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| **Part No.:** | **SFP-XG-SM-LR-10** | |
|---|---|---|
| **Description:** | 10G SFP+ Transceiver, SMF 1310nm 10km | |
| **Release Date** | **Rev.** | **Revision Change Description** |
| **2017/06/07** | **A0** | New Release |
| **2020/12/28** | **A1** | Template Update |

## Features

- ✧ Up to 9.95 Gbps to 10.5Gbps
- ✧ 1310nm Uncooled DFB Laser and PIN photo detector
- ✧ Duplex LC receptacle optical interface compliant
- ✧ Single +3.3V power supply
- ✧ Hot-pluggable
- ✧ AC coupling of LVPECL signals
- ✧ International Class1 laser safety certified
- ✧ Operating temperature range:
- ✧ Commercial: 0℃~+70℃
- ✧ Industry: -40℃~+85℃
- ✧ RoHS Compliant
- ✧ DDMI function available with internally calibrated mode
- ✧ Up to 10km transmission distance over Single Mode Fiber(SMF) without CDR inside

## Application

- ✧ 10GBASE-LR/LW
- ✧ 10G Fiber Channel

## Standard

- ✧ Compliant with MSA SFP+ specification(SFF-8431)
- ✧ Compliant with SFF-8472
- ✧ CPRI Line Rate Option: 9830.4Mbps
- ✧ Compliant to IEEE 802.3ae

# Specification

| Absolute Maximum Ratings | | | | |
|---|---|---|---|---|
| **Parameter** | **Symbol** | **Min** | **Max** | **Unit** |
| Storage temperature | TS | -40 | 85 | ℃ |
| Power Supply Voltage | Vcc3 | -0.5 | +4 | V |
| Relative Humidity | RH | 5 | 95 | % |

| Recommended Operating Conditions | | | | | |
|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Min** | **Typical** | **Max** | **Unit** |
| Operating Case Temperature (Commercial) | Tc | 0 | | 70 | ℃ |
| Operating Case Temperature (industry) | Tc | -40 | | 85 | ℃ |
| Power Supply Voltage | Vcc3 | 3.13 | 3.3 | 3.47 | V |
| Supply Current | Icc3 | | | 285 | mA |
| Data Rate | | | 10.3125 | | Gbps |
| Fiber Length 9/125μm core SMF | | - | 10 | - | km |

| Electrical Characteristics | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Min** | **Typical** | **Max** | **Unit** | **Notes** |
| Transmitter differential input voltage | Vin,pp | 180 | | 700 | m V | |
| Receiver differential output Voltage | Vout,pp | 300 | | 850 | m V | |
| Transmit Fault (TX_Fault) | Voh | 2.4 | | Vdd3+0.3 | V | LVTTL |
| | Vol | -0.3 | | 0.4 | V | LVTTL |
| Transmit disable voltage | VIH | 2.0 | | Vcc+0.3 | V | LVTTL |
| Transmit enable voltage | VIL | -0.3 | | 0.8 | V | LVTTL |
| Loss of Signal (LOS) | Voh | 2.4 | | Vdd3+0.3 | V | LVTTL |
| | Vol | -0.3 | | 0.4 | V | LVTTL |

| Optical transmitter Characteristics | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Min** | **Typical** | **Max** | **Unit** | **Notes** |
| Launched Power (avg.) | Pout | -6 | | 0.5 | dBm | EOL |
| | | -6 | | 0.5 | dBm | BOL |
| Operating Wavelength Range | λc | 1260 | 1310 | 1355 | nm | |
| Spectral Width | Δλ | | | 1 | nm | |
| Side Mode Suppression Ratio | SMSR | 30 | | | dB | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Extinction Ratio | ER | 3.5 | | | dB | 2 |
| Transmitter and Dispersion Penalty | TDP | | | 3.2 | dB | |
| Optical Modulation Amplitude | $P_{OMA}$ | -5.2 | | | dBm | |
| Optical Return Loss Tolerance | | | | 12 | dB | |
| Relative Intensity Noise | RIN | | | -128 | dB/Hz | |
| Optical Rise/Fall Time | Tris/Tfall | 28 | | | PS | 3 |
| Optical Tx Output disable | $P_{dis}$ | | | -30 | dBm | |
| Output Eye Diagram | Compliant with ITU-T G.691 eye mask and IEEE802.3ae eye mask | | | | | |

**Optical receiver Characteristics**

| Parameter | | Symbol | Min | Typical | Max | Unit | Notes |
|---|---|---|---|---|---|---|---|
| Receiver Sensitivity | | S | | | -14.4 | dBm | 4 |
| Wavelength Range | | λc | 1260 | | 1355 | nm | |
| Receiver Reflectance | | | | | -12 | dB | |
| Optical Power Input Overload | | $P_{in-max}$ | 0.5 | | | dBm | 4 |
| LOS | Optical De-assert | Pd | | | -17 | dBm | 4 |
| | Optical Assert | Pa | -30 | | | | |
| LOS hysteresis | | | 0.5 | | 5 | dB | 5 |

**Notes:**

1) The supply current is SFP+ module's working current.
2) For the measurements, the device was driven with 10.3125Gbps data pattern with $2^{31}$-1 PRBS payload.
3) Optical transition time is the time interval required for the rising or falling edge of an optical pulse to transition between the 20% and 80% amplitudes relative to the logical 1 and 0 levels.
4) Measured with a PRBS $2^{31}$-1 test pattern, @10.3125Gbps, ER=3.5dB, BER<$10^{-12}$.
5) The LOS Hysteresis minimizes 'chatter' on the output line. In principle, Hysteresis alone does not guarantee chatter-free operation.

## Digital Diagnostic Monitoring Information

| Parameter | Accuracy | Calibration | Range |
|---|---|---|---|
| Temperature | ±3°C | internal | 0~70 |
| Voltage | ±3% | internal | Vcc=3.3V±5% |
| Bias Current | ±10% | internal | 5 to 100mA |
| TX Power | ±2dB | internal | -6 to 0.5dBm |
| RX Power | ±3dB | internal | -14.4 to 0.5dBm |

## Pin Descriptions

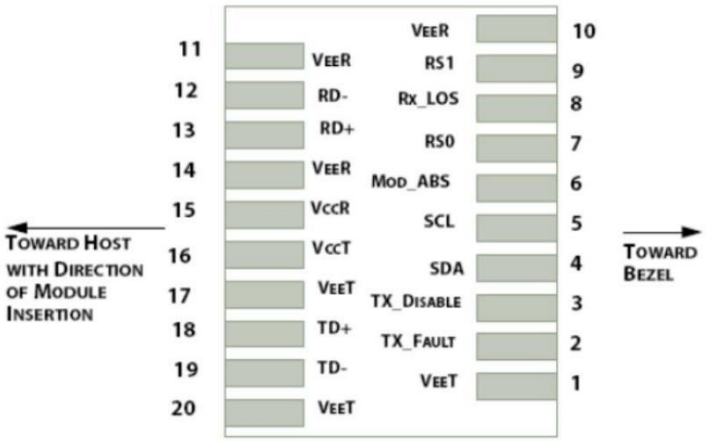



**Figure 1 SFP+ Pad assignment Top View**

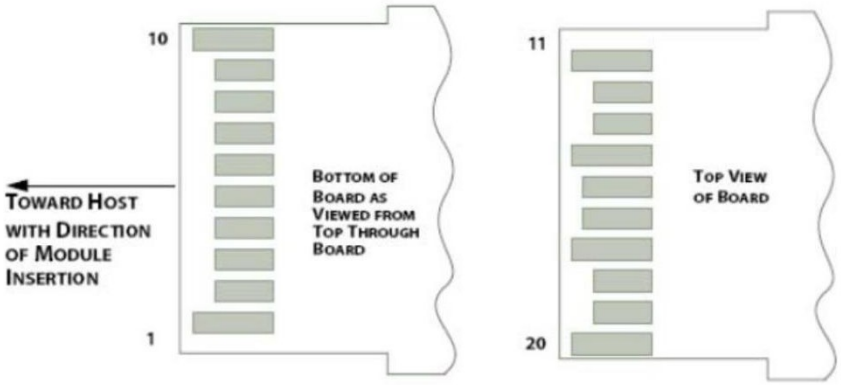



**Figure 2 SFP+ Module Contact Assignments**

## Pin Assignment

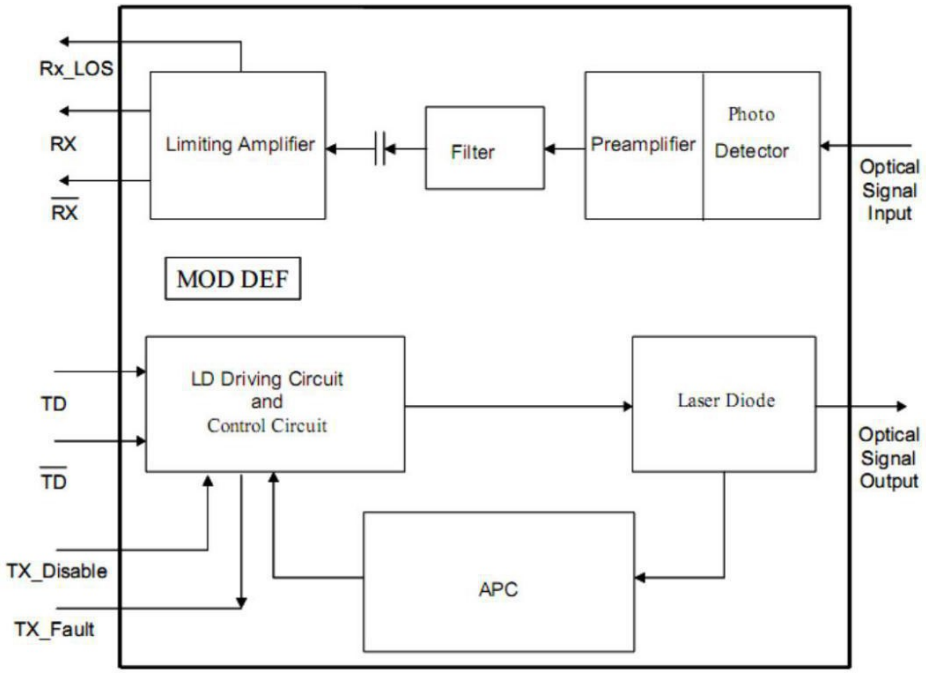
| Pin | Power Seq. | Symbol | Description | Ref |
|---|---|---|---|---|
| 1 | 1st | VeeT | Module Ground(Common with Receiver Ground) | 1 |
| 2 | 3rd | TX_Fault | Transmitter Fault, Low: normal; High: abnormal | 2 |
| 3 | 3rd | TX_Disable | Transmitter Disable<br>High: Transmitter off<br>Low: Transmitter on | 3 |
| 4 | 3rd | SDA | 2-Wire Serial Interface Data Line<br>(Same as MOD-DEF2 in INF-8074i) | 4 |
| 5 | 3rd | SCL | 2-Wire Serial Interface Data Line<br>(Same as MOD-DEF2 in INF-8074i) | 4 |
| 6 | 3rd | Mod_ABS | Module Absent, Connect to VeeT or VeeR in Module | 5 |
| 7 | 3rd | RS0 | Rate Select 0, optionally controls SFP+ module receiver | 6 |
| 8 | 3rd | RX_LOS | Receiver Loss of Signal indication<br>High: loss of signal | 7 |

| | | | | |
|---|---|---|---|---|
| | | | Low: signal detected | |
| 8 | 3rd | RX_LOS | Receiver Loss of Signal indication<br>High: loss of signal<br>Low: signal detected | 7 |
| 9 | 3rd | RS1 | Rate Select 1, optionally controls SFP+ module transmitter | 8 |
| 10 | 1st | VeeR | Receiver Ground | 1 |
| 11 | 1st | VeeR | Receiver Ground | 1 |
| 12 | 3rd | RD- | Receiver Inverted DATA out. AC Coupled. CML-O | 9 |
| 13 | 3rd | RD+ | Receiver Non-inverted DATA out. AC Coupled. CML-O | 9 |
| 14 | 1st | VeeR | Receiver Ground | 1 |
| 15 | 2nd | VccR | Receiver Power Supply | 10 |
| 16 | 2nd | VccT | Transmitter Power Supply | 10 |
| 17 | 1st | VeeT | Transmitter Ground | 1 |
| 18 | 3rd | TD+ | Transmitter Non-Inverted DATA in. AC Coupled. CML-I | 11 |
| 19 | 3rd | TD- | Transmitter Inverted DATA in. AC Coupled. CML-I | 11 |
| 20 | 1st | SDA | Transmitter Ground | 1 |

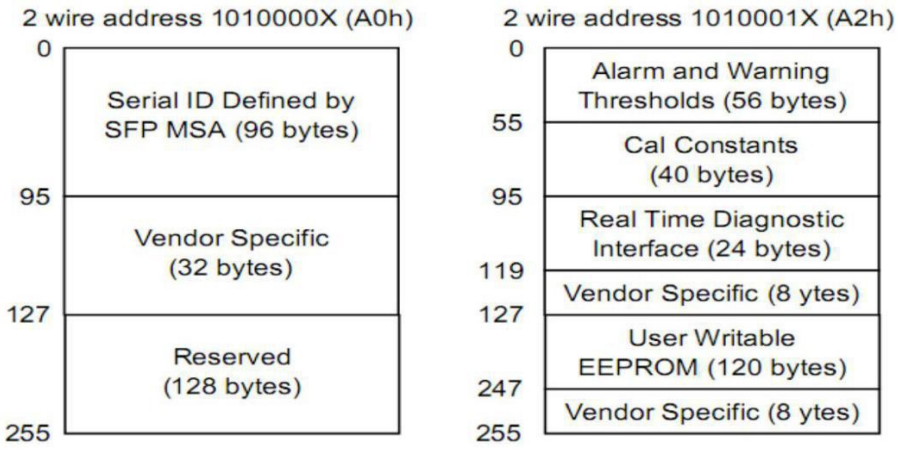
**Notes:**

1) The module signal ground contacts.
2) This pin is an open drain/collector and should be pulled up to Vcc-host in the host with a 4.7k~10k Ohm resistor.
3) This pin should be pulled up to Vcct with a 4.7k~10k Ohm resistor in modules.
4) SDA&SCL (IIC) are needed pull up 4.7k~10k Ohm resistors on host board.
5) Mod_ABS is connected to VeeT or VeeR in the SFP+ module.
6) Rate Select 0,Optionally controls SFP+ module receiver , High: RX input signaling rate＞4.25GBd and Low: RX input signaling rate≤4.25GBd.
7) Module RX_Los of signal indication need pull up 4.7k~10k Ohm resistor on host board.
8) Rate Select 1,Optionally controls SFP+ module transmitter, High: Tx input signaling rate＞4.25GBd and Low : Tx input signaling rate≤4.25GBd.
9) RD -/+: These are the differential receiver outputs. They are CML AC-coupled with 100 Ohm terminal resistor matching internal.
10) VccR and VccT are the receiver and transmitter power supplies.
11) TD-/+: These are the differential transmitter inputs. They are CML AC-coupled with 100 Ohm terminal resistor matching internal.

## Block Diagram

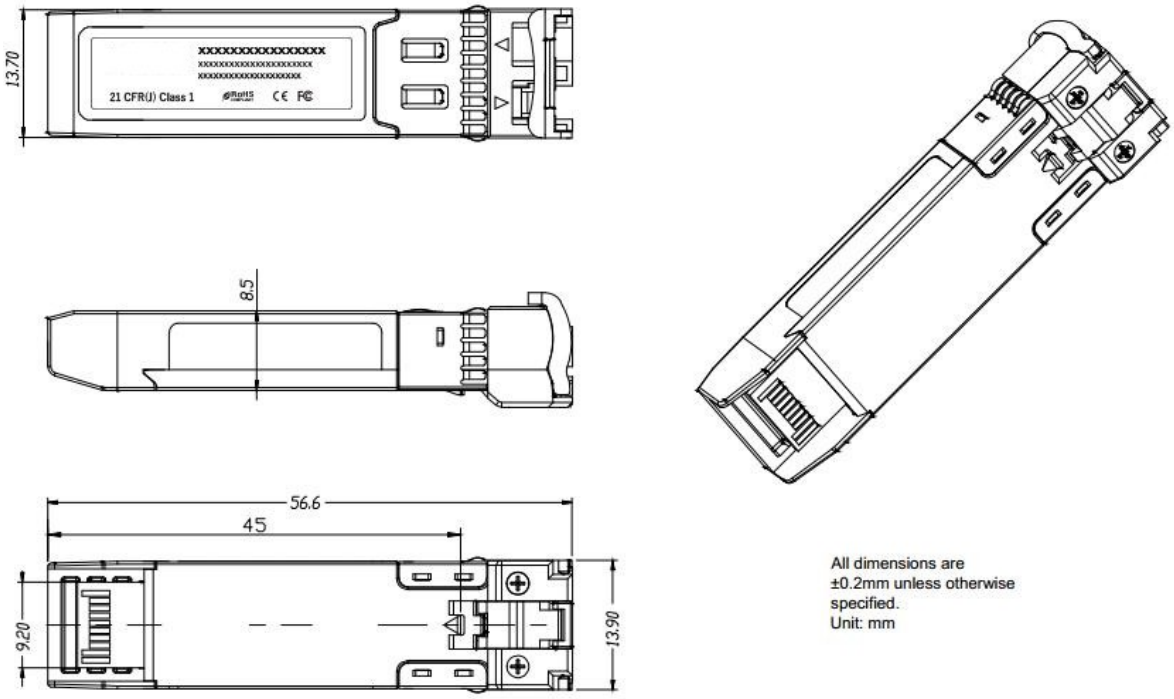



## Digital Diagnostic Memory Map



## Package Outline

Dimensions are in millimeters. All dimensions are ±0.2mm unless otherwise specified. (Unit: mm)




## Regulatory Compliance

| Feature | Test | Method |
|---|---|---|
| Electrostatic Discharge (ESD) to the Electrical Pins | MIL-STD-883E Method 3015.7 | Class 1(>1000V for SFI pins, >2000Vfor other pins.) |
| Electrostatic Discharge (ESD) Immunity | IEC61000-4-2 | Class 2(>4.0kV) |
| Electromagnetic Interference (EMI) | CISPR22 ITE Class B<br>FCC Class B<br>CENELEC<br>EN55022<br>VCCI Class 1 | Comply with standard |
| Immunity | IEC61000-4-3 | Comply with standard |
| Eye Safety | FDA 21CFR 1040.10 and 1040.11 | Compatible with Class I laser Product |