

DATA SHEET

MODULETEK: SFP-OC3-LR2-x-D10

OC-3 LR2/STM-1 SFP (Small Form Pluggable) Transceiver

Overview

ModuleTek's SFP-OC3-LR2-x-D10 SFP optical transceivers are complying with SONET and SDH standards at OC-3 LR-2/STM L-1.2. The optical transceivers provide a quick and reliable interface for single mode applications. The digital diagnostics functions are available via the 2-wire serial bus. In addition, they comply with the Small Form Factor Pluggable Multi-Source Agreement (MSA).

Product Features

- Up to 155Mb/s data links
- Comply to SFP MSA
- Built-in digital diagnostics functions
- Hot-pluggable SFP footprint
- 1550nm DFB laser transmitter
- Duplex LC connector
- Up to 80km on SMF
- Single power supply 3.3V
- RoHS Compliant
- Operating temperature range(Case Temperature):
Commercial Level : 0°C to 70°C
Industrial Level : -40°C to 85°C



Applications

- SONET OC-3 LR-2 / SDH STM L-1.2

Ordering Information

| Part Number | Product ID | Description | Color on Clasp |
|---|------------|--|----------------|
| SFP-OC3-LR2-C-D10 | M444801 | SONET OC-3 LR-2/SDH STM L-1.2, 1550nm, LC Connectors, 80km over SMF,commercial temp. | Green |
| SFP-OC3-LR12-I-D10 | M444802 | SONET OC-3 LR-2/SDH STM L-1.2, 1550nm, LC Connectors, 80km over SMF,industrial temp. | Green |
| For More Information: ModuleTek Limited Web: www.moduletek.com Email: sales@moduletek.com | | | |

General Specifications

| Parameter | Symbol | Min | Typ | Max | Unit | Remarks |
|-----------------------|------------------|------|-----|------------|------|---------|
| Data Rate | DR | | 155 | | Mb/s | |
| Bit Error Rate | BER | | | 10^{-12} | | |
| Operating Temperature | T _C | 0 | | 70 | °C | 1 |
| | | -40 | | 85 | °C | 1 |
| Storage Temperature | T _{STO} | -40 | | 85 | °C | 2 |
| Supply Current | I _{CC} | | 165 | 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

Transmission distance

| Data Rate | Optical Fiber type | Distance range (km) | Remark |
|-----------|---------------------------|---------------------|--------|
| 155Mgb/s | 9/125um Singel mode fiber | 80 | |

Optical – Characteristics – Transmitter

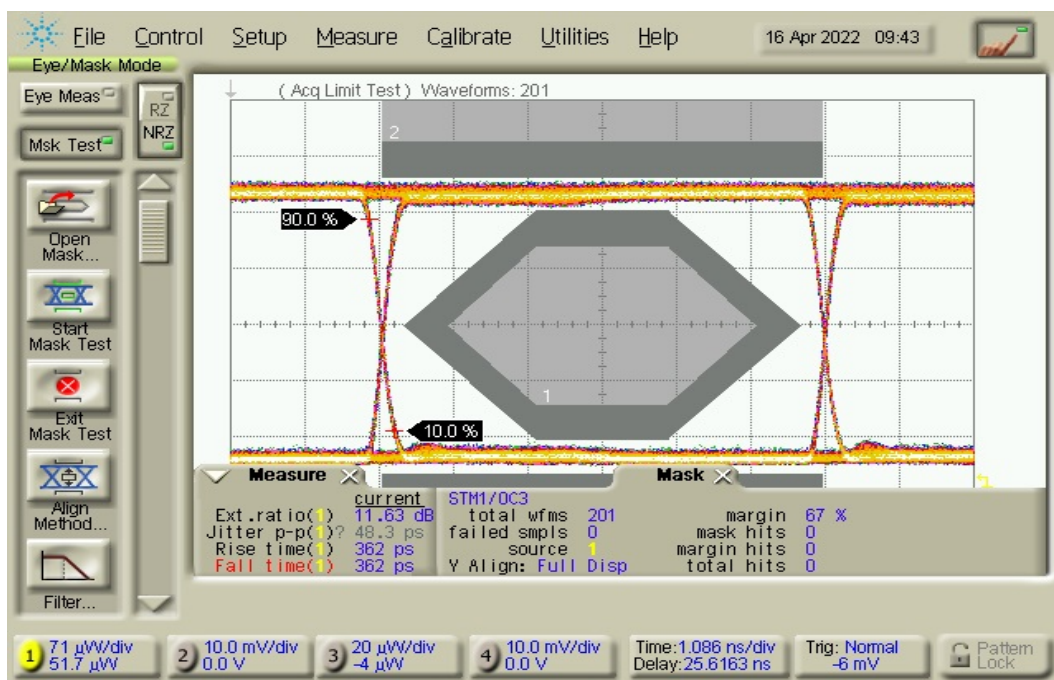
$V_{CC}=3.14V$ to $3.46V$, T_C

| Parameter | Symbol | Min | Typ | Max | Unit | Remarks |
|----------------------------------|-----------------|------|------|------|------|---------|
| Output Optical Power | P_{TX} | -5 | | 0 | dBm | 1 |
| Optical Center Wavelength | λ_c | 1480 | 1550 | 1580 | nm | |
| Extinction Ratio | ER | 9 | | | dB | |
| Spectral Width(-20dB) | $\Delta\lambda$ | | | 1 | nm | |
| Optical Rise/Fall Time (20%-80%) | t_r/t_f | | 250 | 500 | ps | |

Notes:

1. Average

Typical eye diagram



Data pattern: 155Mb/s, PRBS 2^7-1 (1.25Gb/S Filter)

Optical – Characteristics – Receiver

$V_{CC}=3.14V$ to $3.46V$, T_C

| Parameter | Symbol | Min | Typ | Max | Unit | Remarks |
|---------------------------|--------------|------|-----|------|------|---------|
| Receiver Overload | P_{OL} | 0 | | | dBm | |
| Optical Center Wavelength | λ_C | 1260 | | 1600 | nm | |
| Receiver Sensitivity | R_{X_SEN} | | | -32 | dBm | |
| LOS Assert | LOS_A | -45 | | | dBm | |
| LOS De-Assert | LOS_D | | | -32 | dBm | |
| LOS Hysteresis | LOS_H | 0.5 | | | dB | |

Electrical – Characteristics – Transmitter

$V_{CC}=3.14V$ to $3.46V$, T_C

| Parameter | Symbol | Min | Typ | Max | Unit | Remarks |
|-------------------------------|--------------|--------------|-----|--------------|----------|---------|
| Input differential impedance | R_{IN} | | 100 | | Ω | |
| 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 | |

Electrical – Characteristics – Receiver

$V_{CC}=3.14V$ to $3.46V$, T_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 | | 400 | 1300 | ns | |
| LOS Fault | V_{LOS_A} | $V_{CC}-0.5$ | | V_{CC_HOST} | V | |
| LOS Normal | V_{LOS_D} | V_{EE} | | $V_{EE}+0.5$ | V | |

| RX Squelch | Method of RX squelch implemented | Remarks |
|-----------------|----------------------------------|---------|
| Not implemented | N.A | |

A0H Device register description

| IIC Site | Byte size | Register name | Register description | Value(HEX) |
|----------|-----------|------------------------|--|----------------------------|
| 0 | 1 | Identifier | SFP | 03 |
| 1 | 1 | Extended Identifier | Use the IIC interface | 04 |
| 2 | 1 | Connector | Use the LC connector | 07 |
| 3-10 | 8 | Transceiver | SDH STM-1 L1.2, SONET OC-3 LR-2 | 00 08 04 10 00 00 00 00 |
| 11 | 1 | Encoding | NRZ | 03 |
| 12 | 1 | BR, Nominal | 155Mb/s nominal rate | 01 |
| 13 | 1 | Rate Identifier | No rate selection | 00 |
| 14 | 1 | Length(9μm)-km | In single-mode fiber transmission 80KM | 50 |
| 15 | 1 | Length (9μm)-100m | In single-mode fiber transmission 80KM | FF |
| 16 | 1 | Length (50μm)-10m | The transmission distance in the multimode fiber | 00 |
| 17 | 1 | Length (62.5μm)-10m | The transmission distance in the multimode fiber | 00 |
| 18 | 1 | Length (Copper) | The transmission distance over the copper cable | 00 |
| 19 | 1 | Reserved | Undefined | 00 |
| 20-35 | 16 | Trade name | MODULETEK | ASCII Format |
| 36 | 1 | Transceiver | Undefined | 00 |
| 37-39 | 3 | Vendor OUI | Vendor IEEE company ID | 00 00 00 |
| 40-55 | 16 | Vendor PN | Vendor's product model | Vendor defined |
| 56-59 | 4 | Vendor Revision Number | Vendor's product version number | Vendor defined |
| 60-61 | 2 | Wavelength | The laser has a wavelength of 1550 nanometers | 06 0E |
| 62 | 1 | Reserved | Undefined | 00 |
| 63 | 1 | CC_BASE | 0-62 Check and of bytes | Vendor defined |
| 64-65 | 2 | Transceiver Options | 1.Rx_LOS Sigal monitoring 2.Tx_FAULT Sigal monitoring 3.Tx_DIS Sigal monitoring | 00 1A |
| 66 | 1 | BR, max | High bit rate margin | 00 |
| 67 | 1 | BR, min | Low bit rate margin | 00 |
| 68-83 | 16 | Vendor SN | Vendor serial number | Vendor defined |
| 84-91 | 8 | Date code | The date code | Vendor defined |
| 92 | 1 | Monitoring Type | DOM Information internal calibration The received light power is measured using the average light power | 68 |

| | | | | |
|---------|-----|------------------|---|----------------|
| 93 | 1 | Enhanced Options | 1. Emitting light and receiving light alarm and warning monitoring 2. Tx_DIS Signal monitoring and control 3. Rx_LOS Signal monitoring 4. Tx_FAULT Signal monitoring | F0 |
| 94 | 1 | Compliance | As defined in SFF-8472 in version 12.0 | 08 |
| 95 | 1 | CC_EXT | 64-94 Check and bytes | Vendor defined |
| 96-127 | 32 | Vendor Specific | Vendor custom areas | Vendor defined |
| 128-255 | 128 | Vendor Specific | Vendor custom areas | Vendor defined |

Digital Diagnostic Functions

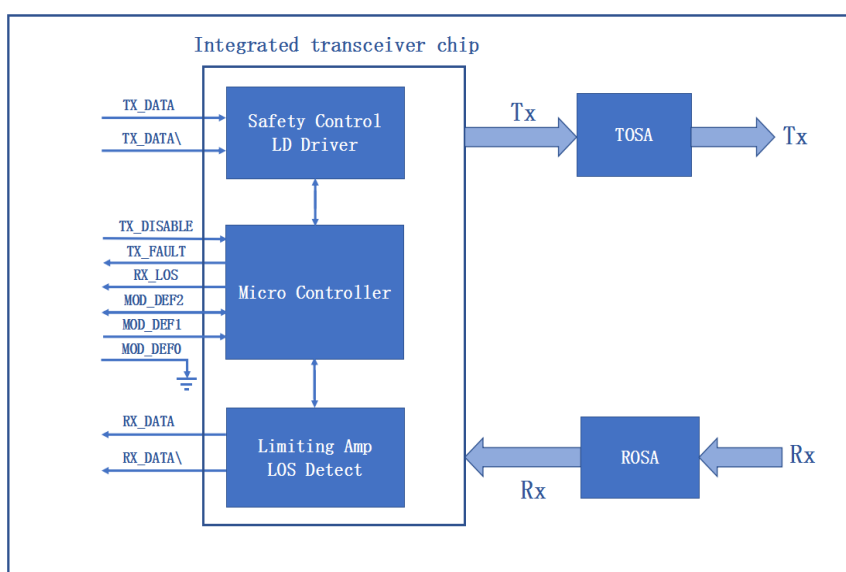
SFP-OC3-LR2-x-D10 supports the 2-wire serial communication protocol as defined in SFP MSA. Digital diagnostic information is accessible over the 2-wire interface at the address 0xA2. Digital diagnostics for SFP-OC3-LR2-x-D10 are internally calibrated by default. The internal micro control unit accesses 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.

DDM Threshold Information

| Parameter | | Alarm Threshold | | Warning Threshold | |
|-------------------|---|-----------------|---------------|-------------------|----------------|
| | | High Value | Low Value | High Value | Low Value |
| Temp (°C) | C | 75 (4B 00) | -5 (FB 00) | 70 (46 00) | 0 (00 00) |
| | I | 90 (5A 00) | -45 (D3 00) | 85 (55 00) | -40 (D8 00) |
| Voltage (V) | | 3.63 (8D CC) | 2.97 (74 04) | 3.46 (87 28) | 3.13 (7A 44) |
| Bias Current (mA) | | 100 (C3 50) | 2 (03 E8) | 80 (9C 40) | 4 (07 D0) |
| Tx Power (dBm) | | 0.79 (2E E0) | -5.97 (09 E1) | 0 (27 10) | -5 (0C 5A) |
| Rx Power (dBm) | | 3.01 (4E 20) | -40 (00 01) | 0.00 (27 10) | -35.23 (00 03) |

| Parameter | Symbol | Accuracy | Units | Report Range | | Unit | Remarks |
|-----------------------------|-------------------|----------|-------|--------------|-----|------|---------|
| Internal Calibration | | | | | | | |
| Temperature | Temp | ±5 | °C | -40 | 95 | °C | |
| Voltage | V _{CC} | ±0.1 | V | 2.7 | 3.9 | V | |
| Bias Current | I _{bias} | ±10 | % | 1 | 80 | mA | |
| Tx Power | P _{TX} | ±3 | dB | -18 | -5 | dBm | |
| Rx Power | P _{RX} | ±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 PIN photodetector and a transimpedance amplifier chip. When the ROSA detects the incident light signal, it will be converted into a photo-generated

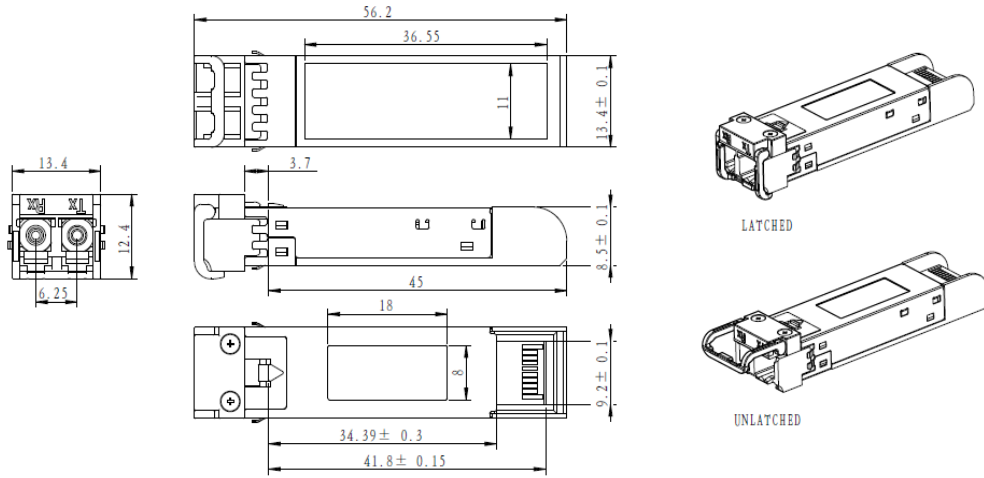
current by the PIN photodetector. The photo-generated current is converted into an electrical signal after passing through the transimpedance amplifier. The electrical signal is further amplified by the limiting amplifier of the intelligent transceiver chip, then outputs a fixed-amplitude electrical 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.

Product weight

Net weight of module: 17.0g/pcs

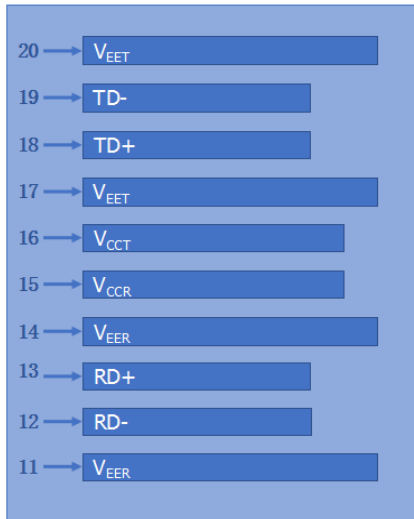
Net weight of dust cap: 0.95g/pcs

Dimensions

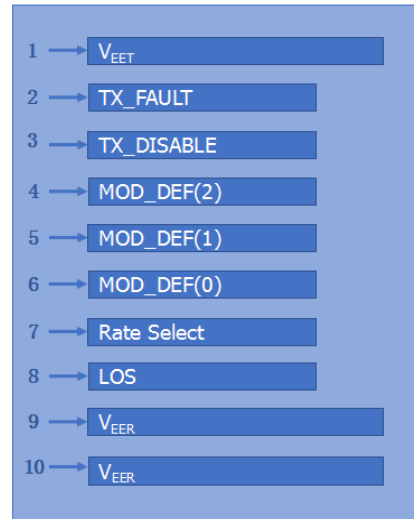


ALL DIMENSIONS ARE ±0.2mm UNLESS OTHERWISE SPECIFIED
UNIT: mm

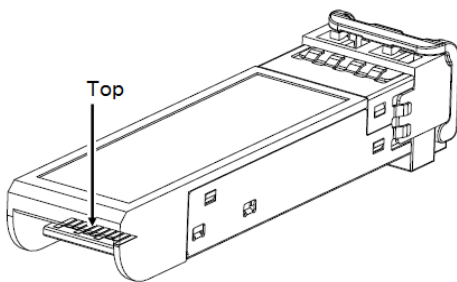
Electrical Pad Layout



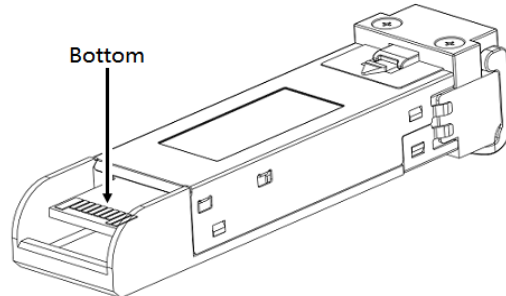
Top of Board



Bottom of Board



Top



Bottom

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), September 2000.
3. Bellcore GR-253 and ITU-T G.957 Specifications.