

# GIGABIT ETHERNET SFP MULTIMODE TRANSCEIVER WITH DIGITAL DIAGNOSTICS

## TRPAG1SXLAES

### Product Description

The TRPAG1SXLAES SFP ber optic transceiver with integrated digital diagnostics monitoring functionality provides a quick and reliable interface for Gigabit Ethernet 1000BASE-SX multimode applications. The diagnostic functions, alarm and warning features as described in the Multi-Source Agreement (MSA) document, SFF-8472(Rev. 9.4), are provided via an I<sup>2</sup>C serial interface.

A highly reliable 850nm wavelength Vertical Cavity Surface Emitting Laser (VCSEL) is used in the transmitter. The transceiver satisfies Class I Laser Safety requirements in accordance with the U.S. FDA/CDRH and international IEC-60825 standards.

The TRPAG1SXLAES transceiver connects to a standard 20-pad SFP connector for hot plug capability. This allows the system designer to make configuration changes or maintenance by simply plugging in different types of transceivers without removing the power supply from the host system.

The transceiver has bail-type latch, which offers an easy and convenient way to release the module. The latch is compliant with the SFP MSA.

The transmitter and receiver DATA interfaces are AC coupled internally. LV-TTL Transmitter Disable control input and Loss of Signal output interfaces are also provided.

The transceiver operates from a single +3.3V power supply over an operating case temperature range of -40°C to +85°C. The housing is made of plastic and metal for EMI immunity.



### Features

- Compatible with SFP MSA
- Compliant with IEEE 802.3z Gigabit Ethernet 1000BASE-SX PMD Specifications
- Digital Diagnostics through Serial Interface
- Internal Calibration for Digital Diagnostics
- Industrial Operating Temperature Range
- 275m Distance with 62.5µm Multimode Fiber
- 550m Distance with 50µm Multimode Fiber
- TX Disable Input
- Hot-pluggable Eye Safe (Class I Laser Safety)
- Duplex LC Optical Interface
- Single +3.3V Power Supply

### Absolute Maximum Ratings

Parameter	Symbol	Minimum	Maximum	Units	
Storage Temperature	$V_{ST}$	- 40	+ 85	°C	
Operating Case Temperature <sup>1</sup>	Industrial <sup>2</sup>	$V_{OP}$	- 40	+ 85	°C
Supply Voltage	$V_{CC}$	0	+ 5.0	V	
Input Voltage	$V_{IN}$	0	$V_{CC}$	V	

<sup>1</sup> Measured on top side of SFP module at the front center vent hole of the cage.

**Transmitter Performance Characteristics** (Over Operating Case Temperature.  $V_{CC} = 3.13$  to  $3.47V$ )

All parameters guaranteed only at typical data rate

Parameter	Symbol	Minimum	Typical	Maximum	Units
Operating Data Rate <sup>1</sup>	$B$	-	1250	-	Mb/s
Optical Output Power <sup>2</sup>	$P_O$	- 9.5	- 7.0	- 4.0	dBm
Center Wavelength	$\lambda_C$	820	-	860	nm
Spectral Width (RMS)	$\Delta\lambda_{RMS}$	-	-	0.85	nm
Extinction Ratio	$P_{hi}/P_{lo}$	9	-	-	dB
Total Jitter	$TJ$	-	-	227	ps
Relative Intensity Noise	$RIN$	-	-	- 117	dB/Hz
Coupled Power Ratio	$CPR$	9	-	-	dB
Transmitter Output Eye	Compliant with Eye Mask Dened in IEEE 802.3z Standard				

<sup>1</sup> Data rate ranges from 1000Mb/s to 1300Mb/s. However, some degradation may be incurred in overall performance.  
<sup>2</sup> Measured average power coupled into either 50 $\mu$ m or 62.5 $\mu$ m multimode fiber.

**Receiver Performance Characteristics** (Over Operating Case Temperature.  $V_{CC} = 3.13$  to  $3.47V$ )

All parameters guaranteed only at typical data rate

Parameter	Symbol	Minimum	Typical	Maximum	Units
Operating Data Rate <sup>1</sup>	$B$	-	1250	-	Mb/s
Minimum Input Optical Power ( $10^{-12}$ BER) <sup>2</sup>	$P_{min}$	- 17.0	-	-	dBm
Maximum Input Optical Power ( $10^{-12}$ BER) <sup>2</sup>	$P_{max}$	0	-	-	dBm
LOS Thresholds	Increasing Light Input	$P_{los+}$	-	-	- 17.0
	Decreasing Light Input	$P_{los-}$	- 30.0	-	-
LOS Hysteresis	-	0.5	-	-	dB
Total Jitter	$TJ$	-	-	266	ps
Wavelength of Operation	$\lambda$	770	-	860	nm
Optical Return Loss	$ORL$	12	-	-	dB
Electrical 3dB Upper Cuto Frequency	-	-	-	1500	MHz
Stressed Receiver Sensitivity	Compliant with 802.3z Standard				

<sup>1</sup> Data rate ranges from 1000Mb/s to 1300Mb/s. However, some degradation may be incurred in overall performance.  
<sup>2</sup> Measured with 27-1 PRBS at 1250Mb/s and 850nm wavelength.

**Laser Safety:** All transceivers are Class I Laser products per FDA/CDRH and IEC-60825 standards. They must be operated under specified operating conditions.

	<b>Oplink Communications, Inc.</b> DATE OF MANUFACTURE:	
	This product complies with 21 CFR 1040.10 and 1040.11 <b>Meets Class I Laser Safety Requirements</b>	

**Transmitter Performance Characteristics** (Over Operating Case Temperature.  $V_{CC} = 3.13$  to  $3.47V$ )

Parameter	Symbol	Minimum	Typical	Maximum	Units
Input Voltage Swing (TD+ & TD-) <sup>1</sup>	$V_{PP-DIF}$	0.50	-	2.4	V
Input HIGH Voltage (TX Disable) <sup>2</sup>	$V_{IH}$	2.0	-	$V_{CC}$	V
Input LOW Voltage (TX Disable) <sup>2</sup>	$V_{IL}$	0	-	0.8	V
Output HIGH Voltage (TX Fault) <sup>3</sup>	$V_{OH}$	2.0	-	$V_{CC} + 0.3$	V
Output LOW Voltage (TX Fault) <sup>3</sup>	$V_{OL}$	0	-	0.8	V

<sup>1</sup> Differential peak-to-peak voltage.  
<sup>2</sup> There is an internal 4.7 to 10kΩ pull-up resistor to VccT.  
<sup>3</sup> Open collector compatible, 4.7 to 10kΩ pull-up resistor to Vcc (Host Supply Voltage).

**Receiver Electrical Interface** (Over Operating Case Temperature.  $V_{CC} = 3.13$  to  $3.47V$ )

Parameter	Symbol	Minimum	Typical	Maximum	Units
Output Voltage Swing (RD+ & RD-) <sup>1</sup>	$V_{PP-DIF}$	0.6	-	2.0	V
Output HIGH Voltage (LOS) <sup>2</sup>	$V_{OH}$	2.0	-	$V_{CC} + 0.3$	V
Output LOW Voltage (LOS) <sup>2</sup>	$V_{OL}$	0	-	0.5	V

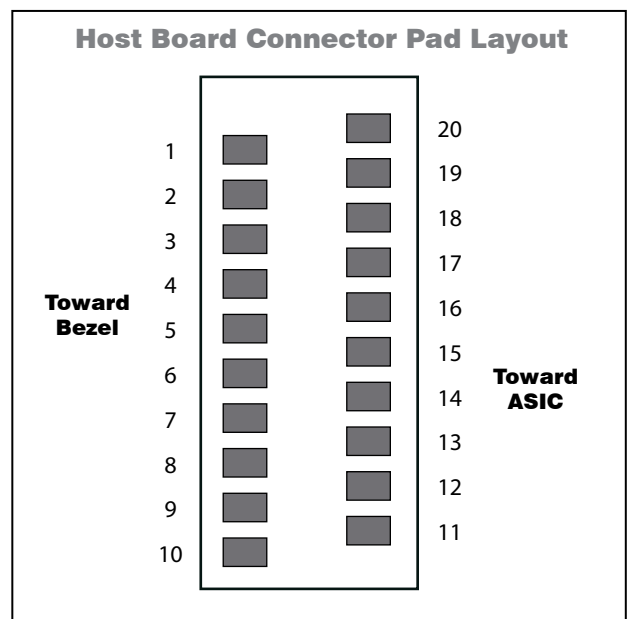
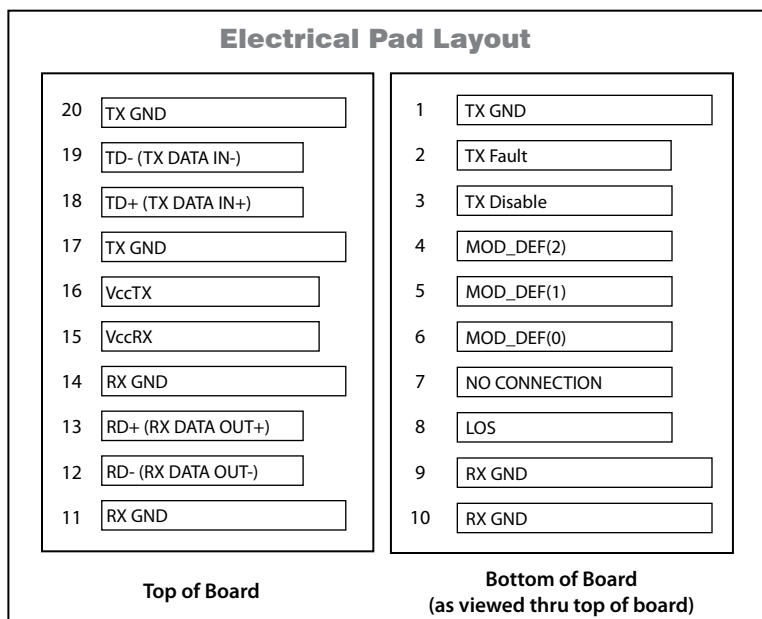
<sup>1</sup> Differential peak-to-peak voltage across external 100Ω load.  
<sup>2</sup> Open collector compatible, 4.7 to 10kΩ pull-up resistor to Vcc (Host Supply Voltage).

**Electrical Power Supply Characteristics** (Over Operating Case Temperature.  $V_{CC} = 3.13$  to  $3.47V$ )

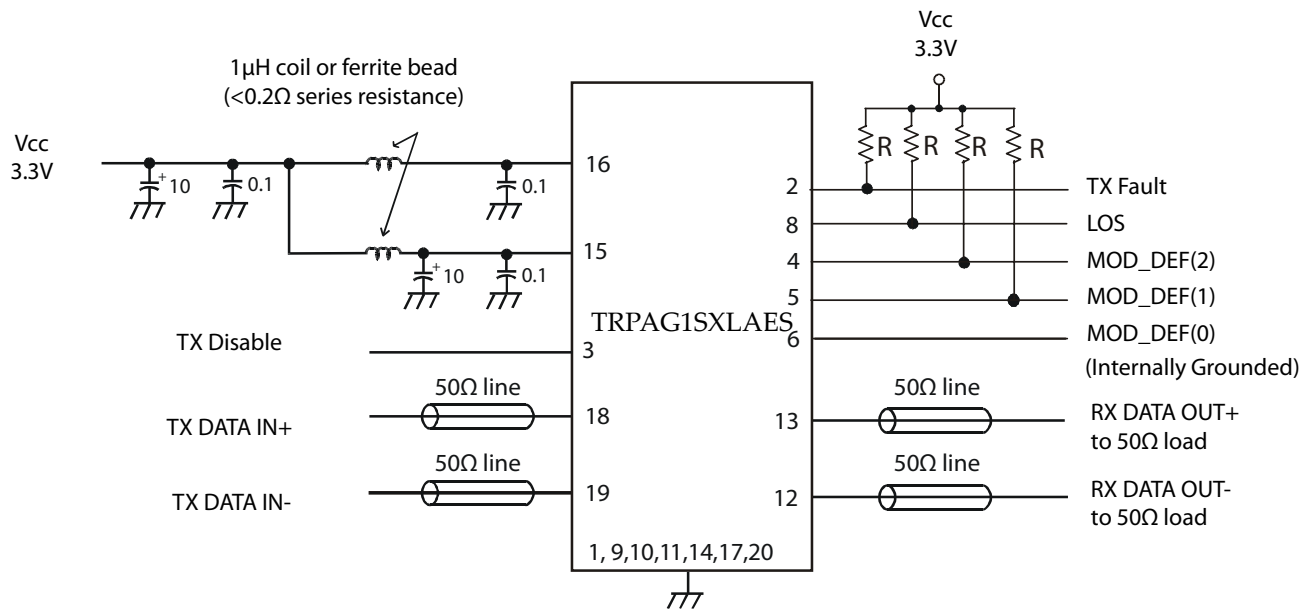
Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply Voltage	$V_{CC}$	3.13	3.3	3.47	V
Supply Current	$I_{CC}$	-	175	245	mA

**Module Definition**

MOD_DEF(0) pin 6	MOD_DEF(1) pin 5	MOD_DEF(2) pin 4	Interpretation by Host
TTL LOW	SCL	SDA	Serial module definition protocol



### Example of SFP host board schematic



R: 4.7 to 10k $\Omega$

### Application Notes

**Electrical interface:** All signal interfaces are compliant with the SFP MSA specification. The high speed DATA interface is differential AC-coupled internally with 0.1 $\mu$ F and can be directly connected to a 3.3V SERDES IC. All low speed control and sense output signals are open collector TTL compatible and should be pulled up with a 4.7 - 10k $\Omega$  resistor on the host board

**Loss of Signal (LOS):** The Loss of Signal circuit monitors the level of the incoming optical signal and generates a logic HIGH when an insufficient photocurrent is produced.

**TX\_Fault:** The output indicates LOW when the transmitter is operating normally, and HIGH with a laser fault including laser end-of-life. TX Fault is an open collector/drain output that should be pulled up with a 4.7 - 10k $\Omega$  resistor on the host board. TX Fault is latched per SFP MSA.

**TX\_Disable:** When the TX Disable pin is at logic HIGH, the transmitter optical output is disabled (less than -45dBm).

**Serial Identification and Monitoring:** The module definition of SFP is indicated by the three module definition pins, MOD\_DEF(0), MOD\_DEF(1) and MOD\_DEF(2).

Upon power up, MOD\_DEF(1:2) appear as NC (no connection), and MOD\_DEF(0) is TTL LOW. When the host system detects

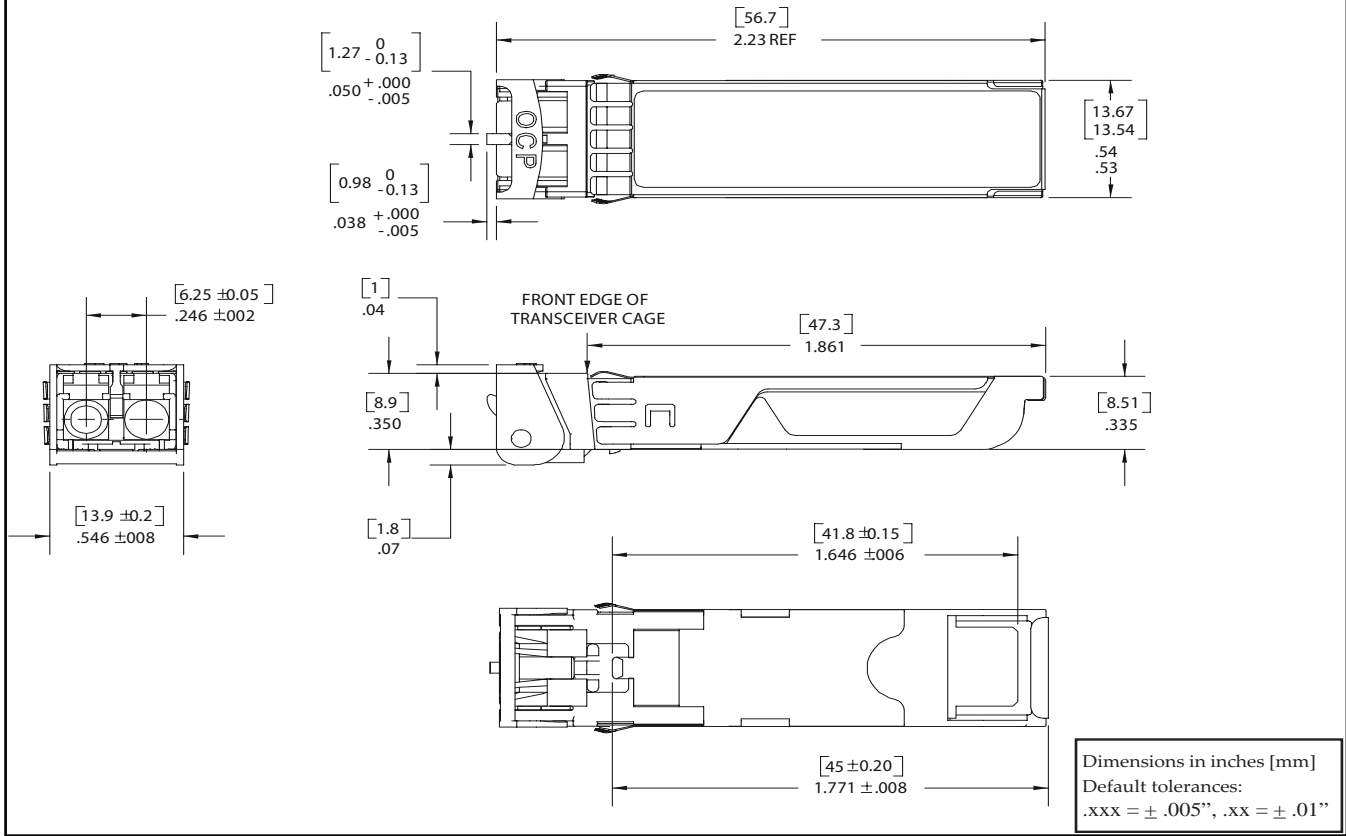
this condition, it activates the serial protocol (standard two-wire I<sup>2</sup>C serial interface) and generates the serial clock signal (SCL). The positive edge clocks data into the EEPROM segments of the SFP that are not write protected, and the negative edge clocks data from the SFP.

The serial data signal (SDA) is for serial data transfer. The host uses SDA in conjunction with SCL to mark the start and end of serial protocol activation. The supported monitoring functions are internal temperature, supply voltage, bias current, transmitter power, average receiver signal, all alarms and warnings and software monitoring of TX Fault/LOS. The device is internally calibrated.

The data transfer protocol and the details of the mandatory and vendor specific data structures are defined in the SFPMSA, and SFF-8472, Rev. 9.4

**Power supply and grounding:** The power supply line should be well-filtered. All 0.1 $\mu$ F power supply bypass capacitors should be as close to the transceiver module as possible.

**Package Outline**



**Ordering Information**

Oplink can provide a remarkable range of customized optical solutions. For detail, please contact Oplink's Sales and Marketing for your requirements and ordering information (510) 933-7200 or Sales@oplink.com.