

PRELIMINARY Product Specification

RoHS-6 Compliant 10Gb/s 220m Multi Mode Datacom SFP+ Transceiver

FTLX1371D3BCL

PRODUCT FEATURES

- Hot-pluggable SFP+ footprint
- Supports 9.95 to 10.3Gb/s bit rates
- Power dissipation < 1W
- RoHS-6 compliant (lead-free)
- Commercial temperature range
-5°C to 70°C
- Single 3.3V power supply
- Maximum link length of upto
220m
- Uncooled directly modulated
Fabry-Perot (FP) laser at 1310 nm
- Receiver linear electrical interface
- Duplex LC connector
- Built-in digital diagnostic functions



APPLICATIONS

- 10GBASE-LRM 10G Ethernet
- Legacy FDDI multimode links

Finisar's FTLX1371D3BCL 10Gb/s Enhanced Small Form Factor Pluggable SFP+ transceivers are designed for use in 10-Gigabit Ethernet links up to 220m over Multi Mode fiber. They are compliant with SFF-8431¹, SFF-8432² and IEEE 802.3 aq³ 10GBASE-LRM. Digital diagnostics functions are available via a 2-wire serial interface, as specified in SFF-8472⁴. The FTLX1371D3BCL is a "linear module" i.e. it employs a linear receiver. Host board designers using an EDC PHY IC should follow the IC manufacturer's recommended settings for interoperating the host board EDC PHY with a linear receiver SFP+ module. The transceiver is RoHS compliant and lead-free per Directive 2002/95/EC⁵, and Finisar Application Note AN-2038⁶.

PRODUCT SELECTION

FTLX1371D3BCL

I. Description

The Finisar FTLX1371D3BCL SFP+ transceiver is a linear-interface transceiver that enables, in conjunction with an Electronic Dispersion Compensation (EDC) on the host board, an IEEE802.3aq 10GBASE-LRM compliant link. The host board EDC provides correction for the severe modal dispersion that may occur during propagation through multimode fiber links, including legacy installed FDDI multimode fiber (see IEEE802.3aq for detailed information regarding fiber coverage).

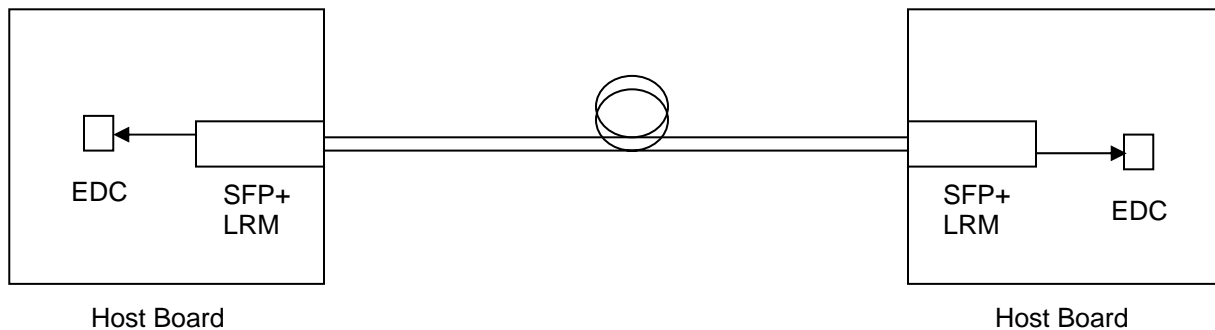


Figure 1. Block Diagram of SFP+ LRM Module on Host Board with EDC

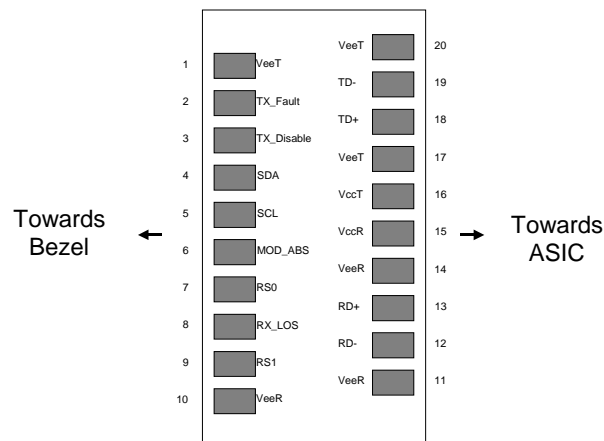
Unlike the XFP MSA transceiver requirements, the SFP+ transceiver does not contain internal retiming circuitry, and thus some of the Transmitter Optical Characteristics stated in this data sheet require that the Host Board is compliant to the SFP+ MSA specifications. See Chapter 3 in Reference [1] for further details.

II. Pin Descriptions

| Pin | Symbol | Name/Description | Ref. |
|-----|--------------------|--|------|
| 1 | V _{EET} | Transmitter Ground | 1 |
| 2 | T _{FAULT} | Transmitter Fault | |
| 3 | T _{DIS} | Transmitter Disable. Laser output disabled on high or open. | 2 |
| 4 | SDA | 2-wire Serial Interface Data Line | 3 |
| 5 | SCL | 2-wire Serial Interface Clock Line | 3 |
| 6 | MOD_ABS | Module Absent. Grounded within the module. | 3 |
| 7 | RS0 | No connection required | |
| 8 | RX_LOS | Loss of Signal indication. Logic 0 indicates normal operation. | 4 |
| 9 | RS1 | No connection required | |
| 10 | V _{EER} | Receiver Ground | 1 |
| 11 | V _{EER} | Receiver Ground | 1 |
| 12 | RD- | Receiver Inverted DATA out. AC Coupled | |
| 13 | RD+ | Receiver Non-inverted DATA out. AC Coupled | |
| 14 | V _{EER} | Receiver Ground | 1 |
| 15 | V _{CCR} | Receiver Power Supply | |
| 16 | V _{CCT} | Transmitter Power Supply | |
| 17 | V _{EET} | Transmitter Ground | 1 |
| 18 | TD+ | Transmitter Non-Inverted DATA in. AC Coupled. | |
| 19 | TD- | Transmitter Inverted DATA in. AC Coupled. | |
| 20 | V _{EET} | Transmitter Ground | 1 |

Notes:

1. Circuit ground is internally isolated from chassis ground.
2. Laser output disabled on T_{DIS} >2.0V or open, enabled on T_{DIS} <0.8V.
3. Should be pulled up with 4.7k – 10kohms on host board to a voltage between 2.0V and 3.6V. MOD_ABS pulls line low to indicate module is plugged in.
4. RX_LOS is open collector output. Should be pulled up with 4.7k – 10kohms on host board to a voltage between 2.0V and 3.6V. Logic 0 indicates normal operation; logic 1 indicates loss of signal.

**Figure 2. Diagram of Host Board Connector Block Pin Numbers and Names**

II. Absolute Maximum Ratings

| | | | | | | |
|----------------------------|----------------|-----|--|----|----|---|
| Storage Temperature | T _S | -40 | | 85 | °C | |
| Case Operating Temperature | T _A | -5 | | 70 | °C | |
| Relative Humidity | RH | 0 | | 85 | % | 1 |

III. Electrical Characteristics (T_{OP} = -5 to 70 °C, V_{CC} = 3.14 to 3.46 Volts)

| Parameter | Symbol | Min | Typ | Max | Unit | Ref. |
|-------------------|-----------------|------|-----|------|------|------|
| Supply Voltage | V _{CC} | 3.14 | | 3.46 | V | |
| Supply Current | I _{CC} | | 200 | 300 | mA | |
| Power Dissipation | P | | | 1.0 | W | |

Exceeding the limits below may damage the transceiver module permanently.

| Parameter | Symbol | Min | Typ | Max | Unit | Ref. |
|----------------------------|-----------------|------|-----|-----|------|------|
| Maximum Supply Voltage | V _{CC} | -0.5 | | 4.0 | V | |
| Storage Temperature | T _S | -40 | | 85 | °C | |
| Case Operating Temperature | T _A | -5 | | 70 | °C | |
| Relative Humidity | RH | 0 | | 85 | % | 1 |

IV. Electrical Characteristics (T_{OP} = -5 to 70 °C, V_{CC} = 3.14 to 3.46 Volts)

| Parameter | Symbol | Min | Typ | Max | Unit | Ref. |
|---|-------------------------------------|-----------------|--------------|-----------------------|------------------|------|
| Supply Voltage | V _{CC} | 3.14 | | 3.46 | V | |
| Supply Current | I _{CC} | | 200 | 300 | mA | |
| Power Dissipation | P | | | 1.0 | W | |
| Transmitter | | | | | | |
| Input differential impedance | R _{in} | | 100 | | Ω | 2 |
| Single ended data input swing | V _{in,pp} | 90 | | 350 | mV | 3 |
| Transmit Disable Voltage | V _D | 2 | | V _{CC} | V | 4 |
| Transmit Enable Voltage | V _{EN} | V _{EE} | | V _{EE} + 0.8 | V | |
| Receiver | | | | | | |
| Termination Mismatch at 1 MHz | ΔZ _M | | | 5 | % | |
| Single Ended Output Voltage Tolerance | | -0.3 | | 4.0 | V | |
| Output AC Common Mode Voltage | | | | 7.5 | mV RMS | |
| Output Rise and Fall time (20% to 80%) | Tr, Tf | 30 | | | Ps | 5 |
| Relative Noise LRM Links with crosstalk | dRN _x | | | TBD equation | dB/Hz | 6 |
| Difference Waveform Distortion Penalty | dWDP | | per SFF-8431 | | dB | 7 |
| Differential Voltage Modulation Amplitude | VMA | 180 | | 600 | mV | |
| LOS Fault | V _{LOS fault} | 2 | | V _{CCHOST} | V | 8 |
| LOS Normal | V _{LOS norm} | V _{EE} | | V _{EE} +0.8 | V | 8 |
| Power Supply Noise Tolerance | V _{CC} T/V _{CC} R | | per SFF-8431 | | mV _{pp} | 9 |

Notes:

1. Non-condensing.
2. Connected directly to TX data input pins. AC coupling from pins into laser driver IC.
3. Per SFF-8431 Rev 3.0
4. Into 100 ohms differential termination.
5. Measured with Module Compliance Test Board and OMA test pattern.
6. Crosstalk source rise/fall time (20%-80%) is 35 ps.
7. Defined with reference receiver with 14 T/2 spaced FFE taps and 5 T spaced DFE taps.
8. LOS is an open collector output. Should be pulled up with 4.7k – 10kΩ on the host board. Normal operation is logic 0; loss of signal is logic 1. Maximum pull-up voltage is 5.5V.
9. As described in Section 2.8.1, SFF-8431 Rev 3.0.

IV. Optical Characteristics (T_{OP} = -5 to 70 °C, V_{CC} = 3.14 to 3.46 Volts)

| 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 | 1 |
| Peak Launch Power | P _{MAX} | | | 3 | dBm | |
| Optical Wavelength | λ | 1260 | | 1355 | Nm | |
| RMS Spectral Width | λ_{rms} @ 1260nm | | | 2.4 | Nm | 2 |
| | λ_{rms} @ 1260nm- 1300nm | | | See Figure 5-1 | | |
| | λ_{rms} @ 1300nm- 1355nm | | | 4 | | |
| Optical Extinction Ratio | ER | 3.5 | | | dB | |
| Optical Eye Mask Margin | | 0 | | | % | 3 |
| Transmitter Waveform Dispersion Penalty | TWDP | | | 4.7 | dB | 4 |
| Average Launch power of OFF transmitter | P _{OFF} | | | -30 | dBm | |
| Uncorrelated Jitter [rms] | T _{Xj} | | | 0.033 | UI | |
| Relative Intensity Noise | RIN ₁₂ OMA | | | -128 | dB/Hz | |
| Encircled Flux | <5 μ m | 30 | | | % | |
| | <11 μ m | 81 | | | | |
| Transmitter Reflectance | | | | -12 | dB | |
| Optical Return Loss Tolerance | | 20 | | | dB | |
| Receiver | | | | | | |
| Receiver Overload | P _{MAX} | +1.5 | | | dBm | 5 |
| Comprehensive Stressed Receiver Sensitivity (OMA) @ 10.3125Gb/s | Precursor | | | -6.5 | dBm | 6 |
| | Symmetrical | | | -6.0 | | |
| | Postcursor | | | -6.5 | | |
| Wavelength Range | λ_C | 1260 | | 1355 | Nm | |
| Receiver Reflectance | R _{rx} | | | -12 | dB | |
| LOS De-Assert | LOS _D | | | -11 | dBm | |
| LOS Assert | LOS _A | -30 | | | dBm | |
| LOS Hysteresis | | 0.5 | | | dB | |

Notes:

1. Average power figures are informative only, per IEEE802.3aq
2. Maximum RMS spectral width as specified by Figure 3
3. Optical Eye Mask requires the host board to be SFF-8431 compliant. Optical eye mask per IEEE802.3aq.
4. TWDP figure requires the host board to be SFF-8431 compliant. TWDP is calculated using the Matlab code provided in clause 68.6.6.2 of IEEE802.3aq
5. Receiver overload specified in OMA and under the worst comprehensive stressed condition.
6. Conditions of stressed receiver tests per IEEE802.3aq. CSRS testing requires the host board to be SFF-8431 compliant.

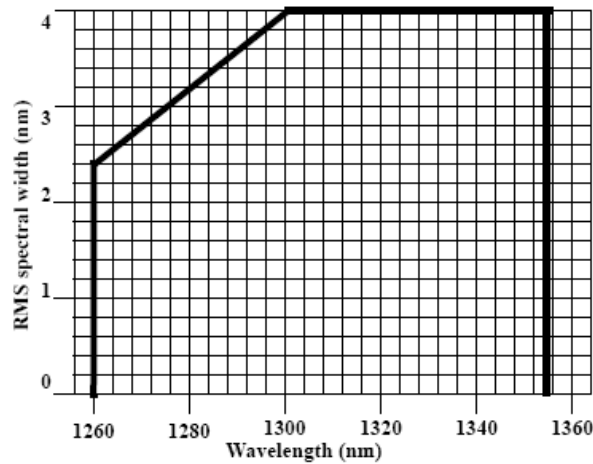


Figure 3
Transmitter Maximum RMS Spectral Width

V. General Specifications

| Parameter | | Symbol | Min | Typ | Max | Units | Ref. |
|------------------------------------|-----------------------------|--------|-----|---------|------------|-------|------|
| Bit Rate | | BR | | 10.3125 | | Gb/s | 1 |
| Bit Error Ratio | | BER | | | 10^{-12} | | 2 |
| Maximum Supported Distances | | | | | | | |
| Fiber Type | 1310nm OFL Bandwidth | | | | | | |
| 62.5μm | “FDDI” 160MHz/km | Lmax | | | 220 | m | 3 |
| | OM1 200MHz/km | | | | 220 | | |
| 50μm | 400MHz/km | Lmax | | | 100 | m | 3 |
| | OM2 500MHz/km | | | | 220 | | |
| | OM3 2000MHz/km | | | | 220 | | |

Notes:

- 10GBASE-LRM
- Tested with a $2^{31} - 1$ PRBS
- Operating range as defined by IEEE standards. Longer reach possible depending upon link implementation.

VI. Environmental Specifications

Finisar 1310nm SFP+ transceivers have a commercial operating temperature range from -5 to +70°C case temperature.

| Parameter | Symbol | Min | Typ | Max | Units | Ref. |
|----------------------------|------------------|-----|-----|-----|-------|------|
| Case Operating Temperature | T _{op} | -5 | | 70 | °C | |
| Storage Temperature | T _{sto} | -40 | | 85 | °C | |

VII. Regulatory Compliance

Finisar transceivers are Class 1 Laser Products and comply with U.S. FDA CDRH regulations. These products are certified by TÜV and CSA to meet the Class 1 eye safety requirements of EN (IEC) 60825 and the electrical safety requirements of EN (IEC) 60950. Copies of certificates are available at Finisar Corporation upon request.

VIII. Digital Diagnostic Functions

Finisar FTLX1371D3BCL SFP+ transceivers support the 2-wire serial communication protocol as defined in the SFF-8472 Specification.

Finisar SFP+ transceivers provide an enhanced digital diagnostic monitoring interface, which allows real-time access to device operating parameters such as transceiver temperature, laser bias current, transmitted optical power, received optical power and transceiver supply voltage. It also defines a sophisticated system of alarm and warning flags, which alerts end-users when particular operating parameters are outside of a factory set normal range.

The SFF-8472 Specification defines a 256-byte memory map in E²PROM that is accessible over a 2-wire serial interface at the 8 bit address 1010000X (A0h). The digital diagnostic monitoring interface makes use of the 8 bit address 1010001X (A2h), so the originally defined serial ID memory map remains unchanged.

The operating and diagnostics information is monitored and reported by a Digital Diagnostics Transceiver Controller (DDTC) inside the transceiver, which is accessed through a 2-wire serial interface. When the serial protocol is activated, the serial clock signal (SCL, Mod Def 1) is generated by the host. The positive edge clocks data into the SFP+ transceiver into those segments of the E²PROM that are not write-protected. The negative edge clocks data from the SFP+ transceiver. The serial data signal (SDA, Mod Def 2) 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.

For more information, please see the SFF-8472 Specification⁴.

IX. Digital Diagnostic Specifications

FTLX1371D3BCL transceivers can be used in host systems that require either internally or externally calibrated digital diagnostics.

| Parameter | Symbol | Min | Typ | Max | Units | Ref. |
|--|---------------------------|-----|-----|-----|-------|------|
| Accuracy | | | | | | |
| Internally measured transceiver temperature | DD _{Temperature} | | | 3 | °C | |
| Internally measured transceiver supply voltage | DD _{Voltage} | | | 100 | mV | |
| Measured TX bias current | DD _{Bias} | | | 10 | % | 1 |
| Measured TX output power | DD _{Tx-Power} | | | 2 | dB | |
| Measured RX received average optical power | DD _{Rx-Power} | | | 2 | dB | |
| Dynamic Range for Rated Accuracy | | | | | | |
| Internally measured transceiver temperature | DD _{Temperature} | 0 | | 80 | °C | |
| Internally measured transceiver supply voltage | DD _{Voltage} | 3.1 | | 3.5 | V | |
| Measured TX bias current | DD _{Bias} | 0 | | 20 | mA | |
| Measured TX output power | DD _{Tx-Power} | tbd | | tbd | dBm | |
| Measured RX received average optical power | DD _{Rx-Power} | tbd | | 1.5 | dBm | |
| Max Reporting Range | | | | | | |
| Internally measured transceiver temperature | DD _{Temperature} | -40 | | 125 | °C | |
| Internally measured transceiver supply voltage | DD _{Voltage} | 2.8 | | 4.0 | V | |
| Measured TX bias current | DD _{Bias} | 0 | | 20 | mA | |
| Measured TX output power | DD _{Tx-Power} | tbd | | tbd | dBm | |
| Measured RX received average optical power | DD _{Rx-Power} | tbd | | 0 | dBm | |

Notes:

1. Accuracy of Measured Tx Bias Current is 10% of the actual Bias Current from the laser driver to the laser.

X. Host - Transceiver Interface Block Diagram

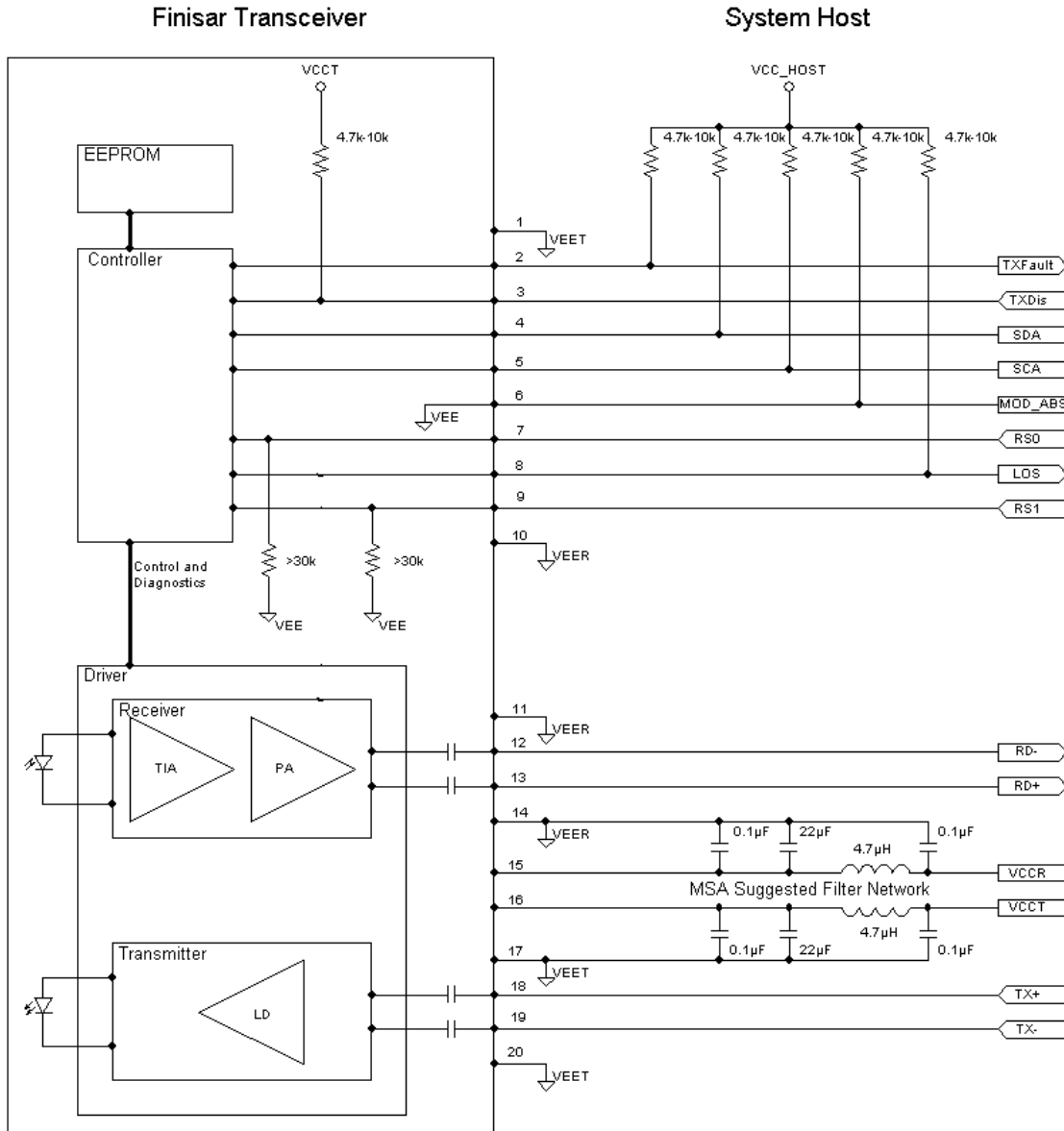
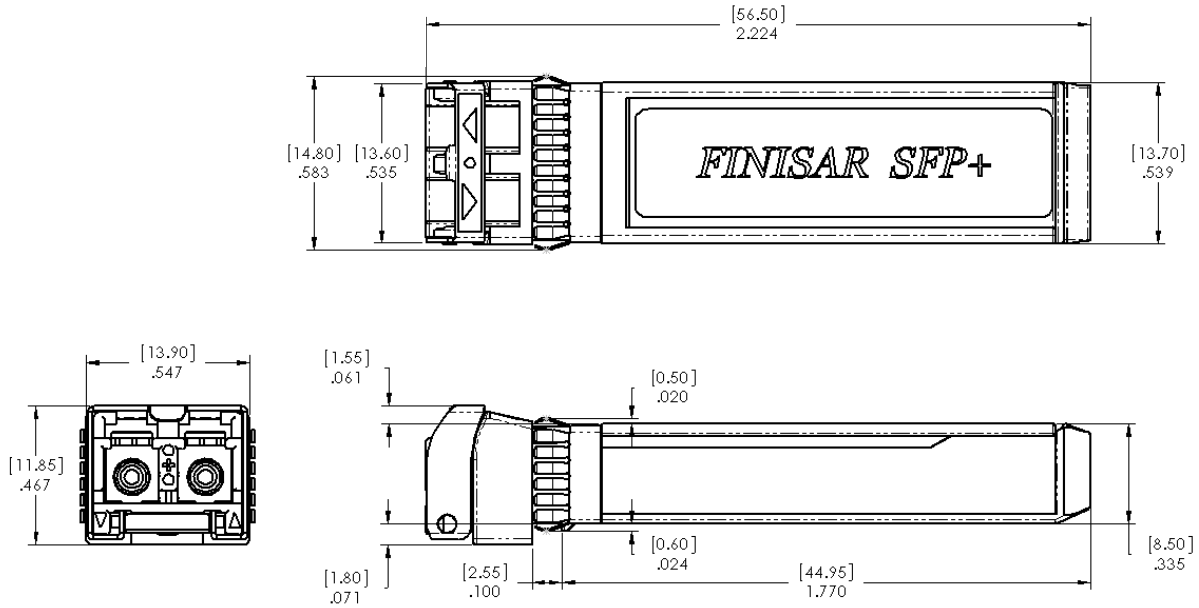


Figure 4-Host-Module Interface

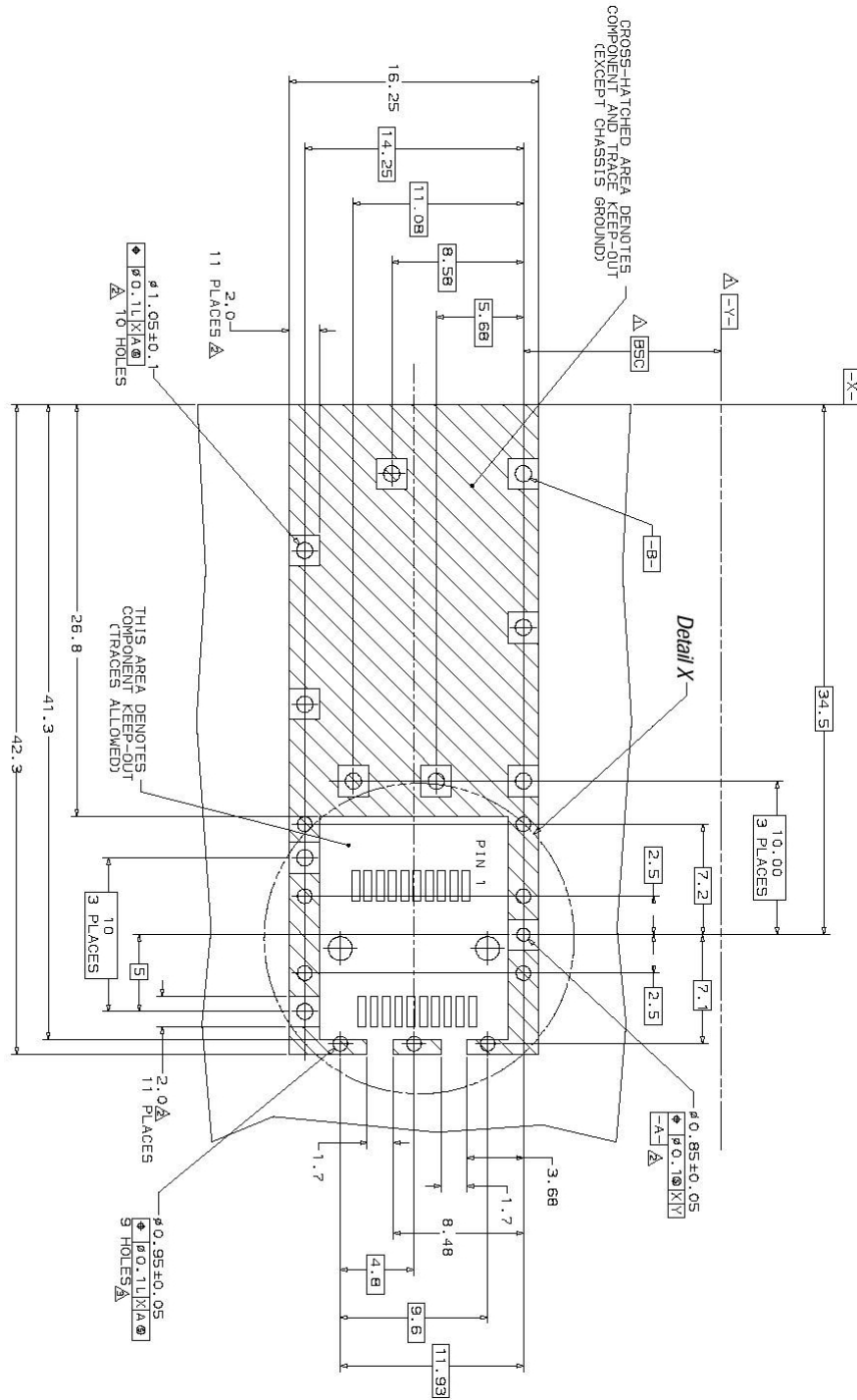
XI. Mechanical Specifications

Finisar’s SFP+ transceivers are compatible with the dimensions defined by the SFP+ Specification SFF-8432. Bail color is orange.

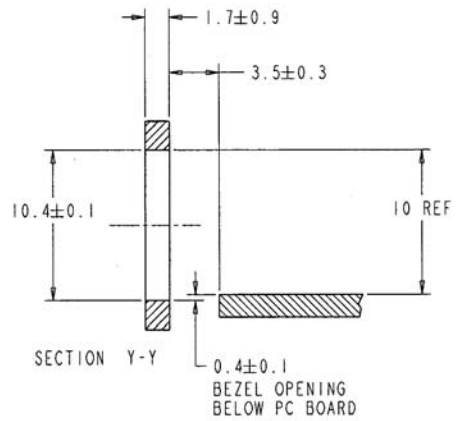
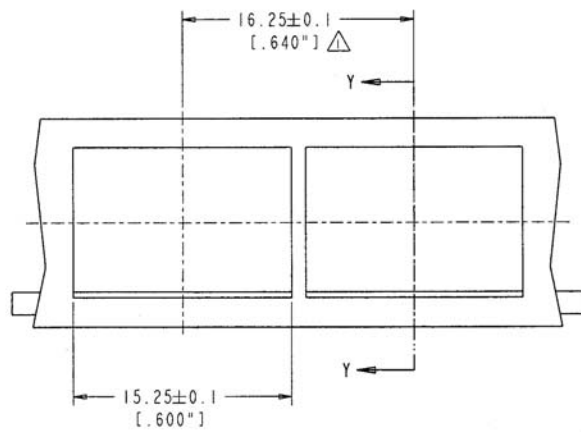
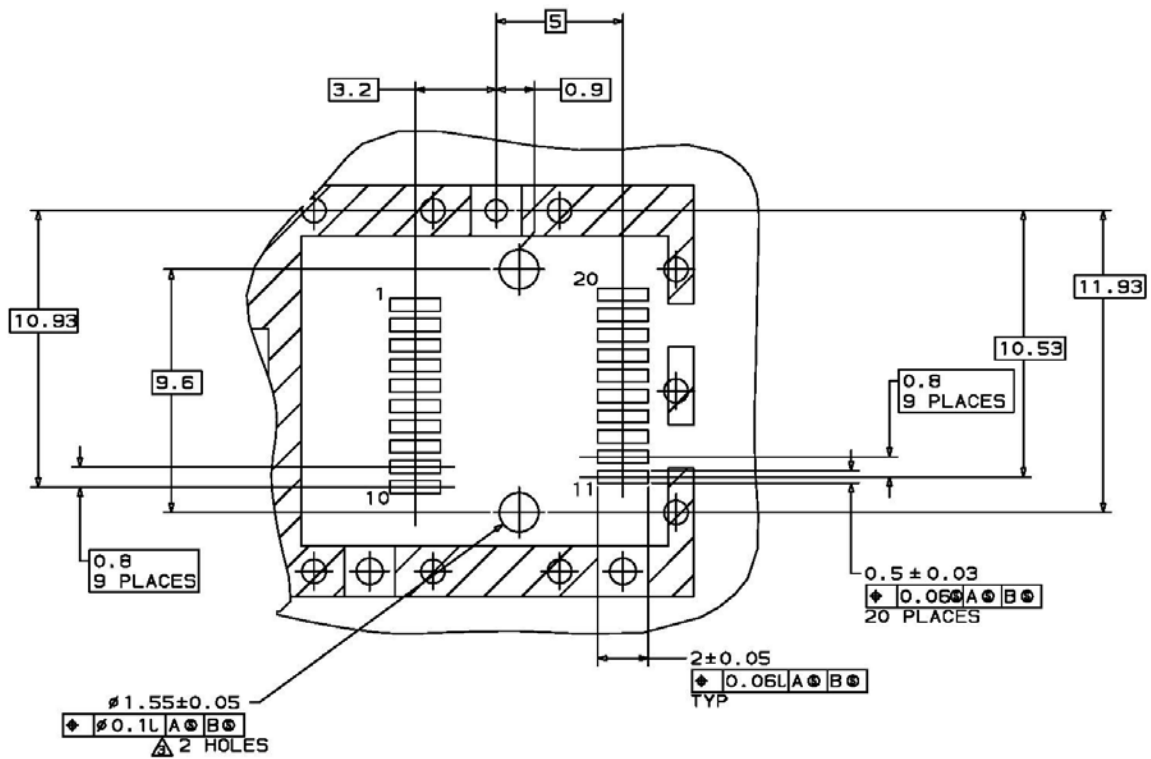


FTLX1371D3BCL Mechanical Dimensions

XII. PCB Layout and Bezel Recommendations



- △ Datum and Basic Dimension Established by Customer
- ⊠ Rads and Vias are Chassis Ground, 11 Places
- ⊡ Through Holes are Unplated



- NOTES:
- 1. Δ MINIMUM PITCH ILLUSTRATED, ENGLISH DIMENSIONS ARE FOR REFERENCE ONLY
 - 2. NOT RECOMMENDED FOR PCI EXPANSION CARD APPLICATIONS

XIII. References

1. SFF-8431 Specifications for Enhanced 10 Gigabit Small Form Factor Pluggable Module “SFP+” Revision 3.0, May 8, 2008.
2. SFF-8432 Specification for Improved Pluggable Form Factor, Revision 5, July 16, 2007
3. IEEE Std 802.3aq-2006, PMD Type 10GBASE-LRM. IEEE Standards Department, 18 October 2006
4. “Digital Diagnostics Monitoring Interface for Optical Transceivers”. SFF Document Number SFF-8472, Revision 10.3, December 1, 2007.
5. 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.
6. “Application Note AN-2038: Finisar Implementation Of RoHS Compliant Transceivers”, Finisar Corporation, January 21, 2005.

XIV. For More Information

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