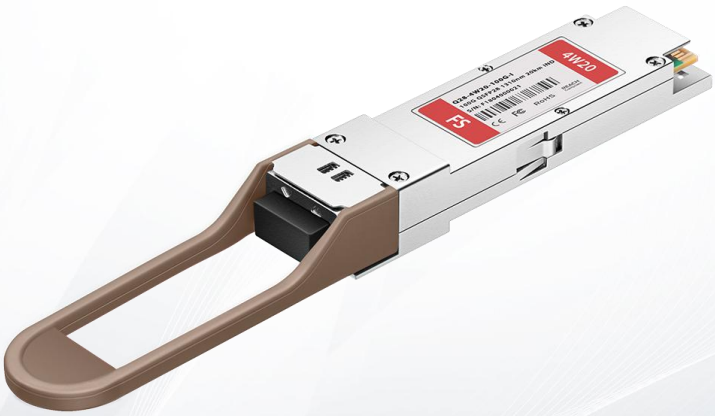
100GBase-4WDM-20 QSFP28 1310nm 20km DOM Transceiver

Q28-4W20-100G-I



Application

- Ethernet

Standards

- Compliant with QSFP28 Standard
  -SFF-8665 Revision 1.9
  -SFF-8636 Revision 2.10a
- Compliant with 4WDM-20

Features

- Maximum Power Consumption 4.5w
- Operating Case Temperature Range: -40 ~ 85℃
- Single 3.3V Supply Voltage
- LAN WDM EML laser and PIN Receiver Array
- QSFP28 MSA Package with Duplex LC Connector
- Two Wire Serial Interface with Digital Diagnostic Monitoring
- High Speed I/O Electrical Interface (CAUI-4)
- Class 1 Laser

Description

The 100G QSFP28 Optical Transceiver Module is designed for use in 100Gb/s Ethernet systems throughput up to 20km over single mode fiber (SMF) with duplex LC connectors. This transceiver is compliant with SFF-8636, SFF-8665 and 4WDM-20 standard. Digital diagnostics functions allow access to real-time operating parameters.

With these features, this easy to install, hot swappable transceiver is suitable to be used in various applications, such as data centers, high-performance computing networks, enterprise core and distribution layer applications.

Product Specifications

I. Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit
Storage Temperature	T_S	-40	85	℃
Supply Voltage	V_{CC}	-0.3	3.6	V
Relative Humidity (Non-condensing)	RH	5	95	%
Data Input Voltage–Differential	$\|V_{DIP}-V_{DIN}\|$		1.0	V
Control Input Voltage	V_I	-0.3	V_{CC}+0.5	V
Control Output Current	I_O	-20	20	mA

II. Recommended Operating Conditions

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Operating Case Temperature	T_{OPR}	40		85	ºC	
Power Supply Voltage	V_{CC}	3.135	3.3	3.465	V	
Instantaneous Peak Current at Hot Plug	I_{CC_IP}			1800	mA	

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Sustained Peak Current at Hot Plug	I_{CC_SP}			1485	mA	
Maximum Power Dissipation	P_D			4.5	W	
Maximum Power Dissipation, Low Power Mode	P_{DLP}			1.5	W	
Aggregate Bit Rate	ABR		103.125		Gb/s	
Data Rate per Lane	DRL		25.78		Gb/s	
Control Input Voltage High	V_{IH}	V_{CC}*0.7		V_{CC}+0.3	V	
Control Input Voltage Low	V_{IL}	-0.3		V_{CC}*0.3	V	
Two Wire Serial Interface Clock Rate				400	kHz	
Power Supply Noise				66	mVpp	
Rx Differential Data Output Load			100		ohms	
Operating Distance		2		2000	m	Note

Note: With FCC

III. Optical Characteristics

Parameter	Symbol	Min.	Typical	Max.	Units	Notes
Transmitter						
Wavelength L0	λ_{C0}	1294.53	1295.56	1296.59	nm	
Wavelength L1	λ_{C1}	1299.02	1300.05	1301.09	nm	
Wavelength L2	λ_{C2}	1303.54	1304.58	1305.63	nm	
Wavelength L3	λ_{C3}	1308.09	1309.14	1310.19	nm	

Parameter	Symbol	Min.	Typical	Max.	Units	Notes
Side-mode Suppression Ratio	SMSR	30				
Total Average Optical Launch Power	P_{OUT}			10.5	dBm	
Average Launch Power Tx_Off (each Lane)	P_{OUT_OFF}			-30	dBm	
Average Optical Launch Power (each Lane)	P_{OUTL}	-4.3		4.5	dBm	
Extinction Ratio	ER	4			dB	
Optical Modulation Amplitude (each Lane)	OMA	-1.3		4.5	dBm	
Launch Power in OMA Minus TDP (each Lane)	OMA-TDP	-2.3			dBm	
Difference in Launch Power Between Any Two Lanes (OMA)	DT_OMA			5	dB	
Transmitter and Dispersion Penalty (each Lane)	TDP			2.8	dB	
Optical Return Loss Tolerance	ORLT			20	dB	
Transmitter Eye Mask Definition		{0.25,0.4,0.45,0.25,0.28,0.4}				
RIN20OMA	RIN			-130	dB/Hz	
Transmitter Reflectance				-26	dB	
Receiver						
Wavelength L0	λ_{C0}	1294.53	1295.56	1296.59	nm	
Wavelength L1	λ_{C1}	1299.02	1300.05	1301.09	nm	
Wavelength L2	λ_{C2}	1303.54	1304.58	1305.63	nm	
Wavelength L3	λ_{C3}	1308.09	1309.14	1310.19	nm	
Receiver Sensitivity (OMA) per Lane				-12.5	dBm	Note

Parameter	Symbol	Min.	Typical	Max.	Units	Notes
Stressed Receiver Sensitivity in OMA (each Lane)				-10	dBm	
Stressed Receiver Sensitivity Test Conditions						
Stressed Eye J2 Jitter (each Lane)			0.33		UI	
Stressed Eye J4 Jitter (each Lane)			0.48		UI	
Vertical Eye Closure Penalty			2.5		dB	
SRS Eye Mask Definition { X1, X2, X3, Y1, Y2, Y3}		{0.39, 0.5, 0.5, 0.39, 0.39, 0.4}				
Damage Threshold for Receiver	$P_{IN, Damage}$	5.5			dBm	
Average Receive Power (each Lane)		-14.5		4.5	dBm	
Receive Power in OMA (each Lane), Overload	OMA			4.5	dBm	
Difference in Receive Power Between Any Two Lanes (OMA)	DR_OMA			5.5	dB	
Receiver 3dB Electrical Upper Cut-off Frequency (each lane)	F_C			31	GHz	
Receiver Reflectance	RX_R			-26	dB	

Note:

1. Measured with a PRBS231-1 test pattern @25.78125Gbps, BER≦5E-5..

IV. Electrical Characteristics

High-Speed Signal: Compliant to CAUI-4 (IEEE 802.3bm).

Low-Speed Signal: Compliant to SFF-8679

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Transmitter						
Differential Data Input Amplitude	$V_{IN, P-P}$	95		900	mVpp	Note
Differential Termination Mismatch				10	%	
LPMode, Reset and ModSelL	V_{IL}	-0.3		0.8	V	
	V_{IH}	2		V_{CC}+0.3	V	
Receiver						
Differential Data Output Amplitude	$V_{OUT, P-P}$			900	mVpp	Note
Differential Termination Mismatch				10	%	
Output Rise/Fall Time, 20%~80%	TR	12			ps	
ModPrsL and IntL	V_{OL}	0		0.4	V	I_{OL} = 4mA
	V_{OH}	V_{CC}-0.5		V_{CC}+0.3	V	I_{OL} = -4mA

Note:

1. Amplitude customization beyond these specs is dependent on validation in customer system.

V. Timing for QSFP+ Soft Control and Status Functions

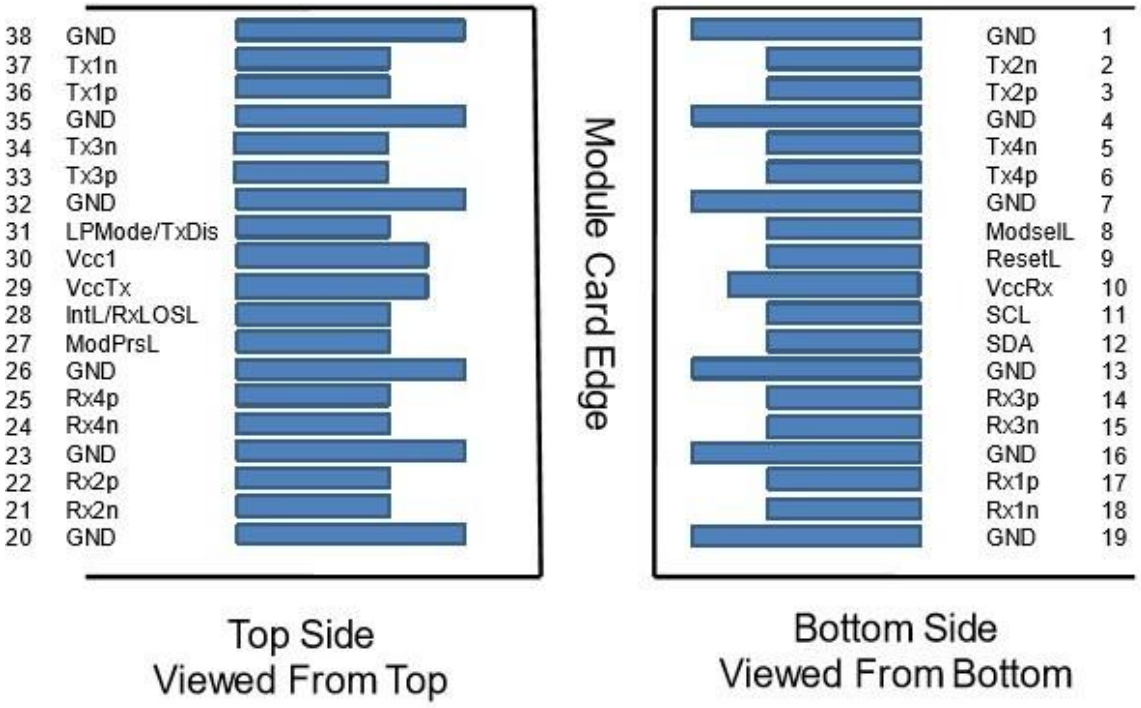
Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Initialization Time	t_init			5	s	
Reset Init Assert Time	t_reset_init	10			μs	
Serial Bus Hardware Ready Time	t_serial			2000	ms	
Monitor Data Ready Time	t_data			2000	ms	
Reset Assert Time	t_reset			2	s	
LPMode/TxDis mode change time	t_LPMode/TxDis			100	ms	
LPMode Assert Time	ton_LPMode			100	ms	
LPMode De-assert Time	toff_LPMode			300	ms	
IntL/RxLOSL mode change time	t_IntL/RxLOSL			100	ms	
IntL Assert Time	ton_IntL			200	ms	
IntL Deassert Time	toff_IntL			500	μs	
RxLOSL Assert Time (Optional Fast Mode)	ton_f_LOS			1	ms	
RxLOSL Deassert Time (Optional Fast Mode)	toff_f_LOS			3	ms	
Rx LOS Assert Time	ton_lol			100	ms	
Tx Fault Assert Time	ton_Txfault			200	ms	
Flag Assert Time	ton_flag			200	ms	
Mask Assert Time	ton_mask			100	ms	
Mask Deassert Time	toff_mask			100	ms	

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Application or Rate Select Change Time	t_ratesel					
Power_over-ride or Power-set Assert Time	ton_Pdown			100	ms	
Power_over-ride or Power-set De-assert Time	toff_Pdown			300	ms	

VI. I/O Timing for Squelch & Disable

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Rx Squelch Assert Time	ton_Rxsq			15		
Rx Squelch Deassert Time	toff_Rxsq			15	ms	
Tx Squelch Assert Time	ton_Txsq			400	ms	
Tx Squelch Deassert Time	toff_Txsq			400	ms	
Tx Disable Assert Time	ton_txdis			100	ms	
Tx Disable Deassert Time	toff_txdis			400	ms	
Tx Disable Assert Time (Optional Fast Mode)	Ton_f_TxDis			3	ms	
Tx Disable Deassert Time (Optional Fast Mode)	Toff_f_TxDis			10	ms	
Rx Output Disable Assert Time	ton_rxdis			100	ms	
Rx Output Disable Deassert Time	toff_rxdis			100	ms	
Squelch Disable Assert Time	ton_sqdis			100	ms	
Squelch Disable Deassert Time	toff_sqdis			100	ms	

VII. Pin Definitions



Pin	Logic	Symbol	Description	Plug Sequence	Notes
1		GND	Ground	1	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	3	
3	CML-I	Tx2p	Transmitter Non-Inverted Data Input	3	
4		GND	Ground	1	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	3	
6	CML-I	Tx4p	Transmitter Non-Inverted Data Input	3	
7		GND	Ground	1	1
8	LVTTL-I	ModselL	Module Select	3	
9	LVTTL-I	ResetL	Module Reset	3	

Pin	Logic	Symbol	Description	Plug Sequence	Notes
10		V_{CC}Rx	3.3V Power Supply Receiver	2	2
11	LVCMOS-I/O	SCL	2-Wire Serial Interface Clock	3	
12	LVCMOS-I/O	SDA	2-Wire Serial Interface Data	3	
13		GND	Ground	1	1
14	CML-O	Rx3p	Receiver Non-Inverted Data Output	3	
15	CML-O	Rx3n	Receiver Inverted Data Output	3	
16		GND	Ground	1	1
17	CML-O	Rx1p	Receiver Non-Inverted Data Output	3	
18	CML-O	Rx1n	Receiver Inverted Data Output	3	
19		GND	Ground	1	1
20		GND	Ground	1	1
21	CML-O	Rx2n	Receiver Inverted Data Output	3	
22	CML-O	Rx2p	Receiver Non-Inverted Data Output	3	
23		GND	Ground	1	1
24	CML-O	Rx4n	Receiver Inverted Data Output	3	
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	3	
26		GND	Ground	1	1
27	LVTTL-O	ModPrsL	Module Present	3	

Pin	Logic	Symbol	Name/Description	Plug Sequence	Notes
28	LVTTL-O	IntL/RxLOSL	Interrupt. Optionally Configurable as RxLOSL via the Management Interface (SFF-8636). Interrupt. Optionally Configurable as RxLOSL via the Management Interface (SFF-8636).	3	
29		V_{CC}Tx	3.3V Power Supply Transmitter	2	2
30		V_{CC}1	3.3V Power Supply	2	2
31	LVTTL-I	LPMode/TxDis	Low Power Mode. Optionally Configurable as TxDis via the Management Interface (SFF-8636).	3	
32		GND	Ground	1	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	3	
34	CML-I	Tx3n	Transmitter Inverted Data Input	3	
35		GND	Ground	1	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	3	
37	CML-I	Tx1n	Transmitter Inverted Data Input	3	
38		GND	Ground	1	1

Notes:

1. GND is the symbol for signal and supply (power) common for the module. All are common within the module and all module voltages are referenced to this potential unless otherwise noted. Connect these directly to the host board signal-common ground plane.

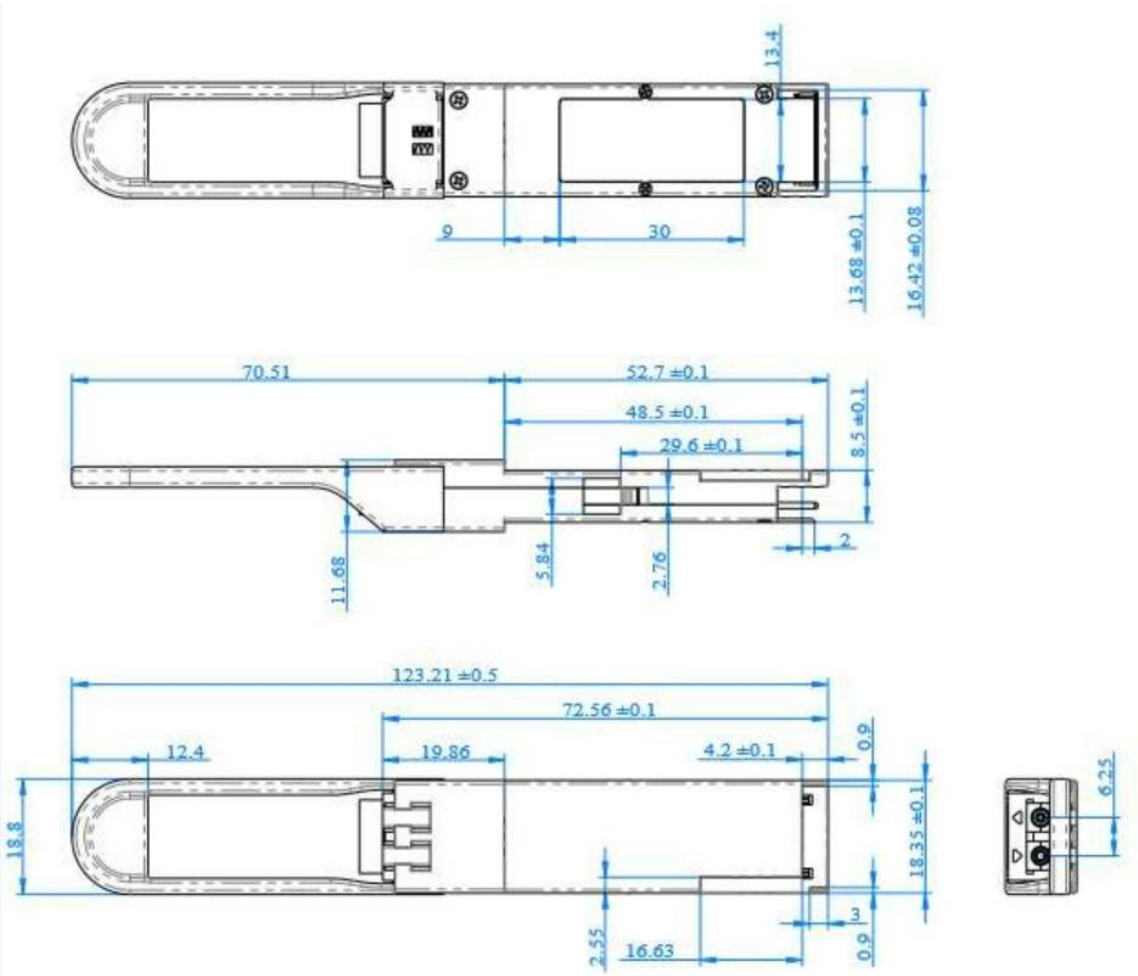
2. V_{CC}Rx, V_{CC}1 and V_{CC}Tx are the are applied concurrently and may be internally connected within the module in any combination. V_{CC} contacts in SFF-8662 and SFF-8672 each have a steady state current rating of 1A.

VIII. Digital Diagnostic Functions

Parameter	Range	Accuracy	Unit	Calibration
Temperature	-40~85	±3	ºC	Internal
Voltage	0~V_{CC}	3%	V	Internal
Tx Bias Current (each Lane)	0~120	10%	mA	Internal
Tx Output Power (each Lane)	-4.3~4.5	±3	dB	Internal
Rx Power (each Lane)	-14.5~4.5	±3	dB	Internal

IX. Mechanical Specifications

Unit: mm

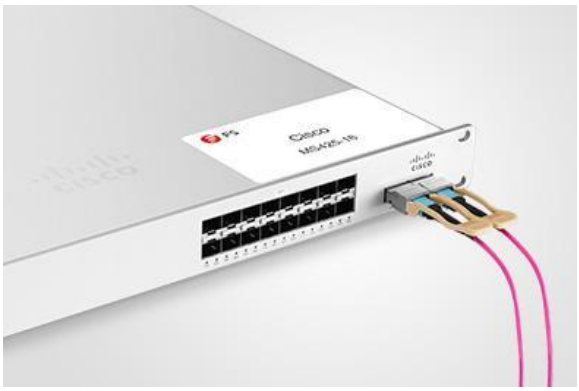


Test Center

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

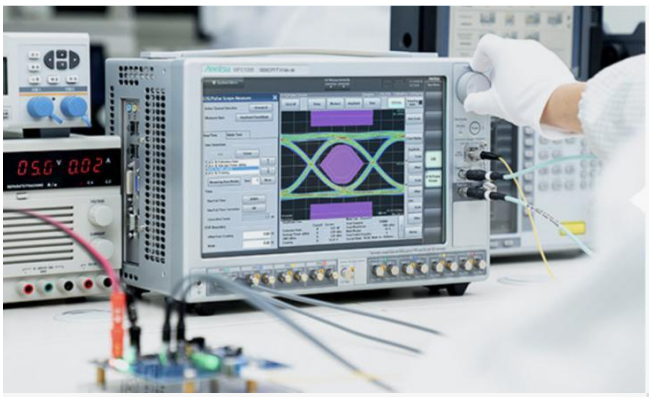
Force⑩tm S60-44T

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

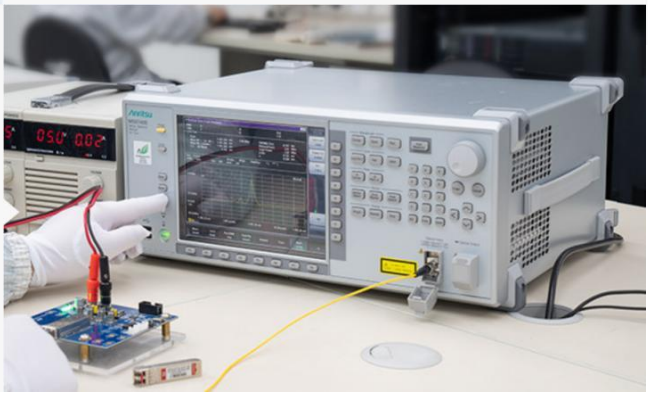
Test the actual transfer data rate and the transmission ability under different protocols with Network Master Pro.

- 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
QSFP28-SR4-100G	QSFP28 100GBASE-SR4 850nm 100m Transceiver
QSFP28-BIDI-100G	QSFP28 100GBASE-SR Bi-Directional 850nm 100m Transceiver
QSFP28-ESR4-100G	QSFP28 100GBASE-ESR4 850nm 300m Transceiver
QSFP28-PIR4-100G	QSFP28 100GBASE-PSM4 1310nm 500m Transceiver
QSFP28-IR4-100G	QSFP28 100GBASE-CWDM4 1310nm 2km Transceiver
QSFP28-PSM4-100G	QSFP28 100GBASE-PSM4 1310nm 2km Transceiver
QSFP28-LR4-100G	QSFP28 100GBASE-LR4 1310nm 10km Transceiver
QSFP28-EIR4-100G	QSFP28 100GBASE-eCWDM4 1310nm 10km Transceiver
QSFP28-ER4-100G	QSFP28 100GBASE-ER4 1310nm 40km Transceiver
QSFP28-ZR4-100G	QSFP28 100GBASE-ZR4 1310nm 80km Transceiver
Q28-100/112G-10	QSFP28 100GBASE-LR4 and 112GBASE-OTU4 Dual Rate 1310nm 10km Transceiver
Q28-100/112G-20	QSFP28 100GBASE-LR4 and 112GBASE-OTU4 Dual Rate 1310nm 20km Transceiver
Q28-100/112G-40	QSFP28 100GBASE-ER4 and 112GBASE-OTU4 Dual Rate 1310nm 40km Transceiver
Q28-ER4L-100G-X	QSFP28 100GBASE-ER4L1310nm 40km Extended
QSFP28-ISR4-100G	QSFP28 100GBASE-SR4 850nm 100m Transceiver(Industrial)
QSFP28-ILR4-100G	QSFP28 100GBASE-LR4 1310nm 10km Transceiver(Industrial)
QSFP28-DR-100G	QSFP28 100GBASE-DR 1310nm 500m Transceiver
QSFP28-FR-100G	QSFP28 100GBASE-FR 1310nm 2km Transceiver
QSFP28-LR-100G	QSFP28 100GBASE-LR 1310nm 10km Transceiver

Order Information

Part Number	Description
QSFP28-LR4-100GE	QSFP28 100GBASE-LR4 1310nm 10km Duplex LC Transceiver for InfiniBand EDR
QSFP28-SR4-100GE	QSFP28 100GBASE-SR4 850nm 100m Duplex LC Transceiver for InfiniBand EDR
QSFP28-IR4-100GE	QSFP28 100GBASE-CWDM4 1310nm 2km Duplex LC Transceiver for InfiniBand EDR
Q28-4W20-100G-I	QSFP28 100GBase-4WDM-20 1310nm 20km Transceiver

https://www.fs.com