Finisar

# Product Specification

## RoHS-6 Compliant
## 10GBASE-LRM X2 Transponder

## FTLX1341E2

### PRODUCT FEATURES

- Hot pluggable X2 MSA form factor
- Total power consumption: 4.0 W maximum
- RoHS-6 compliant (lead-free)
- Temperature range 0°C to 70°C
- Transmission distance up to 220m*
- Uncooled 1310 nm directly modulated Fabry-Perot (FP) laser
- Built In Advanced Electronic Dispersion Compensation (EDC)
- SC connector, multimode fiber
- Full duplex transmission mode
- Digital Optics Monitoring (DOM)
- Power supply: +5.0 V, +3.3 V
- Adaptable Power Supply (APS: +1.2 V)
- XAUI electrical interface
  - 4 x 3.125 Gb/s Ethernet
- Management and control via MDIO 2-wire bus
- 70-pin connector
- Separated signal/chassis ground
- Mid Pak module variance for front panel mounting
- De-latch mechanism with low extraction force

### APPLICATIONS

- IEEE 802.3aq-2006
- 10 Gb/s Ethernet transmission on legacy multimode fiber.

The Finisar FTLX1341E2 transponder incorporates Electronic Dispersion Compensation (EDC) which provides correction for the severe modal dispersion that may occur during propagation through links up to 220m on legacy installed FDDI multimode fiber. The EDC device incorporates a Feed Forward Equalizer (FFE) and a Decision Feedback Equalizer (DFE). The EDC also contains sophisticated clock recovery architecture for extracting a robust clock from extremely distorted signals.

### PRODUCT SELECTION

| FTLX1341E2 |
|---|

* Maximum reach as defined by IEEE. Longer reach possible depending upon link implementation.

## I. Pin Description

| Signal Name | Level | I/O | Pin No. | Description |
|---|---|---|---|---|
| **Management and Monitoring Ports** | | | | |
| MDIO | Open Drain (output) 1.2V CMOS (input) | I/O | 17 | Management Data I/O. Requires external 10 - 22 kΩ pull-up to the APS on host. |
| MDC | 1.2 V CMOS | I | 18 | Management Data Clock Input |
| PRTAD4 | 1.2 V CMOS | 1 | 19 | Port Address Input bit 4 |
| PRTAD3 | 1.2 V CMOS | I | 20 | Port Address Input bit 3 |
| PRTAD2 | 1.2 V CMOS | I | 21 | Port Address Input bit 2 |
| PRTAD1 | 1.2 V CMOS | I | 22 | Port Address Input bit 1 |
| PRTAD0 | 1.2 V CMOS | I | 23 | Port Address Input bit 0 |
| LASI | Open Drain | O | 9 | Link Alarm Status Interrupt Output. Open Drain Compatible Output with 10 - 20 kΩ pull-up on host. Logic high = Normal Operation Logic low = Status Flag Triggered |
| RESET | 1.2 V CMOS | I | 10 | Reset Input. Open Drain Compatible Input with 22 kΩ pull-up to APS internal to transponder. Logic high = Normal Operation Logic low = RESET |
| Vendor Specific | | | 11,15,16,24 | Vendor Specific Pins. Leave unconnected when not used. |
| TX ON/OFF | 1.2 V CMOS | I | 12 | TX ON/OFF Input. Open Drain Compatible Input with 22 kΩ pull-up to APS internal to transponder. Logic high = Transmitter On Logic low = Transmitter Off |
| MOD DETECT | | O | 14 | Module Detect. Pulled low inside transponder through a 1 kΩ resistor to Ground |
| **Transmit Functions** | | | | |
| Reserved<br>Reserved | | I<br>I | 68<br>67 | Reserved For Future Use<br>Reserved For Future Use |
| TX LANE 3–<br>TX LANE 3+ | AC-coupled, Internally biased differential XAUI | I<br>I | 65<br>64 | Module XAUI Input Lane 3–<br>Module XAUI Input Lane 3+ |
| TX LANE 2–<br>TX LANE 2+ | | I<br>I | 62<br>61 | Module XAUI Input Lane 2–<br>Module XAUI Input Lane 2+ |
| TX LANE 1–<br>TX LANE 1+ | | I<br>I | 59<br>58 | Module XAUI Input Lane 1–<br>Module XAUI Input Lane 1+ |
| TX LANE 0–<br>TX LANE 0+ | | I<br>I | 56<br>55 | Module XAUI Input Lane 0–<br>Module XAUI Input Lane 0+ |

| | | | | |
|---|---|---|---|---|
| **Receive Functions** | | | | |
| Reserved<br>Reserved | | O<br>O | 38<br>39 | Reserved For Future Use<br>Reserved For Future Use |
| RX LANE 0+<br>RX LANE 0– | AC-coupled, Internally biased differential XAUI | O<br>O | 41<br>42 | Module XAUI Output Lane 0+<br>Module XAUI Output Lane 0– |
| RX LANE 1+<br>RX LANE 1– | | O<br>O | 44<br>45 | Module XAUI Output Lane 1+<br>Module XAUI Output Lane 1– |
| RX LANE 2+<br>RX LANE 2– | | O<br>O | 47<br>48 | Module XAUI Output Lane 2+<br>Module XAUI Output Lane 2– |
| RX LANE 3+<br>RX LANE 3– | | O<br>O | 50<br>51 | Module XAUI Output Lane 3+<br>Module XAUI Output Lane 3– |
| **DC Power** | | | | |
| GND | 0 V DC | | 1, 2, 3, 33, 34, 35, 36, 37, 40, 43, 46, 49, 52, 53, 54, 57, 60, 63, 66, 69, 70 | Ground connection for signal ground on the module |
| APS | +1.2 V | | 7, 8, 28, 29 | Input from Adaptive Power Supply |
| APS SENSE | +1.2 V | | 27 | APS Sense Output. Connected to the APS input inside transponder. |
| APS SET | | | 25 | Feedback input from APS. Connected to GND through a 1180Ω resistor inside the transponder. |
| 3.3 V | +3.3 V DC | | 5, 6, 30, 31 | DC Power Input, +3.3 V DC, Nominal |
| 5.0 V | +5.0 V DC | | 4, 32 | DC Power Input, +5.0 V DC, Nominal |
| Reserved | | | 26 | Reserved for APD. |
| Reserved | | | 13 | Reserved. |

### Electrical Pad Layout

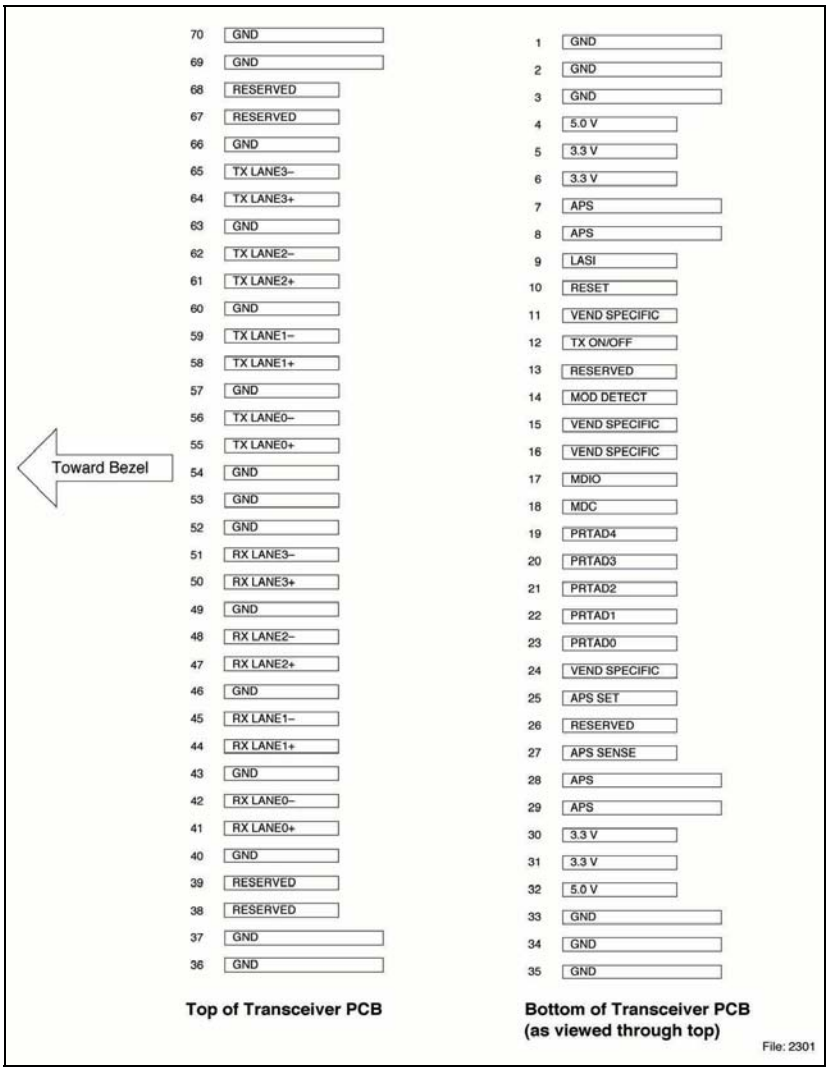


**Figure 1- X2 Transponder Electrical Pad Layout**

## II. Absolute Maximum Ratings

| Parameter | Symbol | Limit Values | | Unit |
|---|---|---|---|---|
| | | min. | max. | |
| Storage Temperature[1)] | $T_S$ | -40 | 85 | °C |
| Supply Voltage +5.0 V | $V_5$ | 0 | 6 | V |
| Supply Voltage +3.3 V | $V_3$ | 0 | 4 | V |
| Supply Voltage APS | $V_{aps}$ | 0 | 1.5 | V |
| Static Discharge Voltage, All Pins[2)] | $ST_d$ | | 500 | V |
| Average Receive Optical Power | $Rx_{P\ max}$ | | 1.5 | dBm |

Notes:
1) Non-condensing
2) HBM

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device.

# III. Electrical Characteristics

## Recommended Operating Conditions

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | min. | typ. | max. | |
| Operating Case Temperature[1)] | $T_C$ | 0 | | 70 | °C |
| Transponder Total Power Consumption | $P$ | | | 4 | W |
| Supply Voltage +5.0 V | $V_{CC5}$ | 4.75 | 5.0 | 5.25 | V |
| Supply Current +5.0 V | $I_{CC5}$ | | | 10 | mA |
| Supply Voltage +3.3 V | $V_{CC3}$ | 3.14 | 3.3 | 3.47 | V |
| Supply Current +3.3 V | $I_{CC3}$ | | | 830 | mA |
| Supply Voltage APS | $V_{CC\ aps}$ | 1.152 | 1.2 | 1.248 | V |
| Supply Current APS | $I_{CC\ aps}$ | | | 850 | mA |

[1)] Measured at reference thermal location, see **Figure 3**.
See also **Environmental Performance.**

## Electrical DC Characteristics

($V_{CC5}$ = 4.75 V to 5.25 V, $V_{CC3}$ = 3.14 V to 3.47 V, $V_{CC\ aps}$ = 1.152 V to 1.248 V, $T_C$ = 0°C to 70°C)

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | min. | typ. | max. | |
| **1.2 V CMOS (1.8 V CMOS Compatible[1)]) I/O DC Characteristics (PRTAD; LASI; RESET; TX_ONOFF)** | | | | | |
| External Pull-up Resistor for Open Drain | $R_{pullup}$ | 10 | | 22 | kΩ |
| Output High Voltage[2)] | $V_{oh}$ | 1 | | | V |
| Output Low Voltage[2)] | $V_{ol}$ | | | 0.15 | V |
| Input High Voltage | $V_{ih}$ | 0.84 | | 1.5 | V |
| Input Low Voltage | $V_{il}$ | | | 0.36 | V |
| Input Pull-down Current[3)] | $I_{pd}$ | 20 | | 120 | µA |
| **MDIO I/O Characteristics (MDIO; MDC)** | | | | | |
| MDIO Data Hold Time | $t_{HOLD}$ | 10 | | | ns |
| MDIO Data Setup Time | $t_{SU}$ | 10 | | | ns |
| Delay from MDC Rising Edge to MDIO Data Change | $t_{DELAY}$ | | | 300 | ns |
| MDC Clock Rate | $f_{MAX}$ | | | 2.5 | MHz |
| Output Low Voltage[5)] | $V_{OL}$ | –0.3 | | 0.2 | V |
| Output Low Current | $I_{OL}$ | | | 20 | mA |
| Input High Voltage | $V_{IH}$ | 0.84 | 1.2 | 1.5 | V |
| Input Low Voltage | $V_{IL}$ | –0.3 | | 0.36 | V |
| Pull-up Supply Voltage | $V_{PU}$ | 0.84 | 1.2 | 1.5 | V |
| Input Capacitance | $C_{IN}$ | | | 10 | pF |
| Load Capacitance | $C_{LOAD}$ | | | 470 | pF |
| External Pull-up Resistance | $R_{LOAD}$ | 200 | | | Ω |
| **Power-On Reset AC Characteristics** | | | | | |
| Power-On Reset and TX_ONOFF Characteristics | According to XENPAK MSA Issue 3.0 Draft 4.0, 2002-9-9 | | | | |

[1)] For 1.8 V CMOS $V_{oh}$ = 1.65 V min., $V_{ol}$ = 0.15 V max., $V_{ih}$ = 1.17 V min., $V_{il}$ = 0.63 V max.
[2)] $R_{pull\text{-}up}$ = 10 kΩ to 1.8 V.
[3)] $V_{in}$ = 1.8 V.
[4)] AC coupled.
[5)] $I_{OL}$ = 100 µA.

### Electrical AC Characteristics

($V_{CC5}$ = 4.75 V to 5.25 V, $V_{CC3}$ = 3.14 V to 3.47 V, $V_{CC\ aps}$ = 1.152 V to 1.248 V, $T_C$ = 0°C to 70°C)

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | min. | typ. | max. | |
| **XAUI Input AC Characteristics (TXLANE[0..3])** | | | | | |
| Baud Rate Ethernet | $R_{XAUIIN}$ | | 3.125 | | Gbit/s |
| Baud Rate Tolerance | $R_{TOLXAUI}$ | –100 | | 100 | ppm |
| Differential Input Impedance | $Z_{INXAUI}$ | 80 | 100 | 120 | Ω |
| Differential Return Loss[1)] | $\|S_{11}\|$ | 10 | | | dB |
| Input Differential Skew[2)] | $t_{SKEWIN}$ | | | 75 | ps |
| Jitter Amplitude Tolerance[3)] | $J_{XAUITOL}$ | | | 0.65 | $UI_{p-p}$ |
| **XAUI Output AC Characteristics (RXLANE[0..3])** | | | | | |
| Baud Rate Ethernet | $R_{XAUIOUT}$ | | 3.125 | | Gbit/s |
| Baud Rate Variation | $R_{XAUIVAR}$ | –100 | | 100 | ppm |
| XAUI Eye Mask (far-end) | According to IEEE 802.3ae | | | | |
| Output Differential Impedance | $Z_{OUTXAUI}$ | 80 | 100 | 120 | Ω |
| Differential Output Return Loss[1)] | $\|S_{22}\|$ | 10 | | | dB |

1) 100 MHz to 2.5 GHz.
2) At crossing point.
3) Per IEEE Std 802.3ae.

## IV. Optical Characteristics

### RMS Spectral Width Mask

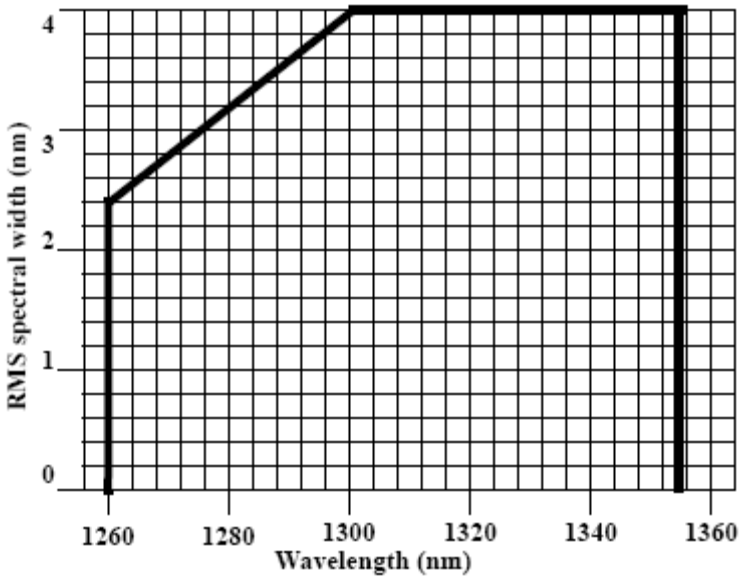


**Figure 2-Transmitter Maximum RMS Spectral Width**

### Optical Specifications

| Parameter | Symbol | Min | Typ | Max | Unit | Ref. |
|---|---|---|---|---|---|---|
| **Transmitter** | | | | | | |
| Optical Modulation Amplitude (OMA) | $P_{OMA}$ | -4.5 | | +1.5 | dBm | |
| Average Launch Power | $P_{AVE}$ | -6.5 | | +0.5 | dBm | |
| Peak Launch Power | $P_{MAX}$ | | | +3 | dBm | |
| Optical Wavelength | λ | 1260 | | 1355 | nm | |
| Spectral Width | $\lambda_{rms}$ @1260nm | | | 2.4 | nm | 1 |
| | $\lambda_{rms}$ @ 1260nm-1300nm | | | See Figure 2 | | |
| | $\lambda_{rms}$ @ 1300nm-1355nm | | | 4 | | |
| Optical Extinction Ratio | *ER* | 3.5 | | | dB | |
| Optical Eye Mask Margin | | 0 | | | % | 2 |
| Transmitter Waveform Dispersion Penalty | *TWDP* | | | 4.7 | dB | 3 |
| Average Launch Power of OFF Transmitter | $P_{OFF}$ | | | -30 | dBm | |
| Uncorrelated Jitter [rms] | $Tx_j$ | | | 0.033 | UI | |
| Relative Intensity Noise | $RIN_{20}OMA$ | | | -128 | dB/Hz | |
| Encircled Flux | <5μm | 30 | | | % | |
| | <11μm | 81 | | | | |
| Tramsmitter Reflectance | | | | -12 | dB | |
| **Receiver** | | | | | | |
| Overload in OMA | | +1.5 | | | dBm | 4 |
| Comprehensive Stressed Receiver Sensitivity (OMA) @ 10.3125Gb/s | Precursor | | | -6.5 | dBm | |
| | Symmetrical | | | -6.0 | | |
| | Postcursor | | | -6.5 | | |
| Optical Center Wavelength | $\lambda_C$ | 1260 | | 1355 | nm | |
| Receiver Reflectance | $R_{rx}$ | | | -12 | dB | |
| Signal Detect Deassert Level | $P_{SDD}$ | | | -14.4 | dBm | |
| Signal Detect Assert Level | $P_{SDA}$ | -25.0 | | | dBm | |
| Signal Detect Hysteresis | $P_{SDH}$ | 0.5 | 1.5 | | dB | |

Notes:
1) Maximum RMS spectral width as specified by Figure 68-3 in IEEE802.3aq -2006
2) Optical eye mask per IEEE802.3aq -2006.
3) TWDP is calculated using the Matlab code provided in clause 68.6.6.2 of IEEE802.3aq -2006
4) Receiver overload specified in OMA and under the worst comprehensive stressed condition.

## V. General Specifications

### Optical Interface Standard Specifications

| Fiber Type | 850nm OFL Bandwidth | Symbol | Distance [1] | Units |
|---|---|---|---|---|
| 62.5μm | "FDDI" 160MHz/km | Lmax | 220 | m |
| | OM1 200MHz/km | | 220 | |
| 50μm | 400MHz/km | Lmax | 100 | m |
| | OM2 500MHz/km | | 220 | |
| | OM3 2000MHz/km | | 220 | |

Notes:
1) Operating range as defined by IEEE standards. Longer reach possible depending upon link implementation.

### Environmental Performance

Operating case temperature: 0°C to +70°C
Operating humidity: 0% -95% RH non-condensing

### Fibers and Connectors

The transponder has SC receptacles for both Tx and Rx. The transponder is designed for multimode SC cables, 0° polished endface (PC).

### 70-pin Connector

The module interface connector is a 70-pin, printed circuit board edge connection with a 0.5 mm pitch. The appropriate mating connector for the customer PCB is a 70-pin SMT, dual row, right angled, edge connector, 0.5 mm pitch (Tyco Electronics part number 1367337-1, Molex part number 74441-0003 or equivalent).

### Rail Requirement

The X2 rail system required to mount the X2 module is fully defined by the MSA. (Tyco Electronics part number 1367608-1: designed for belly to belly applications; and 1367610-1, designed for single sided board mount to fit into the standard host PCB footprint; or equivalent). For further details please refer to vendor-supplied information.

### Aqueous Wash

Finisar X2 transponders are neither solderable nor aqueous washable and are not intended for these processes.

## VI. Regulatory Compliance

| Feature | Standard | Comments |
|---|---|---|
| ESD:<br>Electrostatic Discharge to the Electrical Pins (HBM) | EIA/JESD22-A114-B<br>(MIL-STD 883D Method 3015.7) | Class 1a (> 500 V) |
| Immunity:<br>Against Electrostatic Discharge (ESD) to the Module Receptacle | EN 61000-4-2<br>IEC 61000-4-2 | Discharges ranging from ±2 kV to ±25 kV to the front end / faceplate / receptacle cause no damage to module (under recommended conditions). |
| Immunity:<br>Against Radio Frequency Electromagnetic Field | EN 61000-4-3<br>IEC 61000-4-3 | With field strength of 10 V/m, noise frequency ranges from 10 MHz to 2 GHz. No effect on module performance between the specification limits. |
| Emission:<br>Electromagnetic Interference (EMI) | FCC 47 CFR<br>Part 15, Class B<br>EN 55022 Class B<br>CISPR 22 | Noise frequency range:<br>30 MHz to 40 GHz<br>Radiated emission does not exceed specified limits when measured with module inside a shielding enclosure with a MSA conforming cutout. |

### Eye Safety

Finisar FTLX1341E2 transponders are Class 1 Laser Products. They are certified per the following standards:

| Feature | Agency | Standard | Certificate Number |
|---|---|---|---|
| Laser Eye Safety | FDA/CDRH | CDRH 21 CFR 1040 and Laser Notice 50 | 9210176-77 |
| Laser Eye Safety | TÜV | EN 60825-1: 1994+A11:1996+A2:2001<br>IEC 60825-1: 1993+A1:1997+A2:2001<br>IEC 60825-2: 2000, Edition 2 | R 72082131 |
| Electrical Safety | TÜV | EN 60950 | R 72082131 |
| Electrical Safety | UL/CSA | CLASS 3862.07<br>CLASS 3862.87 | 1439230 |

Copies of the referenced certificates are available from Finisar Corporation upon request.

## VII. DOM Parameters

| Parameter | Values | | | Unit |
|---|---|---|---|---|
| | min. | typ. | max. | |
| Transponder Temperature Monitor Accuracy[1)] | -5 | | +5 | °C |
| Laser Bias Current Monitor Accuracy[2)] | -10 | | +10 | % |
| Transmit Power Monitor Accuracy[3)] | -3 | | +3 | dB |
| Receive Power Monitor Accuracy[3)] | -3 | | +3 | dB |

[1)] 0 to 70°C case temperature.
[2)] 0 to 12.5 mA.
[3)] -8.2 dBm to +0.5 dBm.

## VIII. Mechanical Specifications

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | min. | typ. | max. | |
| Module Retention Force (latch strength) | $F_{RET}$ | | 200 | | N |
| Module Insertion Force | $F_{IN}$ | | 40 | | N |
| Module Extraction Force (with kick-out) | $F_{EXT-K}$ | | 16 | | N |
| Module Extraction Force (without kick-out) | $F_{EXT}$ | | 25 | | N |

Pull Sleeve front face color is orange.

### Package Outline

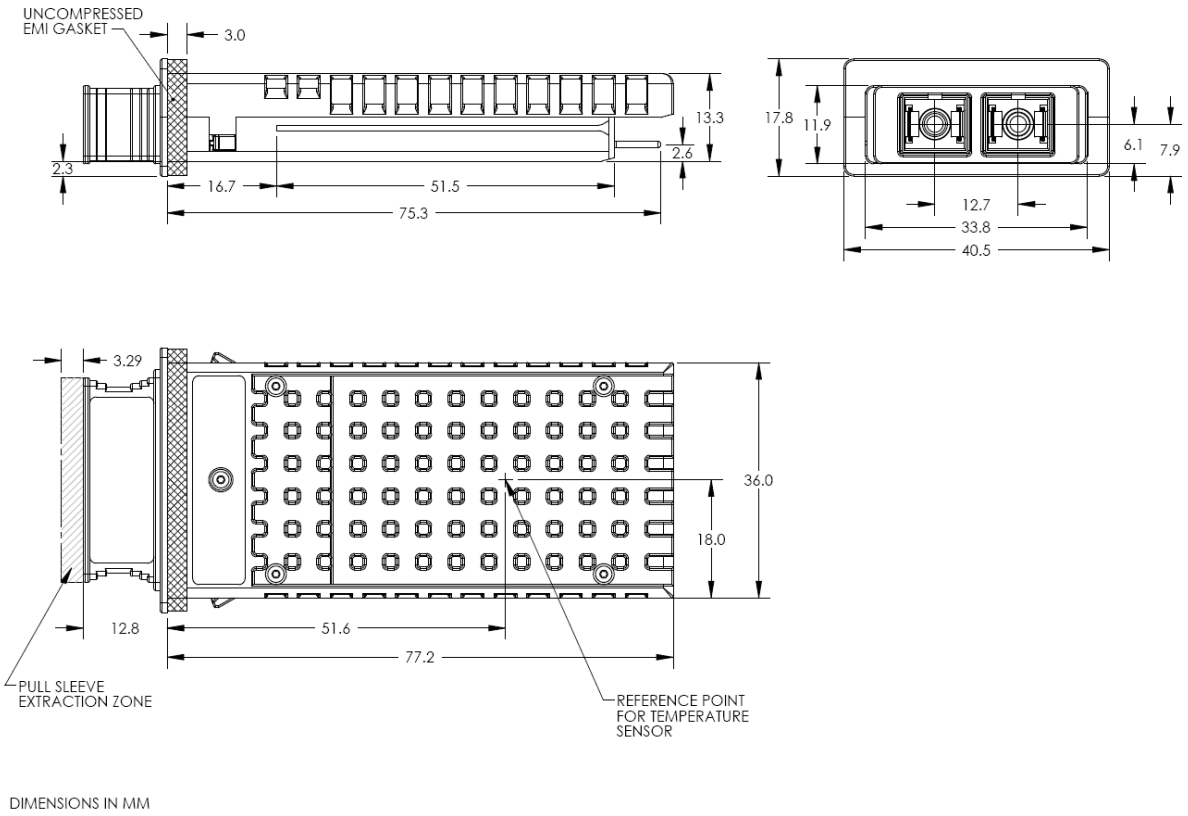


**Figure 3-X2 Mechanical Dimensions**

## IX. References

The following references are provided for informational purposes only. The parameters and operational behavior outlined in this specification describe the complete functionality of the 10G Transponder. Contact Finisar for any items concerning the operational characteristics of this device.

1. IEEE 802.3ae-2002, August 30, 2002.
2. IEEE Std 802.3aq™-2006
3. X2 MSA Rev 2.0b, January 30, 2003

## X. For More Information

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