Implementation Options

This chapter contains the following sections:

Module I/O Description

The following table provides details on the I/O signals.

Table 1: I/O Signals

IO Name	Description	Direction	I/O Standard	Notes
CLK_156M25_*	156.25MHz reference clock	Out	LDVS	If unused terminate with 100 ohm resistor
I2C_*_SDA	I2C data	In/Out	3.3V Open-drain	Pullup on Cisco card
I2C_*_SCL	I2C clock	In/Out	3.3V Open-drain	Pullup on Cisco card
I2C_MUX_RST_L	I2C mux reset	Out	3.3V	Resets the I2C mux
P3_3V_RTC	Backup power for real time clock	In	3.3V	—
CNS_RJ45_TXD_L	RS-232 console	Out	RS-232 Compliant	RS-232 console port
CNS_RJ45_RTS_L	RS-232 console	Out	RS-232 Compliant	RS-232 console port

IO Name	Description	Direction	I/O Standard	Notes
CNS_RJ45_RXD_L	RS-232 console	In	RS-232 Compliant	RS-232 console port
CNS_RJ45_CTS_L	RS-232 console	In	RS-232 Compliant	RS-232 console port
USB_CONSOLE_[P/N]	USB console	Bi	USB 2.0 Compliant	USB 2.0 console port
LED_SH_DIN	Shift chain data	Out	3.3V	
LED_SH_CLK	Shift chain clock	Out	3.3V	
LED_SH_EN_L	Shift chain enable low	Out	3.3V	Pullup on Cisco card
LED_SH_LATCH	Shift chain latch	Out	3.3V	
PUSH_BUTTON_L	Push button	In	3.3V	Pullup on Cisco card
TE1_[1-10]_TXDATA_[P/N]	XFI 10G tx data	Out	LVDS	—
TE1_[1-10]_RXDATA_[P/N]	XFI 10G rx data	In	LVDS	—
SFP_TE1_[1-10]_PRES_L	SFP present low	In	3.3V	Signal indicating the presence of the SFP
USB1_[1-2]_FAULT_L	USB power fault detected	In	3.3V	Pullup on Cisco card
USB1_[1-2]_PWR_EN	Turn on the USB 5V power	Out	3.3V	Pullup on Cisco card
USB1_[1-2]_D_[P/N]	USB for SD or USB Type A	Bi	USB 2.0 Compliant	—
RESET_HOLD_OFF_L	Keeps the Cisco card in reset	In	3.3V	This signal holds the Cisco card in reset until the integrator card is ready.
DC[A-B]_PWR_GOOD	DC power is good or either A or B supply	In	3.3V	High indicates the DC input is good. Pullup on Cisco card.
DYING_GASP_L	Indicates the power supplies are starting to fail	In	3.3V	The supplies must hold up the power until the dying gasp messages can be sent out.
TEMP_SENSOR_[P/N]	Transistor temperature sensor on the Cisco card	Out	N/A	These signals can be used for the integrator to monitor the temperature of the Cisco card.
MGMT_PHY_RXDATA	SGMII signal for management PHY	Out	LVDS	—
MGMT_PHY_TXDATA	SGMII signal for management PHY	In	LVDS	—
MGMT_PHY_RST_L	Management phy reset	Out	3.3V	Pull low if no management phy is populated

IO Name	Description	Direction	I/O Standard	Notes
MDIO_MGMT_PHY	Management phy MDIO signal	Bi	3.3V	MDIO bus, MDIO_MGMT_PHY needs a pullup
MDC_MGMT_PHY	Management phy MDC signal	Out	3.3V	—

Note In the above table, LVDS stands for Low-Voltage Differential Signaling. For further information see the TIA/EIA-644 technical standard.

Block Diagrams

The system integrator can find block diagrams that represents how the ESS board connects into their system located here:

ESS9300 Block Diagram

Power Signals

Table 2: Power Signals

Signal Name	Description	Direction	I/O Standard	Notes
P5V_MODULE	+5V power for Cisco card	In	PWR	See Board Electrical Power Consumption, on page 14
P3_3V_MODULE	+3.3V power for Cisco card	In	PWR	See Board Electrical Power Consumption, on page 14
P3_3V RTC	+3.3V for real time clock hold up	In	PWR	See Board Electrical Power Consumption, on page 14
GND	Reference ground	—	PWR	—

LED Definitions

LED functionality is provided by a dedicated controller for driving an LED shift chain for driving the LEDs on the integrator board. You can select any combination of LEDs to implement. You are not required to implement all of the LEDs but must implement the shift chain up to the last LED needed.

LED	Color	Description
System	Off	System is not powered on.
	Flashing Green	Power on tests in progress.
	Solid Green	System is operating normally.
	Flashing Yellow	System is receiving power but is not functioning properly.
	Yellow	System fault detected.
DC-A/B	Off	Power is not present on the circuit, or the system is not powered up.
	Solid Green	Power is present on the associated circuit.
	Solid Red	Power is not present on the associated circuit, and the switch is configured for dual-input power.
Alarm Out	Off	Alarm Out is not configured.
	Solid Green	Alarm Out is configured, no alarm detected.
	Flashing Red	Switch has detected a major alarm.
	Solid Red	Switch has detected a minor alarm.
Alarm In	Off	Alarm In is not configured.
	Solid Green	Alarm In is configured, no alarm detected.
	Flashing Red	Switch has detected a major alarm.
	Solid Red	Switch has detected a minor alarm.
Under Temperature	Red	The system is under temperature and is warming up.
Port	Off	No link or the port was administratively shut down.
	Solid Green	Link is present, no activity.
	Flashing Green	Link is healthy, with activity.
	Alternating Green/Yellow	Link faulty or an error.
	Solid Yellow	Port is disabled.
Console	Off	USB cable or Blue-tooth dongle not connected.
	Solid Green	USB console is active.
	Flashing Green	Blue-tooth dongle is active.
Zeroize	Off	Normal operation.
	Flashing Green	Zeroization procedure has been initiated.
	Solid Yellow	Zeroization procedure has completed; switch is about to reboot.
	Solid Green	Zeroization procedure has completed.

Board LED Register Bits

The following table provides a listing of the Board LED register bits for the system integrator.

Table 3: LED Shift Chain

GPIO Position	Carrier
0 (First bit out of the Cisco card)	TE1/12 Green
1	TE1/12 Yellow
2	TE1/11 Green
3	TE1/11 Yellow
4	TE1/10 Green
5	TE1/10 Yellow
6	TE1/9 Green
7	TE1/9 Yellow
8	TE1/8 Green
9	TE1/8 Yellow
10	TE1/7 Green
11	TE1/7 Yellow
12	TE1/6 Green
13	TE1/6 Yellow
14	TE1/5 Green
15	TE1/5 Yellow
16	TE1/4 Green
17	TE1/4 Yellow
18	TE1/3 Green
19	TE1/3 Yellow
20	TE1/2 Green
21	TE1/2 Yellow
22	TE1/1 Green
23	TE1/1 Yellow
24	USB console Green

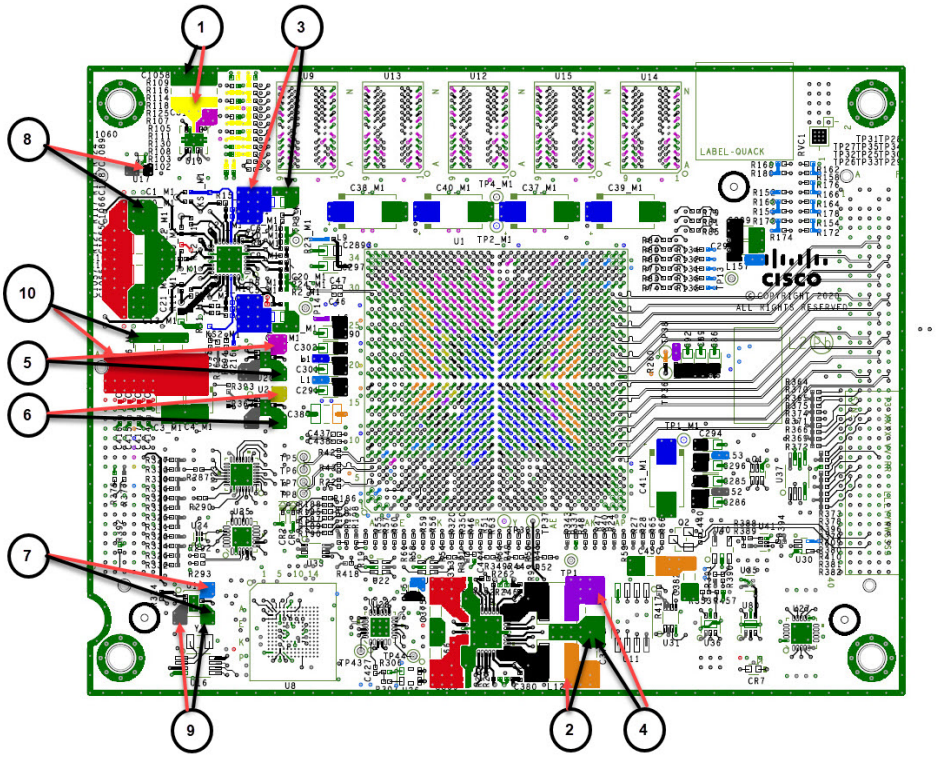
GPIO Position	Carrier
25	Under temperature Red
26	Alarm IN 2 Green
27	Alarm IN 2 Red
28	Alarm IN 1 Green
29	Alarm IN 1 Red
30	Alarm Out Green
31	Alarm Out Red
32	DC-B Green
33	DC-B Red
34	DC-A Green
35	DC-A Red
36	ZEROIZE Green
37	ZEROIZE Yellow
38	SYSTEM Green
39 (Last bit out of shift chain)	SYSTEM Yellow

Module Voltage Test Points

The following figure shows voltage test points on the board with descriptions in the following table.

Note Red lines are Positive, Black lines are Ground.

Figure 1: Voltage Test Points



Test Point	Location	Location Color	Voltage
1	C311	Yellow	0.60V
2	C370	Orange	0.80V
3	C30_M1	Blue	0.85V
4	C373	Purple	0.90V
5	Surface trace	Pink	1.20V
6	Surface trace	Light Yellow	1.20V (VDDH)
7	Surface trace	Light Blue	1.80V
8	Surface trace	Dark Green	2.50V
9	Surface trace	Brown	3.30V
10	C16_M1	Red	5.0V

Mechanical and Environmental Testing

The tests listed in the following tables were successfully executed on the Cisco ESS9300 using Cisco passive cooling design. These tests used a representative enclosure that conforms to the mounting and thermal mechanisms. Because this type of testing is highly dependent on factors such as the test enclosure design, the thermal solution, the front panel connectors, and the mounting, the following test results should only be used as a reference.

Table 4: Temperature

High and Low Temperature Cycle Stress (Operational)	High Temperature: 74°C (165°F) Low Temperature: -40°C (-40°F) Reference: MIL-STD-810F, Method 501.4, Procedure II and Method 502.4, Procedure II; SAE J1455 (Rev AUG94), Section 4.1.3
Thermal Shock (Non-Operational)	High Temperature: 85°C (185 °F) Low Temperature: -40°C (-40 °F) Cycle: 2 hours high temperature, 2 hours low temperature Test Period: 2 hour pre-soak at low temperature, followed by 5 cycles Repetition: 5 test periods Reference: MIL-STD-810F, Method 503.4; SAE J1455 (Rev AUG94), Section 4.1.3.2
High Temperature Component Thermal Test (Operational)	Method: Thermocouples on all critical/hot components at board level. Bring temperature of top center surface of thermal plate to 85°C (185 °F) and allow it to stabilize. Ensure that all components are within manufacturer thermal specifications.

Table 5: Altitude

Low Pressure/Altitude (Operational)	Altitude: 4.6km (15,000ft) Equivalent Absolute Pressure: 57.2 kPa (8.3 lbf/in2) Temperature: -40°C (-40°F) to 74°C (165°F) Altitude Ramp Rate: 10m/s (max) Temperature Ramp Rate: 1.5°C (min) to 4.5°C (max) Reference: MIL-STD 810F, Method 500.4, Procedure II; SAE J1455 (Rev AUG94), Section 4.1.3.1

Operational Altitude	Altitude: 12.2km (40,000ft) Equivalent Absolute Pressure: 18.6kPa (2.7lbf/in2) Temperature: -40C (-40F) to 25C (77F)
Low Pressure/Altitude (Non-Operational)	Altitude: 12.2km (40,000 ft) Equivalent Absolute Pressure: 18.6kPa (2.7lbf/in2) Temperature: -40°C (-40°F) to 85°C (185°F) Altitude Ramp Rate: 10m/s (max) Temperature Ramp Rate: 1.5°C (min) to 4.5°C (max) Reference: MIL-STD-810F, Method 500.4; SAE J1455 (Rev AUG94), Section 4.1.3.1

Table 6: Humidity

Temperature & Humidity Cycle Stress (Non-Operational; Energized)	Humidity: 95% +/- 5% RH Pressure: 103.4 kPa (15 lbf in2) Temperature: -40°C (-40°F) to 65°C (149°F) Cycle: One, 24 hour cycle Reference: SAE J1455 (Rev AUG94), Section 4.2.3
Active Temperature/Humidity 10 Day Soak (Non-Operational; Energized)	Temperature: -40°C (-40°F) to 65 °C (149 °F) Humidity: 95% +/- 5% RH Cycle: Ramp from 25°C to 0°C over 75 minute period, dwell at 0°C for 240 minutes, ramp to 65°C over 120 minute period, dwell at 65°C for 240 minutes (95% +/- 5% RH), ramp to 25°C over 45 minute period, dwell at 25°C for 120 minutes (50% +/- 5% RH) Repetition: 20 total cycles (10 days total) Reference: MIL-STD-810F, Method 507.4; SAE J1211 (Rev NOV78), Section 4.2.2; SAE J1455 (Rev AUG94), Section 4.2.3

Table 7: Vibration and Shock

Random Vibration (Operational)	Acceleration: 1.04g rms vertical, 0.204g rms transverse, 0.740g rms longitudinal Duration: 2 hours per axis Test orientation: 3 axes Reference: MIL-STD-810F, Method 514.5, Category 4

Crash Hazard Shock (Non-Operational)	Acceleration: 75G Duration: 8-13ms Test orientation: 3 axes (positive and negative) Number of shocks: 2 shocks in each direction, 12 shocks total Reference: MIL-STD-810F, Method 516.5, Procedure V
Functional Shock (Operational)	Acceleration: 40G Duration: 15-23ms Test orientation: All 6 faces, in 3 perpendicular axes Reference: MIL-STD-810F, Method 516.5, Procedure I
Bench handling shock (tip) (Operational)	Test orientation: All four edges of each face to form 10° angle with bench top Reference: MIL-STD-810F, Method 516.5, Procedure VI

Overtemperature Detection

The board has a temperature sensor mounted on the edge of the board that should be thermally attached to the Customer Designed Conduction Plate. When the temperature sensor detects a temperature exceeding the threshold of 203°F (96°C), the overtemperature LED will illuminate.

The digital temperature sensor measures the temperature of the Customer Designed Conduction Plate, not the local ambient temperature. The product datasheet states the board will operate as long as the conduction plate is in the range of -40C to +85C. The alarms are set accordingly, and the high temperature alarm thresholds are set as follows:

- Minor alarm at +80C the Customer Designed Conduction Plate temperature is close to the rated thermal limit of the unit, and will notify the user. The components are still within the specification, so there is no degradation to the long term reliability of the system.
- Major alarm at +90C the Customer Designed Conduction Plate temperature is over the rated thermal limit of the unit, and will notify the user. This will impact the long term reliability of the system.
- Critical alarm at +96C the Customer Designed Conduction Plate temperature is way over the rated thermal limit of the unit, and will notify the user. This will impact the long term reliability of the system. For the Critical Alarm threshold to be reached, it means that the ambient temperature of the system will be exceeded. Hardware failure is immanent, and the failure time will depend upon your installation. Depending on the severity at this point, the failure may be temporary or permanent.

Caution IOS will never shut down a device because the temperature exceeds the specification. Cisco does not guarantee the functionality, nor the long term reliability of a device operating beyond Cisco specifications, but lets the device continue operating until some piece of hardware physically shuts down. Operating outside of the temperature specifications will void the product warranty.

The status of the temperature sensors can be reported from the Cisco ESS-9300 IOS CLI:

```
Switch# show environment all
ALARM CONTACT 1
   Status:      not asserted
   Description: external alarm contact 1
   Severity:    minor
   Trigger:     closed
ALARM CONTACT 2
   Status:      not asserted
   Description: external alarm contact 2
   Severity:    minor
   Trigger:     closed
Supervisor Temperature Value: 51 C
Temperature State: GREEN
System Temperature thresholds
------------------------------
Minor Threshold    : 80 C (Yellow)
Major Threshold    : 90 C (Red)
Critical Threshold : 96 C
Shutdown Threshold : 105 C
Pwr Supply         Type     Status
-------------------------------------
POWER SUPPLY-A      DC      OK
POWER SUPPLY-B      DC      OK
```

Thermal Design Considerations

The following sections outline the methods for dealing with thermal issues and the mounting options involving the Customer Designed Conduction Plate.

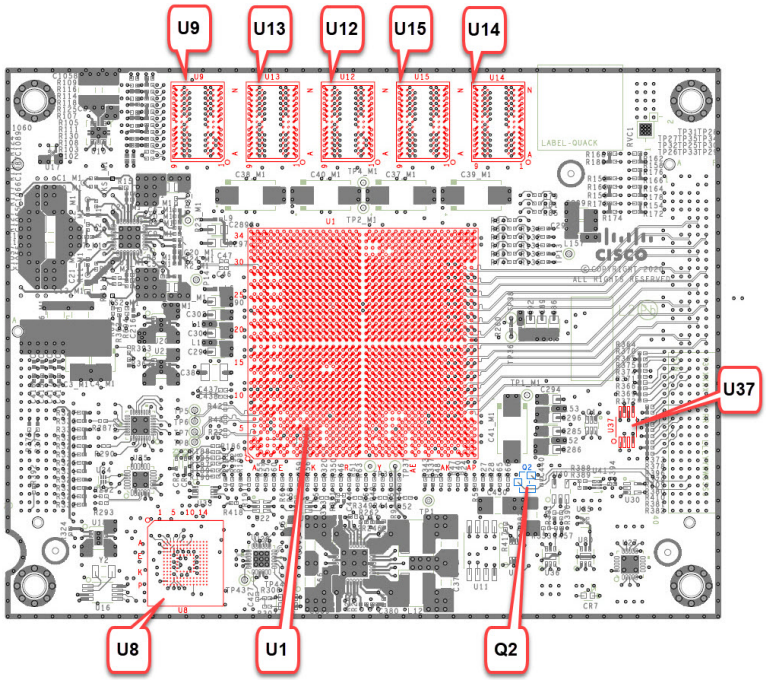
As the ESS9300 is intended for use in extreme environments, industrial temperature rated components are used.

As a general rule, the thermal plate of the card needs to make contact with an adequate thermal mass to draw heat away from the card. This can be done in a number of ways.

The important note is that the Customer Designed Conduction Plate temperature, as measured at the center of the top surface of the conduction plate, must not exceed 85°C. As long as this requirement is satisfied, all of the card's components will be within a safe operating temperature range on the high temperature side.

Note The area in the following figure noted by the red square is the 45A power supply and needs some additional cooling.

Figure 2: Thermally Significant Components of Cisco ESS-9300



Note Cisco uses the following TIMs at each REFDES:

The U1, U9, U12, U13, U14, U15, U8, and other items in the figure above use the Chomerics GEL30. U1 uses a Fujipoly 32x32, 150Xr-PE thermal pad.

Samtec has 3D models, footprints, and schematic symbols for their connectors here:

https://www.samtec.com/connectors/high-speed-board-to-board/high-density-arrays/searay

RefDes	Thermal Design Power (in W)	Allowable junction temp (in °C)	Allowable case temp (in °C)	Package Type	Theta Jc (in °C/W)	Theta Jb (in °C/W)
U1	33	115	—	FCTEBGA1155	—	-
U9, U12, U13, U14, U15	0.2 Each	—	95	FBGA96	3.0	—
U8	1	—	—	FBGA153	—	—
U37	—	—	—	MSOP8	—	—

Note Q2 is a NPN transistor that can be used by the system integrator to read the temperature of the cooling plate for their use.

Validating a Thermal Solution

To validate a thermal solution, monitor the thermal sensor of the Cisco ESS 9300 cards in a thermal chamber set to the desired maximum ambient operating temperature and with traffic running.

The temperature sensor should make contact with the Customer Designed Conduction Plate using thermal interface material. The temperature of the sensors should be less than 90.5C. The **show environment all** command can be executed from the IOS prompt to monitor the thermal sensor temperatures.

```
Switch# show environment all
ALARM CONTACT 1
   Status:      not asserted
   Description: external alarm contact 1
   Severity:    minor
```

Product Specifications

The following tables list the product specifications for the Cisco ESS 9300.

Table 8: Interface Support

Item	Description
ESS-9300	10 ports of 1 or 10 GE fiber (XFI)

Table 9: Memory

Item	Description
DRAM	4GB
SPI Flash	16MB
eMMC Flash	7 GB, 2.5 GB user accessible

Table 10: Hardware Specifications

Item	Description
Input voltages	+5Vdc (+/- 5%) and +3.3Vdc (+/- 3%)
Total Power	Thermal Power = 35W Max Power = 43W
Mass	88 grams (3.10 ounces)

Note For Environmental Specifications, please see the Mechanical and Environmental Testing section for complete specifications.

Power Requirements

The board requires +5 VDC and +3.3 VDC to operate. Board Electrical Power Consumption, on page 14 lists the DC power requirements.

The ESS-9300 can display a POWER GOOD status for two Power Inputs via the DC-A-GOOD and DC-B-GOOD signals. If these signals are not used, connect DC-A-GOOD to 3.3 V and DC-B-GOOD to ground through a 1k resistor.

Note There is no specific voltage sequence requirement for the 5V and 3.3V power inputs. They can ramp up in any order.

Dying Gasp

If the switch is configured, and the feature is enabled, in the case of a temporary power outage, the switch will send a Dying Gasp packet. If the power recovers, the switch will continue to operate normally. See more about Dying Gasp in the ESS9300 Software Configuration Guide .

Board Electrical Power Consumption

Table 11: Power Requirements

Voltage Rail	Tolerance	Typical Current (A)	Maximum Current (A)
5V	+/- 3%	N/A	7.0A
3.3V	+/- 3%	N/A	2.0A
P3_3V RTC	+10% / -60%	0.4uA	0.7uA

SD Support

There is one Cisco SD card that has been tested and is recommended, the SD-IE-4GB. If the end user or system integrator chooses to use a 3rd party device, it may work for their application and to their satisfaction. However, the end user or system integrator is solely responsible for testing and ensuring proper operation.

The following message displays when a different SD card is installed:

```
WARNING: Non-IT SD flash detected. Use of this card during normal operation can impact and
severely degrade performance of the system. Please use supported SD flash cards only.
```

You can find Cisco's policy on Third Party Components here:

https://www.cisco.com/c/en/us/products/warranties/warranty-doc-c99-740959.html#_Toc3320258

SFP Support

The following table lists the specific SFP transceivers and their characteristics.

Note LRM optics are not supported since the SFP is direct driven from the Cisco ASIC.

Supported SFP and SFP+ Modules

Table 12: Supported Modules

Part Number	Specification	SFP Type	Max Distance	Cable Type	Temp Range	DOM Support
GLC-SX-MM-RGD=	1000BASE-SX	GE	550m	MMF	IND	Yes
GLC-LX-SM-RGD=	1000BASE-LX/LH	GE	550m/10km	MMF/SMF	IND	Yes
GLC-SX-MMD=	1000BASE-SX	GE	550m	MMF	EXT	Yes
GLC-LH-SMD=	1000BASE-LX/LH	GE	550m/10km	MMF/SMF	EXT	Yes
GLC-BX-D=	1000BASE-BX10	GE	10km	SMF	COM	Yes
GLC-BX-U=	1000BASE-BX10	GE	10km	SMF	COM	Yes
GLC-ZX-SM-RGD	1000BASE-ZX	GE	Approx. 70km	SMF	IND	Yes
GLC-EX-SMD=	1000BASE-EX	GE	40km	SMF	EXT	Yes
SFP-GE-S=	1000BASE-SX	GE	550m	MMF	EXT	Yes
GLC-SX-MM=	1000BASE-SX	GE	550m	MMF	COM	No
GLC-T-RGD=	1000BASE-T	GE	100m	Copper	IND	N/A
GLC-LH-SM=	1000BASE-LX/LH	GE	550m/10km	MMF/SMF	COM	No
GLC-TE=	1000BASE-T	GE	100m	Copper	EXT	N/A
GLC-T=	1000BASE-T	GE	100m	Copper	COM	N/A
CWDM-SFP-xxxx= (8 freq)	CWDM 1000BASE-X	GE	—	SMF	COM	Yes
DWDM-SFP-xxxx= (40 freq)	DWDM 1000BASE-X	GE	—	SMF	COM	Yes

Part Number	Specification	SFP Type	Max Distance	Cable Type	Temp Range	DOM Support
SFP-10G-BXD-I=	10GBASE-BX10	10GE	10km	SMF	IND	Yes
SFP-10G-BXU-I=	10GBASE-BX10	10GE	10km	SMF	IND	Yes
SFP-10G-SR-X=	10GBASE-SR	10GE	400m	MMF	EXT	Yes
SFP-10G-LR-X=	10GBASE-LR	10GE	10km	SMF	EXT	Yes
SFP-10G-SR=	10GBASE-SR	10GE	400m	MMF	COM	Yes
SFP-10G-LR=	10GBASE-LR	10GE	10km	SMF	COM	Yes
SFP-H10GB-CUxM=	10G Passive Twinax	10GE	1m/3m/5m	Twinax	COM	N/A
SFP-H10GB-ACUxM=	10G Active Twinax	10GE	7m/10m	Twinax	COM	N/A
SFP-10G-T-X *	10GBASE-T	10GE	Up to 30 meters	Cat6A/Cat7	EXT	NA