

# CNF-86210

2 channel, 1G-25Gbps, Transponder, SFP+ to SFP28, PM



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Asian Games Champion  
CNFIBERNET Ambassador



## CNF-86210IN SHORT

- Supported Protocols:
  - 10G Ethernet (LAN & WAN)
  - 1G Ethernet
  - 1G Fibre Channel
  - 10G Fibre Channel
  - 25G Fibre Channel
- Low power consumption
- SFP+ interfaces, tunable DWDM, DWDM, CWDM, BiDi, LR and SR
- Client and line performance monitoring
- PRBS traffic test
- Plug and play operation

## CNF-86210VERSATILE 1G/10G/25G 2CHANNEL TRANSPONDER

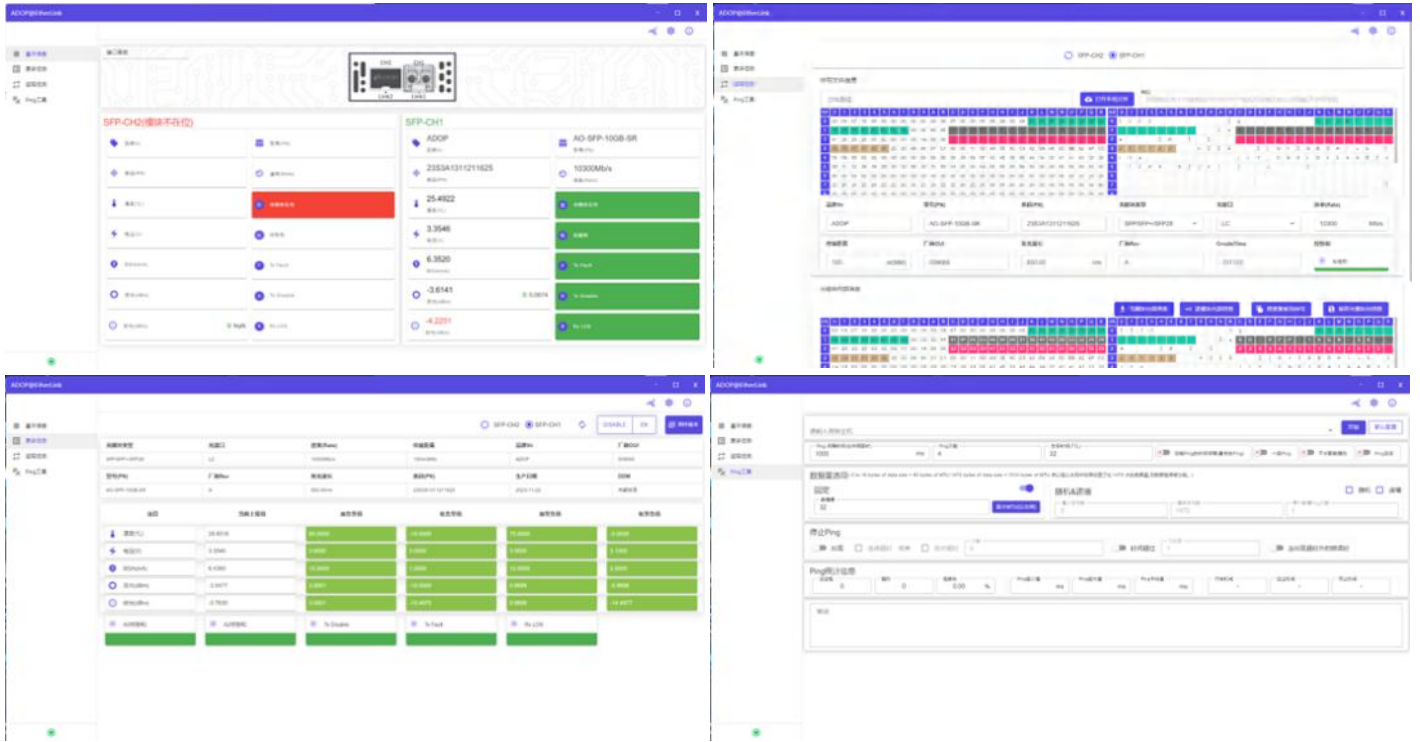
Each CNF-86210 offers ten independent transponders operating from 1G to 10G 25G line rates.

Twisted pair: category 5 or 6 (the longest distance is up to 100M)

Optical fiber (multimode): 50/125, 62.5/125 $\mu$ m (the longest distance is 2~5KM)

Optical fiber (single mode): 8/125, 8.7/125, 9/125, 10/125 $\mu$ m (the longest distance is 20-120KM)





## Software Features

- Meet the needs of high-speed interconnection and transparent
- Support 3R functions: optical signal balanced amplification, clock extraction and optical identification regeneration
- Support SAN, LAN, WAN, point-to-point transmission
- Support network management function: WEB Smartoptics



## CNF-86210VERSATILE TRANSPONDER

- 1) Link1, link2 optical module interface: used for optical module link
- 2) Type-C interface: device status viewing interface
- 3) DC interface: DC 5.5mm power interface, working voltage 5V-2A

You can view detailed information about the module used, including the interface, wavelength, production date, and transmit and receive light threshold range.

The Ping tool can be used to check the communication status of the entire link and connect to the computer's network port to perform a link test when on-site services are not enabled.

## TECHNICAL SPECIFICATIONS

### PRODUCT CONFIGURATION

2x1G-25G Transponder, SFP+ to SFP28

### LINE INTERFACE

Optical interface: SFP+ to SFP28

Line rate: up to 25.3Gbps

25G/10G/1G traffic:

10G DWDM ER

10G DWDM ZR

10G DWDM ER

10G CWDM ZR

10G CWDM ER

1G-25G traffic:

Multirate from 1G to 25G

Tunable ER 40km

Tunable ZR 80km

DWDM ER 40km

DWDM ZR 80km

### CLIENT INTERFACE

Optical interface: SFP+ to SFP28

1G-25G traffic:

SR, LR

1G-25G traffic:

SR, LR

### VISUAL INDICATORS

Indicator LED:

Client link

Client Tx

Client Rx

Line link

Line Tx

Line Rx

Status LED:

System Critical / Major / Minor / Power

### PERFORMANCE MONITORING

Layer 1 PM for all services

OTN PM for uplink

Optical power Rx & Tx levels for all optical ports

### SOFTWARE UPGRADES

Traffic hitless software upgrades

### APS (FUTURE RELEASE)

Automatic protection switching

### ENVIRONMENT

Operating temp: 0° C to 45° C

Humidity: 5% to 85% RHI

Cooling: front to back and back to front straight through air flow

### POWER CONSUMPTION

AC 110V~240V

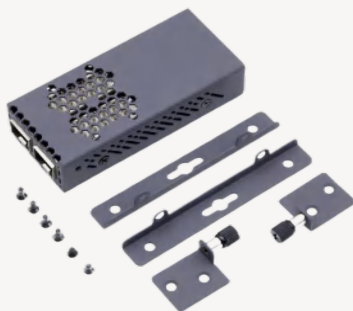
DC 5V+2A (External)

### DIMENSIONS CNF-86210, INCLUDING SFP+ HOUSING (HxWxD)

50x 30 x 100mm

## ORDERING INFORMATION

Part number	Description
CNF-86210	2 channel, 1G-25Gbps, Transponder, SFP+ to SFP28, PM



## **DATA SHEET**

### **CNFIBERNET:SFP-10GB-ER**

10Gb/s SFP+ ER Transceiver

#### **SFP-10GB-ER Overview**

CNFIBERNETSFP-10GB-ER SFP+ optical transceivers are based on 10G Ethernet IEEE 802.3ae standard and SFF-8431 standard, providing a fast and reliable interface for 10G Ethernet applications. The product implements digital diagnostics via a 2-wire serial bus, compliant with the SFF-8472 standard.

#### **Product Features**

- Supports from 1.2 Gb/s to 11.3 Gb/s bit rates
- Compliant with IEEE 802.3ae 10GBASE-ER/EW
- Compliant with 10GFC
- Compliant with SFF-8431
- Wireless CPRI Compliant
- Hot-pluggable SFP+ footprint
- EML transmitter and PIN receiver
- Duplex LC connector
- Built-in digital diagnostic functions
- Up to 40km on SMF
- Single power supply 3.3V
- Low power consumption <1.5W
- RoHS Compliant
- Operating temperature range: 0°C to 70°C

#### **Applications**

- 10GBASE-ER/EW Ethernet
- 4x, 8x, and 10x Fibre Channel
- CPRI options 2 through 8
- OTN G.709 OTU1e/2/2e FEC bit rates

## Ordering Information

Part Number	Description	Color on Clasp
SFP-10GB-ER	10G SFP+ 1550nm LC Connectors 40km on SMF, Commercial Temperature with DOM function	Red
<b>For More Information:</b> China Fiber Optic Network Supply Chain Center 10 Xiyuan Road, Hangzhou, Zhejiang Province, China Sales email : sales@cnfibernet.cn WEB: <a href="https://cnfibernet.cn/">https://cnfibernet.cn/</a>		

## General Specifications

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Data Rate	DR	1.2	10.3125	11.3	Gb/s	1
Bit Error Rate	BER			10 <sup>-12</sup>		
Operating Temperature	T <sub>c</sub>	0		70	°C	2
Storage Temperature	T <sub>STO</sub>	-40		85	°C	3
Supply Current	I <sub>CC</sub>		400	450	mA	4
Input Voltage	V <sub>CC</sub>	3.14	3.3	3.46	V	
Maximum Voltage	V <sub>MAX</sub>	-0.5		4	V	4

### Notes:

1. IEEE 802.3ae
2. Case temperature, commercial temperature
3. Ambient temperature
4. For electrical power interface

## Link Distances

Data Rate	Fiber Type	Distance Range (km)
1.2–11.3 Gb/s	9/125umSMF	40

## Optical – Characteristics – Transmitter

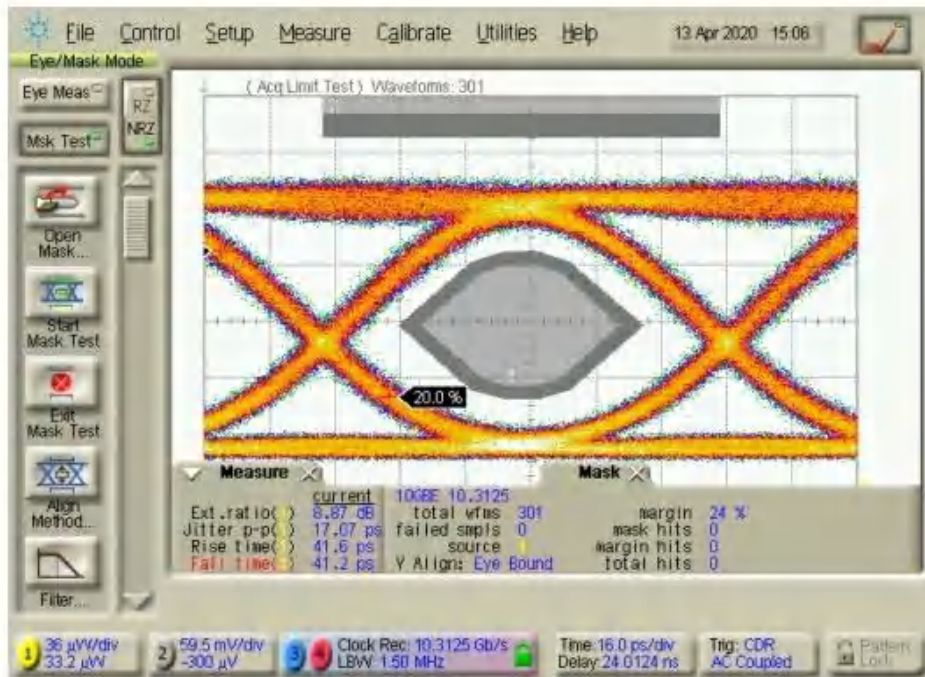
$V_{CC}=3.14V$  to  $3.46V$ ,  $T_C=0^{\circ}C$  to  $70^{\circ}C$

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Output Optical Power	$P_{TX}$	-4		4	dBm	1
Optical Center Wavelength	$\lambda_c$	1530		1565	nm	
Extinction Ratio	ER	8.2			dB	
Spectral Width (-20dB)	$\Delta\lambda$			0.6	nm	
Side Mode Suppression Ratio	SMSR	30			dB	
Relative Intensity Noise	RIN			-128	dB/Hz	
Transmitter Dispersion Penalty	TDP			2	dB	
Transmitter Jitter	According to IEEE 802.3ae requirement					
Launch Power of OFF Transmitter	$P_{OUT\_OFF}$			-30	dBm	1

### Notes:

1. Average

## Typical eye diagram



## Optical – Characteristics – Receiver

$V_{CC}=3.14V$  to  $3.46V$ ,  $T_C=0^{\circ}C$  to  $70^{\circ}C$

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Optical Center Wavelength	$\lambda_C$	1260		1600	nm	
Average Receive Power	$P_{RX}$	-16		0.5	dBm	
Receiver Sensitivity (Average)@10.3Gb/s	$RX\_AVE$			-16	dBm	
Receiver Reflectance	$TR_{RX}$			-27	dB	
LOS Assert	$LOS_A$	-25			dBm	
LOS De-Assert	$LOS_D$			-18	dBm	
LOS Hysteresis	$LOS_H$	0.5			dB	

## Electrical – Characteristics – Transmitter

$V_{CC}=3.14V$  to  $3.46V$ ,  $T_C=0^{\circ}C$  to  $70^{\circ}C$

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Input differential impedance	$R_{IN}$		100		$\Omega$	
Differential data input swing	$V_{IN\_PP}$	120		850	mV	
Transmit disable voltage	$V_D$	2		$V_{CC}$	V	
Transmit enable voltage	$V_{EN}$	$V_{EE}$		$V_{EE}+0.8$	V	

## Electrical – Characteristics – Receiver

$V_{CC}=3.14V$  to  $3.46V$ ,  $T_C=0^{\circ}C$  to  $70^{\circ}C$

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Differential data output swing	$V_{OUT\_PP}$	300		850	mV	
Data output rise/fall time (20%-80%)	$t_r/t_f$	28			ps	
LOS Fault	$V_{LOS\_A}$	2		$V_{CC\_HOST}$	V	
LOS Normal	$V_{LOS\_D}$	$V_{EE}$		$V_{EE}+0.5$	V	

## A0/A2 Write Protection

Security Level 1 Password		
Password Entry ADDR	Size	Vaules(hex)
Page A2,7BH-7EH	4	00 00 10 11

This module has the A0 / A2 write protection function. The user can enter the security level 1 working state and write the contents of Table 00 and Table 01 of the device address A0H and A2H of the module. The method to enter the working state of security level 1 is to write the security level 1 password in order in the 7BH-7EH registers of A2H of the module. After entering security level 1, the user can directly write to the contents of the A0H device address, or modify the contents of the A2H 7F table selection register to write to the contents of Table 00 or Table 01. This version of the module does not support users to modify the password of security level 1. If you need to modify the security level 1 password, you must notify our company to modify it before shipping.

## I2C Memory Map(Page A0 HEX, Unlisted Fields are Blank/Empty)

IIC ADDR	Size	Name	Description	Vaules(HEX)
0	1	Identifier	SFP	03
1	1	Extended Identifier	Extended Identifier	04
2	1	Connector	Connector Type=LC	07
3-10	8	Transceiver	10G Base ER	80 00 00 00 00 00 00 00
11	1	Encoding	Code for high speed serial encoding algorithm	03
12	1	BR,Nominal	Nominal Bit Rate 10.3Gb/s	67
13	1	Rate Identifier	Type of rate select functionality	00
14	1	Lenth(9μm)-km	40km Link Length in Thousands of Meters / SMF	28
15	1	Lenth(9μm)-100m	9-micron MMF Link Length	FF
16	1	Lenth(50μm)-10m	50-micron MMF Link Length = N/A	00
17	1	Lenth(62.5μm)-10m	62.5-micron MMF Link Length = N/A	00
18	1	Lenth(Copper)	Copper Link Length = N/A	00
19	1	Reserved	Reserved	00
20-35	16	Vendor name	CNFIBERNET	ASCII Format
36	1	Transceiver	Code for electronic or optical compatibility	00

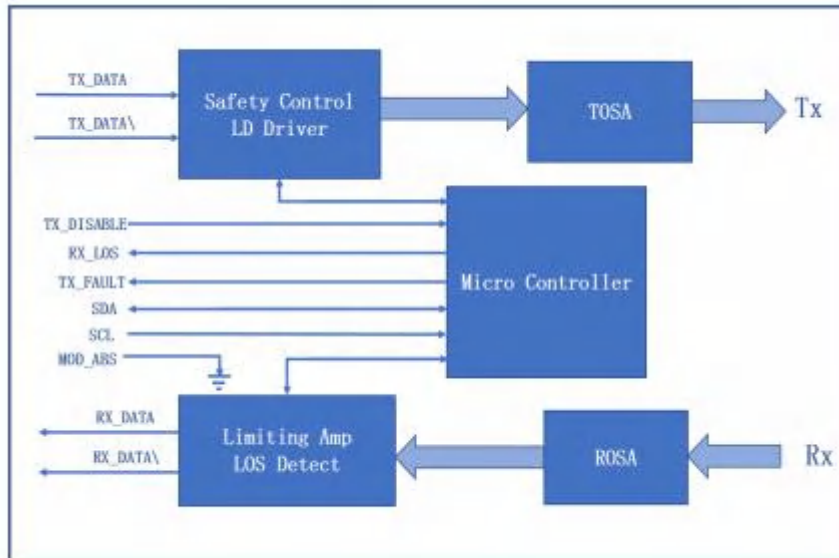
37-39	3	Vendor OUI	SFP Vendor IEEE Company ID	ASCII Format
40-55	16	Vendor PN	The Part number in the Ordering Information	ASCII Format
56-59	4	Vendor Revision Number	Vendor Revision Number	Programmed by Factory
60-61	2	Wavelength	Wavelength	according to actual wavelength
62	1	Reserved	Reserved	00
63	1	CC BASE	Check sum of bytes 0-62	Programmed by Factory
64-65	2	Transceiver Options	1.Rx LOS 2.Tx FAULT 3.Tx DIS	00 1A
66	1	BR, max	Upper bit rate margin	00
67	1	BR, min	Lower bit rate margin	00
68-83	16	Vendor SN	Vendor SN	Programmed by Factory
84-91	8	Date code	Year,Month,Day	Programmed by Factory
92	1	Monitoring Type	Internally Calibrated Received power measurement type-Average Power	68
93	1	Enhanced Options	1. Optional Alarm/Warning Flags Implemented 2. Soft Tx DIS Monitor and Control 3. Soft Rx LOS Monitor 4.Soft Tx FAULT Monitor	F0
94	1	SFF-8472 Compliance	Indicates which revision of SFF-8472 the transceiver complies with	08
95	1	CC EXT	Check sum of bytes 64-94	Programmed by Factory
96-127	32	Vendor Specific	Vendor Specific EEPROM	Programmed by Factory
128-255	128	Vendor Specific	Vendor Specific	Programmed by Factory

## Digital Diagnostic Functions

SFP-10GB-ER supports the 2-wire serial communication protocol as defined in SFF-8472. Digital diagnostic information is accessible over the 2-wire interface at the address 0xA2. Digital diagnostics for SFP-10GB-ER are internally calibrated by default. The internal micro control unit accesses the device operating parameters in real time, Such as transceiver temperature, laser bias current, transmitted optical power, received optical power and transceiver supply voltage. The module implements the alarm function of the SFF-8472, alerts the user when a particular operating parameter exceeds the factory-set normal range.

Digital Diagnostic Threshold Range				
Parameter	High Alarm	High Warning	Low Warning	Low Alarm
Temperature (°C)	75 (0x4B00)	70 (0x4600)	0 (0x0000)	-5 (0xFB00)
Voltage (V)	3.63 (0x8DCC)	3.46 (0x8728)	3.13 (0x7A44)	2.97 (0x7404)
Bias Current (mA)	100 (0xC350)	95 (0xB98C)	20 (0x2710)	15 (0x1D4C)
Tx Power (μW)	3014.2 (0x75BE)	2511.8 (0x621E)	316.2 (0x0C5A)	252.9(0x75BE)
Rx Power (μW)	2000 (0x4E20)	1500 (0x3A98)	23.7 (0x00ED)	15.8 (0x009E)

## Block-Diagram-of-Transceiver



## Functions Description

The transmitter consists of a laser driver chip and a TOSA (light-emitting component). The TOSA includes a 1550nm DFB laser, an electroabsorption modulator (EAM), a TEC, and a backlight diode. Unlike DML, EML TOSA uses external modulation. When the transmission rate of the system is high, the transmission distance is not only limited by the attenuation of the optical fiber, but also by the dispersion of the optical fiber, and the dispersion of the optical communication system is related to the modulation spectral width. The directly modulated laser has a large dispersion cost, and has spectral broadening, frequency chirp, and short transmission distance, so the external modulation method is CNFIBERNETted in the medium-long-distance transmission at a rate of 10 Gb/s. TEC

(Thermo Electric Cooler) Controls the temperature of the laser tube. When a temperature is set, the TOSA temperature of the module will remain unchanged through the control of the TEC.

The wavelength of the module laser tube is related to the temperature of the laser tube.

The module wavelength can be set by setting the TOSA temperature. When stable,

the module has excellent wavelength stability. The electrical signal enters

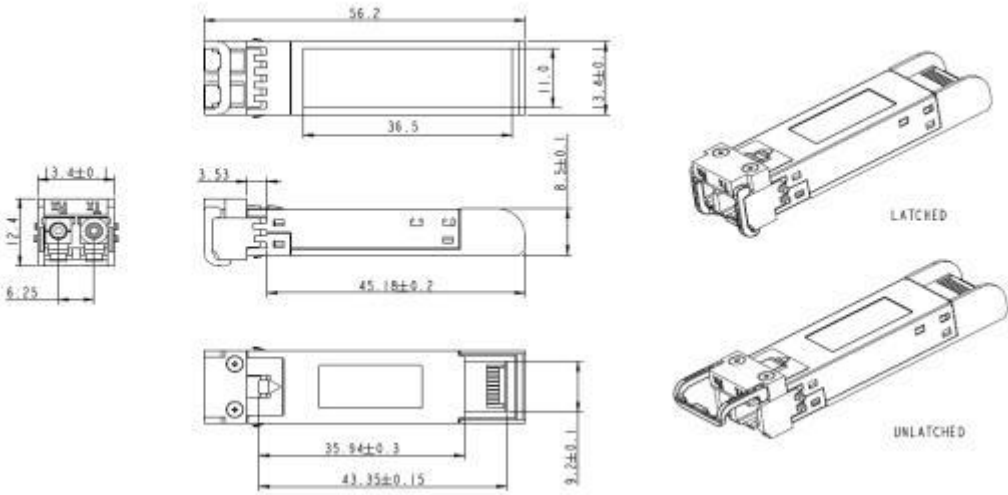
the optical module from the serial electrical interface and is then input to the laser driver chip. The laser driver chip supplies the bias current and the modulation current to the laser. The laser driver chip simultaneously uses an automatic optical power control (APC) feedback loop to maintain a constant average optical power of the laser output. The purpose is to eliminate the change of the output optical signal due to temperature changes and aging of the light source device. When the transmitter enable pin (TX\_Disable) is high (TTL logic "1"), the laser output is turned off. When TX\_Disable is low (TTL logic "0"), the laser will turn on within 1ms. When the transmitter fault signal (TX\_Fault) is reported as high, indicates a transmitter failure caused by the transmitter's bias current or transmitted optical power or laser tube temperature exceeding a preset alarm threshold. Low indicates normal operation.

The receiver consists of a ROSA (light-receiving component) and a limiting amplifier chip, ROSA includes a PIN photodetector and a transimpedance amplifier chip. The ROSA detects the incident optical signal, converts the optical signal into an electrical signal, and outputs the electrical signal to the

limiting amplifier. The electrical signal is further amplified by the limiting amplifier, then outputs a fixed-amplitude electrical signal to the host. When the amplitude of the electrical signal received from the incident light conversion of the opposite optical transceiver module is lower than the set threshold, the module reports that the received signal is lost, the RX\_LOS pin is high (logic "1"), which can be used to diagnose whether the physical signal is normal. The signal is operated in TTL level. The microprocessor inside the module monitors the module's operating voltage, temperature, transmitted optical power, received optical power, and laser bias current value in real time. The host acquires this information over a 2-wire serial bus.

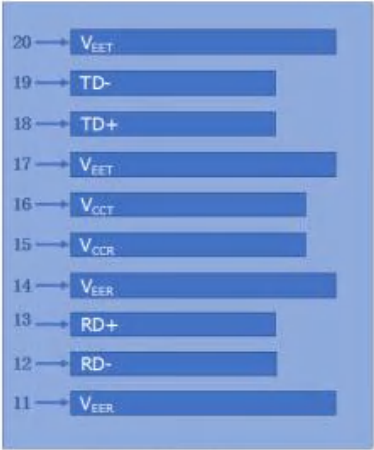
### Dimensions

**Module Weight: 16.5g**  
**Dust Cap Weight: 0.95g**

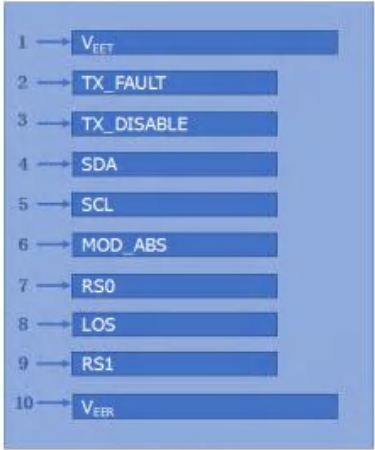
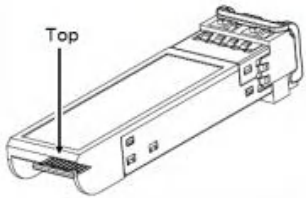


ALL DIMENSIONS ARE ±0.2mm UNLESS OTHERWISE SPECIFIED  
 UNIT: mm

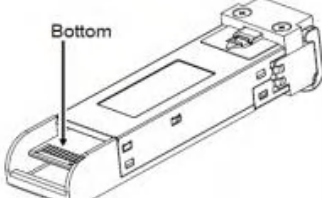
# Electrical Pad Layout



Top of Board



Bottom of Board



## Pin Assignment

PIN #	Symbol	Description	Remarks
1	VEET	Transmitter ground (common with receiver ground)	1
2	TX_FAULT	Transmitter Fault	
3	TX_DISABLE	Transmitter Disable. Laser output disabled on high or open	2
4	SDA	2-wire Serial Interface Data Line	3
5	SCL	2-wire Serial Interface Clock Line	3
6	MOD_ABS	Module Absent. Grounded within the module	3
7	RS0	No connection required	
8	LOS	Loss of Signal indication. Logic 0 indicates normal operation	4
9	RS1	No connection required	1
10	VEER	Receiver ground (common with transmitter ground)	1
11	VEER	Receiver ground (common with transmitter ground)	1
12	RD-	Receiver Inverted DATA out. AC coupled	
13	RD+	Receiver Non-inverted DATA out. AC coupled	
14	VEER	Receiver ground (common with transmitter ground)	1
15	VCCR	Receiver power supply	
16	VCCT	Transmitter power supply	
17	VEET	Transmitter ground (common with receiver ground)	1
18	TD+	Transmitter Non-Inverted DATA in. AC coupled	
19	TD-	Transmitter Inverted DATA in. AC coupled	
20	VEET	Transmitter ground (common with receiver ground)	1

### Notes:

1. Circuit ground is isolated from chassis ground
2. Disabled:  $T_{DIS} > 2V$  or open, Enabled:  $T_{DIS} < 0.8V$
3. Should Be pulled up with 4.7k –10k ohm on host board to a voltage between 2V and 3.6V
4. LOS is open collector output

## DATA SHEET

### CNFIBERNET: SFP-10GB-ZR

10Gb/s SFP+ ZR 80km Transceiver

#### SFP-10GB-ZR Overview

CNFIBERNET SFP-10GB-ZR SFP+ optical transceivers are based on 10G Ethernet IEEE 802.3ae standard and SFF-8431 standard, providing a fast and reliable interface for 10G Ethernet applications. The product implements digital diagnostics via a 2-wire serial bus, compliant with the SFF-8472 standard.

#### Product Features

- Supports from 1.2Gb/s to 11.3Gb/s bit rates
- Compliant with IEEE 802.3ae 10GBASE-ZR
- Compliant with 10G FC
- Compliant with SFF-8431
- Hot-pluggable SFP+ footprint
- 1550nm EML laser transmitter and APD receiver
- Duplex LC connector
- Built-in digital diagnostic functions
- Up to 80km on SMF
- Single power supply 3.3V
- Low power consumption (Module work consumption <1.5W)
- RoHS Compliant
- Operating temperature range: 0°C to 70°C

#### Applications

- 10GBASE-ZR Ethernet
- 4x, 8x, and 10x Fibre Channel
- CPRI options 2 through 8
- OTN G.709 OTU1e/2/2e FEC bit rates

## Ordering Information

Part Number	Description	Color on Clasp
SFP-10GB-ZR	10GBASE-ZR SFP+ 1550nm LC Connectors 80km on SMF, with DOM function.	Green
<b>For More Information:</b> ChinaFiberOpticNetworkSupplyChainCenter 10XiyuanRoad, Hangzhou, Zhejiang Province, China Salesemail : sales@cnfibernet.cn WEB: <a href="https://cnfibernet.cn/">https://cnfibernet.cn/</a>		

## General Specifications

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Data Rate	DR	1.2	10.3125	11.3	Gb/s	1
Bit Error Rate	BER			10 <sup>-12</sup>		
Operating Temperature	T <sub>c</sub>	0		70	°C	2
Storage Temperature	T <sub>STO</sub>	-40		85	°C	3
Supply Current	I <sub>CC</sub>		400	450	mA	4
Input Voltage	V <sub>CC</sub>	3.14	3.3	3.46	V	
Maximum Voltage	V <sub>MAX</sub>	-0.5		4	V	4

### Notes:

1. IEEE 802.3ae
2. Case temperature, commercial temperature
3. Ambient temperature
4. For electrical power interface

## Link Distances

Data Rate	Fiber Type	Distance Range (km)
1.2–11.3 Gb/s	9/125umSMF	80

## Optical – Characteristics – Transmitter

$V_{CC}=3.14V$  to  $3.46V$ ,  $T_C=0^{\circ}C$  to  $70^{\circ}C$

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Output Optical Power	$P_{TX}$	0		4	dBm	1
Optical Center Wavelength	$\lambda_C$	1530		1565	nm	
Extinction Ratio	ER	9			dB	
Spectral Width (-20dB)	$\Delta\lambda$			0.6	nm	
Side Mode Suppression Ratio	SMSR	30			dB	
Relative Intensity Noise	RIN			-128	dB/Hz	
Transmitter Dispersion Penalty	TDP			3.2	dB	
Launch Power of OFF Transmitter	$P_{OUT\_OFF}$			-30	dBm	1

**Notes:**

1. Average

## Optical – Characteristics – Receiver

$V_{CC}=3.14V$  to  $3.46V$ ,  $T_C=0^{\circ}C$  to  $70^{\circ}C$

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Optical Center Wavelength	$\lambda_C$	1260		1600	nm	
Average Receive Power	$P_{RX}$	-24		-7	dBm	
Receiver Sensitivity@10.3Gb/s	$RX\_SEN$			-24	dBm	1
Receiver Reflectance	$TR_{RX}$			-27	dB	
LOS Assert	$LOS_A$	-35			dBm	
LOS De-Assert	$LOS_D$			-27	dBm	
LOS Hysteresis	$LOS_H$	0.5			dB	

**Notes:**

1. Measured with worst ER: BER<10<sup>-12</sup>;2<sub>31</sub>-1 PRBS

## Electrical – Characteristics – Transmitter

$V_{CC}=3.14V$  to  $3.46V$ ,  $T_C=0^{\circ}C$  to  $70^{\circ}C$

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Input differential impedance	$R_{IN}$		100		$\Omega$	
Differential data input swing	$V_{IN\ PP}$	120		850	mV	
Transmit disable voltage	$V_D$	2		$V_{CC}$	V	
Transmit enable voltage	$V_{EN}$	$V_{EE}$		$V_{EE}+0.8$	V	

## Electrical – Characteristics – Receiver

$V_{CC}=3.14V$  to  $3.46V$ ,  $T_C=0^{\circ}C$  to  $70^{\circ}C$

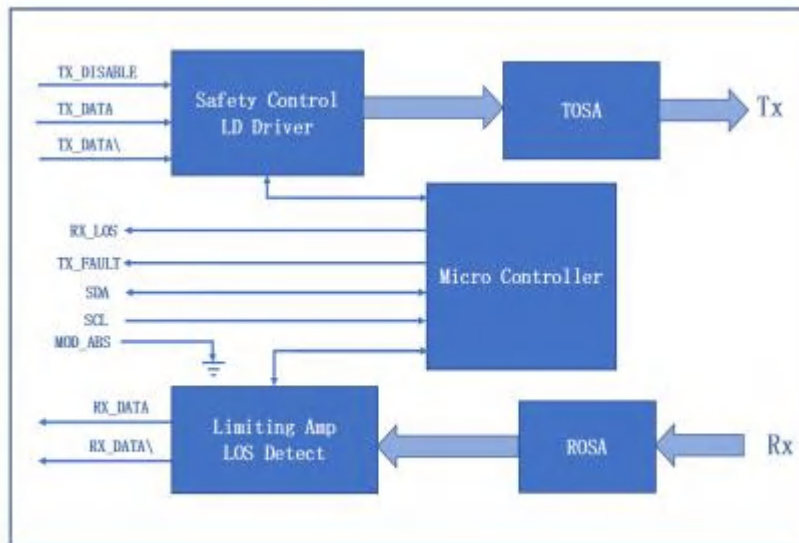
Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Differential data output swing	$V_{OUT\ PP}$	300		850	mV	
Data output rise/fall time (20%-80%)	$t_r/t_f$	28			ps	
LOS Fault	$V_{LOS\ A}$	2		$V_{CC\ HOST}$	V	
LOS Normal	$V_{LOS\ D}$	$V_{EE}$		$V_{EE}+0.5$	V	

## Digital Diagnostic Functions

SFP-10GB-ZR supports the 2-wire serial communication protocol as defined in SFF-8472. Digital diagnostic information is accessible over the 2-wire interface at the address 0xA2. Digital diagnostics for SFP-10GB-ZR are internally calibrated by default. The internal micro control unit accesses the device operating parameters in real time, such as transceiver temperature, laser bias current, transmitted optical power, received optical power and transceiver supply voltage. The module implements the alarm function of the SFF-8472, alerts the user when a particular operating parameter exceeds the factory-set normal range.

Digital Diagnostic Threshold Range					
Parameter	High Alarm	High Warning	Low Warning	Low Alarm	Remarks
Temperature ( $^{\circ}C$ )	75	70	0	-5	
Voltage (V)	3.63	3.46	3.13	2.97	
Bias Current (mA)	100	95	20	15	
Tx Power ( $\mu w$ )	3014.2	2511.8	1000	800	
Rx Power ( $\mu w$ )	251.7	188.8	2.9	1.9	

## Block-Diagram-of-Transceiver



## Functions Description

The transmitter consists of a laser driver chip and a TOSA (light-emitting component). The TOSA includes a 1550nm DFB laser, an electroabsorption modulator (EAM), a TEC, and a backlight diode. Unlike DML, EML TOSA uses external modulation. When the transmission rate of the system is high, the transmission distance is not only limited by the attenuation of the optical fiber, but also by the dispersion of the optical fiber, and the dispersion of the optical communication system is related to the modulation spectral width. The directly modulated laser has a large dispersion cost, and has spectral broadening, frequency chirp, and short transmission distance, so the external modulation method is CNFIBERNETted in the medium-long-distance transmission at a rate of 10 Gb/s.

TEC (Thermo Electric Cooler) Controls the temperature of the laser tube. When a temperature is set, the TOSA temperature of the module will remain unchanged through the control of the TEC.

The wavelength of the module laser tube is related to the temperature of the laser tube.

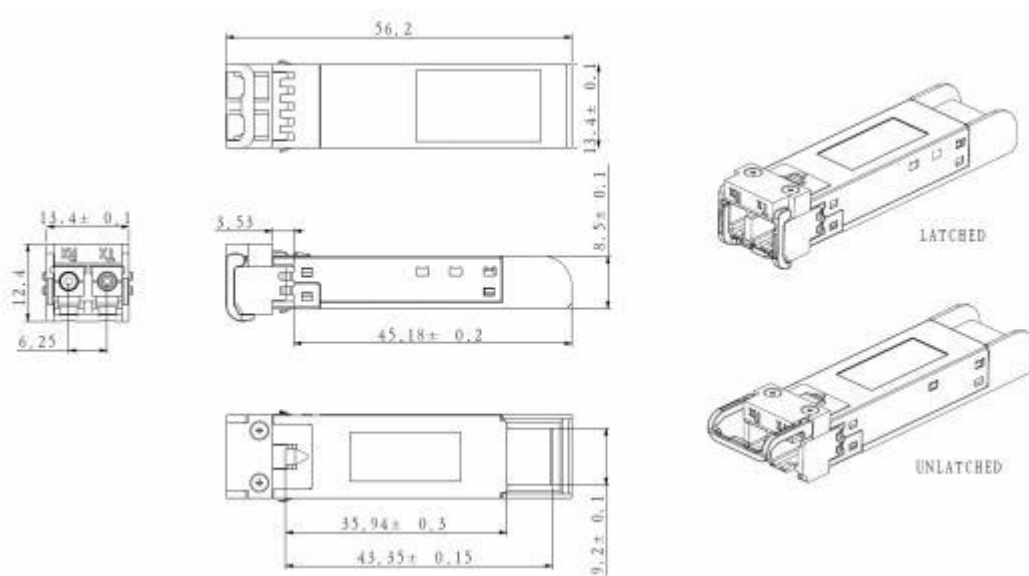
The module wavelength can be set by setting the TOSA temperature. When stable, the module has excellent wavelength stability. The electrical signal enters

the optical module from the serial electrical interface and is then input to the laser driver chip. The laser driver chip supplies the bias current and the modulation current to the laser. The laser driver chip simultaneously uses an automatic optical power control (APC) feedback loop to maintain a constant average optical power of the laser output. The purpose is to eliminate the change of the output optical signal due to temperature changes and aging of the light source device. When the transmitter enable pin (TX\_Disable) is high (TTL logic "1"), the laser output is turned off. When TX\_Disable is low (TTL logic "0"), the laser will turn on within 1ms. When the transmitter fault signal (TX\_Fault) is reported as high, indicates a transmitter failure caused by the transmitter's bias current or transmitted optical power or laser tube temperature exceeding a preset alarm threshold. Low indicates normal operation.

The receiver consists of a ROSA (light-receiving component) and a limiting amplifier chip, ROSA includes a APD photodetector and a transimpedance amplifier chip. The ROSA detects the incident optical signal, converts the optical signal into an electrical signal, and outputs the electrical signal to the

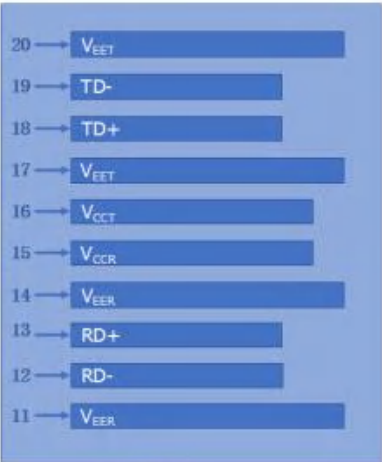
limiting amplifier. The electrical signal is further amplified by the limiting amplifier , then outputs a fixed-amplitude electrical signal to the host. When the amplitude of the electrical signal received from the incident light conversion of the opposite optical transceiver module is lower than the set threshold, the module reports that the received signal is lost, the RX\_LOS pin is high (logic "1"), which can be used to diagnose whether the physical signal is normal. The signal is operated in TTL level. The microprocessor inside the module monitors the module's operating voltage, temperature, transmitted optical power, received optical power, and laser bias current value in real time. The host acquires this information over a 2-wire serial bus.

## Dimensions

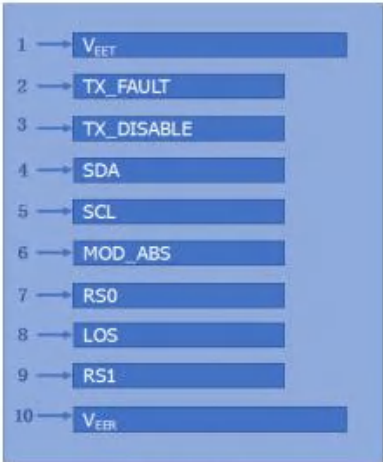
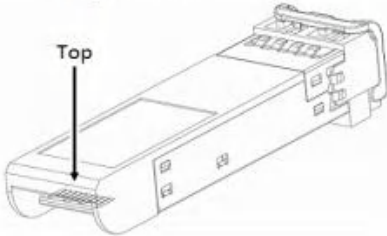


ALL DIMENSIONS ARE  $\pm 0.2$ mm UNLESS OTHERWISE SPECIFIED  
UNIT: mm

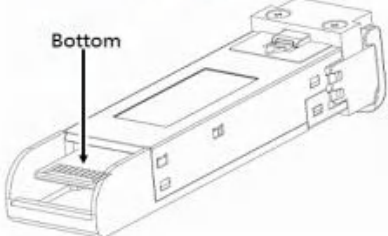
# Electrical Pad Layout



Top of Board



Bottom of Board



## Pin Assignment

PIN #	Symbol	Description	Remarks
1	V <sub>EET</sub>	Transmitter ground (common with receiver ground)	1
2	TX_FAULT	Transmitter Fault	
3	TX DISABLE	Transmitter Disable. Laser output disabled on high or open	2
4	SDA	2-wire Serial Interface Data Line	3
5	SCL	2-wire Serial Interface Clock Line	3
6	MOD_ABS	Module Absent. Grounded within the module	3
7	RS0	No connection required	
8	LOS	Loss of Signal indication. Logic 0 indicates normal operation	4
9	RS1	No connection required	1
10	V <sub>EER</sub>	Receiver ground (common with transmitter ground)	1
11	V <sub>EER</sub>	Receiver ground (common with transmitter ground)	1
12	RD-	Receiver Inverted DATA out. AC coupled	
13	RD+	Receiver Non-inverted DATA out. AC coupled	
14	V <sub>EER</sub>	Receiver ground (common with transmitter ground)	1
15	V <sub>CCR</sub>	Receiver power supply	
16	V <sub>CCT</sub>	Transmitter power supply	
17	V <sub>EET</sub>	Transmitter ground (common with receiver ground)	1
18	TD+	Transmitter Non-Inverted DATA in. AC coupled	
19	TD-	Transmitter Inverted DATA in. AC coupled	
20	V <sub>EET</sub>	Transmitter ground (common with receiver ground)	1

### Notes:

1. Circuit ground is isolated from chassis ground
2. Disabled: T<sub>DIS</sub>>2V or open, Enabled: T<sub>DIS</sub><0.8V
3. Should Be pulled up with 4.7k –10k ohm on host board to a voltage between 2V and 3.6V
4. LOS is open collector output



## **CNFIBERNET10GBASE-T Copper SFP+ Transceiver**

### **SFP-10GE-T**



### **1.PRODUCT FEATURES**

- Support 10Gbase-T / 5Gbase-T / 2.5Gbase-T / 1000base-T
- Hot-pluggable SFP footprint
- Compact RJ-45 connector assembly
- RoHS compliant and lead-free
- Single +3.3V power supply
- 10 Gigabit Ethernet over Cat 6a cable
- Ambient Operating temperature: 0°C to +65°C

### **2.PRODUCT DESCRIPTION**

SFP-10GE-T Copper Small Form Pluggable (SFP) transceivers are based on the SFP Multi Source Agreement (MSA) . They are compatible with the 10Gbase-T / 5Gbase-T /





2.5Gbase-T / 1000base-T standards as specified in IEEE Std 802.3 . SFP-10GE-T uses the SFP's RX\_LOS(must be pulled up on host) pin for link indication. If pull up or open SFP's TX\_DISABLE pin, PHY IC be reset.

### 3. Cable Length

Standard	Cable	Reach	Host Port
10Gbase-T	CAT6A	30m	XFI
5Gbase-T/2.5Gbase-t	CAT5E	50m	5GBase-R/2.5GBase-X
1000base-T	CAT5E	100m	1000base-FX

### 4.SFP to Host Connector Pin Out

Pin	Symbol	Name/Description	Ref.
1	VEET	Transmitter Ground (Common with Receiver Ground)	1
2	TFAULT	Transmitter Fault. Not supported.	
3	TDIS	Transmitter Disable. Laser output disabled on high or open.	2
4	MOD_DEF(2)	Module Definition 2. Data line for Serial ID.	3
5	MOD_DEF(1)	Module Definition 1. Clock line for Serial ID.	3
6	MOD_DEF(0)	Module Definition 0. Grounded within the module.	3
7	Rate Select	No connection required	
8	LOS	High indicates no linked. low indicates linked.	4
9	VEER	Receiver Ground (Common with Transmitter Ground)	1
10	VEER	Receiver Ground (Common with Transmitter Ground)	1
11	VEER	Receiver Ground (Common with Transmitter Ground)	1
12	RD-	Receiver Inverted DATA out. AC Coupled	
13	RD+	Receiver Non-inverted DATA out. AC Coupled	
14	VEER	Receiver Ground (Common with Transmitter Ground)	1
15	VCCR	Receiver Power Supply	
16	VCCT	Transmitter Power Supply	

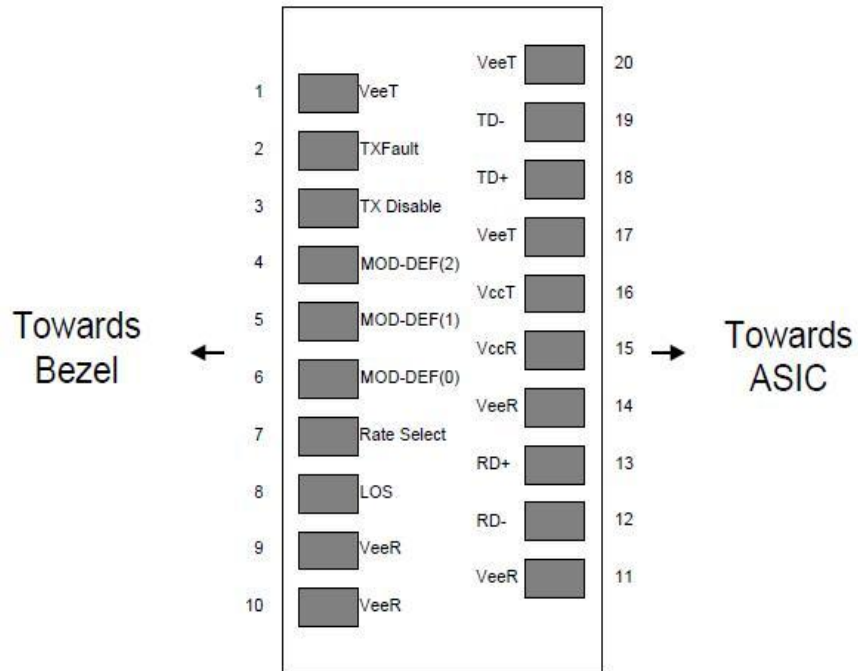




17	VEET	Transmitter Ground (Common with Receiver Ground)	1
18	TD+	Transmitter Non-Inverted DATA in. AC Coupled.	
19	TD-	Transmitter Inverted DATA in. AC Coupled.	
20	VEET	Transmitter Ground (Common with Receiver Ground)	1

**Notes:**

1. Circuit ground is connected to chassis ground
2. PHY disabled on  $T_{DIS} > 2.0V$  or open, enabled on  $T_{DIS} < 0.8V$
3. Should be pulled up with 4.7k - 10k Ohms on host board to a voltage between 2.0 V and 3.6 V.  
MOD\_DEF(0) pulls line low to indicate module is plugged in.
4. LVTTTL compatible with a maximum voltage of 2.5V.



**Figure 1. Diagram of host board connector block pin numbers and names**





## 5. +3.3V Volt Electrical Power Interface

The SFP-10GE-T has an input voltage range of 3.3 V +/- 5%. The 4V maximum voltage is not allowed for continuous operation.

+3.3 Volt Electrical Power Interface						
Parameter	Symbol	Min	Typ	Max	unit	Notes/Conditions
Supply Current	Is		700	900	mA	3.0W max power over full range of voltage and temperature. See caution note below
Input Voltage	Vcc	3.13	3.3	3.47	V	Referenced to GND
Maximum Voltage	Vmax			4	V	
Surge Current	Isurge		TBD		mA	Hot plug above steady state current. See caution note below

Caution: Power consumption and surge current are higher than the specified values in the SFP MSA

## 6. Low-Speed Signals

MOD\_DEF(1) (SCL) and MOD\_DEF(2) (SDA), are open drain CMOS signals (see section VII, "Serial Communication Protocol"). Both MOD\_DEF(1) and MOD\_DEF(2) must be pulled up to host\_Vcc

Low-Speed Signals, Electronic Characteristics					
Parameter	Symbol	Min	Max	unit	Notes/Conditions
SFP Output LOW	VOL	0	0.5	V	4.7k to 10k pull-up to host_Vcc, measured at host side of connector
SFP Output HIGH	VOH	host_Vcc -0.5	host_Vcc + 0.3	V	4.7k to 10k pull-up to host_Vcc, measured at host side of connector
SFP Input LOW	VIL	0	0.8	V	4.7k to 10k pull-up to Vcc, measured at SFP side of connector
SFP Input HIGH	VIH	2	Vcc + 0.3	V	4.7k to 10k pull-up to Vcc, measured at SFP side of connector





## 7.High-Speed Electrical Interface

All high-speed signals are AC-coupled internally.

High-Speed Electrical Interface, Transmission Line-SFP						
Parameter	Symbol	Min	Typ	Max	unit	Notes/Conditions
Line Frequency	fL		125		MHz	5-level encoding, per IEEE 802.3
Tx Output Impedance	Zout,TX		100		Ohm	Differential, for all frequencies between 1MHz and 125MHz
Rx Input Impedance	Zin,RX		100		Ohm	Differential, for all frequencies between 1MHz and 125MHz

High-Speed Electrical Interface, Host-SFP						
Parameter	Symbol	Min	Typ	Max	unit	Notes/Conditions
Single ended data input swing	Vinsing	250		1200	mV	Single ended
Single ended data output swing	Voutsing	350		800	mV	Single ended
Rise/Fall Time	T <sub>r</sub> ,T <sub>f</sub>		175		psec	20%-80%
Tx Input Impedance	Zin		50		Ohm	Single ended
Rx Output Impedance	Zout		50		Ohm	Single ended

## 8.General Specifications

General						
Parameter	Symbol	Min	Typ	Max	unit	Notes/Conditions
Data Rate	BR	1		10	Gb/sec	IEEE 802.3 compatible. See Notes 1,2 below

**Notes:**

1. Clock tolerance is +/- 50 ppm

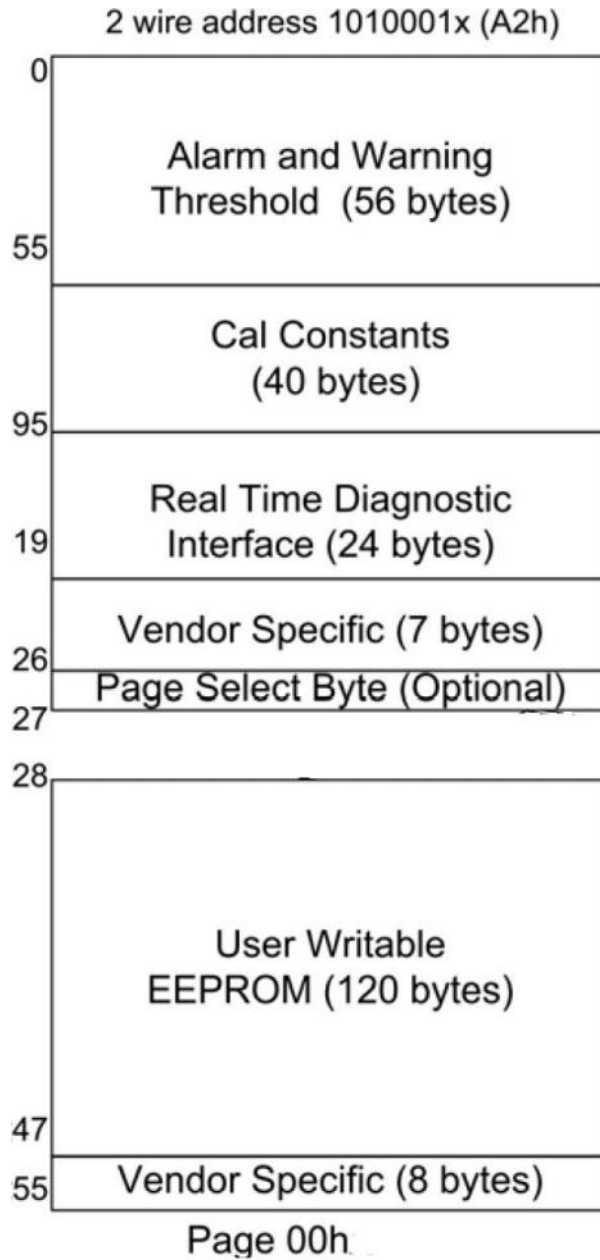
## 9. EEPROM INFORMATION (A0)



Addr	Field Size (Bytes)	Name of Field	HEX	Description
0	1	Identifier	03	SFP
1	1	Ext. Identifier	04	MOD4
2	1	Connector	22	RJ45
3-10	8	Transceiver	00 00 00 00 00 00 00 00	Transmitter Code
11	1	Encoding	06	64B66B
12	1	BR, nominal	67	10000M bps
13	1	Reserved	00	
14	1	Length (9um)-km	00	
15	1	Length (9um)	00	
16	1	Length (50um)	00	
17	1	Length (62.5um)	00	
18	1	Length (copper)	1E	30m
19	1	Reserved	00	
20-35	16	Vendor name	57 49 4E 54 4F 50 20 20 20 20 20 20 20 20 20 20	OEM
36	1	Reserved	00	
37-39	3	Vendor OUI	00 00 00	
40-55	16	Vendor PN	xx xx xx xx xx xx xx xx xx xx xx xx xx xx xx xx	ASC II
56-59	4	Vendor rev	31 2E 30 20	V1.0
60-61	2	Wavelength	00 00	850nm
62	1	Reserved	00	
63	1	CC BASE	XX	Check sum of byte 0~62
64-65	2	Options	00 1A	LOS, TX_DISABLE, TX_FAULT
66	1	BR, max	00	
67	1	BR, min	00	
68-83	16	Vendor SN	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	Unspecified
84-91	8	Vendor date code	XX XX XX 20	Year, Month, Day
92-94	3	Reserved	00	
95	1	CC_EXT	XX	Check sum of byte 64~94
96-255	160	Vendor specific		



### 10. EEPROM INFORMATION (A2) , optional



### 11.Environmental Specifications





Automatic crossover detection is enabled. External crossover cable is not required

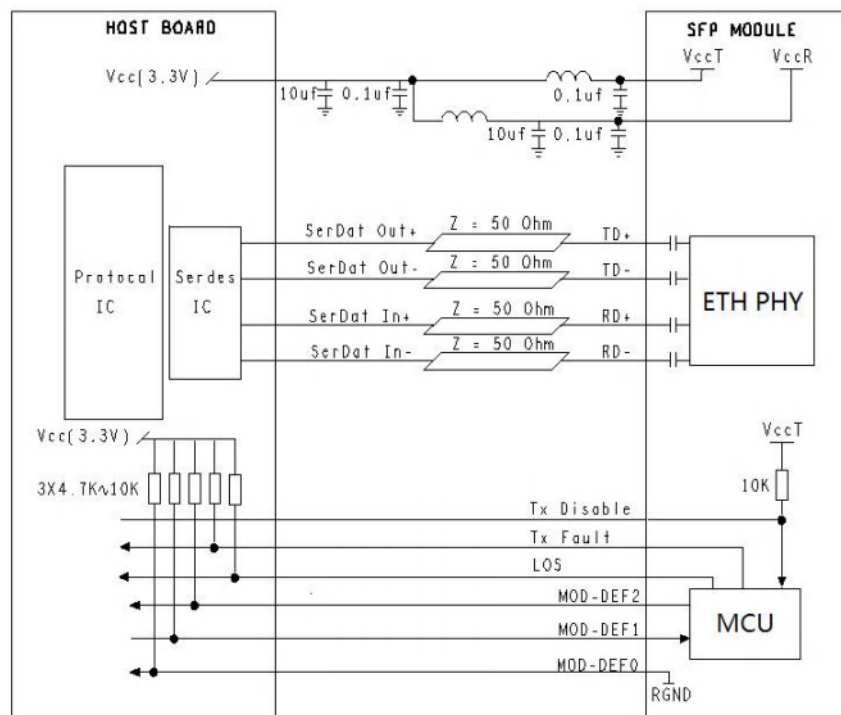
Environmental Specifications						
Parameter	Symbol	Min	Typ	Max	unit	Notes/Conditions
Operating Temperature	Top	0		65	°C	Case temperature
Storage Temperature	Tsto	-40		85	°C	Ambient temperature

## 12. Serial Communication Protocol

All CNFIBERNETSFPs support the 2-wire serial communication protocol outlined in the SFP MSA. These SFPs use an MCU, can be accessed with address of A0h.

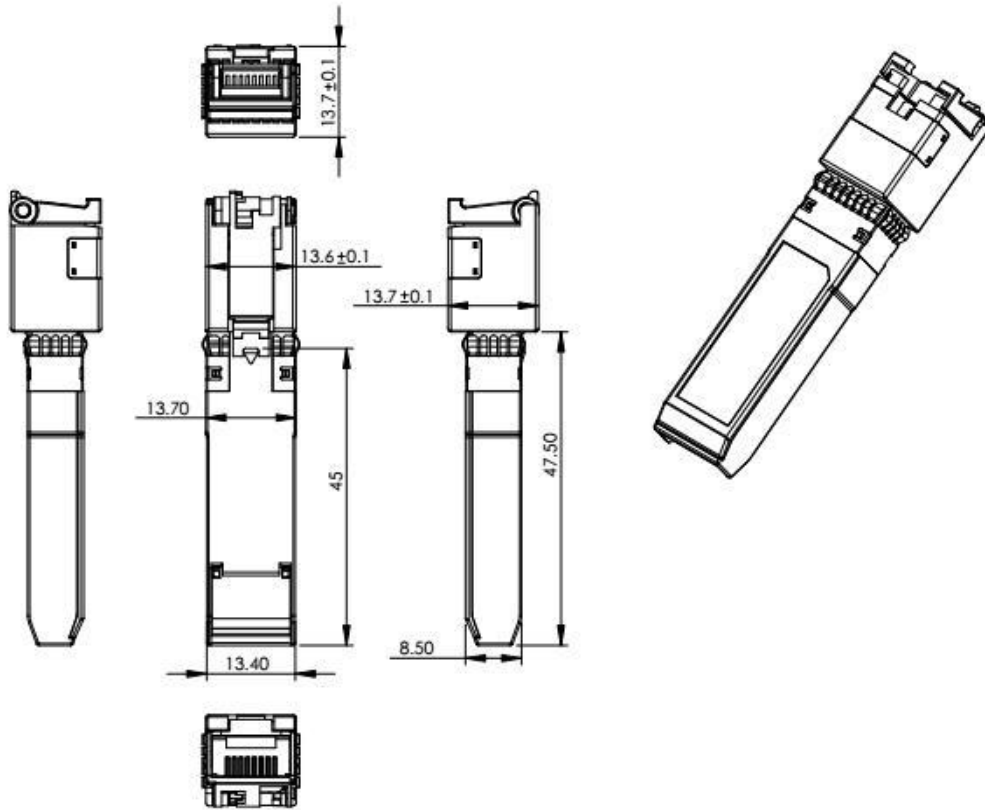
Serial Bus Timing, Requirements						
Parameter	Symbol	Min	Typ	Max	unit	Notes/Conditions
I <sup>2</sup> C Clock Rate		0		200,000	Hz	

## 13. Recommended Application Circuit





### 14. Mechanical Specifications (Unit:mm)



## DATA SHEET

### CNFIBERNET: SFP-10GB-LR

10Gb/s SFP+ LR Transceiver

#### SFP-10GB-LR

CNFIBERNET SFP-10GB-LR SFP+ optical transceivers are based on 10G Ethernet IEEE 802.3ae standard and SFF-8431 standard, providing a fast and reliable interface for 10G Ethernet applications. The product implements digital diagnostics via a 2-wire serial bus, compliant with the SFF-8472 standard.

#### Product Features

- Supports from 9.83Gb/s to 11.3Gb/s bit rates
- Compliant with IEEE 802.3ae 10GBASE-LR/LW
- Compliant with 10G FC 1200-SM-LL-L
- Compliant with SFF-8431
- Hot-pluggable SFP+ footprint
- 1310nm DFB laser transmitter
- Duplex LC connector
- Built-in digital diagnostic functions
- Up to 10km on SMF
- Single power supply 3.3V
- RoHS Compliant
- Operating temperature range (Case Temperature) : C Grade 0°C to 70°C  
I Grade -40°C to 85°C

#### Applications

- 10GBASE-LR/LW Ethernet
- 10G Fibre Channel
- 10G CPRI

## Ordering Information

Part Number	Description	Color on Clasp
SFP-10GB-LR	10GBASE-LR SFP+ 1310nm LC Connectors 10km on SMF, Commercial Temperature.	Blue
<b>For More Information:</b> China Fiber Optic Network Supply Chain Center 10 Xiyuan Road, Hangzhou, Zhejiang Province, China Sales email : sales@cnfibernet.cn WEB: <a href="https://cnfibernet.cn/">https://cnfibernet.cn/</a>		

## General Specifications

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Data Rate	DR	9.83	10.3125	11.3	Gb/s	1
Bit Error Rate	BER			10 <sup>-12</sup>		
Operating Temperature	T <sub>c</sub>	0		70	°C	2
		-40		85	°C	2
Storage Temperature	T <sub>STO</sub>	-40		85	°C	3
Supply Current	I <sub>CC</sub>		200	285	mA	4
Input Voltage	V <sub>CC</sub>	3.14	3.3	3.46	V	
Maximum Voltage	V <sub>MAX</sub>	-0.5		4	V	4

### Notes:

1. IEEE 802.3ae
2. Case temperature
3. Ambient temperature
4. For electrical power interface

## Link Distances

Data Rate	Fiber Type	Distance Range (km)
9.83 - 11.3 Gb/s	9/125umSMF	10

## Optical – Characteristics – Transmitter

$V_{CC}=3.14V$  to  $3.46V$ ,  $T_C$

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Output Optical Power	$P_{TX}$	-8.2		0.5	dBm	1
Optical Center Wavelength	$\lambda_C$	1260		1355	nm	
Optical Modulation Amplitude	OMA	-5.2			dBm	2
Extinction Ratio	ER	3.5	5.5		dB	
Spectral Width(-20dB)	$\Delta\lambda$			1	nm	
Side Mode Suppression Ratio	SMSR	30			dB	
Relative Intensity Noise	RIN			-128	dB/Hz	
Transmitter Dispersion Penalty	TDP			3.2	dB	
Launch Power of OFF Transmitter	$P_{OUT\_OFF}$			-30	dBm	1
Transmitter Jitter						2

**Notes:**

1. Average
2. According to IEEE 802.3ae requirement

## Optical – Characteristics – Receiver

$V_{CC}=3.14V$  to  $3.46V$ ,  $T_C$

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Optical Center Wavelength	$\lambda_C$	1260		1600	nm	
Average Receive Power	$P_{RX}$	-14.4		0.5	dBm	
Receiver Sensitivity @10.3Gb/s	$RX\_SEN$			-14.4	dBm	1
Receiver Reflectance	$TR_{RX}$			-12	dB	
LOS Assert	$LOS_A$	-30			dBm	
LOS De-Assert	$LOS_D$			-17	dBm	
LOS Hysteresis	$LOS_H$	0.5			dB	

**Notes:**

1. Test the resulting value using the minimum ER value within the defined range; BER<10<sup>-12</sup>; 2<sup>31</sup>-1 PRBS

## Electrical – Characteristics – Transmitter

$V_{CC}=3.14V$  to  $3.46V$ ,  $T_C$

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Input differential impedance	$R_{IN}$		100		$\Omega$	
Differential data input swing	$V_{IN\ PP}$	180		700	mV	
Transmit disable voltage	$V_D$	2		$V_{CC}$	V	
Transmit enable voltage	$V_{EN}$	$V_{EE}$		$V_{EE}+0.8$	V	

## Electrical – Characteristics – Receiver

$V_{CC}=3.14V$  to  $3.46V$ ,  $T_C$

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Differential data output swing	$V_{OUT\ PP}$	300		850	mV	
Data output rise/fall time (20%-80%)	$t_r/t_f$	28			ps	
LOS Assert	$V_{LOS\ A}$	2		$V_{CC\ HOST}$	V	
LOS De-Assert	$V_{LOS\ D}$	$V_{EE}$		$V_{EE}+0.5$	V	

## A0H Register Description

IIC Addr	Size	Name	Description	Values(HEX)
0	1	Identifier	SFP/SFP+/SFP28	03
1	1	Extended Identifier	Use IIC interface	04
2	1	Connector	Connector Type = LC	07
3-10	8	Transceiver	10G Base LR	20 00 00 00 00 00 00 00
11	1	Encoding	Encoding Type = 64B/66B	06
12	1	BR, Nominal	Nominal Bit Rate 10.3Gb/s	67
13	1	Rate Identifier	Without rate selection function	00
14	1	Length(9μm)-km	Link Length / SMF = 10km	0A
15	1	Length (9μm)-100m	Link Length / SMF = 10km	64
16	1	Length (50μm)-10m	50μm MMF Link Length = N/A	00
17	1	Length (62.5μm)-10m	62.5μm MMF Link Length = N/A	00
18	1	Length (Copper)	Copper Link Length = N/A	00
19	1	Reserved	Reserved	00
20-35	16	Vendor name	CNFIBERNET	4D 4F 44 55 4C 45 54 45 4B 20 20 20 20 20 20 20
36	1	Transceiver	Reserved	00
37-39	3	Vendor OUI	Without vendor OUI	00 00 00
40-55	16	Vendor PN	Part number in the Ordering Information	Programmed by Factory
56-59	4	Vendor Revision Number	Manufacturer product version number	Programmed by Factory
60-61	2	Wavelength	Laser Wavelength = 1310nm	05 1E
62	1	Reserved	Reserved	00
63	1	CC_BASE	Checksum of bytes 0-62	Programmed by Factory
64-65	2	Transceiver Options	1.Rx_LOS 2.Tx_FAULT 3.Tx_DIS	00 1A
66	1	BR, max	NA	00
67	1	BR, min	NA	00
68-83	16	Vendor SN	Manufacturer serial number	Programmed by Factory
84-91	8	Date code	Date code	Programmed by Factory
92	1	Monitoring Type	Internal calibration of DOM RxPower measurement using average optical power	68
93	1	Enhanced Options	1.Monitor Alarm and Warning of TxPower and RxPower 2.Tx_DIS Monitor and Control 3.Rx_LOS Monitor 4.Tx_FAULT Monitor	F0
94	1	Compliance	Revision Implemented	08
95	1	CC_EXT	Check sum of bytes 64-94	Programmed by Factory
96-127	32	Vendor Specific	Vendor Specific Area	Programmed by Factory
128-255	128	Vendor Specific	Vendor Specific Area	Programmed by Factory

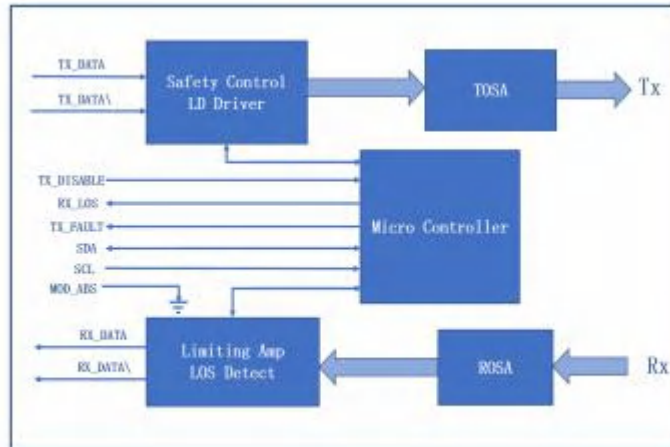
## Digital Diagnostic Functions

SFP-10GB-LR supports the 2-wire serial communication protocol as defined in SFF-8472. Digital diagnostic information is accessible over the 2-wire interface at the address 0xA2. Digital diagnostics for SFP-10GB-LR are internally calibrated by default. The internal micro control unit accesses the device operating parameters in real time, Such as transceiver temperature, laser bias current, transmitted optical power, received optical power and transceiver supply voltage. The module implements the alarm function of the SFF-8472, alerts the user when a particular operating parameter exceeds the factory-set normal range.

## DDM Threshold Information

Parameter		Alarm Threshold		Warning Threshold	
		High Value	Low Value	High Value	Low Value
Temperature (°C)	C	90 (5A 00)	-10 (F6 00)	85 (55 00)	-5 (FB 00)
	I	90 (5A 00)	-45 (D3 00)	85 (55 00)	-40 (D8 00)
Vcc (V)		3.63(8D CC)	2.97 (74 04)	3.46 (87 28)	3.13 (7A 44)
Bias (mA)		100 (C3 50)	2 (03 E8)	80 (9C 40)	4 (07 D0)
TxPower (dBm)		1.3 (34 98)	-9.2 (04 BA)	0.5 (2B D4)	-8.2 (05 E9)
RxPower (dBm)		3.0 (4E 20)	-18.0 (00 9E)	0.0 (27 10)	-15.0 (01 3C)

## Block-Diagram-of-Transceiver



## Functions Description

The transmitter consists of a laser driver chip and a TOSA (light-emitting component), the TOSA includes a 1310nm DFB laser and a backlight photodetection chip. When the module is working, and the input signal is connected to the laser driver chip. The laser driver chip supplies the bias current and the modulation current to the laser. The laser driver chip simultaneously uses an automatic optical power control (APC) feedback loop to maintain a constant average optical power of the laser output. The purpose is to eliminate the change of the output optical signal due to temperature changes and aging of the light source device. When the transmitter enable pin (TX\_Disable) is high (TTL logic "1"), the laser output is turned off. When TX\_Disable is low (TTL logic "0"), the laser will turn on within 1ms. When the transmitter fault signal (TX\_Fault) is reported as high, indicates a transmitter failure caused by the transmitter's bias current or transmitted optical power or laser tube temperature exceeding a preset alarm threshold. Low indicates normal operation.

There is no isolator at the transmitter and the anti-reflection capability will be deteriorated, which is related to the actual link fiber environment.

The receiver consists of a ROSA (light-receiving component) and a limiting amplifier chip, the ROSA includes a PIN photodetector and a transimpedance amplifier chip. When the ROSA detects the incident light signal, it will be converted into a photo-generated current by the PIN photodetector. The photo-generated current is converted into an electrical signal after passing through the transimpedance amplifier. The electrical signal is further amplified by the limiting amplifier, then outputs a fixed-amplitude electrical signal to the host. When the amplitude of the electrical signal received from the incident light conversion of the opposite optical transceiver module is lower than the set threshold, the module reports that the received signal is lost, the RX\_LOS pin is high (logic "1"), which can be used to diagnose whether the physical signal is normal. The signal is operated in TTL level. The microprocessor inside the module monitors the module's operating voltage, temperature, transmitted optical power, received optical power, and laser bias current value in real time. The host acquires this information over a 2-wire serial bus.

After the module is powered on, the read value of the security level access registers 7BH ~ 7EH of A2H is replaced with 0x00. After the content of this group of registers is updated, the read value is

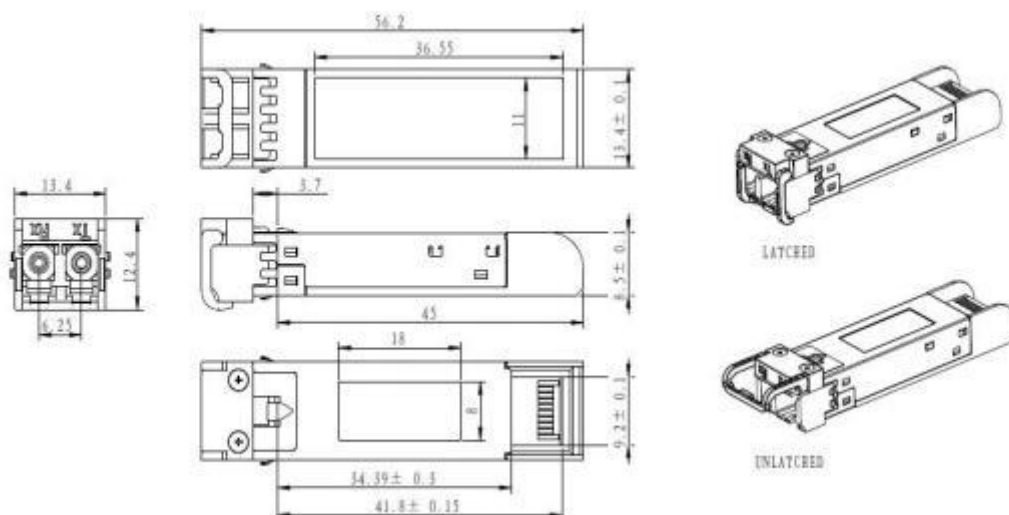
the last written value. The security level 1 password of this module is 0x00000000. The method to enter the security level 1 working state is to convert and write the security level 1 password in the A2H 7BH ~ 7EH registers of the module, namely 0x00, 0x00, 0x00, 0x00. After entering the security level 1 working state, the user can directly write to the contents of the A0H device address. This version does not support the user to write to the contents of Table 00 and Table 01 of A2H in the security level 1 state. And this version of the module does not support users to modify the security level 1 password.

## Product Weight

Net weight of module : 18.0g/pcs

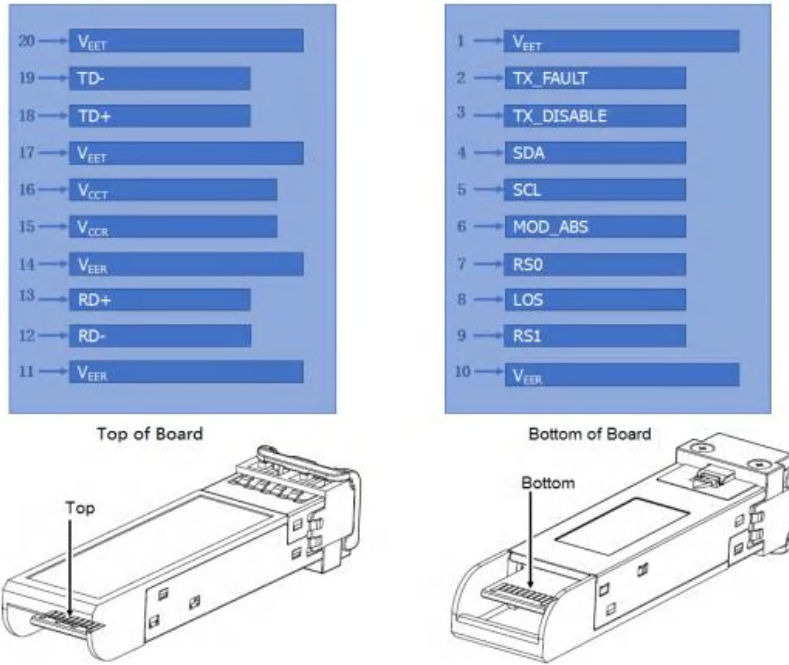
Net weight of dust cap: 0.95g/pcs

## Dimensions

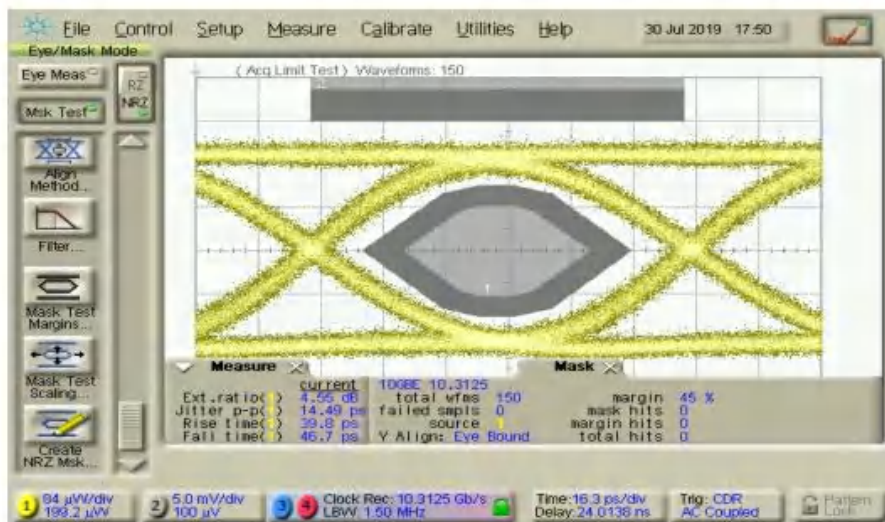


ALL DIMENSIONS ARE  $\pm 0.2\text{mm}$  UNLESS OTHERWISE SPECIFIED  
UNIT: mm

## Electrical Pad Layout



## Typical Eye Diagram



## Pin Assignment

PIN #	Symbol	Description	Remarks
1	VEET	Transmitter ground (common with receiver ground)	1
2	TX_FAULT	Transmitter Fault	2
3	TX_DISABLE	Transmitter Disable. Laser output disabled on high or open	3
4	SDA	2-wire Serial Interface Data Line	4
5	SCL	2-wire Serial Interface Clock Line	4
6	MOD_ABS	Module Absent. Grounded within the module	4
7	RS0	No connection required	
8	LOS	Loss of Signal indication. Logic 0 indicates normal operation	5
9	RS1	No connection required	1
10	VEER	Receiver ground (common with transmitter ground)	1
11	VEER	Receiver ground (common with transmitter ground)	1
12	RD-	Receiver Inverted DATA out. AC coupled	
13	RD+	Receiver Non-inverted DATA out. AC coupled	
14	VEER	Receiver ground (common with transmitter ground)	1
15	VCCR	Receiver power supply	
16	VCCT	Transmitter power supply	
17	VEET	Transmitter ground (common with receiver ground)	1
18	TD+	Transmitter Non-Inverted DATA in. AC coupled	
19	TD-	Transmitter Inverted DATA in. AC coupled	
20	VEET	Transmitter ground (common with receiver ground)	1

### Notes:

1. Circuit ground is isolated from chassis ground
2. TX\_FAULT is the open collector output and should be pulled up with 4.7k–10k ohm on host board to a voltage between 2V and  $V_{cc}+0.3V$
3. Disabled:  $T_{DIS}>2V$  or open, Enabled:  $T_{DIS}<0.8V$
4. Should be pulled up with 4.7k–10k ohm on host board to a voltage between 2V and  $V_{cc} + 0.3V$
5. LOS is open collector output and should be pulled up with 4.7k–10k ohm on host board to a voltage between 2V and  $V_{cc}0.3V$ , the logic "0" indicates normal operation, and the logic "1" indicates that the receiver signal is lost.

## DATA SHEET

### CNFIBERNET: SFP-10GB-SR

10Gb/s SFP+ Short Wavelength (850nm) Transceiver

#### SFP-10GB-SR

CNFIBERNETSFP-10GB-SR SFP optical transceivers are based on 10G Ethernet IEEE 802.3ae standard and SFF-8431 standard, providing a fast and reliable interface for 10G Ethernet applications. The product implements digital diagnostics via a 2-wire serial bus, compliant with the SFF-8472 standard.

#### Product Features

- Supports from 9.83 Gb/s to 11.3 Gb/s bit rates
- Compliant with IEEE 802.3ae 10GBASE-SR/SW
- Compliant with SFF-8431
- Hot-pluggable SFP+ footprint
- 850nm VCSEL laser transmitter
- Duplex LC connector
- Built-in digital diagnostic functions
- Up to 300m on OM3 MMF
- Low power consumption (Module work consumption <1W)
- Single power supply 3.3V
- RoHS Compliant
- Class 1 laser product complies with EN 60825-1
- Operating temperature range (Case Temperature) : C Grade 0°C to 70°C  
E Grade -5°C to 85°C  
I Grade -40°C to 85°C

#### Applications

- 10GBASE-SR/SW Ethernet
- 10G Fibre Channel
- 10G CPRI

## Ordering Information

Part Number	Description	Color on Clasp
SFP-10GB-SR	10GBASE-SR SFP+ 850nm LC 300m on MMF, with DOM function, Commercial Temperature	Black
<b>For More Information:</b> ChinaFiberOpticNetworkSupplyChainCenter 10XiyuanRoad, Hangzhou, Zhejiang Province, China Salesemail : sales@cnfibernet.cn WEB: <a href="https://cnfibernet.cn/">https://cnfibernet.cn/</a>		

## General Specifications

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Data Rate	DR	9.83	10.3125	11.3	Gb/s	1
Bit Error Rate	BER			10 <sup>-12</sup>		
Operating Temperature	T <sub>c</sub>	0		70	°C	3
		-5		85	°C	3
		-40		85	°C	3
Storage Temperature	T <sub>STO</sub>	-40		85	°C	3
Supply Current	I <sub>CC</sub>		180	290	mA	4
Input Voltage	V <sub>CC</sub>	3.14	3.3	3.46	V	
Maximum Voltage	V <sub>MAX</sub>	-0.5		4	V	4

### Notes:

1. IEEE 802.3ae
2. Case temperature
3. Ambient temperature
4. For electrical power interface

## Link Distances

Data Rate	Fiber Type	Modal Bandwidth @850nm (MHz-km)	Distance Range (m)
9.83–11.3 Gb/s	62.5/125umMMF	160	26
9.83–11.3 Gb/s	62.5/125umMMF	200	33
9.83–11.3 Gb/s	50/125umMMF	400	66
9.83–11.3 Gb/s	50/125umMMF	500	82
9.83–11.3 Gb/s	50/125umMMF	2000	300

## Optical – Characteristics – Transmitter

V<sub>CC</sub>=3.14V to 3.46V, T<sub>C</sub>

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Output Optical Power	P <sub>TX</sub>	-7		-1	dBm	1
Optical Center Wavelength	$\lambda_c$	840		860	nm	
Optical Modulation Amplitude	OMA		-1.5		dBm	2
Extinction Ratio	ER	3	5.5		dB	
Spectral Width (RMS)	$\Delta\lambda$			0.45	nm	
Relative Intensity Noise	RIN			-128	dB/Hz	
Transmitter Dispersion Penalty	TDP			3.9	dB	
Transmitter Jitter						3
Launch Power of OFF Transmitter	P <sub>OUT_OFF</sub>			-30	dBm	1

### Notes:

- 1.Average
2. IEEE 802.3ae
- 3.According to IEEE 802.3ae requirement

## Optical – Characteristics – Receiver

$V_{CC}=3.14V$  to  $3.46V$ ,  $T_C$

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Optical Center Wavelength	$\lambda_C$	840		860	nm	
Receiver Sensitivity@10.3Gb/s	RX_SEN			-10	dBm	1
Receiver Overload	POL	0.5			dBm	
Receiver Reflectance	TRRX			-12	dB	
LOS Assert	LOSA	-30			dBm	
LOS De-Assert	LOS <sub>D</sub>			-14	dBm	
LOS Hysteresis	LOSH	0.5			dB	

### Notes:

1.Measured with worst ER;BER<10<sup>-12</sup>;2<sub>31</sub>-1 PRBS

## Electrical – Characteristics – Transmitter

$V_{CC}=3.14V$  to  $3.46V$ ,  $T_C$

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Input differential impedance	R <sub>IN</sub>		100		$\Omega$	
Differential data input swing	V <sub>IN PP</sub>	180		700	mV	
Transmit disable voltage	V <sub>D</sub>	2		V <sub>CC</sub>	V	
Transmit enable voltage	V <sub>EN</sub>	V <sub>EE</sub>		V <sub>EE</sub> +0.8	V	

## Electrical – Characteristics – Receiver

$V_{CC}=3.14V$  to  $3.46V$ ,  $T_C$

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Differential data output swing	V <sub>OUT PP</sub>	300		850	mV	
Data output rise/fall time (20%-80%)	t <sub>r</sub> /t <sub>f</sub>	28			ps	
LOS Assert	V <sub>LOS A</sub>	2		V <sub>CC HOST</sub>	V	
LOS De-Assert	V <sub>LOS D</sub>	V <sub>EE</sub>		V <sub>EE</sub> +0.5	V	

## A0H Register Description

IIC Addr	Size	Name	Description	Values(HEX)
0	1	Identifier	SFP+	03
1	1	Extended Identifier	Use IIC interface	04
2	1	Connector	Connector Type = LC	07
3-10	8	Transceiver	10G Base SR	10 00 00 00 00 00 00 00
11	1	Encoding	Encoding Type = NRZ	03
12	1	BR, Nominal	Nominal Bit Rate 10.3Gb/s	67
13	1	Rate Identifier	Without rate selection function	00
14	1	Length(9μm)-km	Link Length / SMF = N/A	00
15	1	Length (9μm)-100m	Link Length / SMF = N/A	00
16	1	Length (50μm)-10m	50μm MMF Link Length = 80m	08
17	1	Length (62.5μm)-10m	62.5μm MMF Link Length = 20m	02
18	1	Length (Copper)	Copper Link Length = N/A	00
19	1	Length (50μm)-10m	50μm MMF Link Length = 300m	1E
20-35	16	Vendor name	CNFIBERNET	ASCII Format
36	1	Transceiver	Reserved	00
37-39	3	Vendor OUI	Without vendor OUI	00 00 00
40-55	16	Vendor PN	Part number in the Ordering Information	Programmed by Factory
56-59	4	Vendor Revision Number	Manufacturer product version number	Programmed by Factory
60-61	2	Wavelength	Laser Wavelength	03 52
62	1	Reserved	Reserved	00
63	1	CC_BASE	Checksum of bytes 0-62	Programmed by Factory
64-65	2	Transceiver Options	1.Tx_DIS 2.Rx_LOS 3.Tx_FAULT	00 1A
66	1	BR, max	NA	00
67	1	BR, min	NA	00
68-83	16	Vendor SN	Manufacturer serial number	Programmed by Factory
84-91	8	Date code	Date code	Programmed by Factory
92	1	Monitoring Type	Internal calibration of DOM RxPower measurement using average optical power	68
93	1	Enhanced Options	1.Monitor Alarm and Warning of TxPower and RxPower 2.Tx_DIS Monitor and Control 3.Rx_LOS Monitor 4.Tx_FAULT Monitor	F0
94	1	Compliance	Revision Implemented	08
95	1	CC_EXT	Check sum of bytes 64-94	Programmed by Factory
96-127	32	Vendor Specific	Vendor Specific Area	Programmed by Factory
128-255	128	Vendor Specific	Vendor Specific Area	Programmed by Factory

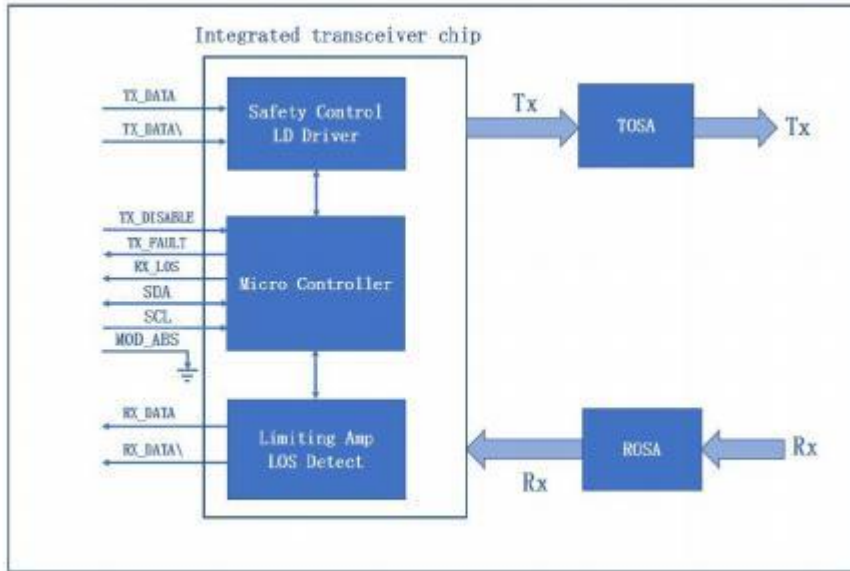
## Digital Diagnostic Functions

SFP-10GB-SR supports the 2-wire serial communication protocol as defined in SFF-8472. Digital diagnostic information is accessible over the 2-wire interface at the address 0xA2. Digital diagnostics for SFP-10GB-SR are internally calibrated by default. The internal micro control unit accesses the device operating parameters in real time, Such as transceiver temperature, laser bias current, transmitted optical power, received optical power and transceiver supply voltage. The module implements the alarm function of the SFF-8472, alerts the user when a particular operating parameter exceeds the factory-set normal range.

## DDM Threshold Information

Parameter		Alarm Threshold		Warning Threshold	
		High Value	Low Value	High Value	Low Value
Temperature (°C)	C	90 (5A 00)	-10 (F6 00)	85 (55 00)	-5 (FB 00)
	E	90 (5A 00)	-10 (F6 00)	85 (55 00)	-5 (FB 00)
	I	90 (5A 00)	-45 (D3 00)	85 (55 00)	-40 (D8 00)
Vcc (V)		3.63(8D CC)	2.97 (74 04)	3.46 (87 28)	3.13 (7A 44)
Bias (mA)		15 (1D 4C)	1 (01 F4)	12 (17 70)	2 (03 E8)
TxPower (dBm)		0.79 (2E E0)	-7.97 (06 3C)	0.0 (27 10)	-7.0 (07 CB)
RxPower (dBm)		3.01 (4E 20)	-16.02 (00 FA)	0.0 (27 10)	-13.0 (01 F5)

## Block-Diagram-of-Transceiver



## Functions Description

The transmitter is mainly composed of a laser driver part of the intelligent transceiver chip and a TOSA (light-emitting component), the TOSA includes a 850nm VCSEL laser and a backlight photodetection chip, When the module is working, the input signal is connected to the intelligent transceiver chip, at this time, the laser driver of the intelligent transceiver chip supplies the bias current and the modulation current to the laser. The intelligent transceiver chip simultaneously uses an automatic optical power control (APC) feedback loop to maintain a constant average optical power of the laser output. The purpose is to eliminate the change of the output optical signal due to temperature changes and aging of the light source device. When the transmitter enable pin (TX\_Disable) is high (TTL logic "1"), the laser output is turned off. When TX\_Disable is low (TTL logic "0"), the laser will turn on within 1ms. When the transmitter fault signal (TX\_Fault) is reported as high, indicates a transmitter failure caused by the transmitter's bias current or transmitted optical power or laser tube temperature exceeding a preset alarm threshold. Low indicates normal operation.

The receiver is mainly composed of a limiting amplifier part of the intelligent transceiver chip and a ROSA (light-receiving component), the ROSA includes a PIN photodetector and a transimpedance amplifier chip. When the ROSA detects the incident light signal, it will be converted into a photo-generated current by the PIN photodetector. The photo-generated current is converted into an electrical signal after passing through the transimpedance amplifier. The electrical signal is further amplified by the limiting amplifier of the intelligent transceiver chip, then outputs a fixed-amplitude electrical signal to the host. When the amplitude of the electrical signal received from the incident light conversion of the opposite optical transceiver module is lower than the set threshold, the module reports that the received signal is lost, the RX\_LOS pin is high (logic "1"), which can be used to diagnose whether the physical signal is normal. The signal is operated in TTL level. The microprocessor inside the module monitors the module's operating voltage, temperature, transmitted optical power, received optical power, and laser bias current value in real time. The host acquires this information over a 2-wire serial bus.

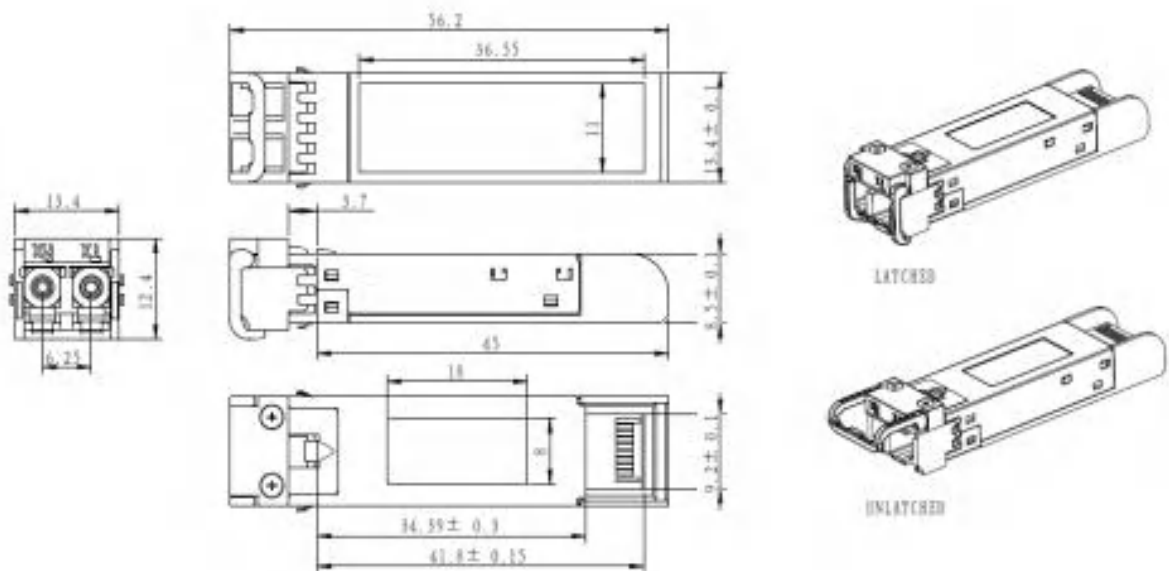
After the module is powered on, the read value of the security level access registers 7BH ~ 7EH of A2H is replaced with 0x00. After the content of this group of registers is updated, the read value is the last written value. The security level 1 password of this module is 0x00001011. The method to enter the security level 1 working state is to convert and write the security level 1 password in the A2H 7BH ~ 7EH registers of the module, namely 0x00, 0x00, 0x10, 0x11. After entering the security level 1 working state, the user can directly write to the content of the A0H device address, or modify the content of the A2H 7FH table selection register to write to the contents of Table 00 or Table 01. And this version of the module does not support users to modify the security level 1 password.

## product Weight

Net weight of module : 15.7g/pcs

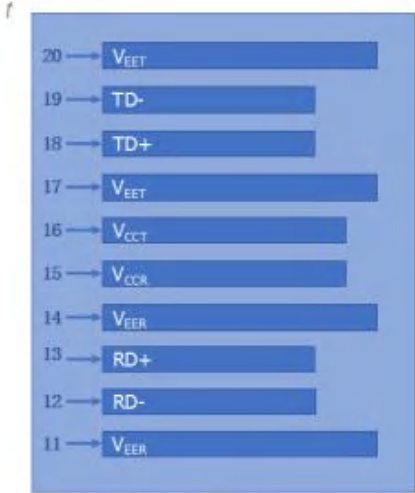
Net weight of dust cap: 0.95g/pcs

## Dimensions

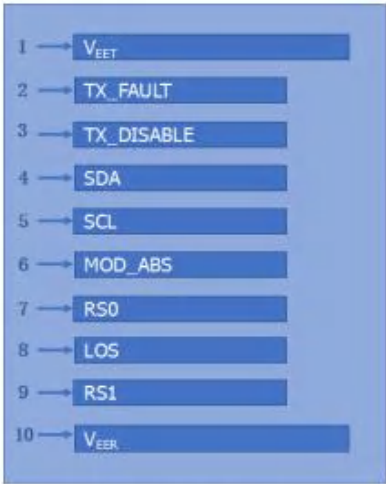
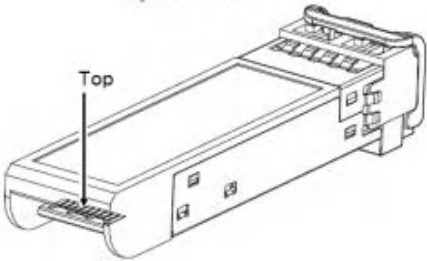


ALL DIMENSIONS ARE  $\pm 0.2$ mm UNLESS OTHERWISE SPECIFIED  
UNIT: mm

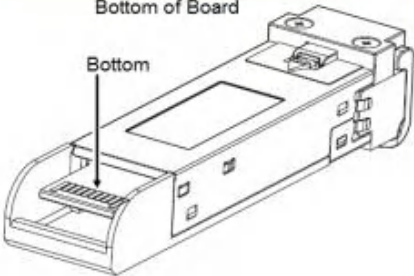
# Electrical Pad Layout



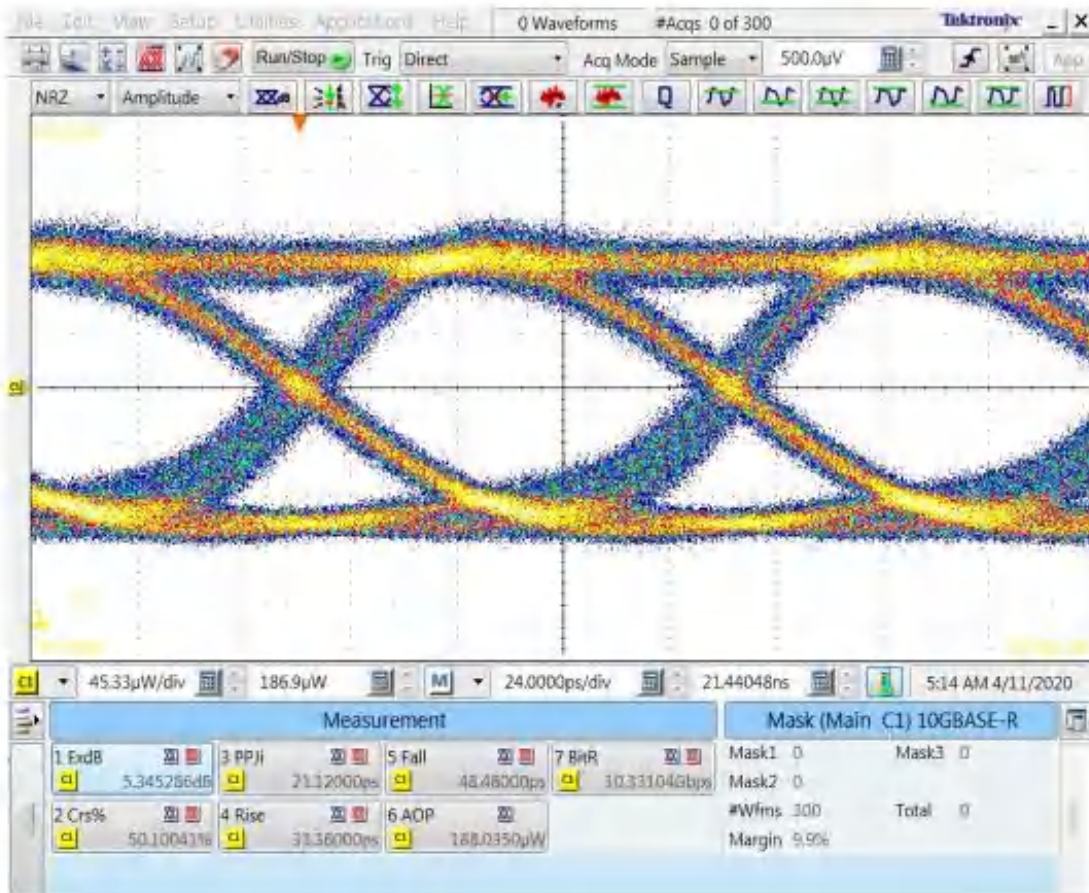
Top of Board



Bottom of Board



## Typical Eye Diagram



## Pin Assignment

PIN #	Symbol	Description	Remarks
1	VEET	Transmitter ground (common with receiver ground)	1
2	TX_FAULT	Transmitter Fault	
3	TX DISABLE	Transmitter Disable. Laser output disabled on high or open	2
4	SDA	2-wire Serial Interface Data Line	3
5	SCL	2-wire Serial Interface Clock Line	3
6	MOD ABS	Module Absent. Grounded within the module	3
7	RS0	No connection required	
8	LOS	Loss of Signal indication. Logic 0 indicates normal operation	4
9	RS1	No connection required	1
10	VEER	Receiver ground (common with transmitter ground)	1
11	VEER	Receiver ground (common with transmitter ground)	1
12	RD-	Receiver Inverted DATA out. AC coupled	
13	RD+	Receiver Non-inverted DATA out. AC coupled	
14	VEER	Receiver ground (common with transmitter ground)	1
15	VCCR	Receiver power supply	
16	VCCT	Transmitter power supply	
17	VEET	Transmitter ground (common with receiver ground)	1
18	TD+	Transmitter Non-Inverted DATA in. AC coupled	
19	TD-	Transmitter Inverted DATA in. AC coupled	
20	VEET	Transmitter ground (common with receiver ground)	1

### Notes:

1. Circuit ground is isolated from chassis ground
2. Disabled:  $T_{DIS} > 2V$  or open, Enabled:  $T_{DIS} < 0.8V$
3. Should Be pulled up with 4.7k –10k ohm on host board to a voltage between 2V and 3.6V
4. LOS is open collector output

# AO-SFP28-BX40D-2731/3127-I

SFP28, BiDi, 25G, CPRI, 1270/1310nm, SM, DDM, 18dB, 40km, I-temp

## OVERVIEW

The AO-SFP28-BX40D-2731/3127-I is a bi-directional transceiver solution operating directly on a single-fiber without the need for a separate optical filter. This is achieved by having two transceivers that inject different wavelengths into the same single-fiber. The solution thus consists of two transceivers; AO-SFP28-BX40D-2731 and AO-SFP28-BX40D-3127, operating at 1270nm and 1310nm respectively. Using a single-fiber solution provides a cost-efficient solution for interconnect and it simplifies the patching since no separate transmit/receive direction has to be taken into account.

The transceiver pair supports 25GbE and CPRI option 10 services, having an optical performance that provides a bridgeable distance of up to 40km.

As stipulated by the 25G Ethernet standards, Forward Error Correction (FEC) is required to be implemented by the host equipment in order to ensure reliable system operation. The optical parameters below will provide a bit error ratio (BER) of  $5 \times 10^{-5}$  for 25G Ethernet. FEC will provide the required quality for secure service.

The transceiver solution is available in the Industrial temperature range (I-temp) of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$  to  $+185^{\circ}\text{F}$ ). The transceivers provide digital diagnostic functions via a 2-wire serial interface as defined by the SFF-8472 specification.

## TECHNICAL DATA

Parameter	Value
Technology	BiDi SFP28
Transmission media	SM (1x LC)
Typical reach	40km
Nominal wavelength	1270nm <sup>1)</sup> / 1310nm <sup>2)</sup>
Bit rate support	25.78Gbps 24.33Gbps
Protocol support	25GE CPRI opt 10
Power budget	10 – 18dB
Dispersion penalty	Max 2.7dB
Power consumption	< 1.8W
Operating temperature	$-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$
Storage temperature	$-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$

<sup>1)</sup> AO-SFP28-BX40D-2731

<sup>2)</sup> AO-SFP28-BX40D-3127

<sup>3)</sup> Average power

<sup>4)</sup> Specified at 25GE and BER  $5 \times 10^{-5}$

### Safety/regulatory compliance:

TUV/UL/FDA

RoHS compliance

Parameter	Value
<b>Transmitter data:</b>	
Output power	Min: -1.0dBm <sup>3)</sup> Max: +6.0dBm <sup>3)</sup>
Transmit wavelength	1260 – 1280nm <sup>1)</sup> 1300 – 1320nm <sup>2)</sup>
<b>Receiver data:</b>	
Minimum input power	-19.0dBm <sup>3)4)</sup>
Overload (max power)	-4.0dBm <sup>3)4)</sup>
Wavelength range	1300 – 1320nm <sup>1)</sup> 1260 – 1280nm <sup>2)</sup>
LOS De-assert	Max -23dBm
LOS Assert	Min -35dBm
LOS Hysteresis	Min 0.5dB
DDM	Yes
MSA compliance	SFP 8402

Subject to change without notice.

For more information

visit <https://cnfibernet.cn/>

## ORDERING INFORMATION

Ordering number	Description
AO-SFP28-BX40D-2731-I	SFP28, BiDi, 25G Ethernet, CPRI Opt10, Tx/Rx=1270/1310nm, 40km, 18dB, I-tmp, LC
AO-SFP28-BX40D-3127-I	SFP28, BiDi, 25G Ethernet, CPRI Opt10, Tx/Rx=1310/1270nm, 40km, 18dB, I-tmp, LC

## GENERAL DEFINITIONS

Parameter	Description
Technology	Grey; Transceiver type for non-WDM applications. Electrical or optical. CWDM; Transceiver type for CWDM applications using G.694.2 channel grid. DWDM; Transceiver type for DWDM applications using G.694.1 channel grid. BiDi; Transceiver pair using two different wavelength channels operating on a single-fiber. DAC: Direct Attach Cable. Electrical cable with attached connectors. AOC: Active Optical Cable. Optical cable with attached connectors.
Transmission Media	Type of fiber, e.g. Multimode (MM) or Singlemode (SM). Number of and connector type within brackets (e.g. 2x LC, 1x MPO).
Typical reach	Nominal distance performance based on typical fiber dispersion, fiber loss and power budget properties, i.e. w/o dispersion compensation and optical amplification. Actual distance is dependent on actual optical path loss and dispersion properties.
Bit rate range	Supported bit rate range in Gigabit or Megabit per second (Gbps or Mbps).
Protocols	Protocols within supported bit rate range.
Nominal wavelength	Typical wavelength(s) from transmitter.
Interface standards	Referenced interface standards or MSA's, e.g. IEEE 802.3 standard for 10GbE services or 100G 4WDM-10 etc.
Power budget	Min and max power budget between Transmitter and Receiver w/o optical path penalties.
Dispersion tolerance/penalty	Maximum amount of tolerated dispersion and required reduction of power budget to maintain stipulated Bit Error Rate (BER) and at a given bit rate.
Temperature range	Max operating case temperature range. Standard temperature range (C-temp): 0°C to +70°C (32°F to +158°F) Extended temperature range (E-temp): typically -20°C to +75°C (-4°F to +167°F) Industrial temperature range (I-temp): -40°C to +85°C (-40°F to +185°F)
Power consumption	Worst case power consumption. Will vary over temperature.
Transmitter Output power	Average output power. Provided in min and max values.
Receiver minimum input power	Minimum average input power at specified BER, normally $1E^{-12}$ . Note that some protocols require FEC to achieve sufficient BER.
Receiver max input power	Maximum average input power giving a BER, normally $1E^{-12}$ .
DDM	Digital Diagnostic Monitoring functionality as defined in e.g. SFF-8472 MSA.

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# AO-SFP28-LR

SFP28, 25G/10G Ethernet LR, 1310nm, SM, 10km, 6.3dB, LC

## OVERVIEW

The AO-SFP28-LR is an SFP+ form-factor transceiver for 25 Gbps Ethernet applications. Since the transmission rate can reach up to 28Gbps, the engineering and industry name is SFP28. It is intended for use in interconnect applications between data centers with switches, routers, storage equipment etc. The optical performance supports distances up to 10km over a SingleMode (SM) fiber. AO-SFP28-LR also supports the high data rate CPRI option 10 having a bit rate of 24.33024 Gbps. With the Clock and Data Recovery (CDR) functionality disabled, the transceiver can also be used for 10GbE-LAN and 10GbE-WAN services.

AO-SFP28-LR uses a single 1310nm channel @ 25.78 Gbps to transport a 25G Ethernet signal. As stipulated by the 25G Ethernet standards, Forward Error Correction (FEC) is required to be implemented by the host equipment in order to ensure reliable system operation. The optical parameters below will provide a bit error ratio (BER) of  $5 \times 10^{-5}$  for 25G Ethernet. FEC will provide the required quality for secure service.

Digital diagnostics functions are available via an I2C interface, as specified by the MSA.

## TECHNICAL DATA

Parameter	Value
Technology	Grey SFP28
Transmission media	SM (2x LC)
Typical reach	10km
Nominal wavelength	1x 1310nm
Bit rate support	24.33 / 25.78Gbps <sup>1)</sup> 9.953 / 10.312Gbps <sup>2)</sup>
Protocol support	25GE <sup>1)</sup> 10GE WAN/LAN <sup>2)</sup> CPRI opt 10 <sup>1)</sup>
Power budget	0 – 6.3dB
Dispersion penalty	Max 2.7dB
Power consumption	< 1.2W
Operating temperature	0°C to +70°C
Storage temperature	-40°C to +85°C

<sup>1)</sup> CDR engaged

<sup>2)</sup> CDR disengaged

<sup>3)</sup> Average power

<sup>4)</sup> at 25.78 Gbps (25GE) and BER  $5 \times 10^{-5}$

### Safety/regulatory compliance:

TUV/UL/FDA

RoHS compliance

Parameter	Value
<b>Transmitter data:</b>	
Output power	Min: -7.0dBm <sup>3)</sup> Max: +2.0dBm <sup>3)</sup>
Transmit wavelength	1295 – 1325nm
<b>Receiver data:</b>	
Minimum input power	-13.3dBm <sup>3) 4)</sup>
Overload (max power)	+2.0dBm <sup>3) 4)</sup>
Wavelength range	1260 – 1325nm
LOS De-assert	Max -17dBm
LOS Assert	Min -30dBm
LOS Hysteresis	Min 0.5dB
DDM	Yes
MSA compliance	SFF-8402

Note: The 25GbE specification states that a 25GbE interface can operate with or without FEC. The optical data above is defined at a BER of  $5 \times 10^{-5}$ , implying that FEC shall be enabled on the host equipment to provide required quality at specified distance.

## ORDERING INFORMATION

Ordering number	Description
AO-SFP28-LR	SFP28, 25G/10G Ethernet LR, 1310nm, SM, 10km, 6.3dB, LC

## CDR RATE SELECT LOGIC

Logic OR of RS0 Pin and Bit 110.3 of A2H	Logic OR of RS1 Pin and Bit 118.3 of A2H	RX Data Rate	TX Data Rate	Status of RX CDR	Status of TX CDR
High / 1	High / 1	24.33G/25.78G	24.33G/25.78G	CDR Engaged	CDR Engaged
Low / 0	Low / 0	9.95G/10.31G	9.95G/10.31G	CDR Bypassed	CDR Bypassed

## GENERAL DEFINITIONS

Parameter	Description
Technology	Grey; Transceiver type for non-WDM applications. Electrical or optical. CWDM; Transceiver type for CWDM applications using G.694.2 channel grid. DWDM; Transceiver type for DWDM applications using G.694.1 channel grid. BiDi; Transceiver pair using two different wavelength channels operating on a single-fiber. DAC: Direct Attach Cable. Electrical cable with attached connectors. AOC: Active Optical Cable. Optical cable with attached connectors.
Transmission Media	Type of fiber, e.g. Multimode (MM) or Singlemode (SM). Number of and connector type within brackets (e.g. 2x LC, 1x MPO).
Typical reach	Nominal distance performance based on typical fiber dispersion, fiber loss and power budget properties, i.e. w/o dispersion compensation and optical amplification. Actual distance is dependent on actual optical path loss and dispersion properties.
Bit rate range	Supported bit rate range in Gigabit or Megabit per second (Gbps or Mbps).
Protocols	Protocols within supported bit rate range.
Nominal wavelength	Typical wavelength(s) from transmitter.
Interface standards	Referenced interface standards or MSA's, e.g. IEEE 802.3 standard for 10GbE services or 100G 4WDM-10 etc.
Power budget	Min and max power budget between Transmitter and Receiver w/o optical path penalties.
Dispersion tolerance/penalty	Maximum amount of tolerated dispersion and required reduction of power budget to maintain stipulated Bit Error Rate (BER) and at a given bit rate.
Temperature range	Max operating case temperature range. Standard temperature range (C-temp): 0°C to +70°C (32°F to +158°F) Extended temperature range (E-temp): typically -20°C to +75°C (-4°F to +167°F) Industrial temperature range (I-temp): -40°C to +85°C (-40°F to +185°F)
Power consumption	Worst case power consumption. Will vary over temperature.
Transmitter Output power	Average output power. Provided in min and max values.
Receiver minimum input power	Minimum average input power at specified BER, normally 1E <sup>-12</sup> . Note that some protocols require FEC to achieve sufficient BER.
Receiver max input power	Maximum average input power giving a BER, normally 1E <sup>-12</sup> .
DDM	Digital Diagnostic Monitoring functionality as defined in e.g. SFF-8472 MSA.

# AO-SFP28-SR

SFP28, 25G/10G, 850nm, MM, DDM, 1.9dB, 70m@OM3, 100m@OM4

## OVERVIEW

The AO-SFP28-SR is an SFP+ form-factor transceiver for 25Gbps Ethernet applications. Since the transmission rate can reach up to 28Gbps, the engineering and industry name is SFP28. It is intended for use in inter- and intra-connect applications within data centers between switches, routers, storage equipment etc. The optical performance is in accordance with the IEEE -SR standard, i.e. for optical distances up to 100m over a MultiMode (MM) OM4-grade fiber.

With the Clock and Data Recovery (CDR) functionality disabled, the transceiver can also be used for 10GbE-LAN and 10GbE-WAN services.

AO-SFP28-SR uses a single 850nm channel @ 25.78 Gbps to transport a 25G Ethernet signal. Digital diagnostics functions are available via an I2C interface, as specified by the MSA.

As stipulated by the 25G Ethernet standards, Forward Error Correction (FEC) is required to be implemented by the host to ensure reliable system operation. The optical parameters below will provide a bit error ratio (BER) of  $1 \times 10^{-5}$  for 25G Ethernet. FEC will provide the required quality for secure service.

## TECHNICAL DATA

Parameter	Value
Technology	Grey SFP28
Transmission media	MM (2x LC)
Typical reach	70m @ OM3, 100m @ OM4
Nominal wavelength	1x 850nm
Interface standards	25GBASE-SR
Bit rate support	25.78 Gbps <sup>1)</sup> & 9.953 / 10.312Gbps <sup>2)</sup>
Protocol support	25GbE <sup>1)</sup> & 10GbE-WAN/LAN <sup>2)</sup>
Power budget	0 – 1.9dB @ 25GbE
Power consumption	< 1W
Operating temperature	0°C to +70°C
Storage temperature	-40°C to +85°C

<sup>1)</sup> CDR engaged

<sup>2)</sup> CDR disengaged

<sup>3)</sup> Average power

<sup>4)</sup> at 25.78 Gbps (25GE) and BER  $5E^{-5}$

Parameter	Value
<b>Transmitter data:</b>	
Output power, per lane	Min: -8.4dBm <sup>3)</sup> Max: +2.4Bm <sup>3)</sup>
Transmit wavelength	840 – 860nm
<b>Receiver data:</b>	
Minimum input power	-10.3dBm <sup>3) 4)</sup>
Overload (max power)	+3.0dBm <sup>3) 4)</sup>
Wavelength range	840 – 860nm
LOS Assert	Min -30dBm
LOS De-assert	Max -13dBm
LOS Hysteresis	Min 0.5dB
DDM	Yes
MSA compliance	SFP28, SFF-8402

### Safety/regulatory compliance:

TUV/UL/FDA

RoHS compliance

Note: The 25GbE specification states that a 25GbE interface can operate with or without FEC. The optical data above is defined at a BER of  $5 \times 10^{-5}$ , implying that FEC shall be enabled on the host equipment to provide required quality at specified distance.

## ORDERING INFORMATION

Ordering number	Description
AO-SFP28-SR	SFP28, 25GBase, 850nm, MM, DDM, 1.9dB, 70m@OM3, 100m@OM4

## CDR RATE SELECT LOGIC

Logic OR of RS0 Pin and Bit 110.3 of A2H	Logic OR of RS1 Pin and Bit 118.3 of A2H	RX Data Rate	TX Data Rate	Status of RX CDR	Status of TX CDR
High / 1	High / 1	25.78G	25.78G	CDR Engaged	CDR Engaged
Low / 0	Low / 0	9.95G/10.31G	9.95G/10.31G	CDR Bypassed	CDR Bypassed

## GENERAL DEFINITIONS

Parameter	Description
Technology	Grey; Transceiver type for non-WDM applications. Electrical or optical. CWDM; Transceiver type for CWDM applications using G.694.2 channel grid. DWDM; Transceiver type for DWDM applications using G.694.1 channel grid. BiDi; Transceiver pair using two different wavelength channels operating on a single-fiber. DAC: Direct Attach Cable. Electrical cable with attached connectors. AOC: Active Optical Cable. Optical cable with attached connectors.
Transmission Media	Type of fiber, e.g. Multimode (MM) or Singlemode (SM). Number of and connector type within brackets (e.g. 2x LC, 1x MPO).
Typical reach	Nominal distance performance based on typical fiber dispersion, fiber loss and power budget properties, i.e. w/o dispersion compensation and optical amplification. Actual distance is dependent on actual optical path loss and dispersion properties.
Bit rate range	Supported bit rate range in Gigabit or Megabit per second (Gbps or Mbps).
Protocols	Protocols within supported bit rate range.
Nominal wavelength	Typical wavelength(s) from transmitter.
Interface standards	Referenced interface standards or MSA's, e.g. IEEE 802.3 standard for 10GbE services or 100G 4WDM-10 etc.
Power budget	Min and max power budget between Transmitter and Receiver w/o optical path penalties.
Dispersion tolerance/penalty	Maximum amount of tolerated dispersion and required reduction of power budget to maintain stipulated Bit Error Rate (BER) and at a given bit rate.
Temperature range	Max operating case temperature range. Standard temperature range (C-temp): 0°C to +70°C (32°F to +158°F) Extended temperature range (E-temp): typically -20°C to +75°C (-4°F to +167°F) Industrial temperature range (I-temp): -40°C to +85°C (-40°F to +185°F)
Power consumption	Worst case power consumption. Will vary over temperature.
Transmitter Output power	Average output power. Provided in min and max values.
Receiver minimum input power	Minimum average input power at specified BER, normally $1E^{-12}$ . Note that some protocols require FEC to achieve sufficient BER.
Receiver max input power	Maximum average input power giving a BER, normally $1E^{-12}$ .
DDM	Digital Diagnostic Monitoring functionality as defined in e.g. SFF-8472 MSA.

## Features

- Hot-pluggable QSFP+ form factor
- 240m operation over duplex OM3 MMF (350m over OM4, 440m over OM5)
- Supports 41.2 Gb/s aggregate bit rates
- Uncooled 4x10Gb/s SWDM transmitter
- Built-in SWDM mux and demux
- Power dissipation < 2.5W
- Commercial case temperature range: 0°C to 70°C
- XLPP1 electrical interface
- Duplex LC receptacles
- Built-in digital diagnostic functions, including Tx/Rx power monitoring
- RoHS-6 compliant



## Applications

- 40G Ethernet over duplex MMF
- Allows upgrades from 10GBASE-SR without changing fiber plant

## 1. General Product Characteristics

Parameter	Value	Unit	Notes
Module Form Factor	QSFP+		
Maximum Aggregate Data Rate	41.2	Gb/s	
Maximum Data Rate per Lane	10.3	Gb/s	
Protocols Supported	40G Ethernet		
Electrical Interface and Pin-out	38-pin edge connector		Pin-out as defined by the QSFP+ MSA
Maximum Power Consumption	2.5	Watts	
Management Interface	Serial, I2C-based, 400 kHz maximum frequency		As defined by the QSFP+ MSA

Data Rate Specifications	Symbol	Min	Typ	Max	Units	Ref.
Bit Rate per Lane	BR			10.3125	Mb/sec	1
Bit Error Ratio	BER			10 <sup>-12</sup>		2
Link distance on OM3	d	0		240	meters	
Link distance on OM4	d	0		350	meters	

**Notes:**

1. Compliant with XLPP1 per IEEE 802.3ba.
2. Tested with a PRBS 231-1 test pattern.

**2. Absolute Maximum Ratings**

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Maximum Supply Voltage	Vcc1, VccTx, VccRx	-0.5		3.6	V	
Storage Temperature	TS	-40		85	°C	
Case Operating Temperature	TOP	0		70	°C	
Relative Humidity	RH	0		85	%	1
Damage Threshold, per Lane	DT	4			dBm	

**Note 1:**

Non-condensing.

**3. Electrical Characteristics**

(TOP = 0 to 70 °C, VCC = 3.1 to 3.47 Volts)

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Supply Voltage	Vcc1, VccTx, VccRx	3.1		3.47	V	
Supply Current	Icc			0.9	A	1
<b>Link turn-on time</b>						
Transmit turn-on time				2000	ms	2
<b>Transmitter (Per Lane)</b>						
Single-ended input voltage tolerance	VinT	-0.3		4.0	V	
Differential data input swing	Vin,pp	120		1200	mVpp	3
Differential input threshold			50		mV	

AC common mode input voltage tolerance (RMS)		15			mV	
Differential input return loss		Per IEEE P802.3ba, Section 86A.4.1.1			dB	4
J2 Jitter Tolerance	Jt2	0.17			UI	
J9 Jitter Tolerance	Jt9	0.29			UI	
Data Dependent Pulse Width Shrinkage	DDPWS	0.07			UI	
Eye mask coordinates {X1, X2 Y1, Y2}		0.11, 0.31 95, 350			UI mV	5
<b>Receiver (Per Lane)</b>						
Single-ended output voltage		-0.3		4.0	V	
Differential data output swing	Vout,pp	200		400		6, 7
		300		600		
		400		800		
		600		1200		
AC common mode output voltage (RMS)				7.5	mV	
Termination mismatch at 1 MHz				5	%	
Differential output return loss		Per IEEE P802.3ba, Section 86A.4.2.1			dB	4
Common mode output return loss		Per IEEE P802.3ba, Section 86A.4.2.2			dB	4
Output transition time, 20% to 80%		28			ps	
J2 Jitter output	Jo2			0.42	UI	
J9 Jitter output	Jo9			0.65	UI	
Eye mask coordinates #1 {X1, X2 Y1, Y2}		0.29, 0.5 150, 425			UI mV	5
Power Supply Ripple Tolerance	PSR	50			mVpp	

**Notes:**

1. Will be <2.5W in link established mode. If the input optical signal is without data, the CDR will keep searching and push the supply current over the maximum spec.
2. From power-on and end of any fault conditions.
3. After internal AC coupling. Self-biasing 100Ω differential input.
4. 10 MHz to 11.1 GHz range.
5. Hit ratio = 5 x 10E-5.
6. AC coupled with 100Ω differential output impedance.
7. Output voltage is settable in 4 discrete steps via I2C.

#### 4. Optical Characteristics

(TOP = 0 to 70°C, VCC = 3.1 to 3.47 Volts)

Per-channel optical characteristics vary over the 4 wavelengths. Below are the worst-case

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
<b>Transmitter</b>						
Signaling Speed per Lane			10.3125		GBd	1
Lane center wavelengths			850		nm	
			880			
			910			
			940			
Spectral width @ 850nm	SBW			0.53		
Spectral width @ 880nm, 910nm, 940nm	SBW			0.59	nm	
Total Average Launch Power	POUT	-1.6		9.0	dBm	3
Average Launch Power per Lane	TXPx	-7.6		3.0	dBm	2,3
Transmit OMA per Lane	TxOMA	-5.3		3	dBm	2
Launch Power Tx OMA - TDP		-6.6			dBm	
Transmitter and Dispersion Penalty	TDP			4.9	dB	2
Optical Extinction Ratio	ER	3.0			dB	
Average launch power of OFF transmitter, per lane				-30	dBm	
Relative Intensity Noise	RIN			-128	dB/Hz	4
Optical Return Loss Tolerance		12			dB	
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}		0.23, 0.34, 0.43, 0.27, 0.35, 0.4				
<b>Receiver</b>						
Signaling Speed per Lane			10.3125		GBd	5
Lane center wavelengths			850		nm	
			880			
			910			
			940			
Average Receive Power per Lane	RXPx	-9.0		3.0	dBm	2,6
Receive Power (OMA) per Lane	RxOMA			3	dBm	2
Receiver Sensitivity (OMA) per Lane	Rxsens			-9.1	dBm	2,7

Stressed Receiver Sensitivity (OMA) per Lane @ 850nm	SRS			-5.7	dBm	2
Stressed Receiver Sensitivity (OMA) per Lane @ 880nm, 910nm, 940nm	SRS			-4.4	dBm	2
Return Loss	RL			12	dB	
LOS De-Assert	LOSD			-13	dBm	
LOS Assert	LOSA	-30			dBm	
LOS Hysteresis		0.5			dB	
Transmitter and Dispersion Penalty	TDP			4.9	dB	2
Optical Extinction Ratio	ER	3.0			dB	
Average launch power of OFF transmitter, per lane				-30	dBm	
Relative Intensity Noise	RIN			-128	dB/Hz	4
Optical Return Loss Tolerance		12			dB	
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}		0.23, 0.34, 0.43, 0.27, 0.35, 0.4				

**Notes:**

1. Transmitter consists of 4 lasers operating at 10.3Gb/s each.
2. This value varies among the 4 channels. The value shown is for the worst-case channel.
3. Minimum value is informative.
4. Maximum value is informative. TDP guarantees Tx performance
5. Receiver consists of 4 photodetectors operating at 10.3 Gb/s each.
6. Minimum value is informative, equals min TxOMA with infinite ER and max channel insertion loss.
7. Maximum value is informative based on a theoretical perfect unstressed optical source

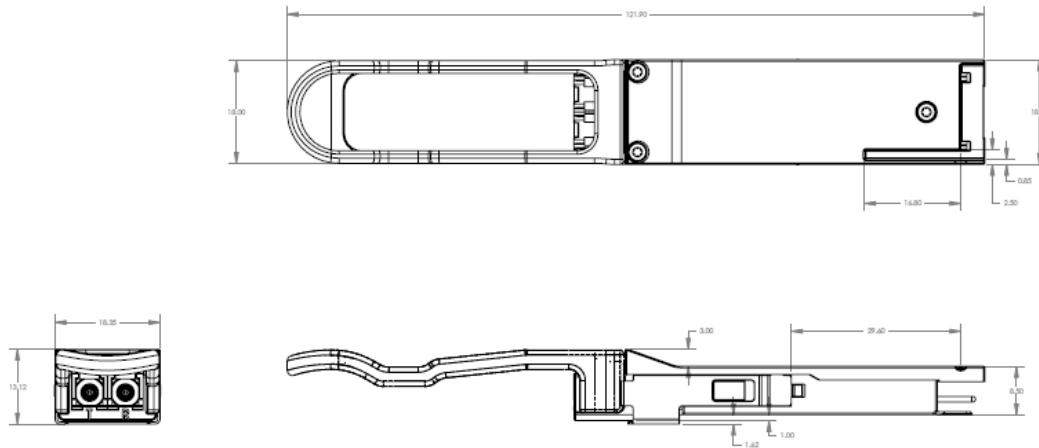
**5. Environmental Specifications**

Approved Networks QSFP-40G-SWDM4-A transceivers have an operating temperature range from 0°C to +70°C case temperature.

Environmental Specifications	Symbol	Min	Typ	Max	Units
Case Operating Temperature	Top	0		70	°C
Storage Temperature	Tsto	-40		85	°C

## 6. Mechanical Diagram

Mechanical specifications are compliant to the QSFP+ MSA transceiver module specifications.



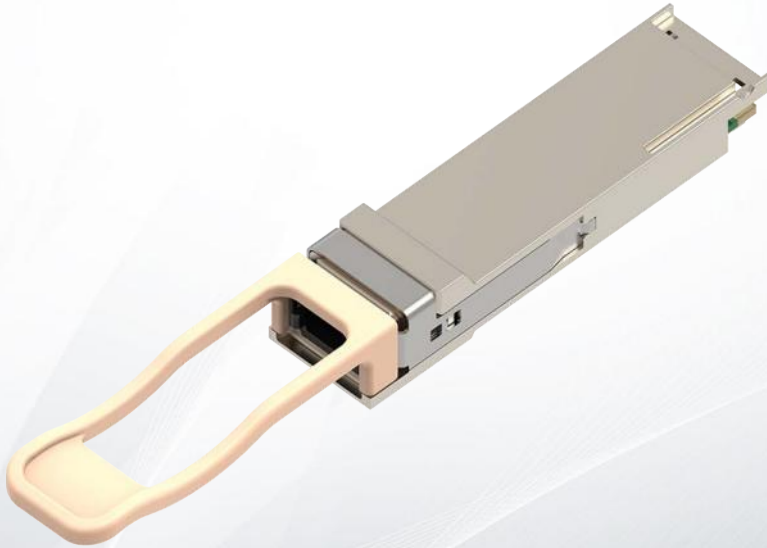
**Note:** External physical characteristics are subject to variation. This may include, but is not limited to, external case designs, pull tab colors and/or shapes, removal latch styles or colors, and label sizes and placement. These variations do not affect the function or characteristics of the transceivers.

## 7. Ordering Information

OEM	Part Number	OEM	Part Number
Arista	QSFP-40G-SWDM4-AN-A	Palo Alto	PAN-QSFP-40GBASE-SWDM4-A
Cisco	QSFP-40G-SWDM4-A	Brocade	40G-QSFP-SR4-SWDM4-A
Cisco	QSFP-40G-CSR-S-C1	F5 Networks	F5-UPG-QSFP+SWDM4-A
Finisar	FTL4S1QE1C-A	Gigamon	QSF-502-SWDM4-A
Intel	E40GQSFP4SWDM4-A	Juniper	QFX-QSFP-40G-SWDM4-A
Juniper	JNP-QSFP-40GE-SWDM4-A	MSA	AN-QSFP-SWDM4

# 40GBASE-ZR4 QSFP+ 1310nm 80km Duplex LC Transceiver

AO-QSFP-40G-ZR4



## Application

- 40G BASE Ethernet
- Data Center
- InfiniBand QDR

## Features

- Up to 11.3Gb/s Data Rate Per Channel
- Supports 44.6Gb/s Aggregate Bit Rate
- Transmitter: Cooled 4x10Gb/s LAN WDM EML TOSA (1295.56, 1300.05, 1304.58, 1309.14nm)
- Receiver: 4x10Gb/s PIN Receiver with SOA
- Up to 80km Reach for G.652 SMF
- Duplex LC Optical Receptacle
- 4x10G Electrical Interface (OIF CEI-28G-VSR)
- RoHS-10 Compliant and Lead-free
- Single +3.3V Power Supply
- Maximum Power Consumption 4.5W
- Case Operating Temperature  
Commercial: 0 ~ +70°C

## Description

The QSFP+ module is designed for use in 40GBASE Ethernet throughput up to 80km over single mode fiber (SMF) using a wavelength of 1310nm via duplex LC connectors. This transceiver is compliant with QSFP+ MSA and RoHS standards. Digital diagnostics functions are also available via the I2C interface, as specified by the QSFP+ 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 centers, high-performance computing networks, enterprise core and distribution layer applications.

## Product Specifications

### I. Absolute Maximum Ratings

It has to be noted that the operation in excess of any individual absolute maximum ratings might cause permanent damage to this module.

Parameter	Symbol	Min.	Max.	Unit	Notes
Storage Temperature	$T_s$	-40	85	°C	
Power Supply Voltage	$V_{CC}$	-0.3	4.0	V	
Relative Humidity (non-condensation)	RH	0	85	%	
Damage Threshold	$TH_d$	-3.0		dBm	

### II. Recommended Operating Conditions

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Operating Case Temperature	$T_{OP}$	0		70	°C	commercial
Power Supply Voltage	$V_{CC}$	3.135	3.3	3.465	V	
Data Rate, Each Lane			10.3125		Gb/s	
Control Input Voltage High		2		$V_{CC}$	V	
Control Input Voltage Low		0		0.8	V	
Link Distance (SMF)	D			80	km	1

Notes:

1. Depending on actual fiber loss/km (link distance specified is for fiber insertion loss of 0.35dB/km)

### III. Optical Characteristics

The following optical characteristics are defined over the Recommended Operating Environment unless otherwise specified.

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Transmitter						
Lane Wavelength (Range)	L0	1294.53	1295.56	1296.59	nm	
Signaling Rate, Each Lane			10.3125		GBd	
Side-mode Suppression Ratio	SMSR	30				
Total Launch Power	P <sub>T</sub>			12	dBm	
Average Launch Power, Each Lane	P <sub>avg</sub>	1		6	dBm	1
OMA, Each Lane	P <sub>OMA</sub>	1		6	dBm	2
Extinction Ratio	ER	8.2			dB	
Difference in Launch Power between any Two Lanes (OMA)	P <sub>tx,diff</sub>			3.6	dB	
Transmitter and Dispersion Penalty, Each Lane	TDP			3.2	dB	
OMA Minus TDP, Each Lane	OMA-TDP	-0.65			dBm	
Average Launch Power of OFF Transmitter, Each Lane	P <sub>off</sub>			-30	dBm	
Transmitter Reflectance	R <sub>T</sub>			-12	dB	
RIN <sub>20OMA</sub>	RIN			-130	dB/Hz	
Optical Return Loss Tolerance	TOL			20	dB	
Optical Return Loss Tolerance	TOL			20	dB	
Transmitter Eye Mask {X1, X2,X3, Y1, Y2, Y3}		{0.25, 0.4, 0.45, 0.25, 0.28, 0.4}				

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Receiver						
Signaling rate, Each Lane			10.3125		GBd	
Average Receive Power, Each Lane		-23		-4.9	dBm	
Receiver Sensitivity, Each Lane				-25	dBm	3
Input Saturation Power (Overload)	Psat	-8			dBm	
Receiver Reflectance				-26	dB	
Difference in Receive Power between any Two Lanes (Average and OMA)	Ptx,diff			3.6	dB	
LOS Assert	LOSA	-35			dBm	
LOS Deassert	LOSD			-26	dBm	
LOS Hysteresis	LOSH	0.5			dB	
Receiver Electrical 3 dB upper	Fc			31	GHz	

Notes:

1. The minimum average launch power spec is based on ER not exceeding 9.5dB and transmitter OMA higher than 0.1dBm.
2. Even if the TDP < 0.75 dB, the OMA min must exceed the minimum value specified here.
3. Measured with a PRBS=2<sup>31</sup>-1 test pattern @10.3125Gbps, ER=8.2dB, BER =<10<sup>-12</sup>

## V. Electrical Characteristics

The following electrical characteristics are defined over the Recommended Operating Environment unless otherwise specified.

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Power Consumption	p			4.5	W	
Supply Current	Icc			1360	mA	

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Transmitter (each Lane)						
Overload Differential Voltage pk-pk	TP1a	900			mV	
Common Mode Voltage (Vcm)	TP1	-350		2850	mV	1
Differential Termination Resistance Mismatch	TP1			10	%	At 1MHz
Receiver						
Differential Voltage, pk-pk	TP4			900	mV	
Common Mode Voltage (Vcm)	TP4	-350		2850	mV	1
Common Mode Noise, RMS	TP4			10	%	At 1MHz
Common Mode Return Loss (SCC22)	TP4			-2	dB	2
Transition Time, 20 to 80%	TP4	9.5			ps	
Vertical Eye Closure (VEC)	TP4			5.5	dB	
Eye Width at 10-15 Probability (EW15)	TP4	0.57			UI	
Eye Height at 10-15 Probability (EH15)	TP4	228			mV	

#### IV. Digital Diagnostic Functions

The following digital diagnostic characteristics are defined over the normal operating conditions unless otherwise specified.

Parameter	Symbol	Min.	Max.	Unit	Notes
Temperature Monitor Absolute Error	DML_Temp	-3	3	°C	Over operating temp
Supply Voltage Monitor Absolute Error	DML_VCC	-3	3	%	Full operating range
RX Power Monitor Absolute Error	DML_RX	-3	3	dB	

Parameter	Symbol	Min.	Max.	Unit	Notes
Bias Current Monitor Error	DMI_bias	-10	10	%	
TX Power Monitor Absolute Error	DMI_TX	-3	3	dB	

Notes:

1. Vcm is generated by the host. Specification includes effects of ground offset voltage.
2. From 250MHz to 30GHz.

### VI. Pin Assignment

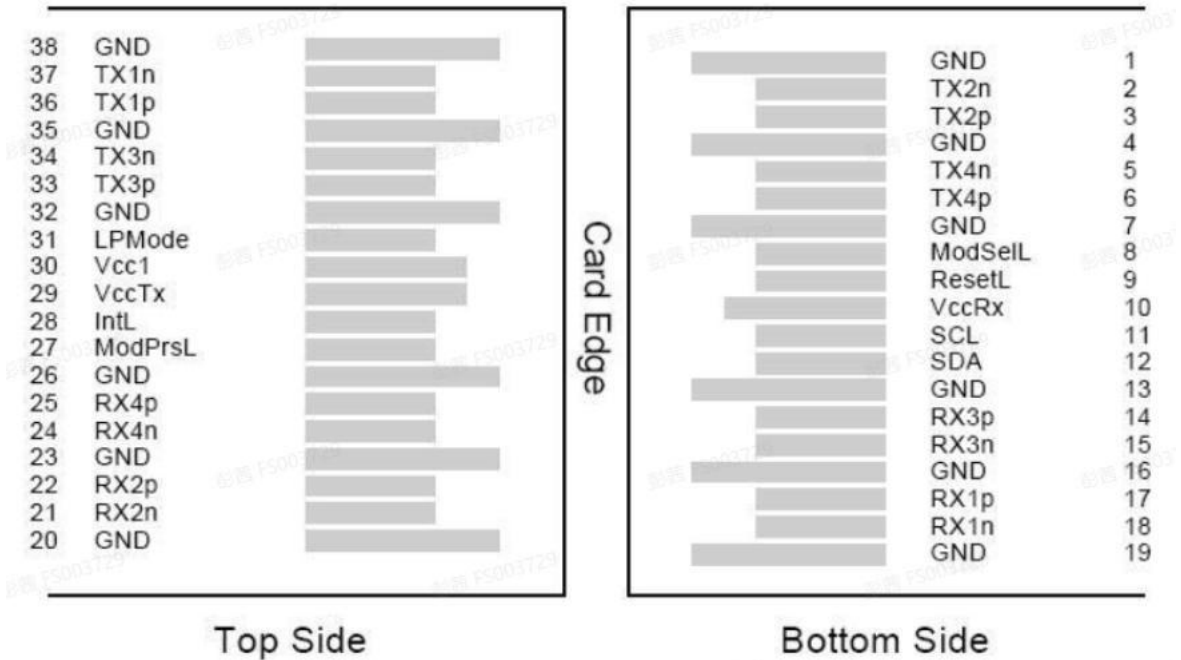


Figure1. Diagram of host board connector block pin numbers and names

### VII. Pin Description

Pin	Symbol	Name/Description	Notes
1	GND	Transmitter Ground (Common with Receiver Ground)	1
2	Tx2n	Transmitter Inverted Data Input	
3	Tx2p	Transmitter Non-Inverted Data Input	
4	GND	Transmitter Ground (Common with Receiver Ground)	1
5	Tx4n	Transmitter Inverted Data Input	

Pin	Symbol	Name/Description	Notes
6	Tx4p	Transmitter Non-Inverted Data output	
7	GND	Transmitter Ground (Common with Receiver Ground)	1
8	ModSelL	Module Select	
9	ResetL	Module Reset	
10	VccRx	3.3V Power Supply Receiver	2
11	SCL	2-Wire serial interface clock	
12	SDA	2-Wire serial interface data	
13	GND	Transmitter Ground (Common with Receiver Ground)	
14	Rx3p	Receiver Non-Inverted Data Output	
15	Rx3n	Receiver Inverted Data Output	
16	GND	Transmitter Ground (Common with Receiver Ground)	1
17	Rx1p	Receiver Non-Inverted Data Output	
18	Rx1n	Receiver Inverted Data Output	
19	GND	Transmitter Ground (Common with Receiver Ground)	1
20	GND	Transmitter Ground (Common with Receiver Ground)	1
21	Rx2n	Receiver Inverted Data Output	
22	Rx2p	Receiver Non-Inverted Data Output	
23	GND	Transmitter Ground (Common with Receiver Ground)	1
24	Rx4n	Receiver Inverted Data Output	1

Pin	Symbol	Name/Description	Notes
25	Rx4p	Receiver Non-Inverted Data Output	
26	GND	Transmitter Ground (Common with Receiver Ground)	1
27	ModPrsL	Module Present	
28	IntL	Interrupt	
29	Vcc Tx	3.3V Power supply transmitter	2
30	Vcc1	3.3V Power supply	2
31	LPMode	Low Power Mode	
32	GND	Transmitter Ground (Common with Receiver Ground)	1
33	Tx3p	Transmitter Non-Inverted Data Input	
34	Tx3n	Transmitter Inverted Data Output	
35	GND	Transmitter Ground (Common with Receiver Ground)	1
36	Tx1p	Transmitter Non-Inverted Data Input	
37	Tx1n	Transmitter Inverted Data Input	
38	GND	Transmitter Ground (Common with Receiver Ground)	1

## Notes:

1. GND is the symbol for signal and supply (power) common for QSFP28 modules. All are common within the QSFP28 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. VccRx, Vcc1 and VccTx are the receiving and transmission power suppliers and shall be applied concurrently. Recommended host board power supply filtering is shown below. Vcc Rx, Vcc1 and Vcc Tx may be internally connected within the QSFP28 transceiver module in any combination. The connector pins are each rated for a maximum current of 1000mA.

### VIII. Mechanical Dimensions

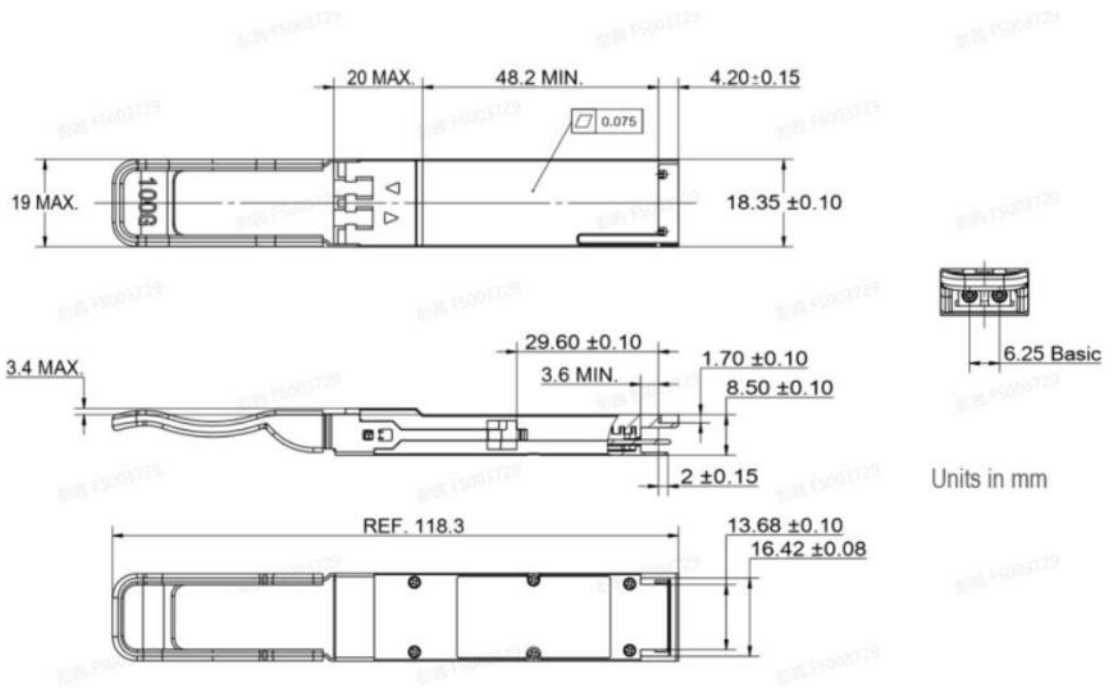


Figure2. Mechanical Outline

# AO-QSFP-LR4-PSM

QSFP+, 40G Ethernet LR4, SM, 1310nm, 10km, 6.6dB, MPO (APC)

## OVERVIEW

The AO-QSFP-LR4-PSM is a QSFP+ (Quad Small Form-factor Pluggable Plus) transceiver for 40 Gbps applications where the transport is made using four channels at 10 Gbps. It is intended for use in inter- and intra-connect applications within and between data centers with switches, routers, storage equipment etc. The transceiver can also be used for 10GbE-LAN interconnect applications, providing a higher density as compared to four individual 10G connections using e.g. SFP+ transceivers.

The AO-QSFP-LR4-PSM provides transport over an MPO/MTP 12 or 8 ribbon fiber cable up to 10 km over a SingleMode (SM) fiber.

## TECHNICAL DATA

Parameter	Value
Technology	Grey QSFP+
Transmission media	SM (1x MPO/APC)
Typical reach	10km
Nominal wavelength	1310nm
Interface standards	40GBASE-LR4
Bit rate support	41.25Gbps <sup>1)</sup> 4x 10.3125Gbps <sup>2)</sup>
Protocol support	40GbE / 4x 10GbE-LAN Infiniband QDR, DDR, SDR
Power budget	0 – 6.6dB
Power consumption	< 3.5W
Operating temperature	0°C to +70°C
Storage temperature	-40°C to +85°C

Parameter	Value
<b>Transmitter data:</b>	
Output power, per lane	Min: -6.0dBm <sup>3)</sup> Max: +1.5dBm <sup>3)</sup>
Transmit wavelength	1260 – 1355nm
<b>Receiver data:</b>	
Minimum input power	-12.6Bm <sup>2) 3) 4)</sup>
Overload (max power)	+2.3dBm <sup>2) 3) 4)</sup>
Wavelength range	1260 – 1355nm
LOS Assert	Min -30dBm
LOS De-Assert	Max -15dBm
LOS Hysteresis	Min 0.5dB
DDM	Yes
MSA compliance	QSFP+ MSA, SFF-8436

<sup>1)</sup> Aggregated line rate

<sup>2)</sup> Per lane

<sup>3)</sup> Average power

<sup>4)</sup> At BER less than 10<sup>-12</sup>, with a 2<sup>31</sup>-1 PRBS

### Safety/regulatory compliance:

TUV/UL/FDA

RoHS compliance

MPO (Multi-fiber Push On) is an optical connector for ribbon cables with four to twenty-four fibers.

MTP is a specific brand of an MPO connector.

Note: An MPO/MTP connector with 8-degree Angled Physical Contact (APC) shall be used with this product to minimize MPO/MTP connection induced reflections.

Subject to change without notice.

For more information

visit <https://cnfibernet.cn/>

## ORDERING INFORMATION

Ordering number	Description
AO-QSFP-LR4-PSM	QSFP+, 40G Ethernet LR4, SM, 1310nm, 10km, 6.6dB, MPO (APC)

## GENERAL DEFINITIONS

Technology:	Grey; Transceiver type for non-WDM applications. Electrical or optical. CWDM; Transceiver type for CWDM applications using G.694.2 channel grid. DWDM; Transceiver type for DWDM applications using G.694.1 channel grid. BiDi; Transceiver pair using two different wavelength channels operating on a single-fiber. DAC: Direct Attach Cable (DAC). Electrical or optical cable with attached connectors.
Transmission Media:	Type of fiber, e.g. Multimode (MM) or Singlemode (SM). Number of and connector type within brackets (e.g. 2x LC, 1x MPO).
Typical reach:	Nominal distance performance based on dispersion and power budget properties, i.e. w/o dispersion compensation and optical amplification.
Bit rate range:	Supported bit rate range in Gigabit or Megabit per second (Gbps or Mbps).
Protocols:	Protocols within supported bit rate range.
Nominal wavelength:	Typical wavelength from transmitter.
Interface standards:	Referenced interface standards e.g. IEEE 802.3 standard for 10GbE services.
Power budget:	Min and max power budget between Transmitter and Receiver.
Dispersion tolerance/penalty:	Maximum amount of tolerated dispersion and required reduction of power budget to maintain stipulated Bit Error Rate (BER) and at a given bit rate.
Temperature range:	Max operating case temperature range. Commercial temperature range (C-temp): 0°C to +70°C (32°F to +158°F) Extended temperature range (E-temp): typically -20°C to +75°C (-4°F to +167°F) Industrial temperature range (I-temp): -40°C to +85°C (-40°F to +185°F)
Power consumption:	Worst case power consumption. Will vary over temperature.
Transmitter Output power:	Average output power. Provided in min and max values.
Receiver minimum input power:	Minimum average input power at specified BER, normally 1E <sup>-12</sup> .
Receiver max input power:	Maximum average input power giving a BER, normally 1E <sup>-12</sup> .
DDM:	Digital Diagnostic Monitoring functionality as defined in SFF-8472 MSA.

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# 40GMQ-10KM-PSM4-I

## 40Gb/s QSFP+ PSM4 10KM Optical Transceiver

### Product Features

- Four-channel full-duplex transceiver modules
- Transmission data rate up to 11.2Gbit/s per channel
- Up to 10km transmission of single mode fiber
- Low power consumption <2.5W, meet class 3
- Operating case temperature: -20 to 85°C
- 3.3V power supply voltage
- Hot Pluggable QSFP form factor
- RoHS 6 compliant
- Single MPO connector receptacle
- Built-in digital diagnostic function

### Applications

- Infiniband QDR and DDR interconnects
- 40G Ethernet
- Proprietary High Speed Interconnections
- Data center

The CNFIBERNET 40GMQ-10KM-PSM4-I is a Four-Channel, Pluggable, Parallel, Fiber-Optic QSFP+ Transceiver for InfiniBand QDR/DDR/SDR, 10G/8G/4G/2G fiber channel, PCIe and SAS

Applications. The QSFP full-duplex optical module offers 4 independent transmit and receive channels, each capable of 10.3Gbps operation for an aggregate data rate of 40Gbps 10km using single mode fiber. These modules are designed to operate over single mode fiber systems using 1310nm DFB laser array. An optical fiber ribbon cable with an MPO/MTP™ connector can be plugged into the QSFP module receptacle. QSFP+ PSM LR4 is one kind of parallel transceiver which provides increased port density and total system cost savings.

### Ordering Information

Part Number	Description
40GMQ-10km -PSM4-I	QSFP+ PSM4 10km optical transceiver with full real-time digital diagnostic monitoring and pull tab

### For More Information:

China Fiber Optic Network Supply Chain Center  
10 Xiyuan Road, Hangzhou, Zhejiang Province, China  
Sales email : sales@cnfibernet.cn

### Regulatory Compliance

Feature	Standard	Performance
Electromagnetic Interference (EMI)	FCC Part 15 Class B EN 55022:2010, Class B	Compatible with standards
Electromagnetic susceptibility (EMS)	EN 55024:2010	Compatible with standards
Laser Eye Safety	FDA 21CFR 1040.10 and 1040.11 EN60950, EN (IEC) 60825-1,2	Compatible with Class I laser product

### Absolute Maximum Ratings

The operation in excess of any absolute maximum ratings might cause permanent damage to this module.

Parameter	Symbol	Min	Max	Unit	Notes
Storage Temperature	T <sub>S</sub>	-40	85	°C	
Operating Case Temperature	T <sub>OP</sub>	-20	85	°C	
Power Supply Voltage	V <sub>CC</sub>	-0.3	3.6	V	
Relative Humidity (non-condensation)	RH	0	85	%	
Input Voltage	V <sub>in</sub>	-0.3	V <sub>CC</sub> +0.3	V	

### Recommended Operating Conditions and Power Supply Requirements

Parameter	Symbol	Min	Typical	Max	Unit	Notes
Operating Case Temperature	T <sub>OP</sub>	-20		85	°C	
Power Supply Voltage	V <sub>CC</sub>	3.135	3.3	3.465	V	
Power Consumption			1.7	2.5	W	
Data Rate, each Lane	DR		10.3		Gb/s	
Data Speed Tolerance	ΔDR	-100		+100	ppm	
Link Distance with G.652	D	0		10	km	

### Electrical Characteristics

Parameter	Symbol	Min	Typical	Max	Unit	Notes
Differential input impedance	Z <sub>in</sub>	90	100	110	ohm	
Differential Output impedance	Z <sub>out</sub>	90	100	110	ohm	
Differential input voltage amplitude	ΔV <sub>in</sub>	300		1100	mVp-p	
Differential output voltage amplitude	ΔV <sub>out</sub>	500		800	mVp-p	
Bit Error Rate	BR			E-12		
Input Logic Level High	V <sub>IH</sub>	2.0		V <sub>CC</sub>	V	
Input Logic Level Low	V <sub>IL</sub>	0		0.8	V	
Output Logic Level High	V <sub>OH</sub>	V <sub>CC</sub> -0.5		V <sub>CC</sub>	V	
Output Logic Level Low	V <sub>OL</sub>	0		0.4	V	

### Optical Characteristics

Parameter	Symbol	Min	Typical	Max	Unit	Notes
<b>Transmitter</b>						
Center Wavelength	λ <sub>C</sub>	1270	1310	1350	nm	1
RMS Spectral Width	λ <sub>rms</sub>			3.5	nm	1
Average Launch Power, each lane	PAVG	-5.5	-0.5	+2.3	dBm	
Optical Modulation Amplitude (OMA)	POMA	-4.5	-0.5	+3.5	dBm	1
Difference in Launch Power between any two lanes	P <sub>tx,diff</sub>			5.0	dB	
Launch Power in OMA minus Transmitter and Dispersion Penalty (TDP), each Lane	OMA-TDP	-9.7			dBm	1
Rise/Fall Time	T <sub>r</sub> /T <sub>f</sub>			50	ps	
Extinction Ratio	ER	3.5			dB	
Relative Intensity Noise	R <sub>in</sub>			-128	dB/Hz	
Optical Return Loss Tolerance	TOL			12	dB	

Transmitter Reflectance	RT			-12	dB	
Transmitter Eye Mask Margin	EMM	10			%	2
Transmitter Eye Mask Definition {X1, X2, X3, Y1, Y2, Y3}		{0.25, 0.4, 0.45, 0.25, 0.28, 0.4}				
Average Launch Power OFF Transmitter, each Lane	Poff			-30	dBm	
<b>Receiver</b>						
Center Wavelength	λC	1270	1310	1350	nm	
Damage Threshold	THd	+3			dBm	
Overload, each lane	OVL	+2.3			dBm	
Receiver Sensitivity in OMA, each Lane	SEN			-11.5	dBm	
Difference in Receive Power between any two Lanes (OMA)	Prx,diff			5.0	dB	
Signal Loss Assert Threshold	LOSA	-30			dBm	
Signal Loss Deassert Threshold	LOSD			-15	dBm	
LOS Hysteresis	LOSH	0.5		6	dB	
Optical Return Loss	ORL			-12	dBm	
Receive Electrical 3 dB upper Cutoff Frequency, each Lane	Fc			12	GHz	

Notes:

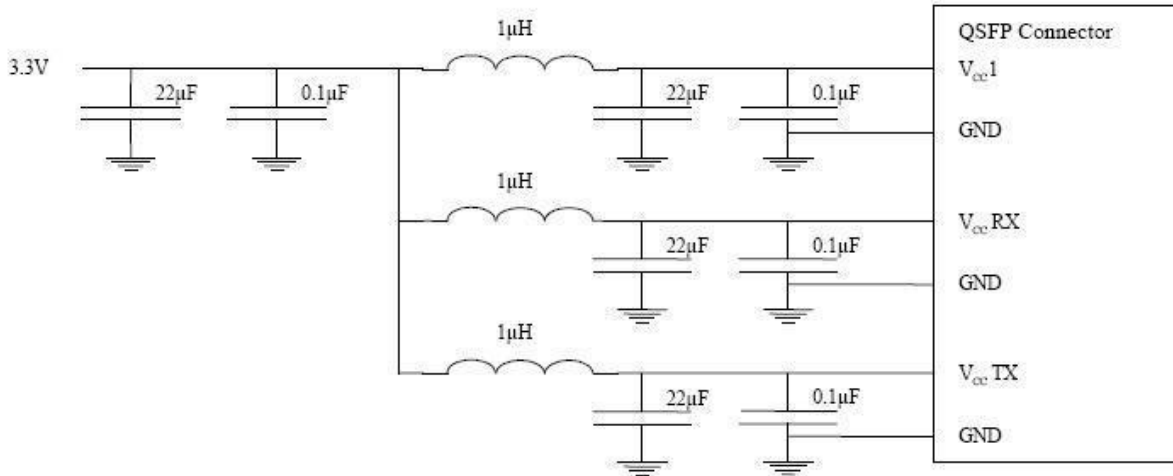
1. Transmitter wavelength, RMS spectral width and power need to meet the OMA minus TDP specs to guarantee link performance.
2. The eye diagram is tested with 1000 waveform.

**Digital Diagnostic Functions**

Digital diagnostics monitoring function is available on all CNFIBERNETQSFP+ PSM LR4. A 2-wire serial interface provides user to contact with module. The structure of the memory is shown in Figure 3. The memory space is arranged into a lower, single page, address space of 128 bytes and multiple upper address space pages. This structure permits timely access to addresses in the lower page, such as Interrupt Flags and Monitors. Less time critical time entries, such as serial ID information and threshold settings, are available with the Page Select function. The interface address used is A0xh and is mainly used for time critical data like interrupt handling in order to enable a one-time-read for all data related to an interrupt situation. After an interrupt, IntL, has been asserted, the host can read out the flag field to determine the affected channel and type of flag.

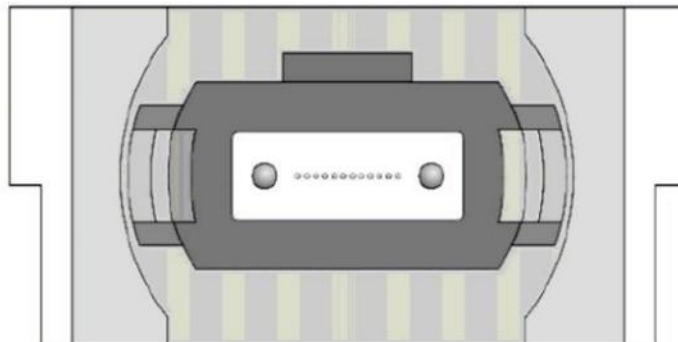
Parameter	Symbol	Min	Max	Unit	Notes
Temperature monitor absolute error	DMI_Temp	-3	+3	°C	Over operating temperature range
Supply voltage monitor absolute error	DMI_VCC	-0.1	+0.1	V	Over full operating range
Channel RX power monitor absolute error	DMI_RX_Ch	-3	+3	dB	1
Channel Bias current monitor	DMI_Ibias_Ch	-10%	+10%	mA	
Channel TX power monitor absolute error	DMI_TX_Ch	-3	+3	dB	1

Recommended Power Supply Filter



Optical Interface Lanes and Assignment

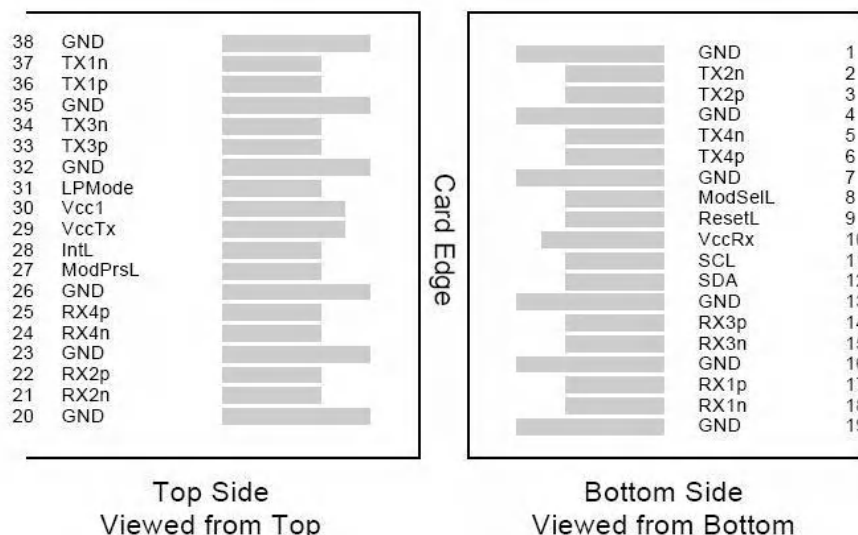
The optical interface port is a male MPO connector. The four fiber positions on the left as shown in Figure 2, with the key up, are used for the optical transmit signals (Channel 1 through 4). The fiber positions on the right are used for the optical receive signals (Channel 4 through 1). The central four fibers are physically present.



Transmit Channels: 1 2 3 4  
 Unused positions: x x x x  
 Receive Channels: 4 3 2 1



Pin Assignment and Description



**ModSel Pin**

The ModSel is an input pin. When held low by the host, the module responds to 2-wire serial communication commands. The ModSel allows the use of multiple QSFP modules on a single 2-wire interface bus. When the ModSel is "High", the module will not respond to any 2-wire interface communication from the host. ModSel has an internal pull-up in the module.

**ResetL Pin**

Reset. LPMODE\_Reset has an internal pull-up in the module. A low level on the ResetL pin for longer than the minimum pulse length (t\_Reset\_init) initiates a complete module reset, returning all user module settings to their default state. Module Reset Assert Time (t\_init) starts on the rising edge after the low level on the ResetL pin is released. During the execution of a reset (t\_init) the host shall disregard all status bits until the module indicates a completion of the reset interrupt. The module indicates this by posting an IntL signal with the Data\_Not\_Ready bit negated. Note that on power up (including hot insertion) the module will post this completion of reset interrupt without requiring a reset.

**LPMODE Pin**

CNFIBERNETPSM IR4operate in the low power mode (less than 1.5 W power consumption) This pin active high will decrease power consumption to less than 1W.

**ModPrsL Pin**

ModPrsL is pulled up to Vcc on the host board and grounded in the module. The ModPrsL is asserted "Low" when the module is inserted and deasserted "High" when the module is physically absent from the host connector.

**IntL Pin**

IntL is an output pin. When "Low", it indicates a possible module operational fault or a status critical to the host system. The host identifies the source of the interrupt by using the 2-wire serial interface. The IntL pin is an open collector output and must be pulled up to Vcc on the host board.

**Pin Assignment**

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 output	
4		GND	Ground	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	

6	CML-I	Tx4p	Transmitter Non-Inverted Data output	
7		GND	Ground	1
8	LVTTLL-I	ModSelL	Module Select	
9	LVTTLL-I	ResetL	Module Reset	
10		VccRx	+3.3V Power Supply Receiver	2
11	LVC MOS-I/O	SCL	2-Wire Serial Interface Clock	
12	LVC MOS-I/O	SDA	2-Wire Serial Interface Data	
13		GND	Ground	
14	CML-O	Rx3p	Receiver Non-Inverted Data Output	
15	CML-O	Rx3n	Receiver Inverted Data Output	
16		GND	Ground	1
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	1
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	
26		GND	Ground	1
27	LVTTTL-O	ModPrsL	Module Present	
28	LVTTTL-O	IntL	Interrupt	
29		VccTx	+3.3 V Power Supply transmitter	2
30		Vcc1	+3.3 V Power Supply	2
31	LVTTTL-I	LPMODE	Low Power Mode	
32		GND	Ground	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	
34	CML-I	Tx3n	Transmitter Inverted Data Output	
35		GND	Ground	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	
37	CML-I	Tx1n	Transmitter Inverted Data Output	
38		GND	Ground	1

## Notes:

1. Module circuit ground is isolated from module chassis ground within the module. GND is the symbol for signal and supply (power) common for QSFP modules.
2. The connector pins are each rated for a maximum current of 500mA.

# QSFP28 100GE BiDi 40km

QSFP28, BiDi, 100G Ethernet, 1304nm/1309nm, SM, 40km, 18.3dB, LC

## AO-Q28-100G-BD-40

The AO-Q28-100G-BD-40 is a bi-directional transceiver solution operating directly on a single-fiber without the need for a separate optical filter. This is achieved by having two transceivers that inject different wavelengths into the same single-fiber. The solution thus consists of two transceivers; AO-Q28-100G-BD and AO-Q28-100G-BD-40, operating at transmit wavelengths 1304nm and 1309nm respectively. Using a single-fiber solution provides a cost-efficient solution for interconnect and it simplifies the patching since no separate transmit/receive direction has to be taken into account.

AO-Q28-100G-BD has an optical performance enabling distances of up to 40km over a SingleMode (SM) G.652 fiber-pair cable. The module includes FEC coding Forward Error Correction (KP4 FEC) to ensure reliable system operation. The host system shall thus not have FEC activated. The optical parameters will provide a bit error ratio (BER) of  $2.4 \times 10^{-4}$ . FEC will render in the required BER of better than  $1 \times 10^{-12}$ .

The AO-Q28-100G-BD transceivers uses a single 1304nm or 1309nm channel/lane @ 50Gbaud using PAM4 modulation to transport the Ethernet signal. The electrical interface is 4x 25.78Gbps and compliant with OIF CEI-28G-VSR. Digital diagnostics functions (DDM) are available via an I2C interface, as specified by the QSFP28 MSA.

The transceivers provide digital diagnostic functions via a 2-wire serial interface as defined by the SFF-8472 specification.

## TECHNICAL DATA

Parameter	Value
Technology	BiDi QSFP28
Transmission media	SM (1x LC)
Typical reach	40km
Nominal wavelengths	Tx: 1304nm / Rx: 1309nm <sup>1)</sup> Tx: 1309nm / Rx: 1304nm <sup>2)</sup>
Interface standards	100G ER1-40
Bit rate support	106.25Gbps <sup>3)</sup> 52.125Gbd <sup>4)</sup>
Protocol support	100GbE
Power budget	10.5 – 18.3dB
Power consumption	< 4.5W
Operating temperature	0°C to +70°C
Storage temperature	-40°C to +85°C

<sup>1)</sup> AO-Q28-100G-BD

<sup>2)</sup> AO-Q28-100G-BD

<sup>3)</sup> Aggregated line rate 100GbE with FEC

<sup>4)</sup> Line baud rate

<sup>5)</sup> Average power, per lane

<sup>6)</sup> Specified at BER  $2.4 \times 10^{-4}$

### Safety/regulatory compliance:

TUV/UL/FDA (contact CNFIBERNET for latest certification

information) RoHS compliance

Parameter	Value
<b>Transmitter data:</b>	
Output power, per lane	Min: +3.7dBm <sup>5)</sup> Max: +7.1dBm <sup>5)</sup>
Transmit wavelengths	1304.06 – 1305.10nm <sup>1)</sup> 1308.61 – 1309.66nm <sup>2)</sup>
<b>Receiver data:</b>	
Minimum input power	-14.6dBm <sup>5)</sup> <sup>6)</sup>
Overload (max power)	-3.4dBm <sup>5)</sup> <sup>6)</sup>
Wavelength range	1308.61 – 1309.66nm <sup>1)</sup> 1304.06 – 1305.10nm <sup>2)</sup>
LOS Assert	-26dBm
LOS De-assert	-17dBm
DDM	Yes
MSA compliance	QSFP28 MSA SFF-8472

Subject to change without notice.

For more information visit

<https://cnfibernet.cn/>

## ORDERING INFORMATION

Ordering number	Description
AO-Q28-100G-BD49-40	QSFP28, BiDi, 100G Eth, Tx/Rx=1304/1309nm, SM, 40km, 18.3dB, LC
AO-Q28-100G-BD94-40	QSFP28, BiDi, 100G Eth, Tx/Rx=1309/1304nm, SM, 40km, 18.3dB, LC

## GENERAL DEFINITIONS

Parameter	Description
Technology	Grey; Transceiver type for non-WDM applications. Electrical or optical. CWDM; Transceiver type for CWDM applications using G.694.2 channel grid. DWDM; Transceiver type for DWDM applications using G.694.1 channel grid. BiDi; Transceiver pair using two different wavelength channels operating on a single-fiber. DAC: Direct Attach Cable. Electrical cable with attached connectors. AOC: Active Optical Cable. Optical cable with attached connectors.
Transmission Media	Type of fiber, e.g. Multimode (MM) or Singlemode (SM). Number of and connector type within brackets (e.g. 2x LC, 1x MPO).
Typical reach	Nominal distance performance based on typical fiber dispersion, fiber loss and power budget properties, i.e. w/o dispersion compensation and optical amplification. Actual distance is dependent on actual optical path loss and dispersion properties.
Bit rate range	Supported bit rate range in Gigabit or Megabit per second (Gbps or Mbps).
Protocols	Protocols within supported bit rate range.
Nominal wavelength	Typical wavelength(s) from transmitter.
Interface standards	Referenced interface standards or MSA's, e.g. IEEE 802.3 standard for 10GbE services or 100G 4WDM-10 etc.
Power budget	Min and max power budget between Transmitter and Receiver w/o optical path penalties.
Dispersion tolerance/penalty	Maximum amount of tolerated dispersion and required reduction of power budget to maintain stipulated Bit Error Rate (BER) and at a given bit rate.
Temperature range	Max operating case temperature range. Standard temperature range (C-temp): 0°C to +70°C (32°F to +158°F) Extended temperature range (E-temp): typically -20°C to +75°C (-4°F to +167°F) Industrial temperature range (I-temp): -40°C to +85°C (-40°F to +185°F)
Power consumption	Worst case power consumption. Will vary over temperature.
Transmitter Output power	Average output power. Provided in min and max values.
Receiver minimum input power	Minimum average input power at specified BER, normally $\leq 1 \times 10^{-12}$ . Some protocols require FEC to achieve sufficient BER.
Receiver max input power	Maximum average input power giving a BER, normally $\leq 1 \times 10^{-12}$ .
DDM	Digital Diagnostic Monitoring functionality as defined in e.g. SFF-8472 MSA.

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# AO-QSFP28-LR4-112

QSFP28, 100GBASE-LR4, OTU4, 1310nm, SM, DDM, 6.3dB, 10km

## OVERVIEW

The AO-QSFP28-LR4-112 is a QSFP28 form-factor transceiver for 100 Gbps Ethernet (112GBASE-LR4) and OTN (OTU4) applications. It is intended for use in inter- and intra-connect applications within and between data centers between switches, routers, storage equipment etc. The optical performance is in accordance with the 100GBASE-LR4 standard, i.e. for optical distances up to 10km over a SingleMode (SM) fiber. The lasers are of EML type.

AO-QSFP28-LR4-112 uses four LANWDM channels/lanes @ 25.78Gbps and 27.95Gbps to transport an Ethernet and OTN signal, respectively. Digital diagnostics functions are available via an I<sup>2</sup>C interface, as specified by the QSFP28 MSA.

## TECHNICAL DATA

Parameter	Value
Technology	Grey QSFP28
Transmission media	SM (2x LC)
Typical reach	10km
Nominal wavelength	Lane 1: 1295.56nm Lane 2: 1300.05nm Lane 3: 1304.58nm Lane 4: 1309.14nm
Interface standards	100GBASE-LR4 OTU4 411-9D1F
Bit rate support	103.12 / 112 Gbps <sup>1)</sup> 25.78 / 27.95 Gbps <sup>2)</sup>
Protocol support	100GbE OTU4
Power budget	0 – 6.3dB (100GbE/OTU4)
Optical path penalty	2.2dB (100GbE) 1.5dB (OTU4)
Power consumption	< 3.5W
Operating temperature	0°C to +70°C
Storage temperature	-40°C to +85°C

<sup>1)</sup> Aggregated line rate 112GbE / OTU4

<sup>2)</sup> Per lane

<sup>3)</sup> Average power

<sup>4)</sup> Specified at BER 1x10<sup>-12</sup>

<sup>5)</sup> Specified at pre-FEC BER 1x10<sup>-6</sup>

### Safety/regulatory compliance:

TUV/UL/FDA

RoHS compliance

Parameter	Value
<b>Transmitter data:</b>	
Output power, total	Max +10.5dBm <sup>3)</sup> (100GbE) Max +8.9dBm <sup>3)</sup> (OTU4)
Output power, per lane 100GbE	Min: -1.7dBm <sup>3)</sup> Max: +4.5dBm <sup>3)</sup>
Output power, per lane OTU4	Min: -2.5dBm <sup>3)</sup> Max: +2.9dBm <sup>3)</sup>
Transmit wavelength	1294.53 – 1296.59nm 1299.02 – 1301.09nm 1303.54 – 1305.63nm 1308.09 – 1310.19nm
<b>Receiver data:</b>	
Minimum input power, per lane	-8.0dBm <sup>3) 4)</sup> (100GbE) -8.8dBm <sup>3) 5)</sup> (OTU4)
Overload (max power), per lane	+4.5dBm <sup>3) 4)</sup> (100GbE) +2.9dBm <sup>3) 5)</sup> (OTU4)
Wavelength range	1294.53 – 1296.59nm 1299.02 – 1301.09nm 1303.54 – 1305.63nm 1308.09 – 1310.19nm
LOS Assert	Min -25dBm
LOS De-assert	Max -12dBm
LOS Hysteresis	Min 0.5dB
DDM	Yes
MSA compliance	QSFP28 MSA, SFF-8636



Subject to change without notice.

For more information visit <https://cnfibernet.cn/>

## ORDERING INFORMATION

Ordering number	Description
AO-QSFP28-LR4-112	QSFP28, 112GBASE-LR4, OTU4, 1310nm, SM, DDM, 6.3dB, 10km

## GENERAL DEFINITIONS

Parameter	Description
Technology	Grey; Transceiver type for non-WDM applications. Electrical or optical. CWDM; Transceiver type for CWDM applications using G.694.2 channel grid. DWDM; Transceiver type for DWDM applications using G.694.1 channel grid. BiDi; Transceiver pair using two different wavelength channels operating on a single-fiber. DAC: Direct Attach Cable. Electrical cable with attached connectors. AOC: Active Optical Cable. Optical cable with attached connectors.
Transmission Media	Type of fiber, e.g. Multimode (MM) or Singlemode (SM). Number of and connector type within brackets (e.g. 2x LC, 1x MPO).
Typical reach	Nominal distance performance based on typical fiber dispersion, fiber loss and power budget properties, i.e. w/o dispersion compensation and optical amplification. Actual distance is dependent on actual optical path loss and dispersion properties.
Bit rate range	Supported bit rate range in Gigabit or Megabit per second (Gbps or Mbps).
Protocols	Protocols within supported bit rate range.
Nominal wavelength	Typical wavelength(s) from transmitter.
Interface standards	Referenced interface standards or MSA's, e.g. IEEE 802.3 standard for 10GbE services or 100G 4WDM-10 etc.
Power budget	Min and max power budget between Transmitter and Receiver w/o optical path penalties.
Dispersion tolerance/penalty	Maximum amount of tolerated dispersion and required reduction of power budget to maintain stipulated Bit Error Rate (BER) and at a given bit rate.
Temperature range	Max operating case temperature range. Standard temperature range (C-temp): 0°C to +70°C (32°F to +158°F) Extended temperature range (E-temp): typically -20°C to +75°C (-4°F to +167°F) Industrial temperature range (I-temp): -40°C to +85°C (-40°F to +185°F)
Power consumption	Worst case power consumption. Will vary over temperature.
Transmitter Output power	Average output power. Provided in min and max values.
Receiver minimum input power	Minimum average input power at specified BER, normally $1E^{-12}$ . Note that some protocols require FEC to achieve sufficient BER.
Receiver max input power	Maximum average input power giving a BER, normally $1E^{-12}$ .
DDM	Digital Diagnostic Monitoring functionality as defined in e.g. SFF-8472 MSA.

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## QSFP-100G-CWDM-BD

100Gbps QSFP28 CWDM4 BIDI Transceiver, 2km Reach

### Features

- QSFP28 MSA compliant
- 4 CWDM lanes MUX/DEMUX design
- Supports 103.1Gb/s aggregate bit rate
- Compliant to 100G CWDM4 MSA Technical Spec Rev1.1
- Bidirectional optical data transmission/receiving
- Up to 2km transmission on single mode fiber (SMF) with FEC
- Operating case temperature: 0 to 70 o C
- 4x25G electrical interface (OIF CEI-28G-VSR)
- Maximum power consumption 3.5W
- Optical connector: SMF angled polished LC simplex connector
- Hot pluggable: the module needs to be hot pluggable for ease of installation and service
- RoHS compliant

### Applications

- Data Center Interconnect
- 100G Ethernet
- 100G Campus Link

### Description

This product is a transceiver module designed for 2km optical communication applications. The design is compliant to 100GBASE CWDM4 MSA standard. The module converts 4 inputs channels (ch) of 25Gb/s electrical data to 4 CWDM optical signals, and multiplexes them into a single channel for 100Gb/s optical transmission. Reversely, on the receiver side, the module optically de-multiplexes a 100Gb/s input into 4 CWDM channels signals, and converts them to 4 channel output electrical data.

The central wavelengths of the 4 CWDM channels are 1271, 1291, 1311 and 1331 nm as members of the CWDM wavelength grid defined in ITU-T G.694.2. It contains an LC/APC simplex connector for the optical interface and a 38-pin connector for the electrical interface. To minimize the optical dispersion in the long-haul system, single-mode fiber (SMF) has to be applied in this module. Host FEC is required to support up to 2km fiber transmission.

The product is designed with form factor, optical/electrical connection and digital diagnostic interface according to the QSFP28 Multi-Source Agreement (MSA). It has been designed to meet the harshest external operating conditions including temperature, humidity and EMI interference.

## Functional Description

This product converts the 4-channel 25Gb/s electrical input data into CWDM optical signals (light), by a driven 4-wavelength Distributed Feedback Laser (DFB) array. The light is combined by the MUX parts as a 100Gb/s data, propagating out of the transmitter module from the SMF. The receiver module accepts the 100Gb/s CWDM optical signals input, and de-multiplexes it into 4 individual 25Gb/s channels with different wavelength. Each wavelength light is collected by a discrete photo diode, and then outputted as electric data after amplified by a TIA and a post amplifier. Figure 1 shows the functional block diagram of this product.

A single +3.3V power supply is required to power up this product. Both power supply pins VccTx and VccRx are internally connected and should be applied concurrently. As per MSA specifications the module offers 7 low speed hardware control pins (including the 2-wire serial interface): ModSelL, SCL, SDA, ResetL, LPMode, ModPrsL and IntL.

Module Select (ModSelL) is an input pin. When held low by the host, this product responds to 2-wire serial communication commands. The ModSelL allows the use of this product on a single 2-wire interface bus - individual ModSelL lines must be used.

Serial Clock (SCL) and Serial Data (SDA) are required for the 2-wire serial bus communication interface and enable the host to access the QSFP+ memory map.

The ResetL pin enables a complete reset, returning the settings to their default state, when a low level on the ResetL pin is held for longer than the minimum pulse length. During the execution of a reset the host shall disregard all status bits until it indicates a completion of the reset interrupt. The product indicates this by posting an IntL (Interrupt) signal with the Data\_Not\_Ready bit negated in the memory map. Note that on power up (including hot insertion) the module should post this completion of reset interrupt without requiring a reset.

Low Power Mode (LPMode) pin is used to set the maximum power consumption for the product in order to protect hosts that are not capable of cooling higher power modules, should such modules be accidentally inserted.

Module Present (ModPrsL) is a signal local to the host board which, in the absence of a product, is normally pulled up to the host Vcc. When the product is inserted into the connector, it completes the path to ground through a resistor on the host board and asserts the signal. ModPrsL then indicates its present by setting ModPrsL to a “Low” state.

Interrupt (IntL) is an output pin. “Low” indicates a possible operational fault or a status critical to the host system. The host identifies the source of the interrupt using the 2-wire serial interface. The IntL pin is an open collector output and must be pulled to the Host Vcc voltage on the Host board.

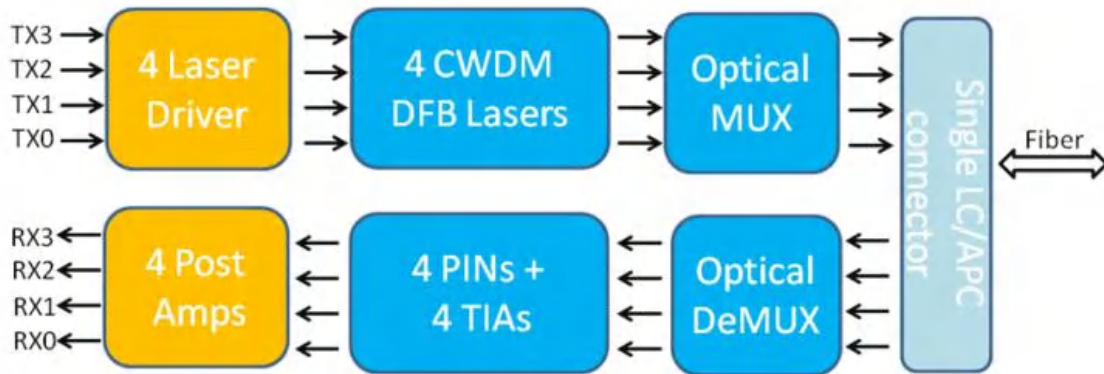


Figure 1: Transceiver Block Diagram

### Absolute Maximum Ratings

It has to be noted that the operation in excess of any individual absolute maximum ratings might cause permanent damage to this module.

Table 1 - Absolute Maximum Ratings

Parameter	Symbol	Min	Typical	Max	Unit
Storage Temperature	T <sub>s</sub>	-40		85	degC
Operating Case Temperature	T <sub>OP</sub>	0		70	degC
Power Supply Voltage	V <sub>CC</sub>	-0.5	3.3	3.6	V
Relative Humidity (non-condensation)	RH	0		85	%
Damage Threshold, each Lane	TH <sub>d</sub>	3.5			dBm

### Recommended Operating Conditions

Table 2- Recommended Operating Conditions

Parameter	Symbol	Min	Typical	Max	Units
Operating Case Temperature	T <sub>OP</sub>	0		70	degC
Power Supply Voltage	V <sub>CC</sub>	3.135	3.3	3.465	V
Data Rate, each lane			25.78125		Gb/s
Data Rate Accuracy		-100		100	ppm
Control Input Voltage High		2		V <sub>CC</sub>	V
Control Input Voltage Low		0		0.8	V
Link Distance with G.652	D	0.002		2	km

## Electrical Characteristics

The following electrical characteristics are defined over the Recommended Operating Environment unless otherwise specified.

**Table 3- Electrical Characteristics**

Parameter	Test Point	Min	Typical	Max	Units	Notes
Power Consumption				3.5	W	
Supply Current	I <sub>cc</sub>			1.06	A	
<b>Transmitter (each Lane)</b>						
Overload Differential Voltage pk-pk	TP1a	900			mV	
Common Mode Voltage (V <sub>cm</sub> )	TP1	-350		2850	mV	1
Differential Termination Resistance Mismatch	TP1			10	%	At 1MHz
Differential Return Loss (SDD11)	TP1			See CEI-28G-VSR Equation 13-19	dB	
Common Mode to Differential conversion and Differential to Common Mode conversion (SDC11, SCD11)	TP1			See CEI-28G-VSR Equation 13-20	dB	
Stressed Input Test	TP1a	See CEI-28G-VSR Section 13.3.11.2.1				
<b>Receiver (each Lane)</b>						
Differential Voltage, pk-pk	TP4			900	mV	
Common Mode Voltage (V <sub>cm</sub> )	TP4	-350		2850	mV	1
Common Mode Noise, RMS	TP4			17.5	mV	
Differential Termination Resistance Mismatch	TP4			10	%	At 1MHz
Differential Return Loss (SDD22)	TP4			See CEI-28G-VSR Equation 13-19	dB	
Common Mode to Differential conversion and Differential to Common Mode conversion (SDC22, SCD22)	TP4			See CEI-28G-VSR Equation 13-21	dB	
Common Mode Return Loss (SCC22)	TP4			-2	dB	2
Transition Time, 20 to 80%	TP4	9.5			ps	
Vertical Eye Closure (VEC)	TP4			5.5	dB	

Eye Width at $10^{-15}$ probability (EW15)	TP4	0.57			UI	
Eye Height at $10^{-15}$ probability (EH15)	TP4	228			mV	

**Notes:**

1. Vcm is generated by the host. Specification includes effects of ground offset voltage.
2. From 250MHz to 30GHz.

**Optical Characteristics****Table 4- Optical Characteristics**

Parameter	Symbol	Min	Typical	Max	Unit	Notes
Wavelength Assignment	L0	1264.5	1271	1277.5	nm	
	L1	1284.5	1291	1297.5	nm	
	L2	1304.5	1311	1317.5	nm	
	L3	1324.5	1331	1337.5	nm	
<b>Transmitter</b>						
Side-mode Suppression Ratio	SMSR	30			dB	
Total Average Launch Power	$P_T$			8.5	dBm	
Average Launch Power, each Lane	$P_{AVG}$	-6.5		2.5	dBm	
Optical Modulation Amplitude (OMA), each Lane	$P_{OMA}$	-4.0		2.5	dBm	1
Launch Power in OMA minus Transmitter and Dispersion Penalty (TDP), each Lane		-5.0			dBm	
TDP, each Lane	TDP			3.0	dB	
Extinction Ratio	ER	3.5			dB	
Optical Return Loss Tolerance	TOL	-		20	dB	
Transmitter Reflectance	$R_T$			-12	dB	
Average Launch Power OFF Transmitter, each Lane	$P_{off}$			-30	dBm	
Transmitter Eye Mask Definition {X1, X2, X3, Y1, Y2, Y3}		{0.31, 0.4, 0.45, 0.34, 0.38, 0.4}				2
<b>Receiver</b>						
Damage Threshold	$TH_d$	3.3			dBm	3
Average Receiver Power, each Lane		-11.5		2.5	dBm	
Receive Power (OMA), each Lane				2.5	dBm	
Receiver Sensitivity (OMA), each Lane				-10	dBm	

Stressed Receiver Sensitivity (OMA), each Lane	SEN			-7.3	dBm	for BER = $5 \times 10^{-5}$
Receiver Reflectance	R <sub>R</sub>			-26	dB	4
LOS Assert	LOSA	-30			dBm	
LOS Deassert	LOSD			-15		
LOS Hysteresis	LOSH	0.5			dB	
Receiver Electrical 3 dB upper Cutoff Frequency, each Lane				31	GHz	
<b>Conditions of Stress Receiver Sensitivity Test (Note 5)</b>						
Vertical Eye Closure Penalty, each Lane			1.9		dB	
Stressed Eye J2 Jitter, each Lane			0.33		UI	
Stressed Eye J4 Jitter, each Lane			0.48		UI	
SRS eye mask definition { X1, X2, X3, Y1, Y2, Y3 }			{0.39, 0.5, 0.5, 0.39, 0.39, 0.4}			

**Notes:**

1. Even if the TDP < 1.0 dB, the OMA min must exceed the minimum value specified here.
2. Hit ratio  $5 \times 10^{-5}$ .
3. The receiver shall be able to tolerate, without damage, continuous exposure to a modulated optical input signal having this power level on one lane. The receiver does not have to operate correctly at this input power.
4. Measured with conformance test signal for BER =  $5 \times 10^{-5}$ .
5. Vertical eye closure penalty, stressed eye J2 jitter, stressed eye J4 jitter, and SRS eye mask definition are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

**Digital Diagnostic Functions**

The following digital diagnostic characteristics are defined over the normal operating conditions unless otherwise specified.

**Table 5- Digital Diagnostic Functions**

Parameter	Symbol	Min	Max	Units	Notes
Temperature monitor absolute error	DMI_Temp	-3	3	degC	1
Supply voltage monitor absolute error	DMI_VCC	-0.1	0.1	V	2
Channel RX power monitor absolute error	DMI_RX_Ch	-2	2	dB	3
Channel Bias current monitor	DMI_Ibias_Ch	-10%	10%	mA	
Channel TX power monitor absolute error	DMI_TX_Ch	-2	2	dB	3

**Notes:**

1. Over operating temperature range
2. Over full operating range

3. Due to measurement accuracy of different single mode fibers, there could be an additional +/-1 dB fluctuation, or a +/- 3 dB total accuracy.

### Pin Assignment and Description

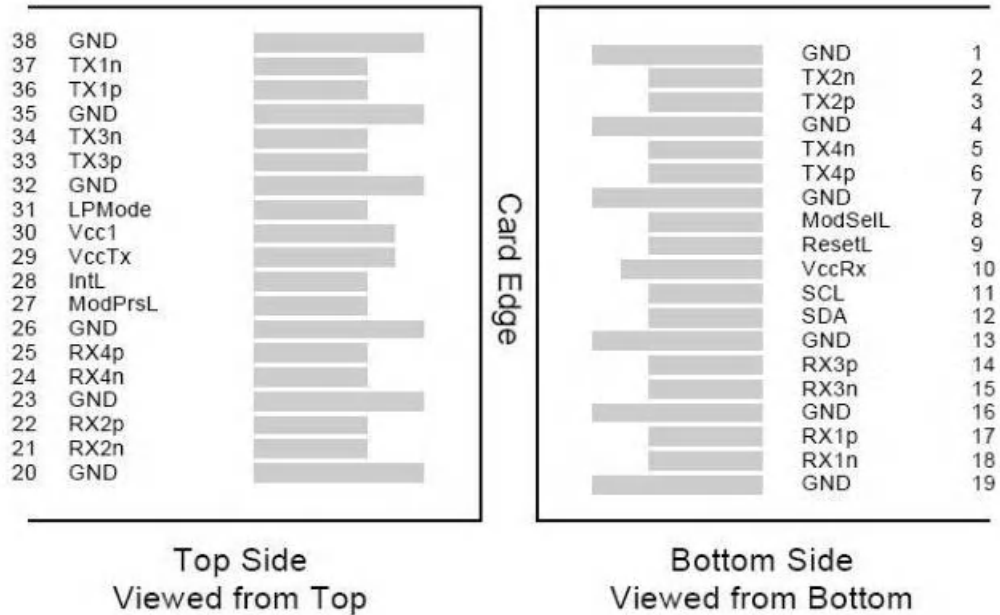


Figure 2: MSA Compliant Connector

### Pin Definition

Table 6- Pin Definition

Pin	Logic	Symbol	Name/Description	Notes
1		GND	Ground	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	
3	CML-I	Tx2p	Transmitter Non-Inverted Data output	
4		GND	Ground	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	
6	CML-I	Tx4p	Transmitter Non-Inverted Data Output	
7		GND	Ground	1
8	LVTTTL-I	ModSelL	Module Select	
9	LVTTTL-I	ResetL	Module Reset	
10		VccRx	+3.3V Power Supply Receiver	2
11	LVCMOS-I/O	SCL	2-Wire Serial Interface Clock	

12	LVC MOS-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
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	1
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		VccTx	+3.3V Power Supply Transmitter	2
30		Vcc1	+3.3V Power Supply	2
31	LVTTL-I	LPMODE	Low Power Mode	
32		GND	Ground	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	
34	CML-I	Tx3n	Transmitter Inverted Data Output	
35		GND	Ground	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	
37	CML-I	Tx1n	Transmitter Inverted Data Output	
38		GND	Ground	1

**Notes:**

1. GND is the symbol for signal and supply (power) common for QSFP28 modules. All are common within the QSFP28 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. VccRx, Vcc1 and VccTx are the receiving and transmission power suppliers and shall be applied concurrently. Recommended host board power supply filtering is shown in Figure 3 below. Vcc Rx, Vcc1 and Vcc Tx may be internally connected within the QSFP28 transceiver module in any combination. The connector pins are each rated for a maximum current of 500mA.

### Recommended Power Supply Filter

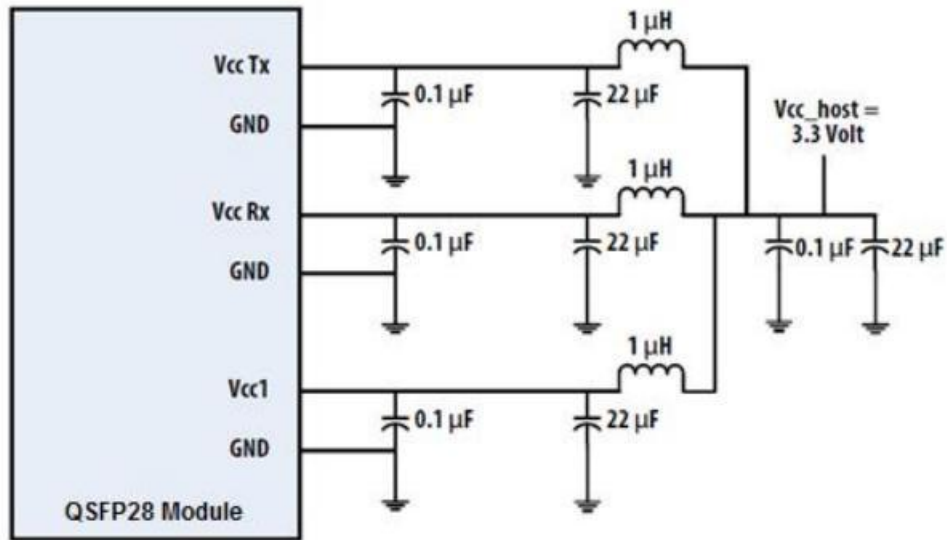
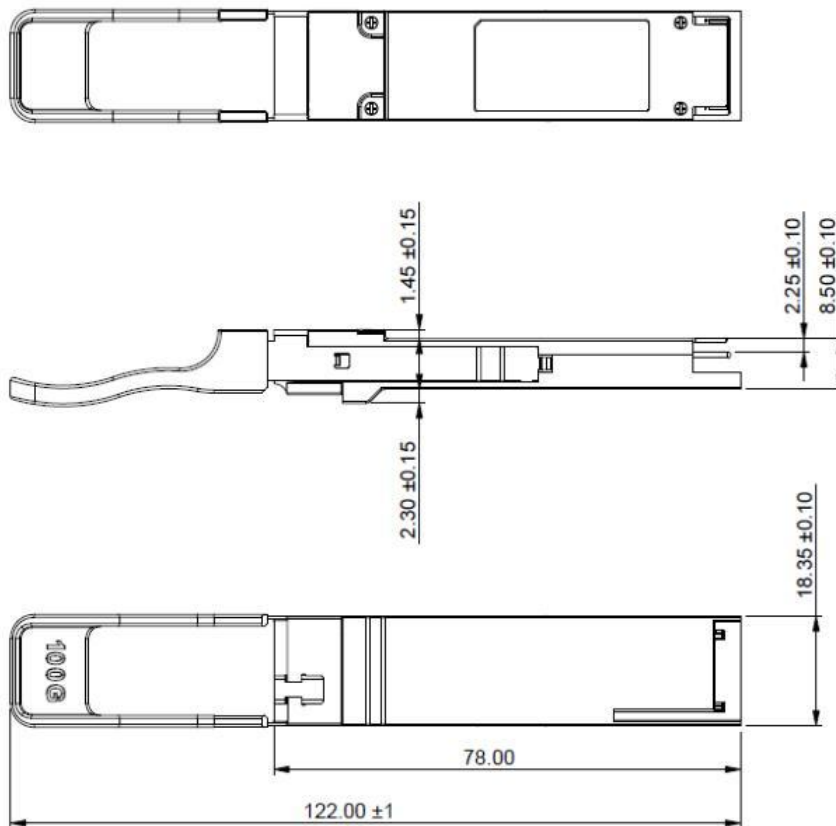


Figure 3: Recommended Power Supply Filter

### Mechanical Dimensions



## ESD

This transceiver is specified as ESD threshold 1kV for high speed data pins and 2kV for all other electrical input pins, tested per MIL-STD-883, Method 3015.4 /JESD22-A114-A (HBM). However, normal ESD precautions are still required during the handling of this module. This transceiver is shipped in ESD protective packaging. It should be removed from the packaging and handled only in an ESD protected environment.

## Laser Safety

This is a Class 1 Laser Product according to EN 60825-1:2014. This product complies with 21 CFR 1040.10 and 1040.11 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.

## Ordering Information

**Table 7- Ordering Information**

Part Number	Product Description
QSFP-100G-CWDM-BD	100Gbps QSFP28 CWDM4 BIDI, LC Connector, 2km, with DDM

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## Product Specification

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### 100G QSFP28 SR4

#### PRODUCT FEATURES

- Hot-pluggable QSFP28 form factor
- Supports 103.1Gb/s aggregate bit rate
- Power dissipation < 2.5W
- RoHS-6 compliant
- Extended case temperature range of 0°C to 85°C
- Single 3.3V power supply
- Maximum link length of 100m on



OM4 Multimode Fiber (MMF)

#### APPLICATIONS

- 4x25Gb/s 850nm VCSEL-based 100G QSFP28 SR4
- 4x25G electrical interface
- Single MPO12 receptacle
- I2C management interface

CNFIBERNET's 100G QSFP28 SR4 transceiver modules are designed for use in 100 Gigabit Ethernet links over multimode fiber with extended case temperature range of 0°C to 85°C.

They are compliant with the QSFP28 MSA<sup>1</sup> and IEEE 802.3bm 100G-QSFP28-SR4<sup>2</sup> and CAUI-4<sup>2</sup>. Digital diagnostics functions are available via the I2C interface, as specified by the QSFP28 MSA<sup>1</sup> and CNFIBERNET Application Note AN-2141<sup>3</sup>. The transceiver is RoHS-6 compliant per Directive 2011/65/EU<sup>4</sup> and CNFIBERNET Application Note AN-2038<sup>5</sup>.

**PRODUCT SELECTION**

**100G QSFP28 SR4**

- R: 100G Ethernet maximum bit rate (103.1Gb/s)
- E: 4x25G parallel optics
- P: Pull tab release
- M: MPO receptacle
- 3: Extended temperature range

**I. Pin Descriptions**

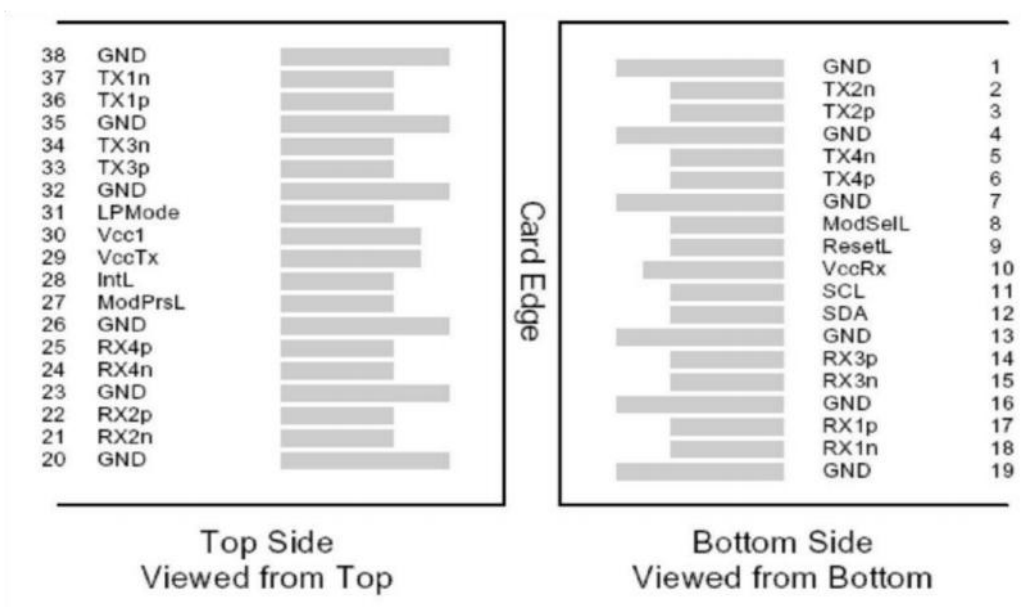


Figure 1 – QSFP28-compliant 38-pin connector (per SFF-8679)

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	
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	Vcc Tx	+3.3 V Power supply transmitter	
30	Vcc1	+3.3 V Power Supply	
31	LPMode	Low Power Mode	
32	GND	Ground	1
33	Tx3p	Transmitter Non-Inverted Data Input	

34	Tx3n	Transmitter Inverted Data Input	
35	GND	Ground	1
36	Tx1p	Transmitter Non-Inverted Data Input	
37	Tx1n	Transmitter Inverted Data Input	
38	GND	Ground	1

**Notes**

1. Circuit ground is internally isolated from chassis ground.

**II. Absolute Maximum Ratings**

Module performance is not guaranteed beyond the operating range (see Section VI). Exceeding the limits below may damage the transceiver module permanently.

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Maximum Supply Voltage	V <sub>cc</sub>	-0.5		4.0	V	
Storage Temperature	T <sub>s</sub>	-40		85	C	
Case Operating Temperature	T <sub>OP</sub>	0		85	C	
Relative Humidity	RH	15		85	%	1
Receiver Damage Threshold, per Lane	P <sub>Rdmg</sub>	3.4			dBm	

**Notes:**

1. Non-condensing.

**III. Electrical Characteristics (EOL, T<sub>OP</sub> = 0 to 85 °C, V<sub>CC</sub> = 3.135 to 3.465 Volts)**

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Supply Voltage	V <sub>cc</sub>	3.135		3.465	V	
Supply Current	I <sub>cc</sub>			1.5	A	
Module total power	P			2.5	W	1
<b>Transmitter</b>						
Signaling rate per lane		25.78125 ± 100ppm			Gb/s	
Differential pk-pk input voltage tolerance	V <sub>in,pp,diff</sub>			900	mV	
Single-ended voltage tolerance	V <sub>in,pp</sub>	-0.35		+3.3	V	
Module stress input test		Per Section 83E.3.4.1, IEEE 802.3bm				
<b>Receiver</b>						

Signaling rate per lane		25.78125 ± 100ppm			Gb/s	
Differential data output swing	Vout,pp	100		400	mVpp	2
		300		600		
		400	600	800		
		600		1200		
Eye width		0.57			UI	
Eye height, differential		228			mV	
Vertical eye closure	VEC	5.5			dB	
Transition time (20% to 80%)	tr, tr	12			ps	

Notes: 1. Maximum total power value is specified across the full operational temperature and voltage range when CDRs are locked or a lack of input signal results in squelch being activated. If incorrect frequencies cause the CDRs to continuously attempt to lock, maximum power dissipation may reach 3.5 W.  
2. Output voltage is settable in 4 discrete ranges via I2C. Default range is Range 2 (400 – 800 mV).

#### IV. Optical Characteristics (EOL, T<sub>OP</sub> = 0 to 85 °C, V<sub>CC</sub> = 3.135 to 3.465 Volts)

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
<b>Transmitter</b>						
Signaling Speed per Lane		25.78125 ± 100ppm			Gb/s	1
Center wavelength		840	850	860	nm	
RMS Spectral Width	SW			0.6	nm	
Average Launch Power per Lane	TXP <sub>x</sub>	-8.4		2.4	dBm	
Transmit OMA per Lane	TxOMA	-6.4		3	dBm	
Launch Power [OMA] minus TDEC per Lane	P-TDEC	-7.3			dBm	
TDEC per Lane	TDEC			4.3	dBm	
Optical Extinction Ratio	ER	2			dB	
Optical Return Loss Tolerance	ORL			12	dB	
Encircled Flux	FLX	>86% at 19 μm <30% at 4.5 μm				
Average Launch Power of OFF Transmitter, per Lane				-30	dBm	
Transmitter Eye mask definition {X1, X2, X3, Y1, Y2, Y3}		{0.3,0.38,0.45,0.35,0.41,0.5}				2
<b>Receiver</b>						
Signaling Speed per Lane		25.78125 ± 100ppm			GBd	3
Center wavelength		840		860	nm	
Damage Threshold	DT	3.4			dBm	
Average Receive Power per Lane	RXP <sub>x</sub>	-10.3		2.4	dBm	4

Receive Power (OMA) per Lane	RxOMA			3	dBm	
Receiver Reflectance	Rfl			-12	dB	
Stressed Receiver Sensitivity (OMA) per Lane	SRS			-5.2	dBm	
Stressed Conditions:						
Stressed Eye Closure	SEC		4.3		dB	
Stressed Eye J2 Jitter	J2		0.39		UI	
Stressed Eye J4 Jitter	J4		0.53		UI	
OMA of each aggressor lane			3		dBm	
Stressed Receiver Eye Mask Definition {X1, X2, X3, Y1, Y2, Y3}			{0.28,0.5,0.5,0.33,0.33,0.4}			5
LOS De-Assert	LOS <sub>D</sub>			-13	dBm	
LOS Assert	LOS <sub>A</sub>	-30			dBm	
LOS Hysteresis		0.5	2		dB	

Notes:

1. Transmitter consists of 4 lasers operating at a maximum speed of 25.78125Gb/s ±100ppm each.
2. Hit Ratio 1.5 x 10<sup>-3</sup> hits/sample.
3. Receiver consists of 4 photodetectors operating at a maximum speed of 25.78125Gb/s ±100ppm each.
4. Minimum value is informative only and not the principal indicator of signal strength.
5. Hit Ratio 5 x 10<sup>-5</sup> hits/sample.

V. General Specifications

Parameter	Symbol	Min	Typ	Max	Units	Ref.
Bit Rate (all wavelengths combined)	BR			103.1	Gb/s	1
Bit Error Ratio (pre-FEC)	BER			5x10 <sup>-5</sup>		2
<b>Maximum Supported Distances</b>						
Fiber Type						
OM3 MMF	Lmax1			70	m	3
OM4 MMF	Lmax2			100	m	3

Notes:

1. Supports 100G-QSFP28-SR4 per IEEE 802.3bm.
2. Tested with a 2<sup>31</sup> - 1 PRBS.
3. Requires FEC on the host to support maximum distance, per 100G-QSFP28-SR4.

## VI. Environmental Specifications

CNFIBERNET 100G QSFP28 SR4 transceivers have a extended operating case temperature range of 0°C to +85°C.

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

## VII. Regulatory Compliance

CNFIBERNET 100G QSFP28 SR4 transceivers are Class 1 Laser Products. They are certified per the following standards:

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

Copies of the referenced certificates will be available at CNFIBERNET upon request. 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.

## VIII. Digital Diagnostics Functions

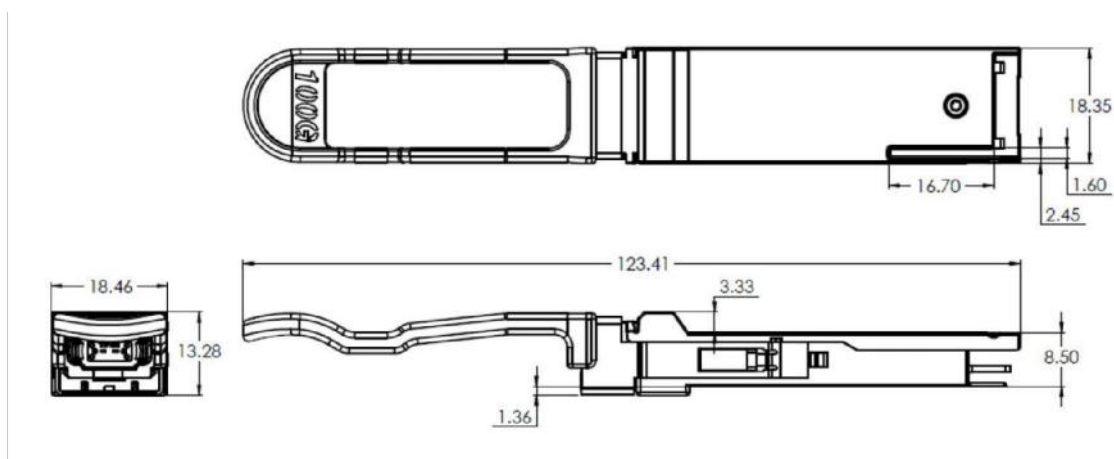
100G QSFP28 SR4 transceivers support the I2C-based diagnostics interface specified by the QSFP28 MSA<sup>1</sup>. See CNFIBERNET Application Note AN-2141<sup>3</sup>.

**IX. Memory Contents**

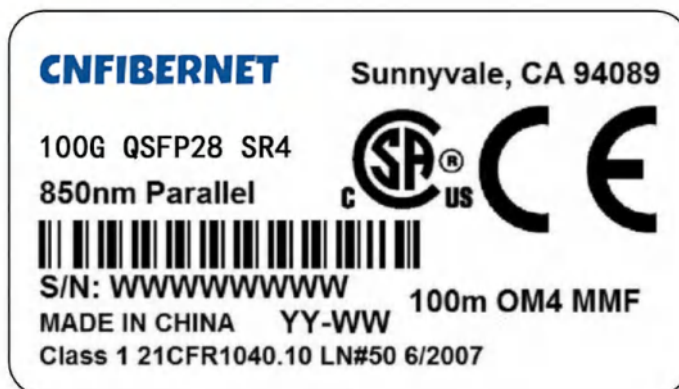
Per the QSFP28 MSA<sup>1</sup>. See CNFIBERNET Application Note AN-2141<sup>3</sup>.

**XI. Mechanical Specifications**

CNFIBERNET 100G QSFP28 SR4 transceivers are compatible with the QSFP28 MSA specification<sup>1</sup>.



**Figure 2. Mechanical Dimensions.**



**XII. 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. SFF8679
  - iii. SFF-8636
  - iv. SFF8662
  - v. SFF-8663
  - vi. SFF-8672
  - vii. SFF-8683
2. IEEE 802.3bm, PMD Type 100G QSFP28 SR4 and CAUI-4.
3. Application Note AN-2141, “100G QSFP28 SR4 NVR Application Note”, CNFIBERNET Corporation.
4. 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.
5. “Application Note AN-2038: CNFIBERNET Implementation Of RoHS Compliant Transceivers”, CNFIBERNET Corporation, January 21, 2005.

**For More Information:**

China Fiber Optic Network Supply Chain Center  
10 Xiyuan Road, Hangzhou, Zhejiang Province, China

Sales email : [sales@cnfibernet.cn](mailto:sales@cnfibernet.cn)

# QSFP56-100G-SR4

## 4x26.56GBaud 850nm Transceiver

### Product Description

The QSFP28 Optical transceiver for 4x26.56GBaud optical links. It is compliant with the SFF-8679 MSA. It operates at 26.56GBaud up to 100m over OM4 Multi-mode fiber.

### Applications

- High performance computing interconnect
- Data center

### Features

- 4 independent parallel optical channels
- Each channel typical data rate 26.56GBaud with integrated CDR
- Hot Pluggable
- Up to 100m link on OM4 Multi-mode Fiber and 70m OM3 Multi-mode Fiber
- 850nm VCSEL/PD Array Technology
- CML Compatible electrical I/O
- SFF-8679 MSA Compliance
- Timing requirement of control and status I/O comply QSFP-DD Hardware Rev5.1
- MPO-12 UPC Interface
- CMIS5.0
- Case Operating Temperature:
  - Commercial: 0 to 70°C
- RoHS II Compliance

Ordering Information	
Part Number	Case Operating Temperature
QSFP56-100G-SR4	0 to 70 °C

Absolute Maximum Ratings					
Parameter	Symbol	Min	Max	Units	Notes
Storage Ambient Temperature	T <sub>stg</sub>	-40	+100	°C	Exceeding the Absolute Maximum Ratings may cause irreversible damage to the device. The device is not intended to be operated under the condition of simultaneous Absolute Maximum Ratings, a condition which may cause irreversible damage to the device.
Relative Humidity - Storage	RH <sub>s</sub>	0	95	%	
Relative Humidity - Operating	RH <sub>o</sub>	0	85	%	
Module Supply Voltage	V <sub>cc</sub>	-0.5	3.6	V	

**QSFP56-100G-SR4****4x26.56GBaud 850nm Transceiver**

Recommended Operating Conditions						
Parameter	Symbol	Min	Typ	Max	Units	Notes
Case Operating Temperature	$T_{case}$	0	+25	+70	°C	Temperature Range = C
Module Supply Voltage	$V_{CC}$	3.135	3.3	3.465	V	
Module Supply Current	$I_{IN}$	-	1180	-	mA	
Signaling Speed Per Channel	S	-	26.56	-	GBaud	
Storage Temperature	$T_{stg}$	-40	-	85	°C	

Transmitter Electrical Interfaces							
Parameter	Symbol	Min	Typ	Max	Units	Notes	
Tx_Data Differential Input Voltage	$V_{IN}$	400	-	900	mV		
Tx_Data Differential Input Impedance	$Z_{IN}$	-	100	-	$\Omega$		

Receiver Electrical Interfaces						
Parameter	Symbol	Min	Typ	Max	Units	Notes
Rx_Data Differential Output Voltage	$V_{OUT}$	-	-	900	mV	
Rx_Data Differential Output Impedance	$Z_{OUT}$	90	100	110	$\Omega$	
Link BER	BER			5E-5		@26.56GBaud PRBS31Q

# QSFP56-100G-SR4

## 4x26.56GBaud 850nm Transceiver

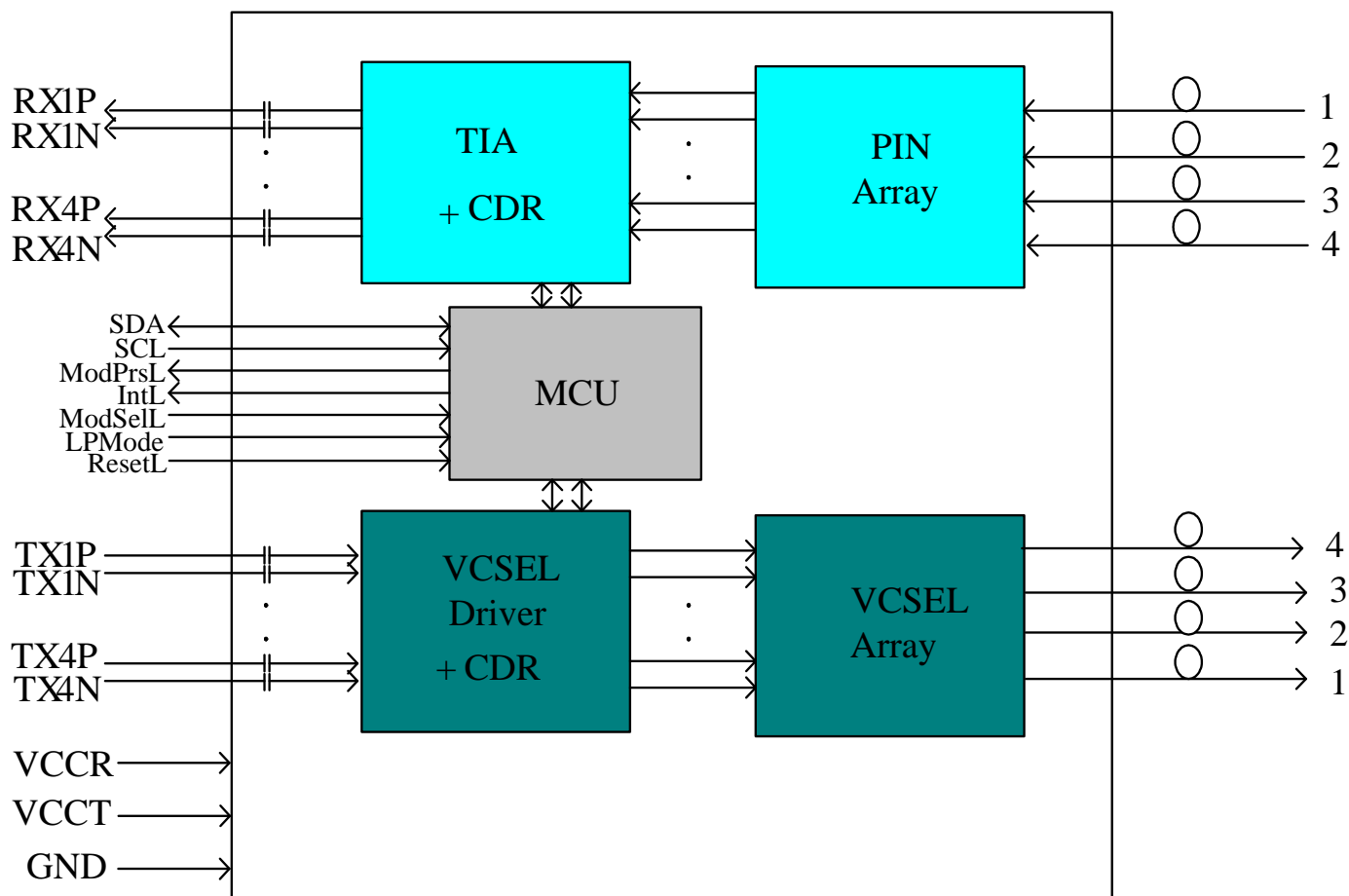
Transmitter Optical Characteristics						
Parameter	Symbol				Units	Notes
		Min	Typ	Max		
Signaling rate, each lane	SR	-	26.56	-	GBd	
Signaling Speed Accuracy	SSA	-100		100	ppm	
Modulation format		PAM4				
Average Launch Power ,each lane	$P_{OUT}$	-6	-	4	dBm	Average Optical Output
Outer Optical Modulation Amplitude each lane	$OMA_{outer}$	-4	-	3	dBm	
Optical Output with Tx OFF	$P_{OFF}$	-	-	-30	dBm	
Extinction ratio	ER	3			dB	
Center Wavelength	$\lambda$	840	850	860	nm	
RMS Spectral Width	$\Delta\lambda$	-	-	0.6	nm	
Transmitter and dispersion eye closure (TDECQ) each lane	TDECQ	-	-	4.9	dB	
Launch power in $OMA_{outer}$ minus TDECQ, each lane (min)		-5.9	-	-	dB	
TDECQ – $10\log_{10}(Ceq)$ , each lane (max)		-	-	4.5	dB	

Receiver Optical Characteristics						
Parameter	Symbol				Units	Notes
		Min	Typ	Max		
Signaling rate, each lane	SR	-	26.56	-	GBd	
Signaling Speed Accuracy		-100		100	ppm	
Modulation format		PAM4				
Average power at receive input, each lane	$P_{IN}$	-8.4	-	4	dBm	
Receive power ( $OMA_{outer}$ ), each lane (max)		-	-	3	dBm	
Receiver sensitivity ( $OMA_{outer}$ ) each lane	$Sen$	-	-	max(-6.6, SECQ – 8)	dBm	Note1
Center Wavelength	$\lambda$	840	850	860	nm	
Rx_LOS of Signal - Assert	$P_A$	-24.6	-	-	dBm	
Rx_LOS of Signal - Deassert	$P_D$	-	-	-8.6	dBm	
Rx_LOS of Signal - Hysteresis	$P_{Hy}$	0.5	-	-	dB	
Note 1: Sensitivity where the BER = 2.4E-4 measured with a PRBS 31Q test pattern@26.56GBaud						

# QSFP56-100G-SR4

## 4x26.56GBaud 850nm Transceiver

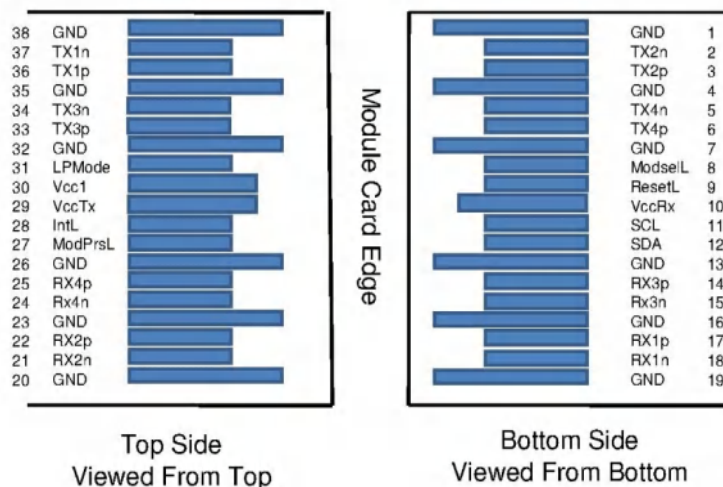
Block Diagram



# QSFP56-100G-SR4

## 4x26.56GBaud 850nm Transceiver

**Pin Assignment**



Pin Description			
Pin	Symbol	Description	Notes
1	GND	Ground	
2	Tx2n	Transmitter Inverted Data Input	
3	Tx2p	Transmitter Non Inverted Data Input	
4	GND	Ground	
5	Tx4n	Transmitter Inverted Data Input	
6	Tx4p	Transmitter Non Inverted Data Input	
7	GND	Ground	
8	ModselL	Module Select	
9	RetsetL	Module Reset	
10	V <sub>CC</sub> Rx	Receiver +3.3V DC Power Supply	
11	SCL	I <sup>2</sup> C Serial Clock	
12	SDA	I <sup>2</sup> C Serial Data	
13	GND	Ground	
14	Rx3p	Receiver Non Inverted Differential Output	
15	Rx3n	Receiver Inverted Differential Output	
16	GND	Ground	
17	Rx1p	Receiver Non Inverted Differential Output	
18	Rx1n	Receiver Inverted Differential Output	
19	GND	Ground	
20	GND	Ground	
21	Rx2n	Receiver Inverted Differential Output	
22	Rx2p	Receiver Non Inverted Differential Output	
23	GND	Ground	

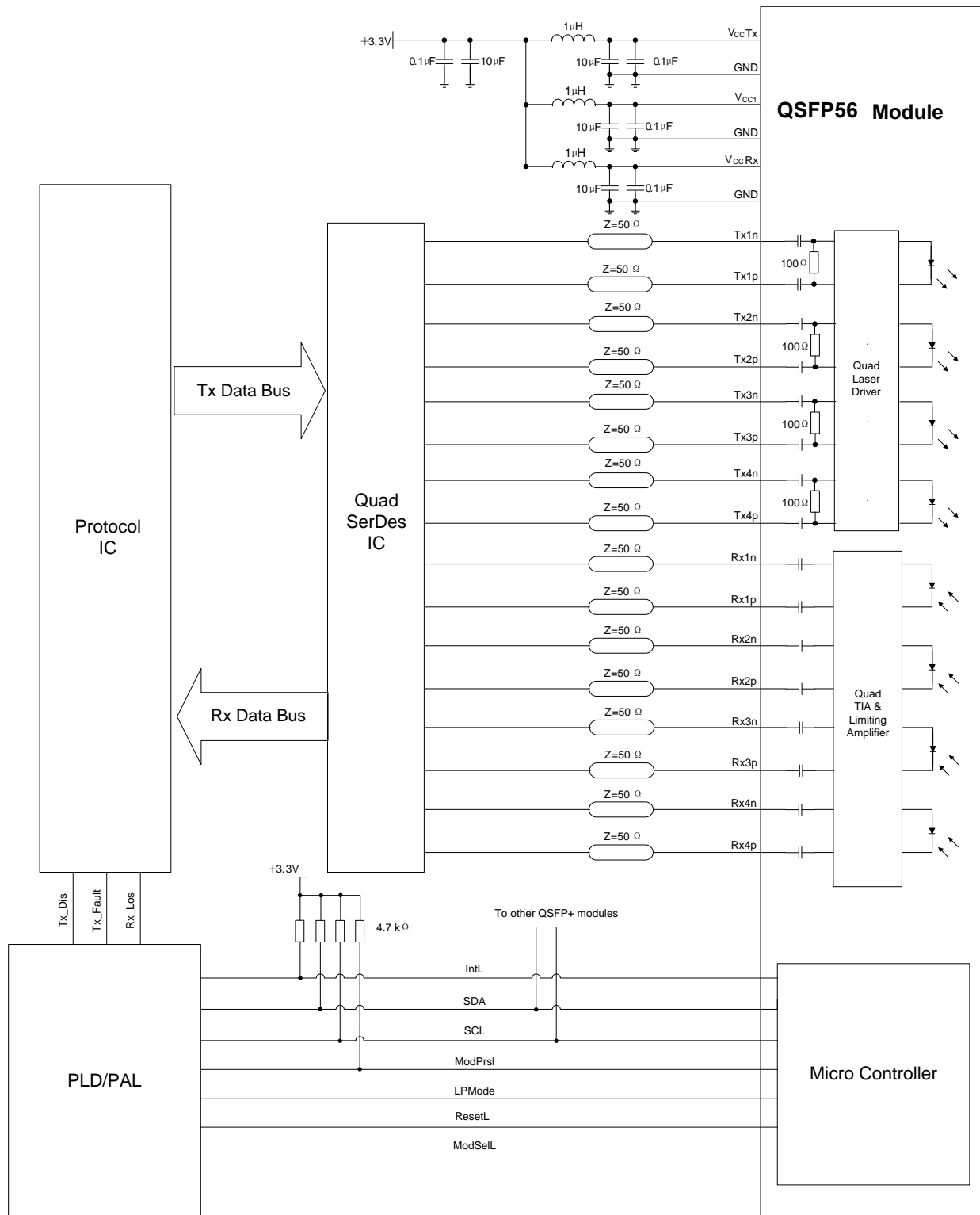
**QSFP56-100G-SR4****4x26.56GBaud 850nm Transceiver**

24	Rx4n	Receiver Inverted Differential Output	
25	Rx4p	Receiver Non Inverted Differential Output	
26	GND	Ground	
27	ModPrsL	Module Present	
28	IntL	Interrupt	
29	V <sub>CC</sub> Tx	Transmitter +3.3V DC Power Supply	
30	V <sub>CC</sub> 1	+3.3V DC Power Supply	
31	LPMoD	Low Power Mode	
32	GND	Ground	
33	Tx3p	Transmitter Non Inverted Data Input	
34	Tx3n	Transmitter Inverted Data Input	
35	GND	Ground	
36	Tx1p	Transmitter Non Inverted Data Input	
37	Tx1n	Transmitter Inverted Data Input	
38	GND	Ground	

# QSFP56-100G-SR4

## 4x26.56GBaud 850nm Transceiver

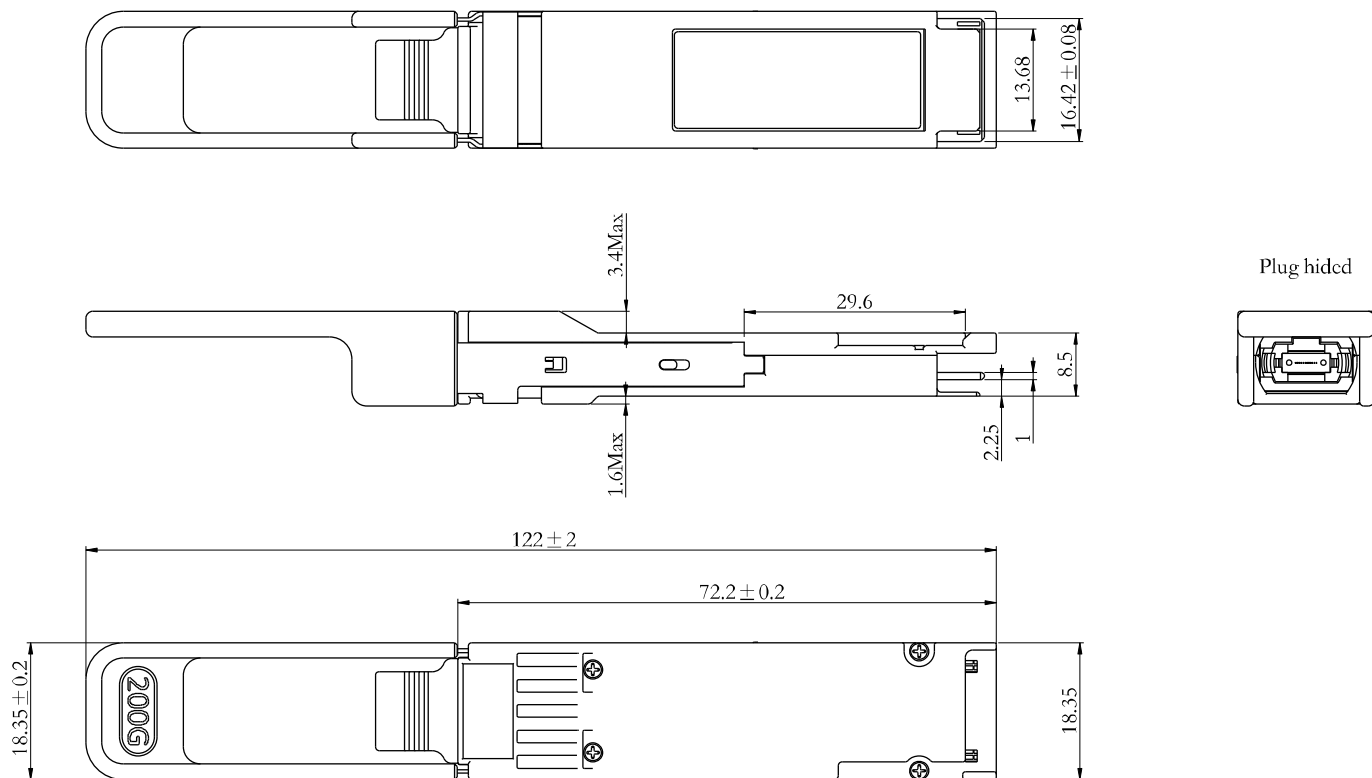
### Electrical Interface



# QSFP56-100G-SR4

## 4x26.56GBaud 850nm Transceiver

### Mechanical Dimensions



- NOTES:
- 1.TOLERANCE:  $\pm 0.1\text{MM}$ .
  - 2.OTHERS ACCORDING WITH SFF-8661 MSA OR CUSTOMER SPEC.
  - 3.LIGHT PORT ACCORDING WITH FIBER CONNECTOR SPEC.

# QSFP56-100G-SR4

---

## 4x26.56GBaud 850nm 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.

#### Notice:

The information provided on this page contains the product target specifications which are subject to change without notice.

Check with your Hisense Sales Office for product updates, changes in specifications, sample availability and production release dates.

#### EYE SAFETY

Complies with 21 CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 Ed.3., as described in Laser Notice No. 56, dated May 8, 2019.

Complies with IEC/EN 60825-1 and IEC/EN 60825-2. Class 1 laser safety compliant.

INVISIBLE LASER RADIATION.

#### CAUTION:

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

## 200G QSFP56 Active Optical Cable

**Part Number – AO-QSFP56-200G-OC** is a high performance 200G QSFP56 Active Optical Cable for Gigabit Ethernet data links.

### Features

- Low latency DSP-free electronics-based CDR
- Multi-data rate up to 56.15 Gb/s per lane
- PAM4 modulation
- HPC-grade BER  $\leq 5 \times 10^{-8}$
- Single 3.3 V power supply
- Low power consumption : 3.6 W per cable end with all CDRs enabled
- Up to 100 m length
- SFF-8665 compliant QSFP56 port
- SFF-8636 compliant I2C management interface
- Commercial operating case temperature range: 0 to 70°C
- Hot pluggable
- RoHS/REACH compliant
- TUV-certified
- LSZH, LSZH/OFNR or OFNP-rated cable

### Applications

- IEEE 802.3cd 200GBASE SR4
- IBTA InfiniBand HDR
- Datacenter: servers, switches, storages and NIC adapters
- Proprietary HPC interconnections

### Ordering Information

Part Number	Description
AO-QSFP56-200G-OCx	200G QSFP56 Active Optical Cable, yyy is the length in meters. For fractional length up to 10m, please use "P" designation. Example 0.5 meters - AO-QSFP56-200G-OC05

## Product Overview

CNFIBERNETAO-QSFP56-200G-SR4 is designed for 200Gbase links over fiber used in InfiniBand or Ethernet applications in LSZH, LSZH/OFNR or OFNP-rated cable jackets.

## General Specifications

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Storage Temperature	TS	-40		85	°C	Ambient
Relative Humidity	RH	5		85	%	
Supply Voltage	VIN	0		4.0	V	
Input Swing	VIN-MAX			1500	mVpp	
Operating Case Temperature	TC	0		70	oC	
Power Supply Voltage	Vcc	3.15	3.3	3.47	V	
Power Supply Current	Icc	-	1100	1250	mA	1
Power Consumption		-	3.6	4.0	W	1

1. Per end, all channel CDRs enabled

## Electrical – Transmitter

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Data Rate (Per Channel)	BR	-	26.5625		GBd	1
Input Differential Impedance	ZIN		100		Ω	
Differential Data Input Voltage	VIN P-P	900			mV	
Input High Voltage	VIH	0.7×Vcc			V	
Input Low Voltage	VIL			0.3×Vcc	V	
Output High Voltage	VOH	Vcc-0.7			V	
Output Low Voltage	VOL			0.6	V	

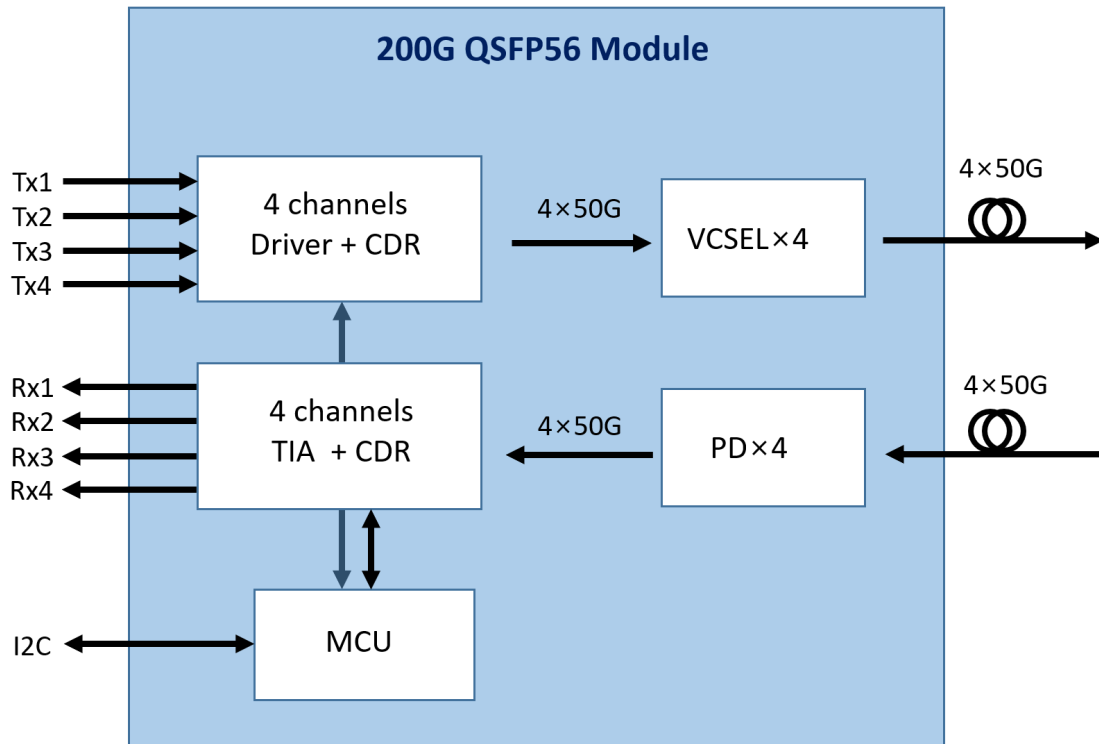
1. Dual data rate of 25.78125 and 28.07618 Gbaud are available upon request.

## Electrical – Receiver

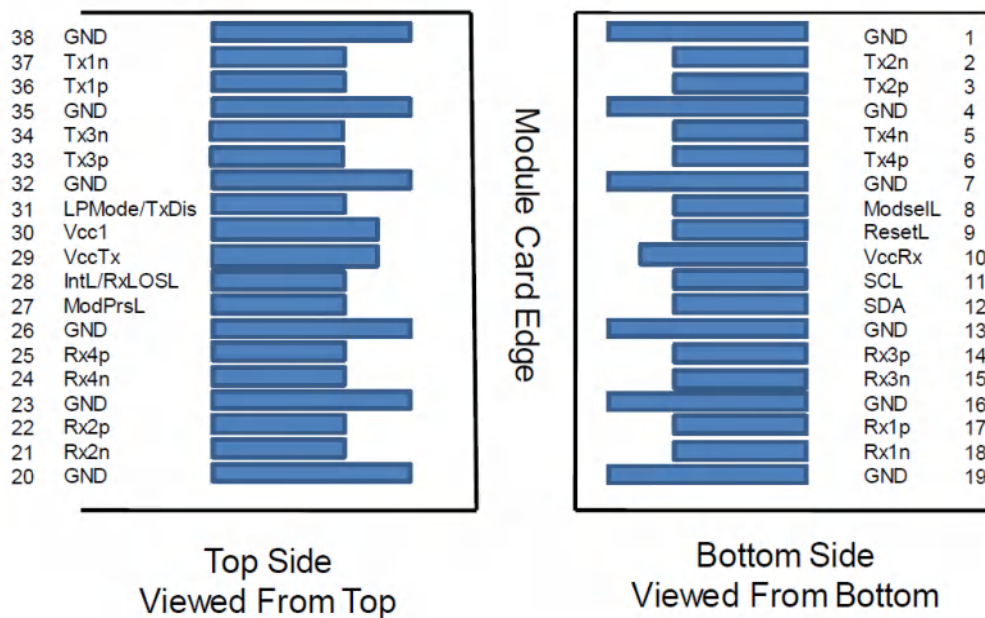
Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Output Differential Impedance	ZO		100		Ω	
Differential Data Output Voltage	VOUT,	700	800	900	mV-P	
Bit Error Ratio (at 26.5625 GBd)	-	-	-	2.4×10 <sup>-4</sup>		1

1. Pre-FEC Bit Error Ratio with a PRBS 2<sup>31</sup> – 1 test pattern over a normal operating temperature range

## Block Diagram



## Electrical Connector Layout



**Electrical Pin Definition**

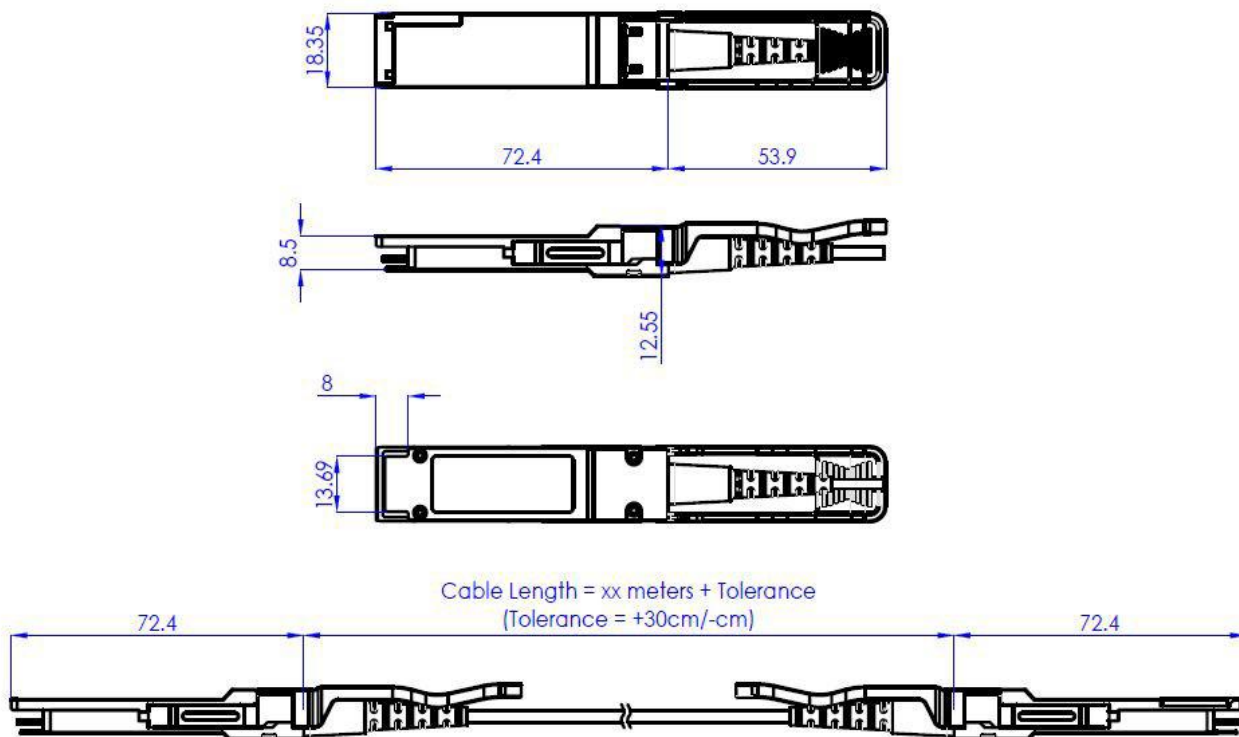
PIN #	Symbol	Description	Remarks
1	GND	Ground	1
2	Tx2n	Transmitter Inverted Data Input	
3	Tx2p	Transmitter Non-Inverted Data Input	
4	GND	Ground	1
5	Tx4n	Transmitter Inverted Data Input	
6	Tx4p	Transmitter Non-Inverted Data Input	
7	GND	Ground	1
8	ModSelL	Module Select	2
9	ResetL	Module Reset	2
10	Vcc Rx	+3.3V Power Supply Receiver	
11	SCL	2-wire Serial Interface Clock	2
12	SDA	2-wire Serial Interface Data	2
13	GND	Ground	1
14	Rx3p	Receiver Non-Inverted Data Output	
15	Rx3n	Receiver Inverted Data Output	
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	Grounds	1
24	Rx4n	Receiver Inverted Data Output	
25	Rx4p	Receiver Non-Inverted Data Output	
26	GND	Ground	1
27	ModPrsL	Module Present	
28	IntL/RxL OSL	Interrupt. Optionally configurable as RxLOSL via the management interface (SFF-8636).	2
29	Vcc Tx	+3.3V Power Supply Transmitter	
30	Vcc1	+3.3V Power Supply	

31	LPMoDe/ TxDis	Low Power Mode. Optionally configurable as TxDis via the management interface (SFF-8636).	2
32	GND	Ground	1
33	Tx3p	Transmitter Non-Inverted Data Input	
34	Tx3n	Transmitter Inverted Data Input	
35	GND	Ground	1
36	Tx1p	Transmitter Non-Inverted Data Input	
37	Tx1n	Transmitter Inverted Data Input	
38	GND	Ground	1

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. Vcc Rx, Vcc1 and Vcc Tx are the receiver and transmitter power supplies and shall be applied concurrently. Vcc Rx, Vcc1 and Vcc Tx may be internally connected within the QSFP transceiver module in any combination. The connector pins are each rated for a maximum current of 500 mA.

## Mechanical Dimensions



**Active Optical Cable**

Parameters	Value	Unit	Remarks
Cable Diameter	<ul style="list-style-type: none"><li>LSZH, LSZH/OFNR: <math>\varnothing 3.0 \pm 0.15</math></li><li>OFNP: <math>\varnothing 3.0 \pm 0.20</math></li></ul>	mm	
Minimum Bend Radius	30	mm	Without tension
Length Tolerance	+300 / -0	mm	
Cable Jacket	LSZH, LSZH/OFNR or OFNP-rated, Aqua		

**Revision History**

Date	Rev	Description
6/15/2021	1.0	Initial Release

## 200G QSFP56 SR4 Specification Q56-200G-SR4-DS

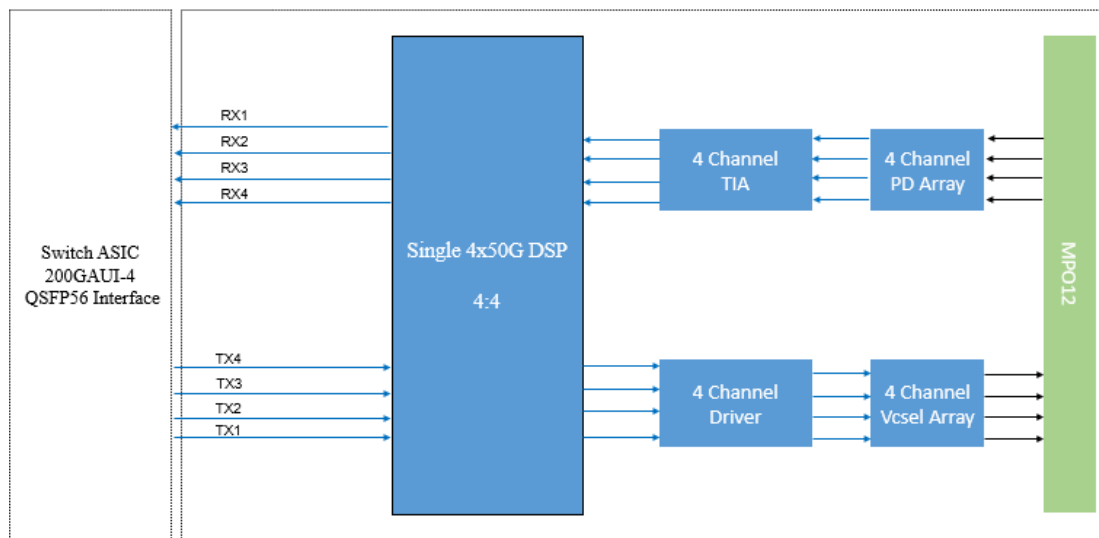
### Features

- ◆ QSFP56 Serial Optical Interface
  - 4x50G PAM4 retimed 200GAUI-4 C2M electrical interface
  - MPO-12 connector
  - 4 channel VCSEL array and 4 channels PIN photo detector array
  - Maximum link length of 70m on OM3 or 100m on OM4
  
- ◆ QSFP MSA Compliant
  - Hot Pluggable QSFP56 form factor
  - Compliant with CMIS 5.2
  
- ◆ Support Protocol
  - Compliant with IEEE 802.3cd
  
- ◆ Low Power Consumption
  - Less than 5W in temperature range of 0 to 70°C

### Applications

- ◆ 200GBASE-SR4 200G Ethernet
- ◆ Data center

### Functional Blcok Diagram



## 1. General Description

Q56-200G-SR4-DS 200GE QSFP56 Optical Transceiver modules are designed for use in 200Gigabit Ethernet links over OM3/OM4 multimode fiber. They are compliant with the QSFP MSA and with IEEE 802.3cd 200GBASE-SR4 specification. Digital diagnostics functions are available via the I2C interface as specified by CMIS V5.2. The transceiver is RoHS 2.0 compliant and lead-free per Directive 2011/65/EU.

## 2. Absolute Maximum Ratings and Recommended Operating Conditions

Table 2.1 Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
Storage Temperature	Ts	-40	85	°C
Relative Humidity (non-condensation)	RH		85	%
Supply Voltage	Vcc	-0.5	3.6	V
Receiver Damage Threshold, per Lane	PRdmg	5		dBm

Table 2.2 Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
Operating Case Temperature	Top	0	70	°C
Power Supply Voltage	Vcc	3.135	3.465	V
Total Power Consumption	Pc	-	5	W
Bit Rate	BR		212.5	Gbps
Fiber Length on OM3 MMF			70	m
Fiber Length on OM4 MMF			100	m

### 3. Optical Specification

#### 3.1 Optical Transmitter

Table 3.1 Transmitter Optical Interface

Parameter	Symbol	Min	Typical	Max	Unit
Data rate per lane	DR		26.5625		Gbd
Modulation format		PAM4			
Center Wavelength	$\lambda$	840	850	860	nm
RMS spectral width	$\sigma$			0.6	nm
Average Launch power, each lane	$P_{avg}$	-6.5		4	dBm
Optical Power OMA, each Lane	$P_{OMA}$	-4.5		3	dBm
Launch power in OMAouter minus TDECQ		-5.9			dBm
Transmitter and dispersion eye closure (TDECQ), each lane	TDECQ			4.5	dB
Extinction ratio	ER	3			dB
Optical Return Loss Tolerance	ORLT			12	dB
Optical Power for TX DISABLE				-30	dBm
Encircled flux <sup>b1</sup>		$\geq 86\%$ at 19 $\mu\text{m}$ $\leq 30\%$ at 4.5 $\mu\text{m}$			

Notes:

1. Measured into type A1a.2 or type A1a.3, or A1a.4, 50  $\mu\text{m}$  fiber, in accordance with IEC 61280-1-4

#### 3.2 Optical Receiver

Table 3.2 Receiver Optical Interface

Parameter	Symbol	Min	Typical	Max	Unit
Data rate per lane	BR		26.5625		Gbd
Modulation format		PAM4			
Center Wavelength	$\lambda$	840	850	860	nm
Damage threshold		5			dBm
Average receive power, each lane		-8.4		4	dBm
Receiver reflectance	Rr			-12	dB
Receiver sensitivity, each lane <sup>1</sup>		RS = max (-6.5, SECQ - 7.9)			dBm
Stressed receiver sensitivity, each lane				-3.4	dBm
Rx LOS	Assert		-30		dBm
	De-assert			-9	dBm
	Hysteresis		0.5		dB

Notes:

1. Receiver sensitivity is informative and is defined for a transmitter with a value of SECQ. Measured with conformance test signal at TP3 for BER = 2.4E-4 Pre-FEC.

## 4. Electrical Specification

Table 4.1 High speed Electrical Specifications

Parameters	Min	Typical	Max	Unit
Supply voltage	3.135		3.465	V
Supply Current			1.59	A
Input differential impedance	90	100	110	Ω
Differential pk-pk input Voltage Tolerance	900			mVpp
Differential data output swing			900	mVpp
Bit Error Rate Pre-FEC			2.4E-4	
Input Logic Level High	2		Vcc	V
Input Logic Level Low	0		0.8	V
Output Logic Level High	Vcc-0.5		Vcc	V
Output Logic Level Low	0		0.4	V

## 5. User Interface

### 5.1 Management Interface

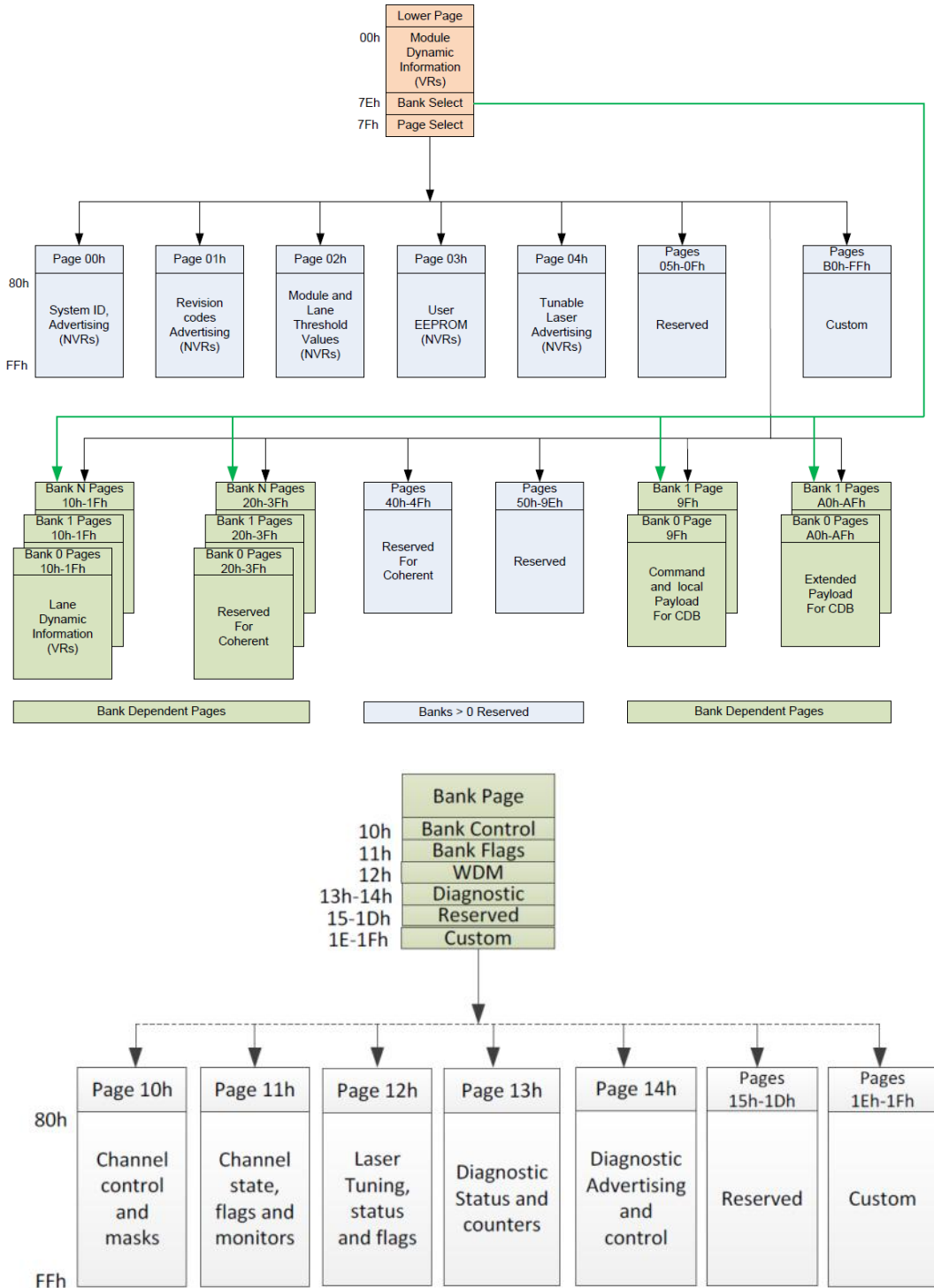


Figure 5.1 CMIS Module Memory Map

**5.2 Multiple Applications Support**

The Q56-200G-SR4-DS supports CMIS 5.2 defined Application Advertising, Application Selection and Instantiation.

**5.2.1 Application Advertising**

**Table 5.2 Q56-200G-SR4-DS Application Advertising**

Address (Dec)	Application		Value (Hex)	Description
	AppSel Code	Name		
85	NA	Module Type encoding	1	Optical Interfaces: MMF
86	0001b	HostInterfaceID	A	HostInterfaceIDApp1:50GAUI-1 C2M
87		MediaInterfaceID	7	MediaInterfaceIDApp1:50GBASE-SR
88		HostLaneCount&MediaLaneCount	11	LaneCountApp1: TX & RX 1 lanes
89		HostLaneAssignmentOptions	F	Permissible first host lane number: lanes 1, 2, 3, 4
01h:176		MediaLaneAssignmentOptions	F	Permissible first media lane number: lanes 1, 2, 3,4
90	0010b	HostInterfaceID	F	HostInterfaceIDApp2:200GAUI-4
91		MediaInterfaceID	E	MediaInterfaceIDApp2:200GBASE-SR4
92		HostLaneCount&MediaLaneCount	44	LaneCountApp2:TX & RX 4lanes
93		HostLaneAssignmentOptions	1	Permissible first host lane number: lane 1
01h:177		MediaLaneAssignmentOptions	1	Permissible first media lane numern: lane 1
94	0011b	HostInterfaceID	C	HostInterfaceIDApp3:100GAUI-4 C2M
95		MediaInterfaceID	0	MediaInterfaceIDApp3:100GBASE-SR4(SFF-8024 Undefined)
96		HostLaneCount&MediaLaneCount	44	LaneCountApp3:TX & RX 4 lanes
97		HostLaneAssignmentOptions	1	Permissible first host lane number: lane 1
01h:178		MediaLaneAssignmentOptions	1	Permissible first media lane number: lane 1
98	0100b	HostInterfaceID	42	HostInterfaceIDApp4:CAUI-4 C2M
99		MediaInterfaceID	9	MediaInterfaceIDApp4:100GBASE-SR4
100		HostLaneCount&MediaLaneCount	44	LaneCountApp4:TX & RX 4 lanes
101		HostLaneAssignmentOptions	1	Permissible first host lane number: lane 1
01h:179		MediaLaneAssignmentOptions	1	Permissible first media lane number: lane 1
102	0101b	HostInterfaceID	D	HostInterfaceIDApp5:100GAUI-2 C2M
103		MediaInterfaceID	C	MediaInterfaceIDApp5:100GBASE-SR2
104		HostLaneCount&MediaLaneCount	22	LaneCountApp5:TX & RX 2 lanes
105		HostLaneAssignmentOptions	5	Permissible first host lane number: lanes 1,3
01h:180		MediaLaneAssignmentOptions	5	Permissible first media lane number: lanes 1,3
106			FF	HostInterfaceIDApp6:
107			0	MediaInterfaceIDApp6
108			0	LaneCountApp6
109			0	Permissible first host lane number
110			0	HostInterfaceIDApp7
111			0	MediaInterfaceIDApp7
112			0	LaneCountApp7
113			0	HostLaneAssignmentOptionsApp7
114			0	HostInterfaceIDApp8
115			0	MediaInterfaceIDApp8
116			0	LaneCountApp8
117			0	HostLaneAssignmentOptionsApp8

As shown in the table above, the Q56-200G-SR4-DS supports 5 applications, 200GBASE-SR4, 100GBASE-SR4, 100GBASE-SR2 and 50GBASE-SR1

## 5.2.2 Application Selection and Instantiation

The host can select Applications by programming the AppSel value in Staged Set 0. AppSel=1 is the default Application populated in the Active Control Set at power-on or reset.

*\*Note that the channels of the module are independent and can be configured separately.(ie. up to four 100GBASE-SR instances can be configured), however, it does not support different applications with different channels at the same time*

Q56-200G-SR4-DS supports two methods of application selection and instantiation. The first method is implemented according to CMIS, and the second method is customized, which is simpler.

### ◆ First method:

The applications switching configuration sequence is as follows: read Application Descriptor Registers and select the required Appsel. Write application configuration to DPConfigLane<i> in Stage Control Set 0, then write 1 to ApplyDPInitLane<i> to trigger Application Instantiation. The Active Set can be read from page11h.

For example, select AppDescriptor3:

Step 1: Write 0x30 in Page10h Byte145~Byte152(8 bytes)—Set AppselCode3

Step 2: Write 0xFF in Page10h Byte143—Set trigger register to run Application Instantiation.

### ◆ Second method:

Set the value of Page10h Byte240. This is a private definition.

**Table 5.3 Private Host Electrical Interface Codes**

Code Value	Bit Pattern	Host Electrical Interface	Media Interface
0	0000000b	50GAUI-1 C2M	50GBASE-SR
1	0000001b	200GAUI-4 C2M	200GBASE-SR4
2	0000010b	100GAUI-4 C2M	100GBASE-SR4
3	0000011b	CAUI-4 C2M	100GBASE-SR4
4	0000100b	100GAUI-2 C2M	100GBASE-SR2

### 5.3 TX & RX Squelch

Default TX and RX auto-squelch is enabled. But TX and RX auto squelch disable, and force squelching function are not supported

### 5.4 TX input equalization

Default TX adaptive equalization is enabled. But TX adaptive equalization disable, and fixed equalization adjust function are not supported.

### 5.5 RX output Equalization

RX output Equalization follows CMIS Table 6-7, with default 1dB, readable and writable.

**Table 5.5 Rx Output Equalization code table**

**Table 6-7 Rx Output Equalization Codes**

Code Value	Bit pattern	Post-Cursor Equalization	Pre-Cursor Equalization
0	0000b	0dB (No Equalization)	0dB (No Equalization)
1	0001b	1 dB	0.5 dB
2	0010b	2 dB	1.0 dB
3	0011b	3 dB	1.5 dB
4	0100b	4 dB	2.0 dB
5	0101b	5 dB	2.5 dB
6	0110b	6 dB	3.0 dB
7	0111b	7 dB	3.5 dB
8-10	1000b-1010b	<b>Reserved</b>	<b>Reserved</b>
11-15	1011b-1111b	Custom	Custom

### 5.6 RX output amplitude

RX output amplitude follows CMIS Table 6-8, Rx output amplitude is the difference peak-to-peak EYE high when Rx output equalization is set to 0dB. The default value of output amplitude is set to 2, with typical differential 600mVp-p.

**Table 5.6 Rx Output Amplitude code table**

**Table 6-8 Rx Output Amplitude Codes**

Code Value	Bit pattern	Output Amplitude
0	0000b	100-400 mV (P-P)
1	0001b	300-600 mV (P-P)
2	0010b	400-800 mV (P-P)
3	0011b	600-1200 mV (P-P)
4-14	0100b-1110b	<b>Reserved</b>
15	1111b	Custom

**5.7 Loopback capabilities**

Media side input loopback and Host side input loopback feature are supported, loopback control method refers to CMIS.

**Table 5.7 Rx Output Equalization code table**

Byte	Bits	Field Name	Field Description
13h:128	6	Simultaneous Host And Media Side loopbacks	0b: not supported
	5	Per Lane Media Side Loopbacks	1b: supported
	4	Per Lane Host Side Loopbacks	1b: supported
	3	Host Side Input Loopback	1b: supported
	2	Host Side Output Loopback	1b: supported
	1	Media Side Input Loopback	1b: supported
	0	Media Side Output Loopback	1b: supported

**5.8 Digital Diagnostic Monitor Accuracy**

The following characteristics are defined over recommended operating conditions.

**Table 5.8 Digital Diagnostic Monitor Accuracy**

Parameter	Accuracy	Unit
Internally measured transceiver temperature	+/-3	°C
Internally measured transceiver supply voltage	+/-3%	V
Measured Tx bias current	+/-10%	mA
Measured Tx output power	+/-3	dB
Measured Rx received average optical power	+/-3	dB

## 6. Pin Assignment and Description

### 6.1 PIN Definitions

QSFP56 pin-out as being defined by QSFP MSA, PIN Descriptions are as follows :

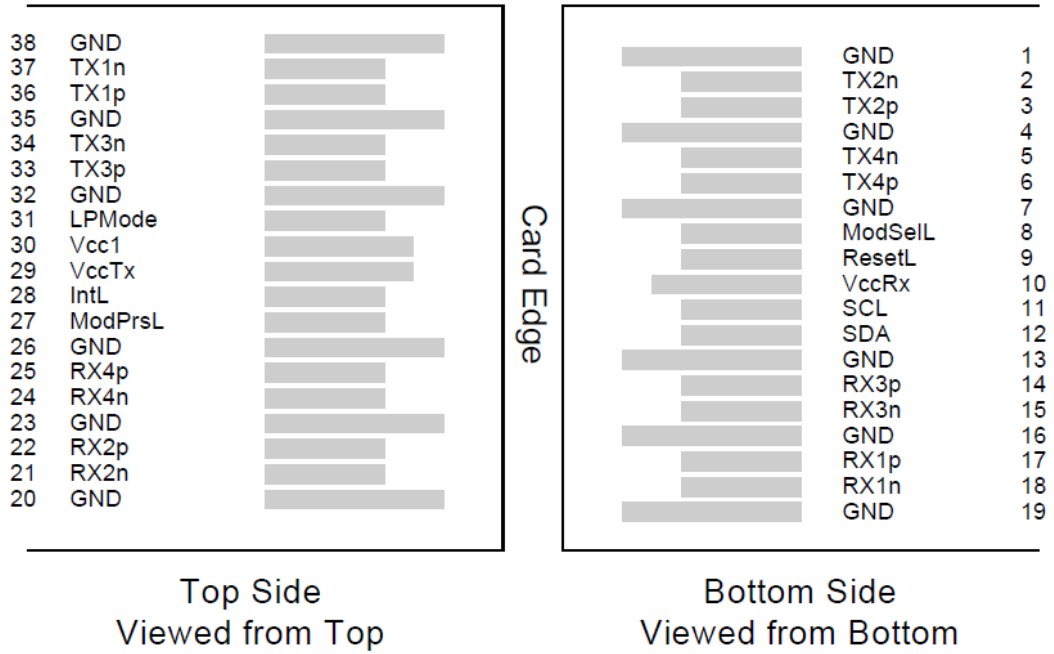


Figure 6.1 QSFP56 Transceiver Electrical Pad Layout

## 6.2 Pin Description

Table 6.2 Pin Description

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	3
6	CML-I	Tx4p	Transmitter Non-Inverted Data Input	3	3
7		GND	Ground	1	1
8	LVTTTL-I	ModselL	Module Select	3	
9	LVTTTL-I	ResetL	Module Reset	3	
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	3
15	CML-O	Rx3n	Receiver Inverted Data Output	3	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	3
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	3	3
26		GND	Ground	1	1
27	LVTTTL-O	ModPrsL	Module Present	3	
28	LVTTTL-O	IntL	Interrupt	3	

Note:

- [1] GND is the symbol for signal and supply (power) common for the QSFP 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] Vcc Rx, Vcc1 and Vcc Tx are the receiver and transmitter power supplies and shall be applied concurrently.

## 7. Mechanical Dimensions

### 7.1 Package dimensions

Figure 7.1 shows the package dimensions of the module. Package dimensions are specified in QSFP MSA.

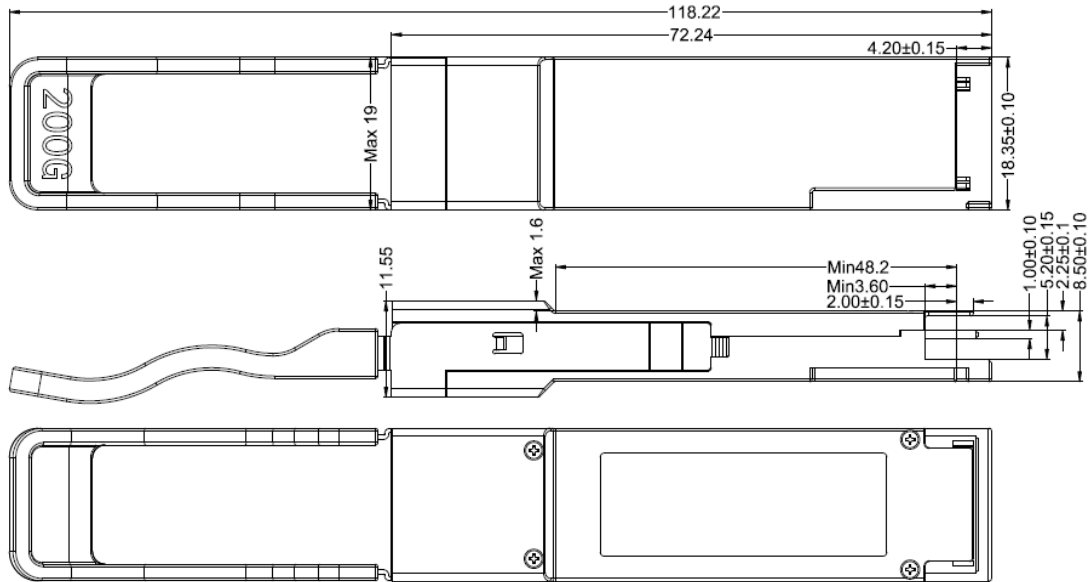


Figure 7.1 Package dimensions

### 7.2 Pull-tab Color

Pull-tab color is Pantone 475U (Beige).



Figure 7.2 Pull-tab

**7.3 Optical interface requirement**

The optical port is MPO 12 UPC optical interface as shown in Figure 7.3

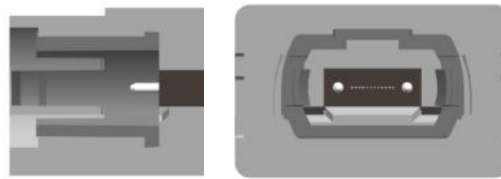


Figure 7.3 MPO12 UPC interface

**8. Laser safety and Electromagnetic Compatibility**

**8.1 Laser safety**

The Q56-200G-SR4-DS are Class 1 Laser products according to FDA/CDRH、IEC-60825-1 and IEC60825-2 standards. They must be operated under the specified operating conditions

**8.2 Electromagnetic Compatibility**

The Q56-200G-SR4-DS are designed to meet FCC Class B limits.

**9. Ordering Information**

Part Number	Temperature Range	Distance	Fiber Type	E/O	O/E
Q56-200G-SR4-DS	0 to 70°C	100m	MMF	VCSEL 850nm	PIN

**10.Revision History**

Release Date	Version	Initiated	Reviewed	Approved
2022-2-21	V1.0	Xu Huang	Bin Chen	Jerry.Quan

# AO-OSFP-400G-SR8 PAM4 850nm 100m MTP/MPO MMF Transceiver

OSFP-400G-SR8



## Application

- Data Center Interconnect
- 400G Ethernet
- Infiniband Interconnects
- Enterprise Networking

## Features

- Maximum Power Consumption 12W
- MPO-16 Connector
- Up to 100m Transmission on Multi-mode Fiber (MMF) OM3 with FEC
- Operating Case Temperature: 0 to 70°C
- 8 Parallel Lanes on 850nm Center Wavelength
- 8x53.125Gb/s Electrical Interface (400GAUI-8)
- Data Rate 53.125Gbps (PAM4) per Channel
- RoHS Compliant
- OSFP MSA Compliant
- Compliant to IEEE 802.3bs Specification

## Description

The AO-OSFP-400G-SR8 transceiver supports up to 100m link lengths over multimode fiber (MMF) with MTP/MPO-16 connector. This transceiver is compliant with OSFP MSA, IEEE 802.3bs protocol and 400GAUI-8 standards. The 400 Gigabit Ethernet signal is carried over eight wavelengths. Multiplexing and demultiplexing of the eight wavelengths are managed within the device. It is suitable for 400G Ethernet, Data Center and Cloud Networks.

## Product Specifications

### I. Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit
Storage Temperature Range	$T_S$	-40	85	°C
Operating Temperature	$T_{OP}$	0	70	°C
Power Supply Voltage	$V_{CC}$	-0.5	3.6	V
Relative Humidity(Non-Condensation)	RH	0	85	%

### II. Operating Environment

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Operating Case Temperature	$T_{OP}$	0		70	°C	
Power Supply Voltage	$V_{CC}$	3.135	3.3	3.465	V	
Data Rate, Each Lane(PAM4)			26.5625		GBd	
Data Rate Accuracy		-100		100	ppm	
Pre-FEC Bit Error Ratio				$2.4 \times 10^{-4}$		
Post-FEC Bit Error Ratio				$1 \times 10^{-12}$		1
Link Distance with OM3	D	0.5		100	m	2

Notes:

1. FEC provided by host system.
2. FEC required on host system to support maximum distance.

### III. Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
<b>Power Consumption</b>				12	W	
<b>Supply Current</b>	$I_{CC}$			3.63	A	
<b>Transmitter</b>						
<b>Signaling Rate, Each Lane</b>	TP1	26.5625 ± 100ppm			GBd	
<b>Differential pk-pk Input Voltage Tolerance</b>	TP1a	900			mVpp	1
<b>Differential Termination Mismatch</b>	TP1			10	%	
<b>Differential Input Return Loss</b>	TP1	IEEE802.3-2015Equation (83E-5)			dB	
<b>Differential to Common Mode Input Return Loss</b>	TP1	IEEE802.3-2015Equation (83E-6)			dB	
<b>Module Stressed Input Test</b>	TP1a	See IEEE 802.3bs 120E.3.4.1				2
<b>Single-ended Voltage Tolerance Range(Min)</b>	TP1a	-0.4 to 3.3			V	
<b>DC Common Mode Input Voltage</b>	TP1	-350		2850	mV	3

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
<b>Receiver</b>						
<b>Signaling Rate, Each Lane</b>	TP4	26.5625 ± 100ppm			GBd	
<b>Differential Peak-to-Peak Output Voltage</b>	TP4			900	mVpp	
<b>AC Common Mode Output Voltage, RMS</b>	TP4			17.5	mV	
<b>Differential Termination Mismatch</b>	TP4			10	%	
<b>Differential Output Return Loss</b>	TP4	IEEE802.3-2015Equation(83E-2)				
<b>Common to Differential Mode Conversion Return Loss</b>	TP4	IEEE802.3-2015Equation(83E-3)				
<b>Transition Time, 20% to 80%</b>	TP4	9.5			ps	
<b>Near-end Eye Symmetry Mask Width(ESMW)</b>	TP4		0.265		UI	
<b>Near-end Eye Height, Differential</b>	TP4	70			mV	
<b>Far-end Eye Symmetry Mask Width(ESMW)</b>	TP4		0.2		UI	
<b>Far-end Eye Height, Differential</b>	TP4	30			mV	
<b>Far-end Pre-cursor ISI Ratio</b>	TP4	-4.5		2.5	%	
<b>Common Mode Output Voltage(Vcm)</b>	TP4	-350		2850	mV	3

## Notes:

1. With the exception to IEEE 802.3bs 120E.3.1.2 that the pattern is PRBS31Q or scrambled idle.
2. Meets BER specified in IEEE 802.3bs 120E.1.1.
3. DC common mode voltage generated by the host. Specification includes effects of ground offset voltage.

## IV. Optical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
<b>Transmitter</b>						
<b>Center Wavelength</b>	$\lambda_c$	840	850	860	nm	
<b>Data Rate, Each Lane</b>		26.5625 ± 100ppm			GBd	
<b>Modulation Format</b>		PAM4				
<b>RMS Spectral Width(Modulated)</b>	$\Delta\lambda_{rms}$			0.6	nm	
<b>Average Launch Power, Each Lane</b>	PAVG	-6.5		4	dBm	1
<b>Outer Optical Modulation Amplitude (OMA<sub>outer</sub>), Each Lane</b>	POMA	-4.5		3	dBm	2
<b>Launch Power in OMA<sub>outer</sub> Minus TDECQ, Each Lane</b>		-5.9			dB	
<b>Transmitter and Dispersion Eye Clouser for PAM4, Each Lane</b>	TDECQ			4.5	dB	
<b>Extinction Ratio</b>	ER	3			dB	
<b>Optical Return Loss Tolerance</b>	TOL			12	dB	
<b>Average Launch Power of OFF Transmitter, Each Lane</b>	P <sub>off</sub>			-30	dBm	
<b>Encircled Flux</b>		≥86%at19μm≤30%at4.5μm				

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
<b>Receiver</b>						
<b>Center Wavelength</b>	$\lambda_c$	840	850	860	nm	
<b>Data Rate, Each Lane</b>		26.5625 ± 100ppm			GBd	
<b>Modulation Format</b>		PAM4				
<b>Damage Threshold, Each Lane</b>	TH <sub>d</sub>	5			dBm	3
<b>Average Receive Power, Each Lane</b>		-7.9		4	dBm	4
<b>Receive Power(OMA<sub>outer</sub>), Each Lane</b>				3	dBm	
<b>Receiver Sensitivity(OMA<sub>outer</sub>), Each Lane</b>	SEN			-6.5	dBm	5
<b>Stressed Receiver Sensitivity(OMA<sub>outer</sub>), Each Lane</b>	SRS			-3	dBm	6
<b>Receiver Reflectance</b>	R <sub>R</sub>			-12	dB	
<b>LOS Assert</b>	LOS <sub>A</sub>	-30			dBm	
<b>LOS De-assert</b>	LOS <sub>D</sub>			-12	dBm	
<b>LOS Hysteresis</b>	LOS <sub>H</sub>	0.5			dB	

## Notes:

1. 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.
2. Even if the TDECQ < 1 dB, the OMA<sub>outer</sub> (min) must exceed the minimum value specified here.
3. The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level.
4. 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.
5. Receiver Sensitivity OMA<sub>outer</sub>, each lane (max) is informative and is defined for a BER of 2.4x10<sup>-4</sup>.
6. Measured with conformance test signal at receiver input for the BER of 2.4x10<sup>-4</sup>.
7. These test conditions are for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

### V. Digital Diagnostic Monitor Characteristics

Parameter	Symbol	Min.	Max.	Unit	Notes
<b>Temperature Monitor Absolute Error</b>	DMI_Temp	-3	3	degC	Over operating temperature range
<b>Supply Voltage Monitor Absolute Error</b>	DMI_VCC	-0.1	0.1	V	Over full operating range
<b>Channel RX Power Monitor Absolute Error</b>	DMI_RX_Ch	-2	2	dB	1
<b>Channel Bias Current Monitor</b>	DMI_Ibias_Ch	-10%	10%	mA	
<b>Channel TX Power Monitor Absolute Error</b>	DMI_TX_Ch	-2	2	dB	1

Notes:

1. Due to measurement accuracy of different fibers, there could be an additional +/-1 dB fluctuation, or a +/- 3 dB total accuracy.

### VI. Pin Configuration

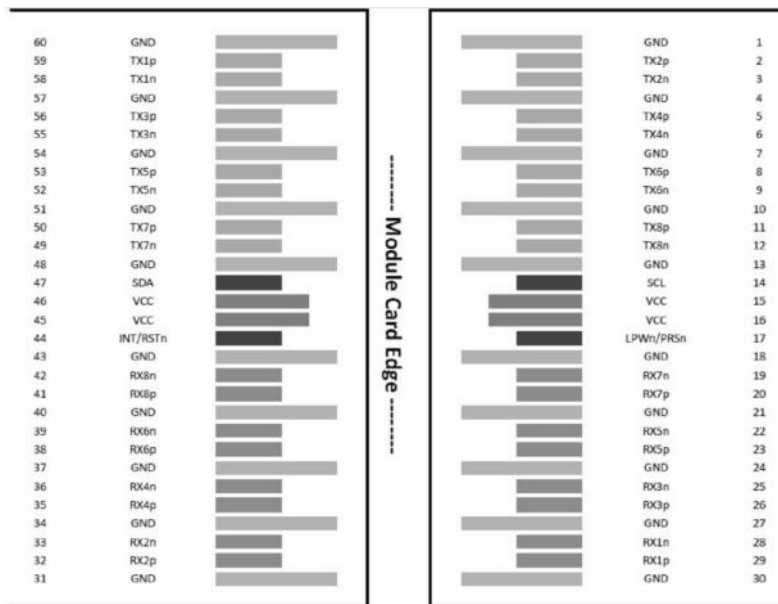


Figure 1: Pin out of Connector Block on Host Board

## VII. Transceiver Pin Descriptions

Pin No.	Symbol	Description	Logic	Direction	Plug Sequence
1	GND		Ground		1
2	TX2p	Transmitter Data Non-Inverted	CML-I	Input from Host	3
3	TX2n	Transmitter Data Inverted	CML-I	Input from Host	3
4	GND		Ground		1
5	TX4p	Transmitter Data Non-Inverted	CML-I	Input from Host	3
6	TX4n	Transmitter Data Inverted	CML-I	Input from Host	3
7	GND		Ground		1
8	TX6p	Transmitter Data Non-Inverted	CML-I	Input from Host	3
9	TX6n	Transmitter Data Inverted	CML-I	Input from Host	3
10	GND		Ground		1
11	TX8p	Transmitter Data Non-Inverted	CML-I	Input from Host	3
12	TX8n	Transmitter Data Inverted	CML-I	Input from Host	3
13	GND		Ground		1
14	SCL	2-wire Serial Interface Clock	LVC MOS-I/O	Bi-directional	3
15	V <sub>CC</sub>	+3.3V Power		Power from Host	2
16	V <sub>CC</sub>	+3.3V Power		Power from Host	2
17	LPWn/PRSn	Low-Power Mode/Module Present	Multi-Level	Bi-directional	3
18	GND		Ground		1
19	RX7n	Receiver Data Inverted	CML-O	Output to Host	3
20	RX7p	Receiver Data Non-Inverted	CML-O	Output to Host	3

Pin No.	Symbol	Description	Logic	Direction	Plug Sequence
21	GND		Ground		1
22	RX5n	Receiver Data Inverted	CML-O	Output to Host	3
23	RX5p	Receiver Data Non-Inverted	CML-O	Output to Host	3
24	GND		Ground		1
25	RX3n	Receiver Data Inverted	CML-O	Output to Host	3
26	RX3p	Receiver Data Non-Inverted	CML-O	Output to Host	3
27	GND		Ground		1
28	RX1n	Receiver Data Inverted	CML-O	Output to Host	3
29	RX1p	Receiver Data Non-Inverted	CML-O	Output to Host	3
30	GND		Ground		1
31	GND		Ground		1
32	RX2p	Receiver Data Non-Inverted	CML-O	Output to Host	3
33	RX2n	Receiver Data Inverted	CML-O	Output to Host	3
34	GND		Ground		1
35	RX4p	Receiver Data Non-Inverted	CML-O	Output to Host	3
36	RX4n	Receiver Data Inverted	CML-O	Output to Host	3
37	GND		Ground		1
38	RX6p	Receiver Data Non-Inverted	CML-O	Output to Host	3
39	RX6n	Receiver Data Inverted	CML-O	Output to Host	3
40	GND		Ground		1

Pin No.	Symbol	Description	Logic	Direction	Plug Sequence
41	RX8p	Receiver Data Non-Inverted	CML-O	Output to Host	3
42	RX8n	Receiver Data Inverted	CML-O	Output to Host	3
43	GND		Ground		1
44	INT/RSTn	Module Interrupt/Module Reset	Multi-Level	Bi-directional	3
45	V <sub>CC</sub>	+3.3V Power		Power from Host	2
46	V <sub>CC</sub>	+3.3V Power		Power from Host	2
47	SDA	2-wire Serial Interface Data	LVC MOS-I/O	Bi-directional	3
48	GND		Ground		1
49	TX7n	Transmitter Data Inverted	CML-I	Input from Host	3
50	TX7p	Transmitter Data Non-Inverted	CML-I	Input from Host	3
51	GND		Ground		1
52	TX5n	Transmitter Data Inverted	CML-I	Input from Host	3
53	TX5p	Transmitter Data Non-Inverted	CML-I	Input from Host	3
54	GND		Ground		1
55	TX3n	Transmitter Data Inverted	CML-I	Input from Host	3
56	TX3p	Transmitter Data Non-Inverted	CML-I	Input from Host	3
57	GND		Ground		1
58	TX1n	Transmitter Data Inverted	CML-I	Input from Host	3
59	TX1p	Transmitter Data Non-Inverted	CML-I	Input from Host	3
60	GND		Ground		1

### VIII. Block Diagram of Transceiver

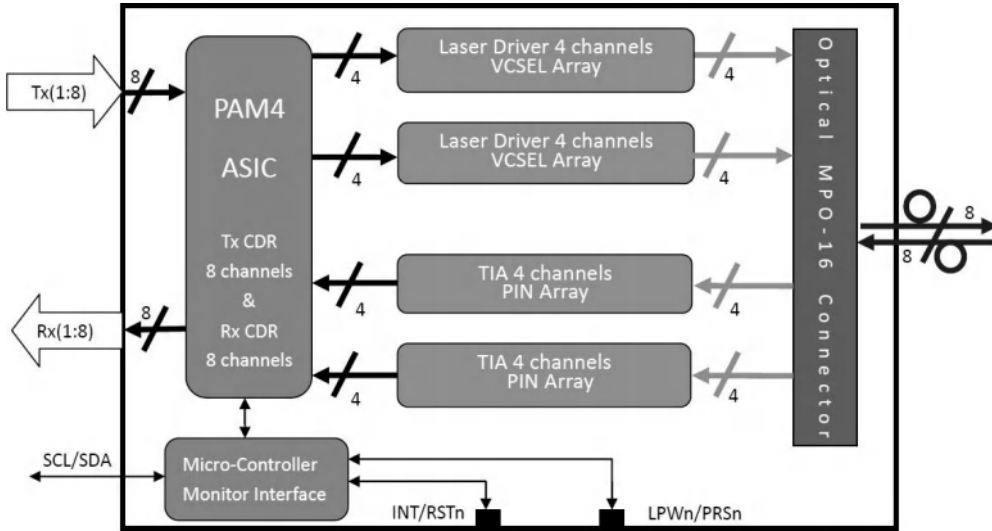


Figure 2

### IX. Mechanical Dimensions

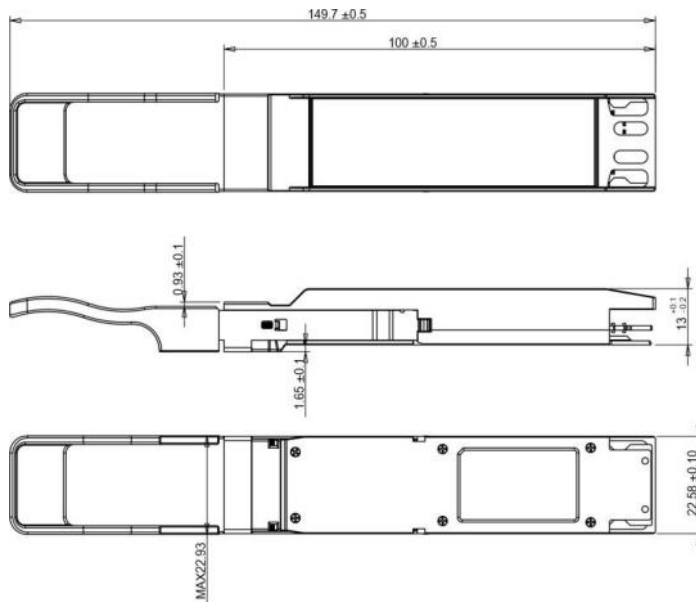


Figure 3

# QSFP-DD 400GBASE-LR8 1310nm 10km Transceiver

AO-QDD-400G-LR8



## Application

- 400GBASE-LR8 400G Ethernet
- Data Center

## Features

- Compliant with IEEE 802.3bs standard:
  - 400GBASE-LR8 optical interface
  - 400GAUI-8 electrical interface
- Compliant with QSFP-DD MSA HW Rev 3.0 with duplex LC connector
- Maximum power consumption tbd W
- Case operating temperature 0° C to 70° C
- Two wire serial Interface with digital diagnostic monitoring
- Complies with EU Directive 2011/65/EU (RoHS compliant)
- Class 1 Laser

## Product Specifications

### I. Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit	Notes
Storage Temperature	$T_s$	-40	85	°C	
Supply Voltage	$V_{CC}$	-0.5	3.6	V	
Relative Humidity (non-condensing)	RH	5	95	%	
Data Input Voltage Differential	$ V_{DIP}-V_{DIN} $		1	V	
Control Input Voltage	$V_I$	-0.3	$V_{CC}+0.5$	V	
Control Output Current	$I_o$	-20	20	mA	

### II. Recommended Operating Environment

Parameter	Symbol	Min	Typ.	Max	Unit	Notes
Operating Case Temperature	$T_{OPR}$	0		70	°C	1
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	$P_D$			TBD	W	
Maximum Power Dissipation, Low Power Mode	$P_{DLP}$			TBD	W	
Signalling Speed per Lane	DRL		26.5625		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	

<b>Two Wire Serial Interface Clock Rate</b>				400	kHz	
<b>Power Supply Noise</b>				50	mVpp	
<b>Rx Differential Data Output Load</b>			100		Ohm	
<b>Operating Distance</b>		2		10000	m	

### III. Optical Characteristics

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

Parameter	Symbol	Min	Typ.	Max	Unit	Notes
<b>Transmitter</b>						
<b>Wavelength L0</b>	$\lambda_{C0}$	1272.55	1273.55	1274.54	nm	
<b>Wavelength L1</b>	$\lambda_{C1}$	1276.89	1277.89	1278.89	nm	
<b>Wavelength L2</b>	$\lambda_{C2}$	1281.25	1282.26	1283.27	nm	
<b>Wavelength L3</b>	$\lambda_{C3}$	1285.65	1286.67	1287.68	nm	
<b>Wavelength L4</b>	$\lambda_{C4}$	1294.53	1295.56	1296.59	nm	
<b>Wavelength L5</b>	$\lambda_{C5}$	1299.02	1300.06	1301.09	nm	
<b>Wavelength L6</b>	$\lambda_{C6}$	1303.54	1304.59	1305.63	nm	
<b>Wavelength L7</b>	$\lambda_{C7}$	1308.09	1309.14	1310.19	nm	
<b>Side Mode Suppression Ratio</b>	SMSR	30			dB	
<b>Total Average Launch Power</b>	$AOP_T$			13.2	dBm	
<b>Average Launch Power, each lane</b>	$AOP_L$	-2.8		5.3	dBm	1
<b>Outer Optical Modulation Amplitude (<math>OMA_{outer}</math>), each Lane</b>	$T_{OMA}$	0.2		5.7	dBm	
<b>Difference in Launch Power between any two Lanes (<math>OMA_{outer}</math>)</b>	$D_{T,OMA}$			4	dB	



<b>Damage Threshold, each Lane</b>	AOP <sub>D</sub>	6.3			dBm	
<b>Average Receive Power, each Lane</b>	AOP <sub>R</sub>	-9.1		5.3	dBm	
<b>Receive Power (OMA<sub>outer</sub>), each Lane</b>	OMA <sub>R</sub>			5.7	dBm	
<b>Difference in Receive Power between any two Lanes (OMA<sub>outer</sub>)</b>	D <sub>R_OMA</sub>			4.5	dB	
<b>Receiver Reflectance</b>	RR			-26	dB	
<b>Receiver Sensitivity (OMA<sub>outer</sub>), each Lane</b>	S <sub>OMA</sub>			-7.1	dBm	1
<b>Stressed Receiver Sensitivity (OMA<sub>outer</sub>), each Lane</b>	SRS			-4.7	dBm	2

**Notes:**

- 1.Receiver sensitivity (OMA<sub>outer</sub>), each lane (max) is informative and is defined for a transmitter with SECQ of 0.9 dB
- 2.Measured with conformance test signal at TP3 for the BER = 2.4x10<sup>-4</sup>

### IV. Electrical Characteristics

**Table 1 - Electrical Specification High Speed Signal (compliant with IEEE 802.3bs 400GAUI-8)**

Parameter	Symbol	Min	Typ.	Max	Unit	Notes
<b>Transmitter (Module Input)</b>						
<b>Differential pk-pk input Voltage tolerance</b>		900			mV	
<b>Differential termination mismatch</b>				10	%	
<b>Single-ended voltage tolerance range</b>		-0.4		3.3	V	
<b>DC common mode Voltage</b>		-350		2850	mV	
<b>Receiver (Module Output)</b>						
<b>AC common-mode output Voltage (RMS)</b>				17.5	mV	
<b>Differential output Voltage</b>				900	mV	

<b>Near-end Eye height, differential</b>		70			UI	
<b>Far-end Eye height, differential</b>		30			UI	
<b>Far end pre-cursor ratio</b>				2.5	%	
<b>Differential Termination Mismatch</b>				10	%	
<b>Transition Time (min, 20% to 80%)</b>		9.5			ps	
<b>DC common mode Voltage</b>		-350		2850	mV	

**Table 2 - Electrical Specification Low Speed Signal (compliant with QSFP-DD HW Rev 3.0)**

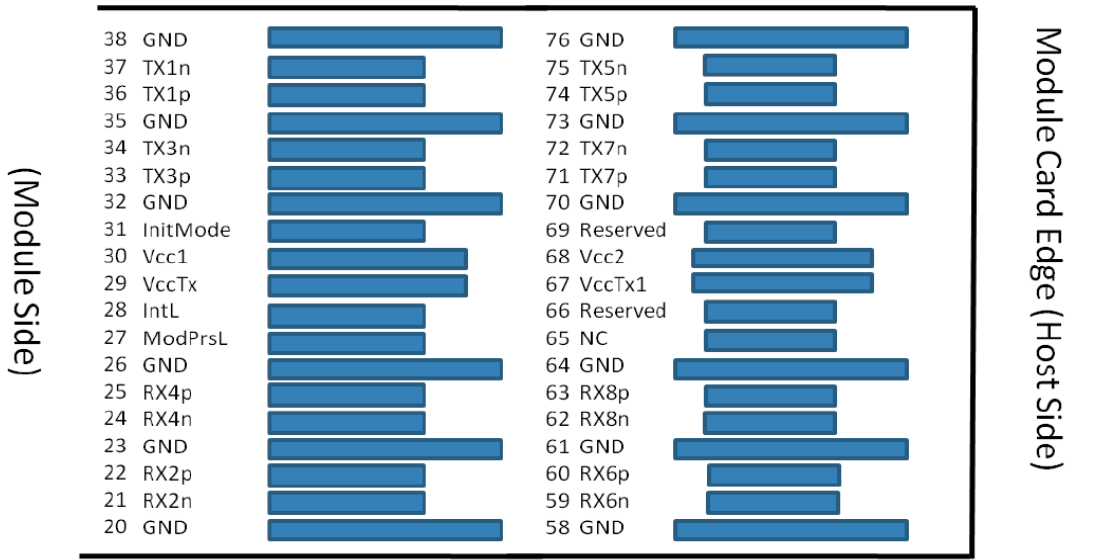
Parameter	Symbol	Min	Max	Unit	Condition
<b>Module output SCL and SDA</b>	$V_{OL}$	0	0.4	V	
	$V_{OH}$	$V_{CC}-0.5$	$V_{CC}+0.3$	V	
<b>Module Input SCL and SDA</b>	$V_{IL}$	-0.3	$V_{CC}*0.3$	V	
	$V_{IH}$	$V_{CC}*0.7$	$V_{CC}+0.5$	V	
<b>InitMode, ResetL and ModSelL</b>	$V_{IL}$	-0.3	0.8	V	
	$V_{IH}$	2	$V_{CC}+0.3$	V	
<b>IntL</b>	$V_{OL}$	0	0.4	V	
	$V_{OH}$	$V_{CC}-0.5$	$V_{CC}+0.3$	V	

## V. Digital Diagnostic Monitoring Information

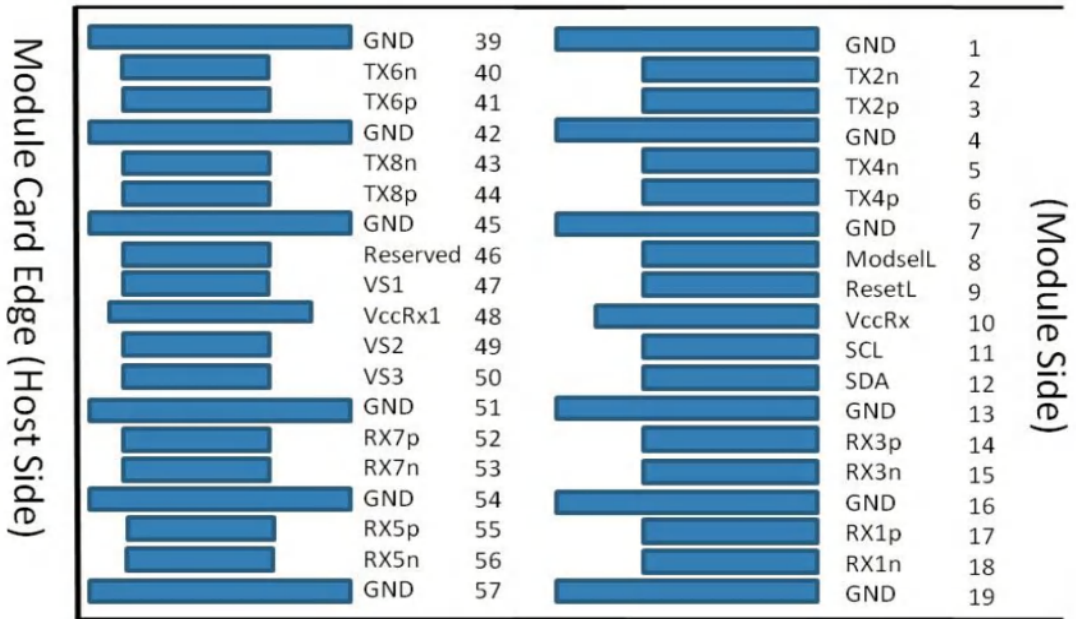
Parameter	Range	Accuracy	Unit	Calibration
<b>Temperature</b>	0 to 70	$\pm 3$	$^{\circ}C$	Internal
<b>Voltage</b>	0 to $V_{CC}$	0.1	V	Internal
<b>Tx Bias Current (Each Lane)</b>	0 to 100	10%	mA	Internal

<b>Tx Output Power (Each Lane)</b>	-3.5 to +5.3	±3dB	dBm	Internal
<b>Rx Receive Power (Each Lane)</b>	-9.1 to +5.3	±3dB	dBm	Internal

**VI. Pin Definitions**



Top side viewed from top



Bottom side viewed from bottom

Figure 1 – Pin definitions of the module high speed inputs/outputs

### Pin Definitions

Pin #	Logic	Symbol	Definition
1		GND	Ground
2	CML-I	Tx2n	Transmitter Inverted Data Input
3	CML-I	Tx2p	Transmitter Non-Inverted Data Input
4		GND	Ground
5	CML-I	Tx4n	Transmitter Inverted Data Input
6	CML-I	Tx4p	Transmitter Non-Inverted Data Input
7		GND	Ground
8	LVTTTL-I	ModSelL	Module Select
9	LVTTTL-I	ResetL	Module Reset
10		VccRx	+3.3 V Power Supply Receiver
11	LVC MOS-I/O	SCL	2-wire serial interface clock
12	LVC MOS-I/O	SDA	2-wire serial interface data
13		GND	Ground
14	CML-O	Rx3p	Receiver Non-Inverted Data Output
15	CML-O	Rx3n	Receiver Inverted Data Output
16		GND	Ground
17	CML-O	Rx1p	Receiver Non-Inverted Data Output
18	CML-O	Rx1n	Receiver Inverted Data Output
19		GND	Ground
20		GND	Ground
21	CML-O	Rx2n	Receiver Inverted Data Output
22	CML-O	Rx2p	Receiver Non-Inverted Data Output

23		GND	Ground
24	CML-O	Rx4n	Receiver Inverted Data Output
25	CML-O	Rx4p	Receiver Non-Inverted Data Output
26		GND	Ground
27	LVTTTL-O	ModPrsL	Module Present
28	LVTTTL-O	IntL	Interrupt
29		VccTx	+3.3V Power supply transmitter
30		Vcc1	+3.3V Power supply
31	LVTTTL-I	InitMode	Initialization mode
32		GND	Ground
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input
34	CML-I	Tx3n	Transmitter Inverted Data Input
35		GND	Ground
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input
37	CML-I	Tx1n	Transmitter Inverted Data Input
38		GND	Ground
39		GND	Ground
40	CML-I	Tx6n	Transmitter Inverted Data Input
41	CML-I	Tx6p	Transmitter Non-Inverted Data Output
42		GND	Ground
43	CML-I	Tx8n	Transmitter Inverted Data Input
44	CML-I	Tx8p	Transmitter Non-Inverted Data Output

45		GND	Ground
46		Reserved	
47		VS1	Module Vendor Specific 1
48		VccRx1	3.3V Power Supply
49		VS2	Module Vendor Specific 2
50		VS3	Module Vendor Specific 3
51		GND	Ground
52	CML-O	Rx7p	Receiver Non-Inverted Data Output
53	CML-O	Rx7n	Receiver Inverted Data Output
54		GND	Ground
55	CML-O	Rx5p	Receiver Non-Inverted Data Output
56	CML-O	Rx5n	Receiver Inverted Data Output
57		GND	Ground
58		GND	Ground
59	CML-O	Rx6n	Receiver Inverted Data Output
60	CML-O	Rx6p	Receiver Non-Inverted Data Output
61		GND	Ground
62	CML-O	Rx8n	Receiver Inverted Data Output
63	CML-O	Rx8p	Receiver Non-Inverted Data Output
64		GND	Ground
65		NC	No Connected

66		Reseved	
67		VccTx1	3.3V Power Supply
68		Vcc2	3.3V Power Supply
69		Reseved	
70		GND	Ground
71	CML-I	Tx7p	Transmitter Non-Inverted Data Output
72	CML-I	Tx7n	Transmitter Inverted Data Output
73		GND	Ground
74	CML-I	Tx5p	Transmitter Non-Inverted Data Output
75	CML-I	Tx5n	Transmitter Inverted Data Output
76		GND	Ground

### VII. Recommended QSFP-DD Host Board Schematic

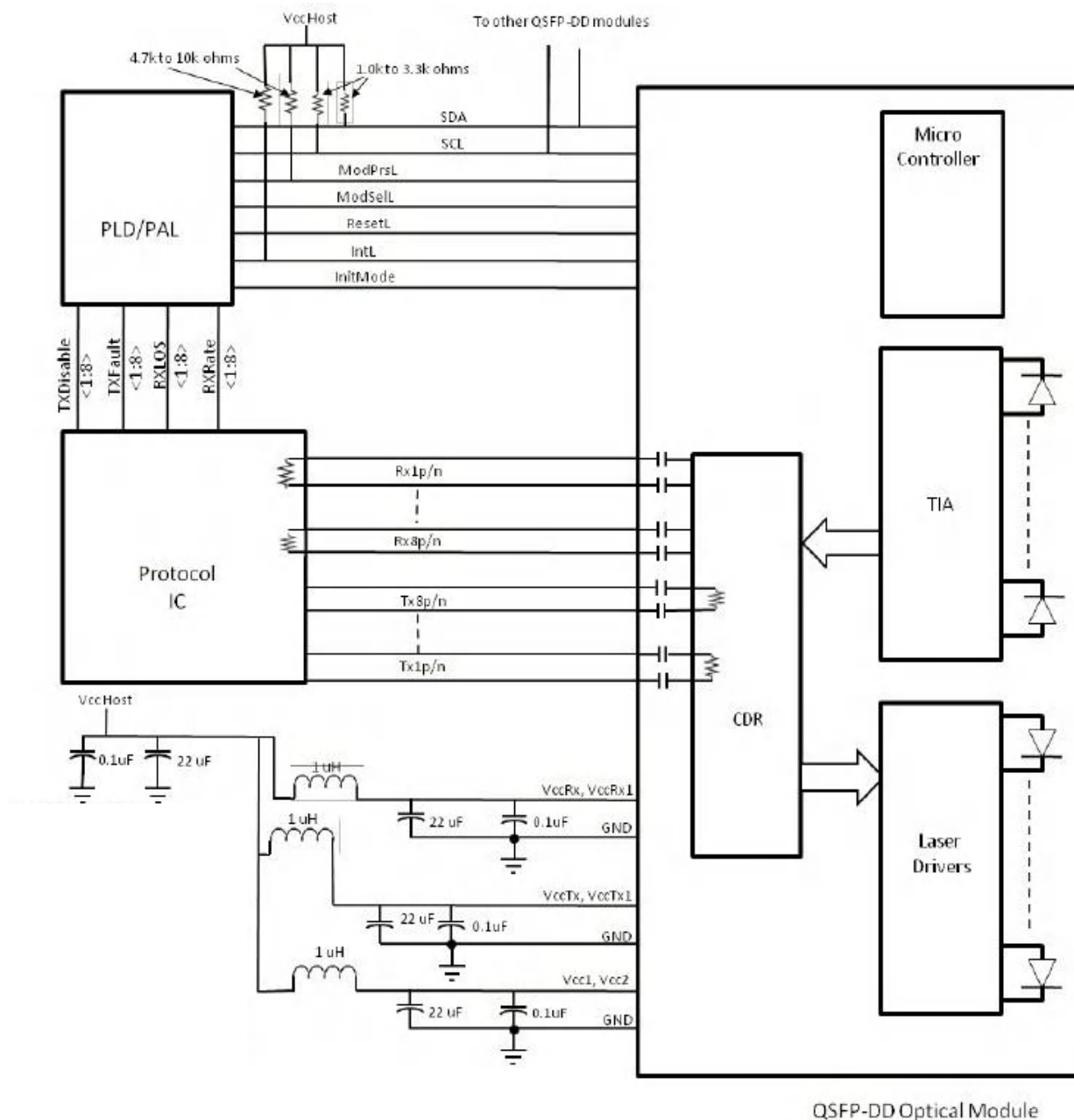


Figure 2 – Recommended QSFP-DD Host Board Schematic

**Notes:**

- 1.Filter capacitor values are informative and vary depending on applications, 0.1 uF capacitors should be placed in close proximity to power pins and may be duplicated for individual pins to provide additional high frequency filtering.
- 2.Vcc1 and/or Vcc2 may be connected to VccTx, VccTx1 or VccRx, VccRx1 provided the applicable derating of the maximum current limit is used.

**Table 3 - Timing for Soft Control and Status Functions**

Parameter	Symbol	Min	Max	Unit	Notes
<b>MgmtInit Duration</b>			2000	ms	
<b>ResetL Assert Time</b>	t_reset_init	10		μs	
<b>IntL Assert Time</b>	ton_IntL		200	ms	
<b>IntL Deassert Time</b>	toff_IntL		500	ms	
<b>Rx LOS Assert Time</b>	ton_los		100	ms	
<b>Tx Fault Assert Time</b>	ton_Txfault		200	ms	
<b>Flag Assert Time</b>	ton_flag		200	ms	
<b>Mask Assert Time</b>	ton_mask		100	ms	
<b>Mask Deassert Time</b>	toff_mask		100	ms	
<b>Application or Rate Select Change Time</b>	t_ratesel		N/A	ms	1

**Notes:**

1.This feature is not supported

**Table 4 - I/O Timing for Squelch and Disable**

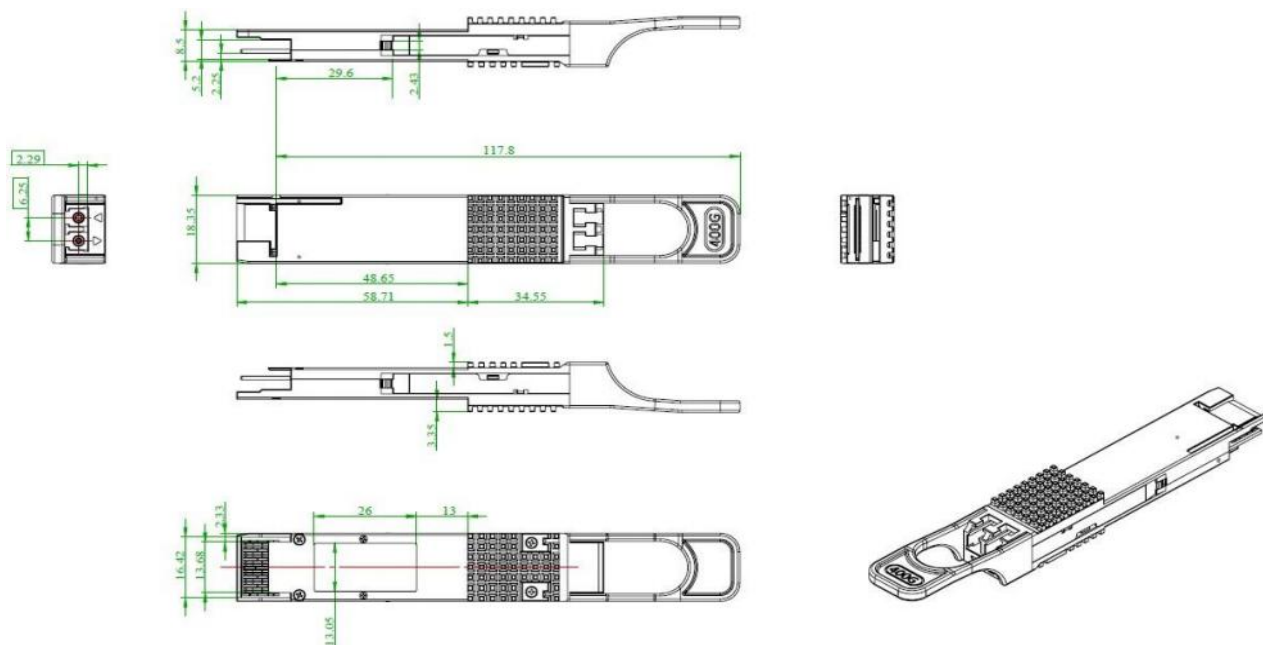
Parameter	Symbol	Min	Max	Unit	Notes
<b>Rx Squelch Assert Time</b>	ton_Rxsq		15	ms	
<b>Rx Squelch Deassert Time</b>	toff_Rxsq		15	ms	
<b>Tx Squelch Assert Time</b>	ton_Txsq		400	ms	1
<b>Tx Squelch Deassert Time</b>	toff_Txsq		400	ms	1
<b>Tx Disable Assert Time</b>	ton_Txdis		100	ms	

<b>Tx Disable Deassert Time</b>	toff_Txdis		400	ms	
<b>Rx Output Disable Assert Time</b>	ton_Rxdis		100	ms	
<b>Rx Output Disable Deassert Time</b>	toff_Rxdis		100	ms	
<b>Squelch Disable Assert Time</b>	ton_sqdis		100	ms	
<b>Squelch Disable Deassert Time</b>	toff_sqdis		100	ms	

**Notes:**

1. Not implemented by default

**VIII. Mechanical Diagram**



**IX. 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.