

MULTI-RATE OC-12/STM-4 SFP TRANSCEIVERS WITH DIGITAL DIAGNOSTICS

TRPE12-E2 SM MULTI-RATE

Product Description

The TRPE12-E2 SM SFP series of multi-rate fiber optic transceivers with integrated digital diagnostics monitoring functionality provide a quick and reliable interface for OC-12 short reach (SR), intermediate reach (IR) and long reach (LR) applications. 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.

Available products under this series are compliant with SONET/SDH standards for OC-12/STM-4 applications and are capable of operating down to 155Mb/s data rate. The SR-1 and IR-1 versions are compliant with OC-12/STM-4 and OC-3/STM-1 interface standards. All modules satisfy 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 TRPE12-E2 SM multi-rate 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 shutting down the power supply of the host system.

The transceivers have colored bail-type latch, which offer an easy and convenient way to release the modules. The latch is compliant with the SFP MSA.

The transmitter design incorporates a highly reliable 1310nm or 1550nm 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. LVTTTL Transmitter Disable control input and Loss of Signal output interfaces are also provided.

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



Features

- Compliant with SONET/SDH OC-12/STM-4 (622Mb/s)
- Compatible with SONET/SDH OC-3/STM-1 (155Mb/s)
- Compatible with SFP MSA
- SONET/SDH Reaches (SR-1, IR-1, LR-1 & LR-2)
- Digital Diagnostics through Serial Interface
- Internal Calibration for Digital Diagnostics
- Eye Safe (Class I Laser Safety)
- Duplex LC Optical Interface
- 40°C to +85°C Operating Temperature Option
- Excellent EMI & ESD Protection
- 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 ¹	"COM"	- 5	+ 70	°C
	"IND"	- 40	+ 85	
Supply Voltage	V_{cc}	0	+ 5.0	V
Input Voltage	V_{in}	0	+ 5.0	V

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

TRPE12-E2 SINGLE MODE MULTI-RATE

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	-	622	Mb/s
Average Optical Output Power (coupled into single mode fiber), 50% duty cycle	SR-1 & IR-1	- 15.0	- 11.0	- 8.0	dBm
	LR-1 & LR-2	- 3.0	- 1.0	+ 2.0	
Transmitter OFF Output Power	P_{OFF}	-	-	- 45.0	dBm
Extinction Ratio	SR-1 & IR-1	8.2	-	-	dB
	LR-1 & LR-2	10	-	-	
Center Wavelength ¹	SR-1	1261	1310	1360	nm
	IR-1	1274	1310	1356	
		1293	1310	1334	
	LR-1	1280	1310	1335	
	LR-2	1480	1550	1580	
Spectral Width (RMS) ¹	SR-1	-	-	4.0	nm
	IR-1	-	-	2.5 or 4.0	
Spectral Width (-20dB)	LR-1 & LR-2	-	-	1.0	nm
Side Mode Suppression Ratio	LR-1 & LR-2	30	-	-	dB
Optical Output Eye	Compliant with Telcordia GR-253-CORE and ITU-T Recommendation G.957				
¹ For IR version, the center wavelength is either $1274nm \leq \lambda_c \leq 1356nm$ for $\Delta\lambda_{RMS} \leq 2.5nm$ or $1293nm \leq \lambda_c \leq 1334nm$ for $\Delta\lambda_{RMS} \leq 4.0nm$					

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	-	622	Mb/s
Receiver Sensitivity (10^{-10} BER) ¹	P_{min}	- 28.0	- 31.0	-	dBm
Maximum Input Optical Power (10^{-10} BER) ¹	P_{max}	- 7.0	- 3.0	-	dBm
LOS Thresholds ¹	Increasing Light Input	P_{los+}	-	- 28.0	dBm
	Decreasing Light Input	P_{los-}	- 45.0	-	
LOS Timing Delay	Increasing Light Input	t_{loss_off}	-	100	μs
	Decreasing Light Input	t_{loss_on}	2.3	100	
LOS Hysteresis	-	0.5	2.0	-	dB
Wavelength of Operation	λ	1100	-	1600	nm
Receiver Reflectance (LR-2)	-	-	-	- 27.0	dB
¹ Specified in average optical input power and measured at 155Mb/s & 622Mb/s and 1310nm wavelength (1550nm for LR-2) with $2^{23}-1$ PRBS, and at 125Mb/s with 2^7-1 PRBS.					

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 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}	0.25	-	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

¹Differential peak-to-peak voltage.

²There is an internal 4.7 to 10kΩ pull-up resistor to $V_{CC}T$.

³Open collector compatible, 4.7 to 10kΩ 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	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

¹Differential peak-to-peak voltage across external 100Ω load.

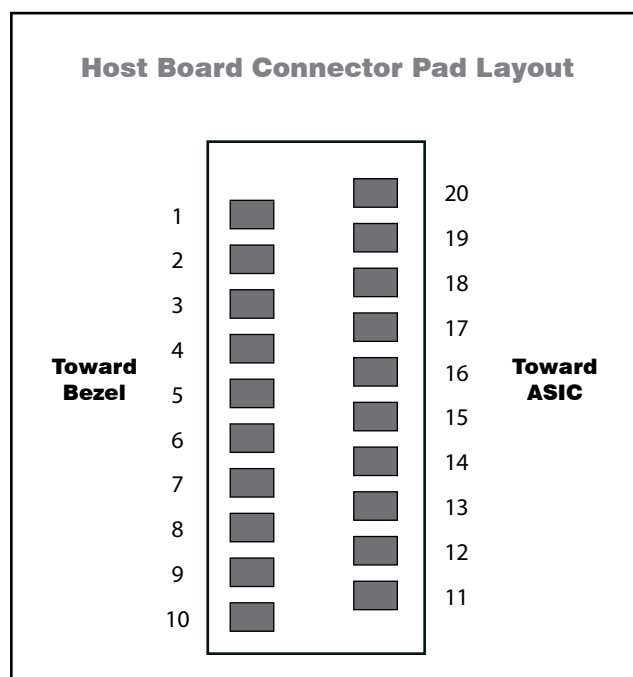
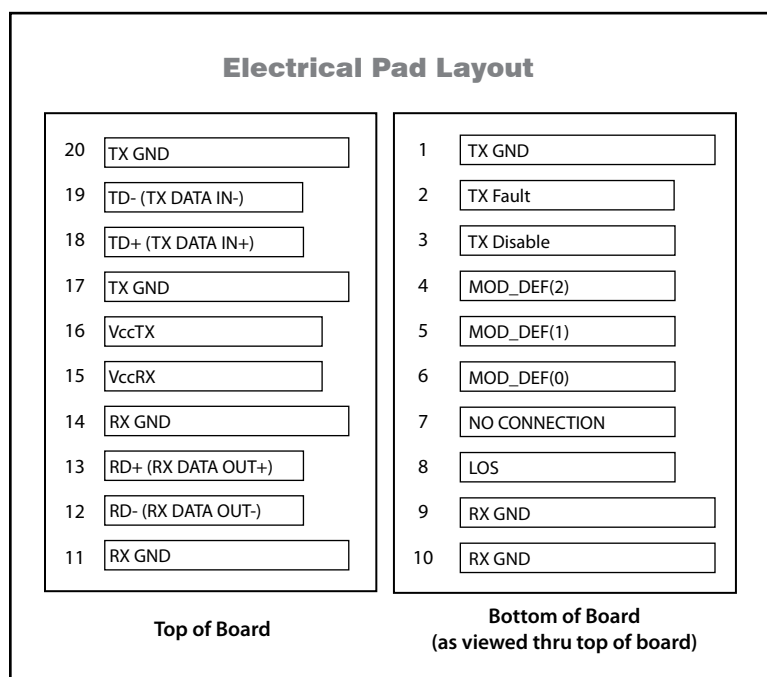
²Open collector compatible, 4.7 to 10kΩ pull-up resistor to V_{CC} (Host Supply Voltage).

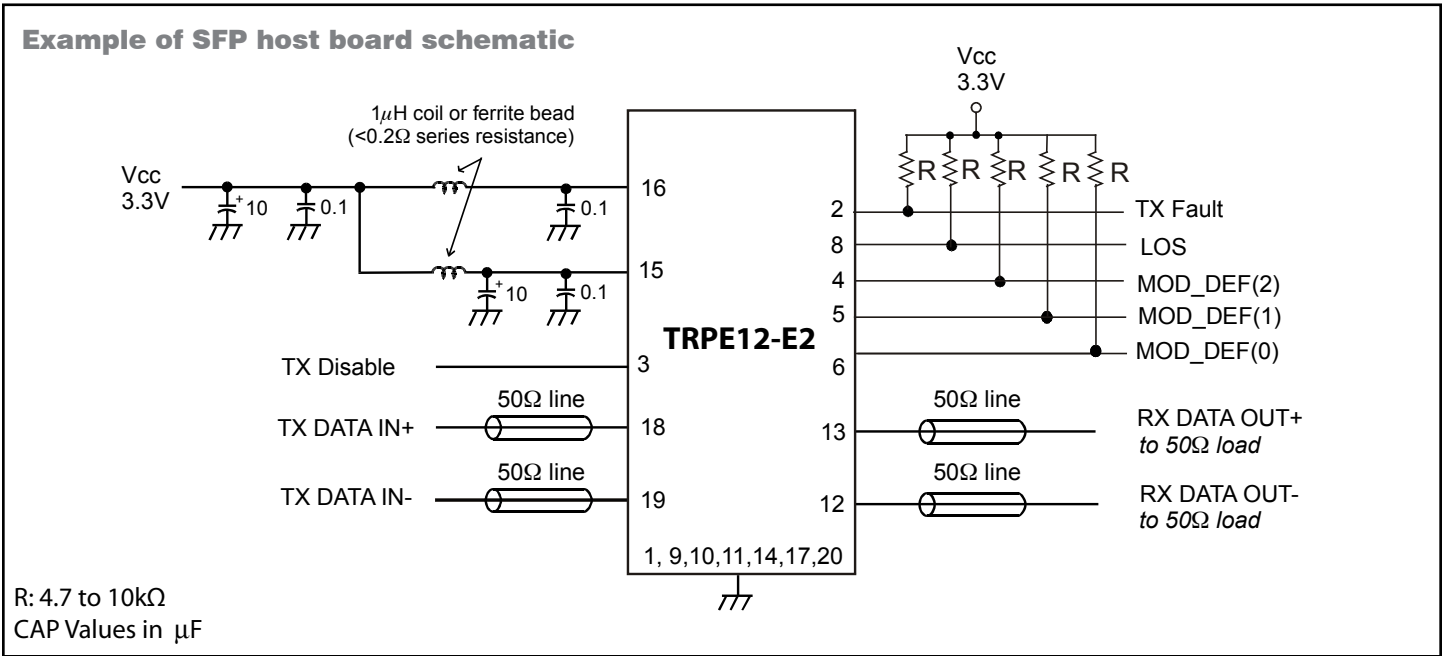
Electrical Power Supply Characteristics (Over Operating Case Temperature, $V_{CC} = 3.13$ to $3.47V$)

Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply Voltage	V_{CC}	3.13	3.3	3.47	V
Supply Current	I_{CC}	-	190	220	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





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 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)

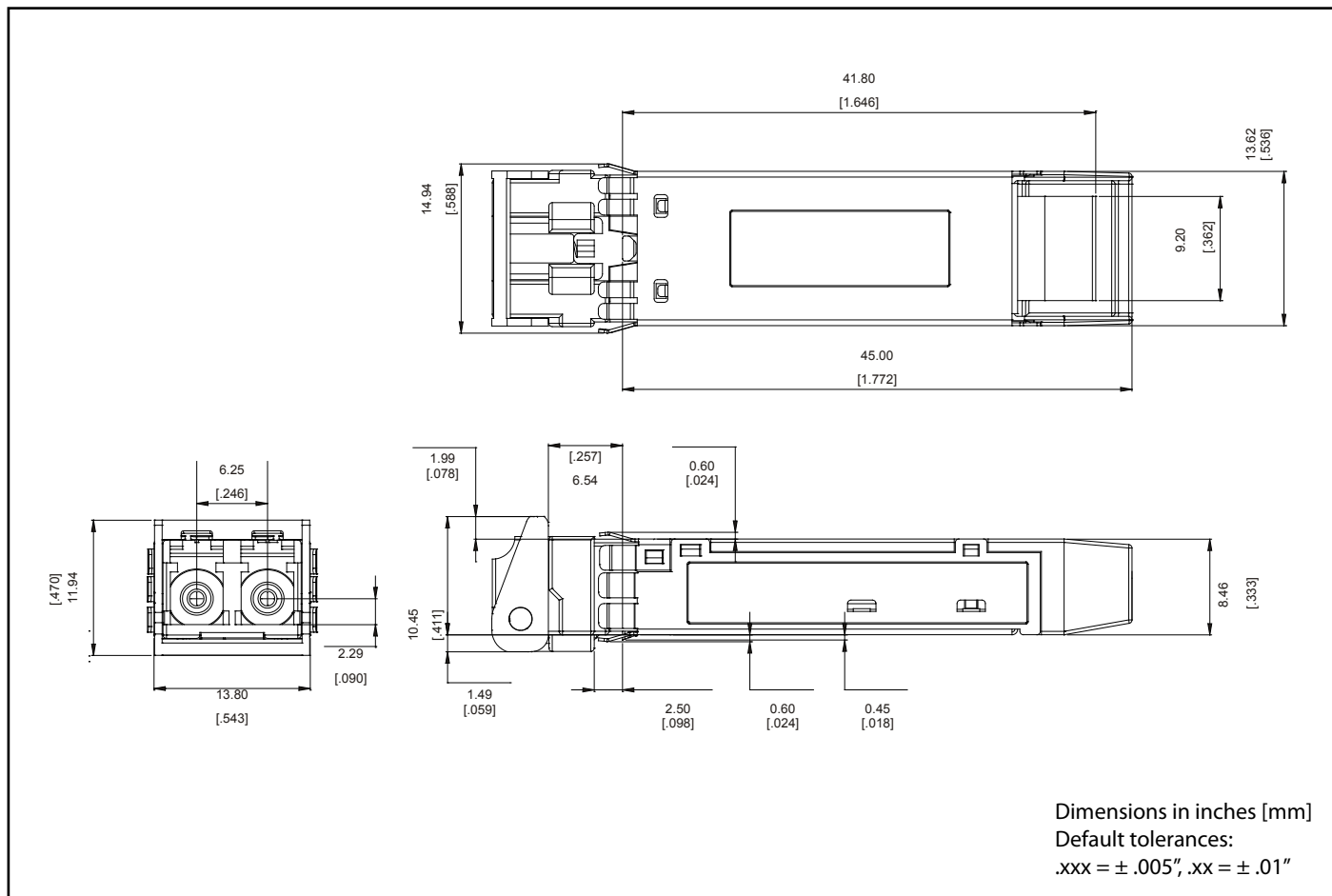
is TTL LOW. When the host system detects this condition, it activates the serial protocol (standard two-wire I²C serial interface) and generates the serial clock signal (SCL). The positive edge clocks data into the EEPROM segments of the SFP that are not write protected and the negative edge clocks data from the SFP.

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.

Package Outline



Ordering Information

Part Number	Operating Temperature	Latch Color	Nominal Wavelength	SONET/SDH Standards	Distance ¹
TRPE12AS1C000E2	- 5°C to +70°C	Gray	1310nm	SR-1/I-4	12/2km
TRPE12AI1C000E2	- 5°C to +70°C	Yellow	1310nm	IR-1/S-4.1	21/15km
TRPE12GL1C000E2	- 5°C to +70°C	Red	1310nm	LR-1/L-4.1	42/40km
TRPE12GL2C000E2	- 5°C to +70°C	White	1550nm	LR-2/L-4.2	85/80km
TRPE12AS1I000E2	- 40°C to +85°C	Gray	1310nm	SR-1/I-4	12/2km
TRPE12AI1I000E2	- 40°C to +85°C	Yellow	1310nm	IR-1/S-4.1	21/15km
TRPE12GL1I000E2	- 40°C to +85°C	Red	1310nm	LR-1/L-4.1	42/40km
TRPE12GL2I000E2	- 40°C to +85°C	White	1550nm	LR-2/L-4.2	85/80km

¹These are target distances to be used for classification and not for specification, per Telcordia GR-253-CORE/ITU-T Recommendation G.957.