

40Gb/s QSFP+ LX4 Optical Transceiver

Product Features

- QSFP+ MSA compliant
- Compliant with QDR/DDR Infiniband data rates
- Up to 11.2Gb/s data rate per wavelength
- 4 CWDM lanes MUX/DEMUX design
- Up to 100m on OM3, 150m on OM4 MMF and 2km on SMF
- Operating case temperature: 0 to 70°C
- Maximum power consumption 2.5W
- LC duplex connector
- RoHS compliant

Applications

- Infiniband QDR and DDR interconnects
- Client-side 40G Telecom connections

This product is a transceiver module designed for 100m on OM3, 150m on OM4 MMF and 2km on SMF optical communication applications. The module converts 4 inputs channels (ch) of 10Gb/s electrical data to 4 CWDM optical signals, and multiplexes them into a single channel for 40Gb/s optical transmission. Reversely, on the receiver side, the module optically de-multiplexes a 40Gb/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 148-pin connector for the electrical interface. To minimize the optical dispersion in the long-haul system, single-mode fiber (SMF) has to be applied in this module.

The product is designed with form factor, optical/electrical connection and digital diagnostic interface according to the QSFP+ Multi-Source Agreement (MSA). It has been designed to meet the harshest external operating conditions including temperature, humidity and EMI interference.

Ordering Information

Part Number	Description
AC-B-Q40LX4-xx	QSFP+ 40G LX4 100m on OM3, 150m on OM4 MMF and 2km on SMF optical transceiver with full real-time digital diagnostic monitoring and pull tab

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

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	TS	-40	85	°C	
Operating Case Temperature	TOP	0	70	°C	
Power Supply Voltage	V _{CC}	-0.5	3.6	V	
Relative Humidity (non-condensation)	RH	0	85	%	
Damage Threshold, each Lane	TH _d	3.3		dBm	

Recommended Operating Conditions and Power Supply Requirements

Parameter	Symbol	Min	Typical	Max	Unit	Notes
Operating Case Temperature	TOP	0		70	°C	
Power Supply Voltage	V _{CC}	3.135	3.3	3.465	V	
Data Rate, each Lane			10.3125		Gb/s	
Control Input Voltage High		2		V _{CC}	V	
Control Input Voltage Low		0		0.8	V	

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				2.5	W	
Supply Current	I _{cc}			0.7	A	
Transceiver Power-on Initialization Time				2000	ms	1
Transmitter (each Lane)						
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			mV _{pp}	LOSA Threshold
Differential Input Voltage Swing	V _{in,pp}	190		700	mV _{pp}	
Differential Input Impedance	Z _{in}	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			UI	Hit Ratio = 5x10 ⁻⁵
		95, 350			mV	
Receiver (each Lane)						
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 _{out,pp}	300		850	mV _{pp}	

Differential Output Impedance	Zout	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	
Transmitter						
Side Mode Suppression Ratio	SMSR	30			dB	
Total Average Launch Power	P _T			8.3	dBm	
Average Launch Power, each Lane (SMF)	P _{AVG}	-7		2.3	dBm	
Average Launch Power, each Lane (MMF)	P _{AVG}	-5		4.3	dBm	

Optical Modulation Amplitude (OMA), each Lane (MMF)	P _{OMA}	-3		4.5	dBm	1
Optical Modulation Amplitude (OMA), each Lane (SMF)	P _{OMA}	-4		3.5	dBm	1
Difference in Launch Power between any Two Lanes (OMA)	P _{tx,diff}			6.5	dB	
Launch Power in OMA minus Transmitter and Dispersion Penalty (TDP), each Lane		-4.8			dBm	
TDP, each Lane (MMF)	TDP			2.6	dB	
TDP, each Lane (SMF)	TDP			4.7	dB	
Extinction Ratio	ER	3.5			dB	
Relative Intensity Noise	RIN			-128	dB/Hz	12dB reflection
Optical Return Loss Tolerance	TOL			20	dB	
Transmitter Reflectance	R _T			-12	dB	
Transmitter Eye Mask Definition {X1, X2, X3, Y1, Y2, Y3}		{0.25, 0.4, 0.45, 0.25, 0.28, 0.4}				
Average Launch Power OFF Transmitter, each Lane	P _{off}			-30	dBm	
Receiver						
Damage Threshold, each Lane	TH _d	3.3			dBm	2
Total Average Receive Power				8.3	dBm	
Average Receive Power, each Lane(MMF)		-10		4.3	dBm	
Average Receive Power, each Lane(SMF)		-13.7		2.3	dBm	
Receiver Reflectance	R _R			-26	dB	
Receive Power (OMA), each Lane				-3.5	dBm	
Receiver Sensitivity (OMA), each Lane(MMF)	SEN			-9.5	dBm	

Receiver Sensitivity (OMA), each Lane(SMF)	SEN			-11.5	dBm	
Difference in Receive Power between any Two Lanes (OMA)	Prx,diff			7.5	dB	
LOS Assert	LOSA	-28			dBm	
LOS Deassert	LOSD			-14	dBm	
LOS Hysteresis	LOSH	0.5			dB	
Receiver Electrical 3 dB upper Cutoff Frequency, each Lane	F _c			12.3	GHz	
Conditions of Stress Receiver Sensitivity Test (Note 5)						
Vertical Eye Closure Penalty, each Lane			1.9		dB	
Stressed Eye J2 Jitter, each Lane			0.3		UI	
Stressed Eye J9 Jitter, each Lane			0.47		UI	

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. Measured with conformance test signal at receiver input for BER = 1×10^{-12} .
4. MVertical eye closure penalty and stressed eye jitter are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

Digital Diagnostic Functions

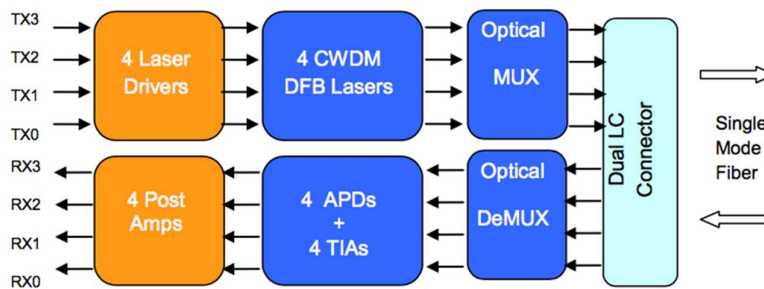
The following digital diagnostic characteristics are defined over the normal operating conditions unless otherwise specified.

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	-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

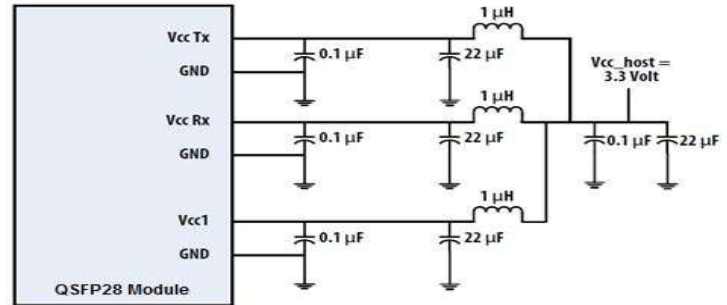
Notes:

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

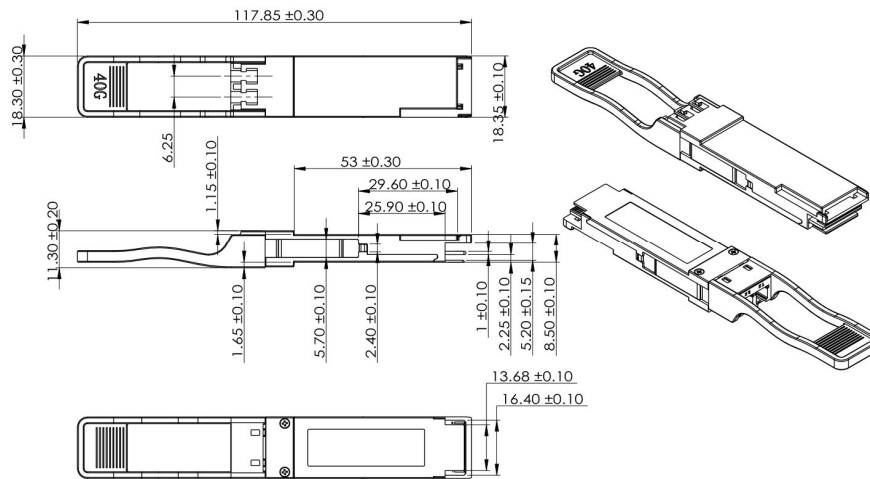
Block Diagram of Transceiver



Recommended Power Supply Filter



Mechanical Dimensions



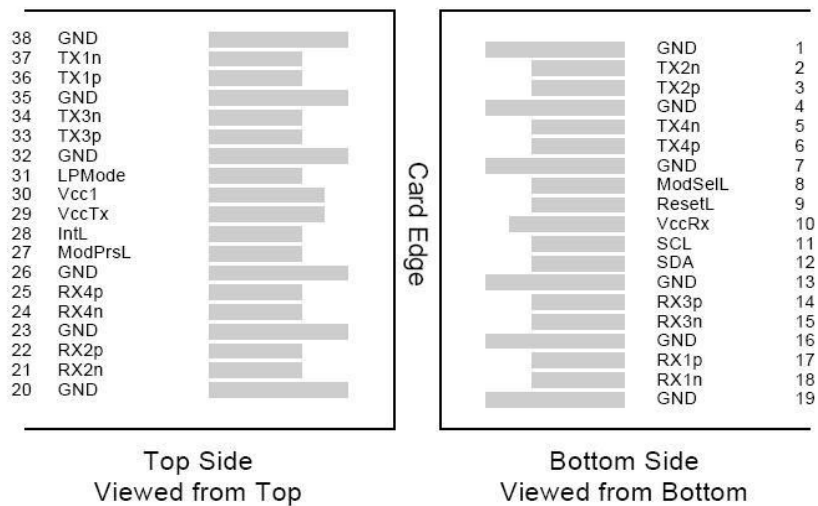
ESD

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	LVTTTL-I	ModSelL	Module Select	
9	LVTTTL-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	LVTTTL-O	ModPrsL	Module Present	
28	LVTTTL-O	IntL	Interrupt	
29		VccTx	+3.3 V Power Supply transmitter	2
30		Vcc1	+3.3 V Power Supply	2
31	LVTTTL-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.