

# MULTI-RATE OC-12/STM-4 SFP CWDM SINGLE MODE TRANSCEIVERS WITH DIGITAL DIAGNOSTICS

## TRPA12M CWDM

### Product Description

The TRPA12M CWDM SFP series of multi-rate transceivers with integrated digital diagnostics monitoring functionality provide a quick and reliable interface for long reach (LR) applications. The diagnostic functions, alarm and warning features as described in the Multi-Source Agreement (MSA) document, SFF-8472 (Rev. 9.3), are provided via an I<sup>2</sup>C serial interface.

Products under this series are compatible with SONET/SDH standards for OC-12/STM-4 LR-2/L-4.2 and are capable of operating down to 155Mb/s data rate. There are eight (8) wavelengths available: 1471nm, 1491nm, 1511nm, 1531nm, 1551nm, 1571nm, 1591nm and 1611nm. Two optical link power budgets are available, 27dB and 29dB, providing an extra 2dB and 4dB over SONET/SDH link budgets, respectively, to accommodate the wavelength multiplexing and de-multiplexing insertion losses. 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 TRPA12M CWDM 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 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 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 ("B" option) or -5°C to +85°C ("E" option). The housing is made of plastic and metal for EMI immunity.



### Features

- ☑ Eight (8) Wavelength CWDM Transceivers
- ☑ Compatible with SFP MSA
- ☑ Compatible with SONET/SDH OC-12/STM-4 (622Mb/s) LR-2/L-4.2 Long Reach Specifications
- ☑ Compatible with SONET/SDH OC-3/STM-1 (155Mb/s)
- ☑ Digital Diagnostics through Serial Interface
- ☑ Internal Calibration for Digital Diagnostics
- ☑ Optical Link Power Budgets of 27dB & 29dB Minimum
- ☑ Eye Safe (Class I Laser Safety)
- ☑ Duplex LC Optical Interface
- ☑ Excellent EMI & ESD Protection
- ☑ Hot-pluggable
- ☑ TX Fault & Loss of Signal Outputs
- ☑ TX Disable Input

### Absolute Maximum Ratings

Parameter	Symbol	Minimum	Maximum	Units
Storage Temperature	$T_{ST}$	- 40	+ 85	°C
Operating Case Temperature <sup>1</sup>	"B" Option	- 5	+ 70	°C
	"E" Option	- 5	+ 85	
Supply Voltage	$V_{CC}$	0	+ 5.0	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		$B$	125	-	2.67	Mb/s
Average Optical Output Power (coupled into single mode fiber), 50% duty cycle	TRPA12L2HBxMx	$P_O$	-2.0	-	+3.0	dBm
	TRPA12L2IBxMx		0	-	+5.0	
Extinction Ratio		$P_{hi}/P_{lo}$	10	-	-	dB
Center Wavelength	1471	$\lambda_C$	1464.5	1471	1477.5	nm
	1491		1484.5	1491	1497.5	
	1511		1504.5	1511	1517.5	
	1531		1524.5	1531	1537.5	
	1551		1544.5	1551	1557.5	
	1571		1564.5	1571	1577.5	
	1591		1584.5	1591	1597.5	
	1611		1604.5	1611	1617.5	
Spectral Width (-20dB)		$\Delta\lambda_{20}$	-	-	1.0	nm
Side Mode Suppression Ratio		$SMSR$	30	-	-	dB
Optical Output Eye		Compliant with Telcordia GR-253-CORE and ITU-T Recommendation G.957				


**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		$B$	125	-	622	Mb/s
Receiver Sensitivity ( $10^{-10}$ BER) <sup>1</sup>		$P_{min}$	-29.0	-31.0	-	dBm
Maximum Input Optical Power ( $10^{-12}$ BER) <sup>1</sup>		$P_{max}$	-7.0	-3.0	-	dBm
LOS Thresholds	Increasing Light Input	$P_{los+}$	-	-	-29.0	dBm
	Decreasing Light Input	$P_{los-}$	-45.0	-	-	
LOS Timing Delay	Increasing Light Input	$t_{loss\_off}$	-	-	100	$\mu s$
	Decreasing Light Input	$t_{loss\_on}$	2.3	-	100	
LOS Hysteresis		-	0.5	1.5	-	dB
Wavelength of Operation		$\lambda$	1260	-	1620	nm
Receiver Reflectance		-	-	-	-27.0	dB
<sup>1</sup> When measured at 125Mb/s & 200Mb/s with 2 <sup>7</sup> -1 PRBS, and at 155Mb/s & 622Mb/s with 2 <sup>23</sup> -1 PRBS.						

**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.

	<b>Oplink Communications, Inc.</b> DATE OF MANUFACTURE:	
	This product complies with 21 CFR 1040.10 and 1040.11 <b>Meets Class I Laser Safety Requirements</b>	

**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

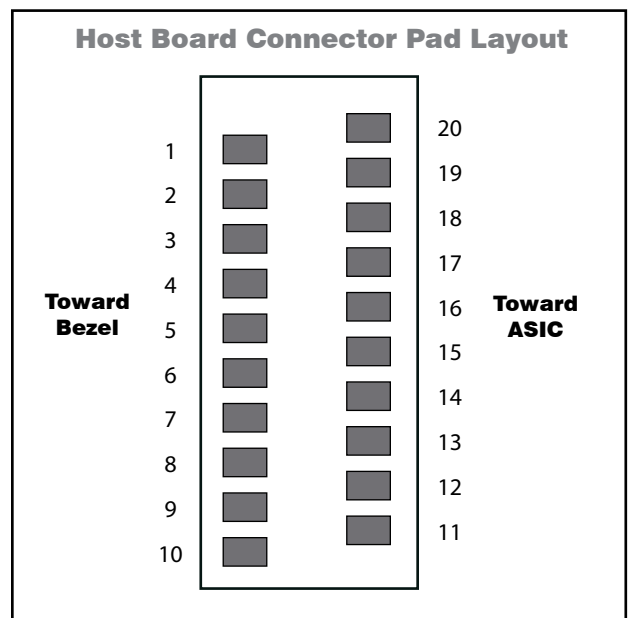
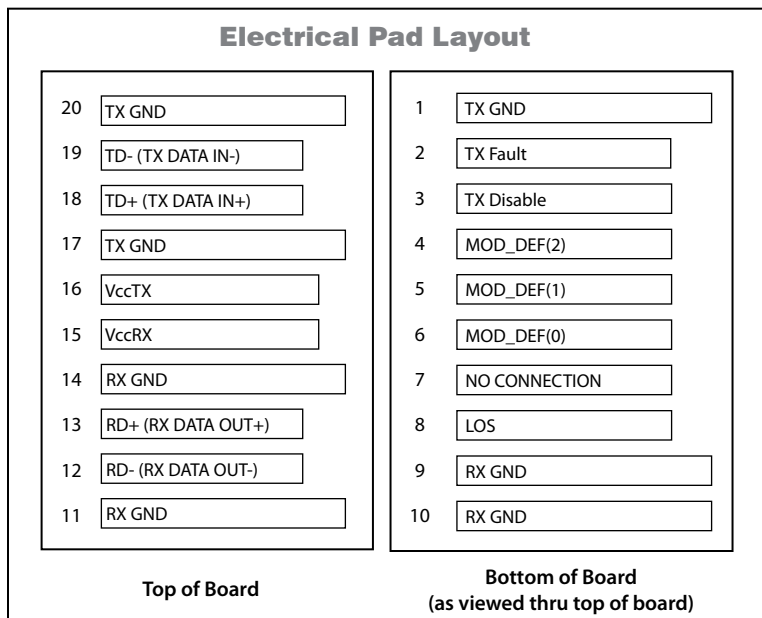
<sup>1</sup> Differential peak-to-peak voltage across external 100Ω load.  
<sup>2</sup> Open collector compatible, 4.7 to 10kΩ pull-up resistor to Vcc (Host Supply Voltage).

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

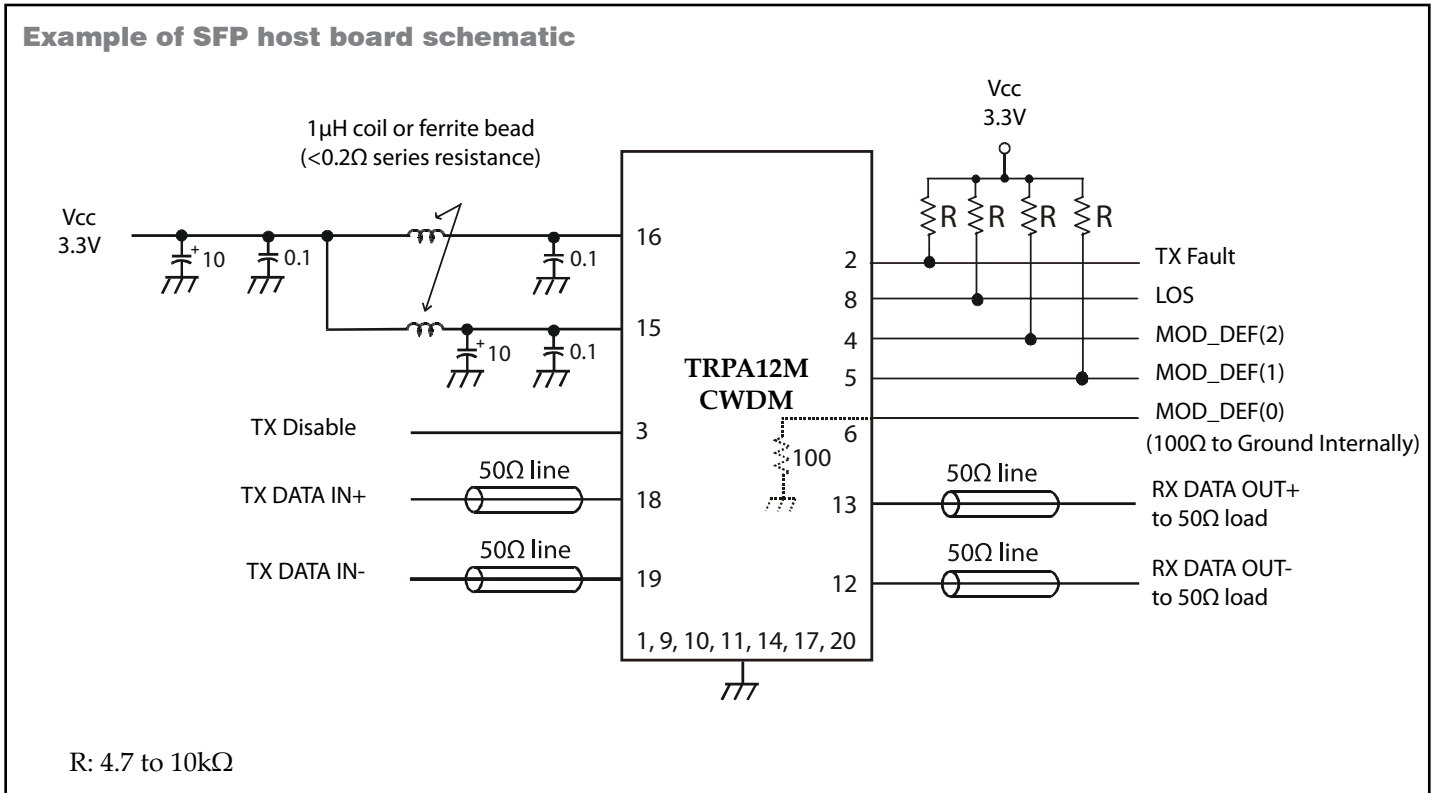
Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply Voltage	$V_{CC}$	3.13	3.3	3.47	V
Supply Current	$I_{CC}$	-	210	275	mA

**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



### 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 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 -35dBm).

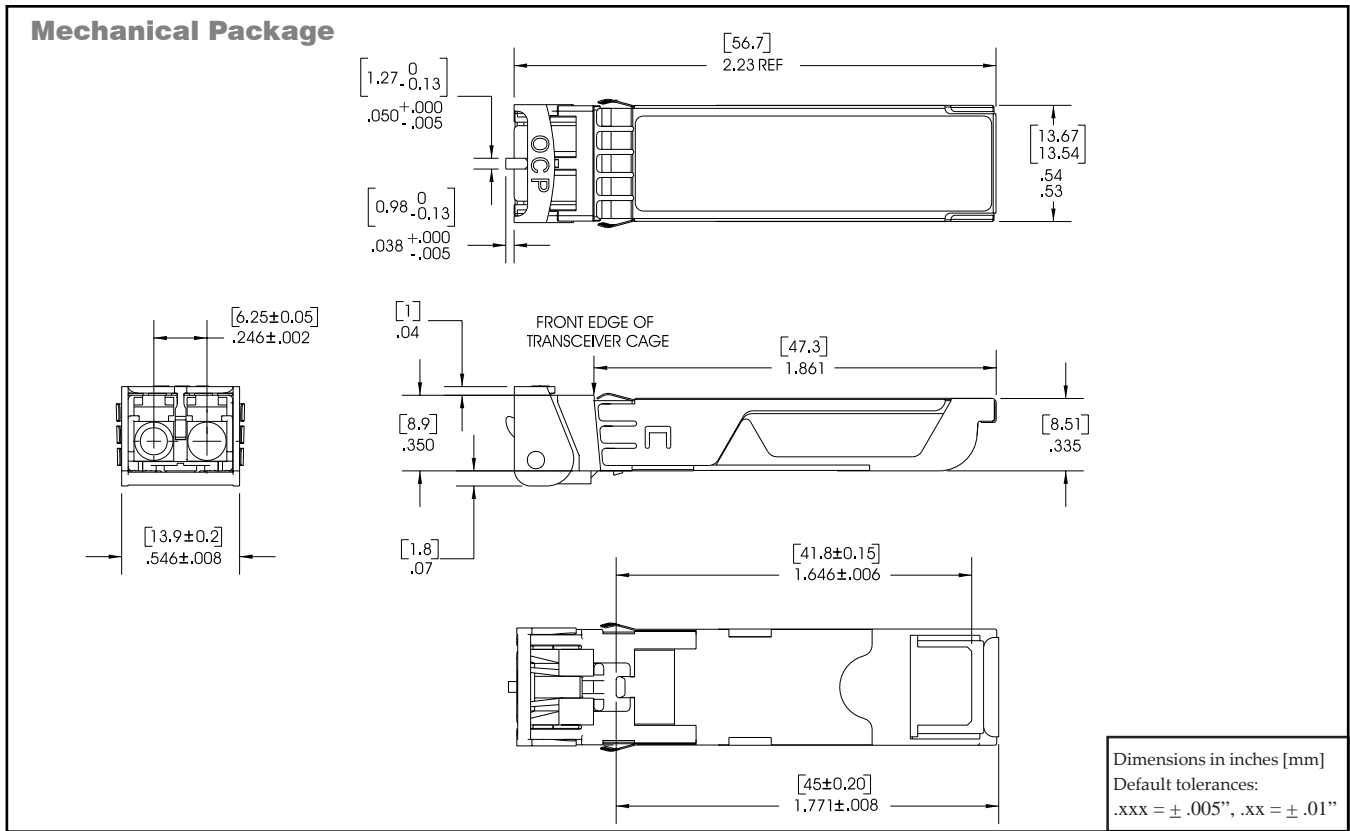
**Serial Identification and Monitoring:** The module definition of SFP is indicated by the three module definition pins, MOD\_DEF(0), MOD\_DEF(1) and MOD\_DEF(2).

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 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.



**Ordering Information**

Oplink can provide a remarkable range of customized optical solutions. For detail, please contact Oplink's Sales and Marketing for your requirements and ordering information (510) 933-7200 or Sales@oplink.com.

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