

Product Specification

Multiprotocol, 80km, 10Gb/s DWDM XFP Optical Transceiver

FTLX3813M3xx

PRODUCT FEATURES

- Supports 8.5Gb/s to 11.32Gb/s
- Hot-pluggable XFP footprint
- Temperature-stabilized DWDM EML transmitter
- RoHS-6 Compliant (lead-free)
- 100GHz ITU Grid, C-Band
- Duplex LC connector
- Power dissipation <3.5W
- Built-in digital diagnostic functions
- Temperature range: 0°C to 70°C
- Point-to-Point & OSNR optimized versions



APPLICATIONS

- ITU G.698.1, DW100S-2Dx, 10Gb/s DWDM SONET/SDH
- IEEE 10GBASE-ZR based DWDM Ethernet
- 10GFC (SM-1200-LL-L), 8GFC (SM-800-LC-L), and 10G CPRI
- ITU G.709, OTN/FEC applications including IEEE OTU1e and OTU2e

Finisar's FTLX3813M3xx Small Form Factor 10Gb/s (XFP) transceiver complies with the current XFP Multi-Source Agreement (MSA) Specification, INF-8077i (rev 4.5). It supports multiple protocols for point-to-point and amplified 10Gb/s DWDM applications with a maximum link length of 80km. This multi-rate, DWDM XFP transceiver supports clock and data recovery for 8G Fibre Channel, 10G Fibre Channel, 10G CPRI, 10Gb/s SONET/SDH, 10Gb/s Ethernet, and OTN/FEC protocols up to 11.32Gb/s. Digital diagnostics functions are available via a 2-wire serial interface, as specified in the XFP MSA. The transceiver is RoHS compliant and lead free per Directive 2002/95/EC³, and Finisar Application Note AN-2038⁴.

PRODUCT SELECTION

FTLX3813M3xx

xx: 100GHz ITU channel number

Part Numbers for Amplified (OSNR optimized) Applications:

| Channel # | Product Code | Frequency (THz) | Center Wavelength (nm) |
|------------------|---------------------|------------------------|-------------------------------|
| 17 | FTLX3813M317 | 191.7 | 1563.86 |
| 18 | FTLX3813M318 | 191.8 | 1563.05 |
| 19 | FTLX3813M319 | 191.9 | 1562.23 |
| 20 | FTLX3813M320 | 192.0 | 1561.42 |
| 21 | FTLX3813M321 | 192.1 | 1560.61 |
| 22 | FTLX3813M322 | 192.2 | 1559.79 |
| 23 | FTLX3813M323 | 192.3 | 1558.98 |
| 24 | FTLX3813M324 | 192.4 | 1558.17 |
| 25 | FTLX3813M325 | 192.5 | 1557.36 |
| 26 | FTLX3813M326 | 192.6 | 1556.55 |
| 27 | FTLX3813M327 | 192.7 | 1555.75 |
| 28 | FTLX3813M328 | 192.8 | 1554.94 |
| 29 | FTLX3813M329 | 192.9 | 1554.13 |
| 30 | FTLX3813M330 | 193.0 | 1553.33 |
| 31 | FTLX3813M331 | 193.1 | 1552.52 |
| 32 | FTLX3813M332 | 193.2 | 1551.72 |
| 33 | FTLX3813M333 | 193.3 | 1550.92 |
| 34 | FTLX3813M334 | 193.4 | 1550.12 |
| 35 | FTLX3813M335 | 193.5 | 1549.32 |
| 36 | FTLX3813M336 | 193.6 | 1548.51 |
| 37 | FTLX3813M337 | 193.7 | 1547.72 |
| 38 | FTLX3813M338 | 193.8 | 1546.92 |
| 39 | FTLX3813M339 | 193.9 | 1546.12 |
| 40 | FTLX3813M340 | 194.0 | 1545.32 |
| 41 | FTLX3813M341 | 194.1 | 1544.53 |
| 42 | FTLX3813M342 | 194.2 | 1543.73 |
| 43 | FTLX3813M343 | 194.3 | 1542.94 |
| 44 | FTLX3813M344 | 194.4 | 1542.14 |
| 45 | FTLX3813M345 | 194.5 | 1541.35 |
| 46 | FTLX3813M346 | 194.6 | 1540.56 |
| 47 | FTLX3813M347 | 194.7 | 1539.77 |
| 48 | FTLX3813M348 | 194.8 | 1538.98 |
| 49 | FTLX3813M349 | 194.9 | 1538.19 |
| 50 | FTLX3813M350 | 195.0 | 1537.40 |
| 51 | FTLX3813M351 | 195.1 | 1536.61 |
| 52 | FTLX3813M352 | 195.2 | 1535.82 |
| 53 | FTLX3813M353 | 195.3 | 1535.04 |
| 54 | FTLX3813M354 | 195.4 | 1534.25 |
| 55 | FTLX3813M355 | 195.5 | 1533.47 |
| 56 | FTLX3813M356 | 195.6 | 1532.68 |
| 57 | FTLX3813M357 | 195.7 | 1531.90 |
| 58 | FTLX3813M358 | 195.8 | 1531.12 |
| 59 | FTLX3813M359 | 195.9 | 1530.33 |
| 60 | FTLX3813M360 | 196.0 | 1529.55 |
| 61 | FTLX3813M361 | 196.1 | 1528.77 |

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

| Channel # | Product Code | Frequency (THz) | Center Wavelength (nm) |
|-----------|---------------|-----------------|------------------------|
| 17 | FTLX3813M317P | 191.7 | 1563.86 |
| 18 | FTLX3813M318P | 191.8 | 1563.05 |
| 19 | FTLX3813M319P | 191.9 | 1562.23 |
| 20 | FTLX3813M320P | 192.0 | 1561.42 |
| 21 | FTLX3813M321P | 192.1 | 1560.61 |
| 22 | FTLX3813M322P | 192.2 | 1559.79 |
| 23 | FTLX3813M323P | 192.3 | 1558.98 |
| 24 | FTLX3813M324P | 192.4 | 1558.17 |
| 25 | FTLX3813M325P | 192.5 | 1557.36 |
| 26 | FTLX3813M326P | 192.6 | 1556.55 |
| 27 | FTLX3813M327P | 192.7 | 1555.75 |
| 28 | FTLX3813M328P | 192.8 | 1554.94 |
| 29 | FTLX3813M329P | 192.9 | 1554.13 |
| 30 | FTLX3813M330P | 193.0 | 1553.33 |
| 31 | FTLX3813M331P | 193.1 | 1552.52 |
| 32 | FTLX3813M332P | 193.2 | 1551.72 |
| 33 | FTLX3813M333P | 193.3 | 1550.92 |
| 34 | FTLX3813M334P | 193.4 | 1550.12 |
| 35 | FTLX3813M335P | 193.5 | 1549.32 |
| 36 | FTLX3813M336P | 193.6 | 1548.51 |
| 37 | FTLX3813M337P | 193.7 | 1547.72 |
| 38 | FTLX3813M338P | 193.8 | 1546.92 |
| 39 | FTLX3813M339P | 193.9 | 1546.12 |
| 40 | FTLX3813M340P | 194.0 | 1545.32 |
| 41 | FTLX3813M341P | 194.1 | 1544.53 |
| 42 | FTLX3813M342P | 194.2 | 1543.73 |
| 43 | FTLX3813M343P | 194.3 | 1542.94 |
| 44 | FTLX3813M344P | 194.4 | 1542.14 |
| 45 | FTLX3813M345P | 194.5 | 1541.35 |
| 46 | FTLX3813M346P | 194.6 | 1540.56 |
| 47 | FTLX3813M347P | 194.7 | 1539.77 |
| 48 | FTLX3813M348P | 194.8 | 1538.98 |
| 49 | FTLX3813M349P | 194.9 | 1538.19 |
| 50 | FTLX3813M350P | 195.0 | 1537.40 |
| 51 | FTLX3813M351P | 195.1 | 1536.61 |
| 52 | FTLX3813M352P | 195.2 | 1535.82 |
| 53 | FTLX3813M353P | 195.3 | 1535.04 |
| 54 | FTLX3813M354P | 195.4 | 1534.25 |
| 55 | FTLX3813M355P | 195.5 | 1533.47 |
| 56 | FTLX3813M356P | 195.6 | 1532.68 |
| 57 | FTLX3813M357P | 195.7 | 1531.90 |
| 58 | FTLX3813M358P | 195.8 | 1531.12 |
| 59 | FTLX3813M359P | 195.9 | 1530.33 |
| 60 | FTLX3813M360P | 196.0 | 1529.55 |
| 61 | FTLX3813M361P | 196.1 | 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.

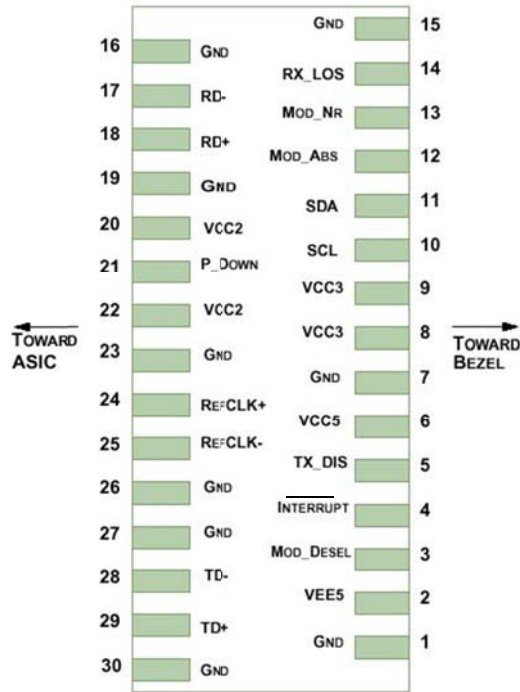


Diagram of Host Board Connector Block Pin Numbers and Names

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 | |
| Receiver Damage Threshold | P _{Rdmg} | +5 | | | 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. | |
|--------------------------------|------------------|------------------|-----|-----------------|----------|------|---|
| Supply Voltage #1 | Vcc5 | 4.75 | | 5.25 | V | | |
| Supply Voltage #2 | Vcc3 | 3.13 | | 3.46 | V | | |
| Supply Current – Vcc5 supply | Icc5 | | | 350 | 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 | $V_{in,pp}$ | 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 | $V_{out,pp}$ | 340 | | 850 | mV | 4 | |
| Data output rise time | t_r | | | 38 | ps | 5 | |
| Data output fall time | t_f | | | 38 | ps | 5 | |
| LOS Fault | $V_{LOS\ fault}$ | $V_{cc} - 0.5$ | | $V_{CC_{HOST}}$ | 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 Specification¹.

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

| Transmitter | | | | | | |
|--|--------------------|--------------------|--|---------------------------------|----------------------------|----------------------------|
| Parameter | Symbol | Min | Typ | Max | Unit | Ref. |
| Output Opt. Pwr: 9/125 SMF | P _{OUT} | -1 | | +3 | dBm | |
| Optical Extinction Ratio | ER | 8.2 | | | dB | |
| Center Wavelength Spacing | | | 100 | | GHz | 1 |
| Transmitter Center Wavelength – End Of Life | λ _C | X-100 | X | X+100 | pm | 2 |
| Transmitter Center Wavelength – Beginning Of Life | λ _C | X-25 | X | X+25 | pm | 2 |
| Sidemode Suppression ratio | SSR _{min} | 30 | | | dB | |
| Tx Jitter (SONET) 20kHz-80MHz | T _{Xj1} | | | 0.3 | UI | |
| Tx Jitter (SONET) 4MHz-80MHz | T _{Xj2} | | | 0.1 | UI | |
| Relative Intensity Noise | RIN | | | -130 | dB/Hz | |
| Receiver | | | | | | |
| Maximum Input Power | P _{MAX} | -7 | | | dBm | |
| Optical Center Wavelength | λ _C | 1260 | | 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 (FTLX3813M3xx & FTLX3813M3xxP) | | | | | | 3 |
| Data rate (Gb/s) | BER | Dispersion (ps/nm) | Sensitivity back-to-back at OSNR>30dB (dBm) | Power Penalty at OSNR>30dB (dB) | Threshold Adjust. Required | |
| 8.5 | 1e-12 | -500 to 1450 | -24 | 3 | No | |
| 9.95 | 1e-12 | -500 to 1450 | -24 | 3 | No | |
| 10.3 | 1e-12 | -500 to 1450 | -24 | 3 | No | |
| 10.7 | 1e-4 | -500 to 1300 | -27 | 3 | Yes | |
| 11.1 | 1e-4 | -500 to 1300 | -27 | 3 | Yes | |
| 11.3 | 1e-4 | -500 to 1100 | -27 | 3 | Yes | |
| OSNR Performance (FTLX3813M3xx ONLY) | | | | | | 4 |
| Data rate (Gb/s) | BER | Dispersion (ps/nm) | Max OSNR w/ dispersion at Power: -7 to -18dBm (dB) | | | Threshold Adjust. Required |
| 8.5 | 1e-12 | -500 to 1450 | 28 | | | No |
| 9.95 | 1e-12 | -500 to 1450 | 28 | | | No |
| 10.3 | 1e-12 | -500 to 1450 | 28 | | | No |
| 10.7 | 1e-4 | -500 to 1300 | 22 | | | Yes |
| 11.1 | 1e-4 | -500 to 1300 | 22 | | | Yes |
| 11.3 | 1e-4 | -500 to 1100 | 22 | | | Yes |

Notes:

1. Corresponds to approximately 0.8 nm.
2. X = Specified ITU Grid wavelength. Wavelength stability is achieved within 10 seconds of power up.
3. Measured at 1528-1600nm with worst ER; BER<10⁻¹²; PRBS31.
4. All OSNR measurements are performed with 0.1nm resolution over specific Rx_power range

V. General Specifications

| Parameter | Symbol | Min | Typ | Max | Units | Ref. |
|----------------------------|------------------|-----|-----|-------|-------|------|
| Bit Rate | BR | 8.5 | | 11.32 | Gb/s | 1 |
| Max. Supported Link Length | L _{MAX} | | 80 | | km | |

Notes:

- SONET/SDH OC-192, 10G Ethernet, SONET OC-192 with FEC, 10G Ethernet with FEC (OTU1e & OTU2e), 10GFC, 8GFC, and 10G CPRI

VI. Environmental Specifications

Finisar XFP transceivers have an operating temperature range from 0°C to +70°C case temperature.

| 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 IEC 60825-1: 2007 (2 nd Edition) IEC 60825-2: 2010 (3 rd Edition) | R72101686 |
| Electrical Safety | TÜV | EN 60950:2006+All | R72101686 |
| Electrical Safety | UL/CSA | CLASS 3862.07 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 MSA¹, 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
- TEC Temperature

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 documentation¹.

Receiver Threshold Adjustment

The FTLX3813M3xx also provides access to receiver decision threshold adjustment via 2-wire serial interface, in order to improve receiver OSNR performance based on specific link conditions. It is implemented as follows:

- Rx Threshold of XFP transceivers will be factory-set for optimized performance in non-FEC applications. This will be the default value during both cold start (power-up) and warm start (module reset).
- The transceiver supports adjustment of Rx Threshold value by the host through register 76d, table 01h. This is intended to be used in FEC applications.

- Register 76d, table 01h is a volatile memory. Therefore if the transceiver is power-cycled, the register starts up with a value of 00h which corresponds to the default Rx Threshold value.
- The threshold adjustment input value is 2's complement 7 bit value (-128 to +127), with 0 corresponding to default Rx threshold value. Full range of adjustment provides at least a $\pm 10\%$ change in Rx threshold from the default value.

8.5Gb/s Fibre-Channel rate select:

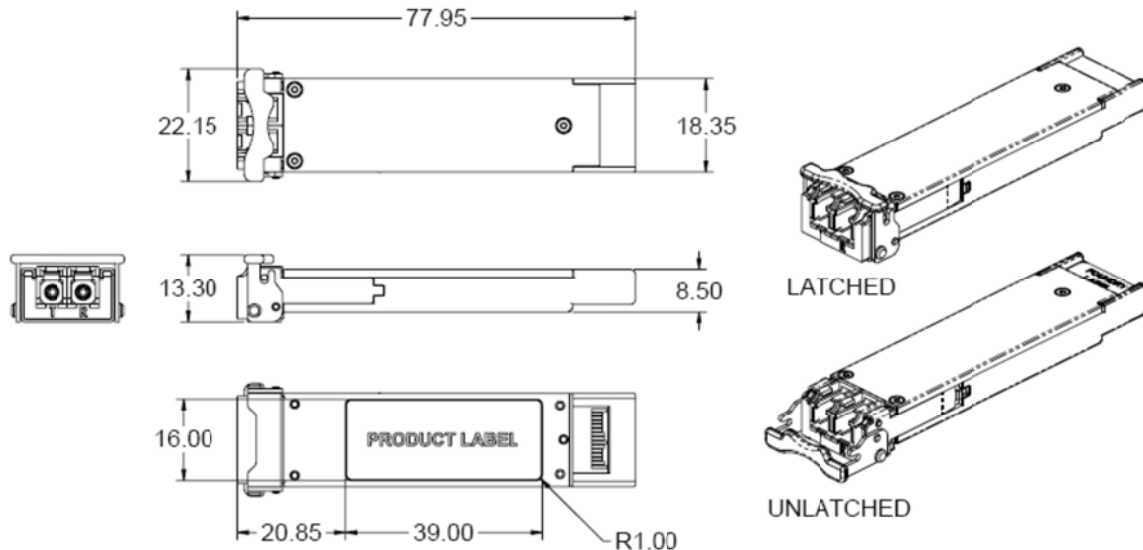
To operate the FTLX3813M3xx at 8.5Gb/s Fibre-Channel, the EEPROM-Table 0, Byte 117, Bit 0 must be set as follows;

- 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.

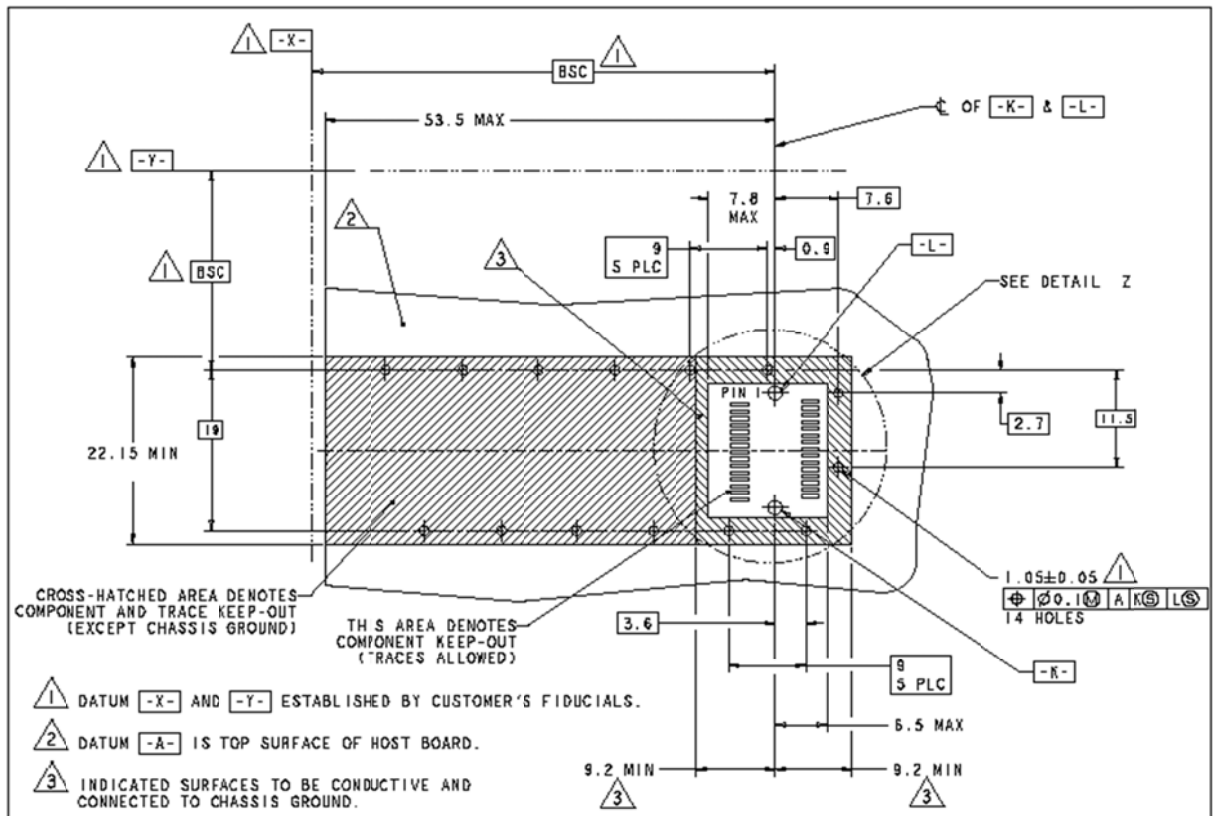
IX. Mechanical Specifications

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

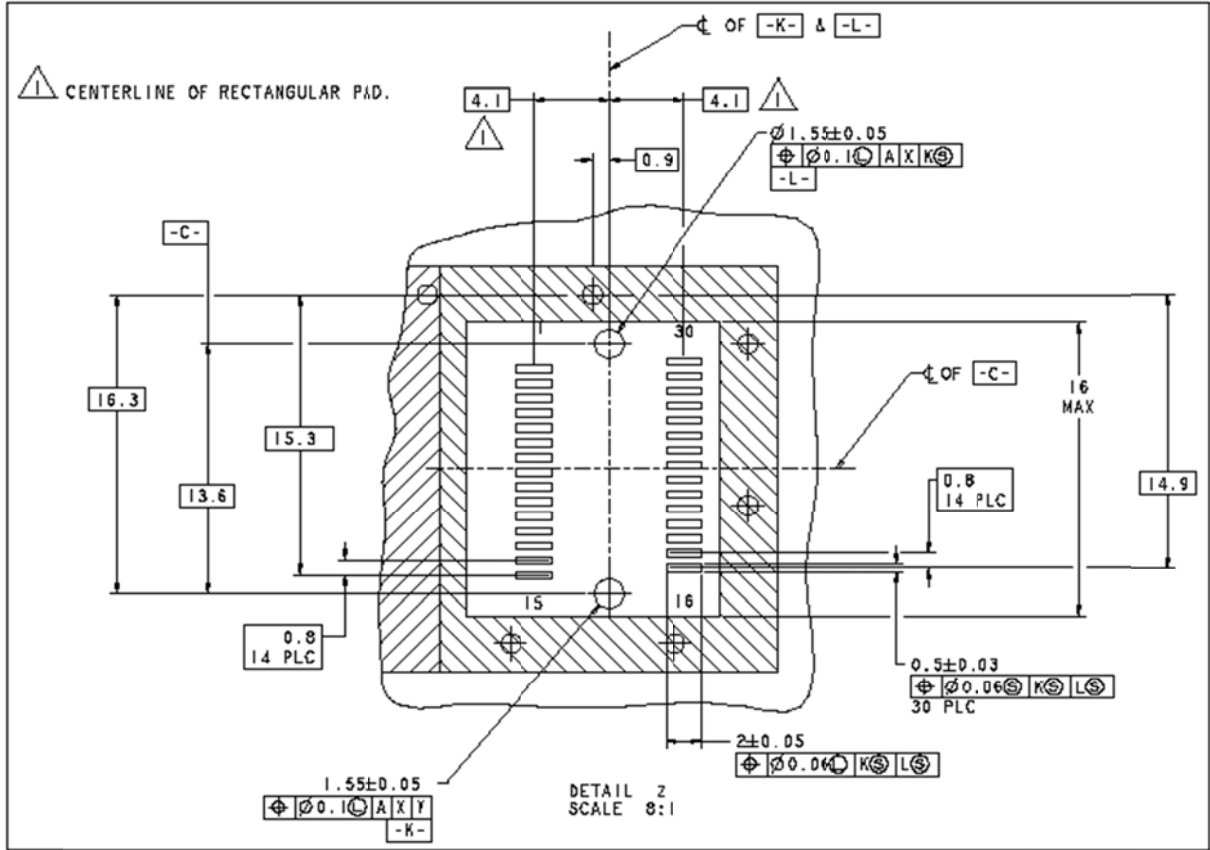


XFP Transceiver (dimensions are in mm)

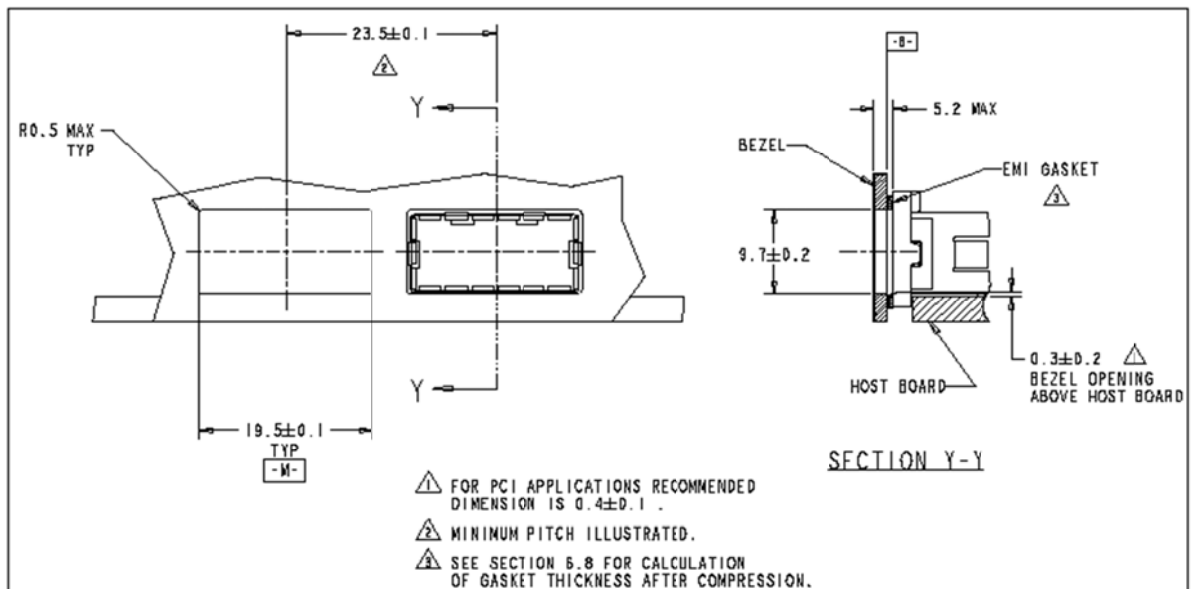
X. PCB Layout and Bezel Recommendations



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 2002/95/EC of the European Council Parliament and of the Council, “on the restriction of the use of certain hazardous substances in electrical and electronic equipment”. January 27, 2003.
4. “Application Note AN-2038: Finisar Implementation Of RoHS Compliant Transceivers”, Finisar Corporation, January 21, 2005.

XII. For More Information

Finisar Corporation
1389 Moffett Park Drive
Sunnyvale, CA 94089-1133
Tel. 1-408-548-1000
Fax 1-408-541-6138
sales@finisar.com
www.finisar.com