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FINISAR

## Product Specification

# High Link Budget, Multi-Rate, DWDM XFP Optical Transceiver

# FTLX3912M3xx

### PRODUCT FEATURES

- Supports 8.5Gb/s* to 11.3Gb/s bit rates
- 100GHz channel spacing on the ITU C-band
- Hot-pluggable XFP footprint
- RoHS-6 Compliant (lead-free)
- Temperature-stabilized 1550nm EML transmitter
- Supports -300ps/nm to +800ps/nm
- 3.3V and 5V power supplies required
- Point-to-Point & OSNR optimized versions
- Power dissipation < 3.5W
- Commercial temperature range: 0°C to 70°C
- Reference clock not required

### APPLICATIONS

- SONET OC-192 IR-2 Transmitter w/APD
  SDH STM S-64.2b Transmitter w/APD
  SDH STM S-64.3b Transmitter w/APD
  ITU-T G.709 Transmitter w/APD
- 10GBASE-ER/EW Transmitter w/APD
  10GBASE-ER/EW + FEC Tx w/APD
- 40km 10G Fibre Channel Transmitter w/APD

Finisar's 40km DWDM FTLX3912M3xx Small Form Factor 10Gb/s XFP transceivers comply with the current XFP Multi-Source Agreement (MSA) Specification[1]. The transmitter specification is based upon SONET OC-192 IR-2, OC-192 IR-3, SDH STM S-64.2b, STM S-64.3b and 10-Gigabit Ethernet 10GBASE-ER/EW per IEEE 802.3ae but uses an APD ROSA for additional link budget. Digital diagnostics functions are available via a 2-wire serial interface, as specified in the XFP MSA. The optical transceiver is compliant per the RoHS Directive 2011/65/EU[3]. See Finisar Application Note AN-2038 for more details[4].

### PRODUCT SELECTION

| FTLX3912M3xx |
|---|

**xx**: 100GHz ITU Grid wavelength (see next page)

## Part Numbers for Amplified (OSNR) Applications:

| Channel # | Product Code | Frequency (THz) | Center Wavelength (nm) |
|---|---|---|---|
| 17 | FTLX3912M317 | 191.7 | 1563.86 |
| 18 | FTLX3912M318 | 191.8 | 1563.05 |
| 19 | FTLX3912M319 | 191.9 | 1562.23 |
| 20 | FTLX3912M320 | 192.0 | 1561.42 |
| 21 | FTLX3912M321 | 192.1 | 1560.61 |
| 22 | FTLX3912M322 | 192.2 | 1559.79 |
| 23 | FTLX3912M323 | 192.3 | 1558.98 |
| 24 | FTLX3912M324 | 192.4 | 1558.17 |
| 25 | FTLX3912M325 | 192.5 | 1557.36 |
| 26 | FTLX3912M326 | 192.6 | 1556.55 |
| 27 | FTLX3912M327 | 192.7 | 1555.75 |
| 28 | FTLX3912M328 | 192.8 | 1554.94 |
| 29 | FTLX3912M329 | 192.9 | 1554.13 |
| 30 | FTLX3912M330 | 193.0 | 1553.33 |
| 31 | FTLX3912M331 | 193.1 | 1552.52 |
| 32 | FTLX3912M332 | 193.2 | 1551.72 |
| 33 | FTLX3912M333 | 193.3 | 1550.92 |
| 34 | FTLX3912M334 | 193.4 | 1550.12 |
| 35 | FTLX3912M335 | 193.5 | 1549.32 |
| 36 | FTLX3912M336 | 193.6 | 1548.51 |
| 37 | FTLX3912M337 | 193.7 | 1547.72 |
| 38 | FTLX3912M338 | 193.8 | 1546.92 |
| 39 | FTLX3912M339 | 193.9 | 1546.12 |
| 40 | FTLX3912M340 | 194.0 | 1545.32 |
| 41 | FTLX3912M341 | 194.1 | 1544.53 |
| 42 | FTLX3912M342 | 194.2 | 1543.73 |
| 43 | FTLX3912M343 | 194.3 | 1542.94 |
| 44 | FTLX3912M344 | 194.4 | 1542.14 |
| 45 | FTLX3912M345 | 194.5 | 1541.35 |
| 46 | FTLX3912M346 | 194.6 | 1540.56 |
| 47 | FTLX3912M347 | 194.7 | 1539.77 |
| 48 | FTLX3912M348 | 194.8 | 1538.98 |
| 49 | FTLX3912M349 | 194.9 | 1538.19 |
| 50 | FTLX3912M350 | 195.0 | 1537.40 |
| 51 | FTLX3912M351 | 195.1 | 1536.61 |
| 52 | FTLX3912M352 | 195.2 | 1535.82 |
| 53 | FTLX3912M353 | 195.3 | 1535.04 |
| 54 | FTLX3912M354 | 195.4 | 1534.25 |
| 55 | FTLX3912M355 | 195.5 | 1533.47 |
| 56 | FTLX3912M356 | 195.6 | 1532.68 |
| 57 | FTLX3912M357 | 195.7 | 1531.90 |
| 58 | FTLX3912M358 | 195.8 | 1531.12 |
| 59 | FTLX3912M359 | 195.9 | 1530.33 |
| 60 | FTLX3912M360 | 196.0 | 1529.55 |
| 61 | FTLX3912M360 | 196.0 | 1528.77 |

## Part Numbers for Point-to-Point (maximum Link Budget) Applications:

| Channel # | Product Code | Frequency (THz) | Center Wavelength (nm) |
|---|---|---|---|
| 17* | FTLX3912M317P | 191.7 | 1563.86 |
| 18* | FTLX3912M318P | 191.8 | 1563.05 |
| 19 | FTLX3912M319P | 191.9 | 1562.23 |
| 20 | FTLX3912M320P | 192.0 | 1561.42 |
| 21 | FTLX3912M321P | 192.1 | 1560.61 |
| 22 | FTLX3912M322P | 192.2 | 1559.79 |
| 23 | FTLX3912M323P | 192.3 | 1558.98 |
| 24 | FTLX3912M324P | 192.4 | 1558.17 |
| 25 | FTLX3912M325P | 192.5 | 1557.36 |
| 26 | FTLX3912M326P | 192.6 | 1556.55 |
| 27 | FTLX3912M327P | 192.7 | 1555.75 |
| 28 | FTLX3912M328P | 192.8 | 1554.94 |
| 29 | FTLX3912M329P | 192.9 | 1554.13 |
| 30 | FTLX3912M330P | 193.0 | 1553.33 |
| 31 | FTLX3912M331P | 193.1 | 1552.52 |
| 32 | FTLX3912M332P | 193.2 | 1551.72 |
| 33 | FTLX3912M333P | 193.3 | 1550.92 |
| 34 | FTLX3912M334P | 193.4 | 1550.12 |
| 35 | FTLX3912M335P | 193.5 | 1549.32 |
| 36 | FTLX3912M336P | 193.6 | 1548.51 |
| 37 | FTLX3912M337P | 193.7 | 1547.72 |
| 38 | FTLX3912M338P | 193.8 | 1546.92 |
| 39 | FTLX3912M339P | 193.9 | 1546.12 |
| 40 | FTLX3912M340P | 194.0 | 1545.32 |
| 41 | FTLX3912M341P | 194.1 | 1544.53 |
| 42 | FTLX3912M342P | 194.2 | 1543.73 |
| 43 | FTLX3912M343P | 194.3 | 1542.94 |
| 44 | FTLX3912M344P | 194.4 | 1542.14 |
| 45 | FTLX3912M345P | 194.5 | 1541.35 |
| 46 | FTLX3912M346P | 194.6 | 1540.56 |
| 47 | FTLX3912M347P | 194.7 | 1539.77 |
| 48 | FTLX3912M348P | 194.8 | 1538.98 |
| 49 | FTLX3912M349P | 194.9 | 1538.19 |
| 50 | FTLX3912M350P | 195.0 | 1537.40 |
| 51 | FTLX3912M351P | 195.1 | 1536.61 |
| 52 | FTLX3912M352P | 195.2 | 1535.82 |
| 53 | FTLX3912M353P | 195.3 | 1535.04 |
| 54 | FTLX3912M354P | 195.4 | 1534.25 |
| 55 | FTLX3912M355P | 195.5 | 1533.47 |
| 56 | FTLX3912M356P | 195.6 | 1532.68 |
| 57 | FTLX3912M357P | 195.7 | 1531.90 |
| 58 | FTLX3912M358P | 195.8 | 1531.12 |
| 59 | FTLX3912M359P | 195.9 | 1530.33 |
| 60 | FTLX3912M360P | 196.0 | 1529.55 |
| 61 | FTLX3912M361P | 196.0 | 1528.77 |

## I. Pin Descriptions

| Pin | Logic | Symbol | Name/Description | Ref. |
|---|---|---|---|---|
| 1 | | GND | Module Ground | 1 |
| 2 | | VEE5 | Optional –5.2 Power Supply – **Not required** | |
| 3 | LVTTL-I | Mod-Desel | Module De-select; When held low allows the module to respond to 2-wire serial interface commands | |
| 4 | LVTTL-O | $\overline{\text{Interrupt}}$ | Interrupt (bar); Indicates presence of an important condition which can be read over the serial 2-wire interface | 2 |
| 5 | LVTTL-I | TX_DIS | Transmitter Disable; Transmitter laser source turned off | |
| 6 | | VCC5 | +5 Power Supply | |
| 7 | | GND | Module Ground | 1 |
| 8 | | VCC3 | +3.3V Power Supply | |
| 9 | | VCC3 | +3.3V Power Supply | |
| 10 | LVTTL-I | SCL | Serial 2-wire interface clock | 2 |
| 11 | LVTTL-I/O | SDA | Serial 2-wire interface data line | 2 |
| 12 | LVTTL-O | Mod_Abs | Module Absent; Indicates module is not present. Grounded in the module. | 2 |
| 13 | LVTTL-O | Mod_NR | Module Not Ready; Finisar defines it as a logical OR between RX_LOS and Loss of Lock in TX/RX. | 2 |
| 14 | LVTTL-O | RX_LOS | Receiver Loss of Signal indicator | 2 |
| 15 | | GND | Module Ground | 1 |
| 16 | | GND | Module Ground | 1 |
| 17 | CML-O | RD- | Receiver inverted data output | |
| 18 | CML-O | RD+ | Receiver non-inverted data output | |
| 19 | | GND | Module Ground | 1 |
| 20 | | VCC2 | +1.8V Power Supply – **Not Required** | |
| 21 | LVTTL-I | P_Down/RST | Power Down; When high, places the module in the low power stand-by mode and on the falling edge of P_Down initiates a module reset | |
| | | | Reset; The falling edge initiates a complete reset of the module including the 2-wire serial interface, equivalent to a power cycle. | |
| 22 | | VCC2 | +1.8V Power Supply – **Not Required** | |
| 23 | | GND | Module Ground | 1 |
| 24 | PECL-I | RefCLK+ | Reference Clock non-inverted input, AC coupled on the host board – **Not required** | |
| 25 | PECL-I | RefCLK- | Reference Clock inverted input, AC coupled on the host board – **Not required** | |
| 26 | | GND | Module Ground | 1 |
| 27 | | GND | Module Ground | 1 |
| 28 | CML-I | TD- | Transmitter inverted data input | |
| 29 | CML-I | TD+ | Transmitter non-inverted data input | |
| 30 | | GND | Module Ground | 1 |

Notes:
1. Module circuit ground is isolated from module chassis ground within the module.
2. Open collector; should be pulled up with 4.7k – 10kohms on host board to a voltage between 3.15V and 3.6V.

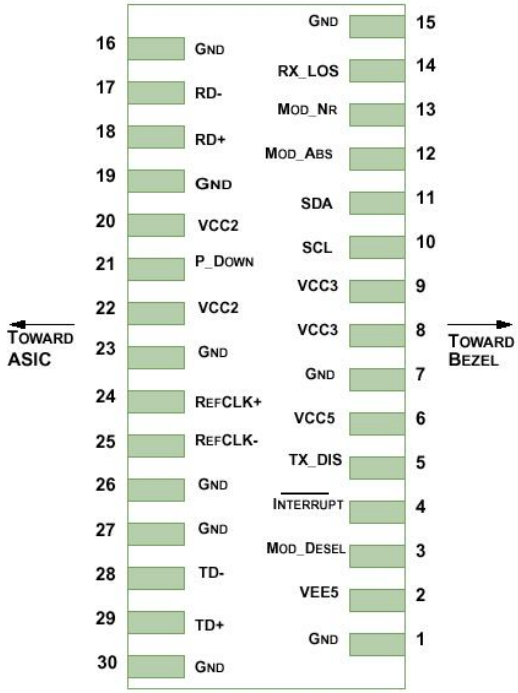



**Diagram of Host Board Connector Block Pin Numbers and Names**

## II. Absolute Maximum Ratings

| Parameter | Symbol | Min | Typ | Max | Unit | Ref. |
|---|---|---|---|---|---|---|
| Maximum Supply Voltage 1 | Vcc3 | -0.5 | | 4.0 | V | |
| Maximum Supply Voltage 2 | Vcc5 | -0.5 | | 6.0 | V | |
| Storage Temperature | $T_S$ | -40 | | 85 | °C | |
| Case Operating Temperature | $T_{OP}$ | 0 | | 70 | °C | |
| SBS Threshold | $Tx_{SBS}$ | 8 | | | dBm | |

## III. Electrical Characteristics ($T_{OP}$ = 0 to 70 °C, $V_{CC5}$ = 4.75 to 5.25 Volts)

| Parameter | Symbol | Min | Typ | Max | Unit | Ref. |
|---|---|---|---|---|---|---|
| Main Supply Voltage | Vcc5 | 4.75 | | 5.25 | V | |
| Supply Voltage #2 | Vcc3 | 3.13 | | 3.45 | V | |
| Supply Current – Vcc5 supply | Icc5 | | | 450 | mA | |
| Supply Current – Vcc3 supply | Icc3 | | | 750 | mA | |
| Module total power | P | | | 3.5 | W | 1 |
| **Transmitter** | | | | | | |
| Input differential impedance | $R_{in}$ | | 100 | | Ω | 2 |
| Differential data input swing | Vin,pp | 120 | | 820 | mV | |
| Transmit Disable Voltage | $V_D$ | 2.0 | | Vcc | V | 3 |
| Transmit Enable Voltage | $V_{EN}$ | GND | | GND+ 0.8 | V | |
| Transmit Disable Assert Time | | | | 10 | us | |
| **Receiver** | | | | | | |
| Differential data output swing | Vout,pp | 340 | 650 | 850 | mV | 4 |
| Data output rise time | $t_r$ | | | 38 | ps | 5 |
| Data output fall time | $t_f$ | | | 38 | ps | 5 |
| LOS Fault | $V_{LOS\ fault}$ | Vcc – 0.5 | | $Vcc_{HOST}$ | V | 6 |
| LOS Normal | $V_{LOS\ norm}$ | GND | | GND+0.5 | V | 6 |
| Power Supply Rejection | PSR | See Note 6 below | | | | 7 |

Notes:
1. Maximum total power value is specified across the full temperature and voltage range.
2. After internal AC coupling.
3. Or open circuit.
4. Into 100 ohms differential termination.
5. 20 – 80 %
6. Loss Of Signal is open collector to be pulled up with a 4.7k – 10kohm resistor to 3.15 – 3.6V. Logic 0 indicates normal operation; logic 1 indicates no signal detected.
7. Per Section 2.7.1. in the XFP MSA Specification[1].

## IV. Optical Characteristics ($T_{OP}$ = 0 to 70°C, $V_{CC5}$ = 4.75 to 5.25 Volts)

Please note that the Transmitter of the FTLX3912M3xx becomes operational within 5 seconds of power-up. This is due to the time required for the EML to reach its optimum operating temperature.

| Parameter | Symbol | Min | Typ | Max | Unit | Ref. |
|---|---|---|---|---|---|---|
| **Transmitter** | | | | | | |
| Output Opt. Pwr: 9/125 SMF | $P_{OUT}$ | -1 | | +3 | dBm | |
| Optical Extinction Ratio | ER | 8.2 | | | dB | |
| Center Wavelength Spacing | | | 100 | | GHz | |
| Transmitter Center Wavelength – End Of Life | λc | X-100 | X | X+100 | pm | |
| Transmitter Center Wavelength – Beginning Of Life | λc | X-25 | X | X+25 | pm | |
| Transmitter Dispersion Penalty (@ 800 ps/nm) | TDP | | | 2 | dB | 1 |
| Sidemode Supression ratio | $SSR_{min}$ | 30 | | | dB | |
| Tx Jitter (SONET) 20kHz-80MHz | $Tx_{j1}$ | | | 0.3 | UI | |
| Tx Jitter (SONET) 4MHz – 80MHz | $Tx_{j2}$ | | | 0.1 | UI | |
| Relative Intensity Noise | RIN | | | -130 | dB/Hz | |
| **Receiver** | | | | | | |
| Maximum Input Power | $P_{MAX}$ | -7 | | | dBm | |
| Rx Damage Threshold | $P_{DAM}$ | +5 | | | dBm | |
| Optical Center Wavelength | $\lambda_C$ | 1270 | | 1600 | nm | |
| Receiver Reflectance | $R_{rx}$ | | | -27 | dB | |
| LOS De-Assert | $LOS_D$ | | | -30 | dBm | |
| LOS Assert | $LOS_A$ | -37 | | | dBm | |
| LOS Hysteresis | | 0.5 | | | dB | |

**Receiver Sensitivity (FTLX3912M3xx & FTLX3912M3xxP)**

| Data rate (Gb/s) | BER | Dispersion (ps/nm) | Sensitivity back-to-back at OSNR>30dB (dBm) | Sensitivity at -300 to +800ps/nm with OSNR>30dB (dB) | Threshold Adjustm. |
|---|---|---|---|---|---|
| 8.5 | 1e-12 | -300 to +800 | -24 | -22 | No |
| 9.95 | 1e-12 | -300 to +800 | -24 | -22 | No |
| 10.3 | 1e-12 | -300 to +800 | -24 | -22 | No |
| 10.7 | 1e-12 | -300 to +800 | -24 | -21 | No |
| 10.7 | 1e-4 | -300 to +800 | -27 | -24 | Yes |
| 11.1 | 1e-4 | -300 to +800 | -27 | -23 | Yes |
| 11.3 | 1e-4 | -300 to +800 | -27 | -23 | Yes |

**OSNR Performance (FTLX3912M3xx ONLY)**

| Data rate (Gb/s) | BER | Dispersion (ps/nm) | Max OSNR, -300 ps/nm to +800 ps/nm at Power: -9 to -19dBm (dB) | Threshold Adjustm. |
|---|---|---|---|---|
| 9.95 | 1e-12 | -300 to +800 | 26 | No |
| 10.3 | 1e-12 | -300 to +800 | 26 | No |
| 10.7 | 1e-4 | -300 to +800 | 19 | Yes |
| 11.1 | 1e-4 | -300 to +800 | 19 | Yes |
| 11.3 | 1e-4 | -300 to +800 | 19 | Yes |

Notes:
1. 2dB spec is defined for 9.95Gb/s operation

## V. General Specifications

| Parameter | Symbol | Min | Typ | Max | Units | Ref. |
|---|---|---|---|---|---|---|
| Bit Rate | BR | 9.95 | | 11.3 | Gb/s | 1 |
| Bit Error Ratio | BER | | | $10^{-12}$ | | 2 |
| Max. Supported Link Length | $L_{MAX}$ | | 40 | | km | 3 |

Notes:
1. SONET OC-192 IR-2, OC-192 IR-3, 10GBASE-ER/EW, 10G Fibre Channel, ITU-T G.709, 10GBASE-ER/EW + FEC, 10G Fibre Channel + FEC
2. Tested with a $2^{31} - 1$ PRBS
3. G.652 fibre

## VI. Environmental Specifications

The FTLX3912M3xx transceiver has an operating case temperature range from 0°C to +70°C.

| Parameter | Symbol | Min | Typ | Max | Units | Ref. |
|---|---|---|---|---|---|---|
| Case Operating Temperature | $T_{op}$ | 0 | | 70 | °C | |
| Storage Temperature | $T_{sto}$ | -40 | | 85 | °C | |

## VII. Regulatory Compliance

Finisar XFP transceivers 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: 2007, EN60825-2:2004+A1<br>IEC 60825-1: 2007 (2nd Edition)<br>IEC 60825-2: 2010 (3rd Edition) | R72101686 |
| Electrical Safety | TÜV | EN 60950:2006+A11 | R72101686 |
| Electrical Safety | UL/CSA | CLASS 3862.07<br>CLASS 3862.87 | 2283290 |

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

## VIII. Digital Diagnostics Functions

As defined by the XFP MSA[1], Finisar XFP transceivers provide digital diagnostic functions via a 2-wire serial interface, which allows real-time access to the following operating parameters:

- Transceiver temperature
- Laser bias current
- Transmitted optical power
- Received optical power
- Transceiver supply voltage

It also provides a sophisticated system of alarm and warning flags, which may be used to alert end-users when particular operating parameters are outside of a factory-set normal range.

The operating and diagnostics information is monitored and reported by a Digital Diagnostics Transceiver Controller (DDTC) inside the transceiver, which is accessed through the 2-wire serial interface. When the serial protocol is activated, the serial clock signal (SCL pin) is generated by the host. The positive edge clocks data into the XFP transceiver into those segments of its memory map that are not write-protected. The negative edge clocks data from the XFP transceiver. The serial data signal (SDA pin) is bi-directional for serial data transfer. The host uses SDA in conjunction with SCL to mark the start and end of serial protocol activation. The memories are organized as a series of 8-bit data words that can be addressed individually or sequentially. The 2-wire serial interface provides sequential or random access to the 8 bit parameters, addressed from 000h to the maximum address of the memory.

For more detailed information, including memory map definitions, please see the XFP MSA documentation[1].

**8.5Gb/s Fibre-Channel:**

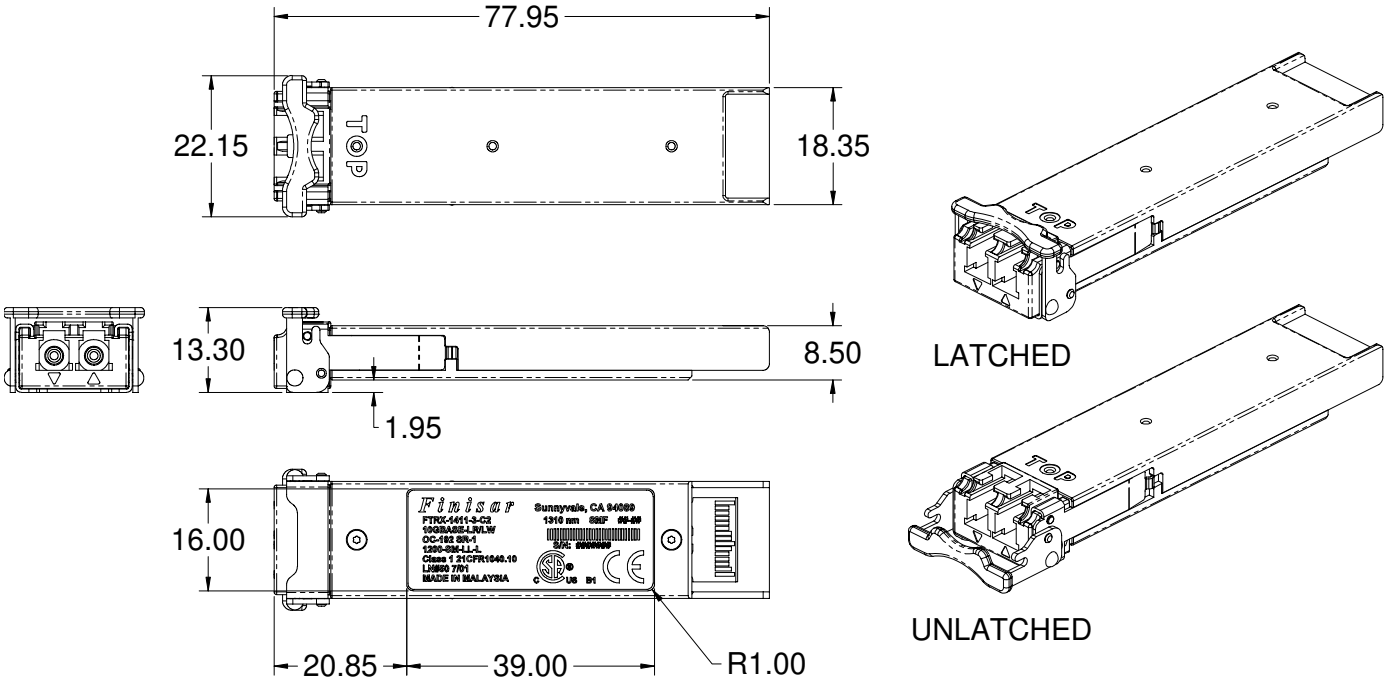
To operate the FTLX3912M3xx at 8.5Gb/s Fibre-Channel, the EEPROM-Table 0, Byte 117, Bit 0 must be set as follows; .

- EEPROM Byte 117, Bit 0, value “1” for 8GFC:
- EEPROM Byte 117, Bit 0 value “0” for 10Gb/s rates:
    - (It is also possible to bypass the CDRs with, Byte 111, Bit 0.)

By default, a power cycling the transceiver will return the transceiver to normal 10Gb/s operation with the CDRs active.

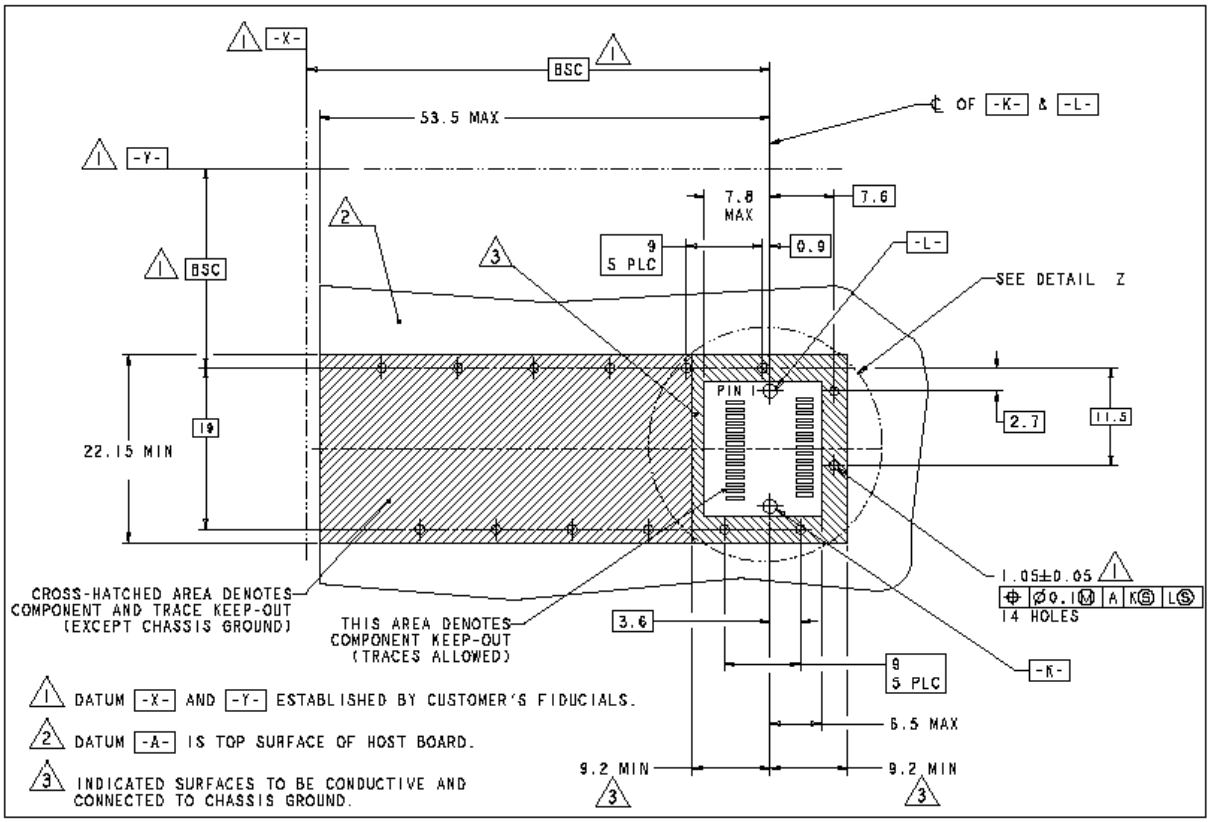
## IX. Mechanical Specifications

Finisar's XFP transceivers are compliant with the dimensions defined by the XFP Multi-Sourcing Agreement (MSA).

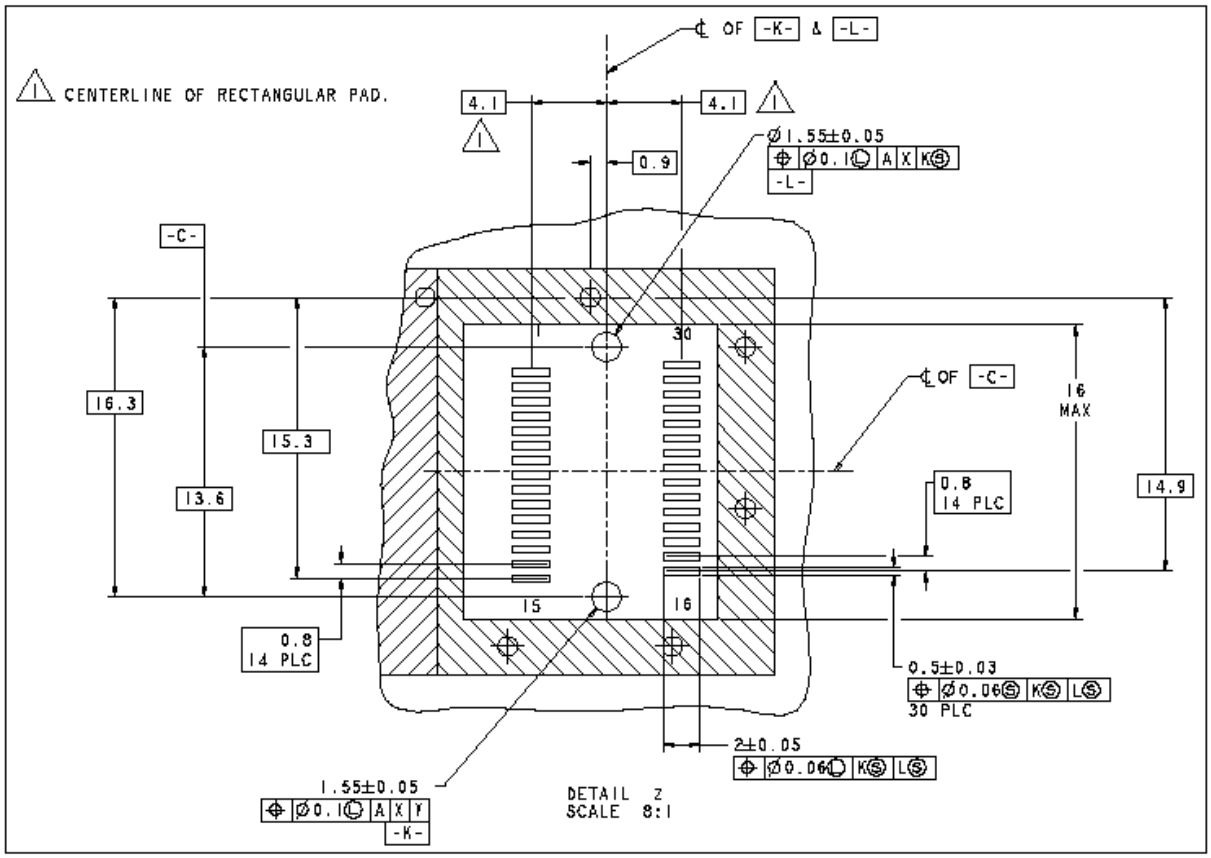



**XFP Transceiver (dimensions are in mm)**

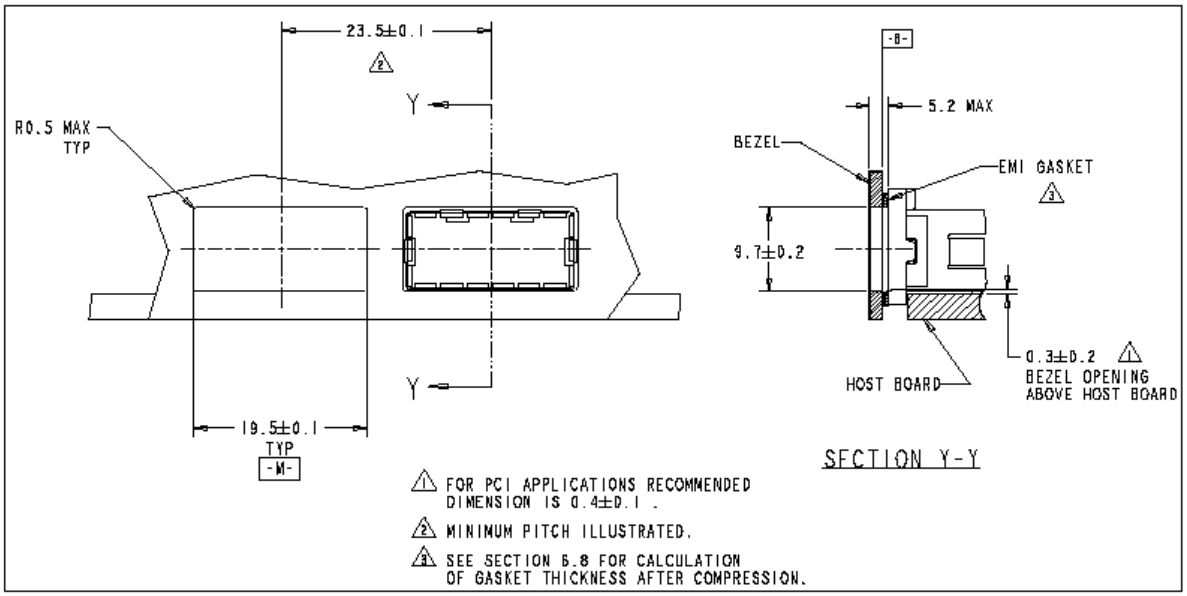
## X. PCB Layout and Bezel Recommendations




**XFP Host Board Mechanical Layout (dimensions are in mm)**




**XFP Detail Host Board Mechanical Layout (dimensions are in mm)**




**XFP Recommended Bezel Design (dimensions are in mm)**

## XI. References

1. 10 Gigabit Small Form Factor Pluggable Module (XFP) Multi-Source Agreement (MSA), Rev 4.5 – August 2005. Documentation is currently available at http://www.xfpmsa.org/

2. Application Note AN-2035: "Digital Diagnostic Monitoring Interface for XFP Optical Transceivers" – Finisar Corporation, December 2003

3. Directive 2011/65/EU of the European Council Parliament and of the Council, "on the restriction of the use of certain hazardous substances in electrical and electronic equipment"

4. "Application Note AN-2038: Finisar Implementation Of RoHS Compliant Transceivers"

## XII. Revision History

| Revision | Date | Description |
|---|---|---|
| A1 | 8/31/2010 | • Document created. |
| C1 | 4/15/2012 | • Production Release Datasheet |
| C4 | 9/18/2013 | • Minor corrections |
| D1 | 8/31/2015 | • Updated logo and RoHS statement |

## XIII. For More Information

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