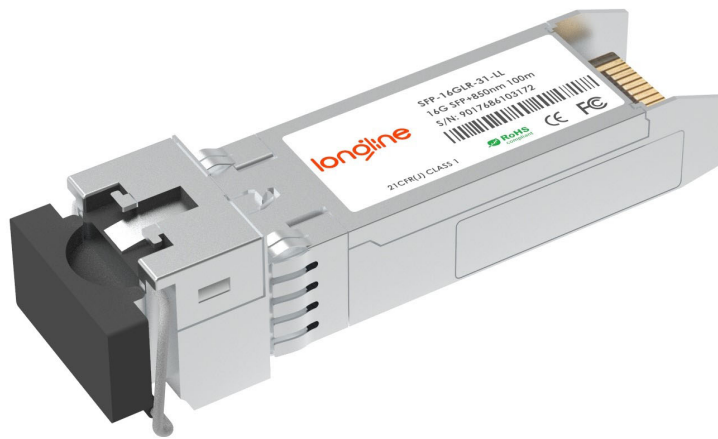


# 16G Fiber Channel SFP+ 1310nm 10km DOM LC SMF Transceiver

SFP-16GLR-31-LL



## Application

- High-Speed Storage Area Networks
- Computer Cluster Cross-Connect
- Custom High-Speed Data Pipes
- Inter Rack Connection

## Features

- Up to 14.025Gb/s Data Links
- 1310nm DFB Laser and PIN Receiver
- Up to 10km on 9/125um SMF
- Hot-Pluggable SFP Footprint
- Support Digital Monitoring Interface
- Class 1 Laser Safety Certified
- Cost Effective SFP+ Solution, Enables Higher Port Densities and Greater Bandwidth
- RoHS-10 compliant and Lead-Free
- Single +3.3V Power Supply
- 2-Wire Interface for Management Specifications
- Compliant with SFF-8472
- Digital Diagnostic Monitoring Interface for Optical Transceivers
- All-Metal Housing for Superior EMI Performance
- Case Operating Temperature: Commercial: 0 ~ 70°C

## Description

16G fiber channel SFP+ transceiver consists of five sections: the LD driver, the limiting amplifier, the digital diagnostic monitor, the DFB laser and the PIN photo-detector. The module data link up to 10km in 9/125um single mode fiber.

The module optical connection is duplex LC and shall be compatible with SFP+ 14.025Gbps and backward compatible with legacy 10G SFP+ pluggable. The SFP+ LR module is a dual directional device with a transmitter and receiver plus a control management interface (2-wire interface) in the same physical package. 2-wire interface is used for serial ID, digital diagnostics and module control function.

The transmitter converts 14.025Gbit/s serial PECL or CML electrical data into serial optical data compliant with the 16GBASE-LR standard. An open collector compatible Transmit Disable (Tx\_Dis) is provided. Logic "1" or no connection on this pin will disable the laser from transmitting. Logic "0" on this pin provides normal operation. The transmitter has an internal automatic power control loop (APC) to ensure constant optical power output across supply voltage and temperature variations. An open collector compatible Transmit Fault (Tx\_Fault) is provided. TX\_Fault is module output contact that when high, indicates that the module transmitter has detected a fault condition related to laser operation or safety. The TX\_Fault output contact is an open drain/collector and shall be pulled up to the Vcc\_Host in the host with a resistor in the range 4.7-10 kΩ. TX\_Disable is a module input contact. When TX\_Disable is asserted high or left open, the SFP28 module transmitter output shall be turned off. This contact shall be pulled up to VccT with a 4.7 kΩ to 10 kΩ resistor

The receiver converts 14.025Gbit/s serial optical data into serial PECL/CML electrical data. An open collector compatible Loss of Signal is provided. Rx\_LOS when high indicates an optical signal level below that specified in the relevant standard. The Rx\_LOS contact is an open drain/collector output and shall be pulled up to Vcc\_Host in the host with a resistor in the range 4.7-10 kΩ, or with an active termination. Power supply filtering is recommended for both the transmitter and receiver. The Rx\_LOS signal is intended as a preliminary indication to the system in which the 16GFC SFP+ is installed that the received signal strength is below the specified range. Such an indication typically points to non-installed cables, broken cables, or a disabled, failing or a powered off transmitter at the far end of the cable.

## 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
<b>Storage Temperature</b>	T <sub>C</sub>	-40	85	°C
<b>Power Supply Voltage</b>	V <sub>CC</sub>	-0.5	3.6	V
<b>Relative Humidity (Non-Condensation)</b>	RH	5	95	%
<b>Damage Threshold</b>	TH <sub>d</sub>	3		dBm

## II. Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
<b>Operating Case Temperature</b>	Top	0		70	°C	commercial
		-40		85	°C	Industrial
<b>Power Supply Voltage</b>	V <sub>CC</sub>	3.135	3.3	3.465	V	
<b>Data Rate</b>			14.025		Gb/s	
<b>Control Input Voltage High</b>		2		V <sub>CC</sub>	V	
<b>Control Input Voltage Low</b>		0		0.8	V	
<b>Link Distance (SMF)</b>	D			10	km	9/125um

## III. Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
<b>Power Consumption</b>	p			1.75	W	
<b>Supply Current</b>	I <sub>CC</sub>			520	mA	
<b>Transmitter</b>						
<b>Single-Ended Input Voltage Tolerance</b>	V <sub>CC</sub>	-0.3		4.0	V	
<b>Common Mode Voltage Tolerance</b>		15			mV	
<b>Differential Input Voltage Swing</b>	V <sub>in,pp</sub>	180		700	mV	
<b>Differential Input Impedance</b>	Z <sub>in</sub>	90	100	110	Ohm	1
<b>Transmit Disable Assert Time</b>				100	us	
<b>Transmit Disable Voltage</b>	V <sub>dis</sub>	V <sub>CC</sub> -1.3		V <sub>CC</sub>	V	

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
<b>Transmit Enable Voltage</b>	V <sub>en</sub>	V <sub>ee</sub>		V <sub>ee</sub> +0.8	V	2
<b>Receiver</b>						
<b>Single-Ended Input Voltage Tolerance</b>	V <sub>CC</sub>	-0.3		4.0	V	
<b>Differential Output Voltage Swing</b>	V <sub>out,pp</sub>	300		900	mV	
<b>Differential Output Impedance</b>	Z <sub>out</sub>	90	100	110	Ohm	3
<b>Data Output Rise/Fall time</b>	T <sub>r</sub> /T <sub>f</sub>	9.5			ps	4
<b>LOS Assert Voltage</b>	V <sub>losH</sub>	V <sub>CC</sub> -1.3		V <sub>CC</sub>	V	5
<b>LOS De-Assert Voltage</b>	V <sub>losL</sub>	V <sub>ee</sub>		V <sub>ee</sub> +0.8	V	5

**Notes:**

1. Connected directly to TX data input pins. AC coupled thereafter.
2. Or open circuit.
3. Input 100 ohms differential termination.
4. These are unfiltered 20-80% values.
5. Loss of Signal is LVTTTL. Logic 0 indicates normal operation; logic 1 indicates no signal detected.

## IV. Optical Characteristics

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

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
<b>Transmitter</b>						
<b>Center Wavelength</b>	$\lambda_C$	1295	1310	1325	nm	
<b>Optical Spectral Width</b>	$\Delta\lambda$			1	nm	
<b>Average Optical Power</b>	P <sub>AVG</sub>	-7		2	dBm	1
<b>Side Mode Suppression Ratio</b>	SMSR	30			dB	
<b>Optical Extinction Ratio</b>	ER	3.5			dB	

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
<b>Transmitter Off Output Power</b>	Poff			-30	dBm	
<b>Transmitter and Dispersion Penalty</b>	TDP			4.4	dB	
<b>Optical Return Loss Tolerance</b>	ORLT			20	dB	
<b>Transmitter Eye Mask</b>	Compliant with IEEE802.3ae					

### Receiver

<b>Center Wavelength</b>	$\lambda_C$	1295	1310	1325	nm	
<b>Receiver Sensitivity (OMA)</b>	Sen.			-12	dBm	2
<b>Average Receive Power</b>		-18		2	dBm	
<b>Input Saturation Power (overload)</b>	Psat	0.5			dBm	
<b>LOS Assert</b>	LOSA	-30			dBm	
<b>LOS De-assert</b>	LOSD			-17	dBm	
<b>Damage Threshold</b>	THd	3			dBm	
<b>LOS Hysteresis</b>	LOSH	0.5			dB	

#### Notes:

1. Class 1 Laser Safety per FDA/CDRH and IEC-825-1 regulations.
2. Measured with Light source 1310nm, ER=3.5dB; BER =  $<10^{-12}$  @ PRBS=2<sup>31</sup>-1 NRZ.

## V. Digital Diagnostic Functions

The following digital diagnostic characteristics are defined over the Recommended Operating Environment unless otherwise specified. It is compliant to SFF-8472 Rev10.2 with internal calibration mode. For external calibration mode please contact our sales staff.

Parameter	Symbol	Min.	Max.	Unit	Notes
<b>Temperature Monitor Absolute Error</b>	DMI_Temp	-3	3	°C	Over Operating Temp

Parameter	Symbol	Min.	Max.	Unit	Notes
<b>Supply Voltage Monitor Absolute Error</b>	DMI_Vcc	-0.15	0.15	V	Full Operating Range
<b>RX Power Monitor Absolute Error</b>	DMI_RX	-3	3	dB	
<b>Bias Current Monitor</b>	DMI_bias	-10%	10%	mA	
<b>TX Power Monitor Absolute Error</b>	DMI_TX	-3	3	dB	

## VI. Pin Assignment

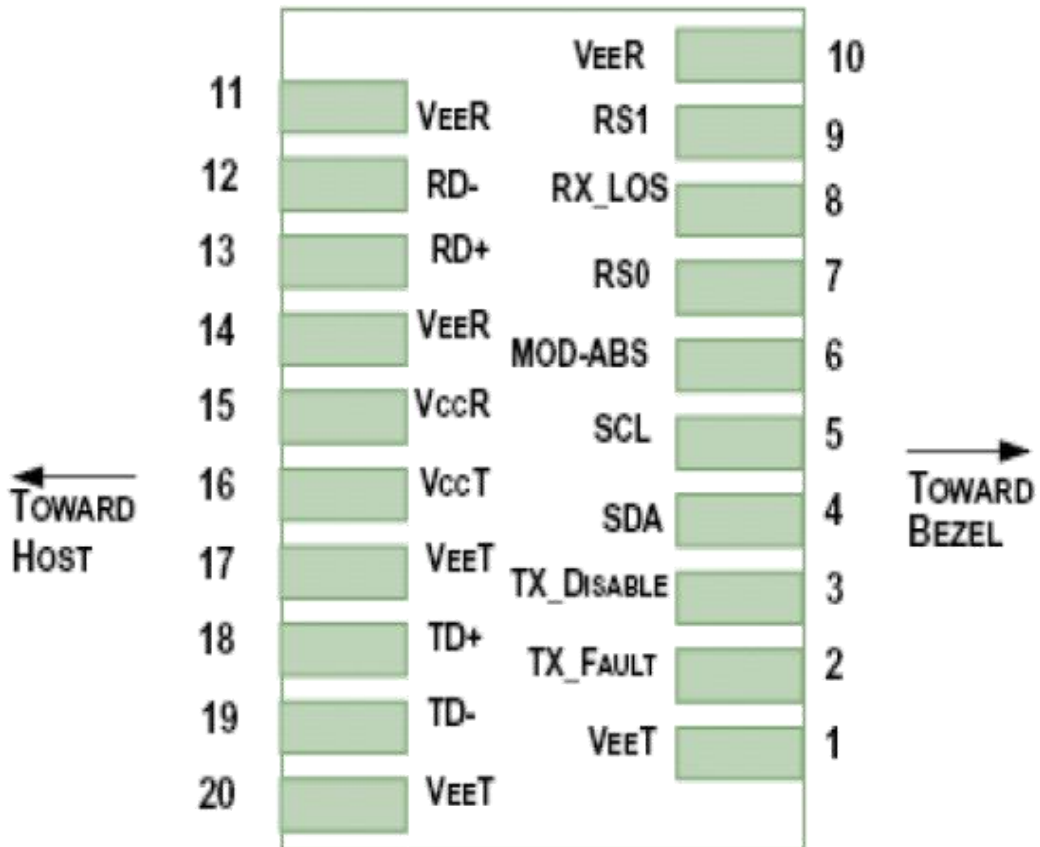


Figure1. Diagram of host board connector block pin numbers and names

## VII. Pin Description

PIN	Name	Name/Description	Notes
1	V <sub>ee</sub> T	Transmitter Ground	1
2	TX_Fault	Transmitter Fault	
3	TX_Disable	Transmitter Disable; Turns Off Transmitter Laser Output	
4	SDA	Two Wire Serial Interface Data Line (LVCMOS-I/O) (MOD-DEF2)	2
5	SCL	Two Wire Serial Interface Clock Line (LVCMOS-I/O) (MOD-DEF1)	2
6	MOD_ABS	Module Definition, Grounded in the Module	
7	RS0	Rx Rate Select	
8	RX_LOS	Receiver Loss of Signal Indication Active LOW	
9	RS1	Transmitter Rate Select (Not Used)	
10	V <sub>ee</sub> R	Receiver Ground	1
11	V <sub>ee</sub> R	Receiver Ground	1
12	RD-	Receiver Inverted Data Output	
13	RD+	Receiver Data Output	
14	V <sub>ee</sub> R	Receiver Ground	1
15	V <sub>cc</sub> R	Receiver Power - +3.3V	
16	V <sub>cc</sub> T	Transmitter Power - +3.3 V	
17	V <sub>ee</sub> T	Transmitter Ground	1
18	TD+	Transmitter Non-Inverted Data Input	

PIN	Name	Name/Description	Notes
19	TD-	Transmitter Inverted Data Input	
20	V <sub>ee</sub> T	Transmitter Ground	1

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 3.47V on the host board.

### VIII. Mechanical Dimensions

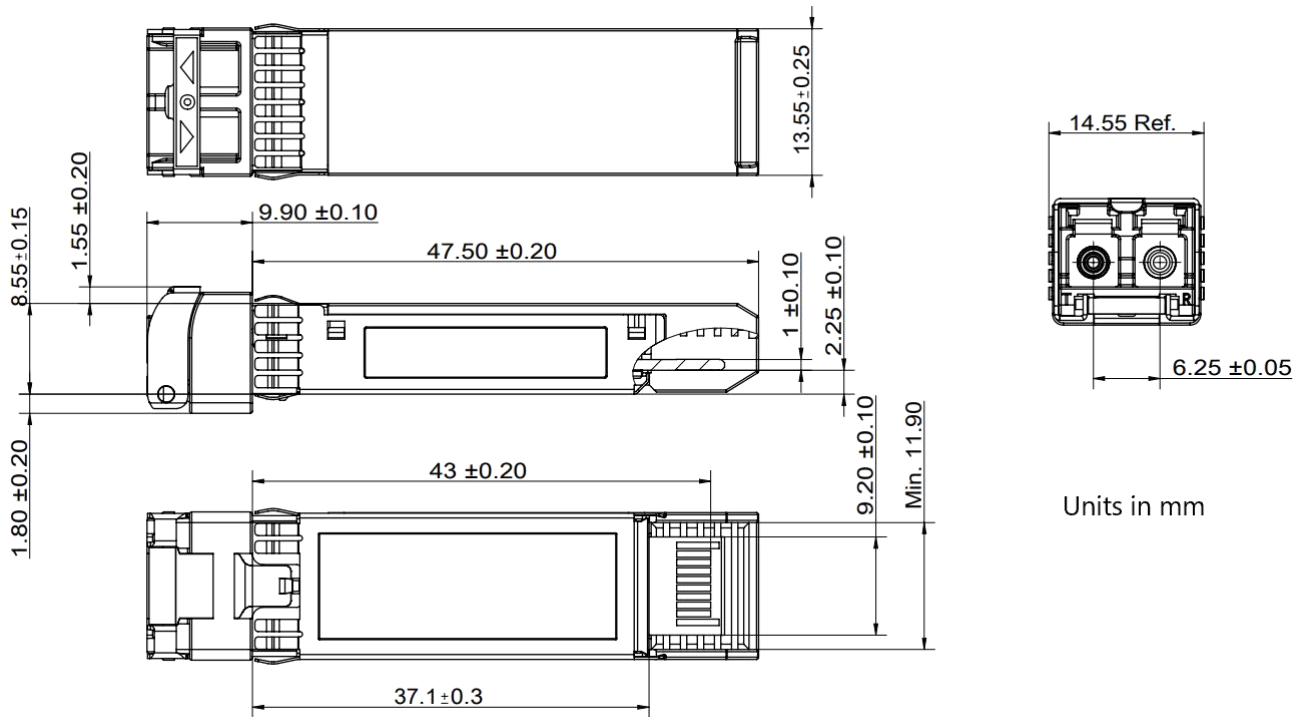


Figure 2. Mechanical Outline