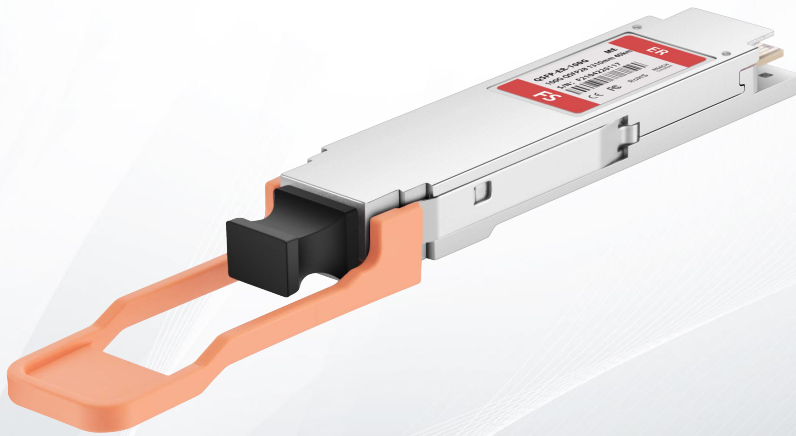


100GBASE-ER QSFP28 Single Lambda 1310nm 40km Duplex LC Transceiver

QSFP-ER-100G



Application

- 100GBASE Ethernet
- Data Center

Features

- Compliant with QSFP28 Standard: SFF-8636 Rev 2.10a
- Compliant with SFF-8679 V1.8
- Compliant with 100G Lambda MSA 100G-ER1-40
- High Speed I/O Electrical Interface (CAUI-4)
- Single 3.3V Supply Voltage
- 0-70 °C Case Operating Temperature
- Hermetically Sealed TO Based Design
- QSFP28 MSA Package with Duplex LC Connector
- Two Wire Serial Interface with Digital Diagnostic Monitoring
- Supporting 40km Reach of Single Mode Fiber
- Complies with EU Directive 2011/65/EU (RoHS Compliant)
- Class 1 Laser

Description

The 100GBASE-ER Single Lambda QSFP28 Optical Transceiver Module is designed for use in 100GBASE Ethernet throughput up to 40km over single mode fiber (SMF) using a wavelength of 1310nm via duplex LC connectors. The transceiver includes a Broadcom chip to convert the 4x25G NRZ electrical signals to a 1x100G PAM4 optical signal. Digital diagnostics functions are also available via the I2C interface, as specified by the QSFP28 MSA, to 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 Center, 100G Ethernet.

Product Specifications

I. Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit	Notes
Storage Temperature	T_S	-40	85	°C	
Supply Voltage	V_{CC}	-0.3	4.0	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}	0	-	70	°C	
Power Supply Voltage	V_{CC}	3.135	3.3	3.465	V	
Instantaneous Peak Current at Hot Plug	I_{CC_IP}	-	-	TBD	mA	
Sustained Peak Current at Hot Plug	I_{CC_SP}	-	-	TBD	mA	
Maximum Power Dissipation	P_D	-	-	5.5	W	
Maximum Power Dissipation, Low Power Mode	P_{DLP}	-	-	1.5	W	

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Signalling Rate	SR	-	53.125	-	GBd	
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	10Hz-10MHz
Rx Differential Data Output Load	-	-	100	-	ohms	
Operating Distance	-	2	-	30000	m	

Functional Characteristics (Optical)

The following tables list the performance specifications for the various functional blocks of the integrated optical transceiver module.

III. Transmitter Optical Specifications

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Wavelength	λ_c	1308.09	-	1310.19	nm	
Side Mode Suppression Ratio	SMSR	30	-	-	dB	
Average Optical Launch Power	P_{OUT}	1.7	-	7.1	dBm	1
Average Launch Power of OFF Transmitter	P_{OUT_OFF}	-	-	-15	dBm	
Extinction Ratio	ER	5	-	-	dB	
Outer Optical Modulation Amplitude (OMA_{outer})	OMA_{outer}	-	-	6.4	dBm	
Outer Optical Modulation Amplitude (OMA_{outer}) for TDECQ < 1.4 dB for 1.4 dB ≤ TDECQ ≤ 3.4 dB	OMA_{outer}	3.0 1.6+ TDECQ	-	-	dBm	

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Transmitter and Dispersion Eye Closure	TDECQ	-	-	3.9	dB	
Transmitter Eye Closure for PAM4 (TECQ)	TECQ	-	-	3.9	dB	
 TDECQ - TECQ 	-	-	-	2.7	dB	
Over/under-shoot	-	-	-	22	%	
Transmitter Power Excursion	-	-	-	3.9	dBm	
Transmitter And Dispersion Eye Closure	TDECQ	-	-	3.9	dB	
RIN_{15OMA}	RIN	-	-	-136	dB/Hz	
Optical Return Loss Tolerance	ORLT	-	-	15	dB	
Transmitter Transition Time		-	-	17	ps	
Transmitter Reflectance	TR	-	-	-26	dB	

Note 1: Average launch power, each lane (min) is informative and not the principal indicator of signal strength.

IV. Receiver Optical Specifications

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Wavelength	λ_c	1308.09	-	1310.19	nm	
Damage Threshold		-2.4	-	-	dBm	
Average Receive Power		-16	-	-3.4	dBm	1
Receive Power (OMA_{outer})	RP	-	-	-2.6	dBm	
Receiver Reflectance	RR	-	-	-26	Db	
Receiver Sensitivity (OMA_{outer}) for TECQ < 1.4 dB	RS	-	-	-12.5	dBm	

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
for 1.4 dB ≤ TECQ ≤ 3.4 dB				-13.9 + TECQ		
Stressed Receiver Sensitivity	SRS	-	-	-10	dBm	2
Stressed Receiver Sensitivity Test Conditions:	-	-	-	-		
Stressed Eye Closure for PAM4 (SECQ)	SECQ	-	-	3.9	dB	

Note 1: Average receive power, (min) is informative and not the principal indicator of signal strength.

Note 2: Measured with conformance test signal at TP3 for the BER = 2.4×10^{-4} .

V. Electrical Specification High Speed Signal (compliant with IEEE 802.3 CAUI-4)

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Receiver (Module Output)						
AC Common-Mode Output Voltage (RMS)		-	-	17.5	mV	
Differential Output Voltage		-	-	900	mV	
Eye Width		0.57	-	-	UI	
Eye Height Differential		228	-	-	mV	
Vertical Eye Closure		-	-	5.5	dB	
Differential Termination Mismatch		-	-	10	%	
Transition Time (min, 20% to 80%)		12	-	-	ps	
DC Common Mode Voltage		-350	-	2850	mV	

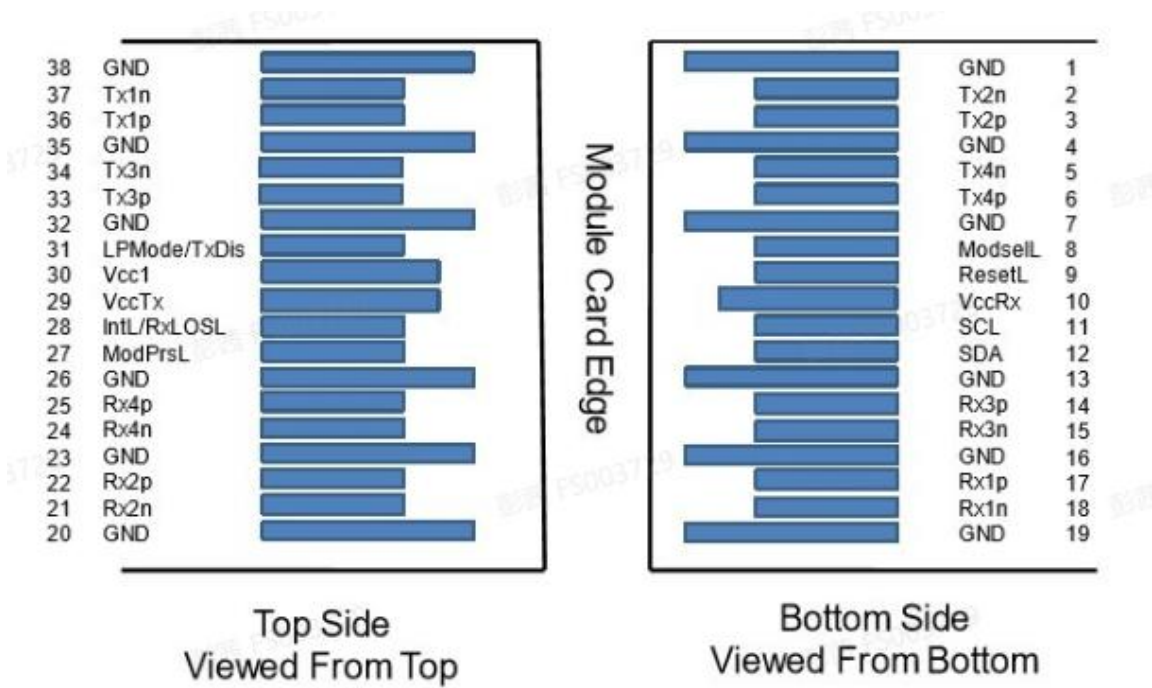
Transmitter (Module Input)

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Differential pk-pk Input Voltage Tolerance		900	-	-	mV	
Differential Termination Mismatch		-	-	10	%	
Single-Ended Voltage Tolerance Range		-0.4	-	3.3	V	
Dc Common Mode Voltage		-350	-	2850	mV	

VI. Electrical Specification High Speed Signal (compliant with IEEE 802.3 CAUI-4)

Parameter	Symbol	Min.	Max.	Unit	Condition
Module Output SCL and SDA	V_{OL}	0	0.4	V	
	V_{OH}	$V_{CC}-0.5$	$V_{CC}+0.3$	V	
Module Input SCL and SDA	V_{IL}	-0.3	$V_{CC}^*0.3$	V	
	V_{IH}	$V_{CC}^*0.7$	$V_{CC}+0.5$	V	
LPMoDe/TxDis, ResetL and ModSelL	V_{IL}	-0.3	0.8	V	
	V_{IH}	2	$V_{CC}+0.3$	V	
ModPrsL and IntL/RxLOSL	V_{OL}	0	0.4	V	
	V_{OH}	$V_{CC}-0.5$	$V_{CC}+0.3$	V	

VII. Pin Function Definitions



VIII. Transceiver Pin Descriptions (compliant with IEEE 802.3 CAUI-4)

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	LVTTTL-I	ModselL	Module Select	3	
9	LVTTTL-I	ResetL	Module Reset	3	

Pin	Logic	Symbol	Name/Description	Plug Sequence	Notes
10		Vcc Rx	+3.3V Power Supply Receiver	2	2
11	LVC MOS-I/O	SCL	2-wire serial interface clock	3	
12	LVC MOS-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	LV TTL-O	ModPrsL	Module Present	3	
28	LV TTL-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	

Pin	Logic	Symbol	Name/Description	Plug Sequence	Notes
29		Vcc Tx	+3.3V Power supply transmitter	2	2
30		Vcc1	+3.3V Power supply	2	2
31	LVTTTL-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

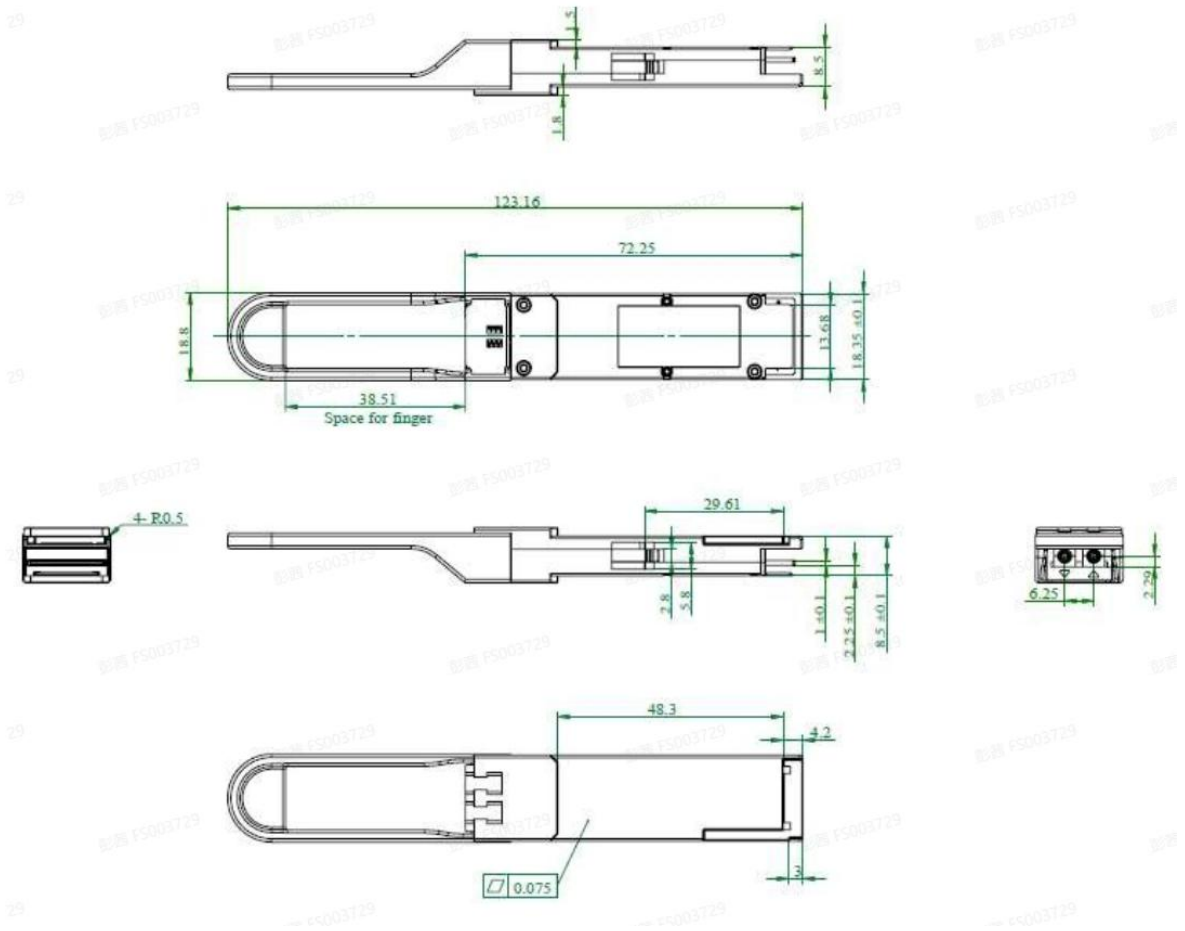
Note 1: GND is the symbol for signal and supply (power) common for the module. All are common within the module and all module voltages are referenced to this potential unless otherwise noted. Connect these directly to the host board signal-common ground plane.

Note 2: VccRx, Vcc1 and VccTx are applied concurrently and may be internally connected within the module in any combination. Vcc contacts in SFF-8662 and SFF-8672 each have a steady state current rating of 1 A.

VIII. Digital Diagnostics

Parameter	Range	Accuracy	Unit	Calibration
Temperature	0 to 70	±3	°C	Internal
Voltage	0 to VCC	3%	V	Internal
Tx Bias Current (Each Lane)	0 to 120	10%	mA	Internal
Tx Output Power (Each Lane)	1.7 to +7.1	±3	dB	Internal
Rx Receive Power (Each Lane)	-16 to -3.4	±3	dB	Internal

Mechanical Dimensions



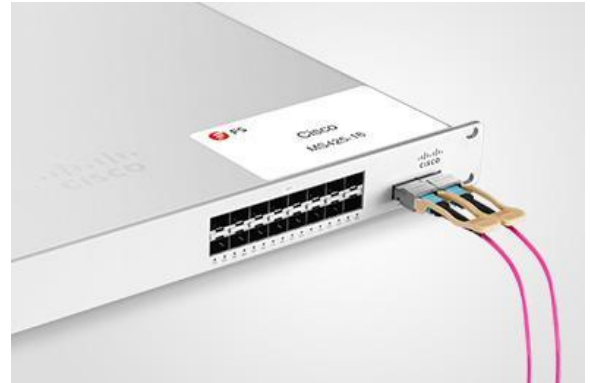
Test Center

I. Compatibility Testing

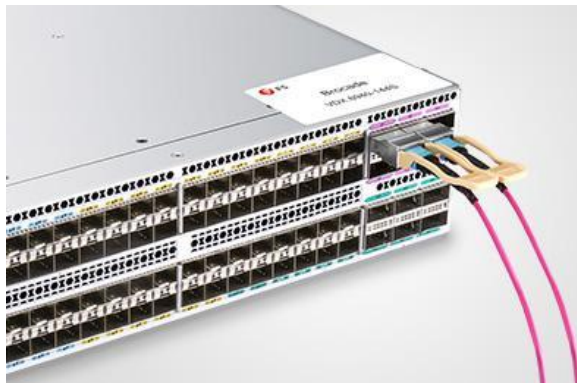
Each fiber optical transceiver has been tested in host device on site in FS Assured Program to ensure full compatibility with over 200 vendors.



Cisco Catalyst C9500-24Y4C



Cisco MS425-16



Brocade VDX 6940-144S



Dell EMC Networking Z9100-ON



Force10 S60-44T

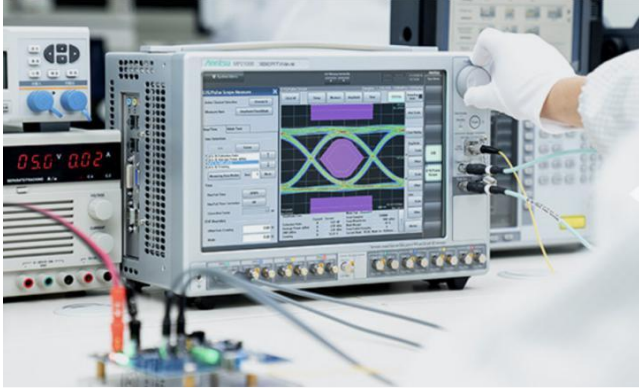


HUAWEI S6720-30L-HI-24S

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
QSFP-DR-100G	QSFP28 100GBASE-DR Single Lambda 1310nm 500m Transceiver
QSFP-FR-100G	QSFP28 100GBASE-FR Single Lambda 1310nm 2km Transceiver
QSFP-FR-100G-27	QSFP28 100GBASE-FR Single Lambda 1270nm 2km Transceiver
QSFP-FR-100G-29	QSFP28 100GBASE-FR Single Lambda 1290nm 2km Transceiver
QSFP-FR-100G-33	QSFP28 100GBASE-FR Single Lambda 1330nm 2km Transceiver
QSFP-LR-100G	QSFP28 100GBASE-LR Single Lambda 1310nm 10km Transceiver
QSFP-LR-100G-27	QSFP28 100GBASE-LR Single Lambda 1270nm 10km Transceiver
QSFP-LR-100G-29	QSFP28 100GBASE-LR Single Lambda 1290nm 10km Transceiver
QSFP-LR-100G-33	QSFP28 100GBASE-LR Single Lambda 1330nm 10km Transceiver
QSFP-ERL-100G	QSFP28 100GBASE-ERL Single Lambda 1310nm 25km Transceiver
QSFP-ER-100G	QSFP28 100GBASE-ER Single Lambda 1310nm 40km Transceiver

Warnings

Handling Precautions: This device is susceptible to damage as a result of electrostatic discharge (ESD). A static free environment is highly recommended. Follow guidelines according to proper ESD procedures.

Laser Safety: Radiation emitted by laser devices can be dangerous to human eyes. Avoid eye exposure to direct or indirect radiation.