

### **SFP-1GB-CW-59-40-I-OPC**

MSA and TAA 1000Base-CWDM SFP Transceiver (SMF, 1590nm, 40km, LC, DOM, -40 to 85C)

#### **Features**

- INF-8074 and SFF-8472 Compliance
- Duplex LC Connector
- Single-mode Fiber
- Industrial Temperature -40 to 85 Celsius
- Hot Pluggable
- Metal with Lower EMI
- Excellent ESD Protection
- RoHS Compliant and Lead Free



#### **Applications:**

- Gigabit Ethernet over CWDM
- Access and Enterprise

#### **Product Description**

This MSA compliant SFP transceiver provides 1000Base-CWDM throughput up to 40km over single-mode fiber (SMF) using a wavelength of 1590nm via an LC connector. It is capable of withstanding rugged environments and can operate at temperatures between -40 and 85C. The listed reach has been determined using a link budget calculation and tested in a standard environment. Actual link distances achieved will be dependent upon the deployed environment. All of our transceivers are built to comply with Multi-Source Agreement (MSA) standards and are uniquely serialized and tested for data-traffic and application to ensure seamless network integration. Additional product features include Digital Optical Monitoring (DOM) support which allows access to real-time operating parameters. This transceiver is Trade Agreements Act (TAA) compliant. We stand behind the quality of our products and proudly offer a limited lifetime warranty.

## Regulatory Compliance

- ESD to the Electrical PINs: compatible with MIL-STD-883E Method 3015.4
- ESD to the LC Receptacle: compatible with IEC 61000-4-3
- EMI/EMC compatible with FCC Part 15 Subpart B Rules, EN55022:2010
- Laser Eye Safety compatible with FDA 21CFR, EN60950-1& EN (IEC) 60825-1,2
- RoHS compliant with EU RoHS 2.0 directive 2015/863/EU

## Absolute Maximum Ratings

| Parameter                  | Symbol          | Min. | Typical        | Max. | Unit |
|----------------------------|-----------------|------|----------------|------|------|
| Maximum Supply Voltage     | V <sub>cc</sub> | -0.5 |                | 4.0  | V    |
| Storage Temperature        | T <sub>S</sub>  | -40  |                | 85   | °C   |
| Operating Case Temperature | T <sub>c</sub>  | -40  |                | 85   | °C   |
| Operating Humidity         | RH              | 5    |                | 95   | %    |
| Data Rate                  |                 |      | 1.25<br>1.0625 |      | Gb/s |

## Electrical Characteristics (TOP=25°C, V<sub>cc</sub>=3.3 Volts)

| Parameter                                                               | Symbol          | Min.  | Typ. | Max.            | Unit              | Notes |
|-------------------------------------------------------------------------|-----------------|-------|------|-----------------|-------------------|-------|
| Power Supply Voltage                                                    | V <sub>cc</sub> | 3.135 | 3.30 | 3.465           | V                 |       |
| Power Supply Current                                                    | I <sub>cc</sub> |       |      | 300             | mA                |       |
| Power Dissipation                                                       | P <sub>D</sub>  |       |      | 1000            | mW                |       |
| Transmitter                                                             |                 |       |      |                 |                   |       |
| Differential data input voltage (TD +/-)                                |                 | 300   |      | 2200            | mV <sub>P-P</sub> | 1     |
| Low speed output: Transmitter Fault (TX_FAULT) / Loss of Signal (LOS)   | VOH             | 2.0   |      | V <sub>cc</sub> | V                 | 3     |
|                                                                         | VOL             | 0     |      | 0.8             | V                 |       |
| Low speed input: Transmitter Disable (TX_DISABLE), MOD_DEF 1, MOD_DEF 2 | VIH             | 2.0   |      | V <sub>cc</sub> | V                 | 4     |
|                                                                         | VIL             | 0     |      | 0.8             | V                 |       |
| Receiver                                                                |                 |       |      |                 |                   |       |
| Differential data output voltage (RD +/-)                               |                 | 600   |      | 1200            | mV <sub>P-P</sub> | 2     |

## Notes

1. Internally AC coupled and terminated to 100Ω differential load.
2. Internally AC coupled, but requires a 100Ω differential termination or internal to Serializer/Deserializer.
3. Pulled up externally with a 4.7KΩ-10KΩ resistor on the host board to VCCT,R.
4. Mod\_Def1 and Mod\_Def2 must be pulled up externally with a 4.7KΩ-10KΩ resistor on the host board to VCCT,R.

## Optical Characteristics

| Parameter                             | Symbol                                                      | Min.  | Typ. | Max.  | Unit | Notes |
|---------------------------------------|-------------------------------------------------------------|-------|------|-------|------|-------|
| Transmitter                           |                                                             |       |      |       |      |       |
| Launch Optical Power                  | P <sub>o</sub>                                              | -5    |      | +5    | dBm  |       |
| Center Wavelength Range               | λ <sub>c</sub>                                              | λ-6.5 | λ    | λ+6.5 | nm   | 1     |
| Extinction Ratio                      | EX                                                          | 9     |      |       | dB   |       |
| Spectral Width (-20dB)                | Δλ                                                          |       |      | 1     | nm   |       |
| Side Mode Suppression Ratio           | SMSR                                                        | 30    |      |       | dB   |       |
| Total Jitter                          | TJ                                                          |       |      | 266   | ps   |       |
| Dispersion Penalty                    |                                                             |       |      | 1     | dB   |       |
| Optical Rise/ Fall Time               | T <sub>rise</sub> /T <sub>fall</sub>                        |       |      | 260   | ps   |       |
| P <sub>out</sub> @TX-Disable Asserted | P <sub>off</sub>                                            |       |      | -45   | dBm  |       |
| Eye Diagram                           | IEEE Std 802.3-2005 Gigabit Ethernet 1000Base-LX compatible |       |      |       |      |       |
| Receiver                              |                                                             |       |      |       |      |       |
| Receiver Sensitivity                  | S                                                           |       |      | -24   | dBm  | 2     |
| Receiver overload                     | P <sub>OL</sub>                                             | -3    |      |       | dBm  |       |
| Optical Return Loss                   | ORL                                                         | 12    |      |       | dB   |       |
| LOS De-Assert                         | LOS <sub>D</sub>                                            |       |      | -25   | dBm  |       |
| LOS Assert                            | LOS <sub>A</sub>                                            | -35   |      |       | dBm  |       |
| LOS Hysteresis                        |                                                             | 0.5   | 3    | 5     | dB   |       |

### Notes:

1. The CWDM Transmitter Center Wavelengths " $\lambda$ " are: 1270, 1290, 1310, 1330, 1350, 1370, 1390, 1410, 1430, 1450, 1470, 1490, 1510, 1530, 1550, 1570, 1590 and 1610nm. 1270 to 1450nm are named herein as O-band wavelength and 1470 to 1610nm as L-band wavelength generally.
2. Measured with PRBS 27-1 test pattern, 1.25Gb/s, EX=9dB, BER<10<sup>-12</sup>.
3. Exceeding the Receiver overload can physically damage the module. Please use appropriate attenuation.

## Timing Characteristics

| Parameter                                     | Symbol     | Min. | Typ. | Max. | Unit | Notes |
|-----------------------------------------------|------------|------|------|------|------|-------|
| Tx_disable assert time                        | T_off      |      |      | 10   | us   |       |
| Tx_disable negate time                        | T_on       |      |      | 1    | ms   |       |
| Time to initialize, include reset of TX_FAULT | T_init     |      |      | 300  | ms   |       |
| TX_FAULT from fault to assertion              | T_fault    |      |      | 100  | us   |       |
| Tx_disable time to start reset                | T_reset    | 10   |      |      | us   |       |
| Receiver LOS Assert Time (on to off)          | T_D,RX_LOS |      |      | 80   | us   |       |
| Receiver LOS Assert Time (off to on)          | T_A,RX_LOS |      |      | 80   | us   |       |
| Serial I2C Clock Rate                         | I2C_Clock  |      |      | 100  | kHz  |       |

## Pin Descriptions

| Pin | Symbol      | Name/Descriptions                                   | Engagement order | Ref. |
|-----|-------------|-----------------------------------------------------|------------------|------|
| 1   | VeeT        | Transmitter Ground                                  | 1                |      |
| 2   | TX Fault    | Transmitter Fault Indication                        | 3                | 1    |
| 3   | TX Disable  | Transmitter Disable-Module disables on high or open | 3                | 2    |
| 4   | MOD-DEF2    | Module Definition 2-Two wire serial ID interface    | 3                | 3    |
| 5   | MOD-DEF1    | Module Definition 1-Two wire serial ID interface    | 3                | 3    |
| 6   | MOD-DEF0    | Module Definition 0-Grounded in module              | 3                | 3    |
| 7   | Rate Select | Not Connected                                       | 3                |      |
| 8   | LOS         | Loss of Signal                                      | 3                | 4    |
| 9   | VeeR        | Receiver Ground                                     | 1                |      |
| 10  | VeeR        | Receiver Ground                                     | 1                |      |
| 11  | VeeR        | Receiver Ground                                     | 1                |      |
| 12  | RD-         | Inverse Received Data out                           | 3                | 5    |
| 13  | RD+         | Received Data out                                   | 3                | 5    |
| 14  | VeeR        | Receiver Ground                                     | 1                |      |
| 15  | VccR        | Receiver Power - +3.3V±5%                           | 2                | 6    |
| 16  | VccT        | Transmitter Power - +3.3 V±5%                       | 2                | 6    |
| 17  | VeeT        | Transmitter Ground                                  | 1                |      |
| 18  | TD+         | Transmitter Data In                                 | 3                | 7    |
| 19  | TD-         | Inverse Transmitter Data In                         | 3                | 7    |
| 20  | VeeT        | Transmitter Ground                                  | 1                |      |

**Notes:**

1. TX Fault is open collector/drain output which should be pulled up externally with a 4.7K $\Omega$ -10K $\Omega$  resistor on the host board to supply  $< V_{ccT} + 0.3V$  or  $V_{ccR} + 0.3V$ . When high, this output indicates a laser fault of some kind. Low indicates normal operation. In the low state, the output will be pulled to  $< 0.8V$ .
2. TX Disable input is used to shut down the laser output per the state table below. It is pulled up within the module with a 4.7K $\Omega$ -10K $\Omega$  resistor.

|                         |                      |
|-------------------------|----------------------|
| Low (0-0.8V):           | Transmitter on       |
| Between (0.8V and 2V):  | Undefined            |
| High (2.0- $V_{ccT}$ ): | Transmitter Disabled |
| Open:                   | Transmitter Disabled |
3. Mod-Def 0, 1, 2. These are the module definition pins. They should be pulled up with a 4.7K $\Omega$ -10K $\Omega$  resistor on the host board to supply less than  $V_{ccT} + 0.3V$  or  $V_{ccR} + 0.3V$ .

Mod-Def 0 is grounded by the module to indicate that the module is present.

Mod-Def 1 is clock line of two wire serial interface for optional serial ID.

Mod-Def 2 is data line of two wire serial interface for optional serial ID.
4. LOS (Loss of signal) is an open collector/drain output which should be pulled up externally with a 4.7K $\Omega$ -10K $\Omega$  resistor on the host board to supply  $< V_{ccT} + 0.3V$  or  $V_{ccR} + 0.3V$ . When high, this output indicates the received optical power is below the worst case receiver sensitivity (as defined by the standard in use). Low indicates normal operation. In the low state, the output will be pulled to  $< 0.8V$ .
5. RD-/+ : These are the differential receiver outputs. They are AC coupled 100 $\Omega$  differential lines which should be terminated with 100 $\Omega$  differential at the user SERDES. The AC coupling is done inside the module and thus not required on the host board.
6.  $V_{ccR}$  and  $V_{ccT}$  are the receiver and transmitter power supplies. They are defined as  $3.3V \pm 5\%$  at the SFP connector pin. The in-rush current will typically be no more than 30mA above steady state supply current after 500ns.
7. TD -/+ : These are the differential transmitter inputs. They are AC coupled differential lines with 100 $\Omega$  differential termination inside the module. The AC coupling is done inside the module and is thus not required on host board.



Pin-out of connector Block on Host board

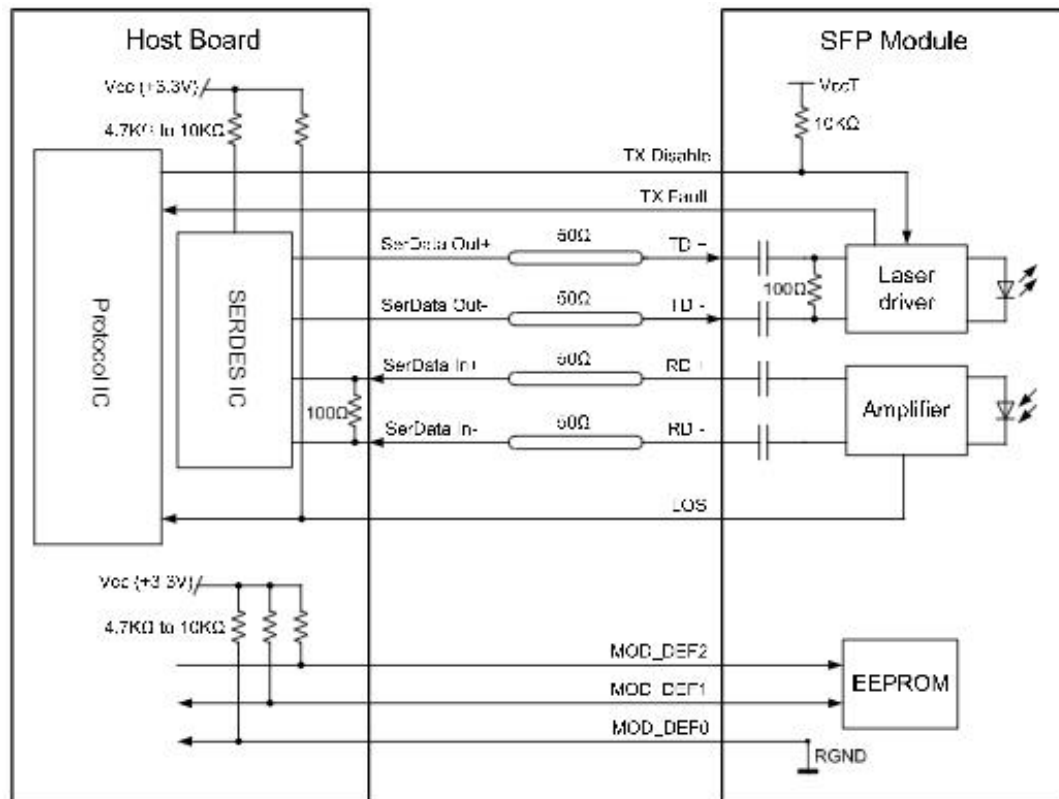
### Digital Diagnostic Memory Map



## Required Host Board Components



## Recommended Application Interface Circuit



**Mechanical Specifications**

Small Form Factor Pluggable (SFP) transceivers are compatible with the dimensions defined by the SFP Multi-Sourcing Agreement (MSA).

