400G QSFP-DD DCO DWDM Tunable Coherent 80km DOM Transceiver

QSFPDD-ZR-400G

Application

- Data Center Interconnect
- 400G Ethernet

Features

- QSFP-DD MSA
- Compliant with OIF 400ZR, Version 01.0, March 10, 2020
- Digital Diagnostic Monitoring Support
- Hot Pluggable by 76-pin Electrical Interface
- Maximum Power Consumption 16.5 W
- 400G 16QAM Modulation
- Compact Size (18.4 mm x 93.4 mm x 8.5 mm)
- LC Duplex Connector
- 400GBASE-R, 425 Gbps Bit Rate
- 400G-AUI-8 C2M; 8 x CEI-56G-VSR PAM-4 Electrical Interface
- Operating Case Temperature: 0℃ to 70℃
- Single 3.3 V Power Supply
- RoHS 2 Compliant

Description

The 400G ZR is a C-band 75G/100 GHz grid coherent optical module that combines coherent DSP ASIC functionality with best in class ultra-narrow line-width tunable lasers, high speed modulators and high responsively coherent receivers. It compliant with the OIF 400ZR MSA and QSFP-DD MSA standards, is designed for DCI applications.

Product Specifications

I. Absolute Maximum Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Power Supply Voltage	V_{CC}	-0.3	3.3	3.6	V	
Storage Temperature	T_S	-40		85	℃	
Relative Humidity	RH	15		85	%	Non-condensing
Receiver Damage Threshold	PRdmg	3			dBm	
Case Temperature	Top	0		70	℃	

Note:

Operating or handling the module out of any specified absolute maximum rating is subject to permanent damage of the module.

II. Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Supply Voltage	V_{CC}	3.2	3.3	3.4	V	
Supply Current	I_{CC}			5.2	A	Steady stateV
Power Supply Noise	Vrip			2 3	%	DC-1 MHz 1–10 MHz
Module Power Consumption	P_{CC}			16.5	W	Power Class 8

Note:

The maximum total power value is specified across the full temperature (0–70° C) and voltage range (3.2–3.4 V).

III. Optical Characteristics

Parameter	Typ.	Min.	Max.	Unit	Conditions/Comments
Transmitter					
Transmitter Frequency Range	193.7	191.3	196.1	THz	ITU-T grid. Frequency range over which the specifications hold unless noted otherwise. The frequency is fixed at 193.7 THz for unamplified link applications.
Transmitter Laser Frequency Stability		-1.8	1.8	GHz	Offset from channel frequency set point. The receiver LO has the same frequency accuracy.
Transmitter Output Power		–10	–6	dBm	Measured at optical connector.
Transmitter Output Power with TX Disabled			–20	dBm	Max Output power with TX_DIS asserted
Transmitter Output Power during Wavelength Switching			-20	dBm	
Transmitter Reflectance			-20	dB	Loss of power in the returned/reflected optical signal
Mean I-Q Amplitude Imbalance			1	dm	
Transmitter Polarization Dependent Power			1.5	dm	Power difference between X and Y polarization
Receiver					
Frequency Offset Between RX and LO		–3.6	3.6	GHz	Acquisition Range
Input Power Range		–12	0	dBm	
Input Sensitivity (Amplified Link Application)		–12		dBm	
Input Sensitivity (Unamplified Link Application)		-20		dBm	For unamplified link applications, the minimum input power is –20 dBm @receiver OSNR tolerance ≥ 34 dB.
OSNR Tolerance (Amplified Link Application)			26	dB/0.1 nm	The OSNR tolerance is referenced to an optical bandwidth of 0.1 nm @193.7 THz or 12.5 GHz.

Parameter	Typ.	Min.	Max.	Unit	Conditions/Comments
OSNR Tolerance (Unamplified Link Application)		34		dB/0.1 nm	The OSNR tolerance cannot be less than 34 dB for unamplified link applications.
Optical Return Loss		20		dB	Optical reflectance at connector input
CD Tolerance		2400		ps/nm	Tolerance to chromatic dispersion
Optical Path Power Penalty			0.5	dB	OSNR penalty tolerance due to – 35 dB interferometric crosstalk and 2400 ps/nm chromatic dispersion.
PMD Tolerance		10		ps	Tolerance to PMD with ≤ 0.5 dB penalty to OSNR sensitivity. 10 ps of PMD corresponds to max 30 ps of DGD and max 500 ps2 of SOPMD
PDL Tolerance (Amplified Link Application)		3.5		dB	Tolerance to PDL with < 1.3 dB penalty to OSNR sensitivity When change in PSP is ≤ 1 rad/ms.
PDL Tolerance (Unamplified Link Application)		2.5		dB	The PDL tolerance is 2.5 dB in unamplified link application when the reciever OSNR s
Tolerance to Change in SOP		50		krad/s	Tolerance to change in SOP with ≤ 0.5 dB penalty to OSNR sensitivity. Measurement relative to reference with 10 ps PMD and 2.5 dB PDL and SOP of < 1 rad/ms under the same conditions.
Optical Input Power Transient Tolerance		+/–2		dB	Tolerance to change in input power with ≤ 0.5 dB penalty to OSNR sensitivity. Received power is within –12 dBm to 0 dBm. Rise/fall times of power change defined by 20%–80% of 50 µs or slower.

IV. Electrical Characteristics

The transmitter and receiver comply with the CEI-56G-VSR-PAM4 electrical specifications. The data lines are AC-coupled inside the module.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Transmitter						
Signaling Rate, Each Lane			26.5625		GBd	PAM4
Differential Voltage Pk-pk	Vin, pp			880	mV	

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Common Mode Voltage	Vcm	–0.3		2.8	V	
Common Mode Noise	RMS			17.5	mV	
Differential Termination Resistance Mismatch				10	%	
Transition Time	Trise/Tfall	12			ps	20%–80%
Eye Width at 10^{-6} Probability	EW6	0.2			UI	
Eye Height at 10^{-6} Probability	EH6	32			mV	
Eye linearity		0.85				
		Receiver				
Signaling Rate, Each Lane			26.5625		GBd	PAM4
Differential Voltage Pk-pk	Vout, pp			900	mV	
Transition Time	Trise/Tfall	9.5			ps	20%–80%
Near-end Eye Width at 10_{-6} Probability	EW6	0.265			UI	
Near-end Eye Height at 10^{-6} Probability	EH6	70			mV	
Far-end Eye Width at 10^{-6} Probability	EW6	0.2			UI	
Far-end Eye Width at 10^{-6} Probability	EH6	30			mV	
Near-end Eye Linearity		0.85				

Note:

400GAUI-8 electrical characteristics refer to CEI-56G-VSR-PAM4 of OIF-CEI-04.0

V. Pin Description

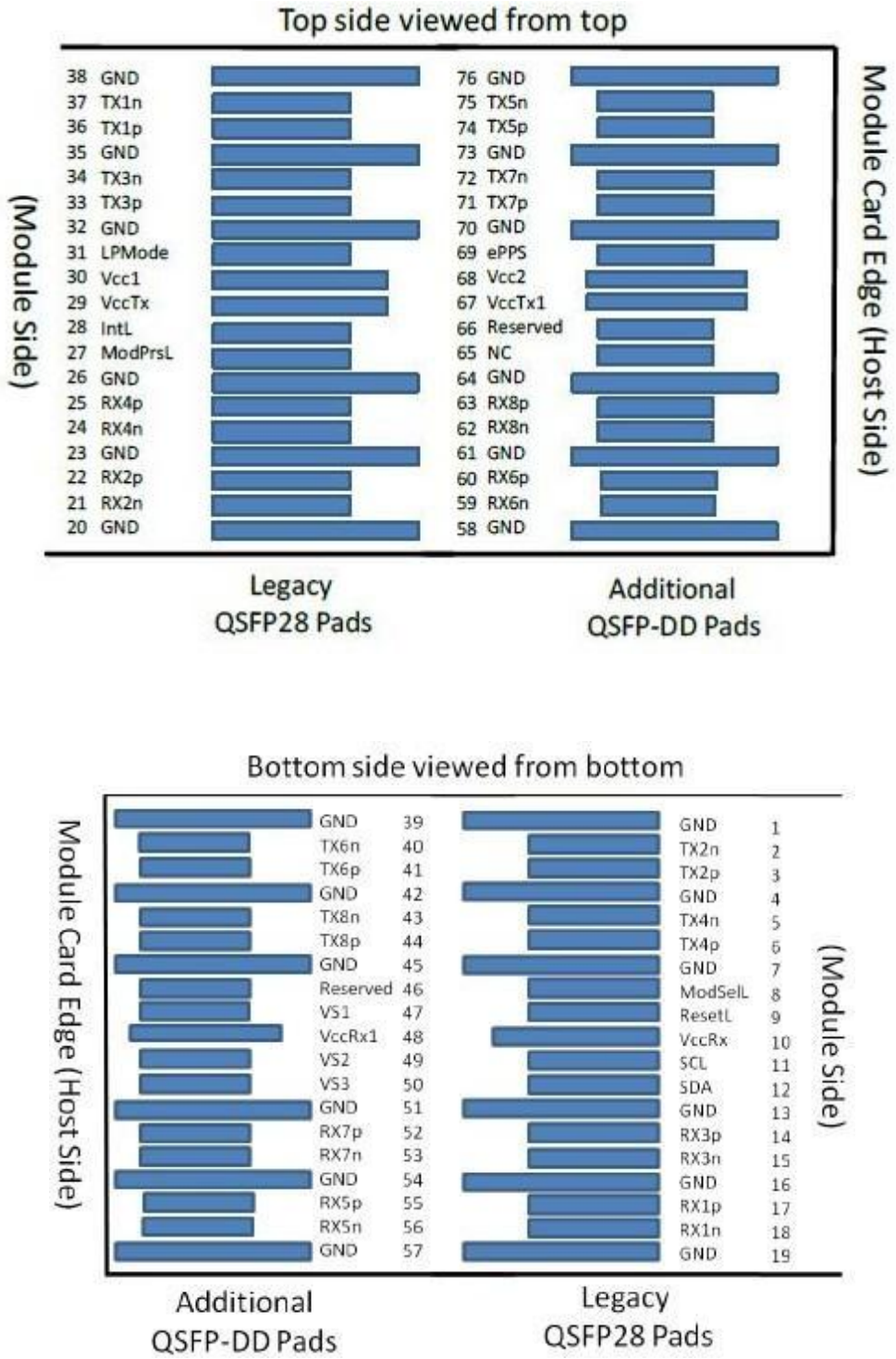


Figure1. Module pad layout

Pin	Logic	Symbol	Description	Notes
1		GND	Ground	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	
3	CML-I	Tx2p	Transmitter Non-Inverted Data Input	
4		GND	Ground	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	
6	CML-I	Tx4p	Transmitter Non-Inverted Data Input	
7		GND	Ground	1
8	LVTTL-I	ModSelL	Module Select	
9	LVTTL-I	ResetL	Module Reset	
10		V_{CC}Rx	+3.3 V Power Supply Receiver	2
11	LVCMOS-I/O	SCL	2-wire serial interface clock	
12	LVCMOS-I/O	SDA	2-wire serial interface data	
13		GND	Ground	1
14	CML-O	Rx3p	Receiver Non-Inverted Data Output	
15	CML-O	Rx3n	Receiver Inverted Data Output	
16		GND	Ground	1

Pin	Logic	Symbol	Description	Notes
17	CML-O	Rx1p	Receiver Non-Inverted Data Output	
18	CML-O	Rx1n	Receiver Inverted Data Output	
19		GND	Ground	1
20		GND	Ground	1
21	CML-O	Rx2n	Receiver Inverted Data Output	
22	CML-O	Rx2p	Receiver Non-Inverted Data Output	
23		GND	Ground	1
24	CML-O	Rx4n	Receiver Inverted Data Output	
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	
26		GND	Ground	1
27	LVTTL-O	ModPrsL	Module Present	
28	LVTTL-O	IntL	Interrupt	
29		V_{CC}Tx	+3.3 V Power supply transmitter	2
30		V_{CC}1	+3.3 V Power supply	2
31	LVTTL-I	InitMode	Initialization mode; In legacy QSFP applications, the InitMode pad is called LPMODE	
32		GND	Ground	1

Pin	Logic	Symbol	Description	Notes
33	CML-I	Tx3p	Transmitter Non-Inverted Data Output	
34	CML-I	Tx3n	Transmitter Inverted Data Output	
35		GND	Ground	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Output	
37	CML-I	Tx1n	Transmitter Inverted Data Output	
38		GND	Ground	1
39		GND	Ground	1
40	CML-I	Tx6n	Transmitter Inverted Data Output	
41	CML-I	Tx6p	Transmitter Non-Inverted Data Output	
42		GND	Ground	1
43	CML-I	Tx8n	Transmitter Inverted Data Output	
44	CML-I	Tx8p	Transmitter Non-Inverted Data Output	
45		GND	Ground	1
46		Reserved	For future use	3
47		VS1	Module Vendor Specific 1	3
48		V_{CC}Rx1	3.3 V Power Supply	2

Pin	Logic	Symbol	Description	Notes
49		VS2	Module Vendor Specific 2	3
50		VS3	Module Vendor Specific 3	3
51		GND	Ground	1
52	CML-O	Rx7p	Receiver Non-Inverted Data Output	
53	CML-O	Rx7n	Receiver Inverted Data Output	
54		GND	Ground	1
55	CML-O	Rx5p	Receiver Non-Inverted Data Output	
56	CML-O	Rx5n	Receiver Inverted Data Output	
57		GND	Ground	1
58		GND	Ground	1
59	CML-O	Rx6n	Receiver Inverted Data Output	
60	CML-O	Rx6p	Receiver Non-Inverted Data Output	
61		GND	Ground	1
62	CML-O	Rx8n	Receiver Inverted Data Output	
63	CML-O	Rx8p	Receiver Non-Inverted Data Output	
64		GND	Ground	1

Pin	Logic	Symbol	Description	Notes
65		NC	No Connect	3
66		Reserved	For future use	3
67		V_{CC}Tx1	3.3 V Power Supply	2
68		V_{CC}2	3.3 V Power Supply	2
69		ePPS	Precision Time Protocol (PTP) reference clock input. It is not used	3
70		GND	Ground	1
71	CML-I	Tx7p	Transmitter Non-Inverted Data Input	
72	CML-I	Tx7n	Transmitter Inverted Data Input	
73		GND	Ground	1
74	CML-I	Tx5p	Transmitter Non-Inverted Data Input	
75	CML-I	Tx5n	Transmitter Inverted Data Input	
76		GND	Ground	1

Note:

1. QSFP-DD uses common ground (GND) for all signals and power supplies. All are common within the QSFP-DD module and all module voltages are referenced to this potential unless otherwise noted. Connect common ground directly to the host board signal-common ground plane.

2. VccRx, VccRx1, Vcc1, Vcc2, VccTx and VccTx1 shall be applied concurrently. Requirements defined for the host side of the host card edge connector are listed in Table 4-2. VccRx, VccRx1, Vcc1, Vcc2, VccTx and VccTx1 may be internally connected within the module in any combination. The connector Vcc pins are each rated for a maximum current of 1000 mA.

3. All Vendor Specific, Reserved and No Connect pins may be terminated with 50 ohms to ground on the host. Pad 65 (No Connect) shall be left unconnected within the module. Vendor Specific and Reserved pads shall have an impedance to GND that is greater than 10,000 ohms and less than 100 pF.

VI. Principle Diagram

The typical application circuits for 400G ZR optical module interfaces, special I/O pins, and the power supply decoupling are shown as below.

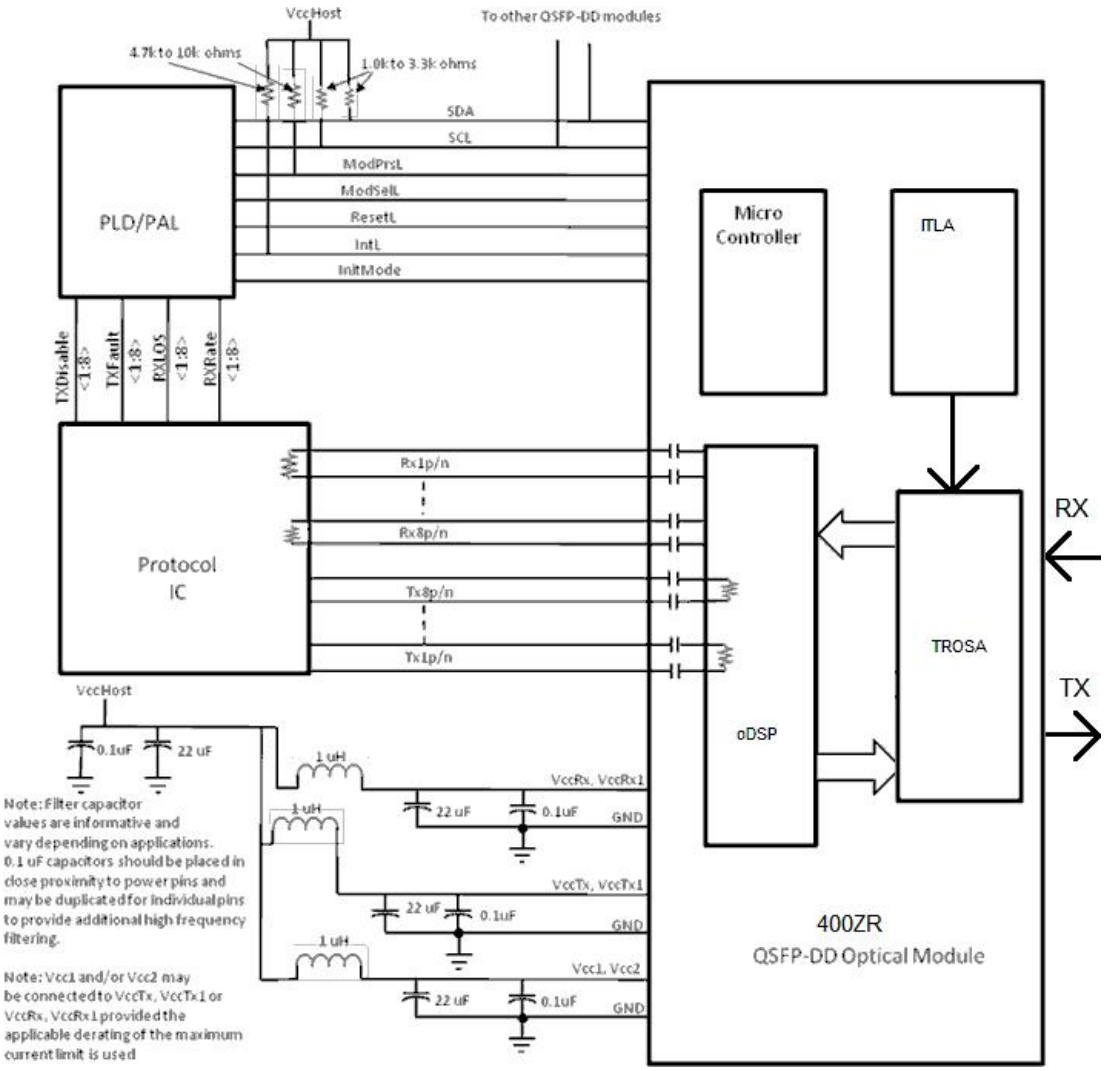


Figure 2. Example QSFP-DD host board schematic for 400ZR optical modules

VII. Mechanical Dimensions

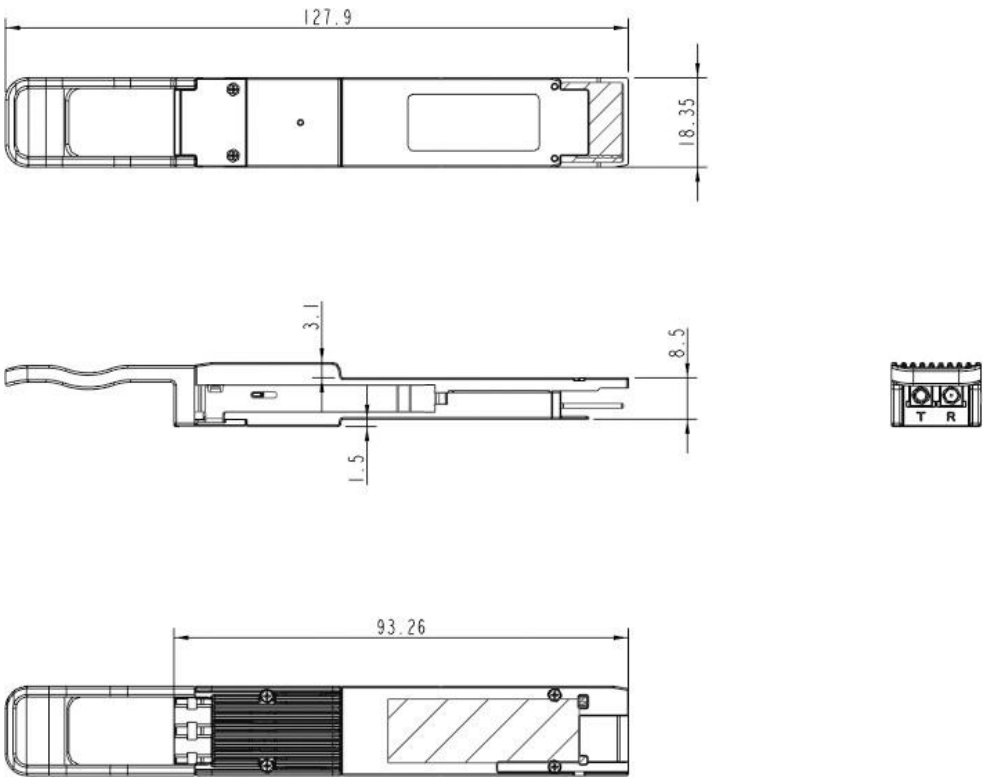


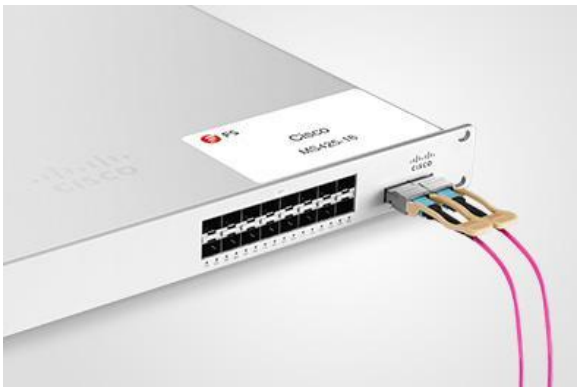
Figure 3. Mechanical dimensions

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

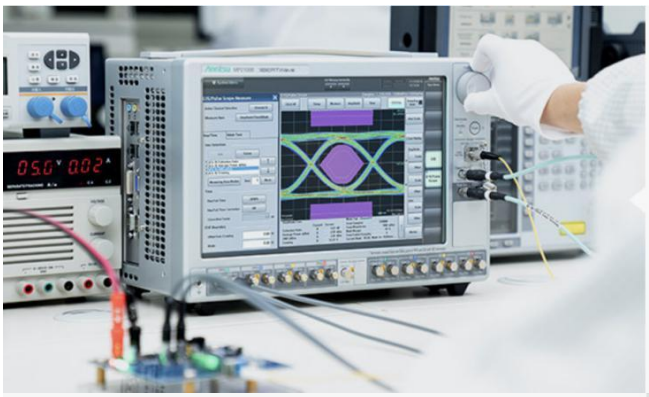
Force⑩tm S60-44T

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

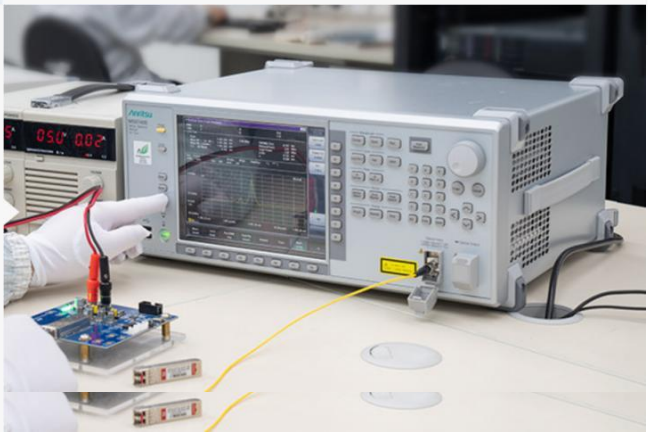
Test the actual transfer data rate and the transmission ability under different protocols with Network Master Pro.

- 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
QSFPDD-SR8-400G	400G QSFP-DD 850nm 100m DOM Transceiver
OSFP-SR8-400G	400G OSFP 850nm 100m DOM Transceiver
Q112-SR4-400G	400G QSFP112 850nm 100m DOM Transceiver
QSFPDD-DR4-400G	400G QSFP-DD 1310nm 500m DOM Transceiver
OSFP-DR4-400G-Si	400G OSFP 1310nm 500m DOM Transceiver
Q112-DR4-400G	400G QSFP112 1310nm 500m DOM Transceiver
QDD-DR4-400G-Si	400G QSFP-DD 1310nm 500m DOM Transceiver
QSFPDD-FR4-400G	400G QSFP-DD 1310nm 2km DOM Transceiver
QSFPDD-XDR4-400G	400G QSFP-DD 1310nm 2km DOM Transceiver
Q112-XDR4-400G	400G QSFP112 1310nm 2km DOM Transceiver
Q112-FR4-400G	400G QSFP112 1310nm 2km DOM Transceiver
QSFPDD-PLR4-400G	400G QSFPDD 1310nm 10km DOM Transceiver
QSFPDD-LR4-400G	400G QSFP-DD 1310nm 10km DOM Transceiver
QSFPDD-LR8-400G	400G QSFP-DD 1310nm 10km DOM Transceiver
Q112-LR4-400G	400G QSFP112 1310nm 10km DOM Transceiver

Part Number	Description
OSFP-LR8-400G	400G OSFP 1310nm 10km DOM Transceiver
QSFPDD-ER8-400G	400G QSFP-DD 1310nm 40km DOM Transceiver
QSFPDD-ZR-400G	400G QSFP-DD DCO DWDM Tunable Coherent 80km DOM Transceiver