40Gb/s QSFP+ LX4 1310nm 2km Optical Transceiver

Features

- Compliant to the industry standard SFF-8436 QSFP+ Transceiver Specification
- QSFP+ MSA compliant
- 4 CWDM lanes MUX/DEMUX design
- Up to 11.2Gb/s data rate per wavelength
- Digital diagnostic capabilities
- Up to 100m transmission on OM3 multi-mode fiber (MMF) or 2km transmission on single mode fiber (SMF)
- Operating case temperature: 0 to 70℃
- Maximum power consumption 3.5W
- LC duplex connector
- ROHS compliant

Applications

- 40GBASE-LX4 Ethernet Links
- Client-side 40G Telecom connections

Compliance

- IEEE 802.3ba Electrical Interface
- SFF-8436 QSFP Specification

General Description

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 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 1331nm as members of the CWDM wavelength grid defined in ITU-T G694.2. It contains a duplex LC connector for the optical interface and a 148-pin connector for the electrical interface.

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.

For applications over OM3/OM4 MMF, MMF cables are directly connected to the LC connectors of QSFP+ 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 QSFP+ IR4 module and SMF cables are directly connected to the LC connectors of the module as shown in Figure 2.

Functional Description

This product converts the 4-channel 10Gb/s electrical input data into CWDM optical signals (light), by a driven 4-wavelength Distributed Feedback Laser (DFB) array. The light is combined by the MUX parts as a 40Gb/s data, propagating out of the transmitter module from the MMF. The receiver module accepts the 40Gb/s CWDM optical signals input, and de-multiplexes it into 4 individual 10Gb/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 QSFP+ 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

Table1-Absolute Maximum Ratings

Parameter	Symbols	Min.	Max.	Unit	Notes
Storage Temperature	TS	-40	+85	°C	
Operating Case Temperature	Top	0	70	°C	
Operating Relative Humidity	RH	0	85	%	
3.3V Supply Voltage	VCC	-0.5	+3.6	V	
Damage Threshold,each Lane	THd	4.5		dBm	

Recommended Operating Conditions

Table2-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			10.3125	11.2	Gb/s	
Control Input Voltage High		2	100	110	Ohms	
Control Input Voltage Low		0		Vcc	V	
Logic Input Voltage Low		-0.3		0.8	V	
Link Distance(OM3 MMF)	D-MMF			100	m	
Link Distance(SMF)	D-SMF			2	km	

Electrical Characteristic

Table3-Electrical Characteristic

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Power Consumption				3.5	W	
Supply Current	Icc			1.1	A	
Transceiver Power-on Initialization Time				2000	ms	1
Transmitter						
Single-ended Input Voltage		-0.3		4.0	V	Referred to TP1

Tolerance(Note2)						signal common
AC Common Mode Input Voltage Tolerance		15			mV	RMS
Differential Input Voltage Swing Threshold		50			mVpp	LOSA Threshold
Differential Input Voltage Swing	Vin,pp	190		700	mVpp	
Differential Input Impedance	Zin	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=5x10-5
Receiver						
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	Vout,pp	300		850	mVpp	
Differential Output Voltage 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

Table4-Optical Characteristics

Parameter	Symbols	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						
Total Average Launch Power	PT			6.0	dBm	
Average Launch Power,each Lane(for SMF)	PAVG,SMF	-7.0		0	dBm	
Average Launch Power,each Lane(for MMF)	PAVG,MMF	-5.0		3.5	dBm	
OMA,each Lane(for SMF)	PAVG,SMF	-6.0		1.0	dBm	1
OMA,each Lane(for MMF)	PAVG,MMF	-4.0		4.5	dBm	
Difference in Launch Power between any Two Lanes(OMA)	Ptx,diff			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	RT			-12	dB	
Transmitter Eye Mask Definition{X1,X2,X3,Y1,Y2,Y3}		{0.23,0.34,0.43,0.27,0.35,0.4}				
Average Launch Power OFF Transmitter,each Lane	Poff			-30	dBm	
Receiver(each Lane)						
Damage Threshold,each Lane	THd	4.5			dBm	2
Total Average Receiver Power				6.0	dBm	
Average Receiver Power,each Lane(for SMF)		-11.7		0	dBm	
Average Receiver Power,each Lane(for MMF)		-7.0		3.5	dBm	
Receiver Reflectance	RR			-26	dB	

Receiver Power(OMA),each Lane(for SMF)				1.0	dBm	
Receiver Power(OMA),each Lane(for MMF)				4.5	dBm	
Receiver Sensitivity(OMA),each Lane	SEN			-11.5	dBm	
Difference in Receive Power between any Two Lanes(OMA)	Prx,diff			7.5	dB	
LOS Assert	LOSA	-28			dBm	
LOS Dessert	LOSD			-15	dBm	
LOS Hysteresis	LOSH	0.5			dB	
Receiver Electrical 3dB upper Cutoff Frequency,each Lane	Fc			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.

Pin Description

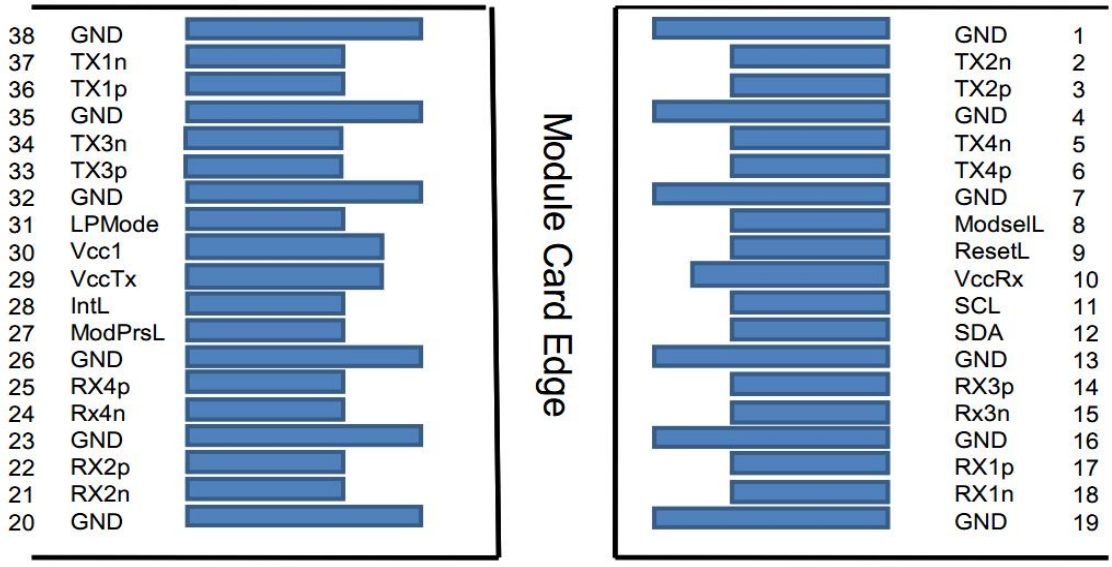

Figure 1 Pin view

Pin Function Definitions

Table5-Pin Function Definitions

Pin	Symbol	Description	Note
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	
9	ModSelL	Module Select	
10	Vcc Rx	+3.3V Power Supply Receiver	2
11	SCL	2-wire serial interface clock	
12	SDA	2-wire serial interface data	
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	Rx1p	Receiver Inverted Data Output	
19	GND	Ground	1
20	GND	Ground	1
21	Rx2n	Receiver Inverted Data Output	
22	Rx2p	Receiver Non-Inverted Data Output	
23	GND	Ground	
24	Rx4n	Receiver Inverted Data Output	
25	Rx4p	Receiver Non-Inverted Data Output Ground	
26	GND	Ground	1
27	ModPrsL	Module Present	
28	IntL	Interrupt	
29	Vcc Tx	+3.3V Power supply transmitter	2
30	Vcc1	+3.3V Power supply	2
31	LPMode	Low Power Mode	
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：

[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 noted otherwise. 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 4 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.

Recommended Power Supply Filter

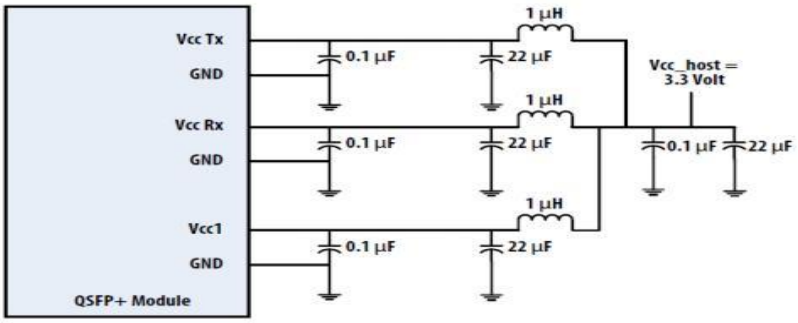

Figure 2 Recommended Power Supply Filter

Transceiver Block Diagrams

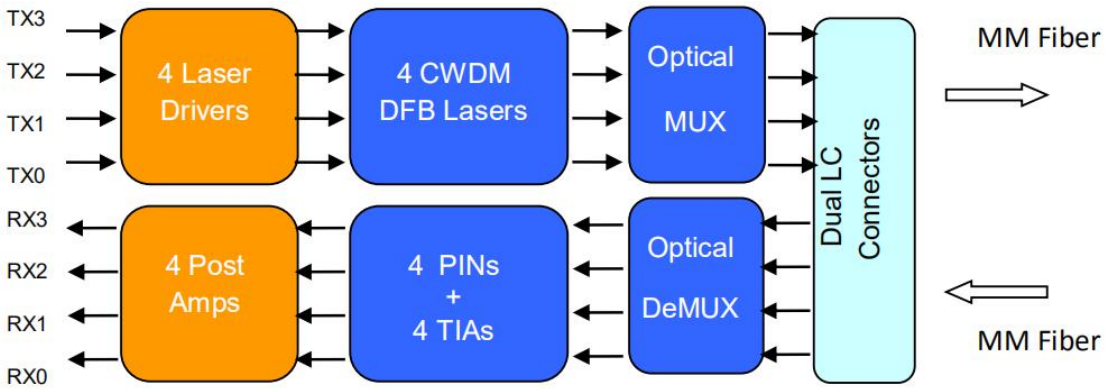

Figure 3 Transceiver Block Diagram for Applications over Multimode Fiber

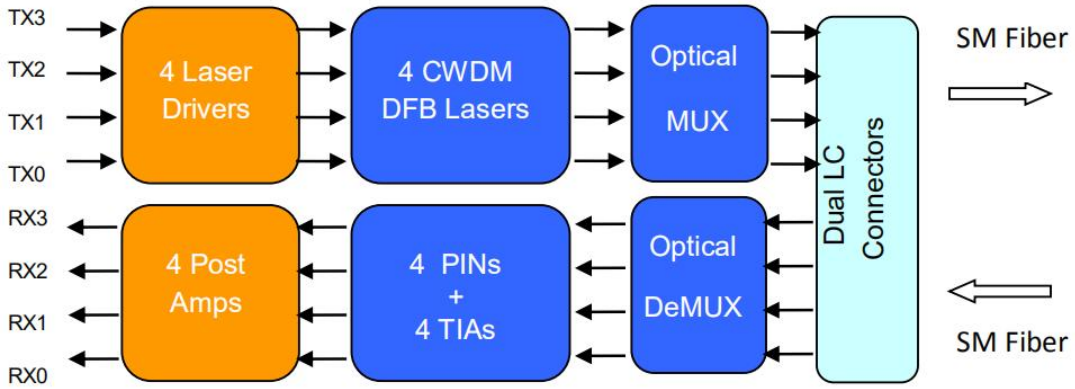

Figure 4 Transceiver Block Diagram for Applications over single Mode Fiber

Mechanical Dimensions

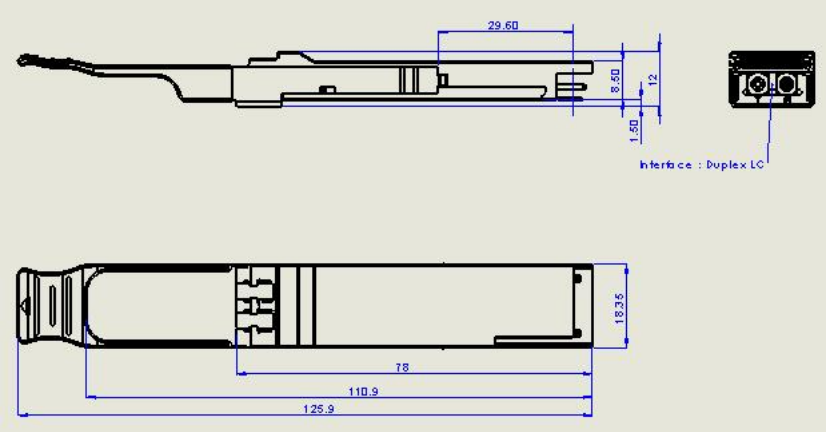

Figure 5 Filter Mechanical Outline

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).

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