OC-3/STM-1 SFP
Transceivers with Digital Diagnostics

TRPE03-E1 Single Mode

Product Description

The TRPE03-E1 SFP series of fiber optic transceivers with integrated digital diagnostics monitoring functionality provide a quick and reliable interface for 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 I^2C serial interface.

Available products under this series are compliant with applicable SONET/SDH standards for OC-3/STM-1. All modules satisfy Class I Laser Safety requirements in accordance with the U.S. FDA/CDRH and international IEC-60825 standards.

The TRPE03-E1 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 design incorporates a highly reliable 1310nm or 1550nm InGaAsP laser and a 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. LVTTL 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

- ☑ Compatible with SFP MSA
- ☑ Compliant with SONET/SDH OC-3/STM-1 (155Mb/s)
- ☑ 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 Case 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"	T_{op}	- 5	+ 70	°C
	"IND"		- 40	+ 85	
Supply Voltage		V_{cc}	0	+ 5.0	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[1]		B	-	156	-	Mb/s
Average Optical Output Power (coupled into single mode fiber), 50% duty cycle	IR-1	P_O	- 15.0	- 11.0	- 8.0	dBm
	LR-1 & LR-2		- 5.0	- 3.0	0	
Extinction Ratio		P_{hi}/P_{lo}	10	-	-	dB
Center Wavelength	IR-1	λ_c	1261	1310	1360	nm
	LR-1		1270	1310	1360	
	LR-2		1480	1550	1580	
Spectral Width (RMS)	IR-1 & LR-1	$\Delta\lambda_{RMS}$	-	-	3	nm
Spectral Width (-20dB)	LR-2	$\Delta\lambda_{20}$	-	-	1	nm
Side Mode Suppression Ratio	LR-2	$SMSR$	30	-	-	dB
Optical Output Eye	Compliant with Telcordia GR-253-CORE and ITU-T Recommendation G.957					

[1]Data rate ranges from 50Mb/s to 266Mb/s. However, some degradation may be incurred in overall performance.

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[1]		B	-	156	-	Mb/s
Receiver Sensitivity (10^{-10} BER)[2]		P_{min}	- 34.0	- 36.0	-	dBm
Maximum Input Optical Power (10^{-10} BER)[2]		P_{max}	- 7.0	0	-	dBm
LOS Thresholds	Increasing Light Input	P_{los+}	-	-	- 34.0	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	1.5	-	dB
Wavelength of Operation		λ	1100	-	1600	nm
Receiver Reflectance (LR-2 only)		-	-	-	- 25.0	dB

[1]Data rate ranges from 50Mb/s to 266Mb/s. However, some degradation may be incurred in overall performance.
[2]Specified in average optical input power and measured with 2^{23}-1 PRBS at 156Mb/s and 1310nm for IR-1& LR-1, and 1550nm for LR-2.

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

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]	$V_{PP\text{-}DIF}$	0.35	-	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]	$V_{PP\text{-}DIF}$	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).

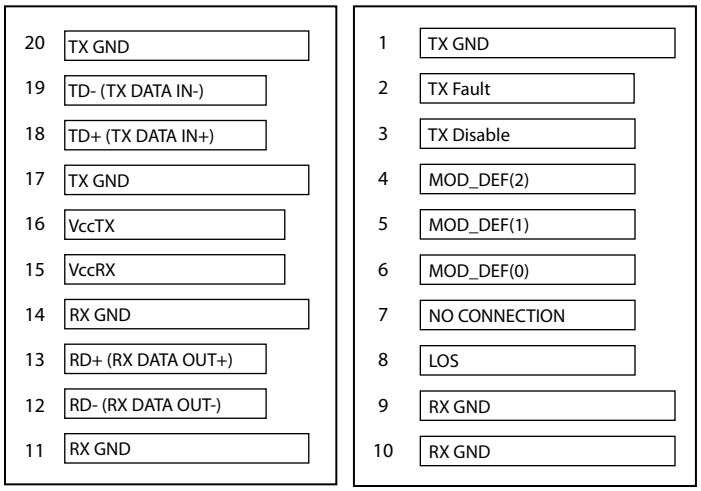
Electrical Power Supply Characteristics (Over Operating Case Temperature, V_{CC} = 3.13 to 3.47V)

Parameter		Symbol	Minimum	Typical	Maximum	Units
Supply Voltage		V_{CC}	3.13	3.3	3.47	V
Supply Current	OC-3 (IR-1, LR-1)	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

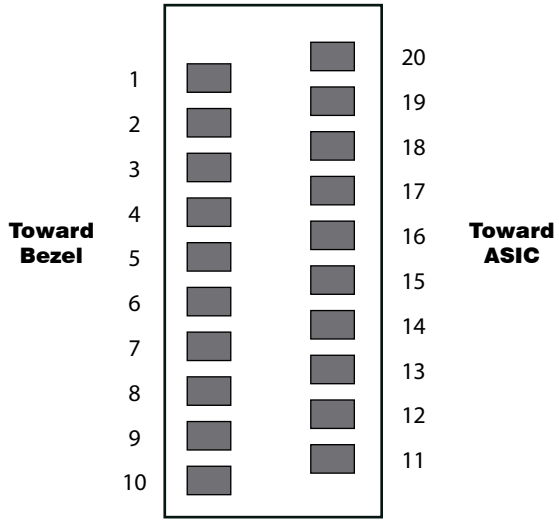
Electrical Pad Layout



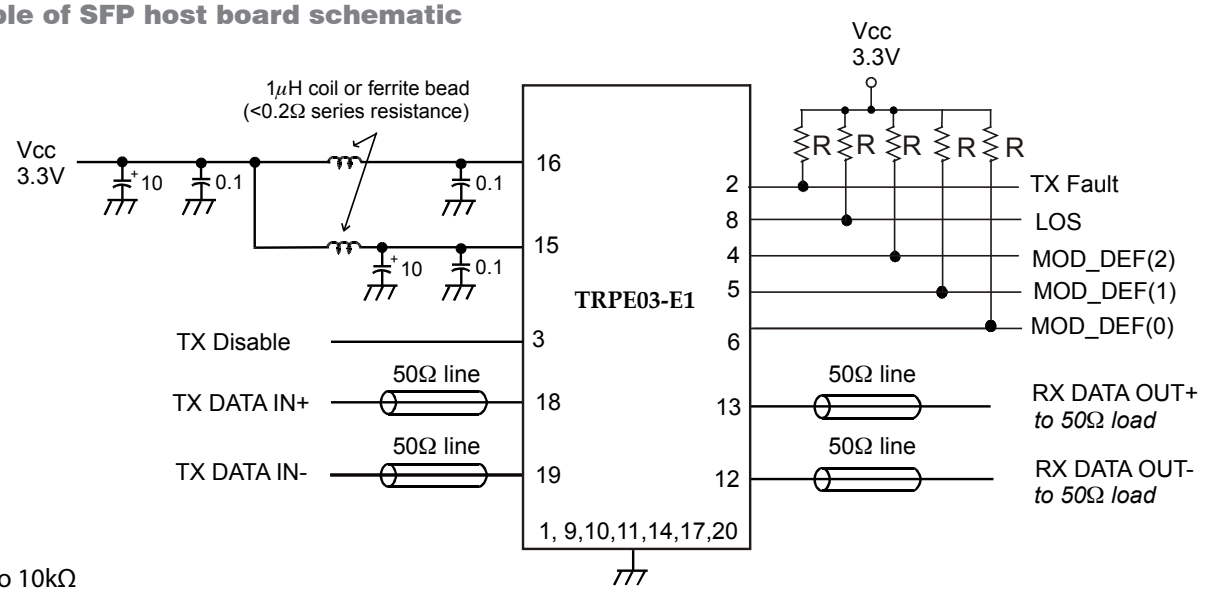
Top of Board

Bottom of Board
(as viewed thru top of board)

Host Board Connector Pad Layout



Example of SFP host board schematic



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).

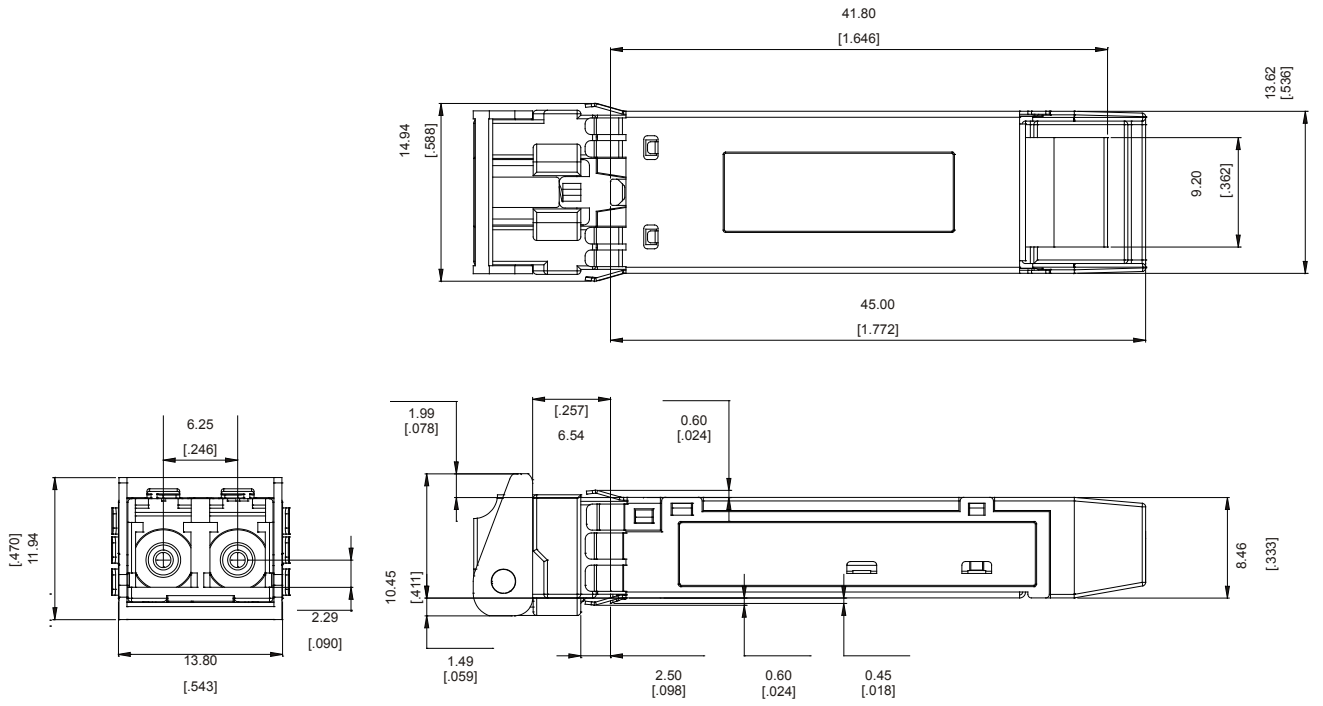
Serial Identification and Monitoring: The module definition of SFP is indicated by the three module definition pins, MOD_DEF(0), MOD_DEF(1) and MOD_DEF(2). Upon power up, MOD_DEF(1:2) appear as NC (no connection), and MOD_DEF(0) is TTL LOW. When the host system detects this condition, it activates the serial protocol (standard two-wire 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.

Package Outline



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

Ordering Information

Part Number	Operating Temperature	Latch Color	Nominal Wavelength	SONET/SDH Standards	Distance[1]
TRPE03AI1C000E1[2]	- 5°C to +70°C	Yellow	1310nm	IR-1/S-1.1	21/15km
TRPE03EL1C000E1	- 5°C to +70°C	Red	1310nm	LR-1/L-1.1	50/40km
TRPE03EL2C000E1	- 5°C to +70°C	White	1550nm	LR-2/L-1.2	100/80km
TRPE03AI1I000E1[2]	- 40°C to +85°C	Yellow	1310nm	IR-1/S-1.1	21/15km
TRPE03EL1I000E1	- 40°C to +85°C	Red	1310nm	LR-1/L-1.1	50/40km
TRPE03EL2I000E1	- 40°C to +85°C	White	1550nm	LR-2/L-1.2	100/80km

[1]These are target distances to be used for classification and not for specification, per Telcordia GR-253-CORE/ITU-T Recommendation G.957.
[2]The TRPE03AI1C000E1 and TRPE03AI1I000E1 can also be used for short reach SR-1/I-1 applications.

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