

DATA SHEET

MODULETEK: SFP10-DWDM-ER-xx.xx-I-C10

Industrial temperature 10 Gigabit DWDM 40km SFP+ Transceiver

SFP10-DWDM-ER-xx.xx-I-C10 Overview

ModuleTek's SFP10-DWDM-ER-xx.xx-I-C10 DWDM SFP+ optical transceivers are based on 10G Ethernet and SFF-8431 standard, providing a fast and reliable interface for 10G DWDM applications. The product implements digital diagnostics via a 2-wire serial bus, compliant with the SFF-8472 standard.

Product Features

- Up to 11.3 Gb/s bi-directional data links
- Compliant with IEEE 802.3ae 10GBASE-ER/EW
- Compliant with 10G Fibre Channel
- Compliant with SFF-8431
- Hot-pluggable SFP+ footprint
- Temperature-stabilized EML laser in DWDM wavelength and Receiver with PIN
- 100GHz ITU Grid, C Band
- Duplex LC connector
- Built-in digital diagnostic functions
- Up to 40km on SMF
- Low power consumption (Module work consumption <1.5W)
- Single power supply 3.3V
- RoHS Compliant
- Case Industrial temperature range: -40°C to 85°C

Applications

- 10G Ethernet
- 10G SONET/SDH
- 4x, 8x and 10x Fibre Channel
- OTN G.709 OUT 1e/2/2e FEC bit rates
- CPRI option 2 through 8

Ordering Information

| Part Number | Description | Color on Clasp |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|----------------|
| SFP10-DWDM-ER-xx.xx-I-C10 | 10 Gigabit DWDM SFP+ Transceiver, Single Mode Fiber 40km (ITU 100GHz Grid) | Red |
| For More Information: ModuleTek Limited Web: www.moduletek.com Email: sales@moduletek.com | | |

Product Selection

| Product number | Description | ITU channel |
|---------------------------|------------------------------------|-------------|
| SFP10-DWDM-ER-63.05-I-C10 | 10GBASE-DWDM 40km, 1563.05 nm SFP+ | C18 |
| SFP10-DWDM-ER-62.23-I-C10 | 10GBASE-DWDM 40km, 1562.23 nm SFP+ | C19 |
| SFP10-DWDM-ER-61.24-I-C10 | 10GBASE-DWDM 40km, 1561.24 nm SFP+ | C20 |
| SFP10-DWDM-ER-60.61-I-C10 | 10GBASE-DWDM 40km, 1560.61 nm SFP+ | C21 |
| SFP10-DWDM-ER-59.79-I-C10 | 10GBASE-DWDM 40km, 1559.79 nm SFP+ | C22 |
| SFP10-DWDM-ER-58.98-I-C10 | 10GBASE-DWDM 40km, 1558.98 nm SFP+ | C23 |
| SFP10-DWDM-ER-58.17-I-C10 | 10GBASE-DWDM 40km, 1558.17 nm SFP+ | C24 |
| SFP10-DWDM-ER-57.36-I-C10 | 10GBASE-DWDM 40km, 1557.36 nm SFP+ | C25 |
| SFP10-DWDM-ER-56.55-I-C10 | 10GBASE-DWDM 40km, 1556.55 nm SFP+ | C26 |
| SFP10-DWDM-ER-55.75-I-C10 | 10GBASE-DWDM 40km, 1555.75 nm SFP+ | C27 |
| SFP10-DWDM-ER-54.94-I-C10 | 10GBASE-DWDM 40km, 1554.94 nm SFP+ | C28 |
| SFP10-DWDM-ER-54.13-I-C10 | 10GBASE-DWDM 40km, 1554.13 nm SFP+ | C29 |
| SFP10-DWDM-ER-53.33-I-C10 | 10GBASE-DWDM 40km, 1553.33 nm SFP+ | C30 |
| SFP10-DWDM-ER-52.52-I-C10 | 10GBASE-DWDM 40km, 1552.52 nm SFP+ | C31 |
| SFP10-DWDM-ER-51.72-I-C10 | 10GBASE-DWDM 40km, 1551.72 nm SFP+ | C32 |
| SFP10-DWDM-ER-50.92-I-C10 | 10GBASE-DWDM 40km, 1550.92 nm SFP+ | C33 |
| SFP10-DWDM-ER-50.12-I-C10 | 10GBASE-DWDM 40km, 1550.12 nm SFP+ | C34 |
| SFP10-DWDM-ER-49.32-I-C10 | 10GBASE-DWDM 40km, 1549.32 nm SFP+ | C35 |
| SFP10-DWDM-ER-48.51-I-C10 | 10GBASE-DWDM 40km, 1548.51 nm SFP+ | C36 |
| SFP10-DWDM-ER-47.72-I-C10 | 10GBASE-DWDM 40km, 1547.72 nm SFP+ | C37 |
| SFP10-DWDM-ER-46.92-I-C10 | 10GBASE-DWDM 40km, 1546.92 nm SFP+ | C38 |
| SFP10-DWDM-ER-46.12-I-C10 | 10GBASE-DWDM 40km, 1546.12 nm SFP+ | C39 |
| SFP10-DWDM-ER-45.32-I-C10 | 10GBASE-DWDM 40km, 1545.32 nm SFP+ | C40 |
| SFP10-DWDM-ER-44.53-I-C10 | 10GBASE-DWDM 40km, 1544.53 nm SFP+ | C41 |

| | | |
|---------------------------|------------------------------------|-----|
| SFP10-DWDM-ER-43.73-I-C10 | 10GBASE-DWDM 40km, 1543.73 nm SFP+ | C42 |
| SFP10-DWDM-ER-42.94-I-C10 | 10GBASE-DWDM 40km, 1542.94 nm SFP+ | C43 |
| SFP10-DWDM-ER-42.14-I-C10 | 10GBASE-DWDM 40km, 1542.14 nm SFP+ | C44 |
| SFP10-DWDM-ER-41.35-I-C10 | 10GBASE-DWDM 40km, 1541.35 nm SFP+ | C45 |
| SFP10-DWDM-ER-40.56-I-C10 | 10GBASE-DWDM 40km, 1540.56 nm SFP+ | C46 |
| SFP10-DWDM-ER-39.77-I-C10 | 10GBASE-DWDM 40km, 1539.77 nm SFP+ | C47 |
| SFP10-DWDM-ER-38.98-I-C10 | 10GBASE-DWDM 40km, 1538.98 nm SFP+ | C48 |
| SFP10-DWDM-ER-38.19-I-C10 | 10GBASE-DWDM 40km, 1538.19 nm SFP+ | C49 |
| SFP10-DWDM-ER-37.40-I-C10 | 10GBASE-DWDM 40km, 1537.40 nm SFP+ | C50 |
| SFP10-DWDM-ER-36.61-I-C10 | 10GBASE-DWDM 40km, 1536.61 nm SFP+ | C51 |
| SFP10-DWDM-ER-35.82-I-C10 | 10GBASE-DWDM 40km, 1535.82 nm SFP+ | C52 |
| SFP10-DWDM-ER-35.04-I-C10 | 10GBASE-DWDM 40km, 1535.04 nm SFP+ | C53 |
| SFP10-DWDM-ER-34.25-I-C10 | 10GBASE-DWDM 40km, 1534.25 nm SFP+ | C54 |
| SFP10-DWDM-ER-33.47-I-C10 | 10GBASE-DWDM 40km, 1533.47 nm SFP+ | C55 |
| SFP10-DWDM-ER-32.68-I-C10 | 10GBASE-DWDM 40km, 1532.68 nm SFP+ | C56 |
| SFP10-DWDM-ER-31.90-I-C10 | 10GBASE-DWDM 40km, 1531.90 nm SFP+ | C57 |
| SFP10-DWDM-ER-31.12-I-C10 | 10GBASE-DWDM 40km, 1531.12 nm SFP+ | C58 |
| SFP10-DWDM-ER-30.33-I-C10 | 10GBASE-DWDM 40km, 1530.33 nm SFP+ | C59 |
| SFP10-DWDM-ER-29.55-I-C10 | 10GBASE-DWDM 40km, 1529.55 nm SFP+ | C60 |
| SFP10-DWDM-ER-28.77-I-C10 | 10GBASE-DWDM 40km, 1528.77 nm SFP+ | C61 |

General Specifications

| Parameter | Symbol | Min | Typ | Max | Unit | Remarks |
|---------------------------|------------------|------|---------|------------|------|---------|
| Data Rate | DR | 1.25 | 10.3125 | 11.3 | Gb/s | 1 |
| Bit Error Rate | BER | | | 10^{-12} | | |
| Operating Temperature | T _C | -40 | | 85 | °C | 2 |
| Storage Temperature | T _{STO} | -40 | | 85 | °C | 3 |
| Supply Current | I _{CC} | | 400 | 500 | mA | 4 |
| Input Voltage | V _{CC} | 3.14 | 3.3 | 3.46 | V | 4 |
| Maximum Voltage | V _{MAX} | -0.5 | | 4 | V | 4 |
| Power Consumption (-40°C) | P ₁ | | 1.2 | 1.5 | W | 2 |
| Power Consumption (75°C) | P ₂ | | 1.3 | 1.5 | W | 2 |
| Power Consumption (85°C) | P ₃ | | 1.5 | 1.6 | W | 2 |

Notes:

- 1.IEEE 802.3ae
- 2.Case temperature,Industrial temperature
- 3.Ambient temperature
- 4.For electrical power interface

Link Distances

| Data Rate | Fiber Type | Distance Range(km) |
|-----------------|-------------|--------------------|
| 1.2 - 11.3 Gb/s | 9/125um SMF | 40 |

Optical - Characteristics - Transmitter

$V_{CC}=3.14V$ to $3.46V$, $T_C=-40^{\circ}C$ to $85^{\circ}C$

| Parameter | Symbol | Min | Typ | Max | Unit | Remarks |
|---------------------------------|-----------------|---------------|-----------|---------------|-------|---------|
| Optical Power | P_{OUT} | -4 | | 4 | dBm | 1 |
| Optical Wavelength | λ | $\lambda-0.1$ | λ | $\lambda+0.1$ | nm | 2 |
| Extinction Ratio | ER | 8.2 | | | dB | |
| Spectral Width(- 20 dB) | $\Delta\lambda$ | | | 0.6 | nm | |
| Side Mode Suppression Ratio | SMSR | 30 | | | dB | |
| Relative Intensity Noise | RIN | | | - 128 | dB/Hz | |
| Transmitter Dispersion Penalty | TDP | | | 2 | dB | |
| Launch Power of OFF Transmitter | P_{OUT_OFF} | | | -30 | dBm | 1 |

Notes:

- 1.Average Launch Power
2. λ = specified ITU Grid wavelength

Optical – Characteristics – Receiver

$V_{CC}=3.14V$ to $3.46V$, $T_C=-40^{\circ}C$ to $85^{\circ}C$

| Parameter | Symbol | Min | Typ | Max | Unit | Remarks |
|--------------------------------|--------------|------|-----|------|------|---------|
| Optical Center Wavelength | λ_C | 1260 | | 1600 | nm | |
| Average Receive Power | P_{RX} | -16 | | 1 | dBm | |
| Receiver Sensitivity @10.3Gb/s | R_{X_SEN} | | | -16 | dBm | 1 |
| Receiver Reflectance | TR_{RX} | | | -27 | dB | |
| LOS Assert | LOS_A | -25 | | | dBm | |
| LOS De-Assert | LOS_D | | | -18 | dBm | |
| LOS Hysteresis | LOS_H | 0.5 | | | dB | |

Notes:

1. Measured with the PRBS $2^{31}-1$ test mode, $BER < 10^{-12}$;

Electrical – Characteristics – Transmitter

$V_{CC}=3.14V$ to $3.46V$, $T_C=-40^{\circ}C$ to $85^{\circ}C$

| Parameter | Symbol | Min | Typ | Max | Unit | Remarks |
|-------------------------------|--------------|----------|-----|--------------|----------|---------|
| Input differential impedance | R_{IN} | | 100 | | Ω | |
| Differential data input swing | V_{IN_PP} | 300 | | 850 | mV | |
| Transmit Disable Voltage | V_D | 2 | | V_{CC} | V | |
| Transmit Enable Voltage | V_{EN} | V_{EE} | | $V_{EE}+0.8$ | V | |

Electrical – Characteristics – Receiver

$V_{CC}=3.14V$ to $3.46V$, $T_C=-40^{\circ}C$ to $85^{\circ}C$

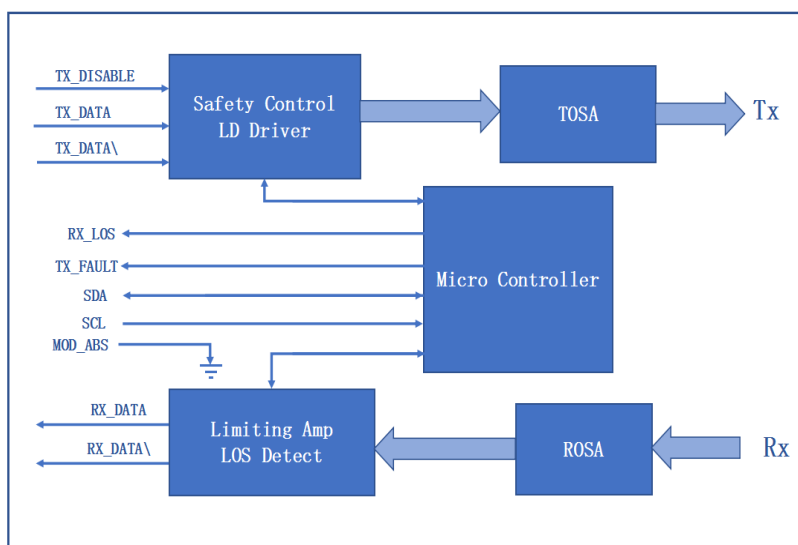
| Parameter | Symbol | Min | Typ | Max | Unit | Remarks |
|-------------------------------------------|---------------|----------|-----|----------------|------|---------|
| Differential data output swing | V_{OUT_PP} | 300 | | 850 | mV | |
| Data output rise time/fall time (20%-80%) | t_r/t_f | 28 | | | ps | |
| LOS Fault | V_{LOS_A} | 2 | | V_{CC_HOST} | V | |
| LOS Normal | V_{LOS_D} | V_{EE} | | $V_{EE}+0.5$ | V | |

Digital Diagnostic Functions

SFP10-DWDM-ER-xx.xx-I-C10 supports the 2-wire serial communication protocol as defined in SFF-8472. Digital diagnostic information is accessible over the 2-wire interface at the address 0xA2. Digital diagnostics for SFP10-DWDM-ER-xx.xx-I-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 SFF-8472, alerts the user when a particular operating parameter exceeds the factory-set normal range.

| Digital Diagnostic Threshold Range | | | | | |
|------------------------------------|------------|--------------|-------------|-----------|---------|
| Parameter | High Alarm | High Warning | Low Warning | Low Alarm | Remarks |
| Temperature ($^{\circ}C$) | 90 | 85 | -40 | -45 | |
| Voltage (V) | 3.63 | 3.46 | 3.13 | 2.97 | |
| Bias Current (mA) | 100 | 95 | 20 | 15 | |
| Tx Power (uw) | 3014.2 | 2511.8 | 316.2 | 252.9 | |
| Rx Power (uw) | 2000 | 1500 | 23.7 | 15.8 | |

Block-Diagram-of-Transceiver



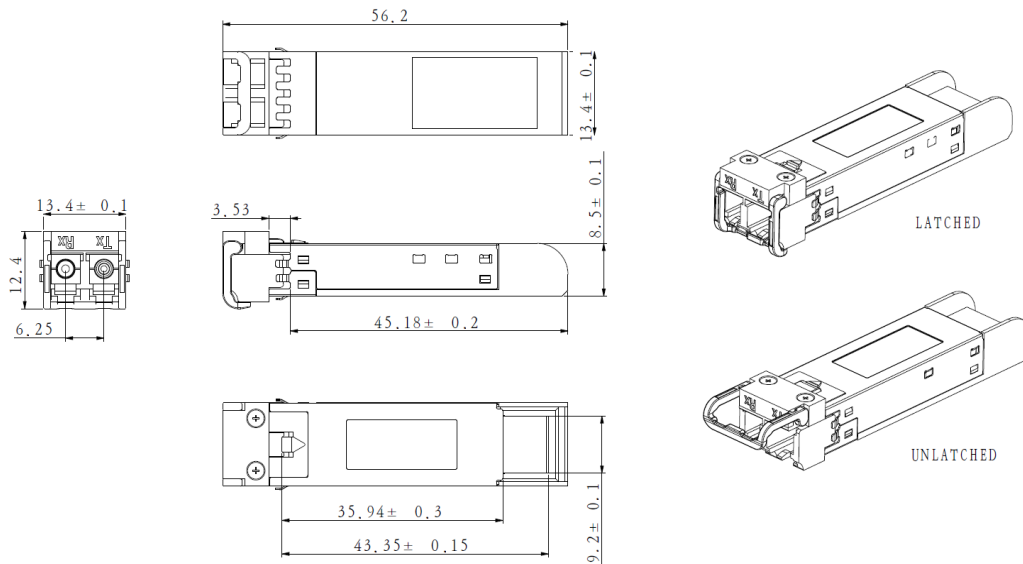
Functions Description

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 PIN 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

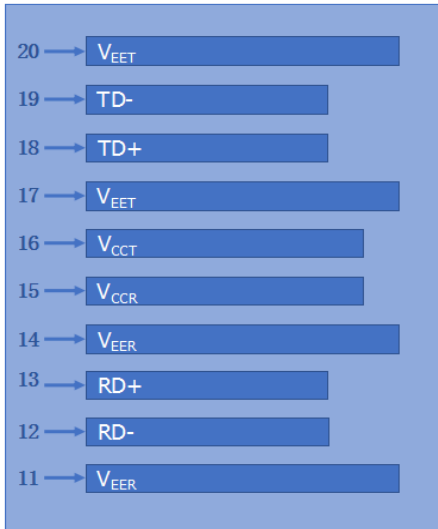
limiting amplifier. The electrical signal is further amplified by the limiting amplifier, then outputs a fixed-amplitude electrical signal to the host. When the amplitude of the electrical signal received from the incident light conversion of the opposite optical transceiver module is lower than the 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

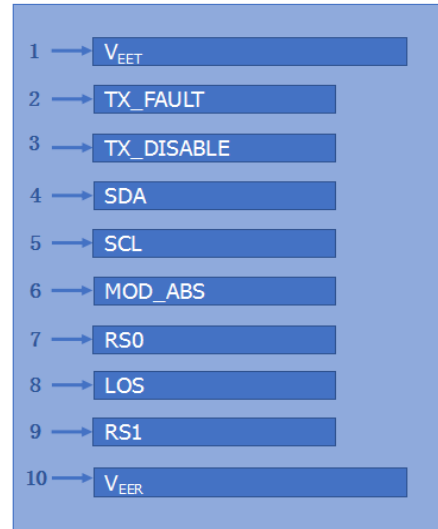
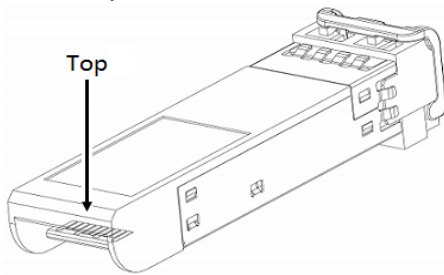


ALL DIMENSIONS ARE ±0.2mm UNLESS OTHERWISE SPECIFIED
UNIT: mm

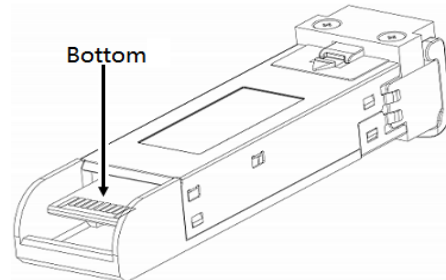
Electrical Pad Layout



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. | |
| 3 | TX_DISABLE | Transmitter Disable. Laser output disabled on high or open | 2 |
| 4 | SDA | 2-wire Serial Interface Data Line | 3 |
| 5 | SCL | 2-wire Serial Interface Clock Line | 3 |
| 6 | MOD_ABS | Module Absent. Grounded within the module | 3 |
| 7 | RS0 | Rate Select 0 | |
| 8 | LOS | Loss of Signal indication. Logic 0 indicates normal operation | 4 |
| 9 | RS1 | Rate Select 1 | 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}>2Vor 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 802.3ae. IEEE Standard Department,2005.
- 2.Enhanced 8.5 and 10 Gigabit Small Form Factor Pluggable Module “SFP+” –SFF-8431
- 3.Digital Diagnostics Monitoring Interface for Optical Transceivers –SFF-8472.