

# SFP-1G-LX 1Gbps SFP SMF Optical Transceiver, 1310nm, 20km

#### **Features**

- ♦ Data-rate of 1.25Gbps operation
- ♦ 1310nm FP laser and PIN photodetector for 20km transmission
- Digital Diagnostic Monitoring
- Compliant with SFP MSA and SFF-8472 with duplex LC receptacle
- +3.3V single power supply
- ♦ Industrial operating case temperature: -40 to +85°C
- RoHS6 compliant (lead free)



## **Applications**

- Gigabit Ethernet
- Switch to Switch interface
- ♦ Other optical transmission systems

#### **Product description**

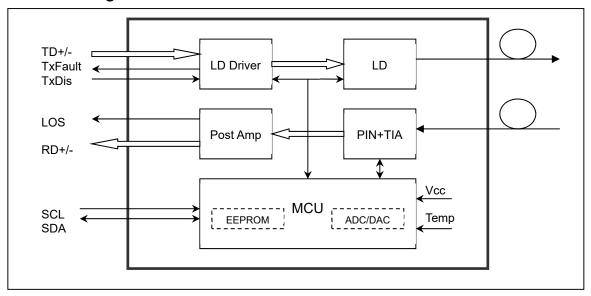
This SFP transceiver is a high performance, cost effective modules supporting data-rate of 1.25Gbps and 20km transmission distance with SMF.

The transceiver consists of three sections: a FP laser transmitter, a PIN photodiode integrated with a trans-impedance preamplifier (TIA) and MCU control unit. All modules satisfy class I laser safety requirements.

The transceivers are compatible with SFP Multi-Source Agreement (MSA) and SFF-8472. For further information, please refer to SFP MSA.



## **Module Block Diagram**



## **Absolute Maximum Ratings**

**Table 1 - Absolute Maximum Ratings** 

| Parameter           | Symbol | Min  | Max | Unit |
|---------------------|--------|------|-----|------|
| Supply Voltage      | Vcc    | -0.5 | 4.5 | V    |
| Storage Temperature | Ts     | -40  | +85 | °C   |
| Operating Humidity  | -      | 5    | 85  | %    |

## **Recommended Operating Conditions**

**Table 2 - Recommended Operating Conditions** 

| and 1 Hotominonata e portaming contained |        |      |         |      |      |
|--|--------|------|---------|------|------|
| Parameter                                | Symbol | Min  | Typical | Max  | Unit |
| Operating Case Temperature               | Тс     | -40  |         | +85  | °C   |
| Power Supply Voltage                     | Vcc    | 3.13 | 3.3     | 3.47 | V    |
| Power Supply Current                     | Icc    |      |         | 300  | mA   |
| Data Rate                                |        |      | 1.25    |      | Gbps |



## **Optical and Electrical Characteristics**

**Table 3 - Optical and Electrical Characteristics** 

|                    | neter           | Symbol                         | Min    | Typical | Max  | Unit | Notes |
|--------------------|-----------------|--------------------------------|--------|---------|------|------|-------|
|                    | Transmitter     |                                |        |         |      |      |       |
| Centre Wavelen     | gth             | λc                             | 1260   | 1310    | 1360 | nm   |       |
| Spectral Width (F  | RMS)            | σ                              |        |         | 4    | nm   |       |
| Average Output     | Power           | Pout                           | -9     |         | -3   | dBm  | 1     |
| Extinction Ratio   |                 | ER                             | 9      |         |      | dB   |       |
| Optical Rise/Fall  | Time (20%~80%)  | t <sub>r</sub> /t <sub>f</sub> |        |         | 0.26 | ns   |       |
| Data Input Swing   | g Differential  | VIN                            | 400    |         | 1800 | mV   | 2     |
| Input Differential | Impedance       | Z <sub>IN</sub>                | 90     | 100     | 110  | Ω    |       |
| TX Disable         | Disable         |                                | 2.0    |         | Vcc  | V    |       |
| 1 A Disable        | Enable          |                                | 0      |         | 0.8  | V    |       |
| TX Fault           | Fault           |                                | 2.0    |         | Vcc  | V    |       |
| 1X Fault           | Normal          |                                | 0      |         | 0.8  | V    |       |
|                    |                 |                                | Receiv | er      |      |      |       |
| Centre Wavelen     | gth             | λc                             | 1260   |         | 1580 | nm   |       |
| Receiver Sensiti   | vity            |                                |        |         | -23  | dBm  | 3     |
| Receiver Overloa   | ad              |                                | -3     |         |      | dBm  | 3     |
| LOS De-Assert      |                 | LOS <sub>D</sub>               |        |         | -24  | dBm  |       |
| LOS Assert         |                 | LOSA                           | -35    |         |      | dBm  |       |
| LOS Hysteresis     |                 |                                | 1      |         | 4    | dB   |       |
| Data Output Swi    | ng Differential | Vout                           | 400    |         | 1800 | mV   | 4     |
| LOS                |                 | High                           | 2.0    |         | Vcc  | V    |       |
| 105                |                 | Low                            |        |         | 0.8  | V    |       |

#### Notes:

- 1. The optical power is launched into SMF.
- 2. PECL input, internally AC-coupled and terminated.
- 3. Measured with a PRBS 2<sup>7</sup>-1 test pattern @1250Mbps, BER ≤1×10<sup>-12</sup>.
- 4. Internally AC-coupled.



## **Timing and Electrical**

**Table 4 - Timing and Electrical** 

| Parameter                                       | Symbol         | Min | Typical | Max | Unit |
|---|----------------|-----|---------|-----|------|
| Tx Disable Negate Time                          | t_on           |     |         | 1   | ms   |
| Tx Disable Assert Time                          | t_off          |     |         | 10  | μs   |
| Time To Initialize, including Reset of Tx Fault | t_init         |     |         | 300 | ms   |
| Tx Fault Assert Time                            | t_fault        |     |         | 100 | μs   |
| Tx Disable To Reset                             | t_reset        | 10  |         |     | μs   |
| LOS Assert Time                                 | t_loss_on      |     |         | 100 | μs   |
| LOS De-assert Time                              | t_loss_off     |     |         | 100 | μs   |
| Serial ID Clock Rate                            | f_serial_clock |     |         | 400 | KHz  |
| MOD_DEF (0:2)-High                              | V <sub>H</sub> | 2   |         | Vcc | V    |
| MOD_DEF (0:2)-Low                               | VL             |     |         | 0.8 | V    |

## **Diagnostics**

**Table 5 – Diagnostics Specification** 

| Parameter    | Range      | Unit | Accuracy | Calibration         |
|--------------|------------|------|----------|---------------------|
| Temperature  | 0 to +70   | °C   | ±3°C     | Internal / External |
| remperature  | -40 to +85 | J.   | ±3 C     | internar/ Externar  |
| Voltage      | 3.0 to 3.6 | V    | ±3%      | Internal / External |
| Bias Current | 0 to 100   | mA   | ±10%     | Internal / External |
| TX Power     | -9 to -3   | dBm  | ±3dB     | Internal / External |
| RX Power     | -23 to-3   | dBm  | ±3dB     | Internal / External |

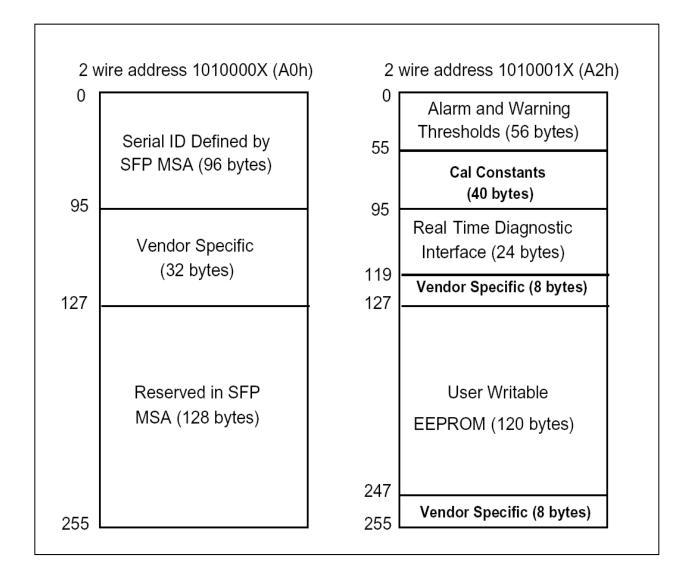


### **Digital Diagnostic Memory Map**

The transceivers provide serial ID memory contents and diagnostic information about the present operating conditions by the 2-wire serial interface (SCL, SDA).

The diagnostic information with internal calibration or external calibration all are implemented, including received power monitoring, transmitted power monitoring, bias current monitoring, supply voltage monitoring and temperature monitoring.

The digital diagnostic memory map specific data field defines as following.





#### **Pin Definitions**

Pin Diagram

|    |  | 1             |  |  |  |
|----|--|---------------|--|--|--|
| 20 | VeeT   | 1 VeeT        |  |  |  |
| 19 | TD-  | 2 TxFault     |  |  |  |
| 18 | TD+  | 3 Tx Disable  |  |  |  |
| 17 | VeeT   | 4 MOD-DEF(2)  |  |  |  |
| 16 | VccT   | 5 MOD-DEF(1)  |  |  |  |
| 15 | VccR   | 6 MOD-DEF(0)  |  |  |  |
| 14 | VeeR   | 7 Rate Select |  |  |  |
| 13 | RD+  | 8 LOS         |  |  |  |
| 12 | RD-  | 9 VeeR        |  |  |  |
| 11 | VeeR   | 10 VeeR       |  |  |  |
|    | Top of Board Board (as viewed thru top of board) |               |  |  |  |



#### **Pin Descriptions**

| Pin | Signal Name | Description                  | Plug Seq. | Notes  |
|-----|-------------|------------------------------|-----------|--------|
| 1   | VEET        | Transmitter Ground           | 1         |        |
| 2   | TX FAULT    | Transmitter Fault Indication | 3         | Note 1 |
| 3   | TX DISABLE  | Transmitter Disable          | 3         | Note 2 |
| 4   | MOD_DEF(2)  | SDA Serial Data Signal       | 3         | Note 3 |
| 5   | MOD_DEF(1)  | SCL Serial Clock Signal      | 3         | Note 3 |
| 6   | MOD_DEF(0)  | TTL Low                      | 3         | Note 3 |
| 7   | Rate Select | Not Connected                | 3         |        |
| 8   | LOS         | Loss of Signal               | 3         | Note 4 |
| 9   | VEER        | Receiver ground              | 1         |        |
| 10  | VEER        | Receiver ground              | 1         |        |
| 11  | VEER        | Receiver ground              | 1         |        |
| 12  | RD-         | Inv. Received Data Out       | 3         | Note 5 |
| 13  | RD+         | Received Data Out            | 3         | Note 5 |
| 14  | VEER        | Receiver ground              | 1         |        |
| 15  | Vccr        | Receiver Power Supply        | 2         |        |
| 16  | Vccт        | Transmitter Power Supply     | 2         |        |
| 17  | VEET        | Transmitter Ground           | 1         |        |
| 18  | TD+         | Transmit Data In             | 3         | Note 6 |
| 19  | TD-         | Inv. Transmit Data In        | 3         | Note 6 |
| 20  | VEET        | Transmitter Ground           | 1         |        |

#### Notes:

Plug Seq.: Pin engagement sequence during hot plugging.

- 1) TX Fault is an open collector output, which should be pulled up with a 4.7k~10kΩ resistor on the host board to a voltage between 2.0V and Vcc+0.3V. Logic 0 indicates normal operation; Logic 1 indicates a laser fault of some kind. In the low state, the output will be pulled to less than 0.8V.
- 2) TX Disable is an input that is used to shut down the transmitter optical output. It is pulled up within the module with a 4.7k~10kΩ resistor. Its states are:

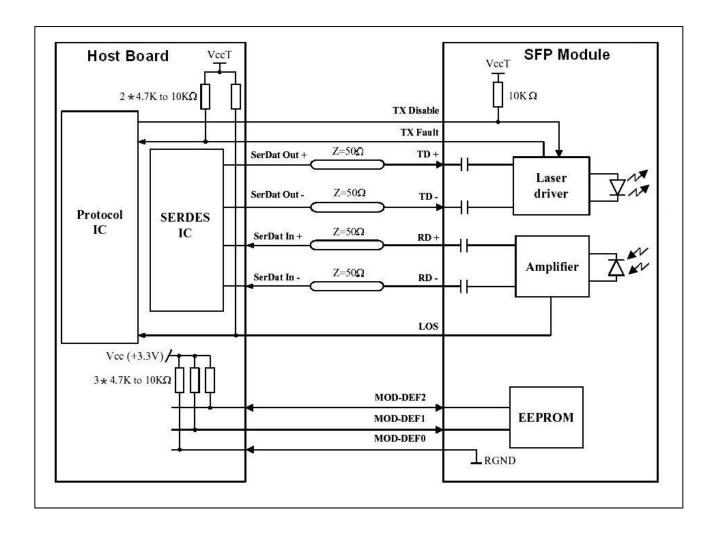
Low (0 to 0.8V): Transmitter on (>0.8V, < 2.0V): Undefined

High (2.0 to 3.465V): Transmitter Disabled Open: Transmitter Disabled

- 3) Mod-Def 0,1,2. These are the module definition pins. They should be pulled up with a 4.7k~10kΩ resistor on the host board. The pull-up voltage shall be VccT or VccR.
  - Mod-Def 0 is grounded by the module to indicate that the module is present
  - Mod-Def 1 is the clock line of two wire serial interface for serial ID
  - Mod-Def 2 is the data line of two wire serial interface for serial ID
- 4) LOS is an open collector output, which should be pulled up with a 4.7k~10kΩ resistor. Pull up voltage between 2.0V and Vcc+0.3V. Logic 1 indicates loss of signal; Logic 0 indicates normal operation. In the low state, the output will be pulled to less than 0.8V.
- 5) RD-/+: These are the differential receiver outputs. They are internally AC-coupled 100 differential lines which should be terminated with 100Ω (differential) at the user SERDES.
- 6) TD-/+: These are the differential transmitter inputs. They are internally AC-coupled, differential lines with 100Ω differential termination inside the module.

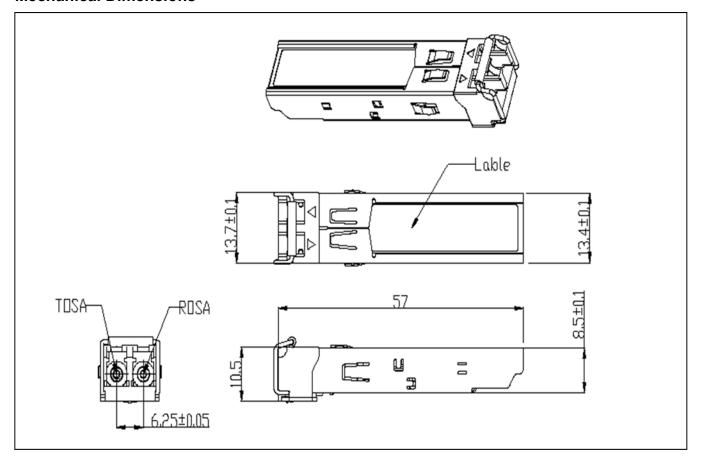


#### **Recommended Interface Circuit**





## **Mechanical Dimensions**



## **Regulatory Compliance**

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

| Feature                  | Agency | Standard  | Certificate /<br>Comments |
|--------------------------|--------|---|---------------------------|
| Laser Safety             | FDA    | CDRH 21 CFR 1040 annd Laser Notice<br>No. 50                | 1120295-000               |
| Product Safety           | BST    | EN 60825-1: 2007<br>EN 60825-2: 2004<br>EN 60950-1: 2006    | BT0905142001              |
| Environmental protection | SGS    | RoHS Directive 2002/95/EC                                   | GZ0902007478/CHEM         |
| EMC                      | CCIC   | EN 55022: 2006+A1: 2007<br>EN 55024: 1998+A1: 2001+A2: 2003 | CTE09020023               |



**Ordering information** 

| Part Number | Product Description                             |                |
|-------------|---|----------------|
| SFP-1G-LX   | 1G SFP SMF LX Optical Transceiver, 1310nm, 20km | -45°C to +85°C |

#### References

- 1. Small Form Factor Pluggable (SFP) Transceiver Multi-Source Agreement (MSA), September 2000.
- 2. Telcordia GR-253-CORE and ITU-T G.957 Specifications.

#### **Important Notice**

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