

# 100Gb/s QSFP28 PSM4 1310nm 2km Optical Transceiver

## Features

- 4 independent full-duplex channels
- Up to 28Gb/s data rate per channel
- QSFP28 MSA compliant
- Compliant to IEEE 802.3bm 100GBASE PSM4
- Up to 2km reach for G.652 SMF
- Maximum power consumption 3.5W
- Single +3.3V power supply
- RoHS-6 compliant
- Operating case temperature: 0~70°C

## Applications

- 100GBASE Ethernet Links
- Client-side 100G Telecom connections

## General Description

The QSFP-100G-PSM4 transceiver is a parallel 100Gb/s Quad Small Form-factor Pluggable (QSFP28) optical module. It provides increased port density and total system cost savings. The QSFP28 full-duplex optical module offers 4 independent transmit and receive channels, each capable of 25Gb/s operation for an aggregate data rate of 100Gb/s on 2km of single mode fiber.

An optical fiber ribbon cable with an MTP/MPO connector can be plugged into the QSFP28 module receptacle. Proper alignment is ensured by the guide pins inside the receptacle. The cable usually cannot be twisted for proper channel to channel alignment. Electrical connection is achieved through an MSA compliant 38-pin edge type connector.

The module operates with single +3.3V power supply. LVCMOS/LVTTL global control signals, such as Module Present, Reset, Interrupt and Low Power Mode, are available with the modules. A 2-wire serial interface is available to send and receive more complex control signals, and to receive digital diagnostic information. Individual channels can be addressed and unused channels can be shut down for maximum design flexibility.

The product is designed with form factor, optical/electrical connection and digital diagnostic interface according to the QSFP28 Multi-Source Agreement (MSA). It has been designed to meet the harshest external operating conditions including temperature, humidity and EMI interference. The module can be managed through the I2C two-wire serial interface.

## Functional Description

This product is a QSFP28 parallel single mode optical transceiver with an MTP/MPO fiber ribbon connector. The transmitter module accepts electrical input signals compatible with Common Mode Logic (CML) levels. All input data signals are differential and internally terminated. The receiver module converts parallel optical input signals via a photo detector array into parallel electrical output signals. The receiver module outputs electrical signals are also voltage compatible with Common Mode Logic (CML) levels. All data signals are differential and support a data rates up to 25Gb/s per channel. Figure 1 shows the functional block diagram of this product.

A single +3.3V power supply is required to power up this product. Both power supply pins VccTx and VccRx are internally connected and should be applied concurrently. As per MSA specifications the module offers 7 low speed hardware control pins (including the 2-wire serial interface): ModSelL, SCL, SDA, ResetL, LPMode, ModPrsL and IntL.

Module Select (ModSelL) is an input pin. When held low by the host, this product responds to 2-wire serial communication commands. The ModSelL allows the use of this product on a single 2-wire interface bus – individual ModSelL lines must be used.

Serial Clock (SCL) and Serial Data (SDA) are required for the 2-wire serial bus communication interface and enable the host to access the QSFP28 memory map.

The ResetL pin enables a complete reset, returning the settings to their default state, when a low level on the ResetL pin is held for longer than the minimum pulse length. During the execution of a reset the host shall disregard all status bits until it indicates a completion of the reset interrupt. The product indicates this by posting an IntL (Interrupt) signal with the Data\_Not\_Ready bit negated in the memory map. Note that on power up (including hot insertion) the module should post this completion of reset interrupt without requiring a reset.

Low Power Mode (LPMode) pin is used to set the maximum power consumption for the product in order to protect hosts that are not

capable of cooling higher power modules, should such modules be accidentally inserted.

Module Present (ModPrsL) is a signal local to the host board which, in the absence of a product, is normally pulled up to the host Vcc. When the product is inserted into the connector, it completes the path to ground through a resistor on the host board and asserts the signal. ModPrsL then indicates its present by setting ModPrsL to a “Low” state.

Interrupt (IntL) is an output pin. “Low” indicates a possible operational fault or a status critical to the host system. The host identifies the source of the interrupt using the 2-wire serial interface. The IntL pin is an open collector output and must be pulled to the Host Vcc voltage on the Host board.

## Absolute Maximum Ratings

Parameter	Symbols	Min.	Typical	Max.	Unit	Notes
Storage Temperature	TSTG	-40		+85	°C	
Operating Relative Humidity (non-condensing)	RH	0		85	%	
Power Supply Voltage	VCC	-0.5		3.6	V	
Damage Threshold,each Lane	TH <sub>d</sub>	4.5			dBm	

## Recommended Operating Conditions

Parameter	Symbols	Min.	Typical	Max.	Unit	Notes
Operating Case Temperature	Top	0		+70	°C	
Power Supply Voltage	VCC	3.135	3.3	3.465	V	
Data Rate,each Lane			25.78125		Gb/s	
Data Rate Accuracy		-100		100	ppm	
Control Input Voltage High		2		VCC	V	
Control Input Voltage Low		0		0.8	V	
Link Distance with G.652	D	0.002		2	km	

## Electrical Characteristic

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Supply current	I <sub>cc</sub>			1.1	A	
Power Consumption				3.5	W	
Transceiver Power-on Initialization Time				2000	ms	1

Optical Transmitter Characteristics						
Single-ended Input Voltage Tolerance (Note 2)		-0.3		4.0	V	Referred to TP1 Signal common
AC Common Mode Input Voltage Tolerance		15			mV	RMS
Differential Input Voltage Swing Threshold		50			mVpp	LOSA Threshold
Differential Input Voltage Swing	V <sub>in,pp</sub>	190		700	mVpp	
Differential Input Impedance	Z <sub>in</sub>	90	100	110	Ohm	
Optical Receiver Characteristics						
Single-ended Output Voltage		-0.3		4.0	V	Referred to signal common
AC Common Mode Output Voltage				7.5	mV	RMS
Differential Output Voltage Swing	V <sub>out,pp</sub>	300		850	mVpp	
Differential Output Impedance	Z <sub>out</sub>	90		110	Ohm	

Notes:

[1] Power-on Initialization Time is the time from when the power supply voltages reach and remain above the minimum recommended operating supply voltages to the time when the module is fully functional.

[2] The single ended input voltage tolerance is the allowable range of the instantaneous input signals.

## Optical Characteristics

Table4-Optical Characteristics						
Parameter	Symbols	Min.	Typical	Max.	Unit	Notes
Center Wavelength	$\lambda C$	1295	1310	1325	nm	
Transmitter						
SMSR	SMSR	30			dB	
Total Average Launch Power	PT			8.0	dBm	
Average Launch Power,each Lane	PAVG	-5.5		2.0	dBm	
OMA,each Lane	POMA	-3.5		2.2	dBm	1
Difference in Launch Power between any Two Lanes(OMA)	Ptx,diff			5	dB	
Launch Power in OMA minus Transmitter and Dispersion Penalty(TDP),each Lane		-4.3			dBm	
TDP,each Lane	TDP			2.9	dB	
Extinction Ratio	ER	3.5			dB	

RIN200MA	RIN			-128	dB/Hz	
Optical Return Loss Tolerance	TOL			20		
Transmitter Reflectance	RT			-12		
Average Launch Power OFF Transmitter,each Lane	Poff			-30		
Eye Mask{X1,X2,X3,Y1,Y2,Y3}		{0.25,0.4,0.45,0.25,0.28,0.4}				2
<b>Receiver</b>						
Damage Threshold,each Lane	THd	4.5			dBm	3
Average Receiver Power,each Lane			-10.2		2.0	dBm
Receiver Power(OMA),each Lane					2.2	dBm
Receiver Sensitivity(OMA),each Lane	SEN1				-9.0	dBm
Receiver Sensitivity(OMA),each Lane	SEN2				-12.0	dBm
Receiver reflectance	RR				-26	dB
Difference in Receiver Power between any Two Lanes(Average and OMA)	Prx,diff				5.5	dB
LOS Assert	LOSA			-20		dBm
LOS Deassert	LOSD			-18		dBm
LOS Hysteresis	LOSH	0.5				dB
Receiver Electrical 3dB upper Cutoff Frequency,each Lane	Fc				31	GHz

Notes:

[1] Even if the TDP<0.8 dB, the OMA min must exceed the minimum value specified here.

[2] See Figure 1 below.

[3] The receiver shall be able to tolerate, without damage, continuous exposure to a modulated optical input signal having this power level on one lane. The receiver does not have to operate correctly at this input power.

[4] Measured at receiver input for BER =  $1 \times 10^{-12}$ .

[5] Measured at receiver input for BER =  $5 \times 10^{-5}$ .

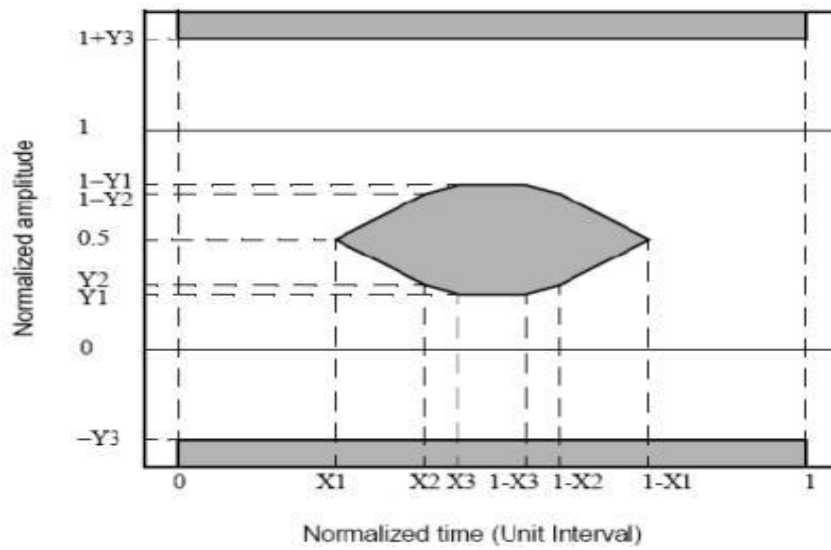


Figure 1 Eye Mask Definition

## Digital Diagnostic Functions

Table 5 Digital Diagnostic Functions					
Parameter	Symbols	Min.	Max.	Unit	Notes
Temperature monitor absolute error	DMI_Temp	-3	+3	degC	Over operating temperature range
Supply voltage monitor absolute error	DMI_VCC	-0.1	0.1	V	Over full operating range
Channel RX power monitor absolute error	DMI_RX_Ch	-2	2	dB	1
Channel Bias current monitor	DMI_Ibias_Ch	-10%	10%	mA	
Channel TX power monitor absolute error	DMI_TX_Ch	-2	2	dB	1

Notes:

[1] Due to measurement accuracy of different single mode fibers, there could be an additional +/- 1 dB fluctuation, or a +/- 3 dB total accuracy.

## Pin Description

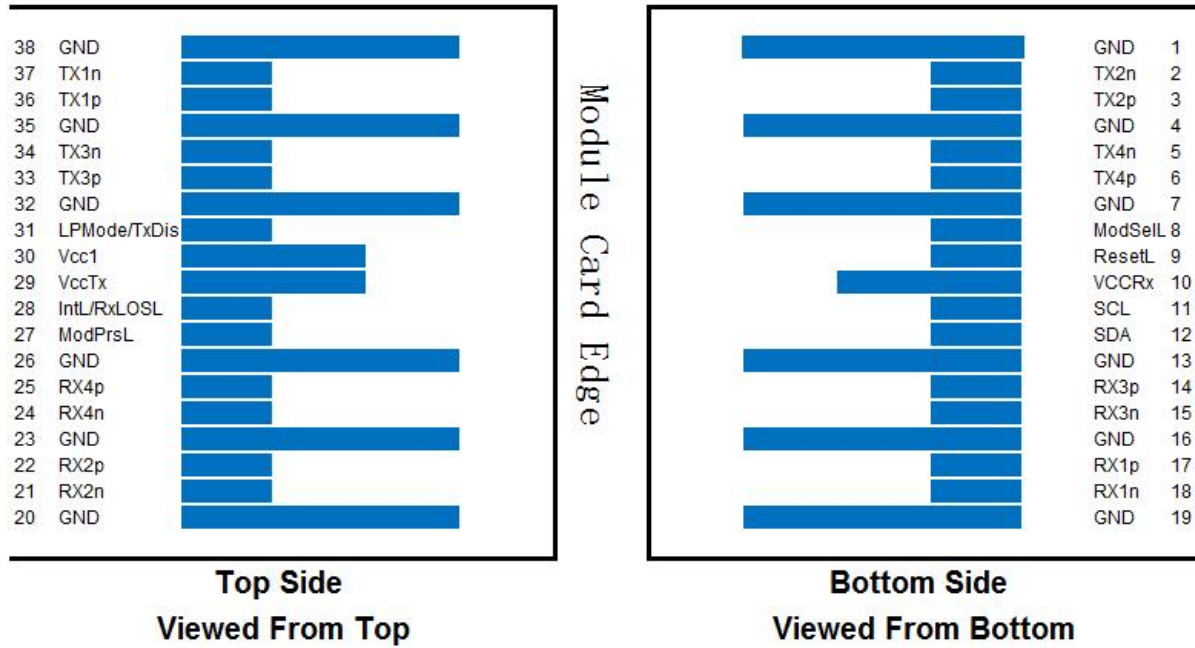


Figure 2 Pin view

## Pin Function Definitions

**Table 6-Pin Function Definitions**

Pin	Logic	Name	Description	Notes
1		GND	Ground	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	
3	CML-I	Tx2p	Transmitter Non-Inverted Data Input	
4		GND	Ground	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	
6	CML-I	Tx4p	Transmitter Non-Inverted Data Input	
7		GND	Ground	
8	LVTLL-I	ModSelL	Module Select	
9	LVTLL-I	ResetL	Module Reset	
10		Vcc Rx	+3.3V Power Supply Receiver	2
11	LVCMOS-I/O	SCL	2-wire serial interface clock	
12	LVCMOS-I/O	SDA	2-wire serial interface data	
13		GND	Ground	
14	CML-O	Rx3p	Receiver Non-Inverted Data Output	
15	CML-O	Rx3n	Receiver Inverted Data Output	
16		GND	Ground	1

17	CML-O	Rx1p	Receiver Non-Inverted Data Output	
18	CML-O	Rx1n	Receiver Inverted Data Output	1
19		GND	Ground	1
20		GND	Ground	
21	CML-O	Rx2n	Receiver Inverted Data Output	
22	CML-O	Rx2p	Receiver Non-Inverted Data Output	
23		GND	Ground	
24	CML-O	Rx4n	Receiver Inverted Data Output	
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	
26		GND	Ground	1
27	LVTTTL-O	ModPrsL	Module Present	
28	LVTTTL-O	IntL/RxLOSL	Interrupt	
29		VccTx	+3.3V Power supply transmitter	2
30		Vcc1	+3.3V Power supply	2
31	LVTTTL-I	LPMODE/TxDis	Low Power Mode	
32		GND	Ground	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	
34	CML-I	Tx3n	Transmitter Inverted Data Input	
35		GND	Ground	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	
37	CML-I	Tx1n	Transmitter Inverted Data Input	
38		GND	Ground	1

Notes:

[1] GND is the symbol for signal and supply (power) common for the module. All are common within the module and all module voltages are referenced to this potential unless otherwise noted. Connect these directly to the host board signal-common ground plane.

[2] Vcc Rx, Vcc1 and Vcc Tx are the receiver and transmitter power supplies and shall be applied concurrently. Recommended host board power supply filtering is shown in Figure2. Vcc Rx Vcc1 and Vcc Tx may be internally connected within the Module in any combination. The connector pins are each rated for a maximum current of 1000 mA.



## Transceiver Block Diagram

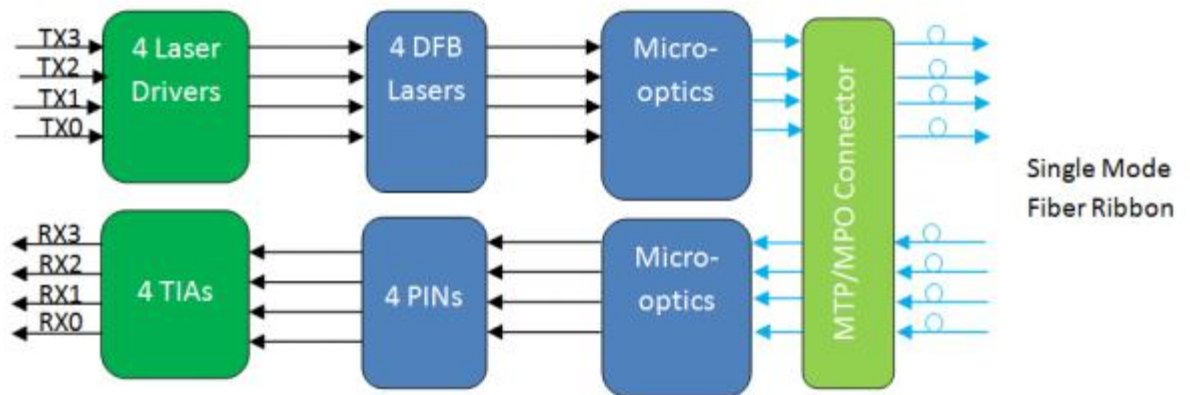


Figure 3 Transceiver Block Diagram

## Mechanical Dimensions

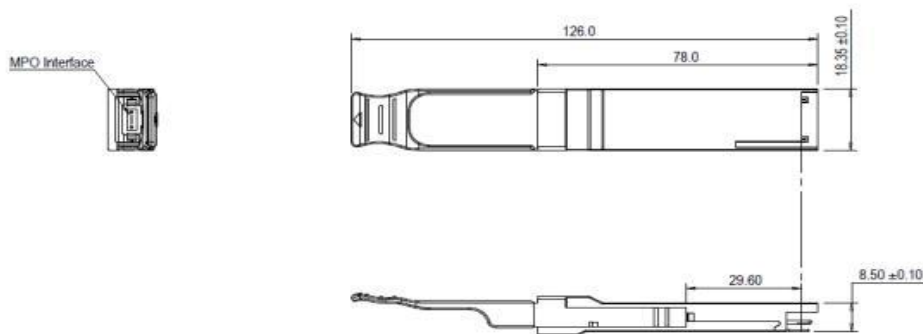


Figure 4 Mechanical Outline

Attention: To minimize MPO connection induced reflections, an MPO receptacle with 8-degree angled end-face is utilized for this product. A female MPO connector with 8-degree end-face should be used with this product as illustrated in Figure 5.

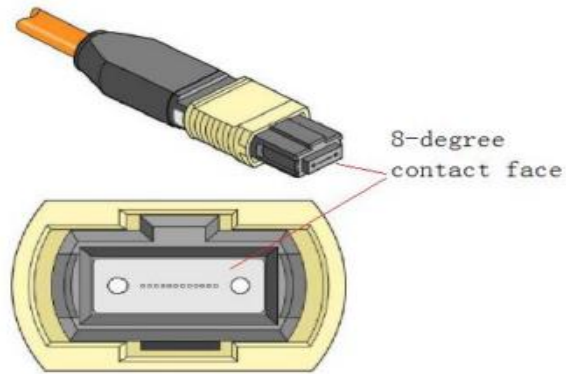


Figure 5 Female MPO Connector with 8-degree End-face

## ESD

This transceiver is specified as ESD threshold 1kV for high speed data pins and 2kV for all other electrical input pins, tested per MIL-STD-883, Method 3015.4 /JESD22-A114-A (HBM). However, normal ESD precautions are still required during the handling of this module. This transceiver is shipped in ESD protective packaging. It should be removed from the packaging and handled only in an ESD protected environment.

## Laser Safety

This is a Class 1 Laser Product according to EN 60825-1:2014. This product complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated (June 24, 2007).

Caution: Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

## Further Information:

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## Disclaimer

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