estel

Datasheet

QSFP-DD 400GBase-FR4 2 km | C-Temp (RSMD4BFR400CT)

Product Features

- QSFP-DD MSA compliant
- 100G Lambda MSA compliant
- 802.3cu compliant
- QSFP-DD CMIS4.0 management interface
- Non-hermetic package design
- 4 CWDM lanes MUX/DEMUX design
- 8 x 53.125 Gbps PAM4 electrical interface (400GAUI-8)
- Maximum power consumption 9W
- LC duplex connector
- Single 3.3 V power supply
- 400GE FR4 specification compliant
- Up to 2 km transmission on single mode fiber with FEC
- ROHS 2 Compliant

Applications

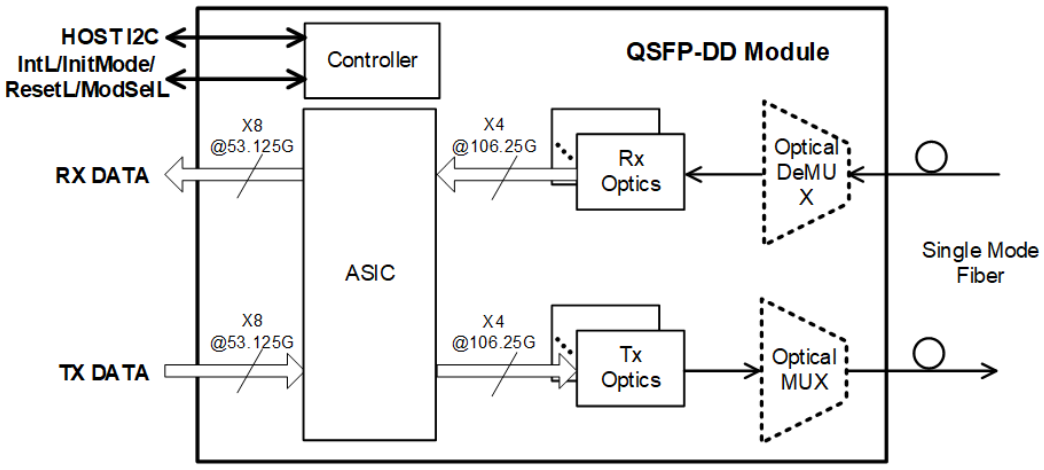
- 400G Ethernet
- Data center network

1. Table of Contents

2.Product Description

The RSMD4BFR400CT transceiver module is engineered for optical communication endeavors spanning up to 2 kilometers and adheres to the 100G Lambda MSA standard. This sophisticated module is capable of transforming 8-channel electrical data, each channel running at 53.125 Gbps, into 4-channel optical signals at a rate of 106.25 Gbps. These signals are then combined into a single channel, facilitating an optical transmission capacity of 425 Gbps. In a reverse operation, the module is also adept at de-multiplexing a 425 Gbps optical input back into 4-channel signals, which are subsequently converted into 8-channel electrical data on the receiving end. Designed to withstand extreme external operating conditions, including variations in temperature, humidity, and EMI interference, this module boasts remarkable functionality and feature integration. These features are readily accessible through the I2C interface, making the RSMD4BFR400CT an exemplary choice for robust and efficient optical communication applications.

Figure 1 Block Diagram



3.Recommended Operating Environnements

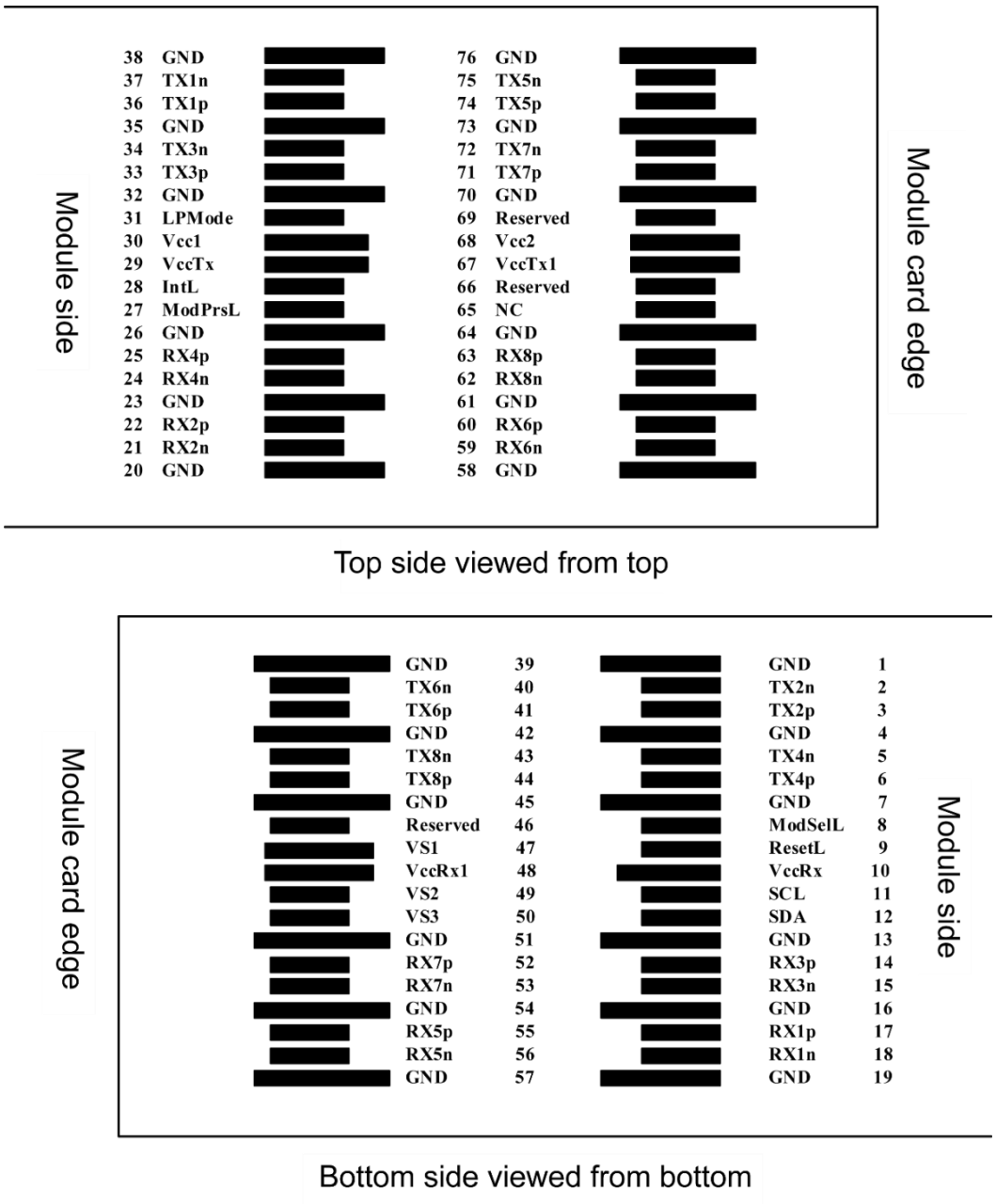
Unless specifically noted, the electrical and optical characteristics mentioned are measured within the given operating conditions.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Supply voltage	Vcc	3.135	3.3	3.465	V	
Case temperature	T	0		70	°C	
Data rate accurancy		-100		100	ppm	
Link distance		0.5		2	Km	[1]

[1] G.652 single-mode optical fiber

4.Pin Descriptions

Figure 2 MSA Compliant Connector



Pin	Logic	Symbol	Description	Plug sequence	Notes
1		GND	Ground	1B	[2]
2	CML-I	Tx2n	Transmitter inverted Data Input	3B	
3	CML-I	Tx2p	Transmitter Non-inverted Data Input	3B	
4		GND	Ground	1B	2
5	CML-I	Tx4n	Transmitter Inverted Data Input	3B	
6	CML-I	Tx4p	Transmitter Non-Inverted Data Input	3B	
7		GND	Ground	1B	2
8	LVTTL-I	ModSelL	Module Select	3B	
9	LVTTL-I	ResetSelL	Module Reset	3B	
10		VccRx	+3.3 Power Supply receiver	2B	[3]
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	2
14	CML-O	Rx3p	Receiver Non-Inverted Data Output	3B	
15	CML-O	Rx3n	Receiver Inverted Data Output	3B	
16		GND	Ground	1B	
17	CML-O	Rx1p	Receiver Non-Inverted Data Output	3B	
18	CML-O	Rx1n	Receiver Inverted Data Output	3B	
19		GND	Ground	1B	2
20		GND	Ground	1B	2
21	CML-O	Rx2n	Receiver Inverted Data Output	3B	

[2] QSFP-DD uses common ground (GND) for all signals and supply (power). All are common within the QSFP-DD module and all module voltage are referenced to this potential unless otherwise noted. Connect these directly to the host board signal-common ground plane.

[3] VccRx, VccRx1, Vcc1, Vcc2, VccTX and VccTx1 shall be apply concurrently. Requirements defined for the host side of the Host Card Edge Connector are listed in the table. VccRx, VccRx1,Vcc1, Vcc2, Vcctx and VccTc1 may be internally connected within the module in any combination. The connector Vcc pins are each rated for a maximum current of 1000 mA.

22	CML-O	Rx2p	Receiver Non-Inverted Data Output	3B	
23		GND	Ground	1B	2
24	CML-O	Rx4n	Receiver Inverted Data Output	3B	
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	3B	
26		GND	Ground	1B	2
27	LVTTL-I	ModPrsl	Module Present	3B	
28	LVTTL-I	IntL	Interrupt	3B	
29		VccTx	+3.3 V Power Supply Transmitter	2B	3
30		Vcc1	+3.3 V Power Supply	2B	3
31	LVTTL-I	InitMode	Initialization Mode; In legacy QSFP applications, the InitMode pad is called LPMODE	3B	
32		GND	Ground	1B	2
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	3B	
34	CML-I	Tx3n	Transmitter Inverted Data Input	3B	
35		GND	Ground	1B	2
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	3B	
37	CML-I	Tx1n	Transmitter Inverted Data Input	3B	
38		GND	Ground	1B	2
39		GND	Ground	1A	2
40	CML-I	Tx6n	Transmitter Inverted Data Input	3A	
41	CML-I	Tx6p	Transmitter Non-Inverted Data Input	3A	
42		GND	Ground	1A	2
43	CML-I	Tx8n	Transmitter Inverted Data Input	3A	
44	CML-I	Tx8p	Transmitter Non-Inverted Data Input	3A	
45		GND	Ground	1A	2

46		Reserved	For Future use	3A	[4]
47		VS1	Module Vendor Specific 1	3A	4
48		VccRx1	+3.3 V Power supply	2A	3
49		VS2	Module Vendor Specific 2	3A	4
50		VS3	Module Vendor Specific 3	3A	4
51		GND	Ground	1A	2
52	CML-O	Rx7p	Receiver Non-Inverted Data Output	3A	
53	CML-O	Rx7n	Receiver Inverted Data Output	3A	
54		GND	Ground	1A	2
55	CML-O	Rx5p	Receiver Non-Inverted Data Output	3A	
56	CML-O	Rx5n	Receiver Inverted Data Output	3A	
57		GND	Ground	1A	2
58		GND	Ground	1A	2
59	CML-O	Rx6n	Receiver Inverted Data Output	3A	
60	CML-O	Rx6p	Receiver Non-Inverted Data Output	3A	
61		GND	Ground	1A	2
62	CML-O	Rx8n	Receiver Inverted Data Output	3A	
63	CML-O	Rx8p	Receiver Non-Inverted Data Output	3A	
64		GND	Ground	1A	2
65		NC	No Connect	3A	4
66		Reserved	For Future Used	3A	4
67		VccTx1	+ 3.3 V Power Supply	2A	3
68		Vcc2	+ 3.3 V Power Supply	2A	3
69		Reserved	Precision Time Protocol (PTP) Reference Clock Input	3A	4
70		GND	Ground	1A	2
71	CML-I	Tx7p	Transmitter Non-Inverted Data	3A	

[4] All vendor specific, Reserved and No Connect pins may be terminated with 50 Ω to ground on the host. Pad 65 (No Connect) shall be left unconnected within the module. Vendor specific and reserved shall have an impedance to GND that is greater than 10k Ω and less than 100 pF.

			Input		
72	CML-I	Tx7n	Transmitter Inverted Data Input	3A	
73		GND	Ground	1A	2
74	CML-I	Tx5p	Transmitter Non-Inverted Data Input	3A	
75	CML-I	Tx5n	Transmitter Inverted Data Input	3A	
76		GND	Ground	1A	2

5. Absolute Maximum Ratings

Please be aware that exceeding the absolute maximum ratings specified for this module can result in permanent damage.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Maximum supply voltage	Vcc	-0.5	3.3	3.6	V	
Storage temperature	Ts	–40		85	°C	
Relative humidity	RH	0		85	%	Non-condensing

6. Optical Specification

Parameters	Min.	Typ.	Max.	Unit	Notes
Transmitter					
Data rate each lane	53.125 ± 100 ppm			GBd	
Modulation Format	PAM4				
Transmit wavelengths	1264.5	1271	1277.5	nm	
	1284.5	1291	1297.5		
	1304.5	1311	1317.5		
	1324.5	1331	1337.5		
Total Average launch power			9.3	dBm	

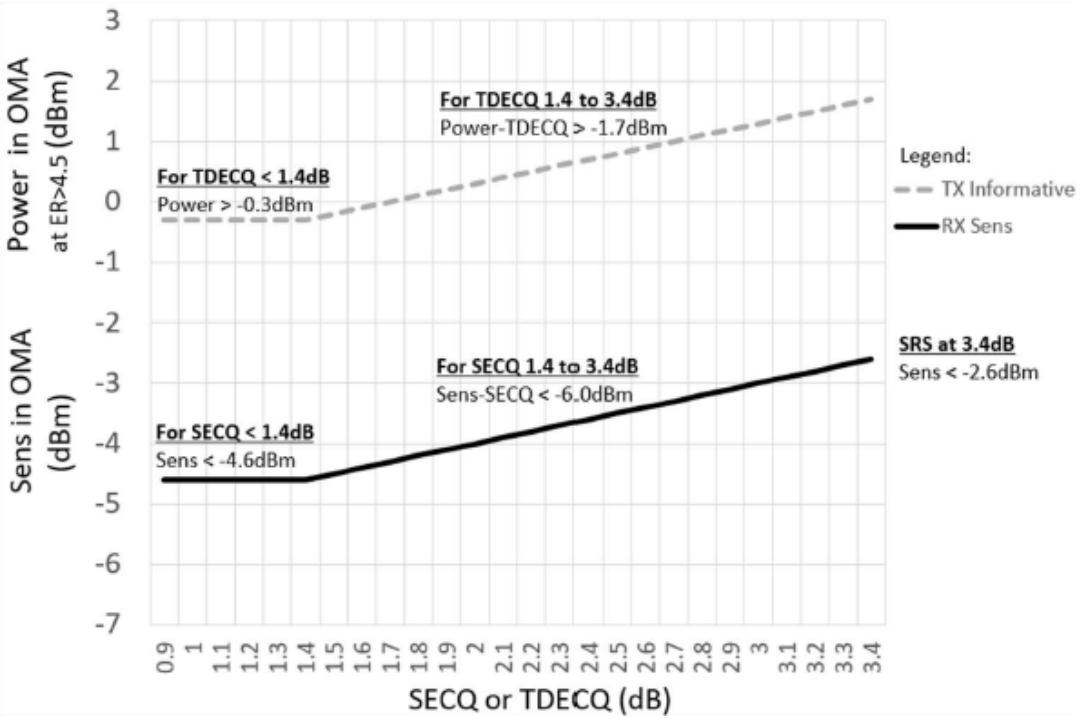
Average launch power, each lane	-3.2		3.5	dBm	
Optical Modulation amplitude (OMA), each lane (max)	-0.2		3.7	dBm	
Launch power in OMA minus TDECQ, each lane (min) for ER < 4.5 dB	-1.6			dB	
Extinction Ratio (ER)	3.5			dB	
Side-Mode suppression ration (SMSR)	30			dB	
Transmitter and Dispersion eye closure for PAM4, each lane (TDECQ)			3.4	dB	
Difference in launch power between any two lanes (OMA outer)			3.9	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	5.4			dBm	
Line wavelengths	1264.5	1271	1277.5	nm	
	1284.5	1291	1297.5		
	1304.5	1311	1317.5		
	1324.5	1331	1337.5		
Average receiver power, each lane	–7.3		3.5	dBm	
Receiver power, each lane (OMA)			3.7	dBm	
Difference in receiver			4.1	dB	

power between any two lanes (OMA)					
Receiver sensitivity (OMAouter), each lane (max)	See note				
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		dB**m**	
Long Term performance test					
BER FLOOR	1E-6@-3.1~2 dBm				

Notes

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

Figure 3 Receiver sensitivity mask for 400GE-FR4



7.Electrical Specifications

Parameter	Min.	Typ.	Max.	Unit	Notes
Power dissipation			9	W	
Supply current			2.72	A	
Receiver (Module Input)					
Overload Differential voltage pk-pk	900			mV	
Data rate, each lane	26.5625 ± 100 ppm			GBd	
Common mode voltage	–350		2850	mV	
Differential termination resistance mismatch			10	%	At 1 MHz

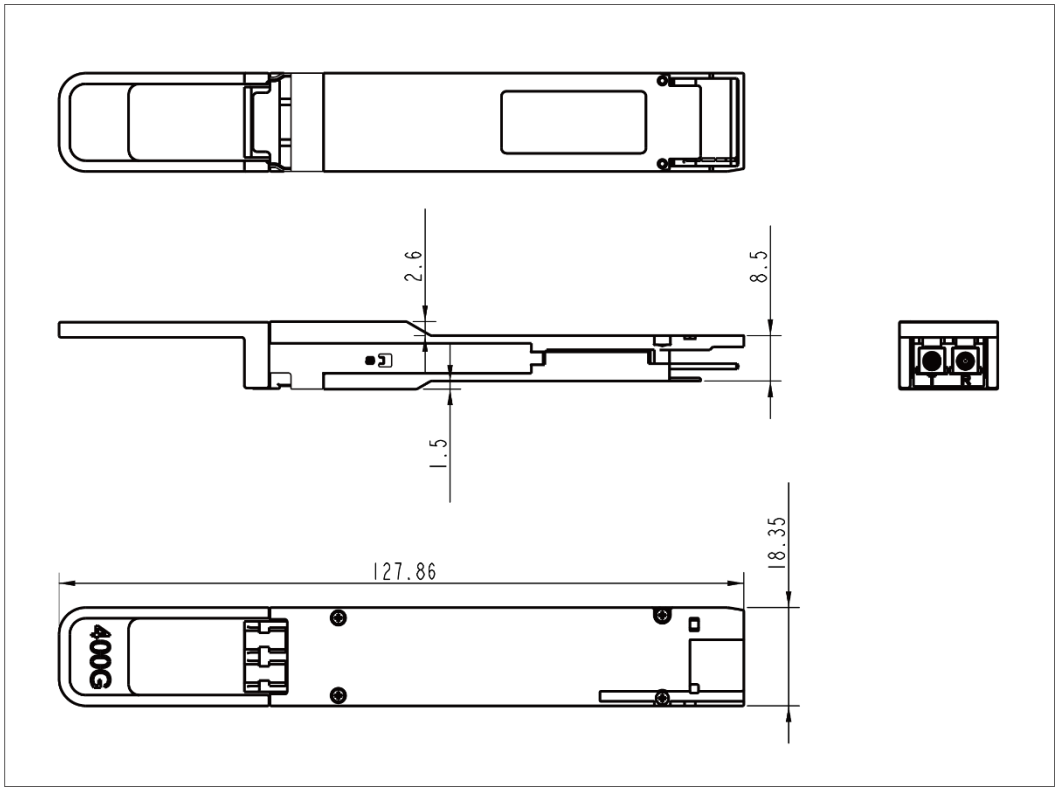
Differential return loss (SDD11)	Equation (16-1)			dB	OIF-CEI-56G-VSR-PAM4
Common mode to differential mode conversion (SCD11)	Equation (16-2)			dB	OIF-CEI-56G-VSR-PAM4
Stressed input test	See OIF-CEI-56G-VSR-PAM4 section 16.3.10.3				
Transmitter (module output)					
Data rate, each lane	26.5625 ± 100ppm				
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	%	
Differential return loss (SDD22)			Equation (16-1)	dB	
Common mode to differential mode conversion (SDC22)			Equation (16-3)	dB	
Common mode return loss (SCC22)			-2	dB	From 250 MHz to fb GHz
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)	0.20			UI	
Far-end eye height at 10^{-6} probability (EH6)	30			mV	
Near-end eye linearity	0.85				

8. Digital Diagnostic Monitoring Functions

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

Performance Item	Data Address		
	Alarm & Warning	Alarm & Warning Threshold	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)

9. Mechanical Specifications



10. Regulatory Compliance

Feature	Agency	Standard	Performance
Safety	TUV	EN 62368-1 EN 60825-1:2014+A11:2021 EN 60825-2	TUV certificate
Electromagnetic Compatibility	Radiated emissions	EN 55032 CISPR 32 ICES-CISPR 32 AS/NZS CISPR21	Class B digital device with a minimum –6 dB margin to the limit when tested with a metal enclosure. Final margin may vary depending on system application, good system EMI design practice, ie: suitable metal enclosure and well-bonding, is required to achieve Class B margins at the system level. Tested frequency range: 30 MHz to 40 GHz or 5th harmonic (5 times the highest frequency), whichever is less.
	ESD	EMC Directive 2014/30/EU EN 55035 IEC/EN 61000-4-2	Withstands discharges of ±8 kV contact, ±15 kV air.
	Radiated immunity	EN 55035 CISPR 35	Field strength of 10 V/m from 80 MHz to 6 GHz.
Restriction of Hazardous Substances	RoHS	EN IEC 63000:2018 & BS EN IEC 63000:2018	CE Certificate

11. ESD Design

Normal ESD precautions are required during the handling of this module. This transceiver is shipped in ESD protective packaging. It should be removed from the packaging and otherwise handled in an ESD protected environment utilizing standard grounded benches, floor mats, and wrist straps.

Parameter	Threshold Value	Notes
ESD of high-speed pins	1 kV	Human body model
ESD of low-speed pins	2 kV	Human body model
Air discharge during operation	15 kV	
Direct contact discharges to the case	8 kV	

12. Ordering Informations

Part Number	Description
RSMD4BFR400CT	QSFP-DD 400GE FR4 2 km

Notice

The purchased products, services and features are stipulated by the contract made between E-S-TEL SRL and the customer. All or part of the products, services and features described in this document may not be within the purchase scope or the usage scope. Unless otherwise specified in

the contract, all statements, information, and recommendations in this document are provided "AS IS" without warranties, guarantees or representations of any kind, either express or implied.

The information in this document is subject to change without notice. Every effort has been made in the preparation of this document to ensure accuracy of the contents, but all statements, information, and recommendations in this document do not constitute a warranty of any kind.


estel