400G QSFP112 DR4 Pluggable Optical Transceiver

Features

- QSFP112 MSA 2.1.1 and CMIS 5.1 compliant
- MPO-12 APC connector
- 4x106.25Gbps (53.125GBd PAM4) electrical interface
- 4x106.25Gbps (53.125GBd PAM4) optical interface
- Up to 500m over SMF
- Power dissipation ≤ 9W
- Operating case temperature: 0°C to 70°C
- IEEE 802.3bs 400GBASE-DR4 compliant
- Built-in digital diagnostic functions
- 3.3V power supply voltage
- RoHS compliant

Applications

- 400GBASE-DR4 Ethernet
- Data center networks

Product Description

The PhoScale PHOS-4QFSD45M121 transceiver is designed for 400G Ethernet communication application links over 500m of single-mode fiber (SMF), and it is compliant with QSFP112 MSA, CMIS 5.1, IEEE 802.3bs, and 802.3ck standards. The optical signal is transmitted over four parallel channels at a central wavelength of 1310nm. The module contains 4 parallel channels on the transmitter and receiver, each operating at 106.25Gbps. The optical interface is MTP/MPO-12 APC connector.

Absolute Maximum Ratings

Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage	V_{cc}	-0.5	-	3.6	V
Storage Temperature	T_{sto}	-40		85	°C
Relative Humidity (Non-condensing)	RH	5		95	%
Control Input Voltage	V_i	-0.3		V_{cc}+0.5	

NOTE: Exceeding these ratings may damage the device permanently.

Specified Operations Conditions

Parameter	Symbol	Min	Typ	Max	Unit
Power Supply Voltage	V_{cc}	3.135	3.3	3.465	V
Case Operating Temperature	T_{op}	0	-	70	°C
Relative Humidity (Non-condensing)	RH	15		85	%
I2C Clock Frequency			100	400	kHz

Electrical Characteristics

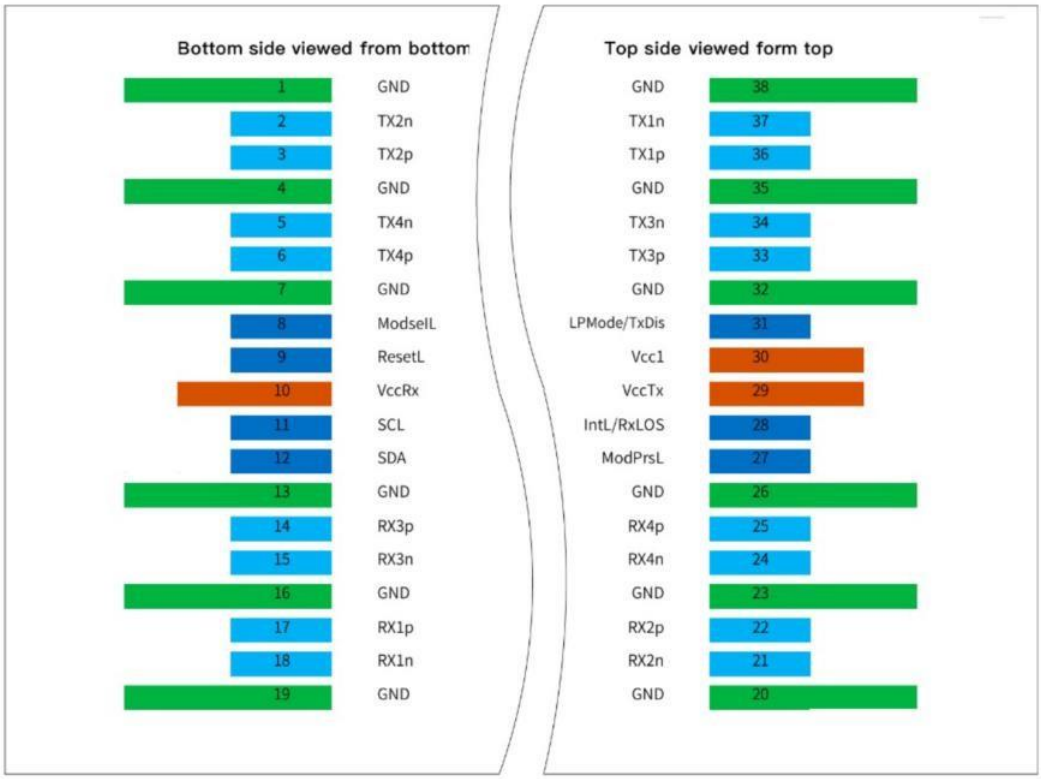
Parameter	Symbol	Min	Typ	Max	Unit
Power Supply Current	I_{cc}			2875	mA
Power On Initialization Time	T_{init}			2000	ms
Transmitter					
Signaling Speed, each lane			53.125		GBd
Signaling Speed Tolerance		-100		+100	ppm
Differential pk-pk input voltage tolerance	$V_{in,pp}$	750			mV
AC common-mode RMS voltage tolerance		25			mV
Differential Input Impedance	Z_{in}	90	100	110	Ohms
Effective return loss	ERL	8.5			dB
Single-ended voltage tolerance range		-0.4		3.3	V
DC Common Mode Voltage		-0.35		2.85	V
Receiver					
Signaling Speed, each lane			53.125		GBd
Signaling Speed Tolerance		-100		+100	ppm
Differential pk-pk output voltage Short mode Long mode	$V_{out,pp}$			 600 845	mV
Eye Height	EH	15			mV
Differential Output Impedance	Z_{out}	90	100	110	Ohms
Transition Time, 20% to 80%	T_r, T_f	8.5			ps
DC Common Mode Voltage		-0.35		2.85	V
AC Common Mode output Voltage (RMS)		25			mV

Optical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Transmitter						
Signaling Speed			53.125		GBd	1
Signaling Speed Tolerance		-100		+100	ppm	
Modulation Format			PAM4			
Wavelength	l	1304.5	1311	1317.5	nm	
Side Mode Suppression Ratio	SMSR	30			dB	
Average TX Power	P_{avg}	-2.9		4	dBm	1
Outer Optical Modulation Amplitude	OMA_{outer}	-0.8		4.2	dBm	1
Extinction Ratio	ER	3.5			dB	1
Avg Launch Power TX Off	P_{off}			-15	dBm	1
Launch Power in OMA_{outer} – TDECQ		-2.2			dBm	1
Transmitter & Dispersion Eye Closure	TDECQ			3.4	dB	1
Relative Intensity Noise	RIN			-136	dB/Hz	
Optical Return Loss	ORTL			21.4	dB	
Reflectance				-26	dB	
Receiver						
Signaling Speed			53.125		GBd	1
Signaling Speed Tolerance		-100		+100	ppm	
Modulation Format			PAM4			
Wavelength	l	1304.5	1311	1317.5	nm	
Damage Threshold		5			dBm	1
Average RX Power		-5.9		4	dBm	1
RX Power (OMA_{outer})				4.2	dBm	2
RX Reflectance				-26	dBm	
RX Sensitivity (OMA_{outer})				-4.4	dBm	3
Stressed RX Sensitivity (OMA_{outer})				-1.9	dBm	1
Conditions of Stressed RX Sensitivity Test						
Stressed Eye Closure, lane under test	SECQ		3.4		dB	
OMA_{outer} of Each Agressor Lane			4.2			

1. *Each lane.*
2. *Receiver sensitivity (OMAouter) each lane (max) is informative and is defined for a transmitter with SECQ of 0.9 dB.*
3. *Measured with conformance test signal at TP3 for BER=2.4x10^{-4}.*

Electrical Input/Output



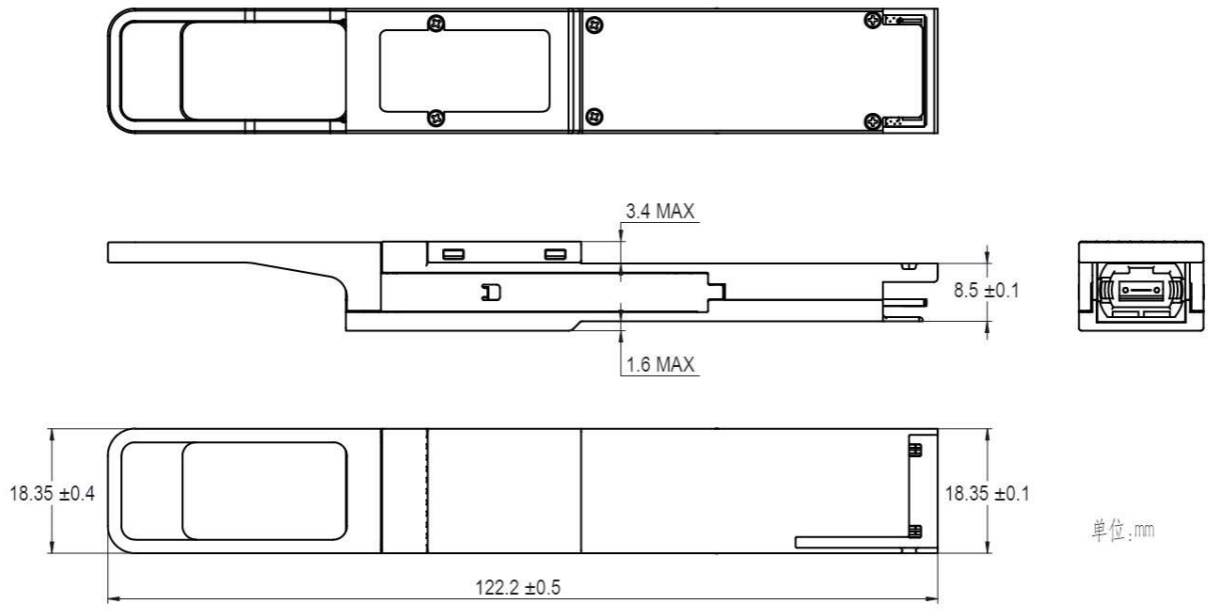
QSFP112 Module contact pad electrical definition

PIN	Logic	Symbol	Description	Notes
1		GND	Ground	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	
3	CML-I	Tx2p	Transmitter Non-Inverted Data Input	
4		GND	Ground	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	
6	CML-I	Tx4p	Transmitter Non-Inverted Data Input	
7		GND	Ground	1
8	LVTTL-I	ModSelL	Module Select	
9	LVTTL-I	ResetL	Module Reset	
10		VccRx	+3.3V Power Supply Receiver	2
11	LVCOMS-I/O	SCL	2-wire serial interface clock	
12	LVCOMS-I/O	SDA	2-wire serial interface data	
13		GND	Ground	1
14	CML-O	Rx3p	Receiver Non-Inverted Data Input	
15	CML-O	Rx3n	Receiver Inverted Data Input	
16		GND	Ground	1

17	CML-O	Rx1p	Receiver Non-Inverted Data Input	
18	CML-O	Rx1n	Receiver Inverted Data Input	
19		GND	Ground	1
20		GND	Ground	1
21	CML-O	Rx2n	Receiver Inverted Data Input	
22	CML-O	Rx2p	Receiver Non-Inverted Data Input	
23		GND	Ground	1
24	CML-O	Rx4n	Receiver Inverted Data Input	
25	CML-O	Rx4p	Receiver Non-Inverted Data Input	
26		GND	Ground	1
27	LVTTL-O	ModPrsL	Module Present	
28	LVTTL-O	IntL/RxLOS	Interrupt/Optional RxLOS	
29		VccTx	+3.3V Power supply transmitter	2
30		Vcc1	+3.3V Power supply	2
31	LVTTL-I	LPMode/TX Dis	Low Power Mode/optional TX Disable	
32		GND	Ground	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	
34	CML-I	Tx3n	Transmitter Inverted Data Input	
35		GND	Ground	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	
37	CML-I	Tx1n	Transmitter Inverted Data Input	
38		GND	Ground	1

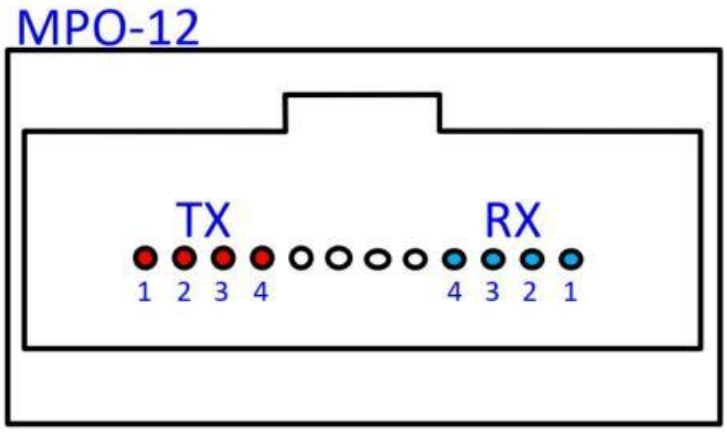
1. *GND is the symbol for signal and supply (power) common for the QSFP112 module. All are common within the QSFP112 module and all voltages are referenced to this potential unless otherwise noted. Connect these directly to the host board signal-common ground plane.*
2. *Vcc Rx, Vcc1 and Vcc Tx are the receiver and transmitter power supplies and shall be applied concurrently. Requirements, defined for the host side of the Host Edge Card Connector. Vcc Rx, Vcc1and Vcc Tx may be internally connected within the QSFP112 module in any combination. The connector pins are each rated for a maximum current of 1.5A (max. current of 2.0 A is required for high module power of 15-20W).*

Mechanical Specifications



Product shall be of design, construction, and physical dimensions specified on the applicable product drawing.

Optical Interface



Laser Safety

This is a Class 1 Laser Product as defined by IEC 60825-1:2014. When operated within the limits of this specification it is considered non-hazardous. Operating this product in a manner inconsistent with specifications and intended usage may result in hazardous radiation exposure.

Regulatory Certifications

This product is certified to the following regulatory standards:

Category	Standard
Radiated Emissions	EMC Directive 2014/30/EU EN 55032 CISPR 32 FCC rules 47 CFR Part 15 ICES-003 VCCI-CISPR 32 AS/NZS CISPR 32
Radiated Immunity	EMC Directive 2014/30/EU EN 55035 CISPR 35 IEC/EN 61000-4-3
RoHS	EU RoHS (2011/65/EU & (EU) 2015/863) & UK RoHS EN IEC 63000:2018 & BS EN IEC 63000:2018
Flammability (PCB)	UL Class 94 V-0

Ordering Information

Part No.	Data Rate	Wavelength	Max Distance	Case Temperature Range
PHOS-4QFSD45M121	425Gbps	1310nm	500m	0°C to 70°C

Notice

PhoScale reserves the right to change specifications of products identified in this datasheet without notice. Applications described herein are for illustrative purposes only, and PhoScale makes no warranty that identified products will be suitable for the described applications without further testing and/or modification.