

# 100GBASE-ER4L QSFP28 1310nm 40km Extended Temperature DOM Transceiver



## Application

- Data Center

## Features

- Maximum Link Length: 40km(with Host FEC), 30km(without Host FEC)
- 103.125Gbps(4x 25.78125 Gb/s) CAUI-4 Compliant
- Single 3.3V Power Supply
- Supports KR4 FEC
- Operating Case Temperature Range: -20 to +85°C
- Transmitter: Cooled 4x LAN-WDM EML-based TOSA
- Receiver: 4x APD-based ROSA
- Hot Pluggable QSFP28 MSA Compliant
- SFF-8636 Management Interface
- Class 1 Laser Safety

## Description

The FS's 100GBASE-ER4L QSFP28 Optical Transceiver Module is designed for use in 100GBASE Ethernet throughput up to 40km over LC duplex SMF using a wavelength of 1310nm. Full 40km reach requires the use of FEC on the host platform. Without FEC, the reach is 30km. Designed for outside plant applications with an extended temperature range (-20°C to +85°C), this transceiver is compliant with SFF-8636 and 4WDM MSA standards. The built-in digital diagnostics monitoring (DDM) allows access to real-time operating parameters. With these features, this easy to install, hot swappable transceiver is suitable for Data Center applications.

## Products Specifications

### I. Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit	Notes
<b>Storage Temperature Range</b>	$T_S$	-40	85	°C	
<b>Supply Voltage</b>	$V_{CC}$	0	+3.6	V	+3.3 V
<b>Optical Receiver Input</b>			-2.5	dBm	Average

### II. Recommended Operating Conditions

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
<b>Operating Case Temperature</b>	$T_{OPR}$	-20	25	85	°C	Cold start - 40degC
<b>Power Supply Voltage</b>	$V_{CC}$	3.135	3.3	3.465	V	
<b>Supply Current</b>				1754	mA	Steady State
<b>Supply Voltage Noise Tolerance</b>	PSNR			66	mV	10Hz-10MHz
<b>Power Consumption</b>				5.5	W	Target

### III. Optical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Ref.
<b>Channel Data Rate</b>	$f_{DC}$		25.78125		Gb/s	
<b>Aggregate Data Rate</b>	$f_D$		103.125		Gb/s	Note 1
<b>Signal Speed Variation from Nominal</b>	$\Delta f_D$	-100		100	ppm	
<b>Transmitter(Each Lane)</b>						
<b>Wavelength L0</b>	$\lambda_1$	1294.53		1296.59	nm	
<b>Wavelength L1</b>	$\lambda_2$	1299.02		1301.09	nm	
<b>Wavelength L2</b>	$\lambda_3$	1303.54		1305.63	nm	
<b>Wavelength L3</b>	$\lambda_4$	1308.09		1310.19	nm	
<b>Optical Output Power in OMA</b>	OMA	0.5		6.5	dBm	Note 2
<b>Average Launch Power</b>		-2.5		6.5	dBm	Note4
<b>Launch Power in OMA Minus TDP, each Lane</b>	OMA	-0.5				
<b>Average Launch Power Tx_Off</b>	$P_{OFF}$			-30	dBm	
<b>Transmitter and Dispersion Penalty (TDP), each Lane</b>				3.0	dB	
<b>Extinction Ratio</b>	ER	4.5			dB	

Parameter	Symbol	Min.	Typ.	Max.	Unit	Ref.
<b>Receiver(Each Lane)</b>						
<b>Receiver Sensitivity(OMA), each Lane at 5x10<sup>-5</sup>BER</b>	P <sub>min</sub> OMA			-18.5	dBm	Note3
<b>Max. Receive Power in OMA</b>				-3.5	dBm	
<b>Average Receive Power</b>		-20.5		-3.5	dBm	Note5
<b>Stressed Receiver Sensitivity(OMA), each Lane at 5 x 10<sup>-5</sup>BER</b>	P <sub>min</sub> SOMA			-16.0	dBm	
<b>Vertical Eye Closure Penalty, each Lane</b>			2.5		dB	Condition for SRS
<b>Receive Reflectance</b>	RF			-26		

**Note1:** Data Rate; NRZ, Mark Ratio 50%, PRBS=231-1 unless otherwise specified.

**Note2:**  $OMA = 10 \log_{10} [2P \{ (A-1)/(A+1) \}]$ ,  $A = 10^{(ER/10)}$ ,  $P = 10^{(Pf/10)}$

**Note3:** Receiver sensitivity, which is defined for an ideal input signal, is informative and compliance is not required. If measured, the test signal should have negligible impairments such as inter-symbol interference (ISI), rise/fall times, jitter and RIN.

**Note4:** Average launch power, each lane (min) is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.

**Note5:** Average receive power, each lane (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.

#### IV. RX\_LOS Alarm Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Ref.
<b>Receiver Loss of Signal Indicator Assert Level</b>	RX_LOS			-20.5	dBm	OMA
<b>Receiver Loss of Signal Indicator De-assert Level</b>				-19.0	dBm	OMA
<b>LOS Hysteresis</b>		0.5			dB	

## V. Electrical Characteristics

Parameter	Min.	Typ.	Max.	Unit	Ref.
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### Transmitter (Each Lane)

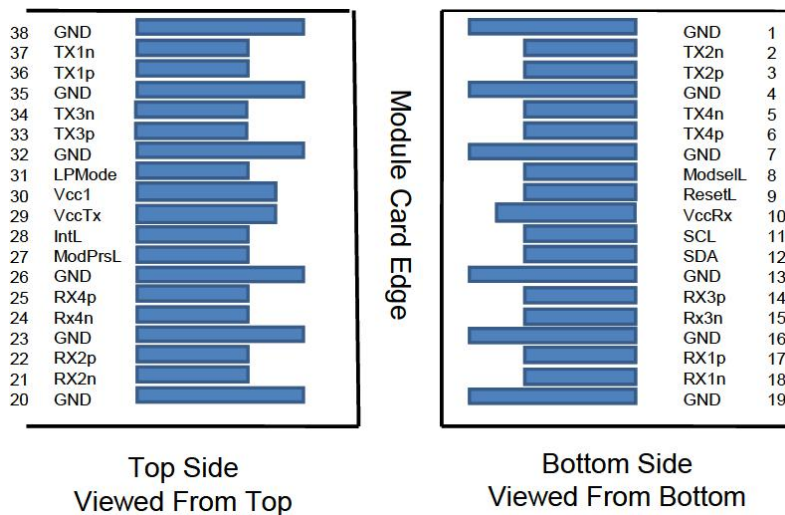
Differential Pk-Pk Input Voltage Tolerance	900			mV	at TP1a
Differential Termination Mismatch			10	%	at TP1
Single-ended Input Voltage Tolerance Range	-0.4		3.3	V	at TP1a
DC Common Mode Voltage	-350		2850	mV	at TP1

### Receiver (Each Lane, at TP4)

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(20% to 80%)	12			ps	
DC Common Mode Voltage	-350		2850	mV	

**Note:** Electrical Rx output is squelched for loss of optical input signal.

## VI. Pin Descriptions



Pin	Logic	Symbol	Description	Plug Sequence	Notes
1		GND	Module Ground	1	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	3	
3	CML-I	Tx2p	Transmitter Non-inverted Data Input	3	
4		GND	Module Ground	1	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	3	
6	CML-I	Tx4p	Transmitter Non-Inverted Data Input	3	
7		GND	Module Ground	1	1
8	LVTTL-I	ModSelL	Module Select	3	
9	LVTTL-I	ResetL	Module Reset	3	
10		Vcc Rx	+3.3V Power Supply for Receiver	2	2
11	LVTTL-I/O	SCL	2-wire Serial Interface Clock	3	

Pin	Logic	Symbol	Description	Plug Sequence	Notes
12	LVTTTL-I/O	SDA	2-wire Serial Interface Data Line	3	
13		GND	Module Ground	1	1
14	CML-O	Rx3p	Receiver Non-Inverted Data Output	3	
15	CML-O	Rx3n	Receiver Inverted Data Output	3	
16		GND	Module Ground	1	1
17	CML-O	Rx1p	Receiver Non-Inverted Data Output	3	
18	CML-O	Rx1n	Receiver Inverted Data Output	3	
19		GND	Module Ground	1	1
20		GND	Module Ground	1	1
21	CML-O	Rx2n	Receiver Inverted Data Output	3	
22	CML-O	Rx2p	Receiver Non-Inverted Data Output	3	
23		GND	Module Ground	1	1
24	CML-O	Rx4n	Receiver Inverted Data Output	3	
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	3	
26		GND	Module Ground	1	1
27	LVTTTL-O	ModPrsL	Module Present	3	
28	LVTTTL-O	IntL	Interrupt.	3	
29		Vcc Tx	+3.3v Power Supply For Transmitter	2	2

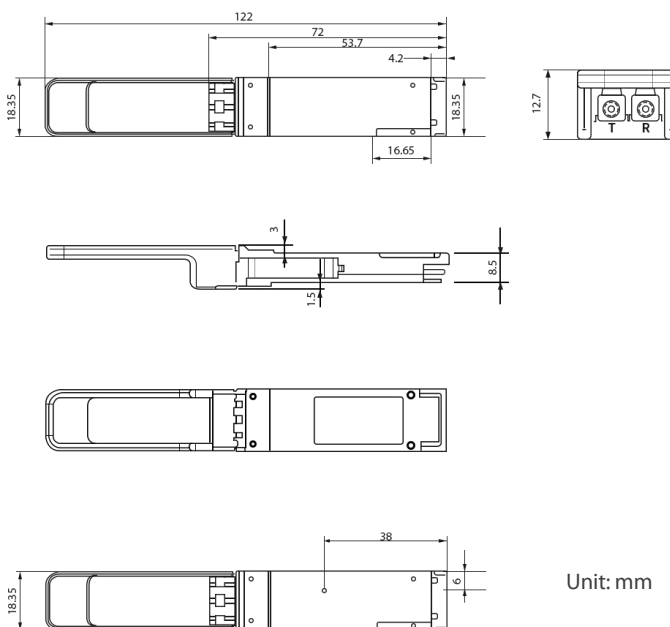
Pin	Logic	Symbol	Description	Plug Sequence	Notes
30		Vcc1	+3.3v Power Supply	2	2
31	LVTTTL-I	LPMODE	Low Power Mode	3	
32		GND	Module Ground	1	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	3	
34	CML-I	Tx3n	Transmitter Inverted Data Input	3	
35		GND	Module Ground	1	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	3	
37	CML-I	Tx1n	Transmitter Inverted Data Input	3	
38		GND	Module Ground	1	1

**Note1:** 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.

**Note2:** Vcc Rx, Vcc1 and Vcc Tx are the receiver and transmitter power supplies and shall be applied concurrently.



## VII. Diagram Mechanical Drawing



## VIII. Regulatory Compliance

Certification	Standard
<b>EMC/EMI</b>	FCC Part 15, Subpart B (Class B) EN55032 (Class B)
<b>ESD</b>	EN61000-4-2, criterion B JEDEC JESD22-A114-B Human Body Model
<b>Laser Safety</b>	Complies with 21 CFR 1040.10 and 1040.11 Except for Conformance with IEC 60825-1 Ed. 3. Described in Laser Notice No. 56, Dated May 8, 2019.
<b>Environmental</b>	RoHS 10 (2011/65/EU + 2015/863) ISA S71.04 G2

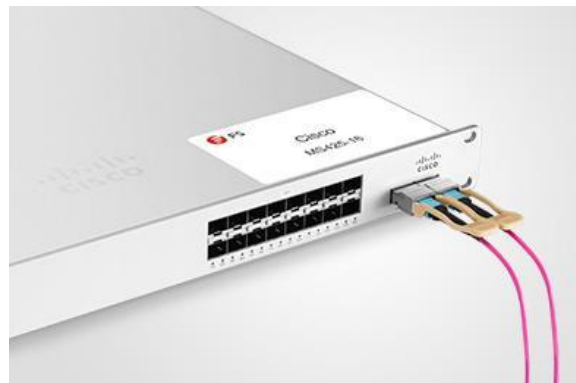
## Test Center

### 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



Force@tm S60-44T

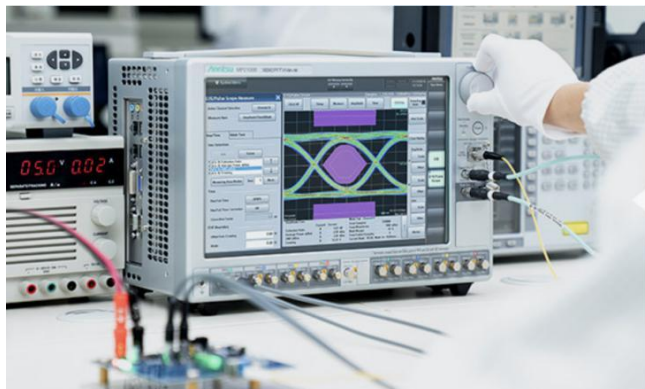


HUAWEI S6720-30L-HI-24S

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

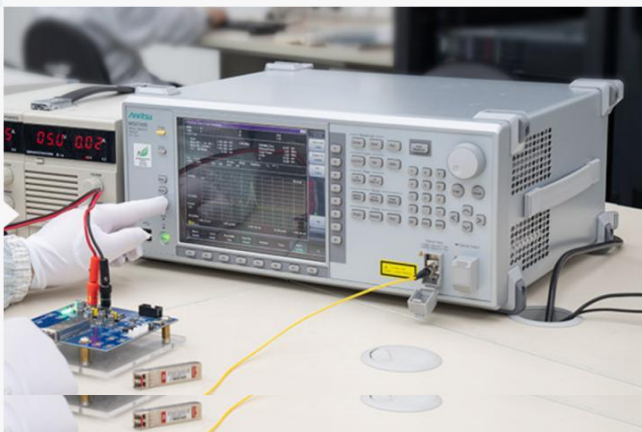
Test the actual transfer data rate and the transmission ability under different protocols with Network Master Pro.

- 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-LR4-100G	QSFP28 100GBASE-LR4 1310nm 10km Transceiver
QSFP28-PIR4-100G	QSFP28 100GBASE-PSM4 1310nm 500m Transceiver
QSFP28-IR4-100G	QSFP28 100GBASE-CWDM4 1310nm 2km Transceiver
QSFP28-EIR4-100G	QSFP28 100GBASE-eCWDM4 1310nm 10km Transceiver
QSFP28-ER4-100G	QSFP28 100GBASE-ER4 1310nm 40km Transceiver
Q28-ER4L-100G-X	QSFP28 100GBASE-ER4L1310nm 40km Extended Temperature Transceiver



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