

## DATA SHEET

### MODULETEK-SFP-OC48-LR1-C10

OC-48 LR-1/STM L-16.1 SFP (Small Form Pluggable) Transceiver with Digital Diagnostics

#### SFP-OC48-LR1-C10 Overview

ModuleTek's SFP-OC48-LR1-C10 SONET OC-48 LR-1/SDH STM L-16.1 SFP optical transceivers are designed to comply with SONET/SDH standards at OC-48 LR-1/STM L-16.1 (2.488Gb/s) data rate. The SFP-OC48-LR1-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 Pluggable Multi-Source Agreement (MSA).

#### Product Features

- Up to 2.67 Gb/s bi-directional data links
- Compliant with SONET and SDH for OC-48/STM-16 (2.488Gb/s)
- Comply with SFP MSA
- Built-in digital diagnostics functions
- Hot-pluggable SFP+ footprint
- Uncooled 1310nm DFB laser transmitter
- APD Receiver
- Duplex LC connector
- Up to 40km 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 OC-48 LR-1/SDH STM L-16.1

## Ordering Information

Part Number	Description	Color on Clasp
SFP-OC48-LR1-C10	OC48/STM-16/LR-1/L16.1 SFP LC Connectors 1310nm SingleMode 40KM, with DOM function	Red
<b>For More Information:</b> ModuleTek Limited Web: <a href="http://www.moduletek.com">www.moduletek.com</a> 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>OP</sub>	0		70	°C	1
Storage Temperature	T <sub>STO</sub>	-40		85	°C	2
Supply Current	I <sub>S</sub>		230	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	$\lambda_C$	1280		1335	nm	
Extinction Ratio	ER	9	11		dB	
Spectral Width (- 20 dB)	$\Delta\lambda$			1	nm	
Optical Rise/Fall Time(20%-80%)	$t_r / t_f$			160	ps	
Relative Intensity Noise	RIN			- 120	dB/Hz	
Generated Jitter (peak to peak)	$G_{JPP}$			0.07	UI	
Generated Jitter (RMS)	$G_{JRMS}$			0.007	UI	
Output Eye						2

**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	$\lambda_C$	1270		1600	nm	
Average Rx Sensitivity	$R_{X\_SEN}$			-27	dBm	1
LOS Assert	$LOS_A$	-41			dBm	
LOS De-Assert	$LOS_D$			-28	dBm	
LOS 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		$\Omega$	
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  $3.46V$ ,  $T_C=0^{\circ}C$  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 time/fall time (20%–80%)	$t_r / t_f$		100	170	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-LR1-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-LR1-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  $\pm 3$  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  $\mu$ Volt, yielding a total range of 0 to +6.55 Volts.

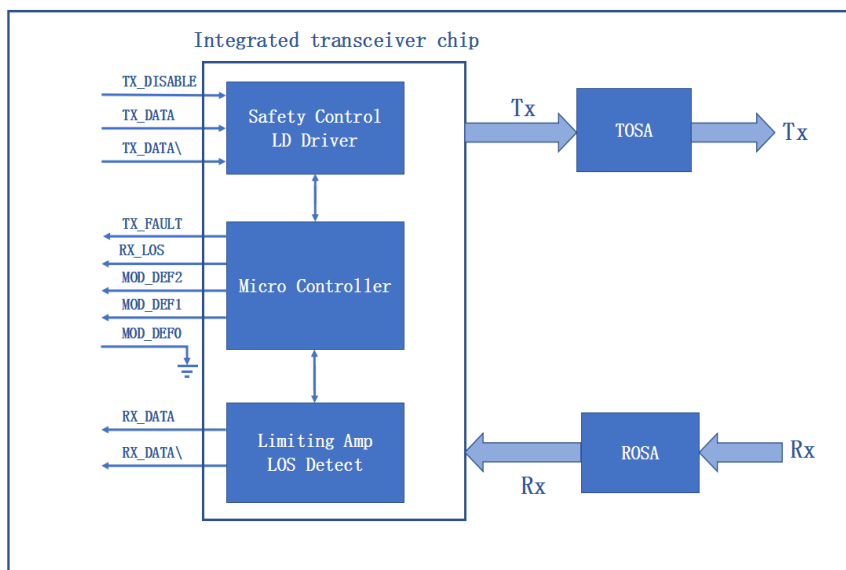
**Transceiver TX bias current**, internally measured, represented as a 16 bit unsigned integer with the current defined as the full 16 bit value (0 – 65535) with LSB equal to 2  $\mu$ A, yielding a total range of 0 to 131mA. Accuracy is better than  $\pm 10\%$  over specified operating temperature and 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  $\mu$ W. Data is assumed to be based on measurement of laser monitor photodiode current. Accuracy is better than  $\pm 3$ 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  $\mu$ W. Accuracy is better than  $\pm 3$ dB over specified temperature and voltage.

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

## Block-Diagram-of-Transceiver



### Transmitter Section

The Laser 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. 1330 DFB 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 an 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 trans-impedance amplifier, with internal 100Ω differential termination.

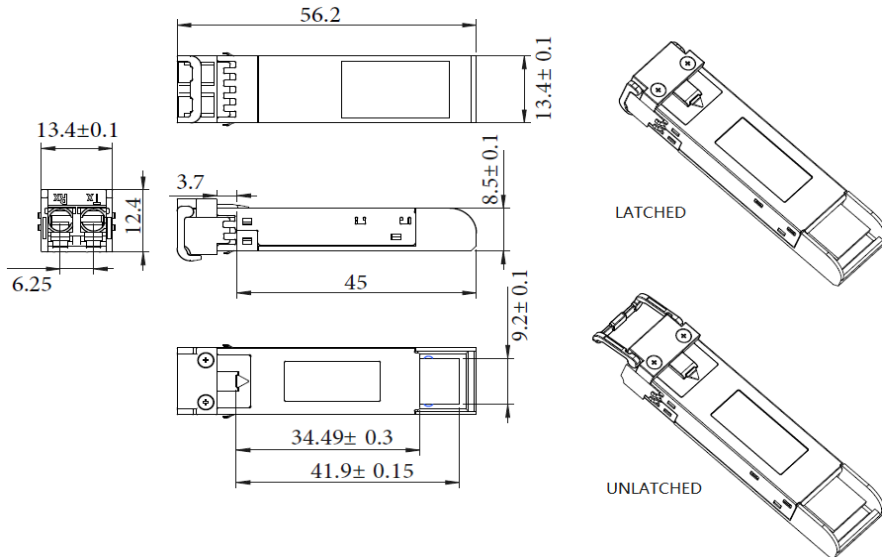
### Receive (RX\_LOS)

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

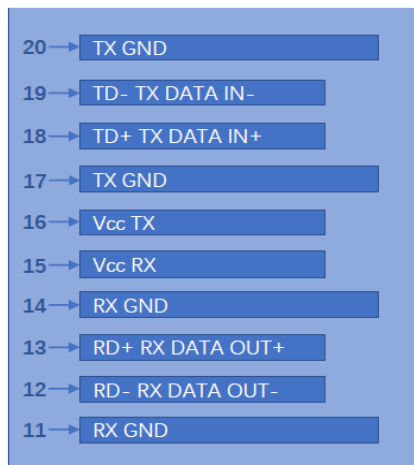
The micro controller unit monitors the operation information of LD driver and Limiting Amplifier. And report these status to the customer.

## Dimensions

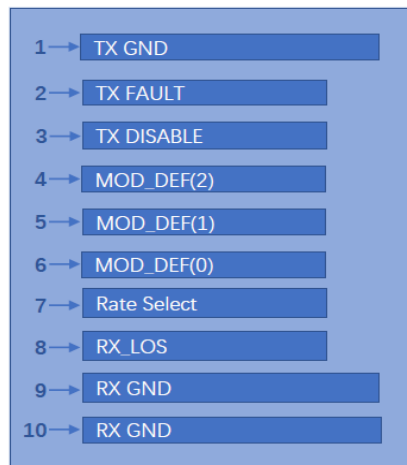


ALL DIMENSIONS ARE  $\pm 0.2$ mm UNLESS OTHERWISE SPECIFIED  
UNIT: mm

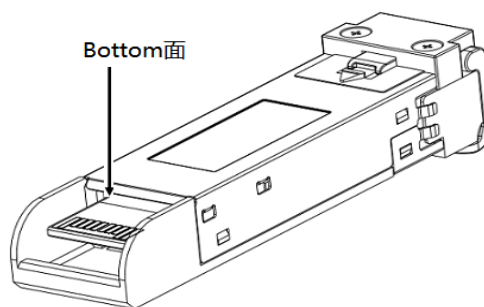
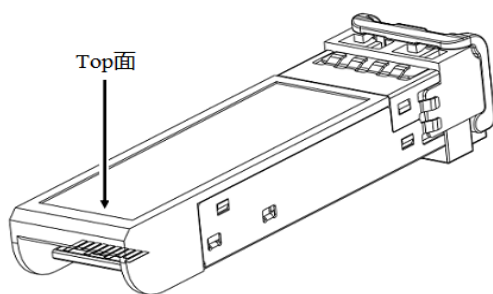
## Electrical Pad Layout



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	T_FAULT	Transmitter Fault. Not supported	
3	T_DIS	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), September 2000.
3. Bellcore GR-253 and ITU-T G.957 Specifications.