

EQD400-ER4

400Gb/s QSFP56-DD ER4 SMF 40km Optical transceiver

PRODUCT FEATURES

- Supports 400GBASE-ER4
- Lane bit rate 106.25Gb/s with PAM4
- Up to 40km transmission on SMF
- Nano-LAN WDM EML laser and SOA+PIN receiver
- 400GAUI-8 Electrical interface with 8 Lanes 53.125 Gb/s PAM4 high-speed signal
- I2C interface with integrated Digital Diagnostic monitoring
- QSFP-DD MSA package with duplex LC connector
- Single +3.3V power supply
- Maximum power consumption 14W
- Operating case temperature: 0 to +70 °C
- Complies with EU Directive 2015/863/EU

APPLICATIONS

- 400G BASE-ER4 Ethernet
- Data Center Interconnect • Enterprise Networking

DESCRIPTIONS

This product is a 400Gb/s QSFP-DD optical module designed for 40km optical communication applications. The module converts 8 channels of 50Gb/s (PAM4) electrical input data to 4 channels of LAN WDM optical signals and multiplexes them into a single channel for 400Gb/s optical transmission.

On the receiver side, the module optically de-multiplexes a 400Gb/s optical input into 4 channels of LAN WDM optical signals and converts them to 8 channels of 50Gb/s (PAM4) electrical output data.

Host FEC is required to support up to 40km fiber transmission.

Ordering Information

Part No.	Data Rate(optical)	Laser	Fiber Type	Distance	Optical Interface	Temp	DDMI
EQD400-ER4	425Gb/s	EML	SMF	40km	LC	0~70°C	Y

Absolute Maximum Ratings

Parameters	Symbol	Min.	Max	Unit
Storage Temperature	TS	-40	85	°C
Supply Voltage	Vcc	-0.5	3.6	V
Operating Relative Humidity 1,2,3	RH	0	85	%

Recommended Operating Conditions

Parameters	Symbol	Min.	Typical	Max.	Unit	Note
Operating Case Temperature	Tc	0	-	70	°C	
Power Supply Voltage	Vcc	3.13	3.3	3.47	V	
Power Dissipation	P	-	-	14	W	
Pre-FEC Bit Error Ratio	Pre-FEC BER	-	-	2.4x10 ⁻⁴		1
Post-FEC Bit Error Ratio	Post-FEC BER	-	-	1 x 10 ⁻¹²		1
Transmission Distance	TD	-	-	40	km	2

Notes:

1. FEC provided by host system.
2. FEC required on host system to support maximum distance.

Electrical Characteristics.

Parameter		Symbol	Min.	Typical	Max.	Unit
Transmitter						
Differential Data Input Amplitude		VIN,P-P	70	-	900	mVpp
Differential Termination Mismatch			-	-	10	%
Tx_Disable	Normal Operation	VIL	-0.3	-	0.8	V
	Laser Disable	VIH	2.0	-	VCC+0.3	V
Receiver (Module Output)						
Differential Data Output Amplitude		VOUT,P-P	200	-	900	mVpp
Differential Termination Mismatch (1MHZ)			-	-	10	%
Rx_LOS	Normal Operation	VOL	-	-	0.4	V
	Lose Signal	VOH	VCC-0.5	-	VCC+0.3	V

Optical and Characteristics

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Transmitter						
Signaling rate, each lane	BR	53.125 ± 100 ppm			GBd	
Modulation format		PAM4				
Lane wavelengths	L0	1304.06	1304.58	1305.1	nm	
	L1	1306.33	1306.85	1307.38	nm	
	L2	1308.61	1309.14	1309.66	nm	
	L3	1310.9	1311	1311.96	nm	
Total average launch power	PMAX	-	-	10	dBm	
Average launch power, each lane	POUT	1.5	-	7.1	dBm	1.2
Outer OMA, each lane	OMAouter	4	-	7.9	dBm	3
Difference in launch power between lanes		-	-	4	dB	
Transmitter and dispersion eye closure for PAM4	TDECQ	-	-	3.9	dBm	
Transmitter eye closure for PAM4 (TECQ), each lane(max)	TECQ	-	-	3.9	dBm	
TDECQ – TECQ		-	-	2.7	dB	
Average POUT (Laser Turn off)	POFF	-	-	-30	dBm	
Extinction ratio, each lane	ER	5	-	-	dB	
Side-mode suppression ratio	SMSR	30	-	-	dB	
Receiver						
Signaling rate, each lane						
Modulation format		PAM4				

Lane wavelengths	L0	1304.06	1304.58	1305.1	nm	
	L1	1306.33	1306.85	1307.38	nm	
	L2	1308.61	1309.14	1309.66	nm	
	L3	1310.9	1311	1311.96	nm	
Damage threshold, each lane	PDAMAGE	-2.4	-	-	dBm	4
Average receive power, each lane	PRX_LANE	-16.2	-	-3.4	dBm	5
Receive power (OMAouter), each lane	RXOMA	-	-	-2.6	dBm	
Receiver sensitivity (OMAouter), each lane	SENOMA	-	-	-14.5	dBm	6
Los De-assert	LosDA	-	-	-17	dBm	
Los Hystersis	LosH	0.5	-	-	dB	

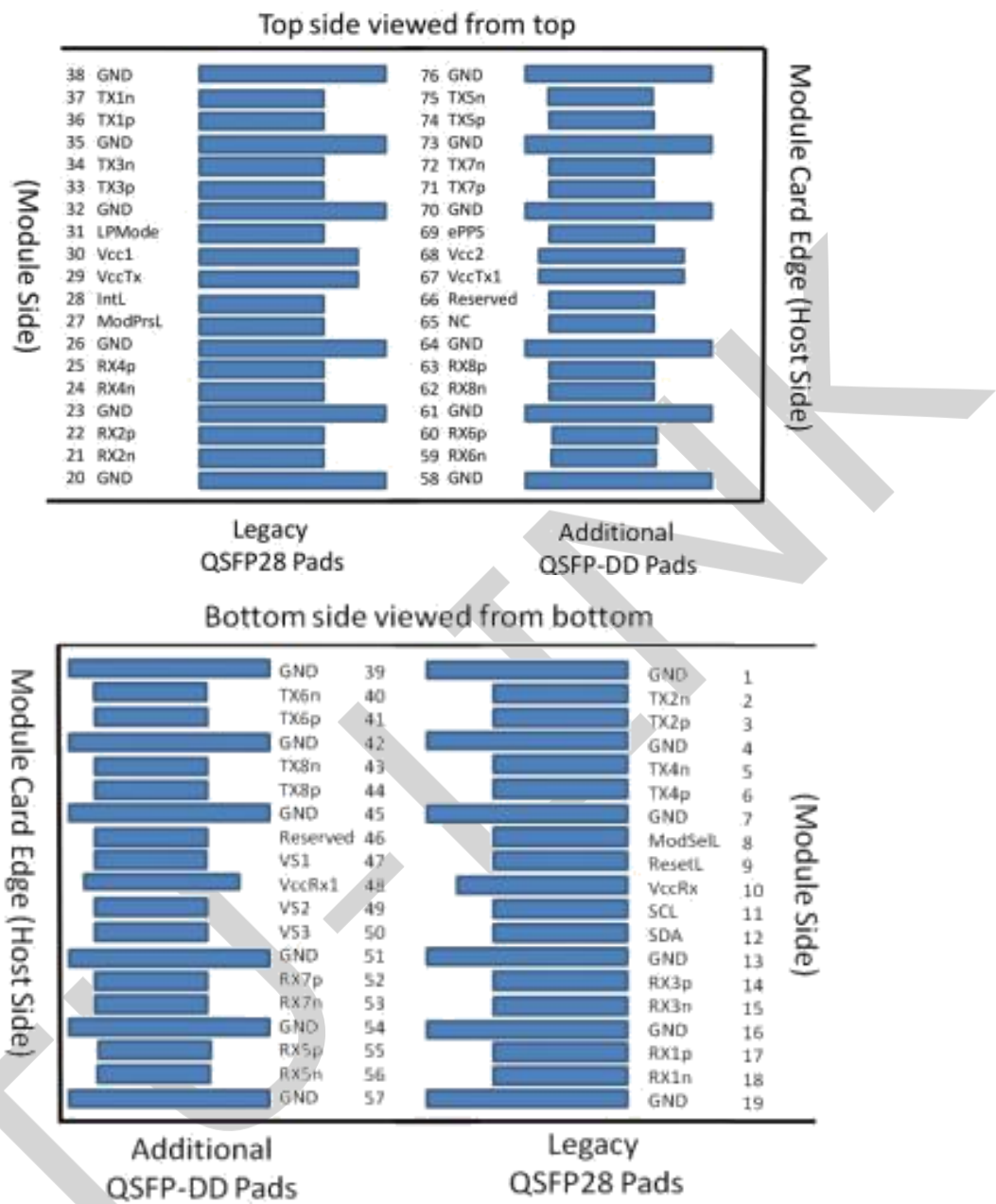
Note

1. As the total average launch power limit has to be met, not all of the lanes can operate at the maximum average launch power ,each lane.
 2. Average launch power, each lane(min) is informative and not the principal indicator of signal strength.A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.
 3. Even if the TDECQ<1.4dB for an extinction ratio of >=4.5dB or TDECQ<1.3dB for an extinction ratio of <4.5dB, the OMAouter (min) must exceed this value.
 4. The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level.
 5. Average receive power, each lane(min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.
- Note6. Measured with conformance test signal at TP3 for the BER specified in 122.1.1 802.3cn-2019.

Digital Diagnostics

Parameter	Range	Accuracy	Unit	Calibration
Temperature	0 to 70	±3	°C	Internal
Voltage	0 to VCC	0.1	V	Internal
Tx Bias Current Per Lane	0 to 100	10%	mA	Internal
Tx Output Power Per Lane	1.5 to 7.1	±3	dBm	Internal
Rx Power (Each Lane)	-16.2 to 3.4	±3	dBm	Internal

Pin Diagram



Pin Definitions

PIN	Logic	Symbol	Description	Plug Seq.	Notes
1		GND	Ground	1B	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	3B	
3	CML-I	Tx2p	Transmitter Non-Inverted Data output	3B	
4		GND	Ground	1B	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	3B	
6	CML-I	Tx4p	Transmitter Non-Inverted Data output	3B	

7		GND	Ground	1B	1
8	LVTLL-I	ModSelL	Module Select	3B	
9	LVTLL-I	ResetL	Module Reset	3B	
10		VccRx	+3.3V Power Supply Receiver	2B	2
11	LVC MOS-I/O	SCL	2-Wire Serial Interface Clock	3B	
12	LVC MOS-I/O	SDA	2-Wire Serial Interface Data	3B	
13		GND	Ground	1B	
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/RX_LOS	Interrupt/Rx LOS	3B	
29		VccTx	+3.3 V Power Supply transmitter	2B	2
30		Vcc1	+3.3 V Power Supply	2B	2
31	LVTTL-I	LPMODE/Tx_DIS	Low Power mode/Tx Disable	3B	
32		GND	Ground	1B	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	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	
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 Data Input	3A	
72	CML-I	Tx7n	Transmitter Inverted Data Input	3A	
73		GND	Ground	1A	1
74	CML-I	Tx5p	Transmitter Non-Inverted Data Input	3A	
75	CML-I	Tx5n	Transmitter Inverted Data Input	3A	
76		GND	Ground	1A	1

Note

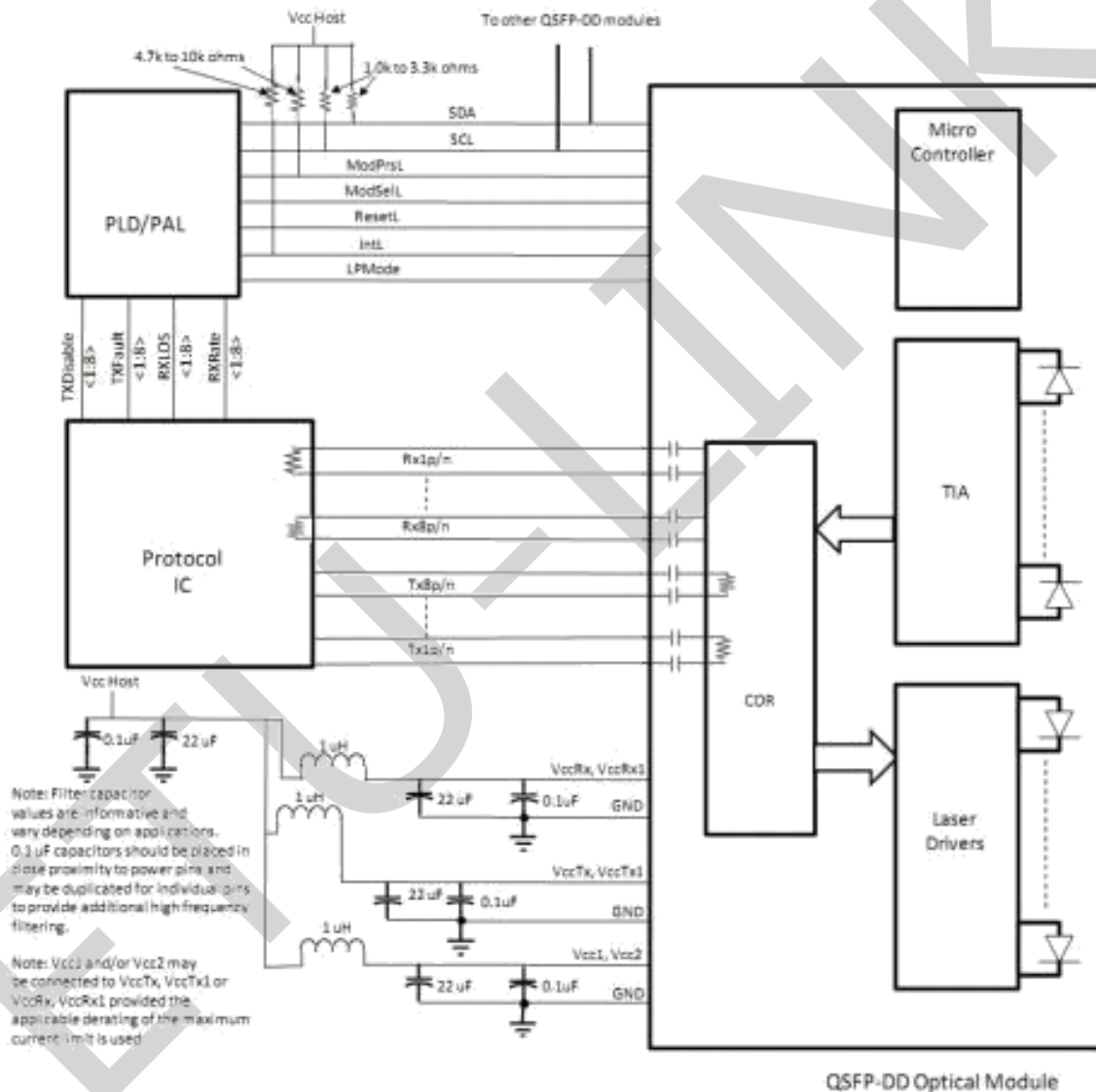
1. QSFP-DD uses common ground (GND) for all signals and supply (power). All are common within the QSFP-DD module and all module voltages are referenced to this potential unless otherwise noted. Connect these directly to the host board signal-common ground plane.
2. VccRx, VccRx1, Vcc1, Vcc2, VccTx and VccTx1 shall be applied concurrently. Requirements defined for the host side of the Host Card Edge Connector are listed in Table 6. VccRx, VccRx1, Vcc1, Vcc2, VccTx and VccTx1 may be internally connected within the module in any combination. The connector Vcc pins are each rated for a maximum

current of 1000 mA.

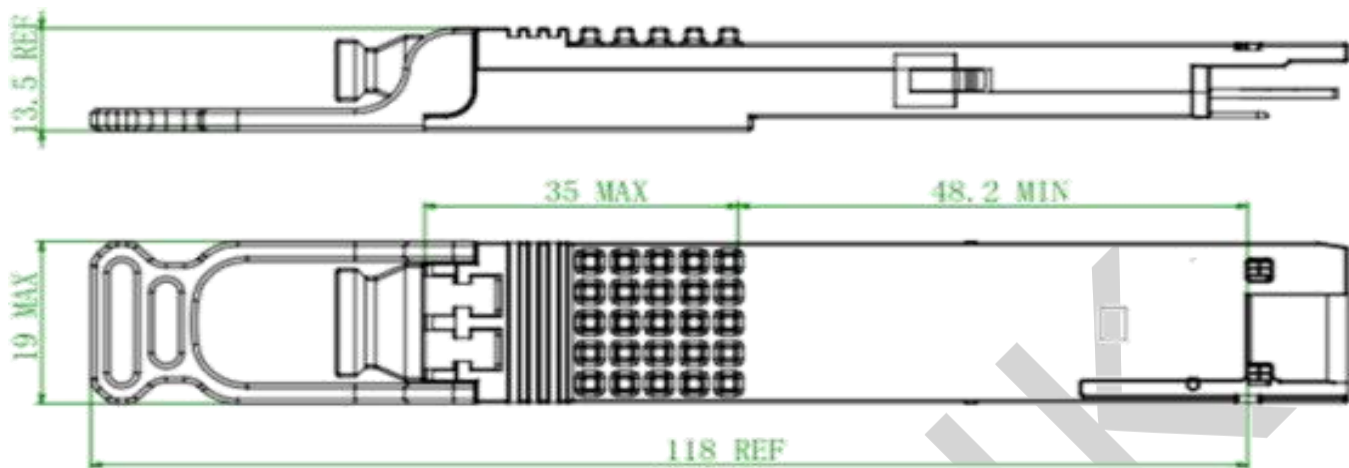
3: All Vendor Specific, Reserved and No Connect pins may be terminated with 50 ohms to ground on the host. Pad 65 (No Connect) shall be left unconnected within the module. Vendor specific and Reserved pads shall have an impedance to GND that is greater than 10 kOhms and less than 100 pF.

4: Plug Sequence specifies the mating sequence of the host connector and module. The sequence is 1A, 2A, 3A, 1B, 2B, 3B. (see Figure 2 for pad locations) Contact sequence A will make, then break contact with additional QSFP-DD pads. Sequence 1A, 1B will then occur simultaneously, followed by 2A, 2B, followed by 3A,3B.

Recommended Interface Circuit



Mechanical Diagram



Revision History

Version No.	Date	Description
1.0	February 12, 2024	Preliminary datasheet

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