

## **Product Specification**

### **10Gb/s CWDM SFP+ 10km Transceiver 10km**

#### **PRODUCT FEATURES**

- Up to 11.1Gbps Data Links
- Up to 10km transmission on SMF
- Power dissipation < 1.5W
- Uncooled CWDM DFB Laser and PIN receiver
- Metal enclosure, for lower EMI
- 2-wire interface with integrated Digital Diagnostic monitoring
- Hot-pluggable SFP+ footprint
- Specifications compliant with SFF 8472
- Compliant with SFP+ MSA with LC connector
- Single 3.3V power supply
- Case operating temperature range:0°C to 70°C

#### **APPLICATIONS**

- 10GBASE-LR/LW 10G Ethernet

#### **STANDARD**

- Compliant to 802.3ae 10GBASE-LR/LW
- Compliant to SFF-8431
- RoHS Compliant.

## Product selection

| Wavelength | xx | Wavelength | xx |
|------------|----|------------|----|
| 1270 nm    | 27 | 1370 nm    | 37 |
| 1290 nm    | 29 | 1390 nm    | 39 |
| 1310 nm    | 31 | 1410 nm    | 41 |
| 1330 nm    | 33 | 1430 nm    | 43 |
| 1350 nm    | 35 | 1450 nm    | 45 |

## I . Absolute Maximum Ratings

| Parameter                   | Symbol | Min.    | Typ. | Max.    | Unit | Note |
|-----------------------------|--------|---------|------|---------|------|------|
| Storage Temperature         | Ts     | -40     | -    | 85      | °C   |      |
| Storage Ambient Humidity    | HA     | 5       | -    | 95      | %    |      |
| Operating Relative Humidity | RH     | -       | -    | 85      | %    |      |
| Power Supply Voltage        | VCC    | -0.3    | -    | 4       | V    |      |
| Signal Input Voltage        |        | Vcc-0.3 | -    | Vcc+0.3 | V    |      |

## II Recommended Operating Conditions

| Parameter                  | Symbol            | Min. | Typ.    | Max. | Unit | Note             |
|----------------------------|-------------------|------|---------|------|------|------------------|
| Case Operating Temperature | Tcase             | 0    | -       | 70   | °C   | Without air flow |
| Power Supply Voltage       | VCC               | 3.14 | 3.3     | 3.47 | V    |                  |
| Power Supply Current       | ICC               | -    |         | 350  | mA   |                  |
| Data Rate                  | BR                |      | 10.3125 |      | Gbps |                  |
| Transmission Distance      | TD                |      | -       | 10   | km   |                  |
| Coupled fiber              | Single mode fiber |      |         |      |      | 9/125um SMF      |

### III. Optical Characteristics

| Parameter                          | Symbol           | Min                         | Typ | Max             | Unit  | NOTE |
|------------------------------------|------------------|-----------------------------|-----|-----------------|-------|------|
| <b>Transmitter</b>                 |                  |                             |     |                 |       |      |
| Output Opt. Pwr                    | P <sub>OUT</sub> | -6                          |     | -1              | dBm   | 1    |
| Optical Wavelength                 | $\lambda$        | $\lambda - 6.5$             |     | $\lambda + 6.5$ | nm    | 2    |
| Spectral Width (-20dB)             | $\sigma$         |                             |     | 1               | nm    |      |
| Optical Extinction Ratio           | ER               | 3.5                         |     |                 | dB    |      |
| Transmitter and Dispersion Penalty | TDP              |                             |     | 3.2             | dB    |      |
| Side mode Supression ratio         | SMSR             | 30                          |     |                 | dB    |      |
| RIN                                | RIN              |                             |     | -128            | dB/Hz |      |
| Output Eye Mask                    |                  | Compliant with IEEE 802.3ae |     |                 |       |      |
| <b>Receiver</b>                    |                  |                             |     |                 |       |      |
| Receiver Sensitivity               | P <sub>sen</sub> |                             |     | -14.4           | dBm   | 3    |
| Input Saturation Power (Overload)  | P <sub>SAT</sub> | 0.5                         |     |                 | dBm   |      |
| Input Optical Wavelength           | IN               | 1270                        |     | 1610            | nm    |      |
| LOS -Assert Power                  | PA               |                             |     | -17             | dBm   |      |
| LOS -Deassert Power                | PD               | -30                         |     |                 | dBm   |      |
| LOS -Hysteresis                    | PHys             | 0.5                         |     |                 | dB    |      |

#### Notes:

1. Class 1 Laser Safety per FDA/CDRH and IEC-825-1 regulations.
2.  $\lambda$  " is:1270,1290,1310,1330,1350,1370,1390,1410,1430,1450, please the "product selection".
3. Measured with a PRBS 2<sup>31</sup>-1 test pattern, @10.325Gb/s, BER<10<sup>-12</sup>.

#### IV. Electrical Characteristics

| Parameter                      | Symbol                 | Min                  | Typ | Max                   | Unit | NOTE |
|--------------------------------|------------------------|----------------------|-----|-----------------------|------|------|
| Supply Voltage                 | V <sub>cc</sub>        | 3.14                 | 3.3 | 3.46                  | V    |      |
| Supply Current                 | I <sub>cc</sub>        |                      |     | 350                   | mA   |      |
| <b>Transmitter</b>             |                        |                      |     |                       |      |      |
| Input differential impedance   | R <sub>in</sub>        |                      | 100 |                       | Ω    | 1    |
| Differential data input swing  | V <sub>in,pp</sub>     | 180                  |     | 1200                  | mV   |      |
| Transmit Disable Voltage       | VD                     | V <sub>cc</sub> ÷1.3 |     | V <sub>cc</sub>       | V    |      |
| Transmit Enable Voltage        | VEN                    | V <sub>ee</sub>      |     | V <sub>ee</sub> + 0.8 | V    | 2    |
| Transmit Disable Assert Time   |                        |                      |     | 10                    | us   |      |
| <b>Receiver</b>                |                        |                      |     |                       |      |      |
| Differential data output swing | V <sub>out,pp</sub>    | 300                  |     | 850                   | mV   | 3    |
| Data output rise time          | t <sub>r</sub>         | 30                   |     |                       | ps   | 4    |
| Data output fall time          | t <sub>f</sub>         | 30                   |     |                       | ps   | 4    |
| LOS Fault                      | V <sub>LOS fault</sub> | V <sub>cc</sub> ÷1.3 |     | V <sub>ccHOST</sub>   | V    | 5    |
| LOS Normal                     | V <sub>LOS norm</sub>  | V <sub>ee</sub>      |     | V <sub>ee</sub> +0.8  | V    | 5    |
| Power Supply Rejection         | PSR                    | 100                  |     |                       | mVpp | 6    |

#### Notes:

1. Connected directly to TX data input pins. AC coupled thereafter.
2. Or open circuit.
3. Input 100 ohms differential termination.
4. These are unfiltered 20-80% values
5. Loss Of Signal is LVTTTL. Logic 0 indicates normal operation; logic 1 indicates no signal detected.
6. Receiver sensitivity is compliant with power supply sinusoidal modulation of 20 Hz to 1.5 MHz up to specified value applied through the recommended power supply filtering network.

## V. Pin Descriptions

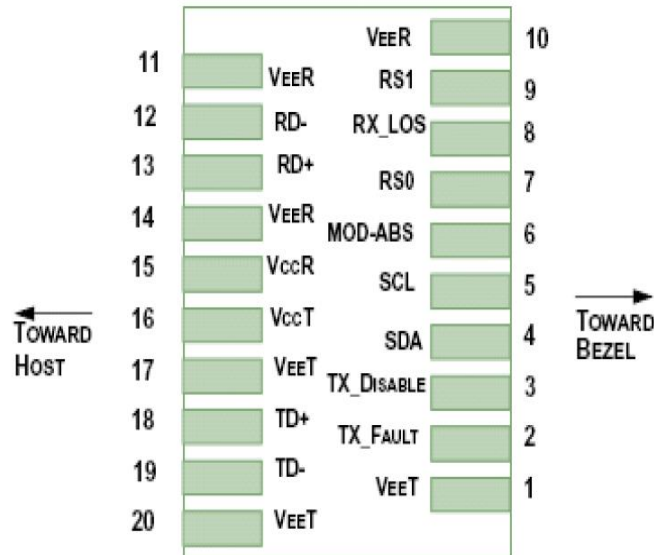


Diagram of Host Board Connector Block Pin Numbers and Name

| Pin | Symbol             | Name/Description   | NOTE |
|-----|--------------------|--|------|
| 1   | V <sub>EET</sub>   | Transmitter Ground (Common with Receiver Ground)               | 1    |
| 2   | T <sub>FAULT</sub> | Transmitter Fault.   | 2    |
| 3   | T <sub>DIS</sub>   | Transmitter Disable. Laser output disabled on high or open.    | 3    |
| 4   | SDA                | 2-wire Serial Interface Data Line                              | 4    |
| 5   | SCL                | 2-wire Serial Interface Clock Line                             | 4    |
| 6   | MOD_ABS            | Module Absent. Grounded within the module                      | 4    |
| 7   | RS0                | Rate Select 0  | 5    |
| 8   | LOS                | Loss of Signal indication. Logic 0 indicates normal operation. | 6    |
| 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 internally isolated from chassis ground.
2. TFAULT is an open collector/drain output, which should be pulled up with a 4.7k  $\pm$  10k Ohms resistor on the host board if intended for use. Pull up voltage should be between 2.0V to  $V_{cc} + 0.3V$ . A high output indicates a transmitter fault caused by either the TX bias current or the TX output power exceeding the preset alarm thresholds. A low output indicates normal operation. In the low state, the output is pulled to  $<0.8V$ .
3. Laser output disabled on  $T_{DIS} > 2.0V$  or open, enabled on  $T_{DIS} < 0.8V$ .
4. Should be pulled up with 4.7k - 10k host board to a voltage between 2.0V and 3.6V. MOD\_ABS pulls line low to indicate module is plugged in.
5. Internally pulled down per SFF-8431 Rev 4.1.
6. LOS is open collector output. It should be pulled up with 4.7k  $\pm$  10k on host board to a voltage between 2.0V and 3.6V. Logic 0 indicates normal operation; logic 1 indicates loss of signal.

## **VI. Digital Diagnostic Functions**

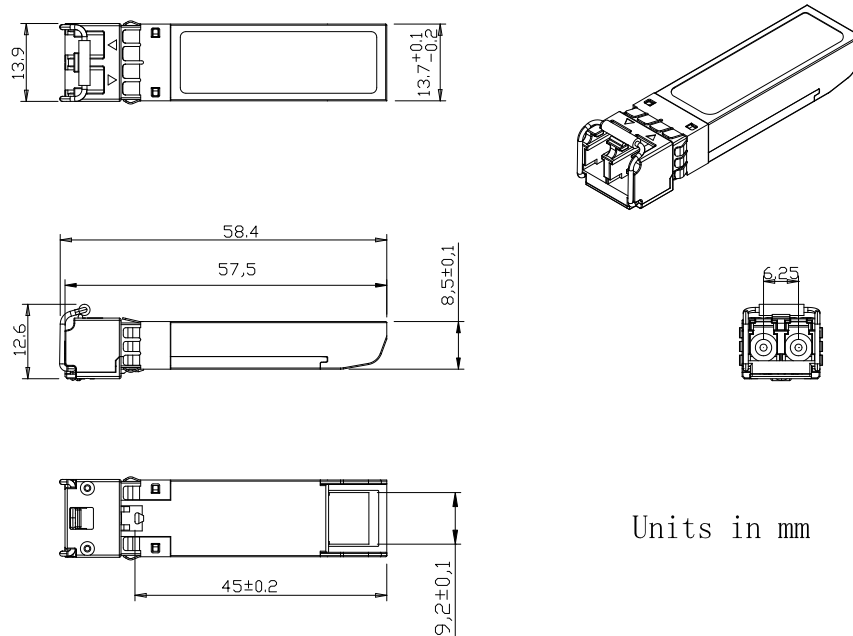
SFP-10GB-CWDM-10 transceivers support the 2-wire serial communication protocol as defined in the SFP+MSA. The standard SFP serial ID provides access to identification information that describes the transceiver's capabilities, standard interfaces, manufacturer, and other information.

Additionally, SFP+ transceivers provide a unique enhanced digital diagnostic monitoring interface, which allows real-time access to device operating parameters such as transceiver temperature, laser bias current, transmitted optical power, received optical power and transceiver supply voltage. It also defines a sophisticated system of alarm and warning flags, which alerts end-users when particular operating parameters are outside of a factory set normal range.

The SFP+ MSA defines a 256-byte memory map in EEPROM that is accessible over a 2-wire serial interface at the 8 bit address 1010000X (A0h). The digital diagnostic monitoring interface makes use of the 8 bit address 1010001X (A2h), so the originally defined serial ID memory map remains unchanged.

The operating and diagnostics information is monitored and reported by a Digital Diagnostics Transceiver Controller (DDTC) inside the transceiver, which is accessed through a 2-wire serial interface. When the serial protocol is activated, the serial clock signal (SCL, Mod Def 1) is generated by the host. The positive edge clocks data into the SFP transceiver into those segments of the EEPROM that are not write-protected. The negative edge clocks data from the SFP transceiver. The serial data signal (SDA, Mod Def 2) is bi-directional for serial data transfer. The host uses SDA in conjunction with SCL to mark the start and end of serial protocol activation. The memories are organized as a series of 8-bit data words that can be addressed individually or sequentially.

## VII. Outline Dimensions



Units in mm

## VIII. Regulatory Compliance

| Feature                            | Reference  | Performance               |
|------------------------------------|--|---------------------------|
| Electrostatic discharge (ESD)      | IEC/EN 61000-4-2                                 | Compatible with standards |
| Electromagnetic Interference (EMI) | FCC Part 15 Class B EN 55022 Class B (CISPR 22A) | Compatible with standards |
| Laser Eye Safety                   | FDA 21CFR 1040.10, 1040.11 IEC/EN 60825-1, 2     | Class 1 laser product     |
| Component Recognition              | IEC/EN 60950 , UL                                | Compatible with standards |
| ROHS                               | 2002/95/EC                                       | Compatible with standards |
| EMC                                | EN61000-3  | Compatible with standards |