

# FAST ETHERNET 100BASE SFP TRANSCEIVER WITH DIGITAL DIAGNOSTICS

## TRPUFEEEXx000E1G



### Product Description

The TRPUFEEEXI000E1G SFP series of fiber optic transceivers provide a quick and reliable interface for 100BASE Fast Ethernet single mode applications. The transceivers are compliant with IEEE 802.3ah/D 3.3 standard. 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. All transceiver modules satisfy Class 1 Laser Safety requirements in accordance with the U.S. FDA/CD RH and international IEC-60825 standards.

The transceivers connect to standard 20-pad SFP connectors 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 transceivers have bail-type latches, which offer an easy and convenient way to release the modules. The latch is compliant with the SFP MSA.

The transmitter incorporates a highly reliable 1310nm laser and an integrated driver circuit. The receiver features a transimpedance amplifier IC optimized for high sensitivity and wide dynamic range. The transmitter and receiver DATA interfaces are AC-coupled internally. LV-TTL Transmitter Disable control input and Loss of Signal (LOS) output interfaces are also provided.

The transceivers operate from a single +3.3V power supply over three operating case temperature ranges of -40°C to +85°C, -5°C to +85°C or -5°C to +70°C. The housing is made of metal for EMI immunity.



### Features

- Compliant with IEEE 802.3ah/D3.3 (100BASE-LX10)
- Compatible with SFP MSA
- RoHS6/6 Compliant
- Digital Diagnostics through Serial Interface
- Internal Calibration for Digital Diagnostics
- 1310nm Fabry Perot Laser Transmitter
- Distances up to 40km
- Eye Safe (Class 1 Laser Safety)
- Duplex LC Optical Interface
- Hot-pluggable
- TX Fault & Loss of Signal Outputs
- TX Disable Input
- Single +3.3V Power Supply

### Absolute Maximum Ratings

Parameter		Symbol	Minimum	Maximum	Units
Storage Temperature Range		$T_{ST}$	- 40	+ 85	°C
Operating Case Temperature <sup>1</sup>	Commercial	$T_{OP}$	- 5	+ 70	°C
	Extended		- 5	+ 85	
	Industrial		- 40	+ 85	
Supply Voltage		$V_{CC}$	0	+ 4.5	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>	$B$	-	125	-	Mb/s
Average Optical Output Power <sup>2</sup>	$P_{AVG}$	- 5.0	-	0	dBm
Center Wavelength	$\lambda_C$	1260	1310	1360	nm
Spectral Width (RMS)	$\Delta\lambda_{RMS}$	-	-	3.0	nm
Extinction Ratio	$ER$	9	-	-	dB
Optical Output Power of OFF Transmitter	$P_{OFF}$	-	-	- 45	dBm
Duty Cycle Distortion (Peak-to-Peak)	$DCD$	-	-	0.6	ns
Deterministic Jitter	$DJ$	-	-	2.44	ns
Optical Return Loss Tolerance	$ORLT$	-	-	12	dB
Total Jitter	$TJ$	-	-	2.48	ns
Transmitter Dispersion Penalty	-	-	-	4.5	dB
Optical Output Eye	<i>Compliant with IEEE 802.3ah/D3.3</i>				
<sup>1</sup> Data rate ranges from 50Mb/s to 200Mb/s. However, some degradation may be incurred in overall performance.					
<sup>2</sup> Measured average power coupled into single mode fiber. The minimum power specified is at Beginning-of-Life.					

**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>	$B$	-	125	-	Mb/s
Receiver Sensitivity ( $10^{-12}$ BER) <sup>2</sup>	$P_{min}$	-	-	- 28.0	dBm
Maximum Input Optical Power ( $10^{-12}$ BER) <sup>2</sup>	$P_{max}$	- 8.0	-	-	dBm
LOS Thresholds	Increasing Light Input	$P_{los+}$	-	- 28.0	dBm
	Decreasing Light Input	$P_{los-}$	- 45.0	-	
LOS Hysteresis <sup>3</sup>	-	0.5	-	-	dB
LOS Timing Delay	Increasing Light Input	$t_{loss\_off}$	-	100	$\mu s$
	Decreasing Light Input	$t_{loss\_on}$	2.3	100	
Wavelength of Operation	$\lambda$	1100	-	1600	nm
Jitter Tolerance		-	-	3.54	ns
Total Contributed Jitter		-	-	0.5	ns
Jitter Corner Frequency		-	20		kHz
Receiver Reflectance		-	-	- 12.0	dB
<sup>1</sup> Data rate ranges from 50Mb/s to 700Mb/s. However, some degradation may be incurred in overall performance.					
<sup>2</sup> Specified in average optical input power and when measured at 1310nm wavelength and 125Mb/s with optical frame based on test pattern specified in IEEE 802.3ah. The optical source Extinction Ratio is set at optimum value during the sensitivity test.					
<sup>3</sup> When measured at 1310nm wavelength and 125Mb/s with 2 <sup>7</sup> -1 PRBS.					

**Laser Safety:**

All transceivers are Class 1 Laser products per FDA/CDRH and IEC-60825 standards. They must be operated under specified operating conditions.

**Oplink Communications, LLC.**

This product complies with  
21 CFR 1040.10 and 1040.11  
**Meets Class 1 Laser Safety Requirements**

**Transmitter Electrical 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>	$V_{PP-DIFF}$	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 Disable) <sup>3</sup>	$V_{OH}$	2.0	-	$V_{CC} + 0.3$	V
Output LOW Voltage (TX Disable) <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 10 kΩ pull-up resistor to Vcc (Host Supply Voltage)

**Receiver Electrical Characteristics** (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>	$V_{PP-DIFF}$	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.

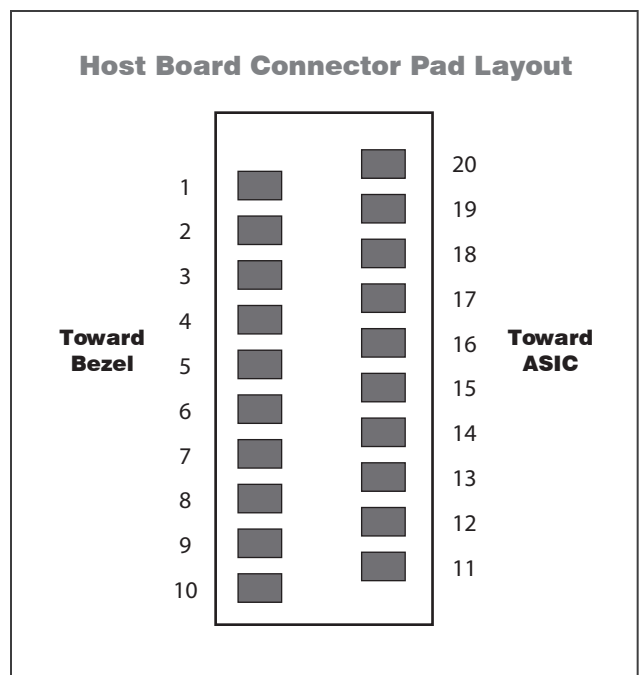
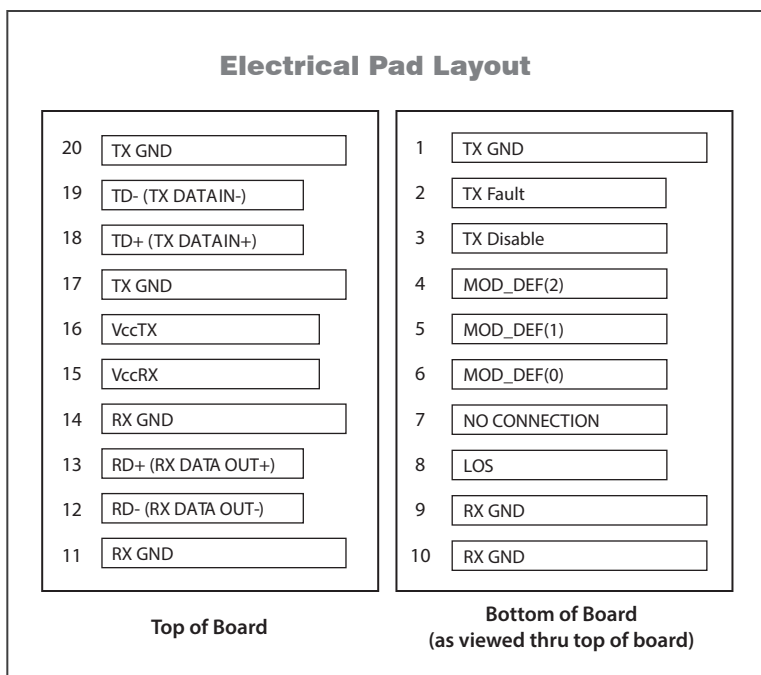
<sup>2</sup>Open collector compatible, 4.7 to 10kΩ pull-up resistor to Vcc (Host Supply Voltage).

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

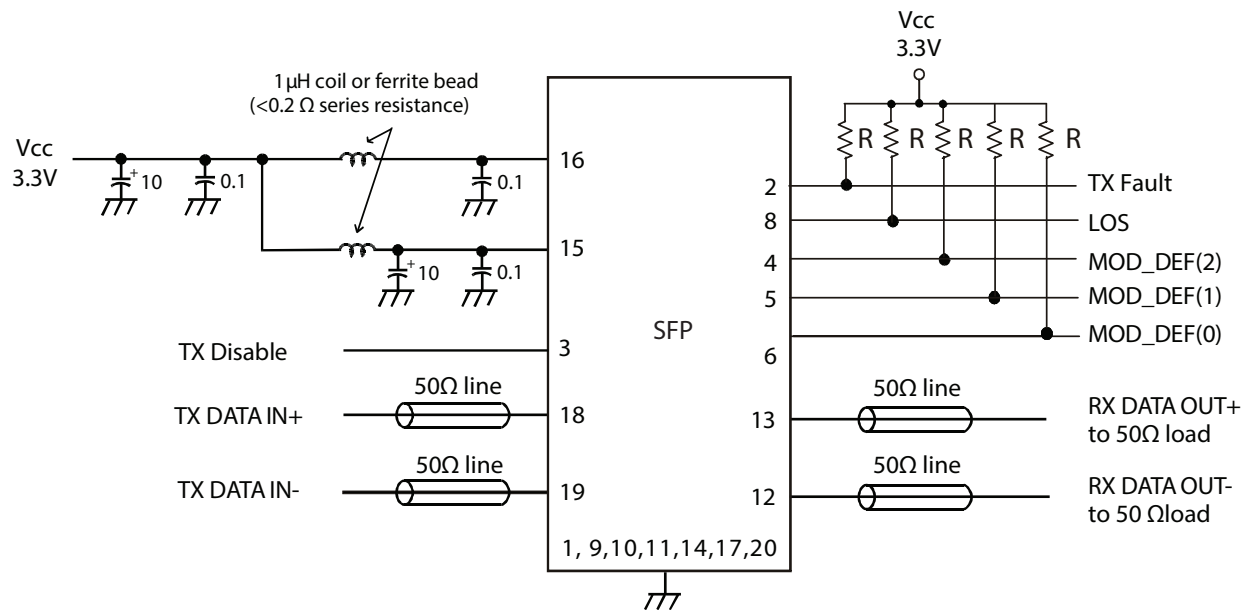
Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply Voltage	$V_{CC}$	3.13	3.3	3.47	V
Power Dissipation	$PW$	-	-	1	W

**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 $\Omega$   
CAP Values in  $\mu\text{F}$

### Application Notes

**Electrical interface:** All signal interfaces are compliant with the SFP MSA specification. The high speed DATA interface is differential AC-coupled internally 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 – 10 k $\Omega$  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 and should be pulled up with a 4.7 – 10 k $\Omega$  resistor on the host board.

**TX\_Disable:** When the TX Disable pin is at logic HIGH, the transmitter optical output is disabled. The laser is also disabled if this line is left floating, as it is pulled high inside the transceiver.

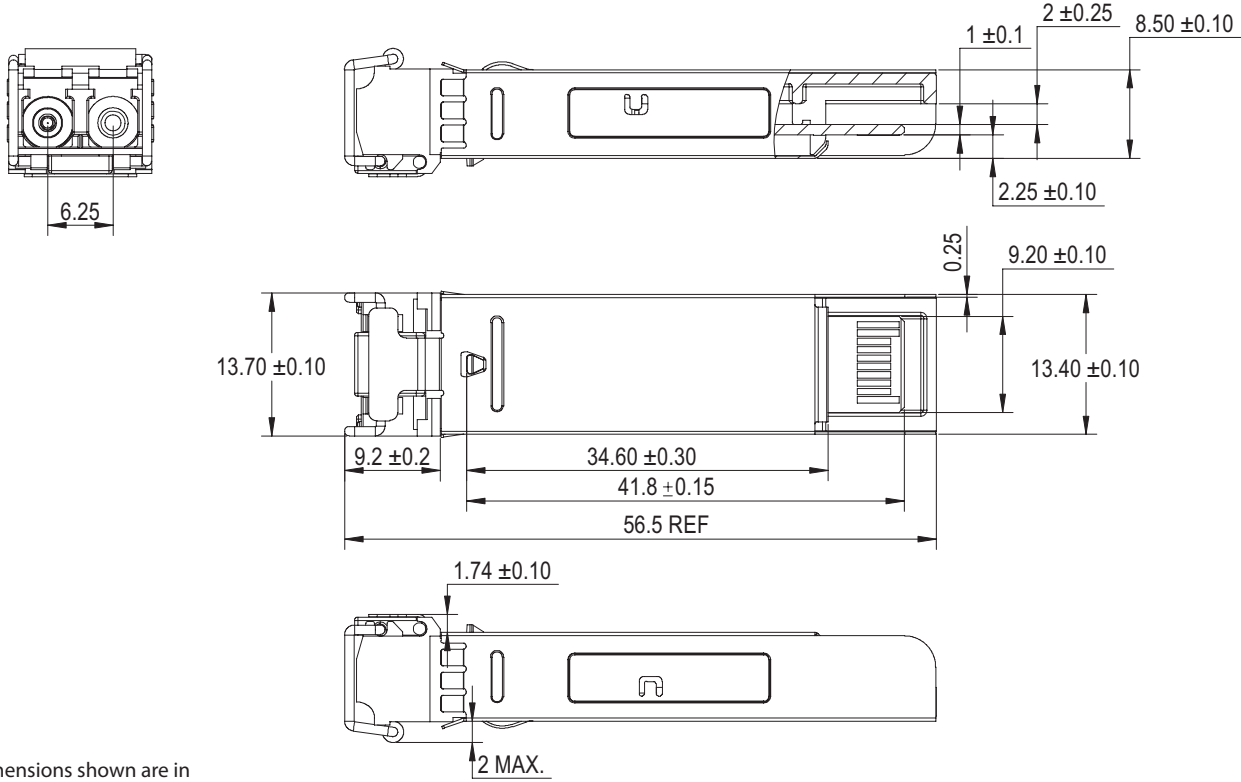
**Serial Identification and Monitoring:** The module definition of SFP is indicated by the MOD\_ABS pin and the 2-wire serial

interface. Upon power up, the 2-wire interface appears as NC (no connection), and MOD\_ABS 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 device that are not write protected, and the negative edge clocks data from the device. 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 temperature, 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 SFP MSA, and SFF-8472, Rev. 9.5.

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

**Mechanical Package**



All dimensions shown are in [inches] and millimeters  
Millimeters are the primary units.  
Tolerances are in accordance with SFF-8432 Rev.5.

**Ordering Information**

Oplink Part Number	Operating Temperature		Center Wavelength	Distance	Latch Color
TRPUFEEEXC000E1G	- 5°C to +70°C	Commercial	1310nm	40km	Red
TRPUFEEEXE000E1G	- 5°C to +85°C	Extended			
TRPUFEEEXI000E1G	- 40°C to +85°C	Industrial			

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