

## 400G QSFP112 DR4 1310 nm Transceiver 500m

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### QSFP112 Series



- **QSFP112 MSA Compliant**
- **CMIS compliance**
- **Support 425Gb/s aggregate bit rate**
- **4 Parallel optical lanes**
- **MPO-12 connector**
- **Up to 500m transmission on SMF with KP4 FEC**
- **Operating temperature 0 to 70°C**

Ascent's Q112-400G-DR4-05 400 Gbps QSFP112 DR4 transceiver is a 400Gb/s Quad Small Form-factor Pluggable (QSFP) optical module design for 500 m optical communication applications. The module converts 4 input channels of 100Gb/s electrical data to 4 channels of 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 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.

This product is designed with form factor, optical/electrical connection and digital diagnostic interface according to the QSFP112 MSA Type2. It has been designed to meet the harshest external operating conditions including temperature, humidity and EMI interference. I2C interface is supported to read and control the status of this product.

## Key Features

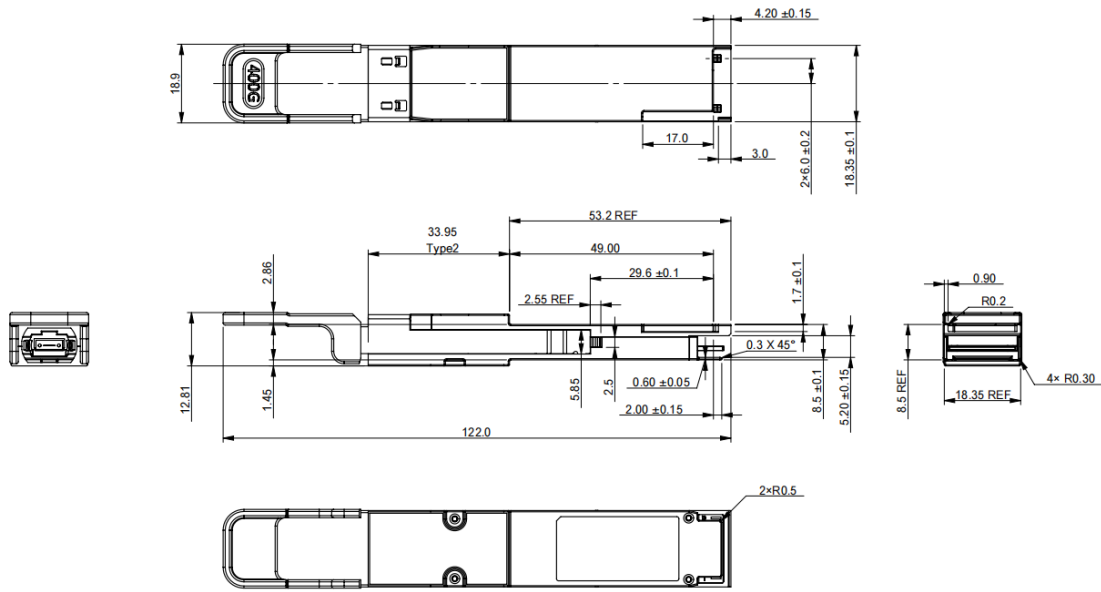
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- QSFP112 MSA Compliant
- CMIS compliance
- Support 425Gb/s aggregate bit rate
- 4 Parallel optical lanes
- MPO-12 connector
- Up to 500m transmission on SMF with KP4 FEC
- Operating case temperature 0 to 70°C

The transceiver complies with common management interface specification (CMIS). The supported key features listed below allow host software to read and control the transceiver status through I2C.

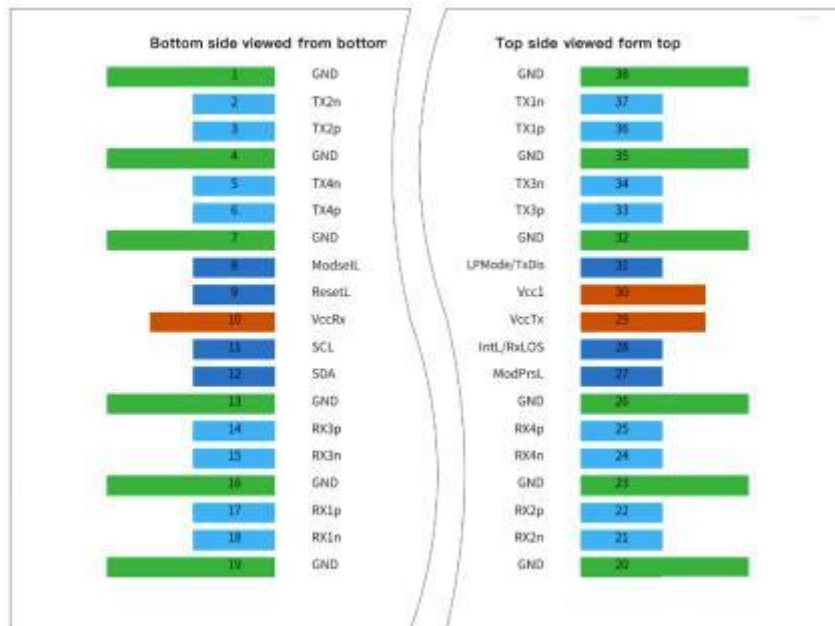
- Adaptive Tx input equalization
- Programmable Rx output amplitude
- Programmable Rx output pre-cursor
- Programmable Rx output post-cursor
- Supply voltage monitoring (DDM\_Voltage)
- Transceiver case temperature monitoring (DDM\_Temperature)
- Tx transmit optical power monitoring for each lane (DDM\_TxPower)
- Tx bias current monitoring for each lane (DDM\_TxBias)
- Rx receive optical power monitoring for each lane (DDM\_RxPower)
- Warning and alarm indication for each DDM function
- Tx & Rx LOL and LOS indication
- Tx fault indication
- Host and line side loopback capabilities
- Host and line side PRBS generator and checker capabilities
- CDB firmware upgrade capability
- Versatile diagnostics monitoring (VDM) capability (optional, additional power consumption increase)
- Other functions defined in CMIS

## Mechanical Dimensions



## Pin Definitions

The electrical interface of QSFP112 module consist of a 38 contacts edge connector as illustrated by the diagram in below picture, which defined in Clause 4.1 of QSFP112 MSA Specification.

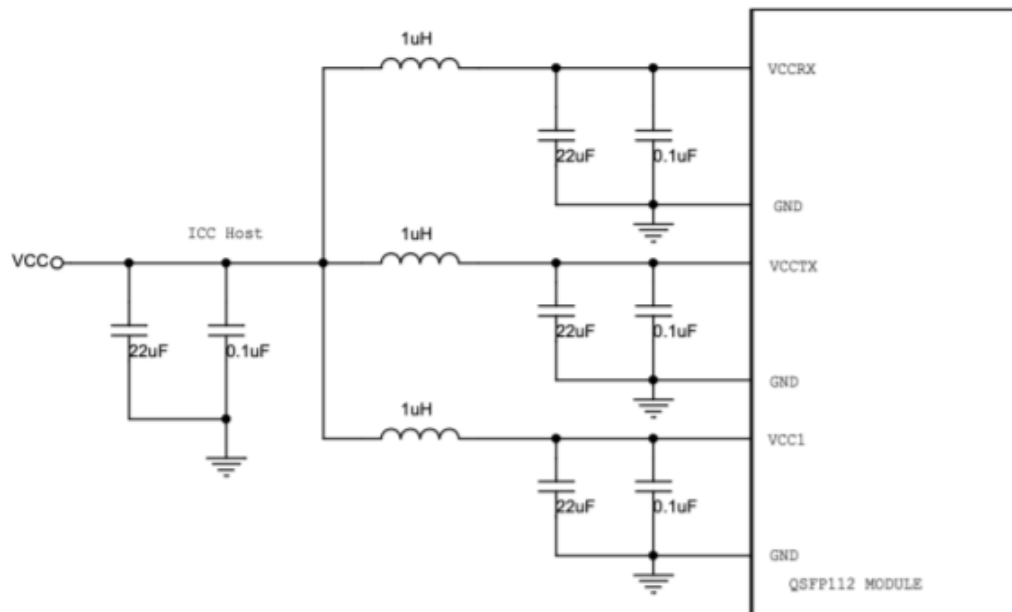


Pin#	Symbol	Description	Logic	Plug Sequence
1	GND		Ground	1
2	TX2n	Transmitter Data Inverted Input	CML-I	3
3	TX2p	Transmitter Data Non-Inverted Input	CML-I	3
4	GND		Ground	1
5	TX4n	Transmitter Data Inverted Input	CML-I	3
6	TX4p	Transmitter Data Non-Inverted Input	CML-I	3
7	GND		Ground	1
8	ModSelL	Module Select	LVTTTL-I	3
9	ResetL	Module Reset	LVTTTL-I	3
10	VccRx	+3.3V Power supply receiver		2
11	SCL	2-wire Serial interface clock	LVC MOS-I/O	3
12	SDA	2-wire Serial interface data	LVC MOS-I/O	3
13	GND		Ground	1
14	RX3p	Receiver Data Non-Inverted Output	CML-O	3
15	RX3n	Receiver Data Inverted Output	CML-O	3
16	GND		Ground	1
17	RX1p	Receiver Data Non-Inverted Output	CML-O	3
18	RX1n	Receiver Data Inverted Output	CML-O	3
19	GND		Ground	1
20	GND		Ground	1
21	RX2n	Receiver Data Inverted Output	CML-O	3
22	RX2p	Receiver Data Non-Inverted Output	CML-O	3
23	GND		Ground	1
24	RX4n	Receiver Data Inverted Output	CML-O	3

Pin#	Symbol	Description	Logic	Plug Sequence
25	RX4p	Receiver Data Non-Inverted Output	CML-O	3
26	GND		Ground	1
27	ModPrsl	Module Present	LVTTTL-O	3
28	IntL/RxLOS	Interrupt/optional RxLOS	LVTTTL-O	3
29	VccTx	+3.3V Power supply transmitter		2
30	Vcc1	+3.3V Power Supply		2
31	LPMoDe/TxDis	Lower Power Mode/optional TX Disable	LVTTTL-I	3
32	GND		Ground	1
33	TX3p	Transmitter Data Non-Inverted Input	CML-I	3
34	TX3n	Transmitter Data Inverted Input	CML-I	3
35	GND		Ground	1
36	TX1p	Transmitter Data Non-Inverted Input	CML-I	3
37	TX1n	Transmitter Data Inverted Input	CML-I	3
38	GND		Ground	1

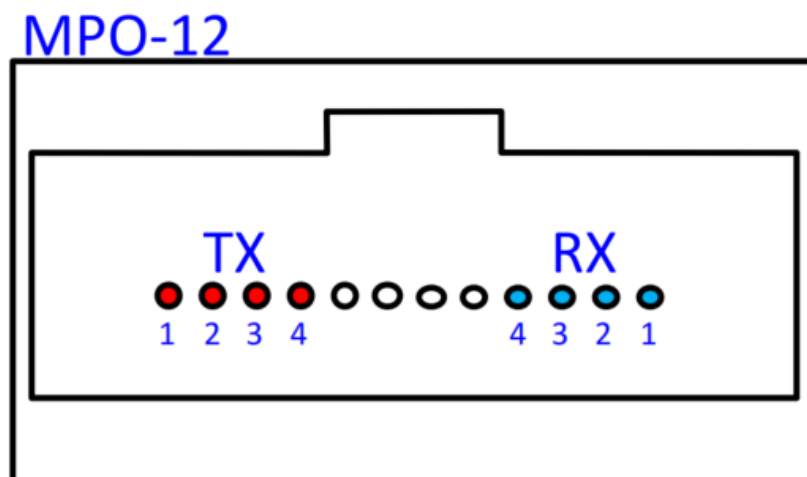
## QSFP112 Control Pins

Name	Direction	Description
SCL	BiDir	2-wire serial clock signal. Requires pull-up resistor to 3.3V on host
SDA	BiDir	2-wire serial data signal. Requires pull-up resistor to 3.3V on host.
IntL/RxLOS	Output	Active low IntL output port only.
LPMoDe/TxDis	Input	Active high LPMoDe input port only.



## Optical Port Description

The optical interface port is a MPO-12 receptacle. The transmit and receive optical lanes shall occupy the positions depicted in below picture when looking into the MDI receptacle with the connector keyway feature on top.



## ESD

This transceiver is specified as ESD threshold 1kV for high-speed data pins and 2kV for all other electrical input pins, tested per MIL-STD-883, Method 3015.4 /JESD22-A114-A (HBM). However, normal 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.

## Laser safety

This is a Class I Laser Product, or Class 1 Laser Product according to IEC/EN 60825-1:2014. This product complies with 21 CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 Ed. 3., as described in Laser Notice No. 56, dated May 8, 2019. Caution: Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

## Specifications

### Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit
Storage Temperature	Ts	-40	85	°C
Case Operating Temperature	Top	0	70	°C
Power Supply Voltage	Vcc	-0.5	3.6	V
Relative Humidity (non-condensation)	RH	0	85	dBm

### Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Operating Case Temperature	Top	0		70	°C	
Power Supply Voltage	Vcc	3.135	3.3	3.465	V	
Data Rate, Each Lane			53.125		GBd	
Data Rate Accuracy		-100		100	ppm	
Pre-FEC Bit Error Ratio				2.4x10 <sup>-4</sup>		
Post-FEC Bit Error Ratio				1x10 <sup>-15</sup>		
Link Distance	D	2		500	m	

#### Note:

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

### Electrical Characteristics

The following electrical characteristics are defined over the Recommended Operating Environment unless otherwise specified.

Parameter	Symbol	Min	Typ.	Max	Unit	Note
Power Consumption				9.5	W	
Supply Current	Icc			2.87	A	
<b>Module Input (each Lane)</b>						
Signaling Rate, Each Lane	TP1	53.125 ± 100 ppm			GBd	
DC Common-Mode Input Voltage	TP1	-0.35		2.85		
Single-Ended Input Voltage	TP1a	-0.4		3.3	V	
AC Common-Mode Voltage Tolerance	TP1a	32			mV	
Low-Frequency, VCMLF		80				
Full-Band, VCMLF						
Module Stressed Input Test		IEEE 802.3ck 120G3.4.3				
Differential Peak-to-Peak Input Voltage Tolerance	TP1a	750			mV	
Common to Different Mode Input Return Loss	TP1	IEEE802.3ck Equation 120G-2				
Effective Input Return Loss	TP1	8.5			dB	
Differential Input Termination Mismatch	TP1			10	%	
<b>Module Output (each Lane)</b>						
Signaling Rate, Each Lane	TP4	53.125 ± 100 ppm			GBd	

Parameter	Symbol	Min	Typ.	Max	Unit	Note
Differential Peak-to-Peak Output Voltage Short Mode	TP4			600	mV	
Long Mode				845		
AC Common Mode Output Voltage, RMS Low-Frequency, VCMLF	TP4			32	mV	
Full-Band, VCMLF				80		
Differential Termination Mismatch	TP4			10	%	
Vertical Eye Closure, VEC	TP4			12	dB	
Eye Height	TP4	15			mV	
Common-Mode to Differential Mode Output Return Loss	TP4			IEEE802.3ck Equation 120G-1		dB
Effective Output Return Loss	TP4	8.5			dB	
Output Transition Time (20% to 80%)	TP4	8.5			ps	
DC Common-Mode Output Voltage	TP4	-350		2850	mV	

## Optical Characteristics

Parameter	Symbol	Min	Typ.	Max	Units	Notes
Wavelength	$\lambda$	1304.5	1310	1317.5	nm	
<b>Transmitter</b>						
Data Rate, Each Lane			53.125 $\pm$ 100 ppm		GBd	
Modulation Format			PAM4			
Side-Mode Suppression Ratio	SMSR	30			dB	
Average Launch Power, Each Lane	$P_{AVG}$	-2.9		4	dBm	
Outer Optical Modulation Amplitude ( $OMA_{outer}$ ), Each Lane	$P_{OMA}$	-0.8		4.2	dBm	1
Launch Power in $OMA_{outer}$ Minus TDECQ, Each Lane		-2.2			dBm	
Transmitter and Dispersion Eye Closure for PAM4 (TDECQ), Each Lane	TDECQ			3.4	dB	
Extinction Ratio	ER	3.5			dB	
$RIN_{21.4OMA}$	RIN			-136	dB/Hz	
Optical Return Loss Tolerance	TOL			21.4	dB	
Transmitter Reflectance	$R_T$			-26	dB	
Average Launch Power of OFF Transmitter, each Lane	$P_{off}$			-15	dBm	
<b>Receiver</b>						
Data Rate, Each Lane			53.125 $\pm$ 100 ppm		GBd	
Modulation Format			PAM4			
Damage Threshold, Each Lane	$TH_d$	5			dBm	3
Average Receive Power, Each Lane		-5.9		4	dBm	4
Receive Power ( $OMA_{outer}$ ), each Lane				4.2	dBm	
Receiver Sensitivity ( $OMA_{outer}$ ), Each Lane	SEN			Equation (1)	dBm	5

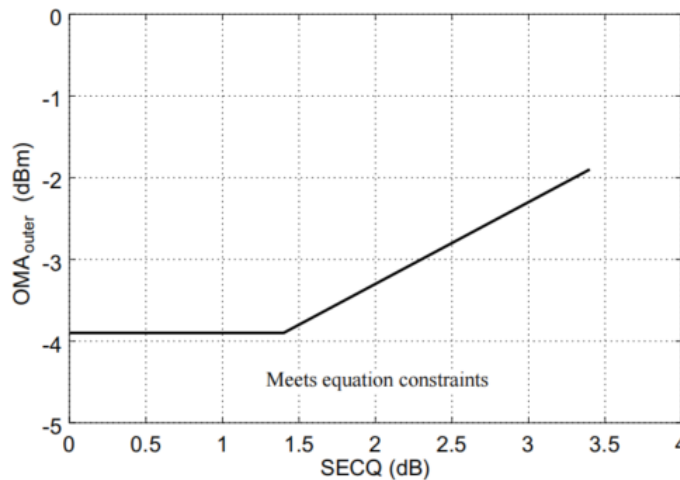


Parameter	Symbol	Min	Typ.	Max	Unit	Note
Stressed Receiver Sensitivity (OMA <sub>outer</sub> ), Each Lane	SRS			-1.9	dBm	6
Receiver Reflectance	R <sub>R</sub>			-26	dB	
LOS Assert	LOSA	-15		-9.9	dBm	
LOS De-assert	LOSD			-6.9	dBm	
LOS Hysteresis	LOSH	0.5			dB	
<b>Conditions of Stress Receiver Sensitivity Test (Note 7)</b>						
Stressed Eye Closure for PAM4 (SECQ), Lane under Test			3.4		dB	
OMA <sub>outer</sub> 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. The values for OMA<sub>outer</sub> (min) vary with TDECQ. Below picture illustrates this along with the values for OMA<sub>outer</sub>(max).
3. 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.
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. Receiver sensitivity (OMA<sub>outer</sub>) is informative and is defined for a transmitter with a value of SECQ up to 3.4dB. Receiver sensitivity should meet Equation (1), which is illustrated in below picture.  

$$RS = \max(-3.9, SECQ - 5.3) \text{ dBm}$$
 (1) Where  
 RS is the receiver sensitivity, and TECQ is the TECQ of the transmitter used to measure the receiver sensitivity.
6. Measured with conformance test signal at TP3 for the BER equal to  $2.4 \times 10^{-4}$ .
7. These test conditions are for measuring stressed receiver sensitivity. They are not characteristics of the receiver.



## Diagnostic Characteristics

The following digital diagnostic characteristics are defined over the normal operating conditions unless otherwise specified.

Parameter	Symbol	Min	Max	Units	Notes
Temperature Monitor Absolute Error	DMI_Temp	-3	3	°C	Over operating temperature range
Supply Voltage Monitor absolute error	DMI_VCC	-0.1	0.1	V	Over full operating range
Channel RX Power Monitor Absolute Error	DMI_RX_Ch	-2	2	dB	1
Channel Bias Current Monitor	DMI_Ibias_Ch	-10%	10%	mA	
Channel TX Power Monitor Absolute Error	DMI_TX_Ch	-2	2	dB	1

## Ordering Information

### Product Name

Q112-400G-DR4-05

### Product Description

QSFP112 400GBASE-DR4 PAM4 1310nm SMF 500m Optical Transceiver Module, MPO12 DOM, Flat Top

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