

64 Gb/s SFP56 SW Fibre Channel 850nm Transceiver

SFP+ Series

- **16GFC/32GFC/64GFC data rates**
- **Up to 100m transmission on multi-mode fiber**
- **VCSEL laser and PIN receiver**
- **Hot-pluggable SFP footprint**
- **Single 3.3V power supply**



The 64GBASE-SW SFP56 Optical Transceiver Module is a high-performance solution designed for short-reach fiber communication applications. Operating over multimode fiber (MMF) at an 850 nm wavelength, it supports data rates up to 64G and link distances of up to 100 meters. With its compact SFP56 form factor and LC duplex connector, the module provides a reliable, space-efficient interface for high-speed data transmission.

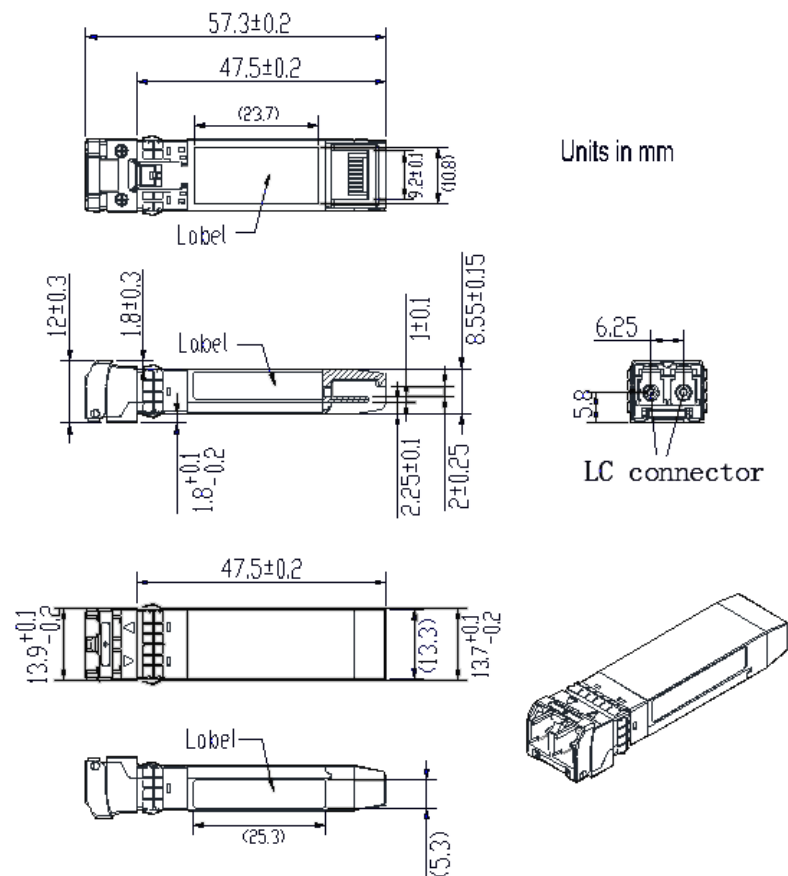
Fully compliant with industry standards including SFF-8472, SFF-8431, SFF-8432, and FC-P1-8, this transceiver ensures seamless interoperability with a wide range of networking equipment. It features Digital Optical Monitoring (DOM) functions accessible via a 2-wire management interface, enabling real-time monitoring of critical operating parameters such as optical power, voltage, and temperature. These advanced diagnostics enhance system management, fault detection, and long-term reliability.

Engineered for ease of use, the module is hot-swappable, allowing quick installation and replacement without disrupting network operations. Its blend of performance, compatibility, and flexibility makes it ideal for data centers, enterprise networks, and high-bandwidth storage environments where efficient short-distance connectivity is essential. With robust compliance and monitoring features, the 64GBASE-SW SFP56 transceiver delivers dependable high-speed optical performance in demanding environments.

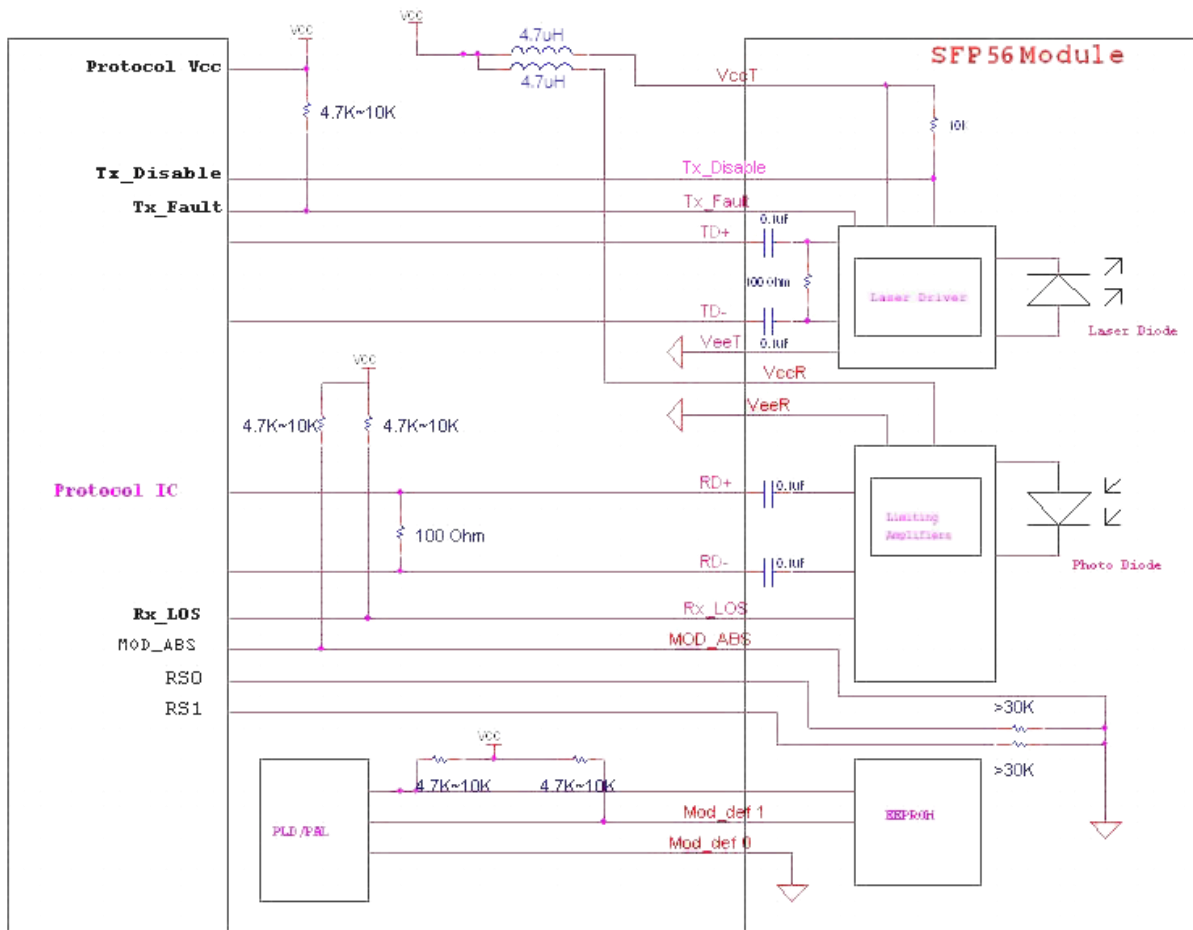
Key Features

- Supports 16GFC/32GFC/64GFC data rates
- Up to 100m transmission on multi-mode fiber
- VCSEL laser and PIN receiver
- 2-wire interface with integrated Digital Diagnostic Monitoring
- Hot-pluggable SFP footprint
- Compliant with SFP MSA with LC connector
- Single 3.3V power supply
- Power consumption < 1.5W
- Case operating temperature range: 0°C to 70°C

Mechanical Dimension



Recommended Interface Circuit



Management Interface and Digital Diagnostic Functions

Rate Select

The signaling rates for the transmitter and receiver can be configured by either the rate select (RS) hard pin signals or the soft register bits as show in the table. TX and RX rates and operating modes can be independently controlled, operate at the same or different speed rates and operating modes.

Logic OR of RS0 Pin7 and RS0 Bit(A2h, Byte 110, Bit 3)	Logic OR of RS1 Pin9 and RS1 Bit(A2h, Byte 118, Bit 3)	A2h, Byte 119, Bit 2 (64GFC Mode bit)	Receiver Retimer/CDR	Transmitter Retimer/CDR
X	X	1	64GFC	64GFC
0	0	0	16GFC	16GFC
0	1	0	16GFC	32GFC
1	0	0	32GFC	16GFC
1	1	0	32GFC	32GFC

64GFC Rate Select Control/Status Register

The host can enable the module 64GFC Mode by asserting bit 2 of byte 119 using I2C, ignoring the RS (0) and RS (1) hard pin settings. Byte 119 status bits 0–1 and 3–4 verify internal settings are properly configured for PAM operation at 28.9GBd. Default for this bit at power up is 0.

Bit#	Status/Control name	Description
5 to 7	Unallocated	
4	64GFC Mode Tx Configured	This status bit is a response to the 64GFC mode control bit. The bit indicates the module Tx logic has finished configuring itself to 64GFC mode at 28.9 GBd.
3	64GFC Mode Rx Configured	This status bit is a response to the 64GFC mode control bit. The bit indicates the module Rx logic has finished configuring itself to 64GFC mode at 28.9 GBd.
2	64GFC Mode	Writing a 1 to this bit selects 64GFC speed of operation at 28.9 GBd. When this bit is set to 1, the rate select settings on the pins or in the registers are ignored. Default at power up for this bit is 0.
1	Tx CDR Not Locked	A value of 0 indicates that the CDR is locked, whereas a value of 1 indicates loss of lock of the CDR. In 64GFC mode, if bit 4 of this byte is set to 1, a value of 0 indicates that the equalizer has finished adaptation and the CDR is locked to the PAM4 signal.
0	Rx CDR Not Locked	A value of 0 indicates that the CDR is locked, whereas a value of 1 indicates loss of lock of the CDR. In 64GFC mode, if bit 3 of this byte is set to 1, a value of 0 indicates that the equalizer has finished adaptation and the CDR is locked to the PAM4 signal.

Monitor Data

The following monitors are supported as described in SFF-8472 :

- Temperature
- Supply Voltage
- Tx Bias Current
- Rx Optical Power
- Tx Optical power

EEPROM Serial ID Memory Contents – Soft Commands (Address A2h, Byte 110)

Bit#	Status/Control name	Description	Note
7	TX_DISABLE State	Digital state of TX_DISABLE Input Pin (1 = TX_DISABLE asserted)	Note1
6	Soft TX_DISABLE Control	Read/write bit for changing digital state of TX_DISABLE function	Note1,2
5	RS(1) State	Digital state of TX Rate_Select Input Pin RS(1) (1 = Rate High asserted)	
4	RS(0) State	Digital state of RX Rate_Select Input Pin RS(0) (1 = Rate High asserted)	
3	Soft RS(0) Control	Read/write bit for changing digital state of Rx Rate_Select RS(0) function	Note3
2	TX_FAULT State	Digital state of TX_FAULT Output Pin (1 = TX_FAULT asserted)	
1	RX_LOS State	Digital state of SFP RX_LOS Output Pin (1 = RX_LOS asserted)	Note 1
0	Data Ready (Bar)	Indicates transceiver is powered and real time sense data is ready (0 = Data Ready)	Note 1

Notes:

1. The response time for soft commands of the SFP-64MM85-1HC is 100msec as specified by MSA SFF-8472.
2. Bit 6 is log OR'd with the SFP TX_DISABLE input pin 3 either asserted will disable the SFP transmitter.
3. Bit 3 is log OR'd with the SFP RS(0) RX Rate_Select input pin 7 either asserted will set receiver to Rate = High.

EEPROM Serial ID Memory Contents – Transmitter Input Electrical Equalization Control (Address A2h, Byte 114)

Bit#	Status/Control name	Description
7 to 4	TX EQ, RS(1)=HIGH	Not supported
3 to 0	TX EQ, RS(1)=LOW	Not supported

EEPROM Serial ID Memory Contents – Receiver Output Electrical Emphasis Control (Address A2h, Byte 115)

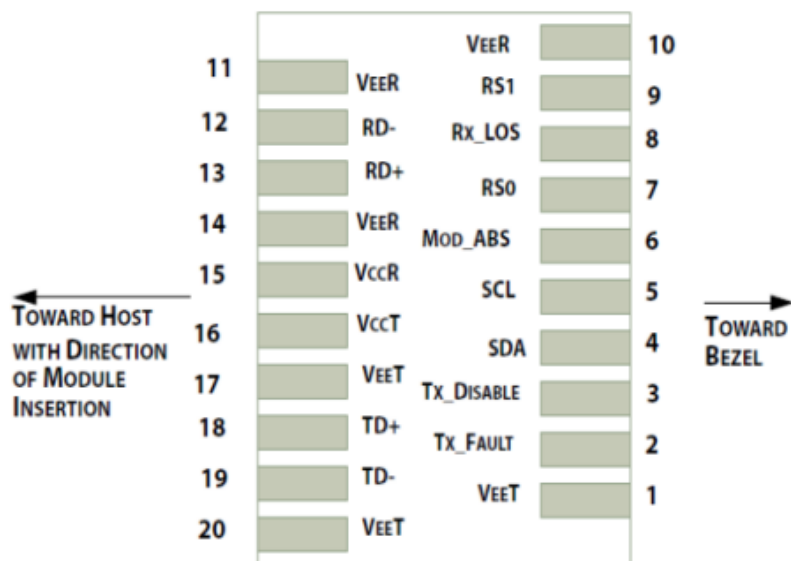
Bit#	Status/Control name	Description
7 to 4	RX EMPH, RS(0)=HIGH	Selects an output emphasis value per SFF-8472, Table 9-14 for high rate operation. 64G/32G
3 to 0	RX EMPH, RS(0)=LOW	Selects an output emphasis value per SFF-8472, Table 9-14 for low rate operation. 16G

Receiver Output Emphasis Control Values (Address A2h, Byte 115)

From Table 9-19 of SFF-8472.

Receiver Output Emphasis At nominal Output Amplitude		
Code	Nominal	Units
1xxx	Vendor Specific	
0111	7	dB
0110	6	dB
0101	5	dB
0100	4	dB
0011	3	dB
0010	2	dB
0001	1	dB
0000	0	No Emphasis

Pin Assignment



Pin	Symbol	Name/Description	Note
1	VEET	Transmitter Ground (Common with Receiver Ground)	1
2	Tx_Fault	Transmitter Fault	
3	Tx_Disable	Transmitter Disable – Logic 1 disables laser output	
4	SDA	2-wire Serial Interface Data Line	
5	SCL	2-wire Serial Interface Clock Line	
6	MOD_ABS	Module Absent. Grounded within the module.	2
7	RS0	Rate Select 0 – Rx signaling rate	3
8	Rx_LOS	Loss of Signal indication – Logic 1 indicates loss of signal	
9	RS1	Rate Select 1 – Tx signaling rate	3
10	VEER	Receiver Ground (Common with Transmitter Ground)	1
11	VEER	Receiver Ground (Common with Transmitter Ground)	1
12	RD-	Receiver Inverted DATA out (AC Coupled)	
13	RD+	Receiver Non-inverted DATA out (AC Coupled)	
14	VEER	Receiver Ground (Common with Transmitter Ground)	1
15	VCCR	Receiver Power Supply	
16	VCCT	Transmitter Power Supply	
17	VEET	Transmitter Ground (Common with Receiver Ground)	1
18	TD+	Transmitter Non-Inverted DATA in (AC Coupled)	
19	TD-	Transmitter Inverted DATA in (AC Coupled)	
20	VEET	Transmitter Ground (Common with Receiver Ground)	1

Notes:

1. Circuit ground is internally isolated from chassis ground.
2. MOD_ABS is pulled low in the module to indicate that the module is plugged in.
3. The signal is internally pulled down per SFF-8431 Rev 4.1.

Specifications

Absolute Maximum Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit
Storage Temperature	T _s	-40		85	°C
Relative Humidity	RH	0		85	%
Power Supply Voltage	V _{CC}	-0.3		3.63	V

Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Unit	Notes
Case Operating Temperature	0		70	°C	
Power Supply Voltage	3.135	3.3	3.45	V	
Power Supply Current				mA	
64GFC Signaling Rate		28.9	GBd	GBd	
32GFC Signaling Rate		28.05	GBd	GBd	
16GFC Signaling Rate		14.025	GBd	GBd	
64GFC Transmission Distance			70 (OM3)	m	
			100 (OM4/OM5)		
32GFC Transmission Distance			20 (OM2)	m	
			70 (OM3)		
			100 (OM4)		
16GFC Transmission Distance			35 (OM2)	m	
			100 (OM3)		
			125 (OM4)		
64GFC Bit Error Rate		10 ⁻¹⁰	1.09x10 ⁻⁴		1
32GFC Bit Error Rate			10 ⁻⁶		2
16GFC Bit Error Rate			10 ⁻¹²		2
Coupled Fiber		Multi-mode fiber			50/125um MMF

Notes:

1. PRBS31Q for 64GFC.
2. PRBS31 for 32GFC/16GFC.

Optical Characteristics (64GFC Optical Parameters)

Parameter	Min.	Typ.	Max.	Unit	Notes
Transmitter (Module Output)					
Center Wavelength	840	850	860	nm	
RMS Spectral Width			0.6	nm	
TDECQ			5.5	dB	
TDECQ-10log10(Ceq)			5.5	dB	
OMA _{outer}	-4.5		3	dBm	
OMA _{outer} Extinction Ratio	3			dB	
Launched Power in OMA _{outer} Minus TDECQ	-5.9			dBm	
Average Launched Power	-7.5		0	dBm	
RIN ₁₂ OMA			-128	dB/Hz	

Parameter	Min.	Typ.	Max.	Unit	Notes
Transition Time 20%-80%			34	ps	
Encircled Flux	≥86% at 19um, ≤30% at 4.5um				
Receiver (Module Input)					
Damage Threshold	5			dBm	1
Average Received Power	-9.4		4	dBm	
Receiver Power (OMA _{outer})			3	dBm	
Return Loss of Receiver	12			dB	
Receiver Sensitivity, OMA _{outer}			-7	dBm	
Stressed Receiver Sensitivity, OMA _{outer}			-2.4	dBm	
LOS De-Assert			-11	dBm	
LOS Assert	-30		-11	dBm	

Note: The receiver should be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level. The receiver does not have to operate correctly at this received power.

32GFC Optical Parameters

Parameter	Min.	Typ.	Max.	Unit	Notes
Transmitter (Module Output)					
Center Wavelength	840	850	860	nm	
RMS Spectral Width			0.570	nm	
Average Launched Power	0.240		1.585	mW	
	(-6.2)		(2)	(dBm)	
Optical Modulation Amplitude	0.479			mW	
	(-3.2)			(dBm)	
Vertical Eye Closure Penalty (VECP _q)			3.13	dB	
RIN ₁₂ OMA			-129	dB/Hz	
Encircled Flux	≥86% at 19um, ≤30% at 4.5um				
Receiver (Module Input)					
Average Received Power			1.585	mW	
			(2)	(dBm)	
Unstressed Receiver Sensitivity, OMA			0.095	mW	
			(-10.2)	(dBm)	
Return Loss of Receiver	12			dB	
Rx Jitter Tracking Test, OMA	0.295(-5.3)			mW(dBm)	
RX Jitter Tracking Test, Jitter Frequency and Pk-Pk Amplitude	(500,1)	(100,5)		(kHz,UI)	
Receiver Electrical 3 dB Upper Cutoff Frequency			32	GHz	
Stressed Receiver Sensitivity, OMA			0.263	mW	
			(-5.8)	(dBm)	
LOS De-Assert			-11	dBm	
LOS Assert	-30		-11	dBm	

16GFC Optical Parameters (Compliant with all other parameters in FC-PI-5)

Parameter	Min.	Typ.	Max.	Unit	Notes
Transmitter (Module Output)					
Center Wavelength	840	850	860	nm	1
RMS Spectral Width			0.59	nm	
Average Launched Power	-7.8		0	dBm	
Optical Modulation Amplitude	0.331 (-4.8)			mW (dBm)	
Vertical Eye Closure Penalty (VECP _q)			2.56	dB	
RIN ₁₂ OMA			-128	dB/Hz	
Encircled Flux	≥86% at 19um, ≤30% at 4.5um				
Receiver (Module Input)					
Average Received Power			0	dBm	
Unstressed Receiver Sensitivity, OMA			0.089 (-10.5)	mW (dBm)	
Return Loss of Receiver	12			dB	
Rx Jitter Tolerance Test, OMA	0.214(-6.7)			mW(dBm)	
RX Jitter Tracking Test, Jitter Frequency and Pk-Pk Amplitude	(840,1) (168,5)			(kHz,UI)	
Receiver Electrical 3dB Upper Cutoff Frequency			18	GHz	
Stressed Receiver Sensitivity, OMA			0.170 (-7.7)	mW (dBm)	
LOS De-Assert			-11	dBm	
LOS Assert	-30		-11	dBm	

Note: Max average launched power shall be the lesser of the value listed here or the Class 1 laser safety limits (CDRH and EN 60825).

Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Power Supply Voltage	V _{CC}	3.135	3.3	3.465	V	
Power Supply Current				454	mA	
Low Speed Signals						
Tx_Fault, Rx_LOS Output Voltage	V _{OL}	-0.3		0.40	V	At 0.7 mA
Tx_Disable, RS0, RS1 Input Voltage	V _{IL}	-0.3		0.8	V	
	V _{IH}	2.0		V _{CC} +0.3	V	

64G Electrical Parameters

Parameter	Min.	Typ.	Max.	Unit	Notes
Transmitter (Module Input)					
Differential Input Voltage Tolerance	900			mV	
Differential Termination Resistance Mismatch			10	%	
Differential Return Loss SDD11	$SDD11, SDD22 \text{ (dB)} < \begin{cases} -9.5 + 0.368 \cdot f & 0.01 < f < 8 \text{ GHz} \\ -4.75 + 7.4 \cdot \log_{10}(f/14.025 \text{ GHz}) & 8 < f < 21 \text{ GHz} \end{cases}$			dB	
Differential-Mode to Common Conversion SCD11	$SDC22, SCD11 \text{ (dB)} < \begin{cases} -22 + 20 \cdot f/25.78 \text{ GHz} & 0.01 < f < 12.89 \text{ GHz} \\ -15 + 6 \cdot f/25.78 \text{ GHz} & 12.89 < f < 21 \text{ GHz} \end{cases}$			dB	At 0.7 mA
Input Equalization	-0.3		10	dB	

Parameter	Min.	Typ.	Max.	Unit	Notes
Receiver (Module Output)					
Differential Voltage, Pk-Pk			900	mV	
Differential Voltage with Transmitter Disabled, Pk-Pk			35	mV	
Common-Mode Noise Rms			17.5	mV	
Differential Termination Resistance Mismatch			10	%	At 1 MHz
Differential Return Loss SDD22	$SDD11, SDD22 \text{ (dB)} < \begin{cases} -9.5 + 0.368 \cdot f & 0.01 < f < 8 \text{ GHz} \\ -4.75 + 7.4 \cdot \log_{10}(f/14.025 \text{ GHz}) & 8 < f < 21 \text{ GHz} \end{cases}$			dB	
Common-Mode to Differential Conversion SDC22	$SDC22, SCD11 \text{ (dB)} < \begin{cases} -22 + 20 \cdot f/25.78 \text{ GHz} & 0.01 < f < 12.89 \text{ GHz} \\ -15 + 6 \cdot f/25.78 \text{ GHz} & 12.89 < f < 21 \text{ GHz} \end{cases}$			dB	
Source Transition Time 20% yto 80%	9.5			ps	
Eye Width at 10 ⁻⁵ Probability EW5	0.265			UI	
Eye Height at 10 ⁻⁵ Probability EH5	70			mV	
Vertical Eye Closure VEC			12	dB	
Output Emphasis			5	dB	

32G Electrical Parameters

Parameter	Min.	Typ.	Max.	Unit	Notes
Transmitter (Module Input)					
Differential Termination Resistance Mismatch			10	%	
Differential Return Loss SDD11	$SDD11, SDD22 \text{ (dB)} < \begin{cases} -11 & 0.05 < f < 4 \text{ GHz} \\ -6.0 + 9.2 \cdot \log_{10}(f/14.025 \text{ GHz}) & 4 < f < 28.05 \text{ GHz} \end{cases}$			%	
Common Mode to Differential Conversion SDC11	$SDC11, SCD11 \text{ (dB)} < \begin{cases} -22 + 14 \cdot f/28.05 \text{ GHz} & 0.05 < f < 14.025 \text{ GHz} \\ -18 + 6 \cdot f/28.05 \text{ GHz} & 14.025 < f < 28.05 \text{ GHz} \end{cases}$			dB	
Differential Mode to Common Conversion SCD11	$SDC11, SCD11 \text{ (dB)} < \begin{cases} -22 + 14 \cdot f/28.05 \text{ GHz} & 0.05 < f < 14.025 \text{ GHz} \\ -18 + 6 \cdot f/28.05 \text{ GHz} & 14.025 < f < 28.05 \text{ GHz} \end{cases}$				
Input Equalization			10	dB	
Receiver (module output)					
Differential Voltage, Pk-Pk			900	mV	
Common-Mode Noise Rms			17.5	mV	
Differential Termination Resistance Mismatch			10	%	At 1 MHz
Differential Return Loss SDD22	$SDD11, SDD22 \text{ (dB)} < \begin{cases} -11 & 0.05 < f < 4 \text{ GHz} \\ -6.0 + 9.2 \cdot \log_{10}(f/14.025 \text{ GHz}) & 4 < f < 28.05 \text{ GHz} \end{cases}$			%	
Common Mode to Differential Conversion SDC22	$SDC11, SCD11 \text{ (dB)} < \begin{cases} -22 + 14 \cdot f/28.05 \text{ GHz} & 0.05 < f < 14.025 \text{ GHz} \\ -18 + 6 \cdot f/28.05 \text{ GHz} & 14.025 < f < 28.05 \text{ GHz} \end{cases}$			dB	
Differential Mode to Common Conversion SCD22	$SDC11, SCD11 \text{ (dB)} < \begin{cases} -22 + 14 \cdot f/28.05 \text{ GHz} & 0.05 < f < 14.025 \text{ GHz} \\ -18 + 6 \cdot f/28.05 \text{ GHz} & 14.025 < f < 28.05 \text{ GHz} \end{cases}$			dB	
Common Mode Return Loss SCC22			-2	dB	
Source Transition Time 20% to 80%	9.5			ps	
Vertical Eye Closure			4	dB	
Eye Width at 10 ⁻⁶ Probability EW6	0.65			UI	
Eye Height at 10 ⁻⁶ Probability EH6	250			mV	
Output Emphasis			5	dB	

16G Electrical Parameters (Compliant with all other parameters in FC-PI-5)

Parameter	Min.	Typ.	Max.	Unit	Notes
Transmitter (Module Input)					
Common Mode Voltage (rms)			30	mV	
Common Mode Voltage, (Spectral Peak)(rms)			20	mV	
Input Equalization			10	dB	
Receiver (module output)					
Output Emphasis			5	dB	

Timing Requirement of Control and Status I/O

Parameter	Symbol	Min.	Max.	Unit.	Notes
Tx_Disable Assert Time	t_off	—	100	µs	
Tx_Disable Negate Time	t_on	—	2	ms	
Time to Initialize 2-Wire Interface	t_2w_start_up	—	800	ms	
Time to Initialize	t_start_up	—	2500	ms	1
Time to Power Up to Level II	t_power_level2	—	1700	ms	1
Time to Power Down from Level II	t_power_down	—	1700	ms	1
Tx_Fault Assert	Tx_Fault_on	—	1	ms	
Tx_Fault Reset	t_reset	10	—	µs	
RS0, RS1 Rate Select Timing for FC	t_RS0_FC,t_RS1_FC	—	4	ms	
Rx_LOS Assert Delay	t_los_on	—	7	ms	
Rx_LOS Negate Delay	t_los_off	—	7	ms	

Note: Including TX DSP locking time.

Regulatory Compliance

Feature	Reference	Performance
Electrostatic discharge(ESD)	IEC/EN 61000-4-2	Compatible with standards
Electromagnetic Interference (EMI)	FCC Part 15 Class B EN 55022 Class B (CISPR 22A)	Compatible with standards
Laser Eye Safety	FDA 21CFR 1040.10, 1040.11 IEC/EN 60825-1, 2	Class 1 laser product
Component Recognition	IEC/EN 60950, UL	Compatible with standards
ROHS	2011/65/EU and (EU)2015/863	Compatible with standards
EMC	EN61000-3	Compatible with standards

Ordering Information

Product Name	Product Description
SFP56-64LP-85-01	SFP56 Plug-in, 64Gbps, 100m, TX/RX 850nm, on two multimode fibres, LC/PC

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