



## Features

- Tri-rate 1~2.125Gbps data links
- Up to 10Km transmission distance
- 1310nm FP laser and PIN photo detector
- Digital diagnostic monitor interface compatible with SFF-8472
- SFP MSA package with duplex LC connector
- With spring latch for high density application
- +3.3V single power supply
- Operating case temperature  
 Standard: -5 to 70°C  
 Extended: -20 to +85°C  
 Industrial: -40 to +85°C
- RoHS compliant

## Regulatory Compliance

**Table 1 - Regulatory Compliance**

| Parameter   | Standard   | Compliance                             |
|---|--|--|
| Electrostatic Discharge (ESD) to the Electrical Pins      | MIL-STD-883E<br>Method 3015.7                                      | Class 2(>2000 V)                       |
| Electrostatic Discharge (ESD) to the Duplex LC Receptacle | IEC 61000-4-2<br>GR-1089-CORE                                      | Compatible with standards              |
| Electromagnetic Interference (EMI)                        | FCC Part 15 Class B<br>EN55022 Class B (CISPR 22B)<br>VCCI Class B | Compatible with standards              |
| Immunity  | IEC 61000-4-3  | Compatible with standards              |
| Laser Eye Safety  | FDA 21CFR 1040.10 and 1040.11<br>EN60950, EN (IEC) 60825-1,2       | Compatible with Class I laser product. |
| RoHS  | 2002/95/EC 4.1&4.2<br>2005/747/EC                                  | Compliant with RoHS 6                  |

## Absolute Maximum Ratings

**Table 2 - Absolute Maximum Ratings**

| Parameter                   | Symbol          | Min. | Typical | Max. | Unit | Notes |
|-----------------------------|-----------------|------|---------|------|------|-------|
| Storage Temperature         | T <sub>s</sub>  | -40  | -       | +85  | °C   |       |
| Supply Voltage              | V <sub>CC</sub> | -0.5 | -       | +3.6 | V    |       |
| Operating Relative Humidity | RH              | +5   | -       | +95  | %    |       |

## Recommended Operating Conditions

**Table 3 – Recommended Operating Conditions**

| Parameter                  |            | Symbol   | Min.   | Typical | Max.  | Unit | Notes |
|----------------------------|------------|----------|--------|---------|-------|------|-------|
| Operating Case Temperature | Standard   | $T_C$    | -5     | -       | +70   | °C   |       |
|                            | Extended   |          | -20    |         | +85   |      |       |
|                            | Industrial |          | -40    |         | +85   |      |       |
| Power Supply Voltage       |            | $V_{CC}$ | 3.13   | 3.3     | 3.47  | V    |       |
| Power Supply Current       |            | $I_{CC}$ | -      |         | 300   | mA   |       |
| Data Rate                  |            |          | 1.0625 |         | 2.125 | Gbps |       |

## Optical Characteristics

**Table 4 – Optical Characteristics**

| Transmitter                    |  |      |         |      |      |       |
|--------------------------------|--|------|---------|------|------|-------|
| Parameter                      | Symbol   | Min. | Typical | Max. | Unit | Notes |
| Centre Wavelength              | $\lambda_C$  | 1270 |         | 1360 | nm   |       |
| Spectral Width (RMS)           | $\sigma$   |      | 2       |      | nm   |       |
| Average Output Power           | $P_{Out}$  | -9.5 |         | -3   | dBm  | 1     |
| $P_{Out}$ @TX Disable Asserted | $P_{Out}$  |      |         | -40  | dBm  | 1     |
| Extinction Ratio               | EX   | 9    |         |      | dB   |       |
| Rise/Fall Time (20%~80%)       | $t_r/t_f$  |      |         | 160  | ps   | 2     |
| Total Jitter                   | $T_J$  |      |         | 0.44 | UI   | 3     |
| Deterministic Jitter           | $D_J$  |      |         | 0.26 | UI   | 3     |
| Output Optical Eye             | ANSI Fibre Channel and Gigabit Ethernet Compatible |      |         |      |      | 4     |
| Receiver                       |  |      |         |      |      |       |
| Centre Wavelength              | $\lambda_C$  | 1260 | 1310    | 1580 | nm   |       |
| Receiver Sensitivity           |  |      |         | -20  | dBm  | 5     |
| Receiver Overload              |  | -3   |         |      | dBm  | 5     |
| Return Loss                    |  | 12   |         |      | dB   |       |
| LOS De-Assert                  | $LOS_D$  |      |         | -20  | dBm  |       |
| LOS Assert                     | $LOS_A$  | -31  |         |      | dBm  |       |
| LOS Hysteresis                 |  | 0.5  |         | 4    | dB   |       |
| Total Jitter (pk-pk)           | $T_J$  |      |         | 0.64 | UI   | 3     |
| Deterministic Jitter (pk-pk)   | $D_J$  |      |         | 0.39 | UI   | 3     |

Notes:

1. The optical power is launched into SMF.
2. Unfiltered, measured with a PRBS  $2^7-1$  test pattern @2.125Gbps
3. Measured with a PRBS  $2^7-1$  test pattern@2.125Gbps, meet the specified maximum output jitter requirements if the specified maximum input jitter is present.

4. Measured with a PRBS  $2^7-1$  test pattern @2.125/1.0625Gbps.
5. Measured with a PRBS  $2^7-1$  test pattern @2.125Gbps, BER  $\leq 1 \times 10^{-12}$ .

## Electrical Characteristics

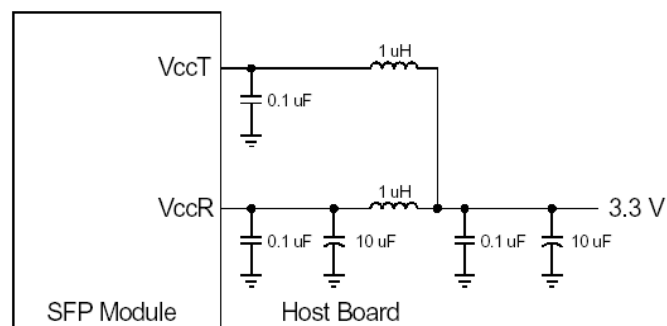
**Table 5 – Electrical Characteristics**

| Transmitter                    |                  |      |         |          |          |       |
|--------------------------------|------------------|------|---------|----------|----------|-------|
| Parameter                      | Symbol           | Min. | Typical | Max.     | Unit     | Notes |
| Data Input Swing Differential  | $V_{IN}$         | 400  |         | 2400     | mV       | 1     |
| Input Differential Impedance   | $Z_{IN}$         | 90   | 100     | 110      | $\Omega$ |       |
| Tx_DIS Disable                 | $V_D$            | 2.0  |         | $V_{CC}$ | V        |       |
| Tx_DIS Enable                  | $V_{EN}$         | GND  |         | GND+0.8  | V        |       |
| TX_ Fault (Fault)              |                  | 2.0  |         | Vcc+0.3  | V        |       |
| TX_ Fault (Normal)             |                  | 0    |         | 0.8      | V        |       |
| Receiver                       |                  |      |         |          |          |       |
| Data Output Swing Differential | $V_{OUT}$        | 350  |         | 2000     | mV       | 1     |
| Rx_LOS Fault                   | $V_{LOS-Fault}$  | 2.0  |         | Vcc+0.3  | V        |       |
| Rx_LOS Normal                  | $V_{LOS-Normal}$ | GND  |         | GND+0.8  | V        |       |

Notes:

1. Internally AC coupled

## Recommended Host Board Power Supply Circuit



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

## Recommended Interface Circuit

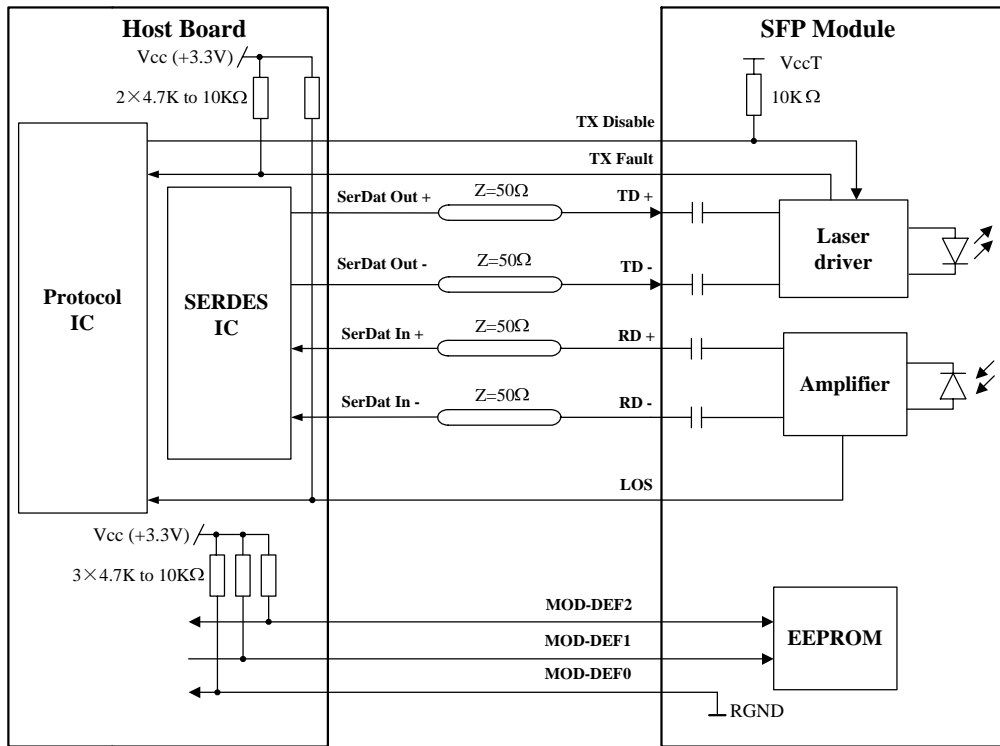


Figure 2, Recommended Interface Circuit

### Pin Definitions

Figure 3 below shows the pin numbering of SFP electrical interface. The pin functions are described in Table 6 with some accompanying notes.

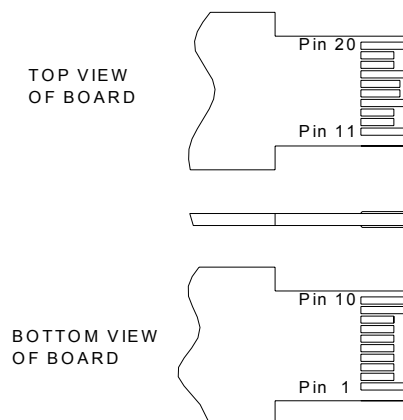


Figure 3, Pin View

Table 6 - Pin Function Definitions

| Pin No. | Name       | Function                     | 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-DEF2    | Module Definition 2    | 3 | Note 3 |
| 5  | MOD-DEF1    | Module Definition 1    | 3 | Note 3 |
| 6  | MOD-DEF0    | Module Definition 0    | 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         | 2 |        |
| 16 | VccT        | Transmitter Power      | 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:**

- 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.
- 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 (0~0.8V): Transmitter on  
 (>0.8V, <2.0V): Undefined  
 High (2.0~3.465V): Transmitter Disabled  
 Open: Transmitter Disabled
- MOD-DEF 0,1,2 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 wires serial interface for serial ID  
 MOD-DEF 2 is the data line of two wires serial interface for serial ID
- LOS 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 loss of signal. In the low state, the output will be pulled to less than 0.8V.
- These are the differential receiver output. They are internally AC-coupled 100Ω differential lines which should be terminated with 100Ω (differential) at the user SERDES.
- These are the differential transmitter inputs. They are AC-coupled, differential lines with 100Ω differential termination inside the module.

## EEPROM Information

The SFP MSA defines a 256-byte memory map in 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 7.

Table 7 - EEPROM Serial ID Memory Contents (A0h)

| Addr.  | Field Size (Bytes) | Name of Field    | Hex  | Description   |
|--------|--------------------|------------------|--|---|
| 0      | 1                  | Identifier       | 03   | SFP   |
| 1      | 1                  | Ext. Identifier  | 04   | MOD4  |
| 2      | 1                  | Connector        | 07   | LC  |
| 3—10   | 8                  | Transceiver      | 00 00 00 02 12 00 01 05                            | 1000BASE-LX, 100/200-SM-LC-L  |
| 11     | 1                  | Encoding         | 01   | 8B10B   |
| 12     | 1                  | BR, nominal      | 15   | 2.125Gbps   |
| 13     | 1                  | Reserved         | 00   |   |
| 14     | 1                  | Length (9um)-km  | 0A   | 10km  |
| 15     | 1                  | Length (9um)     | 64   | 10000m  |
| 16     | 1                  | Length (50um)    | 00   |   |
| 17     | 1                  | Length (62.5um)  | 00   |   |
| 18     | 1                  | Length (copper)  | 00   |   |
| 19     | 1                  | Reserved         | 00   |   |
| 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        | 53 50 54 52 4C 58 xx 44<br>46 41 20 20 20 20 20 20 | "SPTRLXxDFA" (ASC II)   |
| 56—59  | 4                  | Vendor rev       | 31 30 20 20  | 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          | 00 1A  | LOS, TX_FAULT and TX_DISABLE  |
| 66     | 1                  | BR, max          | 00   |   |
| 67     | 1                  | BR, min          | 00   |   |
| 68—83  | 16                 | Vendor SN        | xx xx xx xx xx xx xx xx<br>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  | B0   | Diagnostics(Optional Alarm/warning flags, Soft TX_FAULT and Soft TX_LOS monitoring) |
| 94     | 1                  | SFF-8472         | 02   | Diagnostics (SFF-8472 Rev 9.4)  |
| 95     | 1                  | CC EXT           | xx   | Check sum of bytes 64 - 94  |
| 96—255 | 160                | Vendor specific  |  |   |

Note: The "xx" byte should be filled in according to practical case. For more information, please refer to the

related document of SFF-8472 Rev 9.5.

## Monitoring Specification

The digital diagnostic monitoring interface also defines another 256-byte memory map in EEPROM, which makes use of the 8 bit address 1010001X (A2h). Please see Figure 4. For detail EEPROM information, please refer to the related document of SFF-8472 Rev 9.5. The monitoring specification of this product is described in Table 8.

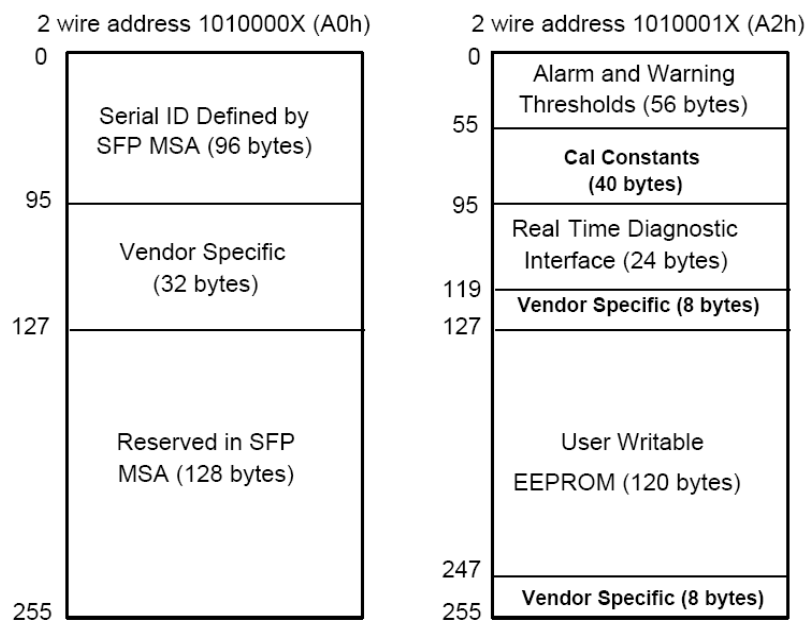


Figure 4, EEPROM Memory Map Specific Data Field Descriptions

**Table 8- Monitoring Specification**

| Parameter    |               | Range        | Accuracy | Calibration |
|--------------|---------------|--------------|----------|-------------|
| Temperature  | SP-TR-LX-CDFA | -10 to +80°C | ±3°C     | Internal    |
|              | SP-TR-LX-RDFA | -30 to +95°C |          |             |
|              | SP-TR-LX-IDFA | -40 to +95°C |          |             |
| Voltage      |               | 3.0 to 3.6V  | ±3%      | Internal    |
| Bias Current |               | 0 to 80mA    | ±10%     | Internal    |
| TX Power     |               | -11 to -2dBm | ±3dB     | Internal    |
| RX Power     |               | -21 to -3dBm | ±3dB     | Internal    |

## Mechanical Diagram

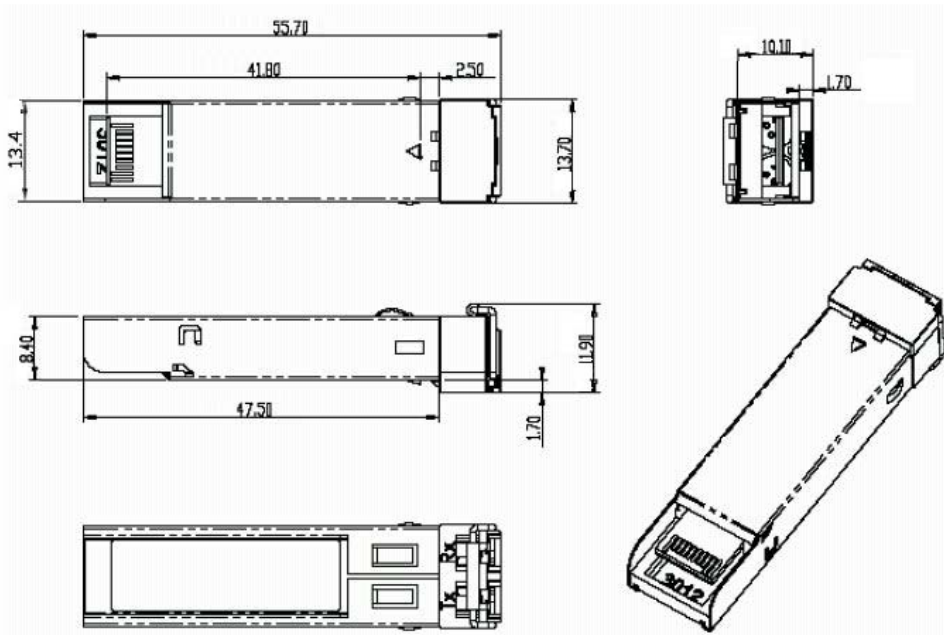


Figure 5, Mechanical Design Diagram of the SFP with Spring-Latch

## Order Information

Table 9 – Order Information

| Part No.                  | Application   | Data Rate                         | Laser Source | Fiber Type |
|---------------------------|---------------|-----------------------------------|--------------|------------|
| SP-TR-LX-CDFA<br>(C-temp) | Fibre Channel | Tri-rate<br>1.0625/2.125/1.25Gbps | 1310nm FP    | SMF        |
| SP-TR-LX-RDFA<br>(E-temp) | Fibre Channel | Tri-rate<br>1.0625/2.125/1.25Gbps | 1310nm FP    | SMF        |
| SP-TR-LX-IDFA<br>(I-temp) | Fibre Channel | Tri-rate<br>1.0625/2.125/1.25Gbps | 1310nm FP    | SMF        |

## Warnings

**Handling Precautions:** This device is susceptible to damage as a result of electrostatic discharge (ESD). A static free environment is highly recommended. Follow guidelines according to proper ESD procedures.

**Laser Safety:** Radiation emitted by laser devices can be dangerous to human eyes. Avoid eye exposure to direct or indirect radiation.

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