EQD400-FR4

400G QSFP-DD FR4 Optical Transceiver

PRODUCT FEATURES

- **400G-FR4 Technical Specification Draft 1.0 Compliant with CMIS5.2**
- **Compliant to 802.3cu& QSFP-DD MSA HW standard**
- **8x53.125Gb/s electrical interface (400GAUI-8)**
- **Lane bit rate 106.25 Gb/s with PAM4**
- **CWDM4(1271/1291/1311/1331nm) EML laser and PIN receiver**
- **Up to 2km transmission on single mode fiber (SMF)**
- **Single +3.3V power supply**
- **Case temperature range: 0 ~ +70℃**
- **Maximum power consumption:10W**
- **Duplex LC receptacle**
- **RoHS compliant**

APPLICATIONS

- **400G BASE-FR4**
- **Data Center Interconnect**
- **Enterprise Networking**

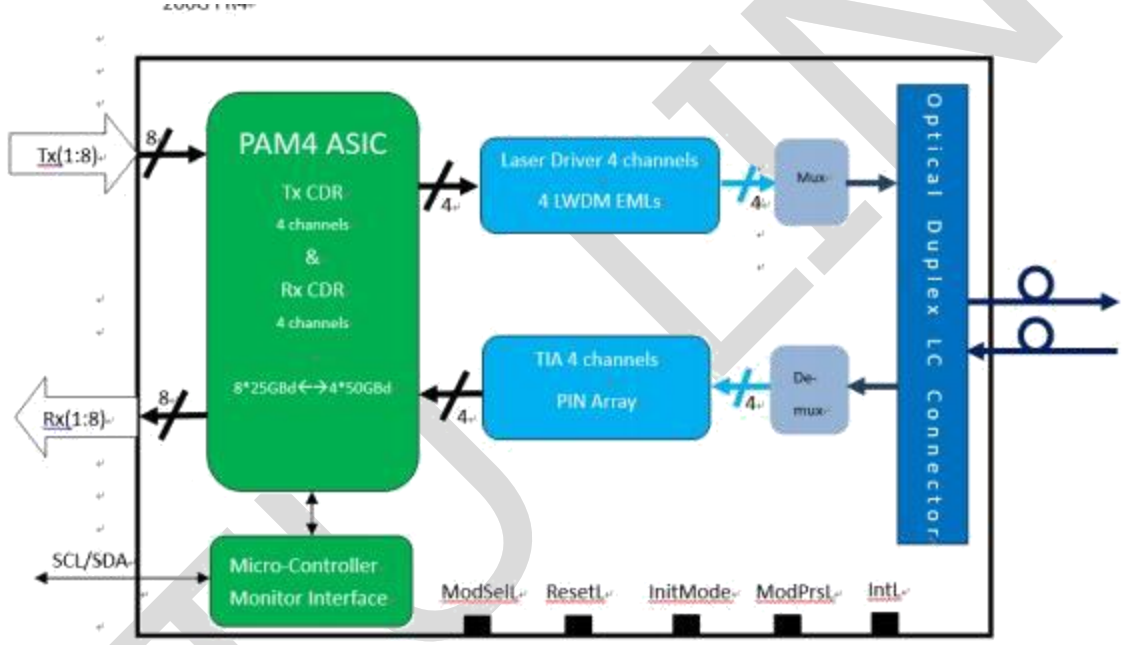
DESCRIPTIONS

ETU-LINK's EQD400-FR4 is a 400Gb/s QSFP-DD optical module designed for 2km optical communication applications. The module converts 8 channels of 50Gb/s (PAM4) electrical input data to 4 channels of CWDM 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 CWDM optical signals and converts them to 8 channels of 50Gb/s (PAM4) electrical output 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. Host FEC is required to support up to 10km fiber transmission

Module Block Diagram



Ordering Information

Part No.	Data Rate(optical)	Laser	Fiber Type	Distance	Optical Interface	Temp	DDMI	Latch Color
EQD400-FR4	400Gbps	EML	SMF	2KM	LC	0~70℃	Yes	Green

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.	Typical	Max.	Unit	Notes

Storage Temperature	T_S	-40	-	+85	°C	
Supply Voltage	V_{CC}	-0.5	-	+4.0	V	
Operating Relative Humidity	RH	-	-	+85	%	

Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Operating Case Temperature	TOP	0		70	degC	
Power Supply Voltage	VCC	3.14	3.3	3.46	V	
Lane Bit Rate			53.125		GBd	With PAM4
Power Consumption	P_D			10	W	
Pre-FEC Bit Error Ratio				$2.4x10^{-4}$		
Link Distance with G.652	TD			2	km	

Electrical Characteristics

High-Speed Signal: Compliant to 400GAUI-8 (IEEE 802.3bs)
Low-Speed Signal: Compliant to QSFP-DD-Hardware-rev5p2.

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Transmitter (Module Input)						
Differential Data Input Amplitude	VIN,P-P	900	-	-	mVpp	
Differential Termination Mismatch		-	-	10	%	
Receiver (Module Output)						
Differential Data Output Amplitude	VOUT,P-P	-	-	900	mVpp	
Differential Termination Mismatch (1MHZ)		-	-	10	%	
Low-speed Electrical Interface						
LPMode, ResetL, ModSelL and ePPS	VIL	-0.3	-	0.8	V	
	VIH	2.0	-	VCC+0.3	V	
ModPrsL	VOL	0	-	0.4	V	
	VIH	ModPrsL can be implemented as a short-circuit to GND on the module				
IntL	VOL	0	-	0.4	V	
	VOH	VCC-0.5	-	VCC+0.3	V	

Optical and Characteristics

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Transmitter						
Center Wavelength Lane 0	λ_0	1264.5	1271	1277.5	nm	
Center Wavelength Lane 1	λ_1	1284.5	1291	1297.5	nm	

Center Wavelength Lane 2	λ_2	1304.5	1311	1317.5	nm	
Center Wavelength Lane 3	λ_3	1324.5	1331	1337.5	nm	
Total Launch Power	P_{ALL}	-	-	9.3	dBm	1
Average Launch Power per Lane	P_{TX_LANE}	-3.2	-	4.4	dBm	1
OMA_{outer} per Lane	OMA_{outer}	–1.6 + TDECQ	-	3.7	dBm	
Launch power in OMA_{outer} minus TDECQ, per lane	OMA_{outer} - TDECQ	-1.7	-	-	dB	ER≧4.5 dB
		-1.6	-	-	dB	ER<4.5dB
Transmitter and dispersion eye closure for PAM4 (TDECQ), per lane	TDECQ	-	-	3.4	dB	
Difference in launch power between any two lanes (OMA_{outer})	$P_{TX\_DELTA\_LANE}$	-	-	4	dB	
Average Output Power (Laser Turn off)	$P_{0UT-OFF}$	-	-	-20	dBm	
Side Mode Suppression Ratio	SMSR	30	-	-	dB	
Extinction Ratio	ER	3.5	-	-	dB	
Receiver						
Center Wavelength Lane 0	λ_0	1264.5	1271	1277.5	nm	
Center Wavelength Lane 1	λ_1	1284.5	1291	1297.5	nm	
Center Wavelength Lane 2	λ_2	1304.5	1311	1317.5	nm	
Center Wavelength Lane 3	λ_3	1324.5	1331	1337.5	nm	
Damage threshold, per lane	Pdamage	5.4	-	-	dBm	2
Average Rx Power per Lane	P_{RX_LANE}	-7.2	-	4.4	dBm	3
Difference in receive power between any two lanes (OMA_{outer})	$P_{RX\_DELTA\_LANE}$	-	-	4.1	dB	
Receiver power (OMA_{outer}), each lane	$P_{OMAouter\_LANE}$	-	-	3.7	dBm	
Receiver sensitivity (OMA_{outer}), per lane	SEN_{OMA}	-	-	-4.6	dBm	4
Stressed receiver sensitivity (OMA_{outer}), per lane	SRS_{OMA}	-	-	-2.6	dBm	5

Notes:

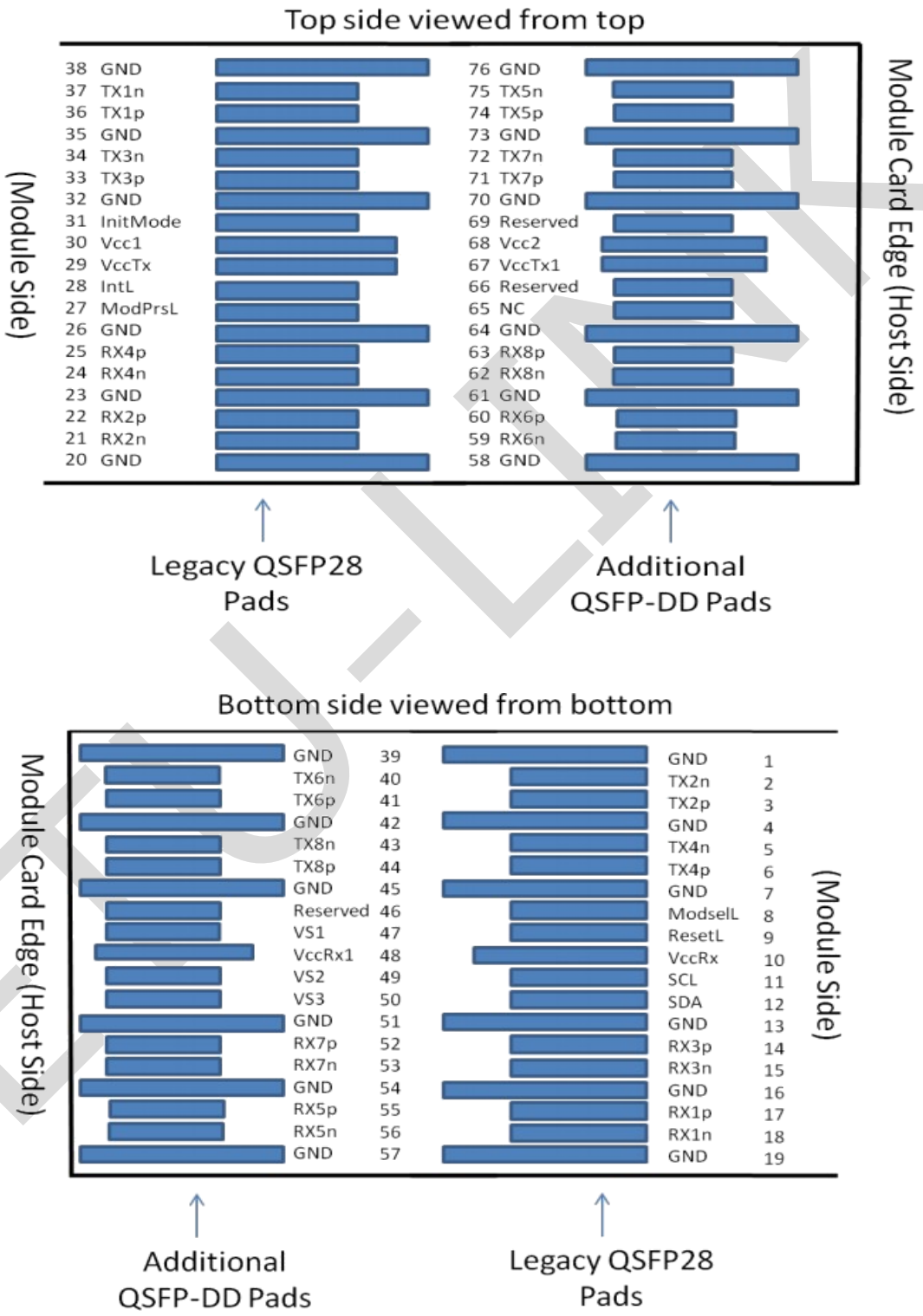
1. The optical power is launched into SMF.
2. The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level. The receiver does not have to operate correctly at this input power.
3. Average receive power, each lane (min) is informative and not the principal indicator of signal strength.
4. Receiver sensitivity (OMA_{outer}),each lane (max) is informative and is defined for a transmitter with SECQ up to 3.4 dB
5. Measured with conformance test signal at TP3 using the test pattern PRBS31Q or scrambled idle for stressed receiver sensitivity for the BER= $2.4x10^{-4}$...

Digital Diagnostics

Parameter	Unit	Specification
Temperature Monitor absolute error	℃	±3.0
Supply Voltage Monitor absolute error	%	± 5℃
I_bias Monitor absolute error	%	± 10

Received Power (Rx) Monitor absolute error	dB	± 3.0
Transmit Power (Tx) Monitor absolute error	dB	± 3.0

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	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	
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	

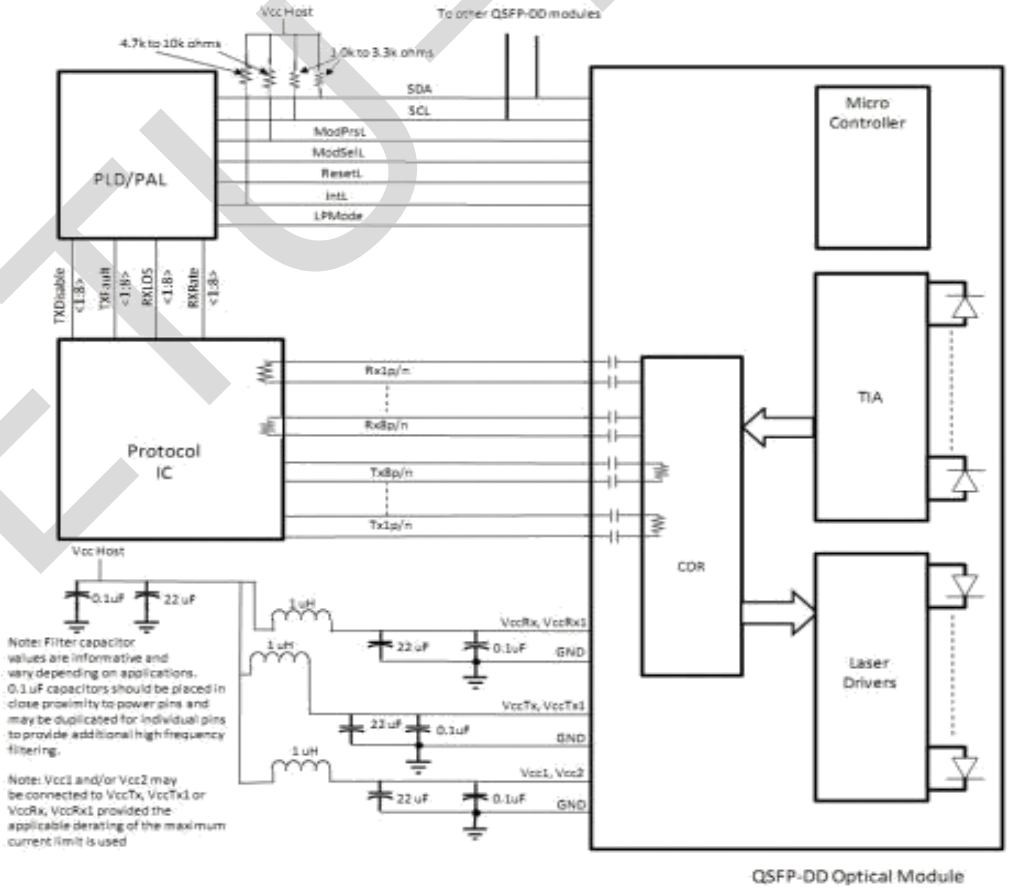
32		GND	Ground	1B	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	3B	
34	CML-I	Tx3n	Transmitter Inverted Data Input	3B	
35		GND	Ground	1B	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	3B	
37	CML-I	Tx1n	Transmitter Inverted Data Input	3B	
38		GND	Ground	1B	1
39		GND	Ground	1A	
40	CML-I	Tx6n	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

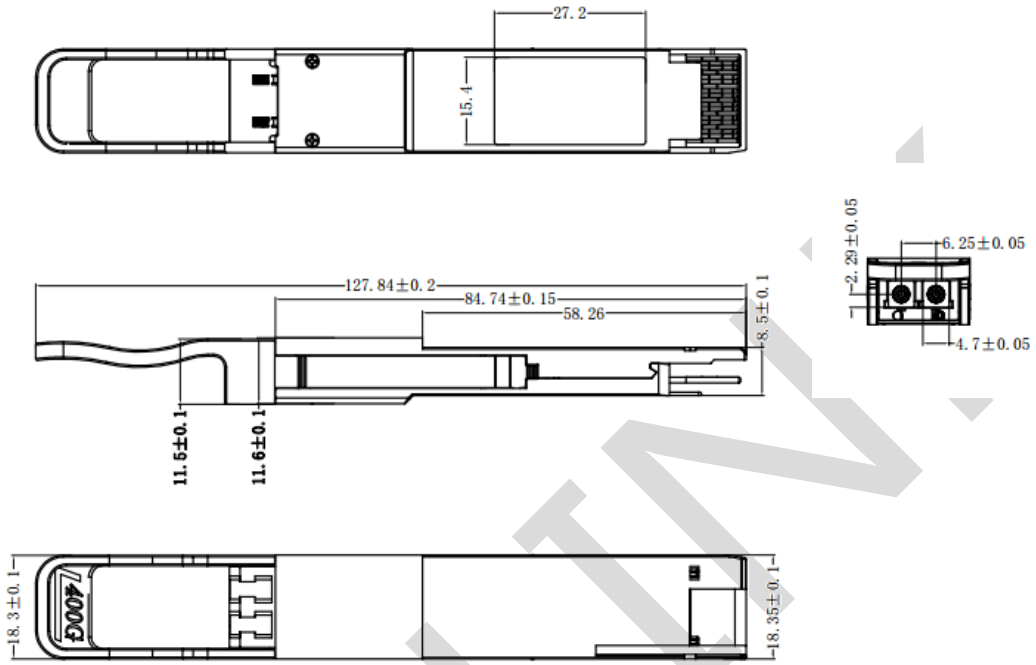
Notes:

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， as per QSFP-DD Hardware Specification V4.0. 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. Pin65 (No Connect) shall be left unconnected within the module. Vendor specific and Reserved Pins shall have an impedance to GND that is greater than 10 kOhms and less than 100 pF.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 18, 2022	Preliminary datasheet
2.0	September 25,2024	Product upgrades

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