Multi-Rate Gigabit Ethernet & Fiber Channel SFP Transceivers with Digital Diagnostics

TRPUG1CLXx000E2G

Product Description

The TRPUG1-E2G SFP series of multi-rate fiber optic transceivers with integrated digital diagnostics monitoring functionality provide a quick and reliable interface for 1000BASE-LX Gigabit Ethernet and 1.062GBd Fiber 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.

The transceivers use a 1310nm Fabry Perot laser and provides a minimum optical link budget of 11dB, corresponding to a minimum distance of 10km, assuming fiber loss of 0.45dB/km. All modules satisfy Class 1 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 bail-type latches, which offer an easy and convenient way to release the modules. The latch is compliant with the SFP MSA. Latches are colored-coded to indicate the different wavelength.

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 operating case temperature ranges of -40°C to +85°C (Industrial), -5°C to +70°C (Commercial) or -5°C to +85°C (Extended) . The housing is made of metal for EMI immunity.



Features

- ☑ Compliant with IEEE 802.3ah Gigabit Ethernet 1000BASE-LX PMD Specifications
- ☑ Compliant with SFP MSA
- ☑ Lead Free Design & RoHS Compliant
- ☑ Digital Diagnostics through Serial Interface
- ☑ Internal Calibration for Digital Diagnostics
- ☑ Distance Options to Support 10km
- ☑ Eye Safe (Class 1 Laser Safety)
- ☑ Duplex LC Optical Interface
- ☑ Loss of Signal Output & TX Disable Input
- ☑ Wide Operating Case Temperature Option
- ☑ Hot-pluggable
- ☑ Single +3.3V Power Supply

Absolute Maximum Ratings

Parameter		Symbol	Minimum	Maximum	Units
Storage Temperature Range		T_{ST}	- 40	+ 85	°C
Operating Case Temperature [1]	Commercial	T_{OP}	- 5	+ 70	°C
	Extended		- 5	+ 85	
	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)

Parameter	Symbol	Minimum	Typical	Maximum	Units
Operating Data Rate	B	125	-	1250	Mb/s
Optical Output Power [1,2]	P_O	- 9.5	-	- 3.0	dBm
Center Wavelength	λ_C	1260	1310	1360	nm
Spectral Width (RMS)	$\Delta\lambda_{RMS}$	Refer to Table 59-4 and Figure 59-3 (from IEEE 802.3ah)			nm
Extinction Ratio	ER	9	-	-	dB
Deterministic Jitter	D_J	-	-	80	ps
Total Jitter	T_J	-	-	227	ps
Optical Rise/Fall Time (20% to 80%)	t_r, t_f	-	-	0.32	ns
Relative Intensity Noise	RIN	-	-	- 120	dB/Hz
Transmitter Output Eye	*Compliant with Telcordia GR-253-CORE and ITU-T Recommendation G.957*				

[1] Measured average power coupled into single mode fiber (SMF).
[2] For 50µm or 62.5µm multimode fiber (MMF) operation, the output power is 0.5dB less and is measured after a SMF offset-launch Mode-conditioning patch cord as specified in IEEE 802.3ah.

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

Parameter		Symbol	Minimum	Typical	Maximum	Units
Operating Data Rate		B	125	-	1250	Mb/s
Minimum Input Optical Power (10^{-12} BER) [1]		P_{min}	-	-	- 20.0	dBm
Maximum Input Optical Power (10^{-12} BER) [1]		P_{max}	- 3.0	-	-	dBm
LOS Thresholds	Increasing Light Input	P_{los+}	-	-	- 20.0	dBm
	Decreasing Light Input	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		D_J	-	-	170	ps
Total Jitter		T_J	-	-	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 802.3ah standard*				

[1] Measured with 2^7-1 PRBS at 125Mb/s, 1062.5Mb/s & 1250Mb/s and 1310nm

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

TÜVRheinland CERTIFIED
Type Approved
Safety
Regular Production
Surveillance
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c US

Oplink Communications, Inc.

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

Table 59–4—1000BASE-LX10 and 1000BASE-BX10 transmitter spectral limits

Center wavelength	RMS spectral width (max)[a]	RMS spectral width to achieve ε ≤0.115 (informative)
nm	nm	nm
1260	2.09	1.43
1270	2.52	1.72
1280	3.13	2.14
1286	3.50	2.49
1290		2.80
1297		3.50
1329		
1340		2.59
1343		2.41
1350	3.06	2.09
1360	2.58	1.76
1480 to 1500	0.88	0.60

[a] These limits for the 1000BASE-LX10 transmitter are illustrated in Figuare 59−3. Limits at intermediate wavelengths may be found by interpolation.

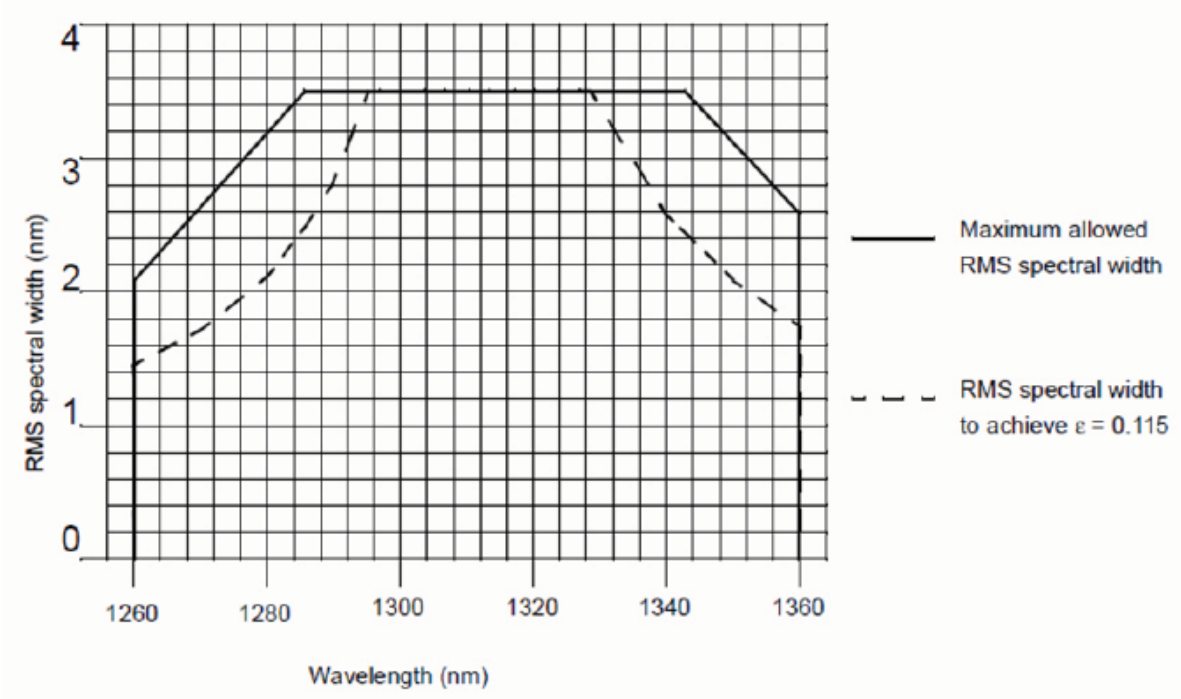


Figure 59–3—1000BASE-LX10 Transmitter spectral limits

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-) [1]	$V_{PP-DIFF}$	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 Characteristics (Over Operating Case Temperature. V_{CC} = 3.13 to 3.47V)

Parameter	Symbol	Minimum	Typical	Maximum	Units
Output Voltage Swing (RD+ & RD-) [1]	$V_{PP-DIFF}$	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).

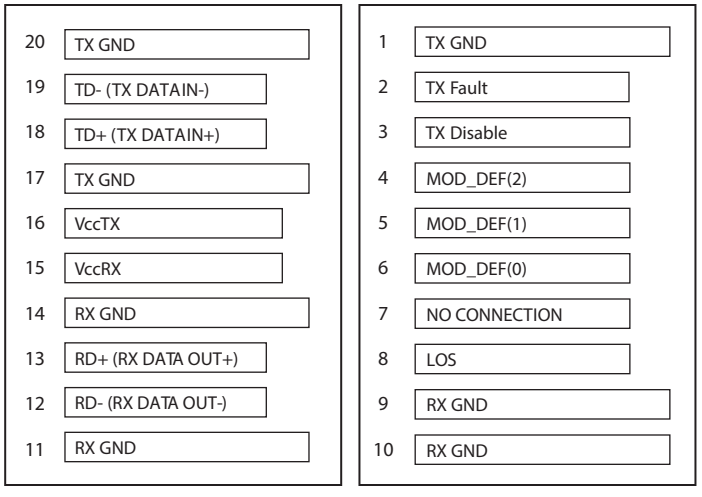
Electrical Power Supply Characteristics (Over Operating Case Temperature. V_{CC} = 3.13 to 3.47V)

Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply Voltage	V_{CC}	3.13	3.30	3.47	V
Supply Current	I_{CC}	-	190	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

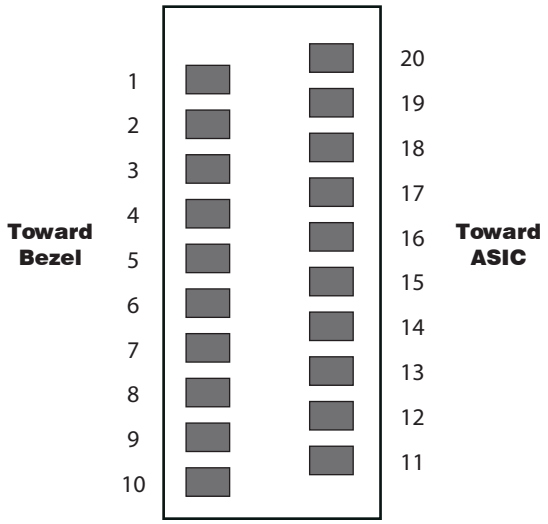
Electrical Pad Layout



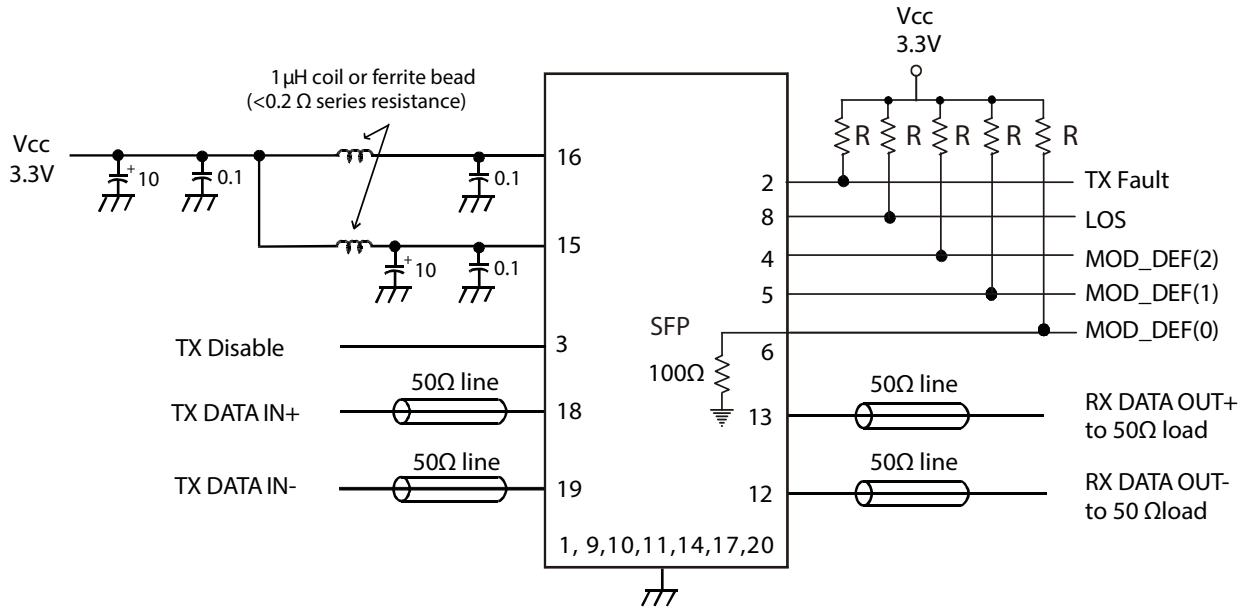
Top of Board

Bottom of Board
(as viewed thru top of board)

Host Board Connector Pad Layout



Example of SFP host board schematic



R: 4.7 to 10kΩ
CAP Values in µF

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 that 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).

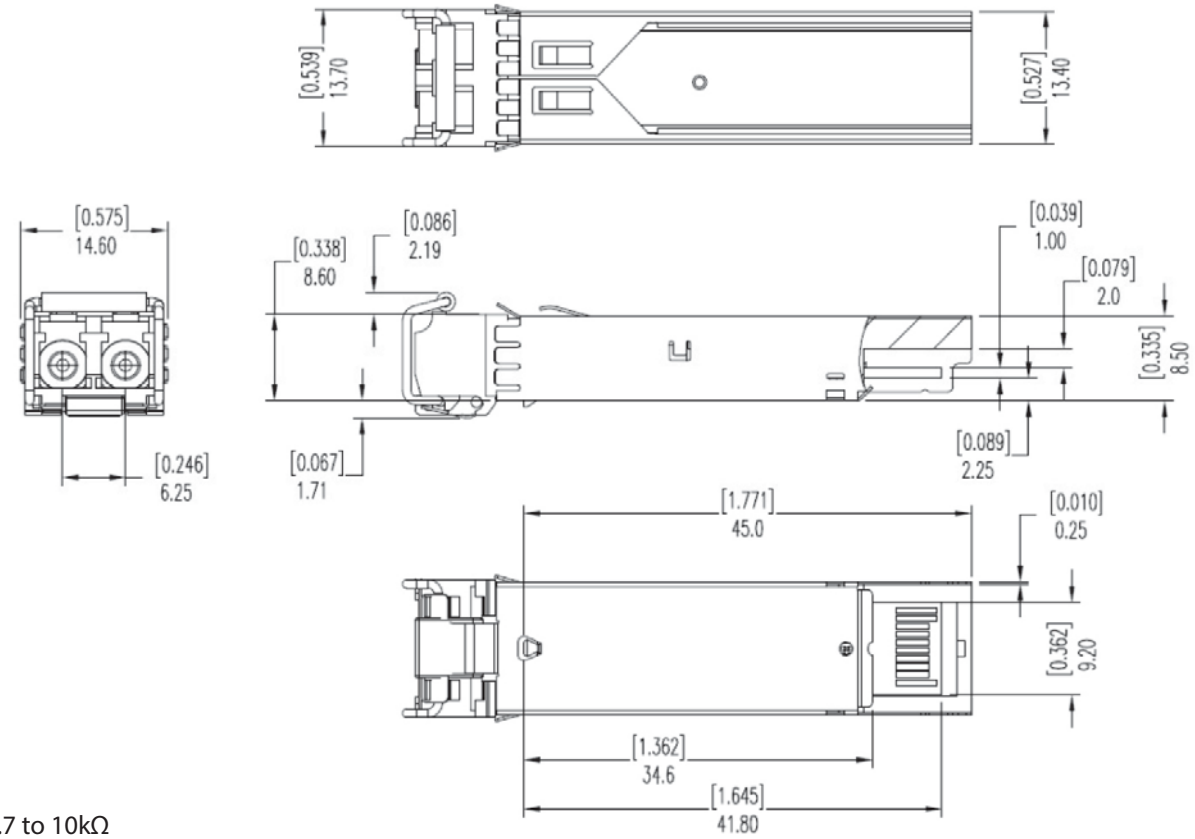
Serial Identification and Monitoring: The module definition of SFP is indicated by the three module definition pins, MOD_DEF(0), MOD_DEF(1) and MOD_DEF(2). Upon power up, MOD_DEF(1:2) appear as NC (no connection), and MOD_DEF(0) is TTL LOW. When the host system detects this condition, it activates the 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 startand 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 0.1µF power supply bypass capacitors should be as close to the transceiver module as possible.

Mechanical Package



R: 4.7 to 10kΩ
CAP Values in µF

Ordering Information

Oplink Part Number	Operating Temperature		Center Wavelength	Distance [1]	Latch Color
TRPUG1CLXC000E2G	- 5°C to +70°C	Commercial	1310nm	10km	Blue
TRPUG1CLXI000E2G	- 5°C to +85°C	Extended			
TRPUG1CLXE000E2G	- 40°C to +85°C	Industrial			

[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.

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46335 Landing Pkwy Fremont, CA 94538 Tel: (510) 933-7200 Fax: (510) 933-7300 Email: Sales@Oplink.com • www.oplink.com