

## SFP-50SM31-02C

### Features

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



### Applications

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

### Product Description

AscentOptics SFP-50SM31-02C SFP56 transceiver module is designed for 50 Gigabit

53.125Gbps with 2 Kilometers link length on single mode fiber via a duplex LCconnector. The transceiver has an SFP+ 20-pin connector compliant to SFF-8431 specification and supports hot plug and digital diagnostic function via an I<sup>2</sup>C.

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.

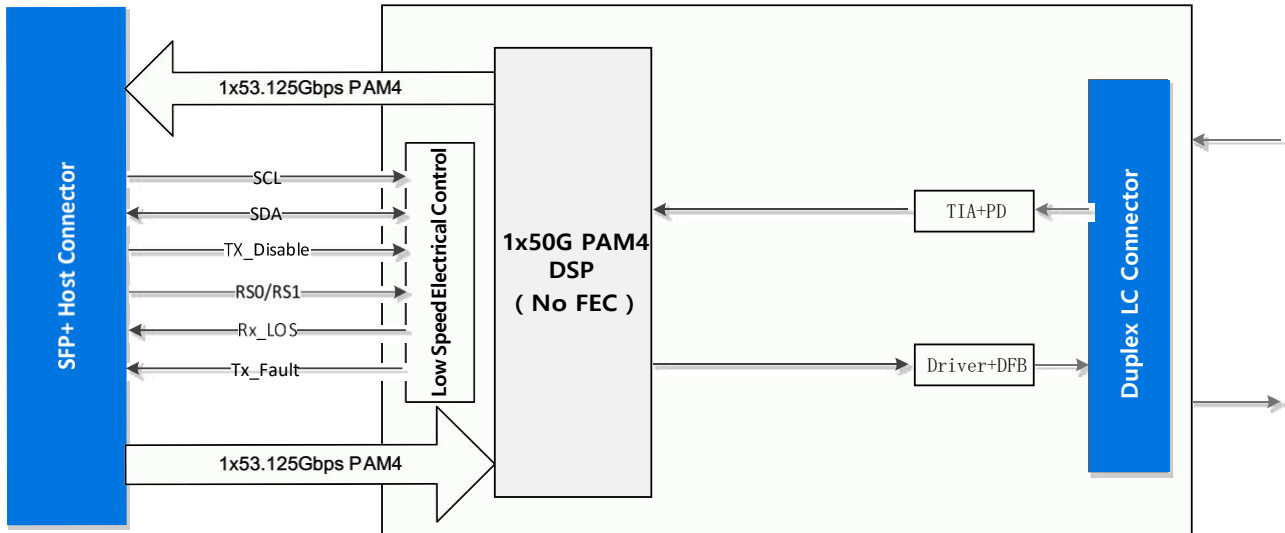
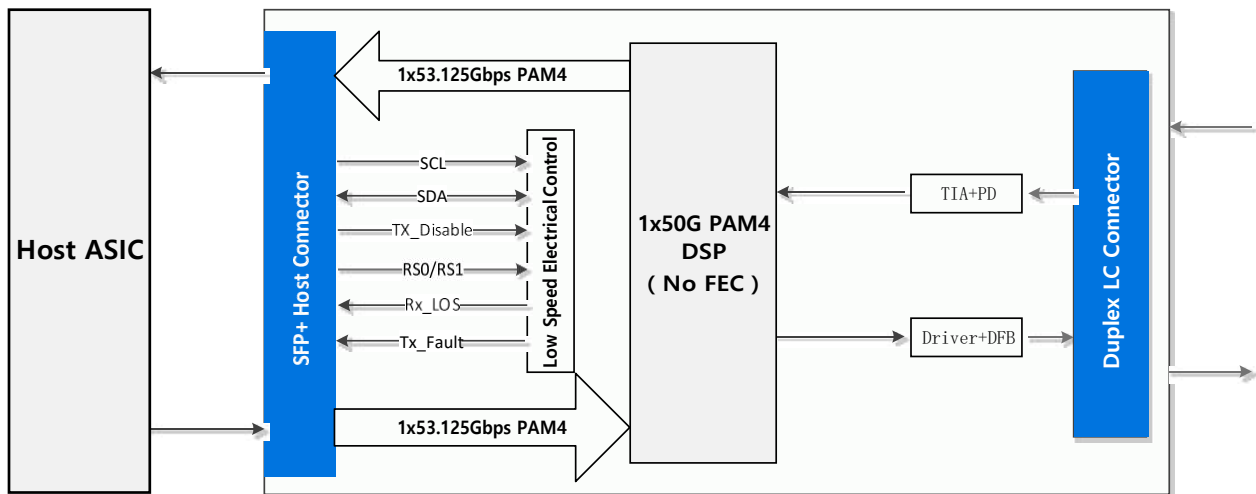


Figure 1: Transceiver Block Diagram



### Transmitter

As shown in Figure 1, the optical transmitter of SFP56 transceiver integrates a DML driver which is an ultra-low power dissipation, high-performance single channel driver for up to 28Gbaud/s PAM4 application and a DFB which is designed for EN 60825 and CDRH Class 1 eye safety compliance with a center wavelength of 1311nm.

### Receiver

As shown in Figure 1, the optical receiver of SFP56 transceiver integrates a PD and a high-performance liner transimpedance amplifier (TIA) which contains a received Signal Indicator (RSSI) can provide a highly accurate measurement of photodiode current down to dark current levels.

### High Speed Electrical Signal Interface

The interface between SFP56 module and ASIC/SerDes is showed in Figure 2. The high-speed signal lines are internally AC-coupled and the electrical inputs are internally terminated to 100 Ohms differential. All transmitter and receiver electrical channels are compliant to 50GAUI-1 specification.

## Handling and Cleaning

Exposure to current surges and overvoltage events can cause immediate damage to the transceiver module. Observe the precautions for normal operation of electrostatic discharge sensitive equipment; Attention shall also be paid to limiting transceiver module exposure to conditions beyond those specified in the absolute maximum ratings.

Each module is equipped with a port guard plug to protect the optical port. The protective plug shall always be in place whenever the optical fiber is not inserted. Before inserting the optical fiber, it is recommended to clean the end of the optical fiber connector to avoid contamination of the module optical port due to dirty connector. If contamination occurs, use standard LC port cleaning methods.

## Absolute Maximum Ratings

Exceeding the absolute maximum ratings table may cause permanent damage to the device. This is just an emphasized rating, and does not involve the functional operation of the device that exceeds the specifications of this technical specification under these or other conditions. Long-term operation under absolute maximum ratings will affect the reliability of the device.

Parameter	Symbol	Min.	Max.	Unit
Storage Temperature	T <sub>s</sub>	-40	+85	°C
Supply Voltage	VCC	-0.5	3.6	V
Relative Humidity	RH	5	85	%

## Recommended Operating Conditions

For operations beyond the recommended operating conditions, optical and electrical characteristics are not defined, reliability is not implied, and such operations for a long time may damage the module.

Parameter	Symbol	Min.	Typ.	Max.	Unit
Operating Case Temperature*2	T <sub>c</sub> – C temp	0		70	°C
	T <sub>c</sub> – 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			2	Km

### Note:

1. The position of case temperature measurement is shown in Figure 8.
2. Power Supply Noise is defined as the peak-to-peak noise amplitude over the frequency range at the host supply side of the recommended power supply filter with the module and recommended filter in place. Voltage levels including peak-to-peak noise are limited to the recommended operating range of the associated power supply. See Figure 6 for recommended power supply filter.

## General Electrical Characteristics

Unless otherwise stated, the following characteristics are defined under recommended operating conditions.

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.

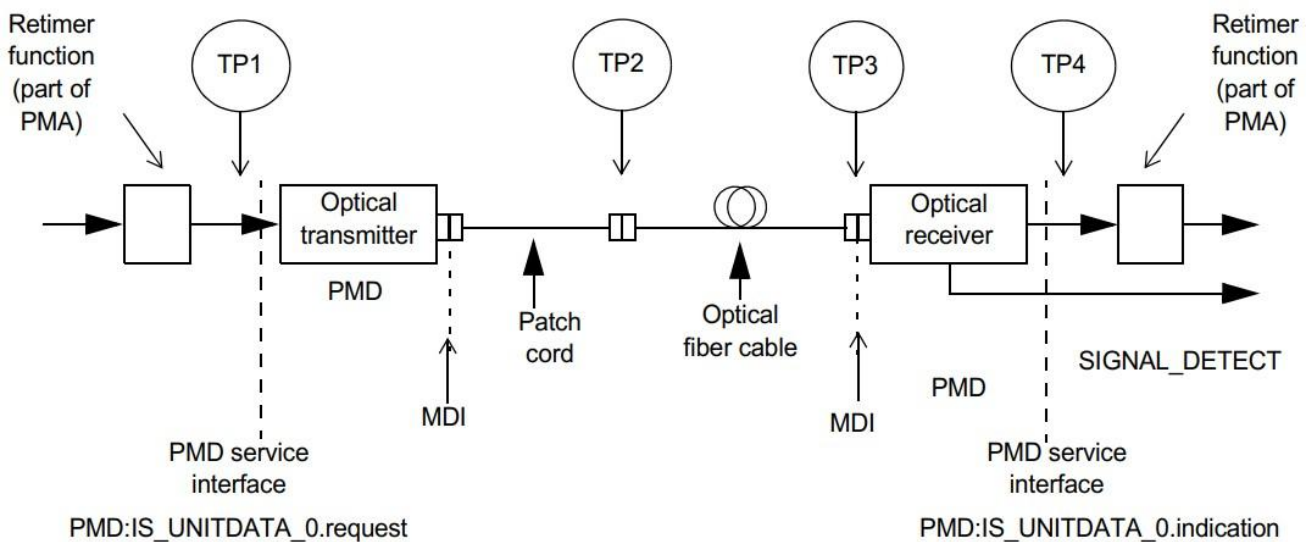


Figure 3: Block diagram for 50GBASE-FR transmit/receive paths

## High Speed Electrical Input Characteristics

Unless otherwise stated, the following characteristics are defined under recommended operating conditions.

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					IEEE802.3	
Eye Height		32		mV		

**Note:**

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

Unless otherwise stated, the following characteristics are defined under recommended operating conditions.

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	

**Note:** DC common mode voltage generated by the host. Specification includes effects of ground offset voltage.

## High Speed Optical Transmitter Characteristics

Unless otherwise stated, the following characteristics are defined under recommended operating conditions.

Parameter	Symbol	Min.	Typical	Max.	Unit
Signaling Rate			53.125		Gbps
Modulation Format			PAM4		
Centre Wavelength	$\lambda_c$		1311		nm
Side-mode Suppression Ratio	SMSR	30			dB
20dB Spectral Width	$\Delta\lambda$			1	nm
Average Launch Power	PAVG	-4.1		3	dBm
Extinction Ratio	ER	3.5			dB
Outer Optical Modulation Amplitude (OMA <sub>outer</sub> )*7	POMA	-2.5		2.8	dBm
Launch Power in OMA <sub>outer</sub> minus TDECQ		-3.9			dB
Transmitter and Dispersion Eye Closure	TDECQ			3	dB
TDECQ-10log <sub>10</sub> (Ceq)				3	dB
Average Launch Power of OFF Transmitter	POFF			-16	dBm
RIN <sub>17.1</sub> OMA				-132	dB/Hz
Optical Return Loss Tolerance				17.1	dB
Transmitter Reflectance				-26	dB

Note: Even if the TDECQ<1.4dB, the OMA<sub>outer</sub>(min) must excess this value.

## High Speed Optical Receiver Characteristics

Unless otherwise stated, the following characteristics are defined under recommended operating conditions.

Parameter	Symbol	Min.	Typical	Max.	Unit
Signaling Rate			53.125		Gbps
Modulation Format			PAM4		

Centre Wavelength	$\lambda_c$		1311		nm
Damage Threshold*8		5.2			dBm
Average Receive Power*9	R <sub>AVG</sub>	-8.1		3	dBm
Receiver Power (OMA <sub>outer</sub> )	R <sub>OMA</sub>			2.8	dBm
Receiver Reflectance				-26	dB
Receiver Sensitivity (OMA <sub>outer</sub> ) *10				-6.9	
Stressed Receiver Sensitivity (OMA <sub>outer</sub> )				-5.3	dBm
LOS Assert	LOS <sub>A</sub>	-30			dBm
LOS De-Assert	LOS <sub>D</sub>			-9	dBm
LOS Hysteresis		0.5			dB
Condition of Stressed Receiver Sensitivity Test*11					
Stressed Eye Closure for PAM4	SECQ			3	dB
SECQ-10log <sub>10</sub> (C <sub>eq</sub> )				3	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  $RS = \max(-6.9, SECQ-8.3)$  with  $BER < 2.4 \times 10^{-4}$  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-50SM31-02C 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.

### Electrostatic Discharge (ESD)

The SFP-50SM31-02C complies with the ESD requirements described in the Regulatory Compliance Table. However, in the normal processing and operation of optical transceiver, the following two types of situations need special attention.

Case I: Before inserting the transceiver into the rack meeting the requirements of SFF MSA, ESD preventive measures must be taken to protect the equipment. For example, the grounding wrist strap, workbench, and floor should be used wherever the transceiver is handled.

Case II: After the transceiver is installed, the electrostatic discharge outside the chassis of the host equipment shall be within the scope of system level ESD requirements. If the optical interface of the transceiver is exposed outside the host equipment cabinet, the transceiver may be subject to equipment system level ESD requirements.

### Electromagnetic Interference (EMI)

Communication equipment with optical transceivers is usually regulated by FCC in the United States and CENELEC EN55032 (CISPR 32) in Europe. The compliance of SFP-50SM31-02C with these standards is detailed in the regulatory compliance table. The metal shell and shielding design of SFP-50SM31-02C will help equipment designers minimize the equipment level EMI challenges they face.

### Flammability

SFP-50SM31-02C optical transceiver meets UL certification requirements, its constituent materials have heat and corrosion resistance, and the plastic parts meet UL94V-0 requirements.



## SFP56 Transceiver Electrical Pad Layout

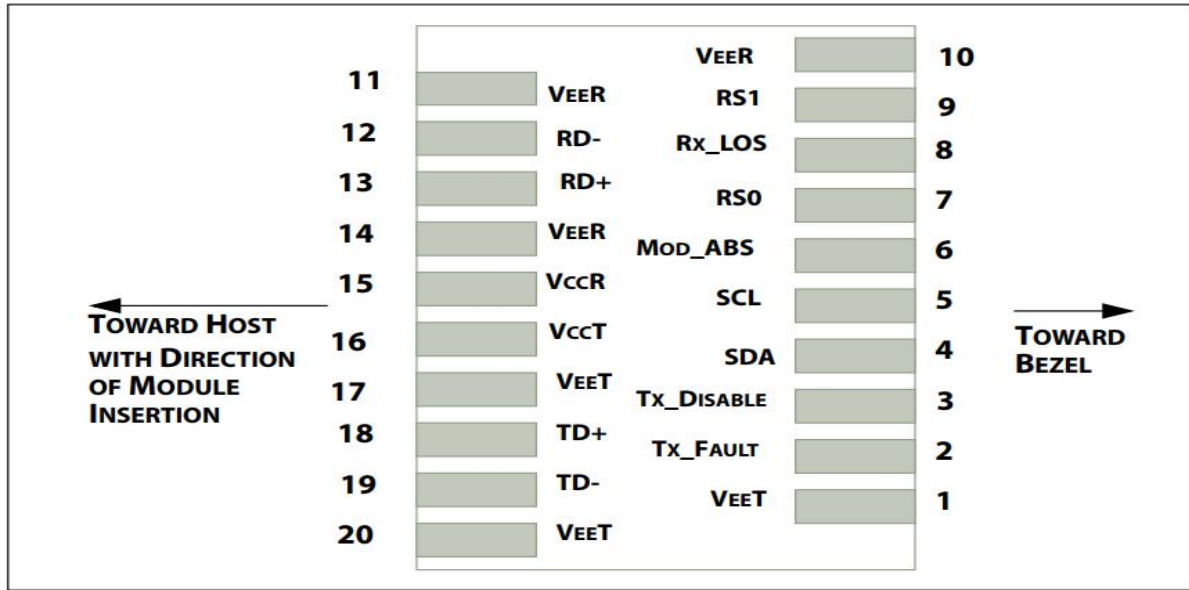


Figure 4: SFP56 Module Pinout

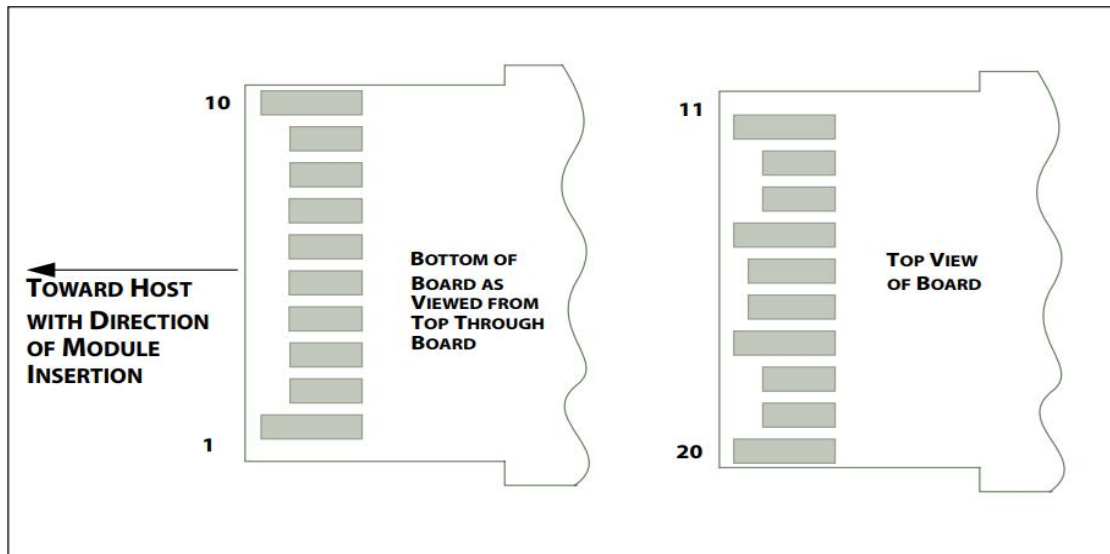


Figure 5: SFP56 Module Contact Assignment

## 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.

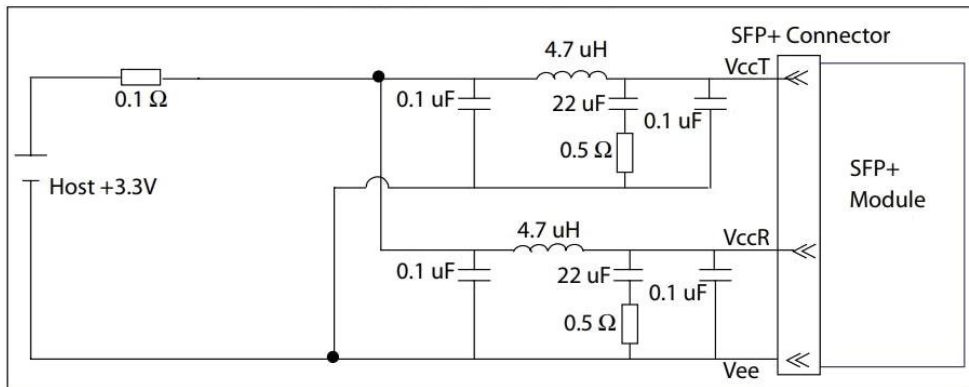


Figure 6: Host Board Power Supply Filter

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.

## Package Outline

The module is designed to meet the package outline defined in the SFF MSA specification. See the package outline for details.

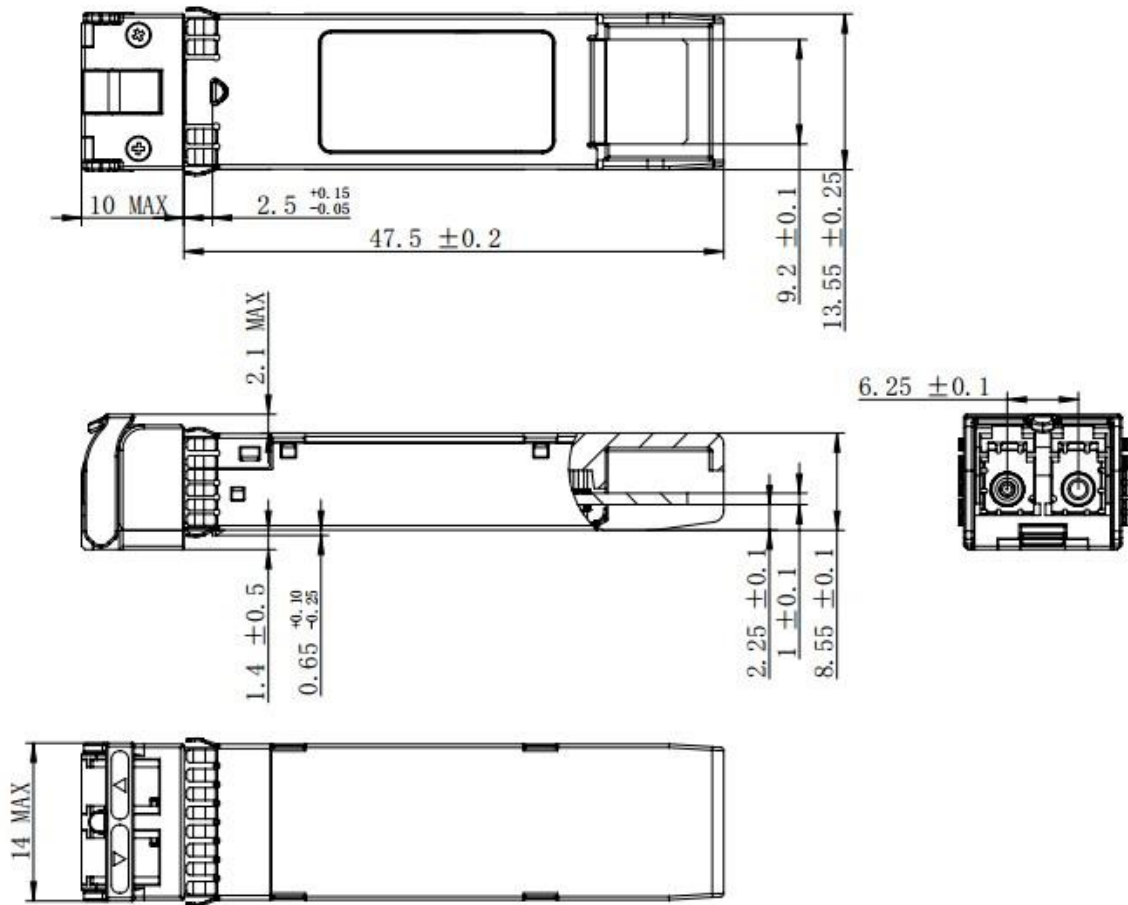


Figure 7: Mechanical Package Outline (All dimensions in mm)

The below picture shows the location of the hottest spot for measuring module case temperature. In addition, the digital diagnostic monitors (DDM) temperature is also calibrated to this spot.

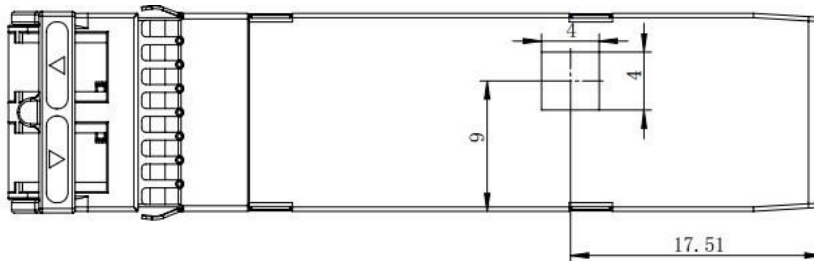


Figure 8: Case Temperature Measurement Point (All dimensions in mm)

## Low-Speed Control Signal Interface

The module has the following low-speed signals for control and indicator: Tx\_Fault, Tx\_Disable, RS0/RS1, Rx\_LOS and SCL/SDA. All the low-speed signals are compliant to SFF-8431 specification.

### SCL and SDA

SCL is the 2-wire serial interface clock and SDA is the 2-wire serial interface data line. SCL and SDA are pulled up to Vcc with resistors in the host side.

### Tx\_Fault

Tx\_Fault is a module output that when high, indicates that the module transmitter has detected a fault condition related to laser operation or safety.

### Tx\_Disable

Tx\_Disable is a module input that when high, the module transmitter output shall be turned off, and when low the module transmitter is operating normally.

### RS0/RS1

For SFP56 standard modules, there is only one operating rate (53.125Gbps), not support rate selection. If you need other operating rates (25.78125Gbps, 10.3125Gbps), please contact AscentOptics.

### Rx\_LOS

Rx\_LOS is a module output when high indicates an optical signal level below that specified in the High Speed Optical Receiver Characteristics.

The Rx\_LOS signal is intended as a preliminary indication to the host in which the module is installed that the received signal strength is below the specified range. Such an indication typically points to non-installed cables, broken cables, or a disabled, failing or a powered off transmitter at the far end of the cable. Additional indications are provided by the host in which the module is installed to verify that the information being transmitted is valid, correctly encoded, and in the correct format. Such additional indications are outside the scope of the module specification.

## Low Speed Control and Sense Signals

Parameter	Symbol	Min.	Typical	Max.	Unit
SCL and SDA	VOL	0		0.4	V
	VOH	V <sub>o.5</sub>		VCC+0.3	V
SCL and SDA	VIL	-0.3		VCC*0.3	V
	VIH	VCC*0.7		VCC+0.5	V

Tx_Fault, Rx_LOS	VOL	-0.3		0.4	V
	IOH	-50	5	37.	μA
Tx_Disable, RS0, RS1,	VIL	0.3	0.8		V
	VIH	2	V <sub>CC</sub> +0.3		V

## Memory Map

The Module provides diagnostic information about the present operating conditions. The 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 digital diagnostic memory map specific data field define as following. For detail EEPROM information, please refer to the related document of SFF 8472.

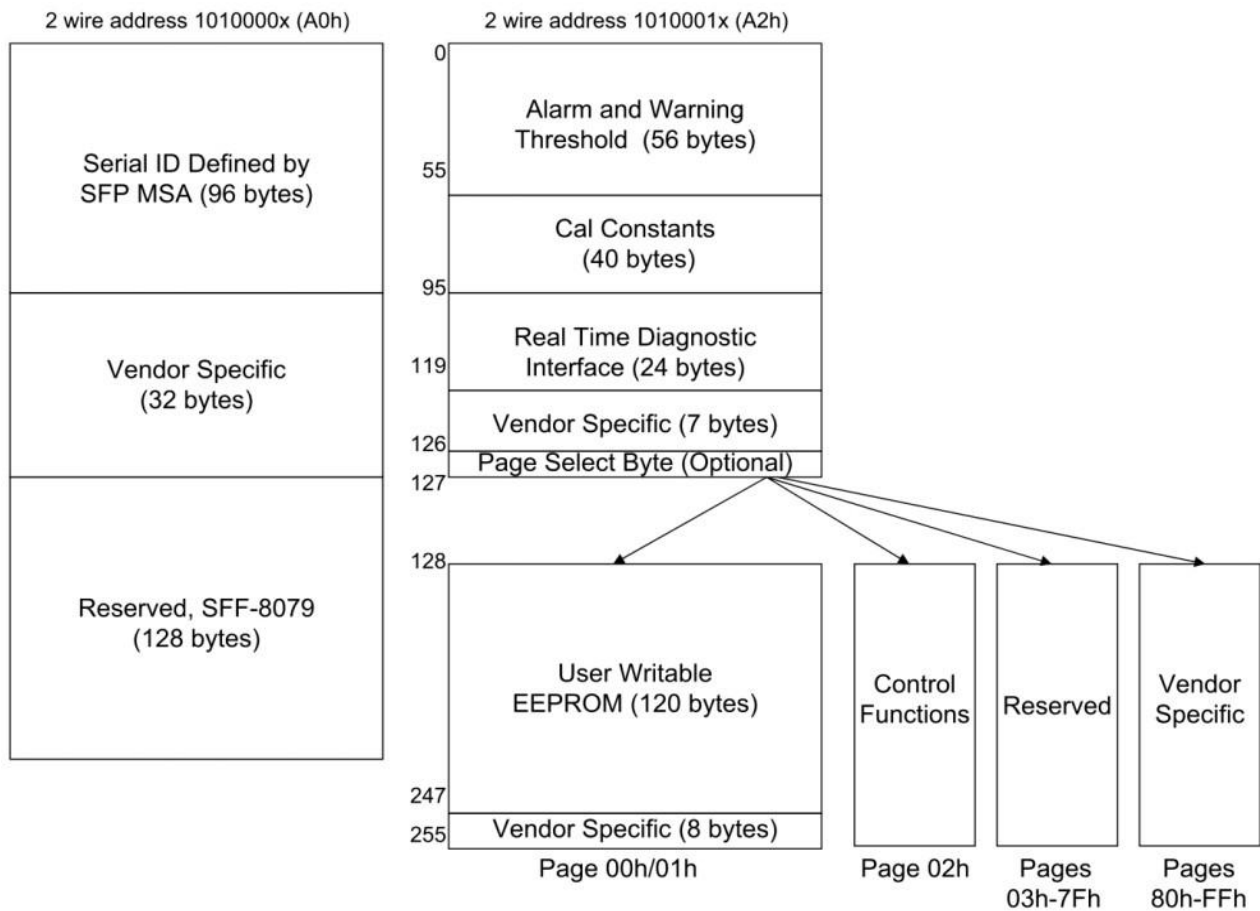


Figure 9: 2-wire Interface Fields

## Ordering Information

Part Number	Description
SFP-50SM31-02C	Up to 53.125Gbps , 1311nm DFB , SMF , 2km , 0~+70°C, with DDM

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