

Features

- QSFP112 MSA Compliant
- IEEE802.3bs 400GBASE-DR4 compliant
- 400GAUI-4 electrical interface
- Support 425Gb/s aggregate bit rate
- Maximum power consumption 8W
- MPO12 connector
- Up to 500m transmission on single mode fiber (SMF) with FEC
- Operating case temperature: 0°C ~70°C
- RoHS compliant



Applications

- Data Center Interconnect
- 400G Ethernet
- Enterprise networking

Description

This product is a 400Gb/s transceiver module designed for 500m optical communication applications. The module converts 4 inputs channels (ch) of 100Gb/s (PAM4) electrical data to 4 parallel optical signals, each capable of 100Gb/s operation for an aggregate data rate of 400Gb/s. Reversely, on the receiver side, the module converts 4 channels of parallel optical signals of 100Gb/s each channel for an aggregate data rate of 400Gb/s into 4 channels of 100Gb/s (PAM4) electrical output data.

An optical fiber cable with an MTP/MPO-12 connector can be plugged into the QSFP112 DR4 module receptacle. Proper alignment is ensured by the guide pins inside the receptacle. The cable usually cannot be twisted for proper channel to channel alignment. Electrical connection is achieved through a QSFP112 MSA-compliant edge type connector.

The product is designed with form factor, optical/electrical connection and digital diagnostic interface according to the QSFP112 Multi-Source Agreement (MSA) Type 2. It has been designed to meet the harshest external operating conditions including temperature, humidity and EMI interference.

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units	Note
Storage Temperature	T_{st}	-40	85	°C	
Power Supply Voltage	V_{cc}	-0.5	3.6	V	
Case Operating Temperature	T_{op}	10	60	°C	
Relative Humidity (non-condensing)	Rh	0	85	%	
Damage Threshold, each Lane	THd	3.5		dBm	

Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Units	Note
Operating Case Temperature	T_{ca}	0		70	°C	
Supply Voltage	V_{cc}	3.135	3.3	3.465	V	
Data Rate, each Lane			26.5625		Gb/s	
			53.125		Gb/s	
Data Rate Accuracy		-100		100	ppm	
Pre-FEC Bit Error Ratio				2.4×10^{-4}		
Post-FEC Bit Error Ratio				1×10^{-12}		1
Link Distance	D			500	m	2

Notes:

1. FEC provided by host system.
2. FEC required on host system to support maximum distance.

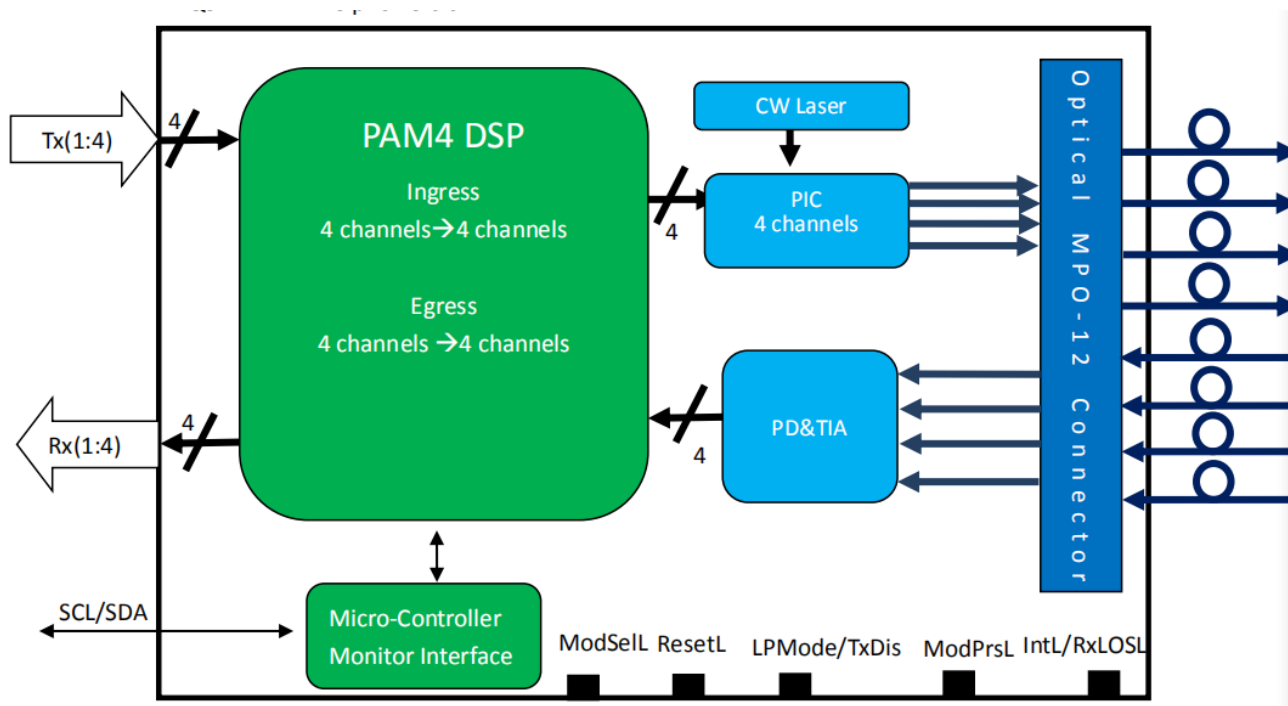
Diagnostic Monitoring Interface

Parameter	Symbol	Accuracy	Unit	Notes
Temperature monitor absolute error	DMI_Temp	± 3	°C	Over operating
Supply voltage monitor absolute error	DMI_VCC	± 0.1	V	Over full operating range
Channel RX power monitor absolute error	DMI_RX_Ch	± 2	dB	1
Channel Bias current monitor	DMI_Ibias_Ch	$\pm 10\%$	mA	
Channel TX power monitor absolute error	DMI_TX_Ch	± 2	dB	1

Notes:

1. Due to measurement accuracy of different single mode fibers, there could be an additional +/-1 dB fluctuation, or a +/-3 dB total accuracy.

Transceiver Block Diagram



Optical Characteristics

Parameter	Symbol	Min	Typ.	Max	Units	Notes
Center Wavelength	λ_c	1304.5	1310	1317.5	nm	
Data Rate, each Lane		53.125 $\pm$ 100 ppm			GBd	
Modulation Format		PAM4				
Transmitter						
Side-mode Suppression Ratio	$SMSR$	30			dB	
Average Launch Power, each Lane	P_{AVG}	-2.9		4	dBm	1
Outer Optical Modulation Amplitude (OMA _{outer}), each Lane	P_{OMA}	-0.8		4.2	dBm	2
Launch Power in OMA _{outer} minus TDECQ), each Lane					dB	
for ER $\geq$ 5dB		-2.2				
for ER < 5dB		-1.9				
Transmitter and Dispersion Eye Closure for PAM4, each Lane	$TDECQ$			3.4	dB	
TDECQ – 10*log10(Ceq), each Lane				3.4	dB	3
Extinction Ratio	ER	3.5			dB	
RIN _{21.4OMA}	RIN			-136	dB/Hz	
Optical Return Loss Tolerance	TOL			21.4	dB	
Transmitter Reflectance	TR			-26	dB	
Transmitter Transition Time				17	ps	
Average Launch Power of OFF Transmitter, each Lane	P_{off}			-15	dBm	
Receiver						
Damage Threshold, each Lane	THd	5			dBm	4
Average Receive Power, each Lane		-5.9		4	dBm	5
Receive Power (OMA _{outer}), each Lane				4.2	dBm	
Receiver Sensitivity (OMA _{outer}), each Lane	SEN			Equation (1)	dBm	6
Stressed Receiver Sensitivity (OMA _{outer}), each Lane	SRS			-1.9	dBm	7
Receiver Reflectance	RR			-26	dB	

LOS Assert	LOSA	-15	dBm
LOS De-assert	LOSD	-8.9	dBm
LOS Hysteresis	LOSH	0.5	dB
Stressed Conditions for Stress Receiver Sensitivity (Note 8)			
Stressed Eye Closure for PAM4 (SECQ), Lane under Test		3.4	dB
SECQ – 10*log10(Ceq), Lane under Test		3.4	dB
OMAouter of each Aggressor Lane		4.2	dBm

Notes:

1. Average launch power, each lane (min) is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.
2. Even if the TDECQ < 1.4dB for an extinction ratio of ≥ 5dB or TDECQ < 1.1dB for an extinction ratio of < 5dB, the OMAouter (min) must exceed the minimum value specified here.
3. Ceq is a coefficient defined in IEEE Std 802.3-2018 clause 121.8.5.3 which accounts for reference equalizer noise enhancement.
4. Average receive power, each lane (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.
5. The receiver shall be able to tolerate, without damage, continuous exposure to a modulated optical input signal having this power level on one lane. The receiver does not have to operate correctly at this input power.
6. Receiver sensitivity (OMAouter), each lane (max) is informative and is defined for a transmitter with a value of SECQ up to 3.4 dB. It should meet Equation (1), which is illustrated in Figure 4.

$$RS = \max(-3.9, SECQ - 5.3) \text{ dBm} \quad (1)$$

Where:

RS is the receiver sensitivity, and

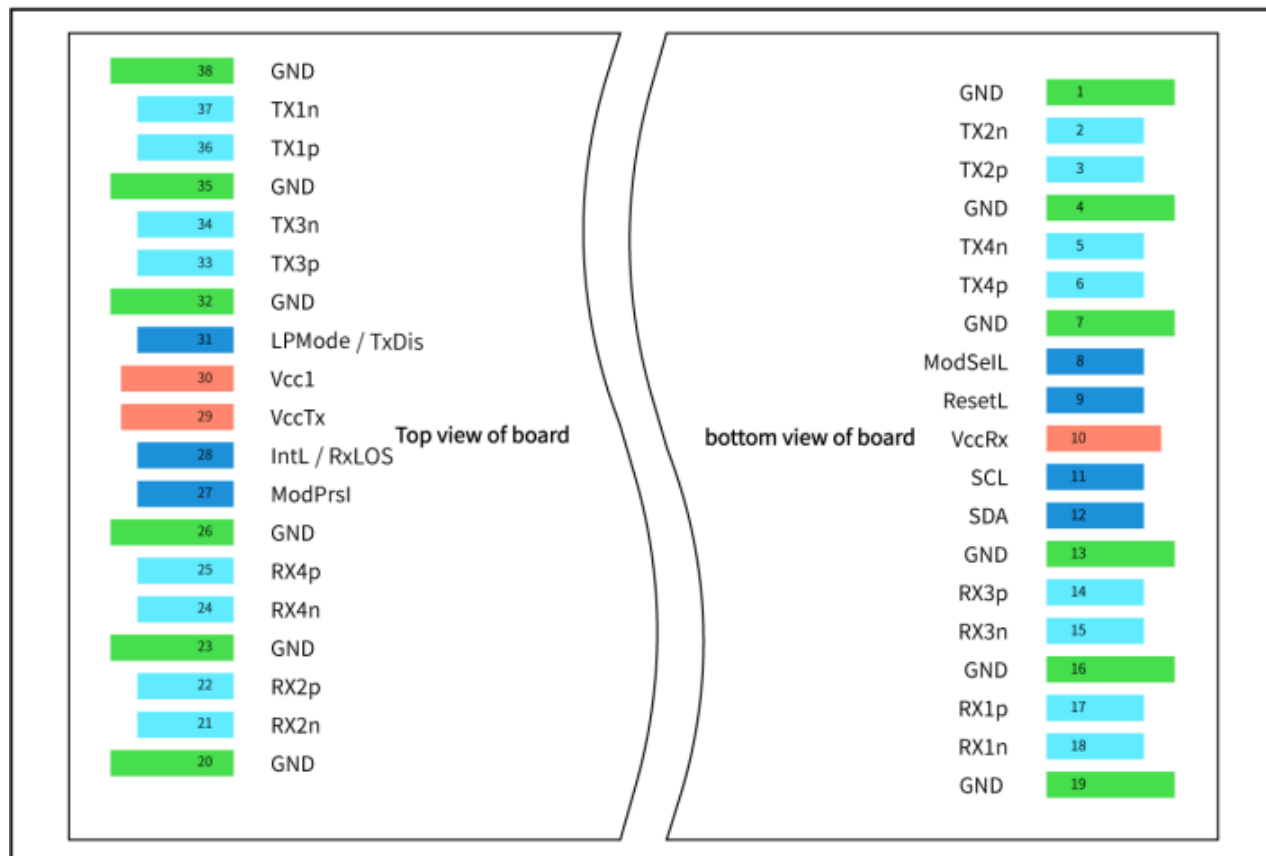
SECQ is the SECQ of the transmitter used to measure the receiver sensitivity.

7. Measured with conformance test signal at TP3 for the BER equal to 2.4x10⁻⁴.
8. These test conditions are for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units	Note
Power Consumption				8	W	
Supply Current	<i>I_{cc}</i>			2.42	A	
Transmitter (each Lane)						
Signaling Rate, each Lane	<i>TP1</i>	53.125 ± 100 ppm			GBd	
DC Common-mode input voltage	<i>TP1</i>	-0.3		2.8	V	
Single-ended input voltage	<i>TP1a</i>	-0.4		3.3	V	
AC Common-mode RMS input Voltage	<i>TP1a</i>			17.5		
Module Stressed Input Tolerance	<i>TP1a</i>	IEEE 802.3ck 120G.3.4.1				
Differential pk-pk input voltage tolerance	<i>TP1a</i>			900	mV	
Differential input Eye Height	<i>TP1a</i>	15				
Differential input Vertical Eye Closure	<i>TP1a</i>	9		9.5		
Common to Different Mode input Return Loss	<i>TP1</i>	IEEE802.3ck Equation 120G-1				
Effective Return Loss, ERL	<i>TP1</i>		TBD		dB	
Differentia termination Mismatch	<i>TP1</i>			10	%	
Input Transition time (20% to 80%)	<i>TP1a</i>	7.5			ps	
Receiver (each Lane)						
Differential peak-to-peak Output Voltage	<i>TP4</i>			900	mV	
AC Common-mode RMS Output Voltage	<i>TP4</i>			17.5		
Differential Termination Mismatch	<i>TP4</i>			10	%	
Common-mode to Differential-mode Return Loss, RL _{dc}	<i>TP4</i>	IEEE802.3ck Equation (120G-1)			dB	
Transition Time, 20% to 80%	<i>TP4</i>	7.5			ps	
DC Common-mode Voltage Tolerance	<i>TP4</i>	-350		2850	mV	

Pin Assignment and Description



MSA compliant Connector

Pin Descriptions

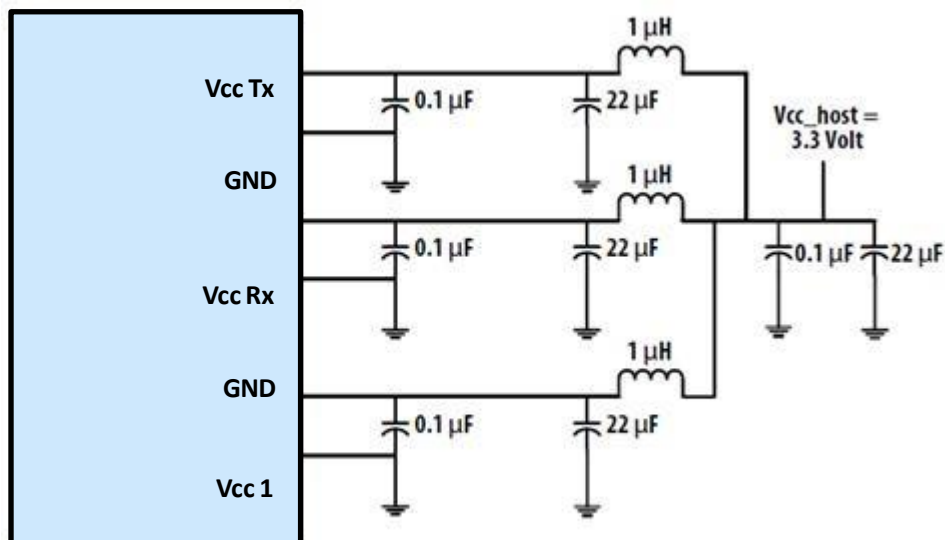
<i>PIN</i>	<i>Logic</i>	<i>Symbol</i>	<i>Name / Description</i>	<i>Note</i>
1	Ground	GND	Ground	1
2	CML-I	Tx2n	Transmitter inverted data input	
3	CML-I	Tx2p	Transmitter non-inverted data input	
4	Ground	GND	Ground	1
5	CML-I	Tx4n	Transmitter inverted data input	
6	CML-I	Tx4p	Transmitter non-inverted data input	
7	Ground	GND	Ground	1
8	LVTTL-I	MoDSelL	Module Select	
9	LVTTL-I	ResetL	Module Reset	
10		VccRx	+3.3v Receiver Power Supply	2
11	LVCMOS-I/O	SCL	2-wire Serial interface clock	
12	LVCMOS-I/O	SDA	2-wire Serial interface data	
13	Ground	GND	Ground	
14	CML-O	RX3p	Receiver non-inverted Data Output	
15	CML-O	RX3n	Receiver inverted Data Output	
16	Ground	GND	Ground	1
17	CML-O	Rx1p	Receiver non-inverted Data Output	
18	CML-O	Rx1n	Receiver inverted Data Output	
19	Ground	GND	Ground	1
20	Ground	GND	Ground	1
21	CML-O	Rx2n	Receiver Inverted Data Output	
22	CML-O	Rx2p	Receiver Non-Inverted Data Output	
23	Ground	GND	Ground	1
24	CML-O	Rx4n	Receiver Inverted Data Output	1
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	
26	Ground	GND	Ground	1
27	LVTTL-O	ModPrsL	Module Present	
28	LVTTL-O	IntL	Interrupt	
29		VccTx	+3.3v Power supply transmitter	2

30		Vcc1	+3.3v Power supply	2
31	LVTTL-I	LPMode	Low Power Mode	
32	Ground	GND	Ground	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	
34	CML-I	Tx3n	Transmitter Inverted Data Input	
35	Ground	GND	Ground	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	
37	CML-I	Tx1n	Transmitter Inverted Data Input	
38	Ground	GND	Ground	1

Notes:

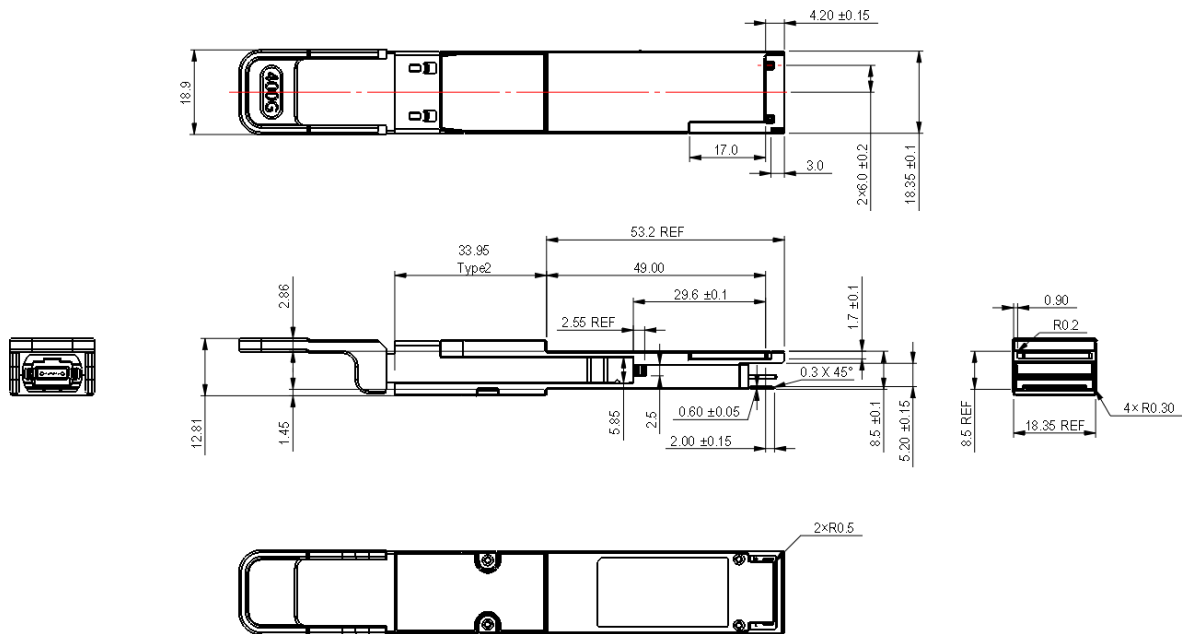
1. GND is the symbol for signal and supply (power) common for QSFP56 modules. All are common within the QSFP56 module and all module voltages are referenced to this potential unless otherwise noted. Connect these directly to the host board signal common ground plane.
2. VccRx, Vcc1 and VccTx are the receiving and transmission power suppliers and shall be applied concurrently. Vcc Rx, Vcc1 and Vcc Tx may be internally connected within the QSFP56 transceiver module in any combination. The connector pins are each rated for a maximum current of 1000mA.

Recommended Power Supply Filter



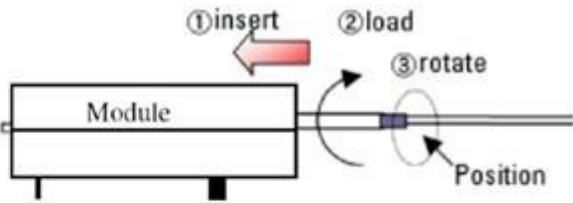
Recommended Power Supply Filter

Dimensions



Optical Receptacle Cleaning Recommendations

All fiber stubs inside the receptacle portions were cleaned before shipment. In the event of contamination of the optical ports, the recommended cleaning process is the use of forced nitrogen. If contamination is thought to have remained, the optical ports can be cleaned using a NTT international Cletop® stick type and HFE7100 cleaning fluid. Before the mating of patch-cord, the fiber end should be cleaned up by using Cletop® cleaning cassette.

Cleaning of patch-cord	Cleaning of fiber stub
	 1. Insert Ensure that stick is held straight when inserting into sleeve. 2. Load Apply sufficient pressure (approx 600-700g) to ensure ferrule a little depressed in sleeve. 3. Rotate Rotate stick clockwise 4-5 times, while ensuring direct contact with ferrule end-face is maintained. <i>Notice: Number of possible wipes: Maintenance (repair) ~1 use / piece Equipment construction: 4 uses / piece (max.)</i>

Note: The pictures were extracted from NTT-ME website. And the Cletop® is a trademark registered by NTT-ME

Ordering Information

<i>Model Number</i>	<i>Part Number</i>	<i>Reach</i>	<i>Temperature</i>
QSFP112 400G DR4	OPEY-SX5-13-CBS	500m	0°C to 70°C

Modification History

<i>Revision</i>	<i>Date</i>	<i>Description</i>
A1	Apr. 2019	Initial Release

Note: All information contained in this document is subject to change without notice.