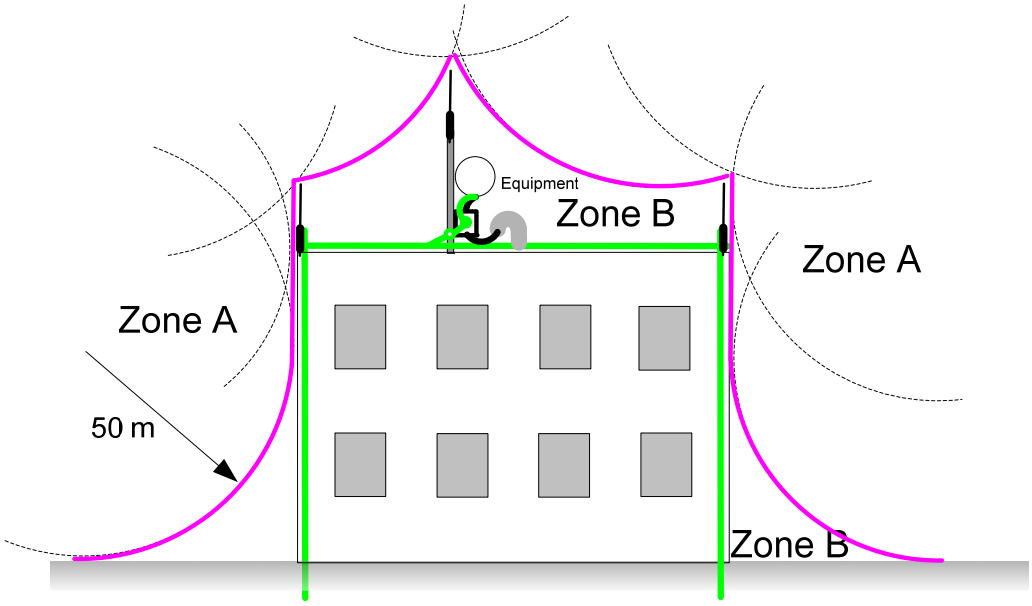
Standards

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.

Lightning protection zones

The ‘rolling sphere method’ (Figure 2-1) is used to determine where it is safe to mount equipment. An imaginary sphere, typically 50 meters in radius, is rolled over the structure. 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 to be in the zone of protection.

Figure 2-1 Rolling sphere method to determine the lightning protection zones



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 equipment 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 equipment in this zone.

⚠ WARNING

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

General protection requirements

Apply the practices and procedures detailed in manual *R56 Standards And Guidelines For Communication Sites* (available for download at www.motorola.com/ptp/software) to all new site build activities.

Basic requirements

The following basic protection requirements must be implemented:

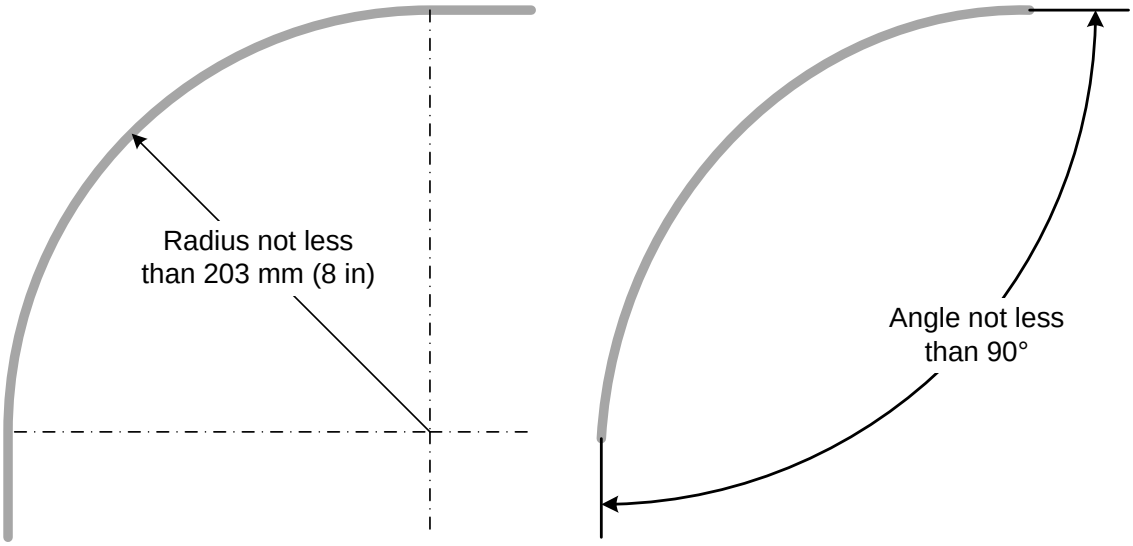
- The ODU must be in 'Zone B' (see Lightning protection zones on page 2-11).
- A lightning protection unit (LPU) must be installed within 600 mm (24 in) of the point at which the drop cable enters the building or equipment room.
- The drop cable must be bonded to the supporting structure in order to prevent lightning creating a potential between the structure and cable, which could cause arcing, resulting in fire risk and damage to equipment.
- The drop cable must be grounded at the building entry point.
- The drop cable must not be laid alongside a lightning air terminal.
- All grounding cables must be a minimum size of 10 mm^2 csa (8AWG), preferably 16 mm^2 csa (6AWG), or 25 mm^2 csa (4AWG).

Grounding cable requirements

When routing, fastening and connecting grounding cables, the following requirements must be implemented:

- Grounding conductors must be run as short, straight, and smoothly as possible, with the fewest possible number of bends and curves.
- Grounding cables must not be installed with drip loops.
- All bends must have a minimum radius of 203 mm (8 in) and a minimum angle of 90° (Figure 2-2). A diagonal run is preferable to a bend, even though it does not follow the contour or run parallel to the supporting structure.
- All bends, curves and connections must be routed towards the grounding electrode system, ground rod, or ground bar.
- Grounding conductors must be securely fastened.
- Braided grounding conductors must not be used.
- Approved bonding techniques must be used for the connection of dissimilar metals.

Figure 2-2 Grounding cable minimum bend radius and angle



ODU requirements

The following ODU protection requirements must be implemented:

- The ODU must be grounded to the supporting structure.

Protection requirements for a mast or tower installation

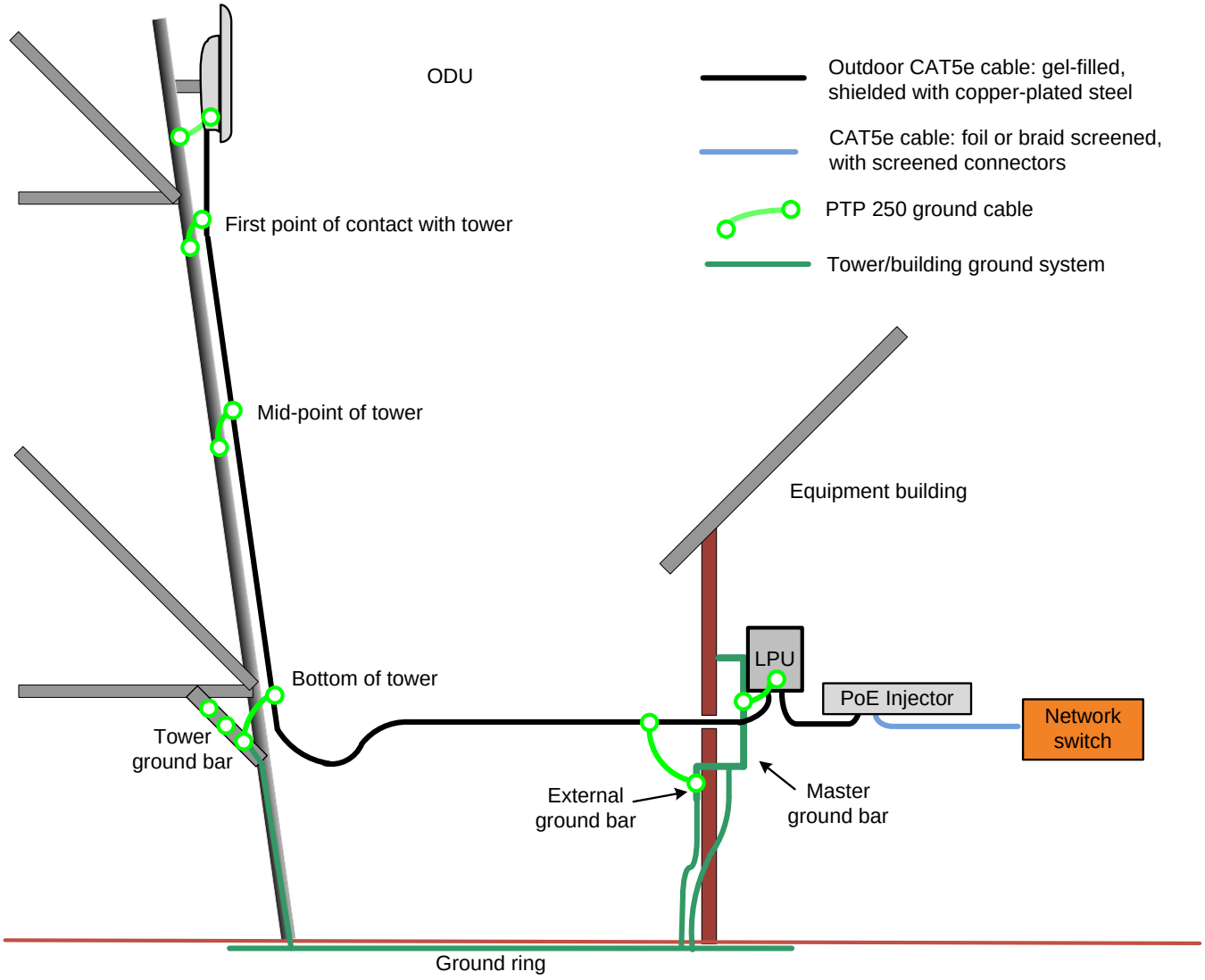
If the ODU is to be mounted on a metal tower or mast, then in addition to the general protection requirements (above), the following requirements must be observed:

- The equipment must be lower than the top of the tower or its lightning air terminal.
- The metal tower or mast must be correctly grounded.
- A grounding kit must be installed at the first point of contact between the drop cable and the tower, near the top.
- A grounding kit must be installed at the bottom of the tower, near the vertical to horizontal transition point. This grounding kit must be bonded to the tower or tower ground bus bar (TGB), if installed.
- If the tower is greater than 61 m (200 ft) in height, an additional grounding kit must be installed at the tower midpoint. Additional ground kits must be installed as necessary to reduce the distance between ground kits to 61 m (200 ft) or less.

- In high lightning prone geographical areas, additional ground kits should be installed at spacing between 15 to 22 m (50 to 75 ft). This is especially important on towers taller than 45 m (150 ft).

A schematic example of a mast or tower installation is shown in Figure 2-3.

Figure 2-3 Grounding and lightning protection on mast or tower



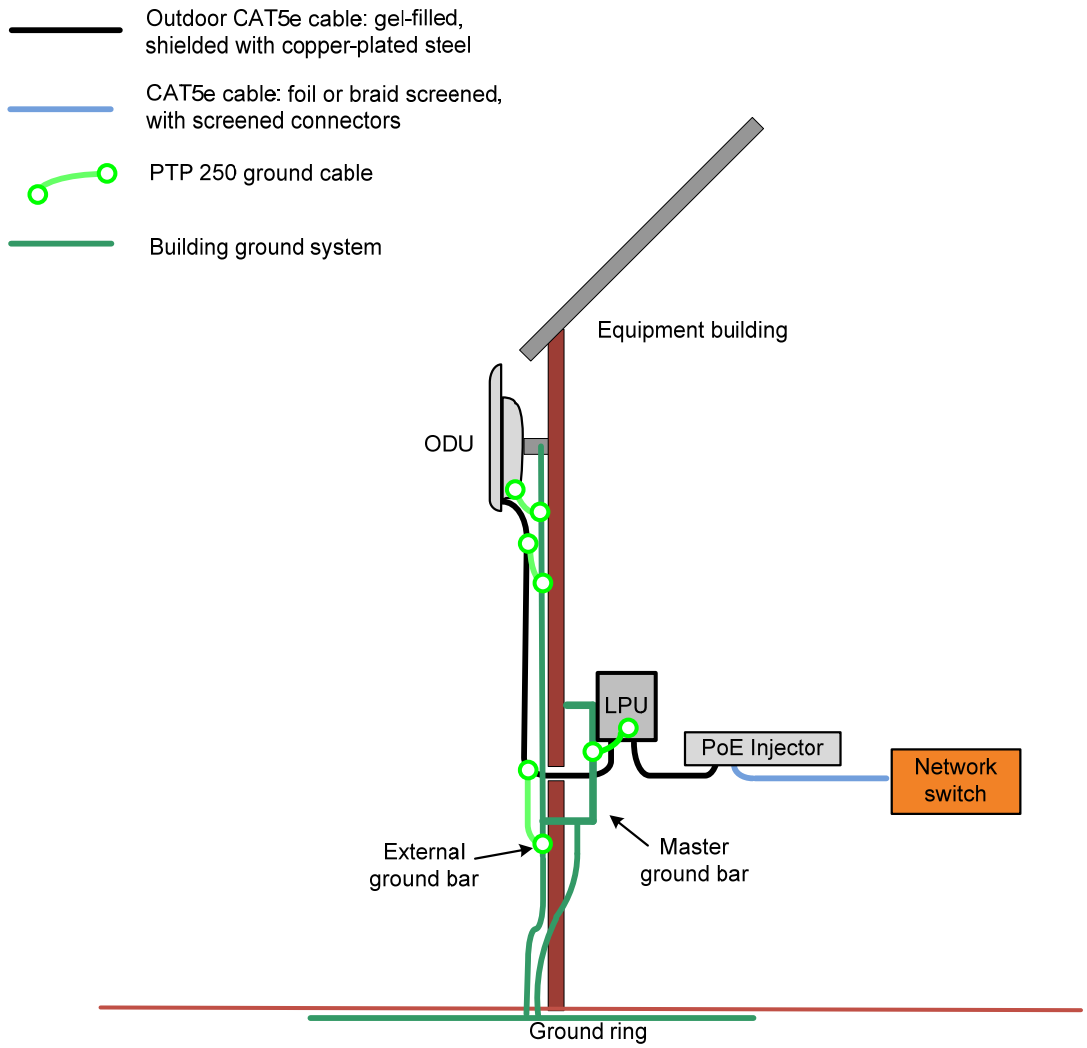
Protection requirements for a wall installation

If the ODU is to be mounted on the wall of a building, then in addition to the general protection requirements (above), the following requirements must be observed:

- The equipment must be lower than the top of the building or its lightning air terminal.
- The building must be correctly grounded.

A schematic example of a wall installation is shown in Figure 2-4.

Figure 2-4 Grounding and lightning protection on wall

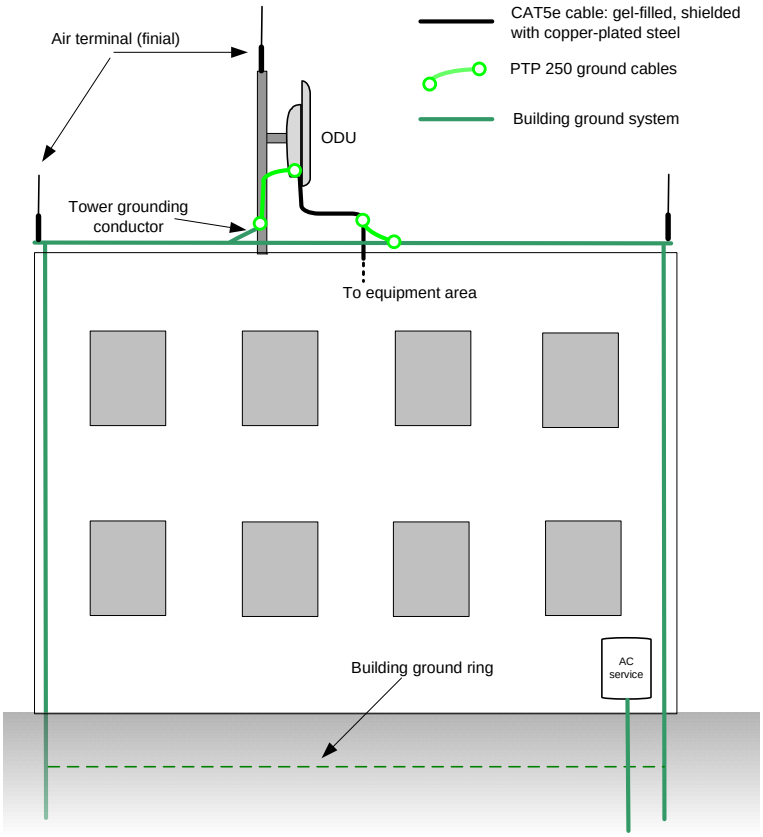


Protection requirements on a high rise building

If the ODU is to be mounted on a high rise building, it is likely that cable entry is at roof level (Figure 2-5) and the equipment room is several floors below (Figure 2-6). In addition to the general protection requirements (above), the following requirements must be observed:

- The ODU must be below the lightning terminals and finials.
- A grounding conductor must be installed around the roof perimeter, to form the main roof perimeter lightning protection ring.
- Air terminals are typically installed along the length of the main roof perimeter lightning protection ring typically every 6.1 m (20 ft).
- The main roof perimeter lightning protection ring must contain at least two down conductors connected to the grounding electrode system. The down conductors should be physically separated from one another, as far as practical.

Figure 2-5 Grounding and lightning protection on building

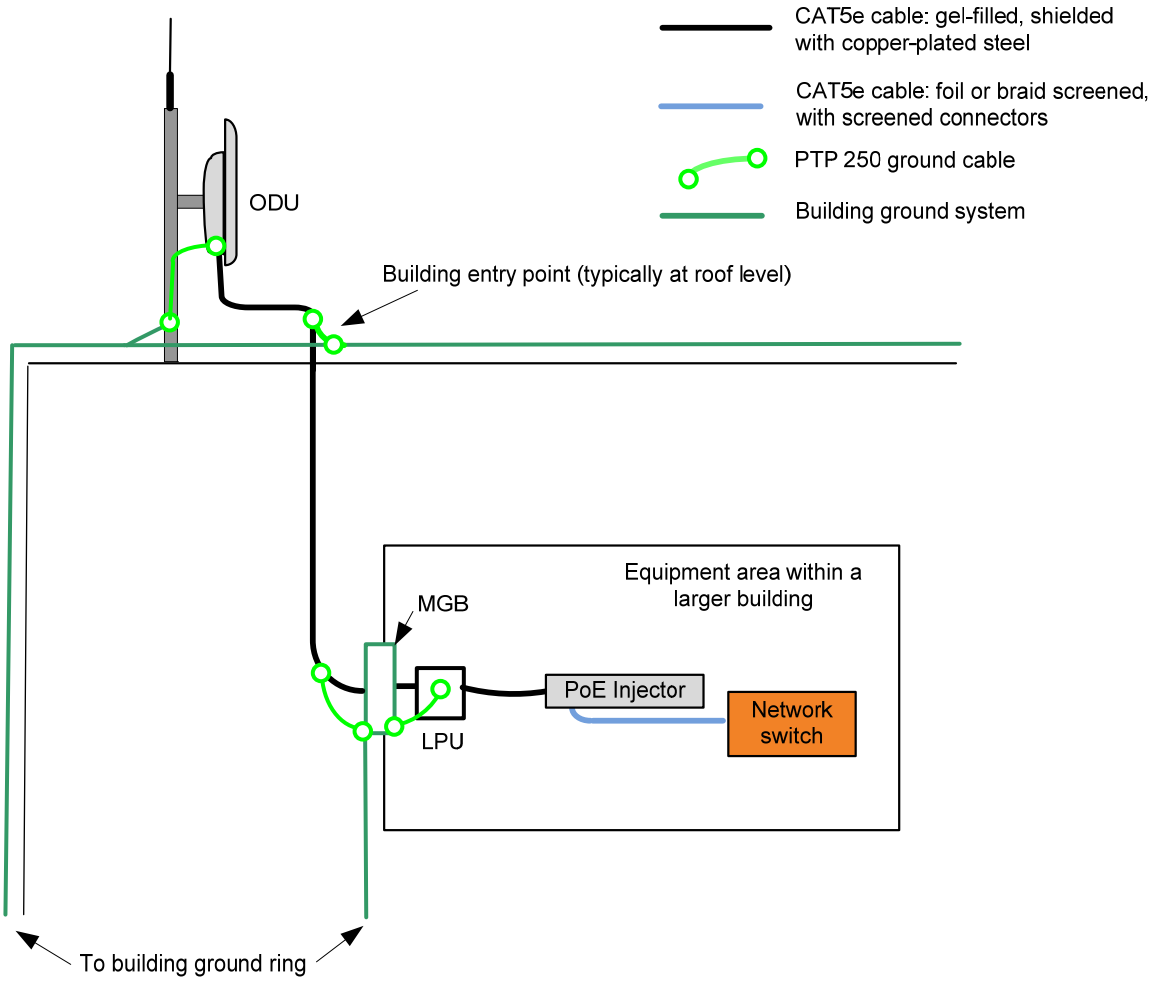


Protection inside a high rise building

The following protection requirements must be observed inside multi-story or high rise buildings (Figure 2-6):

- The drop cable shield must be bonded to the building grounding system at the entry point to the building.
- The drop cable shield must be bonded to the building grounding system at the entry point to the equipment area.
- An LPU must be installed within 600 mm (24 in) of the entry point to the equipment area.

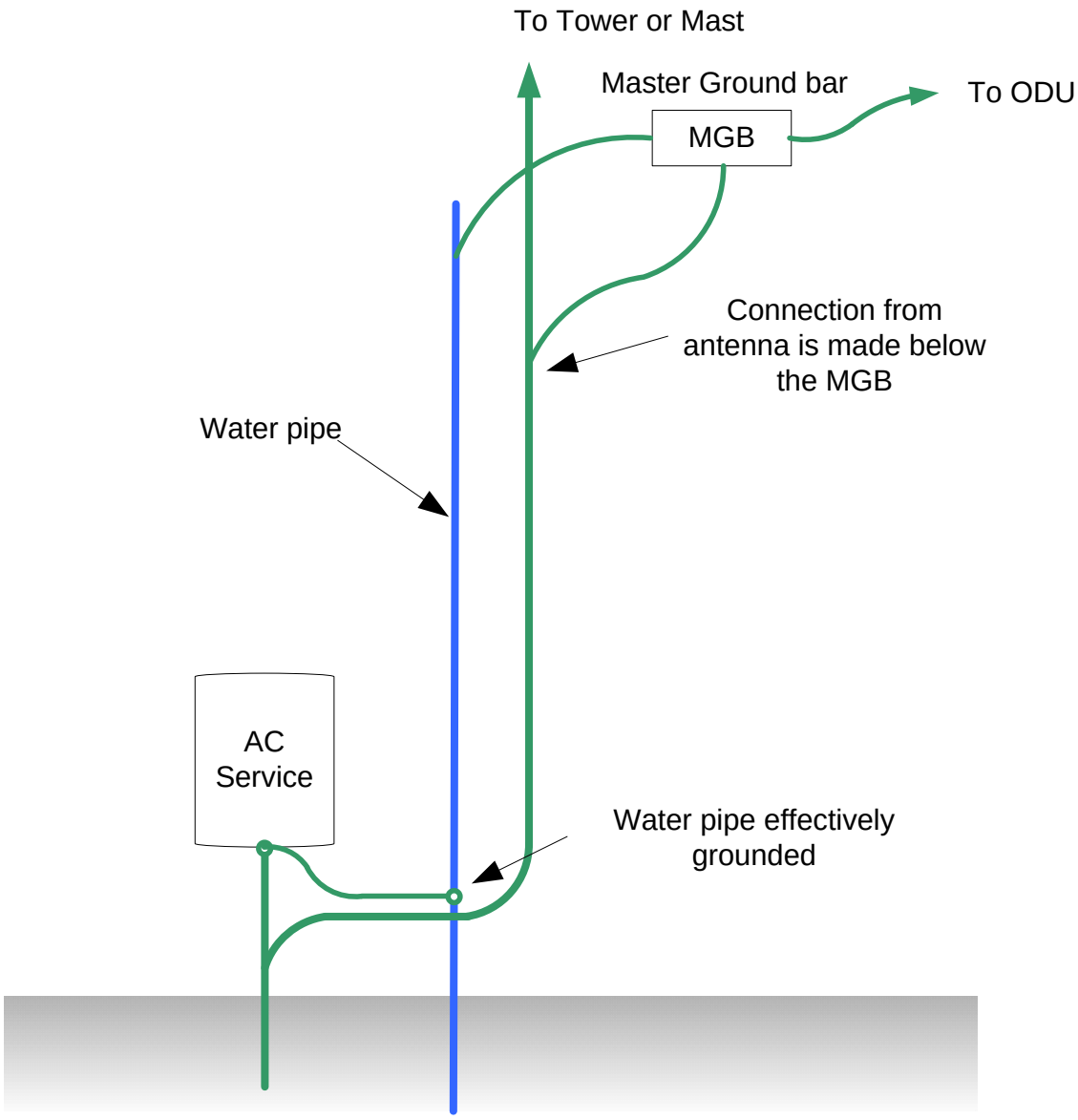
Figure 2-6 Grounding and lightning protection inside high building



Connecting to the grounding conductor

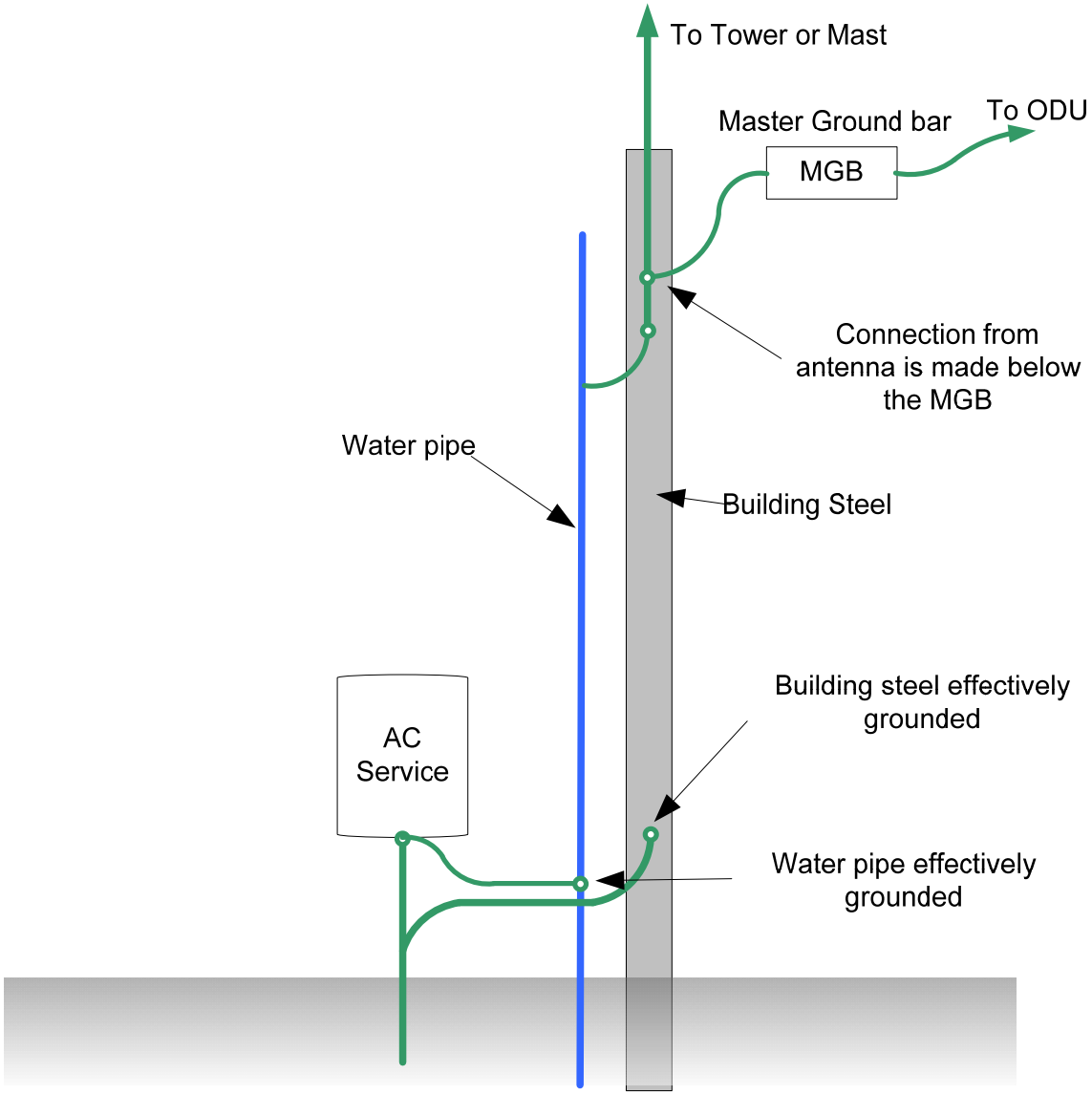
Figure 2-7 and Figure 2-8 illustrate the techniques employed to provide equipment grounding in high rise buildings. A steel component of the building can be used as a grounding conductor, provided it is part of the structural building steel and is effectively grounded.

Figure 2-7 Grounding in a high rise building – building steel not available



ODU on different floor than AC service feed, building steel not available

Figure 2-8 Grounding in a high rise building – building steel available



ODU on different floor than AC service feed, building steel available

Data network planning

This section describes factors to be considered when planning PTP 250 data networks.

IP interface

Choose an IP address for the IP interface of the ODU management agent. The IP address must be unique and valid for the connected network segment.

Ensure that the design of the data network permits bi-directional routing of IP datagrams between network management systems and the ODUs. For example, ensure that the gateway IP address identifies a router or other gateway that provides access to the rest of the data network.

Back to back links

Do not use direct cabled connections between the data ports of two PoE power supplies. Where two or more links are deployed in a chain, always use an Ethernet switch or router to interconnect the links at a relay point.

‘Green Ethernet’ switches

Do not connect PTP 250 units to Ethernet networking products that control the level of the transmitted Ethernet signal based on the measured length of the Ethernet link, for example Green Ethernet products manufactured by D-Link Corporation. The Ethernet interfaces in these networking products do not work correctly when connected directly to the PoE power supply.

Chapter 3 Legal information

This chapter provides legal notices including software license agreements.

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Chapter 4 Reference information

This chapter describes the reference information and regulatory notices that apply to the PTP 250.

The following reference topics are contained in this chapter:

- Installation inventories on page 4-2 lists the components required for PTP 250 installations, including ODUs, with Motorola part numbers.
- ODU specifications on page 4-10 contains specifications of the outdoor unit (ODU) that is supplied by Motorola for PTP 250 installations.
- Power supply unit specifications on page 4-12 contains specifications of the PoE power supply and PIDU that are supplied by Motorola for PTP 250 installations.
- Antenna specifications on page 4-14 contains specifications of the antennas that are approved by the FCC for use with the connectorized ODUs.
- Wireless specifications on page 4-19 contains specifications of the PTP 250 wireless interface, including RF bands, channel width and link loss.
- Data network specifications on page 4-21 contains specifications of the PTP 250 Ethernet interface.
- Compliance with safety standards on page 4-22 lists the safety specifications against which the PTP 250 has been tested and certified. It also describes how to keep RF exposure within safe limits.
- Compliance with radio regulations on page 4-27 describes how the PTP 250 complies with the radio regulations that are in force in various countries.
- Notifications on page 4-33 contains notifications made to regulatory bodies for the PTP 250.

Installation inventories

This section lists the components required for PTP 250 installations, including ODUs, with Motorola part numbers.

PTP 250 kits

The PTP 250 is supplied as a 'Link' or an 'End' kit. A ‘Link’ kit contains components for both ends of a link (including two ODUs and two PoE power supply units). An 'End' kit contains components for one end of a link (including one ODU and one PoE power supply). The kits may contain either integrated ODUs (antennas included) or connectorized ODUs (separate antennas must be purchased).

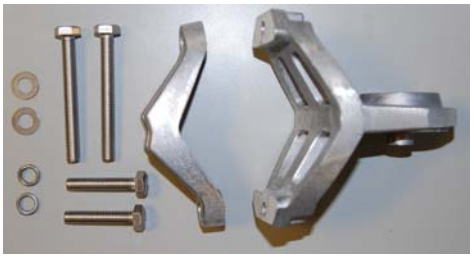
PTP 250 kits are supplied in two regional variants: one is for use in countries where FCC or IC licensing restrictions apply (the USA and Canada), and the other is for use in ETSI countries or the rest of the world (ETSI/RoW). Table 4-1 contains part numbers for all kit variants. Table 4-2 lists PTP 250 kit components.

Table 4-1 PTP 250 kit part numbers

Frequency variant	Regional variant	Integrated or Connectorized	Link or End Complete	Part number
5.4 / 5.8 GHz	ETSI/RoW	Integrated	Link Complete	WB3716
5.4 / 5.8 GHz	ETSI/RoW	Integrated	End Complete	WB3717
5.4 / 5.8 GHz	ETSI/RoW	Connectorized	Link Complete	WB3718
5.4 / 5.8 GHz	ETSI/RoW	Connectorized	End Complete	WB3719
5.8 GHz	FCC/IC	Integrated	Link Complete	WB3720
5.8 GHz	FCC/IC	Integrated	End Complete	WB3721
5.8 GHz	FCC/IC	Connectorized	Link Complete	WB3722
5.8 GHz	FCC/IC	Connectorized	End Complete	WB3723

Table 4-2 Inventory for ODU and PoE power supply kits

Item	Notes
ODUs  	ODUs may be Integrated (as illustrated) or Connectorized. 'End Complete' kit contains one ODU with grounding cable. 'Link Complete' kit contains two ODUs with grounding cables.
PoE power supply 	'End Complete' kit contains one injector. 'Link Complete' kit contains two injectors.

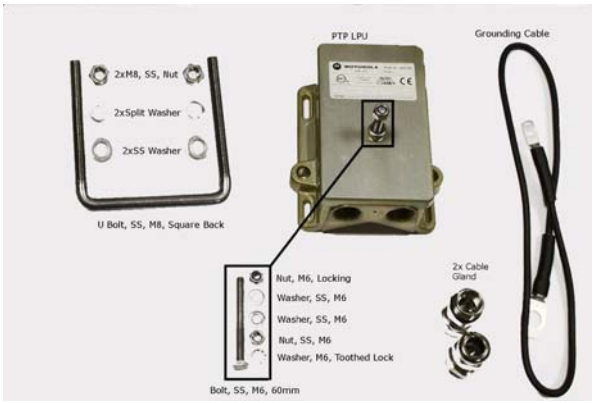
Item	Notes
Mounting bracket assembly 	‘End Complete’ kit contains one bracket. ‘Link Complete’ kit contains two brackets.
Choice of mains leads (US, UK and EU)	‘End Complete’ kit contains one US, one UK and one EU lead. ‘Link Complete’ kit contains two US, two UK and two EU leads.
Cable gland 	‘End Complete’ kit contains one gland. ‘Link Complete’ kit contains two glands.
Reset plug 	‘End Complete’ kit contains one switch. ‘Link Complete’ kit contains two switches.

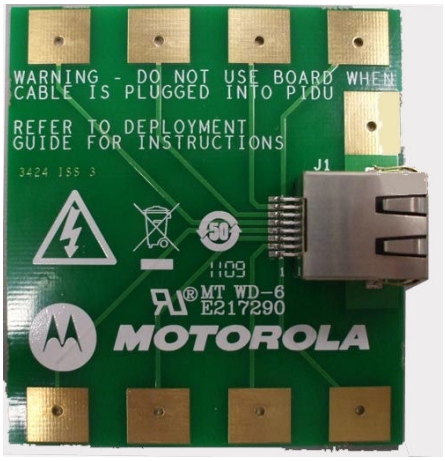
Other standard components

In addition to ODU and PoE power supply kits, standard installations require the components listed in Table 4-3.

Table 4-3 Additional inventory for standard installations

Item	Notes
Outdoor drop cable  **⚠ CAUTION** Always use Cat5e cable that is gel-filled and shielded with copper-plated steel. Alternative types of drop cable are not supported by Motorola.	Superior Essex BBDGe cable is available from Motorola with the following lengths and part numbers (other lengths are available from Superior Essex): '1000 ft Reel Outdoor Copper Clad CAT5E'. Motorola part number WB3175. '328 ft (100 m) Reel Outdoor Copper Clad CAT5E'. Motorola part number WB3176.
RJ45 connectors **NOTE** The specified connectors, crimp tool and die set are specific to Superior Essex BBDGe cable (they may not work with other types of cable).	'Tyco/AMP, Mod Plug RJ45 Unscreened, 25 pk'. Motorola part number WB3177. 'Tyco/AMP Crimp Tool'. Motorola part number WB3211. 'Tyco/AMP Die Set'. Available from Tyco, part number 1-853400-0.
Cable glands 	For protecting the drop cable entry points. Glands are included in the ODU and LPU kits, but additional glands may be purchased from Motorola if required. 'PTP SER EMC CABLE GLAND (GROUNDING)'. Quantity 10. Motorola, part number WB1811.
Cable hoisting grip 	For hoisting the drop cable up to the ODU without damaging the gland or RJ45 plug. Not supplied by Motorola.

Item	Notes
Cable grounding kits 	One kit is required per drop cable grounding point. 'Cable Grounding Kits For 1/4" And 3/8" Cable'. Motorola part number 01010419001. Kit contents: grounding cable, self-amalgamating tape, PVC tape, tie-wraps, bolts, washers and nuts.
Lightning Protection Unit (LPU) kits 	Two kits are required per standard link. 'LPU End Kit PTP 250/300/500'. Motorola part number WB2978D. Kit contents: one LPU, one grounding cable, nuts, bolts and two cable glands.
Cable ties, cable cleats	For securing cables. Purchase separately.
Indoor CAT5e cable **⚠ CAUTION** The connected network equipment must feature screened RJ45 connectors and must be connected to ground, otherwise the PoE power supply will not be grounded.	To connect the PoE power supply to network equipment, use screened cable that meets this specification: **Screening**: Must be either foil screen (FTP) or braided screen (STP) cable. **Connectors**: Must use screened RJ45 connectors with metal shells at both ends. **Electrical connection**: There must be a continuous electrical connection between both screened connectors.

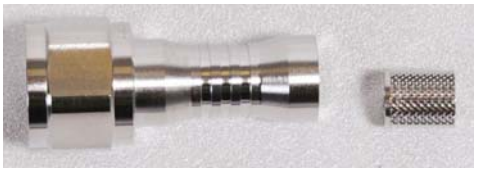
Item	Notes
Drop cable tester 	An optional item for testing the resistances between the RJ45 pins of the drop cable. Order from http://www.motorola.com/ptp/support by selecting **Point-to-Point, Order Cable Tester** and completing the order form.

Components required with connectorized ODUs

Connectorized ODUs require the additional components listed in Table 4-4.

Table 4-4 Additional inventory for connectorized ODUs

Item	Notes
Antenna	One required per link end (or two per link end for spatial diversity). Not supplied by Motorola. Approved antennas are listed in Antenna specifications on page 4-14.
RF cable	For connecting the ODU to the antenna. May be cable of type LMR100, LMR200, LMR300, LMR400 or LMR600. LMR400 is supplied by Motorola: ‘50 Ohm Braided Coaxial Cable - 75 meter’. Motorola part number 30010194001. ‘50 Ohm Braided Coaxial Cable - 500 meter’. Motorola part number 30010195001.

Item	Notes
N type male connectors 	For connecting the RF cables to the ODU. Two connectors required per ODU. Use weatherproof connectors, preferably ones that are supplied with adhesive lined heat shrink sleeves that are fitted over the cable/connector interface. 'RF CONNECTOR,N,MALE,STRAIGHT FOR CNT-400 CABLE'. Motorola part number 09010091001. **NOTE** For the antenna end of the RF cable, refer to the antenna manufacturer's instructions.
Self-amalgamating and PVC tape	To weatherproof the RF connectors.
Cable grounding kits	One kit is required per antenna cable grounding point. Refer to Table 4-3 for specifications and part numbers.
Cable ties, cable cleats	For securing antenna cables.
Lightning arrestor	For protecting the antenna cable at building entry, when the ODU is mounted indoors. One required per antenna cable. For example: Polyphaser LSXL-ME or LSXL.

Alternative components

Some alternatives to standard PTP 250 components are listed in Table 4-5.

Table 4-5 Alternative PTP 250 components

Item	Notes
Powered Indoor Unit (PIDU Plus) 	This is the approved alternative to the PoE power supply. It provides an interface to a -48 V DC power supply. 'PTP 300/500/600 Series PIDU with AUS Lead', Motorola part number WB3022. 'PTP 300/500/600 Series PIDU with EU Lead', Motorola part number WB3023. 'PTP 300/500/600 Series PIDU with UK Lead', Motorola part number WB3024. 'PTP 300/500/600 Series PIDU with US Lead', Motorola part number WB3025. For guidance on choosing the most suitable power supply unit, refer to Power supply selection on page 2-4.

ODU specifications

This section contains specifications of the outdoor unit (ODU) that is supplied by Motorola for PTP 250 installations. These specifications apply to all product variants.

ODU dimensions and weight

The integrated ODU conforms to the physical specifications listed in Table 4-6.

Table 4-6 Integrated ODU physical specifications

Category	Specification
Dimensions	Width 370 mm (14.5 in), Height 370 mm (14.5 in), Depth 95 mm (3.75 in)
Weight	5.35 Kg (11.8 lbs) including bracket

The connectorized ODU conforms to the physical specifications listed in Table 4-7.

Table 4-7 Connectorized ODU physical specifications

Category	Specification
Dimensions	Width 309 mm (12.2 in), Height 309 mm (12.2 in), Depth 105 mm (4.01 in)
Weight	4.7 Kg (10.4 lbs) including bracket

ODU environmental

The ODU conforms to the environmental specifications listed in Table 4-8.

Table 4-8 ODU environmental specifications

Category	Specification
Temperature	-40°C (40°F) to +60°C (140°F)
Wind loading	150 mph (242 kph) maximum. See Wind loading on page 2-5 for a full description.
Humidity	100% condensing
Waterproofing	IP66
UV exposure	10 year operational life (UL746C test evidence)

Power supply unit specifications

This section contains specifications of the PoE power supply and PIDU that are supplied by Motorola for PTP 250 installations. These specifications apply to all PTP 250 product variants.

Power supply unit dimensions and weight

The power supply units conform to the physical specifications listed in Table 4-9.

Table 4-9 Power supply unit physical specifications

Category	PoE power supply	PIDU
Dimensions	88 mm x 51 mm x 166 mm (3.5 ins x 2 ins x 6.5 ins)	250 mm x 40 mm x 80 mm (9.75 ins x 1.5 ins x 3 ins)
Weight	0.35 Kg (0.77 lbs)	0.864 Kg (1.9 lbs)

Power supply unit environmental

The power supply units conform to the environmental specifications listed in Table 4-10.

Table 4-10 Power supply unit environmental specifications

Category	PoE power supply	PIDU
Operating temperature	0°C to 40°C (32°F to 104°F)	-40°C to +60°C (40°F to 140°F))
Storage temperature	-20°C to 70°C (-4°F to 158°F)	
Operating humidity	Maximum 90%	Maximum 95% non-condensing
Storage humidity	Maximum 95%	
Operating altitude	-305 m to 3048 m (-1000 ft to 10,000 ft)	
Waterproofing	Not waterproof	Not waterproof

Power supply unit electrical

The power supply units conform to the electrical specifications listed in Table 4-11.

Table 4-11 Power supply unit electrical specifications

Category	PoE power supply	PIDU
AC input voltage	100 to 240 V AC	90 to 264 V AC
AC input current	0.8A @ 110 to 220 V AC	
AC frequency	50 to 60 Hz	47 to 60 Hz
Alternative DC Input	None.	37 to 60 V DC

The PoE power supply conforms to the Ethernet interface specifications listed in Table 4-12.

Table 4-12 PoE power supply Ethernet interface specifications

Category	PoE power supply
Input (Data In)	Ethernet 10/100/1000 Base-T (RJ-45 female socket)
Output (Data & Power Out)	Ethernet 10/100/1000 Base-T, plus 55 V DC (nominal)
	RJ-45 female socket, with DC voltage on pairs 7-8 (-) and 4-5 (+)
	User Port Power: 30 Watts Max

Antenna specifications

This section contains specifications of the antennas that are approved by the FCC for use with the connectorized ODUs.

Antenna selection criteria

The main selection criterion is the required antenna gain. The secondary criterion is the ease of mounting and alignment. For example, the Radio Waves Parabolic dishes are supplied with a mount that allows adjustment for alignment independent of the actual antenna mounting. This type of antenna is much easier to align than those that have to be rotated around the mounting pole for alignment.

Non-FCC regions

In non-FCC regions, antenna choice is not restricted, but any region specific EIRP limit must be obeyed by reducing the maximum transmit power, see Calculating EIRP for connectorized units on page 4-30.

FCC regions

In FCC regions, antenna choice is restricted as described in 5.8 GHz FCC antenna restrictions on page 4-15.

The maximum permitted antenna gain depends upon product variant and channel width, as specified in Calculating EIRP for connectorized units on page 4-30.

5.8 GHz FCC antenna restrictions

In FCC regions in the 5.8 GHz band, external antennas from the lists in Table 4-13 can be used with the Connectorized version of the PTP 250. 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 37.6 dBi per polarization or antenna.

In FCC regions when using external antennas, cable loss between the connectorized ODU 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 250 in the 5.8 GHz band. The required antenna impedance is 50 ohms.

Table 4-13 Allowed antennas for deployment in USA/Canada – 5.8 GHz

Manufacturer	Antenna Type	Gain (dBi)	Parabolic Dish
Andrew	Andrew 2-foot Parabolic, P2F-52 (29.4 dBi)	29.4	Y
Andrew	Andrew 2-foot Dual-Pol Parabolic, PX2F-52 (29.4 dBi)	29.4	Y
Andrew	Andrew 3-foot Parabolic, P3F-52 (33.4 dBi)	33.4	Y
Andrew	Andrew 3-foot Dual-Pol Parabolic, PX3F-52 (33.4 dBi)	33.4	Y
Andrew	Andrew 4-foot Parabolic, P4F-52 (34.9 dBi)	34.9	Y
Andrew	Andrew 4-foot Dual-Pol Parabolic, PX4F-52 (34.9 dBi)	34.9	Y
Andrew	Andrew 6-foot Parabolic, P6F-52 (37.6 dBi)	37.6	Y
Andrew	Andrew 6-foot Dual-Pol Parabolic, PX6F-52 (37.6 dBi)	37.6	Y

Manufacturer	Antenna Type	Gain (dBi)	Parabolic Dish
Gabriel	Gabriel 2-foot High Performance QuickFire Parabolic, HQF2-52-N	28.2	Y
Gabriel	Gabriel 4-foot High Performance QuickFire Parabolic, HQF4-52-N	34.4	Y
Gabriel	Gabriel 6-foot High Performance QuickFire Parabolic, HQF6-52-N	37.4	Y
Gabriel	Gabriel 2-foot High Performance Dual QuickFire Parabolic, HQFD2-52-N	28.1	Y
Gabriel	Gabriel 4-foot High Performance Dual QuickFire Parabolic, HQFD4-52-N	34.3	Y
Gabriel	Gabriel 6-foot High Performance Dual QuickFire Parabolic, HQFD6-52-N	37.3	Y
Gabriel	Gabriel 2-foot Standard QuickFire Parabolic, QF2-52-N	28.5	Y
Gabriel	Gabriel 2-foot Standard QuickFire Parabolic, QF2-52-N-RK	28.5	Y
Gabriel	Gabriel 2.5-foot Standard QuickFire Parabolic, QF2.5-52-N	31.2	Y
Gabriel	Gabriel 4-foot Standard QuickFire Parabolic, QF4-52-N	34.8	Y
Gabriel	Gabriel 4-foot Standard QuickFire Parabolic, QF4-52-N-RK	34.8	Y
Gabriel	Gabriel 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

Manufacturer	Antenna Type	Gain (dBi)	Parabolic Dish
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 (28.1 dBi)	28.1	Y
RadioWaves	Radio Waves 2-foot Parabolic, SP2-5.2 (29.0 dBi)	29	Y
RadioWaves	Radio Waves 3-foot Dual-Pol Parabolic, SPD3-5.2 (31.1 dBi)	31.1	Y
RadioWaves	Radio Waves 3-foot Parabolic, SP3-5.2 (31.4 dBi)	31.4	Y
RadioWaves	Radio Waves 4-foot Dual-Pol Parabolic, SPD4-5.2 (34.4 dBi)	34.4	Y
RadioWaves	Radio Waves 4-foot Parabolic, SP4-5.2 (34.8 dBi)	34.8	Y
RadioWaves	Radio Waves 6-foot Dual-Pol Parabolic, SPD6-5.2 (37.5 dBi)	37.5	Y
RadioWaves	Radio Waves 2-foot Parabolic, SP2-2/5 (28.3 dBi)	28.3	Y
RadioWaves	Radio Waves 3-foot Parabolic, SP3-2/5 (31.4 dBi)	31.4	Y
RadioWaves	Radio Waves 4-foot Parabolic, SP4-2/5 (34.6 dBi)	34.6	Y
RFS	RFS 2-foot Parabolic, SPF2-52AN or SPFX2-52AN (27.9 dBi)	27.9	Y
RFS	RFS 3-foot Parabolic, SPF3-52AN or SPFX3-52AN(31.4 dBi)	31.4	Y
RFS	RFS 4-foot Parabolic, SPF4-52AN or SPFX4-52AN(33.9 dBi)	33.9	Y
RFS	RFS 6-foot Parabolic, SPF6-52AN or SPFX6-52AN (37.4 dBi)	37.4	Y

Manufacturer	Antenna Type	Gain (dBi)	Parabolic Dish
RFS	RFS 2-foot HP Parabolic, SDF2-52AN or SDFX2-52AN (31.4 dBi)	31.4	Y
RFS	RFS 4-foot HP Parabolic, SDF4-52AN or SDFX4-52AN (33.9 dBi)	33.9	Y
RFS	RFS 6-foot HP Parabolic, SDF6-52AN or SDFX6-52AN (37.4 dBi)	37.4	Y
StellaDoradus	StellaDoradus 45 inch Parabolic Antenna, 58PSD113	33.8	Y

Wireless specifications

This section contains specifications of the PTP 250 wireless interface. These specifications include RF bands, channel width and link loss.

General wireless specifications

Table 4-14 contains radio system specifications for the 5.4 GHz band. Table 4-15 contains radio system specifications for the 5.8 GHz band.

Table 4-14 5.4 GHz 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.
Dynamic frequency control	Initially 10-15 sec. Out of service on interference 100 ms.
Channel width	20 MHz and 40 MHz
Manual power control	Maximum power can be controlled lower than the power limits in order to control interference to other users.
Receiver noise figure	Typically 6 dB
Integrated antenna type	Integrated flat plate antenna; gain 23dBi
External antenna gain	See Calculating EIRP for connectorized units on page 4-30.
Antenna beamwidth	8 Degrees
Max path loss	150 dB (20 MHz channel, integrated antenna)
Range (optical line-of-sight)	27 km (17 miles) at channel width 20 MHz 54 km (34 miles) at channel width 40 MHz
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

Table 4-15 5.8 GHz 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.
Dynamic frequency control	Initial capture 10-15 sec. Out of service on interference 100 ms.
Channel width	20 MHz and 40 MHz
Manual power control	Maximum power can be controlled lower than the power limits in order to control interference to other users.
Receiver noise figure	Typically 6 dB
Antenna type (integrated)	Flat plate antenna; gain 23 dBi
Antenna type (external)	See Antenna specifications on page 4-14.
Antenna beamwidth (integrated)	8 degrees
Max path loss	150 dB (20 MHz channel, integrated antenna)
Range (optical line-of-sight)	27 km (17 miles) at channel width 20 MHz 54 km (34 miles) at channel width 40 MHz
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

Data network specifications

This section contains specifications of the PTP 250 Ethernet interface.

Ethernet interfaces

The PTP 250 Ethernet ports conform to the specifications listed in Table 4-16.

Table 4-16 Ethernet bridging specifications

Ethernet bridging	Specification
Protocol	IEEE802.1 compatible
Interface	1000BaseT (RJ-45), supports MDI/MDIX auto-crossover
Maximum Ethernet data rate	220 Mbps
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.

Compliance with safety standards

This section lists the safety specifications against which the PTP 250 has been tested and certified. It also describes how to keep RF exposure within safe limits.

Electrical safety compliance

The PTP 250 hardware has been tested for compliance to the electrical safety specifications listed in Table 4-17.

Table 4-17 Safety compliance specifications

Region	Specification
USA	UL60950-1, Second Edition
Canada	CSA C22.2 No 60950-1, Second Edition
International	CB Certified to IEC60950-1:2005 (Second Edition) and EN60950-1:2006

Electromagnetic compatibility (EMC) compliance

The PTP 250 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 250 have been tested to ensure immunity to 15 kV air and 8 kV contact.

Table 4-18 lists the EMC specification type approvals that have been granted for the PTP 250.

Table 4-18 EMC emissions compliance

Region	Specification (Type Approvals)
USA	FCC Part 15 Class B
Canada	RSS Gen and RSS 210
Europe	EN55022 CISPR 22 and EN301 489-1/4

Human exposure to radio frequency 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-limites_e.html and Safety Code 6.
- EN 50383:2002 Basic standard for the calculation and measurement of electromagnetic field strength and SAR related to human exposure from radio base stations and fixed terminal stations for wireless telecommunication systems (110 MHz - 40 GHz).
- 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 250 families 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 Human exposure to radio frequency energy on page 4-23) is **10 W/m²** for RF energy in the 5.4 GHz and 5.8 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:

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

Where:	Is:
S	power density in W/m^2
P	maximum average transmit power capability of the radio, in W
G	total Tx gain as a factor, converted from dB
d	distance from point source, in m.

Rearranging terms to solve for distance yields:

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

Calculated distances and power compliance margins

Table 4-19 shows calculated minimum separation distances, 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.

Explanation of terms used in Table 4-19:

Tx burst – maximum average transmit power in burst (Watt)

P – maximum average transmit power capability of the radio (Watt)

G – total transmit gain as a factor, converted from dB

S – power density (W/m^2)

d – minimum distance from point source (meters)

R – recommended distances (meters)

Table 4-19 Power compliance margins

Band	Antenna	Tx Burst (W)	P (W)	G	S (W/m^2)	d (m)	R (m)
5.4 GHz	Integrated	0.0050	0.0050	200	10	0.089	1
	Max gain connectorized	0.0025	0.0025	398	10	0.089	1
ETSI 5.8 GHz	Integrated	0.0200	0.0200	200	10	0.178	1
	Max gain connectorized	0.0025	0.0025	1585	10	0.178	1
FCC 5.8 GHz	Integrated	0.1585	0.1585	200	10	0.502	2
	Max gain connectorized	0.1585	0.1585	5012	10	2.514	5

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.

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.

Compliance with radio regulations

This section describes how the PTP 250 complies with the radio regulations that are in force in various countries.

⚠ CAUTION

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

Regulatory constraints on radio operation

The Radio Regulations of various countries' 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.

Contact your supplier/installer to ensure that your product is configured to fulfill all the local regulatory requirements, especially if you are intending to use a link with external antennas.

Type approvals

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 250 (with external antennas), ensure that regulatory requirements are met for the installation, as described in Calculating EIRP for connectorized units on page 4-30.

Table 4-20 lists the radio specification type approvals that have been granted for PTP 250.

Table 4-20 Radio certifications

Band	Region	Specification (Type Approvals)
5.4 GHz	Europe	EN301 893 V1.5.1
5.8 GHz	USA	FCC Part 15.247
	CANADA	RSS 210 Issue 7, Annex 8
	UK	IR 2007
	Eire	ComReg 06/47R
	Germany	Order No 47/2007
	EU	EN302 502 v 1.2.1
	Spain	CNAF-2010-BOE
	Norway	REG 2009-06-02 no. 580
	Denmark	Danish radio interface 00 007

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.

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.

NOTE

Notwithstanding that Motorola has designed (and qualified) the PTP 250 products to generally meet the Class B requirement to minimize the potential for interference, the PTP 250 product ranges are not marketed for use in a residential environment.

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 PoE power supply into a power outlet on a circuit different from that to which the receiver is connected.
- Consult your installer or supplier for help.

Maximum permitted EIRP

In most countries, operation of products in the band 5470 MHz to 5725 MHz is constrained by an EIRP limit. The constraint is that the EIRP must not exceed 30 dBm or (17 + 10 x Log Channel width) dBm.

In some countries, operation of products in the band 5725 MHz to 5875 MHz is constrained by an EIRP limit. The constraint is that the EIRP must not exceed 36 dBm or (23 + 10 x Log Channel width) dBm.

For examples of countries that impose an EIRP limit, refer to Table 4-23.

Calculating EIRP for connectorized units

When operating with external antennas in countries that impose an EIRP limit, the administrator has to set the maximum transmit power to ensure that EIRP does not exceed the limit allowed by regulations.

To calculate the maximum EIRP that the unit can output, use this formula:

Maximum EIRP (dBm) =

Maximum Power Level (dBm) + Antenna Gain (dBi) – Cable Loss (dB)

To calculate the highest permissible setting of Maximum Power Level, use this formula:

Maximum Power Level (dBm) =

Allowed EIRP (dBm) – Antenna Gain (dBi) + Cable Loss (dB)

Where:	Is:
Maximum Power Level (dBm)	the highest permissible setting of the Maximum Power Level attribute in the Step 2: Wireless Configuration page
Allowed EIRP (dBm)	the EIRP limit allowed by the regulations
Antenna Gain (dBi)	Antenna Gain as set in the Step 2: Wireless Configuration page
Cable Loss (dB)	Cable Loss as set in the Step 2: Wireless Configuration page

NOTE

Choose an antenna and RF cable that will not cause the PTP 250 to exceed Allowed EIRP. As PTP 250 does not support Maximum Power Level settings below 4 dBm, the maximum antenna gain (allowing for cable loss) is limited as follows (examples in Table 4-21):

Maximum Antenna Gain (dBi) – Cable Loss (dB) = Allowed EIRP (dBm) – 4

Table 4-21 Maximum permitted antenna gain (allowing for cable loss)

Allowed EIRP	Maximum (Antenna Gain - Cable Loss)
30 dBm	26 dBi
36 dBm	32 dBi

Calculating RF cable loss (FCC only)

The FCC approval for the product is based on tests with a cable loss between the ODU and antenna of not less than 1.2 dB at 5.8 GHz. If cable loss was below 1.2 dB, the connectorized PTP 250 would exceed the maximum EIRP allowed under FCC 5.8 GHz rules.

Cable loss depends mainly upon cable type and length. To meet or exceed the minimum loss of 1.2 dB, use cables of the type and length specified in Table 4-22 (source: Times Microwave). This data excludes connector losses.

Table 4-22 RF cable lengths required to achieve 1.2 dB loss at 5.8 GHz

RF cable type	Minimum cable length
LMR100	0.6 m (1.9 ft)
LMR200	1.4 m (4.6 ft)
LMR300	2.2 m (7.3 ft)
LMR400	3.4 m (11.1 ft)
LMR600	5.0 m (16.5 ft)

Examples of regulatory limits

Each country imposes specific limits on the frequencies, channel widths and maximum transmit power that may be used by wireless equipment. When a new PTP 250 unit is first accessed via the web interface, the user is required to select the Country Code from a list. The PTP 250 firmware does not allow the unit to be configured to operate outside the regulatory limits that apply to the selected country.

⚠ CAUTION

It is the responsibility of the user to ensure that the PTP product is operated in accordance with local regulatory limits.

Table 4-23 contains examples of the regulatory limits that apply in typical countries of operation.

Table 4-23 Example of regulatory limits

Country	Band	Permitted frequencies	Radar avoidance (DFS) required?	Maximum transmit power
UK	5.4 GHz	5470 - 5600 MHz 5650 - 5725 MHz	Yes	30 dBm EIRP
USA	5.8 GHz	5725 - 5825 MHz	No	30 dBm
Denmark	5.8 GHz	5725 - 5795 MHz 5815 - 5875 MHz	Yes	36 dBm EIRP

The PTP 250 may be constrained to operate within narrower frequency limits than those specified in the regulations for certain countries.

Notifications

The PTP 250 5.4 GHz variant complies with the radio regulations that are in force in Europe. The PTP 250 5.8 GHz variant complies with the radio regulations that are in force in the USA, Canada and Europe. The relevant notifications are specified in this section.

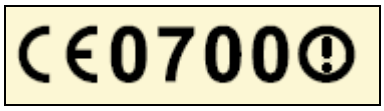
5.4 GHz European Union notification

The products are two-way radio transceivers suitable for use in Broadband Wireless Access System (WAS), Radio Local Area Network (RLAN), or Fixed Wireless Access (FWA) systems operating in the 5.4 GHz band. They are Class 1 devices and use operating frequencies that are harmonized throughout the EU member states. The operator is responsible for obtaining any national licenses required to operate these products and these must be obtained before using the products in any particular country.

Hereby, Motorola Solutions, Inc. declares that the 5.4 GHz products comply with the essential requirements and other relevant provisions of Directive 1999/5/EC. The declaration of conformity may be consulted at http://www.motorola.com/ptp/support.

The European R&TTE directive 1999/5/EC Certification Number is reproduced on the product label (Figure 4-1).

Figure 4-1 European Union certification on 5.4 GHz product label



5.8 GHz 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).

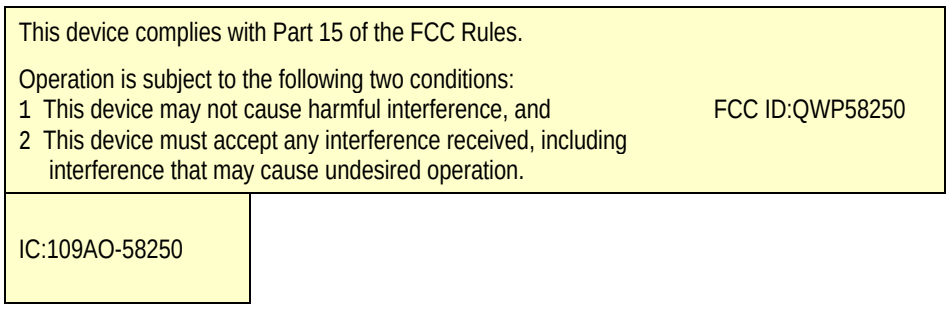
For the connectorized version of the product and in order to reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the Effective Isotropically Radiated Power (EIRP) is not more than that permitted for successful communication.

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 reproduced on the product label (Figure 4-2).

Figure 4-2 FCC and IC certifications on 5.8 GHz product label



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.

5.8 GHz European Union notification

PTP 250 units operating in the 5.8 GHz band are Class 2 devices as they operate on frequencies that are not harmonized across the EU. Currently, only Denmark, Germany, Eire (IRL), Norway, Spain and the UK allow the products to operate in the 5.8 GHz band. However, the regulatory situation in Europe is changing and the radio spectrum may become available in other countries in future. See www.ero.dk for further information. The operator is responsible for obtaining any national licenses required to operate these products and these must be obtained before using the products in any particular country.

NOTE

Norway regulation is FOR2007-04-20 Nr 439 regarding border PFD limit.

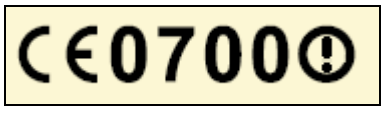
CAUTION

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.

Hereby, Motorola Solutions, Inc. declares that the PTP 250 products comply with the essential requirements and other relevant provisions of Directive 1999/5/EC. The declaration of conformity may be consulted at http://www.motorola.com/ptp/support.

The European R&TTE directive 1999/5/EC Certification Number is reproduced on the product label (Figure 4-3).

Figure 4-3 European Union certification on 5.8 GHz product label



The PTP 250 connectorized products have been notified for operation in those EU countries that allow 5.8 GHz operation.

Chapter 5 Installation

This chapter describes how to install the PTP 250 hardware,

To install the equipment at each PTP 250 link end, perform these tasks:

- Preparing for installation on page 5-2 describes the checks to be performed before proceeding with the installation.
- Installing the ODU on page 5-5 describes how to install the ODU (integrated or connectorized) on the supporting structure.
- Installing connectorized antennas on page 5-9 describes how to install separate antenna(s) (only required for connectorized ODUs).
- Installing the drop cable and LPU on page 5-14 describes how to install the drop cable from the ODU to the LPU and PoE power supply, and to provide grounding for the installation.
- Installing the PoE power supply on page 5-27 describes how to install the PoE power supply and connect it to the ODU and network cables.

Preparing for installation

This section describes the checks to be performed before proceeding with site hardware installation.

Use the installation report to determine which installation options are required. Refer to PTP LINKPlanner on page 2-8.

Unit pre-configuration

It is common practice to pre-configure the units during staging before site installation by performing the following tasks from Chapter 6 Configuration and alignment:

- Connecting to the unit on page 6-3
- Upgrading firmware version on page 6-10
- Using the installation wizard on page 6-14

If the units are to be pre-configured during staging, the safety precautions below MUST be observed.

Safety precautions

All national and local safety standards must be followed while developing a site, installing equipment, or performing maintenance.

⚠ WARNING

Ensure that personnel are not exposed to unsafe levels of RF energy. The units start to radiate as soon as they are powered up. Respect the safety standards defined in Compliance with safety standards on page 4-22, in particular the minimum separation distances. Observe the following guidelines:

- Never work in front of the antenna when the ODU is powered.
- Always power down the PoE power supply when connecting and disconnecting the drop cable from either the PoE power supply or ODU.

Protection requirements

⚠ CAUTION

The installation must meet the requirements defined in Grounding and lightning protection on page 2-11.

⚠ CAUTION

Apply the practices and procedures detailed in manual *R56 Standards And Guidelines For Communication Sites* to all new site build activities. This manual is available for download at www.motorola.com/ptp/software.

Preparing personnel

IN NO EVENT SHALL MOTOROLA SOLUTIONS, INC. BE LIABLE FOR ANY INJURY TO ANY PERSONS OR ANY DAMAGE CAUSED DURING THE INSTALLATION OF THE MOTOROLA PTP 250.

Ensure that only qualified personnel undertake the installation of a PTP 250 link.

Ensure that all safety precautions can be observed.

Preparing inventory

Perform the following inventory checks:

- Check that an installation report is available and that it is based on the principles described in Chapter 2 Planning considerations.
- Check that the correct components are available, as described in Installation inventories on page 4-2.
- Check the contents of all packages against their packing lists.

Preparing tools

Check that following specific tools are available, in addition to general tools:

- 13mm wrench and 22 mm wrench for use with the glands.
- RJ45 crimp tool (it must be the correct tool for the type of RJ45 being used).
- Personal Computer (PC) with 1000BaseT Ethernet.
- Web browser (for example Internet Explorer 7, Internet Explorer 8, Firefox 3 or Firefox 3.5).
- Ethernet patch cables.

Installing the ODU

Perform this task to install the ODU (integrated or connectorized) on the supporting structure.

This task consists of the following procedures:

- Checks and safety precautions on page 5-5
- Selecting a position for the ODU (connectorized) on page 5-7
- Mounting the ODU on page 5-7

If a connectorized ODU is being installed, see also:

- Installing connectorized antennas on page 5-9

Checks and safety precautions

⚠ WARNING

To prevent failure of the assembly, do not remove the mounting bracket, and do not mount the ODU on a pole that is too narrow or too wide.

⚠ WARNING

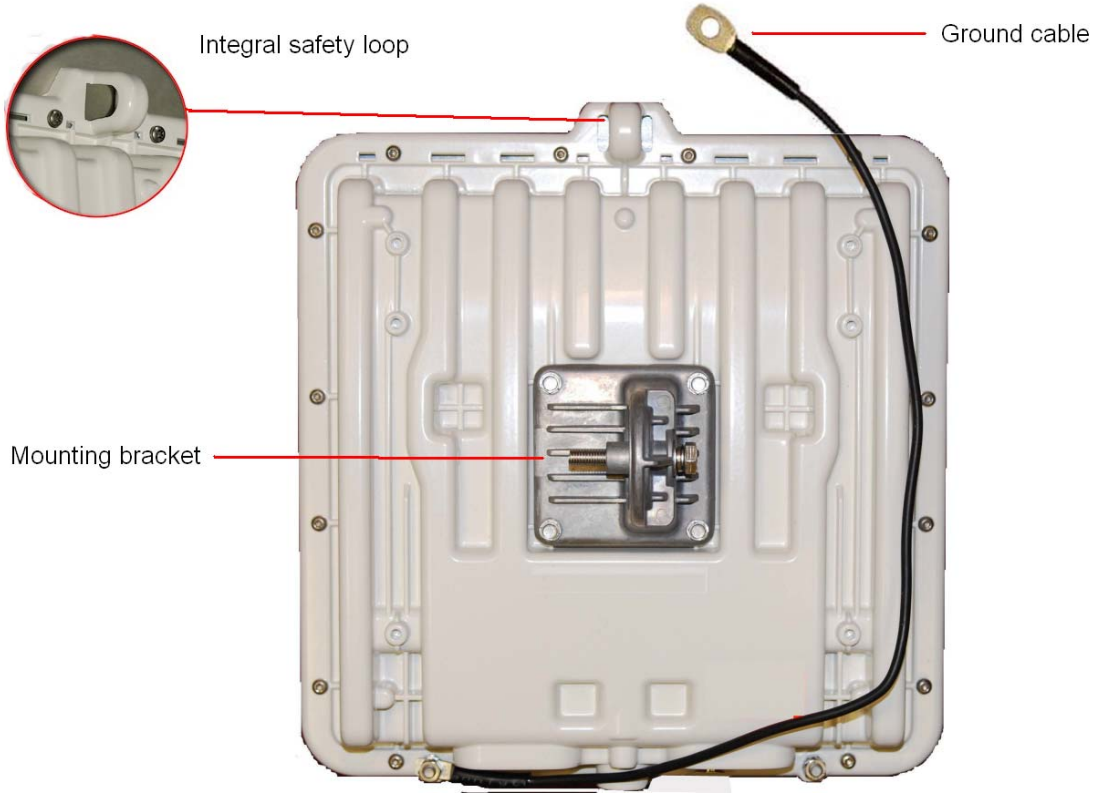
To minimize the risk of injury, do not attempt to hoist the ODU until the necessary precautions have been taken.

⚠ WARNING

To prevent failure of the assembly, do not over-tighten the bolts.

Check that the ODU is pre-fitted with a mounting bracket (designed to ease installation) and with a ground cable (Figure 5-1).

Figure 5-1 Checking the ODU before mounting



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

Before hoisting the ODU, take the following precautions:

- Check that the safety loop (Figure 5-1) and its fixing are not damaged in any way and have not been exposed to a shock loading due to a fall.
- Check that the safety lanyard does not exceed 1m (approx 3 ft) in length.
- Check that the safety lanyard is made from a material that does not degrade in an outdoor environment.
- Check that the safety lanyard is fixed to a separate point that is not part of the direct mounting system for the ODU.

Selecting a position for the ODU (connectorized)

If the ODU is connectorized, select a mounting position that gives it maximum protection from the elements, but still allows easy access for connecting and weatherproofing the cables. To minimize cable losses, select a position where the antenna cable lengths can be minimized.

Mounting the ODU

To mount the ODU, proceed as follows:

1	Attach the ODU bracket strap to the pole using M8 x 70 mm bolts, M8 flat washers and M8 coil washers.  Tighten to ensure the assembly grips, but can be adjusted on the pole.
2	Use the integral safety loop (Figure 5-1) to hoist the ODU up to the bracket, observing the precautions described in Checks and safety precautions on page 5-5.
3	When the ODU is in position, use the safety loop as a fixing point to secure a permanent safety lanyard from the supporting structure to the ODU, as a precaution against mounting failure.

4	Offer the ODU (with pre-fitted mounting bracket) to the bracket strap and affix using the captive M8 bolt. Tighten to ensure the assembly grips, but can be adjusted on the pole. 
5	Adjust the elevation and azimuth of the unit to achieve an approximate visual alignment (does not apply to connectorized ODUs). Tighten both bolts to the required torque settings of 14 Nm (11 lb ft).
6	Connect the ODU ground cable to the to the supporting structure grounding point, within 0.3 meters (1 ft) of the ODU bracket and on the same metal (if necessary, remove paint and apply anti-oxidant compound first). **⚠ CAUTION** Do not attach grounding cables to the ODU mounting bracket bolts, as this arrangement will not provide full protection.
7	To prevent corrosion and possible loss of ground continuity, weatherproof the grounding point.

Installing connectorized antennas

If the ODU is connectorized, perform this task to install separate antenna(s).

Preparing for connectorized installations

Before proceeding with the installation, perform the following checks:

- Check that the correct components are available, as described in Installation inventories on page 4-2.
- Check that the selected antenna conforms to the applicable regulatory restrictions, as described in Antenna specifications on page 4-14 and Compliance with radio regulations on page 4-27.
- Check that the correct tools are available. The tools required for mounting the antennas are specific to the antenna chosen. Refer to the antenna manufacturer's instructions.

Mounting and connecting antennas

To mount and connect the antenna(s), proceed as follows:

1	Mount the antenna(s) according to manufacturer's instructions. When using separate antennas to achieve spatial diversity, mount one with Horizontal polarization and the other with Vertical polarization.
2	Connect the ODU to the antenna with cables of type LMR100, LMR200, LMR300, LMR400 or LMR600. Connect the ODU 'V' interface to the vertical polarization antenna and connect the ODU 'H interface to the horizontal polarization antenna (Figure 1-5). **NOTE** When using separate antennas to achieve spatial diversity, the antenna cables will be disconnected from the ODU during the alignment procedure. Therefore, do not weatherproof the ODU joints until antenna alignment is complete.
3	Where the ODU is mounted indoors, install lightning arrestors at the building entry point (Figure 5-2). Assemble the Polyphaser LSXL-ME or LSXL as shown in Figure 5-3. Connect the lighting arrestors to the master ground bar of the building.

4	When dressing the antenna cables, form drip loops near the lower ends (Figure 5-4). These ensure that water is not constantly channeled towards the connectors.
5	If the ODU is mounted outdoors, weatherproof the ODU joints using self-amalgamating tape under a layer of PVC tape (Figure 5-5). Weatherproof the antenna joints in the same way (unless the antenna manufacturer specifies a different method).
6	Ground the antenna cables to the supporting structure at the correct points (Figure 5-6). They should be grounded within 0.3 meters (1 foot) of the ODU and antennas using the using the cable grounding kit (part number 01010419001). **NOTE** A mast or tower may require additional grounding points, as specified in Protection requirements for a mast or tower installation on page 2-14.
7	Dress the antenna cables and fix them using cable ties, cleats or PVC tape. **CAUTION** Ensure that no undue strain is placed on the ODU or antenna connectors. Ensure that the cables do not flap in the wind, as flapping cables are prone to damage and induce unwanted vibrations in the supporting structure.

Figure 5-2 Lightning arrestor mounting

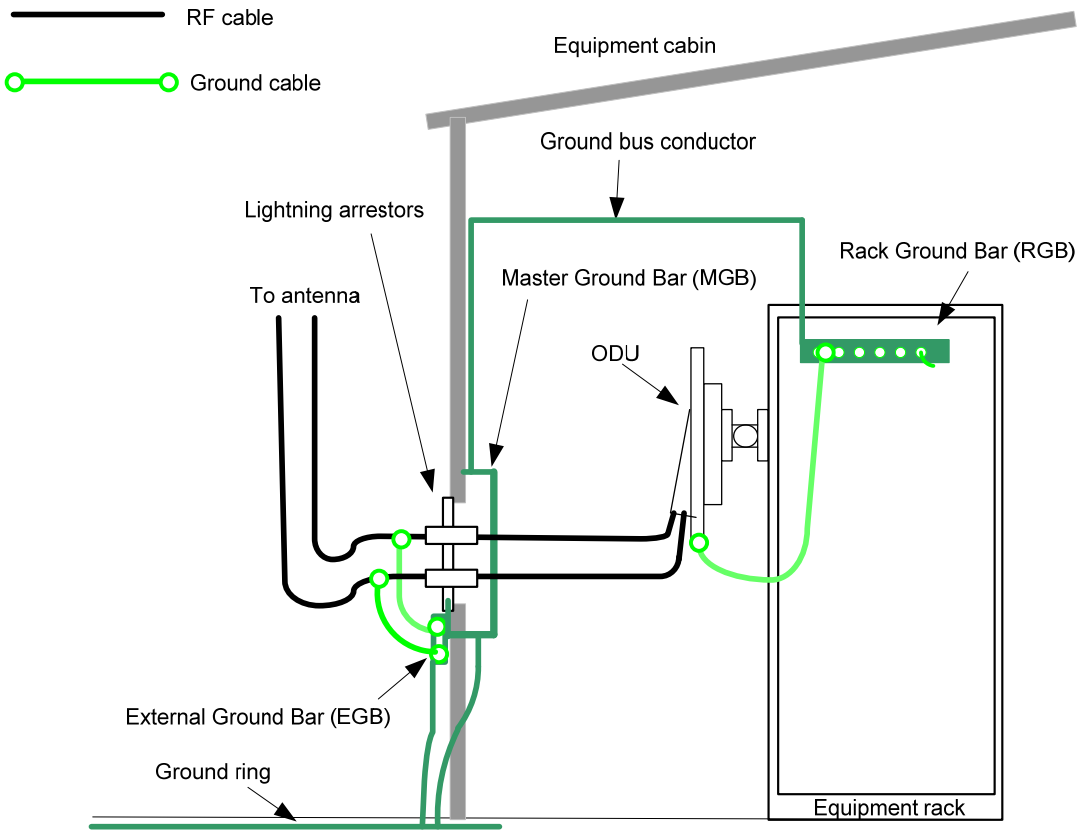


Figure 5-3 Polyphaser assembly

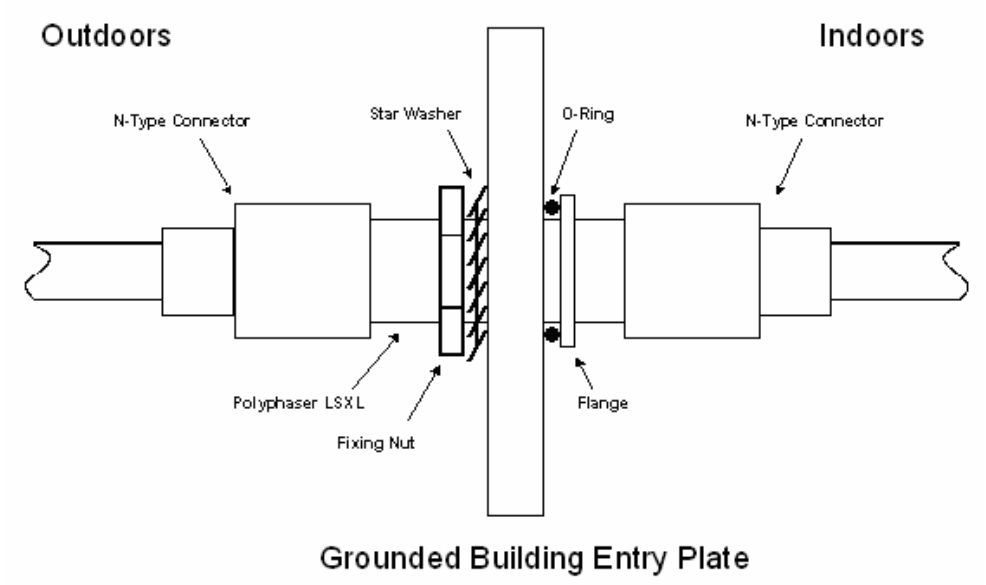


Figure 5-4 Forming a drip loop

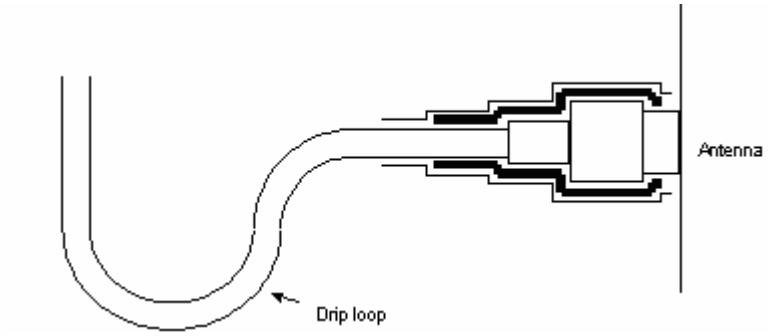


Figure 5-5 Weatherproofing the antenna connections

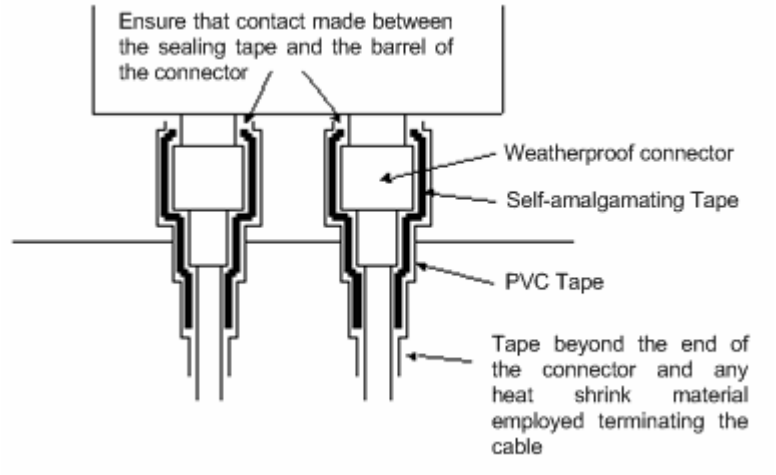
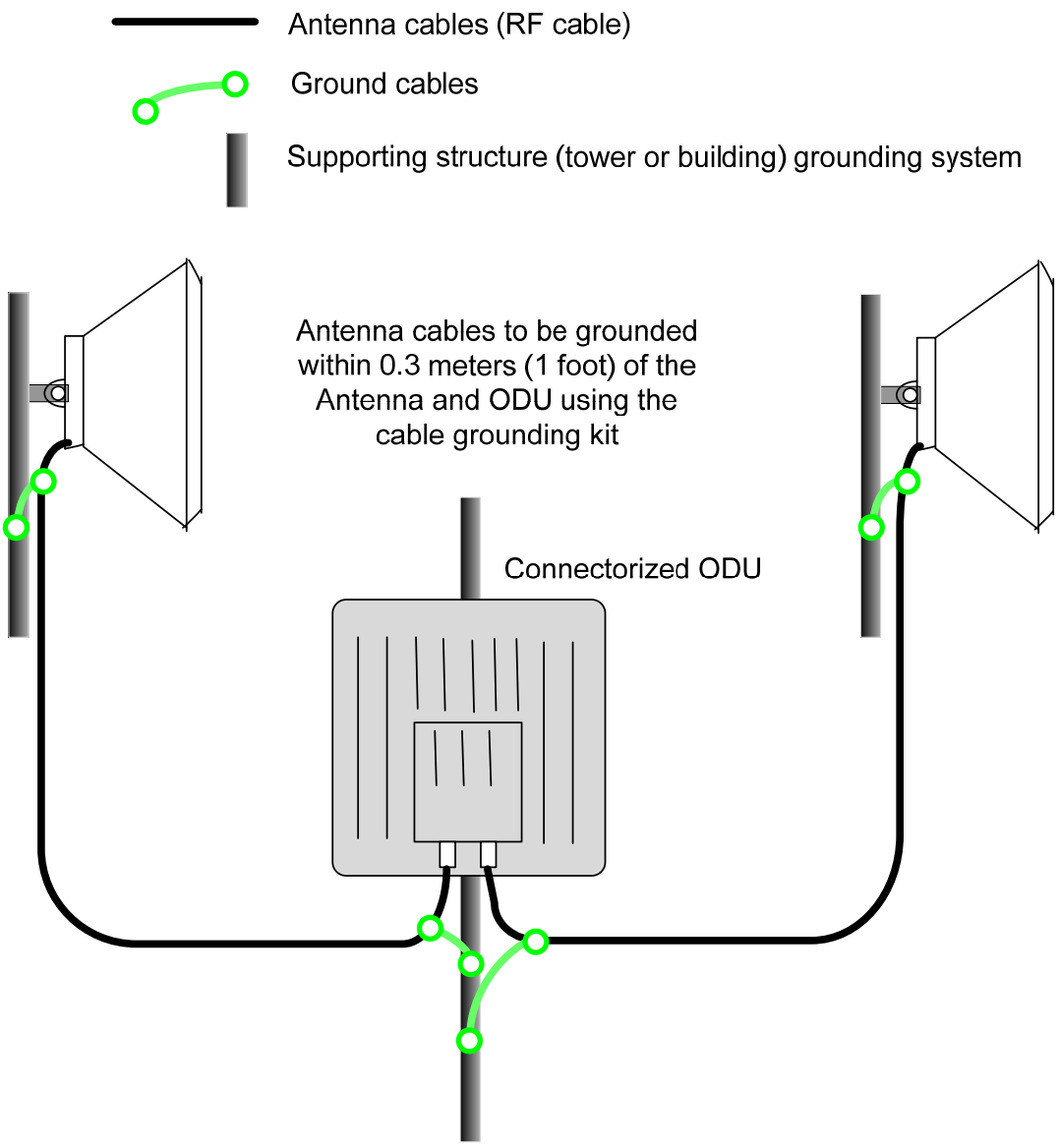


Figure 5-6 Grounding points for antenna cables



Installing the drop cable and LPU

Perform this task to install the drop cable from the ODU to the PoE power supply, and to provide grounding and lightning protection for the installation.

This task consists of the following procedures:

⚠ CAUTION

The drop cable and ground cable installation must meet the requirements defined in Grounding and lightning protection on page 2-11.

⚠ CAUTION

To provide effective protection against lightning induced surges, grounding cables must be installed without drip loops and pointing down towards the ground.

⚠ CAUTION

To avoid damage to the installation, do not connect or disconnect the drop cable when power is applied to the PoE power supply.

Preparing drop cables

Perform this task to prepare the CAT5e cables that connect the ODU to the PoE power supply.

⚠ CAUTION

Always use Cat5e cable that is gel-filled and shielded with copper-plated steel. Alternative types of cable are not supported by Motorola.

NOTE

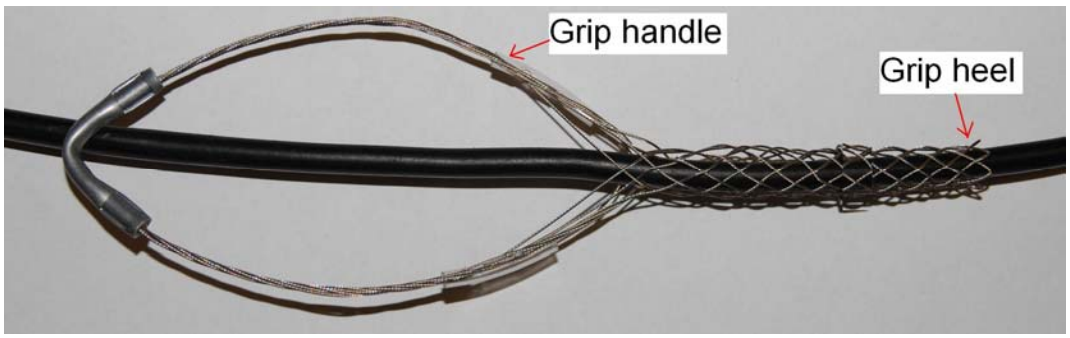
The maximum permitted lengths of CAT5e cables are specified in Maximum cable lengths on page 2-5.

For details of supported cables and recommended connectors, refer to Installation inventories on page 4-2.

'Main' drop cable: To prepare a long section of cable to connect the ODU to the LPU, proceed as follows:

1	Cut off the approximate length required (allowing a bit of surplus), or leave it on the drum so that it can be unwound as the cable is hoisted.
2	Slide one or more hoisting grips onto to the top end of the main drop cable (Figure 5-7). To determine the number of hoisting grips required, consult the grip manufacturer.
3	Secure the hoisting grip to the cable using a special tool, as recommended by the manufacturer.
4	Fit an RJ45 connector and gland to the top end only, as described in Assembling an RJ45 connector and gland on page 5-16.

Figure 5-7 Typical hoisting grip on cable



'LPU-PoE' cable: To prepare a short section of cable to connect the LPU to the PoE power supply, proceed as follows:

1	Cut off the approximate length required (allowing a bit of surplus).
2	Fit an RJ45 connector and gland to the top end only, as described in Assembling an RJ45 connector and gland on page 5-16.

Assembling an RJ45 connector and gland

Perform this task to prepare the outdoor CAT5e cable with connectors and glands.

Safety precautions

⚠ WARNING

The metal screen of the drop cable is very sharp and may cause personal injury.

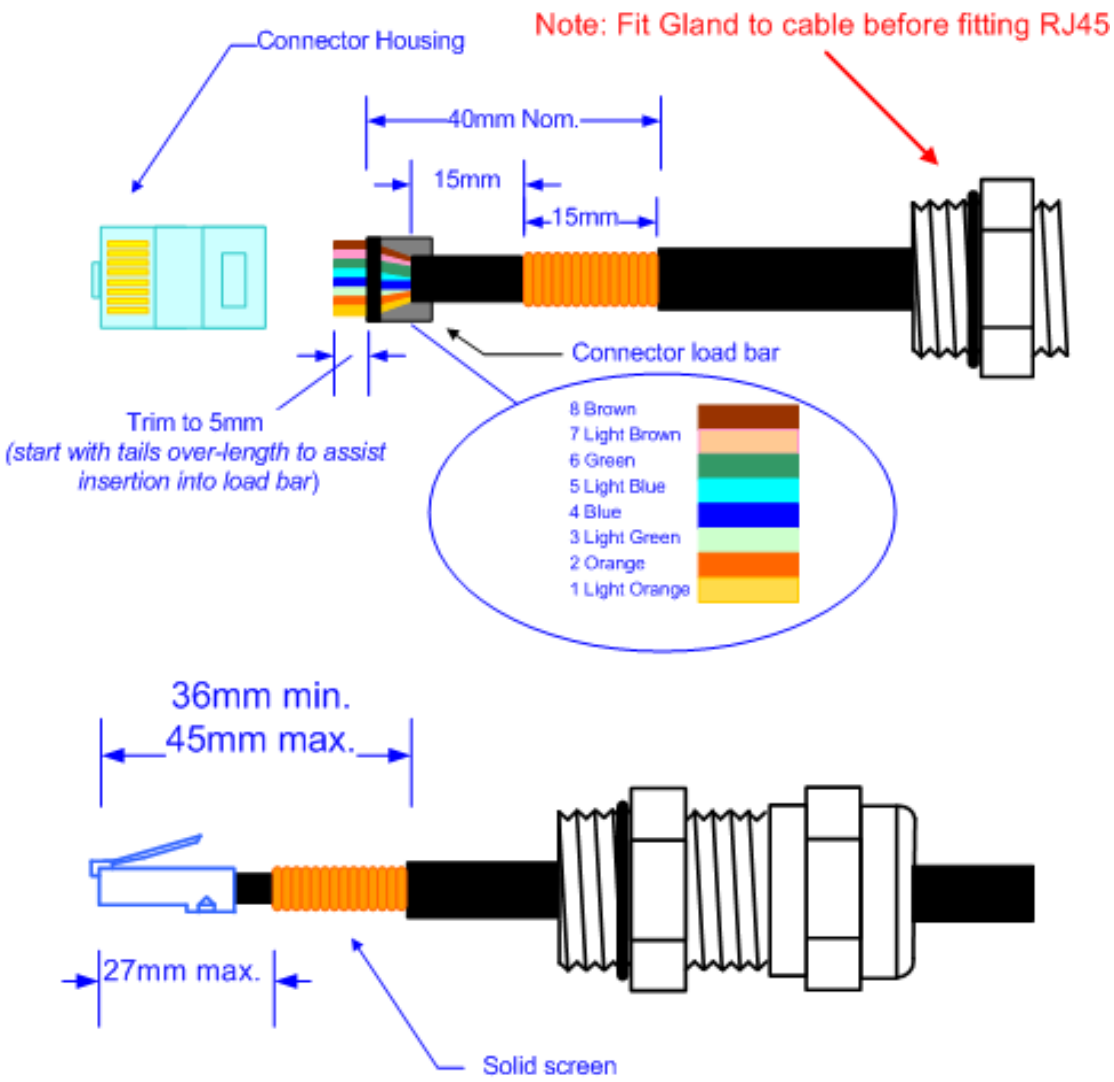
When preparing the drop cable, take the following safety precautions:

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

Assembly

Assemble the drop cable as shown in Figure 5-8. The gland is only required for outdoor connections at the ODU or LPU. The connection to the PoE power supply requires the RJ45 plug but no gland.

Figure 5-8 Correct cable preparation for drop cable of the supported type



⚠ CAUTION

Check that the crimp tool matches the RJ45 connector being used; otherwise the cable or connector may be damaged.

⚠ CAUTION

The cable inner sheath must be located correctly under the connector housing tang. If this is not done correctly, there is no strain relief on the cable terminations.

Figure 5-9 shows the end of a drop cable fitted with an RJ45 plug and a gland.

Figure 5-9 Drop cable with RJ45 and gland

Installing and grounding the main drop cable

Perform this procedure to install the main drop cable, connect it to the ODU, and ground it to the supporting structure.

To install and ground the main drop cable, proceed as follows:

1	Hoist the main drop cable up to the ODU using the hoisting grip and a hoist line. When the cable is in position and the grip handle is fastened to the supporting structure, remove the hoist line.
2	Connect the top end of the long drop cable to the ODU (PoE port), as described in Connecting an RJ45 and gland to a unit on page 5-19.
3	Lay the main drop cable as far as the building entry point, ensuring there is enough length to extend through the wall of the building to the LPU.
4	Attach the main drop cable to the supporting structure using cable ties or cleats.
5	Ground the drop cable to the supporting structure at the points shown in Figure 2-3 (mast or tower installation) or Figure 2-4 (wall installation), as described in Making a drop cable ground point on page 5-22. **NOTE** A mast or tower may require additional grounding points, as specified in Protection requirements for a mast or tower installation on page 2-14.

Connecting an RJ45 and gland to a unit

Perform this task to connect the drop cable to an ODU or LPU. This procedure contains illustrations of an ODU, but it applies in principle to both the ODU and the LPU.

To connect the drop cable with a gland to a unit (LPU or ODU), proceed as follows:

1 Insert the RJ45 plug into the socket in the unit, making sure that the locking tab snaps home.

2 Support the drop cable and gently hand screw the gland body into the unit until the O ring seal is flush to the unit body.

NOTE

Do not fit the back shell prior to securing the gland body.

3 Once the gland is fully hand screwed into the unit, tighten it with a spanner to torque 10 Nm (7.4 ftlbs).

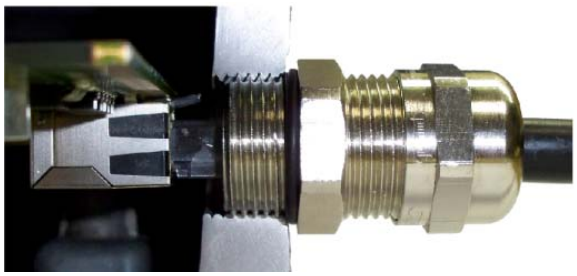
4	When the gland body has been fitted, tighten the gland back shell.  **⚠ CAUTION** Do not over-tighten the gland back shell, as the internal seal and structure may be damaged. Figure 5-10 shows correctly tightened and over-tightened gland back shells.

Figure 5-10 Correct and incorrect tightening of cable gland back shell

Disconnecting an RJ45 and gland from a unit

Perform this task to disconnect the drop cable from an ODU or LPU. This procedure contains illustrations of an ODU, but it applies in principle to both the ODU and the LPU.

To disconnect the drop cable with a gland from a unit (LPU or ODU), proceed as follows:

1	Remove the gland back shell.
2	Wiggle the drop cable to release the tension of the gland body.  When the tension in the glad body is released, a gap opens at the point shown in red in the above photograph.
3	Unscrew the gland body.
4	Use a small screwdriver to depress the RJ45 locking tab.
5	Unplug the RJ45.

Making a drop cable ground point

Perform this task to connect the screen of the drop cable to the metal of the supporting structure using a cable grounding kit.

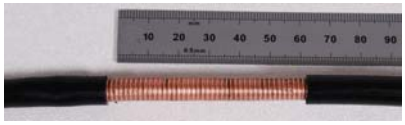
The cable grounding kit for 1/4” and 3/8” cable (Figure 1-8) contains the following components:

- 1 x grounding cable with grounding 2 hole lug fitted (M10)
- 1 x self Amalgamating tape
- 1 x PVC tape
- 3 x tie wraps
- 2 x bolt, washer and nut

⚠ CAUTION

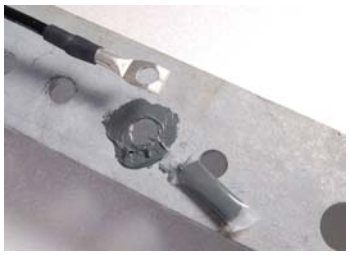
Ground cables must be installed without drip loops and pointing down towards the ground; otherwise they may not be effective.

To ground the drop cable to a metal structure using the Motorola grounding kit (part number 01010419001), proceed as follows:

1	Remove 60mm (2.5inches) of the drop cable outer jacket. 
2	Cut 38mm (1.5 inches) of rubber tape (self amalgamating) and fit to the ground cable lug. Wrap the tape completely around the lug and cable. 

3	Fold the ground wire strap around the drop cable screen. Fit cable ties and tighten with pliers. 
4	Cut the surplus from the cable ties. Cut a 38mm (1.5 inches) section of self-amalgamating tape and fit to the ground cable lug. Wrap the self-amalgamating tape completely around the lug and cable. 
5	Use the remainder of the self-amalgamating tape to wrap the complete assembly. Press the tape edges together so that there are no gaps. 

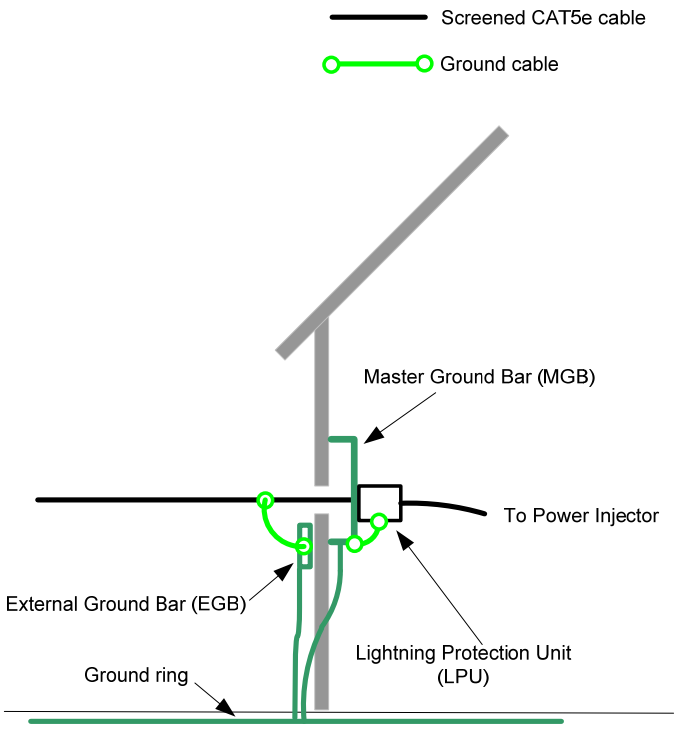
6	Wrap a layer of PVC tape, starting from 25mm (1 inch) above the outer jacket and finishing 25mm (1 inch) below the self-amalgamating tape, over lapping at half width. 
7	Repeat with a further four layers of PVC tape. Start the second layer 25mm (1 inch) above the first layer tape, start the third layer below the finish of the second layer. Continue until five layers have been applied, always over lapping at half width. 
8	If a single-hole tag is required at the mast end, modify the two-hole tag as shown. 

9	Prepare the metal grounding point of the supporting structure to provide a good electrical contact with the grounding cable: Remove paint, grease or dirt, if present. Apply the anti-oxidant compound liberally between the two metals. 

Installing and grounding the drop cable at building entry

Perform this procedure to install and ground the drop cable and LPU at the building (or cabinet) entry point (Figure 5-11).

Figure 5-11 Grounding at building entry



To run the drop cable into the building, proceed as follows:

1	Make an entry point into the building and run the main drop cable into the building.
2	Ground the drop cable to the external ground bar outside the building entry point, as described in Making a drop cable ground point on page 5-22.
3	Install the LPU inside the building, not more than 600 mm (24 in) from the building entry point. Mount the LPU with cable glands facing downwards.
4	Ground the LPU to the master ground bar.
5	Cut any surplus length from the bottom end of the main drop cable and fit an RJ45 connector and gland, as described in Assembling an RJ45 connector and gland on page 5-16.
6	Connect the main drop cable to the LPU, as described in Connecting an RJ45 and gland to a unit on page 5-19.
7	Connect the LPU-PoE cable to the other port of the LPU, as described in Connecting an RJ45 and gland to a unit on page 5-19.
8	Run the LPU-PoE cable to the location of the PoE power supply.

NOTE

If it is necessary to disconnect the drop cable, refer to Disconnecting an RJ45 and gland from a unit on page 5-21.

Installing the PoE power supply

Perform this task to install the PoE power supply, connect it to the ODU, and prepare the network cables.

NOTE

If the PIDU is to be installed rather than the PoE power supply, refer to the *PTP 300 and PTP 500 Series User Guide* (available for download at www.motorola.com/ptp/software) for PIDU installation instructions.

This task consists of the following procedures:

Preparing for PoE power supply installation

The PoE power supply can be installed free standing, on an even horizontal surface or wall mounted using wall mounting key holes on the underside of the unit. The following guidelines should be adhered to before cabling the PoE power supply to the Ethernet source and ODU:

- Verify the device receiving power and Ethernet from the PoE power supply is a PTP 250 ODU.
- Do not block or cover airflow to the PoE power supply.
- Keep the PoE power supply away from excessive heat, humidity, vibration and dust.
- The PoE power supply is not a repeater, and does not amplify the Ethernet data signal. Do not configure the cable length between the Ethernet network source, the PoE power supply and the PTP 250 ODU beyond 100 meters (333ft).

CAUTION

The PoE power supply is not waterproof and should be mounted away from sources of moisture. If mounted outdoors, the unit should be mounted in a moisture proof enclosure, preferably ventilated.

Mounting the PoE power supply

To mount the PTP 250 PoE power supply: install two screws (Table 5-1) in the wall or shelf, then align the mounting slots (Figure 5-12) to capture the surface screws.

Figure 5-12 Mounting slots on underside of PoE power supply

Table 5-1 Screw dimensions for the PoE power supply

Maximum	Minimum
7.0 mm 2.0 mm 2.5 mm clearance from surface 3.0 mm	5.8 mm 1.5 mm clearance from surface
0.27" 0.08" 0.098" clearance from surface 0.12"	0.23" 0.059" clearance from surface

Connecting the PoE power supply to the drop cable

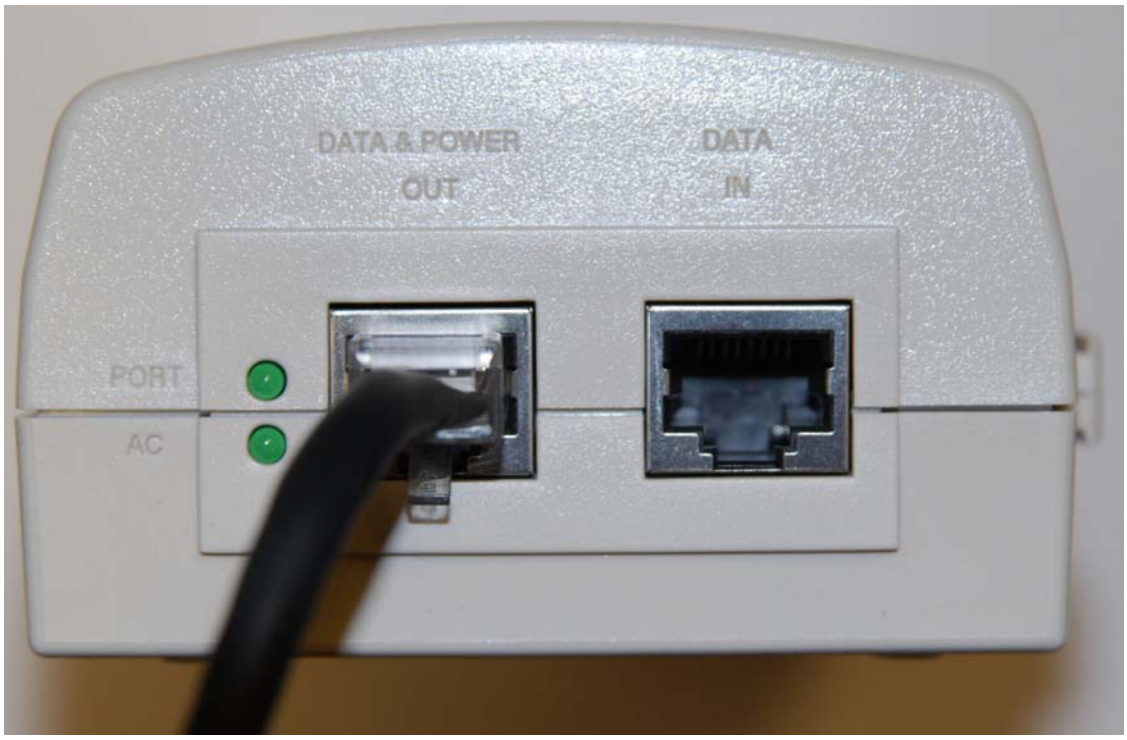
The drop cable from the ODU is connected to the DATA & POWER OUT interface of the PoE power supply.

⚠ CAUTION

Do not dress the PoE power supply cables too tightly, as this may make the connections unreliable.

Fit an RJ45 connector (but no gland) to the PoE end of the LPU-PoE cable. Connect the cable to the DATA & POWER OUT interface of the PoE power supply.

Figure 5-13 PoE power supply connected to LPU-PoE cable



Preparing the PoE power supply to network equipment cable

Prepare the CAT5e cable that will connect the PoE power supply to the network equipment. This cable must meet the following requirements:

- Use either foil screen (FTP) or braided screen (STP) cable.
- Use screened RJ45 connectors with metal shells at both ends.
- Ensure there is a continuous electrical connection between both screened connectors.

⚠ CAUTION

The connected network equipment must feature screened RJ45 connectors and must be connected to ground, otherwise the PoE power supply will not be grounded.

The PoE power supply is not normally connected to the network equipment until antenna alignment is complete. See Connecting to the network on page 6-35.

Chapter 6 Configuration and alignment

This chapter describes all configuration and alignment tasks that are performed when a PTP 250 link is deployed.

Before proceeding with unit configuration and antenna alignment, observe the precautions described in Preparing for configuration and alignment on page 6-2.

Configure the two units, one as ‘Master’ and the other as ‘Slave’ by performing the following tasks:

- Connecting to the unit on page 6-3 describes how to connect a PC to the unit, power it up and open the web interface.
- Upgrading firmware version on page 6-10 describes how to ensure that the latest firmware version is installed on the unit.
- Using the installation wizard on page 6-14 describes how to configure the LAN, wireless, date and email attributes of the unit.

When all equipment has been installed at both link ends, perform the following tasks:

- Aligning antennas on page 6-24 describes how to align integrated and connectorized antennas.
- Connecting link to the network on page 6-31 describes how to review link performance and connect to the network.

Preparing for configuration and alignment

This section describes the checks to be performed before proceeding with unit configuration and antenna alignment.

Safety precautions during configuration and alignment

All national and local safety standards must be followed while configuring the units and aligning the antennas.

⚠ WARNING

Ensure that personnel are not exposed to unsafe levels of RF energy. The units start to radiate as soon as they are powered up. Respect the safety standards defined in Compliance with safety standards on page 4-22, in particular the minimum separation distances. Observe the following guidelines:

- Never work in front of the antenna when the ODU is powered.
- Always power down the PoE power supply (or PIDU) before connecting or disconnecting the drop cable from either the power supply, ODU or LPU.

Regulatory compliance during configuration and alignment

All applicable radio regulations must be followed while configuring the units and aligning the antennas. For more information, refer to Compliance with radio regulations on page 4-27.

Selecting configuration options

Use the installation report to determine which configuration options are required. Refer to PTP LINKPlanner on page 2-8.

Connecting to the unit

Perform this task to connect a management PC to the unit, power it up and open the web interface.

This task consists of the following procedures:

- Configuring the management PC on page 6-3
- Connecting to the PC and powering up on page 6-5
- Logging into the web interface on page 6-6

Configuring the management PC

NOTE

Install Java on the management PC (if not already installed), as this is used by the PTP 250 web interface.

To configure the local management PC to communicate with the PTP 250, proceed as follows:

1	Select **Properties** for the Ethernet port.
2	Select the Internet Protocol (TCP/IP) item as shown in Figure 6-1.
3	Click on **Properties**.
4	Enter an IP address that is valid for the 169.254.X.X network, avoiding: 169.254.0.0 and 169.254.1.1 and 169.254.1.2 A good example is 169.254.1.3 (Figure 6-2).
5	Enter a subnet mask of 255.255.0.0. Leave the default gateway blank.

Figure 6-1 IP configuration on the PC

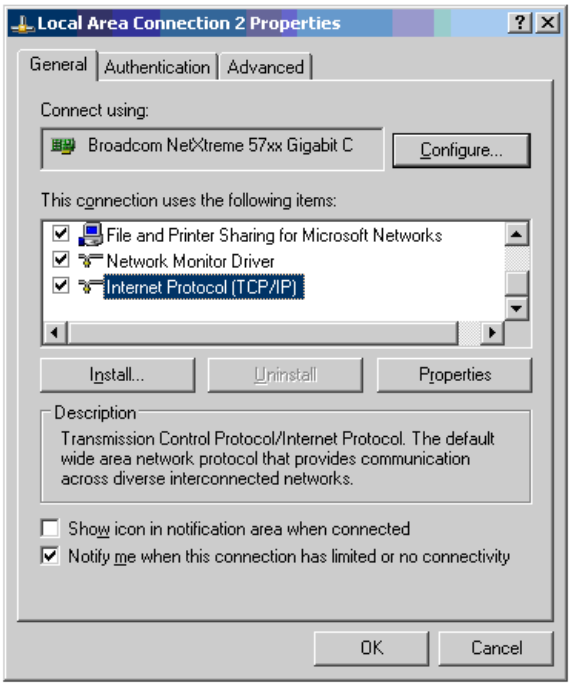
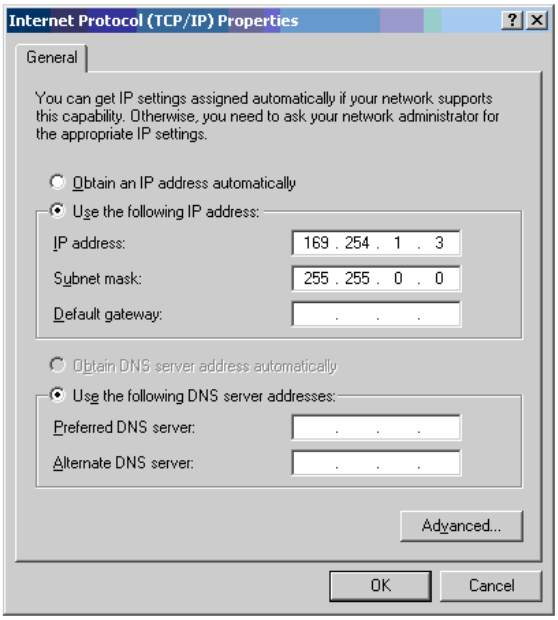


Figure 6-2 Internet Protocol (TCP/IP) Properties page



Connecting to the PC and powering up

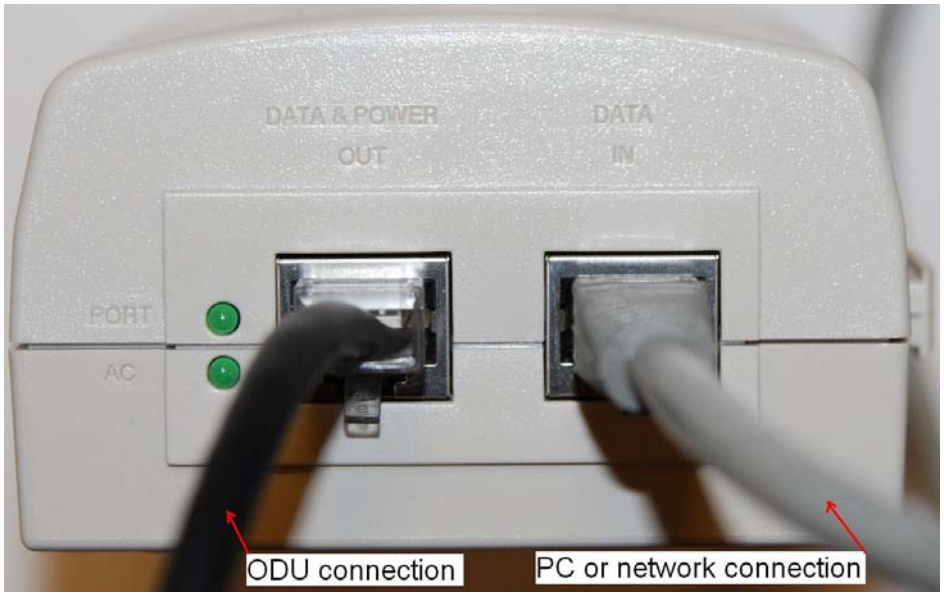
⚠ CAUTION

Ensure AC power is supplied to the PoE power supply using an AC cable with an appropriate ground connection approved for the country of operation.

To connect the ODU to the PC and power up the unit, proceed as follows:

1	Check that the ODU and PoE power supply are correctly connected.
2	Connect the PC Ethernet port to the DATA IN port of the PoE power supply using a standard (not crossed) Cat5e cable (Figure 6-3).
3	Connect the PoE power supply to an AC outlet (100 V AC to 240 V AC). **NOTE** The PoE power supply has no power switch. It supplies power to the ODU as soon as AC power is applied.
4	Check that the AC and PORT LEDs illuminate (green steady). If they blink or do not illuminate, refer to Testing link end hardware on page 8-2.

Figure 6-3 PoE power supply connected to ODU and PC (or network)



NOTE

If the power supply is a PIDU, the Ethernet LED does not illuminate.

Logging into the web interface

To log into the web interface as a system administrator, proceed as follows:

1	Start the web browser from the management PC.
2	Type the IP address of the unit (factory default is 169.254.1.1) into the address bar. Press ENTER. For user security, Motorola digitally signs its applications. On the first login, the digital signature confirmation is displayed (Figure 6-4). Tick the 'Always trust content from this publisher' box and select **Run**. The digitally signed Java app splash screen is displayed (Figure 6-5), followed by the Login page.
3	When the Login page is displayed (Figure 6-6), enter the Username 'admin' and Password (default 'motorola') and select **Login**.
4	On the first login to a new unit, or on the first login to a unit that has been reset to full or partial default configuration, the Change Password page is displayed (Figure 6-7). Enter and confirm the new Password.
5	On the first login to a new unit, or on the first login to a unit that has been reset to full default configuration, the Set Country Code page is displayed (Figure 6-8). Select the Country Code and select **OK** to confirm it is correct. **CAUTION** Ensure the correct Country Code is selected. An incorrect selection may result in illegal radio operation. Once set, the Country Code can only be changed by using the reset switch, as described in Resetting to default configuration (with country reset) on page 7-26.
6	The web interface menu and System Summary page are displayed (Figure 6-9). Continue with configuration.

Figure 6-4 Digital signature confirmation (on first login)

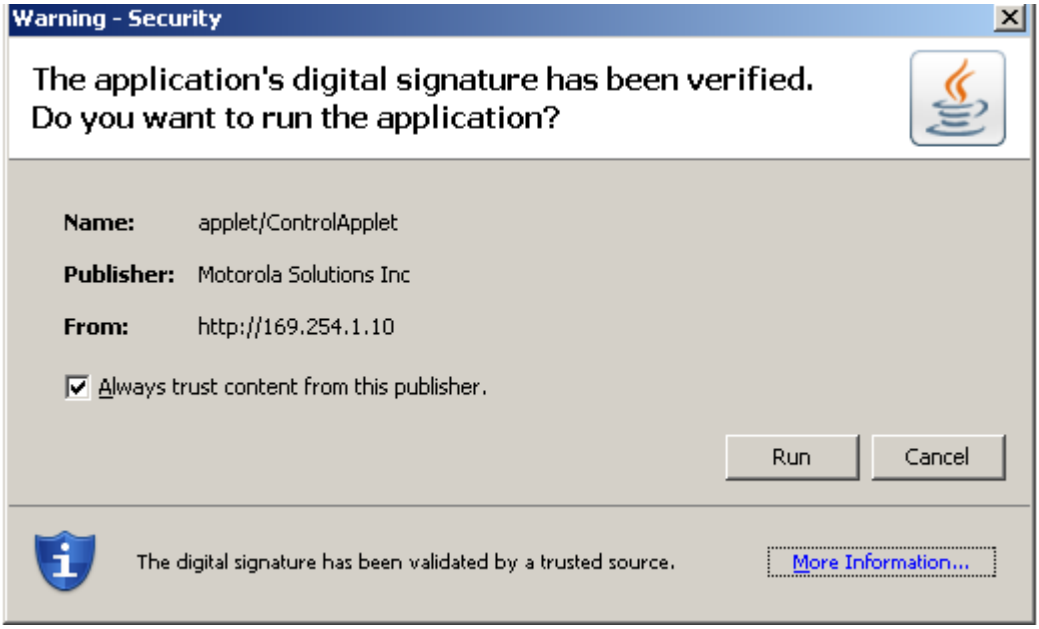


Figure 6-5 Digitally signed Java app splash screen

Figure 6-6 Login page

Figure 6-7 Change Password page (on first login)

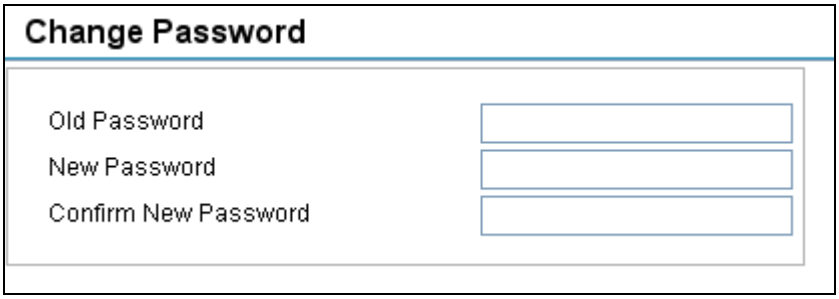


Figure 6-8 Set Country Code page (on first login)

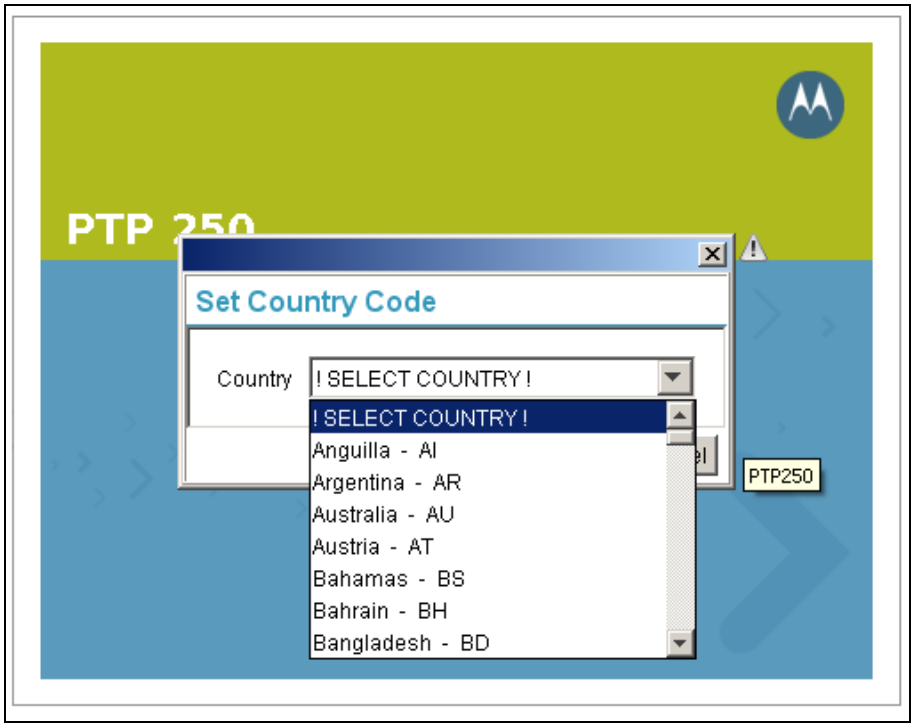
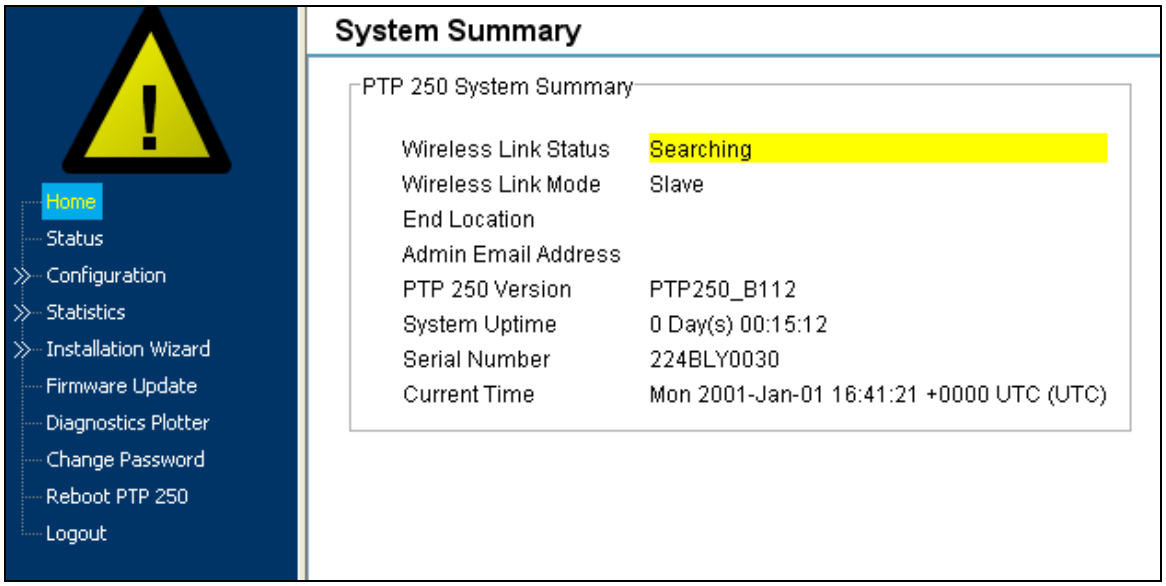


Figure 6-9 Menu and System Summary page (on first login)



Upgrading firmware version

Perform this task to ensure that the latest firmware version is installed on the unit.

This task consists of the following procedures:

- Checking the installed firmware version on page 6-10
- Saving the system configuration on page 6-11
- Uploading a new firmware version on page 6-12

NOTE

Ensure that the correct units are upgraded, as units cannot easily be downgraded afterwards.

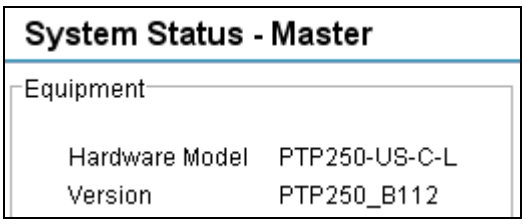
If the link is operational, ensure that the remote end of the link is upgraded first using the wireless connection, and then the local end can be upgraded. Otherwise, the remote end may not be accessible.

Checking the installed firmware version

To check that the latest firmware version is installed, proceed as follows:

1	Select menu option **Status**. The System Status page is displayed. The Version attribute near the top left is the installed firmware version (Figure 6-10).
2	Go to http://www.motorola.com/ptp/support and find Point-to-Point software updates. Check that the latest available firmware version (for example 250-04-01) is the same as the one already installed.
3	If the unit needs to be upgraded to the latest firmware version, perform Saving the system configuration on page 6-11 and Uploading a new firmware version on page 6-12.

Figure 6-10 Firmware Version in System Status page



Saving the system configuration

To save the current configuration before upgrading to a new firmware version, proceed as follows:

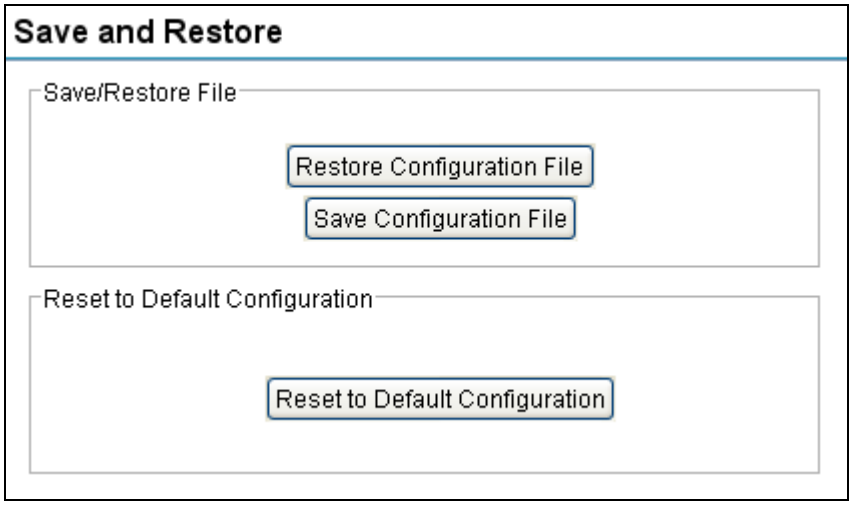
1	Select menu option **System, Configuration**, **Save And Restore**. The Save and Restore page is displayed (Figure 6-11).
2	Select **Save Configuration File**.
3	Save the configuration file to a PC hard drive.

The configuration file format is:

mm-mm-mm-mm-mm-mm_iii-iii-iii-iii.cfg

Where:	**Is:**
mm-mm-mm-mm-mm-mm	MAC address of unit
iii-iii-iii-iii	IP address of unit.

Figure 6-11 Save & Restore page



Uploading a new firmware version

Before performing a firmware upload, save the configuration as described in Saving the system configuration on page 6-11.

To upload a new firmware version, proceed as follows:

1	Go to http://www.motorola.com/ptp/support and find Point-to-Point software updates. Download and save the required firmware image (for example `PTP250-04-01.bin`).
2	Select menu option **Firmware Update**. The Firmware Update page is displayed (Figure 6-12).
3	Select the Method. The default is HTTP. If FTP or TFTP is selected, additional attributes are displayed and must be completed.
4	Select **Browse**. Navigate to the folder containing the downloaded firmware image and select **Open**.
5	Select **Start Firmware Upload** and **Yes** to confirm. The upload progress is displayed. On completion, the Upload Successful page is displayed (Figure 6-13). To ensure that only authorized Motorola firmware is installed, the unit checks the image for a DSA signature. If the DSA signature is missing or incorrect, an error message is displayed and the upload fails.
6	Select **Apply and Reboot**.
7	The reboot process will take up to 120 seconds. During this time it will not be possible to communicate with the unit. After the reboot, check that the required firmware image is loaded and running.

Figure 6-12 Firmware Update page

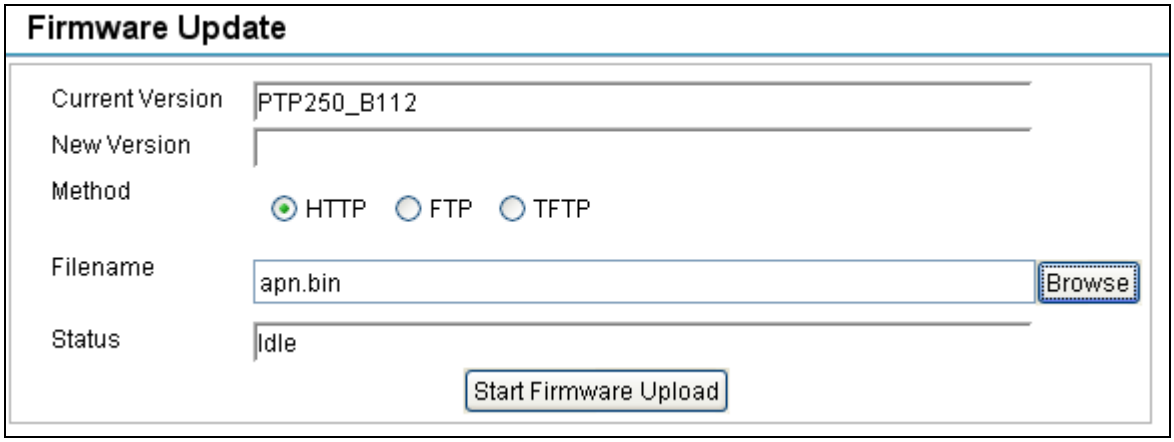
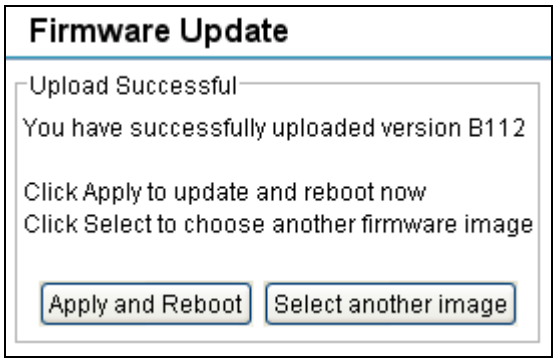


Figure 6-13 Upload Successful page



Using the installation wizard

Perform this task to configure the LAN, wireless, date and email attributes of the unit.

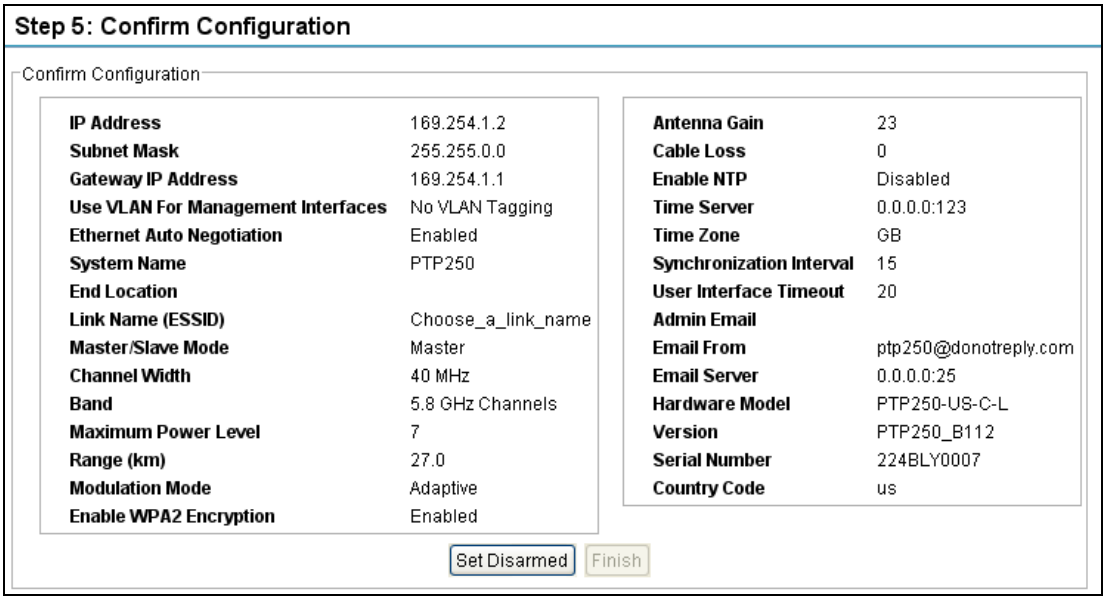
This task consists of the following procedures:

Starting installation wizard

To start the installation wizard, select menu option **Installation Wizard**. The response depends upon the state of the unit:

- If the unit is armed for alignment, the Step 5: Confirm Configuration page is displayed (Figure 6-14). Select **Set Disarmed**, **Yes** to confirm and then **Back** until the Step 1: LAN Configuration page is displayed.
- If the unit is not armed, the Step 1: LAN Configuration page is displayed**.**

Figure 6-14 Step 5: Confirm Configuration page (when unit is armed)



Step 1: LAN configuration

Step 1 of the Installation wizard is for updating the LAN configuration (Figure 6-15). The attributes are described in Table 6-1.

Update IP Address, Subnet Mask and Gateway IP Address to meet network requirements (as specified by the network administrator). Update the other attributes as required and select **Next**.

Figure 6-15 Step 1: LAN Configuration page

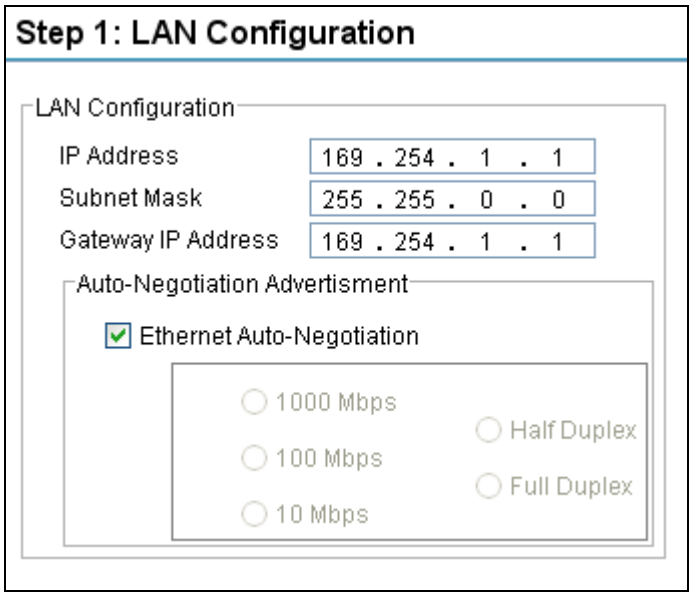


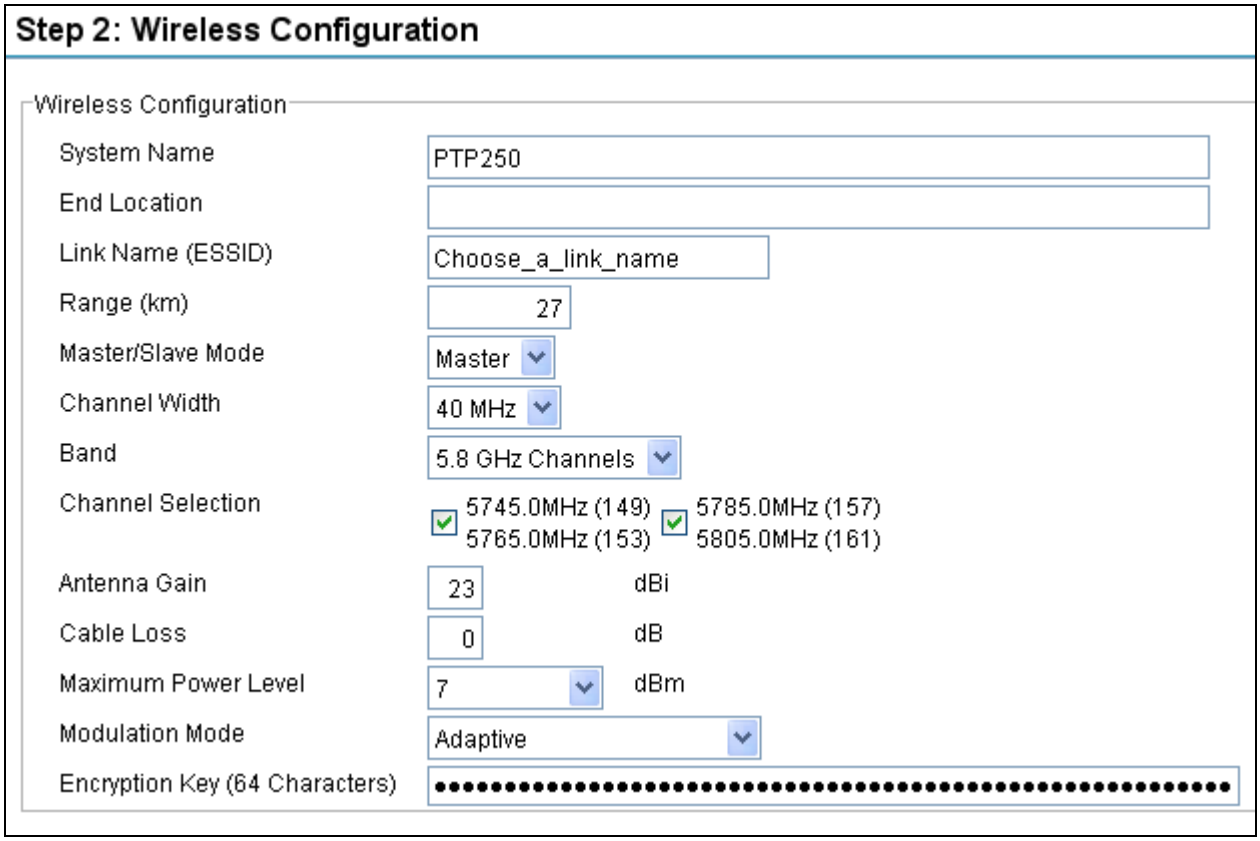
Table 6-1 Step 1: LAN Configuration attributes

Attribute	Meaning
IP Address	Internet protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network. All units are shipped with a default IP address of 169.254.1.1. **NOTE** Change this default IP address to ensure that: (a) it is unique on the network, and (b) the Master and Slave units have different IP addresses.
Subnet Mask	Defines the address range of the connected IP network.
Gateway IP Address	The IP address of a computer on the current network that acts as a gateway. A gateway acts as an entrance and exit to packets from and to other networks.
Ethernet Auto-Negotiation	When the box is ticked, it means that configuration is automatically negotiated. This is the default setting. When the box is not ticked, it means that configuration is forced. Select the data rate that the auto-negotiation mechanism will advertise as available. **CAUTION** Only select a data rate that is within the capability of connected network equipment, otherwise loss of service may occur. **NOTE** Use the same setting for both ends of the link. The configuration should only be forced if problems are experienced with auto-negotiation. Instead of forcing configuration, the IEEE802.3 specification recommends enabling Auto-Negotiation with only the specific ability or abilities advertised.

Step 2: Wireless configuration

Step 2 of the Installation wizard is for updating the wireless configuration (Figure 6-16). The attributes are described in Table 6-2. Update the attributes as required and select **Next**.

Figure 6-16 Step 2: Wireless Configuration page



NOTE

When installing connectorized units, ensure that Antenna Gain, Cable Loss and Maximum Power Level are within regulatory limits. For more information, refer to Calculating EIRP for connectorized units on page 4-30.

Table 6-2 Step 2: Wireless Configuration attributes

Attribute	Meaning
System Name	A name for the link. Spaces are not allowed, so use underscores instead.
End Location	The location of the link end. Spaces are not allowed, so use underscores instead.
Link Name (ESSID)	A link can only be established between units that have identical Link Names. Link Name may consist of letters (A-Z and a-z), numbers (0-9) and the following special characters (no spaces): (),-.,:<=>[]_{}
Range (km)	The link range. The value must not be less than the actual distance between the link ends.
Master/Slave Mode	Each link consists of one 'Master' and one 'Slave' unit. The Master is used to control and maintain the point-to-point link. The Master transmits until the link is made, while the Slave listens for its Master and only transmits when the Master has been identified. As all units are shipped with a default setting of 'Slave', one unit in the link must be reset to 'Master'.
Channel Width	Width (MHz) of the radio channel used by this link. The selection depends upon the frequency variant and country of operation. This can only be updated at the Master unit.
Band	The frequency band (GHz) in which this link operates. This can only be updated at the Master unit.
Channel Selection	The channel (MHz) in which this link operates. This can only be updated at the Master unit. If Channel Width is set to 40 MHz, then each tick box selects two 20 MHz channels: the first is Current Channel and the second is Extended Channel.
Antenna Gain	Gain (dBi) of the antenna that is connected to this unit. See Antenna specifications on page 4-14.

Attribute	Meaning
Cable Loss	Loss (dB) in the RF cable between the ODU and the antenna. **NOTE** If there is a significant difference in length of the antenna cables for the two antenna ports, then enter the average value.
Maximum Power Level	The maximum power (dBm) at which the unit will transmit.
Modulation Mode	The modulation mode used on the transmit channel. The recommended setting is ‘Adaptive’.
Encryption Key (64 characters)	Key to be used for link encryption. The same key must be used at both ends of the link.

Step 3: Date and time settings

Step 3 of the Installation wizard is for setting the date and time (Figure 6-17). The attributes are described in Table 6-3. Update the attributes as required and select **Next**.

The clock supplies accurate date and time information to the system. It can be set to run with or without a connection to a Network Time Protocol (NTP) server:

- In the absence of an NTP server connection, the clock can be set to run manually. The clock is battery backed and will continue to operate for several days after the ODU is switched off.
- If an NTP server connection is available, the clock can be set to synchronize with the server time at regular intervals.

Figure 6-17 Step 3: Date and Time Settings page

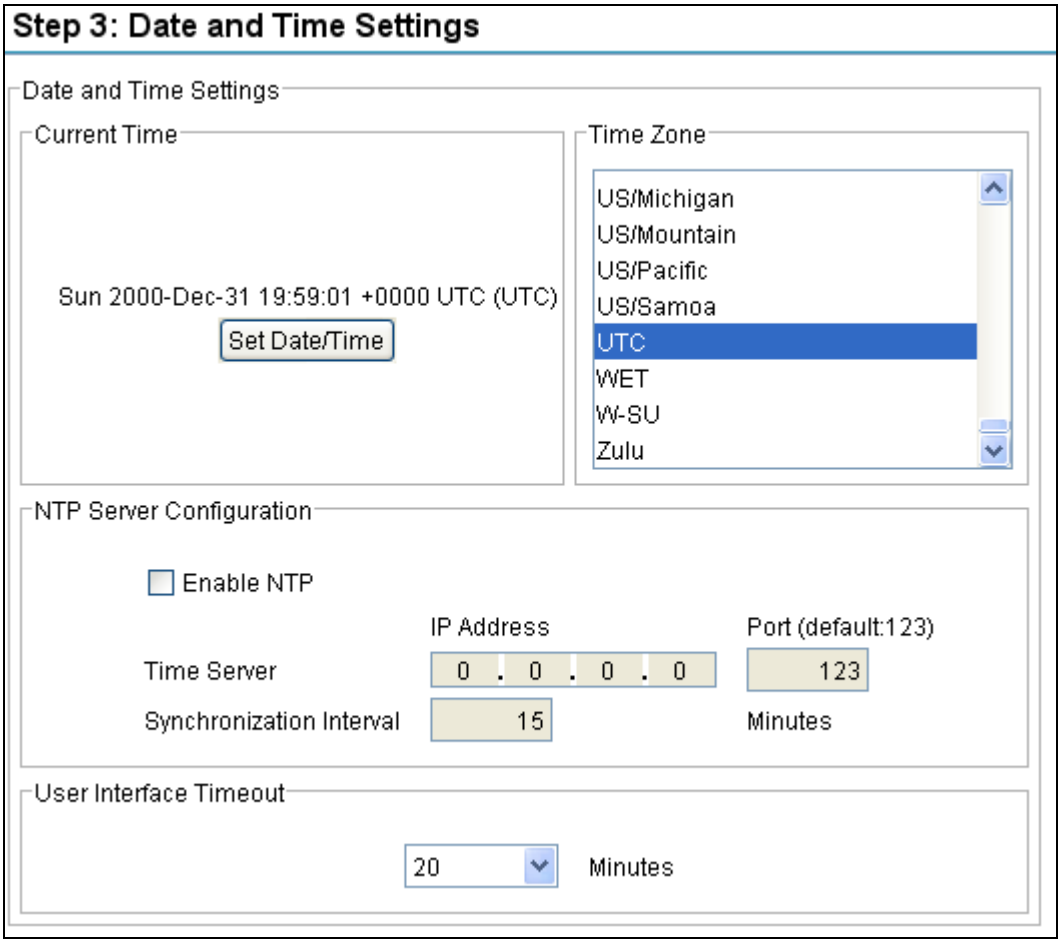


Table 6-3 Step 3: Date and Time Settings attributes

Attribute	Meaning
Current Time	The current date and time setting for this unit. To update this, select **Set Date/Time**.
Time Zone	The time zone in which this unit operates.
Enable NTP	If this is ticked, the PTP 250 will obtain accurate date and time updates from a networked time server.
Time Server IP Address	The IP address of the networked NTP server.
Time Server Port	The port number of the networked NTP server. By convention the default value is 123.
Synchronization Interval	The interval at which the PTP 250 requests time correction updates from the NTP server. If a request fails, the PTP 250 automatically performs three retries before waiting for the next Synchronization Interval.
User Interface Timeout	The time that is allowed to pass without user activity before the user is logged out.

Step 4: Email configuration

Step 4 of the Installation wizard is for configuring email notifications (Figure 6-18). The attributes are described in Table 6-4. Update the attributes as required and select **Next**.

Figure 6-18 Step 4: Email Configuration page

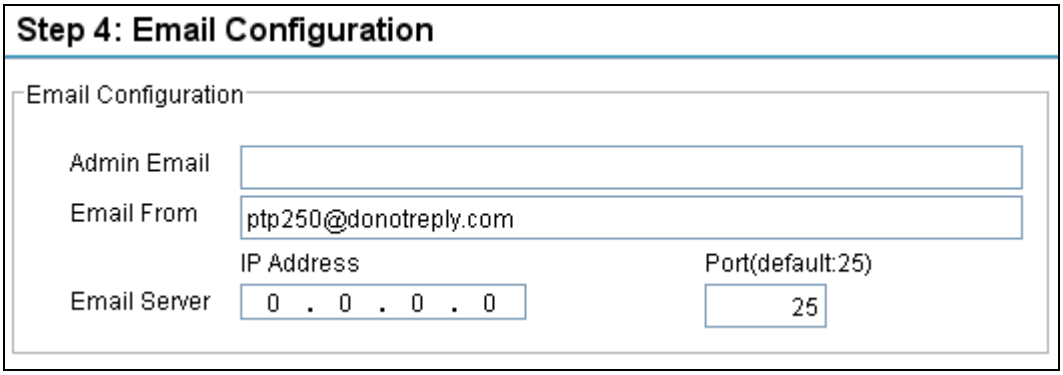


Table 6-4 Step 4: Email Configuration attributes

Attribute	Meaning
Admin Email	The email address to which the PTP 250 will send the alert messages.
Email From	The email address used by the PTP 250 to log into the email server. This must be recognized by the server.
Email Server IP Address	The IP address of the networked email server.
Email Server Port	The port number used by the networked email server. By convention the default value is 25.

Step 5: Confirm installation configuration

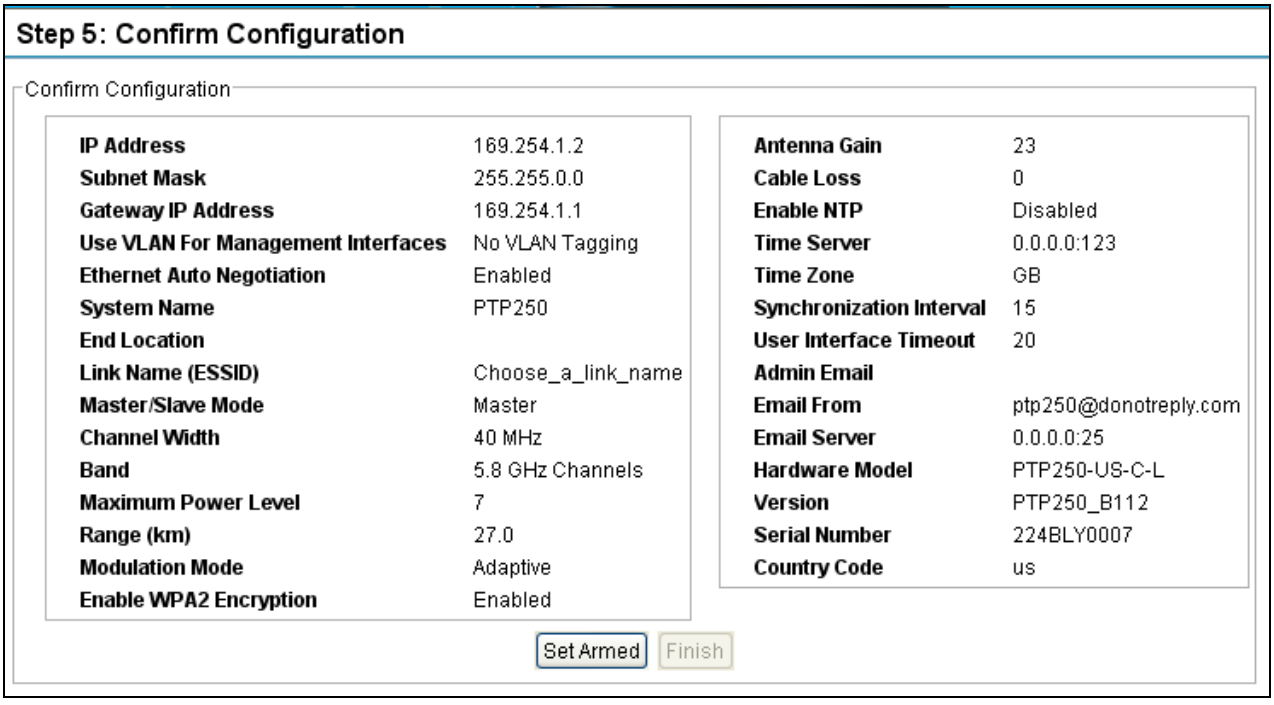
Step 5 of the Installation wizard is for reviewing and confirming the updated attributes (Figure 6-19).

If any of the attributes are incorrect, select **Back** to return to previous steps and update them.

If all attributes are correct, choose one of the following options:

- If antenna alignment tones are not wanted, select **Finish**. This is the preferred option before bench testing the units.
- If antenna alignment tones are wanted, select **Set Armed** and **Yes** to confirm. This is the preferred option before site installation and antenna alignment.

Figure 6-19 Step 5: Confirm Configuration page



NOTE

If the IP Address, Subnet Mask or Gateway IP Address of the unit have been updated to meet network requirements, then reconfigure the local management PC to use an IP address that is valid for the network. Refer to Configuring the management PC on page 6-3.

Aligning antennas

Before performing this task, check that hardware installation is complete (apart from the network connections) at both the Master and Slave sites.

This task consists of the following procedures:

Starting up the units

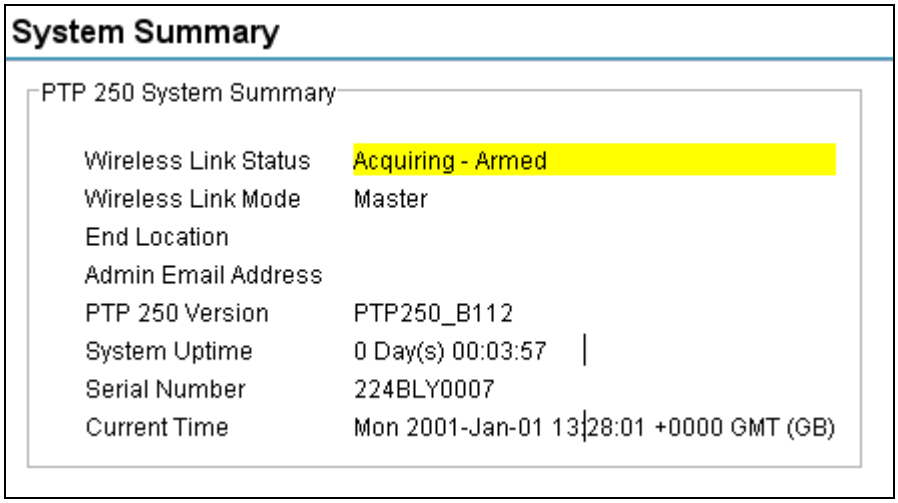
To connect one of the units to a management PC and start up both units, proceed as follows:

1	Select the unit from which this process is to be controlled; either Master or Slave. This is the ‘local’ unit.
2	Check that the management PC is connected to the local unit, powered up and logged on.
3	Start the local unit.
4	Start the remote unit.
5	Log into the local unit as described in Logging into the web interface on page 6-6.

Checking that the units are armed

Select menu option **Home**. The System Summary page is displayed. Check that the Wireless Link Status contains the word 'Armed' (Figure 6-20); this confirms that the units are ready for alignment.

Figure 6-20 System Summary page (when unit is armed)



If the units are not armed, use the installation wizard (Step 5) to arm them, as described in Using the installation wizard on page 6-14.

Aligning antennas

Use this procedure to align linked antennas (master and slave), whether integrated or connectorized.

Prior to alignment, ensure that the following parameters are available:

- Location of both sites (latitude and longitude).
- Bearing to the other end of the link for both sites.
- Prediction of receive signal level for both ends of the link.
- Prediction of link loss.

PTP LINKPlanner provides all of these parameters in the form of an installation report.

If a connectorized ODU is installed at either site with two separate antennas for spatial diversity, refer to Aligning separate antennas for spatial diversity on page 6-27 before starting alignment.

NOTE

To achieve best results, make small incremental changes to elevation and azimuth.

CAUTION

The action of tightening the mounting bolts can alter antenna alignment. This can be helpful when fine-tuning alignment, but it can also lead to misalignment. To prevent misalignment, continue to monitor receive signal level during final tightening of the bolts.

To align the antennas, proceed as follows:

1	At each end of the link, adjust the antenna to point at the other end of the link. This should be done with the aid of a compass.
2	Without moving the master antenna, adjust the elevation and azimuth of the slave antenna to achieve the highest receive signal level (using one of the recommended methods in Monitoring received signal level on page 6-27).
3	Without moving the Slave antenna, adjust the elevation and azimuth of the Master antenna to achieve the highest receive signal level (using one of the recommended methods).
4	Repeat steps 2 and 3 as necessary to fine-tune the alignment to find the center of the beam.
5	When the antennas have been aligned on the center of the beam, verify that the receive level is within the predicted range (from the installation report). If this is not the case, go back to step 2. The current value of receive level can be verified by using Graphical alignment on page 6-29 or by selecting menu option **Status** and monitoring the Receive Power attribute on the System Status page.
6	If after repeated attempts to align, the receive level still does not lie within the predicted range, this may be because the data provided to the prediction tool (such as PTP LINKPlanner) is inaccurate. For example estimates of path obstructions, antenna heights or site locations may be inaccurate. Check this data and update the prediction as necessary.
7	Once the antennas have been aligned correctly, tighten the integrated ODU (or connectorized antenna) mountings. To ensure that the action of tightening does not alter antenna alignment, continue to monitor received signal level.

Aligning separate antennas for spatial diversity

If a connectorized ODU is installed at either site with two separate antennas for spatial diversity, proceed as follows:

1	Connect the horizontal polarization antenna to the ODU, disconnect the vertical polarization antenna, and then perform Aligning antennas on page 6-25.
2	Connect the vertical polarization antenna to the ODU, disconnect the horizontal polarization antenna, and then perform Aligning antennas on page 6-25.
3	Re-connect the horizontal polarization antennas. The received signal level should increase.
4	Weatherproof the antenna connections at the ‘H’ and ‘V’ interfaces of the ODUs, as described in Mounting and connecting antennas on page 5-9.

Monitoring received signal level

The goal of antenna alignment is to find the center of the main beam. This is done by adjusting the antennas while monitoring the receive signal level. Choose one of two methods for monitoring receive signal level:

- Antenna alignment tones on page 6-28
- Graphical alignment on page 6-29

Antenna alignment tones

This is the first method that may be used to monitor receive signal level during antenna alignment.

The ODU emits audible tones during installation to assist with alignment. The pitch of the alignment tone is proportional to the received power of the wireless signals. Adjust the alignment of the unit, in both azimuth and elevation, until the highest pitch tone is achieved.

The tones and their meanings are described in Table 6-5. In each of the states detailed in the table, align the unit to give the highest pitch tone.

Table 6-5 Antenna alignment tones

State Name	Tone Description	State Description	Pitch Indication
Free Channel Search	Regular beep	Executing band scan	N/A
Scanning	Slow broken tone	Not demodulating the wanted signal	Rx Power
Synchronized	Fast broken tone	Demodulating the wanted signal	Rx Power
Registered	Solid tone	Both Master and Slave units exchanging Radio layer MAC management messages	Rx Power
Alarm	Fast broken dual tone	A fatal error has occurred.	

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

⚠ CAUTION

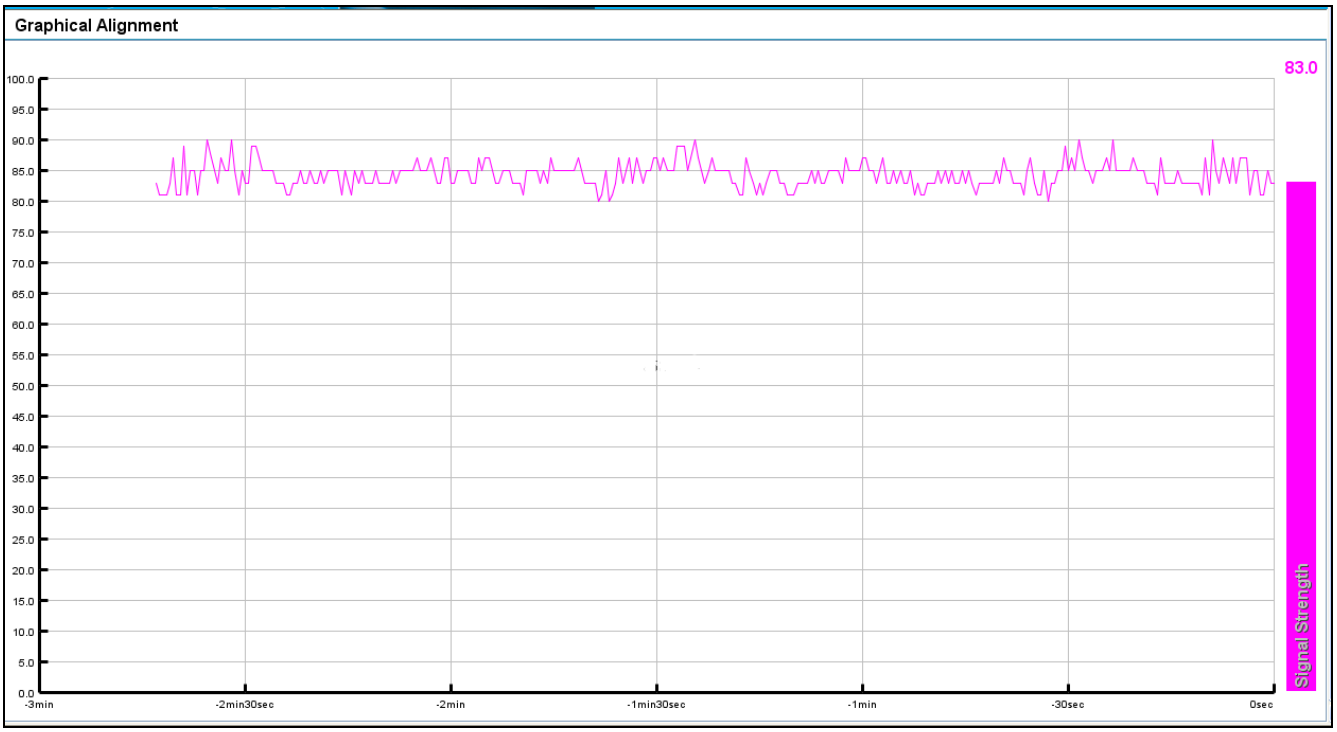
If, when in the Synchronized or Registered state, the tone varies wildly, there may be interference or a fast fading link. Installing in this situation may not give a reliable link. Investigate the cause of the problem.

Graphical alignment

This is the second method that may be used to monitor receive signal level during antenna alignment.

Select menu option **Installation Wizard, Graphical Alignment**. The Graphical Alignment page is displayed (Figure 6-21).

Figure 6-21 Graphical Alignment page



The Graphical Alignment page displays the receive power over the last three minutes. This allows the installer to slowly sweep the antenna during installation and monitor the variation in signal strength with angular position. The page automatically refreshes every three seconds.

The page displays the instantaneous signal strength at the top right.

Disarming the units

When antenna alignment is complete, both units in the link must be disarmed before network connection.

To disarm the units, select menu option **Installation Wizard**. The Step 5: Confirm Configuration page is displayed (Figure 6-14). Select **Set Disarmed**, **Yes** to confirm and then **Back** until the Step 1: LAN Configuration page is displayed.

Connecting link to the network

When antenna alignment is complete, the link performance must be checked and then the link connected to the network for operational running.

This task consists of the following procedures:

- Reviewing system configuration attributes on page 6-31
- Comparing actual to predicted performance on page 6-34
- Connecting to the network on page 6-35

Reviewing system configuration attributes

Review the system configuration to check that it is correct for operational running. To do this, select the following menu options:

- **Configuration** (Figure 6-22).
- **Configuration, LAN Configuration** (Figure 6-23).
- **Configuration, Date/Time** (Figure 6-24).

If any settings are incorrect, return to the installation wizard and update the configuration as described in Using the installation wizard on page 6-14.

Figure 6-22 System Configuration page

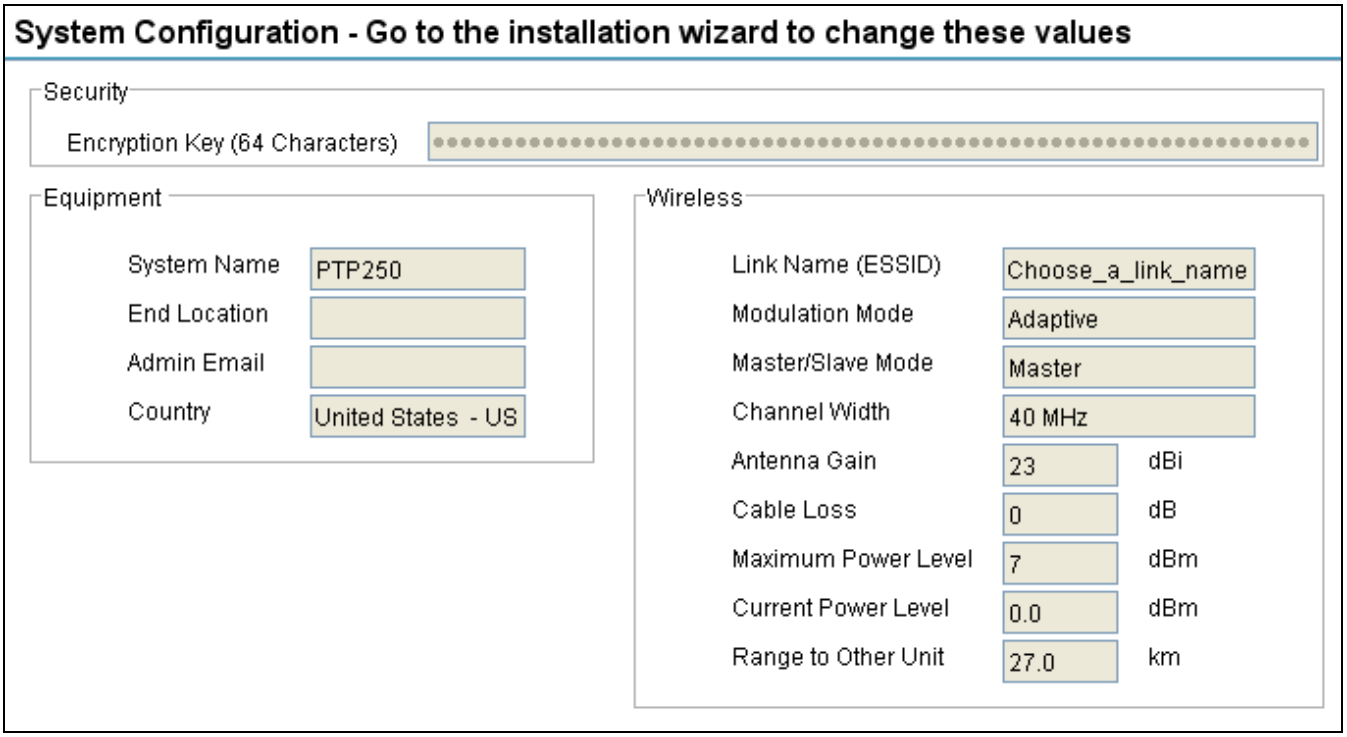


Figure 6-23 LAN Configuration page

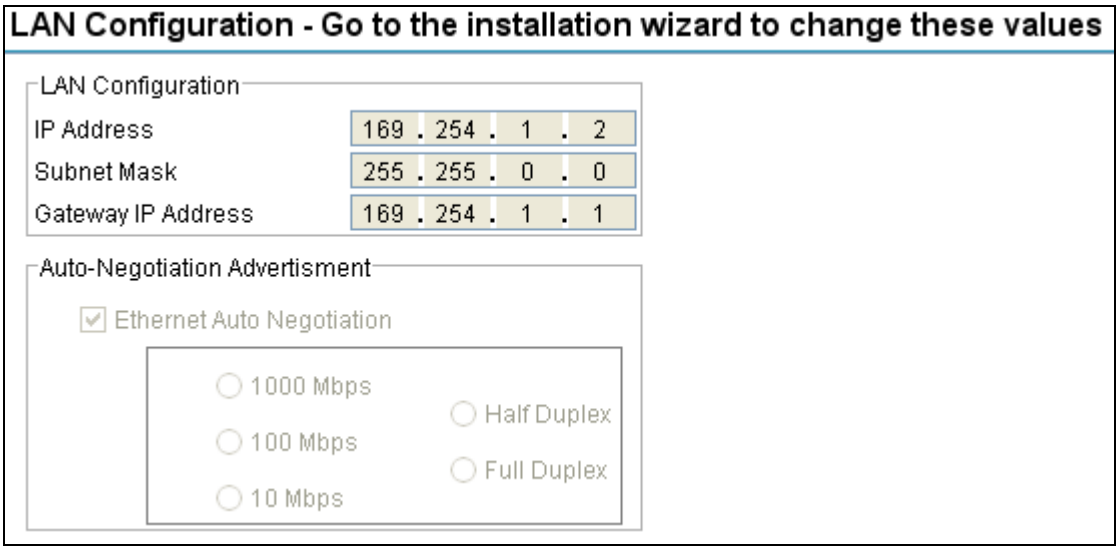
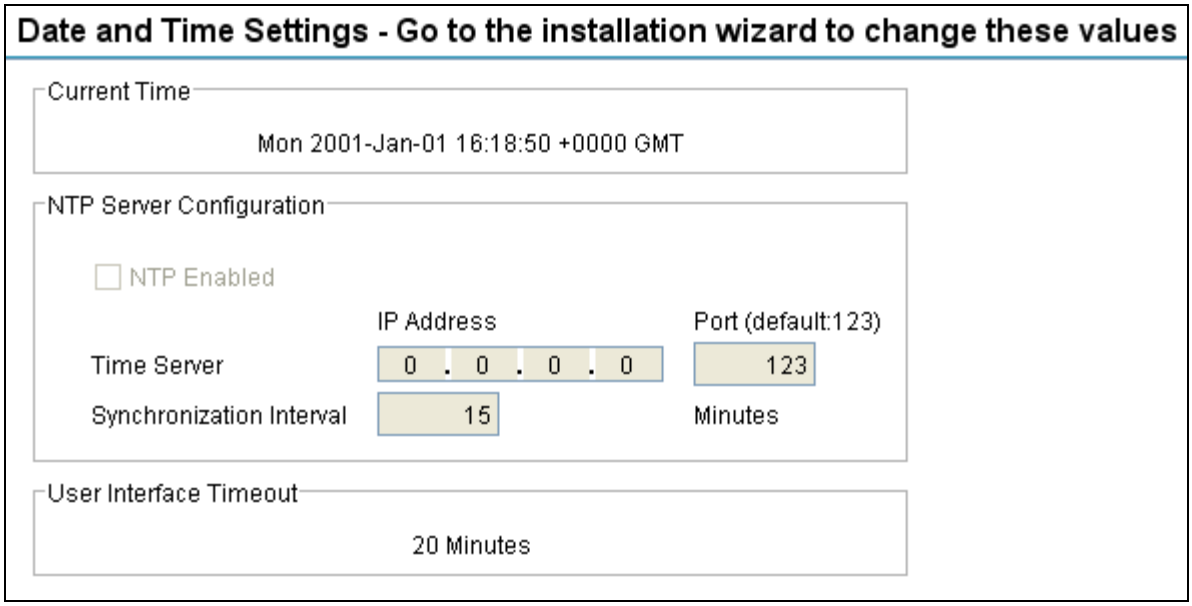


Figure 6-24 Date and Time Settings page



Comparing actual to predicted performance

For at least one hour of operation after disarming, monitor the link to check that it is achieving predicted levels of performance.

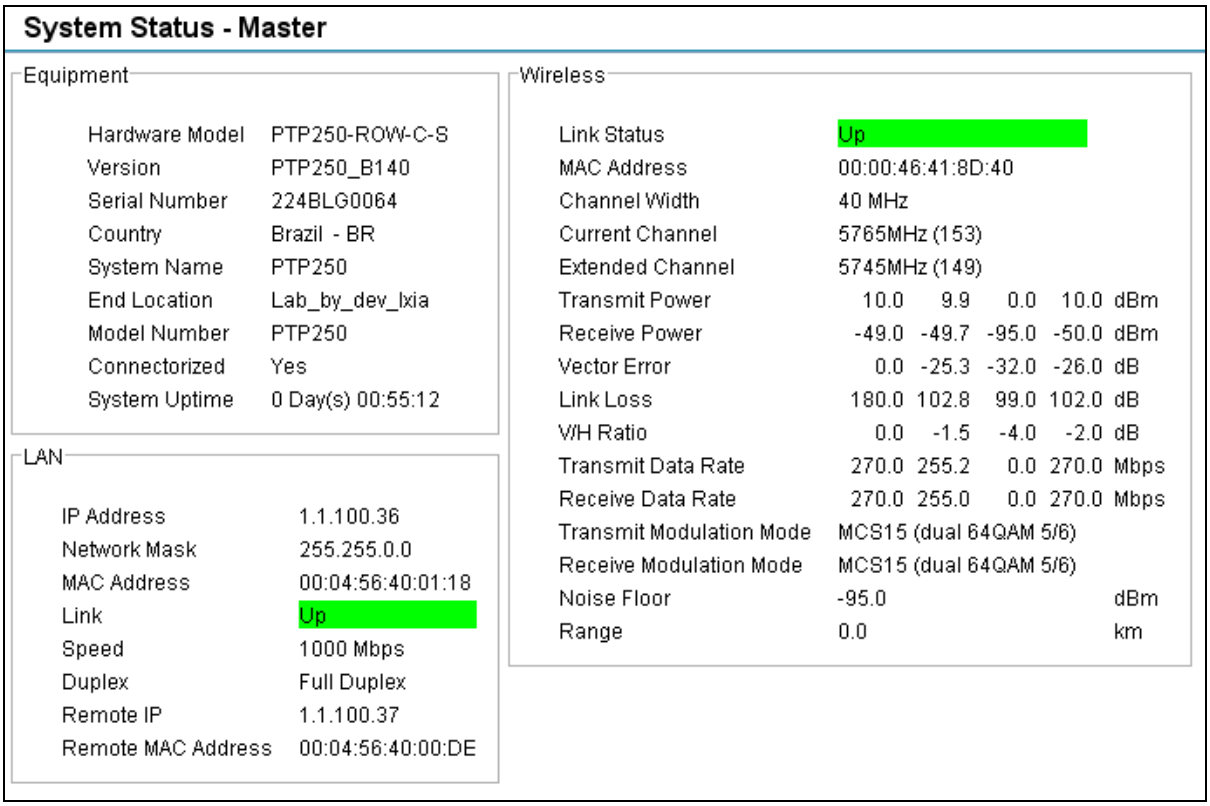
To check performance, select menu option **Status**. The System Status page is displayed (Figure 6-25). Monitor the following attributes:

- Link Loss
- Transmit Data Rate
- Receive Data Rate

For more information on these attributes, refer to Viewing the system status on page 7-8.

PTP LINKPlanner provides the prediction in the form of an installation report.

Figure 6-25 System Status page



Connecting to the network

To connect to the network, proceed as follows:

1	Disconnect the local PC from the PoE power supply at the Master and Slave sites.
2	At each site, connect the PoE power supply DATA IN ports to a router port, switch port or other network equipment in the data network (Figure 6-3) using the CAT5e cable that was prepared for this purpose in Preparing the PoE power supply to network equipment cable on page 5-30.
3	Check that the Master and Slave units are reachable from the network management system by opening the web interface to the management agents, or by requesting ICMP echo response packets using the Ping application. The network management system will normally be geographically remote from the sites, so it may be necessary to request that this action is completed by co-workers at the management center.
4	Check the data network for correct operation across the wireless link. This may be by requesting ICMP echo response packets between hosts in the connected network segments, or by some more structured use of network testing tools.
5	Select menu option **Home** or **Status** and check that the Wireless Link Status is 'Up' on both units. If it is not 'Up', refer to Managing link status and alerts on page 7-15.

Chapter 7 Operation

This chapter provides instructions for operators of the PTP 250 web user interface.

The following topics are described in this chapter:

- Web-based management on page 7-2 describes the layout and the main menu options of the PTP 250 web-based management interface.
- Managing link status and alerts on page 7-15 describes how to manage PTP 250 link status and alerts.
- Managing performance on page 7-17 describes how to manage the performance of the PTP 250 link.
- Restoring, resetting and rebooting on page 7-24 describes how to restore the system configuration, reset to defaults, recover the IP address and reboot the unit.

Web-based management

This section describes the layout and the main menu options of the PTP 250 web-based management interface. The following topics are covered:

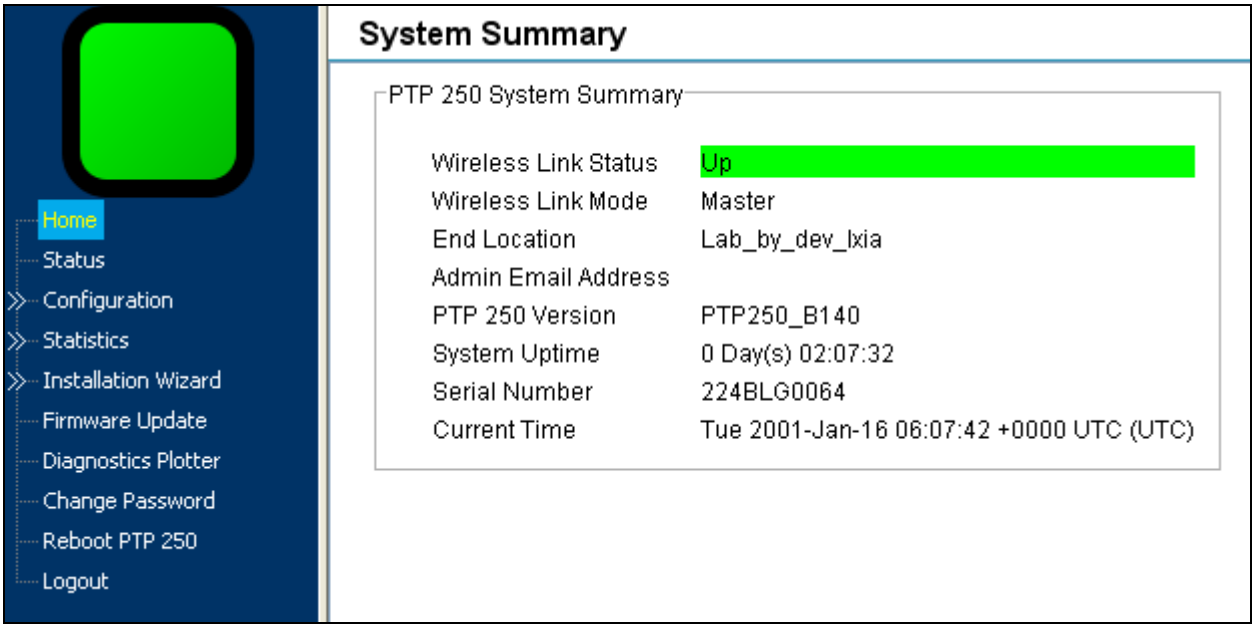
Accessing the web interface

The web interface is best viewed using a screen resolution of at least 1024 x 768 pixels. The web pages have been tested with: Internet Explorer 7, Internet Explorer 8, Firefox 3 and Firefox 3.5 on PCs; and Safari on Mac OS X. Other browsers have not been tested.

To access the web interface, type the IP address of the unit into the browser address bar and press ENTER. When the login page is displayed (Figure 7-1), enter Username 'admin' and Password (factory default is 'motorola', but this must be changed at first login) and select **Login**. The Menu and System Summary are displayed (Figure 7-2).

Figure 7-1 Login page

Figure 7-2 Menu and System Summary page (wireless link up)



Using the menu options

All web pages contain the menu navigation bar on the left hand side (Figure 7-3). The menu is used to navigate to other web pages. The currently selected option is always highlighted with a light blue background.

Figure 7-3 Menu navigation bar

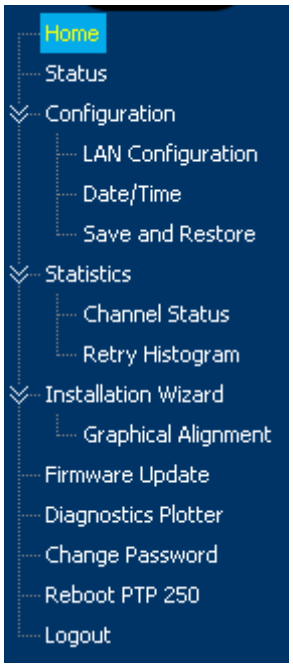


Table 7-1 lists the procedures that may be performed from each menu option. Many of these procedures are part of the initial configuration and alignment process described in Chapter 6 Configuration and alignment.

Table 7-1 Procedures performed from each menu option

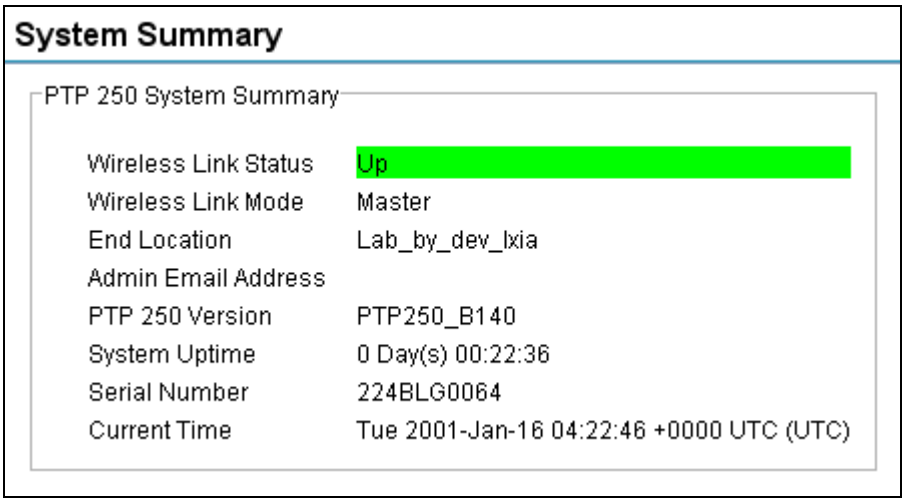
Menu option	Procedures
Home	Viewing the system summary on page 7-6 Managing link status and alerts on page 7-15 Checking that the units are armed on page 6-25
Status	Viewing the system status on page 7-8 Checking the installed firmware version on page 6-10
Configuration	Reviewing system configuration attributes on page 6-31
LAN Configuration	Reviewing system configuration attributes on page 6-31 Recovering a lost IP address on page 7-28
Date/Time	Reviewing system configuration attributes on page 6-31
Save and Restore	Saving the system configuration on page 6-11 Saving and restoring the configuration file on page 7-24 Resetting to default configuration (without country reset) on page 7-25
Statistics	Checking system statistics on page 7-17 Comparing actual to predicted performance on page 6-34 Test Ethernet packet errors reported by ODU on page 8-8
Channel Status	Checking channel status on page 7-19
Retry Histogram	Checking the retry histogram on page 7-20
Installation Wizard	Using the installation wizard on page 6-14
Graphical Alignment	Graphical alignment on page 6-29
Firmware Update	Uploading a new firmware version on page 6-12
Diagnostics Plotter	Using the diagnostics plotter on page 7-21
Change Password	Changing password on page 7-14
Reboot PTP 250	Rebooting the unit on page 7-28
Logout	Logging out on page 7-14

Viewing the system summary

To display the System Summary page, select menu option **Home**.

The System Summary page (Figure 7-4) contains a high level summary of the status of the wireless link and associated equipment.

Figure 7-4 System Summary page



The attributes of the System Summary page are described in Table 7-2.

Table 7-2 System Summary attributes

Attribute	Meaning
Wireless Link Status	Current status of the wireless link. A green background with status text 'Up' means that the point-to-point link is established. A yellow background with suitable status text (for example 'Acquiring') indicates that the link is not established. Whenever the Wireless Link Status is not 'Up', a yellow warning triangle is displayed on the navigation bar. For more information, refer to Managing link status and alerts on page 7-15.
Wireless Link Mode	Master or Slave. This is set in the Installation Wizard; see Step 2: Wireless configuration on page 6-17.
End Location	Location of this link end. This is set in the Installation Wizard; see Step 2: Wireless configuration on page 6-17.

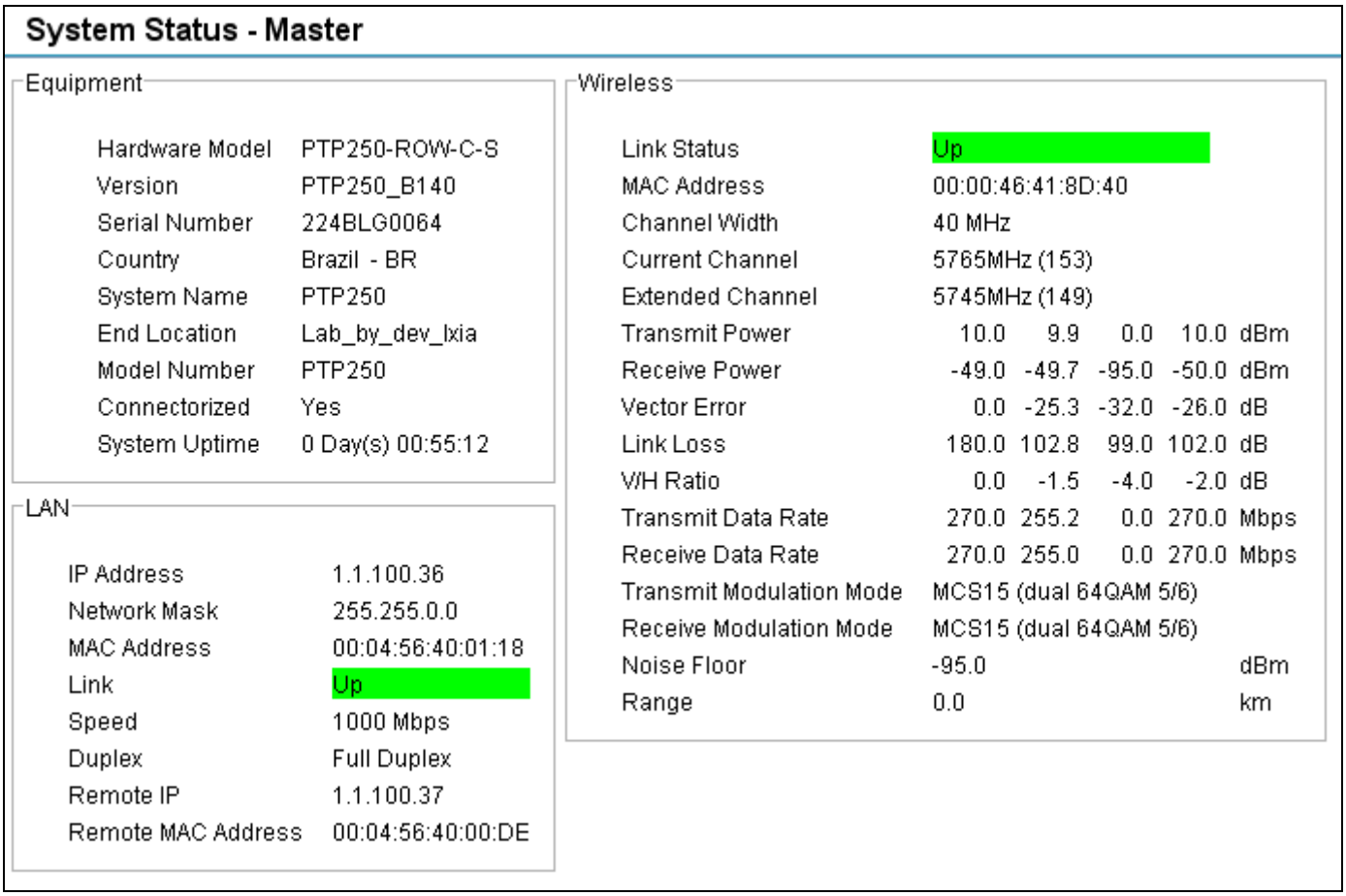
Attribute	Meaning
Admin Email Address	The email address configured for email alerts. This is set in the Installation Wizard; see Step 4: Email configuration on page 6-22.
PTP 250 Version	The currently running firmware version.
System Uptime	The time (days and hh:mm:ss) that has elapsed since the last system reboot. The system can reboot for several reasons, for example, commanded reboot from the Reboot PTP 250 webpage, or a power cycle of the equipment.
Serial Number	Serial number of this unit.
Current Time	The system clock presented as local time, allowing for zone and daylight saving. This is set in the Installation Wizard; see Step 3: Date and time settings on page 6-20.
Status attributes	Status attributes may be displayed in the System Summary page to indicate abnormal states.

Viewing the system status

To display the System Status page, select menu option **Status**.

The System Status page (Figure 7-5) gives the user a detailed view of the operation of the system from both the wireless and network perspectives.

Figure 7-5 System Status page



The page is subdivided into three sections:

- **Equipment**: This contains the unit's inventory and identification information.
- **LAN**: This describes the unit's network identity and connectivity.
- **Wireless**: This presents the key wireless metrics, which are displayed as a series of measurements.

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

The status page attributes are defined in Table 7-3, Table 7-4 and Table 7-5.

Table 7-3 System Status Equipment attributes

Attribute	Meaning
Hardware Model	Hardware model of this unit.
Version	The version of firmware installed. The format of the attributes is *250-xx-yy* where: *xx* is system release, *yy* minor system release.
Serial Number	Serial number of this unit.
Country	The country in which this unit is configured to operate. This is set at first login, as described in Logging into the web interface on page 6-6. This can only be reset by restoring the unit to factory default configuration, as described in Resetting to default configuration (with country reset) on page 7-26.
System Name	Name of this PTP 250 system. This is set in the Installation Wizard; see Step 2: Wireless configuration on page 6-17.
End Location	Location of this link end. This is set in the Installation Wizard; see Step 2: Wireless configuration on page 6-17.
Model Number	Model number of this unit.
Connectorized	'Yes' means that the unit is connectorized. 'No' means that the unit is integrated.
System Uptime	The time (days and hh:mm:ss) that has elapsed since the last system reboot. The system can reboot for several reasons, for example, commanded reboot from the Reboot PTP 250 webpage, or a power cycle of the equipment.

Table 7-4 System Status LAN attributes

Attribute	Meaning
IP Address	Internet protocol (IP) address. The factory default is 169.254.1.1, but it may be reset in the Installation Wizard; see Step 1: LAN configuration on page 6-15.
Network Mask	Defines the address range of the connected IP network. The factory default is 255.255.0.0, but it may be reset in the Installation Wizard; see Step 1: LAN configuration on page 6-15.
MAC Address	MAC address of the Ethernet LAN port of this unit. This is not user-configurable.
Link	The current status of the Ethernet link. A state of ‘Up’ with a green background indicates that an Ethernet link is established. Any status on a yellow background indicates that the Ethernet link is not established.
Speed	The negotiated speed (Mbps) of the Ethernet interface.
Duplex	Indicates whether the unit is transmitting data in full duplex or half duplex mode. Full duplex is expected in normal operation.

Table 7-5 System Status Wireless attributes

Attribute	Meaning
Link Status	Current status of the wireless link. A state of 'Up' on a green background indicates that a point-to-point link is established. Any status on a yellow background indicates that the wireless link is not established. Whenever the Link Status is not 'Up', a yellow warning triangle is displayed on the navigation bar. For more information, refer to Managing link status and alerts on page 7-15.
MAC Address	MAC address of the radio interface of this unit.
Channel Width	Width of the wireless channel, either 20 MHz or 40 MHz. This is set in the Installation Wizard; see Step 2: Wireless configuration on page 6-17.
Current Channel	The channel (MHz) in which this link operates. This is set in the Installation Wizard; see Step 2: Wireless configuration on page 6-17.
Extended Channel	The extended channel (MHz). This only applies when Channel Width is 40 MHz.
Transmit Power	The maximum, mean, minimum and latest measurements of Transmit Power (dBm). See Diagnostics calculated over time on page 7-23.
Receive Power	The maximum, mean, minimum and latest measurements of Receive Power (dBm). See Diagnostics calculated over time on page 7-23.
Vector Error	The maximum, mean, minimum and latest measurements of Vector Error (dB). See Diagnostics calculated over time on page 7-23. The vector error measurement compares the In-phase / Quadrature (IQ) modulation characteristics to an ideal signal to determine the composite error vector magnitude. Vector Error is expected to range from -2 dB (NLOS link operating at sensitivity limit on BPSK 0.50) to –27 dB (short LOS link running 64QAM 0.83). These are approximate values.

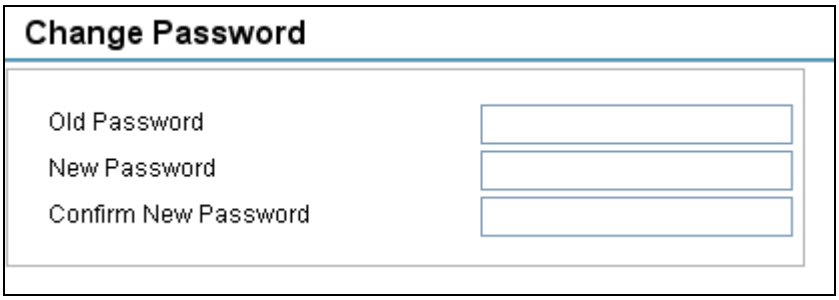
Attribute	Meaning
Link Loss	The maximum, mean, minimum and latest measurements of Link Loss (dB). See Diagnostics calculated over time on page 7-23. The link loss is the total attenuation of the wireless signal between the two point-to-point units. The link loss calculation presented below: $P_{ll} = P_{T_x} - P_{R_x} + g_{T_x} + g_{R_x}$ Where: P_{ll} = Link Loss (dB) P_{T_x} = Transmit power of the remote wireless unit (dBm) P_{R_x} = Received signal power at the local unit (dBm) g_{T_x}, g_{R_x} = Antenna gain at the remote and local units respectively (dBi). The antenna gain of the ODU (23.5 dBi) is used unless one or both of the units is a Connectorized version. For connectorized ODUs, the link loss calculation is modified to allow for the increased antenna gains at each end of the link.

Attribute	Meaning
V/H Ratio	The maximum, mean, minimum and latest measurements of V/H Ratio. See Diagnostics calculated over time on page 7-23. This is calculated from: Power received by the vertical antenna input (dB) ÷ Power received by the horizontal antenna input (dB) V/H Ratio is an aid to debugging a link. If it has a large positive or negative value, then investigate the following potential problems: An antenna coaxial lead may be disconnected. When spatial diversity is employed, the antenna with the lower value may be pointing in the wrong direction. When a dual polar antenna is deployed, the antenna may be directed using a side lobe rather than the main lobe. When there is a reflection from water on the link and spatial diversity is employed, then one expects large, slow swings in V/H Ratio. This indicates the antenna system is doing exactly as intended.
Transmit Data Rate	The maximum, mean, minimum and latest measurements of Transmit Data Rate (Mbps). See Diagnostics calculated over time on page 7-23.
Receive Data Rate	The maximum, mean, minimum and latest measurements of Receive Data Rate (Mbps). See Diagnostics calculated over time on page 7-23.
Transmit Modulation Mode	The modulation mode currently being used on the transmit channel.
Receive Modulation Mode	The modulation mode currently being used on the receive channel.
Noise Floor	The noise floor reported by the radio in this unit (dBm).
Range	The distance (km) between the two ODUs.

Changing password

To change the admin password, select menu option **Change Password**. The Change Password page is displayed (Figure 7-6). Enter and confirm the new password.

Figure 7-6 Change Password page



Logging out

To maintain security, always log out at the end of a session by selecting menu option **Logout**.

Alternatively, the unit will log out automatically, but this depends upon the setting of User Interface Timeout; see Step 3: Date and time settings on page 6-20.

Managing link status and alerts

This section describes how to manage PTP 250 link status and alerts.

This section contains the following procedures:

- Managing link status on page 7-15.
- Managing email alerts on page 7-16.

Managing link status

Whenever the Wireless Link Status is not 'Up', a yellow warning triangle is displayed on the navigation bar (Figure 7-7). The warning triangle is visible from all web pages. Click the warning triangle (or menu option **Home**) to return to the System Summary page and view the Wireless Link Status. If the warning triangle is replaced by a green square, it indicates that the Wireless Link Status is 'Up' (Figure 7-2).

The Wireless Link Status values are defined in Table 7-6.

Figure 7-7 Status warning triangle

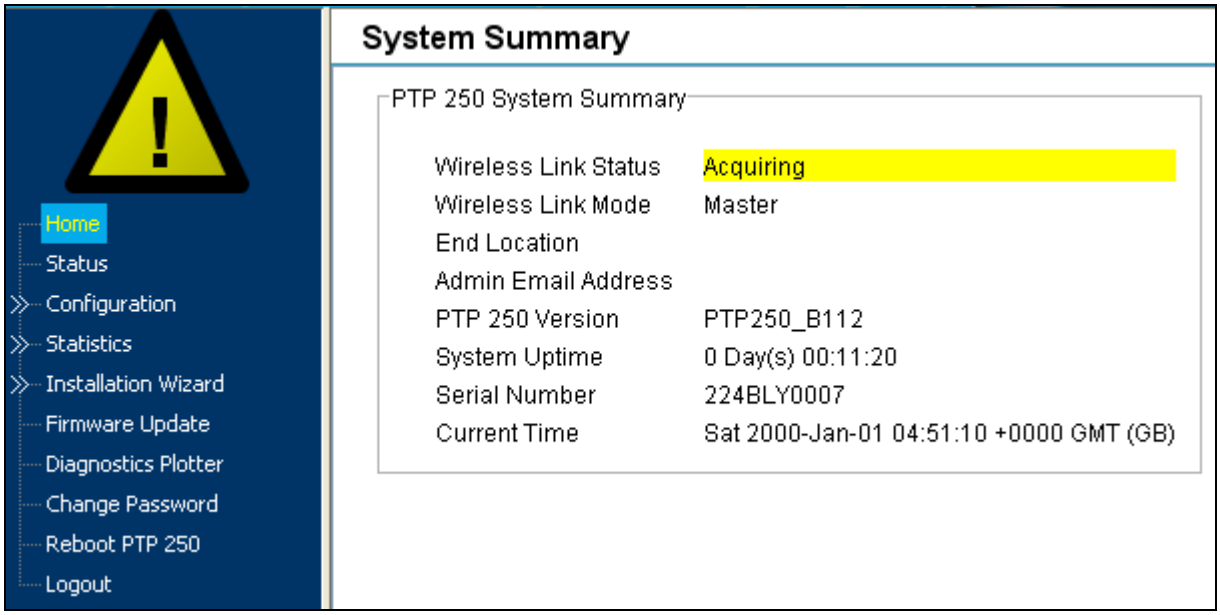


Table 7-6 Wireless Link Status attribute values

Value	Meaning
Up	The wireless link is up and running.
Registering	The wireless link is up, but not yet running (still handshaking, setting security and so on).
Acquiring	The Master unit is waiting for a slave. Only displayed at a Master unit.
Searching	At a Master unit: searching for a quality channel. At a Slave unit: searching for a Master.
Radar CAC	Radar Channel Availability Check (CAC) in progress.
Initializing	The unit is starting up or resetting (for example, for a configuration change or because radar has been detected).
No Channels	Radar CAC has determined that there are no useable channels.

Managing email alerts

The management agent can be configured to generate alerts by electronic mail when certain events occur. The email message configuration procedure is described in Step 4: Email configuration on page 6-22. The alerts are defined in Table 7-7.

Table 7-7 Email alerts

Alert	Meaning
Cold Start	The unit has rebooted.
Link Down	The link is down.
Link Up	The link is up.

Managing performance

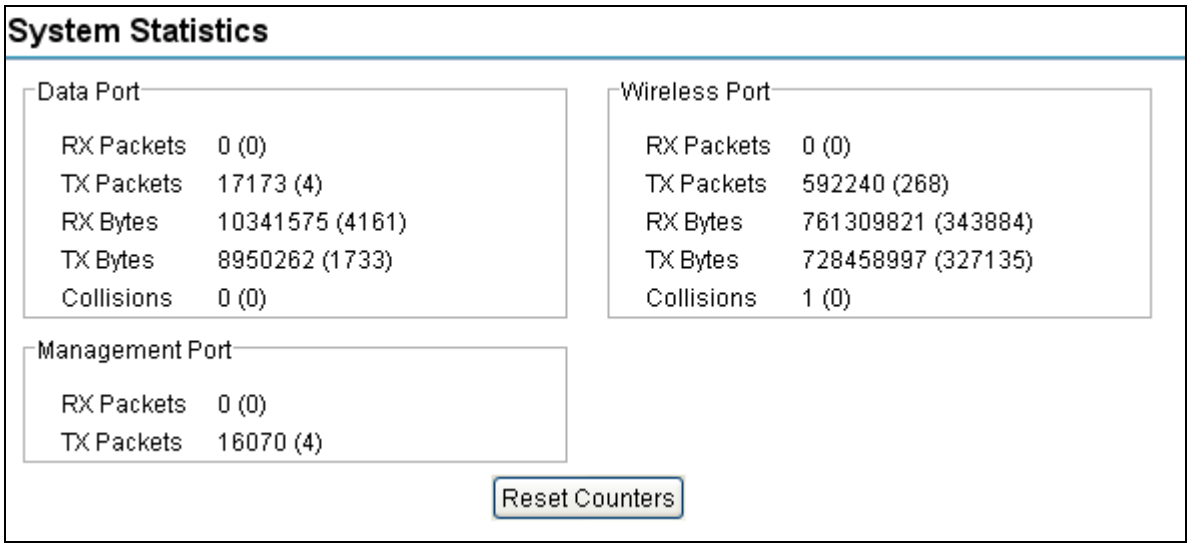
This section describes how to manage the performance of the PTP 250 link.

This section contains the following procedures:

Checking system statistics

To check system statistics, select menu option **Statistics**. The System Statistic page is displayed (Figure 7-8).

Figure 7-8 System Statistics page



The System Statistics page contains the following system counters:

- Data port counters (Table 7-8)
- Management port counters (Table 7-9)
- Wireless port counters (Table 7-10)

The packet counter attributes each contain a number in parentheses; this shows the number of packets received since the last page refresh. The page automatically refreshes every two seconds.

To reset all system counters to zero, select **Reset Counters**.

Table 7-8 Data Port Counter attributes in the System Statistics page

Attribute	Meaning
Rx Packets	The number of good and bad packets received from the local Ethernet interface.
Tx Packets	The number of good packets the bridge has sent for transmission by the local Ethernet interface.
Rx Bytes	The number of bytes received by the Ethernet interface.
Tx Bytes	The number of bytes transmitted by the Ethernet interface.
Collisions	The number of frames experiencing collisions in the local Ethernet interface.

Table 7-9 Management Port Counter attributes in the System Statistics page

Attribute	Meaning
Rx Packets	The total number of good packets the bridge has received from the internal stack (for example ARP responses, PING replies, HTTP responses).
Tx Packets	The total number of good packets the bridge has transmitted to the internal stack (for example, ARP requests, PING requests, HTTP requests).

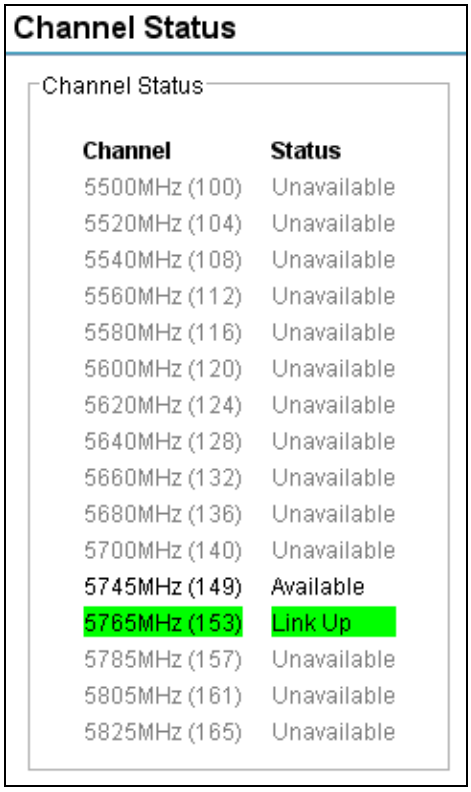
Table 7-10 Wireless Port Counter attributes in the System Statistics page

Attribute	Meaning
Rx Packets	The number of good packets the bridge has received from the wireless interface.
Tx Packets	The number of good packets the bridge has sent for transmission by the wireless interface.
Rx Bytes	The number of bytes received from the wireless interface.
Tx Bytes	The number of bytes transmitted by the wireless interface.

Checking channel status

To check channel status, select menu option **Statistics, Channel Status**. The Channel Status page is displayed (Figure 7-9).

Figure 7-9 Channel Status page

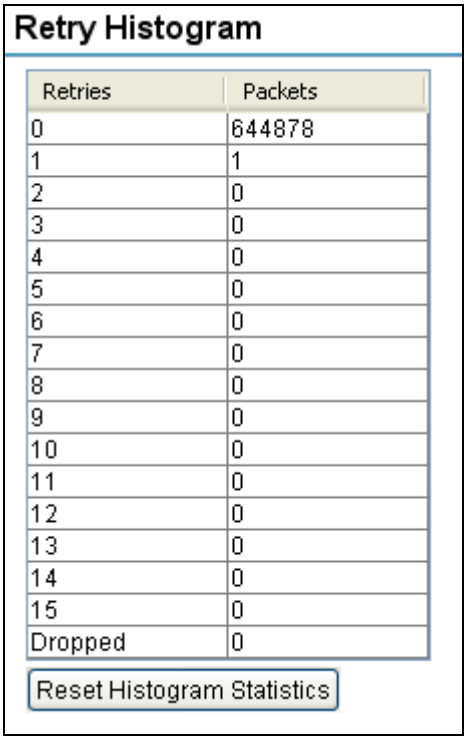


Checking the retry histogram

The retry histogram gives an indication of wireless quality. It records how many frames have been re-transmitted how many times. Valid values can vary; a short range LOS link should run with very few retries. A longer range nLOS link may run with up to 10% retries.

To check the retry histogram, select menu option **Statistics, Retry Histogram**. The Retry Histogram page is displayed (Figure 7-10).

Figure 7-10 Retry Histogram page



To reset all retry statistics, select **Reset Histogram Statistics**.

Using the diagnostics plotter

The Diagnostics Plotter page is used to plot key performance statistics against time.

To plot diagnostics, proceed as follows:

1	Select menu option **Diagnostics Plotter**. The Diagnostics Plotter page is displayed (Figure 7-11).
2	Use the Diagnostics Selector drop-down list to select a diagnostic type to plot.
3	Use the Trace Selection to select traces of the maximum, mean or minimum values of the diagnostic type. Maximum values are displayed in **blue**, mean values are displayed in **red** and minimum values are displayed in **green**.

Figure 7-11 Diagnostic Plotter page

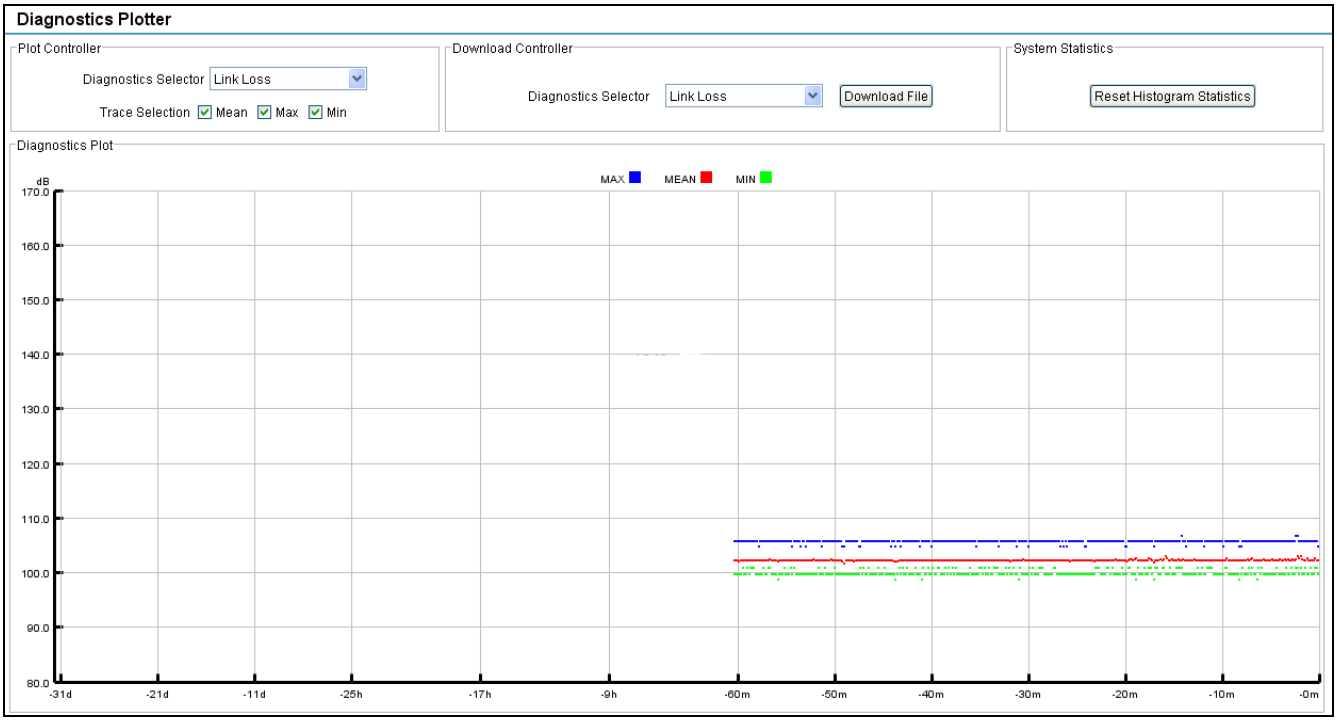


Table 7-11 Diagnostics Plotter attributes

Attribute	Meaning
Link Loss	Defined in Table 7-5.
Transmit Power	Defined in Table 7-5.
Receive Power	Defined in Table 7-5.
Receive Vector Error	Defined in Table 7-5.
Transmit Data Rate	Defined in Table 7-5.
Receive Data Rate	Defined in Table 7-5.
Aggregated Data Rate	The sum of the transmit and receive data rates (Mbps).
V/H Ratio	Defined in Table 7-5.

The maximum, mean, minimum and latest values of some of these statistics are also displayed on the System Status page. See Diagnostics calculated over time on page 7-23.

Downloading diagnostic data

To download a statistic to a CSV file, use the Download Controller. Select the statistic from the list and select **Download File**.

The CSV file contains at most 5784 entries, recorded over a 32 day period:

- 3600 entries recorded in the last hour.
- 1440 entries recorded in the previous 24 hours.
- 744 entries recorded in the previous 31 days.

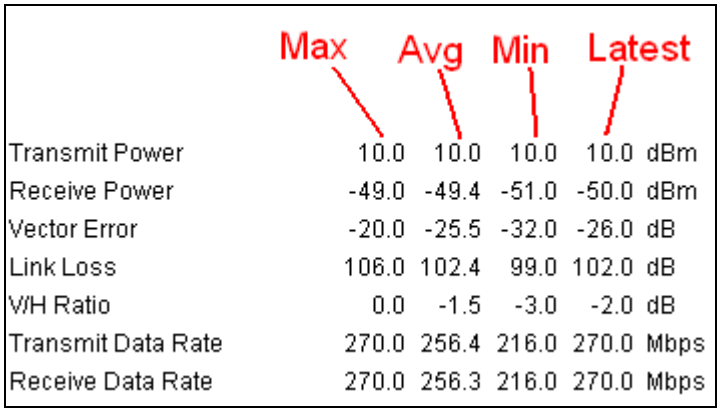
Resetting statistics

To reset all the statistics that are available in the Diagnostics Plotter page, select **Reset Histogram Statistics**.

Diagnostics calculated over time

The System Status page (Figure 7-5) contains seven diagnostic attributes that are calculated over time and presented as arrays of four elements (Figure 7-12).

Figure 7-12 Diagnostic attributes calculated over time



These attributes are defined in Table 7-5.

The element arrays represent the following:

- Max: The maximum value measured over the last hour.
- Avg: The mean of a set of values recorded at one second intervals over the last hour.
- Min: The minimum value measured the last hour.
- Latest: The latest value measured.

If the link has been running for less than one hour, then the values are calculated over the time that has elapsed since the link was established.

These attributes can be plotted against time, downloaded and reset by using the Diagnostics Plotter page, as described in Using the diagnostics plotter on page 7-21.

Restoring, resetting and rebooting

This section describes how to restore the system configuration, reset to defaults, recover the IP address and reboot the unit.

This section contains the following procedures:

Saving and restoring the configuration file

Save the configuration (by following the procedure in Saving the system configuration on page 6-11) in the following situations:

- Before and after upgrading the firmware version.
- Before replacing a faulty unit in the field.
- After the unit has been configured or reconfigured.

The restore is only guaranteed to work if the installed firmware version has not been changed since the configuration file was saved.

To restore the configuration file, proceed as follows:

1	Select menu option **Configuration**, **Save And Restore**. The Save & Restore Configuration page is displayed (Figure 6-11).
2	Select **Browse** and navigate to the PC folder containing the saved configuration file (.cfg). Select **Open**.
4	Select **OK** to confirm the restore. The configuration file is uploaded and used to reconfigure the unit to its previous state.

Resetting to default configuration (without country reset)

Use the Save & Restore page to reset the unit to factory default configuration, without resetting the country of operation (selected at first login).

CAUTION

When the unit is reset to default configuration, the current configuration is lost and the unit reboots, causing loss of service.

NOTE

To reset the unit to factory default configuration, including reset of the country that was selected at first login, follow the procedure in Resetting to default configuration (with country reset) on page 7-26.

To reset to default configuration without country reset, proceed as follows:

1	Select menu option **Configuration**, **Save And Restore**. The Save & Restore page is displayed (Figure 6-11).
2	Select **Reset to Default Configuration** and **Yes** to confirm.
3	Wait for at least 45 seconds.
4	The unit should now be reset to partial factory default settings, including the following: Password ‘motorola’, IP address ‘169.254.1.1’, Master Slave Status ‘Slave’. The Country Code (selected at first login) remains unchanged.
5	To reconfigure the unit, follow the instructions in Connecting to the unit on page 6-3 and Using the installation wizard on page 6-14. **NOTE** When logging into the unit, change Password (this will be prompted).

Resetting to default configuration (with country reset)

Use the reset plug (supplied in each PTP 250 ‘Link Complete’ or ‘End Complete’ kit) to reset the unit to factory default configuration, including reset of the country of operation (this will have to be reselected at first login after the reset).

CAUTION

When the unit is reset to default configuration, the current configuration is lost and the unit reboots, causing loss of service.

NOTE

To reset the unit to factory defaults without resetting the country of operation, follow the procedure in Resetting to default configuration (without country reset) on page 7-25.

To reset to default configuration including country reset, proceed as follows:

1	Remove the ODU drop cable from the PoE power supply DATA & POWER OUT port.
2	Plug the ODU drop cable into the reset plug and then plug the reset plug into the PoE power supply DATA & POWER OUT port (Figure 7-13).
3	Wait for at least 45 seconds.
4	Disconnect the reset plug and re-insert the ODU drop cable into the PoE power supply DATA & POWER OUT port.
5	The unit should now be reset to factory default settings, including the following: Password ‘motorola’, IP address ‘169.254.1.1’, Master Slave Status ‘Slave’, Country Code is blank.
6	To reconfigure the unit, follow the instructions in Connecting to the unit on page 6-3 and Using the installation wizard on page 6-14. **NOTE** When logging into the unit, change Password and select Country Code (these will be prompted).

Figure 7-13 Using the reset plug

NOTE

If the power supply is a PIDU, the PIDU reset switch WILL NOT work. The PTP 250 reset plug must be used.

Recovering a lost IP address

To recover a lost IP address, physical access to the PoE power supply is recommended.

NOTE

The unit does still respond to its normal IP address through a power cycle.

If the IP address of the unit has been lost or forgotten, proceed as follows:

1	Set the management PC Ethernet port to an IP address that is valid for the 169.254.X.X network, avoiding 169.254.0.0, 169.254.1.1 and 169.254.1.2. Refer to Configuring the management PC on page 6-3.
2	Connect the management PC Ethernet port to the DATA IN port of the PoE power supply using a standard (not crossed) Cat5e cable (Figure 6-3).
3	Perform a power cycle, that is, disconnect and then reconnect the PoE power supply to its AC supply.
4	Access the web interface within 30 seconds of powering on, using default IP address 169.254.1.1.
5	Select menu option **Configuration, LAN Configuration**.
6	Obtain the correct IP address of the unit from the LAN Configuration page.

Rebooting the unit

To reboot the ODU select menu option **Reboot PTP 250**. The Reboot Wireless Unit page is displayed (Figure 7-14). Select **Reboot PTP 250** to confirm.

Figure 7-14 Reboot Wireless Unit page

Chapter 8 Troubleshooting

This chapter contains procedures for identifying and correcting faults in a PTP 250 link. These procedures can be performed either on a newly installed link, or on an operational link if communication is lost, or after a lightning strike.

The following topics are described in this chapter:

- Testing link end hardware on page 8-2 describes how to test the link end hardware, either when it fails on startup, or after a lightning strike.
- Testing the radio link on page 8-12 describes how to test the link when there is no radio communication, or when it is unreliable, or when the data throughput rate is too low

Testing link end hardware

This section describes how to test the link end hardware, either when it fails on startup, or after a lightning strike.

Before testing link end hardware, confirm that all outdoor drop cables, that is those that connect the ODU to equipment inside the building, are of the supported type, as defined in Installation inventories on page 4-2.

NOTE

These tests apply to installations that use the PoE power supply. If the PIDU is installed instead of the PoE power supply, the test procedures will be different.

Testing when PoE LEDs do not illuminate correctly

If the DATA & POWER OUT and DATA IN LEDs do not illuminate correctly during the start-up sequence, test the link end as described in Test flowcharts on page 8-3 and the detailed test procedures that follow.

Testing after a lightning strike

If the installation has been struck by lightning, proceed as follows:

1	Test the link end as described in Test flowcharts on page 8-3 and the detailed test procedures that follow.
2	Ensure that the PoE power supply is working and that the resistances are correct as specified in Test resistance at the PoE end of the drop cable on page 8-10.
3	If the ODU is not working, power off the ODU and LPU and return them to Motorola.
4	If the ODU is working but there is suspicion of damage to the LPU, then refer to *LPU Operational Troubleshooting (phn-1362)*.

Test flowcharts

Figure 8-1 Link end hardware test flowchart #1

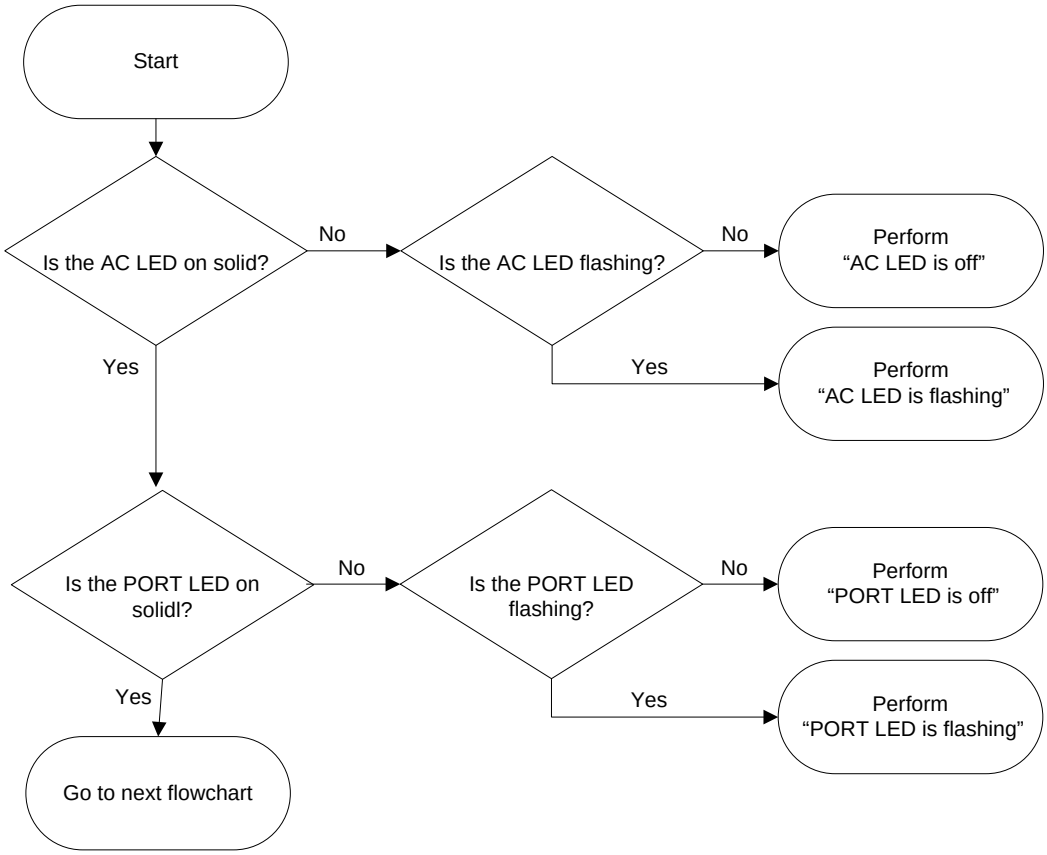
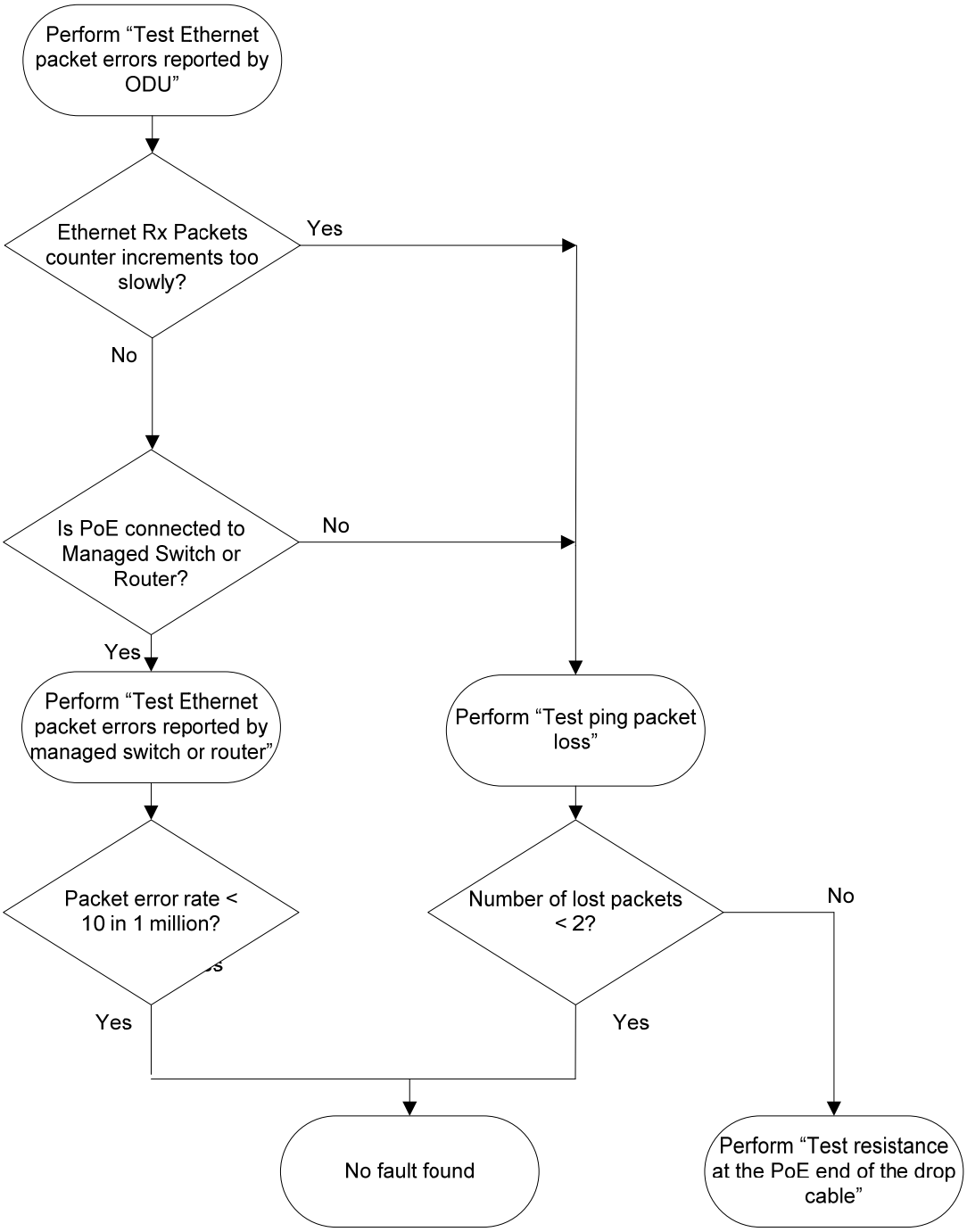


Figure 8-2 Link end hardware test flowchart #2



AC LED is off

If the AC LED is not on solid or flashing, proceed as follows:

1	Remove the power lead from the PoE power supply.
2	Test that the mains power supply is working.
3	If the mains power supply is not working, investigate the cause.
4	If the mains power supply is working, report a suspected PoE power supply fault to Motorola.

AC LED is flashing

If the green AC LED is flashing, proceed as follows:

1	Test that the voltage from the AC outlet that is within the correct range (100 – 240 V AC). If it is out of this range, investigate and correct the AC supply. Otherwise, proceed to step 2.
2	Remove and examine the cable that connects the PoE power supply to the LPU or ODU.
3	Check that the resistances are correct as specified in Test resistance at the PoE end of the drop cable on page 8-10.
4	If either check fails, replace or repair the cable that connects the PoE power supply to the LPU or ODU.

PORT LED is off

When the PoE power supply is connected to the power supply and the AC LED illuminates, there should be a 45 second delay, following which the PORT LED should illuminate (green steady).

If the PORT LED is off, proceed as follows:

1	Check that the RJ45 connection from the DATA IN port of the PoE power supply to the PC is working.
2	If the PC connection is working, remove and examine the cable that connects the PoE power supply to the LPU or ODU.
3	Check that the resistances are correct as specified in Test resistance at the PoE end of the drop cable on page 8-10.
4	If this test fails, replace or repair the cable that connects the PoE power supply to the LPU or ODU.

PORT LED is flashing

If the PORT LED is flashing, proceed as follows:

1	Remove and examine the cable that connects the PoE power supply to the LPU or ODU.
2	Check that the resistances are correct as specified in Test resistance at the PoE end of the drop cable on page 8-10.
3	Use the LPU (if installed) to check that power is available on the cable to the ODU. Access the connections by rotating the LPU lid as shown in Figure 8-3. Slacken the lid nut but do not remove it.
4	Test that test point P1 on the LPU PCB corresponds to pin 1 on the RJ45. Repeat for points P2 to P8. **NOTE** This test is only valid if both the PoE power supply and the ODU are disconnected.

5	Check that the PWR LED near the top right of the LPU PCB is illuminated to indicate power in the Ethernet cable (Figure 8-3).
6	If any test fails, replace or repair the cable that connects the PoE power supply to the LPU or ODU.

Figure 8-3 PTP LPU test points and PWR LED

Test Ethernet packet errors reported by ODU

To test for Ethernet packet errors, proceed as follows:

1	Log in to the unit and select menu option **Statistics**.
2	Select **Reset Counters** at the bottom of the page and wait until the Data Port Rx Packets counter has reached 1 million.
3	If the counter does not increment or increments too slowly, because for example the link is newly installed and there is no offered Ethernet traffic, then abandon this procedure and consider using the procedure Test ping packet loss on page 8-9.

Test Ethernet packet errors reported by managed switch or router

If the ODU is connected to a managed Ethernet switch or router, it may be possible to monitor the error rate of Ethernet packets. Please refer to the user guide of the managed network equipment.

The test has passed if the rate of packet errors reported by the managed Ethernet switch or router is less than 10 in 1 million packets.

Test ping packet loss

Using a computer, it is possible to generate and monitor packets lost between the PoE power supply and the ODU. This can be achieved by executing the Command Prompt application which is supplied as standard with Windows and Max OS X operating systems.

To test ping packet loss, proceed as follows:

1	Ensure that the IP address of the computer is configured appropriately for connection to the ODU under test, and does not clash with the IP addresses of other devices connected to the network.
2	If the PoE power supply is connected to an Ethernet switch or router then connect the computer to a spare port, if available.
3	If it is not possible to connect the computer to a spare port of an Ethernet switch or router, then the PoE power supply will need to be disconnected from the network in order to execute this test. **⚠ CAUTION** The following steps will disrupt network traffic carried by the ODU under test: Disconnect the PoE power supply from the network. Connect the computer directly to the LAN port of the PoE power supply.
4	On the computer, open the Command Prompt application.
5	Send 1000 ping packets of length 1500 bytes. The process will take 1000 seconds, which is approximately 17 minutes. If the computer is running a Windows operating system, this is achieved by typing: **`ping –n 1000 –l 1500 <ipaddress>`** where <ipaddress> is the IP address of the ODU under test. If the computer is running a MAC operating system, this is achieved by typing: **`ping –c 1000 –s 1492 <ipaddress>`** where <ipaddress> is the IP address of the ODU under test.

6	Record how many Ping packets have been lost. This is reported by Command Prompt on completion of the test. The test has passed if the number of lost packets is less than 2.

Test resistance at the PoE end of the drop cable

If the above procedures fail to diagnose the issue, there may be a fault in the wiring of the drop cable that connects the ODU (or LPU) to the PoE power supply. Perform this task to test the resistances between the RJ45 pins.

Use the PTP drop cable tester (Figure 8-4) to make testing easier. This can be ordered from http://www.motorola.com/ptp/support by selecting **Order Cable Tester** and completing the order form.

NOTE

The values printed on the PTP drop cable tester do not apply to the PTP 250.

Figure 8-4 Drop cable tester (front and back views)

Unplug the drop cable from the DATA & POWER OUT port of the PoE power supply. Connect the drop cable tester to the end of the drop cable. Then, perform the tests described in Table 8-1. Record the results in the Result column, if this is helpful.

Table 8-1 RJ45 cable resistance tests at the PoE power supply end

Step	Test	Result
1	Measure the resistance between pins 1 and 2.	Ohms
2	Measure the resistance between pins 3 and 6.	Ohms
3	Measure the resistance between pins 4 and 5.	Ohms
4	Measure the resistance between pins 7 and 8.	Ohms
5	Ensure that all the results of steps 1 to 4 are within 10% of each other as follows: Take the minimum result and multiply by 1.1. If any of the remaining steps 1 to 4 results are greater than this, the test has failed.	PASS or FAIL
6	Measure the resistance between pins 1 and 3. Subtract 0.2 Ohms.	Ohms
7	Measure the resistance between pins 4 and 7. Subtract 0.8 Ohms.	Ohms
8	Compare the results of steps 1 to 4 and steps 6 to 7 to the maximum allowed, that is 20 Ohms. If any of the steps 1 to 6 results are greater than the maximum allowed, the test has failed.	PASS or FAIL
9	Measure the resistance between pin 1 and the screen (ODU ground). If it is less than 100K ohms (regardless of cable length), the test has failed.	K Ohms PASS or FAIL
10	Measure the resistance between pin 8 and the screen (ODU ground). If it is less than 100K ohms (regardless of cable length), the test has failed.	K Ohms PASS or FAIL
11	Measure the resistance between pin 1 and pin 8. If it is less than 100K Ohms (regardless of cable length), the test has failed.	K Ohms PASS or FAIL

Testing the radio link

This section describes how to test the link when there is no radio communication, or when it is unreliable, or when the data throughput rate is too low. It may be necessary to test the ODUs at both ends of the link.

No activity

If there is no wireless activity, proceed as follows:

1	Select menu option **Home** and check Wireless Link Status on the System Summary page.
2	Check that the firmware at each end of the link is the same version.
3	Check Range and Transmit Power.
4	Check Master/Slave Mode for each unit and ensure that one unit is Master and the other unit is Slave.
5	Check that the link is not obstructed or the ODU misaligned.
6	Use the Channel Status web page at each end of the link to confirm that there is a quiet wireless channel to use. Refer to Checking channel status on page 7-19.
7	If there are no faults found in the configuration and there is absolutely no wireless signal, retry the installation procedure.
8	If this does not work then report a suspected ODU fault to Motorola.

Some activity

If there is some activity but the link is unreliable or does not achieve the data rates required, proceed as follows:

1	Use the Channel Status web page to check if a quieter channel is available and is enabled. Refer to Checking channel status on page 7-19.
2	Use the Diagnostics Plotter to check that reported Link Loss is low enough to allow the communication rates required. Refer to Using the diagnostics plotter on page 7-21.
3	Check that the ODU has not become misaligned.
4	Use the Retry Histogram to check the number of retries. An excessive number of retries (>10%) could indicate a problem. Refer to Checking the retry histogram on page 7-20.
5	Use the Diagnostics Plotter to check reported Receive Power at either end of the link. Ensure that this matches the predicted value from LINKPlanner. Refer to Using the diagnostics plotter on page 7-21.

Glossary

Term	Definition
ARP	Address Resolution Protocol
ATPC	Automatic Transmit Power Control
BPSK	Binary Phase Shift Keying
CAC	Channel Availability Check
CSP	Critical Security Parameter
DC	Direct Current
DER	Distinguished Encoding Rules
DFS	Dynamic Frequency Selection
EIRP	Equivalent Isotropic Radiated Power
ETSI	European Telecommunications Standards Institute
FAQ	Frequently Asked Question
FIPS	Federal Information Processing Standard
HTTP	Hypertext Transfer Protocol
ID	Identity
IEEE	Institute of Electrical and Electronic Engineers
IP	Internet Protocol
ISM	Industrial Scientific and Medical
ITPE	Initial Transmit Power Estimate
LAN	Local Area Network
LOS	Line-of-Sight (clear line-of-sight, and Fresnel zone is clear)
LPU	Lightning Protection Unit
MAC	Medium Access Control Layer

Term	Definition
MDI	Medium Dependent Interface
MDIX	Medium Dependent Interface Crossover
MIB	Management Information Base
NLOS	Non-Line-of-Sight
NMEA	National Marine Electronics Association
NTP	Network Time Protocol
ODU	Outdoor Unit
OFDM	Orthogonal Frequency Division Multiplex
PC	IBM Compatible Personal Computer
PoE	Power over Ethernet
PING	ICMP Echo Request
PTP	Point-to-Point
QAM	Quadrature Amplitude Modulation
RAM	Random Access Memory
RF	Radio Frequency
RSSI	Received Signal Strength Indication
SELV	Safety Extra Low Voltage
SMTP	Simple Mail Transport Protocol
SNMP	Simple Network Management Protocol
STP	Shielded Twisted Pair
STP	Spanning Tree Protocol
TCP	Transmission Control Protocol
TDD	Time Division Duplexing
URL	Universal Resource Location
UTP	Unshielded Twisted Pair
UV	Ultraviolet
VLAN	Virtual Local Area Network