

## DATA SHEET

### MODULETEK: SFP-OC48-LR2-C10

OC-48 LR-2/STM L-16.2 SFP (Small Form Pluggable) Transceiver with Digital Diagnostics

### SFP-OC48-LR2-C10 Overview

ModuleTek's SFP-OC48-LR2-C10 OC-48/STM-16 SFP optical transceivers are designed to comply with ATM/SONET/SDH standards at OC-48 LR-2/STM L-16.2 (2.488Gb/s) data rate. The SFP-OC48-LR2-C10 SFP optical transceivers with digital diagnostics monitoring functionality provide a quick and reliable interface for OC-48/STM-16 single mode applications. The 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).

### Product Features

- Up to 2.67 Gb/s bi-directional data links
- Compliant with ANSI-T1.646, ATM and SONET and SDH for OC-48/STM-16 (2.488Gb/s)
- Compliant with Fiber Channel 100-SM-LL-V standard
- Comply with SFP MSA
- Built-in digital diagnostics functions
- Hot-pluggable SFP footprint
- Uncooled 1550nm DFB laser transmitter
- APD Receiver
- Duplex LC connector
- Up to 80km on SMF
- 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

- SONET OC48 LR-2/SDH STM L-16.2

## Ordering Information

| Part Number   | Description  | Color on Clasp |
|---|--|----------------|
| SFP-OC48-LR2-C10  | OC48 LR-2/STM L-16.2 SFP LC Connectors<br>1550nm Single Mode 80km, with DOM function | green          |
| <b>For More Information:</b><br>ModuleTek Limited<br>Web: <a href="http://www.moduletek.com">www.moduletek.com</a><br>Email: <a href="mailto:sales@moduletek.com">sales@moduletek.com</a> |  |                |

## General Specifications

| Parameter             | Symbol           | Min  | Typ   | Max        | Unit | Remarks |
|-----------------------|------------------|------|-------|------------|------|---------|
| Data Rate             | DR               |      | 2.488 |            | Gb/s |         |
| Bit Error Rate        | BER              |      |       | $10^{-12}$ |      |         |
| Operating Temperature | T <sub>C</sub>   | 0    |       | 70         | °C   | 1       |
| Storage Temperature   | T <sub>STO</sub> | -40  |       | 85         | °C   | 2       |
| Supply Current        | I <sub>CC</sub>  |      | 200   | 300        | mA   | 3       |
| Input Voltage         | V <sub>CC</sub>  | 3.14 | 3.3   | 3.46       | V    |         |
| Maximum Voltage       | V <sub>MAX</sub> | -0.5 |       | 4.5        | 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             | $P_{TX}$                     | -2   |     | 3     | dBm   | 1       |
| Optical Center Wavelength        | $\lambda_C$                  | 1480 |     | 1580  | nm    |         |
| Extinction Ratio                 | ER                           | 9    |     |       | dB    |         |
| Spectral Width (-20dB)           | $\Delta\lambda$              |      |     | 1     | nm    |         |
| Side Mode Suppression Ratio      | SMSR                         | 30   |     |       | dB    |         |
| Optical Rise/Fall Time (20%-80%) | $t_r / t_f$                  |      |     | 180   | ps    |         |
| Relative Intensity Noise         | RIN                          |      |     | -120  | dB/Hz |         |
| Generated Jitter (peak to peak)  | $GJ_{PP}$                    |      |     | 0.07  | UI    |         |
| Generated Jitter (RMS)           | $GJ_{RMS}$                   |      |     | 0.007 | UI    |         |
| Output Eye                       | 符合 SONET OC-48/SDH STM-16 标准 |      |     |       |       |         |

**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 Center Wavelength    | $\lambda_C$  | 1260 |     | 1600 | nm   |         |
| Average Rx Sensitivity@ OC48 | $R_{X\_SEN}$ |      |     | -28  | dBm  | 1       |
| Receiver Overload            | $P_{OL}$     | -9   |     |      | dBm  |         |
| Los of Assert                | $LOS_A$      | -40  |     |      | dBm  |         |
| Los of De-Assert             | $LOS_D$      |      |     | -29  | dBm  |         |
| Loss of Hysteresis           | $LOS_H$      | 0.5  |     |      | dB   |         |

**Notes:**

- 1.PRBS 2<sup>23</sup>-1

## 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 |              | $\Omega$ | 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           | $\mu s$  |         |

## Electrical – Characteristics – Receiver

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

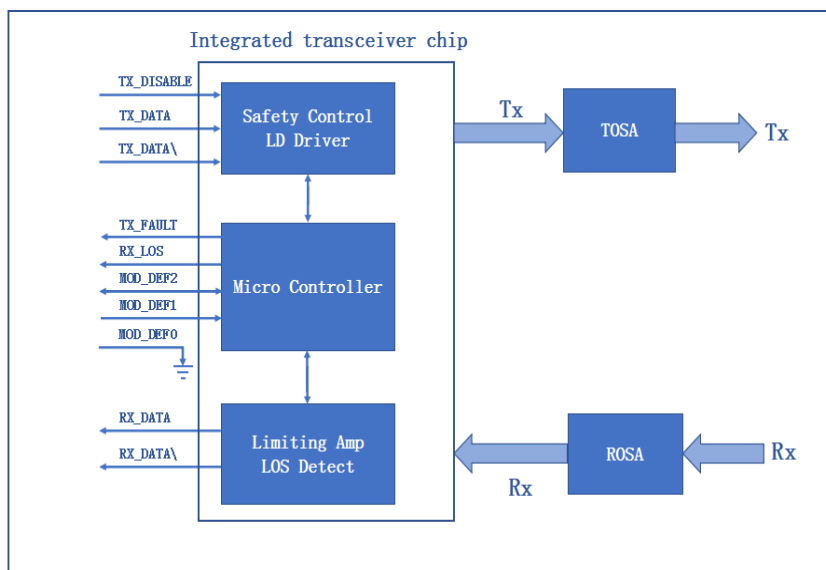
| Parameter                            | Symbol        | Min          | Typ | Max            | Unit | Remarks |
|--------------------------------------|---------------|--------------|-----|----------------|------|---------|
| Single ended data output swing       | $V_{OUT\_PP}$ | 300          | 400 | 800            | mV   |         |
| Data output rise/fall time (20%-80%) | $t_r/t_f$     |              | 100 | 175            | ps   |         |
| LOS Assert                           | $V_{LOS\_A}$  | $V_{CC}-0.5$ |     | $V_{CC\_HOST}$ | V    |         |
| LOS De-Assert                        | $V_{LOS\_D}$  | $V_{EE}$     |     | $V_{EE}+0.5$   | V    |         |

## Digital Diagnostic Functions

SFP-OC48-LR2-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-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.

| Parameter            | Symbol            | Accuracy  | Units       | Report Range | Unit | Remarks     |
|----------------------|-------------------|-----------|-------------|--------------|------|-------------|
| Internal Calibration |                   |           |             |              |      |             |
| Temperature          | Temp              | $\pm 3$   | $^{\circ}C$ | -40          | 95   | $^{\circ}C$ |
| Voltage              | $V_{CC}$          | $\pm 0.1$ | V           | 2.7          | 3.9  | V           |
| Bias Current         | I <sub>bias</sub> | $\pm 10$  | %           | 1            | 80   | mA          |
| Tx Power             | P <sub>TX</sub>   | $\pm 3$   | dB          | -10          | 5    | dBm         |
| Rx Power             | P <sub>RX</sub>   | $\pm 3$   | dB          | -30          | 0    | dBm         |

## Block-Diagram-of-Transceiver

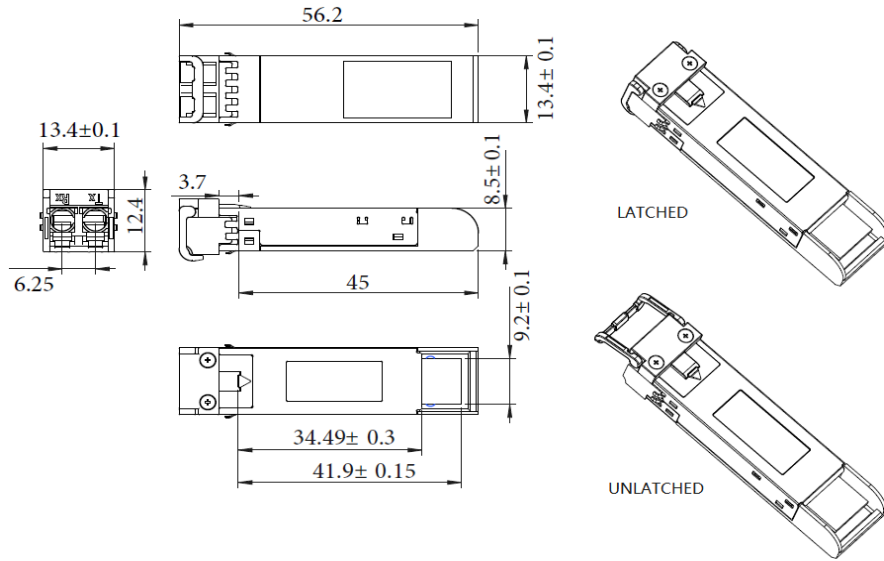


## Functions Description

The transmitter is mainly composed of a laser driver part of the intelligent transceiver chip and a TOSA (light-emitting component), the TOSA includes a 1550nm DFB laser and a backlight photodetection chip, When the module is working, the input signal is connected to the intelligent transceiver chip, at this time, the laser driver of the intelligent transceiver chip supplies the bias current and the modulation current to the laser. The intelligent transceiver 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.

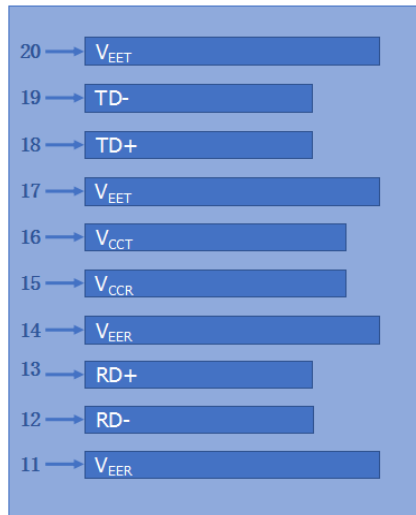
The receiver is mainly composed of a limiting amplifier part of the intelligent transceiver chip and a ROSA (light-receiving component), the ROSA includes a APD photodetector and a transimpedance amplifier chip. When the ROSA detects the incident light signal, it will be converted into a photo-generated current by the APD photodetector. The photo-generated current is converted into an electrical signal after passing through the transimpedance amplifier. The electrical signal is further amplified by the limiting amplifier of the intelligent transceiver chip, 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

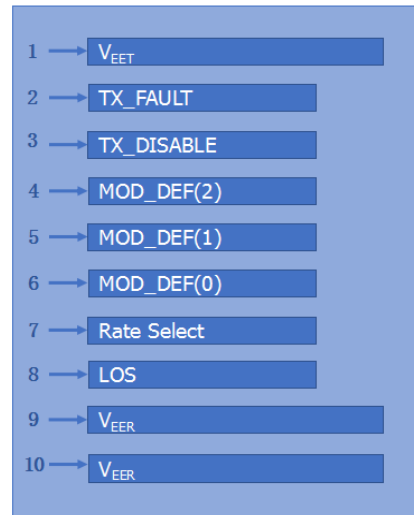


ALL DIMENSIONS ARE ±0.2mm UNLESS OTHERWISE SPECIFIED  
UNIT: mm

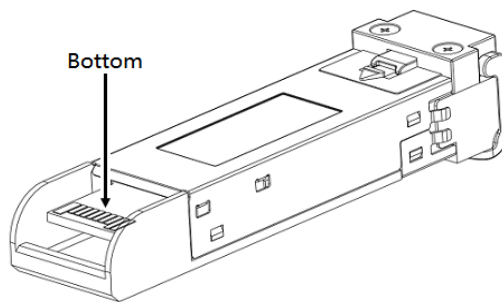
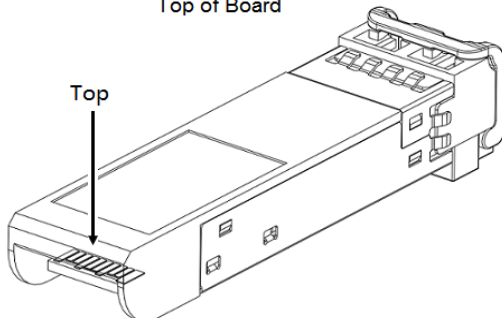
## Electrical Pad Layout



Top of Board



Bottom of Board



## Pin Assignment

| PIN # | Symbol           | Description   | Remarks |
|-------|------------------|---|---------|
| 1     | V <sub>EET</sub> | 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 <sub>EER</sub> | Receiver ground (common with transmitter ground)              | 1       |
| 10    | V <sub>EER</sub> | Receiver ground (common with transmitter ground)              | 1       |
| 11    | V <sub>EER</sub> | 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 <sub>EER</sub> | Receiver ground (common with transmitter ground)              | 1       |
| 15    | V <sub>CCR</sub> | Receiver power supply   |         |
| 16    | V <sub>CCT</sub> | Transmitter power supply                                      |         |
| 17    | V <sub>EET</sub> | 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 <sub>EET</sub> | Transmitter ground (common with receiver ground)              | 1       |

### Notes:

1. Circuit ground is isolated from chassis ground
2. Disabled: T<sub>DIS</sub> > 2V or open, Enabled: T<sub>DIS</sub> < 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, 2002.
2. Small Form Factor Pluggable (SFP) Transceiver Multi-Source Agreement (MSA), INF-8074i.
3. Bellcore GR-253 and ITU-T G.957 Specifications.