200Gb/s QSFP-DD ER4 40km Transceiver

LA-OT-200G-ER4

Description

This product is a 200Gb/s Quad Small Form Factor Pluggable-double density (QSFP-DD) optical module designed for optical communication applications. The module converts 8 channels of 25Gb/s (NRZ) electrical input data to 4 channels of LAN-WDM optical signals, and multiplexes them into a single channel for 200Gb/s(PMA4) optical transmission. Reversely, on the receiver side, the module optically de-multiplexes a 200Gb/s(PMA4) optical input into 4 channels of WDM optical signals, and converts them to 8 channels of 25Gb/s (NRZ) electrical output data. The central wavelengths of the 4 LAN WDM channels are 1295.56, 1300.05, 1304.58 and 1309.14 nm as members of the LAN WDM wavelength grid defined in IEEE802.3ba. It contains a duplex LC connector for the optical interface and a 76-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. It can support up to 30km with 200G FEC and 40km with built-in PFEC. The product is designed with form factor, optical/electrical connection and digital diagnostic interface according to the QSFP-DD Multi-Source Agreement (MSA). It has been designed to meet the harshest external operating conditions including temperature, humidity and EMI interference.

Features

- QSFP-DD MSA compliant
- 4 LWDM lanes MUX/DEMUX design
- Up to 40km transmission on single mode fiber (SMF) with built-in PFEC
- Operating case temperature: 0 to 70oC
- Maximum power consumption 12W
- Duplex LC connector
- RoHS compliant

Applications

- 5G Network
- 200G Ethernet
- Enterprise networking

Transceiver Block Diagram

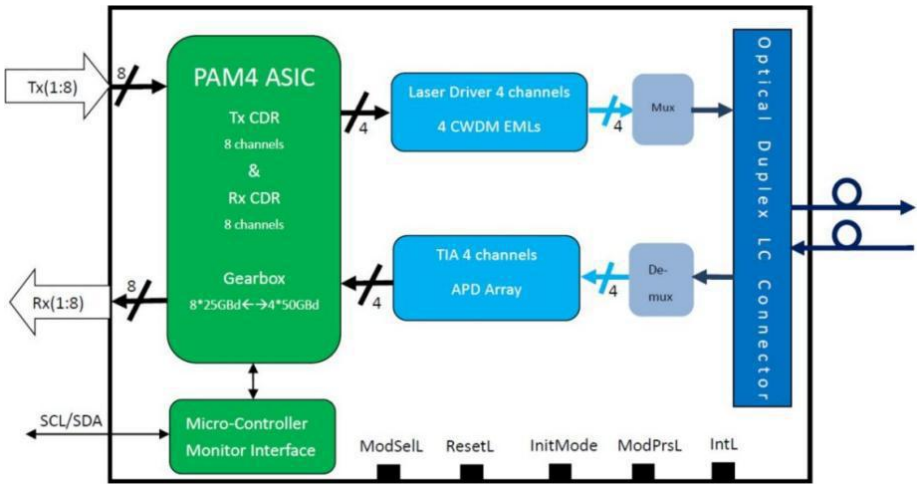


Figure 1. Transceiver Block Diagram

Pin Assignment and Description

The electrical pinout of the QSFP-DD module is shown in Figure 2 below.

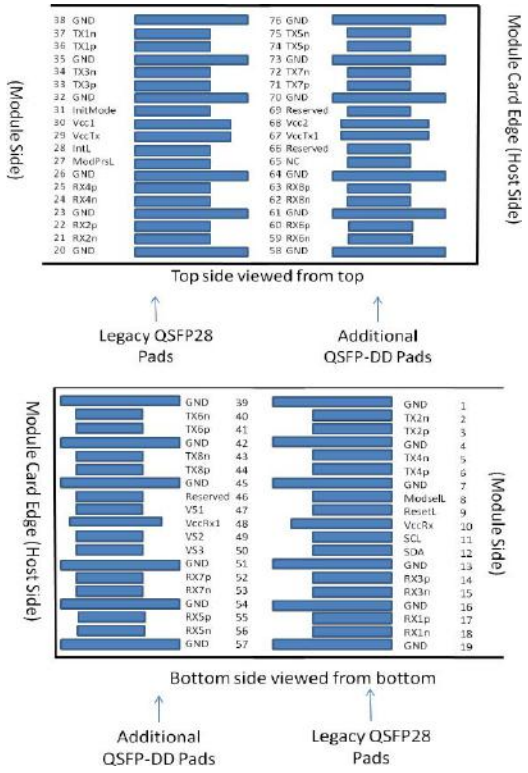


Figure 2. MSA Compliant Connector

Pin Definition

Pin	Logic	Symbol	Description	Plug Sequence	Notes
1		GND	Ground	1B	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	3B	
3	CML-I	Tx2p	Transmitter Non-Inverted Data Input	3B	
4		GND	Ground	1B	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	3B	
6	CML-I	Tx4p	Transmitter Non-Inverted Data Input	3B	
7		GND	Ground	1B	1
8	LVTTL-I	ModSelL	Module Select	3B	
9	LVTTL-I	ResetL	Module Reset	3B	
10		VccRx	+3.3V Power Supply Receiver	2B	2
11	LVCMOS-I/O	SCL	2-wire serial interface clock	3B	
12	LVCMOS-I/O	SDA	2-wire serial interface data	3B	
13		GND	Ground	1B	1
14	CML-O	Rx3p	Receiver Non-Inverted Data Output	3B	
15	CML-O	Rx3n	Receiver Inverted Data Output	3B	
16	GND	Ground	1B		1
17	CML-O	Rx1p	Receiver Non-Inverted Data Output	3B	
18	CML-O	Rx1n	Receiver Inverted Data Output	3B	
19		GND	Ground	1B	1
20		GND	Ground	1B	1
21	CML-O	Rx2n	Receiver Inverted Data Output	3B	
22	CML-O	Rx2p	Receiver Non-Inverted Data Output	3B	
23		GND	Ground	1B	1
24	CML-O	Rx4n	Receiver Inverted Data Output	3B	
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	3B	
26		GND	Ground	1B	1
27	LVTTL-O	ModPrsL	Module Present	3B	
28	LVTTL-O	IntL	Interrupt	3B	
29		VccTx	+3.3V Power supply transmitter	2B	2
30		Vcc1	+3.3V Power supply	2B	2
31	LVTTL-I	InitMode	Initialization mode; In legacy QSFP applications, the InitMode pad is called LPMODE	3B	
32		GND	Ground	1B	1
33	CML-I	Tx3p	Transmitter Non-Inverted DataInput	3B	
34	CML-I	Tx3n	Transmitter Inverted Data Input	3B	
35		GND	Ground	1B	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	3B	

37	CML-I	Tx1n	Transmitter Inverted Data Input	3B	
38		GND	Ground	1B	1
39		GND	Ground	1A	1
40	CML-I	Tx6n	Transmitter Inverted Data Input	3A	
41	CML-I	Tx6p	Transmitter Non-Inverted Data Input	3A	
42		GND	Ground	1A	1
43	CML-I	Tx8n	Transmitter Inverted Data Input	3A	
44	CML-I	Tx8p	Transmitter Non-Inverted Data Input	3A	
45		GND	Ground	1A	1
46		Reserved	For future use	3A	3
47		VS1	Module Vendor Specific 1	3A	3
48		VccRx1	3.3V Power Supply	2A	2
49		VS2	Module Vendor Specific 2	3A	3
50		VS3	Module Vendor Specific 3	3A	3
51		GND	Ground	1A	1
52	CML-O	Rx7p	Receiver Non-Inverted Data Output	3A	
53	CML-O	Rx7n	Receiver Inverted Data Output	3A	
54		GND	Ground	1A	1
55	CML-O	Rx5p	Receiver Non-Inverted Data Output	3A	
56	CML-O	Rx5n	Receiver Inverted Data Output	3A	
57		GND	Ground	1A	1
58		GND	Ground	1A	1
59	CML-O	Rx6n	Receiver Inverted Data Output	3A	
60	CML-O	Rx6p	Receiver Non-Inverted Data Output	3A	
61		GND	Ground	1A	1
62	CML-O	Rx8n	Receiver Inverted Data Output	3A	

63	CML-O	Rx8p	Receiver Non-Inverted Data Output	3A	
64		GND	Ground	1A	1
65		NC	No Connect	3A	3
66		Reserved	For future use	3A	3
67		VccTx1	3.3V Power Supply	2A	2
68		Vcc2	3.3V Power Supply	2A	2
69		Reserved	For Future Use	3A	3
70		GND	Ground	1A	1
71	CML-I	Tx7p	Transmitter Non-Inverted DataInput	3A	
72	CML-I	Tx7n	Transmitter Inverted Data Input	3A	
73		GND	Ground	1A	1
74	CML-I	Tx5p	Transmitter Non-Inverted DataInput	3A	
75	CML-I	Tx5n	Transmitter Inverted Data Input	3A	
76		GND	Ground	1A	1

Recommended Power Supply Filter

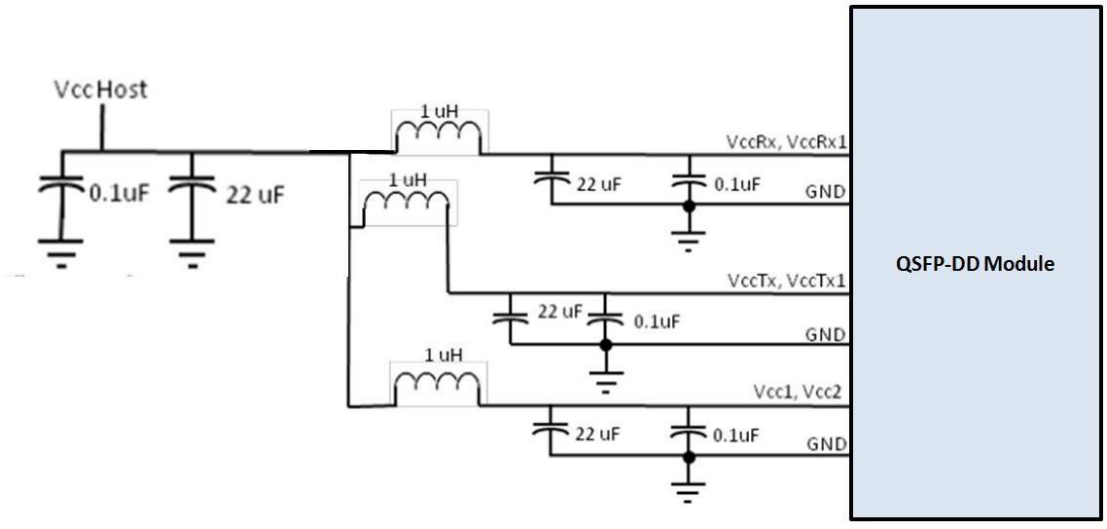


Figure 3. Recommended Power Supply Filter

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	Units	Notes
Storage Temperature	TS	-40	85	degC	
Operating Case Temperature	TOP	0	70	degC	
Power Supply Voltage	VCC	-0.5	3.6	V	
Relative Humidity (non-condensation)	RH	0	85	%	
Damage Threshold, each Lane	THd	-5.0		dBm	

Recommended Operating Conditions and Power Supply Requirements

Parameter	Symbol	Min	Typical	Max	Units	Notes
Operating Case Temperature	TOP	0		70	degC	
Power Supply Voltage	VCC	3.135	3.3	3.465	V	
Data Rate, each Lane			26.5625		GBd	PAM4
Data Rate Accuracy		-100		100	ppm	
Pre-FEC Bit Error Ratio				$2.4x10^{-4}$		
Post-FEC Bit Error Ratio				$1x10^{-12}$		1
Link Distance	D	0.002		30	km	2
Link Distance	D	0.002		40	Km	3

Notes:

1. FEC provided by host system.
2. FEC required on host system to support maximum distance.
3. Built-in PFEC is required to support up to 40km

Electrical Characteristics

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

Parameter	Test Point	Min	Typical	Max	Units	Notes
Power Consumption				12	W	
Supply Current	Icc			3.64	A	
Transmitter (each Lane)						
Signaling Rate, each Lane	TP1	26.5625 ± 100 ppm			GBd	
Differential pk-pk Input Voltage Tolerance	TP1a	900			mVpp	1
Differential Termination Mismatch	TP1			10	%	
Differential Input Return Loss	TP1	IEEE 802.3-2015 Equation (83E-5)			dB	
Differential to Common Mode Input Return Loss	TP1	IEEE 802.3-2015 Equation (83E-6)			dB	
Module Stressed Input Test	TP1a	See IEEE 802.3bs 120E.3.4.1				2
Single-ended Voltage Tolerance Range (Min)	TP1a	-0.4 to 3.3			V	
DC Common Mode Input Voltage	TP1	-350				2850
Receiver (each Lane)						
Signaling Rate, each lane	TP4	26.5625 ± 100 ppm			GBd	
Differential Peak-to-Peak Output Voltage	TP4					900
AC Common Mode Output Voltage, RMS	TP4					17.5
Differential Termination Mismatch	TP4					10

Differential Output ReturnLoss	TP4	IEEE 802.3-2015 Equation (83E-2)		
Common to Differential Mode Conversion ReturnLoss	TP4	IEEE 802.3-2015 Equation (83E-3)		
Transition Time, 20% to 80%	TP4	9.5		
Near-end Eye Symmetry Mask Width (ESMW)	TP4		0.265	
Near-end Eye Height, Differential	TP4	70		
Far-end Eye Symmetry Mask Width (ESMW)	TP4		0.2	
Far-end Eye Height, Differential	TP4	30		
Far-end Pre-cursor ISI Ratio	TP4	-4.5		2.5
Common Mode Output Voltage (Vcm)	TP4	-350		2850

Notes:

1. With the exception to IEEE 802.3bs 120E.3.1.2 that the pattern is PRBS31Q or scrambled idle.
2. Meets BER specified in IEEE 802.3bs 120E.1.1.
3. DC common mode voltage generated by the host. Specification includes effects of ground offset voltage.

Optical Characteristics

Parameter	Symbol	Min	Typical	Max	Units	Notes
Wavelength Assignment	L0	1294.53	1295.56	1296.59	nm	
	L1	1299.02	1300.05	1301.09	nm	
	L2	1303.54	1304.58	1305.63	nm	
	L3	1308.09	1309.14	1310.19	nm	
Transmitter						
Data Rate, each Lane		53.125 ± 100 ppm			GBd	
Modulation Format		PAM4				
Side-mode Suppression Ratio	SMSR	30			dB	
Total Average Launch Power	PT			14.7	dBm	
Average Launch Power, each Lane	PAVG	-0.1		5.6	dBm	
Outer Optical Modulation Amplitude (OMA_{outer}), each Lane	POMA	3.4		6.4	dBm	
Launch Power in OMA_{outer} minus TDECQ, each Lane		3			dB	
Transmitter and Dispersion Eye Closure for PAM4, each Lane	TDECQ			3.2	dB	
Extinction Ratio	ER	6			dB	
Difference in Launch Power between any Two Lanes (OMA_{outer})				4	dB	
$RIN_{15.1}OMA$	RIN	-132			dB/Hz	
Optical Return Loss Tolerance	TOL			15.1	dB	
Transmitter Reflectance	RT			-26	dB	
Average Launch Power of OFF Transmitter, each Lane	Poff			-30	dBm	
Receiver						
Data Rate, each Lane		53.125 ± 100 ppm			GBd	
Modulation Format		PAM4				

Sensitivity, each lane	Sen1	MAX (-11.1, SECQ-12.5)			dBm	For 30km
Sensitivity, each lane	Sen2	MAX (-14.1, SECQ-15.5)			dBm	For 40km
Stressed Conditions for Stress Receiver Sensitivity (Note 8)						
Stressed Eye Closure for PAM4 (SECQ), Lane under Test			3.4		dB	
SECQ – $10*\log_{10}(C_{eq})$, Lane under Test					dB	
OMA_{outer} of each Aggressor Lane			-8		dBm	

Digital Diagnostic Functions

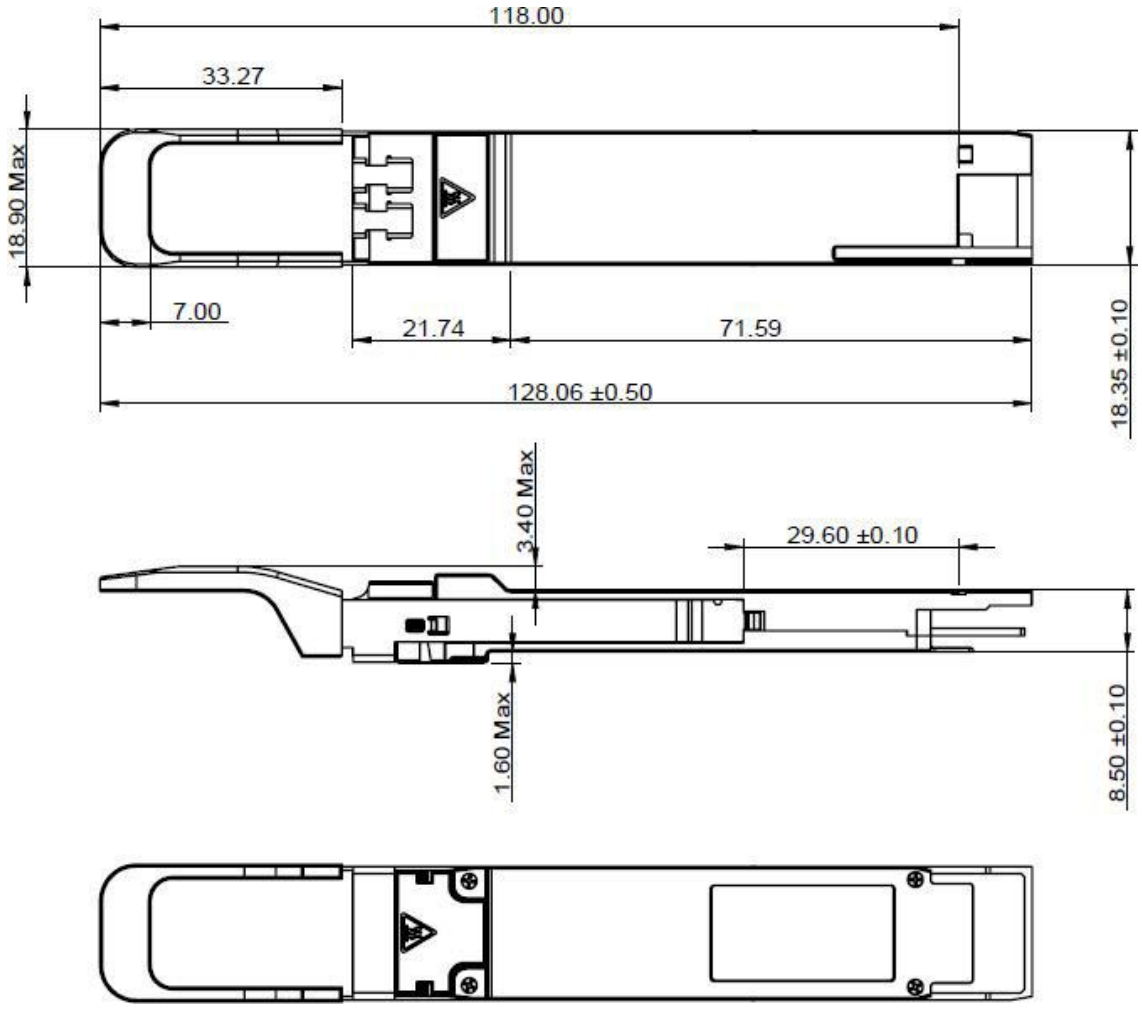
Parameter	Symbol	Min	Max	Units	Notes
Temperature Monitor Absolute Error	DMI_Temp	-3	3	degC	Over operating temperature range
Supply Voltage Monitor Absolute Error	DMI _VCC	-0.1	0.1	V	Over full operating range
Channel RX Power Monitor Absolute Error	DMI_RX_Ch	-2	2	dB	1
Channel Bias Current Monitor	DMI_Ibias_Ch	-10%	10%	mA	
Channel TX Power Monitor Absolute Error	DMI_TX_Ch	-2	2	dB	1

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

Notes:

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

Outline Drawing (mm)



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