

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

TRPU12XXXX000E2G



Product Description

The TRPC12-E2G 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 1 Laser Safety requirements in accordance with the U.S. and international standards as described in the FDA/CDRH and IEC-60825 documents, respectively.

The TRPC12-E2G 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 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 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 operating case temperature ranges of -5°C to +70°C (COM), -40°C to +85°C (IND) or -5°C to +85°C (EXT). The housing is made of metal for EMI immunity.



Features

- Compliant with SONET/SDH OC-12/STM-4(622Mb/s)
- Compliant with SONET/SDH OC-3/STM-1(155Mb/s)
- Compliant 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 1 Laser Safety)
- Duplex LC Optical Interface
- Wide Operating Case Temperature Option
- Excellent EMI & ESD Protection
- Hot-pluggable
- TX Fault & Loss of Signal Outputs
- TX Disable Input
- Single +3.3V Power Supply
- RoHs Compliant

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	+ 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.

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	-	- 8.0	dBm
	LR-1 & LR-2	- 3.0	-	+ 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 $1274 \leq \lambda_C \leq 1356nm$ for $\lambda_{CRMS} \leq 2.5nm$ or $1293 \leq \lambda_C \leq 1334nm$ for $\lambda_{CRMS} \leq 4.0nm$					

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	dBm
Maximum Input Optical Power (10^{-10} BER) ¹	P_{max}	- 7.0	-	-	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	-	-	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 1 Laser products per FDA/CDRH and IEC-60825 standards. They must be operated under specified operating conditions.

**Oplink Communications, Inc.**

This product complies with
21 CFR 1040.10 and 1040.11
Meets Class 1 Laser Safety Requirements

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	$V_{PP-DIFF}$	0.25	-	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

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

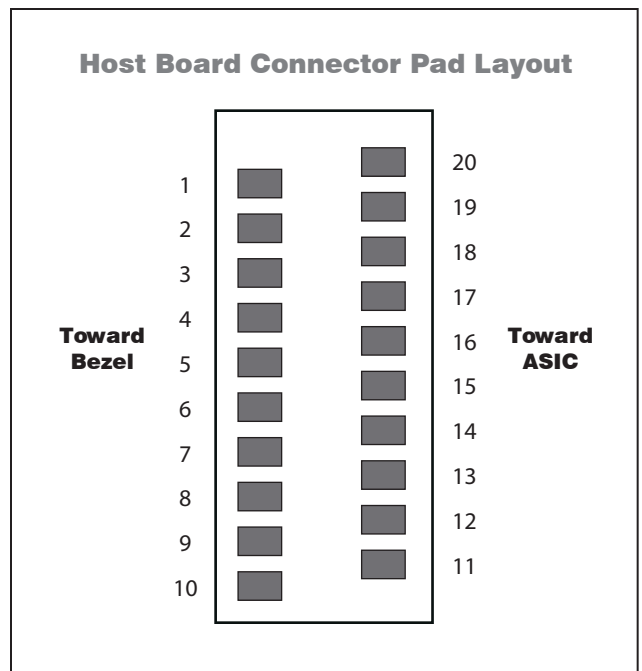
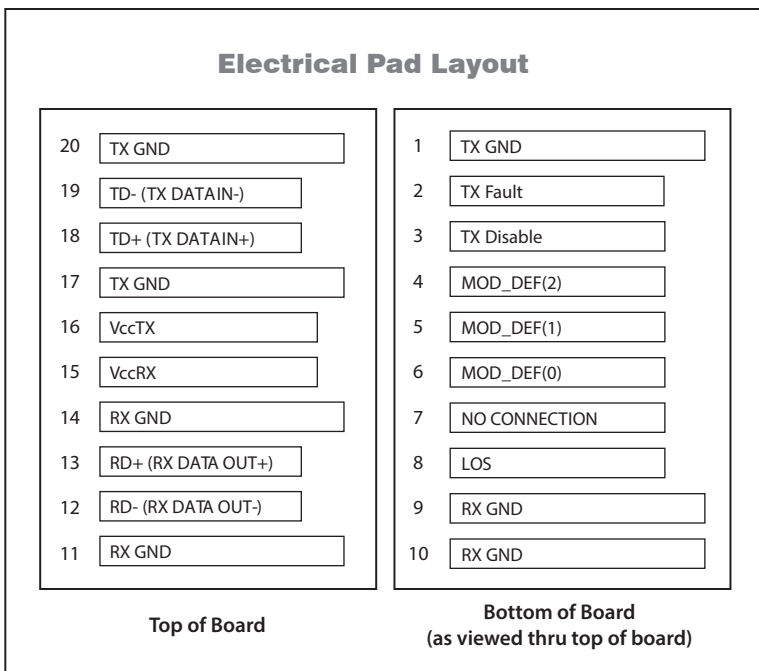
¹ Differential peak-to-peak voltage across external 100Ω load.
² Open collector compatible, 4.7 to 10kΩ pull-up resistor to Vcc (Host Supply Voltage).

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

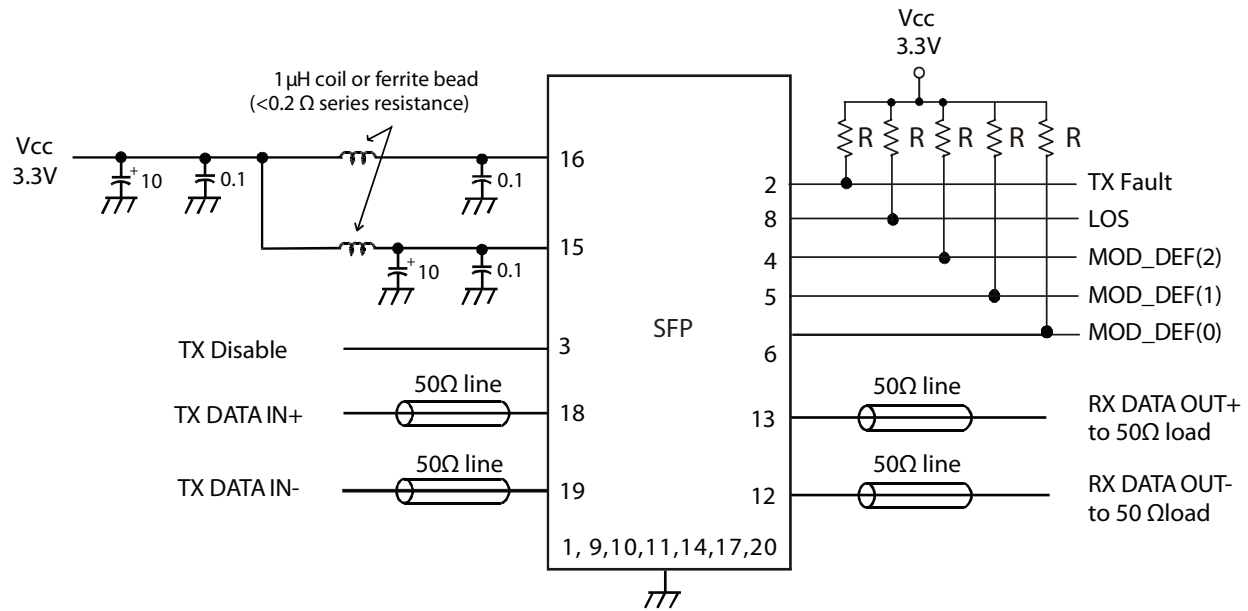
Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply Voltage	V_{CC}	3.13	3.30	3.47	V
Power Dissipation	P_W	-	-	1	W

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 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).

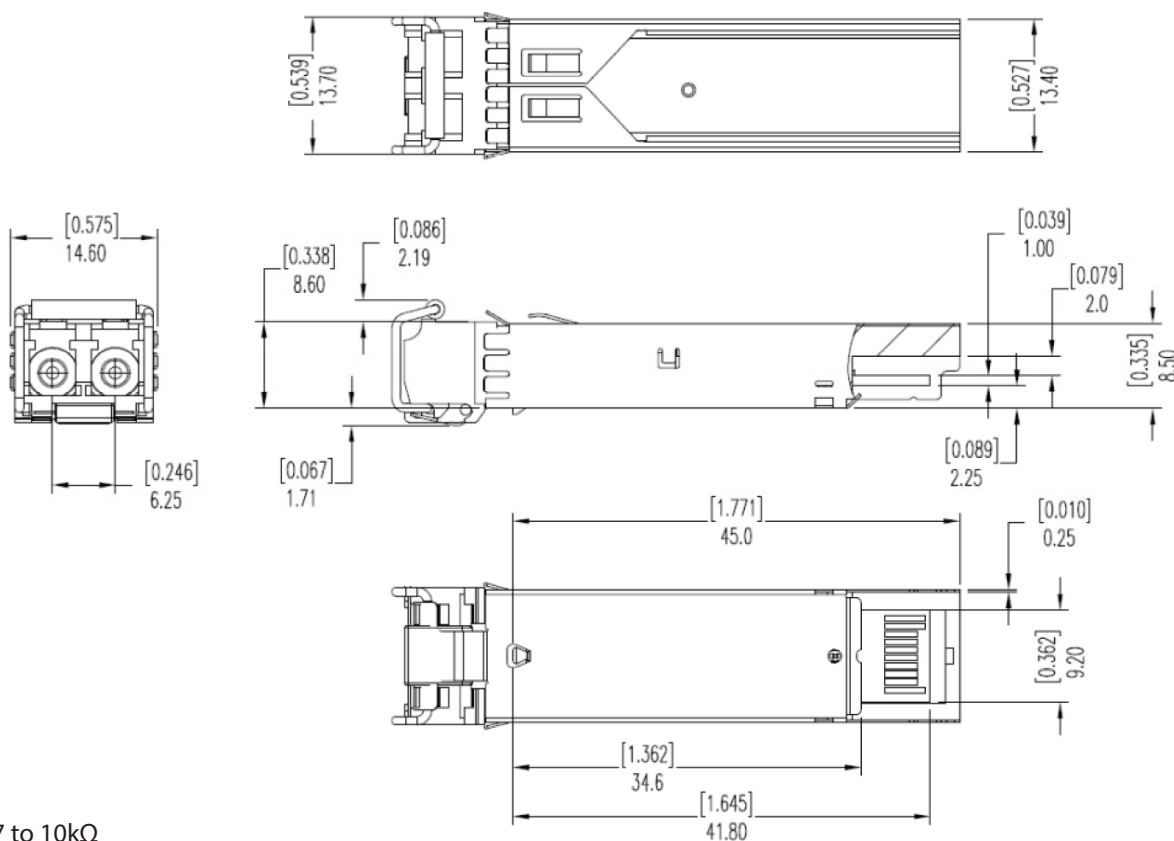
Serial Identification and Monitoring: The module definition of SFP is indicated by the three module definition

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 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 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	Latch Color
TRPU12AS1C000E2G	-5°C to +70°C	Commercial	1310nm	12/2km	Gray
TRPU12AI1C000E2G	-5°C to +70°C	Commercial	1310nm	21/15km	Yellow
TRPU12GL1C000E2G	-5°C to +70°C	Commercial	1310nm	42/40km	Red
TRPU12GL2C000E2G	-5°C to +70°C	Commercial	1550nm	85/80km	White
TRPU12AS1E000E2G	-5°C to +85°C	Extended	1310nm	12/2km	Gray
TRPU12AI1E000E2G	-5°C to +85°C	Extended	1310nm	21/15km	Yellow
TRPU12GL1E000E2G	-5°C to +85°C	Extended	1310nm	42/40km	Red
TRPU12GL2E000E2G	-5°C to +85°C	Extended	1550nm	85/80km	White
TRPU12AS1I000E2G	-40°C to +85°C	Industrial	1310nm	12/2km	Gray
TRPU12AI1I000E2G	-40°C to +85°C	Industrial	1310nm	21/15km	Yellow
TRPU12GL1I000E2G	-40°C to +85°C	Industrial	1310nm	42/40km	Red
TRPU12GL2I000E2G	-40°C to +85°C	Industrial	1550nm	85/80km	White

Oplink Communications, Inc. reserves the right to make changes in equipment design or specifications without notice. Information supplied by Oplink Communications, Inc. is believed to be accurate and reliable. However, no responsibility is assumed by Oplink Communications, Inc. for its use nor for any infringements of third parties, which may result from its use. No license is granted by implication or otherwise under any patent right of Oplink Communications, Inc.