

## Product Features

- Compliant with FC-P1-4 800-SM-LC-L
- Digital Diagnostic Monitoring available
- SFP+ MSA package with duplex LC connector
- 850nm VCSEL Laser
- Up to 8.5Gb/s bi-directional data links
- Single +3.3V DC power supply
- Class 1 laser safety certified
- Hot-pluggable SFP footprint
- Commercial operating temperature:
  - (Commercial) 0°C to +70°C
  - (Industrial) -40°C to +85°C
- Up to 300m on 2000 MHz·km MMF
- RoHS Compliant



## Applications

- 8G Fiber Channel

## Descriptions

LX4501C(I)DR SFP+ transceivers, according to Enhanced Small Form Factor Pluggable “SFP+” Multi-Sourcing Agreement (MSA) SFF-8431 and SFF-8472, revision 10.4, are designed for use in 8x Fibre Channel application of links up to 300m over multimode fiber.

LX4501C(I)DR offer commercial and industrial operating temperature options.

## Ordering Information

**Table 1. Ordering Information**

| Part Number | Transmitter | Output Power | Receiver | Sensitivity | Reach | Temp       | DDM       | RoHS      |
|-------------|-------------|--------------|----------|-------------|-------|------------|-----------|-----------|
| LX4501CDR   | 850nm VCSEL | -5 ~ -1dBm   | PIN      | < -9.9dBm   | 300m  | 0 ~ 70°C   | Available | Compliant |
| LX4501IDR   | 850nm VCSEL | -5 ~ -1dBm   | PIN      | < -9.9dBm   | 300m  | -40 ~ 85°C | Available | Compliant |

## Pin Description

**Table 2. Pin Description**

| Pin | Name     | Function/Description  | Notes |
|-----|----------|---|-------|
| 1   | VeeT     | Transmitter Ground  | 1     |
| 2   | TX_Fault | Transmitter Fault (LVTTTL-O) - High indicates a fault condition | 2     |

|    |            |  |   |
|----|------------|--|---|
| 3  | TX_Disable | Transmitter Disable (LVTTTL-I) – High or open disables the transmitter | 3 |
| 4  | SDA        | Two wire serial interface Data Line (LVCMOS-I/O) (MOD-DEF2)            | 4 |
| 5  | SCL        | Two wire serial interface Clock Line (LVCMOS-I/O) (MOD-DEF1)           | 4 |
| 6  | MOD_ABS    | Module Absent (Output), connected to VeeT or VeeR in the module        | 5 |
| 7  | RS0        | Rate Select 0 – Not used, Presents high input impedance                | - |
| 8  | RX_LOS     | Receiver Loss of Signal (LVTTTL-O)                                     | 2 |
| 9  | RS1        | Rate Select 1 – Not used, Presents high input impedance                | - |
| 10 | VeeR       | Receiver Ground  | 1 |
| 11 | VeeR       | Receiver Ground  | 1 |
| 12 | RD-        | Inverse Received Data out (CML-O)                                      | - |
| 13 | RD+        | Received Data out (CML-O)  | - |
| 14 | VeeR       | Receiver Ground  | - |
| 15 | VccR       | Receiver Power - +3.3V   | - |
| 16 | VccT       | Transmitter Power - +3.3 V   | - |
| 17 | VeeT       | Transmitter Ground   | 1 |
| 18 | TD+        | Transmitter Data In (CML-I)  | - |
| 19 | TD-        | Inverse Transmitter Data In (CML-I)                                    | - |
| 20 | VeeT       | Transmitter Ground   | 1 |

**Notes:**

1. The module signal grounds are isolated from the module case.
2. This is an open collector/drain output that on the host board requires a 4.7KΩ to 10KΩ pull-up resistor to VccHost.
3. This input is internally biased high with a 4.7KΩ to 10KΩ pull-up resistor to VccT.
4. Two-Wire Serial interface clock and data lines require an external pull-up resistor dependent on the capacitance load.
5. This is a ground return that on the host board requires a 4.7KΩ to 10KΩ pull-up resistor to VccHost.

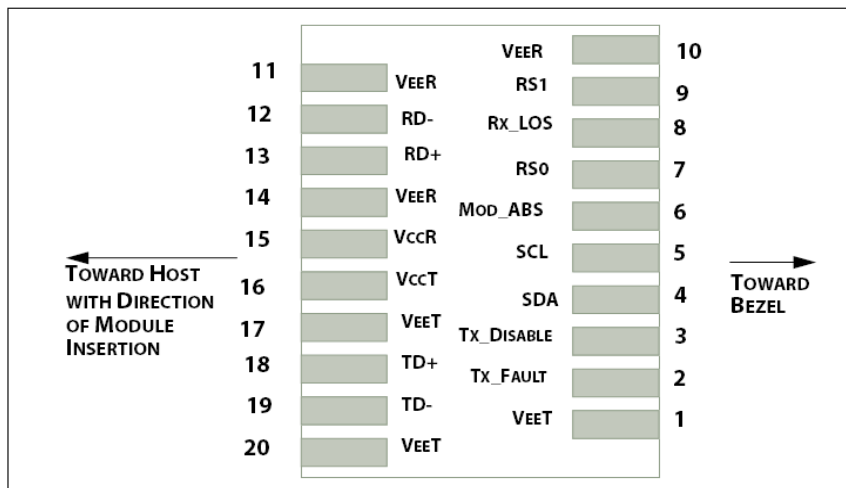


Figure 1. Host PCB SFP+ pad assignment top view

## Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

**Table 3. Absolute Maximum Ratings**

| Parameter           | Symbol          | Minimum | Maximum | Unit |
|---------------------|-----------------|---------|---------|------|
| Storage Temperature | T <sub>s</sub>  | -40     | 85      | °C   |
| Relative Humidity   | RH              | 5       | 95      | %    |
| Supply Voltage      | V <sub>cc</sub> | -0.5    | 4.0     | V    |

## Recommended Operating Conditions

**Table 4. Recommended Operating Conditions**

| Parameter                              | Symbol          | Min   | Typ | Max   | Unit |
|--|-----------------|-------|-----|-------|------|
| Operating Case Temperature(Commercial) | T <sub>c</sub>  | 0     | 25  | 70    | °C   |
| Operating Case Temperature(Industrial) | T <sub>c</sub>  | -40   | 25  | 85    | °C   |
| Supply Voltage                         | V <sub>cc</sub> | 3.135 | 3.3 | 3.465 | V    |
| Data Rate                              | -               | -     | 8.5 | -     | Gb/s |

## Transceiver Electrical Characteristics

**Table 5. Transceiver Electrical Characteristics**

| Parameter                        | Symbol                          | Minimum         | Typical | Maximum | Unit              | Notes |            |
|----------------------------------|---------------------------------|-----------------|---------|---------|-------------------|-------|------------|
| Module Supply Current            | I <sub>cc</sub>                 | -               | -       | 290     | mA                | -     |            |
| Power Dissipation                | P <sub>D</sub>                  | -               | -       | 1000    | mW                | -     |            |
| <b>Transmitter</b>               |                                 |                 |         |         |                   |       |            |
| Input Differential Impedance     | Z <sub>IN</sub>                 | -               | 100     | -       | Ω                 | -     |            |
| Differential Data Input Swing    | V <sub>IN, P-P</sub>            | 180             | -       | 700     | mV <sub>P-P</sub> | -     |            |
| TX_FAULT                         | Transmitter Fault               | V <sub>OH</sub> | 2.0     | -       | V <sub>cc</sub>   | V     | TX_FAULT   |
|                                  | Normal Operation                | V <sub>OL</sub> | 0       | -       | 0.8               | V     |            |
| TX_DISABLE                       | Transmitter Disable             | V <sub>IH</sub> | 2.0     | -       | V <sub>cc</sub>   | V     | TX_DISABLE |
|                                  | Transmitter Enable              | V <sub>IL</sub> | 0       | -       | 0.8               | V     |            |
| <b>Receiver</b>                  |                                 |                 |         |         |                   |       |            |
| Output Differential Impedance    | Z <sub>O</sub>                  | -               | 100     | -       | Ω                 | -     |            |
| Differential Data Output Swing   | V <sub>OUT, P-P</sub>           | 300             | -       | 850     | mV <sub>P-P</sub> | 1     |            |
| Data Output Rise Time, Fall Time | t <sub>r</sub> , t <sub>f</sub> | 28              | -       | -       | ps                | 2     |            |

|        |                      |                 |     |   |                 |   |        |
|--------|----------------------|-----------------|-----|---|-----------------|---|--------|
| RX_LOS | Loss of signal (LOS) | V <sub>OH</sub> | 2.0 | - | V <sub>CC</sub> | V | RX_LOS |
|        | Normal Operation     | V <sub>OL</sub> | 0   | - | 0.8             | V |        |

**Notes:**

1. Internally AC coupled, but requires a external 100Ω differential load termination.
2. 20–80%.
3. LOS is an open collector output. Should be pulled up with 4.7KΩ on the host board.

## Transmitter Optical Characteristics

**Table 6. Transmitter Optical Characteristics**

| Parameter                             | Symbol           | Minimum          | Typical | Maximum | Unit | Notes |
|---------------------------------------|------------------|------------------|---------|---------|------|-------|
| Launch Optical Power                  | P <sub>o</sub>   | -5               | -       | -1      | dBm  | 1     |
| Center Wavelength Range               | λ <sub>c</sub>   | 840              | 850     | 860     | nm   | -     |
| Extinction Ratio                      | EX               | 3                | -       | -       | dB   | 2     |
| Optical Modulation Amplitude          | OMA              | Refer to Table 7 |         |         | dBm  | 1     |
| Spectral Width (RMS)                  | Δλ               | Refer to Table 7 |         |         | nm   | -     |
| Transmitter and Dispersion Penalty    | TDP              | -                | -       | 3.9     | dB   | -     |
| Optical Return Loss Tolerance         | ORLT             | -                | -       | 12      | dB   | -     |
| P <sub>out</sub> @TX-Disable Asserted | P <sub>off</sub> | -                | -       | -30     | dBm  | 1     |

**Notes:**

1. 50/125μm fiber with NA = 0.2, 62.5/125μm fiber with NA = 0.275.
2. Measured with a PRBS 2<sup>31</sup>-1 test pattern @8.5Gbps.

**Table 7. Minimum Optical Modulation Amplitude as a function of center wavelength and spectral width**

| 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        |

## Receiver Optical Characteristics

**Table 8. Receiver Optical Characteristics**

| Parameter                          | Symbol      | Minimum | Typical | Maximum | Unit | Notes |
|------------------------------------|-------------|---------|---------|---------|------|-------|
| Center Wavelength                  | $\lambda_c$ | 840     | -       | 860     | nm   | -     |
| Receiver Sensitivity ( $P_{avg}$ ) | S           | -       | -       | -9.9    | dBm  | 1     |
| Receiver Sensitivity (OMA)         | $S_{OMA}$   | -       | -       | -11.1   | dBm  | 1     |
| Receiver Overload ( $P_{avg}$ )    | $P_{OL}$    | -1.0    | -       | -       | dBm  | 1     |
| Stressed Sensitivity (OMA)         | -           | -       | -       | -7.5    | dBm  | 2     |
| Optical Return Loss                | ORL         | 12      | -       | -       | dB   | -     |
| LOS De-Assert                      | $LOS_D$     | -       | -       | -11     | dBm  | -     |
| LOS Assert                         | $LOS_A$     | -30     | -       | -       | dBm  | -     |
| LOS Hysteresis                     | -           | 0.5     | -       | -       | dB   | -     |

**Notes:**

1. Measured with PRBS  $2^{31}-1$  test pattern, 8.5Gb/s, BER <  $10^{-12}$ .

## Recommended Host Board Power Supply Filter Network

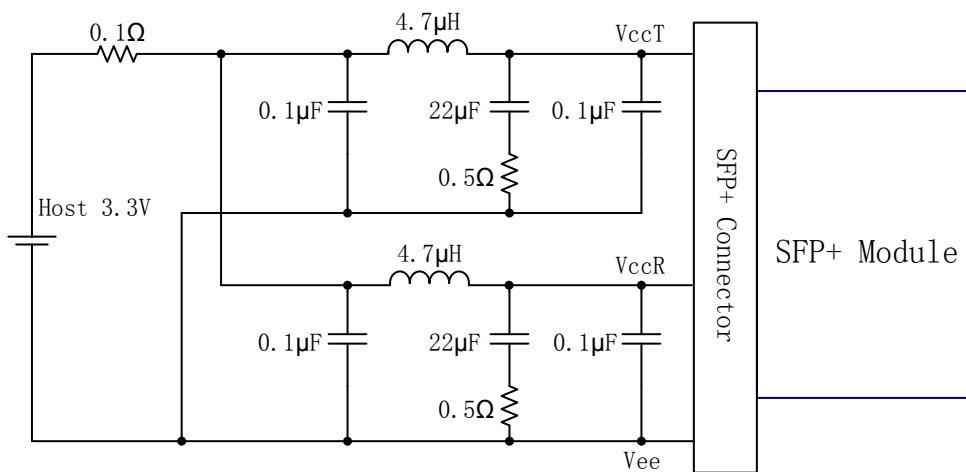


Figure 2. Recommended Host Board Power Supply Filter Network

## Recommended Application Interface Block Diagram

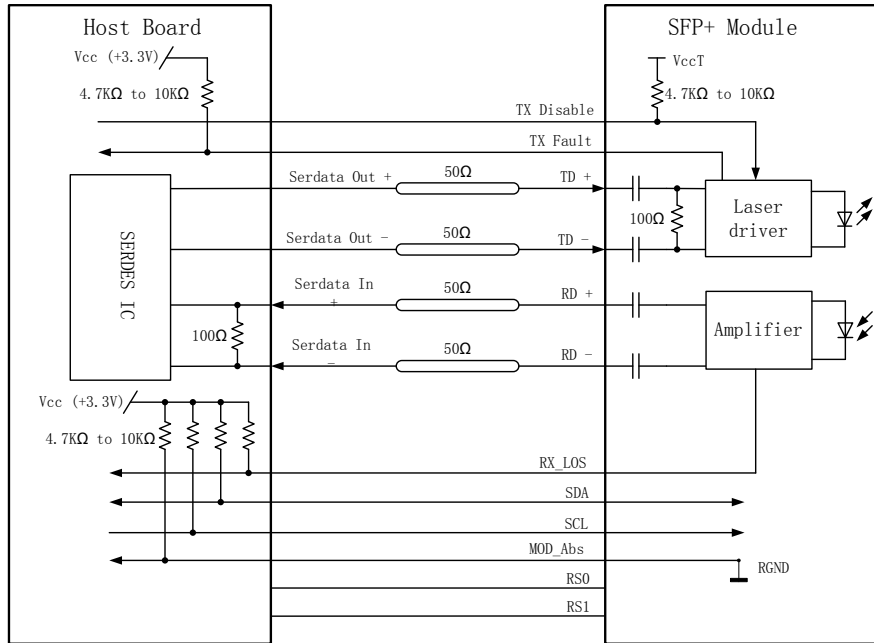


Figure 4. Recommended Application Interface Block Diagram

## Mechanical specifications

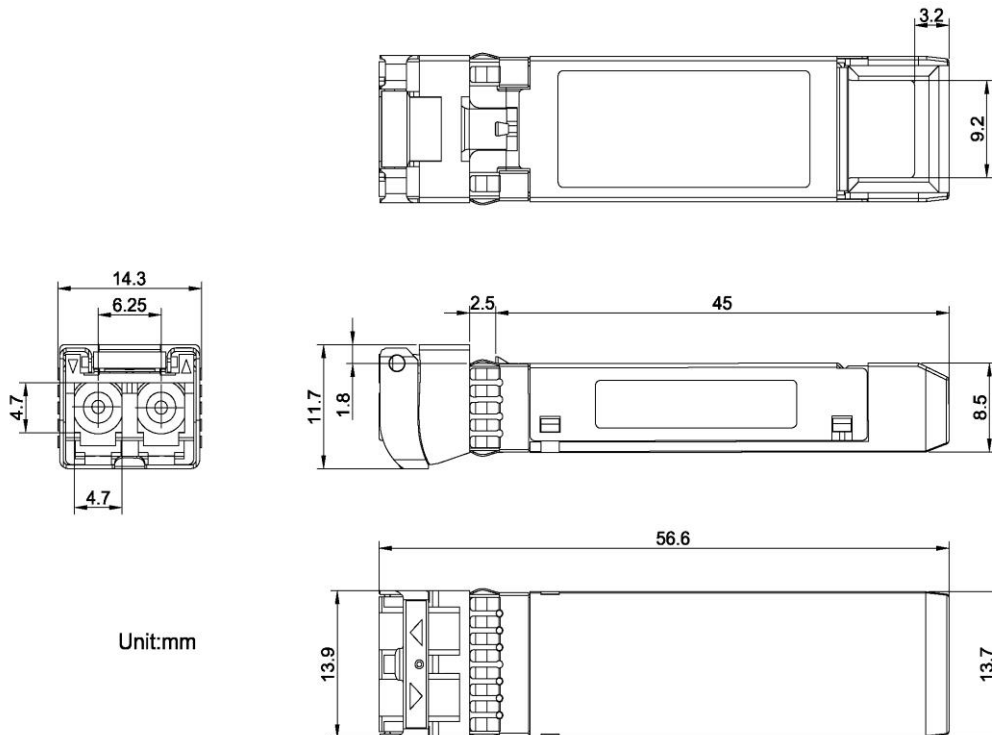


Figure 5. Outline Drawing



## **For More Information**

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