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Product Specification

10Gb/s DWDM 80km Multi-Rate Tunable SFP+ Transceiver FTLX6871MCC and FTLX6872MCC

PRODUCT FEATURES

- Hot-pluggable SFP+ footprint
- Supports 8.5 and 9.95 to 11.3 Gb/s
- Up to 80km link length
- 50GHz ITU-based channel spacing (C-Band) with a wavelength locker
- -5 /70°C case temperature range
- Single 3.3V power supply
- Monolithic MZM Tunable TOSA
- Linear or Limiting electrical interface receiver
- Duplex LC connector
- Built-in digital diagnostic functions
- RoHS-6 compliant (lead-free)



APPLICATIONS

- DWDM 80km point to point links:
 - 8.5Gb/s Fibre Channel
 - 10Gb/s SONET/SDH
 - 10G Ethernet
 - 10G Fibre Channel
- ITU-T G.698.1 DS100S1-2Dz(C)
- ITU-T G.709

Finisar's FTLX6871MCC and FTLX6872MCC transceivers are Enhanced Small Form Factor Pluggable Tunable 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, SFF-8690⁸, and G.698.1 DS100S1-2Dz(C), and support SONET OC-192, SDH STM-64, 10G Ethernet ZR and 10G Fibre Channel over 80km fiber. Digital diagnostics functions are available via a 2-wire serial interface, as specified in SFF-8472³. The optical transceiver is compliant per the RoHS Directive 2011/65/EU⁴. See Finisar Application Note AN-2038 for more details⁵.

PRODUCT SELECTION

| Product Part Number | RX Interface |
|---------------------|--------------|
| FTLX6871MCC | Linear |
| FTLX6872MCC | Limiting |

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 | NA | Not Used | |
| 8 | RX_LOS | Loss of Signal indication. Logic 0 indicates normal operation. | 4 |
| 9 | NA | No Used | |
| 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 | 5 |
| 16 | V _{CCT} | Transmitter Power Supply | 5 |
| 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.
- 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

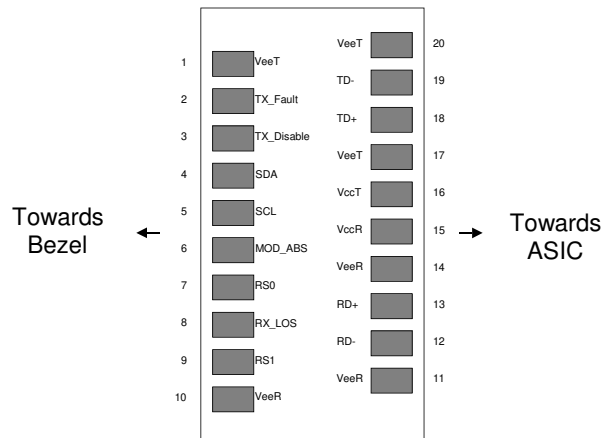


Figure 1. Diagram of Host Board Connector Block Pin Numbers and Names.

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 | RX _{Damage} | 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 | | 3.46 | | |
| Supply Current | I _{cc} | | | 650 | mA | 1 |
| Module total power dissipation | P | | | 2.0 | W | 2 |
| Transmitter | | | | | | |
| Input differential impedance | R _{in} | 80 | 100 | 120 | Ω | |
| Differential data input swing | V _{in,pp} | 200 | | 850 | mV | 3 |
| Transmit Disable Voltage | V _D | V _{cc} -0.8 | | V _{cc} | V | |
| Transmit Enable Voltage | V _{EN} | V _{ee} | | V _{ee} + 0.8 | V | |
| Receiver | | | | | | |
| Output differential impedance | R _{out} | 80 | 100 | 120 | Ω | |
| Differential data output swing | V _{out,pp} | 100 | | 850 | mV | 4 |
| Output rise time and fall time | T _r , T _f | 28 | | | ps | 4,5 |
| LOS asserted | V _{LOS A} | V _{cc} -0.8 | | V _{cc} | V | |
| LOS de-asserted | V _{LOS D} | V _{ee} | | V _{ee} +0.8 | V | |
| Power Supply Noise Tolerance | V _{ccT} /V _{ccR} | Per SFF-8431 Rev 4.1 | | | mV _{pp} | |

Notes:

1. Compliant with the SFP+ Module Power Supply Requirements defined in [1], Tab. 8.
2. Maximum total power value is specified across the full temperature and voltage range.
3. Connected directly to TX data input pins.
4. Into 100Ω differential termination.
5. 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.

IV. Optical Characteristics (TOP = -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} | -1 | | +3 | dBm | |
| Optical Wavelength | | λ_c | As per ITU-T 694.1, 50GHz spacing 1528.77 to 1563.86 | | | nm | |
| Side-Mode Suppression Ratio | | SMSR | 30 | | | dB | |
| Optical Extinction Ratio | | ER | 8.2 | | | dB | |
| Average Launch power when Tx is OFF | | P_{OFF} | | | -30 | dBm | |
| Tx Jitter 20kHz - 80MHz | | T_{Xj1} | | | 0.3 | UI | |
| Tx Jitter 4MHz - 80MHz | | T_{Xj2} | | | 0.1 | UI | |
| Relative Intensity Noise | | RIN | | | -128 | dB/Hz | |
| Center Wavelength | Beginning of Life | $\lambda_{c\ BOL}$ | z-1.5 | z | z+1.5 | GHz | |
| | End of Life | $\lambda_{c\ EOL}$ | z-2.5 | z | z+2.5 | GHz | |
| Path Penalty over 80km | | | | | | | |
| Bit rate | Dispersion | BER | | | | | |
| 8.5 Gb/s | 1450ps/nm | <1E-12 | DP_1 | | 1 | dB | |
| 9.95 Gb/s | | | DP_2 | | 1 | dB | |
| 10.7 Gb/s | | | DP_3 | | 2 | dB | |
| 11.1 Gb/s | 1300ps/nm | <1E-4 | DP_4 | | 2 | dB | |
| 11.3 Gb/s | 1100ps/nm | <1E-4 | DP_5 | | 2 | dB | |
| Receiver (Rx) at 0ps/nm | | | | | | | |
| Bit rate | | BER | | | | | |
| 8.5, 9.95 | | <1E-12 | R_{SENS1} | | -24.0 | dBm | 1,2 |
| 10.7 Gb/s | | <1E-12 | R_{SENS2} | | -23.0 | dBm | 1,2 |
| 11.1 Gb/s | | <1E-12 | R_{SENS3} | | -23.0 | dBm | |
| | | <1E-4 | R_{SENS4} | | -27.0 | dBm | |
| 11.3 Gb/s | | <1E-4 | R_{SENS5} | | -27.0 | dBm | |
| Overload (Average Power) | | | P_{AVE} | | -7 | dBm | |
| Optical Center Wavelength | | | λ_C | 1260 | | 1600 | nm |
| LOS De-Assert | | | LOS_D | | | -25 | dBm |
| LOS Assert | | | LOS_A | -34 | | -27 | dBm |
| LOS Hysteresis | | | LOS_H | 0.5 | | | dB |
| Receiver Reflectance | | | R_{RX} | | | -27 | dB |

| FTLX6871/72MCC | | | | | |
|---|-------|--------------------|--|--|---------------------------|
| Receiver Sensitivity³ | | | | | |
| Data rate (Gb/s) | BER | Dispersion (ps/nm) | Sensitivity back-to-back at OSNR>30dB (dBm) | Dispersion Penalty at OSNR>30dB (dB) | Threshold Adjust Required |
| 9.95 | 1e-12 | -300 to 1450 | -23 | 2 | No ⁵ |
| 10.3 | 1e-12 | -300 to 1450 | -23 | 2.5 | No ⁵ |
| 10.7 | 1e-4 | -300 to 1300 | -27 | 3 | Yes ⁶ |
| 11.1 | 1e-4 | -300 to 1300 | -27 | 3 | Yes ⁶ |
| OSNR Performance⁴ | | | | | |
| Data rate (Gb/s) | BER | Dispersion (ps/nm) | Min OSNR Back-to-back at Power: -18dBm to -7dBm (dB) | Max OSNR Penalty at Power: -18 to -7dBm (dB) | Threshold Adjust Required |
| 9.95 | 1e-12 | -300 to 1450 | 24 | 4 | Yes ⁶ |
| 10.3 | 1e-12 | -300 to 1450 | 24 | 4 | Yes ⁶ |
| 10.7 | 1e-4 | -300 to 1300 | 16 | 4 | Yes ⁶ |
| 11.1 | 1e-4 | -300 to 1300 | 16 | 4 | Yes ⁶ |

Notes:

1. Measured with worst ER=8.2dB; BER<10⁻¹²; 2³¹ – 1 PRBS.
2. For 10G Ethernet application, -24dBm is equivalent to an OMA of -22.09dBm for an ER = 8.2 dB.
3. Measured at 1528-1600nm with worst ER; PRBS31.
4. All OSNR measurements are performed with 0.1nm resolution.
5. Linecard SerDes input threshold adjustment required (set to 50%) at 9.95 and 10.3Gb for AGC ROSA only
6. Linecard SerDes input threshold adjustment required for AGC ROSA. RxDTV control required for Limiting ROSA

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 2³¹ – 1 PRBS pattern at the BER defined in Table IV.
2. Over G.652 single mode fiber.

VI. Timing Parameters

| Parameter | Symbol | Min | Max | Units | Ref. |
|----------------------------------|-------------------|-----|-----|-------|------|
| Time to initialize cooled module | t_start_up_cooled | | 90 | s | |

VII. Environmental Specifications

Finisar FTLX6871/72MCC transceivers have an operating temperature range from -5°C 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 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 FTLX6871/72MCC Tunable SFP+ transceivers support the 2-wire serial communication protocol as defined in the SFP MSA¹. It is very closely related to the memory map 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 T-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 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 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.

IX. Digital Diagnostic Specifications

FTLX6871/72MCC transceivers can be used in host systems that require either internally or externally calibrated digital diagnostics.

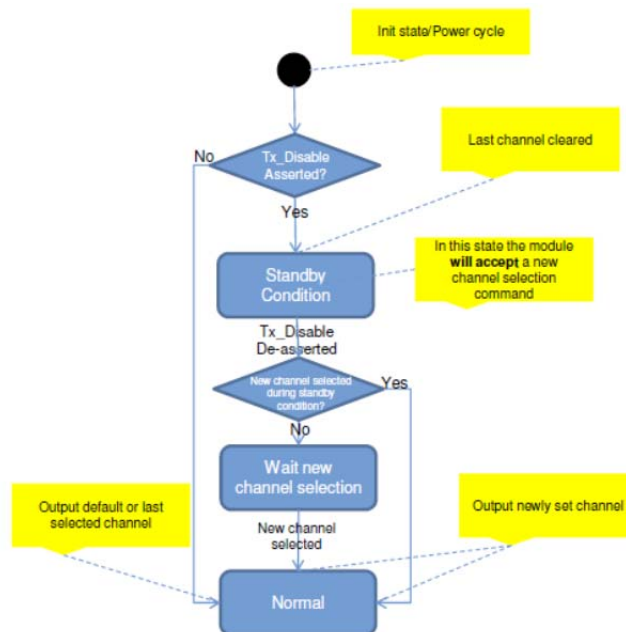
| Parameter | Symbol | Units | Min | Max | Accuracy | Ref. |
|--------------------------------------|-----------------------|-------|-----|-----|-------------------------|------|
| Accuracy | | | | | | |
| Transceiver temperature | Δ_{DDTemp} | °C | -10 | +75 | $\pm 5^{\circ}\text{C}$ | 1 |
| Transceiver supply voltage | $\Delta_{DDVoltage}$ | V | 2.8 | 4.0 | $\pm 3\%$ | |
| Transmitter bias current | Δ_{DDBias} | mA | 0 | 127 | $\pm 10\%$ | 2 |
| Transmitter output power | $\Delta_{DDTx-Power}$ | dBm | -1 | +5 | $\pm 2\text{dB}$ | |
| Receiver average optical input power | $\Delta_{DDRx-Power}$ | dBm | -28 | -5 | $\pm 2\text{dB}$ | |

Notes:

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

X. Start-Up Sequence

The FTLX6871/72MCC modules adhere to MSA SFF-8690 for wavelength / channel selection of these tunable modules. The module behavior is described in the flowchart below:



Alarm and Warning Threshold Values (A2h)

| Address | Parameter | Threshold Values | UNITS |
|---------|-----------------------|------------------|-------|
| 00-01 | Temp High Alarm | 80 | C |
| 02-03 | Temp Low Alarm | -15 | C |
| 04-05 | Temp High Warning | 75 | C |
| 06-07 | Temp Low Warning | -10 | C |
| 08-09 | Voltage High Alarm | 3.56 | V |
| 10-11 | Voltage Low Alarm | 3.04 | V |
| 12-13 | Voltage High Warning | 3.46 | V |
| 14-15 | Voltage Low Warning | 3.14 | V |
| 16-17 | Bias High Alarm | 130 | mA |
| 18-19 | Bias Low Alarm | 5 | mA |
| 20-21 | Bias High Warning | 120 | mA |
| 22-23 | Bias Low Warning | 10 | mA |
| 24-25 | TX Power High Alarm | 6.5 | dBm |
| 26-27 | TX Power Low Alarm | -3 | dBm |
| 28-29 | TX Power High Warning | 6 | dBm |
| 30-31 | TX Power Low Warning | -1.5 | dBm |
| 32-33 | RX Power High Alarm | -4 | dBm |
| 34-35 | RX Power Low Alarm | -31 | dBm |
| 36-37 | RX Power High Warning | -5 | dBm |
| 38-39 | RX Power Low Warning | -25 | dBm |
| 40-55 | Reserved | | |

XI. The FTLX6871/72MCC modules do not contain Internal CDRs.

XII. SFF-8431 Power-up Sequence

The typical power consumption of the FTLX6871/72MCC exceeds the limit of 1.5W specified in the SFF-8431 for the Power Level II device, for which the SFF-8431 recommends a power-up sequence. Per the SFF-8431, at the power-on a Power Level II transceiver can stay in Power Level I until the host enables the transceiver to complete its power-up sequence, reaching its operating power consumption into Power Level Mode II. Please, refer to SFF-8431 and Finisar Application Note AN-2076⁷ for additional details.

The FTLX6871/72MCC 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 above power-up sequence at the power-on. In power level I, the FTLX6871/72MCC does not carry traffic, but the 2-wire serial communication is active.

XIII. Mechanical Specifications

Finisar FTLX6871/72MCC SFP+ transceivers are compatible with the SFF-8432 specification for improved pluggable form factor, and shown here for reference purposes only. Bail color is green.

| 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 |

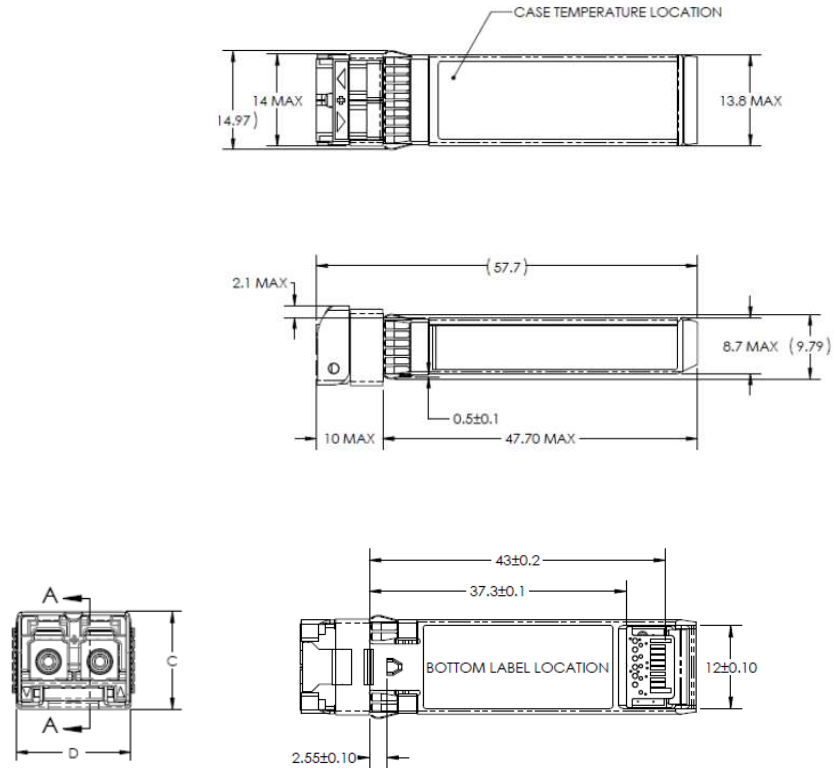
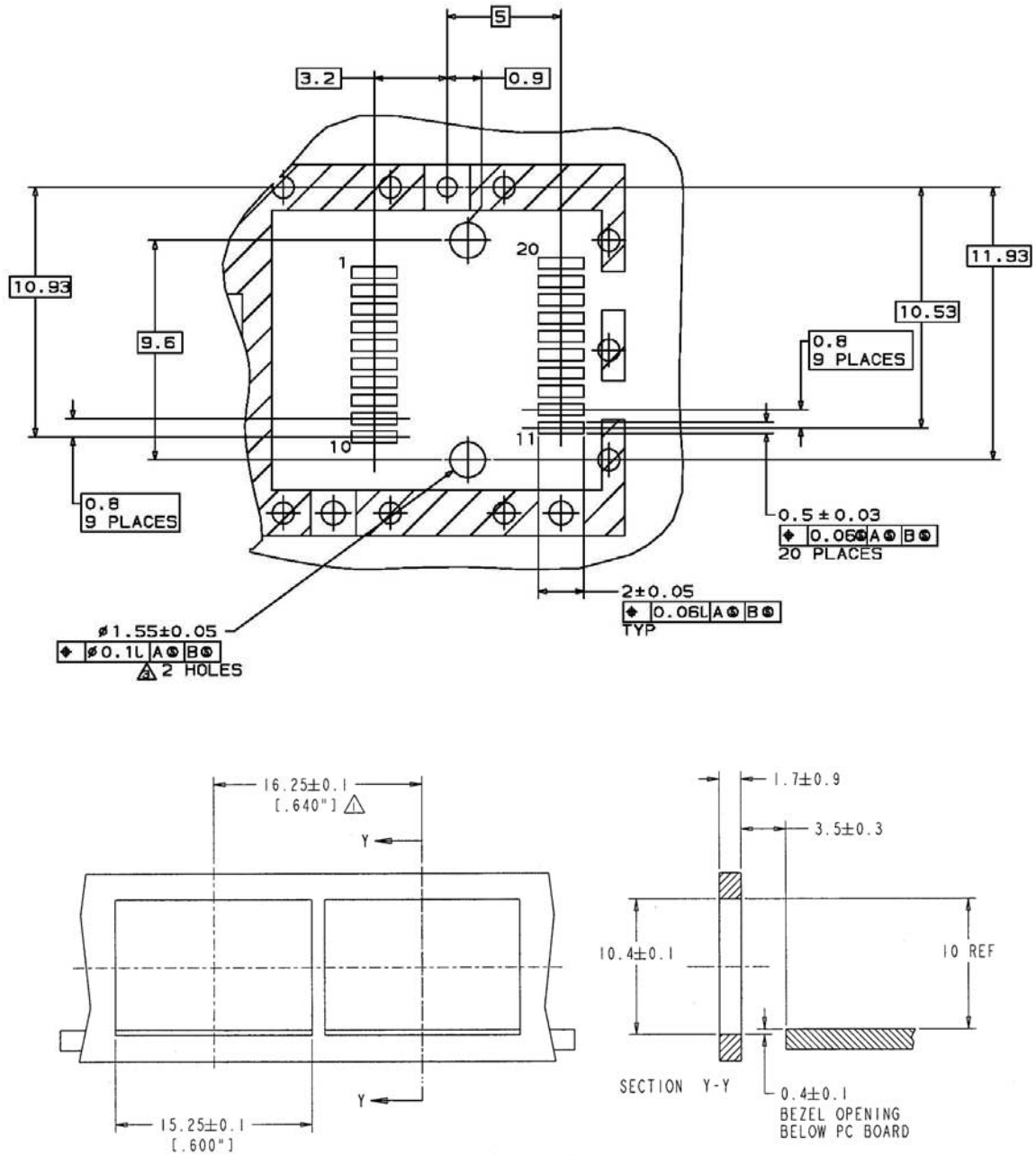


Figure 2. Mechanical Dimensions

Connector Recommendations



NOTES:

△ MINIMUM PITCH ILLUSTRATED, ENGLISH DIMENSIONS ARE FOR REFERENCE ONLY

2. NOT RECOMMENDED FOR PCI EXPANSION CARD APPLICATIONS

Figure 4

XV. Host-Module Interface Diagram

To Be Provided in future release.

Figure 5

XVI. 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”
5. “Application Note AN-2038: Finisar Implementation of RoHS Compliant Transceivers”
6. Small Form-factor Pluggable (SFP) Transceiver Multi-Source Agreement (MSA)
7. “Application Note AN-2076: SFP+ Level II Power Up Sequence”, Rev B
8. Tunable SFP+ MSA; SFF-8690

XVII. Revision History

| Revision | Date | Description |
|-----------------|-------------|--|
| A00 | 5/7/2013 | Preliminary document created |
| A01 | 12/9/2013 | Updated to include a Max Power consumption of 2W (Section III); updated RxLOS |
| A02 | 6/11/2014 | Updated product photo, included turn-on sequence flowchart (Section X); updated Mechanical outline drawing to show label placement on bottom |
| A03 | 7/24/2014 | Updated Table III; Differential Data Input Swing 200mV min.; added Alarms and Warnings in Section X |
| B1 | 10/09/2015 | Updated logo and RoHS statement |

XVIII. For More Information

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