

Features

- Built-in PHY and MCU supporting SGMII Interface
- 125Mbps IEEE 802.3u 100BASE-FX compliant
- Standard serial ID information Compatible with SFP MSA
- AC-coupled differential inputs and outputs
- 2km link on a multimode fiber and 10km/40km on a single mode fiber
- SFF8472 diagnostic monitoring interface
- LC type pluggable optical interface
- Fully metallic enclosure for low EMI
- +3.3V single power supply
- Operating case temperature: -40 to +85°C

Applications

- 125 Mbps 100Base-FX Ethernet / FDDI
- Switch to Switch interface
- Switched backplane applications
- Switch/Router to Switch/Router Link
- Other optical transmission systems

Description

The APAC 100BASE-FX Small Form-Factor Pluggable (SFP) Fast Ethernet interface transceiver is a hot swappable device that plugs into a Gigabit Ethernet SFP port. This SGMII SFP transceiver built-in a PHY chip provides full-duplex 100-Mbps connectivity between switches over multimode fiber (MMF) or single mode fiber (SMF) infrastructures.

The host equipment can access this information via the 2-wire serial CMOS EEPROM protocol. For further information, please refer to SFP Multi-Source Agreement (MSA). To meet the increasing demand of Industrial Ethernet fiber solution, SGMII SFP transceiver series that can operate reliably in electrically harsh, climatically demanding, and wide temperature range (-40°C to 85°C) environment.

Ordering Information

| PART NUMBER | MAC Interface | Speed (Mbps) | Fiber Mode | Connector Interface | Distance | Wavelength (nm) | Operating Temp. |
|-------------------|---------------|--------------|-------------|---------------------|----------|-----------------|-----------------|
| LM38-A3C-TI-N-APZ | SGMII | 125 | Multi-Mode | LC | 2Km | 1310 | -40~85°C |
| LS38-A3S-TI-N-APZ | SGMII | 125 | Single Mode | LC | 10Km | 1310 | -40~85°C |
| LS38-A3L-TI-N-APZ | SGMII | 125 | Single Mode | LC | 40Km | 1310 | -40~85°C |



100BASE-FX SGMII Optical Transceiver with PHY
Small Form Pluggable (SFP), 3.3V
125 Mbps Link Speed

Absolute Maximum Ratings

| PARAMETER | SYMBOL | MIN | MAX | UNITS | NOTE |
|----------------------------|----------|-----|------|-------|----------------|
| Supply Voltage | V_{CC} | 3.0 | 3.65 | V | |
| Storage Temperature | T_s | -40 | +85 | °C | |
| Case Operating Temperature | T_C | -40 | +85 | °C | |
| Storage Humidity | H_s | 5 | +95 | % | Non condensing |

Recommended Operating Conditions

| PARAMETER | SYMBOL | MIN | TYP | MAX | UNITS | NOTE |
|----------------------------|----------|------|------|------|-------|------|
| Case Operating Temperature | T_C | -40 | - | 85 | °C | |
| Operating Humidity | H_o | 10 | - | 85 | % | |
| Power Supply Voltage | V_{CC} | 3.14 | 3.30 | 3.47 | V | |
| Power Supply Current | I_{CC} | - | - | 350 | mA | 1 |
| Data Rate | D_R | - | 125 | - | Mbps | |

Note:

1) The max power supply current after module work stable.

Electrical Characteristics

| PARAMETER | SYMBOL | MIN | TYP. | MAX | UNITS | NOTE |
|----------------------------------|-----------------------|--------------|------|--------------|----------|------|
| Transmitter | | | | | | |
| Data Input differential Voltage | $V_{D, TX}$ | 0.25 | - | 1.20 | V | 1 |
| Differential Input Impedance | Z_{TX} | 80 | 100 | 120 | Ω | |
| Transmitter Disable Input-High | V_{DISH} | 2.0 | - | $V_{cc}+0.3$ | V | |
| Transmitter Disable Input-Low | V_{DISL} | 0 | - | 0.8 | V | |
| Receiver | | | | | | |
| Data Output Differential Voltage | $V_{D, RX}$ | 0.35 | - | 0.8 | V | 3 |
| Differential Output Impedance | Z_{RX} | 80 | 100 | 120 | Ω | |
| Data Output Rise/Fall Time | $T_{r, rx}/T_{f, rx}$ | - | 175 | - | ps | 4 |
| LOS Output Voltage – High | V_{SDHL} | $V_{cc}-0.5$ | - | $V_{cc}+0.3$ | V | 2 |
| LOS Output Voltage – Low | V_{SDL} | 0 | - | 0.5 | V | 2 |

Note:

- 1) Internally AC coupled and terminated to 100 Ohm differential load.
- 2) Pull up to V_{CC} with a 4.7K – 10K Ohm resistor on host Board
- 3) Internally AC coupled, but requires a 100 Ohm differential termination at MAC side.
- 4) 20% ~ 80% values



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Optical Characteristics (LM38-A3C-TI-N-APZ)

| PARAMETER | SYMBOL | MIN | TYP. | MAX | UNITS | NOTE |
|--|---|-------|------|------|-------|--------|
| Transmitter | | | | | | |
| Output Optical Power 62.5/125 μ m fiber | P_{out} | -20 | - | -14 | dBm | |
| Output Optical Power 50/125 μ m fiber | | -23.5 | - | -14 | dBm | |
| Center Wavelength | λ_C | 1260 | - | 1380 | nm | |
| Spectral Width (FWHM) | $FWHM$ | - | - | 100 | nm | |
| Extinction Ratio | ER | 10 | - | - | dB | |
| Rise/Fall Time(10~90%) | T_r/T_f | - | - | 3 | ns | |
| Output Optical Eye | Compliant with ITU-T recommendation G-957 | | | | | |
| Receiver | | | | | | |
| Center Wavelength | λ_C | 1260 | - | 1380 | nm | |
| Optical Input Power-Maximum | P_{IN} | -8 | - | - | dBm | Note 1 |
| Optical Input Power-Sensitivity | P_{IN} | - | - | -31 | dBm | Note 1 |
| LOS-Deasserted | P_D | - | - | -31 | dBm | |
| LOS-Asserted | P_A | -45 | - | - | dBm | |
| Receiver Loss of Signal Output Voltage-Low | RX_LOS_L | 0 | - | 0.5 | V | |
| Receiver Loss of Signal Output Voltage-High | RX_LOS_H | 2.4 | - | Vcc | V | |

Note:

1) Measured with 4B/5B code for 100Mbps, worst-case extinction ratio, BER $\leq 1 \times 10^{-10}$



100BASE-FX SGMII Optical Transceiver with PHY
Small Form Pluggable (SFP), 3.3V
125 Mbps Link Speed

Optical Characteristics (LS38-A3S-TI-N-APZ)

| PARAMETER | SYMBOL | MIN | TYP. | MAX | UNITS | NOTE |
|--|---|------|------|------|-------|--------|
| Transmitter | | | | | | |
| Output Optical Power 9/125 μ m fiber | P_{out} | -15 | - | -8 | dBm | |
| Center Wavelength | λ_C | 1260 | - | 1360 | nm | |
| Spectral Width (RMS) | RMS | v | - | 7.7 | nm | |
| Extinction Ratio | ER | 8.2 | - | v | dB | |
| Rise/Fall Time(10~90%) | T_r/T_f | - | v | 3 | ns | |
| Output Optical Eye | Compliant with ITU-T recommendation G-957 | | | | | |
| Receiver | | | | | | |
| Center Wavelength | λ_C | 1260 | - | 1380 | nm | |
| Optical Input Power-Maximum | P_{IN} | -8 | - | - | dBm | Note 1 |
| Optical Input Power-Sensitivity | P_{IN} | - | - | -31 | dBm | Note 1 |
| LOS-Deasserted | P_D | - | - | -31 | dBm | |
| LOS-Asserted | P_A | -45 | - | - | dBm | |
| Receiver Loss of Signal Output Voltage-Low | RX_LOS_L | 0 | - | 0.5 | V | |
| Receiver Loss of Signal Output Voltage-High | RX_LOS_H | 2.4 | - | Vcc | V | |

Note:

1) Measured with 4B/5B code for 100Mbps, worst-case extinction ratio, BER $\leq 1 \times 10^{-10}$



100BASE-FX SGMII Optical Transceiver with PHY
Small Form Pluggable (SFP), 3.3V
125 Mbps Link Speed

Optical Characteristics (LS38-A3L-TI-N-APZ)

| PARAMETER | SYMBOL | MIN | TYP. | MAX | UNITS | NOTE |
|---|---|------|------|------|-------|--------|
| Transmitter | | | | | | |
| Output Optical Power 9/125 μm fiber | P_{out} | -5 | - | 0 | dBm | |
| Center Wavelength | λ_C | 1260 | - | 1360 | nm | |
| Spectral Width (RMS) | RMS | - | - | 4.0 | nm | |
| Extinction Ratio | ER | 10 | - | - | dB | |
| Rise/Fall Time(10~90%) | T_r/T_f | - | - | 3 | ns | |
| Output Optical Eye | Compliant with ITU-T recommendation G-957 | | | | | |
| Receiver | | | | | | |
| Center Wavelength | λ_C | 1260 | - | 1380 | nm | |
| Optical Input Power-Maximum | P_{IN} | 0 | - | - | dBm | Note 1 |
| Optical Input Power-Sensitivity | P_{IN} | - | - | -34 | dBm | Note 1 |
| LOS-Deasserted | P_D | - | - | -34 | dBm | |
| LOS-Asserted | P_A | -45 | - | - | dBm | |
| Receiver Loss of Signal Output Voltage-Low | RX_LOS_L | 0 | - | 0.5 | V | |
| Receiver Loss of Signal Output Voltage-High | RX_LOS_H | 2.4 | - | Vcc | V | |

Note:

1) Measured with 4B/5B code for 100Mbps, worst-case extinction ratio, BER $\leq 1 \times 10^{-10}$

Recommended Host Board Power Supply Circuit

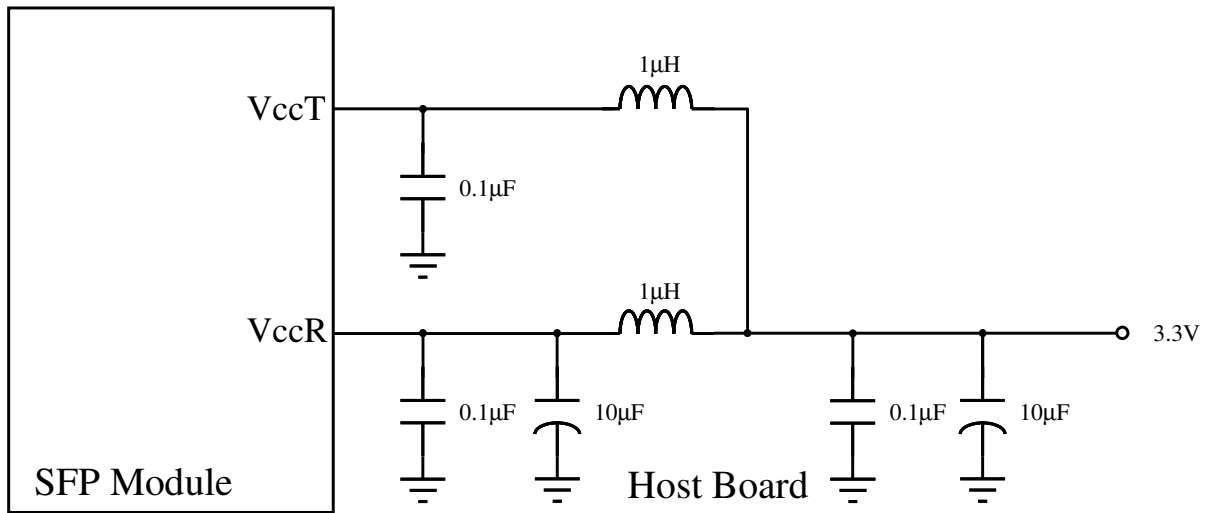


Figure 1: Recommended Host Board Power Supply Circuit

Recommended Interface Circuit

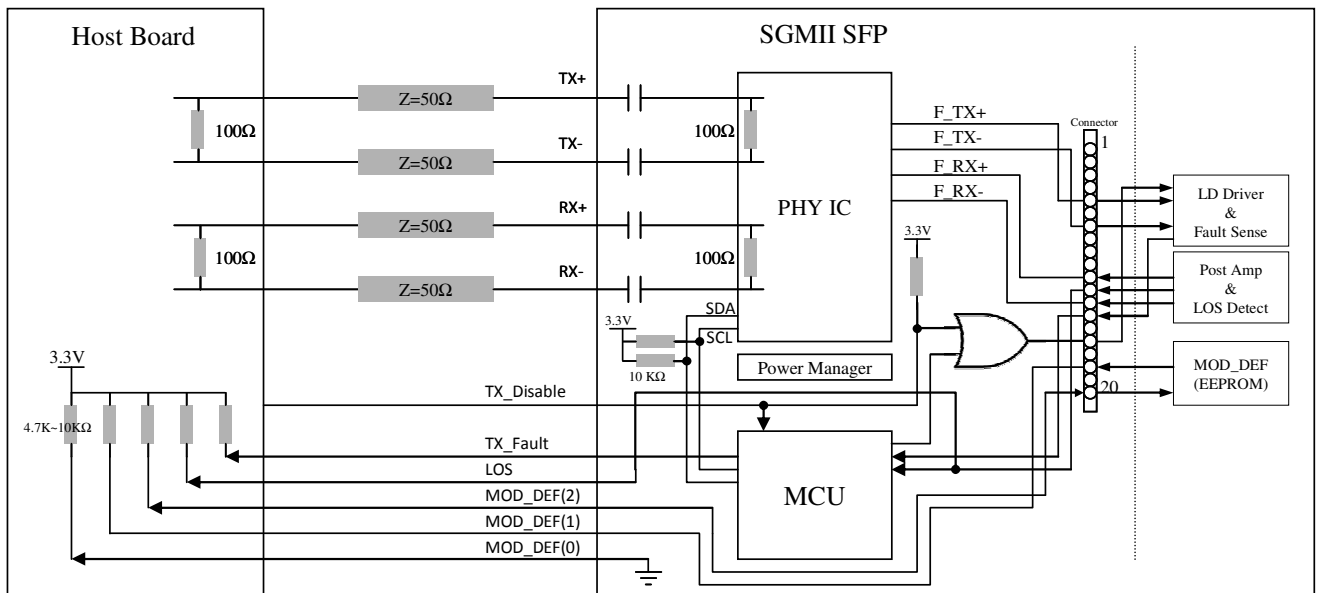


Figure 2: Recommended Interface Circuit



**100BASE-FX SGMII Optical Transceiver with PHY
Small Form Pluggable (SFP), 3.3V
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TX_DISABLE Function

There are active components in the SFP Transceiver as PHY and MCU so it takes some time to start up MCU and initialize the active PHY. The communication path of the SFP is ready after 20ms. The TX_DISABLE signal is high (TTL logic "1") to turn off the laser output. The laser will turn on when TX_DISABLE is low (TTL logic "0").

LOS Function

The SFP MSA specification defines a pin called LOS to indicate loss of signal to the motherboard. This should be pulled up with a 4.7K to 10K resistor. Pull up voltage between 2.0V and $V_{cc-T/R}+0.3V$. When high, this output indicates link fail. Low indicates normal operation. In the low state, the output will be pulled to $<0.8V$.

Termination Circuits

Inputs to the transceiver are AC coupled and internally terminated through 50 ohms. These modules can operate with PECL or ECL logic levels. The input signal must have at least a 250mV peak-to-peak (single ended) signal swing. Output from the receiver section of the module is also AC coupled and is expected to drive a 50 ohm load. Different termination strategies may be required depending on the particular Serializer/Deserializer chip set used.



100BASE-FX SGMII Optical Transceiver with PHY
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125 Mbps Link Speed

EEPROM Section

The Smart SFP support the 2-wire serial communication protocol defined in the SFP MSA. These SFP use a 128 byte EEPROM with an address of A0H. Accessing Serial ID Memory uses the 2 wire address 10100000 (A0H). Memory Contents of Serial ID are shown in Table 1.

Table 1 Serial ID Memory Contents

| Addr. | Size (Bytes) | Name of Field | Hex | Description |
|--------|--------------|----------------------------|--|---|
| 0 | 1 | identifier | 03 | SFP or SFP+ |
| 1 | 1 | Ext.Identifier | 04 | GBIC/SFP function is defined by two-wire interface ID only |
| 2 | 1 | Connector | 07 | LC |
| 3-10 | 8 | Transceiver | 00 00 00 20 00 00 00 00 | 100BASE-FX |
| 11 | 1 | Encoding | 02 | 4B/5B |
| 12 | 1 | BR(Nominal) | 01 | 125Mbps |
| 13 | 1 | Rate Identifier | 00 | Unspecified |
| 14 | 1 | Length(SMFm)-km | 00 | N/A |
| 15 | 1 | Length(SMF) | 00 | N/A |
| 16 | 1 | Length(50µm) | C8 | 2Km |
| 17 | 1 | Length(62.5µm) | C8 | 2Km |
| 18 | 1 | Length(cable) | 00 | N/A |
| 19 | 1 | Length(OM3) | 00 | N/A |
| 20-35 | 16 | Vendor name | XX XX XX XX XX XX XX 20 20 20 20 20 20 20 20 20 | Vendor name (ASCII) |
| 36 | 1 | Transceiver | 00 | Unallocated |
| 37-39 | 3 | Vendor OUI | XX XX XX | Vendor OUI |
| 40-55 | 16 | Vendor PN | XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX | Transceiver part number |
| 56-59 | 4 | Vendor rev | XX XX XX XX | Vendor rev |
| 60-61 | 2 | Wavelength | 05 1E | 1310nm |
| 62 | 1 | Unallocated | 00 | Unallocated |
| 63 | 1 | CC_BASE | Check Sum (Variable) | Check code for Base ID Fields |
| 64-65 | 2 | Options | 00 1A | LOS, TX_FALUT, and TX_DISABLE |
| 66 | 1 | BR | 00 | max |
| 67 | 1 | BR | 00 | min |
| 68-83 | 16 | Vendor SN | 41 34 32 30 33 30 30 34 20 20 20 20 20 20 20 20 | Serial Number of transceiver (ASCII). For example“A4203004”. |
| 84-91 | 8 | Date code | XX XX XX XX XX XX XX XX | Manufacture date code |
| 92 | 1 | Diagnostic Monitoring Type | 68 | N/A |
| 93 | 1 | Enhanced Options | B0 | N/A |
| 94 | 1 | SFF-8472 Compliance | 02 | Digital diagnostic function not included or undefined |
| 95 | 1 | CC_EXT | Check Sum (Variable) | Check sum for Extended ID Field. |
| 96-127 | 32 | Vendor Specific | Read only | Depends on customer information |

Note: The “XX” byte should be filled in according to practical case. For more information, please refer to the related document of SFP Multi-Source Agreement (MSA).

The SGMII SFP transceiver provides diagnostic information about the present operating conditions. This transceiver generates this diagnostic data by digitization of internal analog signals. Calibration and alarm/warning threshold data is written during device manufacture. Received power monitoring, transmitted power monitoring, bias current monitoring, supply voltage monitoring and temperature monitoring all are implemented. The diagnostic data are raw A/D values and must be converted to real world units using calibration constants stored in EEPROM locations 56 – 95 at wire serial bus address **A2h**. The digital diagnostic memory map specific data field defined as following.

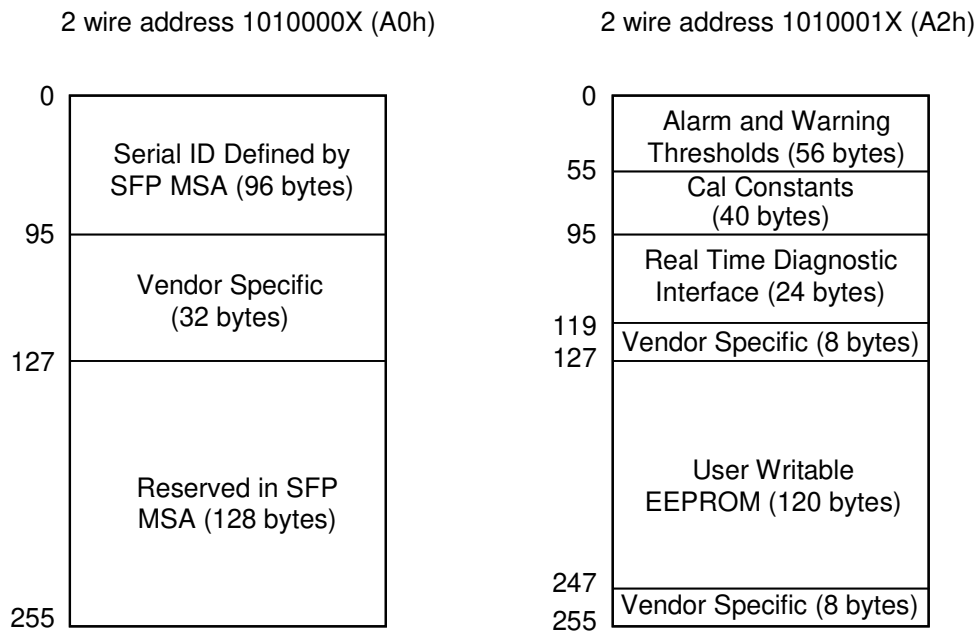


Figure 3: EEPROM Section

SFP Pin Definitions

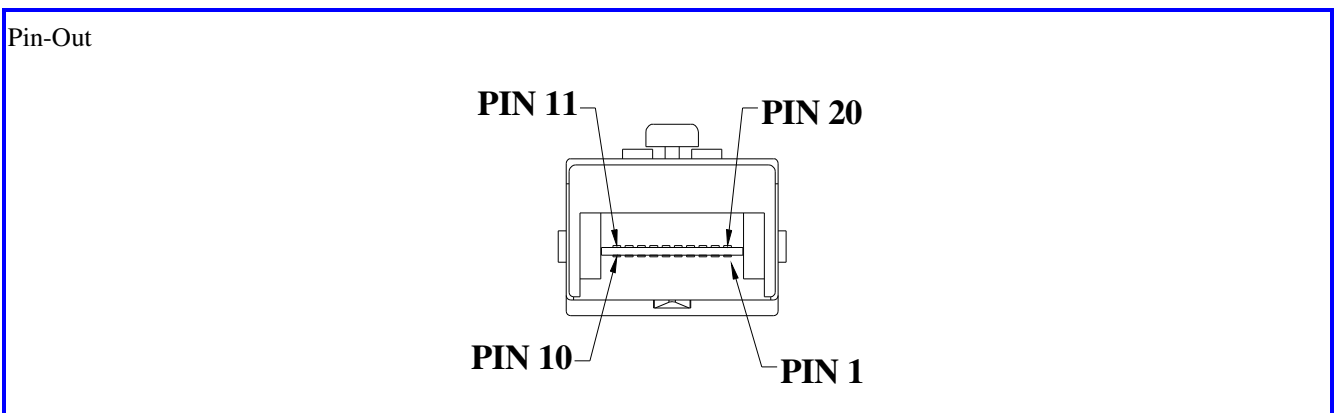


Figure 4: Pin View



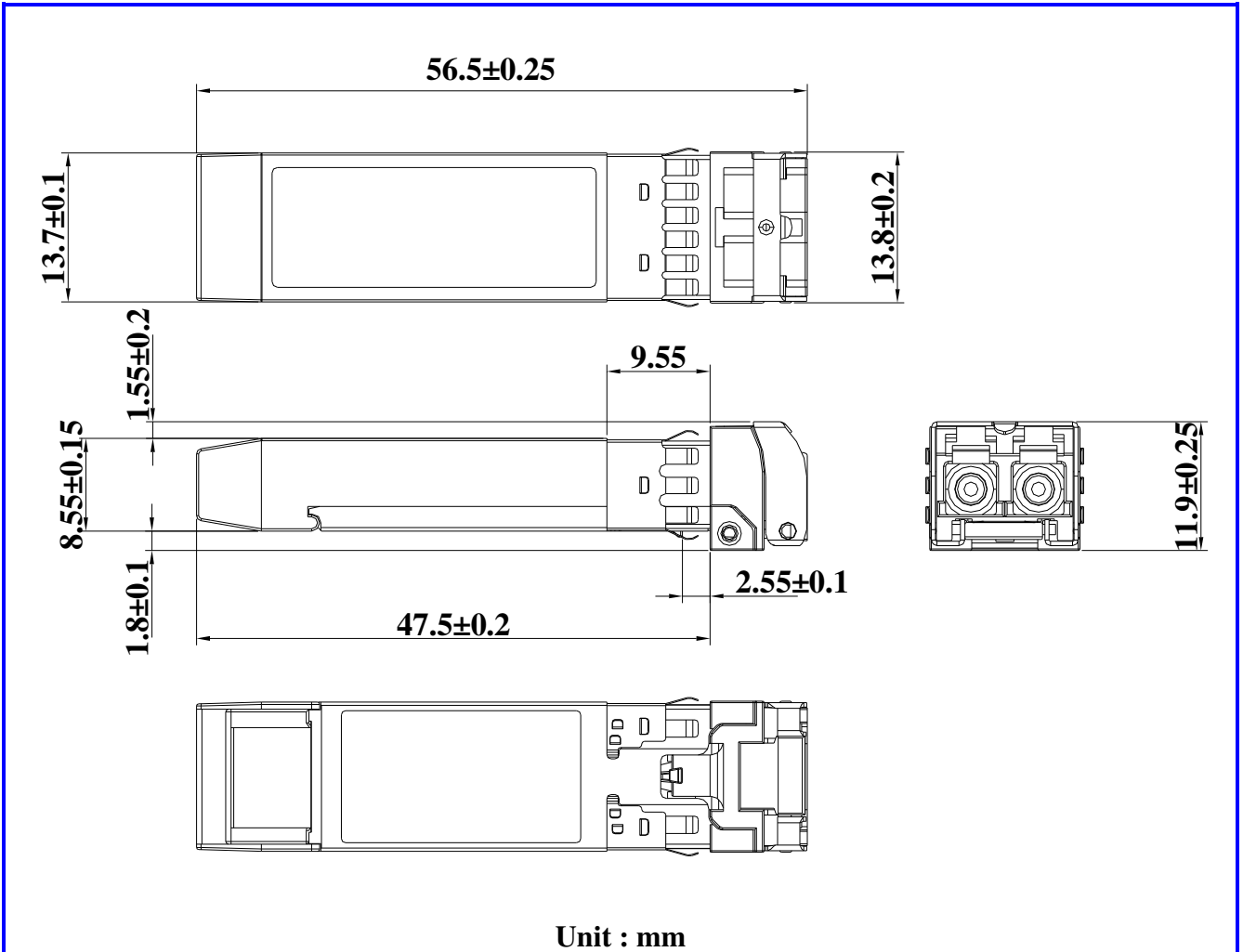
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| Pin | Signal Name | Function | NOTES |
|-----|-------------|--------------------------------|--|
| 1 | VeeT | Transmitter Ground | VeeT and VeeR are connected in SFP. |
| 2 | TX_FAULT | Transmitter Fault Indication | Transmit Fault |
| 3 | TX_DISABLE | Transmitter Disable | Connected to PHY reset |
| 4 | MOD DEF (2) | Module Definition 2 | Data Line for Serial ID (SDA). |
| 5 | MOD DEF (1) | Module Definition 1 | Clock Line for Serial ID (SCL). |
| 6 | MOD DEF (0) | Module Definition 0 | Tied to Vee in SFP. |
| 7 | RATE SELECT | Not Implemented | Not implemented. |
| 8 | LOS | Loss of Signal | See LOS option. |
| 9 | VeeR | Receiver Ground | VeeT and VeeR are connected in SFP. |
| 10 | VeeR | Receiver Ground | VeeT and VeeR are connected in SFP. |
| 11 | VeeR | Receiver Ground | VeeT and VeeR are connected in SFP. |
| 12 | RD- | Inverted Received Data out | AC coupled 100 ohm differential high speed data lines. |
| 13 | RD+ | Non-Inverted Received Data out | AC coupled 100 ohm differential high speed data lines. |
| 14 | VeeR | Receiver Ground | VeeT and VeeR are connected in SFP. |
| 15 | VccR | Receiver Power | VccR and VccT are connected in SFP. |
| 16 | VccT | Transmitter Power | VccR and VccT are connected in SFP. |
| 17 | VeeT | Transmitter Ground | VeeT and VeeR are connected in SFP. |
| 18 | TD+ | Non-inverted Data In | AC coupled 100 ohm differential high speed data lines. |
| 19 | TD- | Inverted Data In | AC coupled 100ohm differential high speed data lines |
| 20 | VeeT | Transmitter Ground | Veet and VeeR are connected in SFP |

Notes:

1. TX Fault is an open collector output, which should be pulled up with a 4.7k-10k Ω resistor on the host board to a voltage between 2.0V and Vcc+0.3V. Logic 0 indicates normal operation; Logic 1 indicates a laser fault of some kind. In the low state, the output will be pulled to less than 0.8V.
2. TX Disable as described in the MSA is connected to PHY reset and optical module for the 100BASE-FX application.
3. Mod-Def 0, 1, 2 are the module definition pins. They should be pulled up with a 4.7k-10k Ω resistor on the host board to a supply less than VccT + 0.3 V or VccR + 0.3 V.
4. RD-/+ : These are the differential receiver outputs. They are ac coupled 100 Ω differential lines which should be terminated with 100 Ω differentials. The ac coupling is done inside the module and is thus not required on the host board. The voltage swing levels are compatible with CML and LVPECL voltage swings.
5. VccR and VccT are the receiver and transmitter power supplies. They are defined as 3.3V \pm 5% at the SFP connector pin.
6. TD-/+ : These are the differential transmitter inputs. They are ac coupled differential lines with 100 Ω differential terminations inside the module. The ac coupling is done inside the module and is thus not required on the host board. The inputs levels are compatible with CML and LVPECL voltage swings.

Drawing Dimensions



Warnings

Laser Safety: Radiation emitted by laser devices can be dangerous to human eyes. Avoid eye exposure to direct or indirect radiation.