100G QSFP28 CWDM4 2km Optical Transceiver

Features

◎ Up to 25.78125Gbps Data rate per channel

◎ Up to reach 2km for G.652 SMF

◎ 4 DFB-based CWDM uncooled transmitter

◎ 4 channels PIN photo detector

◎ Hot-pluggable QSFP28 form factor

◎ Duplex LC receptacle

◎ Internal CDR circuits on both receiver and Transmitter channels

◎ Support CDR bypass

◎ Built-in digital diagnostic functions

◎ Single +3.3V power supply

◎ Low power consumption<3.5 W

◎ Operating case temperature: 0~+70°C

◎ 4 channel full duplex transceiver modules

Applications

◎ 100G CWDM4 applications with FEC

◎ Datacenter and Enterprise networking

◎ Other optical links

Standard

◎ Compliant with SFF-8636

◎ Compliant with IEEE 802.3ba and 100GBASE-CLR4/CWDM4

◎ Compliant with Telcordia GR-468-CORE

◎ RoHS Compliant

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Table 1. Regulatory Compliance

Product Certificate	Certificate Number	Applicable Standard
TUV	R50135086	EN 60950-1:2006+A11+A1+A12+A2 EN 60825-1:2014 EN 60825-2:2004+A1+A2
UL	E317337	UL 60950-1 CSA C22.2 No. 60950-1-07
EMC CE	AE 50285865 0001	EN 55022:2010 EN 55024:2010
FCC	WTF14F0514417E	47 CFR PART 15 OCT., 2013
FDA	/	CDRH 1040.10
ROHS	/	2011/65/EU

Product Description

This product is a 100Gb/s transceiver module designed for optical communication applications compliant to 100GBASE-CWDM4 of the IEEE P802.3ba standard. The module converts 4 input channels of 25.78125Gb/s electrical data to 4 channels of CWDM optical signals and then multiplexes them into a single channel for 100Gb/s optical transmission. Reversely on the receiver side, the module de-multiplexes a 100Gb/s optical input into 4 channels of CWDM optical signals and then convertsthem to 4 output channels of electrical data.

The central wavelengths of the 4 CWDM channels are 1271, 1291, 1311 and 1331nm as members of the CWDM wavelength grid defined in CWDM4. The high performance Uncooled CWDM DFB transmitters and high sensitivity PIN receivers provide superior performance for 100Gigabit Ethernet applications up to 2km links.

The product is designed with form factor, optical/electrical connection and digital diagnostic interface according to the QSFP28 MSA and compliant to IEEE 802.3ba. It has been designed to meet the harshest external operating conditions including temperature, humidity and EMI interference.

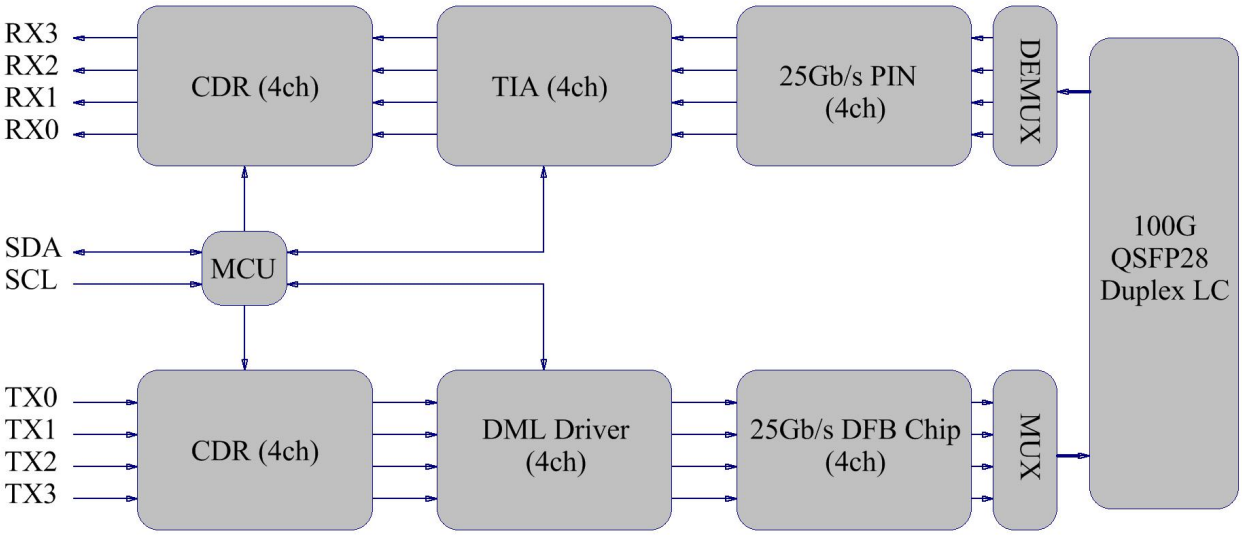

Figure 1.Transceiver functional Block Diagram

Absolute Maximum Ratings

Table 2. Absolute Maximum Ratings

(Exceeding the limits below may damage the transceiver module permanently)

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Maximum Supply Voltage	V_{CC}	-0.5	-	+4.0	V	
Storage Temperature	T_S	-40	-	+85	℃	
Case Operating Temperature	T_A	-5	-	+75	℃	
Relative Humidity	RH	5	-	95	%	1
Receiver Damage Threshold, each lane	P_{Rdmg}	5.5	-	-	dBm	

Notes:

1. Non-condensing.

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Recommend Operation Environment

Table 3. Recommend Operation Environment

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Data Rate, each lane	BR	-	25.78125	-	Gbps	
Data Rate Variation, each lane		-100	-	+100	ppm	
Power Supply Voltage	VCC	3.13	3.3	3.47	V	
Power Supply Current	ICC	-	-	1060	mA	
Power Dissipation	PD	-	-	3.5	W	
Case Operating Temperature	TA	0	-	+70	°C	
Relative Humidity	RH	5	-	85	%	1
Transmission Distance	TD	-	-	10	km	2

Notes:

1. Non-condensing.

2. Measured with ITU-T G.652 SMF

Electricalptical Characteristics

Table 4. Electrical Characteristics(T_{OP} = 0 to +70 °C, V_{CC} = 3.13 to 3.47 V)

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Transmitter						
Differential Data Input Amplitude	VIN,P-P	180	-	900	mVpp	
Input Differential Impedance	ZIN	90	100	110	Ω	
Eye width		-	0.46	-	UI	
Applied pk-pk sinusoidal jitter		Per IEEE 802.3bm Table 88-13				
Eye height		-	95	-	mV	
DC common mode voltage		-350	-	2850	mV	
Transmitter Fault Output-High	VOH	2.4	-	VCC	V	
Transmitter Fault Output-Low	VOL	-0.3	-	0.4	V	
Transmitter Disable Voltage- High	VIH	2.0	-	VCC	V	

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Transmitter Disable Voltage- low	VIL	0	-	0.8	V	
Receiver						
Differential output voltage swing	VOUT,P-P	300	-	900	mVpp	
Output Differential Impedance	ZOUT	90	100	110	Ω	
Eye width		0.57	-	-	UI	
Eye height differential		228	-	-	mV	
Vertical eye closure		-	-	5.5	dB	
LOS Output Voltage-High	VLOSH	2.0	-	VCC	V	
LOS Output Voltage-Low	VLOSL	-	-	0.8	V	

Optical Characteristics

Table 5. Optical Characteristics(T_{OP} = 0 to +70 °C, V_{CC} = 3.13 to 3.47 V)

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Transmitter						
Lane center Wavelength Range	λC-L0	1264.5	1271	1277.5	nm	
	λC-L1	1284.5	1291	1297.5	nm	
	λC-L2	1304.5	1311	1317.5	nm	
	λC-L3	1324.5	1331	1337.5	nm	
RMS Spectral Width (-20dB)	Δσ	-	-	1.0	nm	
Side Mode Suppression Ratio	SMSR	30	-	-	dB	
Data Rate, each lane	BR	-	25.78125	-	Gbps	
Data Rate Variation, each lane		-100	-	+100	ppm	
Total Average Launch Power	POT	-	-	8.5	dBm	
Average Launch Power, each lane	PO	-6.5	-	2.5	dBm	1
Optical Modulation Amplitude (OMA), each lane	POMA	-4.0	-	2.5	dBm	
Difference in launch power between any two lanes (OMA)		-	-	5.0	dBm	

Launch power in OMA minus TDP, each lane	P-TDP	-5.0	-	-	dBm	
Transmitter and dispersion penalty (TDP), each lane	TDP	-	-	3.0	dBm	
Optical Extinction Ratio	ER	3.5	-	-	dB	
Relative Intensity Noise	RIN	-	-	-130	dB/Hz	
Optical Return Loss Tolerance	ORL	-	-	20	dB	
Transmitter Reflectance	RT	-	-	-12	dB	
Average Launch power of Tx OFF, each lane	POFF	-	-	-30	dBm	
Transmitter Eye Mask coordinates: X1, X2, X3, Y1, Y2, Y3	SPECIFICATION VALUES {0.31,0.4,0.45,0.34,0.38,0.4}					2
Receiver						
Lane center Wavelength Range	λC-L0	1264.5	1271	1277.5	nm	
	λC-L1	1284.5	1291	1297.5	nm	
	λC-L2	1304.5	1311	1317.5	nm	
	λC-L3	1324.5	1331	1337.5	nm	
Data Rate, each lane	BR	-	25.78125	-	Gbps	
Data Rate Variation, each lane		-100	-	+100	ppm	
Receiver Power(OMA), each lane	ROMA	-	-	2.5	dBm	
Average Receive Power, each lane	RPO	-11.5	-	2.5		1
Receiver Sensitivity(OMA), each lane	RSENS	-	-	-10.0	dBm	
Stressed Receiver Sensitivity (OMA) , each lane	RSRS	-	-	-7.3	dBm	3,4
LOS Assert	LOSA	-25	-	-	dBm	
LOS De-Assert	LOSD	-	-	-12	dBm	
LOS Hysteresis	LOSH	0.5	-	5.0	dB	
Optica Return Loss	RL	-	-	-26	dB	

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Receive electrical 3 dB upper cutoff frequency, per lane		-	-	31	GHz	
Conditions of stressed receiver sensitivity test						
Vertical eye closure penalty	VECP	-	1.9	-	dB	5
Stressed eye J2 Jitter	J2	-	0.33	-	UI	5
Stressed eye J9 Jitter	J9	-	0.48	-	UI	5

Notes:

1. Average launch/receive power, each lane (min) is informative and not the principal indicator of signal strength. A transmitter with launch/receive power below this value cannot be compliant; however, a value above this does not ensure compliance.
2. Hit Ratio 5 x 10^-5 hits/sample
3. Measured with worst ER=3.5dB, RPBS 2^31-1 test pattern @25.78125Gbs BER=<1x10^-12.
4. SRS is measured with vertical eye closure penalty of 1.9 dB max, J2 of 0.33 UI, and J9 of 0.48 UI.
5. Vertical eye closure penalty, stressed eye J2 Jitter, and stressed eye J9 Jitter are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

Pin Assignment

Table 6. Pin Descriptions

Pin	Symbol	Name/Description	Notes
1	GND	Ground	1
2	Tx2n	Transmitter Inverted Data Input	
3	Tx2p	Transmitter Non-Inverted Data Input	
4	GND	Ground	1
5	Tx4n	Transmitter Inverted Data Input	
6	Tx4p	Transmitter Non-Inverted Data Input	
7	GND	Ground	1
8	ModSelL	Module Select	2
9	ResetL	Module Reset	2
10	Vcc Rx	+3.3 V Power supply receiver	

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11	SCL	2-wire serial interface clock	2
12	SDA	2-wire serial interface data	2
13	GND	Ground	1
14	Rx3p	Receiver Non-Inverted Data Output	
15	Rx3n	Receiver Inverted Data Output	
16	GND	Ground	1
17	Rx1p	Receiver Non-Inverted Data Output	
18	Rx1n	Receiver Inverted Data Output	
19	GND	Ground	1
20	GND	Ground	
21	Rx2n	Receiver Inverted Data Output	
22	Rx2p	Receiver Non-Inverted Data Output	
23	GND	Ground	1
24	Rx4n	Receiver Inverted Data Output	
25	Rx4p	Receiver Non-Inverted Data Output	
26	GND	Ground	1
27	ModPrsL	Module Present	
28	IntL	Interrupt	2
29	Vcc Tx	+3.3 V Power supply transmitter	
30	Vcc1	+3.3 V Power Supply	
31	LPMode	Low Power Mode	2
32	GND	Ground	1
33	Tx3p	Transmitter Non-Inverted Data Input	
34	Tx3n	Transmitter Inverted Data Input	
35	GND	Ground	1
36	Tx1p	Transmitter Non-Inverted Data Input	
37	Tx1n	Transmitter Inverted Data Input	
38	GND	Ground	1

Notes:

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1. Circuit ground is internally isolated from chassis ground.

2. Open collector; should be pulled up with a 4.7kΩ to 10kΩ resistor on host board to a voltage between 3.15Vand 3.6V.

Pin Assignment (continued)

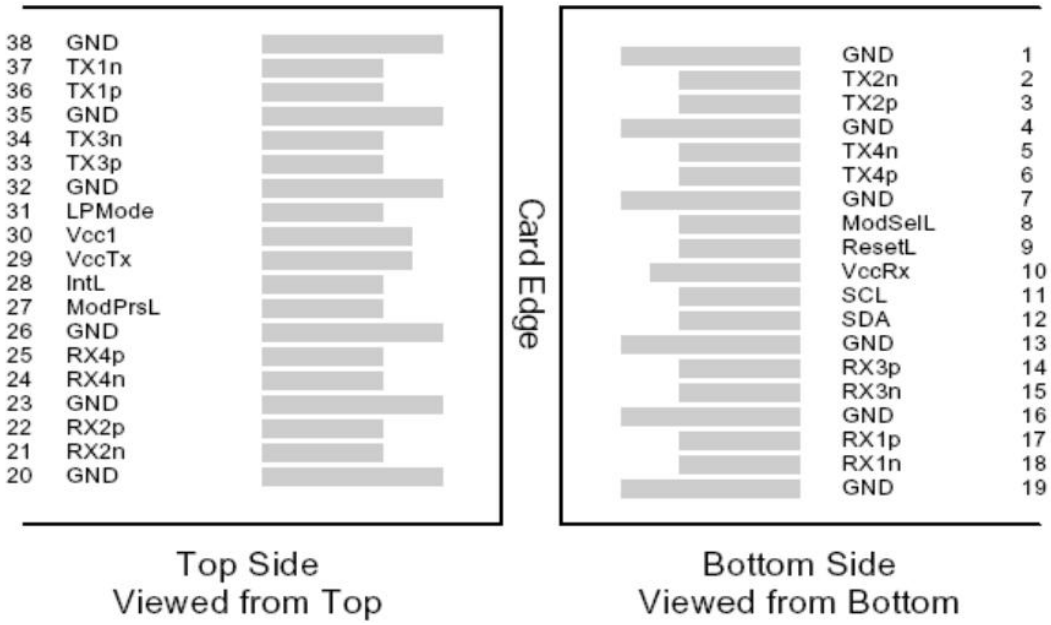

Figure 2. Host PCB QSFP28 pad assignment top view and Names

Table 7. Timing and Electrical

Parameter	Symbol	Min	Typ	Max	Unit
Initialization Time	t_init	-	-	2000	**ms**
Reset Init Assert Time	t_reset_init	-	-	2	**us**
Serial Bus Hardware Ready Time	t_serial	-	-	2000	**ms**
Monitor Data Ready Time	t_data	-	-	2000	**ms**
Reset Assert Time	t_reset	-	-	2000	**ms**
LPMode Assert Time	ton_LPMode	-	-	100	**us**
IntL Assert Time	ton_IntL	-	-	200	**ms**
IntL Deassert Time	toff_IntL	-	-	500	**us**
Rx LOS Assert Time	ton_los	-	-	100	**ms**
Tx Fault Assert Time	ton_Txfault	-	-	200	**ms**

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Flag Assert Time	ton_flag	-	-	200	**ms**
Mask Assert Time	ton_mask	-	-	100	**ms**
Mask Deassert Time	toff_mask	-	-	100	**ms**
ModSelL Assert Time	ton_ModSelL	-	-	100	**us**
ModSelL Deassert Time	toff_ModSelL	-	-	100	**us**
Power_over-ride or Power-set Assert Time	ton_Pdown	-	-	100	**ms**
Power_over-ride or Power-set Deassert Time	toff_Pdown	-	-	300	**ms**

Digital Diagnostic Monitoring Interface

Digital diagnostics monitoring function is available on all QSFP28 module. A 2-wire serial interface provides user to contact with module. The structure of the memory is shown in Figure 4. The memory space is arranged into a lower, single page, address space of 128 bytes and multiple upper address space pages. This structure permits timely access to addresses in the lower page, such as Interrupt Flags and Monitors. Less time critical time entries, such as serial ID information and threshold settings, are available with the Page Select function. The interface address used is A0xh and is mainly used for time critical data like interrupt handling in order to enable a one-time-read for all data related to an interrupt situation. After an interrupt has been asserted, the host can read out the flag field to determine the affected channel and type of flag.

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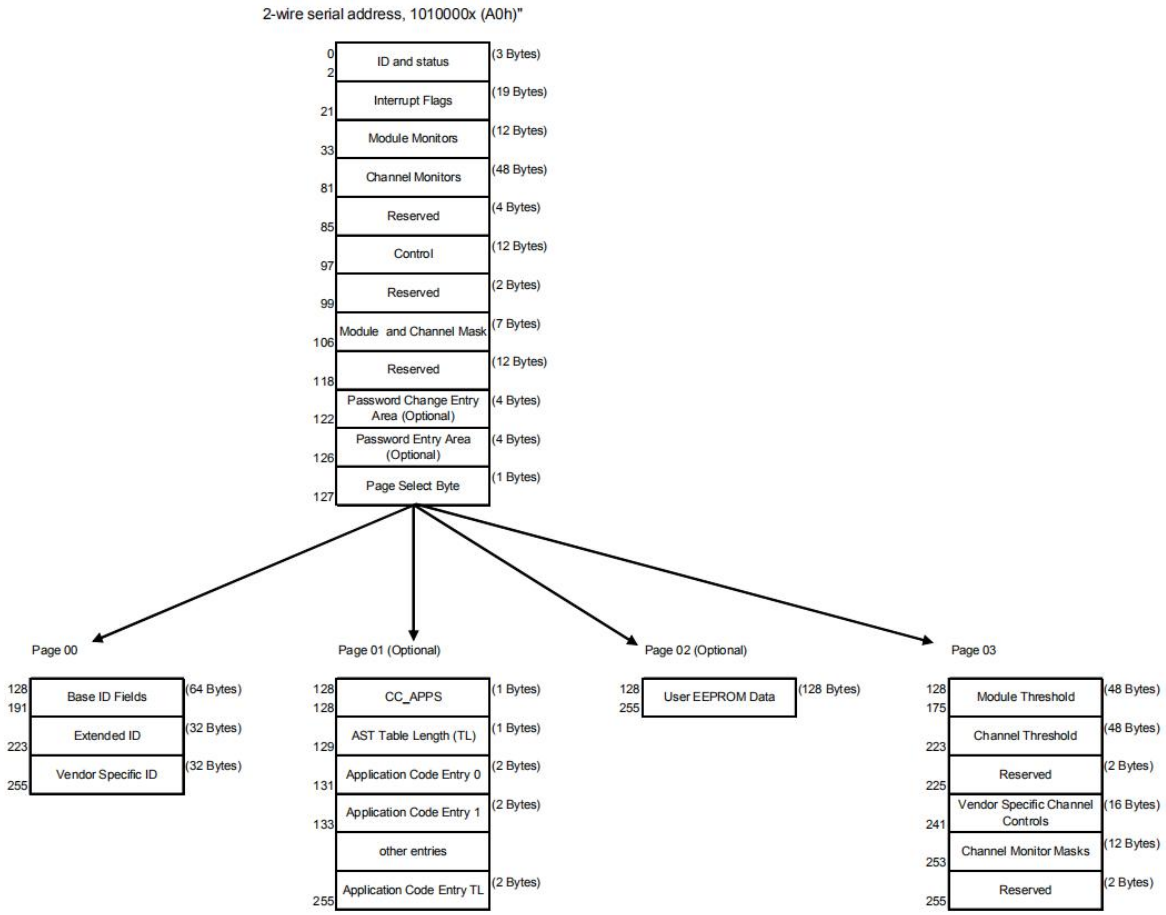

Figure 4, QSFP28 Memory Map (Specific Data Field Descriptions)

Table 8. Digital Diagnostic Monitor Characteristics

Parameter	Calibration	Range	Accuracy	Unit
Transceiver Internal Temperature	Internal	0 to +70°C	±3.0	°C
Vcc Internal Supply Voltage	Internal	3.0 to 3.6V	±3.0	%
Laser Bias Current, each lane	Internal	0 to 90mA	±10	%
Tx Output Power, each lane	Internal	-6.5 to 2.5dBm	±3.0	dBm
Rx Input Power, each lane	Internal	-14.0 to 0dBm	±3.0	dBm

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Recommended Circuit

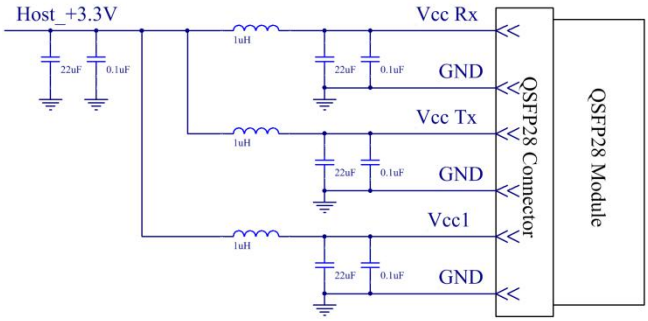

Figure 5, Recommended Host Board Power Supply Circuit

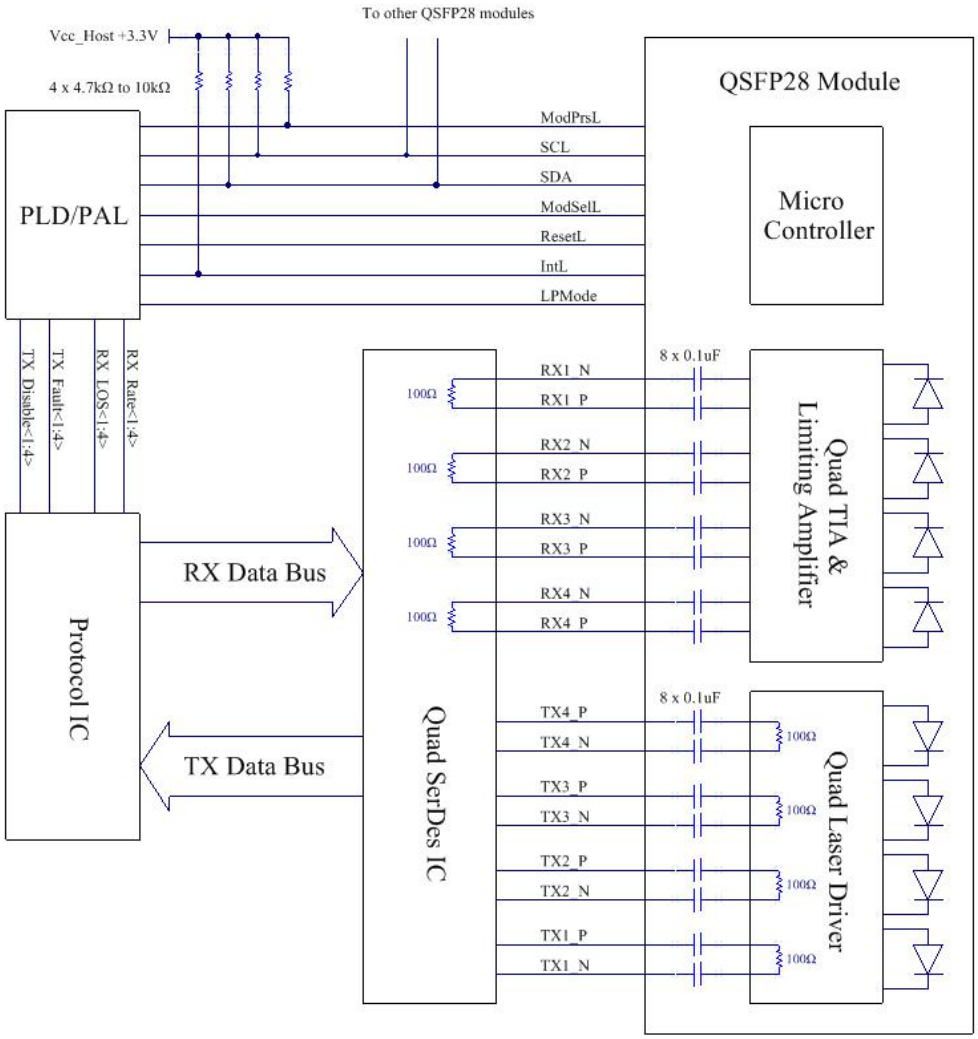

Figure 6, Recommended Interface Circuit

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Mechanical Dimensions

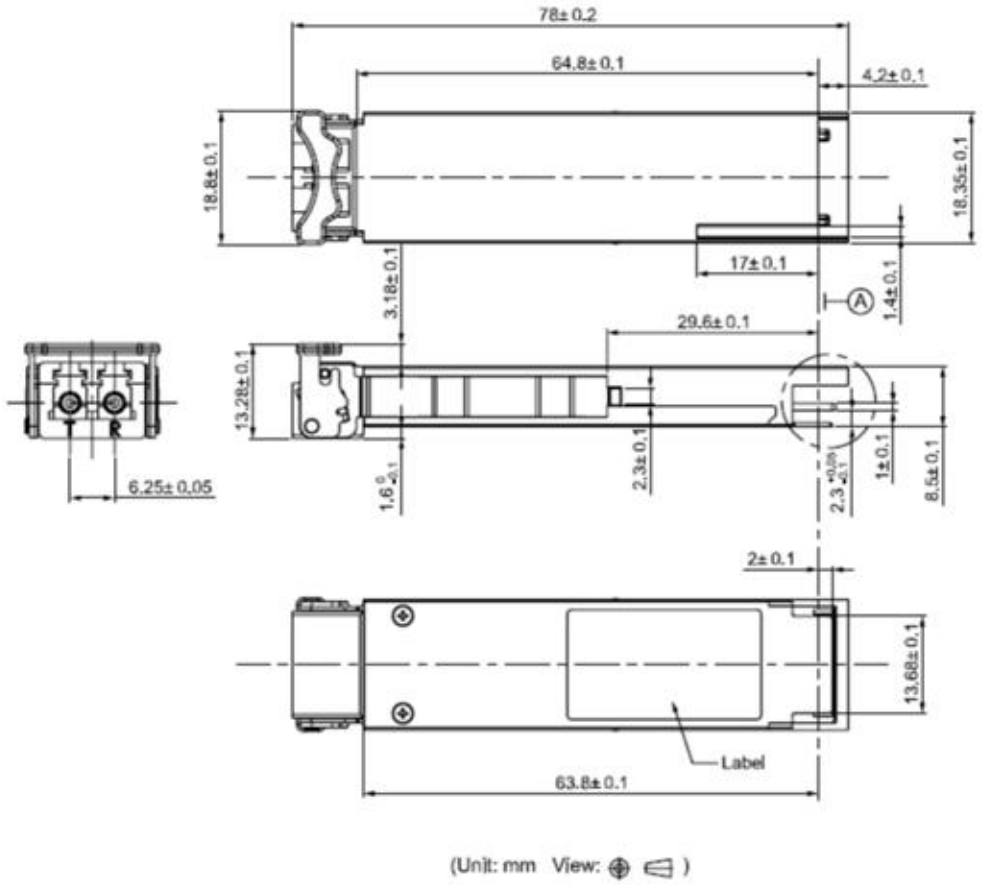

Figure 7, Mechanical Dimensions

Warnings

Handling Precautions: This device is susceptible to damage as a result of electrostatic discharge (ESD). A static free environment is highly recommended. Follow guidelines according to proper ESD procedures.

Laser Safety: Radiation emitted by laser devices can be dangerous to human eyes.

Avoid eye exposure to direct or indirect radiation.

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