



## 10G 1310nm LRM SFP+ Transceiver

(Linear optical receiver, up to 220m transmission)

### Members of Flexon™ Family



### Features

- ◆ 10GBASE-LRM application
- ◆ Support 10.3125Gbps data-rate
- ◆ Up to 220m transmission in MMF
- ◆ 1310nm DFB or FP laser
- ◆ PIN receiver with linear amplifier
- ◆ SFI electrical interface
- ◆ 2-wire interface for integrated Digital Diagnostic monitoring
- ◆ SFP+ MSA package with duplex LC connector
- ◆ Hot pluggable
- ◆ Single +3.3V power supply
- ◆ Power consumption less than 1.5 W
- ◆ Operating case temperature: 0~+70°C

### Applications

- ◆ 10GBASE-LRM at 10.3125Gbps

### Standard

- ◆ Compliant with SFF-8431
- ◆ Compliant with SFF-8472 Rev 10.1
- ◆ Compliant with IEEE 802.3aq-2006 10GBASE-LRM
- ◆ Compliant with FCC 47 CFR Part 15, Class B
- ◆ Compliant with FDA 21 CFR 1040.10 and 1040.11, Class I
- ◆ Compliant with Telcordia GR-468-CORE
- ◆ RoHS compliance

### Description

FTM-311XC-L03G is a high performance, cost effective module, which is applied in 10GBASE-LRM, supporting data-rate of 10.3125Gbps and transmission distance up to 220m in MMF.

The transceiver consists of two sections: The transmitter section incorporates a 1310nm DFB or FP Laser, and laser driver. The receiver section consists of a PIN photodiode integrated with a linear amplifier.

The module is hot pluggable into the 20-pin connector. The high-speed electrical interface is based on low voltage logic, with nominal 100 Ohms differential impedance and AC coupled in the module. The optical output can be disabled by LVTTTL logic high-level input of TX\_Disable.

## Regulatory Compliance

The transceivers are tested according to American and European product safety and electromagnetic compatibility regulations (See Table 1). For further information regarding regulatory certification, please refer to Source Photonics regulatory specification and safety guidelines, or contact with Source Photonics, Inc. America sales office listed at the end of the documentation.

**Table 1- Regulatory Compliance**

| Feature   | Standard   | Performance                           |
|---|--|---------------------------------------|
| Electrostatic Discharge (ESD) to the Electrical Pins      | MIL-STD-883E<br>Method 3015.7                                      | Class 1(>1000 V)                      |
| Electrostatic Discharge (ESD) to the Duplex LC Receptacle | IEC 61000-4-2<br>GR-1089-CORE                                      | Compliant with standards              |
| Electromagnetic Interference (EMI)                        | FCC Part 15 Class B<br>EN55022 Class B (CISPR 22B)<br>VCCI Class B | Compliant with standards              |
| Immunity  | IEC 61000-4-3  | Compliant with standards              |
| Laser Eye Safety  | FDA 21CFR 1040.10 and 1040.11<br>EN60950, EN (IEC) 60825-1,2       | Compliant with Class 1 laser product. |
| Component Recognition                                     | UL and CSA   | Compliant with standards              |

## Absolute Maximum Ratings

Stress in excess of the maximum absolute ratings can cause permanent damage to the module.

**Table 2 - Absolute Maximum Ratings**

| Parameter                   | Symbol   | Min. | Max. | Unit |
|-----------------------------|----------|------|------|------|
| Storage Temperature         | $T_s$    | -40  | +85  | °C   |
| Supply Voltage              | $V_{CC}$ | -0.5 | 4.0  | V    |
| Operating Relative Humidity | RH       |      | 85   | %    |

## Recommended Operating Conditions

**Table 3 - Recommended Operating Conditions**

| Parameter                  | Symbol   | Min. | Typical | Max. | Unit | Notes |
|----------------------------|----------|------|---------|------|------|-------|
| Operating Case Temperature | $T_C$    | 0    |         | +70  | °C   |       |
| Power Supply Voltage       | $V_{CC}$ | 3.15 | 3.3     | 3.45 |      |       |
| Power Supply Current       | $I_{CC}$ |      |         | 450  | mA   |       |
| Power Dissipation          | PD       |      |         | 1.5  | W    |       |
| Data Rate                  |          |      | 10.3125 |      | Gbps |       |
| Transmission Distance      |          |      |         | 220  | m    | 1     |

Note 1: See Table 68-2, IEEE P802aq-2006.

## Optical Characteristics

**Table 4 - Optical Characteristics**

| Parameter  | Symbol                          | Min. | Typical | Max. | Unit | Notes |
|--|---------------------------------|------|---------|------|------|-------|
| <b>Transmitter</b>                               |                                 |      |         |      |      |       |
| Operating Data Rate                              |                                 |      | 10.3125 |      | Gbps |       |
| Centre Wavelength                                | $\lambda_C$                     | 1260 |         | 1355 | nm   |       |
| Launch Power in OMA                              | $P_{OUT-OMA}$                   | -4.5 |         | +1.5 | dBm  | 1     |
| Average Launch Power                             | $P_{OUT}$                       | -6.5 |         | +0.5 | dBm  | 1     |
| Average Launch Power of off transmitter          | $P_{OUT-OFF}$                   |      |         | -30  | dBm  | 1     |
| Peak Launch Power                                | $P_{OUT-PEAK}$                  |      |         | 3.0  | dBm  | 1     |
| Spectral Width                                   | $\Delta\lambda$                 | 2.4  |         | 4    | nm   | 2     |
| Side Mode Suppression Ratio                      | SMSR                            | 30   |         |      | dB   |       |
| Extinction Ratio                                 | ER                              | 3.5  |         |      | dB   | 3     |
| Transmitter Waveform and Dispersion Penalty      | TWDP                            |      |         | 4.7  | dB   | 4     |
| Optical Eye Mask                                 | Compliant with IEEE P802aq-2006 |      |         |      |      |       |
| <b>Receiver</b>                                  |                                 |      |         |      |      |       |
| Operating Data Rate                              |                                 |      | 10.3125 |      | Gbps |       |
| Centre Wavelength                                | $\lambda_C$                     | 1260 |         | 1355 | nm   |       |
| Stressed Sensitivity in OMA                      | $P_{IN}$                        |      |         | -6.5 | dBm  | 5     |
| Stressed Sensitivity in OMA for symmetrical test | $P_{IN}$                        |      |         | -6.0 | dBm  | 5     |
| Overload in OMA                                  | $P_{IN}$                        | 1.5  |         |      | dBm  | 5     |
| Receiver Reflectacne                             |                                 |      |         | -12  | dB   |       |

**Notes:**

1. Measured at TP2, after MMF patch code.
2. See Figure 68-3, IEEE P802aq-2006.
3. Measured with a PRBS  $2^{31}-1$  test pattern @10.3125Gbps.
4. Measured with a PRBS  $2^9-1$  test pattern @10.3125Gbps,  $BER \leq 10^{-12}$ .
5. Measured with a PRBS  $2^{31}-1$  test pattern @10.3125Gbps,  $ER=3.5dB$ ,  $BER \leq 10^{-12}$ .

## Electrical Characteristics

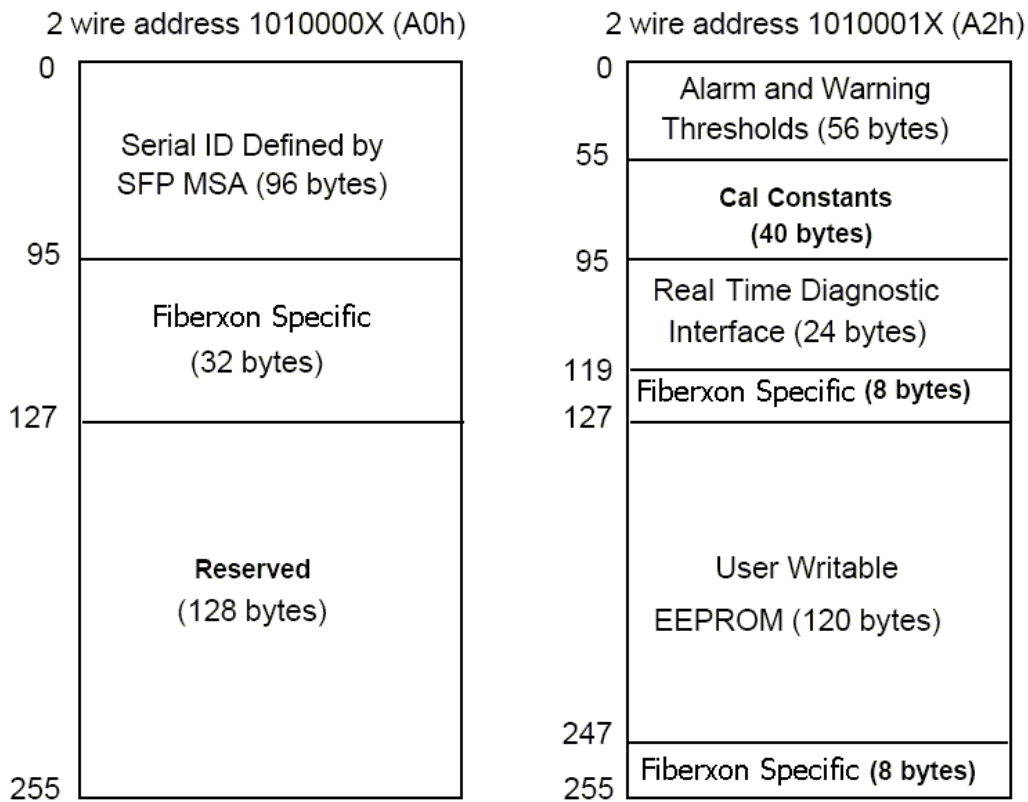
**Table 5 - Electrical Characteristics**

| Parameter  | Symbol    | Min. | Typical | Max. | Unit     | Notes |
|--|-----------|------|---------|------|----------|-------|
| <b>High-speed Signal Interface Specification</b>         |           |      |         |      |          |       |
| Differential Data Input Amplitude                        |           | 400  |         | 1600 | mVpp     |       |
| Input Differential Impedance                             |           |      | 100     |      | $\Omega$ |       |
| Differential Data Output Amplitude                       |           | 250  |         | 580  | mVpp     |       |
| Output Differential Impedance                            |           |      | 100     |      | $\Omega$ |       |
| <b>Low-speed Signal (LVTTTL) Interface Specification</b> |           |      |         |      |          |       |
| Input High Voltage                                       |           | 2.0  |         | 3.3  | V        |       |
| Input Low Voltage  |           | GND  |         | 0.8  | V        |       |
| Output High Voltage                                      |           | 2.4  |         | 3.3  | V        |       |
| Output Low Voltage                                       |           | GND  |         | 0.4  | V        |       |
| <b>2 Wire Serial Interface (LVTTTL) Specification</b>    |           |      |         |      |          |       |
| Clock Frequency  | $f_{SCL}$ |      |         | 100  | KHz      |       |

**EEPROM Information.**

EEPROM describing the transceiver’s capabilities, standard interfaces, manufacturer, and other information, which is accessible over a 2 wire serial interface at the 8-bit address 1010000X (A0h). The memory contents refer to Table 6.

**Table 6 - Digital Diagnostic Memory Map**



**Table 7 - EEPROM Serial ID Memory Contents (A0h)**

| Addr. (Bytes) | Name of Field       | Hex                     | Description        |
|---------------|---------------------|-------------------------|--------------------|
| 0 (1)         | Identifier          | 03                      | SFP                |
| 1 (1)         | Ext. Identifier     | 04                      | SFP with Serial ID |
| 2 (1)         | Connector           | 07                      | LC                 |
| 3-10 (8)      | Transceiver         | 40 00 00 00 00 00 00 00 | 10GBASE-LRM        |
| 11 (1)        | Encoding            | 06                      | 64B/66B            |
| 12 (1)        | BR, nominal         | 67                      | 10.3G              |
| 13 (1)        | Rate identifier     | 00                      | unspecified        |
| 14 (1)        | Length (9um)-km     | 00                      |                    |
| 15 (1)        | Length (9um)        | 00                      |                    |
| 16 (1)        | Length (50um,OM2)   | 16                      | 220m               |
| 17 (1)        | Length (62.5um,OM1) | 16                      | 220m               |

|        |     |                    |  |  |
|--------|-----|--------------------|--|--|
| 18     | 1   | Length (copper)    | 00   |  |
| 19     | 1   | Length (50um, OM3) | 16   | 220m   |
| 20-35  | 16  | Vendor name        | 53 4F 55 52 43 45 50 48<br>4F 54 4F 4E 49 43 53 20 | "SOURCEPHOTONICS "(ASC II )                    |
| 36     | 1   | Reserved           | 00   |  |
| 37-39  | 3   | Vendor OUI         | 00 00 00   |  |
| 40-55  | 16  | Vendor PN          | 46 54 4D 2D 33 31 31 58<br>43 2D 4C 30 33 47 20 20 | "FTM-311XC-L03G" (ASC II )                     |
| 56-59  | 4   | Vendor rev         | xx xx xx xx  | ASC II ("31 30 20 20" means 1.0 revision)      |
| 60-61  | 2   | Wavelength         | 05 1E  | 1310nm   |
| 62     | 1   | Reserved           | 00   |  |
| 63     | 1   | CC BASE            | xx   | Check sum of bytes 0-62                        |
| 64-65  | 2   | Options            | 02 18  | TX_FAULT and TX_DISABLE, see notes 2           |
| 66     | 1   | BR, max            | 00   |  |
| 67     | 1   | BR, min            | 00   |  |
| 68-83  | 16  | Vendor SN          | xx xx xx xx xx xx xx xx                            | ASC II   |
| 84-91  | 8   | Vendor date code   | xx xx xx xx xx xx 20 20                            | Year (2 bytes), Month (2 bytes), Day (2 bytes) |
| 92     | 1   | Diagnostic type    | 68   | Diagnostics (Int.Cal)                          |
| 93     | 1   | Enhanced option    | E0   | Alarm/warning flags, TX_FAULT and TX_DISABLE   |
| 94     | 1   | SFF-8472           | 03   | Diagnostics (SFF-8472 Rev 10.0)                |
| 95     | 1   | CC_EXT             | xx   | Check sum of bytes 64-94                       |
| 96-255 | 160 | Vendor specific    |  | Source Photonics specific EEPROM               |

Note:

1. The "xx" byte should be filled in according to practical case.
2. The module only supports class2 level.

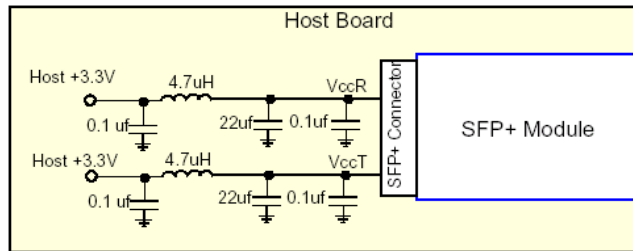
**Table 8 - EEPROM Diagnostics Data Map (A2h)**

| Addr. | (Bytes) | Name of Field         | Description                       |
|-------|---------|-----------------------|-----------------------------------|
| 0-1   | 2       | Temp High Alarm       | MSB at low address                |
| 2-3   | 2       | Temp Low Alarm        | MSB at low address                |
| 4-5   | 2       | Temp High Warning     | MSB at low address                |
| 6-7   | 2       | Temp Low Warning      | MSB at low address                |
| 8-9   | 2       | Voltage High Alarm    | MSB at low address                |
| 10-11 | 2       | Voltage Low Alarm     | MSB at low address                |
| 12-13 | 2       | Voltage High Warning  | MSB at low address                |
| 14-15 | 2       | Voltage Low Warning   | MSB at low address                |
| 16-17 | 2       | Bias High Alarm       | MSB at low address                |
| 18-19 | 2       | Bias Low Alarm        | MSB at low address                |
| 20-21 | 2       | Bias High Warning     | MSB at low address                |
| 22-23 | 2       | Bias Low Warning      | MSB at low address                |
| 24-25 | 2       | TX Power High Alarm   | MSB at low address                |
| 26-27 | 2       | TX Power Low Alarm    | MSB at low address                |
| 28-29 | 2       | TX Power High Warning | MSB at low address                |
| 30-31 | 2       | TX Power Low Warning  | MSB at low address                |
| 32-33 | 2       | RX Power High Alarm   | MSB at low address                |
| 34-35 | 2       | RX Power Low Alarm    | MSB at low address                |
| 36-37 | 2       | RX Power High Warning | MSB at low address                |
| 38-39 | 2       | RX Power Low Warning  | MSB at low address                |
| 40-55 | 16      | Reserved              | For future definition             |
| 56-59 | 4       | Rx_PWR(4)             | External calibration constant     |
| 60-63 | 4       | Rx_PWR(3)             | External calibration constant     |
| 64-67 | 4       | Rx_PWR(2)             | External calibration constant     |
| 68-71 | 4       | Rx_PWR(1)             | External calibration constant     |
| 72-75 | 4       | Rx_PWR(0)             | External calibration constant     |
| 76-77 | 2       | Tx_I(Slope)           | External calibration constant     |
| 78-79 | 2       | Tx_I(Offset)          | External calibration constant     |
| 80-81 | 2       | Tx_PWR(Slope)         | External calibration constant     |
| 82-83 | 2       | Tx_PWR(Offset)        | External calibration constant     |
| 84-85 | 2       | T(Slope)              | External calibration constant     |
| 86-87 | 2       | T(Offset)             | External calibration constant     |
| 88-89 | 2       | V(Slope)              | External calibration constant     |
| 90-91 | 2       | V(Offset)             | External calibration constant     |
| 92-94 | 3       | Reserved              |                                   |
| 95    | 1       | Checksum              | Low order 8 bits of sum from 0-94 |
| 96    | 1       | Temperature MSB       | Internal temperature AD values    |
| 97    | 1       | Temperature LSB       |                                   |

|         |    |                                   |   |
|---------|----|-----------------------------------|---|
| 98      | 1  | Vcc MSB                           | Internally measured supply voltage AD values                  |
| 99      | 1  | Vcc LSB                           |   |
| 100     | 1  | TX Bias MSB                       | TX bias current AD values                                     |
| 101     | 1  | TX Bias LSB                       |   |
| 102     | 1  | TX Power MSB                      | Measured TX output power AD values                            |
| 103     | 1  | TX Power LSB                      |   |
| 104     | 1  | RX Power MSB                      | Measured RX input power AD values                             |
| 105     | 1  | RX Power LSB                      |   |
| 106-109 | 4  | Reserved                          | For future definition   |
| 110-7   |    | TX Disable State                  | Digital state of Tx disable Pin                               |
| 110-6   |    | Soft TX Disable Control           | Writing "1" disables laser, this is OR'd with Tx_Dissable pin |
| 110-5   |    | RS(1) State                       | Digital state of input pin RS(1) per SFF-8431                 |
| 110-4   |    | Rate Select State                 | Digital State of Rate Select Pin RS(0)                        |
| 110-3   |    | Soft Rate Select Control          |   |
| 110-2   |    | TX Fault State                    | Digital state   |
| 110-1   |    | LOS State                         | Digital state   |
| 110-0   |    | Data Ready State                  | Digital state; "1" until transceiver is ready                 |
| 111     | 1  | Reserved                          | Reserved  |
| 112-117 | 8  | Optional alarm & warning flag bit | Refer to SFF-8472 rev 10.1                                    |
| 118     | 1  | Extended module control/status    | Refer to SFF-8472 rev 10.1                                    |
| 119     | 1  | unallocated                       |   |
| 120-127 | 8  | Vendor specific                   | Vendor specific   |
| 128-247 | 16 | User/Customer EEPROM              | Field writeable EEPROM  |
| 248-255 | 8  | Vendor specific                   | Vendor specific   |

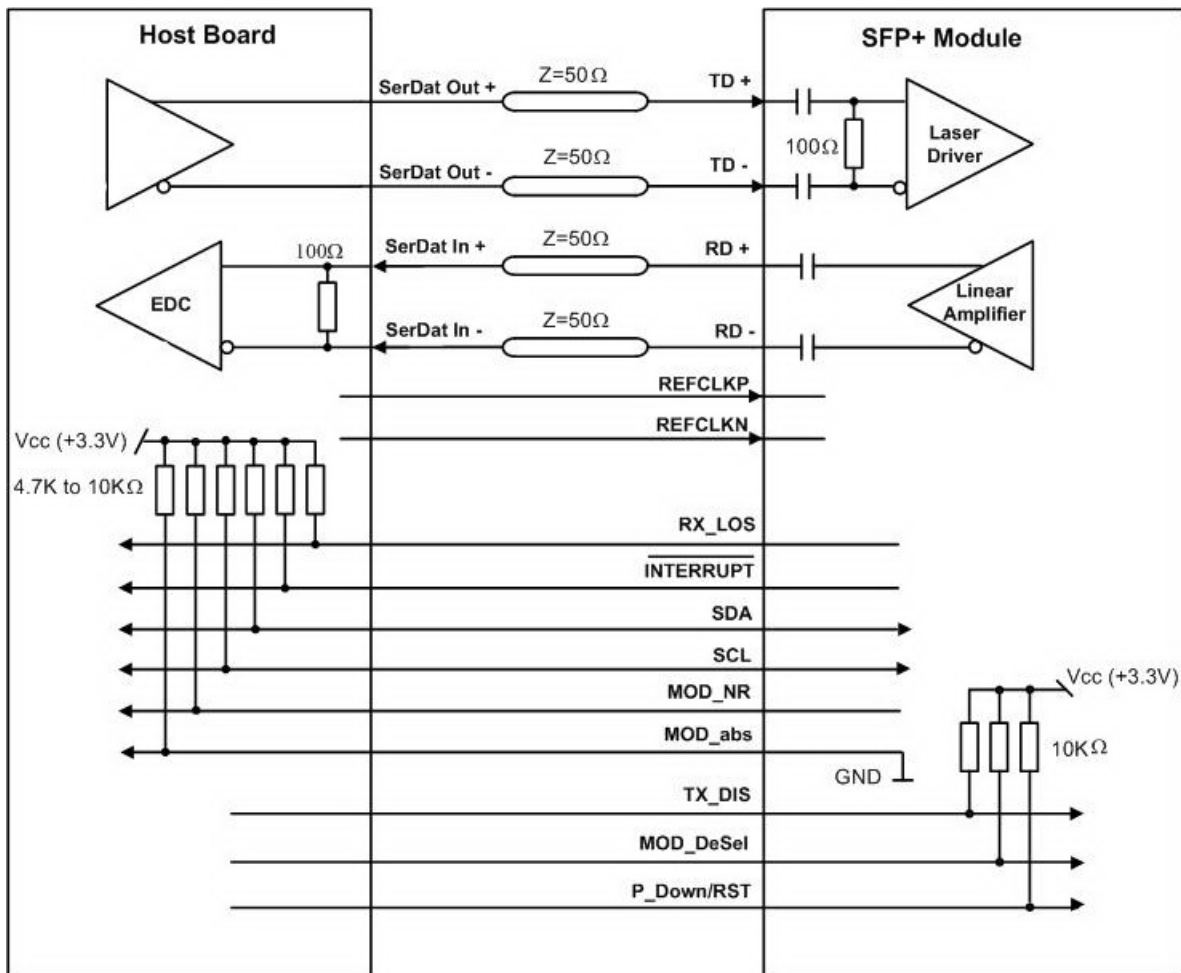


**Recommended Host Board Power Supply Circuit**



**Figure 1, Recommended Host Board Power Supply Circuit**

**Recommended Interface Circuit**



**Figure 2, Recommended Interface Circuit**

### Pin Definitions

Figure 3 below shows the pin numbering of SFP+ electrical interface. The pin functions are described in Table 7 with some accompanying notes. SFP+ module pins make contact to the host in the order of ground, power, and followed by signal as given by Figure 4.

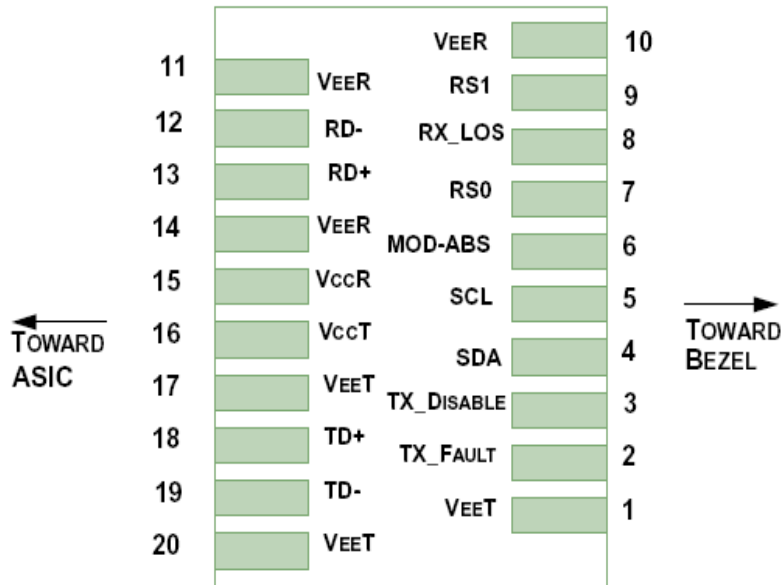


Figure 3, Host PCB Pinout Top View

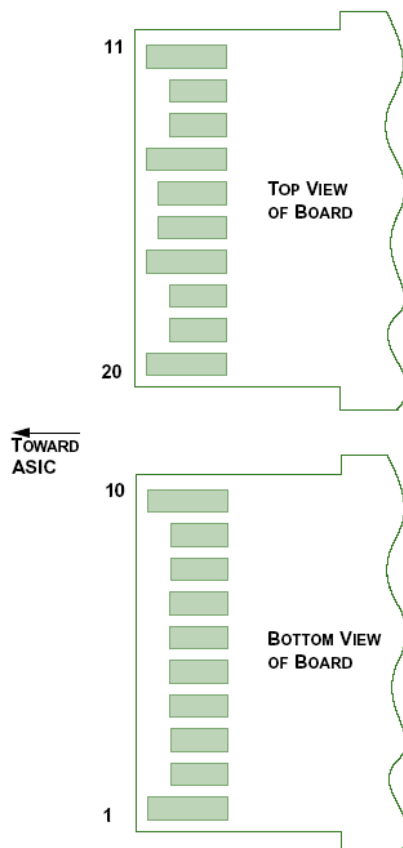


Figure 4, SFP+ module PCB Pinout

**Table 7 – Pin Function Definitions**

| Pin | Logic     | Symbol     | Name/Description  | Note |
|-----|-----------|------------|---|------|
| 1   |           | VeeT       | Module Transmitter Ground   | 1    |
| 2   | LVTTL-O   | TX_Fault   | Module Transmitter Fault  | 2    |
| 3   | LVTTL-I   | TX_DISABLE | Transmitter Disable; Turns off transmitter laser output   | 3    |
| 4   | LVTTL-I/O | SDL        | 2-Wire Serial Interface Data Line (MOD-DEF2)  |      |
| 5   | LVTTL-I/O | SCL        | 2-Wire Serial Interface Clock (MOD-DEF1)  |      |
| 6   |           | MOD_ABS    | Module Absent, connected to VeeT or VeeR in the module  | 3    |
| 7   | LVTTL-I   | RS0        | Rate Select 0, optionally controls SFP+ module receiver as the following when HIGH input data rate > 4.25 Gb/s and when LOW input data rate ≤ 4.25 Gb/s.    |      |
| 8   | LVTTL-O   | RX_LOS     | Receiver Loss of Signal Indication (in FC designated as RX_LOS, in SONET designated as LOS, and in Ethernet designated as NOT Signal Detect)                | 2    |
| 9   | LVTTL-I   | RS1        | Rate Select 1, optionally controls SFP+ module transmitter as the following when HIGH input data rate > 4.25 Gb/s and when LOW input data rate ≤ 4.25 Gb/s. |      |
| 10  |           | VeeR       | Module Receiver Ground  | 1    |
| 11  |           | VeeR       | Module Receiver Ground  | 1    |
| 12  | CML-O     | RD-        | Receiver Inverted Data Output   |      |
| 13  | CML-O     | RD+        | Receiver Non-Inverted Data Output   |      |
| 14  |           | VeeR       | Module Receiver Ground  | 1    |
| 15  |           | VccR       | Module Receiver 3.3 V Supply  |      |
| 16  |           | VccT       | Module Transmitter 3.3 V Supply   |      |
| 17  |           | VeeT       | Module Transmitter Ground   | 1    |
| 18  | CML-I     | TD+        | Transmitter Non-Inverted Data Input   |      |
| 19  | CML-I     | TD-        | Transmitter Inverted Data Input   |      |
| 20  |           | VeeT       | Module Transmitter Ground   | 1    |

**Notes:**

1. The module ground pins, VeeR and VeeT, shall be isolated from the module case.
2. RX\_LOS is not available.
3. Shall be pulled up with 4.7K-10Kohms to VccT in the module.
4. This pin is an open collector/drain input pin and shall be pulled up with 4.7K-10Kohms to VccT in the module.

**Mechanical Design Diagram**

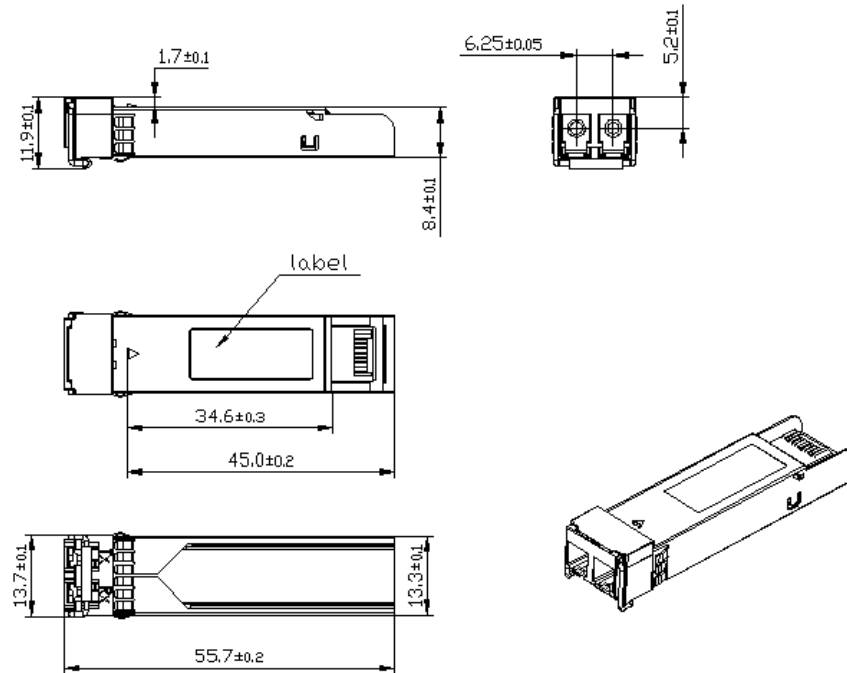
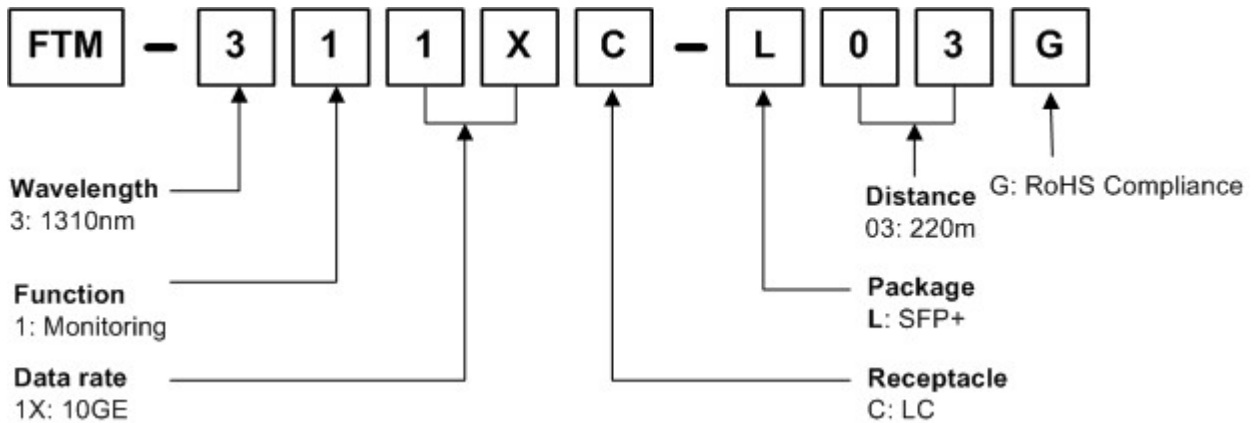


Figure 4, Mechanical Design Diagram of SFP+

**Ordering information**



| Part No.              | Product Description                                 |
|-----------------------|---|
| <b>FTM-311XC-L03G</b> | 1310nm FP, 10GBASE-LRM, 220m, SFP+, RoHS compliance |

## Related Documents

*SFF-8431 (Specifications for Enhanced 8.5 and 10 Gigabit Small Form Factor Pluggable Module "SFP+"), Revision 1.3 February 16, 2007.*

*SFF-8432 (Specifications for Improved Pluggable Form factor), Revision 3.6 October 25, 2006.*

*SFF-8083 (Specifications for 0.8 mm SFP+ Card Edge Connector Dimensioning), Rev 0.9 January 2, 2007*

## Revision History

| Revision | Initiate  | Review        | Approve     | Subject           | Release Date |
|----------|-----------|---------------|-------------|-------------------|--------------|
| Rev. 1a  | Andy Xiao | Tripper Huang | Alain Shang | Initial datasheet | 2007-11-14   |

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