

DATA SHEET

MODULETEK – SFP-OC48-LR2-DWDM-xx.xx-C10 2.67Gb/s SFP (Small Form Pluggable) DWDM Transceiver

SFP-OC48-LR2-DWDM-xx.xx-C10

ModuleTek's SFP-OC48-LR2-DWDM-xx.xx-C10 optical transceivers are designed for operation in Metro Access Rings and Core networks using DWDM networking equipment. They are available in 100GHz ITU Grid, C Band. Digital diagnostics functions are available via a 2-wire serial bus. In addition, they comply with the small form factor pluggable multi-source agreement (MSA) and SFF-8472.

Product Features

- Up to 2.67Gb/s bi-directional data links
- Compliant with IEEE 802.3z Gigabit Ethernet standard
- Compliant with Fiber Channel and 2X Fiber Channel
- Compliant with ANSI-T1.646, ATM and SONET and SDH for OC-48/STM-16 (2.488Gb/s)
- Compliant with SFP MSA
- Hot-pluggable SFP footprint
- Temperature-stabilized DWDM rated EML laser transmitter
- 100GHz ITU Grid, C Band
- Receiver with APD
- Duplex LC connector
- Built-in digital diagnostic functions
- Single power supply 3.3V
- RoHS Compliant
- Class 1 laser product complies with EN 60825-1
- Operating temperature range: 0°C to 70°C.

Applications

- DWDM NETWORKS

Ordering Information

| Part Number | Description |
|-----------------------------|--|
| SFP-OC48-LR2-DWDM-xx.xx-C10 | FC/2FC/GE/SONET OC-48/SDH STM-16 DWDM SFP Transceiver, Single Mode Fiber (ITU 100GHz Grid), 120km |

For More Information:

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Product Selection

| Product number | Description | ITU channel |
|-------------------------------|--|-------------|
| SFP-OC48-LR2-DWDM-1528.77-C10 | DWDM SFP transceiver 1528.77 nm (100-GHz ITU grid) | 61 |
| SFP-OC48-LR2-DWDM-1529.55-C10 | DWDM SFP transceiver 1529.55 nm (100-GHz ITU grid) | 60 |
| SFP-OC48-LR2-DWDM-1530.33-C10 | DWDM SFP transceiver 1530.33 nm (100-GHz ITU grid) | 59 |
| SFP-OC48-LR2-DWDM-1531.12-C10 | DWDM SFP Transceiver 1531.12 nm (100-GHz ITU grid) | 58 |
| SFP-OC48-LR2-DWDM-1531.90-C10 | DWDM SFP Transceiver 1531.90 nm (100-GHz ITU grid) | 57 |
| SFP-OC48-LR2-DWDM-1532.68-C10 | DWDM SFP Transceiver 1532.68 nm (100-GHz ITU grid) | 56 |
| SFP-OC48-LR2-DWDM-1533.47-C10 | DWDM SFP Transceiver 1533.47 nm (100-GHz ITU grid) | 55 |
| SFP-OC48-LR2-DWDM-1534.25-C10 | DWDM SFP Transceiver 1534.25 nm (100-GHz ITU grid) | 54 |
| SFP-OC48-LR2-DWDM-1535.04-C10 | DWDM SFP Transceiver 1535.04 nm (100-GHz ITU grid) | 53 |
| SFP-OC48-LR2-DWDM-1535.82-C10 | DWDM SFP Transceiver 1535.82 nm (100-GHz ITU grid) | 52 |
| SFP-OC48-LR2-DWDM-1536.61-C10 | DWDM SFP Transceiver 1536.61 nm (100-GHz ITU grid) | 51 |
| SFP-OC48-LR2-DWDM-1537.40-C10 | DWDM SFP Transceiver 1537.40 nm (100-GHz ITU grid) | 50 |
| SFP-OC48-LR2-DWDM-1538.19-C10 | DWDM SFP Transceiver 1538.19 nm (100-GHz ITU grid) | 49 |
| SFP-OC48-LR2-DWDM-1538.98-C10 | DWDM SFP Transceiver 1538.98 nm (100-GHz ITU grid) | 48 |
| SFP-OC48-LR2-DWDM-1539.77-C10 | DWDM SFP Transceiver 1539.77 nm (100-GHz ITU grid) | 47 |
| SFP-OC48-LR2-DWDM-1540.56-C10 | DWDM SFP Transceiver 1540.56 nm (100-GHz ITU grid) | 46 |
| SFP-OC48-LR2-DWDM-1541.35-C10 | DWDM SFP Transceiver 1541.35 nm (100-GHz ITU grid) | 45 |
| SFP-OC48-LR2-DWDM-1542.14-C10 | DWDM SFP Transceiver 1542.14 nm (100-GHz ITU grid) | 44 |
| SFP-OC48-LR2-DWDM-1542.94-C10 | DWDM SFP Transceiver 1542.94 nm (100-GHz ITU grid) | 43 |
| SFP-OC48-LR2-DWDM-1543.73-C10 | DWDM SFP Transceiver 1543.73 nm (100-GHz ITU grid) | 42 |
| SFP-OC48-LR2-DWDM-1544.53-C10 | DWDM SFP Transceiver 1544.53 nm (100-GHz ITU grid) | 41 |
| SFP-OC48-LR2-DWDM-1545.32-C10 | DWDM SFP Transceiver 1545.32 nm (100-GHz ITU grid) | 40 |
| SFP-OC48-LR2-DWDM-1546.12-C10 | DWDM SFP Transceiver 1546.12 nm (100-GHz ITU grid) | 39 |
| SFP-OC48-LR2-DWDM-1546.92-C10 | DWDM SFP Transceiver 1546.92 nm (100-GHz ITU grid) | 38 |
| SFP-OC48-LR2-DWDM-1547.72-C10 | DWDM SFP Transceiver 1547.72 nm (100-GHz ITU grid) | 37 |
| SFP-OC48-LR2-DWDM-1548.51-C10 | DWDM SFP Transceiver 1548.51 nm (100-GHz ITU grid) | 36 |
| SFP-OC48-LR2-DWDM-1549.32-C10 | DWDM SFP Transceiver 1549.32 nm (100-GHz ITU grid) | 35 |
| SFP-OC48-LR2-DWDM-1550.12-C10 | DWDM SFP Transceiver 1550.12 nm (100-GHz ITU grid) | 34 |
| SFP-OC48-LR2-DWDM-1550.92-C10 | DWDM SFP Transceiver 1550.92 nm (100-GHz ITU grid) | 33 |
| SFP-OC48-LR2-DWDM-1551.72-C10 | DWDM SFP Transceiver 1551.72 nm (100-GHz ITU grid) | 32 |
| SFP-OC48-LR2-DWDM-1552.52-C10 | DWDM SFP Transceiver 1552.52 nm (100-GHz ITU grid) | 31 |
| SFP-OC48-LR2-DWDM-1553.33-C10 | DWDM SFP Transceiver 1553.33 nm (100-GHz ITU grid) | 30 |
| SFP-OC48-LR2-DWDM-1554.13-C10 | DWDM SFP Transceiver 1554.13 nm (100-GHz ITU grid) | 29 |
| SFP-OC48-LR2-DWDM-1554.94-C10 | DWDM SFP Transceiver 1554.94 nm (100-GHz ITU grid) | 28 |

| | | |
|-------------------------------|--|----|
| SFP-OC48-LR2-DWDM-1555.75-C10 | DWDM SFP Transceiver 1555.75 nm (100-GHz ITU grid) | 27 |
| SFP-OC48-LR2-DWDM-1556.55-C10 | DWDM SFP Transceiver 1556.55 nm (100-GHz ITU grid) | 26 |
| SFP-OC48-LR2-DWDM-1557.36-C10 | DWDM SFP Transceiver 1557.36 nm (100-GHz ITU grid) | 25 |
| SFP-OC48-LR2-DWDM-1558.17-C10 | DWDM SFP Transceiver 1558.17 nm (100-GHz ITU grid) | 24 |
| SFP-OC48-LR2-DWDM-1558.98-C10 | DWDM SFP Transceiver 1558.98 nm (100-GHz ITU grid) | 23 |
| SFP-OC48-LR2-DWDM-1559.79-C10 | DWDM SFP Transceiver 1559.79 nm (100-GHz ITU grid) | 22 |
| SFP-OC48-LR2-DWDM-1560.61-C10 | DWDM SFP Transceiver 1560.61 nm (100-GHz ITU grid) | 21 |
| SFP-OC48-LR2-DWDM-1561.42-C10 | DWDM SFP Transceiver 1561.42 nm (100-GHz ITU grid) | 20 |
| SFP-OC48-LR2-DWDM-1562.23-C10 | DWDM SFP Transceiver 1562.23 nm (100-GHz ITU grid) | 19 |
| SFP-OC48-LR2-DWDM-1563.05-C10 | DWDM SFP Transceiver 1563.05 nm (100-GHz ITU grid) | 18 |

General Specifications

| Parameter | Symbol | Min | Typ | Max | Unit | Remarks |
|-----------------------|------------------|-------|-------------------|------|------|---------|
| Data Rate | DR | 0.622 | | 2.67 | Gb/s | |
| Bit Error Rate | BER | | 10 ⁻¹² | | | |
| Operating Temperature | T _{OP} | 0 | | 70 | °C | 1 |
| Storage Temperature | T _{STO} | - 40 | | 85 | °C | 2 |
| Operating Current | I _{OP} | | | 400 | mA | 3 |
| Supply Current | I _S | | 250 | 300 | mA | 4 |
| Input Voltage | V _{CC} | 3.14 | 3.3 | 3.46 | V | |
| Maximum Voltage | V _{MAX} | - 0.5 | | 4 | V | 4 |

Notes:

1. Case temperature
2. Ambient temperature
3. Absolute Rating
4. For electrical power interface

Optical Characteristics – Transmitter

V_{CC}=3.14V to 3.46V, T_C=0°C to 70°C

| Parameter | Symbol | Min | Typ | Max | Unit | Remarks |
|------------------------------------|--------------------|-------|-----|-------|-------|---------|
| Output Optical Power | P _{TX} | 0 | | 5 | dBm | 1 |
| Center Wavelength space | | | 100 | | GHz | |
| Optical Center Wavelength | λ _C | X-100 | X | X+100 | pm | |
| Extinction Ratio | ER | 8.2 | | | dB | |
| Side Mode Suppression Ratio | SMSR | 30 | | | dB | |
| Spectral Width (- 20dB) | Δλ | | | 0.3 | nm | |
| Optical Rise/Fall Time (20% - 80%) | T _{RF_IN} | | | 180 | ps | |
| Relative Intensity Noise | RIN | | | - 120 | dB/Hz | |

| | | | |
|--------------------------|----|-----|----|
| Transmitter Jitter | TJ | 100 | ps |
| Dispersion Power Penalty | | 3.0 | dB |

Notes:

1. Class 1 Product

Optical Characteristics – Receiver

V_{CC}=3.14V to 3.46V, T_C=0°C to 70°C

| Parameter | Symbol | Min | Typ | Max | Unit | Remarks |
|----------------------------------|---------------------|------|-----|------|------|---------|
| Optical Receiver Power | P _{RX} | - 28 | | - 9 | dBm | |
| Optical Center Wavelength | λ _C | 1260 | | 1620 | nm | |
| Receiver Sensitivity @ 1.062Gb/s | R _{X_SEN1} | | | - 30 | dBm | 1 |
| Receiver Sensitivity @ 1.25Gb/s | R _{X_SEN2} | | | - 30 | dBm | 1 |
| Receiver Sensitivity @ 2.125Gb/s | R _{X_SEN3} | | | - 28 | dBm | 1 |
| Receiver Sensitivity @ 2.488Gb/s | R _{X_SEN3} | | | - 28 | dBm | 1 |
| LOS Assert | P _{LOS_A} | - 35 | | | dBm | |
| LOS De-Assert | P _{LOS_D} | | | - 32 | dBm | |
| LOS Hysteresis | | 0.5 | | | dB | |

Notes:

1. Measured with a PRBS 2⁷-1 test pattern, BER<10⁻¹²

Electrical Characteristics – Transmitter

V_{CC}=3.14V to 3.46V, T_C=0°C to 70°C

| Parameter | Symbol | Min | Typ | Max | Unit | Remarks |
|-------------------------------|--------------------|----------------------|-----|----------------------|------|---------|
| Input differential impedance | R _{IN} | | 100 | | Ω | 1 |
| Single ended data input swing | V _{IN_PP} | 250 | | 1200 | mV | |
| Transmit disable voltage | V _D | V _{CC} -1.3 | | V _{CC} | V | |
| Transmit enable voltage | V _{EN} | V _{EE} | | V _{EE} +0.8 | V | |
| Transmit disable assert time | | | | 10 | us | |

Notes:

1. AC Coupled

Electrical Characteristics – Receiver

V_{CC}=3.14V to 3.46V, T_C=0°C to 70°C

| Parameter | Symbol | Min | Typ | Max | Unit | Remarks |
|--------------------------------------|-------------------------|----------------------|-----|----------------------|------|---------|
| Single ended data output swing | V _{OUT_PP} | 250 | | 800 | mV | |
| Data output rise/fall time (20%-80%) | T _R | | 100 | 175 | ps | |
| LOS Fault | V _{LOS_Fault} | V _{CC} -0.5 | | V _{CC_HOST} | V | |
| LOS Normal | V _{LOS_Normal} | V _{EE} | | V _{EE} +0.5 | V | |

Digital Diagnostic Functions

SFP-OC48-LR2-DWDM-xx.xx-C10 support the 2-wire serial communication protocol as defined in the SFP MSA. Digital diagnostic information is accessible over the 2-wire interface at the address 0xA2. Digital diagnostics for SFP-OC48-LR2-DWDM-xx.xx-C10 are internally calibrated by default. A micro controller unit inside the transceiver gathers the monitoring information and reports the status of transceiver.

Transceiver Temperature, internally measured, represented as a 16 bit signed twos complement value in increments of 1/256 degrees Celsius, Temperature accuracy is better than ± 3 degrees Celsius over specified operating temperature and voltage.

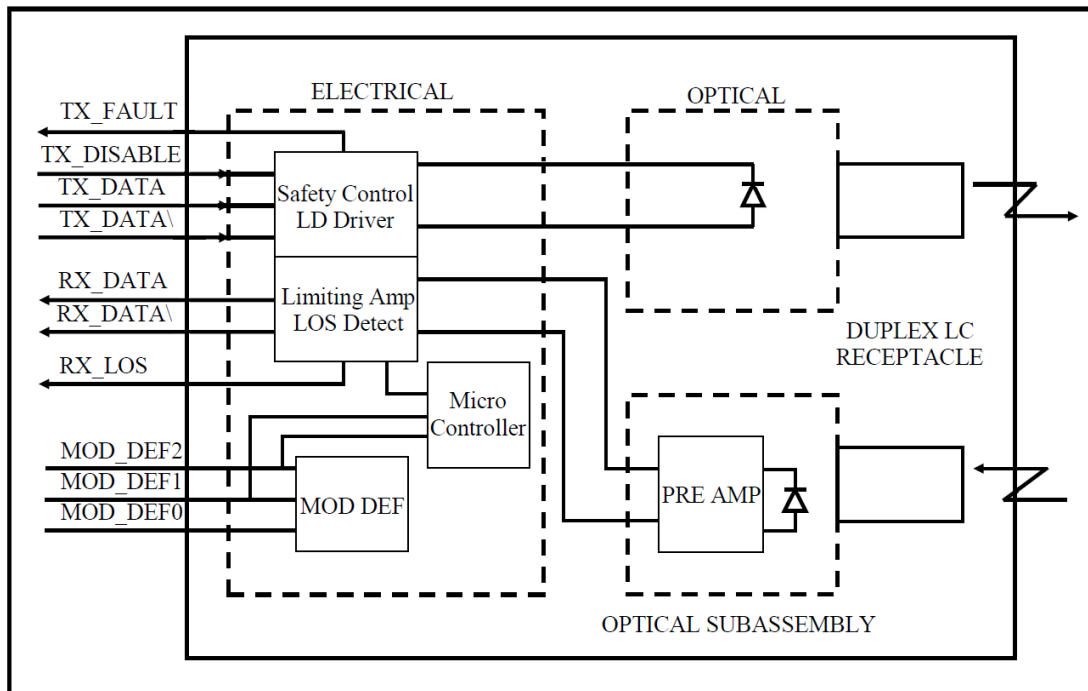
Transceiver Supply Power, internally measured, represented as a 16 bit unsigned integer with the voltage defined as the full 16 bit value (0 – 65535) with LSB equal to 100 μ Volt, yielding a total range of 0 to +6.55 Volts.

Transceiver TX bias current, internally measured, represented as a 16 bit unsigned integer with the current defined as the full 16 bit value (0 – 65535) with LSB equal to 2 μ A, yielding a total range of 0 to 131mA. Accuracy is better than $\pm 10\%$ over specified operating temperature and voltage.

Transceiver TX output power, internally measured, represented as a 16 bit unsigned integer with the power defined as the full 16 bit value (0 – 65535) with LSB equal to 0.1 μ W. Data is assumed to be based on measurement of laser monitor photodiode current. Accuracy is better than ± 3 dB over specified temperature and voltage. Data is not valid when the transmitter is disabled.

Transceiver RX received optical power, internally measured, represented as a 16 bit unsigned integer with the power defined as the full 16 bit 35 value (0 – 65535) with LSB equal to 0.1 μ W. Accuracy is better than ± 3 dB over specified temperature and voltage.

Block Diagram of Transceiver



Transmitter Section

The DFB driver accepts differential input data and provide bias and modulation currents for driving a laser. An automatic power-control (APC) feedback loop is incorporated to maintain a constant average optical power. DFB laser in an eye safe optical

subassembly (OSA) mates to the fiber cable.

TX_DISABLE

The TX_DISABLE signal is high (TTL logic "1") to turn off the laser output. The laser will turn on within 1ms when TX_DISABLE is low (TTL logic "0").

TX_FAULT

When the TX_FAULT signal is high, output indicates a laser fault of some kind. Low indicates normal operation.

Receiver Section

The receiver utilizes a APD detector integrated with a trans-impedance preamplifier in an OSA. This OSA is connected to a Limiting Amplifier which providing post-amplification quantization, and optical signal detection. The limiting Amplifier is AC-coupled to the transimpedance amplifier, with internal 100Ω differential termination.

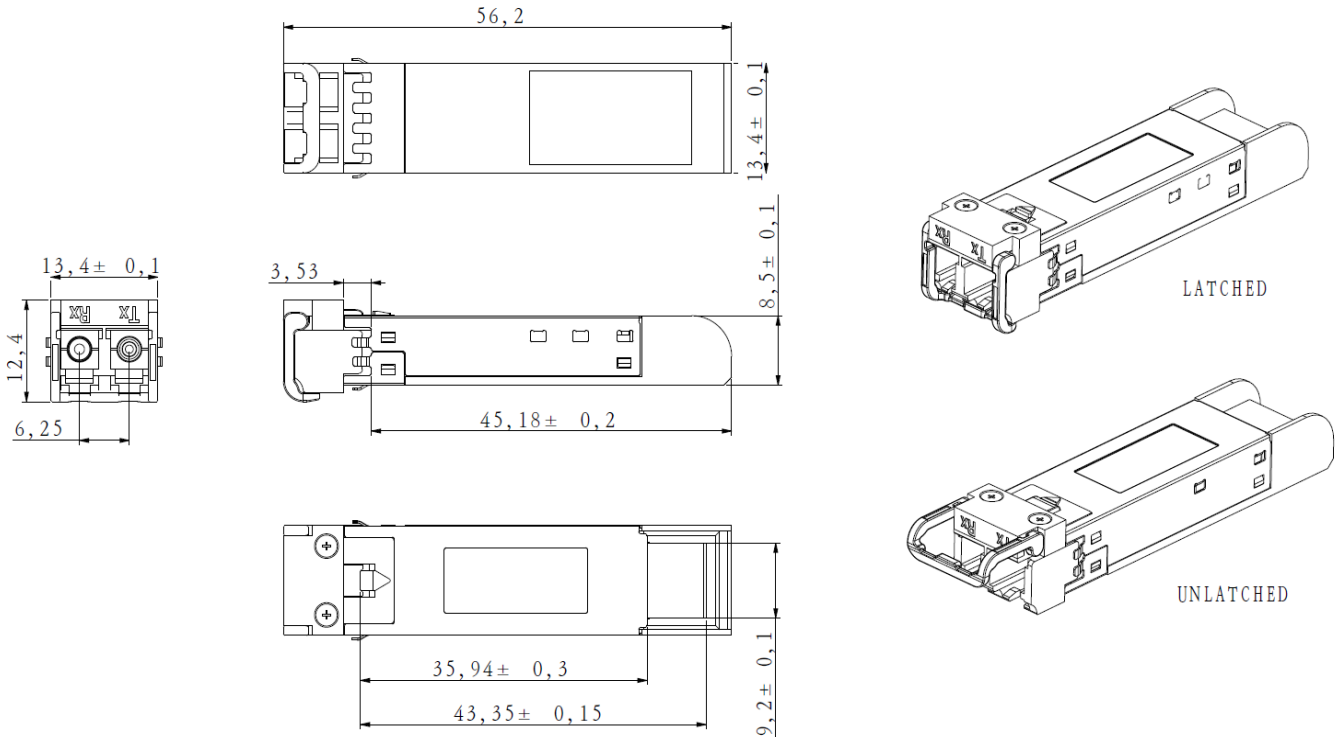
Receive Loss (RX_LOS)

The RX_LOS is high (logic "1") when there is no incoming light from the companion transceiver. This signal is normally used by the system for the diagnostic purpose. The signal is operated in TTL level.

Controller Section

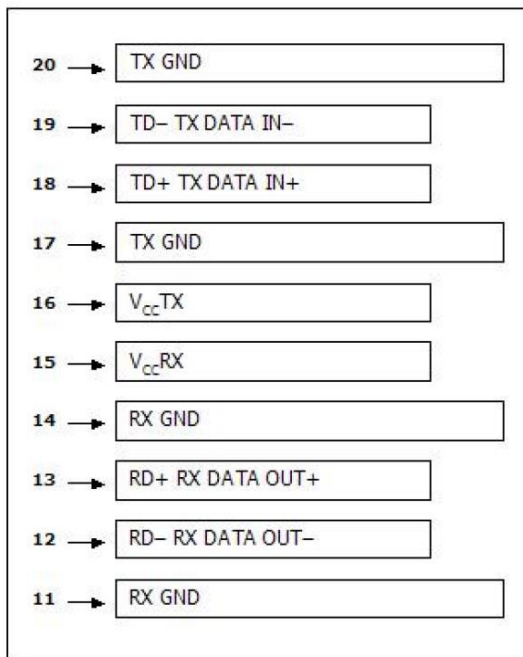
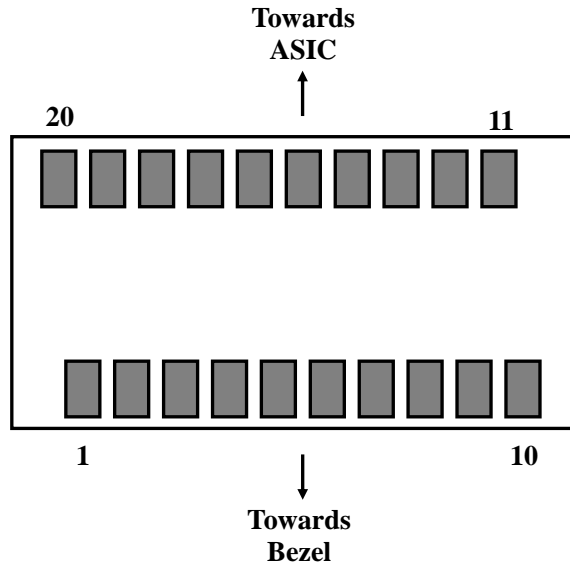
The micro controller unit monitors the operation information of LD driver and Limiting Amplifier, and report these status to the customer.

Dimensions

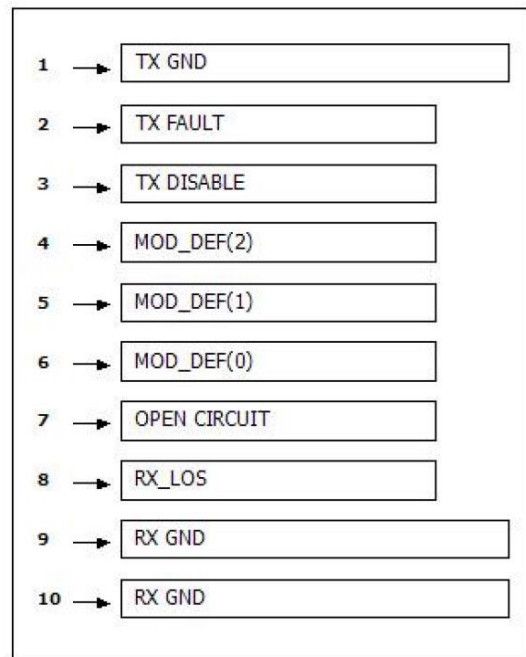


**ALL DIMENSIONS ARE ±0.2mm UNLESS OTHERWISE SPECIFIED
UNIT: mm**

Electrical Pad Layout



Top of Board



Bottom of Board

Pin Assignment

| PIN # | Symbol | Description | Remarks |
|-------|--------------------|---|---------|
| 1 | V _{EET} | Transmitter ground (common with receiver ground) | 1 |
| 2 | T _{FAULT} | Transmitter Fault. Not supported | |
| 3 | T _{DIS} | Transmitter Disable. Laser output disable on high or open | 2 |

| | | | |
|----|------------------|---|---|
| 4 | MOD_DEF (2) | Module Definition 2. Data line for serial ID | 3 |
| 5 | MOD_DEF (1) | Module Definition 1. Clock line for serial ID | 3 |
| 6 | MOD_DEF (0) | Module Definition 0. Grounded within the module | 3 |
| 7 | Rate Select | No connection required | |
| 8 | LOS | Loss of Signal indication. Logic 0 indicates normal operation | 4 |
| 9 | V _{EER} | Receiver ground (common with transmitter ground) | 1 |
| 10 | V _{EER} | Receiver ground (common with transmitter ground) | 1 |
| 11 | V _{EER} | Receiver ground (common with transmitter ground) | 1 |
| 12 | RD- | Receiver Inverted DATA out. AC coupled | |
| 13 | RD+ | Receiver Non-inverted DATA out. AC coupled | |
| 14 | V _{EER} | Receiver ground (common with transmitter ground) | 1 |
| 15 | V _{CCR} | Receiver power supply | |
| 16 | V _{CCT} | Transmitter power supply | |
| 17 | V _{EET} | Transmitter ground (common with receiver ground) | 1 |
| 18 | TD+ | Transmitter Non-Inverted DATA in. AC coupled | |
| 19 | TD- | Transmitter Inverted DATA in. AC coupled | |
| 20 | V _{EET} | Transmitter ground (common with receiver ground) | 1 |

Notes:

1. Circuit ground is isolated from chassis ground
2. Disabled: T_{DIS}>2V or open, Enabled: T_{DIS}<0.8V
3. Should Be pulled up with 4.7k – 10k ohm on host board to a voltage between 2V and 3.46V
4. LOS is open collector output

References

1. IEEE standard 802.3. IEEE Standard Department, 2005.
2. Small Form Factor Pluggable (SFP) Transceiver Multi-Source Agreement (MSA), September 2000.
3. Fiber Channel Draft Physical Interface Specification (FC-PI-2 Rev7.0).
4. Digital Diagnostics Monitoring Interface for Optical Transceivers – SFF-8472.
5. Fiber Channel Physical and Signaling Interface (FC-PH/PH2/PH3).
6. Bellcore GR-253 and ITU-T G.957 Specifications.