

# 16GFC SFP+ SW 850nm 125m Optical Transceiver Module

## Features

- Optical interface compliant to IEEE 802.3ae
- Electrical interface compliant to SFF-8431
- Hot Pluggable SFP+ footprint
- 850nm VCSEL transmitter, PIN photo-detector
- Built-in CDR with shut off control
- All-metal housing for superior EMI performance
- Advanced firmware allow customer system
- Cost effective SFP+ solution, enables higher port densities and greater bandwidth
- Operating case temperature: Standard : 0 to +70°C
- RoHS6 compliant(lead free) 



## Applications

- 14.025Gbps Fibre Channel
- Other optical links

## Description

This 850 nm VCSEL 14Gigabit SFP+ transceiver is designed to transmit and receive optical data over 50/125  $\mu\text{m}$  or 62.5/125  $\mu\text{m}$  multimode optical fiber (Table 1).

**Table 1: SFP+ SR Operating Range for each Optical Fiber Type**

| Fiber type             | Minimum modal band width@850nm (MHz.km) | Operating range(meters) |
|------------------------|---|-------------------------|
| 62.5 $\mu\text{m}$ MMF | 160                                     | 2 to 26                 |
|                        | 200                                     | 2 to 33                 |
| 50 $\mu\text{m}$ MMF   | 400                                     | 2 to 66                 |
|                        | 500                                     | 2 to 82                 |
|                        | 2000                                    | 2 to 100                |
|                        | 4700                                    | 2 to 125                |

The FST-14G-SW module electrical interface is compliant to SFI electrical specifications. The transmitter input and receiver output impedance is 100 Ohms differential. Data lines are internally AC coupled. The module provides differential termination and reduce differential to common mode conversion for quality signal termination and low EMI. SFI typically operates over 200 mm of improved FR4 material or up to about 150mm of standard FR4 with one connector.

The transmitter converts 14.025Gbit/s serial PECL or CML electrical data into serial optical data compliant with the FC standard. The receiver converts 14.025Gbit/s serial optical data into serial PECL/CML electrical data.



### Absolute maximum rating

These values represent the damage threshold of the module. Stress in excess of any of the individual Absolute Maximum Ratings can cause immediate catastrophic damage to the module even if all other parameters are within Recommended Operating Conditions.

| Parameter                  | Symbol | Min | Typical | Max  | Unit |
|----------------------------|--------|-----|---------|------|------|
| Power Supply Voltage       | VCC    | 0   | +3.3    | +3.6 | V    |
| Storage Temperature        | TC     | -40 | +25     | +85  | °C   |
| Operating Case Temperature | TC     | 0   | +25     | +70  | °C   |
| Relative Humidity          | RH     | 5   | 50      | 95   | %    |
| RX Input Average Power     | Pmax   | -   |         | 0    | dBm  |

### Recommended operating environment

Recommended Operating Environment specifies parameters for which the electrical and optical characteristics hold unless otherwise noted.

| Parameter                  | Symbol | Min    | Typical | Max    | Unit |
|----------------------------|--------|--------|---------|--------|------|
| Power Supply Voltage       | VCC    | +3.135 | +3.3    | +3.465 | V    |
| Operating Case Temperature | TC     | 0      | +25     | +70    | °C   |

### Low Speed Characteristics

| Parameter         | Symbol | Min          | Typical | Max          | Unit |
|-------------------|--------|--------------|---------|--------------|------|
| Power Consumption |        |              |         | 1.2          | W    |
| TX_Fault,RX_LOS   | VOL    | 0            |         | 0.4          | V    |
|                   | VOH    | Host_VCC-0.5 |         | Host_VCC+0.3 | V    |
| TX_DIS            | VIL    | -0.3         |         | 0.8          | V    |
|                   | VIH    | 2.0          |         | VCCT+0.3     | V    |
| RS0,RS1           | VIL    | -0.3         |         | 0.8          | V    |
|                   | VIH    | 2.0          |         | VCCT+0.3     | V    |

### Optical characteristics

The following optical characteristics are defined over the Recommended Operating Environment unless otherwise specified.

| Parameter                      | Symbol      | Min  | Typical | Max   | Unit  | Notes           |
|--------------------------------|-------------|------|---------|-------|-------|-----------------|
| <b>Transmitter</b>             |             |      |         |       |       |                 |
| Center Wavelength              | $\lambda_t$ | 840  | 850     | 860   | nm    |                 |
| RMS spectral width             | Pm          |      |         | Note1 | nm    |                 |
| Average Optical Power          | Pavg        | -6.5 |         |       | dBm   | 2               |
| Extinction Ratio               | ER          | 3.5  |         |       | dB    | 3               |
| Transmitter Dispersion Penalty | TDP         |      |         | 3.9   | dB    |                 |
| Relative Intensity Noise       | Rin         |      |         | -128  | dB/Hz | 12dB reflection |
| Optical Return Loss Tolerance  |             |      |         | 12    | dB    |                 |
| <b>Receiver</b>                |             |      |         |       |       |                 |



|                             |                   |     |     |       |     |   |
|-----------------------------|-------------------|-----|-----|-------|-----|---|
| Center Wavelength           | $\lambda_r$       | 840 | 850 | 860   | nm  |   |
| Receiver Sensitivity        | P <sub>sens</sub> |     |     | -10.5 | dBm | 4 |
| Stressed Sensitivity in OMA |                   |     |     | -7.5  | dBm | 4 |
| Los function                | Los               | -30 |     | -12   | dBm |   |
| Overload                    | P <sub>in</sub>   |     |     | -1.0  | dBm | 4 |
| Receiver Reflectance        |                   |     |     | -12   | dB  |   |

**Note:**

1. Trade-offs are available between spectral width, center wavelength and minimum OMA, as shown in table 6.
2. The optical power is launched into MMF
3. Measured with a PRBS 231-1 test pattern @14.025Gbps
4. Measured with a PRBS 231-1 test pattern @14.025Gbps, BER≤10<sup>-12</sup>.

| Center Wavelength (nm) | RMS Spectral width (nm) |             |             |             |             |             |             |             |             |
|------------------------|-------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
|                        | Up to 0.05              | 0.05 to 0.1 | 0.1 to 0.15 | 0.15 to 0.2 | 0.2 to 0.25 | 0.25 to 0.3 | 0.3 to 0.35 | 0.35 to 0.4 | 0.4 to 0.45 |
| 840 to 842             | -4.2                    | -4.2        | -4.1        | -4.1        | -3.9        | -3.8        | -3.5        | -3.2        | -2.8        |
| 842 to 844             | -4.2                    | -4.2        | -4.2        | -4.1        | -3.9        | -3.8        | -3.6        | -3.3        | -2.9        |
| 844 to 846             | -4.2                    | -4.2        | -4.2        | -4.1        | -4.0        | -3.8        | -3.6        | -3.3        | -2.9        |
| 846 to 848             | -4.3                    | -4.2        | -4.2        | -4.1        | -4.0        | -3.8        | -3.6        | -3.3        | -2.9        |
| 848 to 850             | -4.3                    | -4.2        | -4.2        | -4.1        | -4.0        | -3.8        | -3.6        | -3.3        | -3.0        |
| 850 to 852             | -4.3                    | -4.2        | -4.2        | -4.1        | -4.0        | -3.8        | -3.6        | -3.4        | -3.0        |
| 852 to 854             | -4.3                    | -4.2        | -4.2        | -4.1        | -4.0        | -3.9        | -3.7        | -3.4        | -3.1        |
| 854 to 856             | -4.3                    | -4.3        | -4.2        | -4.1        | -4.0        | -3.9        | -3.7        | -3.4        | -3.1        |
| 856 to 858             | -4.3                    | -4.3        | -4.2        | -4.1        | -4.0        | -3.9        | -3.7        | -3.5        | -3.1        |
| 858 to 860             | -4.3                    | -4.3        | -4.2        | -4.2        | -4.1        | -3.9        | -3.7        | -3.5        | -3.2        |

**Electrical characteristics**

The following electrical characteristics are defined over the Recommended Operating Environment unless otherwise specified.

| Parameter                             | Symbol          | Min. | Typical | Max  | Unit | Notes      |
|---------------------------------------|-----------------|------|---------|------|------|------------|
| Data Rate                             |                 | -    | -       | 8.5  | Gbps |            |
| Power Consumption                     |                 | -    | -       | 800  | mW   |            |
| <b>Transmitter</b>                    |                 |      |         |      |      |            |
| Single Ended Output Voltage Tolerance |                 | -0.3 | -       | 4.0  | V    |            |
| C common mode voltage tolerance       |                 | 15   | -       | -    | mV   |            |
| Tx Input Diff Voltage                 | V <sub>I</sub>  | 400  |         | 1600 | mV   |            |
| Tx Fault                              | V <sub>oL</sub> | -0.3 |         | 0.4  | V    | At 0.7mA   |
| Data Dependent Input Jitter           | DDJ             |      |         | 0.10 | UI   |            |
| Data Input Total Jitter               | TJ              |      |         | 0.28 | UI   |            |
| <b>Receiver</b>                       |                 |      |         |      |      |            |
| Single Ended Output Voltage Tolerance |                 | -0.3 | -       | 4.0  | V    |            |
| Rx Output Diff Voltage                | V <sub>o</sub>  | 300  |         | 850  | mV   |            |
| Rx Output Rise and Fall Time          | Tr/Tf           | 30   |         |      | ps   | 20% to 80% |
| Total Jitter                          | TJ              |      |         | 0.70 | UI   |            |
| Deterministic Jitter                  | DJ              |      |         | 0.42 | UI   |            |



**Rate Select Control**

RX and TX rates can be independently controlled by hardware input pins RS0 and RS1. Module electrical input pins 7(RS0) and 9(RS1) are used to select RX and TX rate respectively. The following table shows the way how to select rate by RS0 and RS1.

| RS0 Control Input | RX Operation    | Rate Selected | RS1 Control Input | TX Operation    | Rate Selected |
|-------------------|-----------------|---------------|-------------------|-----------------|---------------|
| 1                 | RX CDR Enabled  | 14.025Gbps    | 1                 | TX CDR Enabled  | 14.025Gbps    |
| 0                 | RX CDR Disabled | 8GFC, 4GFC    | 0                 | TX CDR Disabled | 8GFC, 4GFC    |

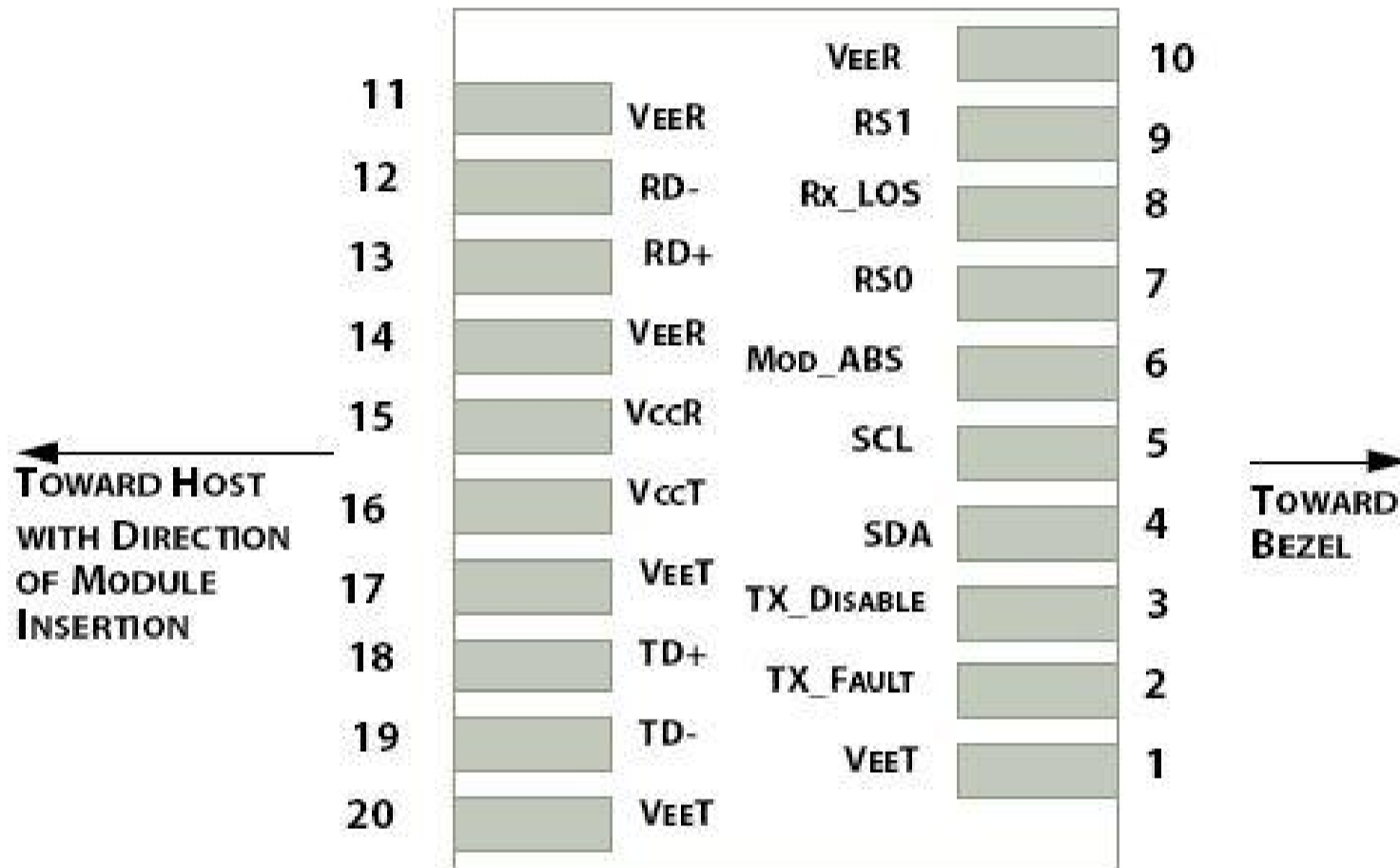


Figure 1: Interface to Host PCB

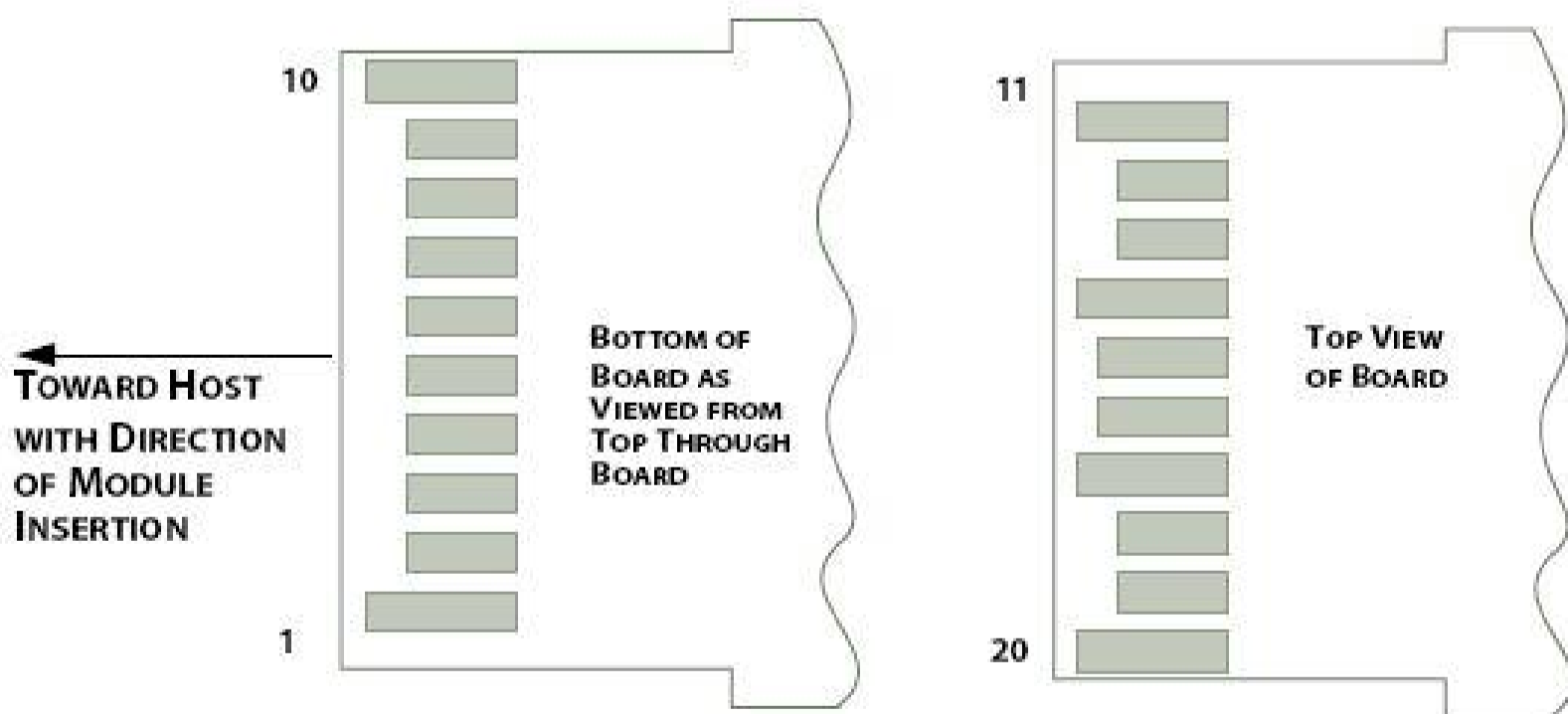


Figure 2: Module Contact Assignment



Pin definition

| Pin | Symbol       | Name/Description  |
|-----|--------------|---|
| 1   | VEET [1]     | Transmitter Ground  |
| 2   | Tx_FAULT [2] | Transmitter Fault   |
| 3   | Tx_DIS [3]   | Transmitter Disable. Laser output disabled on high or open    |
| 4   | SDA [2]      | 2-wire Serial Interface Data Line                             |
| 5   | SCL [2]      | 2-wire Serial Interface Clock Line                            |
| 6   | MOD_ABS [4]  | Module Absent. Grounded within the module                     |
| 7   | RS0 [5]      | Rate Select 0   |
| 8   | RX_LOS [2]   | Loss of Signal indication. Logic 0 indicates normal operation |
| 9   | RS1 [5]      | Rate Select 1   |
| 10  | VEER [1]     | Receiver Ground   |
| 11  | VEER [1]     | Receiver Ground   |
| 12  | RD-          | Receiver Inverted DATA out. AC Coupled                        |
| 13  | RD+          | Receiver DATA out. AC Coupled                                 |
| 14  | VEER [1]     | Receiver Ground   |
| 15  | VCCR         | Receiver Power Supply   |
| 16  | VCCT         | Transmitter Power Supply                                      |
| 17  | VEET [1]     | Transmitter Ground  |
| 18  | TD+          | Transmitter DATA in. AC Coupled                               |
| 19  | TD-          | Transmitter Inverted DATA in. AC Coupled                      |
| 20  | VEET [1]     | Transmitter Ground  |

Notes:

- [1] Module circuit ground is isolated from module chassis ground within the module.
- [2] should be pulled up with 4.7k – 10k ohms on host board to a voltage between 3.15V and 3.6V.
- [3] Tx\_Disable is an input contact with a 4.7 kΩ to 10 kΩ pullup to VccT inside the module.
- [4] Mod\_ABS is connected to VeeT or VeeR in the SFP+ module. The host may pull this contact up to Vcc\_Host with a resistor in the range 4.7 kΩ to 10 kΩ. Mod\_ABS is asserted “High” when the SFP+ module is physically absent from a host slot.
- [5] RS0 and RS1 are module inputs and are pulled low to VeeT with > 30 kΩ resistors in the module.

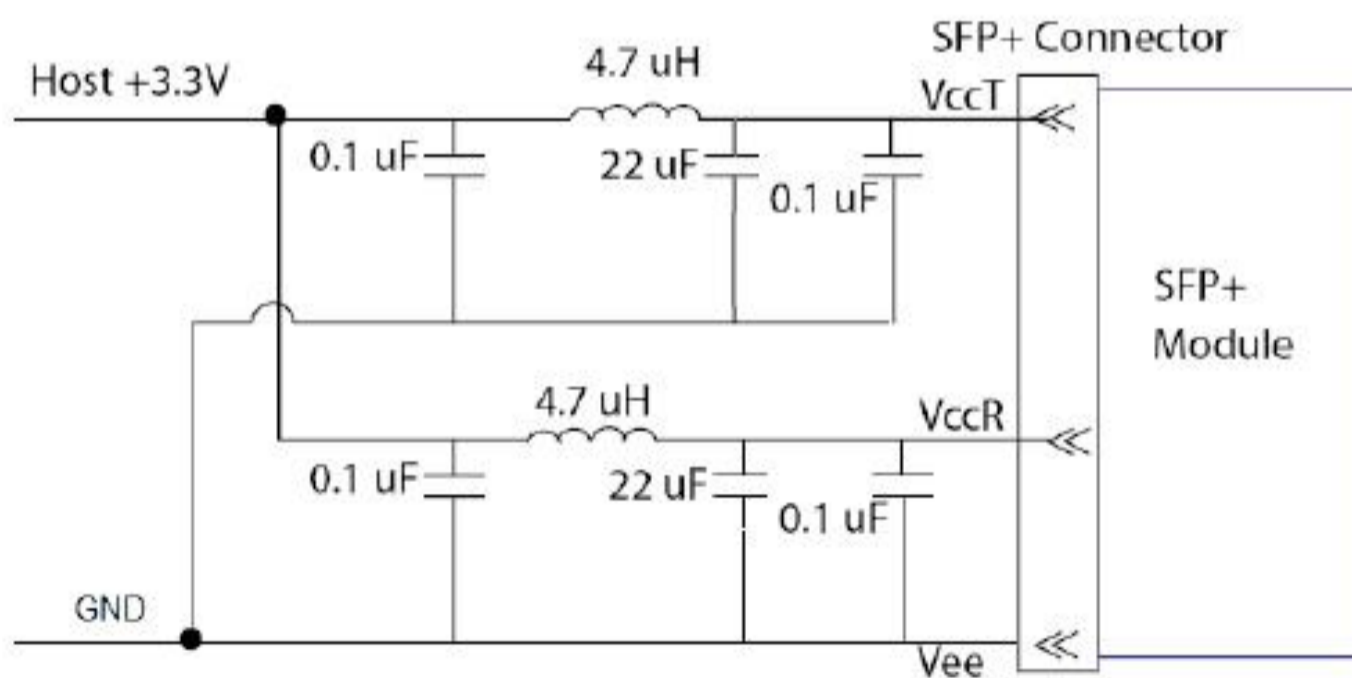


Figure3. Host Board Power Supply Filters Circuit



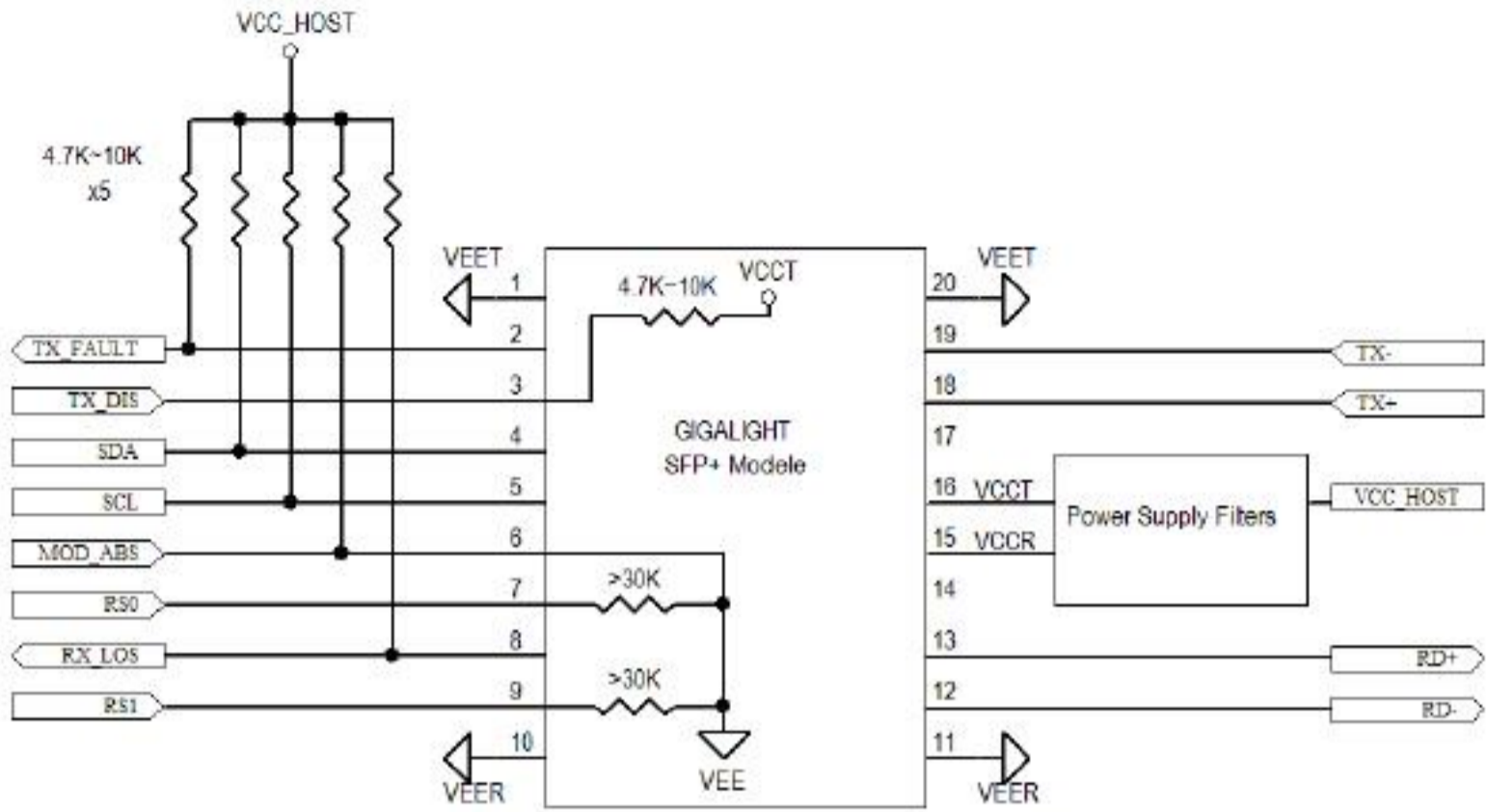


Figure4. Host-Module Interface

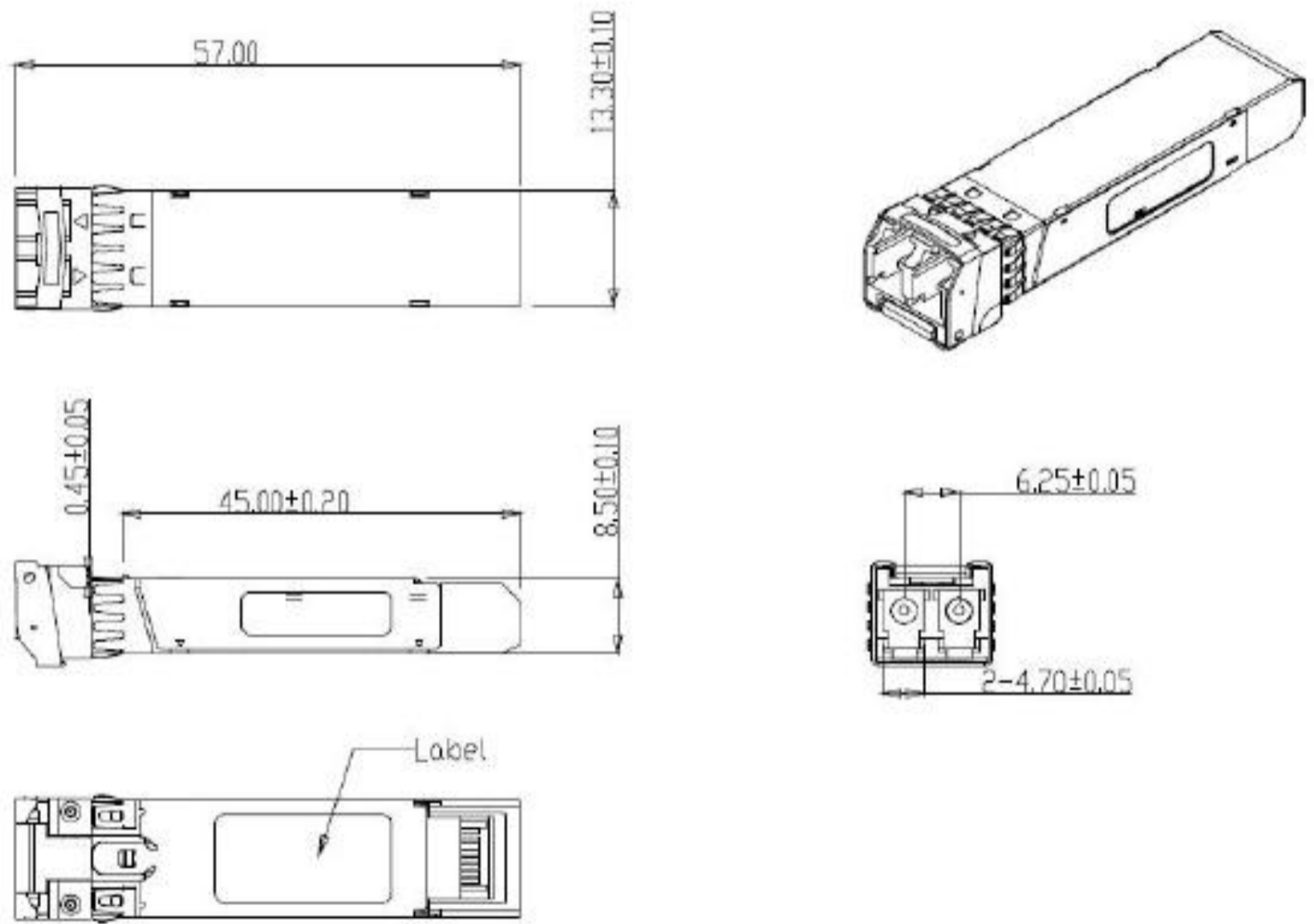


Figure5. Mechanical Specifications



**Regulatory Compliance**

GIGALIGHT SFP+ transceiver is designed to be Class I Laser safety compliant and is certified per the following standards:

| Feature                  | Agency | Standard  | Certificate / Comments |
|--------------------------|--------|---|------------------------|
| Laser Safety             | FDA    | CDRH 21 CFR 1040 and Laser Notice No. 50          | 1120292-000            |
| Product Safety           | UL     | UL and CUL EN60950-2:2007                         | E347511                |
| Environmental protection | SGS    | RoHS Directive 2002/95/EC                         | GZ1001008918/CHEM      |
| EMC                      | WALTEK | EN 55022:2006+A1:2007<br>EN 55024:1998+A1+A2:2003 | WT10093759-D-E-E       |

**Ordering Information**

| Part Number | Product Description                                 |
|-------------|---|
| FST-14G-SW  | 16GFC SFP+ SW 850nm 125m Optical Transceiver Module |

**References**

1. "Specifications for Enhanced Small Form Factor Pluggable Module SFP+", SFF-8431, Rev 4.1, July 6, 2009.
2. "Improved Pluggable Formfactor", SFF-8432, Rev 4.2, Apr 18, 2007
3. IEEE802.3ae-2002
4. "Diagnostic Monitoring Interface for Optical Transceivers" SFF-8472, Rev 10.3, Dec 1, 2007

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