Multi-rate Gigabit Ethernet & Fibre Channel SFP Transceivers with Digital Diagnostics

TRPEG1-E2G Single Mode

Product Description

The TRPEG1-E2G SFP series of multi-rate fiber optic transceivers with integrated digital diagnostics monitoring functionality provide a quick and reliable interface for Gigabit Ethernet and 1.062GBd Fibre Channel applications. The transceivers are designed to support data rates ranging from 1.25Gb/s down to 125Mb/s. 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^2C serial interface.

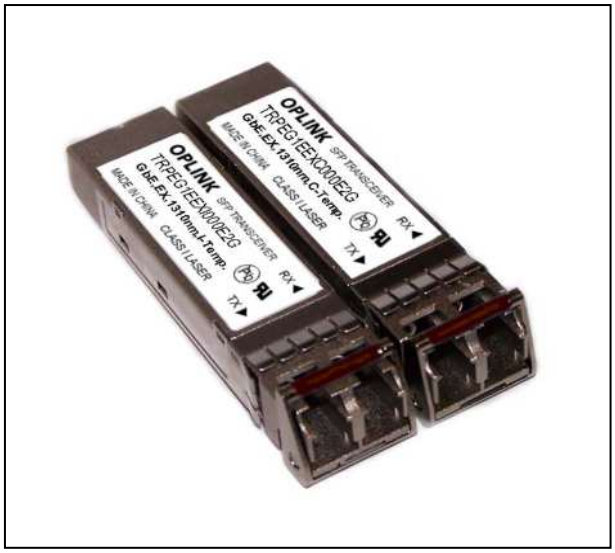
Four options are offered with minimum optical link power budgets of 18dB, 22dB and 24dB to support up to 80km link applications. Option "EX" uses a 1310nm DFB laser and provides a minimum optical link budget of 18dB, corresponding to a minimum distance of 40km, assuming fiber loss of 0.35dB/km. Options "YX" and "ZX" use 1550nm DFB lasers and provide a minimum optical link budgets of 22dB and 24dB respectively, which correspond to minimum distances of 70km and 80km, assuming fiber loss of 0.25dB/km. All modules satisfy Class I Laser Safety requirements in accordance with the U.S. FDA/CDRH 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 colored bail-type latches, which offer an easy and convenient way to release the modules. 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 transceivers operate from a single +3.3V power supply over operating case temperature ranges of -5°C to +70°C or -40°C to +85°C. The housing is made of metal for EMI immunity.



Features

- ☑ Compliant with IEEE 802.3z Gigabit Ethernet Specifications
- ☑ Compliant with SFP MSA
- ☑ Lead Free Design & Fully RoHS Compliant
- ☑ Digital Diagnostics through Serial Interface
- ☑ Internal Calibration for Digital Diagnostics
- ☑ Distance Options to Support up to 80km
- ☑ Eye Safe (Class I Laser Safety)
- ☑ Duplex LC Optical Interface
- ☑ Loss of Signal Output & TX Disable Input
- ☑ -40°C to +85°C Operating Case Temperature Option
- ☑ Hot-pluggable
- ☑ Single +3.3V Power Supply

Absolute Maximum Ratings

Parameter		Symbol	Minimum	Maximum	Units
Storage Temperature		T_{ST}	- 40	+ 85	°C
Operating Case Temperature[1]	Commercial	T_{OP}	- 5	+ 70	°C
	Industrial		- 40	+ 85	
Supply Voltage		V_{CC}	0	+ 3.47	V
Input Voltage		V_{IN}	0	V_{CC}	V

[1] 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		B	125	-	1250	Mb/s
Optical Output Power[1]	EX	P_o	- 4.5	-	0	dBm
	YX		- 2.0	-	+ 3.0	
	ZX		0	-	+ 5.0	
Center Wavelength	EX	λ_c	1280	1310	1335	nm
	YX, ZX		1500	1550	1580	
Spectral Width (-20dB)	EX, YX, ZX	$\Delta\lambda_{20}$	-	-	1.0	nm
Side Mode Suppression Ratio	EX, YX, ZX	$SMSR$	30	-	-	dB
Extinction Ratio		P_{ht}/P_{lo}	9	-	-	dB
Deterministic Jitter		DJ	-	-	80	ps
Total Jitter		TJ	-	-	227	ps
Optical Rise/Fall Time (20% to 80%)		t_r ,t_f	-	-	0.32	ns
Relative Intensity Noise		RIN	-	-	-120	dB/Hz
Dispersion Penalty[2]	YX	-	-	-	1.2	dB
	ZX				1.5	
Optical Output Eye		Compliant with Eye Mask Defined in IEEE 802.3z standard				

[1] Measured average power coupled into single mode fiber (SMF).

[2] Specified at 1440ps/nm (YX) and 1600ps/nm (ZX) dispersion, which corresponds to the approximate worst-case dispersion for 70km and 80km G.652/G.654 fiber over the wavelength range of 1500 to 1580nm.

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			B	125	-	1250	Mb/s
Minimum Input Optical Power (10^{-12} BER)[1]		EX	P_{min}	- 22.5	-	-	dBm
		YX, ZX		- 24.0	-	-	
Maximum Input Optical Power (10^{-12} BER)[1]			P_{max}	- 3.0	-	-	dBm
LOS Thresholds	Increasing Light Input	EX	P_{los+}	-	-	- 22.5	dBm
		EX		-	-	- 22.5	
		YX, ZX		-	-	- 24.0	
	Decreasing Light Input	EX, YX, ZX	P_{los-}	- 35.0	-	-	
LOS Timing Delay	Increasing Light Input		t_loss_off	-	-	100	µs
	Decreasing Light Input		t_loss_on	-	-	100	
LOS Hysteresis			-	0.5	-	-	dB
Deterministic Jitter			DJ	-	-	170	ps
Total Jitter			TJ	-	-	266	ps
Wavelength of Operation			λ	1100	-	1600	nm
Optical Return Loss			ORL	12	-	-	dB
Electrical 3dB Upper Cutoff Frequency			-	-	-	1500	MHz
Stressed Receiver Sensitivity			Compliant with IEEE 802.3z standard				

[1]When measured with 2^7-1 PRBS at 125Mb/s, 1062.5Mb/s & 1250Mb/s and 1310nm for EX and 1550nm for YX & ZX.

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

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

[1] Differential peak-to-peak voltage.
[2] There is an internal 4.7 to 10kΩ pull-up resistor to VccT.
[3] 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-) [1]	V_{PP-DIF}	0.6	-	2.0	V
Output HIGH Voltage (LOS) [2]	V_{OH}	2.0	-	V_{CC} + 0.3	V
Output LOW Voltage (LOS) [2]	V_{OL}	0	-	0.5	V

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

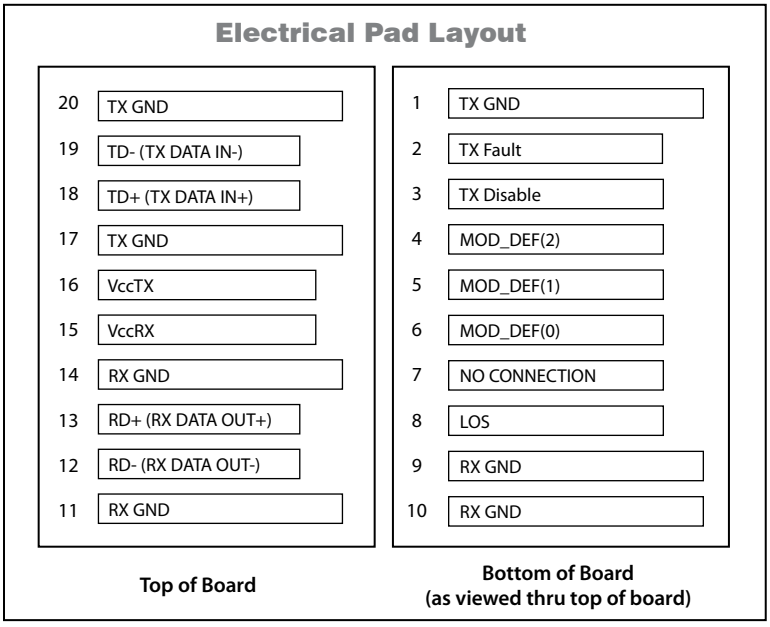
Electrical Power Supply Characteristics (Over Operating Case Temperature. V_{CC} = 3.13 to 3.47V)

Parameter		Symbol	Minimum	Typical	Maximum	Units
Supply Voltage		V_{CC}	3.13	3.3	3.47	V
Supply Current	EX, YX, ZX	I_{CC}	-	200	300	mA

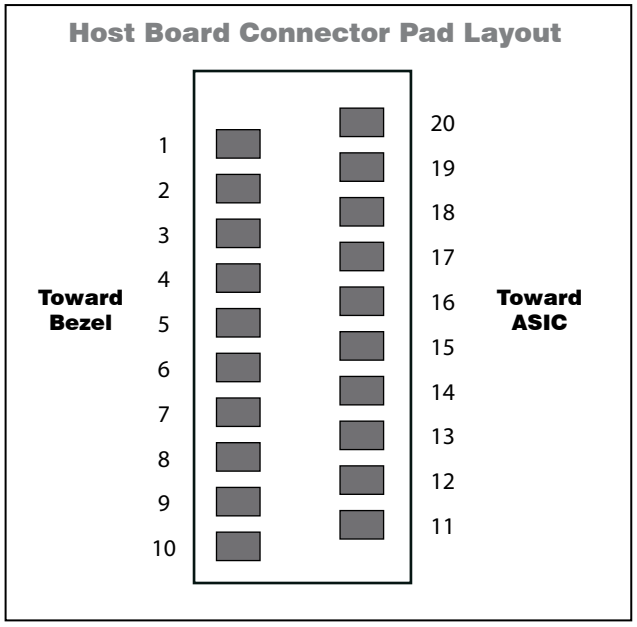
Module Definition

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

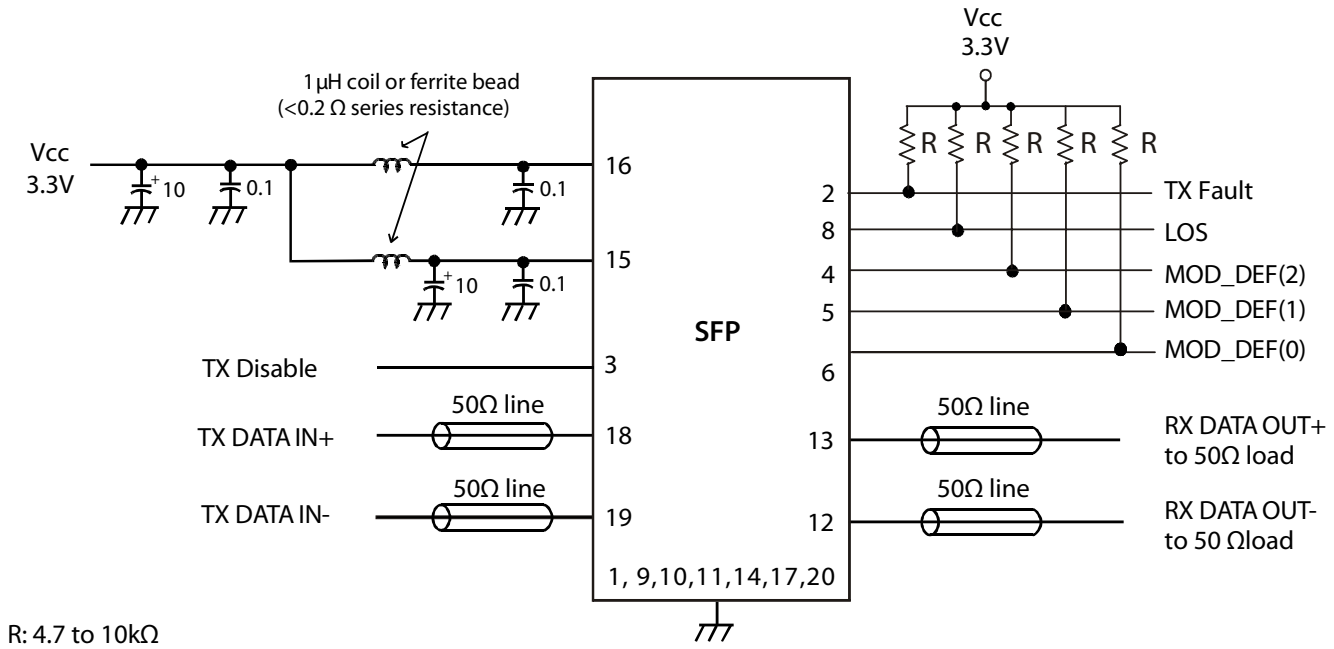
Electrical Pad Layout



Host Board Connector Pad Layout



Example of SFP Host Board Schematic



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 0.1µF 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 - 10kΩ 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 - 10kΩ resistor on the host board. TX Fault is non-latching (automatically deasserts when fault goes away).

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^2C 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 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. 9.4.

Power Supply and Grounding: The power supply line should be well-filtered. All 0.1µF power supply bypass capacitors should be as close to the transceiver module as possible.

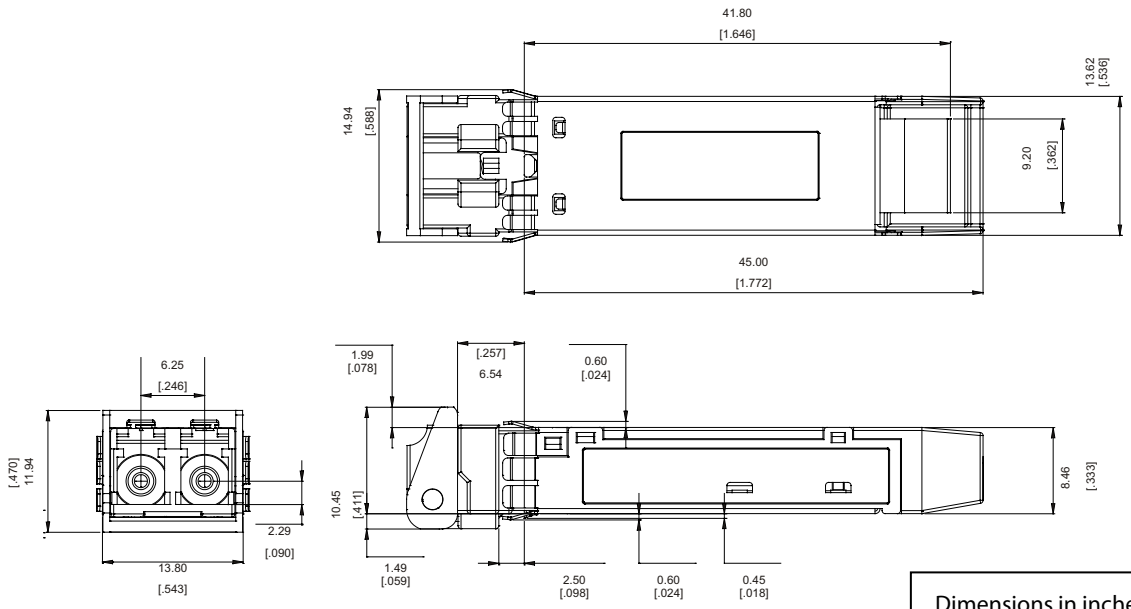
Laser Safety

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

Oplink Communications, Inc.
DATE OF MANUFACTURE:

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

Package Outline



Dimensions in inches [mm]
Default tolerances:
.xxx = ± .005", .xx = ± .01"

Ordering Information

Part Number	Type	Operating Temperature	Latch Color	Nominal Wavelength	Optical Link Power Budget [4]	Distance[1]
TRPEG1EEXC000E2G	EX	- 5°C to +70°C	Brown	1310nm	18dB	40km[2]
TRPEG1HYXC000E2G	YX	- 5°C to +70°C	Orange	1550nm	22dB	70km[3]
TRPEG1JZXC000E2G	ZX	- 5°C to +70°C	Green	1550nm	24dB	80km[3]
TRPEG1EEXI000E2G	EX	- 40°C to +85°C	Brown	1310nm	18dB	40km[2]
TRPEG1HYXI000E2G	YX	- 40°C to +85°C	Orange	1550nm	22dB	70km[3]
TRPEG1JZXI000E2G	ZX	- 40°C to +85°C	Green	1550nm	24dB	80km[3]

[1]The indicated transmission distance is for guidelines only, not guaranteed. The exact distance is dependent on the fiber loss, connector and splice loss, and allocated system penalty. Longer distances can be supported if the optical link power budget is satisfied.
[2]Assuming a total connector and splice loss of 2dB, total system penalty of 2dB and fiber cable loss of 0.35dB/km.
[3]Assuming a total connector and splice loss of 2dB, total system penalty of 2dB and fiber cable loss of 0.25dB/km.
[4]Minimum Optical Link Power Budget.

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