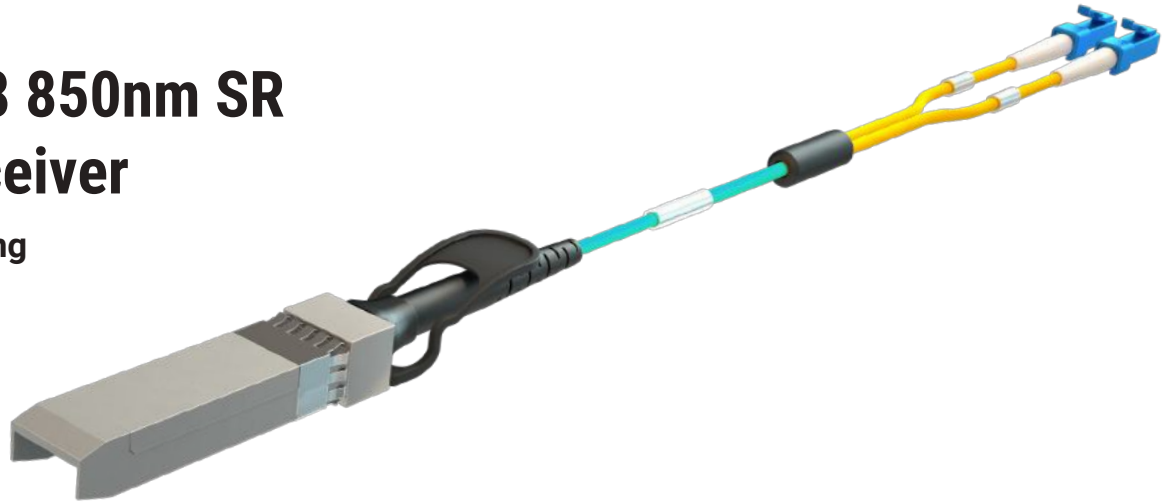




25Gbps SFP28 850nm SR Optical Transceiver

Module for liquid cooling



Key Feature

- Hot-pluggable SFP28 form factor
- Supports 25Gbps data rate
- Maximum link length of 70m on OM3 MMF and 100m on OM4 MMF
- 850nm VCSEL laser and PIN photo-detector
- Internal CDR on both Transmitter and Receiver channel
- Optional pigtail type and length
- Single 3.3V power supply
- Power dissipation < 1W
- Digital diagnostics functions are available via the I2C interface
- RoHS compliant
- Operating case temperature range: 0°C to 60°C

Applications

- 25GBASE-SR Ethernet
- Especially design for liquid immersion environment

Ordering Information - 25Gbps SFP28 SR Optical Transceiver

Part No.	Data Rate	Distance	Wavelength	Media	Connector	Temp.
LIPX-UUSxxxC	25G	~100m	850nm	MMF	LC/FC/MPO Pigtail	C

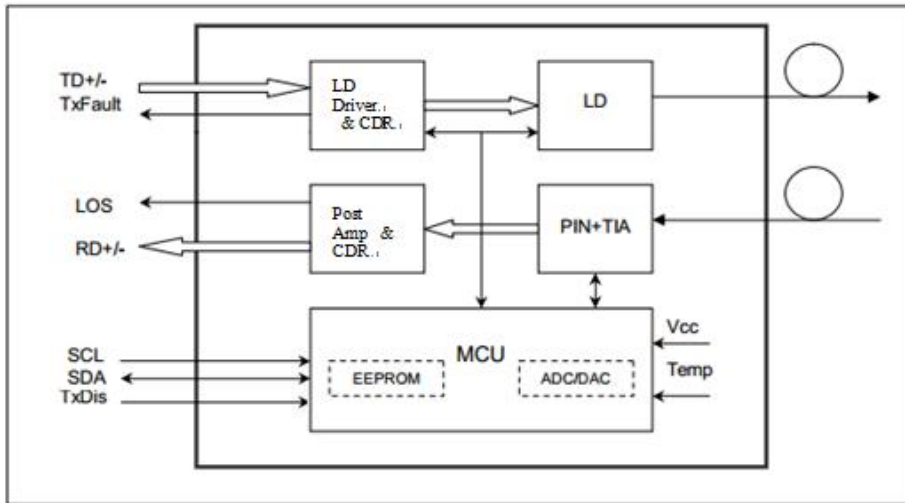
Product Description

The Lumulus Immersion SFP28 transceiver is a single-channel, pluggable fiber optic module designed for 25 Gigabit Ethernet and InfiniBand EDR applications. Engineered specifically for reliable operation in liquid immersion environments, it delivers high performance for short-range data communication and interconnect applications at data rates up to 25.78125 Gbps.

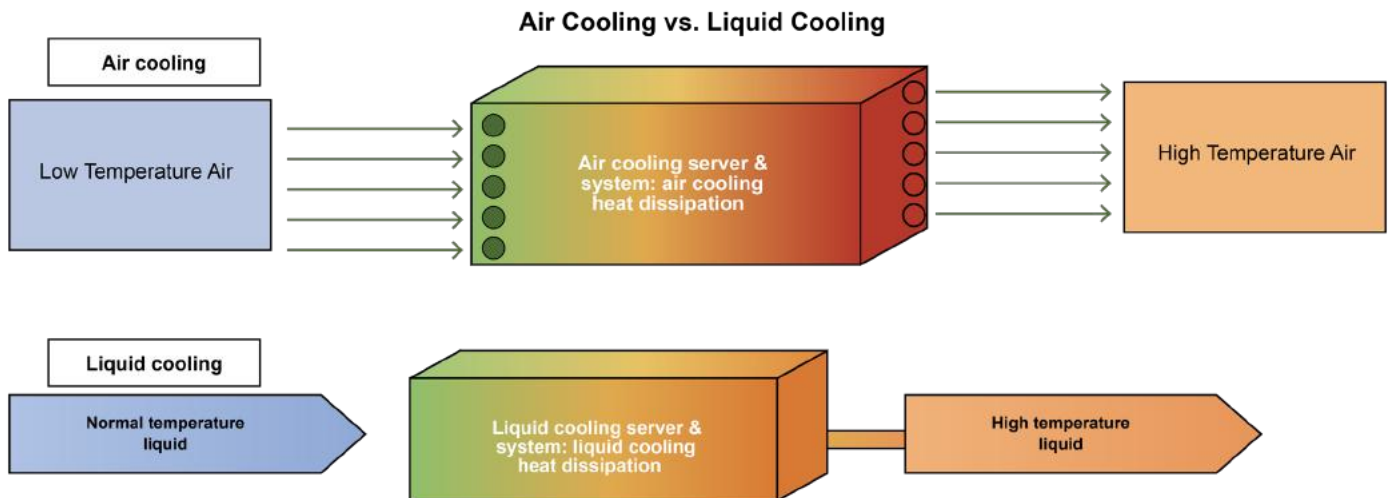
The module supports transmission distances of up to 70 m over OM3 multimode fiber and up to 100 m over OM4 multimode fiber using a nominal wavelength of 850nm. It features a standard 20-contact edge connector electrical interface and incorporates high-performance VCSEL technology to provide long-term reliability, consistent performance, and dependable operation in demanding data center environments.



Module Block Diagram



Liquid cooling advantage



Liquid Immersion Cooling Applications

As data traffic continues to grow and the heat generated by high-performance processors and AI accelerators increases, conventional air-cooling solutions are reaching their practical limits. Liquid cooling technologies provide a more efficient method of heat removal by using dielectric fluids with high thermal capacity, significantly improving cooling efficiency and reducing overall data center power consumption.

This optical transceiver is specifically designed for operation in liquid immersion cooling environments, providing reliable operation when fully immersed in dielectric cooling fluids at depths of up to 10 meters. It is ideally suited for liquid-cooled servers, switches, and high-performance computing systems. The module is compatible with a wide range of dielectric cooling fluids, including fluorinated fluids and mineral oils, ensuring long-term reliability and stable optical performance in demanding immersion cooling applications.



Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
Supply Voltage	V _{cc}	0	3.6	V
Storage Temperature	T _s	-40	85	°C
Operating Humidity	Rh	5	85	%

Recommended Operating Conditions

Parameter	Symbol	Min	Typical	Max	Unit
Operating Case Temperature	T _c	0		+60	°C
Power Supply Voltage	V _{cc}	3.13	3.3	3.47	V
Power Supply Current	I _{cc}			300	mA
Fiber Length on 50/125μm high-bandwidth (OM3) MMF				70	m
Fiber Length on 50/125μm high-bandwidth (OM4) MMF				100	m
Liquid immersion depth				10	m

Optical and Electrical Characteristics

Parameter	Symbol	Min	Typical	Max	Unit	Notes
Transmitter						
Data rate	BR		25.78		Gbps	
Centre Wavelength	λ _c	840	850	860	nm	
Spectral Width (-20dB)	σ			0.6	nm	
Average Output Power	P _{avg}	-8.4		2.4	dBm	
Optical Power OMA	P _{OMA}	-6.4		3	dBm	
Extinction Ratio	ER	2			dB	
Differential data input swing	V _{IN,PP}	40		1000	mV	
Input Differential Impedance	Z _{IN}	90	100	110	Ω	
TX Disable	Disable	2.0		V _{cc}	V	
	Enable	0		0.8	V	
TX Fault	Fault	2.0		V _{cc}	V	
	Normal	0		0.8	V	



Receiver					
Data rate	BR	25.78		Gbps	
Centre Wavelength	λ_c	840	850	860	nm
Receiver Sensitivity (OMA)	Psens			-10	dBm
Stressed Sensitivity (OMA)					-5.2 dBm
Receiver Power (OMA)					3 dBm
LOS De-Assert	LOSD			-13	dBm
LOS Assert	LOSA	-30			dBm
LOS Hysteresis			0.5	dB	
Differential data output swing	Vout,PP	300	850		mV
LOS	High	2.0	Vcc		V
	Low			0.8	V

Notes: Receive Sensitivity measured with a prbs31 pattern @25.78125Gb/s, BER 1E-5.

Timing and Electrical Specifications

Parameter	Symbol	Min.	Max.	Unit	Conditions
Tx_Disable assert time	t _{off}		100	μs	Rising edge of Tx_Disable to fall of output signal below 10% of nominal
Tx_Disable negate time	t _{on}		2	ms	Falling edge of Tx_Disable to rise of output signal above 90% of nominal. This only applies in normal operation, not during start up or fault recovery.
Time to initialize 2-wire interface	t _{2w_start_up}		300	ms	From power on or hot plug after the supply meeting Table 8.
Time to initialize	t _{start_up}		300	ms	From power supplies meeting Table 8 or hot plug or Tx disable negated during power up, or Tx_Fault recovery, until non-cooled power level I part (or non-cooled power level II part already enabled at power level II for Tx_Fault recovery) is fully operational.
Time to initialize cooled module and time to power up a cooled module to Power Level II	t _{start_up_cooled}		90	s	From power supplies meeting Table 8 or hot plug, or Tx disable negated during power up or Tx_Fault recovery, until cooled power level I part (or cooled power level II part during fault recovery) is fully operational. Also, from stop bit low-to-high SDA transition enabling Power Level II until cooled module is fully operational
Time to Power Up to Level II	t _{power_level2}		300	ms	From stop bit low-to-high SDA transition enabling power level II until non-cooled module is fully operational



Time to Power Down from Level II	t _{power_down}	300	ms	From stop bit low-to-high SDA transition disabling power level II until module is within power level I requirements
Tx_Fault assert	Tx_Fault_on	1	ms	From occurrence of fault to assertion of Tx_Fault
Tx_Fault assert for cooled module	Tx_Fault_on_cooled	50	ms	From occurrence of fault to assertion of Tx_Fault
Tx_Fault Reset	t _{reset}	10	μs	Time Tx_Disable must be held high to reset Tx_Fault
RS0, RS1 rate select timing for FC	t _{RS0_FC} , t _{RS1_FC}	500	μs	From assertion till stable output
RS0, RS1 rate select timing non FC	t _{RS0} , t _{RS1}	24	ms	From assertion till stable output
Rx_LOS assert delay	t _{los_on}	100	μs	From occurrence of loss of signal to assertion of Rx_LOS
Rx_LOS negate delay	t _{los_off}	100	μs	From occurrence of presence of signal to negation of Rx_LOS

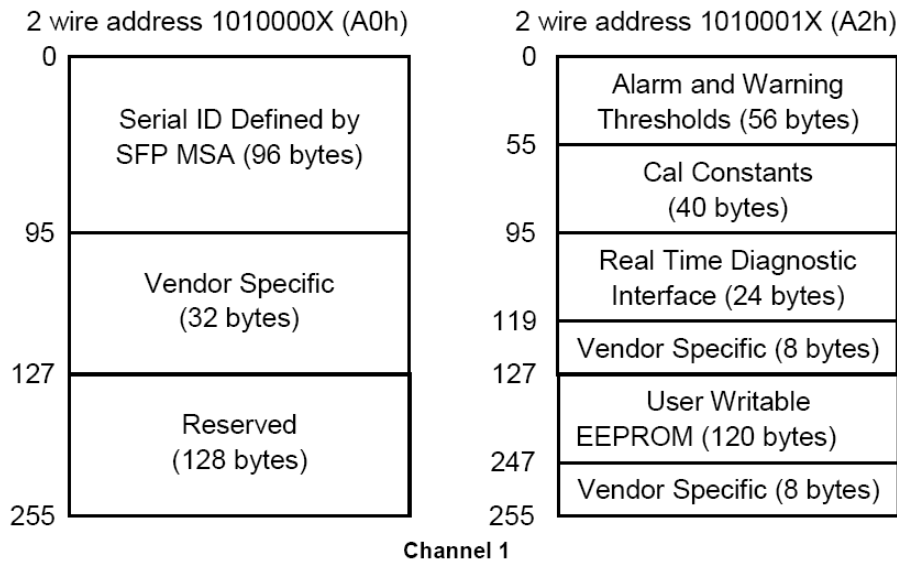
Digital Diagnostic Memory Map

Parameter	Range	Unit	Accuracy	Calibration
Temperature	0 to +70	°C	±3°C	Internal / External
Voltage	3.0 to 3.6	V	±3%	Internal / External
Bias Current	0 to 20	mA	±10%	Internal / External
TX Power	-8 to 3	dBm	±3dB	Internal / External
RX Power	-14 to 0	dBm	±3dB	Internal / External



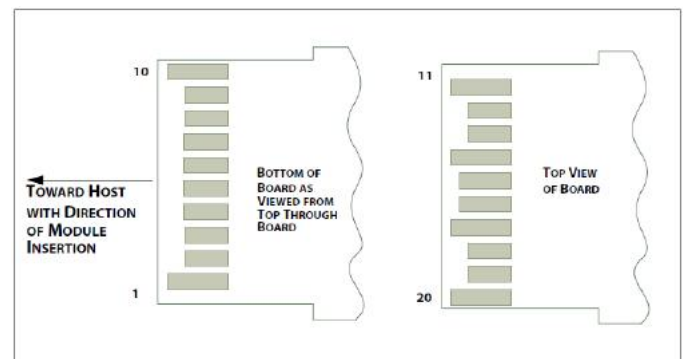
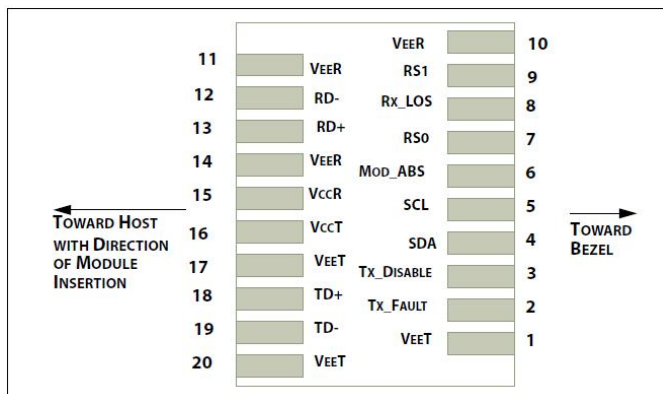
Memory Organization

The transceiver provides serial ID memory contents and diagnostic information about its current operating conditions through a 2-wire serial interface (SCL and SDA). The diagnostic information with internal calibration or external calibration all are implemented, including received power monitoring, transmitted power monitoring, bias current monitoring, supply voltage monitoring and temperature monitoring. The memory map and its specific data fields are defined as follows.



SFP28 Electrical Pad Layout

For detail mechanical information, please refer to the related document of SFP MSA.





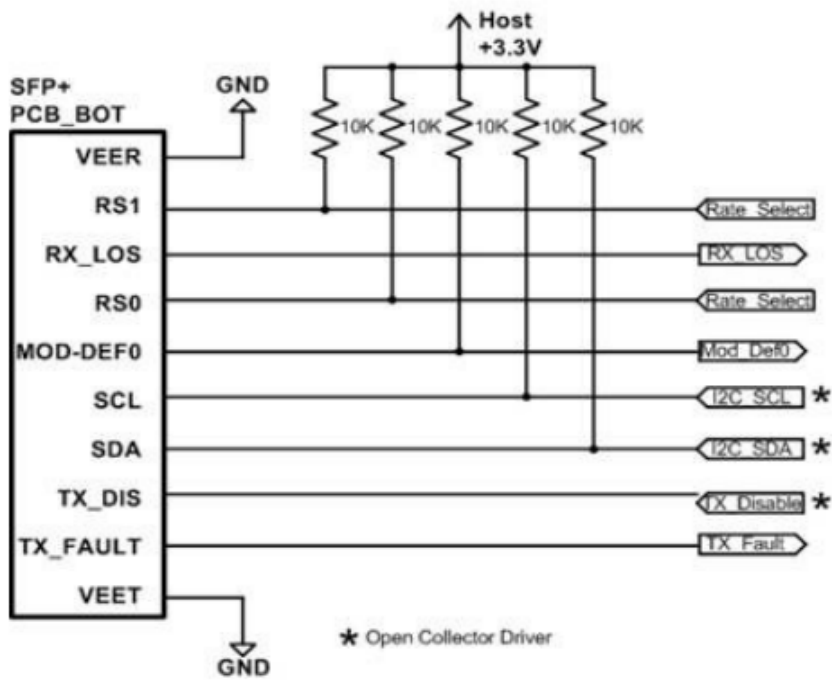
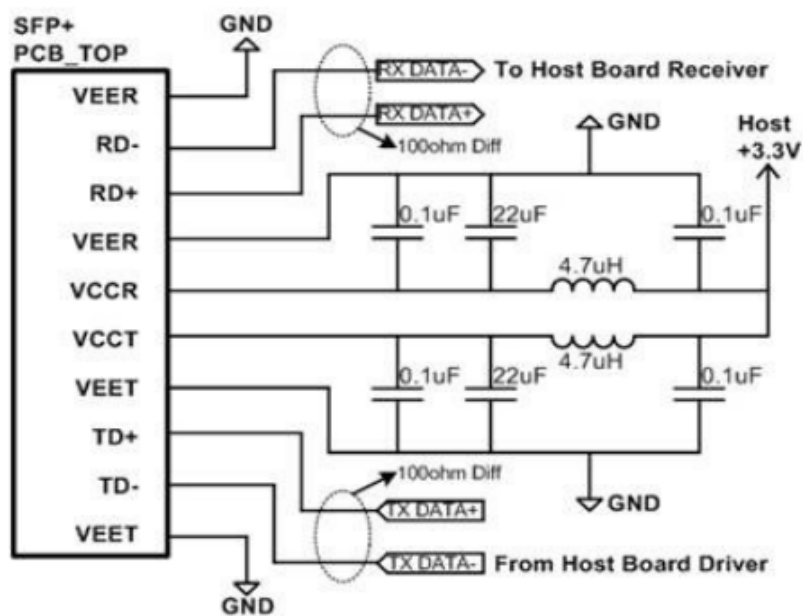
SFP28 PIN Function Definitions

Pin	Logic	Symbol	Description
1		VeeT	Module Transmitter Ground
2	LVTTL-O	Tx_Fault	Module Transmitter Fault
3	LVTTL-I	Tx_DIS	Transmitter Disable; Active High Disable Transmitter Output
4	LVTTL-I/O	SDA	2-Wire Serial Interface Data
5	LVTTL-I/O	SCL	2-Wire Serial Interface Clock
6		Mod_ABS	Module Absent, connected to VeeT or VeeR in the module
7	LVTTL-I	RS0	Rate Select0, optionally controls SFP+ module receiver
8	LVTTL-O	RX_LOS	Receiver Loss of Signal Indication
9	LVTTL-I	RS1	Rate Select1, optionally controls SFP+ module transmitter
10		VeeR	Module Receiver Ground
11		VeeR	Module Receiver Ground
12	CML-O	RD-	Receiver Inverted Data Output
13	CML-O	RD+	Receiver Non-Inverted Data Output
14		VeeR	Module Receiver Ground
15		VccR	Module Receiver 3.3V Supply
16		VccT	Module Transmitter 3.3V Supply
17		VeeT	Module Transmitter Ground
18	CML-I	TD+	Transmitter Non-Inverted Data Input
19	CML-I	TD-	Transmitter Inverted Data Input
20		VeeT	Module Transmitter Ground

Notes:

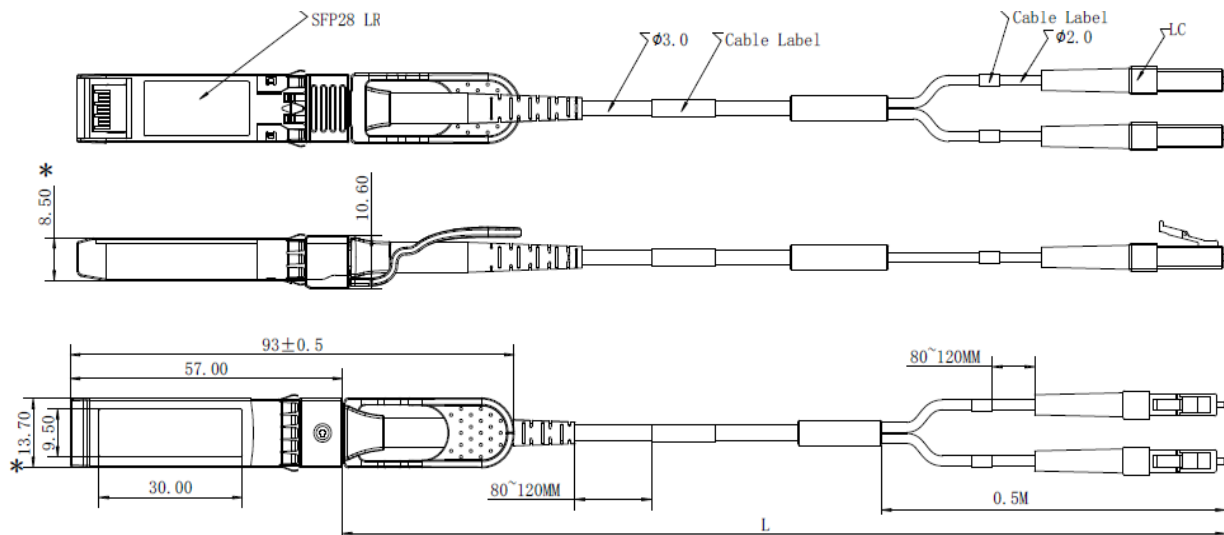
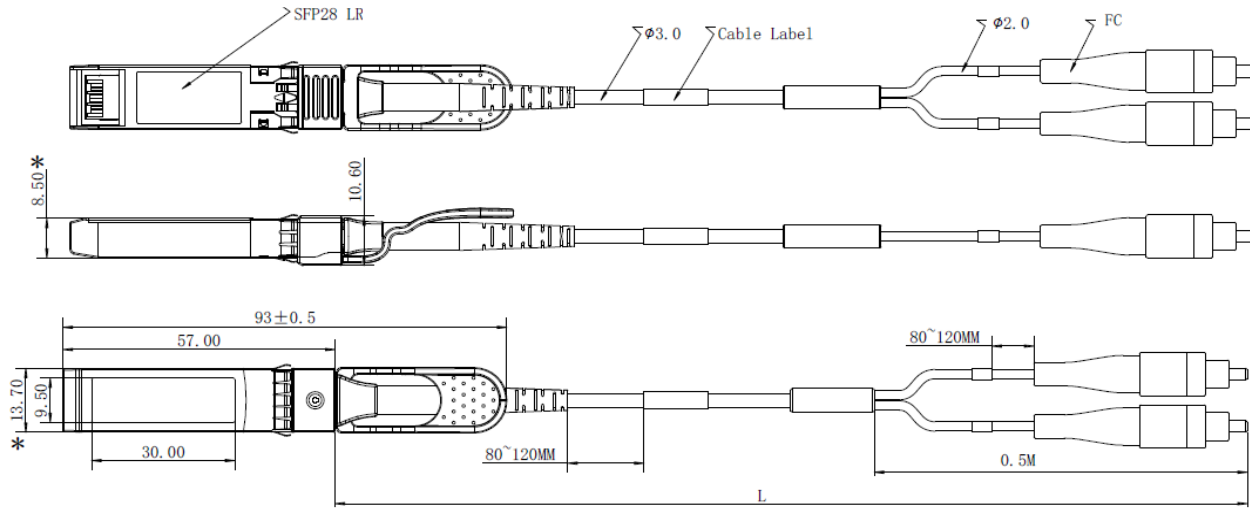
1. Module ground pins GND are isolated from the module case.
2. Shall be pulled up with 4.7K-10Kohms to a voltage between 3.15V and 3.45V on the host board.

Recommended Interface Circuit





Mechanical Dimensions(FC/LC)





Regulatory Compliance

These optical transceivers are classified as Class 1 Laser Products and comply with the following laser safety standards:

Feature	Standard
Laser Safety	IEC 60825-1:2014 (3rd Edition) IEC 60825-2:2004/AMD2:2010 EN 60825-1:2014 EN 60825-2:2004+A1+A2
Electrical Safety	EN 62368-1: 2014 IEC 62368-1:2014 UL 62368-1:2014
Environmental protection	Directive 2011/65/EU with amendment(EU)2015/863
CE EMC	EN55032:2015 EN55035:2017 EN61000-3-2:2014 EN61000-3-3:2013
FCC	FCC Part 15, Subpart B ANSI C63.4-2014

References

- SFP28 MSA
- Ethernet IEEE802.3cc
- 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.



Laser Safety Warning

Caution: Use of optical instruments with this product will increase eye hazard. Do not view the laser beam directly with optical instruments or naked eyes.

Disclaimer

Images are for illustrative purposes only and may not accurately represent the actual product. Specifications and appearances are subject to change without prior notice.

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