

## DATA SHEET

### MODULETEK – SFP10-CWDM-DML-xxxx-15DB-D10 10Gb/s SFP+ CWDM Transceiver

#### SFP10-CWDM-DML-xxxx-15DB-D10 Overview

ModuleTek's SFP10-CWDM-DML-xxxx-15DB-D10 SFP+ CWDM 10km optical transceivers are based on 10G Ethernet IEEE 802.3ae standard and SFF-8431 standard, and provide a quick and reliable interface for the 10G Ethernet application. The digital diagnostics functions are available via the 2-wire serial bus specified in the SFF-8472.

#### Product Features

- Up to 10.7 Gb/s bi-directional data links
- Compliant with IEEE 802.3ae 10GBASE-LR/LW
- Compliant with 10GFC
- Compliant with SFF-8431
- Hot-pluggable SFP+ footprint
- CWDM DFB laser transmitter
- Duplex LC connector
- Built-in digital diagnostic functions
- 1270nm~1370nm: up to 40km on SMF  
1390nm~1450nm: up to 10km on SMF
- Single power supply 3.3V
- RoHS Compliant
- Operating temperature range: 0°C to 70°C.

#### Applications

- 10GBASE-LR/LW Ethernet
- 10GFC

#### Product Identify – By Color on Clasp

| Wavelengths | Color        | Wavelengths | Color         |
|-------------|--------------|-------------|---------------|
| 1270nm      | Light purple | 1370nm      | Beige         |
| 1290nm      | Sky blue     | 1390nm      | White         |
| 1310nm      | Yellow green | 1410nm      | Silver        |
| 1330nm      | Yellow ocher | 1430nm      | Black         |
| 1350nm      | Pink         | 1450nm      | Yellow orange |

#### Ordering Information

| Part Number                  | Description   |
|------------------------------|---|
| SFP10-CWDM-DML-1270-15DB-D10 | 10 Gigabit CWDM SFP+ Transceiver, LC Connectors, 1270nm, Single Mode Fiber 40km |

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|                              |   |
|------------------------------|---|
| SFP10-CWDM-DML-1290-15DB-D10 | 10 Gigabit CWDM SFP+ Transceiver, LC Connectors, 1290nm, Single Mode Fiber 40km |
| SFP10-CWDM-DML-1310-15DB-D10 | 10 Gigabit CWDM SFP+ Transceiver, LC Connectors, 1310nm, Single Mode Fiber 40km |
| SFP10-CWDM-DML-1330-15DB-D10 | 10 Gigabit CWDM SFP+ Transceiver, LC Connectors, 1330nm, Single Mode Fiber 40km |
| SFP10-CWDM-DML-1350-15DB-D10 | 10 Gigabit CWDM SFP+ Transceiver, LC Connectors, 1350nm, Single Mode Fiber 40km |
| SFP10-CWDM-DML-1370-15DB-D10 | 10 Gigabit CWDM SFP+ Transceiver, LC Connectors, 1370nm, Single Mode Fiber 40km |
| SFP10-CWDM-DML-1390-15DB-D10 | 10 Gigabit CWDM SFP+ Transceiver, LC Connectors, 1390nm, Single Mode Fiber 10km |
| SFP10-CWDM-DML-1410-15DB-D10 | 10 Gigabit CWDM SFP+ Transceiver, LC Connectors, 1410nm, Single Mode Fiber 10km |
| SFP10-CWDM-DML-1430-15DB-D10 | 10 Gigabit CWDM SFP+ Transceiver, LC Connectors, 1430nm, Single Mode Fiber 10km |
| SFP10-CWDM-DML-1450-15DB-D10 | 10 Gigabit CWDM SFP+ Transceiver, LC Connectors, 1450nm, Single Mode Fiber 10km |

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**For More Information:**

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## General Specifications

| Parameter             | Symbol           | Min   | Typ     | Max               | Unit | Remarks |
|-----------------------|------------------|-------|---------|-------------------|------|---------|
| Data Rate             | DR               |       | 10.3125 |                   | Gb/s | 1       |
| Bit Error Rate        | BER              |       |         | 10 <sup>-12</sup> |      |         |
| Operating Temperature | T <sub>OP</sub>  | 0     |         | 70                | °C   | 2       |
| Storage Temperature   | T <sub>STO</sub> | - 40  |         | 85                | °C   | 3       |
| Supply Current        | I <sub>S</sub>   |       | 240     | 270               | mA   | 4       |
| Input Voltage         | V <sub>CC</sub>  | 3.14  | 3.3     | 3.46              | V    |         |
| Maximum Voltage       | V <sub>MAX</sub> | - 0.5 |         | 4                 | V    | 4       |

### Notes:

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

## Link Distances

| Parameter    | Fiber Type  | Distance Range (km) |
|--------------|-------------|---------------------|
| 10.3125 Gb/s | 9/125um SMF | 10                  |

## Optical Characteristics – Transmitter

V<sub>CC</sub>=3.14V to 3.46V, T<sub>C</sub>=0°C to 70°C

| Parameter                          | Symbol               | Min  | Typ  | Max   | Unit  | Remarks |
|------------------------------------|----------------------|------|------|-------|-------|---------|
| Output Optical Power               | P <sub>TX</sub>      | 0    |      | 5     | dBm   | 1       |
| Optical Center Wavelength – 1270nm | λ <sub>C</sub>       | 1265 | 1271 | 1277  | nm    |         |
| Optical Center Wavelength – 1290nm |                      | 1285 | 1291 | 1297  | nm    |         |
| Optical Center Wavelength – 1310nm |                      | 1305 | 1311 | 1317  | nm    |         |
| Optical Center Wavelength – 1330nm |                      | 1325 | 1331 | 1337  | nm    |         |
| Optical Center Wavelength – 1350nm |                      | 1345 | 1351 | 1357  | nm    |         |
| Optical Center Wavelength – 1370nm |                      | 1365 | 1371 | 1377  | nm    |         |
| Optical Center Wavelength – 1390nm |                      | 1385 | 1391 | 1397  | nm    |         |
| Optical Center Wavelength – 1410nm |                      | 1405 | 1411 | 1417  | nm    |         |
| Optical Center Wavelength – 1430nm |                      | 1425 | 1431 | 1437  | nm    |         |
| Optical Center Wavelength – 1450nm |                      | 1445 | 1451 | 1457  | nm    |         |
| Extinction Ratio                   | ER                   | 3.5  |      |       | dB    |         |
| Side Mode Suppression Ratio        | SMSR                 | 30   |      |       | dB    |         |
| Relative Intensity Noise           | RIN                  |      |      | - 128 | dB/Hz |         |
| Transmitter Dispersion Penalty     | TDP                  |      |      | 3.2   | dB    |         |
| Launch Power of OFF Transmitter    | P <sub>OUT_OFF</sub> |      |      | - 30  | dBm   | 1       |

**Notes:**

1. Average

**Optical Characteristics – Receiver**

**V<sub>CC</sub>=3.14V to 3.46V, T<sub>C</sub>=0°C to 70°C**

| Parameter                            | Symbol              | Min  | Typ | Max    | Unit | Remarks |
|--------------------------------------|---------------------|------|-----|--------|------|---------|
| Optical Center Wavelength            | $\lambda_C$         | 1260 |     | 1600   | nm   |         |
| Optical Input Power                  | P <sub>IN</sub>     |      |     | 0.5    | dBm  | 1       |
| Receiver Sensitivity @10.3Gb/s       | R <sub>X_SEN1</sub> |      |     | - 15   |      |         |
| Receiver Sensitivity (OMA) @10.3Gb/s | R <sub>X_SEN2</sub> |      |     | - 12.6 | dBm  | 2       |
| Receiver Reflectance                 | TR <sub>RX</sub>    |      |     | - 12   | dB   |         |
| LOS Assert                           | LOS <sub>A</sub>    | - 30 |     |        | dBm  |         |
| LOS De-Assert                        | LOS <sub>D</sub>    |      |     | - 17   | dBm  |         |
| LOS Hysteresis                       | LOS <sub>H</sub>    | 0.5  |     |        | dB   |         |

**Notes:**

1. Average, Informative
2. Measured with worst ER: BER<10<sup>-12</sup> 2<sup>31</sup> – 1 PRBS

**Electrical Characteristics – Transmitter**

**V<sub>CC</sub>=3.14V to 3.46V, T<sub>C</sub>=0°C to 70°C**

| Parameter                     | Symbol             | Min             | Typ | Max                  | Unit | Remarks |
|-------------------------------|--------------------|-----------------|-----|----------------------|------|---------|
| Input differential impedance  | R <sub>IN</sub>    |                 | 100 |                      | Ω    |         |
| Differential data input swing | V <sub>IN_PP</sub> | 180             |     | 700                  | mV   |         |
| Transmit disable voltage      | V <sub>D</sub>     | 2               |     | V <sub>CC</sub>      | V    |         |
| Transmit enable voltage       | V <sub>EN</sub>    | V <sub>EE</sub> |     | V <sub>EE</sub> +0.8 | V    |         |

**Electrical Characteristics – Receiver**

**V<sub>CC</sub>=3.14V to 3.46V, T<sub>C</sub>=0°C to 70°C**

| Parameter                       | Symbol              | Min             | Typ | Max                  | Unit | Remarks |
|---------------------------------|---------------------|-----------------|-----|----------------------|------|---------|
| Differential data output swing  | V <sub>OUT_PP</sub> | 300             |     | 850                  | mV   |         |
| Data output rise time (20%-80%) | T <sub>R</sub>      |                 | 30  |                      | ps   |         |
| Data output fall time (20%-80%) | T <sub>F</sub>      |                 | 30  |                      | ps   |         |
| LOS Assert                      | V <sub>LOS_A</sub>  | 2               |     | V <sub>CC_HOST</sub> | V    |         |
| LOS De-Assert                   | V <sub>LOS_D</sub>  | V <sub>EE</sub> |     | V <sub>EE</sub> +0.5 | V    |         |

**Digital Diagnostic Functions**

SFP10-CWDM-DML-xxxx-15DB-D10 supports the 2-wire serial communication protocol as defined in the SFF-8472. Digital diagnostic information is accessible over the 2-wire interface at the address 0xA2. Digital diagnostics for SFP10-CWDM-DML-xxxx-15DB-D10 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 two's complement value in increments of 1/256 degrees Celsius, Temperature accuracy is better than  $\pm 3$  degrees Celsius over specified operating temperature and voltage.

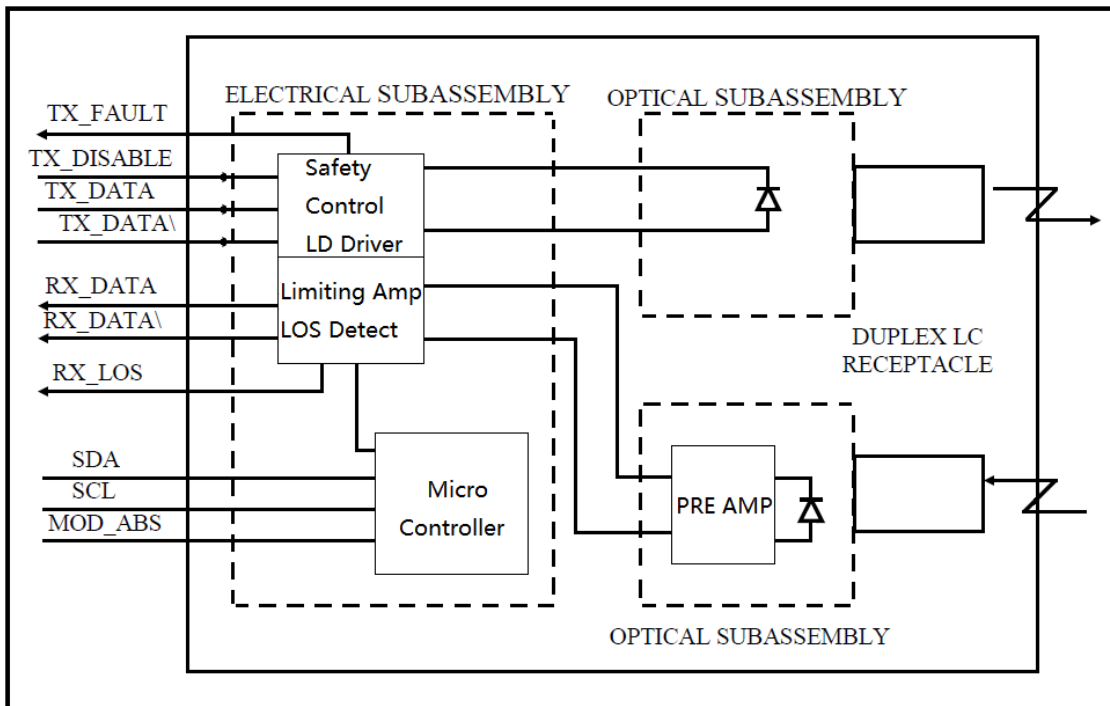
**Transceiver Supply Power**, internally measured, represented as a 16 bit unsigned integer with the voltage defined as the full 16 bit value (0 – 65535) with LSB equal to 100  $\mu$ Volt, yielding a total range of 0 to +6.55 Volts.

**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.

## 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. CWDM 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 a PIN 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.

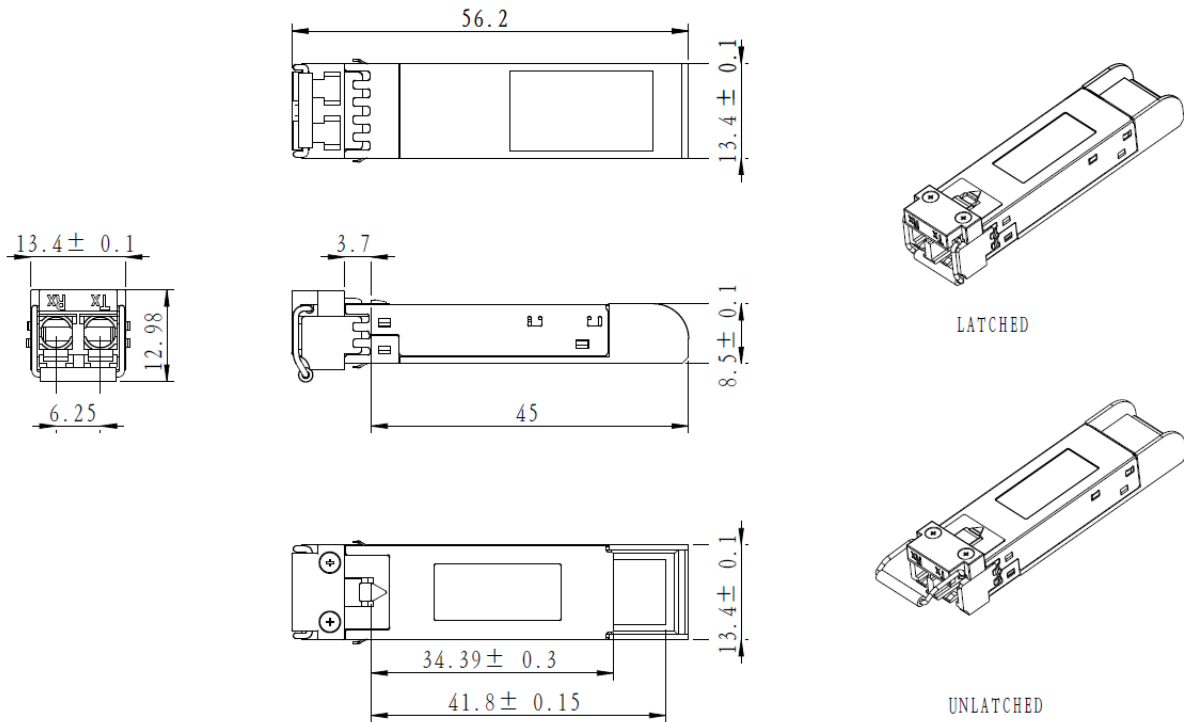
## Receive Loss (RX\_LOS)

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.

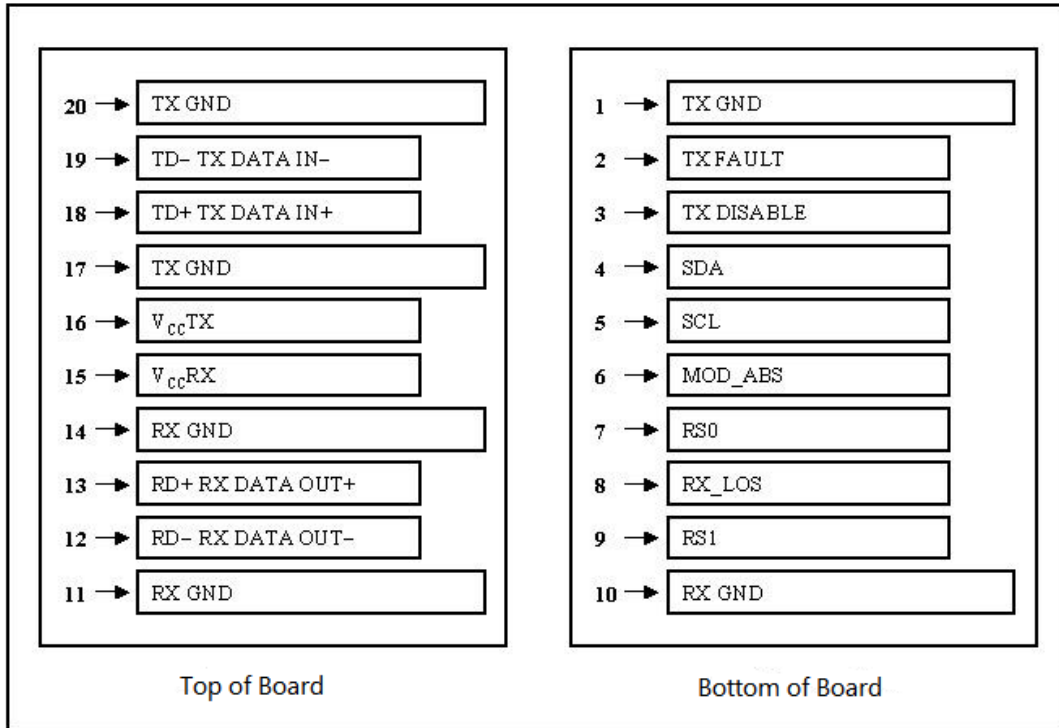
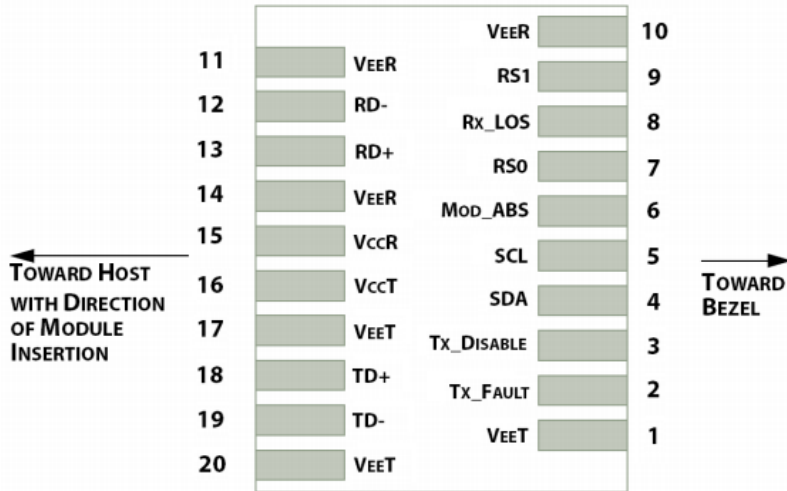
## Dimensions



**ALL DIMENSIONS ARE ±0.2mm UNLESS OTHERWISE SPECIFIED**

**UNIT: mm**

## Electrical Pad Layout



### Pin Assignment

| PIN # | Symbol             | Description  | Remarks |
|-------|--------------------|--|---------|
| 1     | V <sub>EET</sub>   | Transmitter ground (common with receiver ground)           | 1       |
| 2     | T <sub>FAULT</sub> | Transmitter Fault.   |         |
| 3     | T <sub>DIS</sub>   | Transmitter Disable. Laser output disabled on high or open | 2       |
| 4     | SDA                | Data line for serial ID                                    | 3       |
| 5     | SCL                | Clock line for serial ID                                   | 3       |

|    |                  |   |   |
|----|------------------|---|---|
| 6  | MOD_ABS          | Module Absent. Grounded within the module                     | 3 |
| 7  | RS0              | No connection required  |   |
| 8  | LOS              | Loss of Signal indication. Logic 0 indicates normal operation | 4 |
| 9  | RS1              | No connection required  | 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 802.3ae. 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.