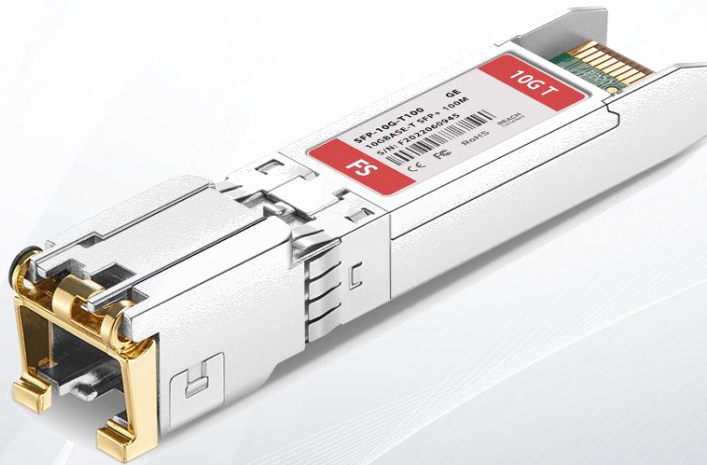


# 10GBASE-T SFP+ Copper RJ-45 100m Transceiver

SFP-10G-T100



## Application

- 10 Gigabit Ethernet over Category 6a/7 Cable
- Switch/Route to Switch/Route Link
- High Speed I/O for File Servers

## Features

- Supports XFI(SFI) or SGMII to Copper Auto-negotiation
- 10G BASE-T Operation in Host Systems with XFI(SFI) Interface
- 10G BASE-T Supports Links Up to 100m Using Cat 6a/7 Cable
- Power Consumption 1.8W MAX. @100m
- 100/1000 BASE-T Operation Requires the Host System to Have an SGMII Interface
- 100/1000 BASE-T or 2.5/5G BASE-T Supports Links Up to 100m Using Cat 5E Cable or Better
- 0°C to 70°C Operating Temperature Range
- Support Unshielded and Shielded Cable
- Support MDI/MDIX Crossover
- 3.3V Single Power Supply
- Hot-pluggable SFP Footprint.
- Fully Metallic Enclosure for Low EMI
- Compact RJ-45 Connector Assembly
- Detailed Product Information in EEPROM
- Access to I2C -Wire Serial Bus Interface for Serial ID and PHY Register Access

## Description

The copper transceiver module is a high performance integrated duplex data link for bi-directional communication over copper cable. It is specifically designed for high speed communication links that require 10 Gigabit Ethernet over Cat 7 cable at XFI to Copper Auto-negotiation mode. It is compliant with the Gigabit Ethernet and 1000BASE-T standards as specified in IEEE 802.3-2012 and IEEE 802.3ab, which supports 100/1000Base-T Copper data-rate up to 100 meters reach over twisted-pair category 5 cable.

## Products Specifications

### I. General Specifications

Parameter	Symbol	Min.	Typical	Max.	Unit	Note/Conditions
<b>Data Rate</b>	BR		10.3125 5.15625 2.578125 1.25		Gb/s	IEEE 802.3 Compatible
<b>Cable Length</b>	L			100	m	@10GBaseT. Category 6a/7, BER<10 <sup>-12</sup>
				100	m	@5GBase-T. Category 5E/6 or Better. BER<10 <sup>-12</sup>
				100	m	@100/1000/2.5GBase-T. Category 5/5E or Better. BER<10 <sup>-12</sup>

#### Notes

1. Automatic crossover detection is enabled. External crossover cable is not required.
2. 10GBASE-T operation requires the host system to have an XFI(SFI) interface with no clocks.
3. 10/100/1000 BASE-T operation requires the host system to have an SGMII interface with no clocks for all part number except HTSFP-XG -11x1TF.

### II. Environmental Specifications

Parameter	Symbol	Min.	Max.	Unit	Note/Conditions
<b>Operating Temperature</b>	T <sub>op</sub>	0	70	°C	Commercial Case Temperature
<b>Storage Temperature</b>	T <sub>sto</sub>	-55	105	°C	Ambient Temperature

### III. +3.3V Volt Electrical Power Interface

The SFP+ Copper Transceiver has an input voltage range of  $3.3\text{ V} \pm 5\%$ . The 4 V maximum voltage is not allowed for continuous operation.

Parameter	Symbol	Min.	Typical	Max.	Unit	Note/Conditions
<b>Supply Current</b>	$I_s$		500	545	mA	At 10GBase-t Cat6a/7 100m 1.8w Max Power over Full Range of Voltage and Temperature
			330	365	mA	At 5GBase-t Cat5E 100m over Full range of voltage and temperature
			300	335	mA	At 2.5GBase-t Cat5E 100m over Full Range of Voltage and Temperature
			200	235	mA	At 1000Base-t Cat5E 100m over Full Range of Voltage and Temperature
			100	125	mA	At 100Base-tCat5E 100m over Full Range of Voltage and Temperature
<b>Input Voltage</b>	$V_{cc}$	3.135	3.3	3.465	V	Referenced to GND

**Note:** Power consumption and surge current are higher than the specified values in the SFP MSA.

### IV. Low-Speed Signals

MOD\_DEF (1) (SCL) and MOD\_DEF (2) (SDA) are open drain CMOS signals. Both MOD\_DEF (1) and MOD\_DEF (2) must be pulled up to  $host\_V_{cc}$ .

Parameter	Symbol	Min.	Max.	Unit	Note/Conditions
<b>SFP Output LOW</b>	$V_{OL}$	0	0.5	V	4.7k to 10k pull-up to $host\_V_{cc}$
<b>SFP Output HIGH</b>	$V_{OH}$	$host\_V_{cc}-0.5$	$host\_V_{cc}+0.3$	V	4.7k to 10k pull-up to $host\_V_{cc}$
<b>SFP Input LOW</b>	$V_{IL}$	0	0.8	V	4.7k to 10k pull-up to $V_{cc}$
<b>SFP Input HIGH</b>	$V_{IH}$	2	$V_{cc}+0.3V$	V	4.7k to 10k pull-up to $V_{cc}$

## V. High-Speed Electrical Interface

All high-speed signals are AC-coupled internally.

### High-Speed Electrical Interface, Transmission Line-SFP+

Parameter	Symbol	Typical	Unit	Note/Conditions
<b>Line Frequency</b>	$f_L$	10.3125	GHz	XFI(SFI) to Copper
		5.15625	GHz	5GBase-R to Copper
		2.578125	GHz	2.5GBase-X to Copper
		1.25	GHz	SGMII to Copper

### High-Speed Electrical Interface, Host-SFP+

Parameter	Symbol	Min.	Typical	Max.	Unit	Note/Conditions
<b>CML DataInput:</b> <b>Transmitter Differential Input Voltage (TD+/-)</b>	$V_{insing}$	250		1200	mV	AC Coupled
<b>CML DataOutput:</b> <b>Receiver Differential Output Voltage (RD+/-)</b>	$V_{outsing}$	350		800	mV	AC Coupled
<b>Rise/Fall Time</b>	$T_r, T_f$	25		47	psec	20%-80%
<b>Tx Input Impedance</b>	$Z_{in}$		100		ohm	Differential Ended
<b>Rx Output Impedance</b>	$Z_{out}$		100		ohm	Differential Ended

### High-Speed Electrical Interface, Host-SFP+

Parameter	Conditions	Min.	Typical	Max.	Unit
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#### XFI Transmitter Performance Specifications

<b>Nominal VCO Center Frequency</b>			10.3125		GHz
<b>Total Jitter</b>	Refer to the XFIINF-8077i specification.			0.61	UI
<b>Total Non-EQJ Jitter</b>	Refer to the XFIINF-8077i specification.			0.41	UI
<b>Eye Mask</b>	X1			0.305	UI
<b>Eye Mask</b>	Y1	60			mV
<b>Eye Mask</b>	Y2			410	mV

#### XFI Differential CMOS Data Output

<b>Reference Differential Impedance</b>			100		$\Omega$
<b>Termination Mismatch</b>				5	%
<b>Output Rise and Fall Time (20% to 80%)</b>	Refer to the XFI specification.	20			ps
<b>Output AC Common Mode Voltage</b>				15	mV (RMS)

#### XFI Receiver Input Performance Specifications

<b>Total Jitter</b>	Refer to the XFI specification.			0.65	UI (p-p)
<b>Total Non-EQJ Jitter</b>	Refer to the XFI specification.			0.45	UI (p-p)
<b>Eye Mask X1</b>	Mask coordinate X1=0.225 if total non-EQJ jitter is measured.			0.325	UI

### High-Speed Electrical Interface, Host-SFP+

Parameter	Conditions	Min.	Typical	Max.	Unit
<b>Eye Mask Y1</b>		55			mV
<b>EyemaskY2</b>	Out of 525mV, 100mV is allocated for multiple reflections.			525	mV

## VI. Serial Communication Protocol

Parameter	Typical	Max.	Unit
<b>I<sup>2</sup>C Clock Rate</b>	100	200	KHz

## VII. Serial ID Memory Contents

The Copper SFP provides standard serial ID information compliant with SFP MSA, which can be accessed with address of A0h via the 2-wire serial CMOS EEPROM protocol.

Address	Field Size (Byte)	Name of Field	Description and Contents	Hex
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### Base ID Fields

<b>0</b>	1	Identifier	Type of Serial Transceiver (SFP)	03	
<b>1</b>	1	Ext. Identifier	Extended Identifier of Type Serial Transceiver (MOD4)	04	
<b>2</b>	1	Connector	Code of Optical Connector Type (Copper)	22 (21)	
<b>3-10</b>	8	Transceiver	XFI (SFI) to 10GBase-T Copper	02 00 00 00 11 88 40 D5	
<b>11</b>	1	Encoding	64B/66B	06	
<b>12</b>	1	BR, Nominal	Nominal Baud Rate, Unit of 100 MBd	10.3125 GBd For 10GBase-T	67

Address	Field Size (Byte)	Name of Field	Description and Contents	Hex
<b>13</b>	1	Rate Identifier	Type of Rate Select Functionality, (Unspecified)	00
<b>14</b>	1	Length (SMF 9um)-km	Link Length Supported for Single Mode Fiber, Units of km	00
<b>15</b>	1	Length (SMF 9um)	Link Length Supported for 9/125um Fiber, Units of 100m	00
<b>16</b>	1	Length (50um)	Link length supported for 50/125um OM2 fiber, units of 10m	00
<b>17</b>	1	Length (62.5um)	Link length supported for 62.5/125um OM1 fiber, units of 10m	00
<b>18</b>	1	Length (OM4 or copper cable)	Link length supported for 50um OM4 fiber, units of 10m. Alternatively copper or direct attach cable, units of m. For copper links, this value specifies minimum link length (30m) supported by the transceiver while operating in compliance with applicable standards using copper cable.	64
<b>19</b>	1	Length (OM3)	Link Length Supported for 50um OM3 Fiber, Units of 10m	00
<b>20-35</b>	16	Vendor Name	SFP Vendor Name (ASCII), "Hi-OPTEL" or "OEM"	48 69 2D 4F 50 54 45 4C 20 20 20 20 20 20 20 20 (4F 45 4D 20 20 20 20 20 20 20 20 20 20 20 20)
<b>36</b>	1	Transceiver	Code for Electronic Optical Compatibility (SFF-8024 Table 4-4) 10GBASE-T with SFI Electrical Interface	16
<b>37-39</b>	3	Vendor OUI	SFP vendor IEEE company ID, A value of all zero in the 3-byte field indicates that the Vendor OUI is unspecified.	00 00 00
<b>40-55</b>	16	Vendor PN	Part Number Provided by SFP Vendor (ASCII) "HTSFP-XG-1115TF" or "10GBase-T C100m"	48 54 53 46 50 2D 58 47 2D 31 31 31 35 54 46 20 (31 30 47 42 61 73 65 2D 54 20 42 21 30 30 6D 20)
<b>56-59</b>	4	Vendor Rev	Part number provided by SFP vendor (ASCII), A value of all zero in the 4-byte field indicates that the vendor revision is unspecified. (1.0revision)	31 2E 30 20
<b>60-61</b>	2	Wavelength	Laser wavelength (Passive/Active Cable Specification Compliance). A value of 00h for both A0h Byte 60 and Byte 61 denotes laser wavelength or cable specification compliance is unspecified.	00 00

Address	Field Size (Byte)	Name of Field	Description and Contents	Hex
<b>62</b>	1	Unallocated		00
<b>63</b>	1	CC_BASE	Check Code for Base Id Fields Least Significant Byte of Check Sum of Data in Address 0 to 62	xx

### Extended ID Fields

<b>64-65</b>	2	Option	Indicates Which Optional Transceiver Signals are Implemented TX_DISABLE and RX_LOS are Implemented	00 12
<b>66</b>	1	BR, Max	Upper Bit Rate Margin, Units of %. A value of 00h Indicates That This Field is Not Specified	00
<b>67</b>	1	BR, Min	Lower Bit Rate Margin, Units of % a Value of 00h Indicates That This Field is Not Specified.	00
<b>68-83</b>	16	Vendor SN	Serial Number Provided by Vendor (ASCII)	xx xx xx xx xx xx xx xx xx xx xx xx xx xx xx xx
<b>84-91</b>	8	Date code	Manufacturing Date Code Year (2 Bytes), Month(2 Bytes), Day(2 Bytes) Vendor Specificlot Code, Maybe Blank (2 Bytes)	xx xx xx xx xx xx xx xx
<b>92</b>	1	Diagnostic MonitoringType	Indicates Which Type of Diagnostic Monitoring is Implemented (if any) in the Transceiver	00
<b>93</b>	1	Enhanced Options	Indicates Which Optional Enhanced Features Are Implemented (if any) in the Transceiver	00
<b>94</b>	1	SFF-8472 Compliance	Indicates which revision of SFF-8472 the transceiver complieswith. Avalue of 00h indicates Digital diagnostic functionality not included or undefined.	00
<b>95</b>	1	CC_EX	Check Code for the Extended Id Fields (Addresses 64 to 94)	xx

### Vendor Specific ID Fields

<b>96-127</b>	32	Vendor Specific	Vendor Specific EEPROM	all 00
<b>128-255</b>	128	Reserved	Reserved for SFF-8079	all 00



### VIII. Pin Definition

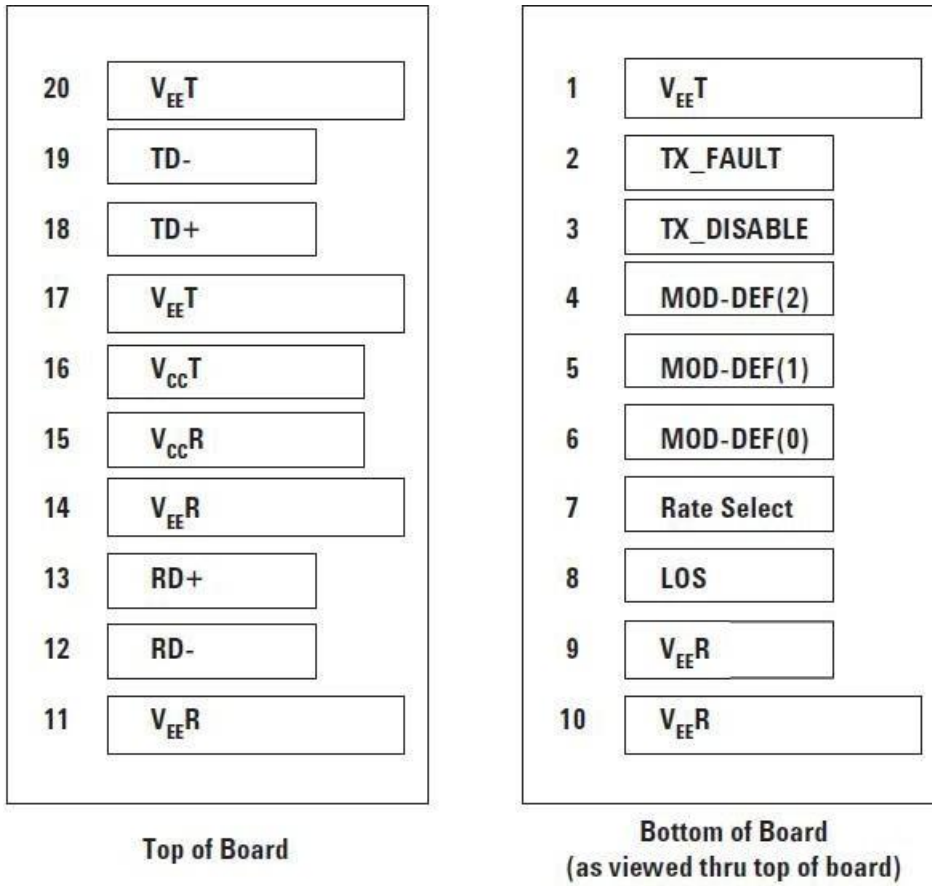


Figure 1 Diagram of Host Board Connector Block Pin Numbers and Names

Pin	Signal Name	Description	MSA Note
1	V <sub>EE</sub> T	Transmitter Ground (common with Receiver Ground)	
2	T <sub>FAULT</sub>	Transmitter Fault. Not Supported, Grounded in Module	Note 1
3	T <sub>DIS</sub>	Transmitter Disable - Module Disables on High or Open	Note 2
4	MOD_DEF (2)	Module Definition 2. Dataline for Serial ID.	Note 3
5	MOD_DEF (1)	Module Definition 1. Clockline for Serial ID.	Note 3
6	MOD_DEF (0)	Module Definition 0. Grounded in Module.	Note 3
7	Rate Select	No Connection	

Pin	Signal Name	Description	MSA Note
8	LOS	Loss of Signal-High Indicates Loss of Signal	Note 4
9	V <sub>EE</sub> R	Receiver Ground (Common with Transmitter Ground)	
10	V <sub>EE</sub> R	Receiver Ground (Common with Transmitter Ground)	
11	V <sub>EE</sub> R	Receiver Ground (Common with Transmitter Ground)	
12	RD-	Receiver Inverted DATA out. AC Coupled	Note 5
13	RD+	Receiver Non-inverted DATA out. AC Coupled	Note 5
14	V <sub>EE</sub> R	Receiver Ground (Common with Transmitter Ground)	
15	V <sub>CC</sub> R	Receiver Power Supply	Note 6
16	V <sub>CC</sub> T	Transmitter Power Supply	Note 6
17	V <sub>EE</sub> T	Transmitter Ground (Common with Receiver Ground)	
18	TD+	Transmitter Non-Inverted DATA in. AC Coupled.	Note 7
19	TD-	Transmitter Inverted DATA in. AC Coupled.	Note 7
20	V <sub>EE</sub> T	Transmitter Ground (Common with Transmitter Ground)	

### Notes

- TX Fault is not used and is always tied to ground.
- TX Disable as described in the MSA is not applicable to the module, but is used for convenience as an input to reset the internal ASIC. This pin is pulled up within the module with a 4.7 Kohm resistor.  
Low (0–0.8 V): Transceiver on  
Between (0.8 V and 2.0 V): Undefined  
High (2.0–3.465 V): Transceiver in reset disable state  
Open: Transceiver in reset disable state
- Mod-Def 0, 1, 2. These are the module definition pins. They should be pulled up with a 4.7-10 Kohm resistor on the host board to a supply less than V<sub>CC</sub>T + 0.3 V or V<sub>CC</sub>R + 0.3 V.  
Mod Def 0 is tied to ground to indicate that the module is present.  
Mod-Def 1 is clock line of two wire serial interface for optional serial ID.  
Mod-Def 2 is data line of two wire serial interface for optional serial ID.

4. This pin is open drain CMOS output signals. They should be pulled up with a 4.7-10 Kohm resistor on the host board to a supply less than  $V_{CC}T + 0.3\text{ V}$  or  $V_{CC}R + 0.3\text{ V}$ . (see Table 3. Low-Speed Signals, Electronic Characteristics)
5. RD-/+ : These are the differential receiver outputs. They are ac coupled 100 ohm differential lines which should be terminated with 100 ohm differential at the user SerDes. The ac coupling is done inside the module and is thus not required on the host board.
6.  $V_{CC}R$  and  $V_{CC}T$  are the receiver and transmitter power supplies. They are defined as  $3.3\text{ V} \pm 5\%$  at the SFP connector pin. The associated in-rush current will typically be no more than 30 mA above steady state after 500 nanoseconds.
7. TD-/+ : These are the differential transmitter inputs. They are ac coupled differential lines with 100 ohm differential termination inside the module. The ac coupling is done inside the module and is thus not required on the host board.

### IX. Typical Application Circuit

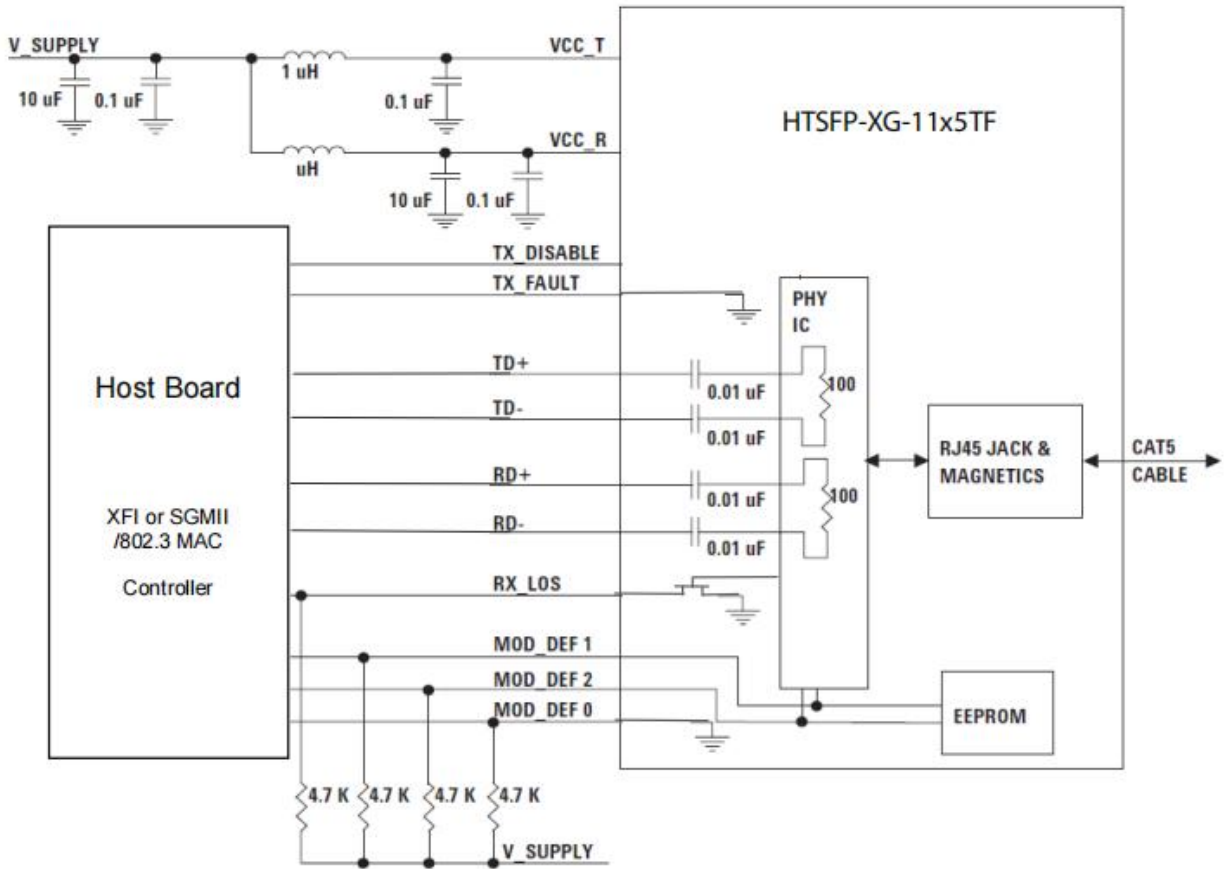


Figure 2 Recommended Interface Circuit

### X. Typical Application Circuit

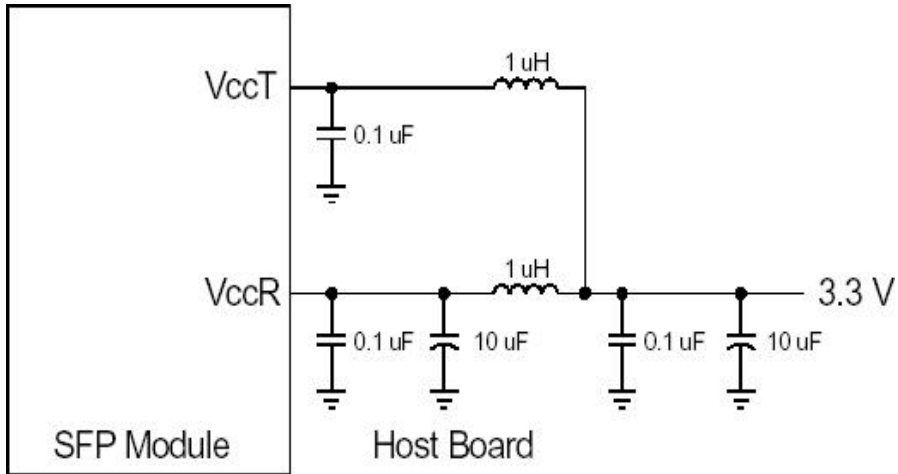


Figure 3 Recommended Host Board Power Supply Circuit

### XI. Diagram Mechanical Drawing

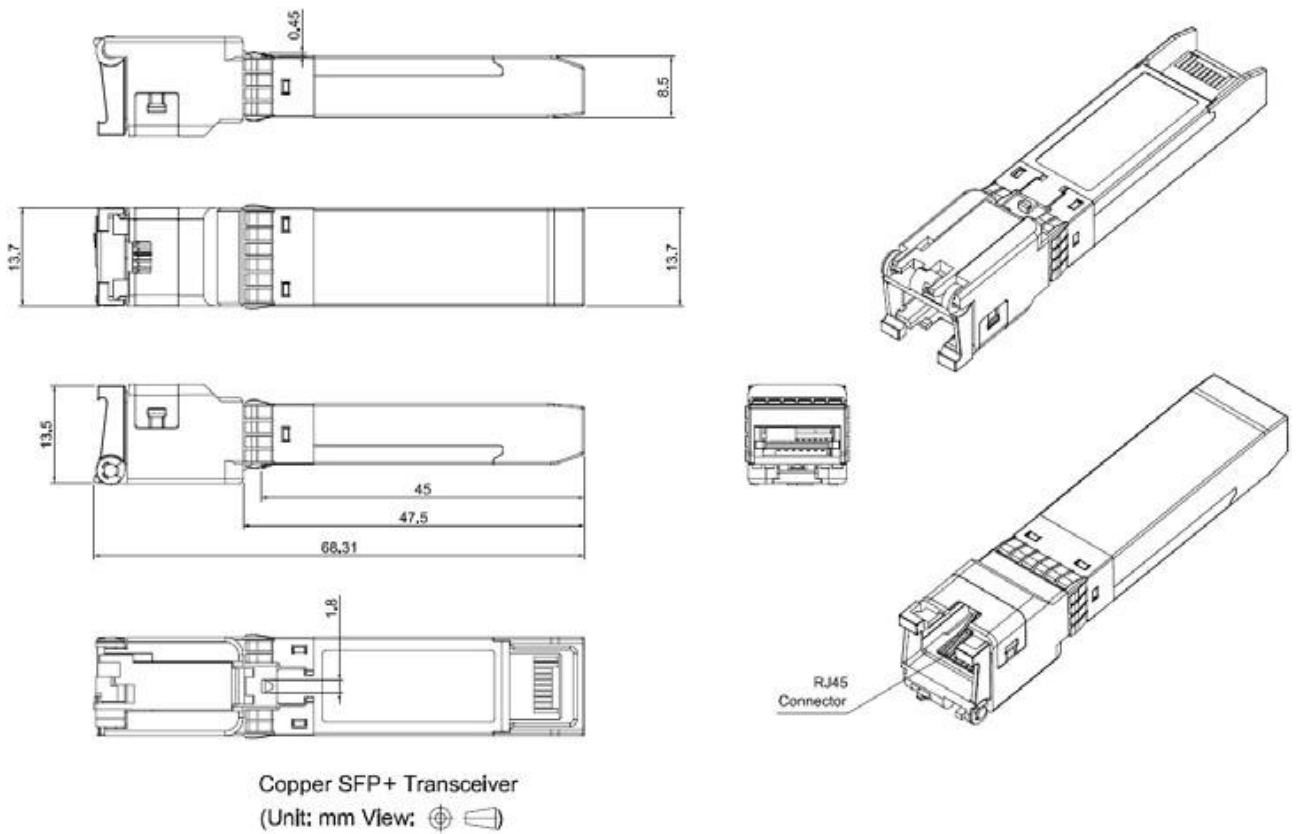


Figure 4 Mechanical Diagram of Copper SFP+

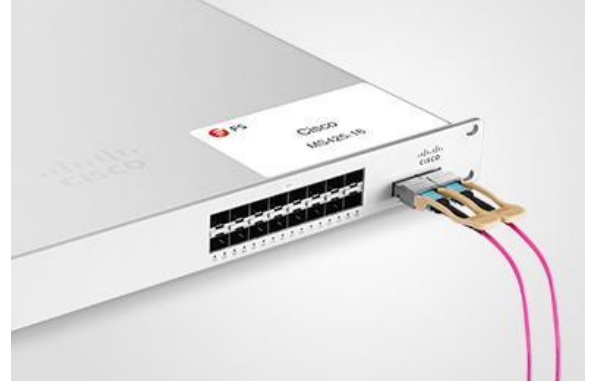
## Test Center

### I. Compatibility Testing

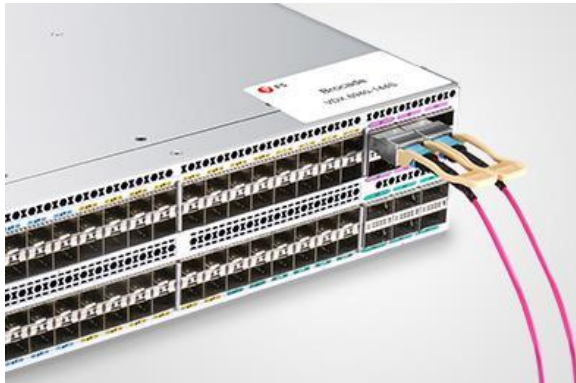
Each fiber optical transceiver has been tested in host device on site in FS Assured Program to ensure full compatibility with over 200 vendors.



Cisco Catalyst C9500-24Y4C



Cisco MS425-16



Brocade VDX 6940-144S



Dell EMC Networking Z9100-ON



Force10 S60-44T

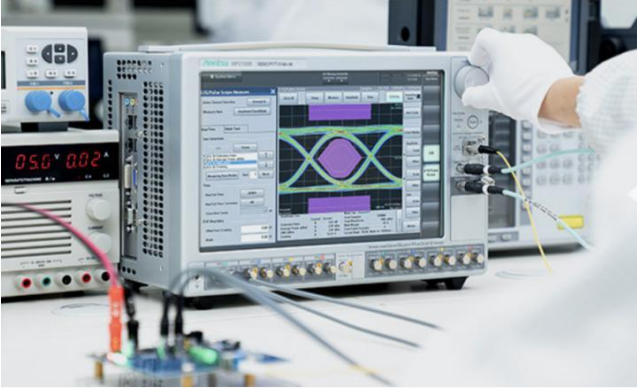


HUAWEI S6720-30L-HI-24S

Above is part of our test bed network equipment. For more information, please click the [Test Bed](#) PDF. It will be updated in real time as we expand our portfolio.

## II. Performance Testing

Each fiber optical transceiver has been fully tested in FS Assured Program equipped with world's most advanced analytical equipment to ensure that our transceivers work perfectly on your device.



### 1. TX/RX Signal Quality Testing

Equipped with the all-in-one tester integrated 4ch BERT & sampling oscilloscope, and variable optical attenuator to ensure the input and output signal quality.

- Eye Pattern Measurements: jitter, Mask Margin, etc
- Average Output Power
- OMA
- Extinction Ratio
- Receiver Sensitivity
- BER Curve

### 2. Reliability and Stability Testing

Subject the transceivers to dramatic changes in temperature on the thermal shock chamber to ensure reliability and stability of the transceivers.

- Commercial: 0 °C to 70 °C
- Extended: -5 °C to 85 °C
- Industrial: -40 °C to 85 °C



### 3. Transfer Rate and Protocol Testing

Test the actual transfer data rate and the transmission ability under different protocols with Network Master Pro.

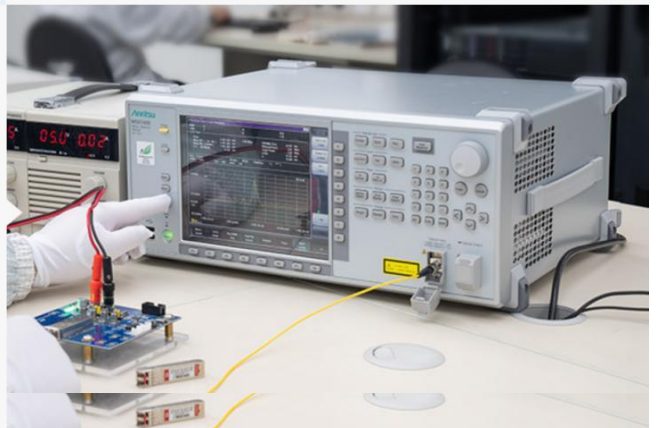
- Ethernet
- Fibre Channel
- SDH/SONET
- CPRI



### 4. Optical Spectrum Evaluation

Evaluate various important parameters with the Optical Spectrum Analyzer to meet the industry standards.

- Center Wavelength, Level
- OSNR
- SMSR
- Spectrum Width



## Order Information

Part Number	Description
SFP-10G-T	10GBASE-T SFP+ Copper RJ-45 30m Transceiver
SFP-10G-T	10GBASE-T SFP+ Copper RJ-45 80m Transceiver
SFP-10G-T100	10GBASE-T SFP+ Copper RJ-45 100m Transceiver
SFP-10GLRM-31	10GBASE-LRM SFP+ 1310nm 220m DOM Transceiver
SFP-10GSR-85	10GBASE-SR SFP+ 850nm 300m DOM Transceiver
SFP-10GSR-85	Dual-Rate 1000BASE-SX and 10GBASE-SR SFP+ 850nm 300m DOM Transceiver
SFP-10GLRM-31	10GBASE-LRM SFP+ 1310nm 2km DOM Transceiver
SFP-10GLR-31	10GBASE-LR SFP+ 1310nm 10km DOM Transceiver
SFP-10GLR-31	Dual-Rate 1000BASE-LX and 10GBASE-LR SFP+ 1310nm 10km DOM Transceiver
SFP-10GER-31	10GBASE-ER SFP+ 1310nm 40km DOM Transceiver
SFP-10GER-55	10GBASE-ER SFP+ 1550nm 40km DOM Transceiver
SFP-10GZR-55	10GBASE-ZR SFP+ 1550nm 80km DOM Transceiver
SFP-10GZRC-55	10GBASE-ZR SFP+ 1550nm 100km DOM Transceiver