Installing Tranceivers and Optical Components on Avaya Virtual Services Platform 9000

Release 4.0
NN46250-305
Issue 05.01
December 2014

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Contents

Chapter 1: Introduction 6
Purpose 6
Related resources 6
Documentation 6
Training 6
Viewing Avaya Mentor videos 7
Support 7
Searching a documentation collection 7
Chapter 2: New in this release 9
Features 9
Other changes 10
Chapter 3: Safety and equipment care 12
Fiber optic equipment care 12
Fiber optic cable care 12
Fiber optic connector care 13
Cleaning single connectors 14
Cleaning duplex connectors 15
Cleaning receptacles 16
Chapter 4: SFP 18
SFP transceivers 18
Selecting an SFP 18
Installing an SFP 22
Removing an SFP 25
SFP specifications 25
SFP labels 26
General SFP specifications 26
Supported SFP transceivers 27
Chapter 5: SFP+ 36
SFP+ transceivers 36
Selecting an SFP+ 36
Installing an SFP+ 37
Removing an SFP+ 39
SFP+ specifications 40
SFP+ labels 40
General SFP+ specifications 41
Supported SFP+ transceivers 41
Chapter 6: QSFP+ 53
QSFP+ transceivers 53
Selecting a QSFP+ 53

Installing a QSFP+ 54
Removing a QSFP+ 56
QSFP+ specifications 57
QSFP+ transceiver labels 57
General QSFP+ transceiver specifications 58
40GBASE-SR4 4x10GBASE-SR QSFP+ specifications 58
40GBASE-LR4 QSFP+ transceiver specifications 59
QSFP+ to QSFP+ 40 gigabit DAC specifications 61
Chapter 7: Translations of safety messages 62
Class A electromagnetic interference warning statement 62
Electrostatic discharge caution statement 63
Laser eye safety danger statement 64
Laser eye safety connector inspection danger statement 65
Connector cleaning safety danger statement 66
Optical fiber damage warning statement 68
Optical fiber connector damage warning statement 69
SFP damage warning statement 70
Glossary 72

Chapter 1: Introduction

Purpose

This document provides installation instructions and technical specifications for the following:

- Small form factor pluggable (SFP) transceivers
- SFP plus (SFP+) transceivers

For a list of supported transceivers, see the latest product-specific release notes. Information in the release notes takes precedence over information in this document.

Related resources

Documentation

See *Documentation Reference for Avaya Virtual Services Platform 9000,* NN46250-100 for a list of the documentation for this product.

Training

Ongoing product training is available. For more information or to register, you can access the website at http://avaya-learning.com/.

Course code	Course title
4D00010E	Knowledge Access: ACIS - Avaya ERS 8000 and VSP 9000 Implementation
5D00040E	Knowledge Access: ACSS - Avaya VSP 9000 Support

Viewing Avaya Mentor videos

Avaya Mentor videos provide technical content on how to install, configure, and troubleshoot Avaya products.

About this task

Videos are available on the Avaya Support website, listed under the video document type, and on the Avaya-run channel on YouTube.

Procedure

- To find videos on the Avaya Support website, go to http://support.avaya.com and perform one of the following actions:
  - In **Search**, type `Avaya Mentor Videos` to see a list of the available videos.
  - In **Search**, type the product name. On the Search Results page, select **Video** in the **Content Type** column on the left.
- To find the Avaya Mentor videos on YouTube, go to www.youtube.com/AvayaMentor and perform one of the following actions:
  - Enter a key word or key words in the Search Channel to search for a specific product or topic.
  - Scroll down Playlists, and click the name of a topic to see the available list of videos posted on the website.

Note:

Videos are not available for all products.

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Searching a documentation collection

On the Avaya Support website, you can download the documentation library for a specific product and software release to perform searches across an entire document collection. For example, you can perform a single, simultaneous search across the collection to quickly find all occurrences of a particular feature. Use this procedure to perform an index search of your documentation collection.

Before you begin

- Download the documentation collection zip file to your local computer.
- You must have Adobe Acrobat or Adobe Reader installed on your computer.

Procedure

1. Extract the document collection zip file into a folder.
2. Navigate to the folder that contains the extracted files and open the file named <*product_name_release*>.pdx.
3. In the Search dialog box, select the option **In the index named <*product_name_release*>.pdx**.
4. Enter a search word or phrase.
5. Select any of the following to narrow your search:
   - Whole Words Only
   - Case-Sensitive
   - Include Bookmarks
   - Include Comments
6. Click **Search**.

   The search results show the number of documents and instances found. You can sort the search results by Relevance Ranking, Date Modified, Filename, or Location. The default is Relevance Ranking.

Chapter 2: New in this release

The following sections detail what is new in *Installing Transceivers and Optical Components on Avaya Virtual Services Platform 9000,* NN46250-305 for Release 4.0.

Features

See the following sections for information about feature changes.

QSFP+ transceivers

Release 4.0.1 adds support for QSFP+ transceivers with the introduction of the 9012QQ-2 module. Use QSFP+ transceivers to connect a module to fiber optic or direct attach cables (DACs). QSFP+ transceivers support 40 gigabit per second (Gbps) connections. For more information, see

- QSFP+ on page 53.
- QSFP+ transceivers on page 53.
- Selecting a QSFP+ on page 53.
- Installing a QSFP+ on page 54.
- Removing a QSFP+ on page 56.
- QSFP+ transceiver labels on page 57.
- General QSFP+ transceiver specifications on page 58.
- 40GBASE-SR4 4x10GBASE-SR QSFP+ specifications on page 58.
- 40GBASE-LR4 QSFP+ transceiver specifications on page 59.
- QSFP+ to QSFP+ 40 gigabit DAC specifications on page 61.

Digital Diagnostic Monitoring (DDM)

Release 4.0 updates the Digital Diagnostic Monitoring (DDM) feature in the following ways:

- Digital Diagnostic Monitoring (DDM) is now enabled by default. The **`pluggable-optical-module ddm-monitor`** and **`no pluggable-optical-module ddm-monitor`** commands to enable and disable DDM are no longer available.
- The **`pluggable-optical-module ddm-alarm-portdown`** command is also no longer available.
- Release 4.0 also updates the **`pluggable-optical-module ddm-monitor-interval <10..40>`**. The DDM monitor interval is now 10–40 seconds. The default is 10 seconds.

- The device sends traps if you enable the DDM traps send feature using the **pluggable-optical-module ddm-traps-send** command. The device always generates logs no matter if the DDM traps send feature is enabled or disabled.

Virtual Services Platform 9000 continues to support older configurations prior to Release 4.0.

For more information, see:

- Selecting an SFP on page 18.
- Job aid on page 19.

Discontinued transceivers

The following table identifies discontinued transceivers. These transceivers continue to be supported by the software but are no longer available for purchase.

Table 1: Discontinued transceivers

Type	Part number	Suggested replacement
1000BASE-XD DDI SFP	AA1419050-E6	–
	AA1419051-E6	AA1419057-E6 (1000BASE DDI CWDM)
1000BASE-ZX DDI SFP	AA1419052-E6	AA1419065-E6 (1000BASE DDI CWDM)

Update to SFP and SFP+ specification

Release 4.0 introduces a second generation 9048XS-2 Input/Output (I/O) module.

The 9048XS-2 module is a 48 port 10 Gigabit per second (Gbps) module that supports: 10GBASE-ER, 10GBASE-ZR, 10 GBASE-SR/SW, 10GBASE-LRM, 10GBASE-LR/LW, 10GBASE-ER/EW CWDM, 10GBASE-ZR/ZW CWDM, and 10GBASE-CX DAC SFP+ transceivers. For more information, see:

- General SFP specifications on page 26.
- General SFP+ specifications on page 41.

Update to SFP and SFP+ specification dimensions

Release 4.0 corrects small form factor pluggable (SFP) and small form factor pluggable plus (SFP+) dimensions. For more information, see:

- General SFP specifications on page 26.
- General SFP+ specifications on page 41.

Other changes

See the following sections for information about changes that are not feature-related.

Document title changes

In Release 4.0, the title of this document changed from *Avaya Virtual Services Platform 9000 Installation — SFP Hardware Components*, NN46250-305 to *Installing Transceivers and Optical Components on Avaya Virtual Services Platform 9000,* NN46250-305.

Regulatory information

Regulatory information is removed from this document because the content exists in a separate regulatory document. For more information, see *Regulatory Reference for Avaya Virtual Services Platform 9000,* NN46250-112 (700509061).

Chapter 3: Safety and equipment care

This chapter contains important safety and regulatory information. Read this section before you install Small Form Factor Pluggable (SFP) and Small Form Factor Pluggable Plus (SFP+).

Fiber optic equipment care

Use the information in this section to properly maintain and care for fiber optic equipment.

Transceivers are static sensitive.

Dust contamination can reduce the performance of optical parts in transceivers. When you store a transceiver, or after you disconnect it from a fiber optic cable, always keep a dust cover over the optical bore.

Dispose of this product according to all national laws and regulations.

To prevent equipment damage, observe the following electrostatic discharge (ESD) precautions when you handle or install the components:

- Ground yourself and the equipment to an earth or building ground. Use a grounded workbench mat (or foam that dissipates static charge) and a grounding wrist strap. The wrist strap must touch the skin and you must ground it through a one megaohm resistor.
- Do not touch anyone who is not grounded
- Leave all components in their ESD-safe packaging until installation, and use only a static-shielding bag for all storage, transport, and handling.

  Clear the area of synthetic materials such as polyester, plastic, vinyl, or styrofoam because these materials carry static electricity that damages the equipment.

Fiber optic cable care

Although reinforcing material and plastic insulation protects the glass fiber in fiber optic cable, it is subject to damage.

Use the following precautions to avoid damaging the glass fiber:

- Do not kink, knot, or vigorously flex the cable.

- Do not bend the cable to less than a 40 mm radius.
- Do not stand on fiber optic cable; keep the cable off the floor.
- Do not pull fiber optic cable harder than you do a cable containing copper wire of comparable size.
- Do not allow a static load of more than a few pounds on a section of the cable.
- Place protective caps on fiber optic connectors that are not in use.
- Store unused fiber optic patch cables in a cabinet, on a cable rack, or flat on a shelf.

Frequent overstressing of fiber optic cable causes progressive degeneration that leads to failure.

If you suspect damage to a fiber optic cable, either due to mishandling or an abnormally high error rate observed in one direction, reverse the cable pairs. If the high error rate appears in the other direction, replace the cable.

Warning:

Risk of equipment damage

Do not crush fiber optic cable. If fiber optic cable is in the same tray or duct with large, heavy electrical cables, the weight of the electrical cable can damage the fiber optic cable.

Fiber optic connector care

Before you connect fiber optic connectors to transmission equipment, test equipment, patch panels, or other connectors, ensure fiber optic connectors are clean. The performance of an optical fiber connector depends on how clean the connector and coupling are at the time of connection.

A damaged or dirty connector can damage a connector with which it pairs. A connector must be clean before you insert it into a transmitter or receiver.

Never clean an optical connector while it carries light. Optical power can cause ignition of the cleaning material when it contacts the end of the optical connector and can destroy the connector. Typical cleaning materials, for example, tissues saturated with alcohol, combust almost instantaneously after you expose them to optical power levels of +15 dBm or higher.

Visually inspect the connector to determine cleanliness and to determine if it needs replacing. You must replace a connector that has a scratch across the core, or a scratch that appears to end in the core.

The proper connector cleaning method depends on the connector contaminants:

- Judge cleanliness by visual inspection with a fiber microscope. First inspect the connector, and then clean as required.

  Danger:

  Risk of eye injury

When you inspect a connector, ensure that light sources are off. The light source in fiber optic cables can damage your eyes.

- If you suspect only the possibility of dust particles, for example, if you leave a connector uncapped in a clean environment, use high-quality canned air or a reel cleaner, for example, a Cletop, to clean the connector. A reel cleaner is a good choice to ensure that no dust contaminates the connector.
- If the connector is visibly dirty or you suspect contamination by chemicals (for example, matching gel), use high-quality alcohol and canned air to clean the connector. This method is the most thorough cleaning method. In some cases, a reel cleaner can suffice.

The more surface manipulation you apply to the connector, the more likely you are to damage the connector.

When you insert a connector ferrule into a connector or adapter, ensure that the ferrule tip does not touch the outside of the mating connector or adapter. This action can produce scratches and dirt deposits on the connector.

To help prevent connectors from collecting dust, cover them when not in use. To avoid the transfer of oil or other contaminants from your fingers to the end face of the ferrule, handle connectors with care. Do not touch the connector end face.

Cleaning single connectors

Clean connectors so that the optical signal is minimally attenuated by the connector.

Perform this procedure if you suspect more than dust contamination.

Before you begin

- You need a lens-grade, lint-free tissue, for example, Kimwipes.
- You need an optical-grade isopropyl alcohol (IPA) (98% or more pure).
- You need a high-quality canned compressed air with extension tube.

  Compressed air must be free of dust, water, and oil, or filmy deposits or scratches on the surface of the connector can result.
- You need a fiber optic microscope to inspect connectors.

Danger:

Risk of eye injury

When you inspect a connector, ensure that light sources are off. The light source used in fiber optic cables can damage your eyes.

To avoid getting debris in your eyes, wear safety glasses when you work with the canned air duster.

To avoid eye irritation on contact, wear safety glasses when you work with isopropyl alcohol.

Procedure

1. Remove dust or debris by applying canned air to the cylindrical and end-face surfaces of the connector.
2. Gently wipe the cylindrical and end-face surfaces with a tissue dampened with optical-grade isopropyl alcohol.
3. Gently wipe the cylindrical and end-face surfaces with a dry tissue.

   Important:

   Do not let the IPA evaporate; wipe it dry immediately. Alcohols can leave a residue that is difficult to remove.
4. Dry the connector surfaces by applying canned air.
5. Inspect the connector to ensure it is clean and undamaged.

   To prevent contamination, do not touch the connector surfaces after cleaning; and cover connectors with dust caps if they are not in use.

Cleaning duplex connectors

Clean connectors so that the optical signal is minimally attenuated by the connector.

Perform this procedure when you suspect more than dust contamination.

Before you begin

- You need a lens-grade, lint-free tissue, for example, Kimwipes.
- You need an optical-grade isopropyl alcohol (IPA) (98% or more pure).
- You need a high-quality canned compressed air with extension tube.

  Compressed air must be free of dust, water, and oil, or filmy deposits or scratches on the surface of the connector can result.
- You need a fiber optic microscope to inspect connectors.

About this task

Danger:

Risk of eye injury

When you inspect a connector, ensure that light sources are off. The light source in fiber optic cables can damage your eyes.

To avoid getting debris in your eyes, wear safety glasses when you work with the canned air duster.

To avoid eye irritation on contact, wear safety glasses when you work with isopropyl alcohol.

Procedure

1. Remove or retract the shroud.

On removable shroud connectors, hold the shroud on the top and bottom at the letter designation, apply medium pressure, and then pull it free from the connector body. Do not discard the shroud.

OR

On retractable shroud connectors, hold the shroud in the retracted position.

2. Remove dust or debris by applying canned air to the cylindrical and end-face surfaces of the connector.
3. Gently wipe the cylindrical and end-face surfaces of both ferrules using a tissue saturated with optical-grade isopropyl alcohol.
4. Gently wipe the cylindrical and end-face surfaces with a dry tissue.

   Important:

   Do not let the IPA evaporate; wipe it dry immediately. Alcohols can leave a residue that is difficult to remove.
5. Blow dry the connector surfaces with canned air.
6. Inspect the connector to ensure it is clean and undamaged.
7. Using care to not touch the clean ferrules, gently push the shroud back onto the connector until it seats and locks in place.

Cleaning receptacles

Clean connector receptacles or ports so that the optical signal is minimally attenuated by the connection.

Before you begin

- You need an optical-grade isopropyl alcohol (IPA) (98% or more pure).
- You need cleaning swabs (also called cleaning sticks or wands).
- You need a high-quality canned compressed air with extension tube.

  Compressed air must be free of dust, water, and oil, or filmy deposits or scratches on the surface of the connector can result.

Warning:

Risk of equipment damage

To avoid contamination, only clean optical ports if you see evidence of contamination or reduced performance exists, or during their initial installation.

To prevent oil contamination of connectors, use only high-quality canned compressed air.

Do not allow the air extension tube to touch the bottom of the optical port.

Procedure

1. Remove dust or debris by blowing canned air into the optical port of the device using the canned air extension tube.
2. Clean the optical port by inserting a wand moistened with alcohol into the receptacle and rotating it.

   Use each cleaning wand to clean only one optical port.
3. Dry the optical port by inserting a dry wand into the receptacle and rotating it.

   Important:

   Do not let the IPA evaporate; wipe it dry immediately. Alcohols can leave a residue that is difficult to remove.
4. Remove lint by blowing compressed air into the optical port.
5. Reconnect the optical connector and check for proper function.

   If you do not reinstall the connector, use a protective cap.

   If problems persist, ensure that the connector or receptacle is free from damage.

Chapter 4: SFP

This chapter provides installation procedures and specifications for small form factor pluggable (SFP) transceivers.

SFP transceivers

This section describes how to select and install small form factor pluggable (SFP) transceivers.

Important:

- The Virtual Services Platform 9000 operates in forgiving mode for SFP transceivers, which means that the switch will bring up the port operationally when using Non-Avaya SFP transceivers. Avaya does not provide support for operational issues related to these SFPs, but they will operate and the port link will come up. The switch logs the device as an unsupported or unknown device.

Selecting an SFP

Use an SFP transceiver to connect a device motherboard to a fiber optic or unshielded twisted pair network cable. Select the appropriate transceiver to provide the required reach.

Procedure

1. Determine the required reach.

   Depending on the product, SFP transceivers are available for cable distances of up to 100 meters (m), 550 m, 10 kilometers (km), 40 km, 70 km, and 120 km.

2. Determine the required media and connector type.

   You need fiber optic cable for a reach over 100 m.

   Possible media include CAT5, single mode fiber, and multimode fiber. Possible connectors include LC, MT-RJ, and RJ-45.

3. If the media is optical fiber, determine wavelength restrictions or requirements.

   To expand available bandwidth on a common optical fiber, use Coarse Wavelength Division Multiplexing (CWDM) SFP transceivers.

4. Determine if you need digital diagnostic monitoring (DDM). DDM is enabled by default.

   Not all SFP transceivers or products support DDM.

Job aid

The following table describes the reach provided by various SFP transceivers. This table is informational only—not all Avaya products support all the SFP transceivers listed here.

SFP model	Common application
1000BASE-T SFP	Lowest-cost gigabit Ethernet solution. Up to 100 m reach over Category 5 (CAT5) unshielded twisted pair (UTP).
100BASE-FX SFP	Up to 2 km reach over multimode fiber (MMF) pair.
1000BASE-SX DDI SFP	Well-suited for campus local area networks (LAN) and intrabuilding links. • up to 275 m using 62.5 micrometer (µm) MMF optic cable • up to 550 m using 50 µm MMF optic cable
100BASE-LX10 1000BASE-LX DDI SFP	Up to 10 km reach over a single mode fiber (SMF) pair. Up to 550 m reach over a multimode fiber pair.
1000BASE-XD DDI SFP	Up to 40 km reach over a single mode fiber pair.
100BASE-ZX 1000BASE-ZX DDI SFP	Up to 70 km reach over a single mode fiber pair.
1000BASE-BX10 DDI SFP	1310 nm to 1490 nm, up to 10 km reach over single mode fiber. AA1419069–E6 to AA1419070–E6 mating pairs.
1000BASE-BX40 DDI SFP	1310 nm to 1490 nm, up to 40 km reach. Bidirectional over one single mode fiber. AA1419076–E6 to AA1419077–E6 mating pairs.
1000BASE-EX DDI SFP	Up to 120 km reach over a single mode fiber pair.

SFP transceivers are hot-swappable input and output enhancement components that permit Gigabit Ethernet ports to link with other Gigabit Ethernet ports over various media types.

The system also supports Coarse Wavelength Division Multiplexer (CWDM) SFP transceivers. CWDM technology consolidates multiple optical channels on a common optical fiber. CWDM uses multiple wavelengths to expand available bandwidth.

CWDM SFP transceivers support high speed data communications for Metropolitan Area Networks (MAN). The system uses a grid of eight CWDM optical wavelengths in both ring and point-to-point configurations. All components are color-coded by wavelength.

Important:

The attainable cable length can vary depending on the quality of the fiber optic cable used.

Use Digital Diagnostic Monitoring (DDM) to monitor SFP laser operating characteristics. DDM is enabled by default. Support for Digital Diagnostic Interfaces (DDI—an interface that supports DDM) involves data collection and alarm and warning monitoring. Static data collection includes SFP vendor information, DDI support information, and DDI alarm and warning threshold values. Dynamic

data collection includes temperature, supply voltage, laser bias current, transmit power, and receive power. DDM works during active laser operation without affecting data traffic.

DDM generates temperature warnings and alarms if the port is administratively enabled. The device only generates other DDM warnings and alarms if the link is up. The device uses an offset of 8 degrees for warning thresholds and an offset of 5 degrees for alarm thresholds to calculate the thresholds used by the monitoring code. For example, if the warning threshold is 73 °C and the alarm threshold is 78 °C for the part, then the monitoring code uses 65 °C as the warning threshold and 73 °C as the alarm threshold. DDM high temperature alarm results in port shutdown for second generation module ports only.

The Virtual Services Platform 9000 only checks warning and alarm status bits during initialization and during requests for dynamic data. If the system asserts or clears an alarm or warning, the system logs a message and generates a trap. The system maps DDM warning and alarm messages into Warning and Fatal message categories for system logging purposes.

The device sends traps if you enable the DDM traps send feature using the **`pluggable-optical-module ddm-traps-send`** command. The device always generates logs no matter if the DDM traps send feature is enabled or disabled. Configure the DDM monitor interval using the **`pluggable-optical-module ddm-monitor-interval <10..40>`** command. The DDM monitor interval is 10–40 seconds. The default is 10 seconds.

The following table describes the Avaya SFP transceiver models that the Virtual Services Platform 9000 supports.

Note:

All SFP models in this table are supported on the 10 Gigabit per second (Gbps) modules and include DDI support, with the following exceptions:

- The 100BASE-FX model is not supported on the 10 Gbps modules.
- The 1000BASE-T model does not support DDI.

Model	Part number	Description
1000BASE-T SFP	AA1419043-E6	Gigabit Ethernet, RJ-45 connector 850 nm, Gigabit Ethernet, duplex LC connector
1000BASE-SX DDI SFP	AA1419048-E6	850 nm, Gigabit Ethernet, duplex LC connector
1000BASE-XD DDI SFP	AA1419050-E6	1310 nm, Gigabit Ethernet, duplex LC connector This transceiver has been discontinued but remains supported by the software.
1000BASE-XD DDI SFP	AA1419051-E6	1550 nm, Gigabit Ethernet, duplex LC connector This transceiver has been discontinued but remains supported by the software. Avaya recommends AA1419057-E6 as a replacement.
1000BASE-ZX DDI SFP	AA1419052-E6	1550 nm, Gigabit Ethernet, duplex LC connector

Model	Part number	Description
		This transceiver has been discontinued but remains supported by the software. Avaya recommends AA1419065-E6 as a replacement.
1000BASE-BX10 DDI SFP	AA1419069-E6 (10 km at 1310 nm) and mating pair AA1419070-E6 (10 km at 1490 nm)	1310 nm (tx) and 1490 nm (rx) Gigabit Ethernet, single-fiber LC connector
1000BASE-BX40 DDI SFP	AA1419076-E6 (40 km at 1310 nm) and mating pair AA1419077-E6 (40 km at 1490 nm)	1490 nm (tx) 1310 nm (rx) Gigabit Ethernet, single-fiber LC connector
1000BASE-EX DDI SFP	AA1419071-E6	1550 nm, Gigabit Ethernet, duplex LC connector
1000BASE–XD DDI CWDM 40 km SFP	AA1419053-E6 to AA1419060-E6	Gigabit Ethernet, duplex LC connector
1000BASE–ZX DDI CWDM 70 km SFP	AA1419061-E6 to AA1419068-E6	Gigabit Ethernet, duplex LC connector
100BASE-FX SFP	AA1419074-E6	1310 nm, 100 Mbps Ethernet, multimode fiber, duplex LC connector

Table 2: Supported SFP transceivers

Model	ROHS product number	Description
1000BASE-T	AA1419043-E6	CAT5 UTP, up to 100 m. Because the 1000BASE-T device is all electrical, it does not need DDI support.
1000BASE-SX DDI	AA1419048-E6	850 nm up to 275 m using 62.5 m MMF optic cable up to 550 m using 50 µm MMF optic cable
1000BASE-LX DDI	AA1419049-E6	1310 nm, up to 10 km
1000BASE-XD DDI	AA1419050-E6	1310 nm, up to 40 km This transceiver has been discontinued but remains supported by the software.
	AA1419051-E6	1550 nm, up to 40km (non-CWDM) This transceiver has been discontinued but remains supported by the software. Avaya recommends AA1419057-E6 as a replacement.
1000BASE-ZX DDI	AA1419052-E6	1550 nm, up to 70 km (non-CWDM) This transceiver has been discontinued but remains supported by the software. Avaya

Model	ROHS product number	Description
		recommends AA1419065-E6 as a replacement.
1000BASE-BX-U-10	AA1419069-E6	Transmits at 1310 nm. The range is up to 10km upstream.
1000BASE-BX-D-10	AA1419070-E6	Transmits at 1490 nm. The range is up to 10 km downstream.
1000BASE-BX-U-40	AA1419076-E6	Transmits at 1310 nm. The range is up to 40 km upstream.
1000BASE-BX-D-40	AA1419077-E6	Transmits at 1490 nm. The range is up to 40 km downstream.
1000BASE-EX DDI	AA1419071-E6	1550 nm, up to 120 km (non-CWDM)
1000BASE DDI CWDM	AA1419053-E6	1470 nm, up to 40 km
	AA1419054-E6	1490 nm, up to 40 km
	AA1419055-E6	1510 nm, up to 40 km
	AA1419056-E6	1530 nm, up to 40 km
	AA1419057-E6	1550 nm, up to 40 km
	AA1419058-E6	1570 nm, up to 40 km
	AA1419059-E6	1590 nm, up to 40 km
	AA1419060-E6	1610 nm, up to 40 km
	AA1419061-E6	1470 nm, up to 70 km
	AA1419062-E6	1490 nm, up to 70 km
	AA1419063-E6	1510 nm, up to 70 km
	AA1419064-E6	1530 nm, up to 70 km
	AA1419065-E6	1550 nm, up to 70 km
	AA1419066-E6	1570 nm, up to 70 km
	AA1419067-E6	1590 nm, up to 70 km
	AA1419068-E6	1610 nm, up to 70 km
100BASE-FX	AA1419074-E6	1310 nm, up to 2km

Installing an SFP

Install an SFP to provide an interface between the device and the network cable.

Before you begin

- Verify that the SFP is the correct model for your network configuration.
- Before you install the optical connector, ensure it is clean.

Danger:

Risk of eye injury by laser

Fiber optic equipment can emit laser or infrared light that can injure your eyes. Never look into an optical fiber or connector port. Always assume that fiber optic cables connect to a light source.

Electrostatic alert:

ESD can damage electronic circuits. Do not touch electronic hardware unless you wear a grounding wrist strap or other static-dissipating device.

Warning:

Risk of equipment damage

Only trained personnel can install this product.

About this task

Installing an SFP takes approximately 3 minutes.

Procedure

1. Remove the SFP from its protective packaging.
2. Grasp the SFP transceiver between your thumb and forefinger.
3. As shown in the following figure, insert the device into the slot on the module.

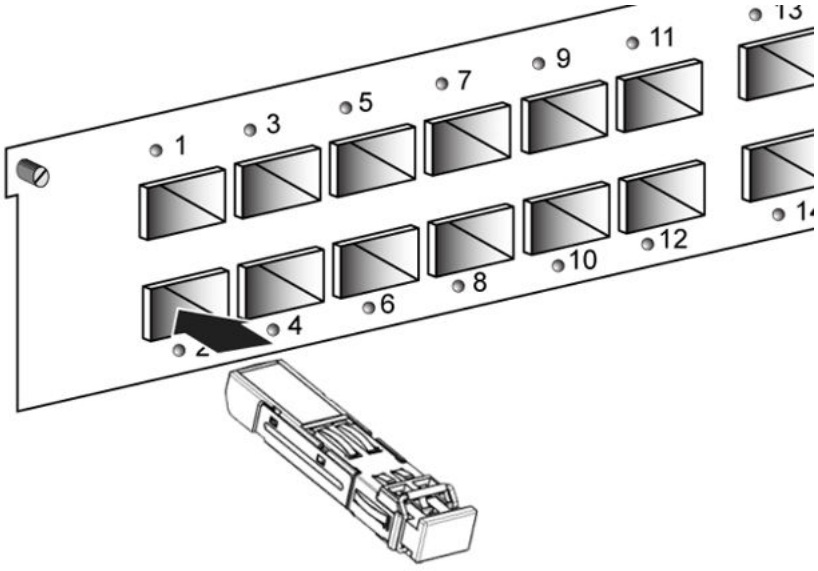
   Warning:

   Risk of equipment damage

   SFP transceivers are keyed to prevent incorrect insertion. If the SFP transceiver resists pressure, do not force it; turn it over, and reinsert it.

   Apply a light pressure to the device until it clicks and locks into position.
4. Remove the dust cover from the optical bore, and insert the fiber optic connector.

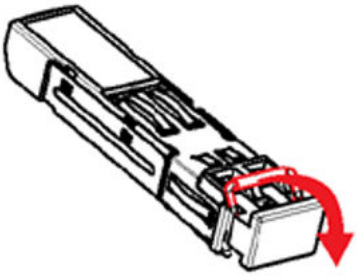
Example



Job aid

Depending on the transceiver manufacturer, the SFP transceiver can use different types of locking and extractor mechanisms.

The following figure shows the typical mechanism used on SFP transceivers; other locking and extractor mechanisms exist, although they are not shown here. In the following figure, the SFP transceiver uses the bore plug. Pull the bail to release the device.



The following figure shows the 1000BASE-SX MT-RJ SFP. Push the tab to release the device.



Removing an SFP

Remove an SFP to replace it or to commission it elsewhere.

Before you begin

- Wear an antistatic wrist strap.

Danger:

Risk of eye injury by laser

Fiber optic equipment can emit laser or infrared light that can injure your eyes. Never look into an optical fiber or connector port. Always assume that fiber optic cables connect to a light source.

Electrostatic alert:

ESD can damage electronic circuits. Do not touch electronic hardware unless you wear a grounding wrist strap or other static-dissipating device.

Procedure

1. Disconnect the network fiber optic cable from the SFP connector.
2. Depending on your SFP model, there are different locking mechanisms to release the SFP transceiver. The following describes the typical mechanism used on SFP transceivers; other locking and extractor mechanisms exist, although they are not described here.
   - Bail latch: Pull the swing-down latch handle to the fully lowered position and hold the handle to extract the module.
3. Slide the SFP out of the module SFP slot.

   If the SFP does not slide easily from the module slot, use a gentle side-to-side rocking motion while firmly pulling the SFP from the slot.
4. Affix dust covers over the fiber optic bore and connector.
5. Store the SFP in a safe place until needed.

   Important:

   If you discard the SFP transceiver, dispose of it according to all national laws and regulations.

SFP specifications

This section provides technical specifications for the supported small form factor pluggable (SFP) models. Use this information to aid in proper network design.

The specifications in this section meet or exceed those specified in the applicable IEEE standards, where they exist.

In these specifications, unless otherwise noted, receiver sensitivity is the minimum average input optical power for which Avaya guarantees the receiver meets the bit error rate (BER) of 10^{-12}.

Important:

For instances where you install a significant number of long-range SFPs and SFP+s, you must be sure to have sufficient power available to power these optical devices.

Virtual Services Platform 9000 supports only Avaya-qualified transceivers. Other vendor transceivers will not work and Avaya does not support them.

SFP labels

The Avaya label on a typical SFP transceiver contains an Avaya serial number, a bar code, a manufacturer code, an interface type, and a part number.

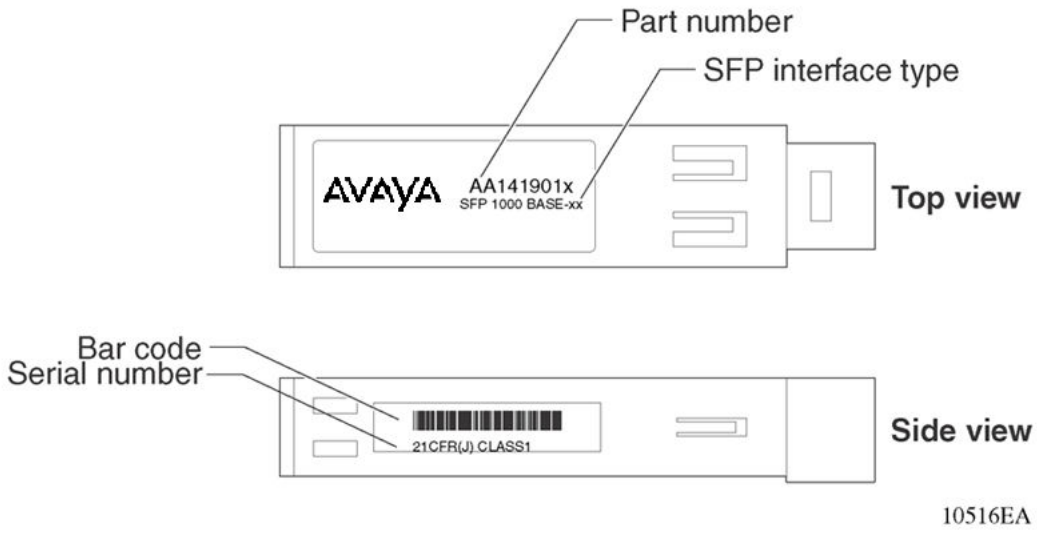


Figure 1: SFP label

General SFP specifications

The following table describes general SFP specifications.

Table 3: General SFP specifications

Parameter	Description
Dimensions (H x W x D)	8.5 x 13.4 x 56.4 millimeters (0.33 x 0.53 x 2.22 inches), unless otherwise stated.

Parameter	Description
Operating temperature	–5 to 85 ºC for RoHS -E6 models
Storage temperature	–40 to 85 ºC
Maximum supply current	300 mA, unless otherwise stated
Maximum power consumption	1.0 W, unless otherwise stated

Supported SFP transceivers

The following section provides specifications for the supported SFP transceivers.

1000BASE-SX (LC) SFP specifications

The 1000BASE-SX SFP transceiver provides 1000BASE-SX gigabit Ethernet connectivity at 850 nm using multimode optical fiber. This SFP supports only full-duplex operation. The part number is AA1419013-E5.

The following table describes standards, connectors, cabling, and distance for the 1000BASE-SX SFP transceivers.

Table 4: IEEE 802.3z 1000BASE-SX (LC) SFP specifications

Parameter	Specifications
Connectors	Duplex LC
Cabling	• 62.5 µm MMF optic cable • 50 µm MMF optic cable
Distance	• up to 275 m using 62.5 µm MMF optic cable • up to 550 m using 50 µm MMF optic cable
Wavelength	850 nanometers (nm)
Link optical power budget	7.0 deciBels (dB)
Transmitter characteristics	
Launch power	–10 to –4.0 dBm
Receiver characteristics	
Receiver sensitivity	–17 dBm
Maximum input power	0 dBm

1000BASE-LX SFP specifications

The 1000BASE-LX SFP transceiver provides 1000BASE-LX gigabit Ethernet connectivity at 1310 nanometers (nm) using single mode or multimode optical fiber. The 1000BASE-LX SFP transceiver supports only full-duplex operation. The part number is AA1419015-E5.

The following table describes standards, connectors, cabling, and distance for the 1000BASE-LX SFP transceiver.

Table 5: IEEE 802.3z 1000BASE-LX SFP specifications

Parameter	Specifications
Connectors	Duplex LC
Cabling	• 50 micrometer (µm) multimode fiber (MMF) • 62.5 µm multimode fiber • 9 µm single mode fiber (SMF)
Distance	• Up to 550 meters (m) using MMF • Up to 10 kilometers (km) using SMF
Wavelength	1310 nm
Link optical power budget	10.5 dB
Transmitter characteristics	
Launch power	–9.5 to –3.0 dBm
Receiver characteristics	
Receiver sensitivity	–20 dBm
Maximum input power	–3.0 dBm

1000BASE-T SFP specifications

The 1000BASE-T SFP provides gigabit Ethernet connectivity using a single eight-pin RJ-45 connector. The 1000BASE-T SFP only operates at 1 gigabits per second (Gbps) and does not support 100BASE-T SFP or 10BASE-T interfaces. The part number for this model is AA1419043-E6.

Important:

You must disable autonegotiation before you use the 1000BASE-T SFP because the default setting on most modules is autonegotiation enabled.

The maximum current requirement of the SFP is 375 milliamperes (mA) at 5 volts (V).

The following table describes the 1000BASE-T SFP specifications.

Table 6: IEEE 802.3z 1000BASE-T SFP specifications

Parameter	Specifications
Standards	IEEE 802.3z, IEEE 802.3ab
Connectors	RJ-45
Cabling	CAT5E or better UTP
Distance	Up to 100 m

1000BASE-SX DDI SFP specifications

The 1000BASE-SX DDI SFP transceiver has a reach of up to 550 m using 50 µm MMF, and of 275 m using 62.5 µm MMF. This SFP transceiver operates at 850 nm. The part number is AA1419048-E6.

The following table describes standards, connectors, cabling, and distance for the 1000BASE-SX DDI SFP transceivers.

Table 7: 1000BASE-SX SFP DDI (550 m) specifications

Parameter	Specifications
Maximum electrical power consumption	1 watt (W)
Connector	Duplex LC
Cabling	MMF
Data rate	1.0 Gbps
Line rate (8B/10B code)	1.25 Gbps
Link optical power budget	7.5 dB
Transmitter characteristics	
Launch power	–9.5 to –4.0 dBm
Receiver characteristics	
Receiver sensitivity	–17 dBm
Maximum receiver power	0 dBm

1000BASE-LX DDI SFP specifications

This SFP transceiver provides 1000BASE-LX gigabit Ethernet connectivity at 1310 nanometers (nm) using single mode or multimode optical fiber. The part number is AA1419049-E6.

Table 8: 1000BASE-LX DDI SFP specifications

Parameter	Specifications
Maximum electrical power consumption	1.0 watt (W)
Connectors	Duplex LC
Cabling	• 50 micrometer (µm) multimode fiber (MMF) • 62.5 µm multimode fiber • 9 µm single mode fiber (SMF)
Distance	• Up to 550 meters (m) using MMF • Up to 10 kilometers (km) using SMF
Data rate	1.0 Gbps
Line rate (8B/10B code)	1.25 Gbps
Link optical power budget	9.5 dB
Transmitter characteristics	

Parameter	Specifications
Launch power	–9.5 to –3.0 dBm
Receiver characteristics	
Receiver sensitivity	–19.0 dBm
Maximum receiver power	–3.0 dBm

1000BASE DDI CWDM 40 km SFP specifications

The 1000BASE SFP transceiver provides CWDM gigabit Ethernet connectivity using single mode fiber. This SFP transceiver supports only full-duplex operation.

Important:

For the 40 km CWDM SFP transceivers, a minimum attenuation of 4 dB must exist between the transmitter and receiver. To avoid receiver saturation, you must insert a minimum attenuation of 4 dB when you test the CWDM SFP transceiver in loopback mode.

The following tables describe specifications for 1000BASE DDI CWDM SFP transceivers numbered AA1419053-E6 to AA1419060-E6.

Warning:

Risk of equipment damage

To prevent damage to the optical receiver, ensure that at least 4 dB of attenuation exists between the transmit and receive ports.

Table 9: Part number and center wavelength assignment

Part number	Center wavelength assignment
AA1419053-E6	1471 nm
AA1419054-E6	1491 nm
AA1419055-E6	1511 nm
AA1419056-E6	1531 nm
AA1419057-E6	1551 nm
AA1419058-E6	1571 nm
AA1419059-E6	1591 nm
AA1419060-E6	1611 nm

Table 10: 1000BASE CWDM SFP DDI (40 km) specifications

Parameter	Specifications
Maximum electrical power consumption	1.0 W
Connectors	Duplex LC
Cabling	SMF, 9 µm
Data rate	1.0 Gbps

Parameter	Specifications
Line rate (8B/10B code)	1.25 Gbps
Link optical power budget	17 dB
Maximum dispersion power penalty	1 dB at 40 km
Minimum attenuation between transmit and receive ports	4 dB
Transmitter characteristics	
Launch power	–4.0 to 1.0 dBm
Receiver characteristics	
Receiver sensitivity	–21 dBm
Maximum receiver power	–3.0 dBm

1000BASE DDI CWDM 70 km SFP specifications

The 1000BASE SFP transceiver provides CWDM gigabit Ethernet connectivity using single mode fiber. This SFP transceiver supports only full-duplex operation.

Important:

For the 70 km CWDM SFP transceiver, a minimum attenuation of 10 dB must exist between the transmitter and receiver.

The following table describes specifications for CWDM SFP transceivers numbered AA1419061-E6 to AA1419068-E6.

Warning:

Risk of equipment damage

To prevent damage to the optical receiver, ensure that at least 8 dB of attenuation exists between the transmit and receive ports.

Table 11: 1000BASE-ZX CWDM SFP DDI (70 km) specifications

Parameter	Specifications
Maximum electrical power consumption	1.0 W
Connectors	Duplex LC
Cabling	SMF, 9 µm
Data rate	1.0 Gbps
Line rate (8B/10B code)	1.25 Gbps
Link optical power budget	24 dB
Maximum dispersion power penalty	2 dB at 70 km
Minimum attenuation between transmit and receive ports	8 dB
Transmitter characteristics	

Parameter	Specifications
Launch power	0 to 5.0 dBm
Receiver characteristics	
Receiver sensitivity	–24 dBm
Maximum receiver power	–3.0 dBm

1000BASE-BX bidirectional SFP transceivers

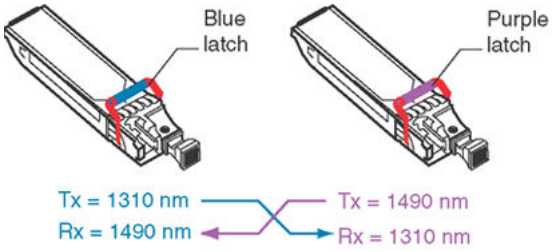
The 1000BASE-BX bidirectional DDI SFP transceivers provides gigabit Ethernet connectivity over a single fiber.

Warning:

Risk of equipment damage

For the 40 km transceivers only. Connect the 1000BASE-BX SFP transceiver using a single mode fiber with at least 6 dB of attenuation. Damage can result if insufficient attenuation is provided or if the same 1000BASE-BX SFP transceivers are connected.

In the following figure, the transmit (Tx) and receive (Rx) paths share the same fiber by using two different wavelengths. One model transmits at 1310 nm and receives at 1490 nm, while the mating model transmits at 1490 nm and receives at 1310 nm. You can only connect a mating pair.



The long wavelength optical transceivers used in these models provide variable distance ranges using single mode fiber optic cabling.

You can use 1000BASE-BX SFP transceivers to double the number of your fiber links. For example, if you install 20 fiber pairs with 20 conventional ports connected, you can use 1000BASE-BX SFP transceivers to expand to 40 ports, using the same fiber.

The following table provides the reach and part numbers for each of the mating pairs.

Table 12: 1000BASE-BX SFP transceivers

Reach	1310 nm	1490 nm
10 km	AA1419069-E6	AA1419070-E6
40 km	AA1419076-E6	AA1419077-E6

1000BASE-BX10 bidirectional DDI SFP specifications

The 1000BASE-BX10 SFP transceivers (part numbers AA1419069-E6 and AA1419070-E6) can attain a reach of up to 10 km.

The following table describes standards, connectors, cabling, and distances for the 1000BASE-BX10 SFP transceiver.

Table 13: IEEE 802.3ah 1000BASE-BX10 bidirectional SFP specifications

Parameter	Specification
Connectors	Single-fiber LC
Data rate	1.0 Gbps
Line rate (8B/10B code)	1.25 Gbps
Distance	Up to 10 km
Wavelength	1310 nm and 1490 nm
Link optical power budget	11.0 dB
Maximum transmitter and dispersion power penalty	3.3 dB
Transmitter characteristics	
Maximum launch power	–3.0 dBm
Minimum launch power	–9.0 dBm
Receiver characteristics	
Maximum receiver sensitivity	–19.5 dBm
Maximum input power (maximum average receive power)	–3.0 dBm

1000BASE-EX DDI SFP specifications

The following table describes the 1000BASE-EX DDI SFP transceiver. This SFP transceiver operates at 1550 nm and has a reach of up to 120 km. The part number is AA1419071-E6.

Warning:

Risk of equipment damage

To prevent damage to the optical receiver, ensure that at least 14 dB of attenuation exists between the transmit and receive ports.

To attain the BER of 10^{-12}, the minimum attenuation between the transmit and receive ports is 15 dB.

Table 14: 1000BASE-EX DDI SFP transceiver specifications

Parameter	Specification
Maximum electrical power consumption	1.2 W
Connectors	Duplex LC
Cabling	SMF, 9 µm

Parameter	Specification
Data rate	1.0 Gbps
Line rate (8B/10B code)	1.25 Gbps
Link optical power budget	30 dB
Maximum dispersion power penalty	2.0 dB at 120 km
Minimum attenuation between transmit and receive ports	14 dB
Transmitter characteristics	
Launch power	0 to 5.0 dBm
Receiver characteristics	
Receiver sensitivity	–30 dBm
Maximum receiver power	–9.0 dBm

100BASE-FX SFP specifications

The 100BASE-FX SFP provides 100 Mbps Ethernet Carrier Sense Multiple Access with Collision Detection (CSMA-CD) connectivity using multimode optical fiber. The 100BaseFX uses an LED transmitter. The centre wavelength, spectral width, and optical rise/fall time satisfy the trade-off curves in the FDDI PMD document (ISO/IEC 9314–3:1900). The supported link length is up to 2 km over MMF. The part number for this model is AA1419074–E6.

The following table describes the 100BASE-FX SFP specifications.

Table 15: 100BASE-FX SFP specifications

Parameter	Specifications
Maximum electrical power consumption	0.8 W
Connectors	Duplex LC
Cabling	• 62.5 µm MMF optic cable • 50 µm MMF optic cable
Distance	Up to 2 km using 500 Mhz-km MMF optic cable
Wavelength	1300 nm
Link optical power budget	10 dB
Transmitter characteristics	
Transmitter type	LED
Nominal wavelength	1300 nm
Transmit output power (max)	– 14 dBm
Transmit output power (min)	– 23.5 to – 20 dBm
Spectral width	140 nm (FHWM)
Minimum extinction ratio	10 dB
Receiver characteristics	

Parameter	Specifications
Receiver type	PIN photodiode
Wavelength range	1270 nm to 1380 nm
Nominal wavelength	—
Receiver sensitivity	– 33.5 dBm
Maximum input power	– 14 dBm
Path penalty	—
Maximum receive reflectance	—

Chapter 5: SFP+

This chapter provides installation procedures and specifications for small form factor pluggable plus (SFP+) transceivers.

SFP+ transceivers

This section describes how to select and install small form factor pluggable plus (SFP+) transceivers.

Use an SFP+ transsceiver to connect a device motherboard to fiber optic or direct attached cables, up to 15 meters in length. SFP+ transceivers are similar to SFP transceivers in physical appearance but SFP+ transceivers support 10-gigabit per second (Gbps) connections. SFP+ modules are not compatible with SFP modules.

Important:

- The Virtual Services Platform 9000 operates in strict mode for SFP+ transceivers, which means that the switch will not bring up the port operationally when using non-Avaya SFP+ transceivers.
- The Virtual Services Platform 9000 operates in forgiving mode for SFP+ direct attached cables (DACs), which means that the switch will bring up the port operationally when using non-Avaya direct attached cables. Avaya does not provide support for operational issues related to these DACs, but the DACs will operate and the port link will come up.

All Avaya SFP+ transceivers support Digital Diagnostic Monitoring (DDM).

Selecting an SFP+

About this task

Use an SFP+ transceiver to interface a device motherboard to a fiber optic cable. Select the appropriate transceiver to provide the required reach.

Procedure

1. Determine the required reach.

Depending on the product, you can obtain SFP+ transceivers for cable distances of up to 15 meters (m), 400 m, 10 kilometers (km), 40 km, and 70 km.

2. Determine wavelength restrictions or requirements.
3. Use the following job aid to determine the appropriate SFP+ transceiver for your application.

Job aid

SFP+ transceivers are hot-swappable input and output enhancement components that allow 10-Gigabit Ethernet ports to link with other 10-Gigabit Ethernet ports.

All Avaya SFP+ transceivers use LC connectors to provide precision keying and low interface losses.

The following table lists and describes the supported Avaya SFP+ models. For more information about these SFP+ transceivers, see SFP+ specifications on page 40.

Table 16: Supported SFP+ transceivers

Model	Part number	Description
10GBASE-LR/LW SFP+	AA1403011-E6	10 km, 1310 nm SMF
10GBASE-ER/EW SFP+	AA1403013-E6	40 km, 1550 nm SMF
10GBASE-SR/SW SFP+	AA1403015-E6	400 m, 850 nm MMF
10GBASE-ZR/ZW SFP+	AA1403016-E6	70 km, 1550 nm SMF
10GBASE-LRM SFP+	AA1403017-E6	220 m, 1260 to 1355 nm; 1310 nm nominal MMF
10GBASE-CX SFP+	AA1403018-E6 to AA1403021-E6	4-pair twinaxial copper cable that plugs into the SFP+ socket and connects two 10 Gb ports
10GBASE-ER CWDM DDI SFP+	AA1403153-E6 to AA1403160-E6	40 km, 1471 to 1611 nm
10GBASE-ZR CWDM DDI SFP+	AA1403161-E6 to AA1403168-E6	70 km, 1471 to 1611 nm

Installing an SFP+

Install an SFP+ transceiver to provide a 10-gigabit Ethernet interface between the device and other network devices.

Before you begin

Important:

Do not install an SFP+ transceiver in an SFP slot. The two transceivers look the same but function differently. Ensure the slot is an SFP+ slot.

- Verify that the SFP+ transceiver is the correct model for your network configuration.
- Before you install the optical connector, ensure it is clean.

Danger:

Risk of eye injury by laser

Fiber optic equipment can emit laser or infrared light that can injure your eyes. Never look into an optical fiber or connector port. Always assume that fiber optic cables connect to a light source.

Electrostatic alert:

ESD can damage electronic circuits. Do not touch electronic hardware unless you wear a grounding wrist strap or other static-dissipating device.

Caution:

Risk of equipment damage

Only trained personnel can install this product.

SFP+ transceivers are keyed to prevent incorrect insertion. If the SFP+ resists pressure, do not force it; turn it over, and reinsert it.

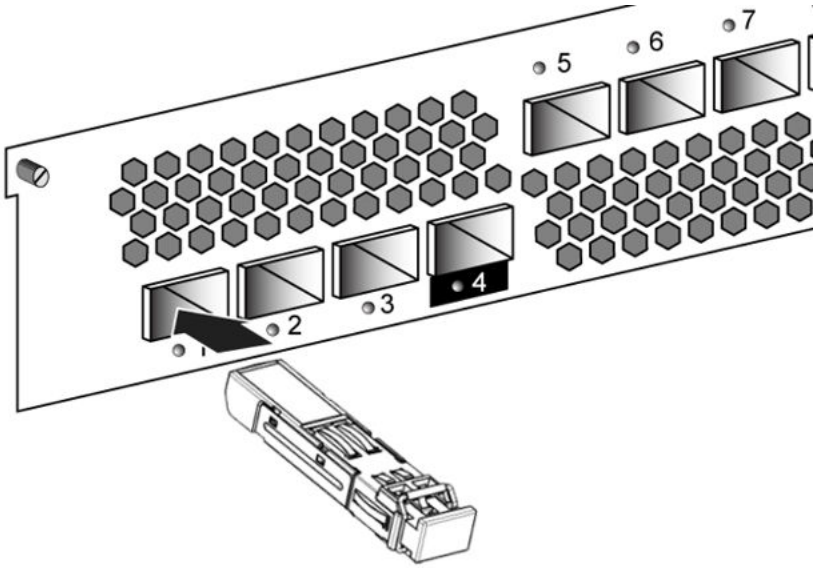
About this task

Installing an SFP+ transceiver takes approximately 3 minutes.

Procedure

1. Remove the SFP+ transceiver from its protective packaging.
2. Grasp the SFP+ transceiver between your thumb and forefinger.
3. Insert the device into the slot on the module, as shown in the following figure.

   Apply a light pressure to the SFP+ transceiver until the device clicks and locks into position in the module.

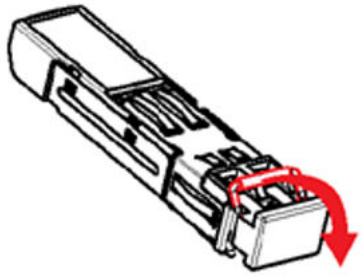


4. Remove the dust cover from the SFP+ optical bores, and insert the fiber optic cable.

Job aid

Depending on the transceiver manufacturer, the SFP+ transceiver uses bail-latch type of locking and extractor mechanism.

The following figure shows typical mechanism used on SFP+ transceivers; other locking and extractor mechanisms exist. SFP+ transceivers are similar to SFP transceivers in physical appearance. In the following figure, the SFP+ transceiver uses the bore plug. Pull the bail to release the device.



Removing an SFP+

Remove an SFP+ transceiver to replace it or to commission it elsewhere.

Before you begin

- Wear an antistatic wrist strap.

Danger:

Risk of eye injury by laser

Fiber optic equipment can emit laser or infrared light that can injure your eyes. Never look into an optical fiber or connector port. Always assume that fiber optic cables connect to a light source.

Electrostatic alert:

ESD can damage electronic circuits. Do not touch electronic hardware unless you wear a grounding wrist strap or other static-dissipating device.

Procedure

1. Disconnect the network fiber optic cable from the SFP+ connector.
2. Pull the swing-down latch handle to the fully lowered position, and hold the handle to extract the module.
3. Slide the SFP+ transceiver out of the module SFP+ slot.

   If the SFP+ does not slide easily from the module slot, use a gentle side-to-side rocking motion while firmly pulling the SFP+ transceiver from the slot.

4. Affix dust covers over the fiber optic bore and connector.
5. Store the SFP+ transceiver in a safe place until needed.

Important:

If you discard the SFP+ transceiver, dispose of it according to all national laws and regulations.

SFP+ specifications

This section provides technical specifications for the supported 10 gigabit SFP+ models. Use these specifications to aid in network design.

The specifications in this section support the IEEE 802.3-2012 standard. For more information, see the IEEE 802.3 document. All Avaya SFP+ transceivers meet or exceed these standards.

Important:

- The Virtual Services Platform 9000 operates in strict mode for SFP+ transceivers, which means that the switch will not bring up the port operationally when using non-Avaya SFP+ transceivers.
- The Virtual Services Platform 9000 operates in forgiving mode for SFP+ direct attached cables (DACs), which means that the switch will bring up the port operationally when using non-Avaya direct attached cables. Avaya does not provide support for operational issues related to these DACs, but the DACs will operate and the port link will come up.

All Avaya SFP+ transceivers support Digital Diagnostic Monitoring (DDM).

SFP+ labels

The typical Avaya SFP+ transceiver has a label on the top and bottom or side of the transceiver. The following figures show example labels. Avaya does use alternate labels, depending on the size of the device and space available for label information. Some devices do not have a CLEI code or label.

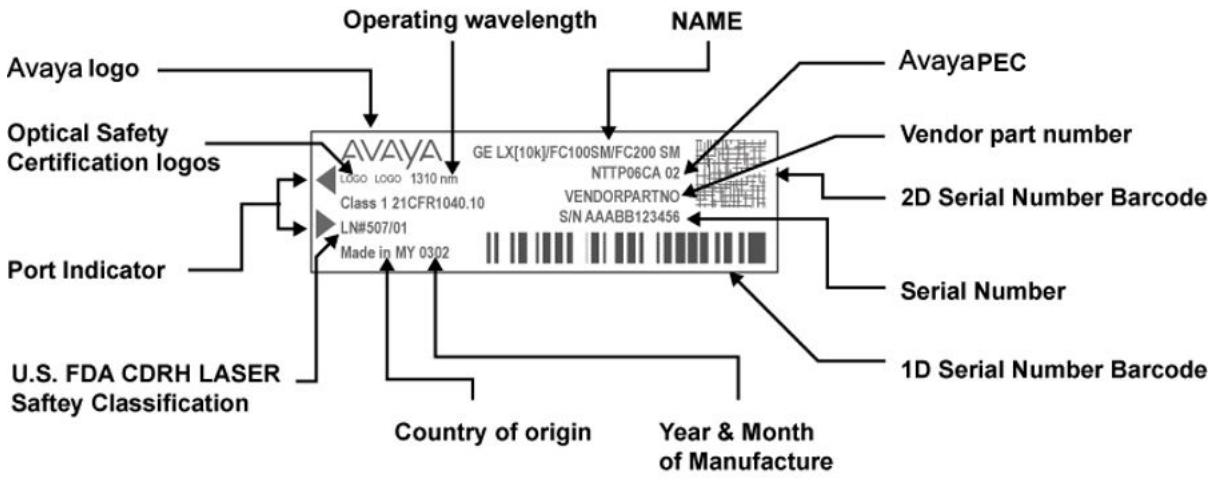


Figure 2: SFP+ top label



Figure 3: SFP+ bottom label

General SFP+ specifications

The following table describes general SFP+ specifications.

Table 17: General SFP+ specifications

Parameter	Specifications
Dimensions (H x W x D)	8.5 x 13.4 x 56.4 millimeters (0.33 x 0.53 x 2.22 inches), unless otherwise stated.
Connectors	LC ultra physical contact (UPC)
Storage temperature	–40 to 85 ºC
Operating temperature	0 to 70 ºC for RoHS -E6 models up to 85 ºC for high temperature models

Supported SFP+ transceivers

The following section provides specifications for the supported SFP+ transceivers.

10GBASE-SR/SW SFP+ specifications

The 10GBASE-SR/SW SFP+ transceivers provides 10 GbE service at 850 nm.

For more information about the 10GBASE-SR/SW SFP+ transceiver, including test and measurement information, see the IEEE 802.3ae standard.

Caution:

Risk of equipment damage

To prevent damage to the optical receiver, ensure that at least 1 dB of attenuation exists between the transmit and receive ports.

The following table lists the specifications for the 10GBASE-SR/SW SFP+ transceivers. The part number of this SFP+ transceiver is AA1403015-E6.

Table 18: IEEE 802.3ae 10GBASE-SR/SW SFP+ transceiver specifications

Parameter	Specifications
Data rate	10 gigabits per second (Gbps)
Line rate (64B/66B code)	10.3125 Gbps ± 100 parts per million (ppm)
Center wavelength range	840 to 860 nanometers (nm), nominal 850 nm
Distance	Using 62.5 µm MMF optic cable: • 160 MHz-km fiber: 2 to 26 m • 200 MHz-km fiber: 2 to 33 m Using 50 µm MMF optic cable: • 400 MHz-km fiber: 2 to 66 m • 500 MHz-km fiber: 2 to 82 m • 2000 MHz-km fiber: 2 to 300 m • 4700 MHz-km fiber (OM4): 2 to 400 m
Link optical power budget	7.3 dB
Maximum transmitter and dispersion penalty	3.9 dB at 300 m
Transmitter characteristics	
Root-mean-square spectral width	0.05 to 0.40 nm
Launch power	–7.3 to –1.0 dBm
Minimum extinction ratio	3.0 dB
Maximum optical return loss tolerance	–12 dB
Receiver characteristics	
Average receive power for BER 10^{-12}	–9.9 to –1.0 dBm
Receiver damage threshold	0 dBm
Maximum receiver sensitivity in OMA	–11.1 dBm
Maximum receiver reflectance	–12 dB
Stressed receiver sensitivity in OMA	–7.5 dBm

10GBASE-SR/SW SFP+ high temperature (0 °C to +85 °C) specifications

The 10GBASE-SR/SW SFP+ high temperature transceiver (0 °C to +85 °C) provides 10 GbE service at 850 nm.

The following table lists the specifications for the 10GBASE-SR/SW SFP+ transceiver (0 °C to +85 °C). The part number of this SFP+ transceiver is AA1403015-E6HT.

For more information about the 10GBASE-SR/SW SFP+ transceiver (0 °C to +85 °C), including test and measurement information, see the IEEE 802.3ae standard.

Warning:

Risk of equipment damage

To prevent damage to the optical receiver, ensure that at least 1 dB of attenuation exists between the transmit and receive ports.

Table 19: IEEE 802.3ae 10GBase–SR/SW SFP+ (0 °C to +85 °C) transceiver specifications

Parameter	Specifications
Data rate	10 Gbps
Line rate (64B/66B code)	10.3125 gigabits per second (Gbps) ± 100 parts per million (ppm)
Center wavelength range	840 to 860 nanometers (nm), nominal 850 nm
Distance	Using 62.5 µm MMF optic cable: • 160 MHz-km fiber: 2 to 26 m • 200 MHz-km fiber: 2 to 33 m Using 50 µm MMF optic cable: • 400 MHz-km fiber: 2 to 66 m • 500 MHz-km fiber: 2 to 82 m • 2000 MHz-km fiber (OM3): 2 to 300 m • 4700 MHz-km fiber (OM4): 2 to 400 m
Link optical power budget	7.3 dB
Maximum transmitter and dispersion penalty	3.9 dB at 300 m
Operating case temperature range	0 °C to +85 °C
Transmitter characteristics	
Root-mean-square spectral width	0.05 to 0.40 nm
Launch power	–7.3 to –1.0 dBm
Minimum extinction ratio	3.0 dB
Maximum optical return loss tolerance	–12 dB
Receiver characteristics	
Average receive power for BER 10^{-12}	–9.9 to –1.0 dBm
Receiver damage threshold	0dBm
Maximum receiver sensitivity in OMA	–11.1 dBm

Parameter	Specifications
Maximum receiver reflectance	–12 dB
Stressed receiver sensitivity in OMA	–7.5 dBm

10GBASE-LRM SFP+ specifications

The 10GBASE-LRM SFP+ transceiver provides 10 GbE service at a wavelength of 1310 nm. This SFP+ transceiver can attain a reach of up to 220 m on 62.5 µm multimode fiber.

The following table lists the transmitter and receiver specifications for the 10GBASE-LRM SFP+ transceiver. These parameters meet the IEEE 802.3aq-2006 standard. The part number of this SFP + transceiver is AA1403017-E6.

In this table, the OMA, average launch power, and peak power specifications apply at TP2, after accounting for patch cord loss.

Table 20: IEEE 802.3aq 10GBASE-LRM SFP+ transceiver specifications

Parameter	Specifications
Data rate	10 Gbps
Line rate (64B/66B code)	10.3125 Gbps ± 100 ppm
Center wavelength range	1260 to 1355 nm; 1310 nm nominal
Distance	Up to 220 m
Link optical power budget	1.7 to 1.9 dB
Maximum transmitter waveform and dispersion penalty (TWDP)	4.7 dB
Transmitter characteristics	
Average launch power	–6.5 to 0.5 dBm
Peak launch power	3 dBm
Root-mean-square spectral width	2.4 to 4 nm
Launch power in OMA	–4.5 to 1.5 dBm
Minimum extinction ratio	3.5 dB
Optical return loss tolerance (minimum)	–20 dB
Receiver characteristics	
Receiver damage threshold	1.5 dBm
Receiver reflectance (maximum)	–12 dB

For more information about the conditions used for the stressed receiver tests, and other information, see the IEEE 802.3–2012 standard.

The following table (from IEEE 802.3–2012) describes the maximum channel insertion loss. The channel insertion loss includes both attenuation and connector loss (1.5 dB); therefore the maximum fiber attenuation is 0.2 to 0.4 dB.

Table 21: 10GBASE-LRM channel insertion loss and range

Fiber type (core diameter and OFL bandwidth)	Range	Maximum channel insertion loss
62.5 µm (FDDI grade) • 160 MHz-km at 850 nm • 500 MHz-km at 1300 nm	Up to 220 m	1.9 dB
62.5 µm (ISO/IEC OM1) • 200 MHz-km at 850 nm • 500 MHz-km at 1300 nm	Up to 220 m	1.9 dB
50 µm (ISO/IEC OM2) • 500 MHz-km at 850 nm • 500 MHz-km at 1300 nm	Up to 220 m	1.9 dB
50 µm • 400 MHz-km at 850 nm • 400 MHz-km at 1300 nm	Up to 100 m	1.7 dB
50 µm (ISO/IEC OM3) • 1500 MHz-km at 850 nm (includes laser launch bandwidth) • 500 MHz-km at 1300 nm (includes laser launch bandwidth)	Up to 220 m	1.9 dB

The following abbreviations are used in the preceding tables:

- FDDI – Fiber Distributed Data Interface
- ISO – International Standards Organization
- IEC – International Electrotechnical Commission
- OFL – Over Filled Launch

10GBASE-LR/LW SFP+ specifications

The 10GBASE-LR/LW SFP+ transceiver provides 10 GbE or OC-192 service at a nominal wavelength of 1310 nm. This SFP+ transceiver can attain link lengths of up to 10 km.

For more information about the 10GBASE-LR/LW SFP+ transceiver, including test and measurement information, see the IEEE 802.3ae standard.

The following table lists the transmitter and receiver specifications for the 10GBASE-LR/LW SFP+ transceiver. The part number of this SFP+ transceiver is AA1403011-E6.

Table 22: IEEE 802.3ae 10GBASE-LR/LW SFP+ transceiver specifications

Parameter	Specifications
Center wavelength range	1260 to 1355 nm; 1310 nm nominal
Distance	Up to 10 km
Link optical power budget	9.4 dB
Maximum transmitter and dispersion penalty	3.2 dB at 10 km
Transmitter characteristics	
Line rate (nominal	10GBASE-LR 10.3125 Gbps ±100 ppm (10 GbE)
Average launch power	–8.2 to 0.5 dBm
Minimum launch power in OMA minus transmission and dispersion penalty (TDP)	–6.2 dBm
Minimum optical modulation amplitude	–5.2 dBm
Minimum extinction ratio	3.5 dB
Maximum optical return loss tolerance	–12 dB
Maximum transmitter reflectance	–12 dB
Receiver characteristics	
Line rate (nominal)	10GBASE-LR 10.3125 Gbps ± 100 ppm (10 GbE)
Average receive power for BER 10^{-12}	–14.4 dBm to 0.5 dBm
Receiver damage threshold	1.5 dBm
Maximum receiver sensitivity in OMA	–12.6 dBm
Maximum receiver reflectance	–12 dB
Stressed receiver sensitivity in OMA	–10.3 dBm

Examples of an OFF transmitter are as follows: no power supplied to the PDM, laser shutdown for safety conditions, activation of a PMD_global_transmit_disable or other optional transmitter shutdown condition.

10GBASE-LR/LW SFP+ high temperature (-5 °C to +85 °C) specifications

The 10GBASE-LR/LW SFP+ high temperature transceiver (–5 °C to +85 °C) provides 10 GbE or OC-192 service at a nominal wavelength of 1310 nm. This SFP+ transceiver can attain link lengths of up to 10 km.

For more information about the 10GBASE-LR/LW SFP+ (–5 °C to +85 °C), including test and measurement information, see the IEEE 802.3ae standard.

The following table lists the transmitter and receiver specifications for the 10GBASE-LR/LW SFP + transceiver (–5 °C to +85 °C) . The part number of this SFP+ transceiver is AA1403011-E6HT.

Table 23: IEEE 802.3ae 10GBASE-LR/LW SFP+ (-5 °C to +85 °C) transceiver specifications

Parameter	Specifications
Center wavelength range	1260 to 1355 nm; 1310 nm nominal

Parameter	Specifications
Distance	Up to 10 km
Link optical power budget	9.4 dB
Maximum transmitter and dispersion penalty	3.2 dB at 10 km
Operating case temperature range	–5 °C to +85 °C
Transmitter characteristics	
Line rate (nominal)	10GBASE-LR 10.3125 Gbps ±100 ppm (10 GbE)
Average launch power	–8.2 to 0.5 dBm
Minimum launch power in OMA minus transmission and dispersion penalty (TDP)	–6.2 dBm
Minimum optical modulation amplitude	–5.2 dBm
Minimum extinction ratio	3.5 dB
Maximum optical return loss tolerance	–12 dB
Maximum transmitter reflectance	–12 dB
Receiver characteristics	
Line rate (nominal)	10GBASE-LR 10.3125 Gbps ± 100 ppm (10 GbE)
Average receive power for BER 10^{-12}	–14.4 dBm to 0.5 dBm
Maximum average receive power for damage	1.5 dBm
Maximum receiver sensitivity in OMA	–12.6 dBm
Maximum receiver reflectance	–12 dB
Stressed receiver sensitivity in OMA	–10.3 dBm

Examples of an OFF transmitter are as follows: no power supplied to the PDM, laser shutdown for safety conditions, activation of a PMD_global_transmit_disable or other optional transmitter shutdown condition.

10GBASE-ER/EW SFP+ specifications

The 10GBASE-ER/EW SFP+ transceiver provides a reach of up to 40 km at a wavelength of 1550 nm.

For more information about the 10GBASE-ER/EW SFP+ transceiver, including test and measurement information, see the IEEE 802.3ae standard.

The following table lists the transmitter and receiver specifications for the 10GBASE-ER/EW SFP+ transceiver. The part number of this SFP+ transceiver is AA1403013-E6.

Table 24: IEEE 802.3ae 10GBASE-ER/EW SFP+ transceiver specifications

Parameter	Specifications
Line rate (nominal)	10GBASE-ER/EW 10.3125 Gb/s ±100 ppm (10 GbE)
Center wavelength range	1530 to 1565 nm; nominal 1550 nm
Distance	Up to 40 km

Parameter	Specifications
Link optical power budget	15 dB
Transmitter and dispersion power penalty	3.0 dB at 40 km
Transmitter characteristics	
Launch power	–4.7 to 4.0 dBm
Minimum side mode suppression ratio	30 dB
Minimum launch power in OMA minus transmission and dispersion penalty (TDP)	–2.1 dBm
Minimum optical modulation amplitude	–1.7 dBm
Maximum average launch power of OFF transmitter	–30 dBm
Minimum extinction ratio	3.0 dB
Maximum $RIN_{12}OMA$	–128 dB/Hz
Maximum optical return loss tolerance	–21 dB
Receiver characteristics	
Average receive power for BER 10^{-12}	– 15.8 dBm to –1.0 dBm
Maximum receive power for damage	4.0 dBm
Maximum receiver sensitivity in OMA	–14.1 dBm
Maximum receiver reflectance	–26 dB
Stressed receiver sensitivity in OMA	–11.3 dBm
Receive electrical 3 dB upper cutoff frequency (maximum)	12.3 GHz

The following list shows examples of an OFF transmitter:

- No power supplied to the PDM.
- Laser shutdown for safety conditions.
- Activation of **`PMD_global_transmit_disable`** or other optional transmitter shutdown condition.

10GBASE-ER CWDM DDI SFP+ specifications

The following table lists the part numbers of the 10GBASE-ER CWDM DDI SFP+ with corresponding wavelengths.

Table 25: Part number and center wavelength assignment

Part number	Center wavelength assignment	Reach	Insertion loss
AA1403153-E6	1471 nm	up to 40 km	5 dB between Tx and Rx
AA1403154-E6	1491 nm	up to 40 km	5 dB between Tx and Rx
AA1403155-E6	1511 nm	up to 40 km	5 dB between Tx and Rx

Part number	Center wavelength assignment	Reach	Insertion loss
AA1403156-E6	1531 nm	up to 40 km	5 dB between Tx and Rx
AA1403157-E6	1551 nm	up to 40 km	5 dB between Tx and Rx
AA1403158-E6	1571 nm	up to 40 km	5 dB between Tx and Rx
AA1403159-E6	1591 nm	up to 40 km	5 dB between Tx and Rx
AA1403160-E6	1611 nm	up to 40 km	5 dB between Tx and Rx

The following table lists the transmitter and receiver specifications for the 10GBASE-ER CWDM DDI SFP+.

Table 26: 10GBASE-ER CWDM DDI SFP+ specifications

Parameter	Specifications
Transmitter characteristics:	
Optical Data Rate (nominal)	9.95 Gbps to 10.313 Gbps
Center wavelength	Nominal –6.5 nm to nominal +6.5 nm
Spectral width (RMS at –20 dB)	1 nm
Average launched power	–0.2 dBm to 4 dBm
Extinction ratio (minimum)	8.2 dB
Tx power, OMA (minimum)	+1.5 dBm
Tx power, OMA-TDP (minimum)	–0.2 dBm
TDP at 800 ps dispersion (maximum)	2.8 dB
Receiver characteristics:	
Wavelength (requirement)	1450 nm to 1620 nm
Receiver sensitivity (unstressed), OMA	–14.1 dBm, P_OMA
IEEE 10GBASE-ER Stressed Rx Sensitivity	–11.3 dBm, P_OMA
Receiver overload	–1 dBm, P_avg
Receiver reflectance	–26 dB
Receiver damage threshold	+4 dBm

10GBASE-CX specifications

The 10GBASE-CX is a 4-pair twinaxial copper cable that plugs into the SFP+ socket and connects two 10 Gb ports. The reach for this cable is up to 15 m with a bit error rate (BER) better than 10^{-12}.

The signaling speed for each lane is 3.125 GBd ± 100 ppm. The 10GBASE-CX is a lower cost alternative to the optical SFP+ devices.

For more information about the 10GBASE-CX, including test and measurement information and more specifications, see the IEEE 802.3ak standard. The following table identifies the part numbers for specific cable lengths.

Table 27: 10GBASE-CX cables

Cable length	Part number
3 meter	AA1403019-E6
5 meter	AA1403020-E6
10 meter	AA1403018-E6

10GBASE-ZR/ZW SFP+ specifications

The following table lists the transmit and receive specifications for the 10GBASE-ZR/ZW SFP+ transceiver. The part number of this SFP+ transceiver is AA1403016-E6.

Warning:

Risk of BER increase

For proper SFP+ transceiver operation, ensure that at least 11 dB of attenuation is present between the transmit and receive ports.

The reach for this SFP+ transceiver is up to 70 km* at a wavelength of 1550 nm.

Table 28: 10GBASE-ZR/ZW SFP+ specifications

Parameter	Specifications
Line rate (nominal)	10GBASE-ZR 10.3125 Gbps ±100 ppm (10 GbE)
Distance	Up to 70 km *
Link optical power budget	24 dB
Dispersion power penalty	3.0 dB at 70 km (G.652 fiber)
Minimum attenuation between transmit and receive ports	11 dB
Transmitter characteristics	
Center wavelength range	1530 to 1565 nm, nominal 1550 nm
Average launch power	0 to 4.0 dBm
Optical modulation amplitude (minimum)	–1.7 dBm
Extinction ratio (ER) (minimum)	8.2 dB
Maximum transmitter reflectance	–12 dB
Receiver characteristics	
Wavelength range	1280 to 1575 nm. Sensitivity specified for 1530 to 1565 nm.
Maximum receiver sensitivity (average power)	–24 dBm
Maximum receiver (average) power, BER 10^{-12}	–7.0 dBm
Receiver damage threshold (average power)	+5.0 dBm
Receiver reflectance (maximum)	–27 dB

* Achievable link distance is primarily dependent on cable plant insertion loss. 70 km is not possible in some situations.

10GBASE-ZR CWDM DDI SFP+ specifications

The following table lists the part numbers for the 10GBASE-ZR CWDM DDI SFP+ transceivers with corresponding wavelengths.

The reach for this SFP+ transceiver is up to 70 km* at a wavelength of 1551 nm.

Table 29: Part number and center wavelength assignment

Part number	Center wavelength assignment	Reach	Insertion loss
AA1403161-E6	1471 nm	70 km	10 dB between Tx and Rx
AA1403162-E6	1491 nm	70 km	10 dB between Tx and Rx
AA1403163-E6	1511 nm	70 km	10 dB between Tx and Rx
AA1403164-E6	1531 nm	70 km	10 dB between Tx and Rx
AA1403165-E6	1551 nm	70 km	10 dB between Tx and Rx
AA1403166-E6	1571 nm	70 km	10 dB between Tx and Rx
AA1403167-E6	1591 nm	70 km	10 dB between Tx and Rx
AA1403168-E6	1611 nm	70 km	10 dB between Tx and Rx

The following table lists the transmitter and receiver specifications for the 10GBASE-ZR CWDM DDI SFP+ transceiver.

Table 30: 10GBASE-ZR CWDM DDI SFP+ specifications

Parameter			Specifications
Transmitter characteristics			
Optical Data Rate (nominal)			9.95 Gbps to 10.313 Gbps
Center wavelength			Nominal –6.5 nm to nominal +6.5 nm
Spectral width (RMS at –20 dB)			1 nm
RIN OMA			–128 dB/Hz
Extinction ratio (minimum)			8.2 dB
Tx output:	Min	Max	Units
P_avg	–1	4	dBm
OMA	+0.7	—	dBm
OMA-TDP	–2.3	—	dBm
TDP at 1400 ps dispersion			3 dB
Optical return loss tolerance			21 dB
Receiver characteristics			
Wavelength range			1460 nm to 1620 nm

Parameter			Specifications
Rx sensitivity:	Min	Max	Units
back-to-back	—	–23	dBm
with 70 km fiber	—	–21	dBm
with 70 km fiber, OMA	—	–19.3	dBm
Receiver overload			–7 dBm, P_avg
Receiver reflectance			–27 dB
Receiver damage threshold			+5 dBm, P_avg

* Achievable link distance is primarily dependent on cable plant insertion loss. 70 km is not possible in some situations.

Chapter 6: QSFP+

This chapter provides installation procedures and specifications for quad small form factor pluggable plus (QSFP+) transceivers.

QSFP+ transceivers

This section describes how to select and install quad small form factor pluggable plus (QSFP+) transceivers.

Use QSFP+ transceivers to connect a port to fiber optic cables to communicate to another transceiver. Direct attach cables (DAC) connect to QSFP+ ports. QSFP+ transceivers support 40–gigabit per second (Gbps) connections, or for some transceiver types, fan out to four 10–Gbps transceivers.

Virtual Services Platform 9000 supports QSFP+ transceivers in the 9012QQ-2 module.

Important:

- The Virtual Services Platform 9000 operates in strict mode for QSFP+ transceivers, which means that the switch will not bring up the port operationally when using non-Avaya QSFP + transceivers.
- The Virtual Services Platform 9000 operates in forgiving mode for QSFP+ DACs, which means that the switch will bring up the port operationally when using non-Avaya direct attached cables. Avaya does not provide support for operational issues related to these DACs, but the DACs will operate and the port link will come up.

All Avaya QSFP+ transceivers support Digital Diagnostic Monitoring (DDM). For information on DDM, see *Monitoring Performance on Avaya Virtual Services Platform 9000,* NN46250-701.

Selecting a QSFP+

Use a QSFP+ transceiver to connect a device motherboard to fiber optic or direct attached cables.

About this task

Select the appropriate transceiver to provide the required reach.

Procedure

1. Determine the required reach.

   Depending on the product, you can obtain a QSFP+ transceiver for cable distances of up to 40 km.

2. Determine wavelength restrictions or requirements.
3. Use the following job aid to determine the appropriate QSFP+ transceiver for your application.

Job aid

QSFP+ transceivers are hot-swappable data input and output components that allow 40–gigabit Ethernet ports to link with other 40–gigabit Ethernet ports. Avaya QSFP+ transceivers use duplex LC connectors or MPO/MTP connectors to provide precision keying and low interface losses.

The following table lists and describes the Avaya QSFP+ models.

Table 31: Compatible 40 gigabit QSFP+ transceivers

Hardware	Description	Minimum software version	Part number
QSFP+ to QSFP+ DAC	1 meter Passive DAC	4.0.1	AA1404029-E6
QSFP+ to QSFP+ DAC	3 meter Passive DAC	4.0.1	AA1404031-E6
QSFP+ to QSFP+ DAC	5 meter Passive DAC	4.0.1	AA1404032-E6
QSFP+ to QSFP+ DAC	0.5 meter Passive flexi-DAC (TAA)	4.0.1	AA1404037-E6GS
QSFP+ to QSFP+ DAC	1 meter Passive flexi-DAC (TAA)	4.0.1	AA1404038-E6GS
QSFP+ to QSFP+ DAC	3 meter Passive flexi-DAC (TAA)	4.0.1	AA1404039-E6GS
40GBASE-LR4 QSFP+	10 km 1300 nm with duplex LC connector	4.0.1	AA1404001-E6
40GBASE-SR4	150 m, (OM4) 850 nm with MPO/MTP connector	4.0.1	AA1404005-E6

Important:

Avaya recommends using Avaya-branded SFP, SFP+, and QSFP+ transceivers as they have been through extensive qualification and testing. Avaya will not be responsible for issues related to non-Avaya branded transceivers.

Installing a QSFP+

Install a QSFP+ transceiver to provide a 40-gigabit Ethernet interface between the device and other network devices.

Before you begin

- Verify that the QSFP+ is the correct model for your network configuration.

- Before you install the optical connector, ensure it is clean.

Danger:

Risk of eye injury by laser

Fiber optic equipment can emit laser or infrared light that can injure your eyes. Never look into an optical fiber or connector port. Always assume that fiber optic cables connect to a light source.

Electrostatic alert:

Risk of equipment damage

ESD can damage electronic circuits. Do not touch electronic hardware unless you wear a grounding wrist strap or other static-dissipating device.

Warning:

Risk of equipment damage

Only trained personnel can install this product.

Warning:

Risk of equipment damage

QSFP+ transceivers are keyed to prevent incorrect insertion. If the QSFP+ resists pressure, do not force it; turn it over, and reinsert it.

About this task

Installing a QSFP+ takes approximately 3 minutes.

Procedure

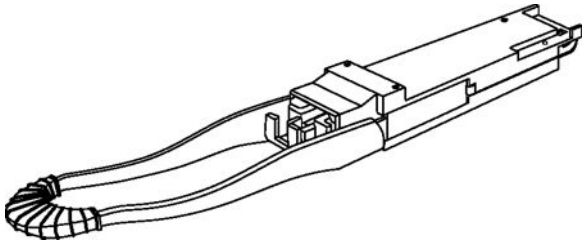
1. Remove the QSFP+ from its protective packaging.
2. Remove the dust cover from the QSFP+ optical bores and insert the fiber optic cable.
3. Grasp the QSFP+ between your thumb and forefinger.
4. Insert the device into an QSFP+ port.

   Apply a light pressure to the QSFP+ until the device clicks and locks into position in the port.

Job aid

Avaya uses the QSFP+ transceiver with the pull-tab type of locking and extractor mechanism.

The following figure shows the QSFP+ transceiver with a bore plug installed. Pull the tab to release the device.



Removing a QSFP+

Remove a QSFP+ transceiver to replace it or to commission it elsewhere.

Before you begin

Danger:

Risk of eye injury by laser

Fiber optic equipment can emit laser or infrared light that can injure your eyes. Never look into an optical fiber or connector port. Always assume that fiber optic cables connect to a light source.

Electrostatic alert:

Risk of equipment damage

To prevent damage from electrostatic discharge, always wear an antistatic wrist strap connected to an electrostatic discharge (ESD) jack.

Procedure

1. Disconnect the network fiber optic cable from the QSFP+ connector.
2. Grasp the pull-tab and slide the QSFP+ transceiver out of the module QSFP+ slot.

   If the QSFP+ transceiver does not slide easily from the module slot, use a gentle side-to-side rocking motion while firmly pulling the QSFP+ transceiver from the slot.
3. Remove connector from transceiver and affix dust covers over the fiber optic bore and connector.
4. Store the QSFP+ transceiver in a safe place until needed.

   Important:

   If you discard the QSFP+ transceiver, dispose of it according to all national laws and regulations.

QSFP+ specifications

The following section provides specifications for supported QSFP+ transceivers.

QSFP+ transceiver labels

A label can be located on either the top or bottom of the typical Avaya QSFP+ transceiver. The following figure shows an example label.

Avaya uses alternate labels, depending on the size of the device and space available for label information.

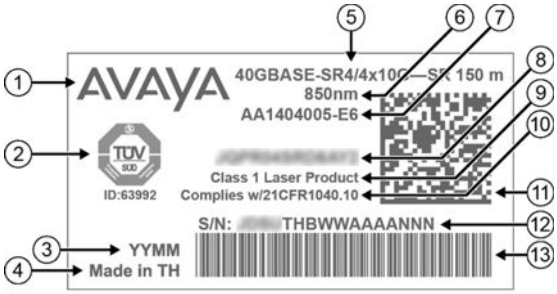


Figure 4: 40GBase–SR4 QSFP+ transceiver label example

The following table identifies the numbered items in the preceding figure.

Table 32: Figure notes for a 40GBase–SR4 QSFP+ transceiver label

1. Avaya logo
2. Optical safety certification logos
3. Year and month of manufacture
4. Country of origin
5. Name
6. Operating wavelength
7. Avaya PEC
8. Vendor part number
9. U.S. FDA CDRH laser classification
10. U.S. FDA CDRH laser classification compliance number
11. 2D serial number barcode
12. Serial number
13. 1D serial number barcode

General QSFP+ transceiver specifications

The following table describes general QSFP+ transceiver specifications.

Table 33: General QSFP+ specifications

Parameter		Specification
Dimensions (H x W x D)		8.5 x 18.35 x 72.4 mm (0.33 x 0.72 x 2.85 in.), unless otherwise stated. **Note:** Note: The length of the pull tab latch varies depending on the vendor and the body, with a length of 125 to 132 mm (4.92 to 5.20 in.).
Connectors	40GBase–SR4 QSFP+	MPO or MTP
	40GBase–LR4 QSFP+	LC Duplex
Storage temperature		–40 °F (–4 °C) to 185 °F (85 °C)
Operating temperature		23 °F (−5 °C) to 158 °F (70 °C)

40GBASE-SR4 4x10GBASE-SR QSFP+ specifications

The 40GBASE-SR4 4x10GBASE-SR transceiver provides a high-speed link at an aggregate signaling rate.

Important:

Not all Avaya networking products support the 4x10GBASE-SR mode of operation.

The following table lists the specifications for the 40GBASE-SR4 4x10GBASE-SR QSFP+ transceiver. The part number of this QSFP+ transceiver is AA1404005-E6.

For more information about the 40GBASE-SR4 4x10GBASE-SR QSFP+ transceiver, including test and measurement information, see the IEEE 802.3-2012 standard.

Table 34: 40GBASE-SR4 4x10GBASE-SR QSFP+ transceiver specifications

Parameter	Specification
Line rate	10.3125 Gbps
Center wavelength range	840 to 860 nanometers
Distance	Up to: • 328 feet (100 meters) – with OM3 fiber cable.

Parameter			Specification
			• 492 feet (150 meters) – with OM4 fiber cable.
Transmitter characteristics			
Signaling rate, each lane			10.3125 Gbps
RMS spectral width			0.65 nanometers maximum
Average launch power, each lane	**Min**	**Max**	**Units**
	–8.0	–1.0	dBm
Optical modulation amplitude (OMA), each lane	**Min**	**Max**	**Units**
	–5.6	+3	dBm
Maximum transmitter and dispersion penalty (TDP), each lane			3.9 dB
Minimum launch power in OMA minus TDP, each lane			–7.8 dBm
Minimum extinction ratio			3 dB
Maximum optical return loss tolerance			12 dB
Receiver characteristics			
Signaling rate, each lane			10.3125 Gbps
Average receive power, each lane	**Min**	**Max**	**Units**
	–9.5	2.4	dBm
Receive power in OMA, each lane	**Min**	**Max**	**Units**
	–7.5	3	dBm
Receive input optical power (damage threshold)			3.4 dBm

40GBASE-LR4 QSFP+ transceiver specifications

The 40GBASE-LR4 QSFP+ transceiver can attain link lengths of up to 10 kilometers on International Telecommunication Union (ITU) recommendation G.652 single-mode fiber (SMF) cable.

The following table lists the transmitter and receiver specifications for the 40GBASE-LR4 transceiver. The part number of this QSFP+ transceiver is AA1404001-E6.

For more information about the 40GBASE-LR4 transceiver, including test and measurement information, see the IEEE 802.3–2012 standard.

Table 35: IEEE 802.3–2012 40GBASE-LR4 transceiver specifications

Parameter	Specification
Distance	Up to 6.2 miles (10 kilometers)
Transmitter characteristics	
Line rate	10 Gbps
Signaling rate, each lane 10GBase	10.3125 Gbps

Parameter	Specification
Data rate, total 40GBase	41.25 Gbps
Lane wavelength ranges	1264.5 nanometers to 1277.5 nanometers 1284.5 nanometers to 1297.5 nanometers 1304.5 nanometers to 1317.5 nanometers 1324.5 nanometers to 1337.5 nanometers
Total average optical power	8.3 dBm
Minimum average optical power, each lane at 10.3125 Gbps.	–7 dBm
Maximum average optical power, each lane at 10.3125 Gbps.	2.3 dBm
Difference in optical power between any two lanes	6.5 dB
Minimum side mode suppression ratio	30 dB
Minimum optical modulation amplitude	–4 dBm
Maximum optical modulation amplitude	3.5 dBm
Maximum average optical power of OFF transmitter, each lane	–30 dBm
Minimum extinction ratio at 10.3125 Gbps	3.5 dB
$RIN_{20}OMA$ (maximum)	–128 dB/Hz
Maximum optical return loss tolerance	20 dB
Receiver characteristics	
Line rate	10 Gbps
Signaling rate, each lane 10GBase	10.3125 Gbps
Data rate, total 40GBase	41.25 Gbps
Lane wavelength ranges	1264.5 nanometers to 1277.5 nanometers 1284.5 nanometers to 1297.5 nanometers 1304.5 nanometers to 1317.5 nanometers 1324.5 nanometers to 1337.5 nanometers
Average receive power, each lane at 10.3125 Gbps.	–13.7 to 2.3 dBm
Maximum receiver power, each lane in OMA.	3.5 dBm
Maximum receiver sensitivity in OMA, each lane at 10.3125 Gbps.	–11.5 dBm
Maximum receiver reflectance	–26 dBm
Stressed receiver sensitivity, each lane at 10.3125 Gbps.	–9.6 dBm
Receive input optical power (damage threshold per lane)	3.3 dBm

QSFP+ to QSFP+ 40 gigabit DAC specifications

The QSFP+ to QSFP+ 40 gigabit Direct Attach Cable (DAC) assembly directly connects two QSFP+ ports. For more information, see the IEEE 802.3ba 40GBASE-CR4 cable assembly specification standard.

The following table identifies the part numbers for specific cable assembly lengths.

Cable length	Part number
1 meter Passive DAC	AA1404029-E6
2 meter Passive DAC	AA1404030-E6
3 meter Passive DAC	AA1404031-E6
5 meter Passive DAC	AA1404032-E6
0.51 meter Passive DAC	AA1404037-E6
0.5 meter Passive flexi-DAC (TAA)	AA1404037-E6GS
1 meter Passive flexi-DAC (TAA)	AA1404038-E6GS
3 meter Passive flexi-DAC (TAA)	AA1404039-E6GS

Important:

Not all Avaya products support all cable lengths.

Chapter 7: Translations of safety messages

This section contains translations of precautionary notices that you must read and follow for safe operation of the Virtual Services Platform 9000.

Class A electromagnetic interference warning statement

Warning:

Risk of electromagnetic interference

This device is a Class A product. Operation of this equipment in a residential area is likely to cause harmful interference, in which case users are required to take appropriate measures necessary to correct the interference at their own expense.

Warning:

AVERTISSEMENT

Le périphérique est un produit de Classe A. Le fonctionnement de cet équipement dans une zone résidentielle risque de causer des interférences nuisibles, auquel cas l'utilisateur devra y remédier à ses propres frais.

Warning:

WARNUNG

Dies ist ein Gerät der Klasse A. Bei Einsatz des Geräts in Wohngebieten kann es Störungen des Radio- und Fernsehempfangs verursachen. In diesem Fall muss der Benutzer alle notwendigen Maßnahmen ergreifen, die möglicherweise nötig sind, um die Störungen auf eigene Rechnung zu beheben.

Warning:

ADVERTENCIA

Este es un producto clase A. El uso de este equipo en áreas residenciales puede causar interferencias nocivas, en cuyo caso, se requerirá que los usuarios tomen cualquier medida necesaria para corregir la interferencia por cuenta propia.

Warning:

AVISO

Este dispositivo é um produto Classe A. Operar este equipamento em uma área residencial provavelmente causará interferência prejudicial; neste caso, espera-se que os usuários tomem as medidas necessárias para corrigir a interferência por sua própria conta.

Warning:

AVVISO

Questo dispositivo è un prodotto di Classe A. Il funzionamento di questo apparecchio in aree residenziali potrebbe causare interferenze dannose, nel cui caso agli utenti verrà richiesto di adottare tutte le misure necessarie per porre rimedio alle interferenze a proprie spese.

Electrostatic discharge caution statement

Electrostatic alert:

ELECTROSTATIC ALERT

ESD can damage electronic circuits. Do not touch electronic hardware unless you wear a grounding wrist strap or other static-dissipating device.

Electrostatic alert:

ELEKTROSTATIKWARNUNG

Elektronische Schaltkreise können durch elektrostatische Entladung beschädigt werden. Berühren Sie elektronische Hardware nur, wenn Sie ein Erdungsarmband oder ein anderes Statik ableitendes Medium tragen.

Electrostatic alert:

ALERTA DE ELECTROESTÁTICA

Una descarga electroestática puede dañar los circuitos eléctrónicos. No toque el hardware electrónico a no ser que utilicé una muñequera antiestática u otro dispositivo disipador de estática.

Electrostatic alert:

ALERTA CONCERNANT LES DÉCHARGES ÉLECTROSTATIQUES

Une décharge électrostatique (DES) peut endommager les circuits électroniques. Ne touchez pas le matériel électronique, à moins de mettre à votre poignet une bande de mise à la masse ou autre dispositif dissipant l'électricité statique.

Electrostatic alert:

ALERTA DE ELETROSTÁTICA

ESD pode danificar circuitos eletrônicos. Não toque em equipamentos eletrônicos a menos que esteja utilizando pulseira de aterramento ou outro dispositivo para dissipação de energia estática.

Electrostatic alert:

AVVISO ELETTROSTATICO

Le scariche elettrostatiche (ESD) possono danneggiare i circuiti elettronici. Non toccare i componenti elettronici senza aver prima indossato un braccialetto antistatico o un altro dispositivo in grado di dissipare l'energia statica.

Laser eye safety danger statement

Danger:

Risk of eye injury by laser

Fiber optic equipment can emit laser or infrared light that can injure your eyes. Never look into an optical fiber or connector port. Always assume that fiber optic cables are connected to a light source.

Danger:

DANGER

Risques de blessure oculaire par lumière laser

L'équipement de fibres optiques peut émettre une lumière laser ou infrarouge nuisible à vos yeux. Ne regardez jamais en direction de fibres optiques ou d'un port connecteur. Supposez toujours que les câbles de fibres optiques sont connectés à une source de lumière.

Danger:

GEFAHR

Risiko einer Augenverletzung durch Laser

Risiko einer Augenverletzung durch Laser Glasfasergeräte können Laserstrahlen oder ultraviolettes Licht aussenden, das Ihre Augen verletzen kann. Schauen Sie nie direkt in einen Glasfaserleiter oder Verbindungsanschluss. Gehen Sie immer davon aus, dass Glasfaserkabel mit einer Lichtquelle verbunden sind.

Danger:

PELIGRO

Riesgo de lesión en los ojos por láser

El equipo de fibra óptica puede emitir una luz láser o infrarroja que dañe sus ojos. Nunca mire un puerto de fibra óptica o conector. Siempre asuma que los cables de fibra óptica están conectados a una fuente de luz.

Danger:

PERIGO

O laser pode causar ferimentos no olho

O equipamento de fibra ótica pode emitir laser ou luz infravermelha que pode causar danos a sua vista. Nunca olhe para dentro da fibra ótica ou da porta do conector. Tenha sempre em mente que os cabos de fibra ótica estão ligados a uma fonte de luz.

Danger:

PERICOLO

Rischio di ustioni agli occhi dovute al laser

Le apparecchiature con fibre ottiche possono emettere raggi laser o infrarossi in grado di provocare ferite agli occhi. Non guardare mai all'interno di una porta di connessione o una fibra ottica. Tenere sempre presente che i cavi a fibra ottica sono collegati a una sorgente luminosa.

Laser eye safety connector inspection danger statement

Danger:

Risk of eye injury

When you inspect a connector, ensure that light sources are off. The light source used in fiber optic cables can damage your eyes.

Danger:

DANGER

Risques de blessure oculaire

Assurez-vous que toutes les sources de lumière ont été désactivées avant de procéder au contrôle d'un connecteur. La source de lumière utilisée dans les câbles de fibres optiques risque de provoquer des lésions oculaires.

Danger:

GEFAHR

Verletzungsrisiko der Augen

Achten Sie bei der Kontrolle der Anschlüsse darauf, dass die Lichtquellen abgeschaltet sind. Die für die Glasfaserkabel verwendeten Lichtquellen können Augenschäden hervorrufen.

Danger:

PELIGRO

Riesgo de lesiones oculares

Cuando inspeccione un conector, controle que las fuentes de luz estén apagadas. La fuente de luz que utilizan los cables de fibra óptica puede ocasionar daños en la vista.

Danger:

PERIGO

Risco de ferimento nos olhos

Ao inspecionar um conector, verifique se as fontes luminosas estão desligadas. A fonte luminosa usada nos cabos de fibra ótica pode causar danos a seus olhos.

Danger:

PERICOLO

Rischio di lesioni agli occhi

Quando si esamina un connettore, assicurarsi che le sorgenti di luce siano spente. La sorgente di luce utilizzata nei cavi a fibre ottiche potrebbero danneggiare gli occhi.

Connector cleaning safety danger statement

Danger:

Risk of eye injury

When you inspect a connector, ensure that light sources are off. The light source used in fiber optic cables can damage your eyes. To avoid getting debris in your eyes, wear safety glasses when you work with the canned air duster. To avoid eye irritation on contact, wear safety glasses when you work with isopropyl alcohol.

Danger:

DANGER

Risques de blessure oculaire

Assurez-vous que toutes les sources de lumière ont été désactivées avant de procéder au contrôle d'un connecteur. La source de lumière utilisée dans les câbles de fibres optiques risque de provoquer des lésions oculaires. Pour éviter tout risque de projection vers les yeux, portez des lunettes de protection lorsque vous utilisez la bombe dépoussiérante à air comprimé. Pour éviter tout risque d'irritation oculaire, portez des lunettes de protection lorsque vous utilisez de l'alcool à 90°.

Danger:

GEFAHR

Verletzungsrisiko der Augen

Achten Sie bei der Kontrolle der Anschlüsse darauf, dass die Lichtquellen abgeschaltet sind. Die für die Glasfaserkabel verwendeten Lichtquellen können Augenschäden hervorrufen. Zum Schutz vor Schmutzteilchen tragen Sie eine Schutzbrille, wenn Sie mit einem Pressluft-Spray arbeiten. Zum Schutz vor Augenirritationen tragen Sie eine Schutzbrille, wenn Sie mit Isopropanol arbeiten.

Danger:

PELIGRO

Riesgo de lesiones

Cuando inspeccione un conector, controle que las fuentes de luz estén apagadas. La fuente de luz que utilizan los cables de fibra óptica puede ocasionar daños en la vista. Cuando trabaje con el pulverizador de aire envasado, utilice gafas de seguridad para evitar el ingreso de residuos en los ojos. Utilice gafas de seguridad cuando trabaje con alcohol isopropilo para evitar irritación en los ojos.

Danger:

PERIGO

Risco de ferimento nos olhos

Ao inspecionar um conector, verifique se as fontes luminosas estão desligadas. A fonte luminosa usada nos cabos de fibra ótica pode causar danos a seus olhos. Para evitar que seus olhos sejam atingidos por resíduos, use óculos de segurança ao trabalhar com lata de ar comprimido. Para evitar irritação dos olhos, use óculos de segurança ao trabalhar com álcool isopropílico.

Danger:

PERICOLO

Rischio di lesioni agli occhi

Quando si esamina un connettore, assicurarsi che le sorgenti di luce siano spente. La sorgente di luce utilizzata nei cavi a fibre ottiche potrebbero danneggiare gli occhi. Per evitare l'accidentale introduzione di detriti negli occhi, indossare gli occhiali di sicurezza quando si lavora con un'impolveratrice ad aria compressa. Per evitare irritazioni oculari da contatto, indossare gli occhiali di sicurezza quando si lavora con alcool isopropilico.

Optical fiber damage warning statement

Warning:

Risk of equipment damage

Do not crush fiber optic cable. If fiber optic cable is in the same tray or duct with large, heavy electrical cables, the weight of the electrical cable can damage the fiber optic cable.

Warning:

AVERTISSEMENT

Risques d'endommagement de l'équipement

N'exercez pas de pression sur les câbles de fibres optiques. Ne placez pas de câbles de fibres optiques dans la même caisse ou dans le même fourreau que des câbles électriques lourds car leur poids risquerait de les endommager.

Warning:

WARNUNG

Risiko von Geräteschäden

Das Glasfaserkabel darf nicht zerdrückt werden. Wenn sich ein Glasfaserkabel zusammen mit großen und schweren Elektrokabeln im gleichen Kabelkanal oder in der gleichen Führung befindet, kann es durch das Gewicht der Elektrokabel beschädigt werden.

Warning:

ADVERTENCIA

Riesgo de daños en los equipos

Evite aplastar los cables de fibra óptica. Si el cable de fibra óptica se encuentra en la misma bandeja o conducto que otros cables eléctricos grandes y pesados, puede dañarse.

Warning:

AVISO

Risco de danos ao equipamento

Não amasse o cabo de fibra ótica. Se o cabo de fibra ótica estiver na mesma bandeja ou duto com cabos elétricos longos e pesados, ele pode ser danificado pelo peso do cabo elétrico.

Warning:

Avvertenza

Rischio di danno all'apparecchio

Non schiacciare o piegare il cavo a fibre ottiche. Se il cavo a fibre ottiche è posizionato in un vassoio o condotto con cavi elettrici pesanti e di grosse dimensioni, esso potrebbe essere danneggiato dal peso dei cavi elettrici.

Optical fiber connector damage warning statement

Warning:

Risk of equipment damage

To prevent further contamination, clean fiber optic equipment only when you see evidence of contamination.

To prevent contamination, cover the optical ports of all active devices with a dust cap or optical connector.

To avoid the transfer of oil or other contaminants from your fingers to the end face of the ferrule, handle connectors with care.

Warning:

AVERTISSEMENT

Risques d'endommagement de l'équipement

Pour éviter tout risque de nouvelle contamination, nettoyez uniquement le matériel en fibre optique lorsque les preuves de contamination sont avérées.

Pour éviter tout risque de contamination, assurez-vous que tous les ports optiques des périphériques sous tension sont protégés par un capuchon anti-poussière ou par un connecteur optique.

Manipulez les connecteurs avec précaution afin d'éviter toute application d'huile provenant de vos doigts ou d'autres contaminants sur l'extrémité de la ferrule.

Warning:

WARNUNG

Risiko von Geräteschäden

Zur Vermeidung weiterer Verunreinigungen reinigen Sie die Glasfiber-Ausrüstung nur dann, wenn sie offensichtlich kontaminiert ist.

Zur Vermeidung von Verunreinigungen schützen Sie die optischen Ports aller aktiven Geräte mit einer Staubkappe oder einem optischen Steckverbinder.

Zur Vermeidung von Verunreinigungen des hinteren Muffenteils durch Öl von den Fingern oder durch andere Kontaminationsstoffe behandeln Sie die Anschlüsse vorsichtig.

Warning:

ADVERTENCIA

Riesgo de daños en los equipos

Limpie los equipos de fibra óptica únicamente cuando existan rastros de contaminación para evitar diseminarla aun más.

Para evitar la contaminación, controle que los puertos ópticos de todos los dispositivos activos estén cubiertos con una tapa protectora o un conector óptico.

Maneje los conectores con cuidado para no contaminar la superficie de los casquillos con la grasa de los dedos ni otros contaminantes.

Warning:

AVISO

Risco de danos ao equipamento

Para evitar contaminação futura, limpe o equipamento ótico apenas quando houver evidência de contaminação.

Para evitar a contaminação, verifique se as portas óticas de todos os dispositivos ativos estão cobertas com uma proteção contra pó ou conector ótico.

Para evitar a transferência de óleo ou outro agente contaminador de seus dedos para a extremidade final da ponteira, manuseie os conectores com cuidado.

Warning:

Avvertenza

Rischio di danno all'apparecchio

Per evitare ulteriori contaminazioni, pulire l'apparecchio a fibre ottiche solo in presenza di evidente contaminazione.

Per evitare contaminazioni, assicurarsi che le porte ottiche di tutti i dispositivi attivi siano coperte da un tappo antipolvere o da un connettore ottico.

Per evitare il trasferimento di olio o di altri agenti contaminanti dalle dita alla parte finale della ghiera, maneggiare con cura i connettori.

SFP damage warning statement

Warning:

Risk of equipment damage

SFPs are keyed to prevent incorrect insertion. If the SFP resists pressure, do not force it; turn it over, and reinsert it.

Warning:

AVERTISSEMENT

Risques d'endommagement de l'équipement

Afin d'éviter tout risque d'insertion incorrecte, les modules SFP sont verrouillés. Si vous ne parvenez pas à insérer un module SFP, ne forcez pas. Retournez-le et renouvelez l'opération.

Warning:

WARNUNG

Risiko von Geräteschäden

Die SFPs sind so konstruiert, dass ein falsches Einsetzen verhindert wird. Lässt sich ein SFP auch auf Druck hin nicht einsetzen, versuchen Sie nicht, es gewaltsam einzusetzen, sondern drehen Sie es um, und setzen Sie es erneut ein.

Warning:

ADVERTENCIA

Riesgo de daños en los equipos

Los módulos SFP cuentan con cuñas que no permiten insertarlos de forma incorrecta. Si el módulo SFP opone resistencia a la presión, no lo fuerce; gírelo e insértelo nuevamente.

Warning:

AVISO

Risco de danos ao equipamento

Os SFPs são chaveados para evitar inserção indevida. Se o SFP resistir à pressão, não o force; inverta e recoloque-o.

Warning:

Avvertenza

Rischio di danni all'apparecchio

Gli SFP dispongono di chiavi in modo da evitarne l'inserimento errato. Se l'SFP resiste alla pressione, non forzarlo ma capovolgerlo e reinserirlo.

Glossary

attenuation	The decrease in signal strength in an optical fiber caused by absorption and scattering.
bit error rate (BER)	The ratio of the number of bit errors to the total number of bits transmitted in a specific time interval.
cable plant	All the optical elements, such as fiber connectors and splices, between a transmitter and a receiver.
coarse wavelength division multiplexing (CWDM)	A technology that uses multiple optical signals with different wavelengths to simultaneously transmit in the same direction over one fiber, and then separates by wavelength at the distant end.
demultiplexing	The wavelength separation in a wavelength-division multiplexing system. The opposite of multiplexing.
dense wavelength division multiplexing (DWDM)	A technology that uses many optical signals (16 or more) with different wavelengths to simultaneously transmit in the same direction across one fiber, and then separate by wavelength at the distant end.
dispersion	The broadening of input pulses as they travel the length of an optical fiber. The following types of dispersion exist: • modal dispersion—caused by the many optical path lengths in a multimode fiber • chromatic dispersion—caused by the differential delay at various wavelengths in an optical fiber • waveguide dispersion—caused by light traveling through both the core and cladding materials in single-mode fibers
gigabit Ethernet (GbE)	Ethernet technology with speeds up to 10 Gbps.
light emitting diode (LED)	A semiconductor diode that emits light when a current passes through it.
media	A substance that transmits data between ports; usually fiber optic cables or category 5 unshielded twisted pair (UTP) copper wires.

metropolitan area network (MAN)	A broadband network that covers an area larger than a Local Area Network.
multimode fiber (MMF)	A fiber with a core diameter larger than the wavelength of light transmitted that you can use to propagate many modes of light. Commonly used with LED sources for low speed and short distance lengths. Typical core sizes (measured in microns) are 50/125, 62.5/125 and 100/140.
multiplexing	Carriage of multiple channels over a single transmission medium; a process where a dedicated circuit is shared by multiple users. Typically, data streams intersperse on a bit or byte basis (time division), or separate by different carrier frequencies (frequency division).
nanometer (nm)	One billionth of a meter (10^{-9} meter). A unit of measure commonly used to express the wavelengths of light.
quad small form-factor pluggable plus (QSFP+)	The quad small form-factor pluggable plus (QSFP+) is a transceiver used for data communications applications, which connects a module to a fiber optic cable.
single-mode fiber (SMF)	One of the various light waves transmitted in an optical fiber. Each optical signal generates many modes, but in single-mode fiber only one mode is transmitted. Transmission occurs through a small diameter core (approximately 10 micrometers), with a cladding that is 10 times the core diameter. These fibers have a potential bandwidth of 50 to 100 gigahertz (GHz) per kilometer.
small form-factor pluggable (SFP)	A hot-swappable input and output enhancement component used with Avaya products to allow gigabit Ethernet ports to link with other gigabit Ethernet ports over various media types.
small form-factor pluggable plus (SFP +)	SFP+ transceivers are similar to SFPs in physical appearance but SFP+ transceivers provide Ethernet at 10 gigabits per second (Gbps).
unshielded twisted pair (UTP)	A cable with one or more pairs of twisted insulated copper conductors bound in a single plastic sheath.
XFP	A pluggable 10 gigabit transceiver capable of providing different optical media for a switch. The XFP is similar to an SFP transceiver but is larger in size.