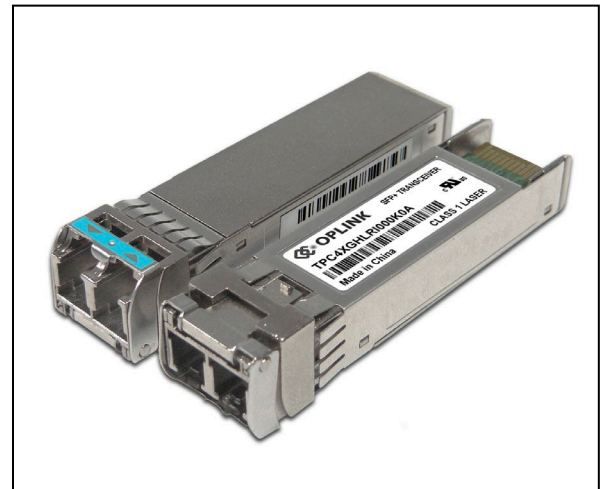


# TPC4XGHLRI000x0A

CWDM 20km SFP+ Transceivers

## Features

- ☑ Four CWDM wavelengths SFP+ transceiver
- ☑ Transmission distance up to 20km (SM fiber)
- ☑ Low power consumption
- ☑ Compliant with SFP+ Electrical MSA SFF-8431
- ☑ Compliant with SFP+ Mechanical MSA SFF-8432
- ☑ Compliant with 10GBASE-L specifications
- ☑ Digital Diagnostics Monitoring (DDM) through Serial Interface compliant with SFF-8472, Rev. 12.2
- ☑ RoHS 6/6 compliant
- ☑ Laser Class 1 IEC/CDRH compliant



## Description

The TPC4XGHLRI000x0A is an enhanced small form factor pluggable (SFP+) fiber optic transceiver with digital diagnostics monitoring functionality (DDM). Compliance with Ethernet standard makes it ideally suited for 10Gbps data-com applications. DDM functionality (alarm and warning features) is integrated into the design via an I<sup>2</sup>C serial interface per the Multi-Source Agreement (MSA) SFF-8472, Rev. 12.2.

The transceiver supports data rate from 1.2288Gbps (CPRI option 2) to 10.1376Gbps (CPRI option 8). It provides an excellent solution for data transmission over up to 20km single mode fiber. It is available in four(4) CWDM wavelengths from 1271nm to 1330nm. The low power consumption and excellent EMI performance allow system design with high port density. The product is RoHS compliant and is designed and tested in accordance with industry safety standards. The transceiver is Class 1 Laser

product per U.S. FDA/CDRH and international IEC-60825 standards.

The TPC4XGHLRI000x0A transceiver connects 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 transceivers without removing the power supply from the host system. The transmitter and receiver DATA interfaces are internally AC-coupled. LV-TTL Transmitter Disable control input and Loss of Signal (LOS) output interfaces are also provided.

The transceiver has bail-type latch, which offers an easy and convenient way to release the modules. The latch is compliant with the SFP MSA.

The transceiver operates from a single +3.3V power supply over a case operating temperature range of -40°C to +85°C (Industry). The housing is made of metal for EMI immunity.

## Absolute Maximum Ratings

Parameters	Symbol	Min	Max	Units
Storage Temperature Range	$T_{ST}$	- 40	+ 85	°C
Case Operating Temperature <sup>1</sup>	$T_{OP}$	- 40	+ 85	°C
Operating Relative Humidity <sup>2</sup>	$RH$	5	95	%
Supply Voltage Range	$V_{CC}$	- 0.5	+ 4	V

<sup>1</sup> Measured on the top side of SFP+ module at the front center vent hole of the cage

<sup>2</sup> Non condensing

**Transmitter Performance Characteristics (Over Operating Case Temperature,  $V_{CC}$ =3.13 to 3.47V)**

Parameter	Symbol	Min	Typ	Max	Units
Data Rate	$B$	1.2288	-	10.1376	Gb/s
Center Wavelength (see Ordering Info)	$\lambda_C$	$\lambda_C-6.5$	$\lambda_C$	$\lambda_C+6.5$	nm
Spectral Width	$\Delta\lambda_{20}$	-	0.4	1.0	nm
Average Optical Output Power <sup>1</sup>	$P_{avg}$	0	-	+5	dBm
Extinction Ratio	$ER$	3.5	-	-	dB
Relative Intensity Noise	$RIN$	-	-	- 128	dB/Hz
Side Mode Suppression Ratio	$SMSR$	30	-	-	dB
Optical Return Loss Tolerance	-	-	-	12	dB
Average Launch Power of OFF transmitter	$P_{OFF}$	-	-	-30	dBm
Reflectance Tolerance	-	-	-	10	dB
Optical Output Eye	Compliant with IEEE 802.3ae				

<sup>1</sup> Average power figures are informative only.

**Receiver Performance Characteristics (Over Operating Case Temperature,  $V_{CC}$ =3.13 to 3.47V)**

Parameter	Symbol	Min	Typ	Max	Units
Data Rate	$B$	1.2288	-	10.1376	Gb/s
Wavelength of Operation	$\lambda$	1260	-	1510	nm
Sensitivity at 10.1376Gbps	$P_{sen}$	-	-	-15.5	dBm
Overload	$P_{max}$	+0.5	-	-	dBm
Receiver Reflectance	-	-	-	- 12	dB
LOS Hysteresis	-	0.5	1.5	-	dB
LOS Thresholds	Increasing Light Input	$P_{los+}$	-	- 20	dBm
	Decreasing Light Input	$P_{los-}$	- 35	-	

<sup>1</sup> Sensitivity specified with BER <math>1 \times 10^{-12}</math>

Note: The specified characteristics are met within the recommended range of operation. Unless otherwise noted typical data are quoted at nominal voltage and +25°C ambient temperature.

**Laser Safety:**

All transceivers are Class 1 Laser products per FDA/CDRH and IEC-60825 standards. They must be operated under specified operating conditions.



**Molex, LLC**

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	Min	Typ	Max	Units
Differential Input Impedance	$Z_d$	-	100	-	$\Omega$
Differential Input Voltage Swing	$V_{PP-DIFF}$	180	-	750	mV
Input High Voltage (TX Disable) <sup>1</sup>	$V_{IH}$	2	-	$V_{CC}T+0.3$	V
Input LOW Voltage (TX Disable) <sup>1</sup>	$V_{IL}$	-0.3	-	0.8	V
Output High Voltage (TX Fault) <sup>2</sup>	$V_{OH}$	2.4	-	$V_{CC}T+0.3$	V
Output LOW Voltage (TX Fault) <sup>2</sup>	$V_{OL}$	-0.3	-	0.8	V

<sup>1</sup> There is an internal 4.7 k $\Omega$  to 10 k $\Omega$  pull-up resistor to  $V_{CC}T$   
<sup>2</sup> Open collector compatible, 4.7 k $\Omega$  to 10 k $\Omega$  pull-up resistor to  $V_{CC}$  (Host Supply Voltage)

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

Parameter	Symbol	Min	Typ	Max	Units
Differential Output Impedance	$Z_d$	-	100	-	$\Omega$
Differential Output Swing	$V_{PP-DIFF}$	300	-	850	mV
Termination Mismatch at 1 MHz	$\Delta Z_m$	-	-	5	%
Output Rise and Fall time (20% to 80%)	$t_{RH}, t_{FH}$	28	-	-	ps
Output HIGH Voltage (LOS) <sup>1</sup>	$V_{OH}$	2.0	-	$V_{CC}+0.3$	V
Output Low Voltage (LOS) <sup>1</sup>	$V_{OL}$	0	-	0.8	V

<sup>1</sup> Open collector compatible, 4.7 k $\Omega$  to 10 k $\Omega$  pull-up resistor to  $V_{CC}$  (Host Supply Voltage)

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

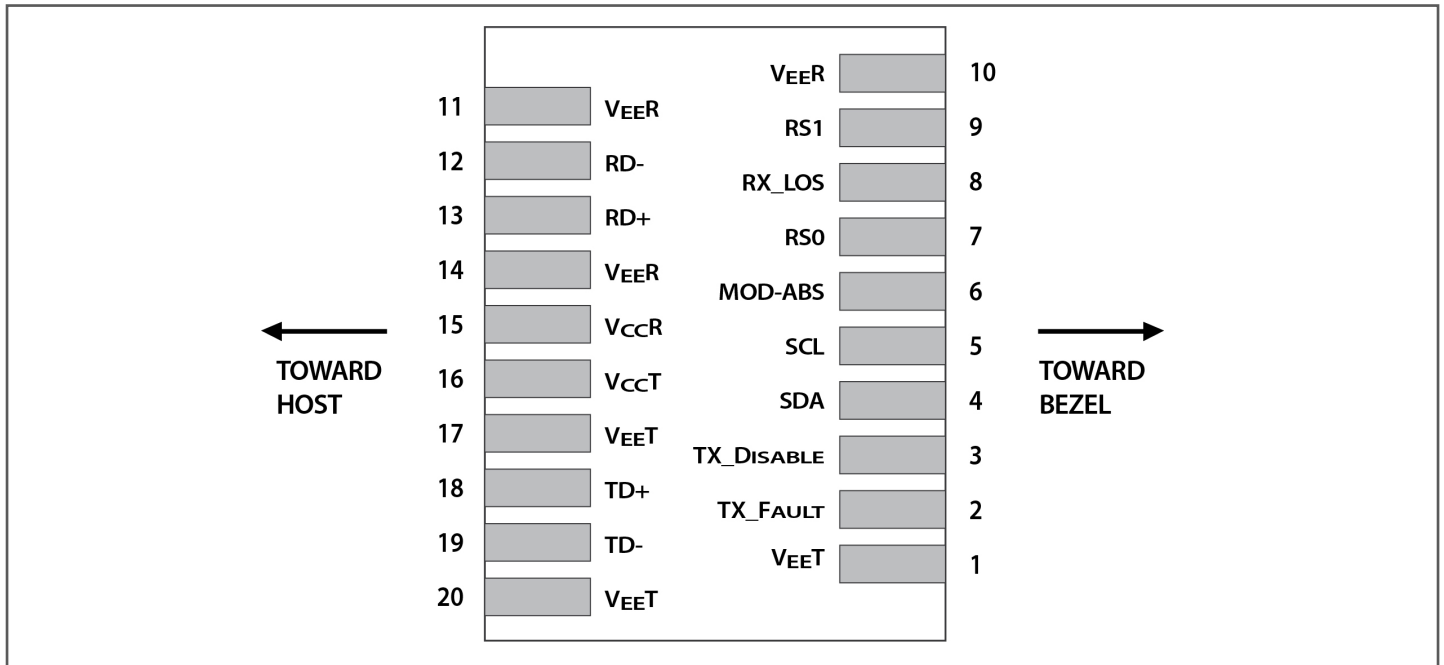
Parameter	Symbol	Min	Typ	Max	Units
Power Supply Voltage	$V_{CC}$	3.13	3.30	3.47	V
DC Common Mode Voltage	$V_{CM}$	0	-	3.60	V
Supply Current	$I_{VCC}$	-	450	-	mA
Power Consumption	$P_W$	-	-	1.5	W

Note: The specified characteristics are met within the recommended range of operation. Unless otherwise noted typical data are quoted at nominal voltage and +25°C ambient temperature.

**Diagnostics Requirement for the Actual and Reported Levels**

Parameter	Symbol	Min	Typ	Max	Units
Temperature	$T_{INT}$	-3	-	3	°C
Vcc Voltage	$V_{INT}$	-0.1	-	0.1	V
Bias Current	$I_{INT}$	-10	-	10	%
Tx Power	$PT$	-2	-	2	dB
Rx Power	$PR$	-3	-	3	dB

### Connector Pin-out



### Electrical Pin Definition

PIN	Logic	Symbol	Name / Description
1	-	<i>VeeT</i>	Module Transmitter Ground
2	LVTTL-O	<i>TX_Fault</i>	Module Transmitter Fault
3	LVTTL-I	<i>TX_Disable</i>	Transmitter Disable; Turns off transmitter laser output
4	LVTTL-I/O	<i>SDA</i>	2-Wire Serial Interface Data Line
5	LVTTL-I/O	<i>SCL</i>	2-Wire Serial Interface Clock
6	-	<i>MOD-ABS</i>	Module Definition, Grounded in the module
7	LVTTL-I	<i>RS0</i>	No function implemented
8	LVTTL-O	<i>RX_LOS</i>	Receiver Loss of Signal Indication
9	LVTTL-I	<i>RS1</i>	No function implemented
10	-	<i>VeeR</i>	Module Receiver Ground
11	-	<i>VeeR</i>	Module Receiver Ground
12	CML-O	<i>RD-</i>	Receiver Inverted Data Output
13	CML-O	<i>RD+</i>	Receiver Non-Inverted Data Output
14	-	<i>VeeR</i>	Module Receiver Ground
15	-	<i>VccR</i>	Module Receiver 3.3V Supply
16	-	<i>VccT</i>	Module Transmitter 3.3V Supply
17	-	<i>VeeT</i>	Module Transmitter Ground
18	CML-I	<i>TD+</i>	Transmitter Non-Inverted Data Input
19	CML-I	<i>TD-</i>	Transmitter Inverted Data Input
20	-	<i>VeeT</i>	Module Transmitter Ground

### 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 k $\Omega$  – 10 k $\Omega$  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 is an open collector/drain output and should be pulled up with a 4.7 k $\Omega$  – 10 k $\Omega$  resistor on the host board.

**TX Disable:** When the TX Disable pin is at logic HIGH, the transmitter optical output is disabled. The laser is also disabled if this line is left floating, as it is pulled high inside the transceiver.

**Serial Identification and Monitoring:** The module definition of SFP is indicated by the MOD\_ABS pin and the 2-wire serial

interface. Upon power up, the 2-wire interface appears as NC (no connection), and MOD\_ABS 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 device that are not write protected, and the negative edge clocks data from the device. 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. 12.2.

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

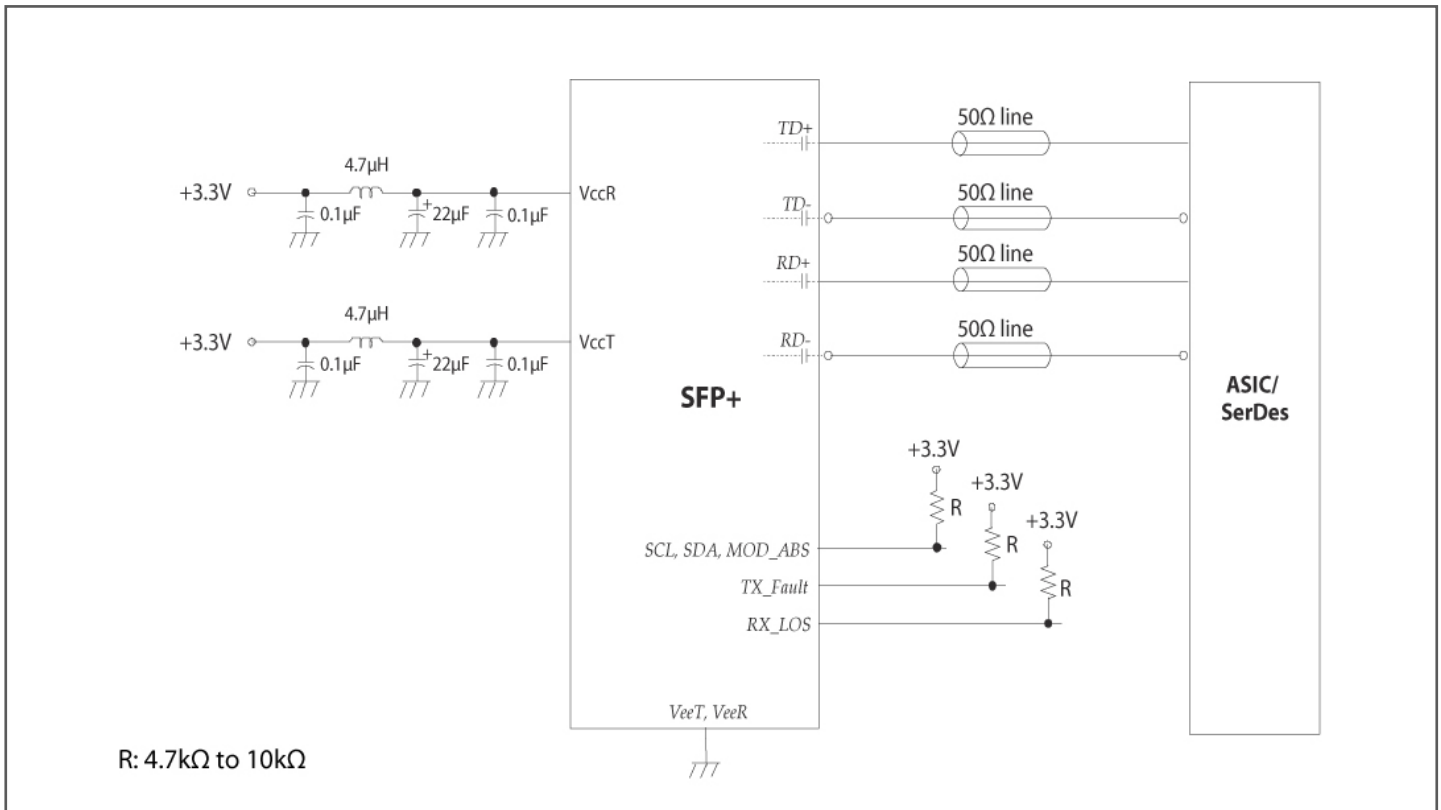
## Interfacing the Transceivers

Communication is via a serial 2-wire serial interface. As described in the document SFF-8472 (REV. 12.2) there are two distinct address spaces:

Base Address A0(hex)	
Byte Address	Content
0 – 95	Serial Transceiver ID as defined in SFP MSA
96 – 127	OPLINK Specific
128 – 255	Reserved

Base Address A2(hex)	
Byte Address	Content
0 - 55	Alarm & Warnings thresholds & limits
56 - 95	External calibration constants (not used)
96 – 119	Values from real time diagnostic monitoring
120 – 127	Not used
128 – 247	Customer specific, writable area
248 - 255	Not used

## Application Schematics



## ESD & Electromagnetic Compatibility

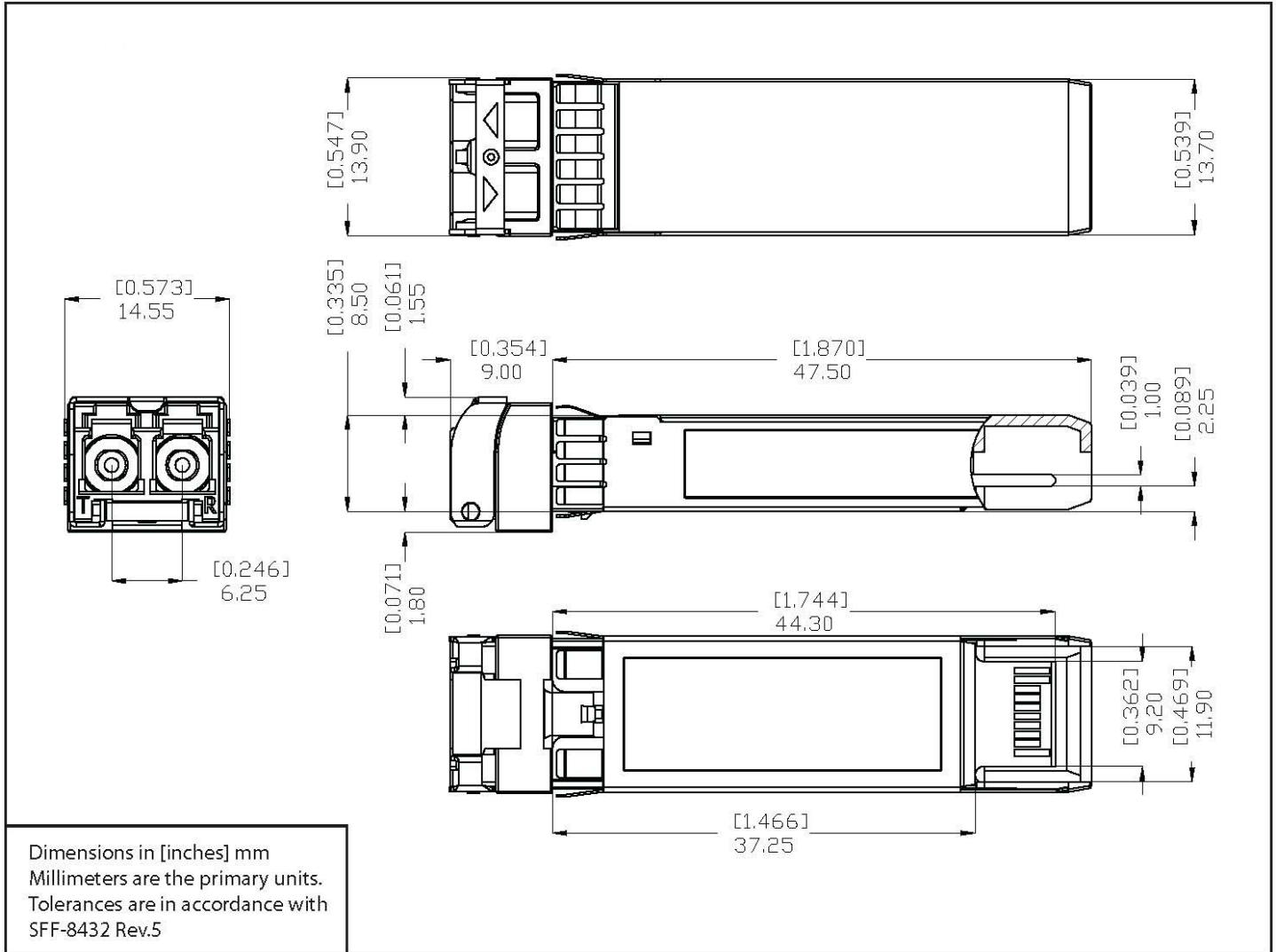
Requirements	Standard	Status
Electro Static Discharge to the Electrical Pins (ESD)	EIA/JESD22-A114-B MIL-STD 883C Method 3015.7	Exceeds requirements Class 1B (>1000V)
Immunity to ESD (housing, receptacle)	IEC 61000-4-2	Exceeds requirements Discharges ranging from 2kV to 15kV without damages to the transceiver
Electromagnetic Emission (EMI)	FCC Part 15, Class B EN 55022 Class B CISPR 22	Exceeds requirements Class B

# TPC4XGHLRI000x0A

CWDM 20km SFP+ Transceivers



## Module Outline



## Ordering Information

Model Name	Operating Temperature Range	Center Wavelength	Latch Color	Distance	
TPC4XGHLRI000L0A	- 40°C to +85°C	Industrial	1271nm	Light Purple	20km
TPC4XGHLRI000K0A	- 40°C to +85°C	Industrial	1291nm	Sky Blue	20km
TPC4XGHLRI000J0A	- 40°C to +85°C	Industrial	1311nm	Yellow Green	20km
TPC4XGHLRI000H0A	- 40°C to +85°C	Industrial	1331nm	Yellow Ocher	20km

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