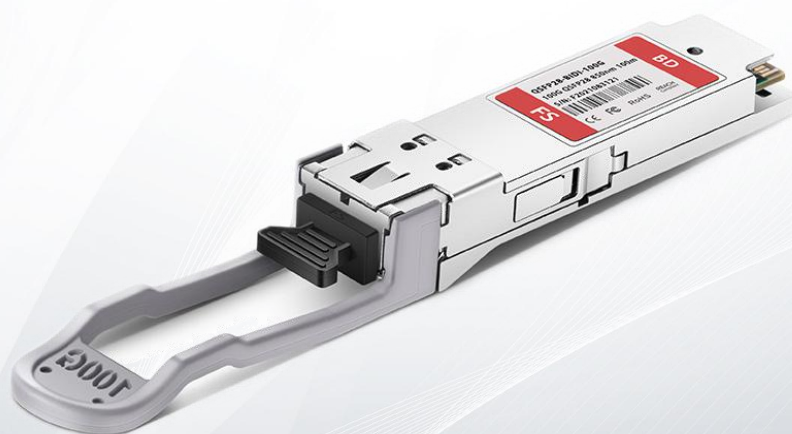


# 100GBASE-SR Bi-Directional QSFP28 850nm 100m DOM LC MMF Optical Transceiver Module

QSFP28-BIDI-100G



## Application

- 100G Ethernet over Duplex MMF

## Features

- Hot-pluggable QSFP28 form factor
- Supports 103.1Gb/s aggregate bit rate
- Power dissipation < 3.5W
- RoHS-6 compliant
- Commercial case temperature range of 0°C~70°C
- Single 3.3V power supply
- Maximum link length of 75m/100m/150m on OM3/OM4/OM5 Duplex Multimode Fiber (MMF)
- VCSEL-based transmitter
- CAUI-4 electrical interface
- Duplex LC receptacles
- I2C management interface

## Description

The 100G QSFP28 transceiver modules are designed for use in 100G Ethernet links over duplex multimode fiber. They are compliant with the QSFP28 MSA<sup>1</sup> and IEEE 802.3bm CAUI-4<sup>2</sup>. Digital diagnostics functions are available via the I2C interface, as specified by the QSFP28 MSA<sup>1</sup>. The transceiver is RoHS-6 compliant per Directive 2011/65/EU<sup>3</sup>.

## Product Specifications

### I. Absolute Maximum Ratings

Module performance is not guaranteed beyond the standard operating range (see Section VI).

Exceeding the limits below may damage the transceiver module permanently.

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
<b>Maximum Supply Voltage</b>	$V_{CC}$	-0.5		3.6	V	
<b>Storage Temperature</b>	$T_S$	-40		85	°C	
<b>Case Operating Temperature</b>	$T_{OP}$	0		70	°C	1
<b>Relative Humidity</b>	RH	15		85	%	2
<b>Receiver Damage Threshold, per Lane</b>	$P_{Rdmg}$	3.8			dBm	

#### Notes:

1. Temporary excursions case operating temperature of -5 to -75 °C not exceeding 72 hours.
2. Non-condensing.

### II. Electrical Characteristics (EOL, TOP = 0 to 70 °C, $V_{CC}$ = 3.135 to 3.465 Volts)

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
<b>Supply Voltage</b>	$V_{CC}$	3.135		3.465	V	
<b>Supply Current</b>	$I_{CC}$			1.5	A	

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
<b>Module total power</b>	P			3.5	W	1
<b>Transmitter</b>						
<b>Signaling rate per lane</b>				25.78125 ± 100ppm	Gb/s	
<b>Differential pk-pk input voltage tolerance</b>	V <sub>in,pp,diff</sub>			900	mV	
<b>Single-ended voltage tolerance</b>	V <sub>in,pp</sub>	-0.35		+3.3	V	
<b>Module stress input test</b>		Per Section 83E.3.4.1, IEEE 802.3bm				
<b>Receiver</b>						
<b>Signaling rate per lane</b>				25.78125 ± 100ppm	Gb/s	
		100		400		
		300		600		
<b>Differential data output swing</b>	V <sub>out,pp</sub>	400	600	800	mVpp	2
		600		1200		
<b>Eye width</b>		0.57			UI	
<b>Eye height, differential</b>		228			mV	
<b>Vertical eye closure</b>	VEC	5.5			dB	
<b>Transition time (20% to 80%)</b>	t <sub>r</sub> , t <sub>f</sub>	12			ps	

**Notes:**

1. Maximum total power value is specified across the full temperature and voltage range.
2. Output voltage is settable in 4 discrete ranges via I2C. Default range is Range 2 (400 – 800 mV).

### III. Optical Characteristics (EOL, TOP = 0 to 70 °C, V<sub>CC</sub> = 3.135 to 3.465 Volts)

Parameter	Symbol	$\lambda_1$	$\lambda_2$	$\lambda_3$	$\lambda_4$	Unit	Ref.
<b>Transmitter</b>							
<b>Signaling Speed per Lane</b>		25.78125 ± 100ppm				Gb/s	1
<b>Lane center wavelengths (range)</b>	$\lambda$	850	850	910	940	nm	
<b>RMS Spectral Width</b>	SW	0.59	0.59	0.59	0.59	nm	
<b>Tx<sub>OMA</sub>min at max TDEC</b>		-3	-3	-3	-2.9	dBm	
<b>TDEC (OM3)</b>	TDEC	3.3	3.5	3.7	4.2	dB	
<b>Tx<sub>OMA</sub>- TDEC</b>	P-TDEC	-6.3	-6.5	-6.7	-7.1	dBm	
<b>Tx<sub>OMA</sub> min</b>	Tx <sub>OMA</sub>	-40	-5.5	-5.5	-5.5	-5.5	
<b>Relative Intensity Noise</b>	RIN	-130				dB/Hz	2
<b>Optical Extinction Ratio</b>	ER	2	2	2	2	dB	
<b>Optical Return Loss Tolerance</b>	ORL	12				dB	
<b>Average launch power of OFF transmitter, per lane</b>		-30				dBm	
<b>Transmitter eye mask definition {X1,X2,X3,Y1,Y2,Y3}</b>		{0.3,0.38,0.45,0.35,0.41,0.5}					3
<b>Receiver</b>							
<b>Signaling Speed per Lane</b>		25.78125 ± 100ppm				GBd	4
<b>Lane Center Wavelength (range)</b>	$\lambda$	850	880	910	940	nm	

Parameter	Symbol	$\lambda 1$	$\lambda 2$	$\lambda 3$	$\lambda 4$	Unit	Ref.
<b>Damage Threshold</b>	DT	3.8	3.8	3.8	3.8	dBm	
<b>Average Receive Power per Lane (min)</b>	RXP <sub>min</sub>	-9.5	-9.4	-9.4	-9.4	dBm	
<b>Average Receive Power per Lane (max)</b>	RXP <sub>max</sub>	3.4	3.4	3.4	3.4	dBm	
<b>Receiver Reflectance (max)</b>	Rfl	-12				dB	
<b>Stressed Receiver Sensitivity (OMA) per Lane</b>	SRS	-5.2	-5.2	-5.2	-5.2	dBm	5
<b>Back to Back Receiver Sensitivity (OMA) per Lane</b>	RxSens	-8.2	-8.4	-8.6	-8.8	dBm	6

**Stressed Conditions:**

<b>Stressed eye closure</b>	SEC	3.3	3.5	3.7	4.2	dB	
<b>Stressed eye J2 jitter</b>	J2	0.39				UI	
<b>Stressed eye J4 jitter</b>	J4	0.53				UI	
<b>Stressed Receiver Eye Mask Definition</b> {X1,X2,X3, Y1, Y2,Y3}		{0.28,0.5,0.5,0.33,0.33,0.4}					7
<b>LOS De-Assert (max)</b>	LOSD	-11				dBm	8
<b>LOS Assert (min)</b>	LOSA	-30				dBm	8
<b>LOS Hysteresis</b>		0.5				dB	

**Notes:**

1. Transmitter consists of 4 lasers and a 4:1 optical multiplexer.
2. Informative, link controlled by TDEC
3. Hit Ratio  $1.5 \times 10^{-3}$  hits/sample.
4. Receiver consists of a 1:4 optical de-multiplexer and 4 photodetectors.
5.  $5 \times 10^{-5}$  BER (pre-FEC).
6. Unstressed receiver sensitivity is information, and assumes  $5 \times 10^{-5}$  BER (pre-FEC).
7. Hit Ratio  $5 \times 10^{-5}$  hits/sample.
8. DC values.

## IV. Link Budget

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
<b>Bit Rate (all wavelengths combined)</b>	BR		103.10		Gb/s	
<b>Bit Error Rate</b>	BER			5x10-5		1
<b>Insertion Loss</b>	IL			1.8	dB	2
<b>Maximum Supported Distances</b>						
<b>Fiber Type</b>						
<b>OM3 MMF</b>		L <sub>max</sub> <sup>1</sup>			75	m
<b>OM4 MMF</b>		L <sub>max</sub> <sup>2</sup>			100	m
<b>OM5 MMF</b>		L <sub>max</sub> <sup>3</sup>			150	m

### Notes:

1. Tested with a 231 – 1 PRBS at 25.78125 Gb/s
2. 850 nm channel can tolerate 1.9 dB insertion loss
3. Specified at 103.1Gb/s. Requires RS-FEC on the host to support maximum distance.

## V. Environmental Specifications

The QSFP28-BIDI-100G transceivers have a commercial operating case temperature range of 0°C to +70°C. They can support temporary excursions to case temperatures of -5°C and +75°C without permanent damage (see Section II).

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
<b>Case Operating Temperature</b>	T <sub>op</sub>	0		70	°C	
<b>Storage Temperature</b>	T <sub>sto</sub>	-40		85	°C	

## VI. Regulatory Compliance

The QSFP28-BIDI-100G transceivers are Class 1 Laser Products. They are certified per the following standards:

Feature	Agency	Standard
<b>Laser Eye Safety</b>	FDA/CDRH	CDRH 21 CFR 1040 and Laser Notice 50
<b>Laser Eye Safety</b>	TÜV	EN 60825-1:2014 EN 60825-2:2004+A1+A2
<b>Electrical Safety</b>	TÜV	EN 60950-1:2006+A11+A1+A12+A2
<b>Electrical Safety</b>	UL/CSA	CAN/CSA-C22.2 No. 60950-1-07+A2:2014 ANSI/UL Std. No. 60950-1:2014

Complies with FDA performance standards for laser products except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007.

CAUTION – Use of Controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

## VII. Pin Descriptions

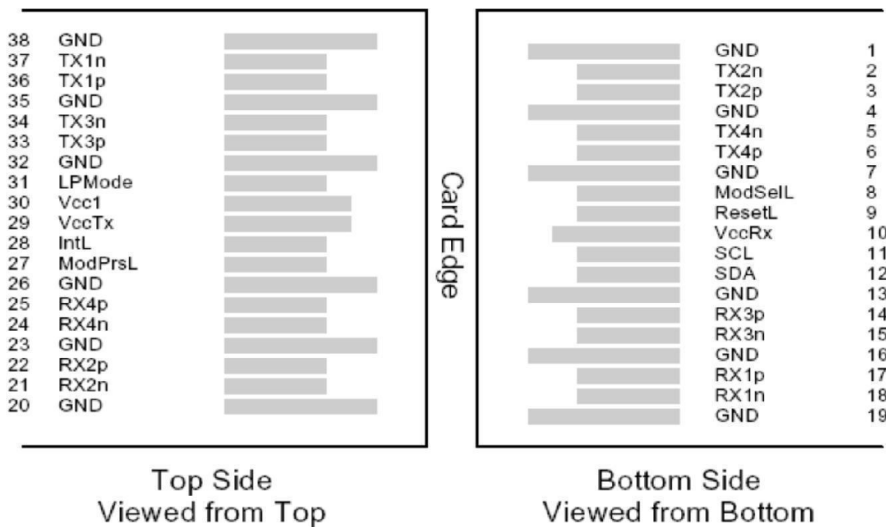


Figure 1 – QSFP28-compliant 38-pin connector (per SFF-8679)

Pin	Symbol	Name/Description	Notes
1	GND	Ground	1
2	Tx2n	Transmitter Inverted Data Input	
3	Tx2p	Transmitter Non-Inverted Data Input	
4	GND	Ground	1
5	Tx4n	Transmitter Inverted Data Input	
6	Tx4p	Transmitter Non-Inverted Data Input	
7	GND	Ground	1
8	ModSelL	Module Select	
9	ResetL	Module Reset	
10	Vcc Rx	+3.3 V Power supply receiver	
11	SCL	2-wire serial interface clock	
12	SDA	2-wire serial interface data	
13	GND	Ground	1
14	Rx3p	Receiver Non-Inverted Data Output	
15	Rx3n	Receiver Inverted Data Output	



Pin	Symbol	Name/Description	Notes
16	GND	Ground	1
17	Rx1p	Receiver Non-Inverted Data Output	
18	Rx1n	Receiver Inverted Data Output	
19	GND	Ground	1
20	GND	Ground	1
21	Rx2n	Receiver Inverted Data Output	
22	Rx2p	Receiver Non-Inverted Data Output	
23	GND	Ground	1
24	Rx4n	Receiver Inverted Data Output	
25	Rx4p	Receiver Non-Inverted Data Output	
26	GND	Ground	1
27	ModPrsL	Module Present	
28	IntL	Interrupt	
29	V <sub>cc</sub>	Tx +3.3 V Power supply transmitter	
30	V <sub>cc</sub> 1	+3.3 V Power Supply	

Pin	Symbol	Name/Description	Notes
<b>31</b>	LPMoDe	Low Power Mode	
<b>32</b>	GND	Ground	1
<b>33</b>	Tx3p	Transmitter Non-Inverted Data Input	
<b>34</b>	Tx3n	Transmitter Inverted Data Input	
<b>35</b>	GND	Ground	1
<b>36</b>	Tx1p	Transmitter Non-Inverted Data Input	
<b>37</b>	Tx1n	Transmitter Inverted Data Input	
<b>38</b>	GND	Ground	1

**Notes:**

1. Circuit ground is internally isolated from chassis ground.

## VIII. Mechanical Specifications

The QSFP28-BIDI-100G transceivers are compatible with the QSFP28 MSA.1. The pull tab color is grey (Pantone 424U).

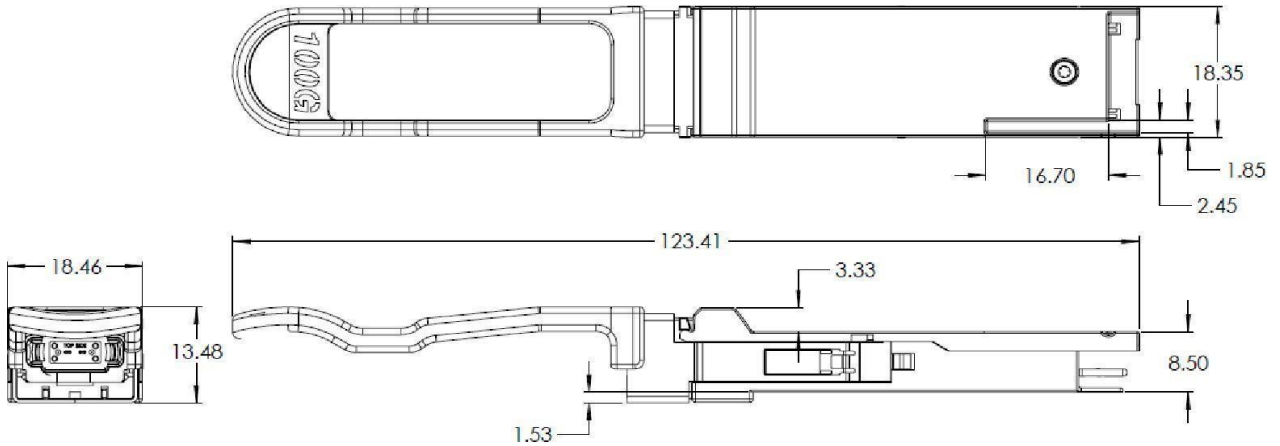


Figure 2. QSFP28-BIDI-100G Mechanical Dimensions.

## IX. References

1. SFF-8665: "QSFP+ 28Gb/s 4X Pluggable Transceiver Solution (QSFP28)", Rev 1.9, June 29, 2015 (and associated SFF documents)

i.SFF-8661

ii.SFF-8679

iii.SFF-8636

iv.SFF-8662

v.SFF-8663

vi.SFF-8672

vii.SFF-8683

2. IEEE 802.3bm, CAUI-4 interface.

3. Directive 2011/65/EU of the European Parliament and of the Council, "on the restriction of the use of certain hazardous substances in electrical and electronic equipment," July 1, 2011.

## Test Center

### I. Compatibility Testing

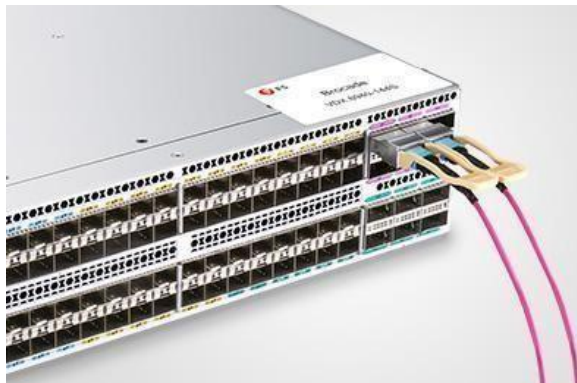
Each fiber optical transceiver has been tested in host device on site in FS Assured Program to ensure full compatibility with over 200 vendors.



Cisco Catalyst C9500-24Y4C



Cisco MS425-16



Brocade VDX 6940-144S



Dell EMC Networking Z9100-ON



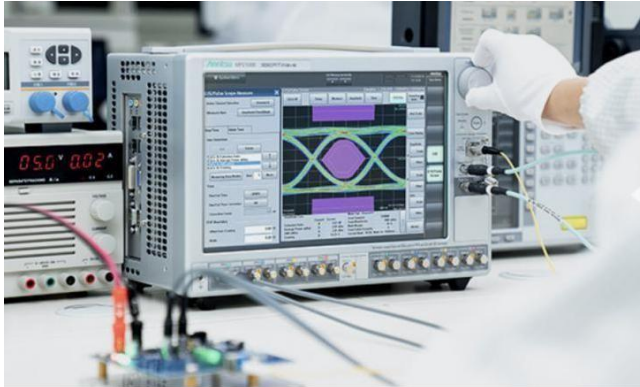
Force@tm S60-44T



HUAWEI S6720-30L-HI-24S

## 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.

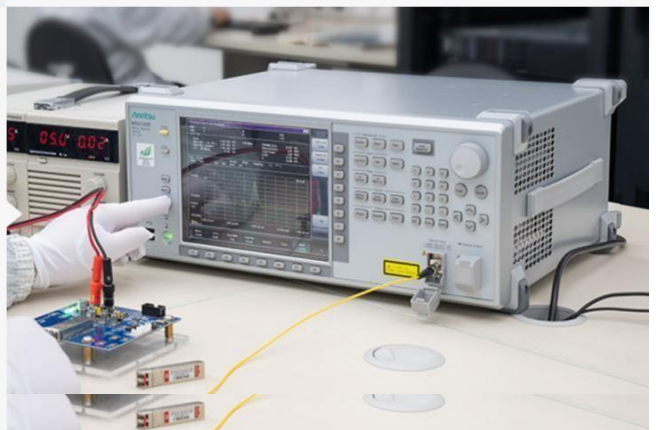
- Ethernet
- Fibre Channel
- SDH/SONET
- CPRI



### 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-BIDI-100G	QSFP28 100GBASE-SR Bi-Directional 850nm 100m Transceiver
SFP28-SR4-100G	QSFP28 100GBASE-SR4 850nm 100m Transceiver
QSFP28-ISR4-100G	QSFP28 100GBASE-SR4 850nm 100m Transceiver (Industrial)
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-BLR4-100G	QSFP28 100GBASE-LR4 1310nm 10km Transceiver
QSFP28-LR4-100G	QSFP28 100GBASE-LR4 1310nm 10km Transceiver for Data Center
QSFP28-ILR4-100G	QSFP28 100GBASE-LR4 1310nm 10km Transceiver (Industrial)
QSFP28-LR4-100G	QSFP28 100GBASE-LR4 and 112GBASE-OTU4 Dual Rate 1310nm 10km Transceiver
QSFP28-LR4-100G	QSFP28 100GBASE-LR4 and 112GBASE-OTU4 Dual Rate 1310nm 20km Transceiver
QSFP28-ER4-100G	QSFP28 100GBASE-ER4 and 112GBASE-OTU4 Dual Rate 1310nm 40km Transceiver
QSFP28-ER4-100G	QSFP28 100GBASE-ER4 1310nm 40km Transceiver
QSFP28-ZR4-100G	QSFP28 100GBASE-ZR4 1310nm 80km Transceiver



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