400G QSFP112 DR4 Optical Transceiver

1.Product Specification

Features

- Silicon photonics integrated solution
- Hot-pluggable QSFP112
- MPO-12 APC
- Up to 500 meters reach on single mode fiber
- 4x106.25 Gbps electrical interface
- Pre-FEC BER ⩽ 1E-8 in the switcher equipment self-loopback test

Application

- Data centers and cloud networks

400G QSFP112 DR4 optical transceiver is a full duplex, silicon-photonics-based optical transceiver that provides a high-speed link at an aggregated data rate of 400Gbps over 500 meters on single-mode fibers (SMF). This product offers a high-density 400 Gigabit Ethernet connectivity solution for data centers, high-performance computing networks, enterprise core and distribution layers, and service provider transport applications. Our transceiver modules are designed to meet commercial temperature application environments and to be compliant with all applicable standards.

1.1 Overview

Today’s hyper-scale data centers require vast amounts of data to be transferred from any point within the data center to another. A significant portion of these connections hyper-scale data centers between racks and servers. 400G QSFP112 DR4 Optical transceiver comprises a transmitter and receiver that each transmits 106.25 Gb/s data, for a total of 400Gb/s. The transceiver uses PIC based silicon photonics solution to provide 500 meters reach data links.

1.2 General features of this module

- QSFP112 MSA Compliance
- Maximum power consumption 12W
- Compliant with CMIS 4.0
- Compliant with IEEE 802.3bs
- Compliant with Laser Class 1
- Compliant with RoHS 2.0

1.3 Ordering Information

Product	Fiber	Transmitter	Wavelength	Application	Part Number
400G QSFP112 DR4	SMF	SiPh	1310nm	500 meters	

Table 1: Ordering information

2. functional Description

The 400G QSFP112 DR4 contains a MPO-12 APC connector for the optical interface and a 38-pins connector for the electrical interface. The chart in Figure 2 shows the functional block diagram of this product.

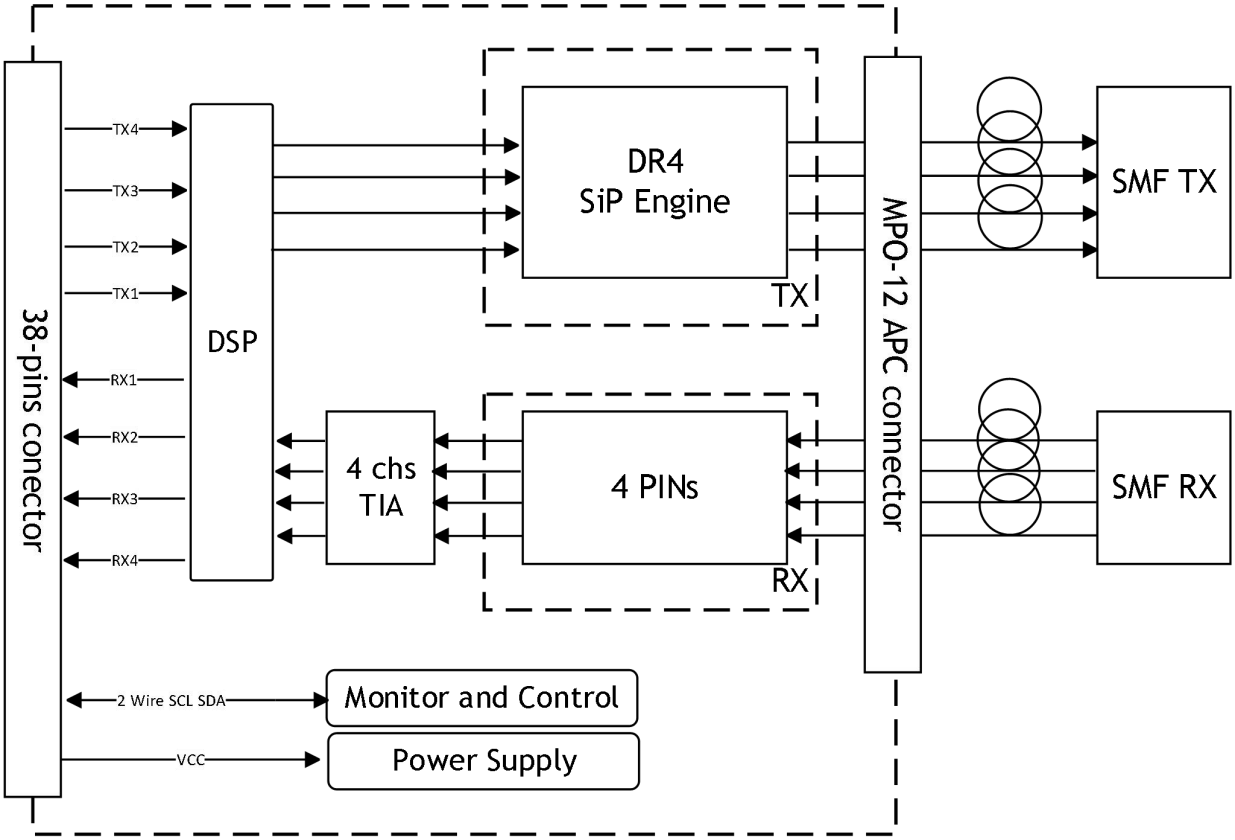

Figure 2 - 400G QSFP112 DR4 Block Diagram

2.1 Transmitter Operation

The transceiver module receives 4 channels of 106.25 Gb/s electrical data, which are processed by optical DSP with CDR functions, that reshape and reduce the jitter of each electrical signal. Subsequently, the integrated silicon photonics engine converts each channel to one of the 4 optical signals. And total outputs deliver a total data rate of 400 Gb/s over 4 parallel single mode fibers .

2.2 Receiver Operation

The receiver section take the optical input of 400Gb/s signals over 4 parallel single mode fibers. Each optical signal is converted to an electrical signal by one of the 4 PIN photodiodes followed by trans-impedance amplifiers (TIA). All 4 electrical signals are fed to the optical DSP with CDR functions to reshape and retime each electrical signal as one of the 4 output channels.

3. IDENTIFICATION OF PINOUT ASSIGNMENT

The transceiver board has 38 pins arranged in the top and bottom rows. The pin map is shown in Table 2 below. The pin orientation is shown below in Figure 3.

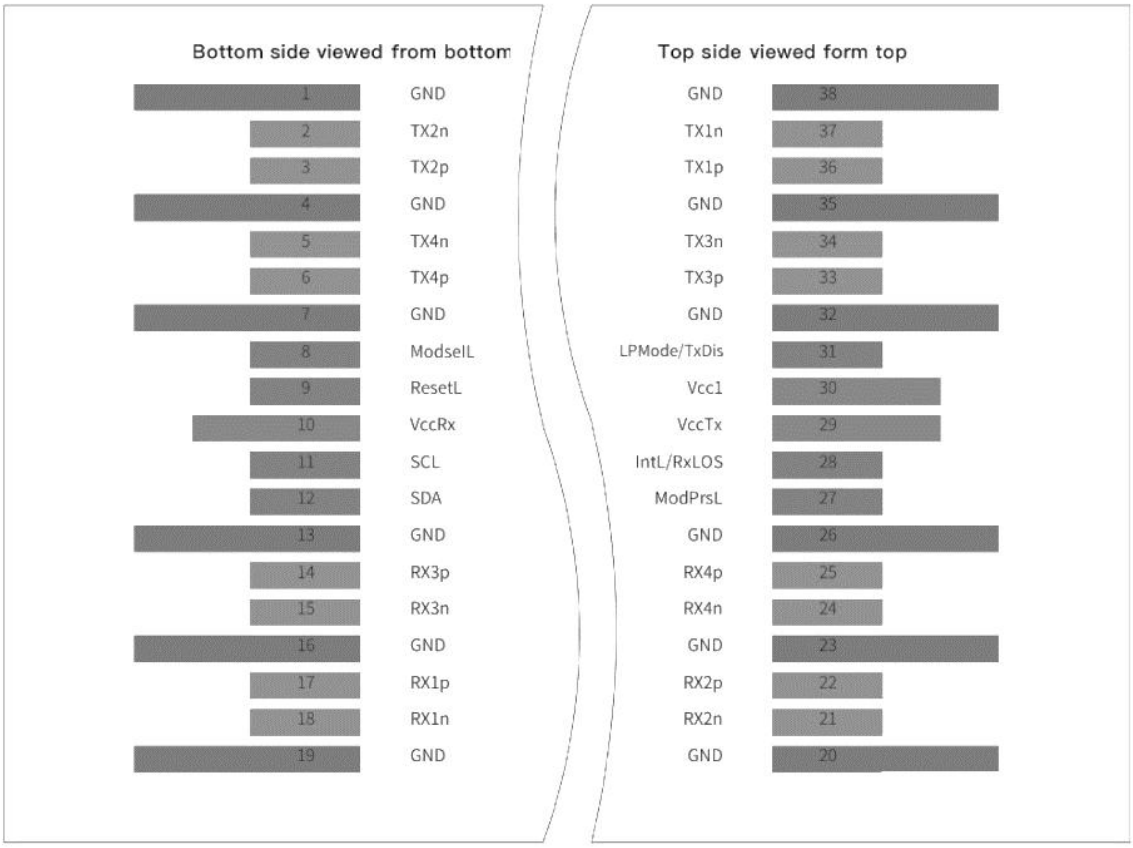

Figure 3 - Pin Orientation and Indication

3.1 Pin map

The following table defines each electrical pin.

Pin	Logic	Symbol	Description	Plug Sequence	Notes
1		GND	Ground	1	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	3	
3	CML-I	Tx2p	Transmitter Non-Inverted Data Input	3	
4		GND	Ground	1	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	3	
6	CML-I	Tx4p	Transmitter Non-Inverted Data Input	3	
7		GND	Ground	1	1
8	LVTTL-I	ModSelL	Select	3	
9	LVTTL-I	ResetL	Reset	3	
10		Vcc Rx	+3.3 V Power supply receiver	2	2
11	LVCMOS-I/O	SCL	2-wire serial interface clock	3	
12	LVCMOS-I/O	SDA	2-wire serial interface data	3	

13		GND	Ground	1	1
14	CML-O	Rx3p	Receiver Non-Inverted Data Output	3	
15	CML-O	Rx3n	Receiver Inverted Data Output	3	
16		GND	Ground	1	1
17	CML-O	Rx1p	Receiver Non-Inverted Data Output	3	
18	CML-O	Rx1n	Receiver Inverted Data Output	3	
19		GND	Ground	1	1
20		GND	Ground	1	1
21	CML-O	Rx2n	Receiver Inverted Data Output	3	
22	CML-O	Rx2p	Receiver Non-Inverted Data Output	3	
23		GND	Ground	1	1
24	CML-O	Rx4n	Receiver Inverted Data Output	3	
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	3	
26		GND	Ground	1	1
27	LVTTL-O	ModPrsL	Present	3	
28	LVTTL-O	IntL/RxLOS	Interrupt/optional RxLOS	3	
29		Vcc Tx	+3.3 V Power supply transmitter	2	2
30		Vcc1	+3.3 V Power Supply	2	2
31	LVTTL-I	LPMode/Tx Dis	Low Power Mode/optional TX Disable	3	
32		GND	Ground	1	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	3	
34	CML-I	Tx3n	Transmitter Inverted Data Input	3	
35		GND	Ground	1	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	3	
37	CML-I	Tx1n	Transmitter Inverted Data Input	3	
38		GND	Ground	1	1

Table 2 – QSFP112 Pin Map

Note 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.

Note 2: Vcc Rx, Vcc1 and Vcc Tx are the receiver and transmitter power supplies and shall be applied concurrently. 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).

4. ABSolute maximum ratings

4.1 Environmental

Parameter	Symbol	Min	Max	Unit	Note
Storage and Transportation Temperature	Ts	-40	+85	°C	
Relative Humidity	RH	5	+85	%	1
Operating Case Temperature	Top	0	+70	°C	

Table 3 - Maximum Environmental Ratings

Note:

1.Non-condensing.

4.2 Electrical

Parameter	Symbol	Min	Max	Unit	Note
+3.3V Power Supply Voltage		-0.3	+3.465	V	

Table 4 - Maximum Electrical Ratings

4.3 Optical

Parameter	Symbol	Min	Max	Unit	Note
RX damage threshold, per Lane	PRdmg	+5		dBm	

Table 5 - Max Electrical Ratings

5. Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit	Note
Relative Humidity	RH	5	+85	%	1
Operating Case Temperature	Top	0	+70	°C	
Operation Supply Voltage	V	3.135	3.465	V	
Date Rate, Each Lane			53.125	Gbd	PAM4
Data Rate Accuracy		-100	+100	ppm	
Pre-FEC Bit Error Ratio			2E-4		
Link Distance with SMF			500	m	2

Table 6 - Recommended Operating Conditions

Note:

1.Non-condensing.

2.FEC required on the host system to support maximum distance.

6. Electrical CHARACTERISTICS

Unless otherwise stated the following parameters and performances are over the full range of operating conditions defined in section 5, over the entire wavelength range. The typical values are referenced to case temperature of +35℃, nominal power supply, and end of life.

Parameter	Symbol	Min.	Typ.	Max.	Units	Ref.
Transmitter						
Signaling Rate per Lane		53.125 ± 100 ppm			GBd	
Receiver						
Signaling Rate per Lane		53.125 ± 100 ppm			GBd	

Operation						
Supply Voltage	Vcc	3.135		3.465	V	
Supply Current	Icc			3.8	A	
Module total power	P			12	W	

Table 7 - Electrical Characteristics

7. OPTICAL CHARACTERISTICS

Unless otherwise stated the following parameters and performances are over the full range of operating conditions defined in section 5, over the full wavelength range. The typical values are referenced to case temperature of +35 oC, nominal power supply, and end of life.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Ref.
Transmitter						
Signaling Rate per Lane		53.125 ± 100 ppm			GBd	
Lane Center Wavelengths (range)	L	1304.5		1317.5	nm	
Modulation Format		PAM4				
Side-mode Suppression ratio (SMSR)	SMSR	30			dB	
Average Launch Power, each lane		-2.9		4	dBm	
Outer Optical Modulation Amplitude, (OMA outer), each Lane	OMA	-0.8		4.2	dB	
Launch power in OMA outer minus TDECQ		-2.2			dB	
Transmitter and dispersion eye closure for PAM4 (TDECQ), each lane				3.4	dBm	
Optical Extinction Ratio	ER	3.5			dB	
Optical Return Loss Tolerance				21.4	dB	
Receiver						
Signaling Rate per Lane		53.125 ± 100 ppm			GBd	
Lane Center Wavelengths (Range)	L	1304.5		1317.5	nm	
Modulation Format		PAM4				
Average Receive Power, each Lane		-5.9		4	dBm	
Receive Power (OMA outer), each Lane				4.2	dBm	
Receiver Reflectance				-26	dB	
Stressed Receiver Sensitivity (OMA outer), each Lane				-1.9	dBm	
Receiver Sensitivity (OMA outer), each Lane				-4.4	dBm	

Table 8 - Optical Characteristics

8. Mechanical CHARACTERISTICS

8.1 Module outline drawing

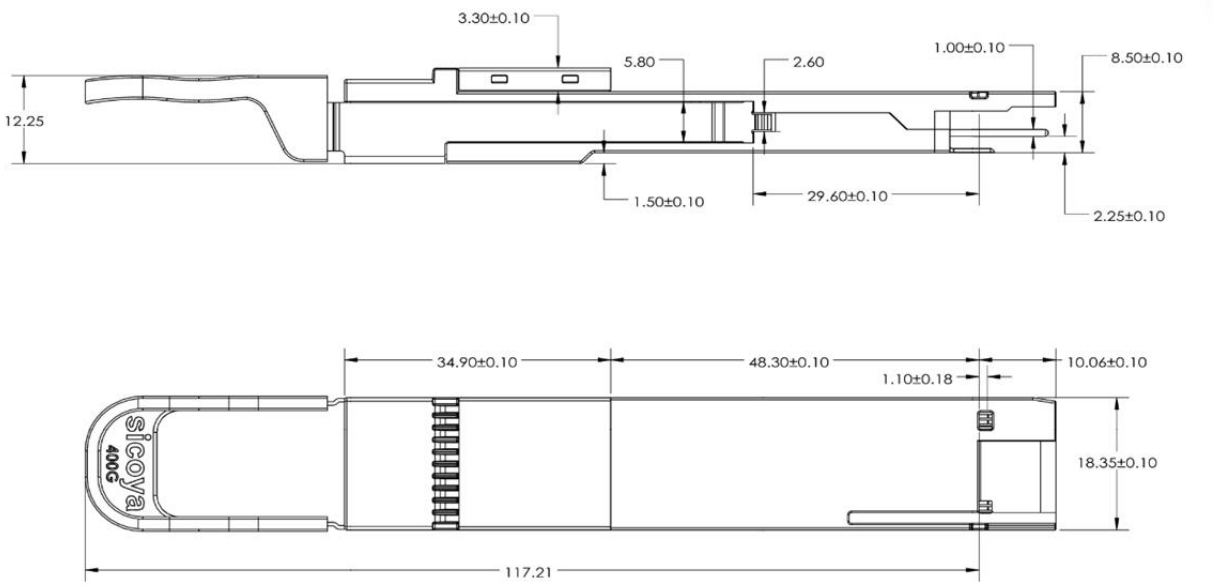

Figure 4 – Mechanical Outline Drawing (Unit: mm)

9. Regulatory specifications.

9.1 Laser Safety

This is a Class 1 Laser product according to IEC 60825-1:1993:+A1:1997+A2:2001. This product complies with 21 CFR 10100.10 and 10100.11 except for deviations pursuant to Laser Notice No. 50 (dated July 26, 2001).

9.2 ESD

This transceiver electrical input pins ESD failure threshold meets classification Class 1. ESD tested per MIL-STD-883, Method 3015.4 / JESD22-A114-A (HBM). However, standard ESD precautions are still required during the handling of this module. This transceiver is shipped in ESD protective packaging. It should be removed from the packaging and handled only in an ESD-protected environment.

9.3 Electromagnetic Emission

The module is designed to comply with Class A electromagnetic emission according to GR-1089-CORE Sections 3.2.1.1 and 3.2.1.3.

9.4 RoHS

The module complies with the requirements of the EU directive 2011/65/EU on the Restriction of Hazardous Substances in Electrical and Electronic Equipment and the amendment of Directive 2015/863.
The module is compatible with the current RoHS requirements for the 10 relevant substances (max 0.1% by weight in homogeneous materials for Lead, Mercury, Hexavalent chromium (Cr6+), Polybrominated biphenyls (PBB), Polybrominated diphenyl ethers (PBDE), Bis(2-ethylhexyl) phthalate (DEHP), Butyl benzyl phthalate (BBP), Dibutyl phthalate (DBP), Di isobutyl phthalate (DIBP) and max 0.01% for cadmium).