

1. Description

TM-866Ax-443I transceiver is an excellent product, which is a series of high performance optical modules suitable for Operation in Metro Access Network system. It is available in various wavelengths to meet the needs of each customer.

Because of its hot-pluggable capability, TM-866Ax-443I SFP transceiver can be installed in or removed from any MSA compliant pluggable small form factor port, regardless of, whether the host equipment is operating or not. Furthermore, TM-866Ax-443I SFP transceiver supports the DDM function and detailed product's information that stored for retrieval by host equipment.

For further information, please refer to SFP Multi- Source Agreement (MSA).

The transceiver operates up to 1.25Gbps data-rate from a single +3.3 V power supply.

2. Feature

- Compliant with SFP MSA
- Compliant with IEEE802.3ah 1000BASE-EX specifications
- Digital Diagnostic SFF-8472 compliant
- 1310nm DFB Laser transmitter / Wide dynamic range PIN-PD receiver
- Single +3.3V power supply
- Up to 40km Transmission on 9/125 um Single Mode Fiber
- LC duplex connector
- Two optional operating temperature ranges
- RoHS compliant

3. Application

- Gigabit Ethernet
- Fiber Channel
- WDM Application

4. Specifications

4.1 Specifications

| Parameter | Specifications | Unit |
|--------------------------------------|---|------|
| Electrical interface | SFP MSA Compatible | - |
| Standard | IEEE 802.3ah, 1000BASE-LX | - |
| Maximum transmission Distance | 40 | km |
| Optical connector type | LC duplex receptacle (IEC61754-4) | - |
| Laser safety standards | IEC60825-1 Class1 | - |
| Reliability | Per Telcordia GR-468-CORE | - |
| EMI standards | VCCI Class B | |
| Optical connector end face standards | IPC-8497-1 | |
| Operating temperature (Ambient) | Option A : 0 to +70 Option B : -40 to 85 | °C |
| Operating current consumption | ≤ 300 | mA |

4.2 Absolute maximum ratings

| Parameter | Symbol | Ratings | Unit | Conditions |
|----------------------|--------|----------------|------|------------|
| Power Supply Voltage | Vcc | 0 to +4 | V | |
| Operating voltage | Vcc | +3.13 to +3.47 | V | |
| Storage Temperature | Tst | -40 to +85 | °C | |
| Operating humidity | Hop | max.85 | %RH | |

5. Optical Characteristics of Transmitter and Receiver

5.1 Transmitter Characteristics

| Parameter | Symbol | Min | Typ | Max | Unit |
|--------------------------------|-------------------------------------|------|------|------|------|
| Bit rate | B | - | 1.25 | - | Gb/s |
| Center Wavelength | λ_c | 1270 | 1310 | 1330 | nm |
| Output Spectral Width | λ_{rms} | - | - | 3 | nm |
| Average Launch Power | Po | -3 | - | +2 | dBm |
| Average Launch Power of Off TX | Poff | - | - | -45 | dBm |
| Extinction Ratio (Note1) | Phi/Plo | 9 | - | - | dB |
| Rise Time, Fall Time (Note2) | Tr/Tf | - | 0.12 | 0.2 | ns |
| Common-Mode input | V _{CM} | - | 1.8 | - | V |
| Transmitter Output Eye | Compliant with IEEE802.3ah standard | | | | |

(Note1) 1.25Gb/s, PRBS 2⁷ - 1

(Note2) Unfiltered, 20%~80% values

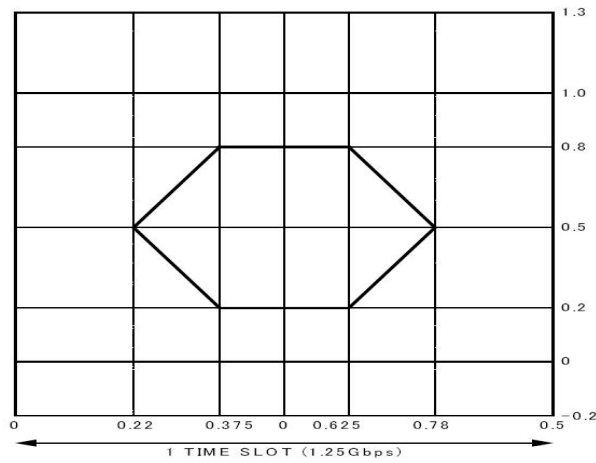


Figure 1. Transmitter Eye Mask

5.2 Receiver Characteristics

| Parameter | Symbol | Min | Typ | Max | Unit |
|--|-------------|------|-----|------------|------|
| Center Wavelength | λ_c | 1100 | - | 1620 | nm |
| Bit Error Ratio | BER | - | - | 10^{-12} | - |
| Sensitivity (EOL) (Note1) | P_{min} | - | - | -22 | dBm |
| Maximum Input Power(Note1) | P_{max} | 0 | - | - | dBm |
| LOS Assert (Note1) | LOS_A | -35 | - | - | dBm |
| LOS De-Assert (Note1) | LOS_D | - | - | -23 | dBm |
| Hysteresis | SD Hys | 0.5 | - | 5 | dB |
| Rise Time, Fall Time (No Slew Note2) | T_r/T_f | - | 90 | 100 | ps |
| Rise Time, Fall Time (Fast Slew Note2) | T_r/T_f | - | 160 | 200 | ps |

(Note1) Receiving signals is 1.25Gbps, PRBS 2^7-1 , BER= 1×10^{-12} , ER=9dB, Tx=ON

(Note2) 20%~80% values

5.3 Block Diagram

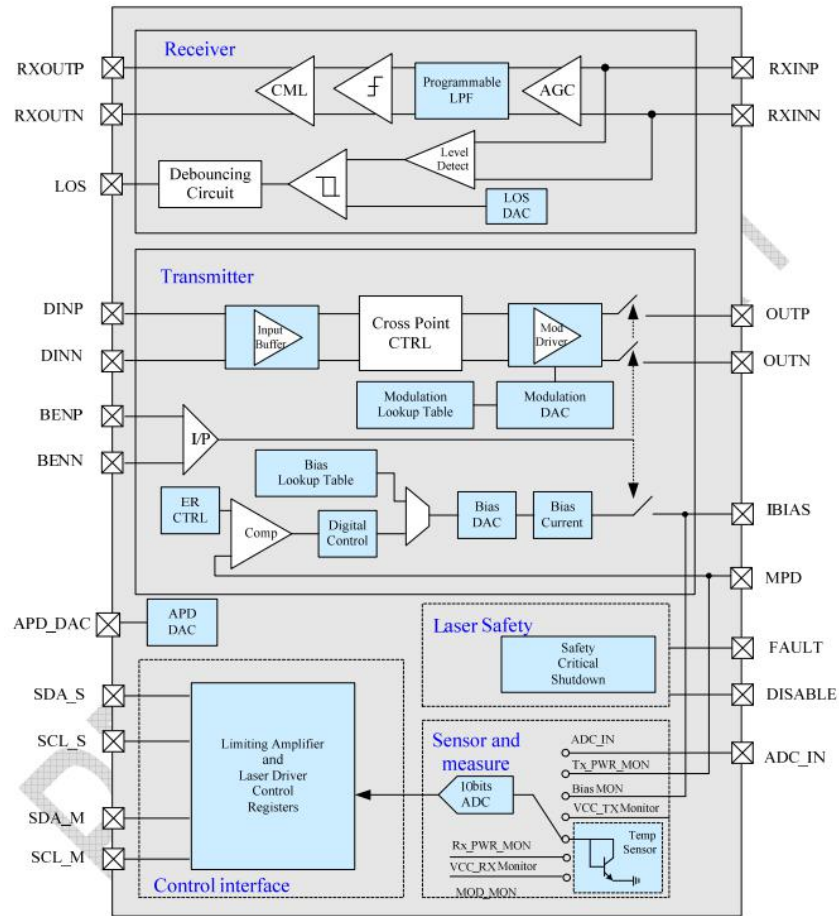


Figure2. Function Block Diagram

6. Electrical characteristics of Transmitter and Receiver

| Parameter | Symbol | Min | Typ | Max | Unit |
|--|----------------|-----|-----|------|----------|
| Transmitter Differential Input Voltage | $V_{IN, p-p}$ | 200 | - | 2400 | mVp-p |
| Tx Disable Input Low Voltage | V_{IL} | 0 | - | 0.8 | V |
| Tx Disable Input High Voltage | V_{IH} | 2.0 | - | Vcc | V |
| TX Fault Output Low Voltage | V_{OL} | 0 | - | 0.4 | V |
| TX Fault Output High Voltage | V_{OH} | 2.0 | - | Vcc | V |
| Input differential impedance | R_{IN} | - | 100 | - | Ω |
| Receiver Differential Output Voltage | $V_{OUT, p-p}$ | 400 | - | 1200 | mVp-p |
| RX_LOS Output Voltage-Low | V_{OL} | 0 | - | 0.4 | V |
| RX_LOS Output Voltage-High | V_{OH} | 2.0 | - | Vcc | V |

7. Timing Characteristics

| Parameter | Symbol | Min | Typ | Max | Unit |
|--|-----------------------|-----|-----|-----|------|
| TX_DISABLE Assert Time | t _{off} | - | 3 | 10 | us |
| TX_DISABLE Negate Time | t _{on} | - | 0.5 | 1 | ms |
| Time to Initialize, Including Reset of TX_FAULT | t _{int} | - | 30 | 300 | ms |
| TX_FAULT Assert Time | t _{fault} | - | 20 | 100 | us |
| TX_DISABLE to Reset | t _{reset} | 10 | - | - | us |
| RX_LOS Assert Time | t _{loss_on} | - | - | 100 | us |
| RX_LOS Negate Time | t _{loss_off} | - | - | 100 | us |

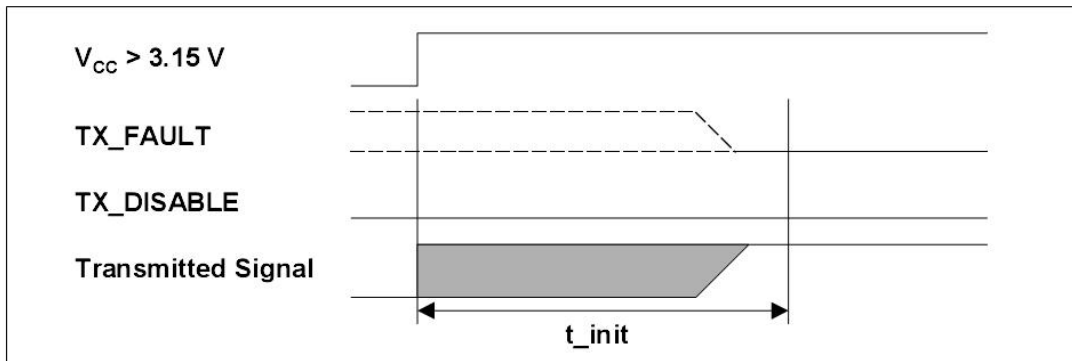


Figure 3. Power on initialization of SFP transceiver, TX_DISABLE negated

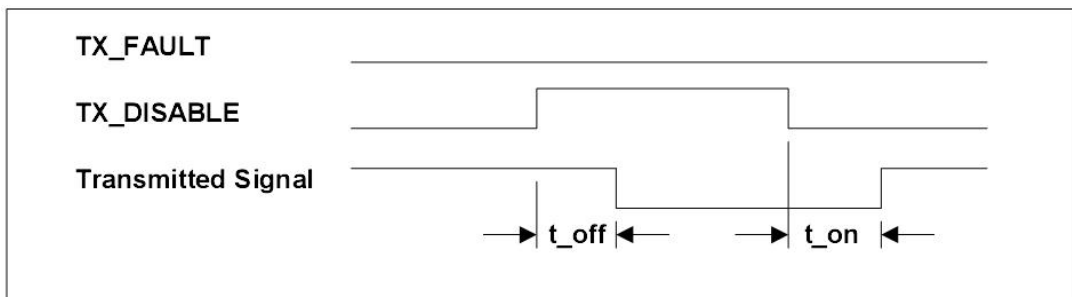


Figure 4. SFP TX_DISABLE timing during normal operation

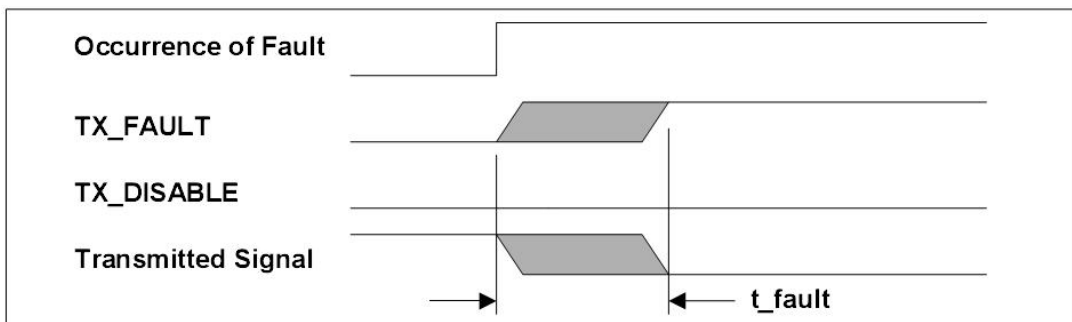


Figure 5. Detection of transmitter safety fault condition

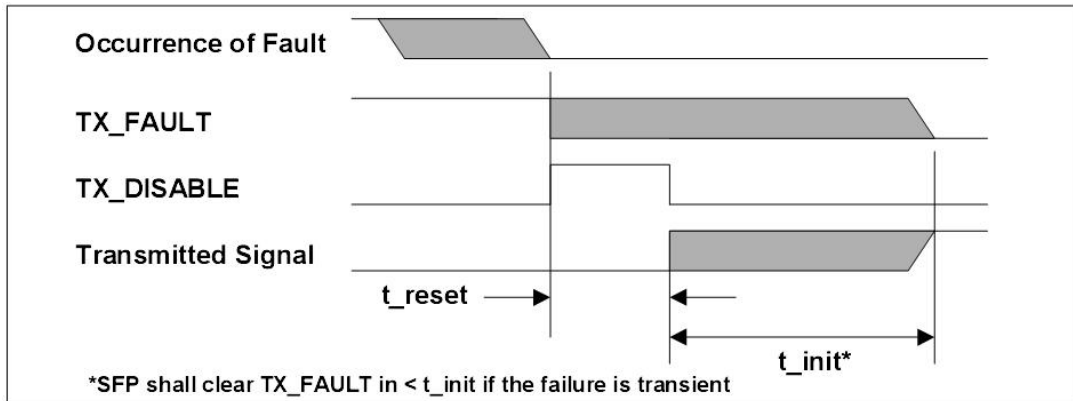


Figure 6. Successful recovery from transient safety fault condition

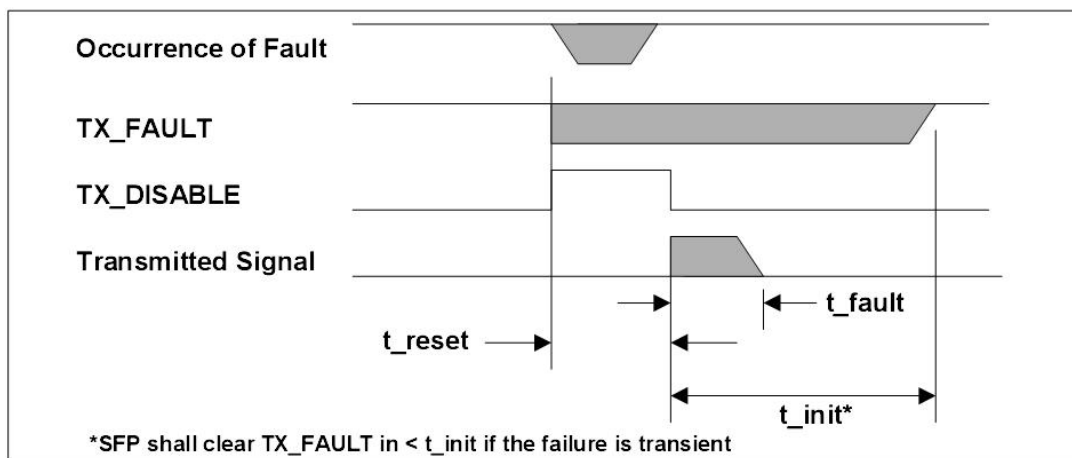


Figure 7. Unsuccessful recovery from safety fault condition

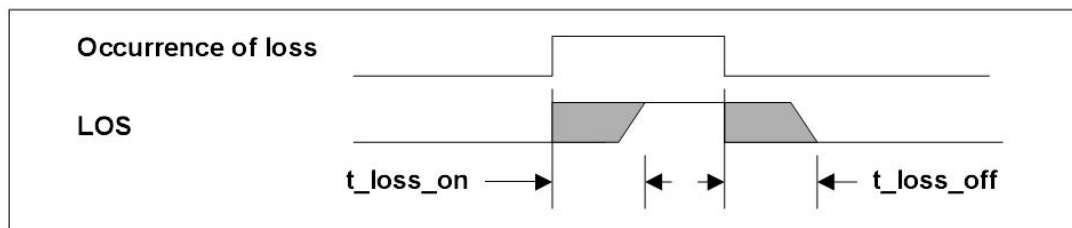


Figure 8. Timing of RX_LOS detection

8. Pin Descriptions

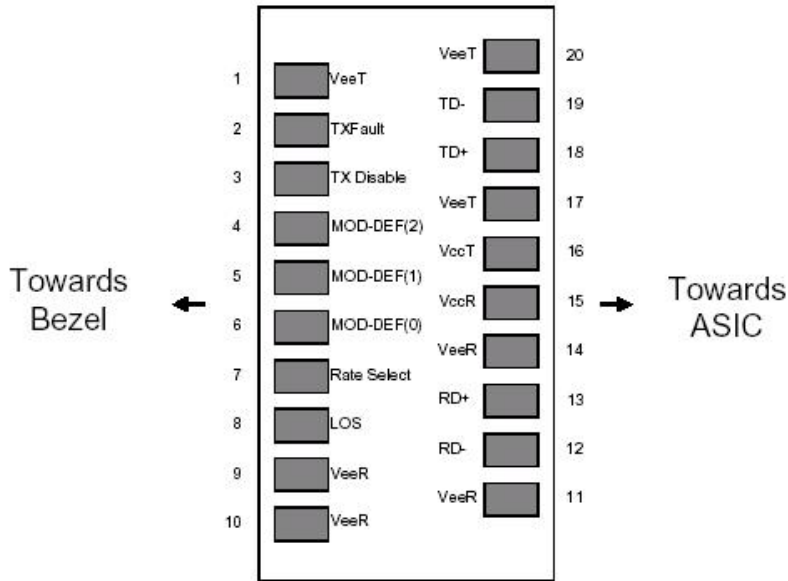


Figure 9. Pin out of Connector Block on Host Board

| Pin | Symbol | Description | Note | Plug Seq. * |
|-----|-----------------------|--|------|-------------|
| 1 | V _{EET} | Transmitter ground (Common with receiver ground) | 1 | 1 |
| 2 | TX _{Fault} | Transmitter Fault. | - | 3 |
| 3 | TX _{Disable} | Transmitter Disable | 2 | 3 |
| 4 | MOD_DEF(2) | SDA Serial Data Signal | 3 | 3 |
| 5 | MOD_DEF(1) | SCL Serial Clock Signal | 3 | 3 |
| 6 | MOD_DEF(0) | Grounded within the module | 3 | 3 |
| 7 | Rate Select | No connection required | - | 3 |
| 8 | LOS | Loss of Signal indication (TTL Output) | 4 | 3 |
| 9 | V _{EER} | Receiver ground (Common with transmitter ground) | 1 | 1 |
| 10 | V _{EER} | Receiver ground (Common with transmitter ground) | 1 | 1 |
| 11 | V _{EER} | Receiver ground (Common with transmitter ground) | 1 | 1 |
| 12 | RD- | Receiver inverted Data out. AC Coupled | - | 3 |
| 13 | RD+ | Receiver Non-inverted Data out. AC Coupled | - | 3 |
| 14 | V _{EER} | Receiver ground | 1 | 1 |
| 15 | V _{CCR} | Receiver Power Supply | - | 2 |
| 16 | V _{CCT} | Transmitter Power Supply | - | 2 |
| 17 | V _{EET} | Transmitter ground (Common with receiver ground) | 1 | 1 |

| | | | | |
|----|------------------|--|---|---|
| 18 | TD+ | Transmitter Non-inverted Data in. AC Coupled | - | 3 |
| 19 | TD- | Transmitter inverted Data in. AC Coupled. | - | 3 |
| 20 | V _{EET} | Transmitter ground (Common with receiver ground) | 1 | 1 |

*Plug Seq. : Pin engagement sequence during hot plugging

(Note1) Circuit ground is internally isolated from chassis ground.

(Note2) Laser output disabled on TDIS >2.0V or open, enabled on TDIS <0.8V.

(Note3) Should be pulled up with 4.7k – 10kohms on host board to a voltage between 2.0V and 3.6V.

MOD_DEF(0) pulls line low to indicate module is plugged in.

(Note4) LOS is open collector output. Should be pulled up with 4.7k – 10kohms on host board to a voltage between 2.0V and 3.6V. Logic 0 indicates normal operation; logic 1 indicates loss of signal.

9. Digital Diagnostic Monitoring Functions

2-wire serial bus address 1010001X (A2h) is used to access measurement of transceiver temperature, internally measured supply voltage, TX bias current, TX optical output power and RX optical input power which are shown in table 1. Each diagnostic parameter has a corresponding high alarm, low alarm, high warning and low warning threshold which are shown in table 2.

Table 1. Diagnostic Parameters

| Diagnostic Parameter | Range | | LSB | Accuracy | Address | Note |
|---|----------|---------|-----------|----------|---------|---------------------------------------|
| | Min | Max | | | | |
| Transceiver Temperature (Temp) Option A | -10[°C] | +80[°C] | 1/256[°C] | ±3[°C] | 96-97 | A 16bit signed two's complement value |
| Transceiver Temperature (Temp) Option B | -50[°C] | +95[°C] | 1/256[°C] | ±3[°C] | 96-97 | |
| Supply Voltage (Voltage) | +3.0[V] | +3.6[V] | 100[μV] | ±3[%] | 98-99 | A 16bit unsigned integer |
| TX Bias Current (Bias) | 3[mA] | 95[mA] | 2.0[μA] | ±10[%] | 100-101 | A 16bit unsigned integer |
| TX Optical Output Power (TX Power) | -4[dBm] | +3[dBm] | 0.1[μW] | ±3 [dB] | 102-103 | A 16bit unsigned integer |
| RX Optical Input Power (RX Power) | -23[dBm] | +0[dBm] | 0.1[μW] | ±3 [dB] | 104-105 | A 16bit unsigned integer |

Table 2. Alarm and Warning Thresholds

| Parameter | Warning | | Alarm | | Unit |
|---|---------|-------|-------|------|------|
| | Low | High | Low | High | |
| Transceiver Temperature (Temp) Option B | -10 | +80 | -20 | +90 | °C |
| Transceiver Temperature (Temp) Option A | -45 | +95 | -50 | 110 | |
| Supply Voltage (Voltage) | +3.13 | +3.47 | +3.0 | +3.6 | V |
| TX Bias Current (Bias) | 5 | 85 | 3 | 95 | mA |
| TX Optical Output Power (TX Power) | -4 | +3 | -5 | +4 | dBm |
| RX Optical Input Power (RX Power) | -23 | +1 | -24 | +2 | dBm |

10. Power Supply Information

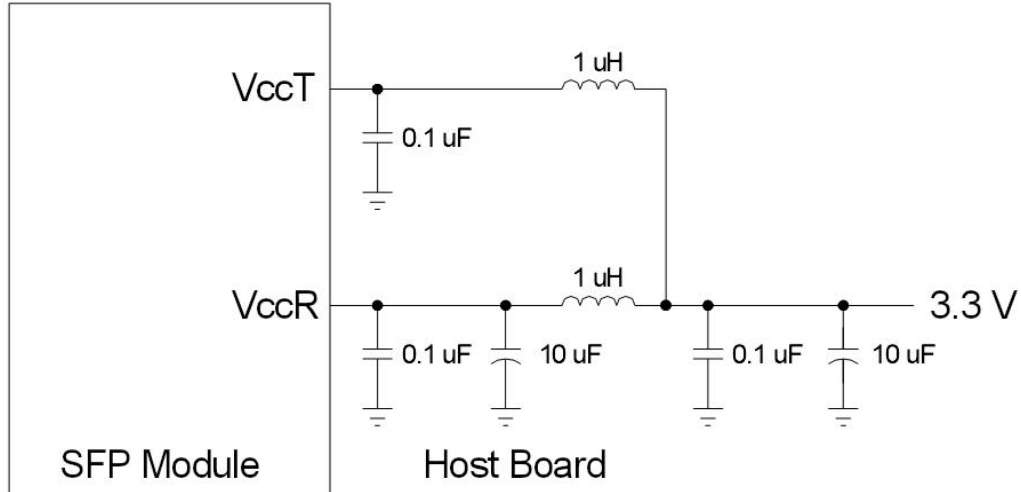
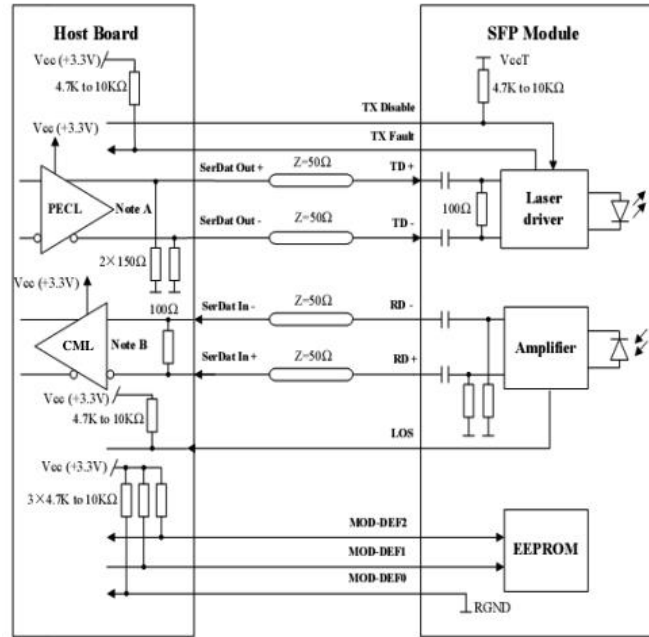


Figure 10. Recommended Host Board Supply Filtering Network



Note A: Circuit assumes open emitter output
Note B: Circuit assumes high impedance internal bias @ Vcc-1.3V

Figure 11. Recommended Circuit

11. Mechanical Dimensions

