



Prisma D-PON iW-2030 Optical Network Terminal Installation and Operation Guide

For Your Safety

Explanation of Warning and Caution Icons

Avoid personal injury and product damage! Do not proceed beyond any symbol until you fully understand the indicated conditions.

The following warning and caution icons alert you to important information about the safe operation of this product:

-  You may find this symbol in the document that accompanies this product. This symbol indicates important operating or maintenance instructions.
-  You may find this symbol affixed to the product. This symbol indicates a live terminal where a dangerous voltage may be present; the tip of the flash points to the terminal device.
-  You may find this symbol affixed to the product. This symbol indicates a protective ground terminal.
-  You may find this symbol affixed to the product. This symbol indicates a chassis terminal (normally used for equipotential bonding).
-  You may find this symbol affixed to the product. This symbol warns of a potentially hot surface.
-  You may find this symbol affixed to the product and in this document. This symbol indicates an infrared laser that transmits intensity-modulated light and emits invisible laser radiation or an LED that transmits intensity-modulated light.

Important

Please read this entire guide. If this guide provides installation or operation instructions, give particular attention to all safety statements included in this guide.

Notices

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Important Rules for Safe Operation

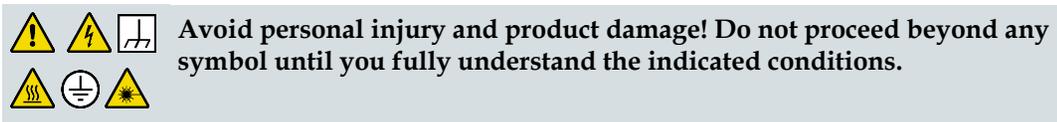
Read and Retain Instructions

Carefully read all safety and operating instructions before operating this equipment, and retain them for future reference.

Follow Instructions and Heed Warnings

Follow all operating and use instructions. Pay attention to all warnings and cautions in the operating instructions, as well as those that are affixed to this equipment.

Explanation of Warning and Caution Icons



Terminology

The terms defined below are used in this document. The definitions given are based on those found in safety standards.

Service Personnel - The term *service personnel* applies to trained and qualified individuals who are allowed to install, replace, or service electrical equipment. The service personnel are expected to use their experience and technical skills to avoid possible injury to themselves and others due to hazards that exist in service and restricted access areas.

User and Operator - The terms *user* and *operator* apply to persons other than service personnel.

Ground(ing) and Earth(ing) - The terms *ground(ing)* and *earth(ing)* are synonymous. This document uses *ground(ing)* for clarity, but it can be interpreted as having the same meaning as *earth(ing)*.

Electric Shock Hazard

Because of the potential for higher humidity, the presence of moisture, the proximity to ground potential and the possibility that hazardous voltages may be present on network connected cables, there is a greater risk of electric shock when working with electronic equipment in the outdoor environment.

To minimize the likelihood and effect of electric shock, follow the instructions in this warning and the precautions below.

Important Rules for Safe Operation



WARNING:

To reduce risk of electric shock, perform only the instructions that are included in the operating instructions. Refer all servicing to qualified service personnel only.

- Do not work in rain, fog or snow conditions.
- Ensure equipment and cables are dry.
- Wear shoes with soles made of insulated material e.g. rubber, vinyl, etc.
- When making electrical connections, work with one hand in your pocket and avoid accidental contact with grounded surfaces.
- Use insulated tools to make electrical connections.
- Make all other connections before connecting power to the equipment.

Installation

This equipment should be installed by qualified service personnel and should comply with national and local requirements.

Note to the Installer

Note to CATV System Installer (U.S.A. and Canada Only)

This reminder is provided to call the CATV system installer's attention to Article 820-40 of the NEC (Section 54, Part I of the Canadian Electrical Code), that provides guidelines for proper grounding and, in particular, specifies that the CATV cable ground shall be connected to the grounding system of the building, as close to the point of cable entry as practical.



This symbol is intended to alert you that uninsulated voltage within this product may have sufficient magnitude to cause electric shock. Therefore, it is dangerous to make any kind of contact with any inside part of this product.



CAUTION: To reduce the risk of electric shock, do not remove cover (or back). No user-serviceable parts inside. Refer servicing to qualified service personnel.

WARNING
**TO PREVENT FIRE OR ELECTRIC SHOCK,
DO NOT EXPOSE THIS UNIT TO RAIN OR
MOISTURE.**



This symbol is intended to alert you of the presence of important operating and maintenance (servicing) instructions in the literature accompanying this product.

Equipment Placement

**WARNING:**

Avoid personal injury and damage to this equipment. An unstable mounting surface may cause this equipment to fall.

To protect against equipment damage or injury to personnel, comply with the following:

- Place this equipment close enough to a mains AC outlet to accommodate the length of this equipment's power cord.
- Route all power cords so that people cannot walk on, place objects on, or lean objects against them. This may pinch or damage the power cords. Pay particular attention to power cords at plugs, outlets, and the points where the power cords exit this equipment.
- Make sure the mounting surface or rack is stable and can support the size and weight of this equipment.

Outdoor Equipment Placement

Equipment intended for outdoor installation is designed to be water-resistant, not water-proof. To protect against equipment damage or injury to personnel, install outdoor equipment so that it is:

- Protected from rain or accumulations of snow as much as possible.
- Not subject to direct water jets from sprinkler systems or garden hoses.
- Not subject to flooding.
- Positioned with cable connectors on the underside to minimize water entry by gravity.

Outdoor Equipment Cabling

To protect outdoor equipment cables, comply with the following:

- Protect cables from chaffing and sharp edges when routing them through building walls or around corners.
- Provide adequate support for cables to prevent strain or sagging.
- Provide a low loop in the cable close to its connection point to the equipment to minimize water ingress and to provide strain relief for the connector.
- Seal outdoor cable/connector joints against moisture ingress using silicone caulk or outdoor sealing tape..

Ventilation



WARNING:

Avoid electric shock and fire hazard! Never push objects through the openings in this equipment. Foreign objects can touch dangerous voltage points or cause electrical shorts that can result in electric shock or fire.

This equipment may have openings for ventilation that protect it from overheating. To ensure the reliability of this equipment, do not obstruct the openings.

- Do not place other equipment, lamps, books, or other objects on top of this equipment.
- Do not place this equipment in any of the following locations.
 - On a bed, sofa, rug, or similar surface
 - Over a radiator or a heat register
 - In an enclosure, such as a bookcase or equipment rack, unless the installation provides proper ventilation

Handling Precautions

When moving a cart that contains this equipment, check for any of the following possible hazards:



WARNING:



Avoid personal injury and damage to this equipment! Move any equipment and cart combination with care. Quick stops, excessive force, and uneven surfaces may cause this equipment and cart to overturn.

Cleaning the Equipment

Before cleaning this equipment, unplug it from the electrical outlet. Use a damp cloth to clean this equipment. Do not use a liquid cleaner or an aerosol cleaner. Do not use a magnetic/static cleaning device (dust remover) to clean this equipment.

Object and Liquid Entry

Never push objects of any kind into this equipment through openings as they may touch dangerous voltage points or short out parts that could result in a fire or electric shock. Do not expose this equipment to liquid or moisture. Do not place this equipment on a wet surface. Do not spill liquids on or near this equipment.

Overloading

Do not overload electrical outlets, extension cords, or integral convenience receptacles, as this can result in a risk of fire or electric shock. For equipment that requires battery power or other sources to operate, refer to the operating instructions for that equipment.

Lightning and Power Surges

To protect this equipment against damage from lightning storms and power-line surges, do the following:

- Disconnect the power cord from the grounded mains electrical outlet and disconnect the antenna or cable system under the following circumstances.
 - During lightning storms, or
 - When you are not using this equipment for an extended period
- Ground your antenna system to provide some protection against voltage surges and built-up static charge.

Power Sources



WARNING:

Avoid electric shock and fire hazard! Do not overload electrical outlet and extension cords. For equipment that requires battery power or other sources to operate, refer to the operating instructions for that equipment.

- A label on this equipment indicates the correct power source for this equipment. Operate this equipment only from an electrical outlet with the voltage and frequency indicated on the equipment label.
- If this equipment plugs into an outlet, the outlet must be near this equipment, and must be easily accessible.
- This equipment may have two power sources. Be sure to disconnect all power sources before working on this equipment.
- If this equipment **does not** have a main power switch, the power cord connector serves as the disconnect device.
- Always pull on the plug or the connector to disconnect a cable. Never pull on the cable itself.
- Unplug this equipment if it will be unused for long periods of time.
- If you are uncertain of the type of power supply to your home or business, consult your local power company.

Grounding

This section provides instructions for verifying that the equipment is properly grounded.

Safety Plugs (USA Only)

This equipment may be equipped with either a 3-terminal (grounding-type) safety plug or a 2-terminal (polarized) safety plug. The wide blade or the third terminal is provided for safety. Do not defeat the safety purpose of the grounding-type or polarized safety plug.

To properly ground this equipment, follow these safety guidelines:

- **Grounding-Type Plug** - For a 3-terminal plug (one terminal on this plug is a protective grounding pin), insert the plug into a grounded mains, 3-terminal outlet.
Note: This plug fits only one way. If this plug cannot be fully inserted into the outlet, contact an electrician to replace the obsolete 3-terminal outlet.
- **Polarized Plug** - For a 2-terminal plug (a polarized plug with one wide blade and one narrow blade), insert the plug into a polarized mains, 2-terminal outlet in which one socket is wider than the other.
Note: If this plug cannot be fully inserted into the outlet, try reversing the plug. If the plug still fails to fit, contact an electrician to replace the obsolete 2-terminal outlet.

Grounding Terminal

If this equipment is equipped with an external grounding terminal, attach one end of an 18-gauge wire (or larger) to the grounding terminal; then, attach the other end of the wire to a ground, such as a grounded equipment rack.

Safety Plugs (European Union)

- **Class I Mains Powered Equipment** - Provided with a 3-terminal AC inlet and requires connection to a 3-terminal mains supply outlet via a 3-terminal power cord for proper connection to the protective ground.
Note: The equipotential bonding terminal provided on some equipment is not designed to function as a protective ground connection.
- **Class II Mains Powered Equipment** - Provided with a 2-terminal AC inlet that may be connected by a 2-terminal power cord to the mains supply outlet. No connection to the protective ground is required as this class of equipment is provided with double or reinforced and/or supplementary insulation in addition to the basic insulation provided in Class I equipment.
Note: Class II equipment, which is subject to EN 50083-1, is provided with a chassis mounted equipotential bonding terminal. See the section titled **Equipotential Bonding** for connection instructions.

Equipotential Bonding

If this equipment is equipped with an external chassis terminal marked with the IEC 60417-5020 chassis icon () , the installer should refer to CENELEC standard EN 50083-1 or IEC standard IEC 60728-11 for correct equipotential bonding connection instructions.

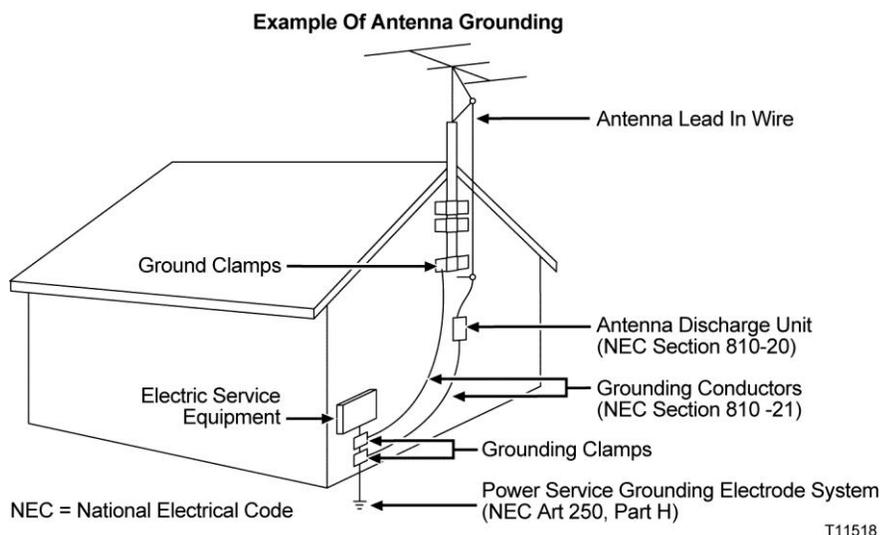
Outdoor Grounding System

If this equipment connects to an outdoor antenna or cable system, be sure the antenna or cable system is grounded. This provides some protection against voltage surges and built-up static charges.

Section 810 of the National Electric Code (NEC), ANSI/NFPA No. 70-1999, provides the following information:

- Grounding of the mast and supporting structure
- Grounding the lead-in wire to an antenna discharge unit
- Size of the grounding conductors
- Location of the antenna-discharge unit
- Connection to grounding electrodes
- Requirements for the grounding electrodes

For European Union countries, refer to CENELEC standard EN 50083-1 for grounding information.



Servicing



WARNING:

Avoid electric shock! Opening or removing this equipment's cover may expose you to dangerous voltages.

Do not open the cover of this equipment. Refer all servicing to qualified personnel only. Contact us for instructions.

Damage that Requires Service

For damage that requires service, unplug this equipment from the electrical outlet. Refer service to qualified service personnel when any of the following occurs:

- There is damage to the power cord or plug
- Liquid enters the equipment
- A heavy object falls on the equipment
- Operation is not normal (the instructions in this manual describe proper operation)
- If you drop this equipment, or damage the cabinet of this equipment
- If this equipment exhibits a distinct change in performance

Upon completion of any service or repairs to this equipment, ask the service technician to perform safety checks to determine that the equipment is in proper operating condition.



CAUTION:

Avoid damage to this equipment! Adjust only what the operating instructions describe. Improper adjustment of controls may result in damage that may require extensive corrective work by qualified service personnel.

Replacement Parts

When replacement parts are required, be sure that qualified service personnel use factory-specified parts or parts having the same characteristics as those specified. Unauthorized substitutions may result in fire, electric shock, or other hazards.

Safety Check

Upon completion of any service or repairs to this equipment, ask the service technician to perform safety checks to determine that this equipment is in proper operating condition.

Modifications

This equipment has been designed and tested to comply with applicable safety, laser safety, and EMC regulations, codes, and standards to ensure safe operation in its intended environment. Refer to this equipment's data sheet for details about regulatory compliance approvals.

Do not make modifications to this equipment. Any changes or modifications could void the user's authority to operate this equipment.

Modifications have the potential to degrade the level of protection built into this equipment, putting people and property at risk of injury or damage. Those persons making any modifications expose themselves to the penalties arising from proven non-compliance with regulatory requirements and to civil litigation for compensation in respect of consequential damages or injury.

Accessories

Use only attachments or accessories specified by the manufacturer.



CAUTION:

Maintain electrical safety! Power-operated equipment or accessories that you connect to this equipment should bear the UL listing mark or CSA certification mark on the accessory itself, and should not be modified so as to defeat the safety features. This will help avoid any potential for electric shock or fire. If in doubt, contact qualified service personnel.

Mounting Accessories



CAUTION:

Use this equipment only with a cart, stand, bracket, table, or other mounting accessories that meet Cisco specifications. Carefully follow all instructions for proper mounting.

Electromagnetic Compatibility Regulatory Requirements

This equipment meets applicable electromagnetic compatibility (EMC) regulatory requirements. Refer to this equipment's data sheet for details about regulatory compliance approvals. EMC performance is dependent upon the use of correctly shielded cables of good quality for all external connections, except the power source, when installing this equipment.

- Ensure compliance with cable/connector specifications and associated installation instructions where given elsewhere in this manual.

Otherwise, comply with the following good practices:

- Multi-conductor cables should be of single-braided, shielded type and have

Important Rules for Safe Operation

conductive connector bodies and backshells with cable clamps that are conductively bonded to the backshell and capable of making 360° connection to the cable shielding. Exceptions from this general rule will be clearly stated in the connector description for the excepted connector in question.

- Ethernet cables should be of single-shielded or double-shielded type.
- Coaxial cables should be of the double-braided shielded type.

EMC Compliance Statements

Where this equipment is subject to USA FCC and/or Industry Canada rules, the following statements apply:

FCC Statement for Class B Equipment

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. 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 receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Industry Canada - Industrie Canadienne Statement

This apparatus complies with Canadian ICES-003.
Cet appareil est conforme à la norme NMB-003 du Canada.

CENELEC/CISPR Statement with Respect to Class A Information Technology Equipment

This is a Class A equipment. In a domestic environment this equipment may cause radio interference in which case the user may be required to take adequate measures.

Laser Safety

Introduction

This equipment contains an infrared laser that transmits intensity-modulated light and emits invisible radiation.

Warning: Radiation



WARNING:

- **Avoid personal injury! Use of controls, adjustments, or procedures other than those specified herein may result in hazardous radiation exposure.**
 - **Avoid personal injury! The laser light source on this equipment (if a transmitter) or the fiber cables connected to this equipment emit invisible laser radiation. Avoid direct exposure to the laser light source.**
 - **Avoid personal injury! Viewing the laser output (if a transmitter) or fiber cable with optical instruments (such as eye loupes, magnifiers, or microscopes) may pose an eye hazard.**
- Do not apply power to this equipment if the fiber is unmated or unterminated.
 - Do not stare into an unmated fiber or at any mirror-like surface that could reflect light emitted from an unterminated fiber.
 - Do not view an activated fiber with optical instruments (e.g., eye loupes, magnifiers, microscopes).
 - Use safety-approved optical fiber cable to maintain compliance with applicable laser safety requirements.

Warning: Fiber Optic Cables



WARNING:

Avoid personal injury! Qualified service personnel may only perform the procedures in this manual. Wear safety glasses and use extreme caution when handling fiber optic cables, particularly during splicing or terminating operations. The thin glass fiber core at the center of the cable is fragile when exposed by the removal of cladding and buffer material. It easily fragments into glass splinters. Using tweezers, place splinters immediately in a sealed waste container and dispose of them safely in accordance with local regulations.

Safe Operation for Software Controlling Optical Transmission Equipment

If this manual discusses software, the software described is used to monitor and/or control ours and other vendors' electrical and optical equipment designed to transmit video, voice, or data signals. Certain safety precautions must be observed when operating equipment of this nature.

For equipment specific safety requirements, refer to the appropriate section of the equipment documentation.

For safe operation of this software, refer to the following warnings.



WARNING:

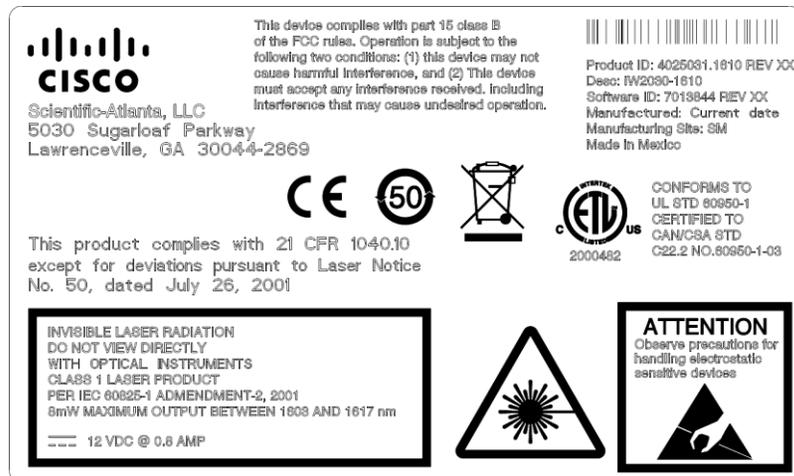
- **Ensure that all optical connections are complete or terminated before using this equipment to remotely control a laser device. An optical or laser device can pose a hazard to remotely located personnel when operated without their knowledge.**
- **Allow only personnel trained in laser safety to operate this software. Otherwise, injuries to personnel may occur.**
- **Restrict access of this software to authorized personnel only.**
- **Install this software in equipment that is located in a restricted access area.**

Laser Warning Labels

The following labels are located on this product.

Laser Radiation
Caution Label

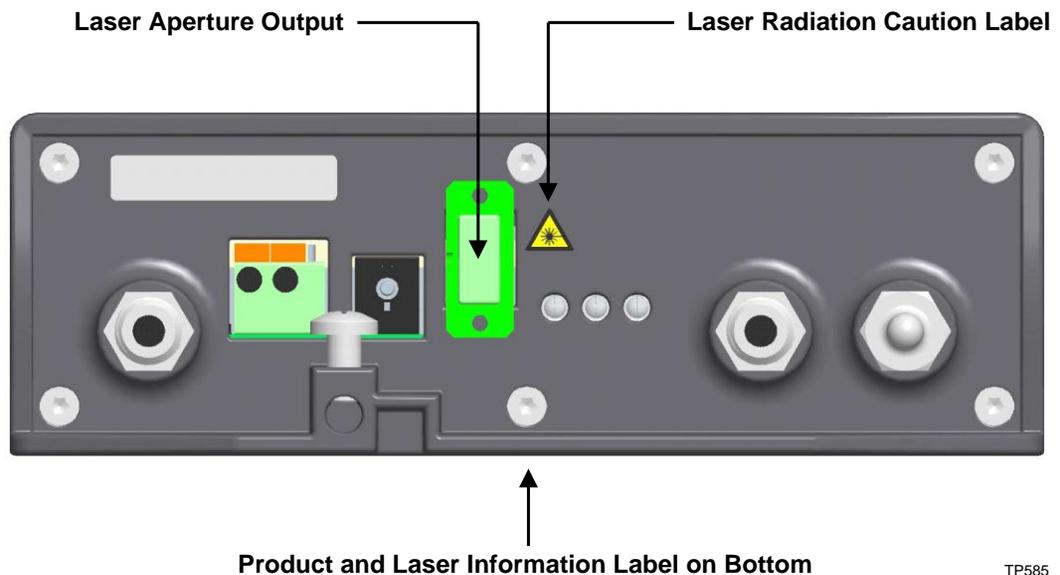
Product and Laser
Information Label



TP581

Location of Labels on Equipment

The following illustration shows the locations of warning labels on this equipment.



TP585

1

Introduction

Overview

This chapter describes the Prisma D-PON iW-2030 optical network terminal (ONT). The D-PON ONT is an indoor customer premises device that serves as the subscriber endpoint of the Prisma D-PON fiber-to-the-home (FTTH) network solution.

Purpose

This guide provides information about the Prisma D-PON iW-2030 ONT.

Who Should Use This Document

This document is intended for authorized service personnel who have experience working with similar equipment. The service personnel should have appropriate background and knowledge to complete the procedures described in this document.

Qualified Personnel

Only appropriately qualified and skilled personnel should attempt to install, operate, maintain, and service this product.



WARNING:

Only appropriately qualified and skilled personnel should attempt to install, operate, maintain, and service this product.

Scope

This guide discusses the following topics.

- Description of the D-PON ONT
- Installation procedures
- Maintenance and troubleshooting
- Customer support information

Document Version

This is the fourth release of this guide.

In This Chapter

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■ Product Identification	6
■ D-PON ONT Operation	9

Related Publications

You may find the following publications useful as you implement the procedures in this document.

- *Prisma D-PON Dual Receiver Installation and Operation Guide*, part number 4028195
- *Prisma D-PON System Installation and Operation Guide*, part number 4030614

Description

Prisma D-PON products make up a complete fiber-to-the-home (FTTH) solution specifically designed for RF- and DOCSIS-based service providers. This solution provides the benefits of a FTTH passive optical network and allows for incremental network growth while maintaining an existing hybrid fiber-coax (HFC) network back-office infrastructure. The Prisma D-PON system is capable of supporting four 64 QAM bonded DOCSIS 3.0 channels in the upstream over a 28 dB link budget (measured at 1310 nm).

The D-PON ONT is the subscriber endpoint of the D-PON FTTH network solution. It provides the RF interface for a DOCSIS cable modem-based system. This open-standards design allows the unit to work with network equipment from multiple vendors.

The D-PON ONT includes a coax interface for broadcast DOCSIS and video, which provides a simple and widely-used method for connection to traditional cable television. This helps network operators to quickly roll out services and avoid possible customer objections to a new and unfamiliar interface.

The D-PON ONT offers the following key benefits:

- Single-fiber solution for DOCSIS data, DOCSIS VOIP, and RF analog and digital video
- Installer-friendly fiber management system
- Automatic gain control (AGC) based on optical input
- Based on open standards; transparent to end users

Features

The D-PON ONT has the following main physical features:

- Extruded aluminum enclosure with integral mounting tabs
- Dedicated fiber tray provides fiber management and tamper protection for connectors
- Fiber tray has mounting bracket for a wavelength pass-through filter or for a single splice
- Three power input options: coax, spring-loaded terminal lugs, 2 mm mini-jack
- Three status LEDs indicate power on, receive power, and laser operation
- 1 SC-APC PON fiber-optic adapter
- 1 RF video connector (75 Ω F connector)
- 1 RF test point at -10 dB (75 Ω F connector)
- Earth grounding lug

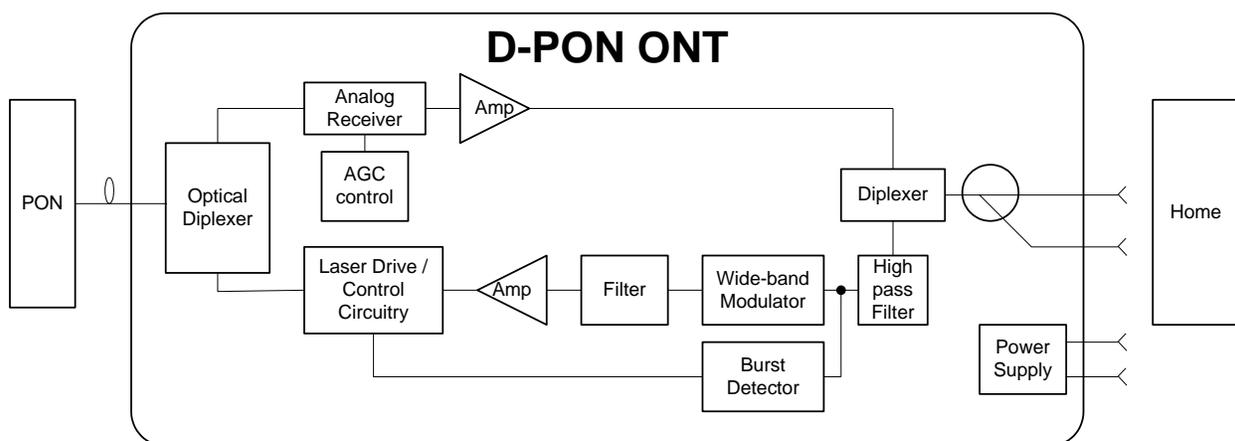
Laser Warning



WARNING:

Avoid damage to your eyes! Do not look into any optical connector while the system is active. Even if the unit is off, there may still be hazardous optical levels present.

D-PON ONT Block Diagram



TP586

Product Identification

D-PON ONT Illustration



TP587

D-PON ONT Front Panel

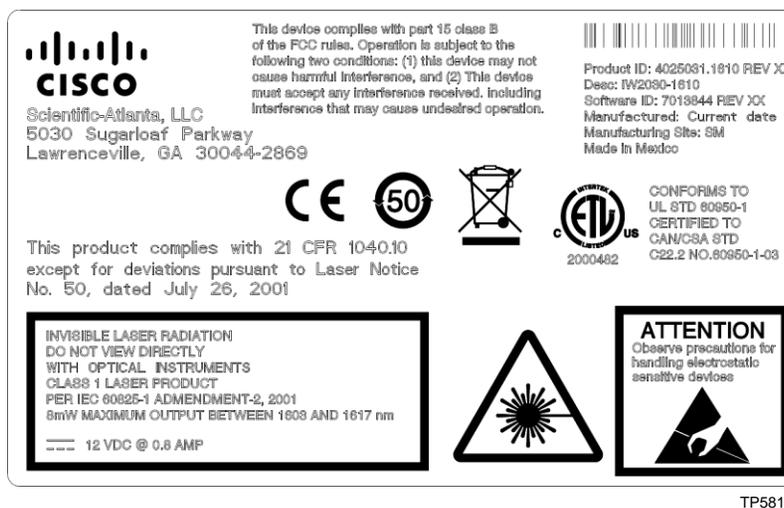
Part	Description
+12 VDC female F connector	Accepts DC input power over coaxial cable.
+/- 12 VDC spring-loaded terminal lugs	Spring-loaded connectors for twisted-pair DC cabling.
+12 VDC 2 mm cylindrical jack	Accepts power plug from the AC-DC power supply (sold separately).
PWR ON Indicator	Green ON - DC is applied to any DC connector and the processor is active. Green Blinking - DC is applied to any DC connector and a fault is detected.
RCV PWR Indicator	Green ON - Optical input power is within a predefined window. Green Blinking - Optical input power exceeds a predefined upper threshold level. OFF - Optical input power falls below a predefined lower threshold level.
LASER ON Indicator	Green ON - Laser enabled.
PON SC-APC Adapter	Provides bidirectional optical network connection.
RF TEST (female F connector)	Provides -10 dB test point for RF transmissions.
RF (female F connector)	Provides bidirectional residential RF connection.
Ground Lug	Provides chassis ground connection for D-PON ONT when required by local electrical code.

Identification Label

Cisco products are identified by means of an ID label affixed to the unit. The ID label provides the following information:

- Product ID numbers
- Date and place of manufacture
- Nominal DC power supply voltage and current
- Laser radiation and electrostatic discharge (ESD) cautions
- FCC compliance and product safety certifications
- Optical output and wavelengths used

The following illustration shows an example of the ID label for this product.



Note: Before operating the unit, always check the ID label for voltage and current requirements.

D-PON ONT Operation

The D-PON ONT is the subscriber component of a D-PON system. Prisma II D-PON transmitter, amplifier, and receiver modules, installed at the headend or hub, support communication with the D-PON ONT to complete the Prisma D-PON solution.

When located at the subscriber residence, wavelength-division multiplexing (WDM) circuits allow the D-PON ONT to exchange downstream and upstream optical signals with the network at the same time over a single fiber connection. Similarly, the D-PON ONT exchanges electrical signals with subscriber equipment in both directions over a single RF connection.

Downstream Reception

The D-PON ONT receives the downstream analog-modulated 1550 nm optical signal from the headend. An optical diplexer in the D-PON ONT separates this signal from upstream optical signals.

A receiver in the unit converts the downstream optical signal to an analog RF electrical signal. The RF signal is amplified, passed through an RF duplex filter and RF test point, and then sent to the residence over an F-style connector.

Upstream Transmission

The D-PON ONT also receives an upstream RF analog signal from the subscriber. An RF duplex filter in the unit separates this signal from the downstream RF signal. The upstream RF signal is passed through a wideband modulator, a filter, an amplifier, and then input to a laser driver and control circuits. These circuits convert the signal to an analog-modulated optical signal at 1610 nm. This optical signal passes through an optical diplexer to separate it from the downstream 1550 nm signal before being sent upstream to the headend or hub.

The upstream information is sent in standard DOCSIS 1.0, 1.1, 2.0, or 3.0 format. Each D-PON ONT can transmit four 6.4 MHz, 64 QAM DOCSIS upstream channels. The cable modem termination system (CMTS) at the headend provides timing and control to ensure that only one ONT transmits at a time.

CMTS Gain Control

The upstream signal is wideband-modulated and used to modulate the optical signal that is transmitted to the headend or hub. Changes in link loss do not affect the receiver output level, but changes in input signal level are reflected. DOCSIS controls the modem output level so that the CMTS input remains fixed. With fixed link gain, the D-PON ONT input level is held constant by the long-loop AGC of the CMTS.

Power Supply

The D-PON ONT is powered from an external +12 VDC, 1A power supply. Power is applied to one of three inlets: coaxial F connector, spring-loaded terminal lugs, or 2 mm barrel-type mini jack.

The AC-to-DC power supply option provides +12 VDC from standard 90-132VAC 60Hz utility power through the 2 mm mini jack.

The coaxial F connector power option is provided for use in CATV installations that supply +12 VDC over coax. Likewise, the spring-loaded terminal lugs are provided for use in battery backup installations that provide +12 VDC over a twisted pair, typically from an uninterruptible power supply (UPS).

Note: The D-PON ONT has no internal backup battery, so backup power for voice over IP (VoIP) or other critical applications must be provided externally.

2

Installation

Introduction

This chapter provides instructions for installing the D-PON ONT with or without fiber tray on a wall or other mounting surface at the customer site. It also describes the site requirements, equipment, and tools needed for installation.

Important: Before beginning the installation, read this chapter in its entirety and confirm that you fully understand all safety guidelines and precautions as well as all necessary procedures.



WARNING:

Only appropriately qualified and skilled personnel should attempt to install, operate, maintain, and service this product. Otherwise, personal injury or equipment damage may result.

In This Chapter

- Before You Start 12
- Mounting the D-PON ONT With Fiber Tray 17
- Mounting the D-PON ONT Without Fiber Tray 24
- Making Signal Connections..... 26
- Connecting Power 28

Before You Start

Make sure that the unit is in good condition and that you have the tools and equipment needed.

Unpack and Inspect the Unit

As you unpack the D-PON ONT, inspect it for shipping damage. If you find any damage, contact Customer Service. Refer to *Customer Support Information* (on page 41) for contact information.

Verify Shipping Carton Contents

Verify that the shipping carton contains all parts supplied:

- D-PON ONT unit
- Information sheet (white)
- Fiber-optic cleaning instruction sheet (pink)

Verify Accessories

Verify that the following accessories are on hand as needed for installation.

- Fiber tray with fiber cover
- External Multimedia over Coax Alliance (MoCa) filter (Europe only)
- External 12 VDC power supply configured for ONE of the following connection methods:
 - Spring-loaded terminal lugs
 - Coax (F connector)
 - 2 mm mini-jack



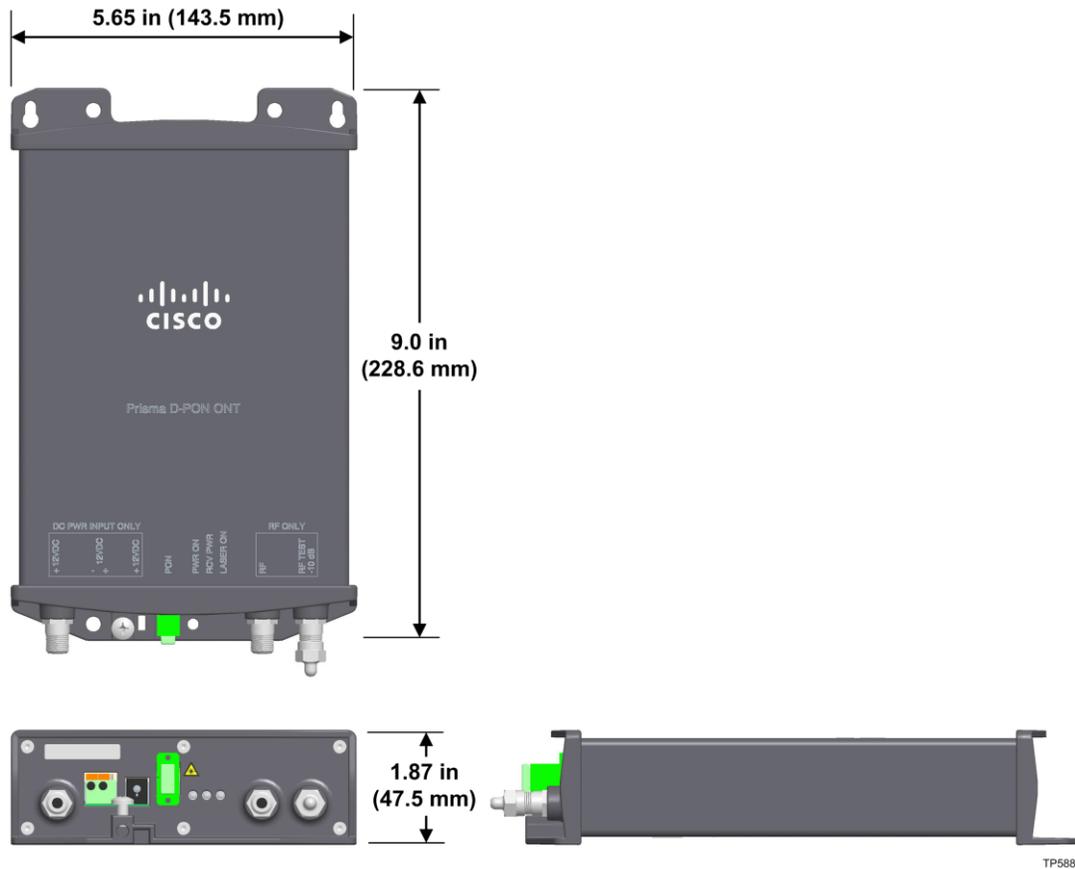
CAUTION:

This product is intended to be supplied by a Nationally Recognized Testing Laboratory (NRTL) Listed power source marked "Class 2" or "LPS" and rated 12 VDC, 800 mA.

Use only one of the three methods provided to connect DC power. Connecting multiple DC power sources to the D-PON ONT may cause permanent damage to the unit.

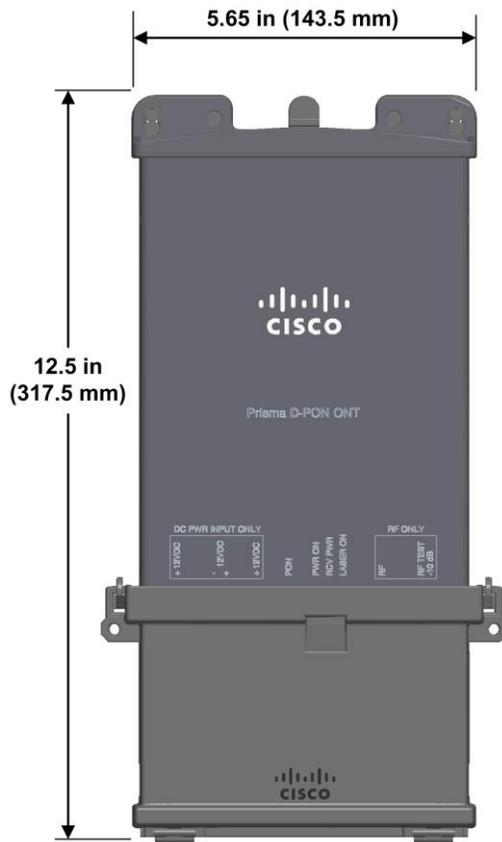
Housing Dimensions

The following illustration shows the housing dimensions of the D-PON ONT itself.



The unit is normally mounted to a fiber handling tray. The fiber tray, in turn, is mounted to the wall of the customer premises.

The following illustration shows the overall dimensions of the D-PON ONT with its fiber tray assembly.



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Space Considerations

Observe the following guidelines for mounting the D-PON ONT:

- Choose a mounting location that will facilitate installation and maintenance.
- Choose a location that will allow for secure mounting and reliable operation.
- Avoid locations that are physically unstable or involve other hazards.

Note: We recommend using the fiber tray for slack storage of fiber whenever space allows. The fiber tray enforces the use of proper fiber bend radius, and the fiber tray cover provides protection for both the fiber and the connectors.

Operating Temperature Requirements

The external operating temperature range is 0°C to +50°C (32°F to 122°F). Before you install the D-PON ONT, confirm that the environment is within the range specified.

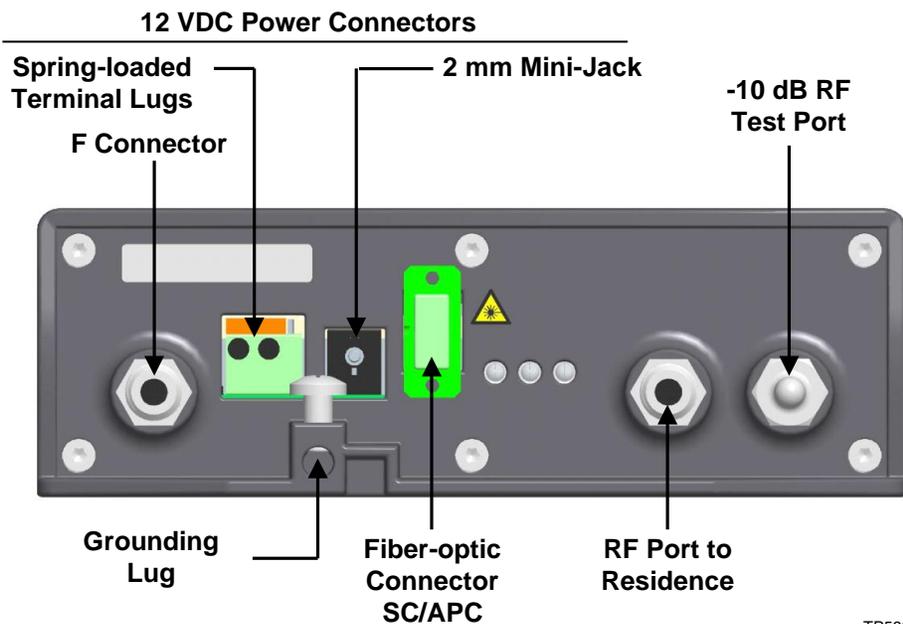
Tools and Accessories

You need the following tools and accessories for mounting the unit:

- Screwdriver
- Fiber cable (up to 3.5 m)
- Splice protector sleeves
- Optical connector
- #6 or #8 screws of appropriate type and length (varies by installation)
- Wall anchors (if needed)
- Soft (e.g. Velcro) cable ties
- Optical fiber inspection equipment
- Optical fiber cleaning equipment

External Connectors

The following illustration identifies the external connectors on the D-PON ONT.



Note: The -10 dB RF test port is for connection to a test modem during installation or servicing. At all other times, this connector must have the supplied 75 Ω terminator installed.



CAUTION:

This product is intended to be supplied by a Nationally Recognized Testing Laboratory (NRTL) Listed power source marked "Class 2" or "LPS" and rated 12 VDC, 800 mA.

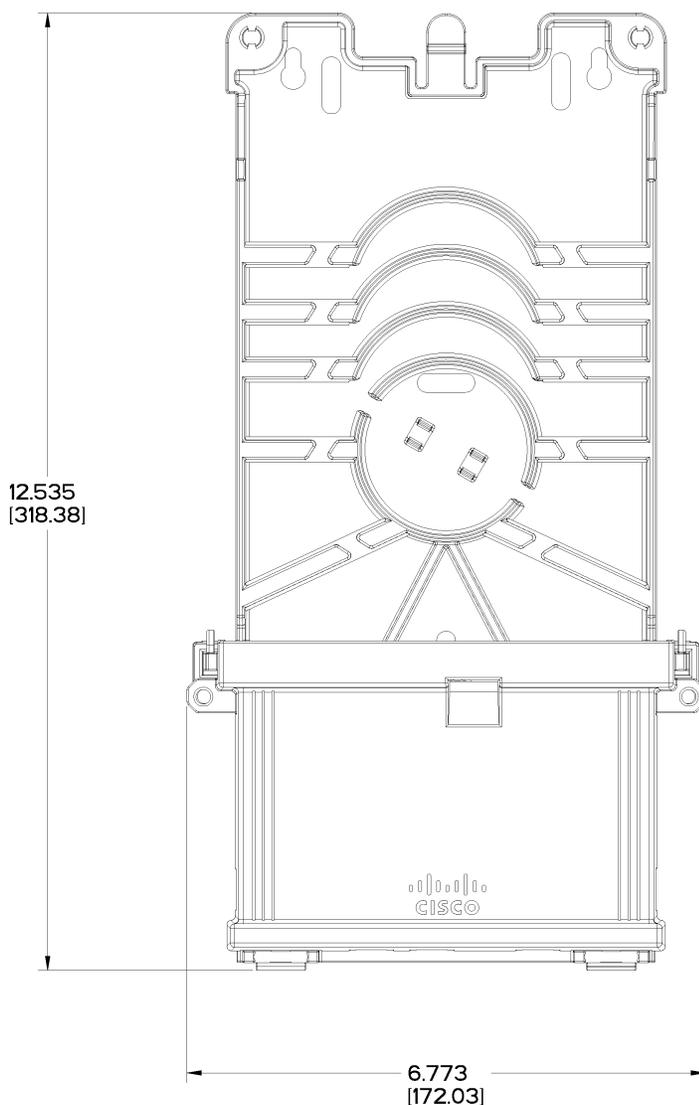
Use only one of the three methods provided to connect DC power. Connecting multiple DC power sources to the D-PON ONT may cause permanent damage to the unit.

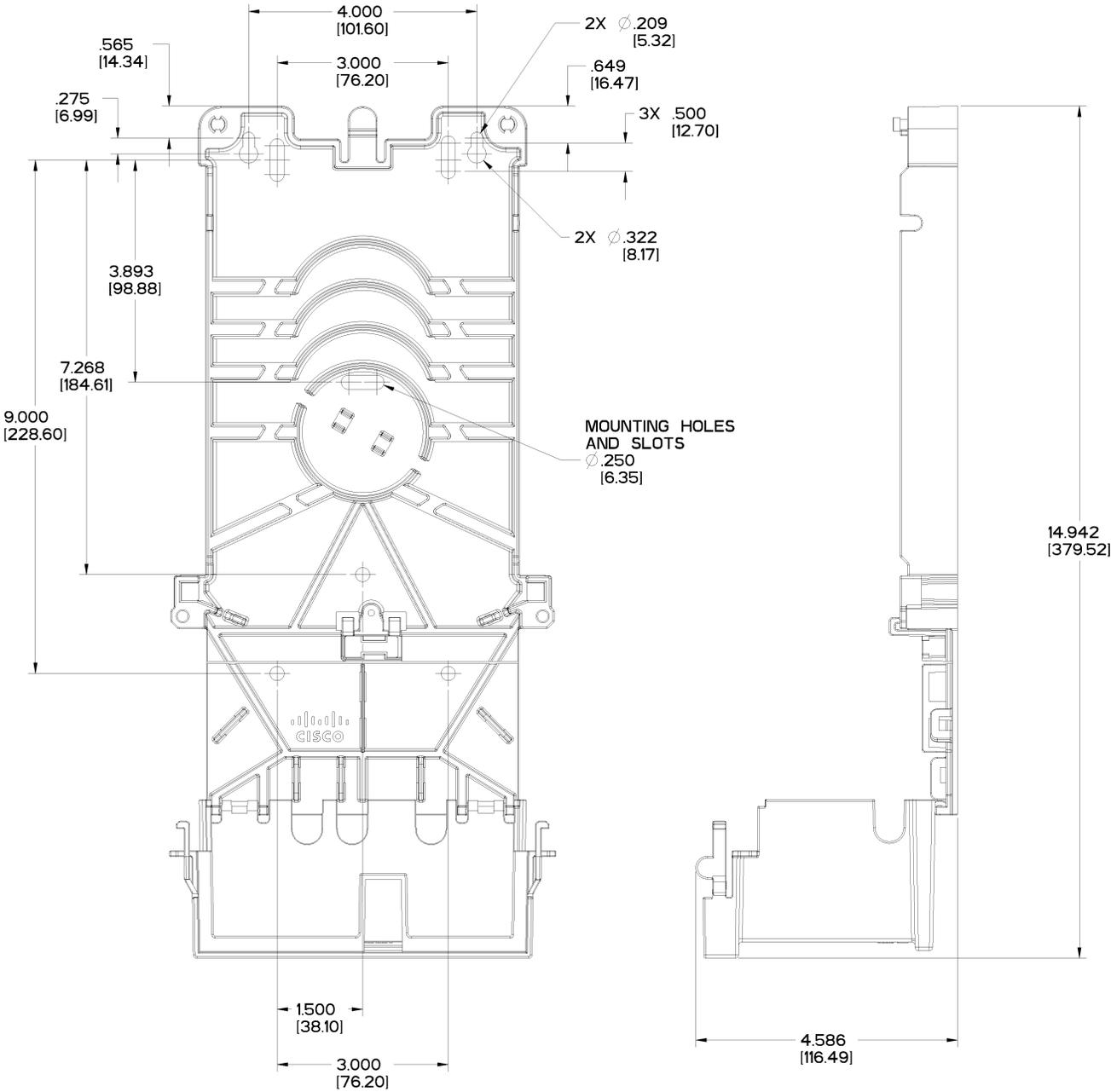
Mounting the D-PON ONT With Fiber Tray

The D-PON ONT mounts to the fiber tray which in turn mounts to the wall. So, the first step in mounting the unit is to mount the fiber tray.

Note: It is possible to mount the D-PON ONT directly to a wall, but in that case, no fiber storage or connector protection is provided. For instructions on direct mounting, see *Mounting the D-PON ONT Without Fiber Tray* (on page 24).

Fiber Tray Mounting Dimensions

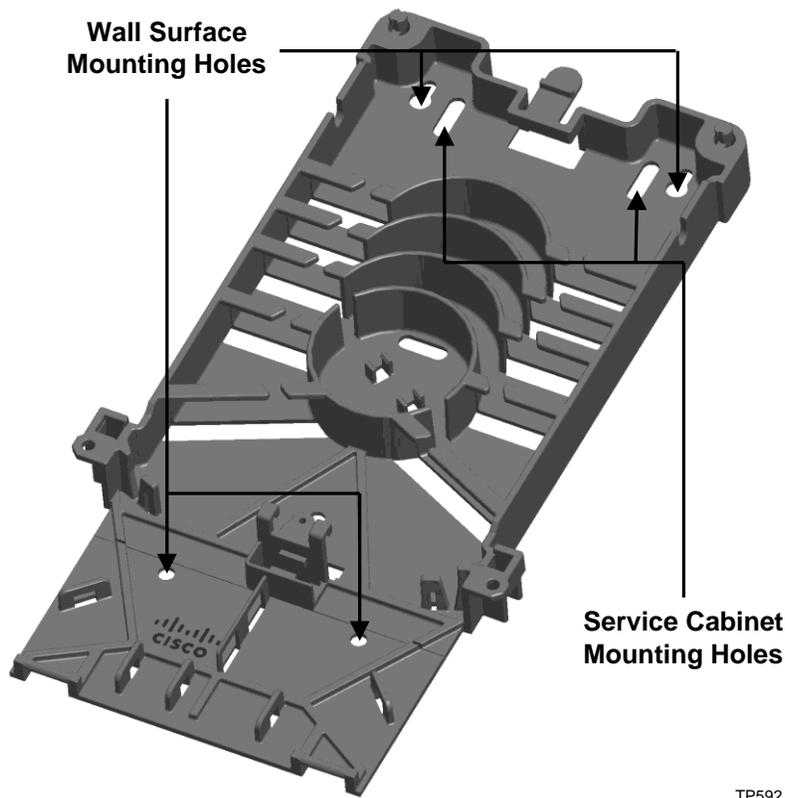




To Mount the Fiber Tray

Complete the following steps to mount the fiber tray.

Note: This section provides two sets of instructions: one for mounting into a standard structural wiring cabinet, and the other for mounting to a wall surface.



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Cabinet Mounting

- 1 Unpack all parts of the D-PON ONT and the fiber tray.
- 2 Open the tray cover to expose the base of the fiber tray and the additional mounting hole.
- 3 Orient the fiber tray with the two keyed holes at the top.
- 4 Mount the fiber tray to the cabinet using the two circular holes near the keyed holes (labeled "cabinet mounting holes" in accompanying illustration).

Note: If using a standard structural wiring cabinet, the circular mounting holes at the top of the fiber tray align with two mounting holes pre-drilled in the wiring cabinet.

Wall Surface Mounting

- 1 Unpack all parts of the D-PON ONT and the fiber tray.
- 2 Open the tray cover to expose the base of the fiber tray and the additional mounting hole.
- 3 Orient the fiber tray with the two keyed holes at the top.
- 4 Hold the base of the fiber tray against the mounting surface and mark the three holes, two keyed and one circular near the bottom (labeled "wall surface mounting holes" in the accompanying illustration).

Chapter 2 Installation

- 5 Remove the fiber tray, drill pilot holes at the three marked locations, and if needed, insert three wall anchors.
- 6 Align the fiber tray with the pilot holes or wall anchors.
- 7 Install three #8 screws of the appropriate type and length, and tighten until the fiber tray is secured to the wall.

Note:

- All screws should be snug, but be careful not to over-tighten, as damage to the fiber tray could result.
- The screws should be long enough to allow at least 1/2 in. (12.7 mm) penetration of the mounting surface.

To Mount the ONT to the Fiber Tray

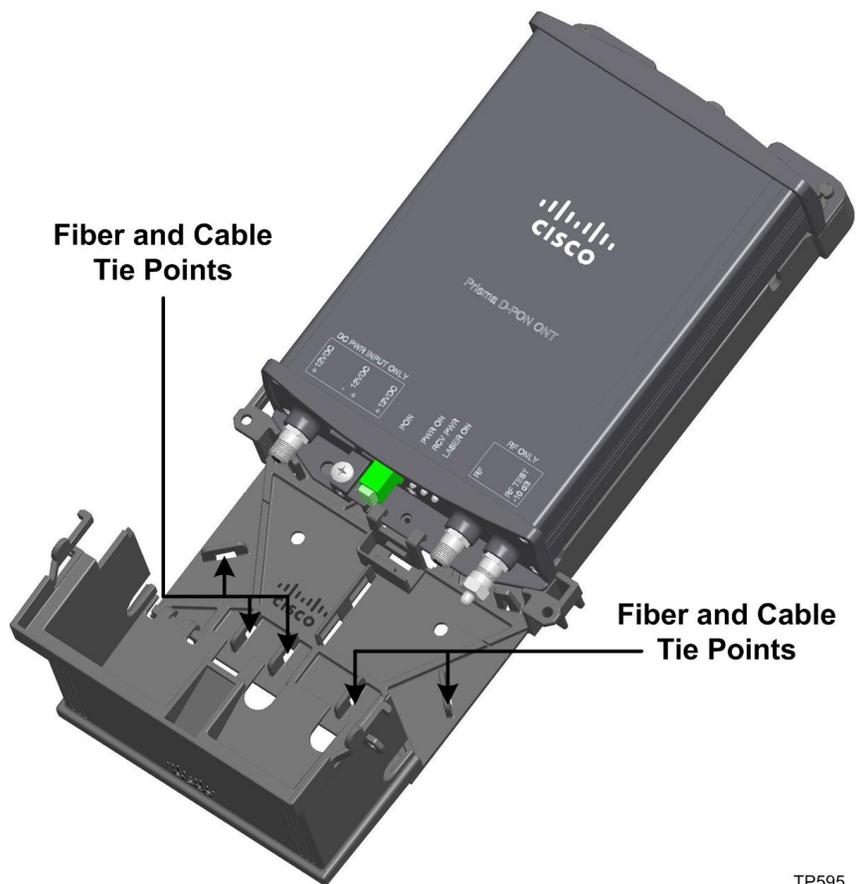
Complete the following steps to mount the D-PON ONT to the fiber tray.

- 1 Open the fiber tray cover so that it hangs down against the mounting surface.
- 2 Position the D-PON ONT over the fiber tray with the connectors pointing down, and with the two posts at the top of the fiber tray aligned with the keyed holes in the back of the unit.
- 3 Push the D-PON ONT onto the posts of the fiber tray until it rests flat against the fiber tray surface.

Note: Some spring tension from the top-mounted locking tab on the fiber tray must be overcome.

- 4 Slide the D-PON ONT downward until it snaps into place. The bottom flange will be captured by the two guides of the tray.
- 5 Secure the D-PON ONT to the fiber tray, if desired, by installing a screw in the center hole at the bottom of the unit.

The D-PON ONT and fiber tray assembly should now appear as shown in the following illustration.



TP595

To Route the Fiber

Complete the following steps to route the fiber in the fiber tray.



CAUTION:

When routing fiber optic cables, be careful to avoid sharp bends that could break the fiber. Keep the fiber radius of curvature below 30 mm (1.2 in) at all times.

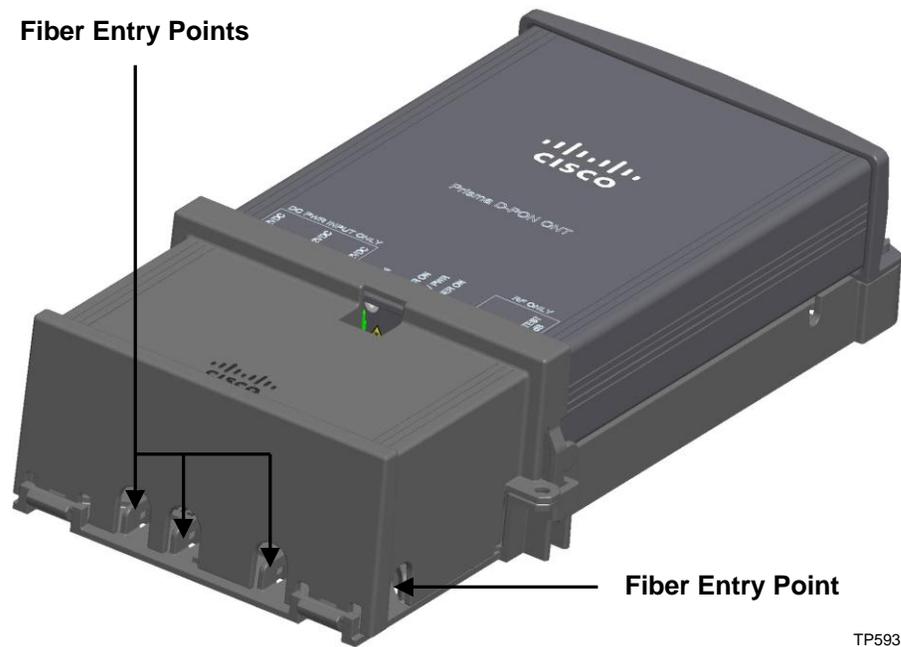


CAUTION:

Fiber optic connectors ship clean from the factory and must be kept clean for best results. If it becomes necessary to clean an optical connector, follow the procedures described in [Cleaning Optical Connectors](#) (on page 39).

- 1 Inspect the fiber tray to confirm that it is free of dirt, nicks, or burrs that could damage the fiber.
- 2 Locate the three fiber entry points on the fiber tray, one on each side and one at the bottom.
- 3 Open the tray cover and secure the fiber cable to the tie point adjacent to a fiber entry point. Use a Velcro or other soft cable tie (not supplied) to secure the fiber cable.

Note: Do not over-tighten the cable tie, or you may risk pinching the fiber.



- 4 Wind the fiber pigtail onto the wheels of the storage area as shown in the following illustration.

Note:

- The fiber tray can store up to 30 feet (9.14 m) of fiber cable.
- Leave an adequate length of uncoiled fiber cable to later attach to the OLT.

The following illustration shows an example of correct fiber routing practice.

Mounting the D-PON ONT With Fiber Tray



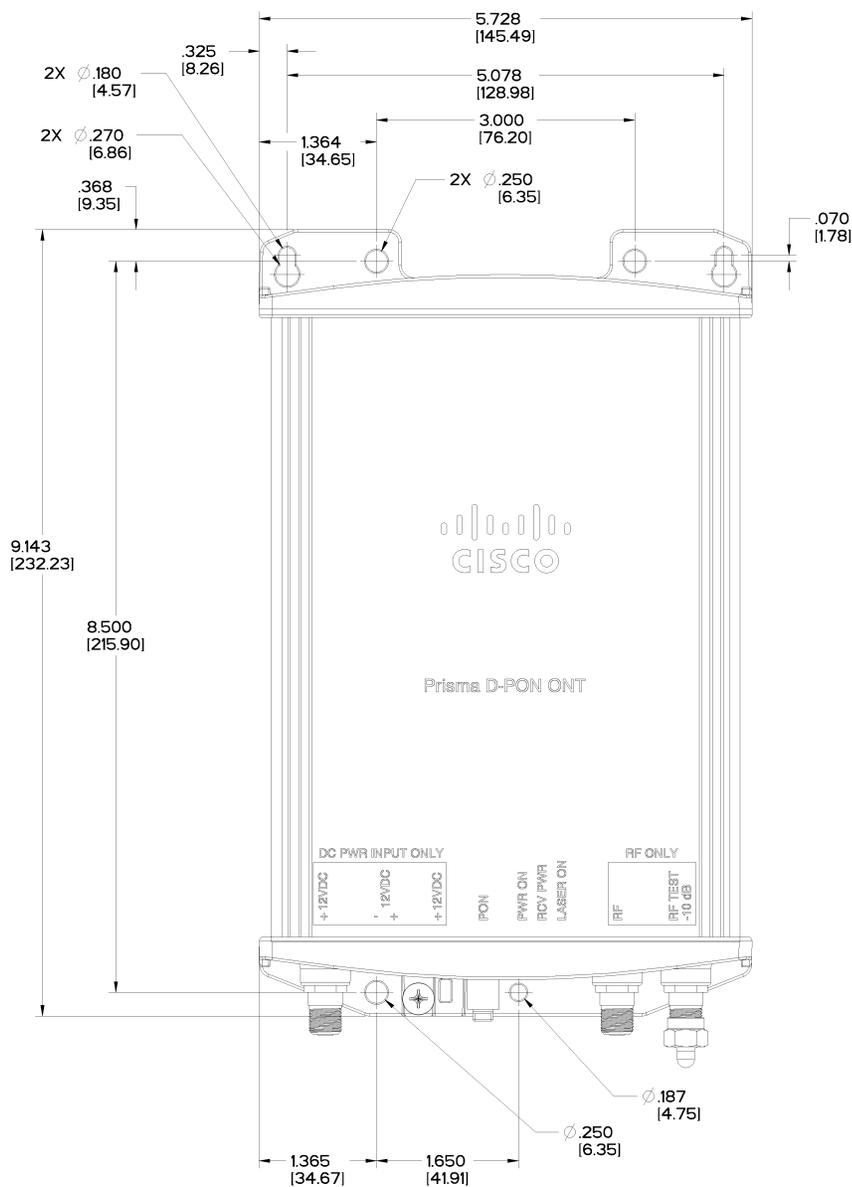
TP594

Note: This picture also shows the inclusion of a WDM filter for routing additional wavelengths to an external PON device.

Mounting the D-PON ONT Without Fiber Tray

Where space does not permit the use of the fiber tray, you can mount the D-PON ONT directly to a wall or other mounting surface. However, keep in mind that no fiber storage or connector protection is provided in this case.

D-PON ONT Direct Mounting Dimensions



To Mount the D-PON ONT Directly

Complete the following steps to mount the D-PON ONT directly to the wall or mounting surface.

- 1 Position the D-PON ONT over the mounting surface with the Cisco logo in reading position.
- 2 Mark the locations of the two top circular mounting holes and one of the two bottom mounting holes, as shown in the accompanying illustration.

Note: Two bottom mounting holes are provided for compatibility with some structural wiring cabinets. Choose one hole according to the application.



TP591

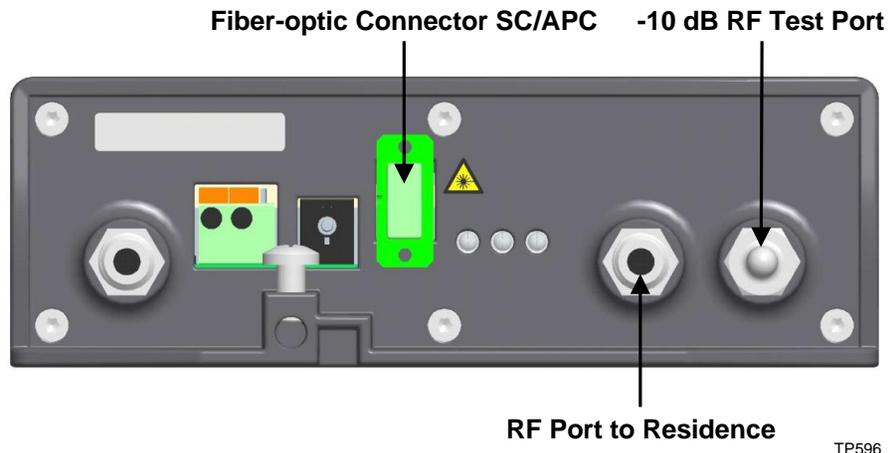
- 3 Remove the D-PON ONT, drill pilot holes at the three marked locations, and if needed, insert three wall anchors.
- 4 Align the D-PON ONT with the pilot holes or wall anchors.
- 5 Install three #6 screws of the appropriate type and length, and tighten until the unit is secured to the mounting surface.

Note:

- All screws should be snug, but be careful not to over-tighten, as damage to the D-PON ONT housing may result.
- The screws should be long enough to allow at least 1/2 in. (12.7 mm) penetration of the mounting surface.

Making Signal Connections

After mounting the D-PON ONT and fiber tray, you are ready to make connections to the unit.



Important: To ensure equipment safety, complete the following procedures in the order given.

To Connect Optical Fiber



CAUTION:

Before connecting the fiber optic cable, confirm that the optical power from the fiber does not exceed the maximum allowed optical level for CATV. Excessive optical power may cause permanent damage to the photodiode in the ONT unit.

Important: The recommended optical input level range is -4.5 dBm to 2.5 dBm.



Warning:

- Avoid personal injury! Use of controls, adjustments, or procedures other than those specified herein may result in hazardous radiation exposure.
- Avoid personal injury! The laser light source on this equipment (if a transmitter) or the fiber cables connected to this equipment emit invisible laser radiation.
- Avoid personal injury! Viewing the laser output (if a transmitter) or fiber cable with optical instruments (such as eye loupes, magnifiers, or microscopes) may pose an eye hazard.

- Do not apply power to this equipment if the fiber is unmated or unterminated.
- Do not stare into an unmated fiber or at any mirror-like surface that could reflect light emitted from an unterminated fiber.
- Use safety-approved optical fiber cable to maintain compliance with applicable laser safety requirements.

Complete the following steps to connect the network fiber optic cable to the D-PON ONT.

- 1 Remove the dust protector from the SC/APC adapter on the D-PON ONT.
- 2 Remove the dust protector from the network fiber optic cable.
- 3 Using the appropriate equipment, visually confirm that the end of the fiber is clean.
- 4 Using an optical power meter, measure the downstream received optical power level at the fiber connector to verify an acceptable level. Refer to the *Prisma D-PON System Installation and Operation Guide*, part number 4030614 for a more detailed system setup procedure.
- 5 Insert the SC/APC connector of the network fiber optic cable into the SC/APC connector on the D-PON ONT.

Note: You should feel and hear a noticeable "click" when properly mating an SC/APC connector.



CAUTION:

Fiber optic connectors ship clean from the factory and must be kept clean for best results. If it becomes necessary to clean an optical connector, follow the procedures described in *Cleaning Optical Connectors* (on page 39).

To Connect RF Cable

Complete the following steps to connect the RF coax cable from the customer premise to the D-PON ONT:

- 1 Locate the desired entry point on the fiber handling tray.
- 2 Open the fiber tray cover and screw the coax F connector onto the RF port F connector.
- 3 Route the RF coax to the desired entry point and use a tie wrap (not supplied) to secure the coax cable to a nearby tie point on the fiber tray.

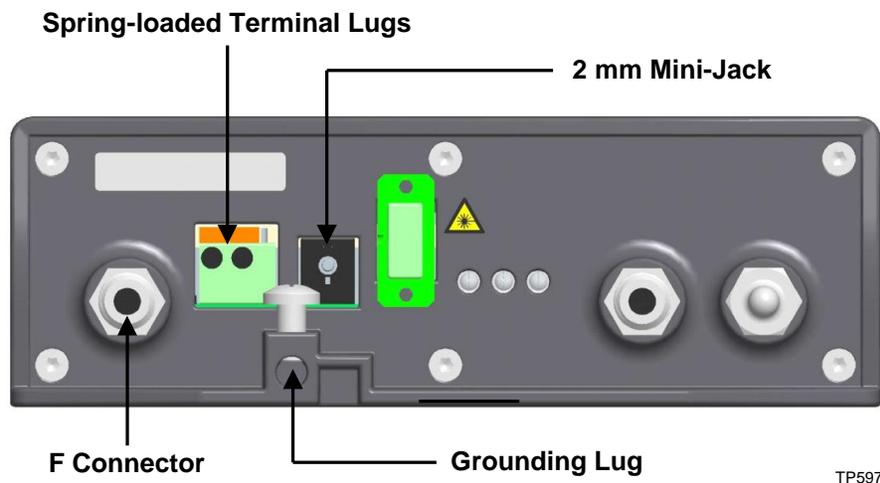
Note:

- The -10 dB RF Test port is available for connection to a test modem during installation.
- The 75 Ω F connector terminator must remain on the unit when the RF Test port is not in use.

Connecting Power

The D-PON ONT is designed to receive DC power at +12 V, 1A from **one** DC power source with **one** of the following connectors:

- F-type power connector
- Spring-loaded terminal lugs
- 2 mm mini-jack



Use any **one** of these connections to supply power to the unit.



CAUTION:

This product is intended to be supplied by a Nationally Recognized Testing Laboratory (NRTL) Listed power source marked "Class 2" or "LPS" and rated 12 VDC, 800 mA.

Use only one of the three methods provided to connect DC power. Connecting multiple DC power sources to the D-PON ONT may cause permanent damage to the unit.

To Connect Ground (Required in Some Areas)

Note: Refer to local electrical wiring codes regarding the need for grounding, acceptable wire gauge, and other specific requirements.

Complete the following steps if necessary to establish a ground connection to the D-PON ONT:

- 1 Insert the bared end of an insulated ground wire into the ground lug and tighten the screw until snug.
- 2 Gently tug the ground wire to confirm that it is firmly held by the screw.
- 3 Attach the other end of the ground wire to an approved earth-ground reference.

To Connect DC Power

Complete the following steps to connect DC power to the D-PON ONT.

- 1 Verify that power is not yet applied to the power cable of choice, or that the DC adapter is not yet plugged into an AC outlet.
- 2 Locate the appropriate DC input connector on the D-PON ONT.
- 3 Connect the power cable to the D-PON ONT.

Note: When using the twisted pair connector, be sure to observe the polarity indication on the connector. Insert the bared end of the insulated wire while pushing on the orange release lever above the wire location. Release the lever and gently tug on the wire to confirm that it is firmly held by the connector. Repeat with the second wire.

- 4 Apply power or plug in the DC power adapter.
- 5 Verify the correct LED power-up sequence, as described in *Checking LED Status* (on page 32).
- 6 If desired, use the slot adjacent to the ground lug to attach a tie wrap (not supplied) for DC power wiring strain relief.



CAUTION:

This product is intended to be supplied by a Nationally Recognized Testing Laboratory (NRTL) Listed power source marked "Class 2" or "LPS" and rated 12 VDC, 800 mA.

Use only one of the three methods provided to connect DC power. Connecting multiple DC power sources to the D-PON ONT may cause permanent damage to the unit.

3

Operation

Introduction

This chapter describes the operating procedures for the D-PON ONT and explains the use of the LED status indicators on the unit to verify correct device operation.

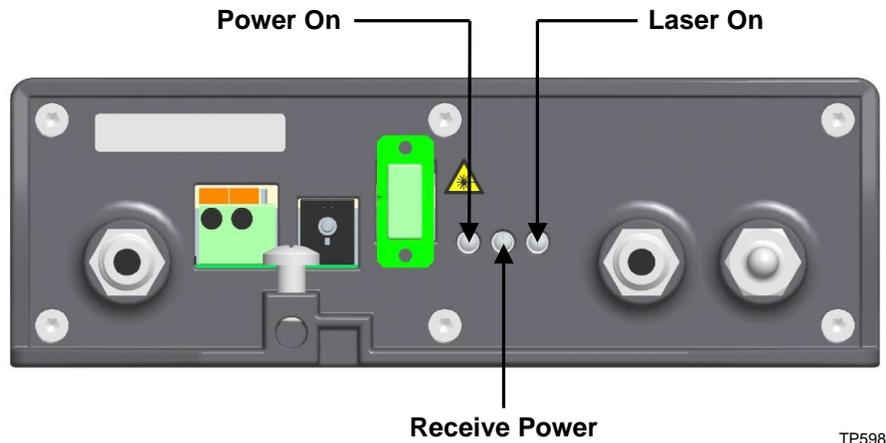
For an overview of module operating features, see *Introduction* (on page 1).

In This Chapter

- Checking LED Status..... 32
- Using the -10 dB RF Test Port 34
- Special Features..... 35

Checking LED Status

Three LEDs on the D-PON ONT connector panel indicate the status of key operating conditions.



Verify that the three LEDs on the D-PON ONT connector panel illuminate in the order described below.

- 1 The Power ON LED should light after a slight delay when applying DC power.
- 2 The Receive Power LED should light within 10 seconds of the Power On LED.
- 3 The Laser On LED should begin flashing when a DOCSIS device attempts to transmit upstream.

Note: When the subscriber DOCSIS set-top gateway (DSG) or cable modem is active, the Laser On LED flashes at a nominal rate of once every two seconds. However, the exact flash rate is dependent on the DOCSIS CMTS setup.

PWR ON LED

This green LED illuminates if DC is applied to any of the DC connectors and if the processor in the D-PON ONT is active.

RCV PWR LED

The green RCV PWR LED uses three possible states to indicate the level of optical power received by the D-PON ONT:

- ON means that received optical power is within predefined threshold values.
- BLINKING means that received optical power exceeds a predefined upper threshold value.
- OFF means that received optical power is below a predefined lower threshold value.

LASER ON LED

The green Laser On LED illuminates when the laser is enabled. It remains illuminated long enough to be visible, even during extremely short laser bursts.

Note: This LED may appear to be on continuously during periods of heavy upstream traffic.

Using the -10 dB RF Test Port

The D-PON ONT provides a -10 dB RF test port to simplify modem connectivity testing. You can connect a certified DOCSIS test modem to this port to verify proper downstream connectivity and upstream level training.

Because a nominal home coax network has 10 dB of loss, the test modem will experience typical home levels at this test port. If the home experiences connection problems, you can use the test port to verify communication directly at the D-PON ONT.

A termination must be attached to this port when not in use. If the port is used, the main RF port must be terminated either with this termination or with a properly built and terminated home coax network.

Special Features

The D-PON ONT has several features that are designed to enhance operational safety and performance.

Upstream Eye Protection

The D-PON ONT disables its upstream laser output if it does not detect sufficient downstream light.

A properly functioning passive optical network should always have downstream light at the fiber interface to the ONT. Otherwise, DOCSIS communication is not possible. If the ONT optical connector is removed, thereby removing 1550 nm input, the laser is immediately shut off to prevent accidental eye damage from the ONT.

Some light will still be present, although at a reduced level, at the loose fiber connection to the home.

Anti-babble Protection

If the RF input is too long in duration to be considered a valid DOCSIS signal (greater than 120 milliseconds), or if an internal fault causes the laser to be excessively active, the laser becomes disabled for the duration of the event plus a variable penalty period.

This first event disables the laser for an additional 1 second. Multiple events increase the penalty time to 2, 4, and finally 5 seconds.

The penalty time is reset with a power cycle. An LED alarm is indicated.

Excess Upstream RF Input Protection

If the RF input exceeds a threshold (greater than 48 dBmV) for more than 250 milliseconds, the laser will be disabled until the signal drops below the threshold. An LED alarm is indicated.

The laser is enabled within 26 milliseconds of detecting an acceptable input level.

4

Maintenance and Troubleshooting

Introduction

This chapter describes the maintenance guidelines and troubleshooting procedures for this module.

Qualified Personnel

Only appropriately qualified and skilled personnel should attempt to maintain or troubleshoot module faults.



WARNING:

Allow only qualified and skilled personnel to install, operate, maintain, and service these products. Otherwise, personal injury or equipment damage may occur.

In This Chapter

- General Troubleshooting Information..... 38
- Cleaning Optical Connectors 39

General Troubleshooting Information

In the unlikely event of a problem with the D-PON ONT, the LED status indicators on the unit can be used to help diagnose the problem.

PWR ON LED

The green Power On LED illuminates when DC is applied to any of the ONT DC connectors and the processor is active. It blinks (off for 225 msec) if there is a fault to indicate an alarm condition, as follows:

- Two blinks per interval – anti-babble has shut off the laser for a penalty period. This alarm is removed 5 minutes after the cause is removed.
- Three blinks per interval – excessive RF input or internal fault. This alarm is removed 5 minutes after the cause is removed.
- Four blinks per interval – ONT is not calibrated (manufacturing alarm).

Note: An interval equals 3 seconds.

RCV PWR LED

The green Received Power LED illuminates when optical input power exceeds a threshold. Interpret the states of this LED as follows:

- OFF – downstream input light < -6 dBm.
- ON – input optical power is between -6 and +3 dBm.
- Continuous blinking – input optical power exceeds +3 dBm.

Note: This indicator is provided as an approximate level alarm. It should not replace the use of a power meter for proper setup.

LASER ON LED

The green Laser On LED illuminates when the laser is enabled. It remains illuminated long enough to be visible (> 200 ms), even during extremely short bursts.

Additional Assistance

If you need additional assistance, telephone one of our Technical Service Centers or your local sales subsidiary. The chapter *Customer Support Information* (on page 41) contains a list of telephone numbers.

Cleaning Optical Connectors

**CAUTION:**

Proper operation of this equipment requires clean optical fibers. Dirty fibers will adversely affect performance. Proper cleaning is imperative.

The proper procedure for cleaning optical connectors depends on the connector type. The following describes general instructions for fiber optic cleaning. Use your company's established procedures, if any, but also consider the following.

Cleaning fiber optic connectors can help prevent interconnect problems and aid system performance. When optical connectors are disconnected or reconnected, the fiber surface can become dirty or scratched, reducing system performance.

Inspect connectors prior to mating, clean as needed, and then remove all residue. Inspect connectors after cleaning to confirm that they are clean and undamaged.

Recommended Equipment

- CLETOP or OPTIPOP ferrule cleaner (for specific connector type)
- Compressed air (also called “canned air”)
- Lint-free wipes moistened with optical-grade (99%) isopropyl alcohol
- Bulkhead swabs (for specific connector type)
- Optical connector scope with appropriate adaptor

Tips for Optimal Fiber Optic Connector Performance

- Do not connect or disconnect optical connectors with optical power present.
- Always use compressed air before cleaning the fiber optic connectors and when cleaning connector end caps.
- Always install or leave end caps on connectors when they are not in use.
- If you have any degraded signal problems, clean the fiber optic connector.
- Advance a clean portion of the ferrule cleaner reel for each cleaning.
- Turn off optical power before making or breaking optical connections to avoid microscopic damage to fiber mating surfaces.

To Clean Optical Connectors



Warning:

- **Avoid personal injury! Use of controls, adjustments, or procedures other than those specified herein may result in hazardous radiation exposure.**
- **Avoid personal injury! The laser light source on this equipment (if a transmitter) or the fiber cables connected to this equipment emit invisible laser radiation.**
- **Avoid personal injury! Viewing the laser output (if a transmitter) or fiber cable with optical instruments (such as eye loupes, magnifiers, or microscopes) may pose an eye hazard.**

- Do not apply power to this equipment if the fiber is unmated or unterminated.
- Do not stare into an unmated fiber or at any mirror-like surface that could reflect light emitted from an unterminated fiber.
- Use safety-approved optical fiber cable to maintain compliance with applicable laser safety requirements.

Important: Ensure that no optical power is present prior to this procedure.

- 1 Turn optical power off to the connector.
- 2 Using an optical connector scope, inspect the connector for scratches, burns, or other signs of damage.

Note: If the connector is damaged, replace the jumper.

- 3 If the connector requires cleaning, swipe it across the face of the appropriate ferrule cleaner several times. This will remove dust and some films.

Note: You may hear a slight "squeak" while cleaning the connector, indicating that it is clean.

- 4 Inspect the connector again. If the connector requires further cleaning, clean it using 99% isopropyl alcohol and a lint-free wipe.
- 5 Swipe the connector across the face of the appropriate ferrule cleaner several more times to remove any film left by the alcohol.
- 6 Repeat all the steps above as needed until the connector is clean.

5

Customer Support Information

If You Have Questions

If you have technical questions, call Cisco Services for assistance. Follow the menu options to speak with a service engineer.

Access your company's extranet site to view or order additional technical publications. For accessing instructions, contact the representative who handles your account. Check your extranet site often as the information is updated frequently.

A

System Design and Operation

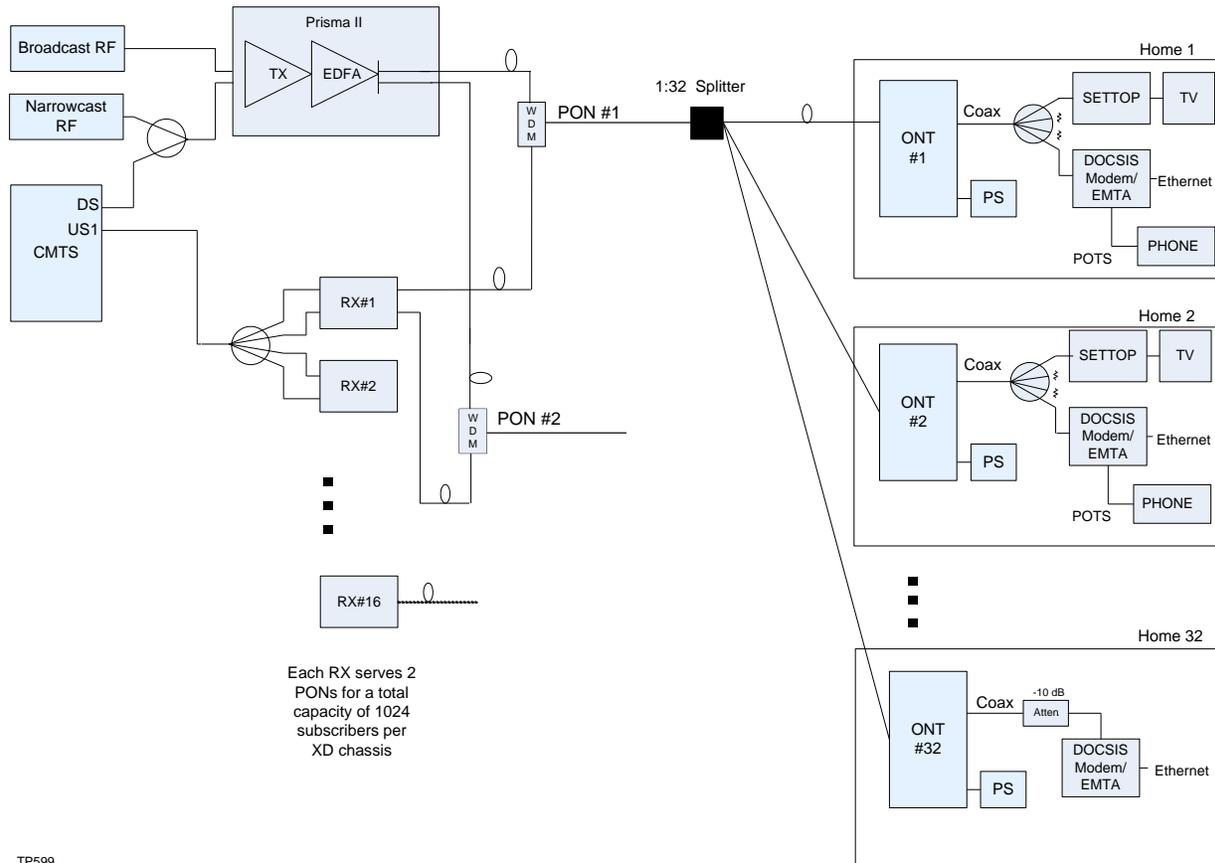
This appendix describes the architecture of a basic Prisma D-PON system, identifies typical signal levels at various points in the system, and explains the operation of the system and its dedicated receiver and D-PON ONT modules.

In This Appendix

■ System Diagram	44
■ System Overview	45
■ System Behavior	51
■ System Signal Levels	52

System Diagram

The following diagram shows the general architecture of the Prisma D-PON system.



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Note that each receiver can serve two passive optical networks. This means that a single Prisma II XD chassis fully populated with receiver modules can serve up to 1,024 subscribers (16 modules x 2 PONs x 32 subscribers per PON).

System Overview

The Prisma D-PON solution uses existing CATV technology in a PON architecture. This architecture features a 32-way split in the downstream optical fiber link from the headend or hub to the subscribers. This downstream link uses 1550 nm optics to carry analog video and CMTS traffic to as many as 32 subscribers simultaneously.

The upstream (subscriber-to-headend) path uses 1610 nm optics to transport the DOCSIS upstream traffic. To eliminate upstream collisions, only one upstream laser is active at a time, and this stream is controlled by the DOCSIS reservation system.

System Components

The D-PON solution consists of the following key components:

- Transmitter
- Erbium-doped Fiber Amplifier (EDFA)
- Wavelength division multiplexer (WDM) filter
- ONT
- Receiver

The transmitter, EDFA, receiver, and WDM filter are located at the headend or hub. The transmitter and EDFA convert downstream RF spectrum to an amplitude-modulated 1550 nm optical signal. This signal is input to the WDM filter and then output from the filter to the PON network fiber link.

The ONT, located at the subscriber residence, converts the 1550 nm downstream optical signal to RF for residential use. It also converts RF signals originating at the residence to optical format at 1610 nm for transmission upstream. The WDM filter at the headend or hub separates these upstream wavelengths from the 1550 nm downstream signal and routes them to the receiver, where they are converted to analog format and then passed on to the CMTS.

Transmitter

The transmitter converts the downstream RF spectrum into an amplitude-modulated optical signal at 1550 nm. Separate input ports are provided for broadcast and narrowcast inputs. The transmitter requires an RF input of 21 dBmV per channel, and outputs greater than 8 dBm optical output.

EDFA

The EDFA, located at the headend or hub, converts the input optical signal from the transmitter to a higher power optical output capable of driving the link losses of the PON. The 4-port version has four separate ports, each capable of providing a minimum of 21.5 dBm output. In the network, the optical signal from each EDFA port is split 32 ways for distribution to up to 32 ONT units.

WDM Filter

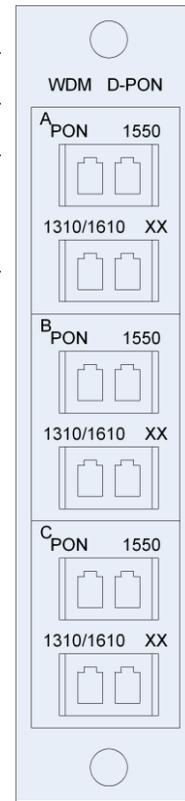
There are two WDM module choices for D-PON. Each LGX style module contains three separate filters, labeled A, B, and C.

- Module part number 4028627 can be used for either 1310 or 1610 D-PON upstream, but has no port for additional PON overlay, which uses 1310/1490 wavelengths.
- Module part number 4028628 should only be used for 1610 D-PON upstream. It has a 1310/1490 port for an additional port overlay. Front panel diagrams are shown below.

Note: 4028627 is the least expensive option if there are no future plans for a PON overlay. The fourth port of each of the three filters of 4028627 is labeled XX, and has no internal connection.

Port Description, Module Part Number 4028627

Port Name	Description
PON Port	Common port to outside PON plant.
1550 Port	Downstream input from 1550 nm source EDFA.
1310/1610 Port	Upstream output to D-PON Receiver module, supports either 1310 nm or 1610 nm wavelengths.
XX Port	Not used.

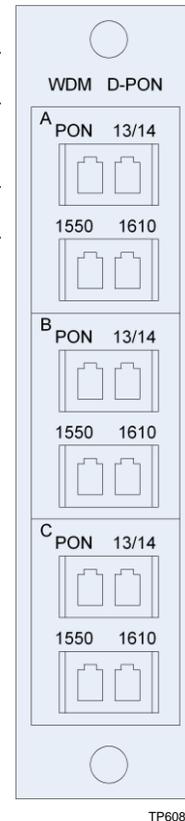


TP607

Appendix A
System Design and Operation

Port Description, Module Part Number 4028628

Port Name	Description
PON Port	Common port to outside PON plant.
13/14 Port	PON overlay bidirectional port to OLT using 1310 nm and 1490 nm.
1550 Port	Downstream input from 1550 nm source EDFA.
1610 Port	Upstream output at 1610 nm to D-PON Receiver module.

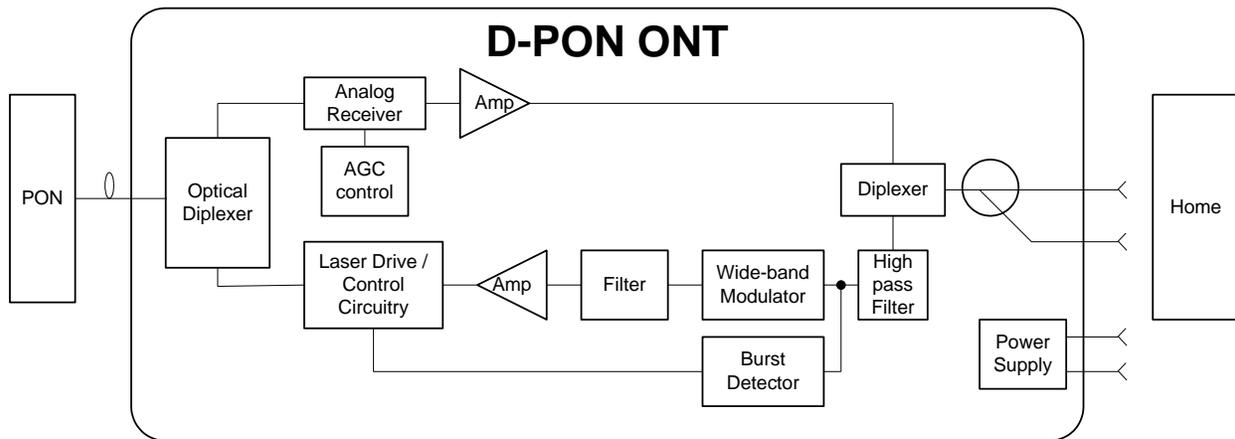


ONT

The ONT is located at the subscriber residence, and performs two functions simultaneously:

- It receives the downstream amplitude-modulated optical 1550 nm signals, converts these signals from optical to electrical RF format, and sends the RF signal out a single connector to the residence.
- It receives RF analog signals from the subscriber side, converts these signals from RF to wideband amplitude-modulated optical format at 1610 nm, and transmits these signals upstream.

The ONT contains a wavelength division multiplexing (WDM) optical diplexer capable of separating upstream from downstream signals. In the downstream direction, an amplitude-modulated optical signal is projected onto a photo-diode which converts it to electrical RF signals.

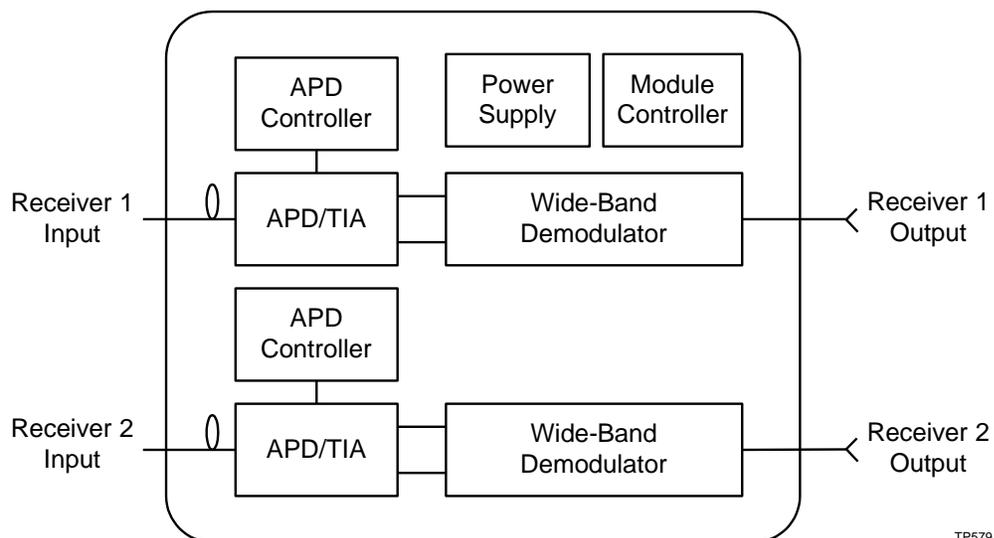


TP586

In the upstream direction, bursts of RF from the subscriber are converted to bursts of optical signal. The ONT hardware modulates customer information onto a laser for transport to the CMTS at the headend. This information will be either a standard DOCSIS 1.0, 1.1, 2.0, or 3.0 format. Each iW-2030 ONT is capable of transmitting up to four 6.4 MHz, 64 QAM, DOCSIS upstream channels.

Receiver

The D-PON receiver is a specialized wideband receiver located at the headend or hub. Each of two receiver channels accepts wideband amplitude-modulated 1610 nm optical burst signals from an ONT unit. The receiver demodulates the optical signal, recovers the analog RF reverse spectrum (5 to 65 MHz), and sends this analog signal to the local CMTS at the headend. The CMTS provides timing and control so that only one ONT is transmitting at a time.



TP579

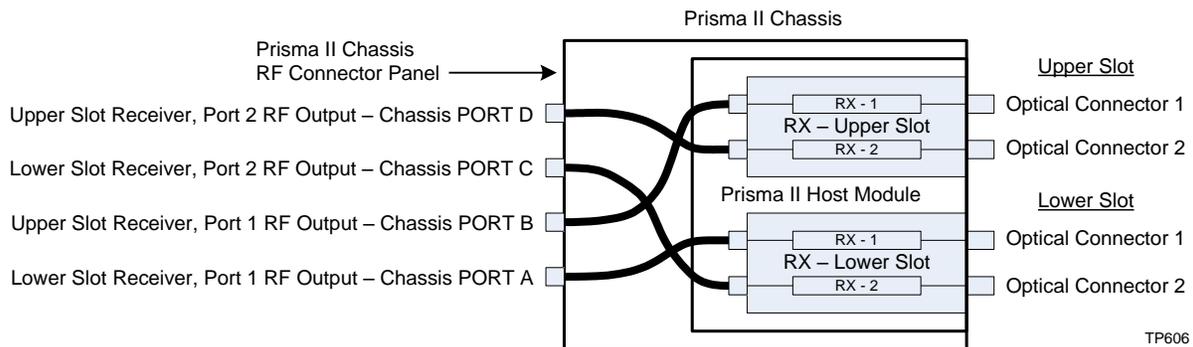
Appendix A System Design and Operation

The output of the D-PON receiver is squelched to limit noise. This minimizes the impact of combining up to four receiver outputs before reaching the CMTS upstream input.

Physically, the receiver is designed to fit into a single slot of the Prisma II XD chassis. Each receiver module contains two independent receiver channels each containing the optics, digital processing, RF output, and controller circuits for one channel. The controller in each channel is responsible for monitoring and controlling the internal functions of the module as well as remote communication via SNMP-based management systems.

Receiver RF Connection Mapping with Host Module

When using the D-PON Dual Receiver in a standard Prisma II Chassis, a Prisma II Host Module is required. Refer to the diagram below for proper RF connections when using the receiver in a host module.



System Behavior

The downstream signal received by the ONT is converted to a broadband RF spectrum. The downstream AGC compensates for differences in optical received power to maintain RF output level over the acceptable optical input range.

Because this AGC is “open loop,” controlled by optical level, variations in RF level to the headend transmitter will be reflected at the ONT output. This means that a change in input level of 1 dB will result in a corresponding 1 dB output level change. ONT output level per channel will not change as channels are added or removed.

The upstream signal is wideband modulated and then modulates the laser, which is received at the headend or hub. Changes in link loss will not affect the receiver output level, while changes in input signal RF level will be reflected.

In both upstream cases, DOCSIS controls the modem output level so that the CMTS input remains fixed. With fixed link gain, the ONT input level is fixed by the long-loop AGC of the CMTS.

Services

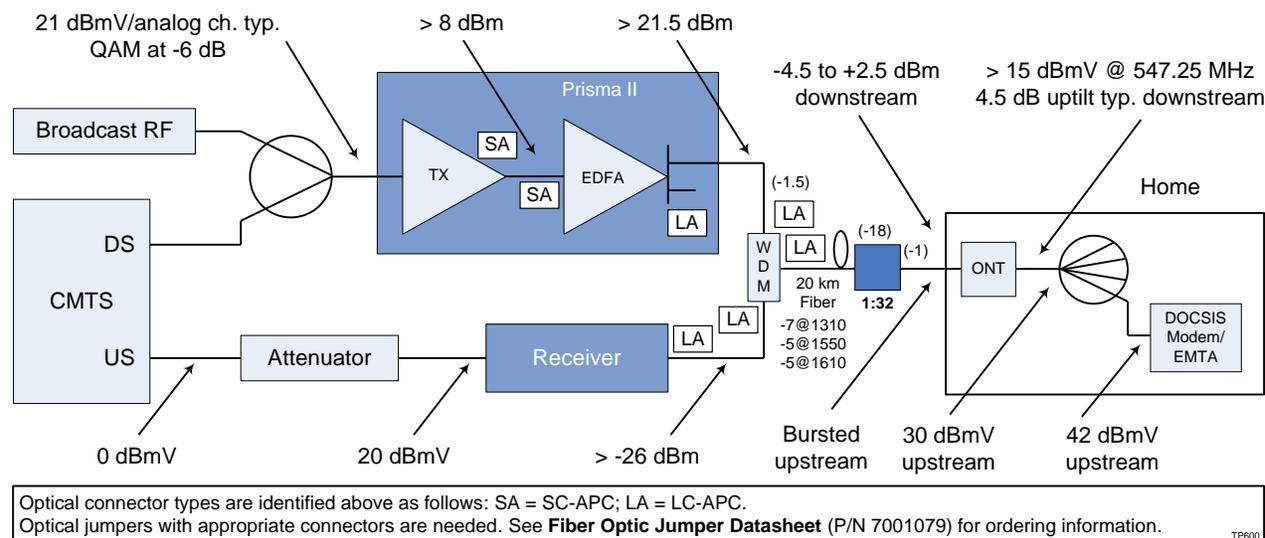
The D-PON is mainly an optical replacement for the HFC plant. As such, it supports broadband services (e.g., Internet, VoIP, Video) between the network and subscriber interfaces that typically flow across the HFC plant.

Management

The D-PON solution supports management of the transmitter, EDFA, and receivers via the ROSA Element Management (EM) system. DOCSIS management of the CMTS and cable modems is available through an external management system.

System Signal Levels

The Prisma D-PON system architecture is designed to achieve key signal levels at the test points shown below.



These key signal levels are identified as follows:

- Maximum link loss including the wavelength division multiplexer (WDM) is 25 dB at 1550 nm or 26 dB at 1610 nm.
- Downstream signal measured at the output of the D-PON ONT is greater than 15 dBmV at 547.25 MHz, with a 4.5 dB up tilt from 54 MHz to 1 GHz. This output is maintained by optical AGC over an optical input range of -4.5 to +2.5 dBm.
- The operator chooses a desired CMTS input level, typically 0 dBmV.
- The recommended D-PON ONT upstream input level is 30 dBmV.
- Guaranteed upstream system link gain is -10 dB, and is insensitive to optical loss.
- The CMTS upstream input attenuator is set to achieve the desired CMTS input level. The total loss, including external path losses, is typically 20 dB.

The goal of the Prisma D-PON product design is to set 30 dBmV upstream at the optimum point in the dynamic range of the system. For example:

- If the upstream home loss is 0 dB, the modem output is set to 30 dBmV.
- If the upstream home loss is 12 dB, the modem output is set to 42 dBmV.

In the second case, the modem output is set to 42 dBmV to allow for a worst-case CMTS error of ± 6 dB. This could give output as high as 48 dB while still leaving a safety margin of 3 dB away from the maximum guaranteed D3.0 output of 51 dBmV.

At power-up, the modem ranges its output level. Assuming 64 QAM error free operation, the output level begins registration at approximately -20 dB from optimum and continues to rise until reaching the optimum D-PON ONT input of 30 dBmV.

As a result of these adjustments:

- All D-PON ONT downstream outputs are the same, being controlled by the optical AGC.
- All D-PON ONT upstream inputs are the same, being controlled by DOCSIS media access control (MAC).

The modem upstream output levels depend only on the variation in home coax network losses.

Glossary

ac, AC

alternating current. An electric current that reverses its direction at regularly recurring intervals.

AGC

automatic gain control. A process or means by which gain is automatically adjusted in a specified manner as a function of input level or other specified parameters.

anti-babble

automated laser output control. If an upstream input signal lasts longer than 125 milliseconds, the laser is turned off. This protects the PON from a non-DOCSIS signal that can serve to jam other valid users.

babble

in telecommunications, the aggregate crosstalk from many interfering channels. In fiber-optic communications, excessive noise on a signal that may continuously trigger a laser and thereby cause collisions on a fiber.

dc, DC

direct current. An electric current flowing in one direction only and substantially constant in value.

EDFA

erbium doped fiber amplifier. Optical fibers doped with the rare earth element, erbium, which can amplify light in the 1550 nm region when pumped by an external light source.

EMC

electromagnetic compatibility. A measure of equipment tolerance to external electromagnetic fields.

ESD

electrostatic discharge. Discharge of stored static electricity that can damage electronic equipment and impair electrical circuitry, resulting in complete or intermittent failures.

Glossary

HD

high density.

I/O

input/output.

ICIM

intelligent communications interface module.

LCD

liquid crystal display. A display medium made of liquid crystal. Liquid crystal's reflectance changes when an electric field is applied. Commonly used in monitors, televisions, cell phones, digital watches, etc.

LED

light-emitting diode. An electronic device that lights up when electricity passes through it.

nm

nanometer. One billionth of a meter.

NMS

network management system. A software system designed specifically to monitor a network and to facilitate troubleshooting.

ONT

optical network termination. Optical network elements that terminate a network signal; also interchangeably referred to as an optical network unit (ONU).

RF

radio frequency. The frequency in the portion of the electromagnetic spectrum that is above the audio frequencies and below the infrared frequencies, used in radio transmission systems.

RMA

return material authorization. A form used to return products.

RX

receive or receiver.

TX

transmit or transmitter.

WDM

wave division multiplexing. The division of the optical bandwidth of a single fiber into different colors of light to increase its transmission capacity. Each color (also known as wavelength or lambda) operates independently as a separate set of bandwidth. A WDM filter is used in the headend or hub to mix or separate the downstream 1550 nm and the upstream 1610 nm or 1310 nm wavelengths.

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