

# RT-QA0PCM-C00

## 100Gb/s QSFP28 LX4 Optical Transceiver

### Product Features

- Four-channel full-duplex transceiver modules
- Transmission data rate up to 26Gbit/s per channel
- Up to 100m transmission on OM3 multimode fiber (MMF) or 2km transmission on single mode fiber (SMF)
- Low power consumption <4W
- Operating case temperature 0°C to +70°C
- 3.3V power supply voltage
- RoHS compliant
- Hot Pluggable QSFP28 form factor
- LC connector receptacle
- Built-in digital diagnostic function

### Applications

- 100G Ethernet
- Proprietary High Speed Interconnections
- Data center
- 100G LX4 application with FEC

This product is a transceiver module designed for optical transmission applications over both MMF and SMF with transmission distances of up to 100m on MMF (OM3) and 2km on SMF. The module converts 4 inputs channels (ch) of 25Gb/s electrical data to 4 CWDM optical signals, and multiplexes them into a single channel for 100Gb/s optical transmission. Reversely, on the receiver side, the module optically de-multiplexes a 100Gb/s input into 4 CWDM channels signals, and converts them to 4 channel output electrical data.

The central wavelengths of the 4 CWDM channels are 1271, 1291, 1311 and 1331 nm as members of the CWDM wavelength grid defined in ITU-T G.694.2. It contains a duplex LC connector for the optical interface and a 38-pin connector for the electrical interface.

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.

For applications over OM3/OM4 MMF, MMF cables are directly connected to the LC connectors of QSFP28 LX4 module and optical signal is directly launched from the transmitter into the MMF cable as shown in Figure 1. For applications over SMF, the module is used as a QSFP28 CWDM4 module and SMF cables are directly connected to the LC connectors of the module as shown in Figure 2.

### Ordering Information

Part Number	Description
RT-QA0PCM-C00	QSFP28LX4100M on MMF or 2KM on SMF optical transceiver with full real-time digital diagnostic monitoring and pull tab

### For More Information:

Wuhan Rayoptek Co.,Ltd  
 Address: G3-201,New Energy Building,No.999 Gao Xin Road, Wuhan, Hubei, China  
 Phone:0086-27-87106345 Fax: 0086-27-87106345 Email: sales@rayoptek.com

### Regulatory Compliance

Feature	Standard	Performance
Electromagnetic Interference (EMI)	FCC Part 15 Class B EN 55022:2010, Class B	Compatible with standards
Electromagnetic susceptibility (EMS)	EN 55024:2010	Compatible with standards
Laser Eye Safety	FDA 21CFR 1040.10 and 1040.11 EN60950, EN (IEC) 60825-1,2	Compatible with Class I laser product

## Functional Description

This product converts the 4-channel 25Gb/s electrical input data into CWDM optical signals (light), by a driven 4-wavelength Distributed Feedback Laser (DFB). The light is combined by the MUX parts as a 100Gb/s data, propagating out of the transmitter module from the MMF. The receiver module accepts the 100Gb/s CWDM optical signals input, and de-multiplexes it into 4 individual 25Gb/s channels with different wavelength. Each wavelength light is collected by a discrete photo diode, and then outputted as electric data after amplified by a TIA and a post amplifier. Figures 1 and 2 show 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

It has to be noted that the operation in excess of any individual absolute maximum ratings might cause permanent damage to this module.

Parameter	Symbol	Min	Max	Unit	Notes
Storage Temperature	T <sub>S</sub>	-40	85	°C	
Operating Case Temperature	T <sub>OP</sub>	0	70	°C	
Power Supply Voltage	V <sub>CC</sub>	-0.5	3.6	V	
Relative Humidity (non-condensation)	RH	0	85	%	
Damage Threshold, each Lane	TH <sub>d</sub>	4.5		dBm	

## Recommended Operating Conditions and Power Supply Requirements

Parameter	Symbol	Min	Typical	Max	Unit	Notes
Operating Case Temperature	T <sub>OP</sub>	0		70	°C	
Power Supply Voltage	V <sub>CC</sub>	3.135	3.3	3.465	V	
Data Rate, each Lane			25.78125		Gb/s	
Control Input Voltage High		2		V <sub>CC</sub>	V	
Control Input Voltage Low		0		0.8	V	
Link Distance (OM3 MMF)	D <sub>MMF</sub>			100	m	
Link Distance (SMF)	D <sub>SMF</sub>			2	km	

## Electrical Characteristics

The following electrical characteristics are defined over the Recommended Operating Environment unless otherwise specified.

Parameter	Test Point	Min	Typical	Max	Unit	Notes
Power Consumption				4	W	
Supply Current	I <sub>CC</sub>			1.22	A	
Transceiver Power-on Initialization Time				2000	ms	1
<b>Transmitter (each Lane)</b>						
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	
Differential Input Return Loss		See IEEE 802.3ba 86A.4.11			dB	10MHz- 11.1GHz
J2 Jitter Tolerance	Jt2	0.17			UI	
J9 Jitter Tolerance	Jt9	0.29			UI	
Data Dependent Pulse Width Shrinkage (DDPWS ) Tolerance		0.07			UI	
Eye Mask Coordinates {X1, X2, Y1, Y2}		0.11, 0.31 95, 350			UI mV	Hit Ratio = 5x10 <sup>-5</sup>
<b>Receiver (each Lane)</b>						
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	100	110	ohm	
Termination Mismatch at 1MHz				5	%	
Differential Output Return Loss		See IEEE 802.3ba 86A.4.2.1			dB	10MHz- 11.1GHz
Common Mode Output Return Loss		See IEEE 802.3ba 86A.4.2.2			dB	10MHz- 11.1GHz
Output Transition Time		28			Ps	20% to 80%
J2 Jitter Output	Jo2			0.42	UI	
J9 Jitter Output	Jo9			0.65	UI	

Eye Mask Coordinates {X1, X2, Y1, Y2}	0.29, 0.5, 150, 425	UI mV	Hit Ratio = 5x10-5
---------------------------------------	---------------------	----------	--------------------

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

Parameter	Symbol	Min	Typical	Max	Unit	Notes
Wavelength Assignment	L0	1264.5	1271	1277.5	nm	
	L1	1284.5	1291	1297.5	nm	
	L2	1304.5	1311	1317.5	nm	
	L3	1324.5	1331	1337.5	nm	
<b>Transmitter</b>						
Total Average Launch Power(for SMF)	P <sub>T,SMF</sub>			8.3	dBm	
Total Average Launch Power(for MMF)	P <sub>T,MMF</sub>			9.5	dBm	
Average Launch Power, each Lane(for SMF)	P <sub>AVG,SMF</sub>	-6.5		2.5	dBm	
Average Launch Power, each Lane(for MMF)	P <sub>AVG,MMF</sub>	-4.5		4.5	dBm	
Optical Modulation Amplitude (OMA), each Lane(for SMF)	P <sub>OMA,SMF</sub>	-4.5		2.5	dBm	1
Optical Modulation Amplitude (OMA), each Lane(for MMF)	P <sub>OMA,MMF</sub>	-3		4.5	dBm	
Difference in Launch Power between any Two Lanes (OMA)	P <sub>tx,diff</sub>			6.5	dB	
Launch Power in OMA minus Transmitter and Dispersion Penalty (TDP), each Lane		-6.8			dBm	
TDP, each Lane	TDP			2.6	dB	
Extinction Ratio	ER	3.5			dB	
Relative Intensity Noise	RIN			-128	dB/Hz	12dB reflection
Transmitter Reflectance	R <sub>T</sub>			-12	dB	
Average Launch Power OFF Transmitter, each Lane	P <sub>off</sub>			-30	dBm	
<b>Receiver</b>						
Overload power, each Lane(AVG)		4.5			dBm	2
Total Average Receive Power(for SMF)				8.3	dBm	
Total Average Receive Power(for MMF)				9.5	dBm	
Average Receive Power, each Lane(for SMF)		-11.5		4.5	dBm	
Average Receive Power, each Lane(for MMF)		-8		3.5	dBm	
Receiver Reflectance	R <sub>R</sub>			-26	dB	
Receiver Sensitivity (OMA), each	SEN,SMF			-11.5	dBm	3

Lane(for SMF)						
Receiver Sensitivity (OMA), each Lane(for MMF)	SEN,MMF			-8	dBm	3
Difference in Receive Power between any Two Lanes (OMA)	Prx,diff			7.5	dB	
LOS Assert	LOSA	-28			dBm	
LOS Deassert	LOSD			-15	dBm	
LOS Hysteresis	LOSH	0.5			dB	
Receiver Electrical 3 dB upper Cutoff Frequency, each Lane	F <sub>c</sub>			12.3	GHz	

Notes:

1. Even if the TDP < 0.8 dB, the OMA min must exceed the minimum value specified here.
2. 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.
3. Sensitivity is specified at 5x10<sup>-5</sup> BER.

### Digital Diagnostic Functions

The following digital diagnostic characteristics are defined over the normal operating conditions unless otherwise specified.

Parameter	Symbol	Min	Max	Unit	Notes
Temperature monitor absolute error	DMI_Temp	-3	+3	°C	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	-3	+3	dB	1
Channel Bias current monitor	DMI_Ibias_Ch	-10%	+10%	mA	
Channel TX power monitor absolute error	DMI_TX_Ch	-3	+3	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.

### Block Diagram of Transceiver

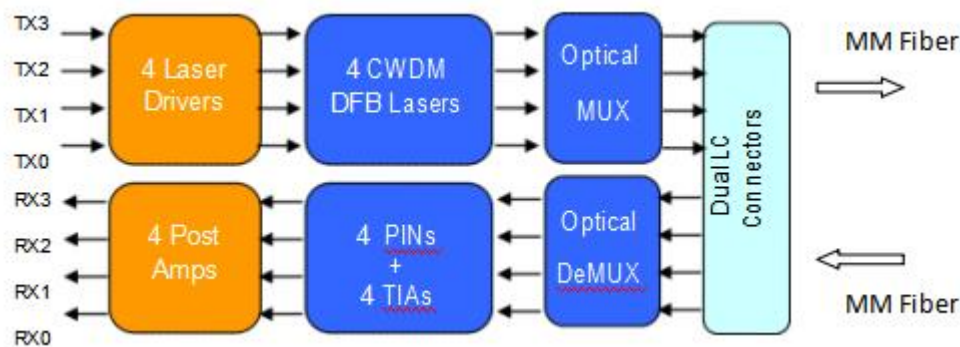


Figure1. Transceiver Block Diagram for Application over Multimode

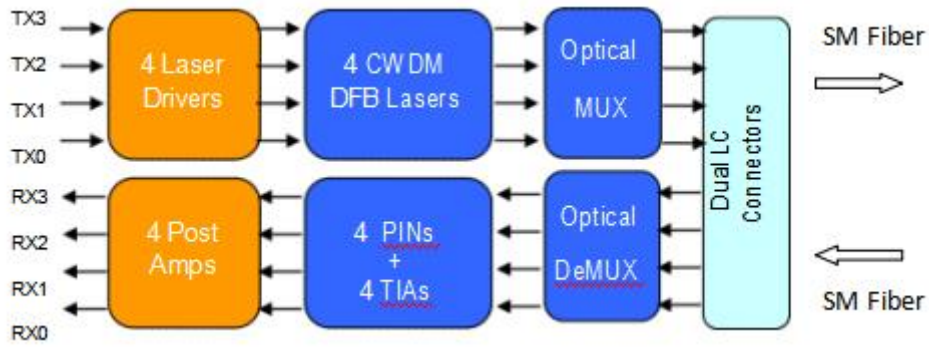
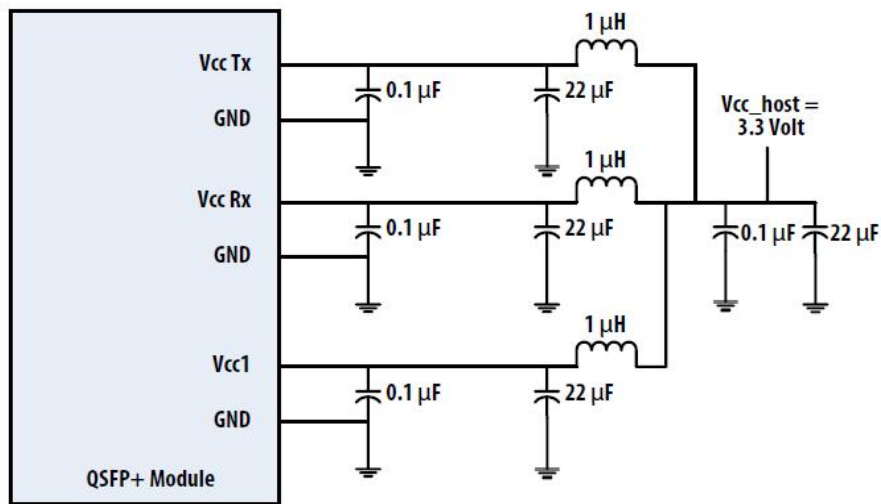
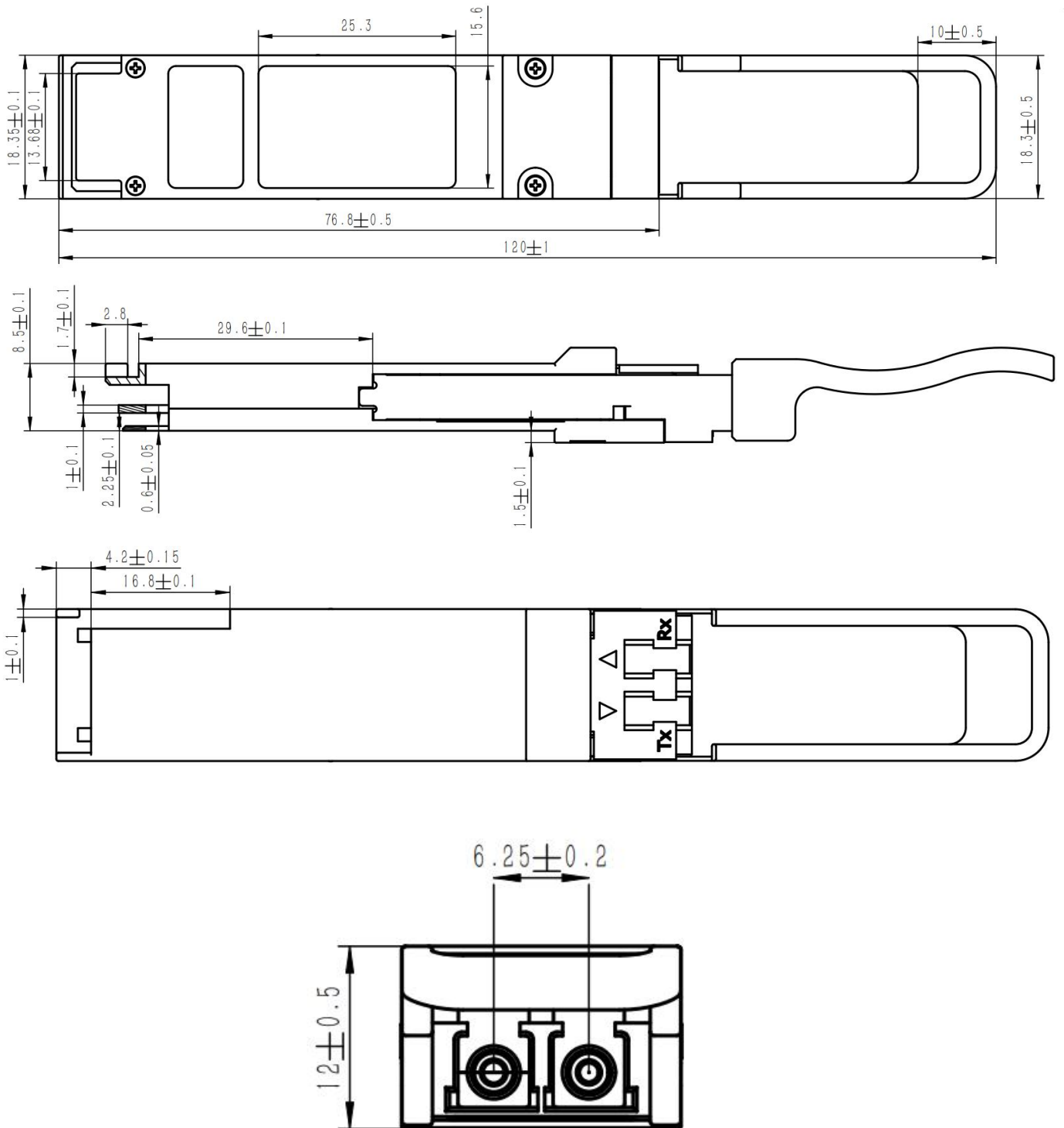


Figure 2. Transceiver Block Diagram for Applications over Single Mode Fiber

## Recommended Power Supply Filter



## Mechanical Dimensions

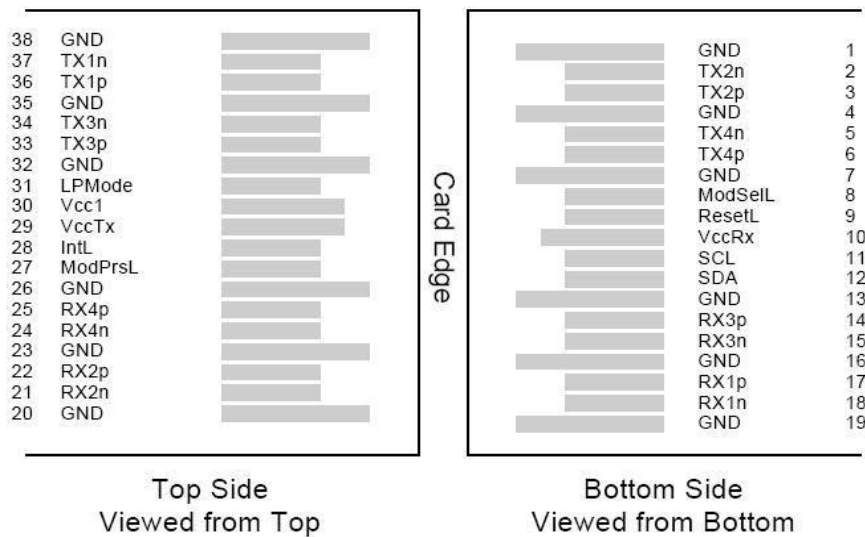


This transceiver is specified as ESD threshold 1kV for SFI pins and 2kV for all other electrical input pins, tested per MIL-STD-883, Method 3015.4 /JESD22-A114-A (HBM). However, normal ESD precautions are still required during the handling of this module. This transceiver is shipped in ESD protective 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 IEC 60825-1:2007. This product complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated (June 24, 2007).

## Pin Assignment and Description



## Pin Assignment

PIN #	Logic	Symbol	Description	Notes
1		GND	Ground	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	
3	CML-I	Tx2p	Transmitter Non-Inverted Data output	
4		GND	Ground	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	
6	CML-I	Tx4p	Transmitter Non-Inverted Data output	
7		GND	Ground	1
8	LVTTLL-I	ModSelL	Module Select	
9	LVTTLL-I	ResetL	Module Reset	
10		VccRx	+3.3V Power Supply Receiver	2
11	LVC MOS-I/O	SCL	2-Wire Serial Interface Clock	
12	LVC MOS-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	
19		GND	Ground	1
20		GND	Ground	1
21	CML-O	Rx2n	Receiver Inverted Data Output	
22	CML-O	Rx2p	Receiver Non-Inverted Data Output	
23		GND	Ground	1
24	CML-O	Rx4n	Receiver Inverted Data Output	1
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	
26		GND	Ground	1
27	LVTTL-O	ModPrsL	Module Present	
28	LVTTL-O	IntL	Interrupt	
29		VccTx	+3.3 V Power Supply transmitter	2
30		Vcc1	+3.3 V Power Supply	2
31	LVTTL-I	LPMODE	Low Power Mode	
32		GND	Ground	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	
34	CML-I	Tx3n	Transmitter Inverted Data Output	
35		GND	Ground	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	
37	CML-I	Tx1n	Transmitter Inverted Data Output	
38		GND	Ground	1

## Notes:

1. GND is the symbol for signal and supply (power) common for QSFP+ modules. All are common within the QSFP+ 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. VccRx, Vcc1 and VccTx are the receiving and transmission power suppliers and shall be applied concurrently. Recommended host board power supply filtering is shown in Figure 3 below. Vcc Rx, Vcc1 and Vcc Tx may be internally connected within the QSFP+ transceiver module in any combination. The connector pins are each rated for a maximum current of 500mA.