

## PROLABS – DS-SFP-FC4G-LW-C

### *4.25 Gigabit SFP Wavelength (1310nm) 10km Transceiver*

#### **DS-SFP-FC4G-LW-C Overview**

PROLABS's DS-SFP-FC4G-LW-C SFP optical transceivers are compatible with Fiber Channel as defined in FC-P1-2 Rev 7.0, also can provide a quick and reliable interface for the 4FC/2FC/FC/GE application. The Digital diagnostics functions are available via 2-wire serial bus. In addition, they comply with the small Form Factor Pluggable Multi Sourcing Agreement (MSA) and SFF 8472.

#### **Product Features**

- Up to 4.25 GBd bi-directional data links
- Compliant with Fiber Channel, 2X Fiber Channel and 4X Fiber Channel
- Compliant with SFP MSA
- Hot-pluggable SFP footprint
- 1310nm FP laser
- Duplex LC connector
- Built-in digital diagnostic functions
- Up to 10km on 9/125um SMF
- Single power supply 3.3V
- RoHS Compliance
- Class 1 laser product complies with EN 60825-1
- Operating temperature range: 0°C to 70°C..

#### **Applications**

- 1.25 GBd Gigabit Ethernet
- 1.063 GBd Fiber Channel
- 2.124 GBd Fiber Channel
- 4.25 GBd Fiber Channel

#### **Ordering Information**

<i><b>Part Number</b></i>	<i><b>Description</b></i>
DS-SFP-FC4G-LW-C	4FC/2FC/FC/GE SFP 1310 LC Connectors 10km on SMF, with DOM function.

## General Specifications

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Data Rate	DR		1.25		GBd	IEEE 802.3z
			1.06			1X Fiber Channel
			2.13			2X Fiber Channel
			4.25			4X Fiber Channel
Bit Error Rate	BER			10 <sup>-12</sup>		
Operating Temperature	T <sub>OP</sub>	0		70	°C	Case temperature
Storage Temperature	T <sub>STO</sub>	-40		85	°C	Ambient temperature
Supply Current	I <sub>S</sub>		175	300	mA	For electrical power interface
Input Voltage	V <sub>CC</sub>	3	3.3	3.6	V	
Maximum Voltage	V <sub>MAX</sub>	-0.5		4	V	For electrical power interface

## Optical Characteristics – Transmitter

V<sub>CC</sub>=3V to 3.6V, T<sub>C</sub>=0°C to 70°C

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Optical Power	P <sub>OUT</sub>	-9.5		-3	dBm	Average
Optical Wavelength	·	1270		1360	nm	Note 1
Spectral Width (-20 dB)	..			0.6	nm	
Optical Modulation Amplitude	OMA	290			uW	Equivalent extinction ratio specification for FC
Optical Modulation Amplitude (<2.125G)	OMA	174			uW	Equivalent extinction ratio specification for FC
Optical Rise/Fall Time(20%-80%)(4.25G)	T <sub>RF IN</sub>			90	ps	
Relative Intensity Noise	RIN			-120	dB/Hz	
Deterministic Jitter Contribution@4.25G	TX <sub>·DJ</sub>			30	ps	
Total Jitter Contribution@4.25G	TX <sub>·TJ</sub>			60	ps	

Note

1、X = specified ITU Grid wavelength

## Optical Characteristics – Receiver

V<sub>CC</sub>=3V to 3.6V, T<sub>C</sub>=0°C to 70°C

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Optical Receiver Power	P <sub>RX</sub>			-7	dBm	Average
Optical Center Wavelength	λ <sub>C</sub>	1265		1600	nm	
Receiver Sensitivity @ 1.063GBd	R <sub>X SEN1</sub>			-22	dBm	BER < 10 <sup>-12</sup> w / PRBS 2 <sup>7</sup> -1 test pattern
Receiver Sensitivity @ 1.25GBd	R <sub>X SEN2</sub>			-22	dBm	
Receiver Sensitivity @ 2.125GBd	R <sub>X SEN3</sub>			-21	dBm	
Receiver Sensitivity @ 4.25GBd	R <sub>X SEN4</sub>			-18	dBm	
Optical Return Loss	ORL	12			dB	
Receiver Electrical 3dB Upper cutoff frequency				1500	MHz	
Loss of Signal-Asserted	P <sub>LOS A</sub>	-30			dBm	
Loss of Signal-Deasserted	P <sub>LOS D</sub>			-22	dBm	
Loss of Signal-Hysteresis		0.5			dB	

## Electrical Characteristics – Transmitter

V<sub>CC</sub>=3V to 3.6V, T<sub>C</sub>=0°C to 70°C

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Input differential impedance	R <sub>IN</sub>		100		Ω	Non condensing
Single ended data input swing	V <sub>IN PP</sub>	250		1200	mV	
Transmit disable voltage	V <sub>D</sub>	V <sub>CC</sub> -1.3		V <sub>CC</sub>	V	
Transmit enable voltage	V <sub>EN</sub>	V <sub>EE</sub>		V <sub>EE</sub> +0.8	V	
Transmit disable assert time				10	us	

## Electrical Characteristics – Receiver

$V_{CC}=3V$  to  $3.6V$ ,  $T_C=0^{\circ}C$  to  $70^{\circ}C$

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Single ended data output swing	$V_{OUT\_PP}$	300	400	800	mV	
Data output rise time (20%-80%)	$T_R$		300		ps	
Data output fall time (20%-80%)	$T_F$		300		ps	
LOS Fault	$V_{LOS\_Fault}$	$V_{CC}-0.5$		$V_{CC\_HOST}$	V	
LOS Normal	$V_{LOS\_normal}$	$V_{EE}$		$V_{EE}+0.5$	V	

## Digital Diagnostic Functions

DS-SFP-FC4G-LW-C supports the 2-wire serial communication protocol as defined in the SFF 8472. Digital diagnostic information are accessible over the 2-wire interface at the address 0xA2. Digital Diagnostics for DS-SFP-FC4G-LW-C are internally calibrated by default. A micro controller unit inside the transceiver gathers the monitoring information and reports the status of transceiver.

**Transceiver Temperature**, internally measured, represented as a 16 bit signed twos complement value in increments of 1/256 degrees Celsius, Temperature accuracy is better than  $\pm 3$  degrees Celsius over specified operating temperature and voltage.

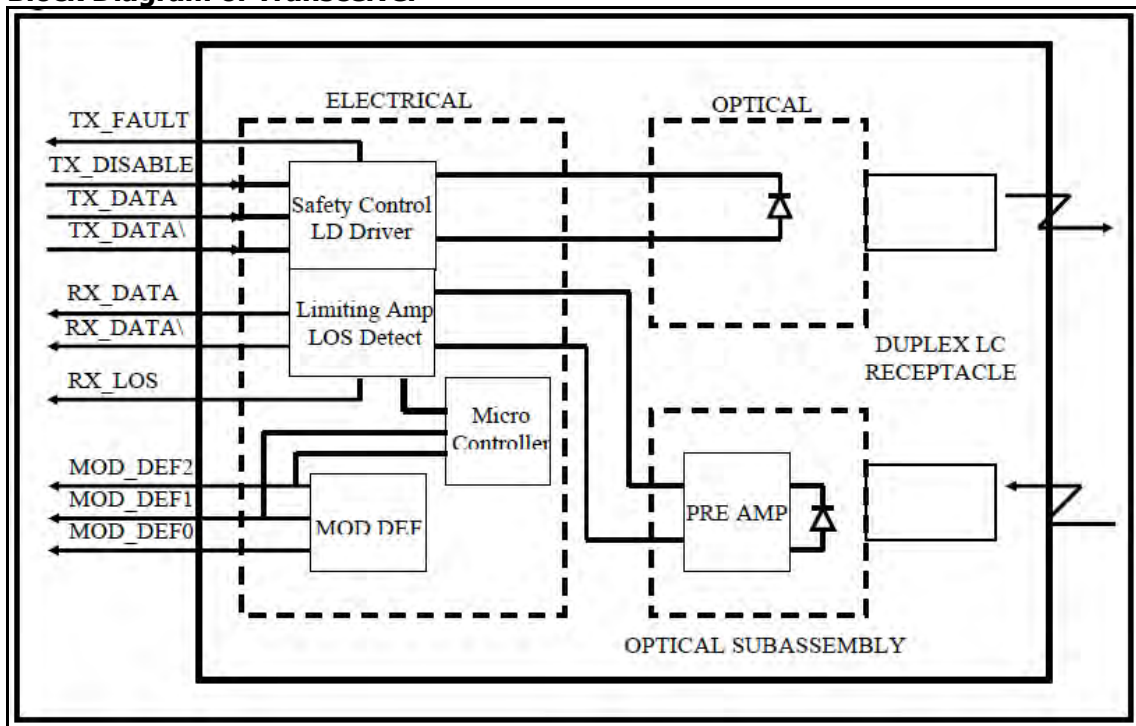
**Transceiver Supply Power**, internally measured, represented as a 16 bit unsigned integer with the voltage defined as the full 16 bit value (0 – 65535) with LSB equal to 100  $\mu$ Volt, yielding a total range of 0 to +6.55 Volts.

**Transceiver TX bias current**, internally measured, represented as a 16 bit unsigned integer with the current defined as the full 16 bit value (0 – 65535) with LSB equal to 2  $\mu$ A, yielding a total range of 0 to 131mA. Accuracy is better than  $\pm 10\%$  over specified operating temperature and voltage.

**Transceiver TX output power**, internally measured, represented as a 16 bit unsigned integer with the power defined as the full 16 bit value (0 – 65535) with LSB equal to 0.1  $\mu$ W. Data is assumed to be based on measurement of laser monitor photodiode current. Accuracy is better than  $\pm 3$ dB over specified temperature and voltage. Data is not valid when the transmitter is disabled.

**Transceiver RX received optical power**, internally measured, represented as a 16 bit unsigned integer with the power defined as the full 16 bit 35 value (0 – 65535) with LSB equal to 0.1  $\mu$ W. Accuracy is better than  $\pm 3$ dB over specified temperature and voltage.

## Block Diagram of Transceiver



### Transmitter Section

The Laser driver accept differential input data and provide bias and modulation currents for driving a laser. An automatic power-control (APC) feedback loop is incorporated to maintain a constant average optical power. 1310nm FP in an eye safe optical subassembly (OSA) mates to the fiber cable.

### TX\_DISABLE

The TX\_DISABLE signal is high (TTL logic "1") to turn off the laser output. The laser will turn on within 1ms when TX\_DISABLE is low (TTL logic "0").

### TX\_FAULT

When the TX\_FAULT signal is high, output indicates a laser fault of some kind. Low indicates normal operation.

### Receiver Section

The receiver utilizes a PIN detector integrated with a trans-impedance preamplifier in an OSA. This OSA is connected to a Limiting Amplifier which providing post-amplification quantization, and optical signal detection. The limiting Amplifier is AC-coupled to the transimpedance amplifier, with internal 100Ω differential termination.

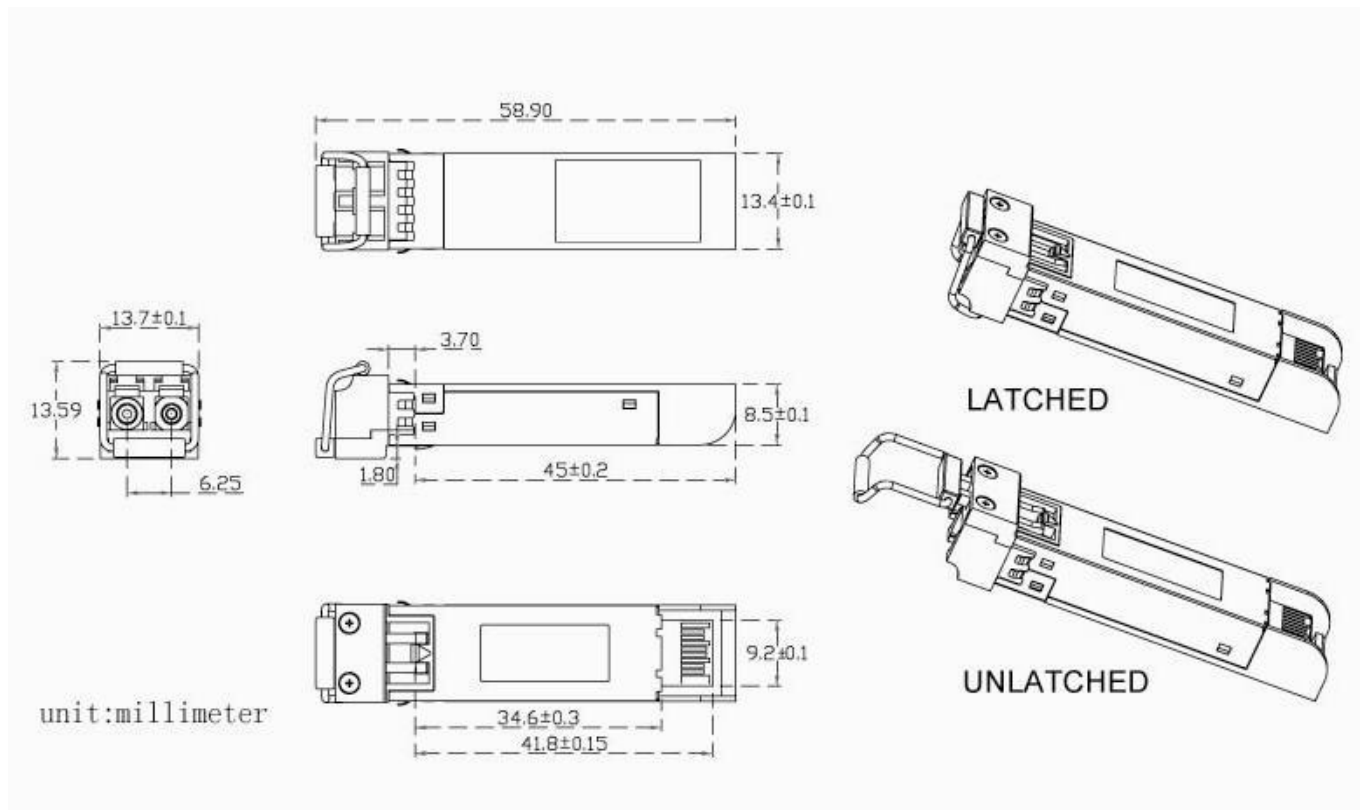
### Receive Loss (RX\_LOS)

The RX\_LOS is high (logic "1") when there is no incoming light from the companion transceiver. This signal is normally used by the system for the diagnostic purpose. The signal is operated in TTL level.

### Controller Section

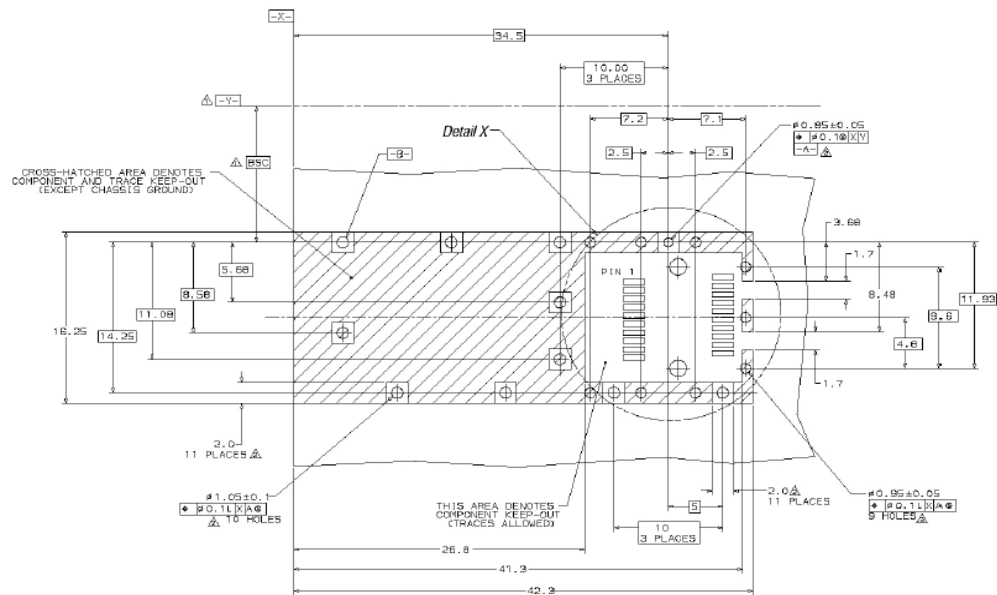
The micro controller unit monitors the operation information of LD driver and Limiting Amplifier. And report these status to the customer.

## Dimensions



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

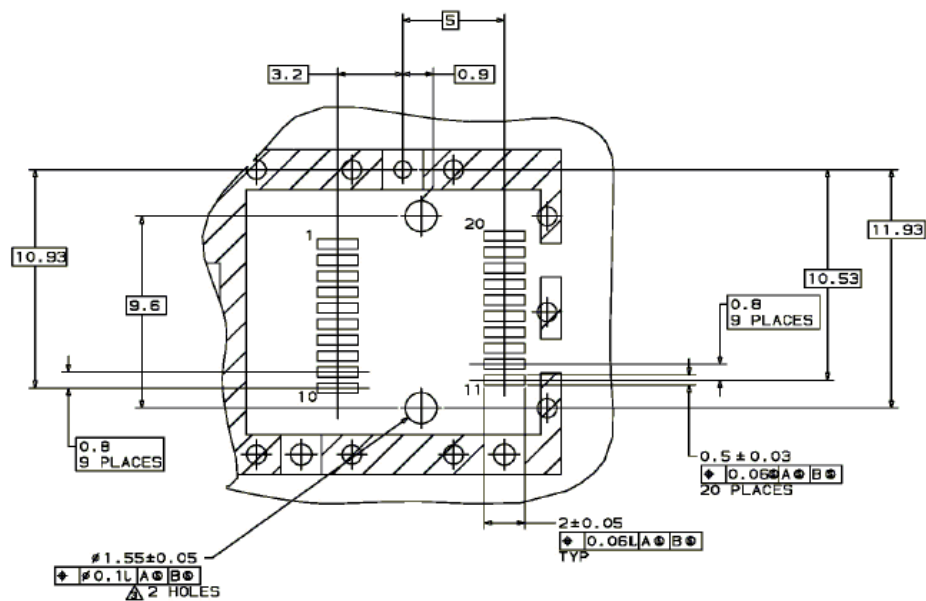
## PCB Layout Recommendation



$\Delta$  Datum and Basic Dimension Established by Customer

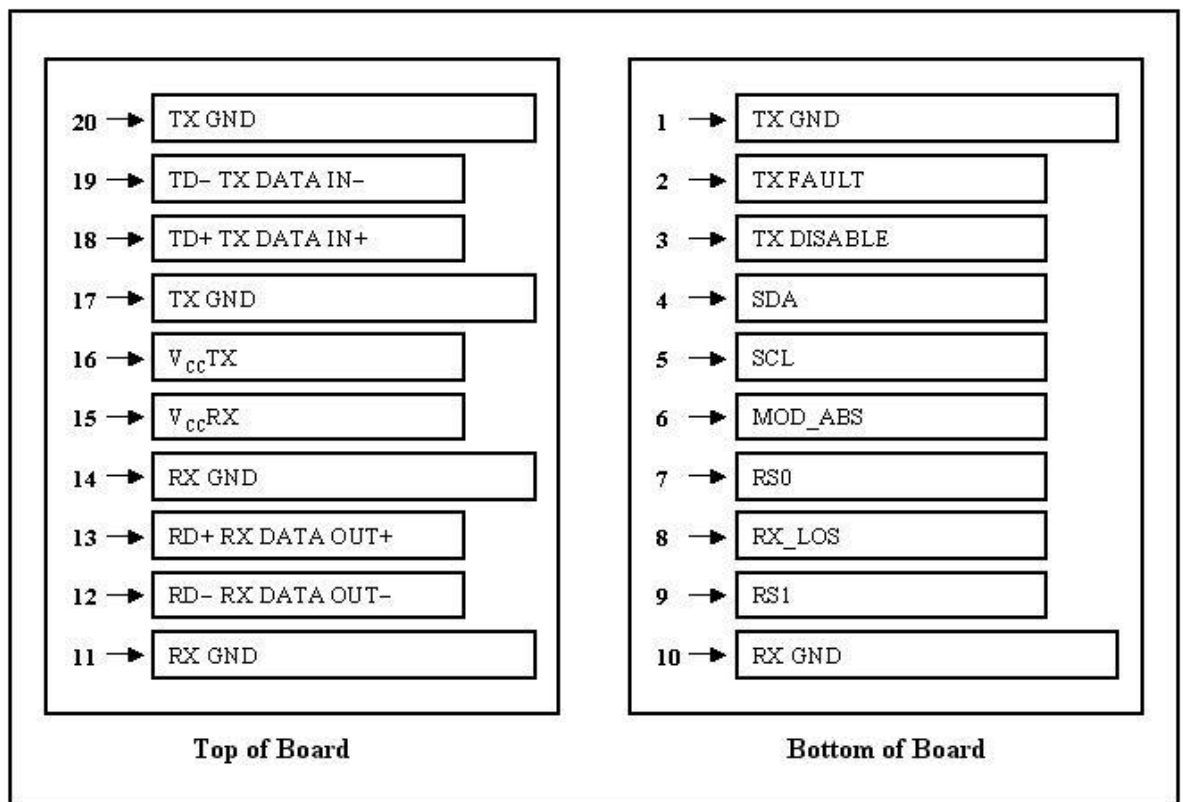
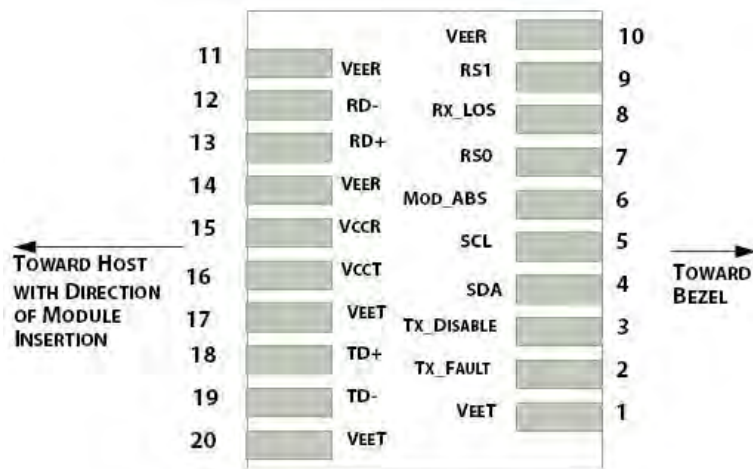
$\Delta$  Pads and Vias are Chassis Ground, 11 Places

$\Delta$  Through Holes are Unplated





## Electrical Pad Layout



## Pin Assignment

<i><b>PIN #</b></i>	<i><b>Symbol</b></i>	<i><b>Description</b></i>	<i><b>Remarks</b></i>
1	V <sub>EET</sub>	Transmitter ground (common with receiver ground)	Circuit ground is isolated from chassis ground
2	T <sub>FAULT</sub>	Transmitter Fault. Not supported	
3	T <sub>DIS</sub>	Transmitter Disable. Laser output disable on high or open	Disabled: T <sub>DIS</sub> >2V or open Enabled: T <sub>DIS</sub> <0.8V
4	SDA	Data line for serial ID	Should Be pulled up with 4.7k – 10k ohm on host board to a voltage between 2V and 3.6V
5	SCL	Clock line for serial ID	
6	MOD_ABS	Module Absent. Grounded within the module	
7	RS0	No connection required	
8	LOS	Loss of Signal indication. Logic 0 indicates normal operation	LOS is open collector output
9	RS1	No connection required	
10	V <sub>EER</sub>	Receiver ground (common with transmitter ground)	Circuit ground is isolated from chassis ground
11	V <sub>EER</sub>	Receiver ground (common with transmitter ground)	
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)	Circuit ground is isolated from chassis ground
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)	Circuit ground is isolated from chassis ground
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)	Circuit ground is isolated from chassis ground

## References

1. Small Form Factor Pluggable (SFP) Transceiver Multi-Source Agreement (MSA), September 2000.
2. Fiber Channel Draft Physical Interface Specification (FC-PI-2 Rev8.0).
3. Digital Diagnostics Monitoring Interface for Optical Transceivers – SFF-8472.
4. Fiber Channel Physical and Signaling Interface (FC-PH/PH2/PH3).