

Product Specification

10Gb/s 80km Single Mode SFP+ Transceiver

FTLX1871D3BCL

PRODUCT FEATURES

- Hot-pluggable SFP+ footprint
- Supports 8.5 and 9.95 to 11.3 Gb/s
- 80km link length
- -5/70°C case temperature range
- Cooled 1550nm EML laser
- Limiting electrical interface receiver
- Duplex LC connector
- Built-in digital diagnostic functions
- RoHS-6 compliant (lead-free)



APPLICATIONS

- 10G Ethernet ZR and 10G Fibre Channel
- OTN G.709 OTU1e/2/2e FEC bit rates
- 8.5Gb/s Fibre Channel

Finisar's FTLX1871D3BCL transceivers are Enhanced Small Form Factor Pluggable SFP+ transceivers designed for use in 10-Gigabit multi-rate links up to 80km of G.652 single mode fiber. They are compliant with SFF-8431¹, SFF-8432² and support 10G Ethernet ZR and 10G Fibre Channel.

Digital diagnostics functions are available via a 2-wire serial interface, as specified in SFF-8472³. Finisar's FTLX1871D3BCL transceivers are RoHS compliant as per Directive 2011/65/EU⁴ and Finisar Application Note AN-2038⁵.

PRODUCT SELECTION

FTLX1871D3BCL

I. Pin Descriptions

| Pin | Symbol | Name/Description | Ref. |
|-----|--------------------|--|------|
| 1 | V _{EET} | Transmitter Ground | 1 |
| 2 | T _{FAULT} | Transmitter Fault | 2 |
| 3 | T _{DIS} | Transmitter Disable. Laser output disabled on high or open. | 3 |
| 4 | SDA | 2-wire Serial Interface Data Line | 2 |
| 5 | SCL | 2-wire Serial Interface Clock Line | 2 |
| 6 | MOD_ABS | Module Absent. Grounded within the module | 2 |
| 7 | RS0 | Rate Select 0. | 4 |
| 8 | RX_LOS | Loss of Signal indication. Logic 0 indicates normal operation. | 5 |
| 9 | RS1 | Rate Select 1. | 4 |
| 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 | 6 |
| 16 | V _{CCT} | Transmitter Power Supply | 6 |
| 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:

- Circuit ground is internally isolated from chassis ground.
- T_{FAULT} is an open collector/drain output, which should be pulled up with a 4.7k – 10k Ohms resistor on the host board if intended for use. Pull up voltage should be between 2.0V to V_{cc} + 0.3V. A high output indicates a transmitter fault caused by either the TX bias current or the TX output power exceeding the preset alarm thresholds. A low output indicates normal operation. In the low state, the output is pulled to <0.8V.
- Laser output disabled on T_{DIS} >2.0V or open, enabled on T_{DIS} <0.8V.
- Internally pulled down per SFF-8431 Rev 4.1.
- LOS is open collector output. Should be pulled up with 4.7k – 10kΩ on host board to a voltage between 2.0V and 3.6V. Logic 0 indicates normal operation; logic 1 indicates loss of signal.
- Internally connected

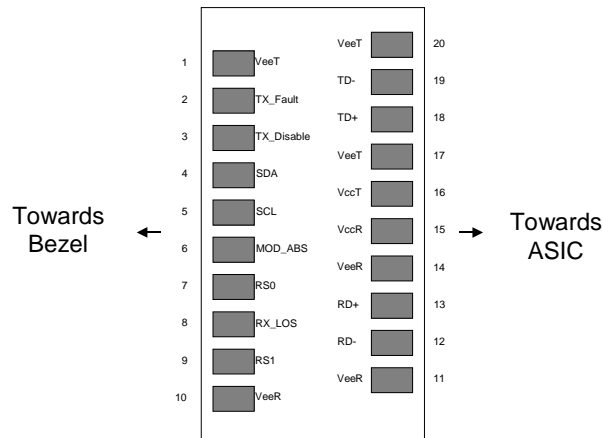


Figure 1. Diagram of Host Board Connector Block Pin Numbers and Names.

II. Absolute Maximum Ratings

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 | |
| Relative Humidity | RH | 0 | | 85 | % | 1 |
| Receiver Optical Damage Threshold | R _{XDamage} | 5 | | | dBm | |

Notes:

1. Non-condensing

III. Electrical Characteristics (T_{OP} = -5 to 70 °C)

| Parameter | Symbol | Min | Typ | Max | Unit | Ref. |
|--------------------------------|-------------------------------------|----------------------|------|-----------------|------|------|
| Supply Voltage | V _{CC} | 3.14 | 3.30 | 3.46 | V | |
| Power Consumption | P _{diss} | | | 1.5 | W | 1 |
| Transmitter (Tx) | | | | | | |
| Input differential impedance | R _{in} | 80 | 100 | 120 | Ω | |
| Differential data input swing | V _{in,pp} | 120 | | 850 | mV | 2 |
| Transmit Disable Voltage | V _D | V _{CC} -0.8 | | V _{CC} | V | |
| Transmit Enable Voltage | V _{EN} | 0 | | 0.8 | V | |
| Receiver (Rx) | | | | | | |
| Output differential impedance | R _{out} | 80 | 100 | 120 | Ω | |
| Differential data output swing | V _{outs,pp} | 300 | | 850 | mV | 2 |
| Output rise time and fall time | T _r , T _f | 28 | | | ps | 3 |
| LOS asserted | V _{LOS_A} | V _{CC} -0.8 | | V _{CC} | V | 4 |
| LOS de-asserted | V _{LOS_D} | 0 | | 0.8 | V | 4 |
| Power Supply Noise Tolerance | V _{CC} T/V _{CC} R | Per SFF-8431 Rev 4.1 | | | mVpp | 5 |

Notes:

1. 70°C case temperature and beginning of life
2. Internally AC coupled.
3. 20 – 80%. Measured with Module Compliance Test Board and OMA test pattern. Use of four 1's and four 0's sequence in the PRBS 9 is an acceptable alternative. SFF-8431 Rev 4.1.
4. LOS is an open collector output. Should be pulled up with 4.7kΩ – 10kΩ on the host board. Normal operation is logic 0; loss of signal is logic 1.
5. See Section 2.8.3 of SFF-8431 Rev 4.1.

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

| Parameter | | Symbol | Min | Typ | Max | Unit | Ref. |
|-------------------------------------|-----------------|-------------|-------------|-----|------|-------|-------|
| Transmitter (Tx) | | | | | | | |
| Average Launch Power | | P_{AVE} | 0 | | 4 | dBm | |
| Optical Wavelength | | λ | 1530 | | 1565 | nm | |
| Side-Mode Suppression Ratio | | SMSR | 30 | | | dB | |
| Optical Extinction Ratio | | ER | 9 | | | dB | |
| Average Launch power when Tx is OFF | | P_{OFF} | | | -30 | dBm | |
| Relative Intensity Noise | | RIN | | | -128 | dB/Hz | |
| Receiver (Rx) | | | | | | | |
| Optical Center Wavelength | | λ_C | 1260 | | 1600 | nm | |
| Receiver Reflectance | | R_{RX} | | | -27 | dB | |
| Sensitivity (0km) | Bit Rate (Gb/s) | BER | | | | | |
| | 8.5, 9.95-10.7 | $<10^{-12}$ | R_{SENS1} | | -24 | dBm | 1,2 |
| | 11.1 | $<10^{-12}$ | R_{SENS2} | | -23 | dBm | 1 |
| | | $<10^{-4}$ | R_{SENS3} | | -27 | dBm | 1 |
| 11.3 | $<10^{-4}$ | R_{SENS4} | | -27 | dBm | 1 | |
| Sensitivity (80km) | 8.5, 9.95-10.7 | $<10^{-12}$ | R_{SENS5} | | -22 | dBm | 1,2,3 |
| | 11.1 | $<10^{-4}$ | R_{SENS6} | | -25 | dBm | 1,3 |
| Overload (Average Power) | | P_{AVE} | -7 | | | dBm | |
| LOS De-Assert | | LOS_D | | | -28 | dBm | |
| LOS Assert | | LOS_A | -37 | | -30 | dBm | |
| LOS Hysteresis | | LOS_H | 0.5 | | | dB | |

Notes:

1. Measured with worst ER=9 dB; PRBS $2^{31} - 1$.
2. For 10G Ethernet application, -24dBm is equivalent to an OMA of -22.09dBm for an ER = 9 dB.
3. The receiver sensitivity over fiber may vary depending on the host's clock and data recovery model.

V. General Specifications

| Parameter | Symbol | Min | Typ | Max | Units | Ref. |
|----------------------------|-----------|-----|-----|---------|-------|------|
| Bit Rate | BR | 8.5 | | 11.3168 | Gb/s | 1 |
| Max. Supported Link Length | L_{MAX} | | | 80 | km | 2 |

Notes:

1. Tested with a $2^{31} - 1$ PRBS pattern at the BER defined in Table IV.
2. Over G.652 single mode fiber.

Timing Parameters

| Parameter | Symbol | Min | Typ | Max | Units | Ref. |
|--------------------|-----------------|-----|-----|-----|-------|------|
| Time to initialize | t_{start_up} | | | 10 | s | |

VI. Environmental Specifications

| 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 US FDA 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 FTLX1871D3BCL SFP+ transceivers support the 2-wire serial communication protocol as defined in the SFP MSA¹. It is very closely related to the E²PROM defined in the GBIC standard, with the same electrical specifications.

The standard SFP serial ID provides access to identification information that describes the transceiver's capabilities, standard interfaces, manufacturer, and other information.

Additionally, 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 SFP MSA 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 interface is identical to, and is thus fully backward compatible with both the GBIC Specification and the SFP Multi Source Agreement. The complete interface is described in Finisar Application Note AN-2030: "Digital Diagnostics Monitoring Interface for SFP Optical Transceivers".

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 SFP MSA documentation³ and Finisar Application Note AN-2030⁷.

Please note that evaluation board FDB-1027 is available with Finisar ModDEMO software that allows simple to use communication over the 2-wire serial interface.

IX. Digital Diagnostic Specifications

FTLX1871D3BCL transceivers can be used in host systems that require either internally or externally calibrated digital diagnostics.

| Parameter | Symbol | Units | Min | Max | Accuracy | Ref. |
|--------------------------------------|------------------------|-------|-----|-----|----------|------|
| Accuracy | | | | | | |
| Transceiver temperature | ΔDD_{Temp} | °C | -5 | +70 | ±5°C | 1 |
| Transceiver supply voltage | $\Delta DD_{Voltage}$ | V | 2.8 | 4.0 | ±3% | |
| Transmitter bias current | ΔDD_{Bias} | mA | 0 | 127 | ±10% | 2 |
| Transmitter output power | $\Delta DD_{Tx-Power}$ | dBm | -1 | +5 | ±2dB | |
| Receiver average optical input power | $\Delta DD_{Rx-Power}$ | dBm | -28 | -5 | ±2dB | |

Notes:

- Internally measured
- The accuracy of the Tx bias current is 10% of the actual current from the laser driver to the laser

X. SFF-8431 Power-up Sequence

The typical power consumption of the FTLX1871D3BCL may exceed the limit of 1.5W specified for the Power Level II transceivers in [1], for which a power-up sequence is recommended. However, the FTLX1871D3BCL is factory set to power-up directly to its operating conditions in Power Level Mode II. Upon request, it can be factory set to follow the power-up sequence specified for transceivers exceeding 1W, as per [1]. In power level I, the FTLX1871D3BCL does not carry traffic, but the 2-wire serial communication is active.

Please refer to [1] and Finisar Application Note AN-2076 for additional details.

XI. Mechanical Specifications

Finisar FTLX1871D3BCL SFP+ transceivers are compatible with the SFF-8432 specification for improved pluggable form factor, and shown here for reference purposes only. Bail color is white.

| ITEM | DIM (mm) | TOL (mm) |
|------|----------|----------|
| A | 9.00 | ±0.3 |
| B | 9.60 | ±0.5 |
| C | 11.90 | ±0.5 |
| D | 13.85 | ±0.15 |
| E | 13.65 | ±0.15 |
| F | 2.80 | ±0.2 |
| G | 1.00 | ±0.2 |
| H | 4.00 | REF |
| J | 2.00 | ±0.2 |
| K | 56.50 | REF |
| L | 1.60 | ±0.5 |
| M | 2.25 | ±0.1 |
| N | 1.80 | ±0.1 |
| P | 37.10 | ±0.3 |
| Q | 9.15 | ±0.15 |
| R | 1.00 | ±0.1 |
| S | 8.55 | ±0.15 |
| T | 47.50 | ±0.2 |
| V | 2.55 | ±0.1 |
| W | 43.00 | ±0.2 |
| X | 14.70 | ±0.5 |
| Z | 0.55 | ±0.15 |

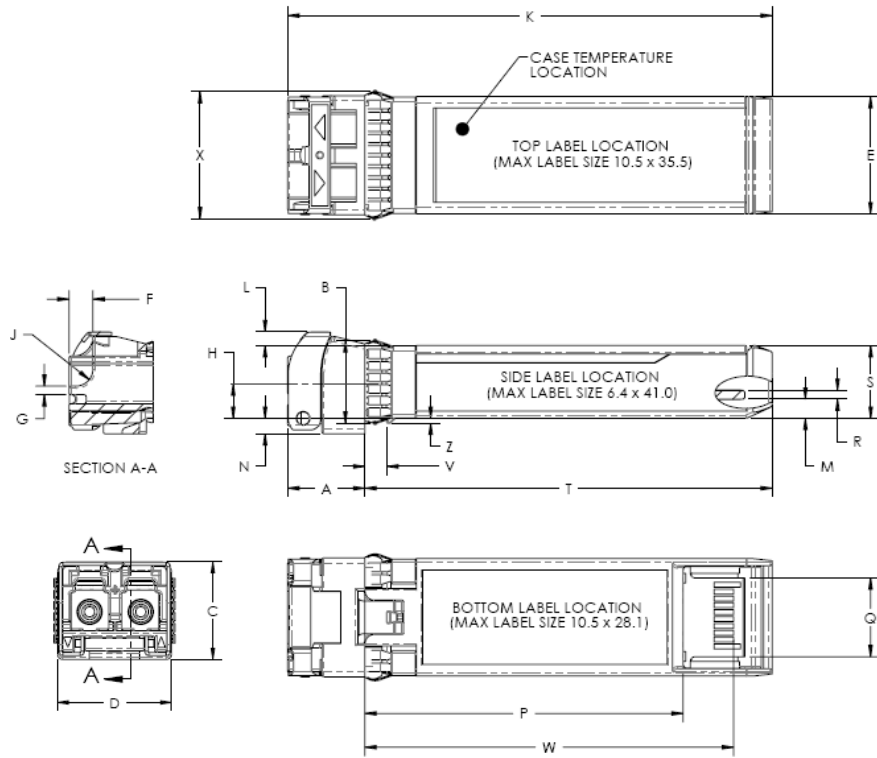


Figure 2. Mechanical Dimensions

Note: the option of the label on the top side of the transceiver is not recommended.

XII. Host Board SFP+ Connector Recommendations

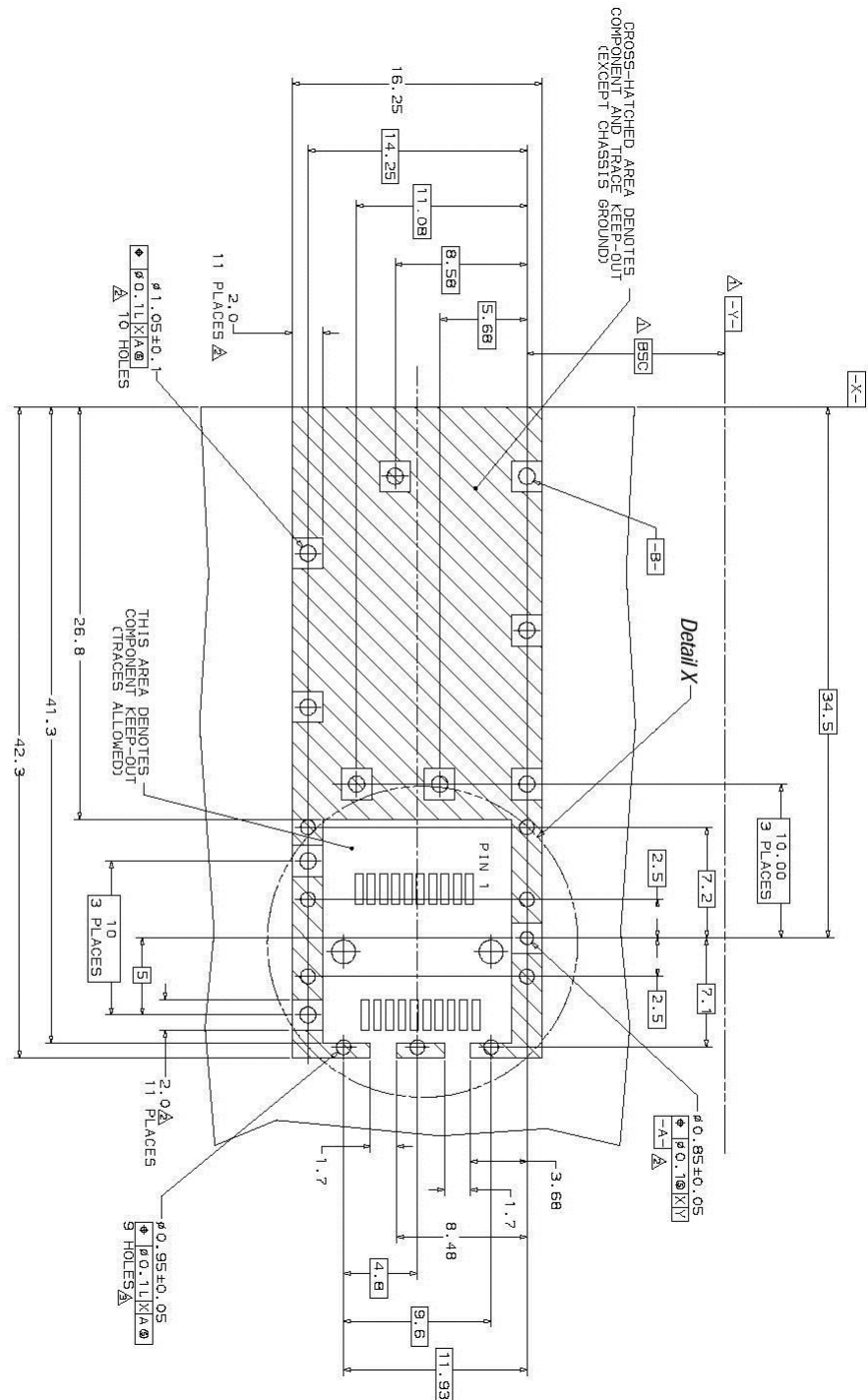
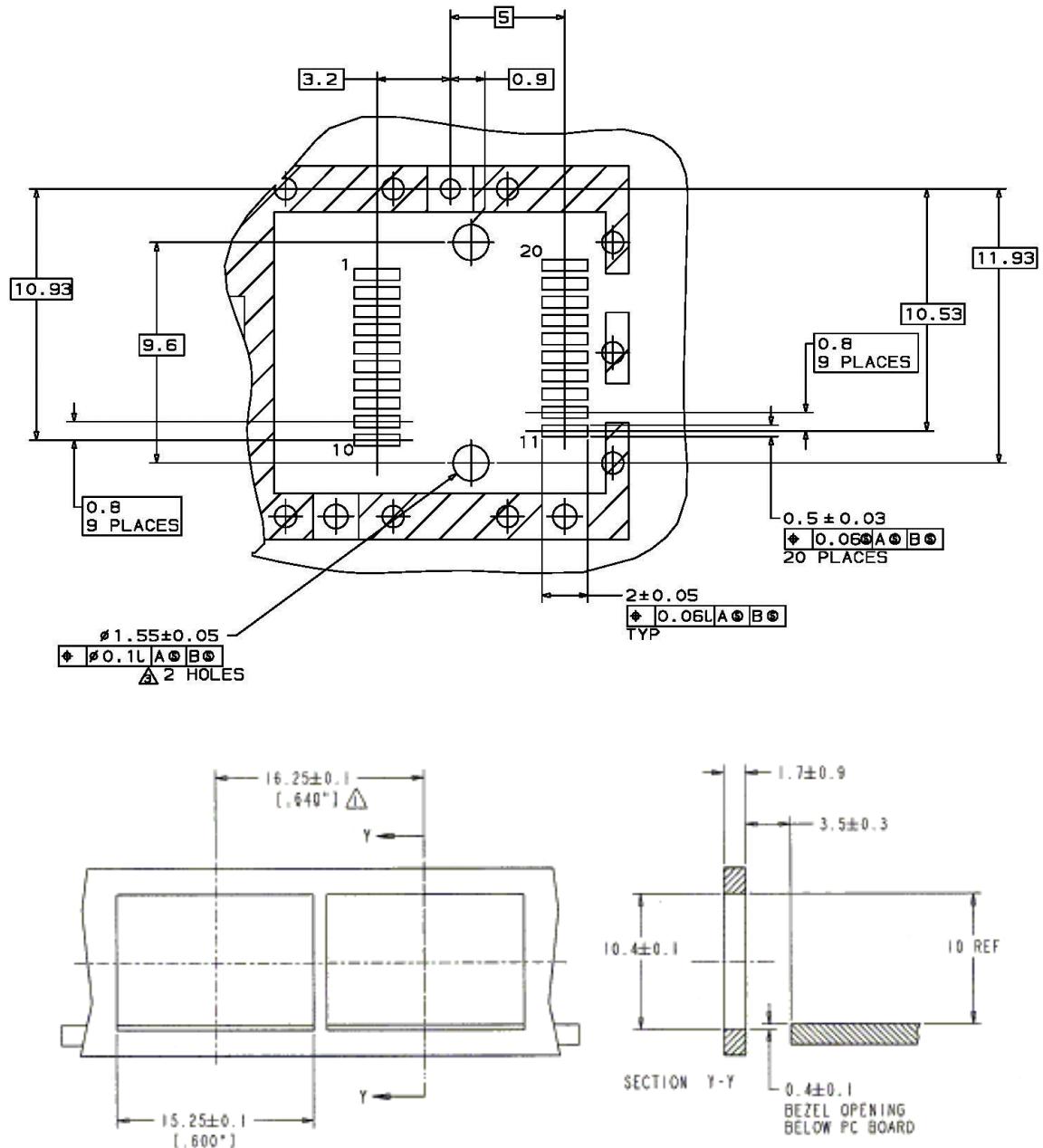


Figure 3. PCB Layout and Bezel Recommendations, as per [9]

- ▲ Datum and Basic Dimension Established by Customer
- ▲ Pads and Vias are Chassis Ground, 11 Places
- ▲ Through Holes are Unplated



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

Figure 4

XIII. Host-Module Interface Diagram

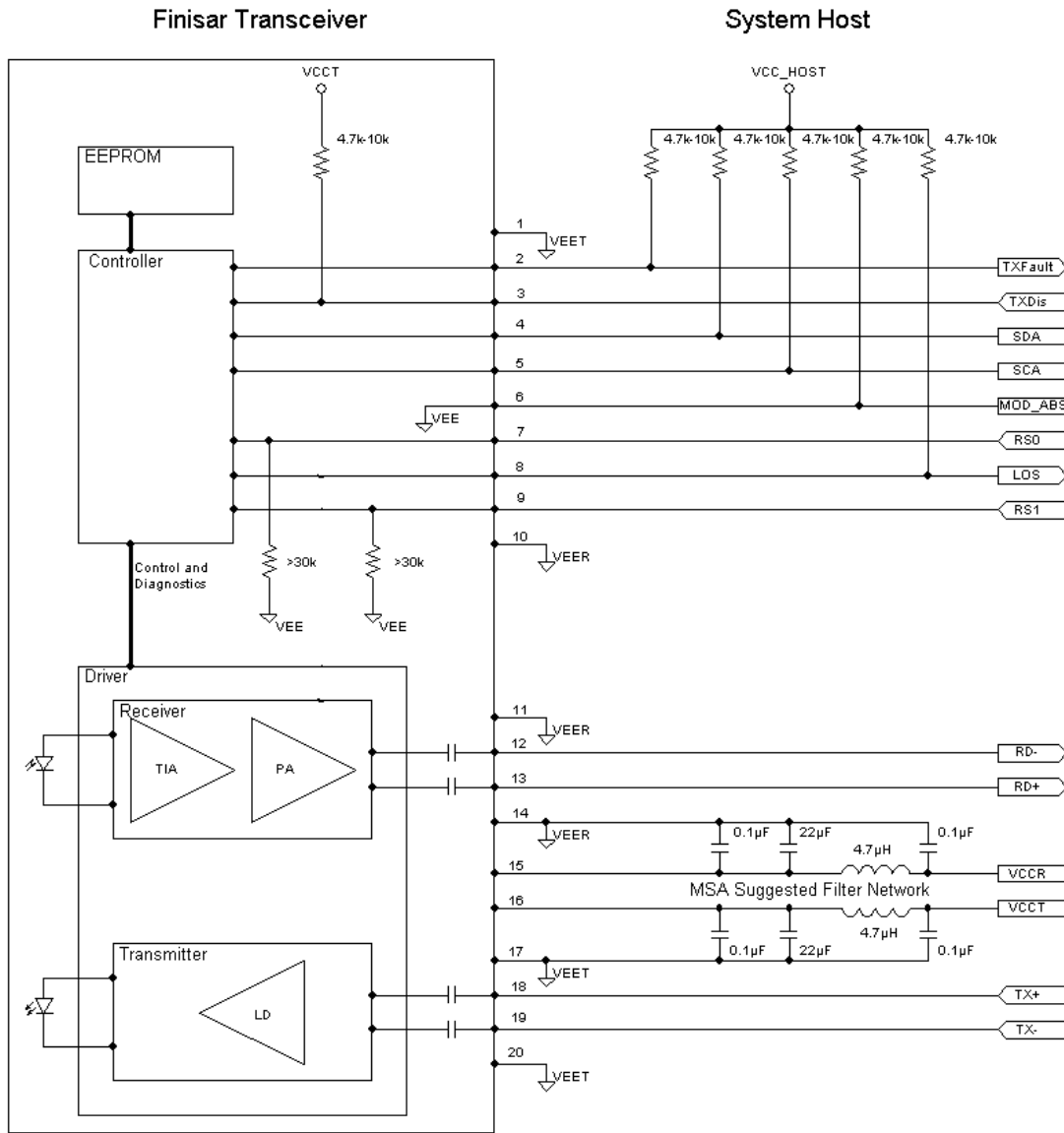


Figure 5

XIV. References

1. “Specifications for Enhanced 8.5 and 10 Gigabit Small Form Factor Pluggable Module ‘SFP+ ’”, SFF Document Number SFF-8431, Revision 4.1.
2. “Improved Pluggable Form factor”, SFF Document Number SFF-8432, Revision 4.2, April 18, 2007.
3. “Digital Diagnostics Monitoring Interface for Optical Transceivers”. SFF Document Number SFF-8472, Revision 10.1, March 1, 2007.
4. 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”, 08-June 2011, which supersedes the previous ROHS Directive 2002/95/EC.
5. “Application Note AN-2038: Finisar Implementation of RoHS Compliant Transceivers”, Finisar Corporation, January 21, 2005.
6. Small Form-factor Pluggable (SFP) Transceiver Multi-Source Agreement (MSA)
7. “Application Note AN-2030: Digital Diagnostic Monitoring Interface for SFP Optical Transceivers”

XV. Modification History

| Revision | Date | Description |
|----------|----------------|---|
| B1 | April 2014 | Initial Release |
| B2 | September 2014 | Correction of a typo in the H/W pin description |

XVI. For More Information

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