

# 10Gb/s SFP+ CWDM 1470-1610nm 100km Optical Transceiver

## Features

- Up to 100km on 9/125µm SMF
- Up to 11.3Gb/s data links
- CWDM EML transmitter and APD receiver
- Hot-pluggable SFP+ footprint
- Compliant with SFF+MSA and SFF-8472
- Duplex LC/UPC type pluggable optical interface
- RoHS-10 compliant and lead-free
- Support Digital Diagnostic Monitoring interface
- Hot pluggable
- Metal enclosure, for lower EMI
- Meet ESD requirements, resist 8KV direct contact voltage
- +3.3V power supply
- Operating case temperature: 0~+70°C

## Applications

- 10GBASE-ZR/ZW & 10G Ethernet
- SDH STM64
- Other Optical Links

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## Compliance

- Compliant with IEEE 802.3ae-2002
- Compliant with MSA SFF-8472
- Compliant with MSA SFF-8431

## Description

The SFP-10G-CW100 transceivers are designed for use in 10-Gigabit Ethernet links up to 100km over single mode fiber. The module consists of CWDM EML Laser, APD and Preamplifier in a high-integrated optical sub-assembly. Digital diagnostics functions are available via a 2-wire serial interface, as specified in SFF-8472.

SFP-10G-CW100 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, and 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.

## Wavelength

| Wavelength | Clasp Color Code | Wavelength | Clasp Color Code |
|------------|------------------|------------|------------------|
| 1470       | Gray             | 1550       | Yellow           |
| 1490       | Purple           | 1570       | Orange           |
| 1510       | Blue             | 1590       | Red              |
| 1530       | Green            | 1610       | Brown            |

## Absolute Maximum Ratings

| Parameter                            | Symbol          | Min. | Max. | Unit |
|--------------------------------------|-----------------|------|------|------|
| Storage Temperature                  | T <sub>s</sub>  | -40  | +85  | °C   |
| Power Supply Voltage                 | V <sub>cc</sub> | -0.5 | 3.6  | V    |
| Relative Humidity (non-condensation) | RH              | 5    | 95   | %    |
| Damage Threshold                     | TH <sub>d</sub> | 0    |      | dBm  |

## Recommended Operating Conditions and Power Supply Requirements

| Parameter                  | Symbol          | Min. | Typical | Max. | Unit | Notes |
|----------------------------|-----------------|------|---------|------|------|-------|
| Operating Case Temperature | T <sub>op</sub> | 0    |         | +70  | °C   |       |

|                            |     |       |         |       |      |               |
|----------------------------|-----|-------|---------|-------|------|---------------|
| Power Supply Voltage       | VCC | 3.135 | 3.3     | 3.465 | V    |               |
| Data Rate                  |     |       | 10.3125 |       | Gb/s |               |
| Control Input Voltage High |     | 2     |         | Vcc   | V    |               |
| Control Input Voltage Low  |     | 0     |         | 0.8   | V    |               |
| Link Distance (SMF)        | D   |       |         | 100   | km   | 9/125 $\mu$ m |

## Electrical Characteristics

| Table4-Electrical Characteristics            |         |         |         |          |      |      |
|--|---------|---------|---------|----------|------|------|
| Parameter                                    | Symbol  | Min.    | Typical | Max.     | Unit | Note |
| Power Consumption                            | p       |         |         | 1.6      | W    |      |
| Supply Current                               | Icc     |         |         | 450      | mA   |      |
| <b>Transmitter</b>                           |         |         |         |          |      |      |
| Single-ended Input Voltage Tolerance         | Vcc     | -0.3    |         | 4.0      | V    |      |
| AC Common Mode Input Voltage Tolerance (RMS) |         | 15      |         |          | mV   |      |
| Differential Input Voltage Swing             | Vin,pp  | 180     |         | 1200     | mVpp |      |
| Differential Input Impedance                 | Zin     | 90      | 100     | 110      | Ohm  | 1    |
| Transmit Disable Assert Time                 |         |         |         | 10       | us   |      |
| Transmit Disable Voltage                     | Vdis    | Vcc-1.3 |         | Vcc      | V    |      |
| Transmit Enable Voltage                      | Ven     | Vee     |         | Vee +0.8 | V    | 2    |
| <b>Receiver</b>                              |         |         |         |          |      |      |
| Differential Output Voltage Swing            | Vout,pp | 300     |         | 850      | mVpp |      |
| Differential Output Impedance                | Zout    | 90      | 100     | 110      | Ohm  | 3    |
| Data output rise/fall time                   | Tr/Tf   | 28      |         |          | ps   | 4    |
| LOS Assert Voltage                           | VlosH   | Vcc-1.3 |         | Vcc      | V    | 5    |
| LOS De-assert Voltage                        | VlosL   | Vee     |         | Vee +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.

## Optical Characteristics

| Table5-Optical Characteristics       |                            |                 |         |                 |       |      |
|--------------------------------------|----------------------------|-----------------|---------|-----------------|-------|------|
| Parameter                            | Symbol                     | Min.            | Typical | Max.            | Unit  | Note |
| <b>Transmitter</b>                   |                            |                 |         |                 |       |      |
| Center Wavelength                    | $\lambda_c$                | $\lambda - 6.5$ |         | $\lambda + 6.5$ | nm    | 1    |
| Optical Spectral Width               | $\Delta \lambda$           |                 |         | 1               | nm    |      |
| Side Mode Suppression Ratio          | SMSR                       | 30              |         |                 | dB    |      |
| Average Optical Power                | $P_{AVG}$                  | 1               |         | 5               | dBm   | 2    |
| Optical Extinction Ratio             | ER                         | 8.2             |         |                 | dB    |      |
| Transmitter and Dispersion Penalty   | TDP                        |                 |         | 3.0             | dB    |      |
| Relative Intensity Noise             | RIN                        |                 |         | -128            | dB/Hz |      |
| Transmitter Eye Mask                 | Compliant with IEEE802.3ae |                 |         |                 |       |      |
| <b>Receiver</b>                      |                            |                 |         |                 |       |      |
| Center Wavelength                    | $\lambda_c$                | 1270            |         | 1610            | nm    |      |
| Receiver Sensitivity (Average Power) | Sen.                       |                 |         | -25             | dBm   | 3    |
| Input Saturation Power (overload)    | $P_{sat}$                  | -8              |         |                 | dBm   |      |
| Receiver Reflectance                 | $R_{rx}$                   |                 |         | -27             |       |      |
| LOS Assert                           | LOSA                       | -35             |         |                 | dBm   |      |
| LOS De-assert                        | LOSD                       |                 |         | -27             | dBm   |      |
| LOS Hysteresis                       | LOSH                       | 0.5             |         |                 | dB    |      |

Notes:

[1]  $\lambda$  refer to wavelength selection, 1470~1610nm please the "product selection.

[2] Class 1 Laser Safety per FDA/CDRH and IEC-825-1 regulations.

[3] Measured with Light source 1470~1610nm, ER=8.2dB; BER =  $<10^{-12}$  @10.3125Gbps, PRBS=2<sup>31</sup>-1 NRZ.

## Digital Diagnostic Functions

The following digital diagnostic characteristics are defined over the Recommended Operating Environment unless otherwise specified. It is compliant to SFF-8472 Rev10.2 with internal calibration mode. For external calibration mode please contact our sales staff.

| Table6-Digital Diagnostic Functions   |          |       |      |      |                      |
|---------------------------------------|----------|-------|------|------|----------------------|
| Parameter                             | Symbol   | Min.  | Max. | Unit | Notes                |
| Temperature monitor absolute error    | DMI_Temp | -3    | 3    | degC | Over operating temp  |
| Supply voltage monitor absolute error | DMI_VCC  | -0.15 | 0.15 | V    | Full operating range |
| RX power monitor absolute error       | DMI_RX   | -3    | 3    | dB   |                      |
| Bias current monitor                  | DMI_bias | -10%  | 10%  | mA   |                      |
| TX power monitor absolute error       | DMI_TX   | -3    | 3    | dB   |                      |

## Pin Description

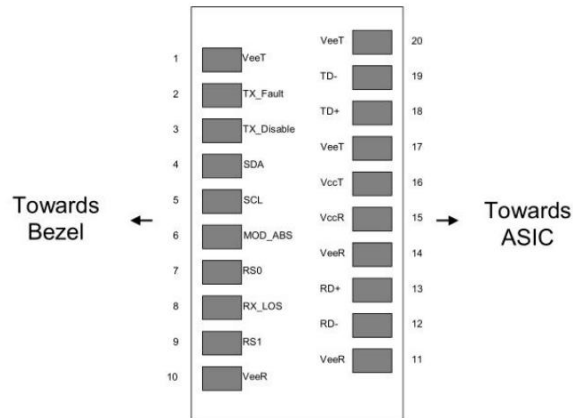


Figure1 Pin view

## Pin Function Definitions

| Table7-Pin Function Definitions |          |  |      |
|---------------------------------|----------|--|------|
| Pin                             | Symbol   | Name/Description   | Note |
| 1                               | VeeT     | Module Transmitter Ground                                  | 1    |
| 2                               | TX_Fault | Module Transmitter Fault                                   | 2    |
| 3                               | TX_Dis   | 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                              | 4    |
| 6                               | MOD_ABS  | Module Absent, connected to VeeT or VeeR in the module     | 4    |
| 7                               | RS0      | Not used   | 5    |
| 8                               | RX_LOS   | Receiver Loss of Signal Indication Active High             | 6    |
| 9                               | RS1      | Not used   |      |
| 10                              | VeeR     | Module Receiver Ground                                     | 1    |
| 11                              | VeeR     | Module Receiver Ground                                     | 1    |
| 12                              | RD-      | Receiver Inverted Data Output                              |      |
| 13                              | RD+      | Receiver Data Output                                       |      |
| 14                              | VeeR     | Module Receiver Ground                                     | 1    |
| 15                              | VccR     | Module Receiver 3.3 V Supply                               |      |
| 16                              | VccT     | Module Receiver 3.3 V Supply                               |      |
| 17                              | VeeT     | Module Transmitter Ground                                  | 1    |
| 18                              | TD+      | Transmitter Non-Inverted Data Input                        |      |
| 19                              | TD-      | Transmitter Inverted Data Input                            |      |
| 20                              | VeeT     | Module Transmitter 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 -10k Ohms resistor on the host board if intended for use. Pull up voltage should be between 2.0V to Vcc + 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 TDIS →2.0V or open, enabled on TDIS <0.8V.
- [4] Should be pulled up with 4.7kΩ-10kΩ on 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 4.7kΩ-10kΩ on host board to a voltage between 2.0V and 3.6V. Logic 0 indicates normal operation; logic 1 indicates loss of signal.

**Mechanical Dimensions**

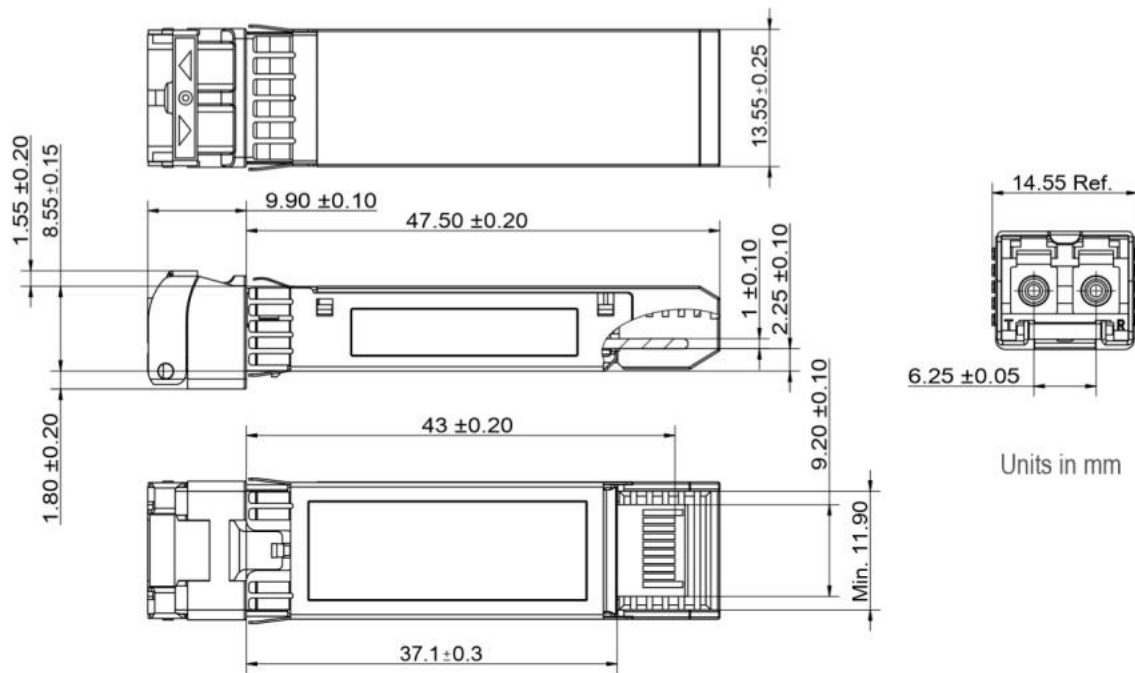


Figure2 Mechanical Outline

**Precautions**

- a. This device is susceptible to damage as a result of electrostatic discharge (ESD). A static free environment is highly recommended. Follow guidelines according to proper ESD procedures.
- b. Radiation emitted by laser devices can be dangerous to human eyes. Avoid eye exposure to direct or indirect radiation.

## Further Information:

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## Disclaimer

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