

# SINGLE FIBER BI-DIRECTIONAL GIGABIT ETHERNET SFP TRANSCEIVERS WITH DIGITAL DIAGNOSTICS

## TRPBG1LX



### Product Description

The TRPBG1LX modules are single fiber, bi-directional SFP transceivers that provide a quick and reliable interface for 1000BASE-BX10-D/U Gigabit Ethernet applications. Two types of modules are available: the 1310nm Fabry Perot laser-based transceiver (BX10-U) and the 1490nm DFB laser-based transceiver (BX10-D). The transceivers are integrated with digital diagnostics monitoring, which provides features to detect a problem before system performance is impacted. The diagnostic functions, alarms and warning features are provided via an I<sup>2</sup>C serial interface as described per the Multi-Source Agreement (MSA) document, SFF-8472 (Rev. 9.4).

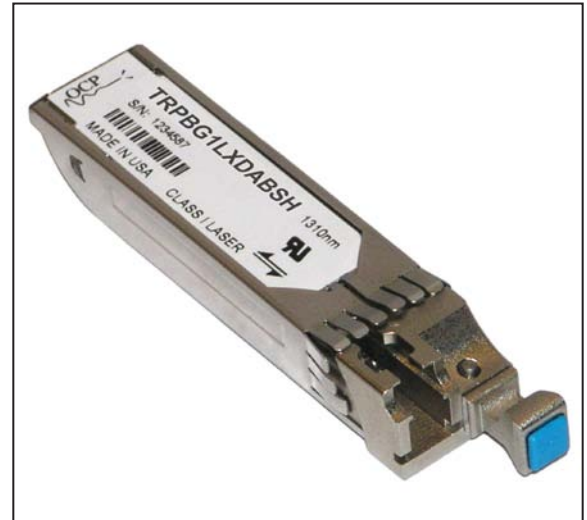
All modules meet Class I Laser Safety requirements in accordance with the U.S. and international standards as described in the FDA/CDRH and IEC-60825 documents, respectively. The TRPBG1LX transceivers connect to standard 20-pad SFP connectors for hot plug capability.

This allows the system designer to make configuration or maintenance changes by simply plugging in different types of transceivers without removing the power supply from the host system.

The transceivers have color-coded latches that identify the TX wavelength. The MSA compliant latch offers an easy and convenient way to release the module.

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 an operating case temperature range of -5°C to +70°C or -40°C to +85°C. The package is made of metal.



### Features

- Compatible with SFP MSA
- Compliant with IEEE 802.3ah Draft 3.3 Gigabit Ethernet 1000BASE-BX10 PMD Specifications
- Wavelengths of 1310nm and 1490nm
- Digital Diagnostics through Serial Interface
- Internal Calibration for Digital Diagnostics
- Distances up to 10km
- Eye Safe (Class I 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	$T_{ST}$	- 40	+ 85	°C
Operating Case Temperature <sup>1</sup>	Commercial	- 5	+ 70	°C
	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>			$B$	-	1250	-	Mb/s
Optical Output Power <sup>2</sup>			$P_O$	- 9.0	-	- 3.0	dBm
Center Wavelength	BX10-U	1310nm FP	$\lambda_c$	1260	1310	1360	nm
	BX10-D	1490nm DFB		1480	1490	1500	
Spectral Width (RMS)	BX10-U	1260 - 1280nm	$\Delta\lambda_{RMS}$	-	-	2.09	nm
		1281 - 1360nm		-	-	2.58	
Spectral Width (-20dB)	BX10-U	1480 - 1500nm	$\Delta\lambda_{20}$	-	-	0.88	dB
Extinction Ratio			$P_{hi}/P_{lo}$	6	-	-	dB
Optical Modulation Amplitude			$OMA$	- 8.2	-	-	dBm
Transmitter OFF Output Power			-	-	-	- 45	dBm
Relative Intensity Noise			$RIN_{12}OMA$	-	-	- 113	dB/Hz
Optical Return Loss Tolerance			$ORLT$	-	-	12	dB
Transmitter Reflectance			$TR$	-	-	- 12	dB
Deterministic Jitter			$DJ$	-	-	80	ps
Total Jitter			$TJ$	-	-	227	ps
Transmitter Output Eye			<i>Compliant with Eye Mask Defined in IEEE 802.3ah Standard</i>				

<sup>1</sup> Data rate ranges from 125Mb/s to 1300Mb/s. However, some degradation may be incurred in overall performance.  
<sup>2</sup> Measured average power coupled into single mode 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>			$P_{min}$	- 20.0	- 22.0	-	dBm
Maximum Input Optical Power ( $10^{-10}$ BER) <sup>2</sup>			$P_{max}$	- 3.0	-	-	dBm
Sensitivity as OMA <sup>3</sup>			$OMA$	- 18.7	-	-	dBm
LOS Thresholds	Increasing Light Input		$P_{los+}$	-	-	- 20.0	dBm
	Decreasing Light Input		$P_{los-}$	- 30.0	-	-	
LOS Hysteresis <sup>2</sup>			-	0.5	-	-	dB
Stressed Sensitivity			-	- 15.4	-	-	dBm
Stressed Sensitivity as OMA			-	- 14.6	-	-	dBm
Vertical Eye-Closure Penalty			-	2.6	-	-	dB
Deterministic Jitter			$DJ$	-	-	170	ps
Total Jitter			$TJ$	-	-	266	ps
Wavelength of Operation	BX10-D		$\lambda$	1260	-	1360	nm
	BX10-U			1480	-	1560	
Receiver Reflectance			-	-	-	- 12	dB
Electrical 3dB Upper Cutoff Frequency			-	-	-	1500	MHz

<sup>1</sup> Data rate ranges from 125Mb/s to 1300Mb/s. However, some degradation may be incurred in overall performance.  
<sup>2</sup> Measured at 1250Mb/s with  $2^7-1$  PRBS and 1310nm & 1490nm wavelengths.  
<sup>3</sup> Specified with minimum extinction ratio of 6dB.

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**

**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>	$V_{PP-DIF}$	0.25	-	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

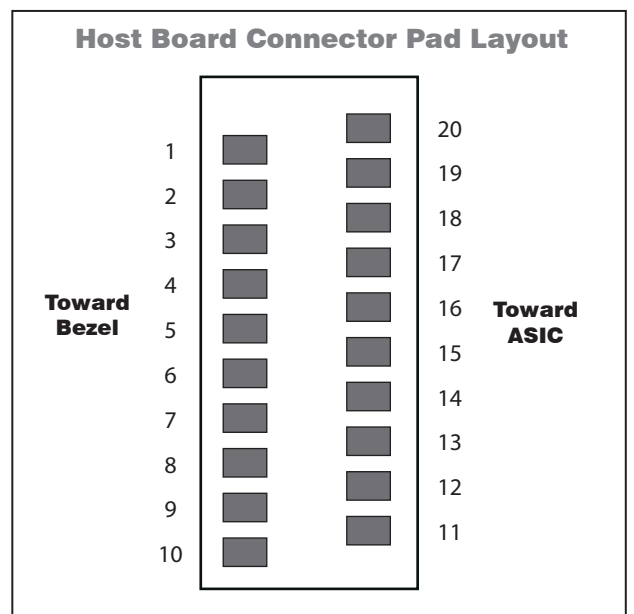
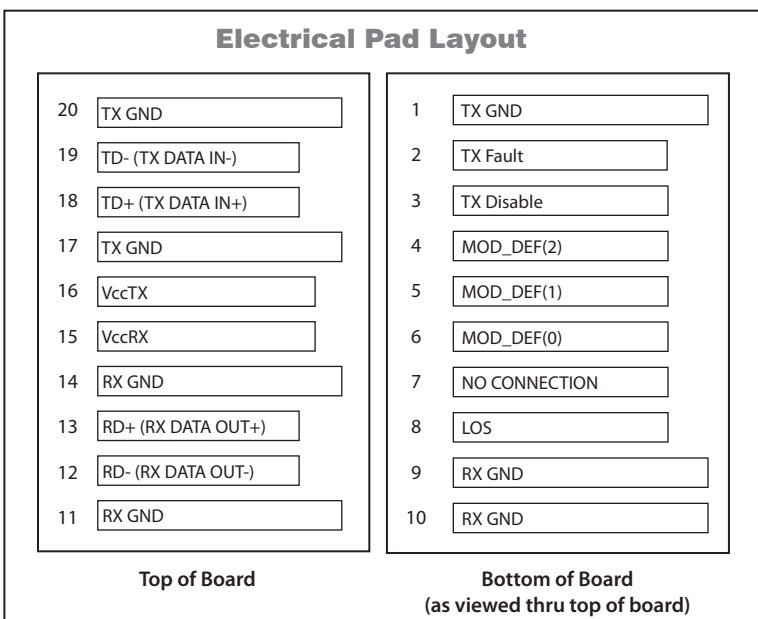
<sup>1</sup> Differential peak-to-peak voltage across external 100Ω load.  
<sup>2</sup> Open collector compatible, 4.7 to 10kΩ pull-up resistor to Vcc (Host Supply Voltage).

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

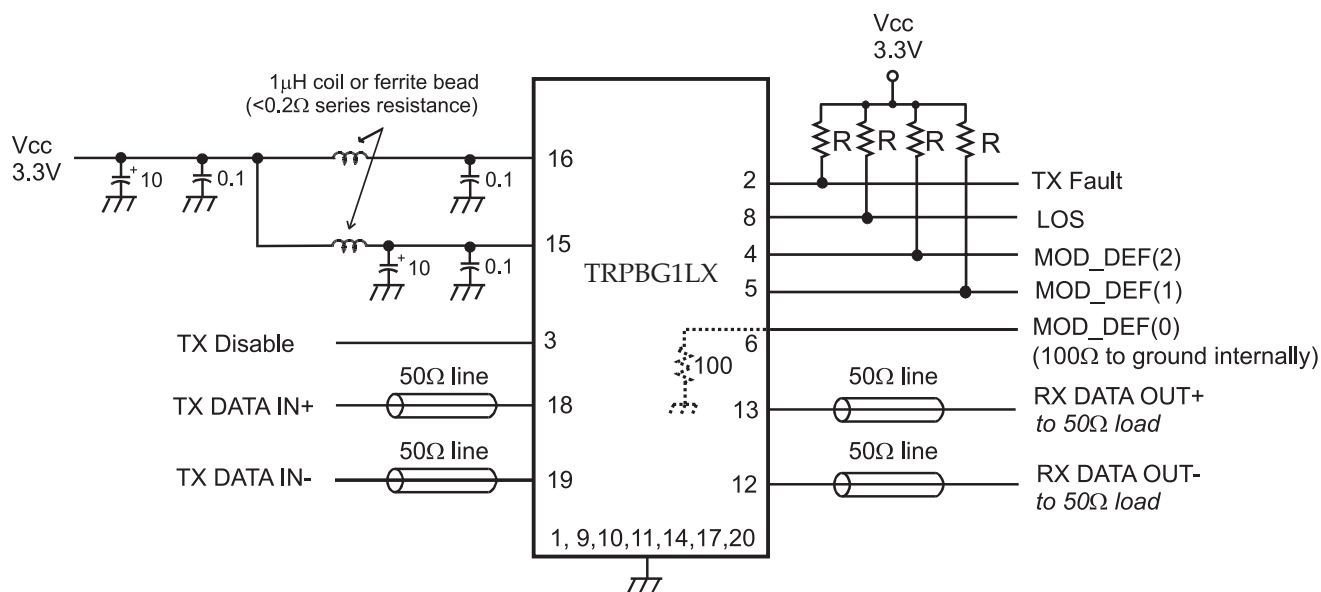
Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply Voltage	$V_{CC}$	3.13	3.3	3.47	V
Supply Current	Commercial	-	175	245	mA
	Industrial	-	175	285	

**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).

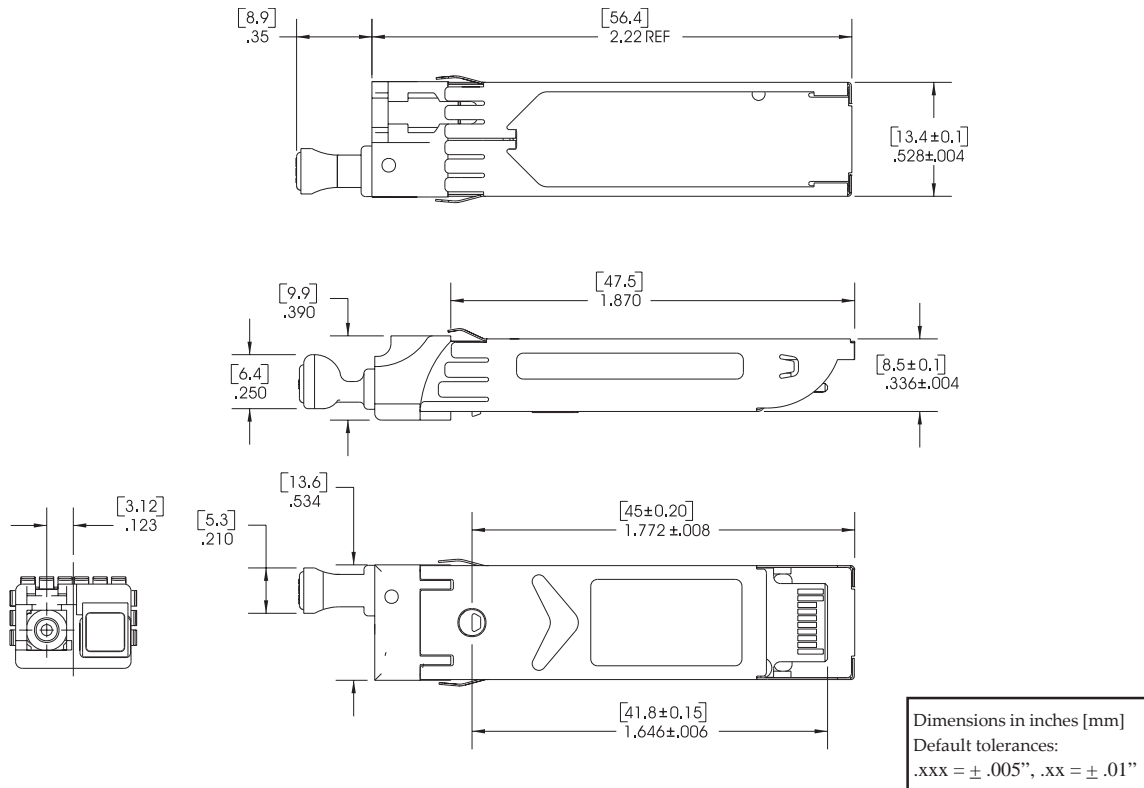
**Serial Identification and Monitoring:** The module definition of SFP is indicated by the three module definition pins, MOD\_DEF(0), MOD\_DEF(1) and MOD\_DEF(2).

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 SFP MSA, 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.

**Mechanical Package**

**Ordering Information**

Model Name		Temperature Range	Latch Color	Typical Wavelength		Distance
Oplink Order Number	Reference OCP P/N			Tx	Rx	
TRB2G1CB1C00000	TRPBG1LXDBBSH	- 5 °C to + 70°C	Blue	1310nm	1490nm	10km
TRB2G1CB2C00000	TRPBG1LXDVBVS2	- 10 °C to + 85°C	Violet	1490nm	1310nm	10km
TRB2G1CB1I00000	TRPBG1LXDABSH	- 40 °C to + 85°C	Blue	1310nm	1490nm	10km
TRB2G1CB2I00000	TRPBG1LXDVAVS2	- 40 °C to + 85°C	Violet	1490nm	1310nm	10km

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