

## Product Specification

### RoHS-6 Compliant 10Gb/s SFPwire<sup>(R)</sup> SFP+ Active Optical Cable

#### FCBG110SD1Cxx

#### PRODUCT FEATURES

- Hot-pluggable SFP+ cable ends
- Supports 10.3125 Gb/s bit rate
- RoHS-6 compliant (lead-free)
- Available in lengths up to 20m
- SFI Limiting interface
- Single 3.3V power supply
- Low power dissipation
- Commercial temperature range:  
0°C to 70°C
- Rigid pull-tab for improved high-density installations



#### APPLICATIONS

- 10G Ethernet Data Center Intra-Rack and Inter-Rack links

Finisar's FCBG110SD1Cxx 10Gb/s SFPwire® SFP+ active optical cables are designed for use in 10-Gigabit Ethernet links. They are electrically compliant with SFF-8431<sup>1</sup>, and the mechanical SFP+ plug is compatible with SFF-8432<sup>2</sup>. SFPwire is SFI limiting. No host electrical transmitter pre-emphasis is required. No host electrical receiver linear equalization is required. 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 limiting receiver. SFPwire is compliant per the RoHS Directive 2011/65/EU. See Finisar Application Note AN-2038 for more details.

#### PRODUCT SELECTION\*

|                      |                 |
|----------------------|-----------------|
| <b>FCBG110SD1C01</b> | 1-meter cable   |
| <b>FCBG110SD1CA5</b> | 1.5-meter cable |
| <b>FCBG110SD1C02</b> | 2-meter cable   |
| <b>FCBG110SD1CB5</b> | 2.5-meter cable |
| <b>FCBG110SD1C03</b> | 3-meter cable   |
| <b>FCBG110SD1CC5</b> | 3.5-meter cable |

|                      |                |
|----------------------|----------------|
| <b>FCBG110SD1C05</b> | 5-meter cable  |
| <b>FCBG110SD1C07</b> | 7-meter cable  |
| <b>FCBG110SD1C10</b> | 10-meter cable |
| <b>FCBG110SD1C15</b> | 15-meter cable |
| <b>FCBG110SD1C20</b> | 20-meter cable |

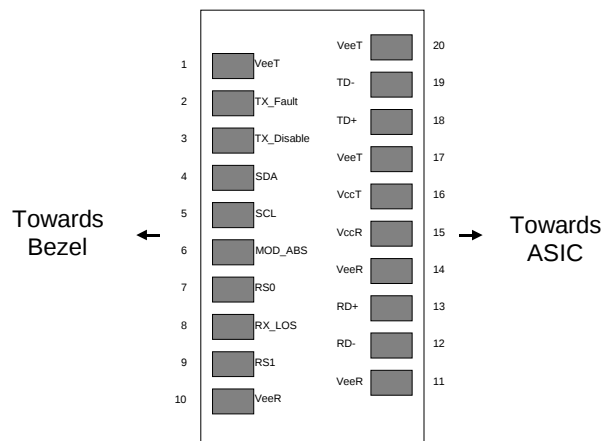
\* Adding the letter "B" to the end of the part number specifies bulk packaging/shipping option.

## I. Pin Descriptions

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

### Notes:

1. Circuit ground is internally isolated from chassis ground.
2. T<sub>FAULT</sub> is an open collector/drain output, which is pulled up with a 4.7k $\Omega$  – 10k $\Omega$  resistor on the host board, but is grounded inside the SFP+ cable plug.
3. Laser output disabled on T<sub>DIS</sub> > 2.0V or open, enabled on T<sub>DIS</sub> < 0.8V.
4. Should be pulled up with 4.7k $\Omega$  – 10k $\Omega$  on host board to a voltage between 2.0V and 3.6V.  
MOD\_ABS pulls line low to indicate module is plugged in.
5. LOS is open collector output. Should be pulled up with 4.7k $\Omega$  – 10k $\Omega$  on host board to a voltage between 2.0V and 3.6V. Logic 0 indicates normal operation; logic 1 indicates loss of signal.



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

## II. Absolute Maximum Ratings

Exceeding the limits below may damage the active optical cable permanently.

| Parameter                  | Symbol          | Min  | Typ | Max | Unit | Ref. |
|----------------------------|-----------------|------|-----|-----|------|------|
| Maximum Supply Voltage     | V <sub>CC</sub> | -0.5 |     | 4.0 | V    |      |
| Storage Temperature        | T <sub>S</sub>  | -40  |     | 85  | °C   | 1    |
| Case Operating Temperature | T <sub>A</sub>  | 0    |     | 70  | °C   |      |
| Relative Humidity          | RH              | 0    |     | 85  | %    | 2    |

### Notes:

- Assumes no mechanical load force on the unit. Ensuring no mechanical load force requires a cable bend radius of >105 mm within 100 mm of either cable and SFP+ end and >60 mm on the rest of the cable. Otherwise, the storage temperature range is -20 to 75°C.

Non-condensing.

## III. Electrical Characteristics (each cable end, T<sub>OP</sub> = 0 to 70 °C, V<sub>CC</sub> = 3.14 to 3.46 Volts)

| Parameter                        | Symbol                              | Min                  | Typ | Max                   | Unit | Ref. |
|----------------------------------|-------------------------------------|----------------------|-----|-----------------------|------|------|
| Supply Voltage                   | V <sub>CC</sub>                     | 3.14                 |     | 3.46                  | V    |      |
| Supply Current                   | I <sub>CC</sub>                     |                      |     | 250                   | mA   |      |
| <b>Transmitter</b>               |                                     |                      |     |                       |      |      |
| Input differential impedance     | R <sub>in</sub>                     |                      | 100 |                       | Ω    | 1    |
| Differential data input swing    | V <sub>in,pp</sub>                  | 180                  |     | 700                   | mV   |      |
| Transmit Disable Voltage         | V <sub>D</sub>                      | 2                    |     | V <sub>CC</sub>       | V    |      |
| Transmit Enable Voltage          | V <sub>EN</sub>                     | V <sub>EE</sub>      |     | V <sub>EE</sub> + 0.8 | V    |      |
| <b>Receiver</b>                  |                                     |                      |     |                       |      |      |
| Differential data output swing   | V <sub>out,pp</sub>                 | 300                  |     | 850                   | mV   | 2,6  |
| Data output rise time, fall time | t <sub>r</sub>                      | 28                   |     |                       | ps   | 3    |
| LOS Fault                        | V <sub>LOS fault</sub>              | 2                    |     | V <sub>CCHOST</sub>   | V    | 4    |
| LOS Normal                       | V <sub>LOS norm</sub>               | V <sub>EE</sub>      |     | V <sub>EE</sub> +0.8  | V    | 4    |
| Power Supply Noise Tolerance     | V <sub>CC</sub> T/V <sub>CC</sub> R | Per SFF-8431 Rev 4.1 |     |                       | mVpp | 5    |

### Notes:

- Connected directly to TX data input pins. AC coupling from pins into laser driver IC.
- Into 100Ω differential termination.
- 20 – 80% . Measured with Module Compliance Test Board and OMA test pattern. Use of four 1's and four 0's in sequence in the PRBS<sup>9</sup> is an acceptable alternative. SFF-8431 Rev 4.1
- 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. Maximum pull-up voltage is 5.5V.
- Testing methodology per SFF-8431. Rev 4.1
- The FCBG110SD1Cxx is SFI Limiting. 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 limiting receiver.

#### IV. General Specifications

| Parameter       | Symbol | Min | Typ  | Max        | Units | Ref. |
|-----------------|--------|-----|------|------------|-------|------|
| Bit Rate        | BR     |     | 10.3 |            | Gb/s  |      |
| Bit Error Ratio | BER    |     |      | $10^{-15}$ |       | 1    |

Notes:

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

#### V. Environmental Specifications

The FCBG110SD1Cxx SFPwire has a commercial operating temperature range from 0°C to 70°C case temperature.

| Parameter                  | Symbol           | Min | Typ | Max | Units | Ref. |
|----------------------------|------------------|-----|-----|-----|-------|------|
| Case Operating Temperature | T <sub>op</sub>  | 0   |     | 70  | °C    |      |
| Storage Temperature        | T <sub>sto</sub> | -40 |     | 85  | °C    | 1    |

Notes:

1. Assumes no mechanical load force on the unit. Ensuring no mechanical load force requires a cable bend radius of >105 mm within 100 mm of either cable and SFP+ end and >60 mm on the rest of the cable. Otherwise, the storage temperature range is -20 to 75°C.

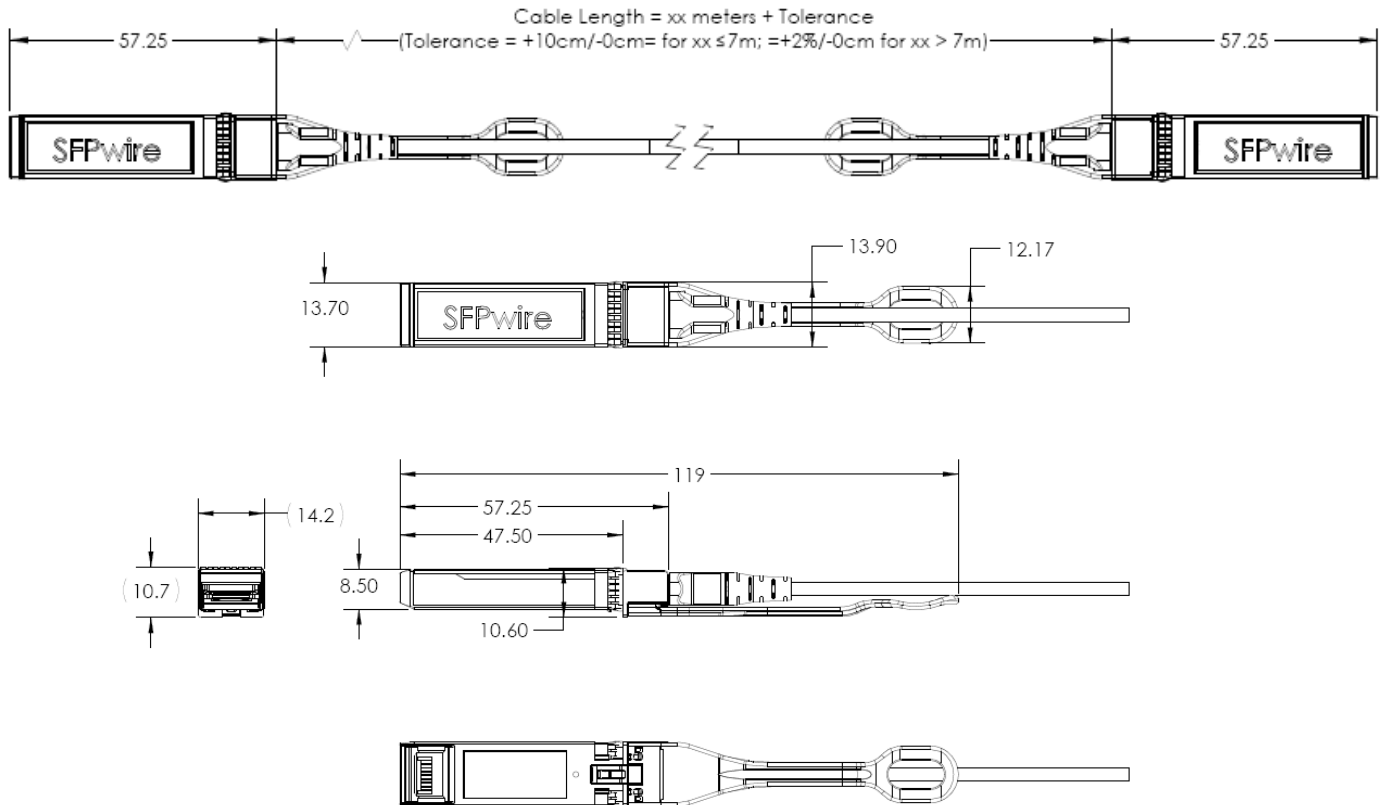
#### VI. Regulatory Compliance

The FCBG110SD1Cxx SFPwire, which contains laser devices, is a Class 1 laser product and complies with 21CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007, and it complies with EN(IEC) 60825 Edition 1.2 regulations. The FCBG110SD1Cxx is also RoHS Compliant.

Copies of certificates are available at Finisar Corporation upon request.

## VII. Mechanical Specifications

The FCBG110SD1Cxx SFPwire SFP+ cable ends are compatible with the SFF-8432 specification for improved pluggable form factor. Rigid pull-tab and cable jacket color are black.



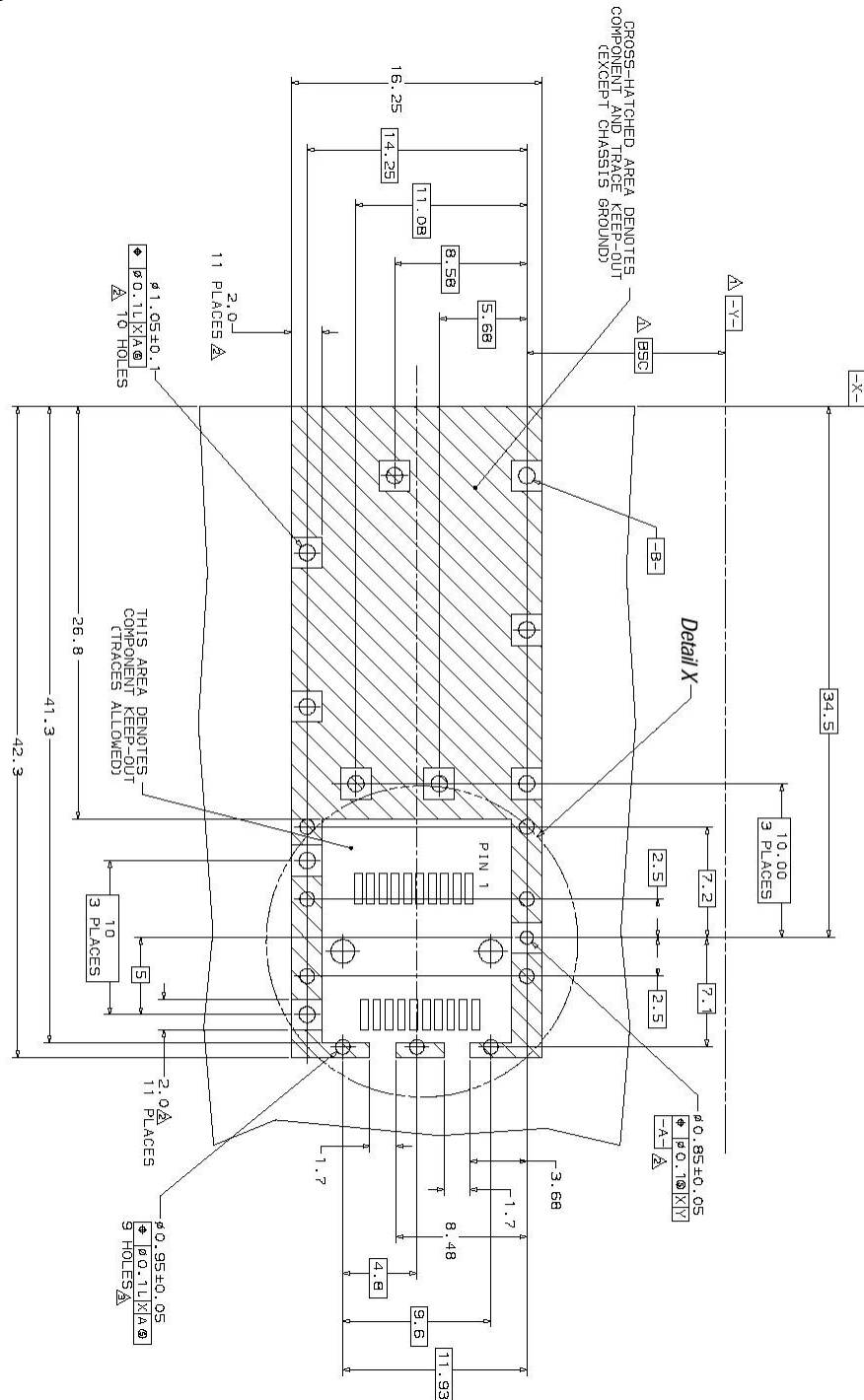
**Figure 2. FCBG110SD1Cxx Mechanical Dimensions.**

### FCBG110SD1Cxx SFPwire® cable details

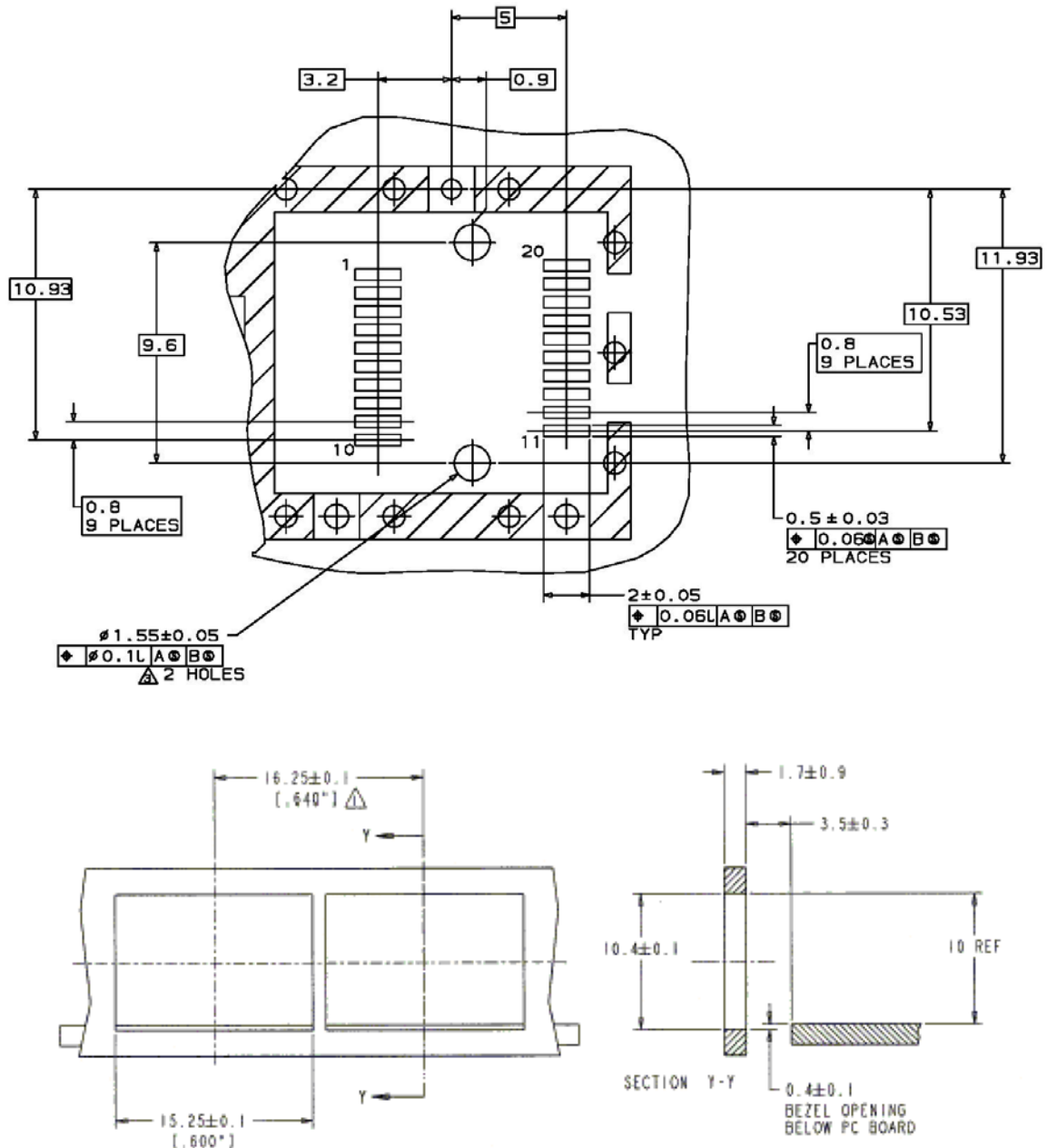
| Description                     | Min | Typ | Max | Units      | Notes           |
|---------------------------------|-----|-----|-----|------------|-----------------|
| Cable Jacket Material           |     |     |     |            | PVC             |
| Cable Flammability Rating       |     |     |     |            | OFNR            |
| Cable Outer Diameter            | 2.8 | 3.0 | 3.2 | mm         |                 |
| Cable Tensile Load (Short Term) |     |     | 200 | Newtons    |                 |
| Cable Tensile Load (Long Term)  |     |     | 100 | Newtons    |                 |
| Crush Resistance                | 10  |     |     | Newtons/mm | FOTP-41         |
| Impact Resistance               | 0.5 |     |     | Newton·m   | FOTP-25         |
| Flexing                         | 300 |     |     | Cycles     | FOTP-104        |
| Twist Bend                      |     |     |     |            | Exceeds FOTP-85 |
| Cable to SFP+ Plug Connection   |     |     | 90  | Newtons    |                 |
| Bend Radius (Short Term)        | 25  |     |     | mm         |                 |
| Bend Radius (Long Term)         | 30  |     |     | mm         |                 |
| Durability                      | 100 |     |     | Cycle Min  |                 |

## VIII. PCB Layout and Bezel Recommendations

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



**Figure 3.**



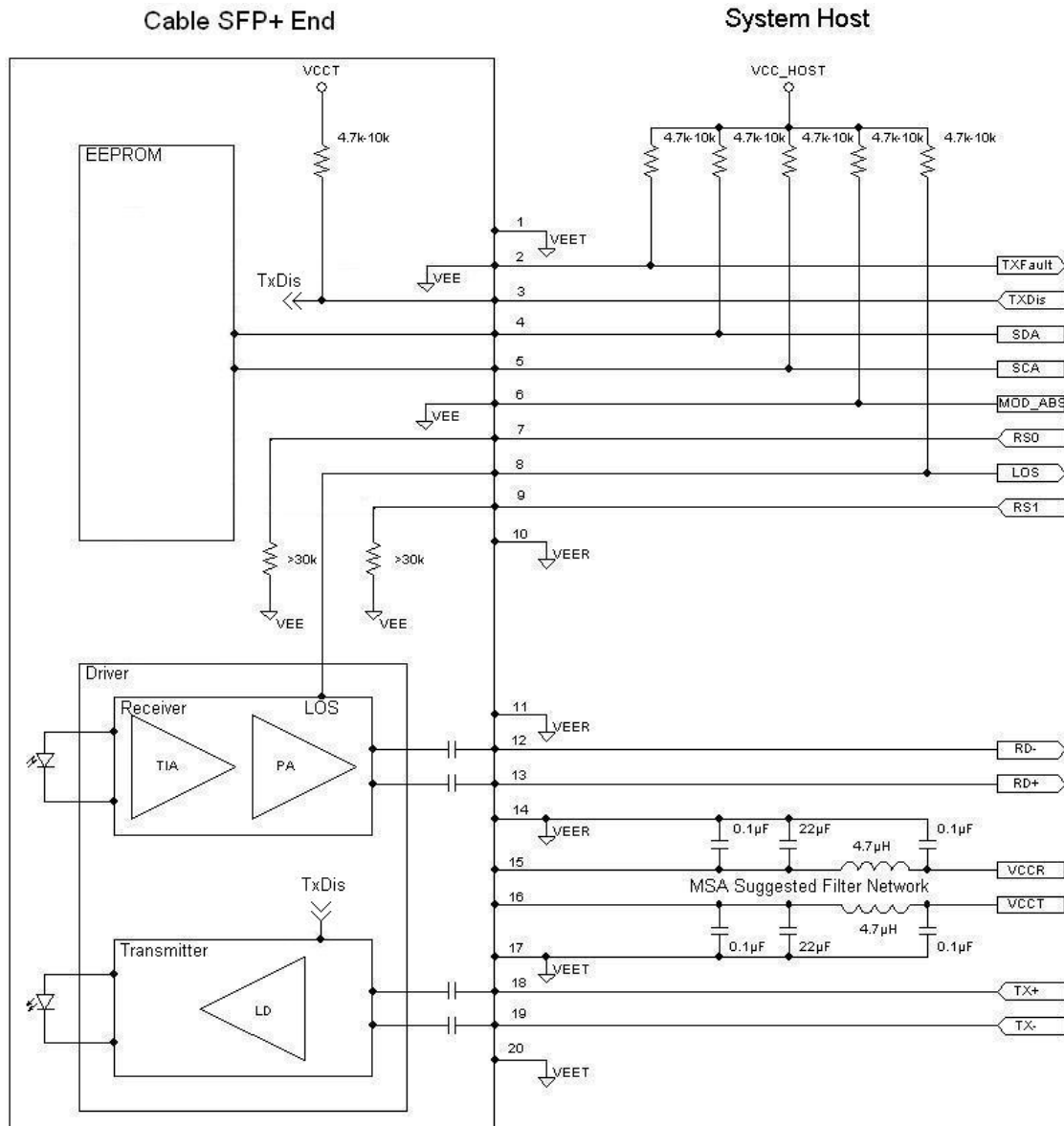
## NOTES:

1. MINIMUM PITCH ILLUSTRATED, ENGLISH DIMENSIONS ARE FOR REFERENCE ONLY

2. NOT RECOMMENDED FOR PCI EXPANSION CARD APPLICATIONS

Figure 4.

## IX. Host - Active optical cable end Interface Block Diagram



**Figure 5.**

## **X. 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 Formfactor”, SFF Document Number SFF-8432, Revision 4.2, April 18, 2007.
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”. Certain products may use one or more exemptions as allowed by the Directive
4. “Application Note AN-2038: Finisar Implementation of RoHS Compliant Transceivers”

## **XI. For More Information**

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