OCP©

*Preliminary*

# TRP-03 & TRP-12

## OC-03/STM-1 & OC-12/STM-4 LC Small Form-factor Pluggable (SFP) Single Mode Transceivers


### Features

- ☑ *Fully Compliant with Small Form-factor Pluggable (SFP) Multi-Source Agreement*
- ☑ *Fully Compliant with SONET/SDH OC-3 (155Mb/s) & OC-12 (622 Mb/s)*
- ☑ *Long Reach 1310nm (40Km distance) and 1550nm (80Km) as well as Intermediate Reach (15Km)*
- ☑ *Hot-pluggable*
- ☑ *- 40°C to + 85°C operating temperature, ("A" Option)*
- ☑ *Excellent EMI & ESD protection*
- ☑ *TX Fault & Loss of Signal outputs*
- ☑ *TX Disable input*
- ☑ *Duplex LC Connector interface*
- ☑ *Single + 3.3 V supply voltage*

## Description

The TRP-03 & TRP-12 Small Form-factor Pluggable (SFP) fiber optic transceiver offers a simple and convenient way to interface PCBs to single mode fiber optic cables. Many performance versions are available which are fully compliant with SONET/SDH standards for OC-3/STM-1 and OC-12/STM-4. All modules satisfy Class I Laser Safety requirements in accordance with the US FDA/CDRH and international IEC-825 standards.

The TRP-03 & TRP-12 use the SFP 20-pad connector to allow hot plug capability. Thus, the system designer can make configuration changes or maintenance simply by plugging in different type of converters without removing the power supply from the host system.

The transceivers offer two different types of release latches, Wrap Around latch and Standard latch. Both latches are conformance to Small Form-factor Pluggable (SFP) multisource agreement. The special Wrap Around latch is designed to offer an easy and convenient way to release the module.

The transmitter incorporates a highly reliable 1300 nm or 1550 nm InGaAsP Laser and a driver circuit which converts data to light. The receiver features a transimpedance amplifier IC with internal AGC for high sensitivity and wide dynamic range. The transmitter and receiver DATA interface are AC coupled internally. An LV-TTL Transmitter Disable control input and Loss of Signal output interface are also provided.

The transceiver operates from a single +3.3V power supply over an operating temperature range of 0°C to +70°C, for -40°C to +85°C consult factory. The package is made of plastic and metal cover for EMI enhancement.

## Absolute Maximum Ratings

| Parameter | | Symbol | Minimum | Maximum | Units |
|---|---|---|---|---|---|
| Storage Temperature | | $T_{st}$ | - 40 | + 85 | °C |
| Operating Case Temperature | "A" optioin | $T_{op}$ | - 40 | + 85 | °C |
| | "B" optioin | | 0 | + 70 | |
| Supply Voltage | | $V_{CC}$ | 0 | + 5.0 | V |
| Input Voltage | | $V_{in}$ | 0 | *Vcc* | V |

# TRP-03

## Transmitter Performance Characteristics (over Operating Case Temperature)

| Parameter | | Symbol | Minimum | Typical | Maximum | Units |
|---|---|---|---|---|---|---|
| Data Rate | | $B$ | 50 | 156 | 300 | Mb/s |
| Average Optical Output Power (coupled into single mode fiber), 50% duty cycle[1] | L0 | $P_o$ | - 5.0 | - 3.0 | 0 | dBm |
| | L3 | | - 15.0 | - 11.0 | - 8.0 | |
| Extinction Ratio | | $P_{hi}/P_{lo}$ | 10 | - | - | dB |
| Center Wavelength | IR (Intermediate Reach) | $\lambda_c$ | 1261 | 1310 | 1360 | nm |
| | LR1 (Long Reach 1310 nm) | | 1270 | 1310 | 1360 | |
| | LR2 (Long Reach 1550 nm) | | 1480 | 1550 | 1580 | |
| Spectral Width (RMS) | IR & LR1 | $\Delta\lambda_{RMS}$ | - | - | 3 | nm |
| Spectral Width (-20 dB) | LR2 | $\Delta\lambda_{20}$ | - | - | 1 | |
| Side Mode Suppression Ratio | LR2 | $SMSR$ | 30 | - | - | dB |
| Optical Output Eye | compliant with Bellcore TR-NWT-000253 and ITU-T Recommendation G.957 | | | | | |

[1] Other optical output power versions are also available, consult factory.

## Receiver Performance Characteristics (over Operating Case Temperature)

| Parameter | | Symbol | Minimum | Typical | Maximum | Units |
|---|---|---|---|---|---|---|
| Data Rate | | $B$ | 50 | 156 | 266 | Mb/s |
| Receiver Sensitivity ($10^{-10}$ BER) [1] | | $P_{min}$ | - 34.0 | - 36.0 | - | dBm |
| Maximum Input Optical Power ($10^{-10}$ BER) [1] | | $P_{max}$ | - 7.0 | 0 | - | dBm |
| Signal Detect Thresholds | Increasing Light Input | $P_{sd+}$ | - | - | - 34.0 | dBm |
| | Decreasing Light Input | $P_{sd-}$ | - 45.0 | - | - | |
| Signal Detect Hysteresis | | - | 0.5 | 1.5 | - | dB |
| Wavelength of Operation | | $\lambda$ | 1100 | - | 1600 | nm |

[1] Specified in Average Optical Input Power and measured at 156Mb/s and 1300 nm (1550 nm for LR2) wavelength with $2^{23}$-1 PRBS.

## Ordering Information (Wrap Around Latch)

| Model Name | | SONET /SDH Standad | Distance [1] |
|---|---|---|---|
| 0°C to 70°C Operating | - 40°C to +85°C Operating [2] | | |
| TRP-03L3I1B | TRP-03L3I1A | IR 1300nm / S -4.1 | 15 km |
| TRP-03L0L1B | TRP-03L0L1A | LR1 1300nm / L-4.1 | 40 km |
| TRP-03L0L2B | TRP-03L0L2A | LR2 1550nm / L-4.2 | 80 km |

[1] These are target distances to be used for classification and not for specification, per ITU-T Recommendation G.957.
[2] For LR2 modules, the termperature range is -25°C to 70°C.

## Ordering Information (Standard Latch)

| Model Name | | SONET /SDH Standad | Distance [1] |
|---|---|---|---|
| 0°C to 70°C Operating | - 40°C to +85°C Operating [2] | | |
| TRP-03L3I1BS | TRP-03L3I1AS | IR 1300nm / S -4.1 | 15 km |
| TRP-03L0L1BS | TRP-03L0L1AS | LR1 1300nm / L-4.1 | 40 km |
| TRP-03L0L2BS | TRP-03L0L2AS | LR2 1550nm / L-4.2 | 80 km |

[1] These are target distances to be used for classification and not for specification, per ITU-T Recommendation G.957.
[2] For LR2 modules, the termperature range is -25°C to 70°C.

# TRP-12

## Transmitter Performance Characteristics (over Operating Case Temperature)

| Parameter | | Symbol | Minimum | Typical | Maximum | Units |
|---|---|---|---|---|---|---|
| Data Rate | | $B$ | 50 | 622 | 700 | Mb/s |
| Average Optical Output Power (coupled into single mode fiber), 50% duty cycle [1] | HP | $P_o$ | - 3.0 | - 1.0 | +2.0 | dBm |
| | L3 | | - 15.0 | - 11.0 | - 8.0 | |
| Extinction Ratio | SR & IR | $P_{hi}/P_{lo}$ | 8.2 | - | - | dB |
| | LR1 & LR2 | | 10 | - | - | |
| Center Wavelength [2] | SR (Short Reach) | $\lambda_c$ | 1261 | 1310 | 1360 | nm |
| | IR (Intermediate Reach) | | 1274 | 1310 | 1356 | |
| | | | 1293 | 1310 | 1334 | |
| | LR1 (Long Reach 1310 nm) | | 1280 | 1310 | 1335 | |
| | LR2 (Long Reach 1550 nm) | | 1480 | 1550 | 1580 | |
| Spectral Width (RMS) [2] | SR (Short Reach) | $\Delta\lambda_{RMS}$ | - | - | 4.0 | nm |
| | IR (Intermediate Reach) | | - | - | 2.5 or 4.0 | |
| Spectral Width (-20 dB) | LR1 & LR2 | $\Delta\lambda_{20}$ | - | - | 1.0 | |
| Side Mode Suppression Ratio | LR1 & LR2 | $SMSR$ | 30 | - | - | dB |
| Optical Output Eye | compliant with Bellcore TR-NWT-000253 and ITU-T Recommendation G.957 | | | | | |

[1] Other optical ouput power versions are also available, consult factory.
[2] For Intermediate Reach version, the Center Wavelength is either 1274 nm $\leq \lambda_c \leq$ 1356 nm for $\Delta\lambda_{RMS} \leq$ 2.5 nm
or 1293 nm $\leq \lambda_c \leq$ 1334 nm for $\Delta\lambda_{RMS} \leq$ 4.0 nm.

## Receiver Performance Characteristics (over Operating Case Temperature)

| Parameter | | Symbol | Minimum | Typical | Maximum | Units |
|---|---|---|---|---|---|---|
| Data Rate | | $B$ | 50 | 622 | 700 | 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 |
| Signal Detect Thresholds | Increasing Light Input | $P_{sd+}$ | - | - | - 28.0 | dBm |
| | Decreasing Light Input | $P_{sd-}$ | - 45.0 | - | - | |
| Signal Detect Hysteresis | | - | 0.5 | 1.5 | - | dB |
| Wavelength of Operation | | $\lambda$ | 1100 | - | 1600 | nm |

[1] Specified in Average Optical Input Power and measured at 622 Mb/s and 1300 nm (1550 nm for LR2) wavelength with $2^{23}$-1 PRBS.

## Ordering Information (Wrap Around Latch)

| Model Name | | SONET /SDH Standad | Distance [1] |
|---|---|---|---|
| 0°C to 70°C Operating | - 40°C to +85°C Operating [2] | | |
| TRP-12L3SRB | TRP-12L3SRA | SR 1300nm / I -4.1 | 2 km |
| TRP-12L3I1B | TRP-12L3I1A | IR 1300nm / S -4.1 | 15 km |
| TRP-12HPL1B | TRP-12HPL1A | LR1 1300nm / L-4.1 | 40 km |
| TRP-12HPL2B | TRP-12HPL2A | LR2 1550nm / L-4.2 | 80 km |

[1] These are target distances to be used for classification and not for specification, per ITU-T Recommendation G.957.
[2] For LR2 modules, the termperature range is -25°C to 70°C.

## Ordering Information (Standard Latch)

| Model Name | | SONET /SDH Standad | Distance [1] |
|---|---|---|---|
| 0°C to 70°C Operating | - 40°C to +85°C Operating [2] | | |
| TRP-12L3SRBS | TRP-12L3SRAS | SR 1300nm / I -4.1 | 2 km |
| TRP-12L3I1BS | TRP-12L3I1AS | IR 1300nm / S -4.1 | 15 km |
| TRP-12HPL1BS | TRP-12HPL1AS | LR1 1300nm / L-4.1 | 40 km |
| TRP-12HPL2BS | TRP-12HPL2AS | LR2 1550nm / L-4.2 | 80 km |

[1] These are target distances to be used for classification and not for specification, per ITU-T Recommendation G.957.
[2] For LR2 modules, the termperature range is -25°C to 70°C.

## Transmitter Electrical Interface (over Operating Case Temperature Range)

| Parameter | Symbol | Minimum | Typical | Maximum | Units |
|---|---|---|---|---|---|
| Input Voltage Swing (TD+ & TD -) [1] | $V_{PP-DIF}$ | 0.50 | - | 2.4 | V |
| Input HIGH Voltage (TX DISABLE) [2] | $V_{IH}$ | $V_{cc}$ - 1.3 | - | $V_{cc}$ + 0.3 | V |
| Input LOW Voltage (TX DISABLE) [2] | $V_{IL}$ | 0 | - | 0.8 | V |
| Output HIGH Voltage (TX FAULT) | $V_{OH}$ | 2.0 | - | $V_{cc}$ | V |
| Output LOW Voltage (TX FAULT) | $V_{OL}$ | 0 | - | 0.8 | V |

[1] Differential peak-to-peak voltage.
[2] There is an internal 4.7K to 10Kohm pullup resistor to VccT.

## Receiver Electrical Interface (over Operating Case Temperature Range)

| Parameter | | Symbol | Minimum | Typical | Maximum | Units |
|---|---|---|---|---|---|---|
| Output Voltage Swing (RD+ & RD-) [1] | | $V_{PP-DIF}$ | 0.60 | - | 2.0 | Vp-p |
| Output HIGH Voltage (LOS) [2] | | $V_{OH}$ | $V_{CC}$ - 1.3 | - | $V_{CC}$ + 0.3 | V |
| Output LOW Voltage (LOS) [2] | | $V_{OL}$ | 0 | - | 0.5 | V |
| Signal Detect Timing Delay | Increasing Light Input | $t_{sd+}$ | - | - | 100 | ms |
| | Decreasing Light Input | $t_{sd-}$ | - | - | 100 | |

[1] Differential peak-to-peak voltage across external 100 ohm load.
[2] Open Collector compatible, 4.7 K to 10 Kohm pullup to *Vcc* (Host Supply Voltage).

## Electrical Power Supply Characteristics (over Operating CaseTemperature Range)

| Parameter | Symbol | Minimum | Typical | Maximum | Units |
|---|---|---|---|---|---|
| Supply Voltage | *Vcc* | 3.13 | 3.3 | 3.5 | V |
| Supply Current | *Icc* | - | 175 | 245 | mA |

## Module Definition

| Module Definition | MOD-DEF0 pin 6 | MOD-DEF1 pin 5 | MOD-DEF2 pin 4 | Interpretation by Host |
|---|---|---|---|---|
| 4 | TTL LOW | SCL | SDA | Serial module definition protocol |

## Application Notes

**Electrical interface**: All the signal interfaces are compliant with MultiSource Agreement specification. The high speed DATA interface is differential AC-coupled internally with 0.022$\mu$F. It can be connected to 3.3 V SERDES IC directly. All the low speed control and sense output signals are open collector TTL compatible. Therefore, proper pull-up resistor (4.7 K to 10 K$\Omega$) is required.

**Loss of Signal (LOS):** The Loss of Signal circuit monitors the level of the incoming optical signal and generates a logic HIGH when insufficient photocurrent is produced.

**TX FAULT:** The output indiactes LOW when the transmitter is operating normally. When HIGH, ouput indicates a laser fault of some kind. TX FAULT also indicates end of life when 1300 nm lasers are used. TX Fault is an open collector/ drain ouput, which should be pulled up with a 4.7K to 10K$\Omega$ resistor on the host board.

**TX DISABLE:** When the TX DISABLE pin is at logic HIGH, the transmitter optical output is disabled (less than -35 dBm).

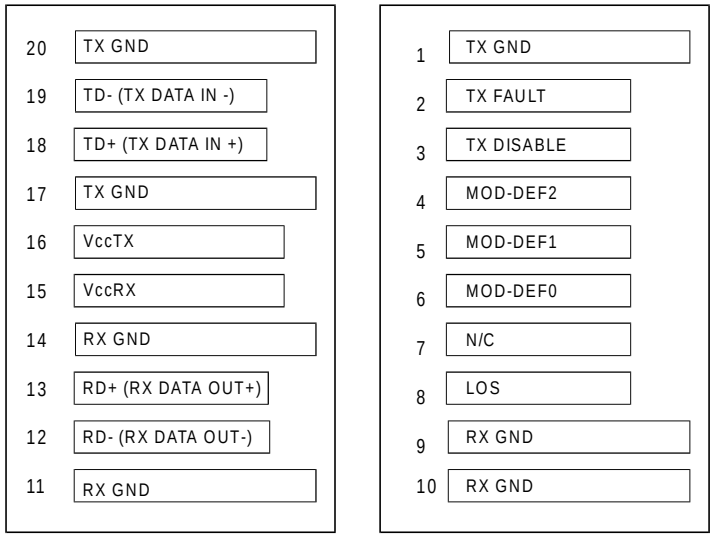
**Serial Identification:** The module definition of SFP is indicated by the 3 module definition pins MOD-DEF0, MOD-DEF1 and MOD-DEF2. Module Definition 4 specifies a serial definition protocol. For this definition, upon power up, MOD-DEF1:2 appear as NC (no connect) and MOD-DEF0 is TTL LOW. When the host system detects this condition, it activates the serial protocol. The protocol uses the 2-wire serial CMOS E$^2$PROM protocol of the ATMEL AT24C01A/02/04 family of components. When the serial protocol is activated, the serial clock signal (SCL) is generated by the host. 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 data transfer protocol and the details of the mandatory and vender specific data structures are defined in Small Form-Factror Pluggable (SFP) Transceiver MultiSource Agreement.

**Power supply and grounding**: The power supply line should be well-filtered. All 0.1 $\mu$F power supply bypass capacitors should be as close to the transceiver module as possible.

# TRP-03 & TRP-12

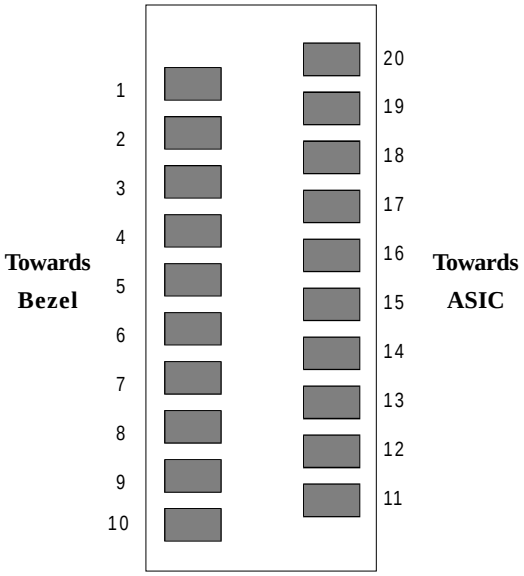
## Electrical Pad Layout



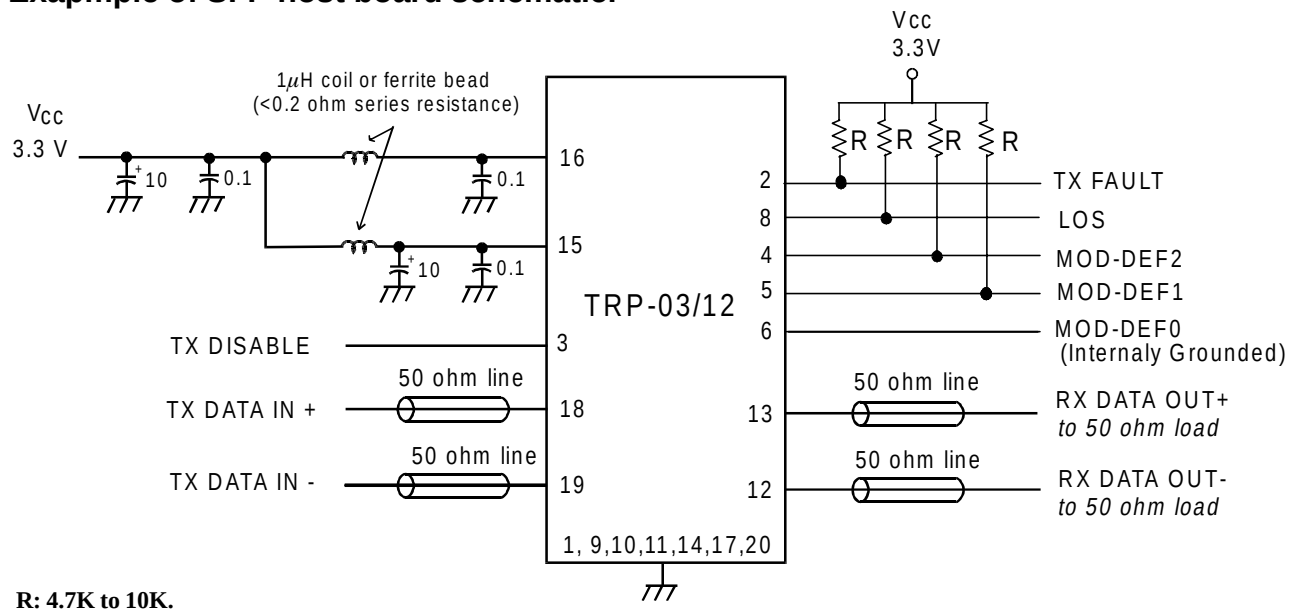

**Top of Board**

**Bottom of Board (as viewed thru top of board)**

## Host Board Connector Pad Layout




## Exapmple of SFP host board schematic.




**R: 4.7K to 10K.**

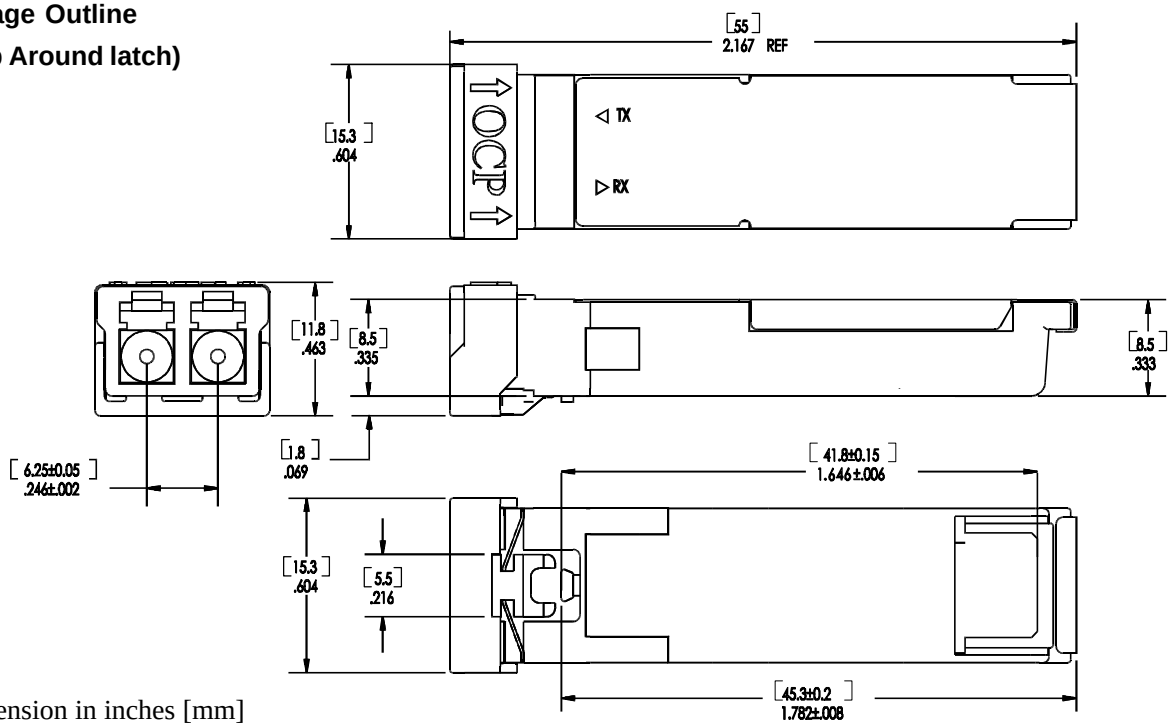
**Laser Safety**: All transmitters are Class I Laser products per FDA/CDRH and IEC-825 standards. They must be operated under specified operating conditions.

**Optical Communication Products, Inc.**
DATE OF MANUFACTURE:

MANUFACTURED IN THE USA
This product complies with
21 CFR 1040.10 and 1040.11
**Meets Class I Laser Safety Requirements**

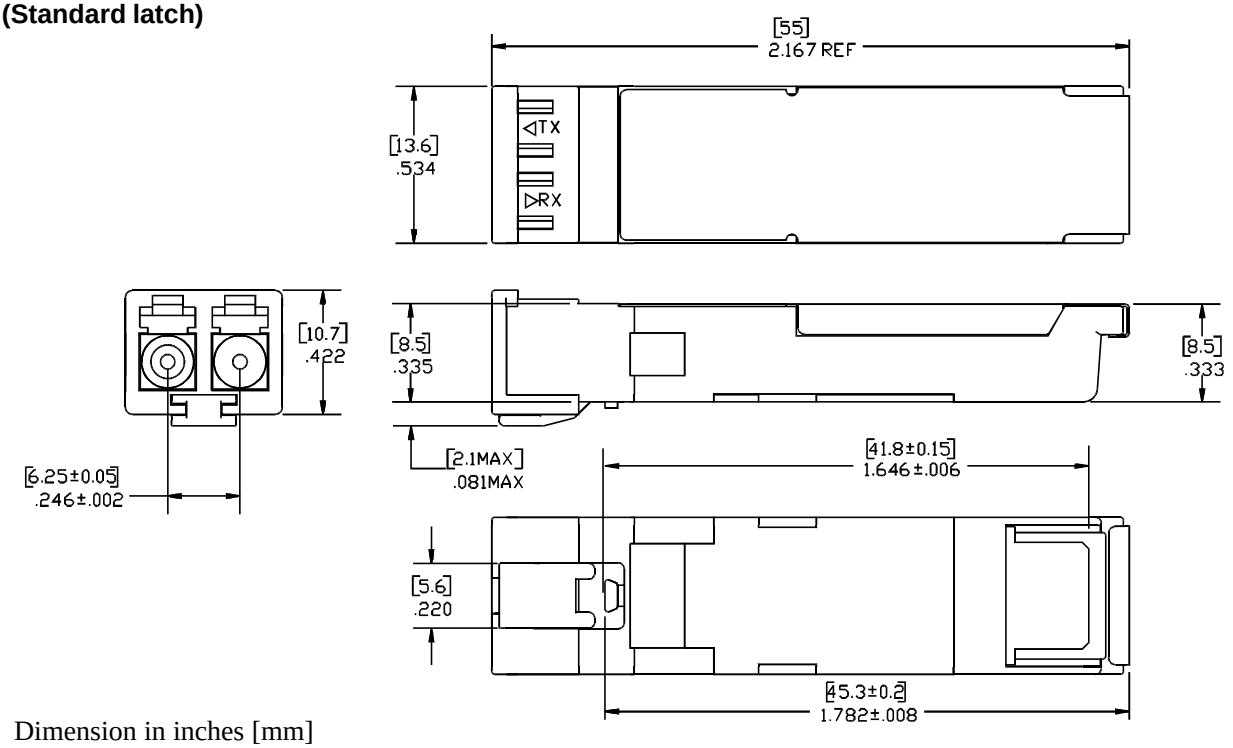
# TRP-03 & TRP-12

**Package Outline**
**(Wrap Around latch)**




Dimension in inches [mm]

**Package Outline**
**(Standard latch)**




Dimension in inches [mm]

For further information, please refer to applications notes for SFP transceivers.


## Optical Communication Products, Inc.

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