

TRPUFEALXx000E1G

Fast Ethernet 100BASE-LX10 SFP
Single Mode Transceivers With Digital Diagnostics



Features

- ☑ Compliant with IEEE 802.3ah/D3.3 (100BASE-LX10)
- ☑ Compatible with SFP MSA
- ☑ RoHS6/6 Compliant
- ☑ Digital Diagnostics through Serial Interface
- ☑ External Calibration for Digital Diagnostics
- ☑ 1310nm Fabry Perot Laser Transmitter
- ☑ Distances up to 10km
- ☑ 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



Description

The TRPUFEALXx000E1G SFP series of fiber optic transceivers provide a quick and reliable interface for 100BASE-LX10 Fast Ethernet single mode applications. The transceivers are compliant with IEEE 802.3ah/D3.3 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 I²C serial interface. All transceiver 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.

The transmitter incorporates a highly reliable 1310nm InGaAsP 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.

Absolute Maximum Ratings

Parameters	Symbol	Min	Max	Units
Storage Temperature Range	T_{ST}	- 40	+ 85	°C
Case Operating Temperature ¹	Industrial	- 40	+ 85	°C
	Extended	- 5	+ 85	
	Commercial	- 5	+ 70	
Supply Voltage	V_{CC}	0	+ 4.5	V
Input Voltage	V_{in}	0	$V_{CC}+0.3$	V
Storage relative humidity	-	0	85	%RH
Sink	-	- 1	5	mA
Differential Input Voltage Swing (TD+, TD-)	-	-	2.5	V_{p-p}
Operating Relative Humidity	-	5	85	%RH

¹ Measured on top side of SFP module at the front center vent hole of the cage

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Transmitter Performance Characteristics (Over Operating Case Temperature, VCC =3.13 to 3.47V)

All parameters guaranteed only at typical data rate

Parameter	Symbol	Min	Typ	Max	Units
Operating Data Rate ¹	B	-	125	-	Mb/s
Optical Output Power ²	P_0	- 15.0	-	- 8.0	dBm
Center Wavelength	λ_C	1260	-	1360	nm
Spectral Width (RMS)	$\Delta \lambda_{RMS}$	-	-	7.7	nm
Optical Modulation Amplitude	OMA	- 14.8	-	-	dBm
Extinction Ratio	ER	5	-	-	dB
Optical Output Power of OFF Transmitter	P_{OFF}	-	-	- 45	dBm
Optical Return Loss Tolerance	$ORLT$	-	-	12	dB
Transmitter Dispersion Penalty ³	-	-	-	4.5	dB
Optical Output Eye	Compliant with IEEE 802.3ah/D3.3				
RIN OMA (max)	dB/Hz	-	-	- 110	dB/Hz
Available power budget	-	-	10	-	dB

¹ 4B/5B should work
² Measured average power coupled into single mode fiber
³ Decision timing offsets for transmitter and dispersion penalty(min) is $\pm 1.6ns$

Receiver Performance Characteristics (Over Operating Case Temperature, VCC =3.13 to 3.47V)

All parameters guaranteed only at typical data rate

Parameter	Symbol	Min	Typ	Max	Units
Operating Data Rate ¹	B	-	125	-	Mb/s
Receiver Sensitivity (10^{-12} BER) ²	P_{min}	-	-	- 25.0	dBm
Receiver Sensitivity as OMA	$P_{OMA,min}$	-	-	- 24.8	dBm
Maximum Input Optical Power (10^{-12} BER) ²	P_{max}	- 8.0	- 5.0	-	dBm
LOS Thresholds	Increasing Light Input	P_{los+}	-	- 25.5	dBm
	Decreasing Light Input	P_{los-}	- 45.0	- 26.0	
LOS Hysteresis ³	-	0.5	-	-	dB
Wavelength of Operation	λ	1100	-	1600	nm
Receiver Reflectance	-	-	-	- 12	dB
Stressed receive sensitivity	-	-	-	- 20.1	dBm
Stressed receiver sensitivity as OMA	-	-	-	- 19.9	dBm
Vertical eye-closure penalty	-	3.7	-	-	dB
Stressed eye jitter	-	0.25	-	-	Ulp-p
Jitter corner frequency	-	-	20	-	kHz
Sinusoidal jitter limits for stressed receiver conformance test	-	0.05	-	0.15	UI

¹ 4B/5B should work.
² 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.
³ When measured at 1310nm wavelength and 125Mb/s with 2^7-1 PRBS.

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

Parameter	Symbol	Min	Typ	Max	Units
Input Voltage Swing(TD+ & TD-) ¹	$V_{PP-DIFF}$	0.5	-	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
Input differential impedance	-	80	-	120	Ω
No.2 pin function	-	Not latched			-
Tx Power function	-	No Shutdown			-
Tx disable action (No.2 pin function)	-	Not Tx Fault indication			-

¹Differential peak-to-peak voltage.
²There is an internal 4.7 to 10 k Ω pull-up resistor to V_{CC}
³Open collector compatible, 4.7 to 10 k Ω pull-up resistor to V_{CC} (Host Supply Voltage)

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

Parameter	Symbol	Min	Typ	Max	Units
Output Voltage Swing(RD+ & RD-) ¹	$V_{PP-DIFF}$	0.4	-	1.2	V
Output HIGH Voltage (LOS) ²	V_{OH}	2.0	-	$V_{CC}+0.3$	V
Output Low Voltage (LOS) ²	V_{OL}	0	-	0.8	V
Data rise/Fall time	-	-	-	1.5	ns
LOS assert time	-	-	-	100	us
Los Output Action	-	No Squelch			-
LOS de-assert time	-	-	-	100	us

¹Differential peak-to-peak voltage across external 100 Ω load.
²Open collector compatible, 4.7 to 10 k Ω pull-up resistor to V_{CC} (Host Supply Voltage)

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

Parameter	Symbol	Min	Typ	Max	Units
Tx disable assert time	-	-	-	10	us
Tx disable negate time ¹	-	-	-	1	ms
Time to initialize, including reset of TX_Fault ³	-	-	-	300	ms
Tx fault assert time ²	-	-	-	100	us
Tx disable to reset ⁴	-	10	-	-	us
Serial ID clock rate	-	-	-	100	kHz

¹There should be no excess optical output power (M ax)
²Tx fault condition: The Tx fault \leq 100 us is defined from when MCU detecting Tx fault happened (By DDM or LDD IC) to Tx fault output pin set to "H" level.
³I2C communication is ready within 100ms.
⁴ Tx Disable Reset is considered in case of Tx Disable to be H after T1 detection time.

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

Parameter	Symbol	Min	Typ	Max	Units
Supply Voltage	V_{CC}	3.13	3.30	3.47	V
Supply Current	I_{CC}	-	175	245	mA
Input voltage	$V_{CC}T$	0	-	$V_{CC}T+0.3$	V
Sink current	-	- 1	-	6	mA
Power dissipation	PD	-	-	1	W
Inrush current	-	-	-	- 30	mA

Module Definition Interface

Parameter	Symbol	Min	Max	Units
MOD_DEF(1:2) input voltage (High)	-	2.0	$V_{CC}T$	V
MOD_DEF (1:2) input voltage (Low)	-	0	0.8	V
MOD_DEF (2) output voltage (High)	-	2.0	$V_{CC}T$	V
MOD_DEF (2) output voltage (Low)	-	0	0.8	V

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

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

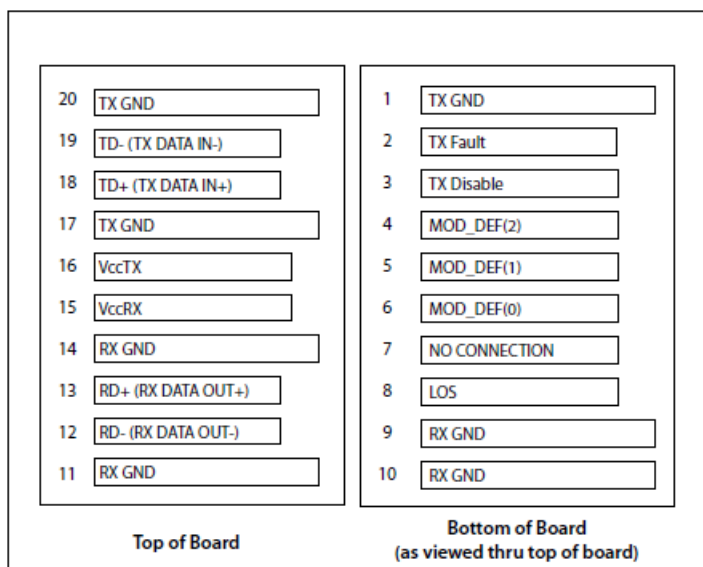


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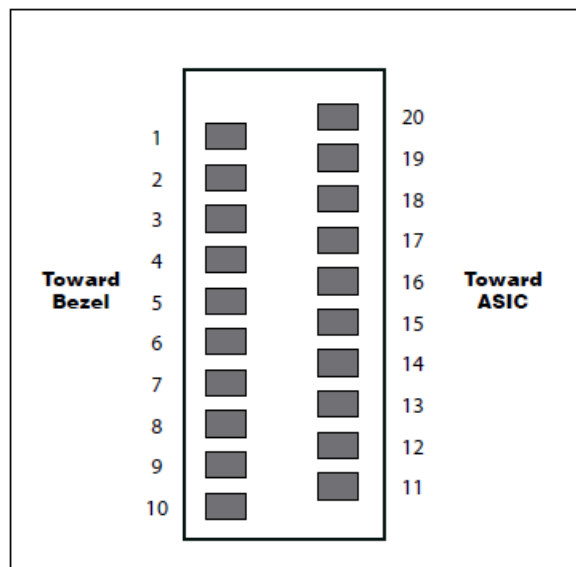
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Electrical Pad Layout

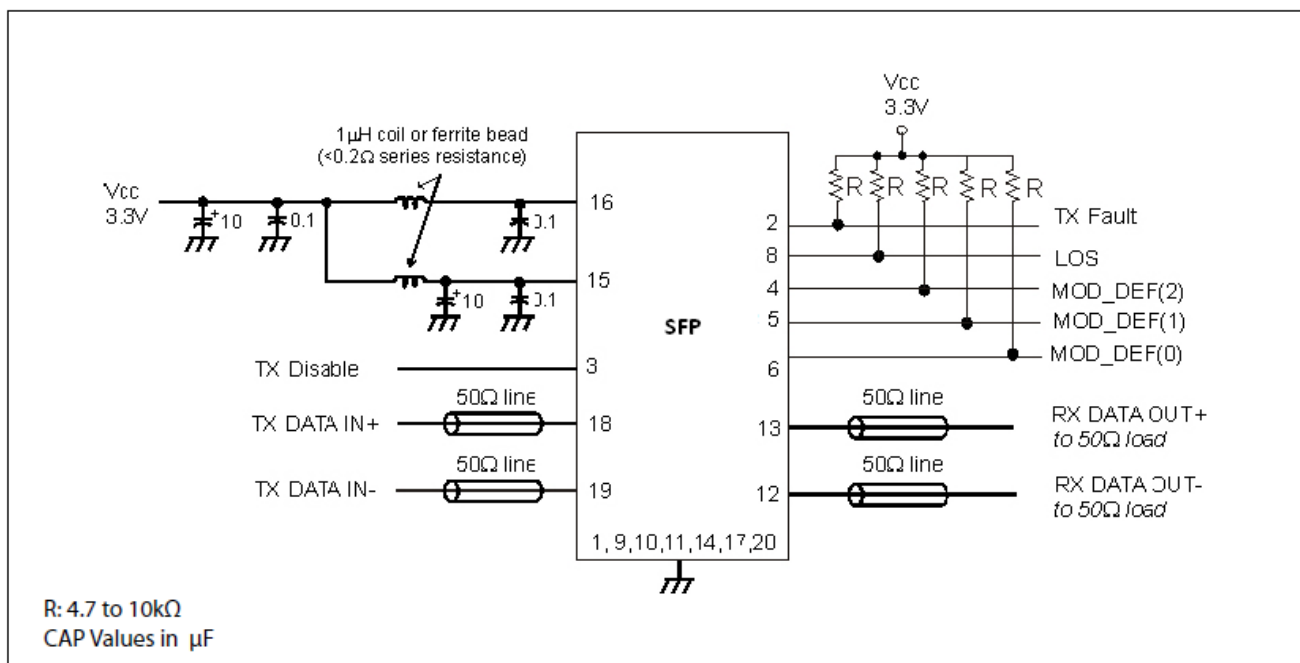


Host Board Connector Pad Layout



No.7 Pin: Prohibit to connect with user's internal circuit

Example of SFP host board schematic



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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 - 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 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 indicates TX Power and Bias, High or Low. 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 I²C 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. This device does not require clock stretching.

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 externally 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.

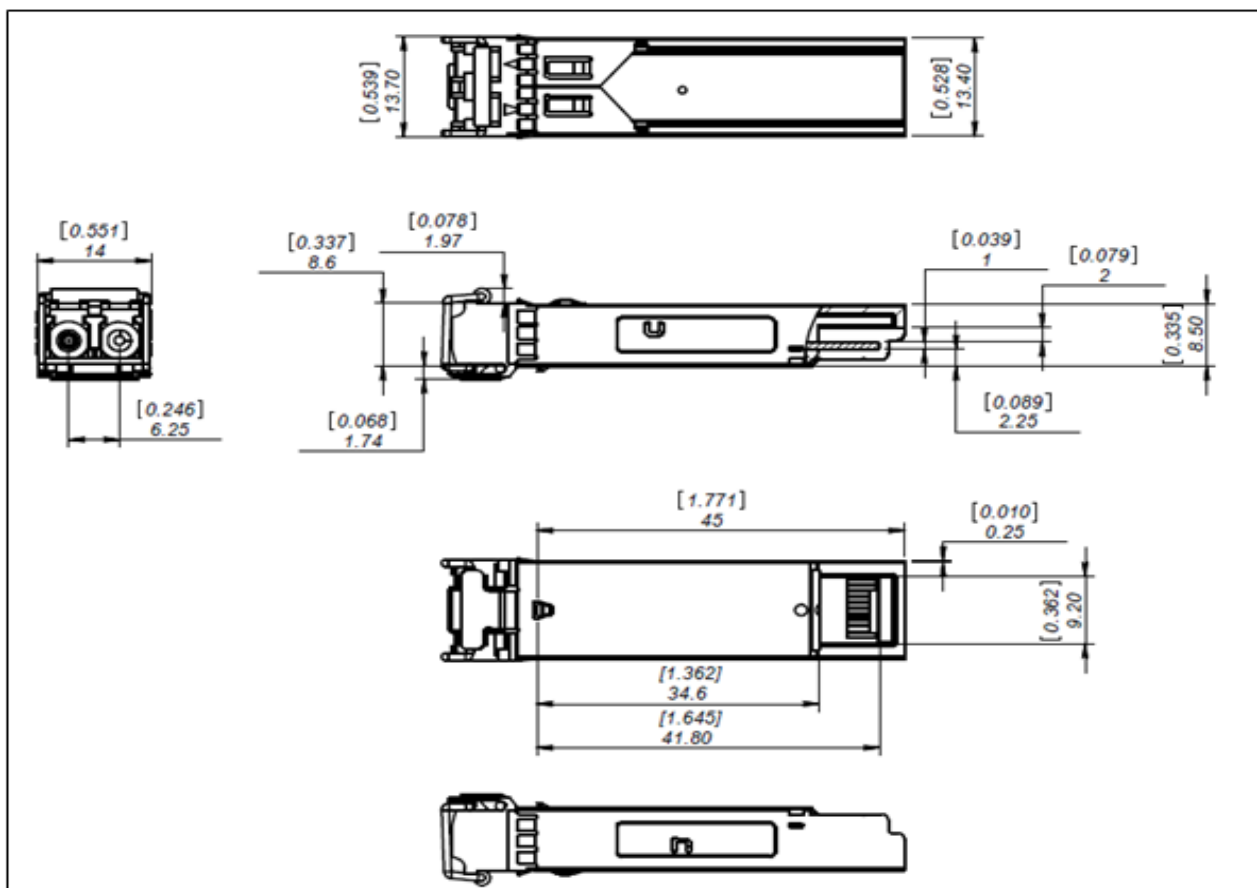
Power supply and grounding: The power supply line should be well-filtered. All 0.1μF power supply bypass capacitors should be as close to the transceiver module as possible.

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Package Outline



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

Ordering Information

Model Name	Operating Temperature	Nominal Wavelength	Distance	Latch Color
TRPUFEALXI000E1G	- 40C to +85C	1310nm	10km	Blue
TRPUFEALXE000E1G	- 5C to +85C	1310nm	10km	Blue
TRPUFEALXC000E1G	- 5C to +70C	1310nm	10km	Blue

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