# SFP56 50G 1310nm 10KM LC DDM Transceiver

# AE-SFP56-LR

## Features

- Up to 53.125Gbps (26.5625GBd PAM4)
- 1311nm DFB Transmitter
- Distance up to 10Km
- Duplex LC Connector Interface, Hot Pluggable
- Compliant to Specification SFF-8472
- Power Dissipation < 1.8W (0℃~+70℃)
- Power Dissipation < 2W (-40℃~+85℃)
- Operating Case Temperature commercial: 0℃~+70℃ Industrial: -40℃~+85℃
- Safety Certification: TUV/UL/FDA*1
- RoHS Compliant

## Applications

- IEEE 802.3cd 50GBASE-LR
- Other Optical Link

## Description

AERECH AE-SFP56-LR transceiver module is designed for 50 Gigabit Ethernet, operating up to 53.125Gbps with 10 Kilometers link length on single mode fiber via a duplex LC connector. The transceiver has an SFP+ 20-pin connector compliant to SFF-8431 specification and supports hot plug and digital diagnostic function via an I2C.

The transmitter of the module integrates a DML chip and a Class 1 DFB laser is compliant to international Safety Standard IEC 60825. The receiver of the module integrates a linear TIA and a PIN detector with high sensitivity.

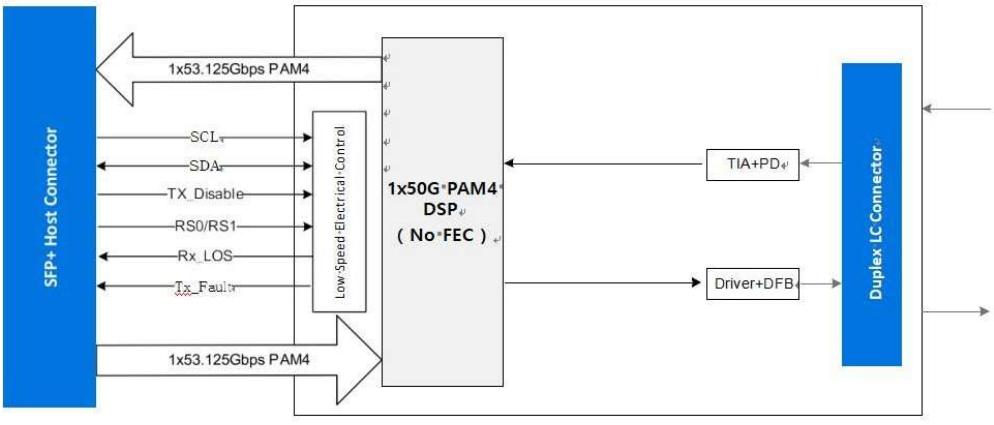



Figure 1: Transceiver Block Diagram

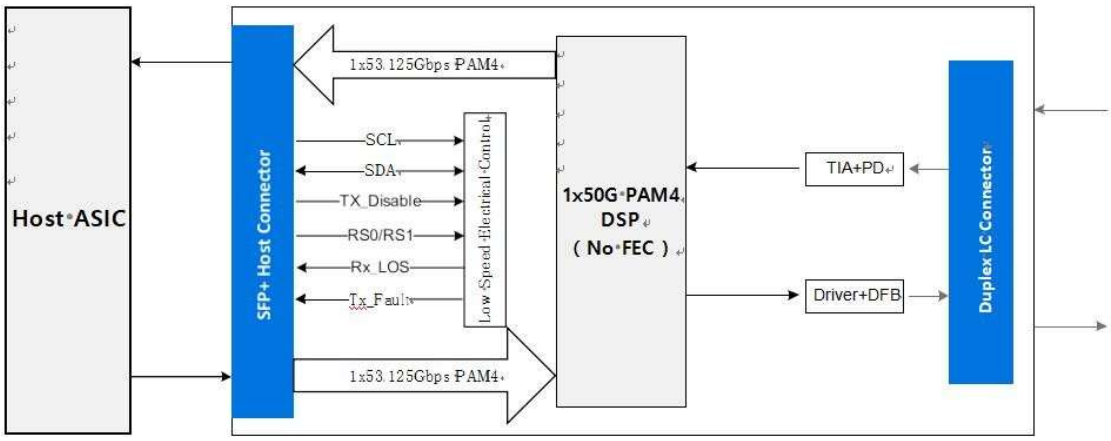



Figure 2: Application Reference Diagram

## Absolute Maximum Ratings

| Parameter | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|
| Storage Temperature | $T_S$ | -40 | +85 | °C |
| Supply Voltage | VCC | -0.5 | 3.6 | V |
| Relative Humidity | RH | 5 | 85 | % |

## Recommended Operating Conditions

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Operating Case Temperature*2 | $T_C$ – C temp | 0 | | 70 | °C |
| | $T_C$ – I temp | -40 | | 85 | °C |
| Power Supply Voltage | VCC | 3.135 | 3.3 | 3.465 | V |
| Power Supply Noise*3 | | | | 66 | mVpp |
| Data Rate | | | 53.125 | | Gbps |
| Transmission Distance | TD | | | 10 | Km |

## General Electrical Characteristics

| Parameter | Symbol | Min. | Typical | Max. | Unit |
|---|---|---|---|---|---|
| Power Dissipation | PD-C temp | | | 1.8 | W |
| | PD-I temp | | | 2 | W |
| Power Supply Current, Total | | | | 519 | mA |
| | | | | 577 | mA |

### Reference Points

| Test Point | Description |
|---|---|
| TP1 | Input to module compliance board through mated module compliance board and module connector. |
| TP1a | Host ASIC transmitter output across the Host Board and Host Edge Card connector at the output of the host compliance board. |
| TP2 | The optical transmit signal is defined at the output end of a single-mode fiber patch cord (TP2). |
| TP3 | The optical receive signal is defined at the output of the fiber optic cabling (TP3). |
| TP4 | Module output through mated module and host edge card connector through module compliance board. |
| TP4a | Input to host compliance board through mated host compliance board and host edge card connector. |

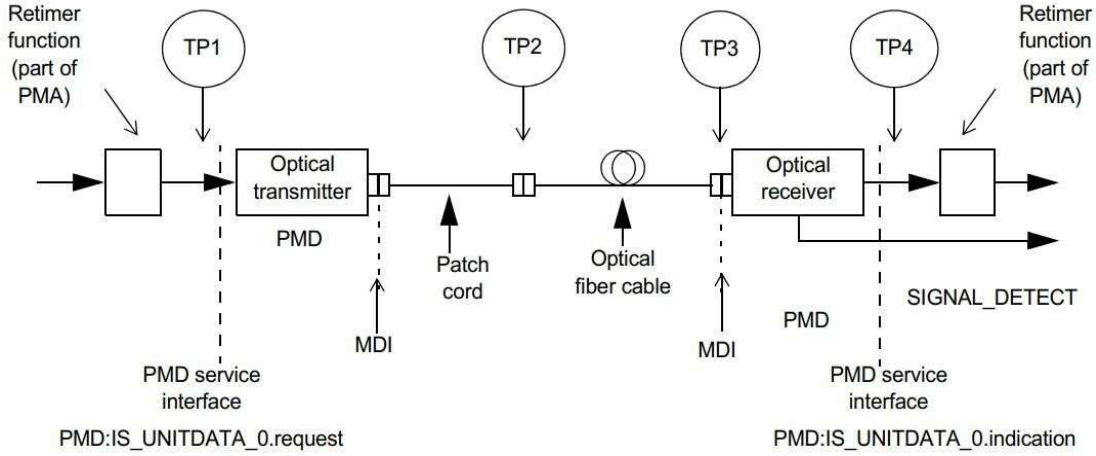



Figure 3: Block diagram for 50GBASE-LR transmit/receive paths

### High Speed Electrical Input Characteristics

| Parameter | Test Point | Min. | Typical | Max | Unit | Conditions |
|---|---|---|---|---|---|---|
| Signaling Rate | TP1 | | 26.5625 | | GBd | +/- 100 ppm |
| Differential pk-to-pk Input Voltage Tolerance | TP1a | 900 | | | mV | |
| Differential Input Return Loss | TP1 | Equation (83E-5) | | | dB | IEEE802.3 |
| Differential to Common-mode Input Return Loss | TP1 | Equation (83E-6) | | | dB | IEEE802.3 |
| Differential Termination Mismatch | TP1 | | | 10 | % | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Single-ended Voltage Tolerance Range | TP1a | -0.4 | | 3.3 | V | |
| DC Common-mode Voltage* 4 | TP1 | -350 | | 2850 | mV | |
| Module stressed input parameters* 5 | | | | | | |
| Eye Width | | | | 0.22 | UI | |
| Applied pk-pk Sinusoidal Jitter | | | | Table 120E-6 | | IEEE802.3 |
| Eye Height | | | | 32 | mV | |

1. DC common mode voltage generated by the host. Specification includes effects of ground offset voltage.
2. Meets BER specified in 120E.1.1 in IEEE802.3 specification.

### High Speed Electrical Output Characteristics

| Parameter | Test Point | Min. | Typical | Max. | Unit | Conditions |
|---|---|---|---|---|---|---|
| Signaling Rate | TP4 | | 26.5625 | | GBd | +/- 100 ppm |
| AC Common-mode Output Voltage (RMS) | TP4 | | | 17.5 | mV | |
| Differential pk-to-pk Output Voltage | TP4 | | | 900 | mV | |
| Near-end ESMW (Eye Symmetry Mask Width) | TP4 | | 0.265 | | UI | |
| Near-end Eye Height, Differential | TP4 | 70 | | | mV | |
| Far-end ESMW (Eye Symmetry Mask Width) | TP4 | | 0.2 | | UI | |
| Near-end Eye Height, Differential | | 30 | | | mV | |
| Far-end Eye Pre-cursor ISI Ratio | | -4.5 | | 2.5 | % | |
| Differential Output Return Loss | TP4 | Equation (83E-2) | | | dB | IEEE802.3 |
| Common to Differential Mode Conversion Return Loss | TP4 | Equation (83E-3) | | | dB | IEEE802.3 |
| Differential Termination Mismatch | TP4 | | | 10 | % | |
| Transition Time (20% to 80%) | TP4 | 9.5 | | | ps | |
| DC Common Mode Voltage*6 | TP4 | -350 | | 2850 | mV | |

1. DC common mode voltage generated by the host. Specification includes effects of ground offset voltage.

## High Speed Optical Transmitter Characteristics

### Optical Characteristics @TP2 Test Point

| Parameter | Symbol | Min. | Typical | Max. | Unit |
|---|---|---|---|---|---|
| Signaling Rate | | | 53.125 | | Gbps |
| Modulation Format | | | PAM4 | | |
| Centre Wavelength | λC | | 1311 | | nm |
| Side-mode Suppression Ratio | SMSR | 30 | | | dB |
| 20dB Spectral Width | Δλ | | | 1 | nm |
| Average Launch Power | PAVG | -4.5 | | 4.2 | dBm |
| Extinction Ratio | ER | 3.5 | | | dB |
| Outer Optical Modulation Amplitude ($OMA_{outer}$)*7 | POMA | -1.5 | | 4 | dBm |
| Launch Power in $OMA_{outer}$ minus TDECQ | | -2.9 | | | dB |
| Transmitter and Dispersion Eye Closure | TDECQ | | | 3.2 | dB |
| TDECQ-10$log_{10}$(Ceq) | | | | 3.2 | dB |
| Average Launch Power of OFF Transmitter | POFF | | | -16 | dBm |
| $RIN_{15.6}$OMA | | | | -132 | dB/Hz |
| Optical Return Loss Tolerance | | | | 15.6 | dB |
| Transmitter Reflectance | | | | -26 | dB |

1. Even if the TDECQ<1.4dB, the $OMA_{outer}$(min) must excess this value.

## High Speed Optical Receiver Characteristics

### Optical Characteristics @TP3 Test Point

| Parameter | Symbol | Min. | Typical | Max. | Unit |
|---|---|---|---|---|---|
| Signaling Rate | | | 53.125 | | Gbps |
| Modulation Format | | | PAM4 | | |
| Centre Wavelength | λC | | 1311 | | nm |
| Damage Threshold*8 | | 5.2 | | | dBm |
| Average Receive Power*9 | RAVG | -10.8 | | 4.2 | dBm |
| Receiver Power ($OMA_{outer}$) | ROMA | | | 4 | dBm |
| Receiver Reflectance | | | | -26 | dB |
| Receiver Sensitivity ($OMA_{outer}$)*10 | | | | -8.4 | |
| Stressed Receiver Sensitivity ($OMA_{outer}$) | | | | -6.6 | dBm |
| LOS Assert | LOSA | -30 | | | dBm |
| LOS De-Assert | LOSD | | | -11 | dBm |
| LOS Hysteresis | | 0.5 | | | dB |
| Condition of Stressed Receiver Sensitivity Test*11 | | | | | |
| Stressed Eye Closure for PAM4 | SECQ | | | 3.2 | dB |
| SECQ-10$log_{10}$($C_{eq}$) | | | | 3.2 | dB |

1. The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal

having this average power level..

2. Average receive power (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.

3. Receiver sensitivity should meet RS = max (-8.4, SECQ-9.8) with BER < $2.4x10^{-4}$ pre-FEC.

4. These test conditions are for measuring stressed receiver sensitivity. They are not characteristics of receiver.

### Regulatory Compliance Issues

Various standards and regulations apply to the SFP-50SM31-10C modules. These include eye-safety, Component Recognition, RoHS, ESD, EMC and Immunity. Please note the transmitter module is a Class 1 laser product. See Regulatory Compliance Table for details.

### Regulatory Compliance Table

| Feature | Test Method | Performance |
|---|---|---|
| Laser Eye Safety and Equipment Type Testing | (IEC) EN 62368-1:2014+A11 (IEC) EN 60825-1:2014 (IEC) EN 60825-2:2004+A1+A2 | CDRH Accession Number:2132182-000 TUV File: R 50457725 0001 CB File: JPTUV-100513 |
| Component Recognition | Underwriters Laboratories (UL) and Canadian Standards Association (CSA) Joint Component Recognition for Information Technology Equipment including Electrical Business Equipment | UL File: E317337 |
| RoHS Compliance | RoHS Directive 2011/65/EU&(EU)2015/863 | Less than 100 ppm of cadmium. Less than 1000 ppm lead, mercury, hexavalent chromium, poly brominated biphenyls (PPB), poly brominated biphenyl ethers (PBDE), dibutyl phthalate, butyl benzyl phthalate, bis (2-ethylhexyl) phthalate and diisobutyl phthalates. |
| Electrostatic Discharge (ESD) to the Electrical Contacts | JEDEC Human Body Model (HBM) (JESD22-A114-B) | High speed contacts shall withstand 1000V. All other contacts shall withstand 2000 V. |

| | | |
|---|---|---|
| Electrostatic Discharge (ESD) to the Optical Connector Receptacle | IEC 61000-4-2:2008 | When installed in a properly grounded housing and chassis the units are subjected to 15kV air discharges during operation and 8kV direct discharges to the case. |
| Electromagnetic Interference (EMI) | FCC Part 15 Class B; CISPR 32 (EN55032) 2015; | System margins are dependent on customer board and chassis design. |
| Immunity | IEC 61000-4-3:2010; EN55035:2017 | Typically shows no measurable effect from a 10V/m field swept from 80 MHz to 1 GHz applied to the module without a chassis enclosure. |

**SFP56 Transceiver Electrical Pad Layout**

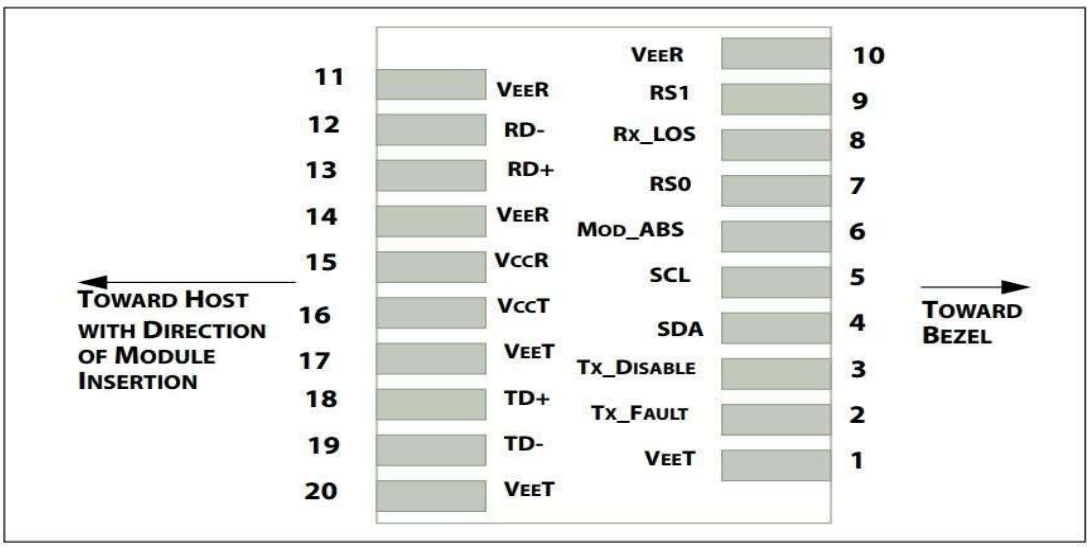



Figure 4: SFP56 Module Pinout

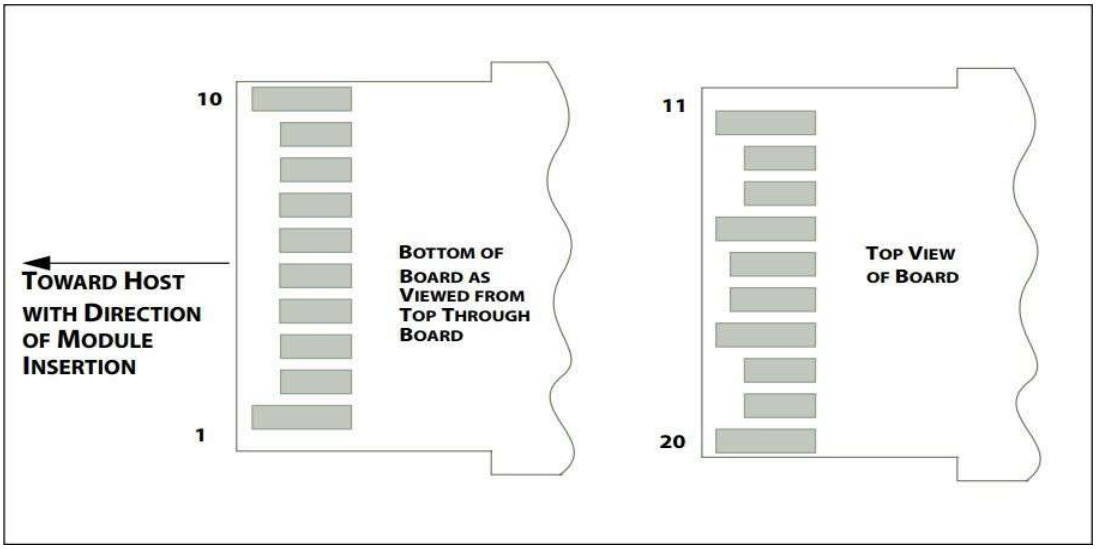



Figure 5: SFP56 Module Contact Assignment

### Pin Arrangement and Definition

| Pin Num. | Name | Function | Plug Seq. | Notes |
|---|---|---|---|---|
| 1 | VeeT | Transmitter Ground | 1 | 1 |
| 2 | Tx_Fault | Transmitter Fault Indication | 3 | 2 |
| 3 | Tx_Disable | Transmitter Disable | 3 | 3 |
| 4 | SDA | 2-Wire Serial Interface Data Line | 3 | |
| 5 | SCL | 2-Wire Serial Interface Clock | 3 | |
| 6 | Mod_ABS | Module Absent | 3 | |
| 7 | RS0 | Rate Select 0 | 3 | |
| 8 | Rx_LOS | Receiver Loss of Signal Indication | 3 | 2 |
| 9 | RS1 | Rate Select 1 | 3 | |
| 10 | VeeR | Receiver Ground | 1 | 1 |
| 11 | VeeR | Receiver Ground | 1 | 1 |
| 12 | RD- | Receiver Inverted Data Output | 3 | |
| 13 | RD+ | Receiver Non-Inverted Data Output | 3 | |
| 14 | VeeR | Receiver Ground | 1 | 1 |
| 15 | VccR | Receiver 3.3V Supply | 2 | |
| 16 | VccT | Transmitter 3.3V Supply | 2 | |
| 17 | VeeT | Transmitter Ground | 1 | 1 |
| 18 | TD+ | Transmitter Non-Inverted Data Input | 3 | |
| 19 | TD- | Transmitter Inverted Data Input | 3 | |
| 20 | VeeT | Transmitter Ground | 1 | 1 |

1: The module signal ground contacts, VeeR and VeeT, should be isolated from the module case.

2: This contact is an open collector/drain output contact and shall be pulled up on the host. Pull ups can be connected to one of several power supplies, however the host board design shall ensure that no module contact has voltage exceeding module VccT/R + 0.5V.

3: Tx_Disable is an input contact with a resistor pullup to VccT inside the module.

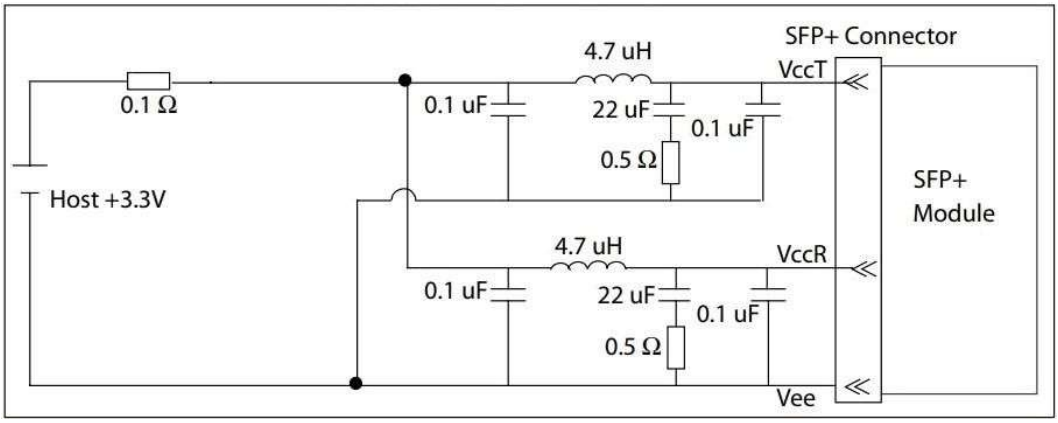
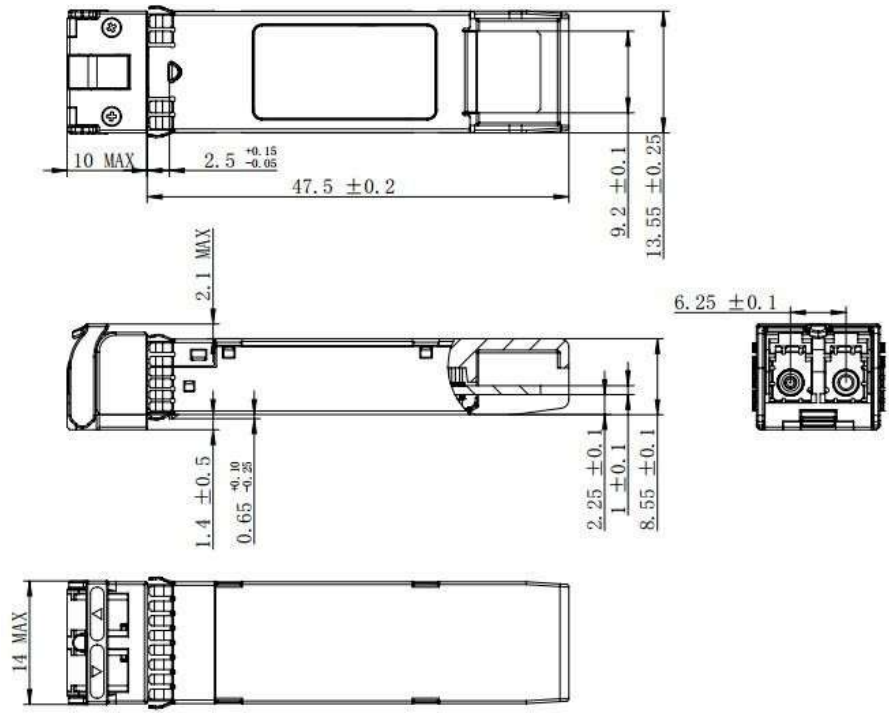



Figure 6: Host Board Power Supply Filter

During power transient events, the host should ensure that any neighboring modules sharing the same supply stay within their specified supply voltage limits. The host should also ensure that the intrinsic noise of the power rail is filtered in order to guarantee the correct operation of the optical modules. The reference power supply filter is shown in Figure 6.

**Dimension**



### Low Speed Control and Sense Signals

| Parameter | Symbol | Min. | Typical | Max. | Unit |
|---|---|---|---|---|---|
| SCL and SDA | VOL | 0 | | 0.4 | V |
| | VOH | $V_{CC}$-0.5 | | $V_{CC}$+0.3 | V |
| SCL and SDA | VIL | -0.3 | | $V_{CC}$*0.3 | V |
| | VIH | $V_{CC}$* 0.7 | | $V_{CC}$+0.5 | V |
| Tx_Fault, Rx_LOS | VOL | -0.3 | | 0.4 | V |
| | IOH | -50 | | 37.5 | μA |
| Tx_Disable, RS0, RS1, | VIL | -0.3 | | 0.8 | V |
| | VIH | 2 | | $V_{CC}$+0.3 | V |

### Ordering Information

| Part Number | Description |
|---|---|
| AE-SFP56-LR | 53.125Gbps, 1311nm DFB, SMF, 10km, 0~+70℃, with DDM |