

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. The product implements digital diagnostics via a 2-wire serial bus , compliant with the INF-8074i Small Form Factor Pluggable Multi-Source Agreement (MSA).

Product Features

- Up to 2.67 Gb/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
- Up to 120km on SMF
- Wavelength controlled within $\pm 0.01\text{nm}$ over the entire lifetime and operating temperature range
- 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
- SONET NETWORKS

Ordering Information

| Part Number | Description | Color on Clasp |
|---|---|----------------|
| 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 | Blue |
| For More Information: ModuleTek Limited Web: www.moduletek.com Email: sales@moduletek.com | | |

Product Selection

| Product number | Description | ITU channel |
|-----------------------------|---------------------------------|-------------|
| SFP-OC48-LR2-DWDM-63.05-C10 | DWDM SFP Transceiver 1563.05 nm | 18 |
| SFP-OC48-LR2-DWDM-62.23-C10 | DWDM SFP Transceiver 1562.23 nm | 19 |
| SFP-OC48-LR2-DWDM-61.24-C10 | DWDM SFP Transceiver 1561.42 nm | 20 |
| SFP-OC48-LR2-DWDM-60.61-C10 | DWDM SFP Transceiver 1560.61 nm | 21 |
| SFP-OC48-LR2-DWDM-59.79-C10 | DWDM SFP Transceiver 1559.79 nm | 22 |
| SFP-OC48-LR2-DWDM-58.98-C10 | DWDM SFP Transceiver 1558.98 nm | 23 |
| SFP-OC48-LR2-DWDM-58.17-C10 | DWDM SFP Transceiver 1558.17 nm | 24 |
| SFP-OC48-LR2-DWDM-57.36-C10 | DWDM SFP Transceiver 1557.36 nm | 25 |
| SFP-OC48-LR2-DWDM-56.55-C10 | DWDM SFP Transceiver 1556.55 nm | 26 |
| SFP-OC48-LR2-DWDM-55.75-C10 | DWDM SFP Transceiver 1555.75 nm | 27 |
| SFP-OC48-LR2-DWDM-54.94-C10 | DWDM SFP Transceiver 1554.94 nm | 28 |
| SFP-OC48-LR2-DWDM-54.13-C10 | DWDM SFP Transceiver 1554.13 nm | 29 |
| SFP-OC48-LR2-DWDM-53.33-C10 | DWDM SFP Transceiver 1553.33 nm | 30 |
| SFP-OC48-LR2-DWDM-52.52-C10 | DWDM SFP Transceiver 1552.52 nm | 31 |
| SFP-OC48-LR2-DWDM-51.72-C10 | DWDM SFP Transceiver 1551.72 nm | 32 |
| SFP-OC48-LR2-DWDM-50.92-C10 | DWDM SFP Transceiver 1550.92 nm | 33 |
| SFP-OC48-LR2-DWDM-50.12-C10 | DWDM SFP Transceiver 1550.12 nm | 34 |
| SFP-OC48-LR2-DWDM-49.32-C10 | DWDM SFP Transceiver 1549.32 nm | 35 |
| SFP-OC48-LR2-DWDM-48.51-C10 | DWDM SFP Transceiver 1548.51 nm | 36 |
| SFP-OC48-LR2-DWDM-47.72-C10 | DWDM SFP Transceiver 1547.72 nm | 37 |
| SFP-OC48-LR2-DWDM-46.92-C10 | DWDM SFP Transceiver 1546.92 nm | 38 |
| SFP-OC48-LR2-DWDM-46.12-C10 | DWDM SFP Transceiver 1546.12 nm | 39 |
| SFP-OC48-LR2-DWDM-45.32-C10 | DWDM SFP Transceiver 1545.32 nm | 40 |

| | | |
|-----------------------------|---------------------------------|----|
| SFP-OC48-LR2-DWDM-44.53-C10 | DWDM SFP Transceiver 1544.53 nm | 41 |
| SFP-OC48-LR2-DWDM-43.73-C10 | DWDM SFP Transceiver 1543.73 nm | 42 |
| SFP-OC48-LR2-DWDM-42.94-C10 | DWDM SFP Transceiver 1542.94 nm | 43 |
| SFP-OC48-LR2-DWDM-42.14-C10 | DWDM SFP Transceiver 1542.14 nm | 44 |
| SFP-OC48-LR2-DWDM-41.35-C10 | DWDM SFP Transceiver 1541.35 nm | 45 |
| SFP-OC48-LR2-DWDM-40.56-C10 | DWDM SFP Transceiver 1540.56 nm | 46 |
| SFP-OC48-LR2-DWDM-39.77-C10 | DWDM SFP Transceiver 1539.77 nm | 47 |
| SFP-OC48-LR2-DWDM-38.98-C10 | DWDM SFP Transceiver 1538.98 nm | 48 |
| SFP-OC48-LR2-DWDM-38.19-C10 | DWDM SFP Transceiver 1538.19 nm | 49 |
| SFP-OC48-LR2-DWDM-37.40-C10 | DWDM SFP Transceiver 1537.40 nm | 50 |
| SFP-OC48-LR2-DWDM-36.61-C10 | DWDM SFP Transceiver 1536.61 nm | 51 |
| SFP-OC48-LR2-DWDM-35.82-C10 | DWDM SFP Transceiver 1535.82 nm | 52 |
| SFP-OC48-LR2-DWDM-35.04-C10 | DWDM SFP Transceiver 1535.04 nm | 53 |
| SFP-OC48-LR2-DWDM-34.25-C10 | DWDM SFP Transceiver 1534.25 nm | 54 |
| SFP-OC48-LR2-DWDM-33.47-C10 | DWDM SFP Transceiver 1533.47 nm | 55 |
| SFP-OC48-LR2-DWDM-32.68-C10 | DWDM SFP Transceiver 1532.68 nm | 56 |
| SFP-OC48-LR2-DWDM-31.90-C10 | DWDM SFP Transceiver 1531.90 nm | 57 |
| SFP-OC48-LR2-DWDM-31.12-C10 | DWDM SFP Transceiver 1531.12 nm | 58 |
| SFP-OC48-LR2-DWDM-30.33-C10 | DWDM SFP transceiver 1530.33 nm | 59 |
| SFP-OC48-LR2-DWDM-29.55-C10 | DWDM SFP transceiver 1529.55 nm | 60 |
| SFP-OC48-LR2-DWDM-28.77-C10 | DWDM SFP transceiver 1528.77 nm | 61 |

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_C | 0 | | 70 | °C | 1 |
| Storage Temperature | T_{STO} | -40 | | 85 | °C | 2 |
| Supply Current | I_{CC} | | 250 | 300 | mA | 3 |
| Input Voltage | V_{CC} | 3.14 | 3.3 | 3.46 | V | |
| Maximum Voltage | V_{MAX} | -0.5 | | 4 | V | 3 |

Notes:

1. Case temperature
2. Ambient temperature
3. For electrical power interface

Optical – Characteristics – Transmitter

$V_{CC}=3.14V$ to $3.46V$, $T_C=0^{\circ}C$ to $70^{\circ}C$

| 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) | $\Delta\lambda$ | | | 0.3 | nm | |
| Optical Rise/Fall Time (20%-80%) | t_r / t_f | | | 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 $3.46V$, $T_C=0^{\circ}C$ to $70^{\circ}C$

| 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 | LOS_A | -35 | | | dBm | |
| LOS De-Assert | LOS_D | | | -32 | dBm | |
| LOS Hysteresis | LOS_H | 0.5 | | | dB | |

Notes:

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

Electrical – Characteristics – Transmitter

$V_{CC}=3.14V$ to $3.46V$, $T_C=0^{\circ}C$ to $70^{\circ}C$

| 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 $3.46V$, $T_C=0^{\circ}C$ to $70^{\circ}C$

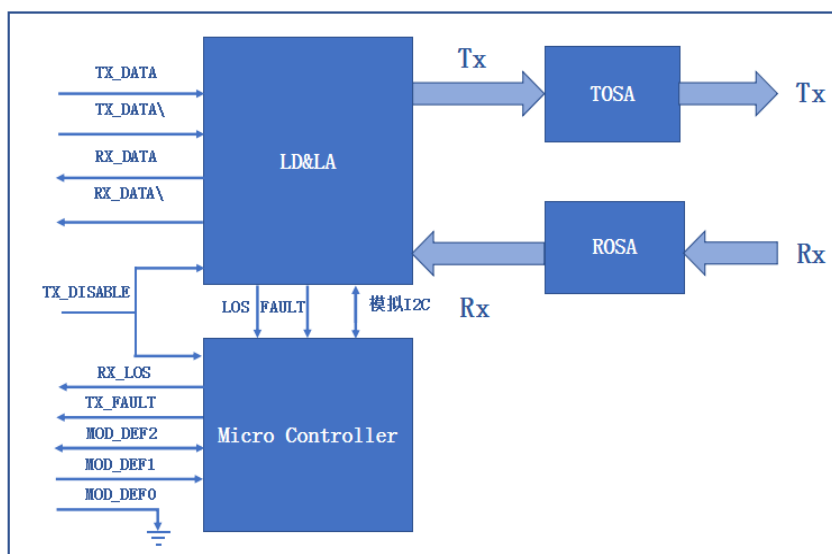
| Parameter | Symbol | Min | Typ | Max | Unit | Remarks |
|---|---------------|--------------|-----|----------------|------|---------|
| Single ended data output swing | V_{OUT_PP} | 250 | | 800 | mV | |
| Data output rise time/fall time (20%-80%) | t_r / t_f | | 100 | 175 | ps | |
| LOS Assert | LOS_A | $V_{CC}-0.5$ | | V_{CC_HOST} | V | |
| LOS De-Assert | LOS_D | V_{EE} | | $V_{EE}+0.5$ | V | |

Digital Diagnostic Functions

SFP-OC48-LR2-DWDM-xx.xx-C10 supports the 2-wire serial communication protocol as defined in 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. The internal micro control unit accesses the device operating parameters in real time, Such as transceiver temperature, laser bias current, transmitted optical power, received optical power and transceiver supply voltage. The module implements the alarm function of the SFP MSA , alerts the user when a particular operating parameter exceeds the factory-set normal range.

| Digital Diagnostic Threshold Range | | | | | |
|------------------------------------|------------|-----------|--------------|-------------|---------|
| Parameter | High Alarm | Low Alarm | High Warning | Low Warning | Remarks |
| Temperature ($^{\circ}C$) | 75 | -5 | 70 | 0 | |
| Voltage (V) | 3.36 | 2.97 | 3.46 | 3.13 | |
| Bias Current (mA) | 100 | 15 | 95 | 20 | |
| Tx Power (uw) | 3014.2 | 253.4 | 2511.8 | 316.2 | |
| Rx Power (uw) | 251.7 | 1.9 | 188.8 | 2.9 | |

Block-Diagram-of-Transceiver



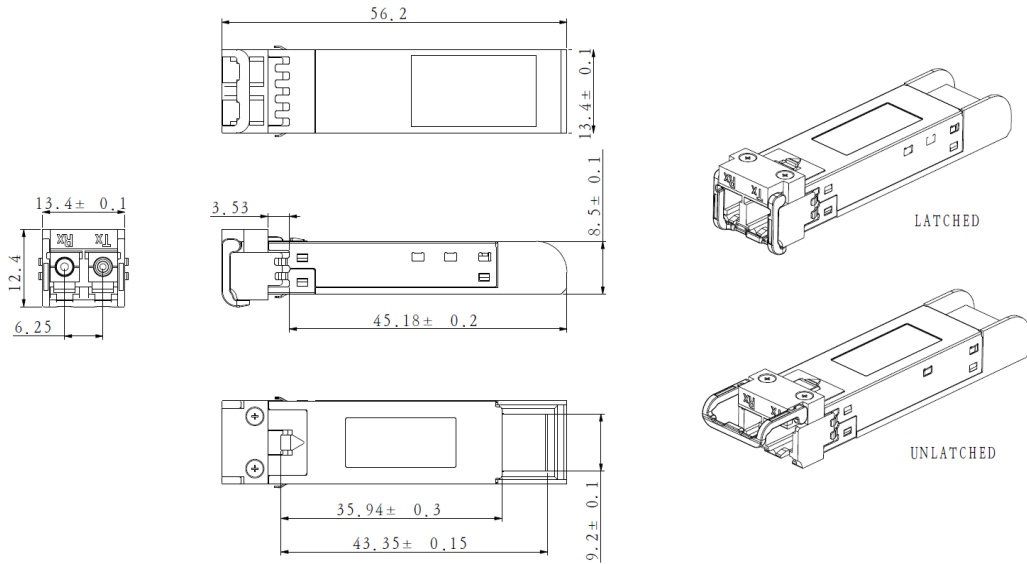
Functions Description

The transmitter consists of a laser driver chip and a TOSA (light-emitting component). The TOSA includes a DFB laser, an electroabsorption modulator (EAM), a TEC, and a backlight diode. Unlike DML, EML TOSA uses external modulation. When the transmission rate of the system is high, the transmission distance is not only limited by the attenuation of the optical fiber, but also by the dispersion of the optical fiber, and the dispersion of the optical communication system is related to the modulation spectral width. The directly modulated laser has a large dispersion cost, and has spectral broadening, frequency chirp, and short transmission distance, so the external modulation method is adopted in the medium-long-distance transmission at a rate of 10 Gb/s. TEC (Thermo Electric Cooler) Controls the temperature of the laser tube. When a temperature is set, the TOSA temperature of the module will remain unchanged through the control of the TEC. The wavelength of the module laser tube is related to the temperature of the laser tube. The module wavelength can be set by setting the TOSA temperature. When stable, the module has excellent wavelength stability. The electrical signal enters the optical module from the serial electrical interface and is then input to the laser driver chip. The laser driver chip supplies the bias current and the modulation current to the laser. The laser driver chip simultaneously uses an automatic optical power control (APC) feedback loop to maintain a constant average optical power of the laser output. The purpose is to eliminate the change of the output optical signal due to temperature changes and aging of the light source device. When the transmitter enable pin (TX_Disable) is high (TTL logic "1"), the laser output is turned off. When TX_Disable is low (TTL logic "0"), the laser will turn on within 1ms. When the transmitter fault signal (TX_Fault) is reported as high, indicates a transmitter failure caused by the transmitter's bias current or transmitted optical power or laser tube temperature exceeding a preset alarm threshold. Low indicates normal operation.

The receiver consists of a ROSA (light-receiving component) and a limiting amplifier chip, ROSA includes a APD photodetector and a transimpedance amplifier chip. The ROSA detects the incident optical signal, converts the optical signal into an electrical signal, and outputs the electrical signal to the

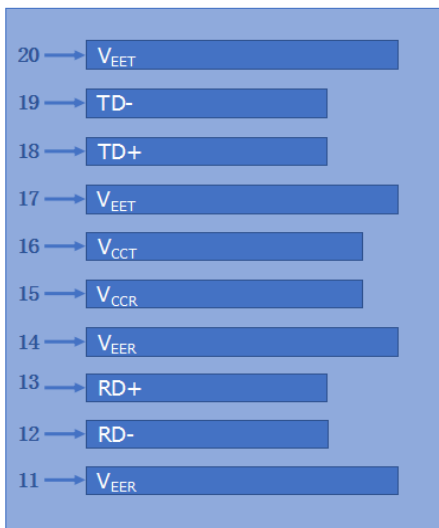
limiting amplifier. The electrical signal is further amplified by the limiting amplifier, then outputs a fixed-amplitude electrical signal to the host. When the amplitude of the electrical signal received from the incident light conversion of the opposite optical transceiver module is lower than the set threshold, the module reports that the received signal is lost, the RX_LOS pin is high (logic "1"), which can be used to diagnose whether the physical signal is normal. The signal is operated in TTL level. The microprocessor inside the module monitors the module's operating voltage, temperature, transmitted optical power, received optical power, and laser bias current value in real time. The host acquires this information over a 2-wire serial bus.

Dimensions

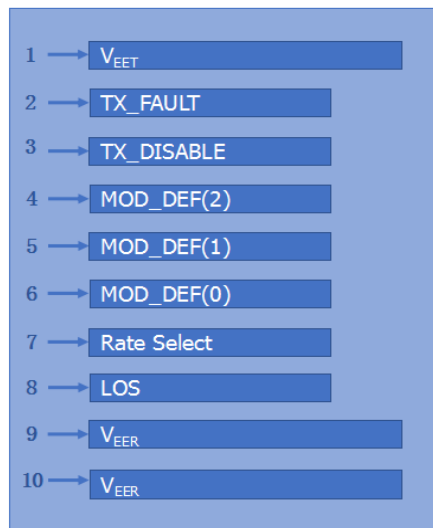


ALL DIMENSIONS ARE ±0.2mm UNLESS OTHERWISE SPECIFIED
UNIT: mm

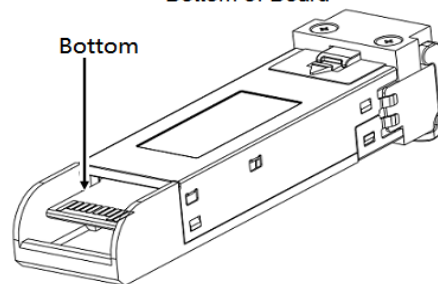
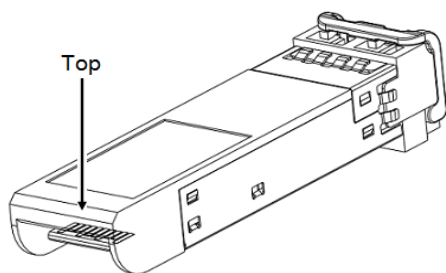
Electrical Pad Layout



Top of Board



Bottom of Board



Pin Assignment

| PIN # | Symbol | Description | Remarks |
|-------|------------------|---|---------|
| 1 | V _{EET} | Transmitter ground (common with receiver ground) | 1 |
| 2 | TX_FAULT | Transmitter Fault. Not supported | |
| 3 | TX_DISABLE | Transmitter Disable. Laser output disabled 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 3.6V
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), INF-8074i.
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.