Data sheet

SM-QD-314H-02C

400Gb/s 2Km QSFP-DD FR4 Transceiver

PRODUCT FEATURES

- Up to 50Gbps data rate per channel by PAM4 modulation
- 4 duplex channels transmitters and PIN receivers
- CWDM lanes MUX/DEMUX design
- 8 x 53.125 Gbps PAM4 electrical interface (400GAUI-8)
- Maximum power consumption 12 W
- LC duplex connector
- Up to 2 km transmission on single mode fiber
- Operating case temperature: 0 °C to 70°C
- Single 3.3 V power supply
- QSFP-DD MSA compliant rev5.0 compliant
- Compliant to IEEE 802.3cu

Applications

- 400G Ethernet
- Data center network

Specifications										
Part No.	**Package**	**Data rate**	**Laser**	**Optical Power**	**Detector**	**Sensitivity**	**Temp**	**Reach**	**Other**	**Application**
SM-QD-314H-02C	QSFP-DD	400G	CWDM EML	-3.3~3.5 dBm	PIN	Max(-4.6,-6+SE CQ)	0~70 ℃	2Km	DDM	400G Ethernet

Function Description

The module is designed for 2 km optical communication applications, and it is compliant with 100G Lambda MSA standard. This module can convert 8-channel 53.125 Gbps electrical data to 4-channel 106.25 Gbps optical signals, and multiplex them into a single channel for 425 Gbps optical transmission. Similarly, it optically de-multiplexes a 425 Gbps input into 4-channel signals, and converts them to 8-channel output electrical data on the receiver side

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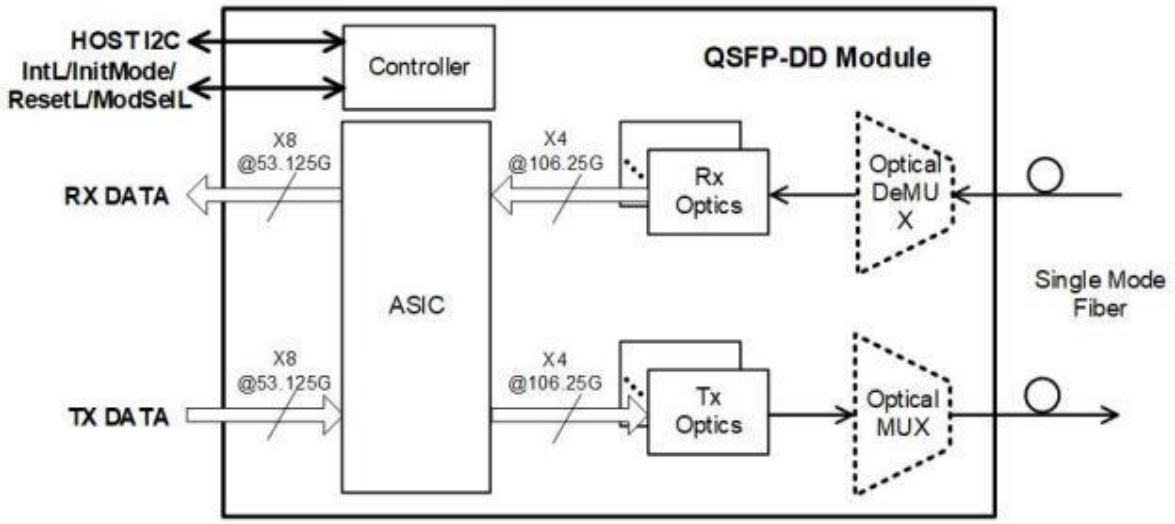

Figure 1-1 Transceiver block diagram

Pin Descriptions

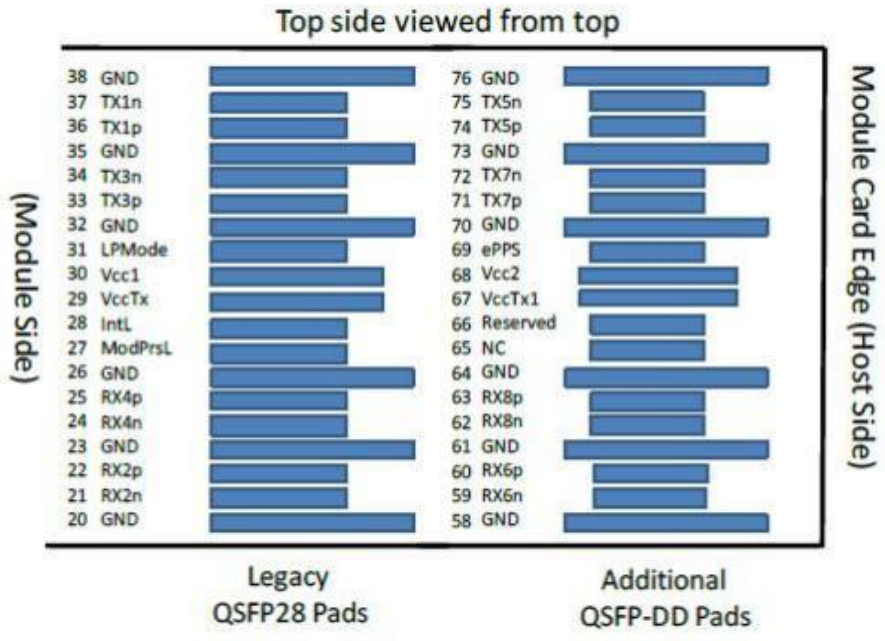

Figure 1-2 MSA compliant connector

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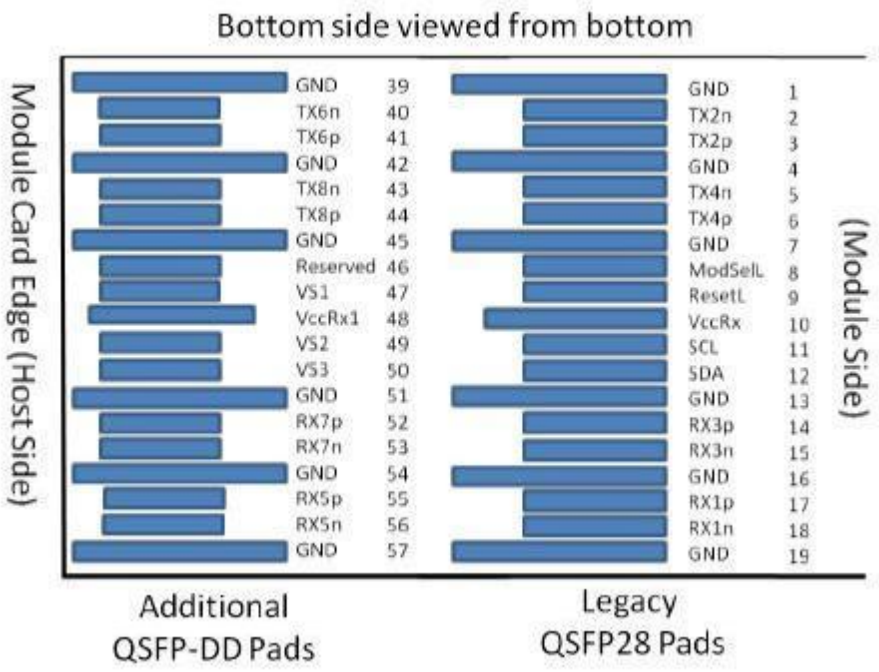

Pin	Symbol	Description	Notes
1	GND	Ground	1
2	Tx2n	Transmitter Inverted Data Input	
3	Tx2p	Transmitter Non-Inverted Data Input	
4	GND	Ground	1
5	Tx4n	Transmitter Inverted Data Input	
6	Tx4p	Transmitter Non-Inverted Data Input	
7	GND	Ground	1
8	ModSelL	Module Select	
9	ResetL	Module Reset	
10	VccRx	+3.3 V 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	Rx1n	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	1
24	Rx4n	Receiver Inverted Data Output	
25	Rx4p	Receiver Non-Inverted Data Output	
26	GND	Ground	1
27	Mod PrsL	Module Present	
28	IntL	Interrupt	
29	VccTx	+3.3 V Power supply transmitter	2
30	Vcc1	+3.3 V 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
39	GND	Ground	1
40	Tx6n	Transmitter Inverted Data Input	
41	Tx6p	Transmitter Non-Inverted Data Input	
42	GND	Ground	1
43	Tx8n	Transmitter Inverted Data Input	
44	Tx8p	Transmitter Non-Inverted Data Input	
45	GND	Ground	1
46	Reserved	For future use	3
47	VS1	Module Vendor Specific 1	3
48	VccRx1	3.3 V Power Supply	2
49	VS2	Module Vendor Specific 2	3
50	VS3	Module Vendor Specific 3	3
51	GND	Ground	1
52	Rx7p	Receiver Non-Inverted Data Output	
53	Rx7n	Receiver Inverted Data Output	
54	GND	Ground	1
55	Rx5p	Receiver Non-Inverted Data Output	
56	Rx5n	Receiver Inverted Data Output	
57	GND	Ground	1
58	GND	Ground	1

59	Rx6n	Receiver Inverted Data Output	
60	Rx6p	Receiver Non-Inverted Data Output	
61	GND	Ground	1
62	Rx8n	Receiver Inverted Data Output	
63	Rx8p	Receiver Non-Inverted Data Output	
64	GND	Ground	1
65	NC	No Connect	3
66	Reserved	For future use	3
67	VccTx1	3.3 V Power Supply	2
68	Vcc2	3.3 V Power Supply	2
69	ePPS	Precision Time Protocol (PTP) reference clock input. It is not used.	3
70	GND	Ground	1
71	Tx7p	Transmitter Non-Inverted Data Input	
72	Tx7n	Transmitter Inverted Data Input	
73	GND	Ground	1
74	Tx5p	Transmitter Non-Inverted Data Input	
75	Tx5n	Transmitter Inverted Data Input	
76	GND	Ground	1

Notes:

1.QSFP-DD uses common ground (GND) for all signals and supply (power). All are comon within the QSFP-DD module and all module voltages are referenced to this po-te-nial 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. 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 50ohms 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 10K ohms and less than 100pF.

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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	Typ	Max	Unit	Notes
Maximum supply voltage	Vcc	-1	3.3	3.6	V	
Storage temperature	Ts	-40		85	℃	
Relative humidity	RH	10		85	%	Non-condensing
Damage threshold, each lane	THd	4.5			dBm	

Operating Environments

Electrical and optical characteristics below are defined under this operating environment, unless otherwise specified

Parameter	Symbol	Min	Typ	Max	Unit
Supply voltage	Vcc	3.1	3.3	3.5	V
Case temperature	Top	0		70	°C
Link distance with G.652		0		2	km

Electrical Characteristics

Parameter	Min	Typ	Max	Unit	Notes
Power dissipation			12	W	
Supply current			3.834	A	
Receiver (module input)					
Data rate, each lane	26.5625 ± 100 ppm			GBd	
Overload differential voltage pk-pk	900			mV	
Common mode voltage	–350		2850	mV	
Differential termination resistance mismatch			10	%	At 1 MHz
Differential return loss (SDD11)					OIF-CEI-56 G-VSR-PA M4
	Equation (16-1)			dB	
Common mode to differential mode					OIF-CEI-56 G-VSR-PA M4
conversion (SCD11)	Equation (16-2)			dB	
Stressed input test	See OIF-CEI-56G-VSR-PAM4 Section 16.3.10.3				
Transmitter (module output)					

Data rate, each lane	26.5625 ± 100 ppm			GBd	
Differential voltage, pk-pk			900	mV	
Common mode voltage (Vcm)	–350		2850	mV	
Common mode noise, RMS			17.5	mV	
Differential termination resistance mismatch			10	%	At 1 MHz
Differential return loss (SDD22)			Equation (16-1)	dB	
Common mode to differential mode			Equation (16-3)		
conversion (SDC22)				dB	
Common mode return loss (SCC22)					From 250 MHz to fb GHz
			–2	dB	
Transition time	9.5			ps	
Near-end eye width at 10^{-6} probability (EW6)	0.265			UI	
Near-end eye height at 10^{-6} probability (EH6)	70			mV	
Far-end eye width at 10^{-6} probability (EW6)	0.2			UI	
Far-end eye height at 10^{-6} probability (EH6)	30			mV	
Near-end eye linearity	0.85				

Optical Characteristics

Parameters	Min	Typ	Max	Unit	Notes
Transmitter					
Data rate, each Lane	53.125 ± 100 ppm			GBd	
Modulation format	PAM4				
	1264.5	1271	1278		
Line wavelengths	1284.5	1291	1298		
	1304.5	1311	1318	nm	
	1324.5	1331	1338		
Total average launch power			9.5	dBm	
Average launch power, each lane	–3.3		3.5	dBm	
Optical modulation					
amplitude (OMA), each lane	–0.2		3.7	dBm	
Extinction ratio (ER)	3.5			dB	
Side-mode suppression ratio (SMSR)	30			dB	
Launch power in OMA					
minus TDECQ, each lane, for ER ≥ 4.5 dB	–1.7			dB	
Launch power in OMA					

minus TDECQ, each lane, for ER < 4.5 dB	–1.6			dBm	
Transmitter and dispersion eye closure for PAM4,					
each Lane (TDECQ)			3.4	dB	
Difference in launch power between any two lanes					
(OMA outer)			4	dB	
RIN17. 1OMA			–136	dB/Hz	
Optical return loss tolerance			17.1	dB	
Transmitter reflectance			–26	dB	
Average launch power of OFF transmitter, each					
Lane			–20	dBm	
Receiver					
Data rate, each Lane	53.125 ± 100 ppm			GBd	
Modulation format	PAM4				
Damage threshold, each lane	4.5			dBm	
	1264.5	1271	1278		
Line wavelengths	1284.5	1291	1298		
	1304.5	1311	1318	nm	
	1324.5	1331	1338		
Average receiver power, each lane					
	–7.3		3.5	dBm	
Receiver power, each lane (OMA)				dBm	
			3.7		
Difference in receiver					
power between any two lanes (OMA)			4.1	dB	
Receiver sensitivity (OMA outer), each lane (max)	Max(-4.6,-6+SECQ)			dBm	1
LOS assert	–20			dBm	
LOS deassert			–8.6	dBm	
LOS hysteresis	0.5			dB	
Receiver reflectance			–26	dB	
Conditions of stressed receiver sensitivity					
Stressed eye closure for PAM4 (SECQ), lane under test					
	0.9		3.4	dB	
OMA outer of each aggressor lane		1.5		dBm	
Long term performance test					
BER FLOOR	1E – 6 @ –3.1 ~ 2 dBm				

Notes:

Measured with conformance test signal for BER = 2.4 x 10^{-4}. A compliant receiver shall have stressed receiver sensitivity (OMA outer), each lane values below the mask ofFigure 1-3, for SECQ values between 0.9 and 3.4 dB.

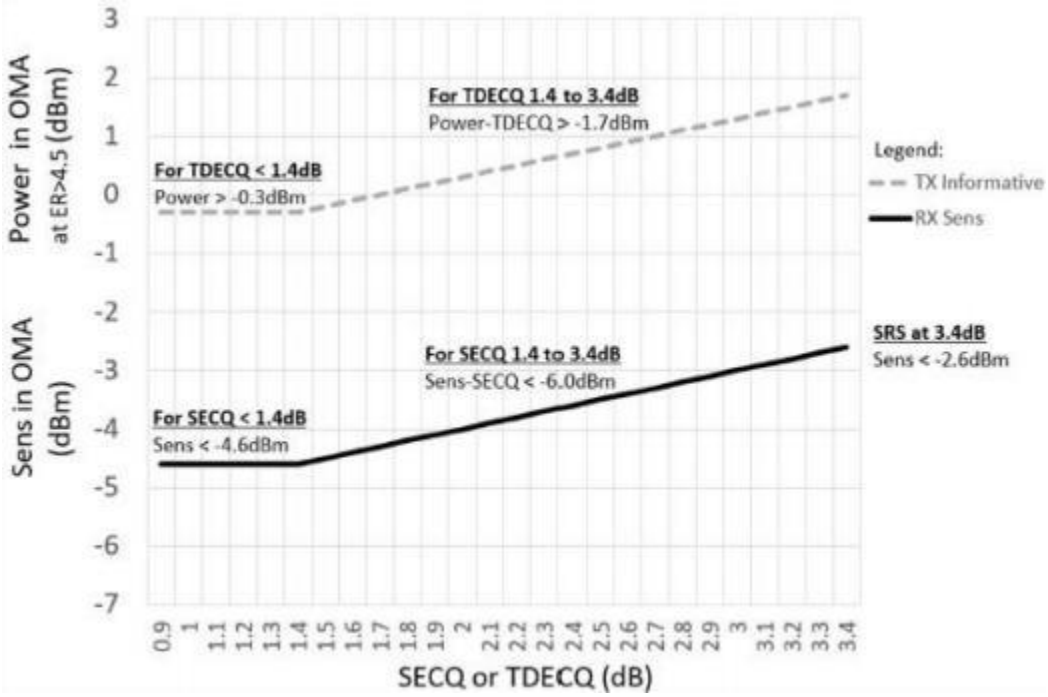

Figure 1-3 Stressed receiver sensitivity mask for 400GE-FR4

Digital Diagnostic Monitoring Functions

Digital diagnostic management interface (DDMI) is realized by I2C interface in compliance with CMIS 4.0. diagnostic management functions are realized, and the data addresses are listed in the form below

Data address			
Performance item	**Alarm & Warning**	**Alarm & Warning thresholds**	**Monitor**
Module temperature	Lower page 9	Page2h (128-135)	Lower page (14-15)
Module voltage	Lower page 9	Page2h (136-143)	Lower page (16-17)
Bias current	Page11h (143-146)	Page2h (184-191)	Page11h (170-177)
Transmitter optical power	Page11h (139-142)	Page2h (176-183)	Page11h (154-161)
Receiver optical power	Page11h (149-152)	Page2h (192-199)	Page11h (186-193)

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Mechanical Specifications