

## Product Specification

### RoHS-6 Compliant

## 40km Multi-Rate XFP Optical Transceiver

### FTLX1612M3BCL

#### PRODUCT FEATURES

- Supports 9.95Gb/s to 11.3Gb/s bit rates
- Hot-pluggable XFP footprint
- Maximum link length of 40km
- RoHS-6 Compliant (lead-free)
- Temperature-stabilized 1550nm 800 ps/nm EML transmitter
- 3.3V and 5V power supplies required
- Duplex LC connector
- Power dissipation < 3.5W
- Built-in digital diagnostic functions
- Commercial temperature range: -5°C to 75°C
- Bail release mechanism
- Reference clock not required



#### APPLICATIONS

- SONET OC-192 IR-2  
SDH STM S-64.2b  
SONET OC-192 IR-3  
SDH STM S-64.3b  
ITU-T G.709
- 10GBASE-ER/EW  
10GBASE-ER/EW + FEC
- 40km 10G Fibre Channel  
40km 10G Fibre Channel + FEC

Finisar's 40km FTLX1612M3BCL Small Form Factor 10Gb/s XFP transceivers comply with the current XFP Multi-Source Agreement (MSA) Specification<sup>1</sup>. They also comply with SONET OC-192 IR-2, OC-192 IR-3, SDH STM S-64.2b, STM S-64.3b as well as with 10-Gigabit Ethernet 10GBASE-ER/EW per IEEE 802.3ae and 40km 10G Fibre Channel applications. 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<sup>3</sup>. See Finisar Application Note AN-2038 for more details<sup>4</sup>.

#### PRODUCT SELECTION

**FTLX1612M3BCL**

## I. Pin Descriptions

| Pin | Logic     | Symbol                        | Name/Description   | Ref. |
|-----|-----------|-------------------------------|--|------|
| 1   |           | GND                           | Module Ground  | 1    |
| 2   |           | VEE5                          | Optional -5.2 Power Supply – <b>Not required</b>   |      |
| 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 – <b>Not Required</b>   |      |
| 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<br><br>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 – <b>Not Required</b>   |      |
| 23  |           | GND                           | Module Ground  | 1    |
| 24  | PECL-I    | RefCLK+                       | Reference Clock non-inverted input, AC coupled on the host board – <b>Not required</b>   |      |
| 25  | PECL-I    | RefCLK-                       | Reference Clock inverted input, AC coupled on the host board – <b>Not required</b>   |      |
| 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.

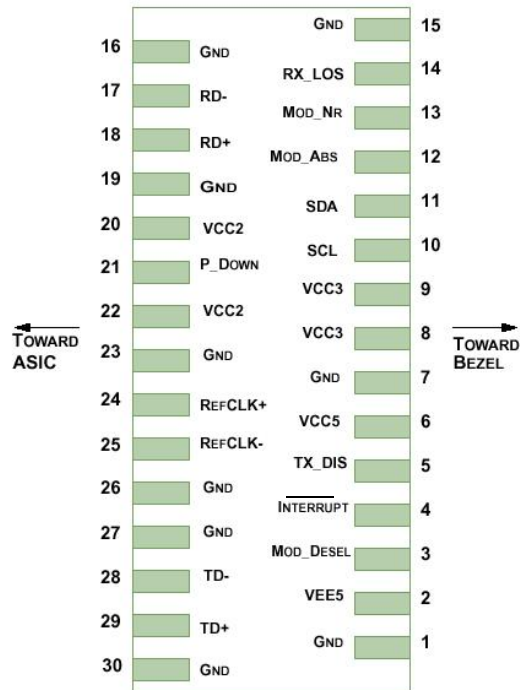


Diagram of Host Board Connector Block Pin Numbers and Names

## 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 <sub>S</sub>  | -40  |     | 85  | °C   |      |
| Case Operating Temperature | T <sub>OP</sub> | -5   |     | 75  | °C   |      |

**III. Electrical Characteristics** ( $T_{OP} = -5$  to  $75$  °C,  $V_{CC5} = 4.75$  to  $5.25$  Volts)

| Parameter                                | Symbol                 | Min                   | Typ | Max                 | Unit | Ref. |   |
|--|------------------------|-----------------------|-----|---------------------|------|------|---|
| Main Supply Voltage                      | V <sub>cc5</sub>       | 4.75                  |     | 5.25                | V    |      |   |
| Supply Voltage #2                        | V <sub>cc3</sub>       | 3.13                  |     | 3.45                | V    |      |   |
| Supply Current – V <sub>cc5</sub> supply | I <sub>cc5</sub>       |                       |     | 350                 | mA   |      |   |
| Supply Current – V <sub>cc3</sub> supply | I <sub>cc3</sub>       |                       |     | 600                 | mA   |      |   |
| Module total power                       | P                      |                       |     | 3.5                 | W    | 1    |   |
| <b>Transmitter</b>                       |                        |                       |     |                     |      |      |   |
| Input differential impedance             | R <sub>in</sub>        |                       | 100 |                     | Ω    | 2    |   |
| Differential data input swing            | V <sub>in,pp</sub>     | 120                   |     | 820                 | mV   |      |   |
| Transmit Disable Voltage                 | V <sub>D</sub>         | 2.0                   |     | V <sub>cc</sub>     | V    | 3    |   |
| Transmit Enable Voltage                  | V <sub>EN</sub>        | GND                   |     | GND+ 0.8            | V    |      |   |
| Transmit Disable Assert Time             |                        |                       |     | 10                  | us   |      |   |
| <b>Receiver</b>                          |                        |                       |     |                     |      |      |   |
| Differential data output swing           | V <sub>out,pp</sub>    | 340                   | 650 | 850                 | mV   | 4    |   |
| Data output rise time                    | t <sub>r</sub>         |                       |     | 38                  | ps   | 5    |   |
| Data output fall time                    | t <sub>f</sub>         |                       |     | 38                  | ps   | 5    |   |
| LOS Fault                                | V <sub>LOS fault</sub> | V <sub>cc</sub> – 0.5 |     | V <sub>ccHOST</sub> | V    | 6    |   |
| LOS Normal                               | V <sub>LOS norm</sub>  | 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<sup>1</sup>.

#### IV. Optical Characteristics ( $T_{OP} = -5$ to $75^{\circ}\text{C}$ , $V_{CC5} = 4.75$ to $5.25$ Volts)

Please note that the Transmitter of the FTLX1612M3BCL 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. |
|--|-------------|------|-----|-------|-------|------|
| <b>Transmitter</b>                             |             |      |     |       |       |      |
| Output Opt. Pwr: 9/125 SMF                     | $P_{OUT}$   | -1   |     | +2    | dBm   | 1    |
| Optical Extinction Ratio                       | ER          | 8.2  |     |       | dB    | 1    |
| Optical Modulation Amplitude                   | OMA         | -2.1 |     |       | dBm   | 2    |
| Center Wavelength                              | $\lambda_C$ | 1530 |     | 1565  | nm    |      |
| Transmitter Dispersion Penalty (@ 800 ps/nm)   | TDP         |      |     | 2     | dB    |      |
| Sidemode Suppression ratio                     | $SSR_{min}$ | 30   |     |       | dB    |      |
| SONET Tx Jitter Generation (peak-to-peak)      | $Tx_j$      |      |     | 0.1   | UI    | 3    |
| Tx Jitter Generation (RMS)                     | $Tx_{jRMS}$ |      |     | 0.01  | UI    | 4    |
| Relative Intensity Noise                       | RIN         |      |     | -130  | dB/Hz |      |
| <b>Receiver</b>                                |             |      |     |       |       |      |
| Receiver Sensitivity @ 9.95Gb/s to 10.7Gb/s    | $R_{SENS1}$ |      |     | -16   | dBm   | 5    |
| Receiver Sensitivity @ 11.1Gb/s to 11.3Gb/s    | $R_{SENS2}$ |      |     | -15   | dBm   |      |
| Stressed Receiver Sensitivity (OMA) @ 11.1Gb/s | $R_{SENS2}$ |      |     | -11.3 | dBm   | 6    |
| Maximum Input Power                            | $P_{MAX}$   | -1   |     |       | dBm   |      |
| Optical Center Wavelength                      | $\lambda_C$ | 1270 |     | 1600  | nm    |      |
| Receiver Reflectance                           | $R_{TX}$    |      |     | -27   | dB    |      |
| Path penalty at 40km (up to 10.7Gb/s)          |             |      |     | 2     | dB    | 7    |
| LOS De-Assert                                  | $LOS_D$     |      |     | -22   | dBm   |      |
| LOS Assert                                     | $LOS_A$     | -28  |     |       | dBm   |      |
| LOS Hysteresis                                 |             | 0.5  |     |       | dB    |      |

##### Notes:

- ER = 8.2dB minimum for data rates 9.9Gb/s to 10.7Gb/s.
- Guaranteed minimum OMA for 9.9Gb/s - 11.3Gb/s.
- Measured with a host jitter of 50 mUI peak-to-peak per Telcordia GR-253.
- Measured with a host jitter of 7 mUI RMS.
- Measured with worst ER; BER <  $10^{-12}$ ; PRBS31. Equivalent to -14.3 dBm OMA at ER = 8.2 dB.
- Per IEEE 802.3ae. Equivalent to -14.3 dBm average power at Infinite ER.
- Dispersion penalty is measured in loopback using 18 ps/(nm\*km) fiber (SMF-28). Path penalty is 2dB at 10.7Gb/s.

## 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    | 1    |

### Notes:

- 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
- Tested with a  $2^{31} - 1$  PRBS

## VI. Environmental Specifications

The FTLX1612M3BCL transceiver has an operating case temperature range from  $-5^{\circ}\text{C}$  to  $+75^{\circ}\text{C}$ .

| Parameter                  | Symbol    | Min | Typ | Max | Units              | Ref. |
|----------------------------|-----------|-----|-----|-----|--------------------|------|
| Case Operating Temperature | $T_{op}$  | -5  |     | 75  | $^{\circ}\text{C}$ |      |
| Storage Temperature        | $T_{sto}$ | -40 |     | 85  | $^{\circ}\text{C}$ |      |

## 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 (2 <sup>nd</sup> Edition)<br>IEC 60825-2: 2010 (3 <sup>rd</sup> Edition) | 72101686           |
| Electrical Safety | TÜV      | EN 60950:2006+A11   | 72101686           |
| 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<sup>1</sup>, 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

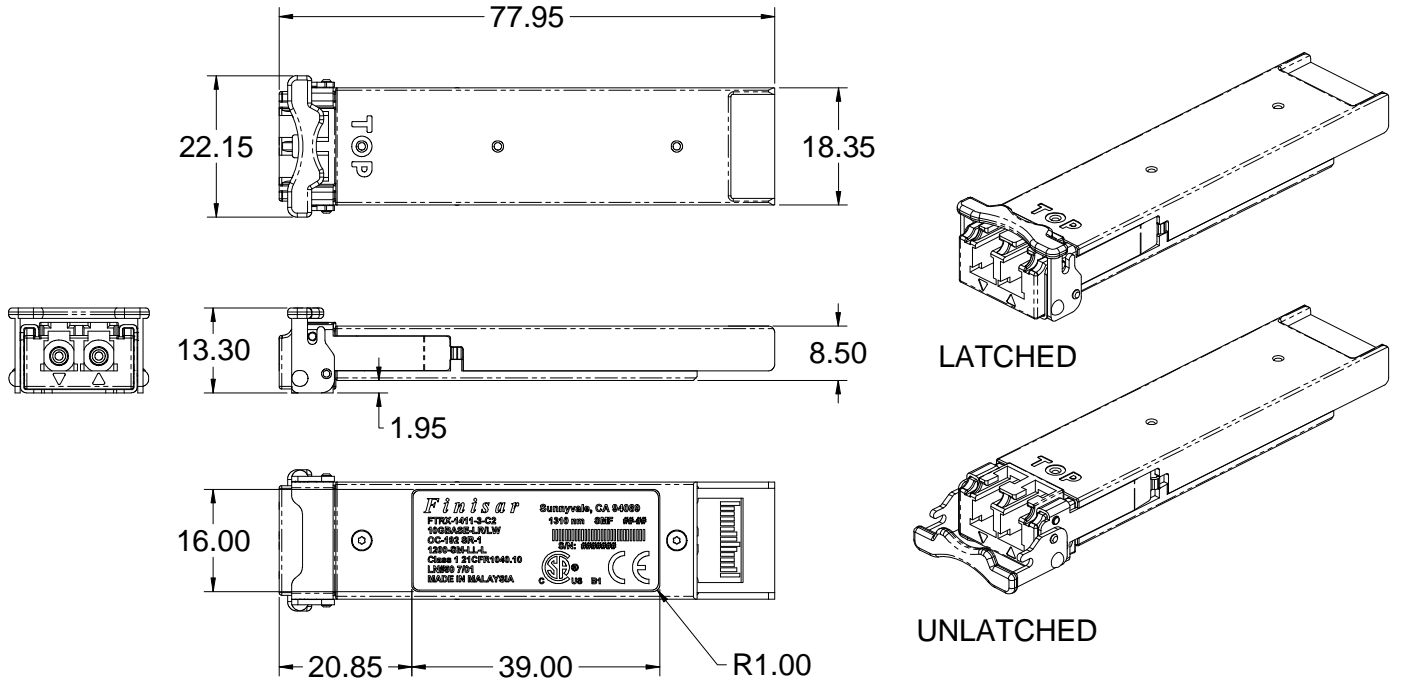
It also provides a sophisticated system of alarm and warning flags, which may be used to alert end-users when particular operating parameters are outside of a factory-set normal range.

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<sup>1</sup>.

### IX. Mechanical Specifications

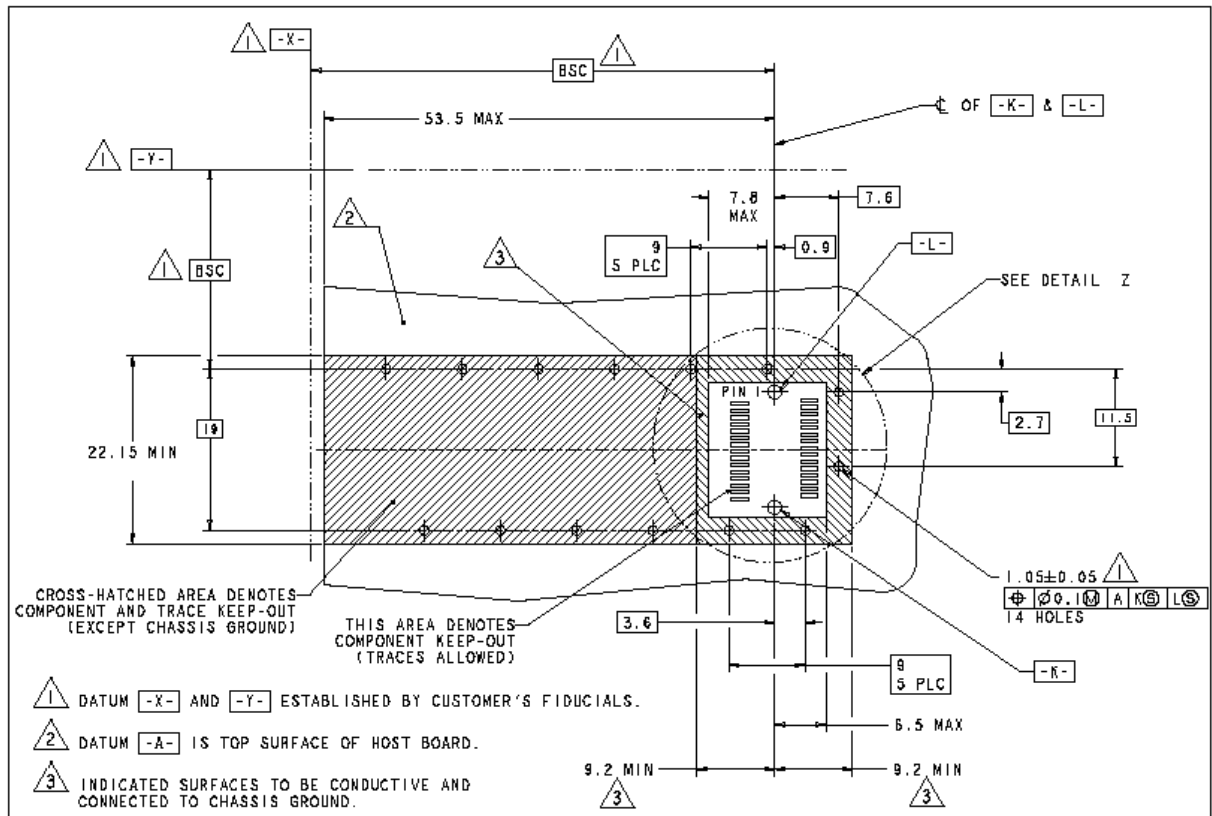
Finisar's XFP transceivers are compliant with the dimensions defined by the XFP Multi-Sourcing Agreement (MSA).



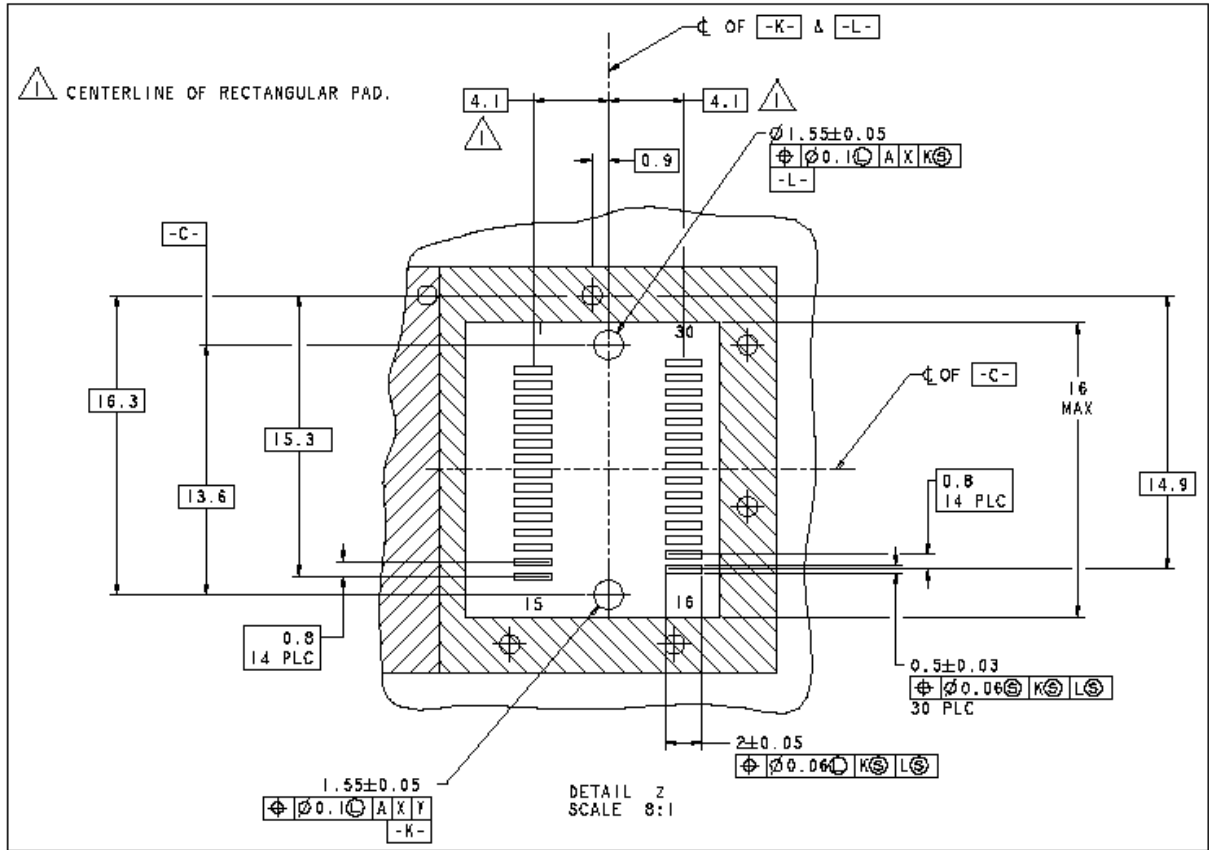
XFP Transceiver (dimensions are in mm)



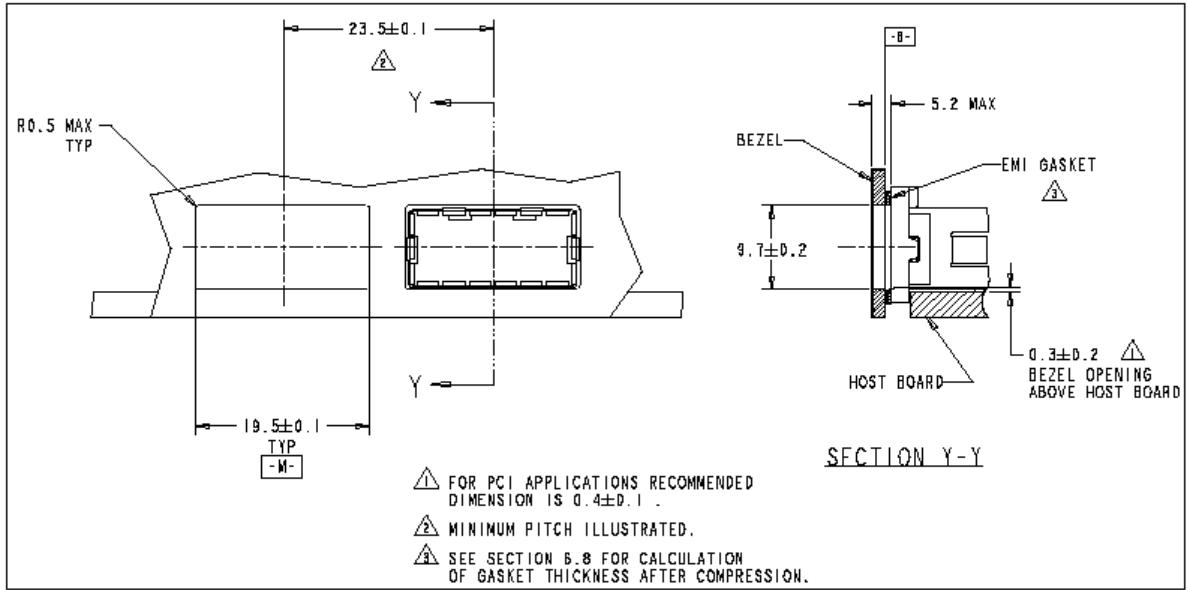
### X. PCB Layout and Bezel Recommendations



**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       | 3/5/2007   | <ul style="list-style-type: none"> <li>• Document created.</li> </ul>  |
| A2       | 1/21/2008  | <ul style="list-style-type: none"> <li>• Removed 1.8V power supply and reference clock requirements.</li> <li>• Added receiver sensitivity specification at 11.3Gb/s.</li> </ul> |
| A3       | 12/15/2008 | <ul style="list-style-type: none"> <li>• Updated Icc3 to 600mA</li> <li>• Removed 1.8V power supply current</li> </ul>   |
| B3       | 2/5/2010   | <ul style="list-style-type: none"> <li>• Updated Max Power Consumption to 3.5W (Power class III)</li> </ul>  |
| C1       | 11/22/2010 | <ul style="list-style-type: none"> <li>• Updated Laser Safety Certificates</li> </ul>  |
| D1       | 8/31/2015  | <ul style="list-style-type: none"> <li>• Updated logo and RoHS statement</li> </ul>  |

## XIII. For More Information

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