

**Alpha Bridge  
AQSFP-DD-DR4  
Datasheet**

## Features

- QSFP-DD MSA compliant
- Parallel 4 Optical Lanes
- IEEE 802.3bs 400GBASE-DR4 Specification compliant
- Up to 500m transmission on single mode fiber (SMF) with FEC
- 8x53.125Gb/s electrical interface (400GAUI-8)
- Data Rate 106.25Gbps (PAM4) per channel
- Maximum power consumption 10.5W
- MPO-12 connector
- Operating case temperature: 0°C~70°C
- RoHS compliant.

## Applications

- 400G Ethernet
- Infini interconnects
- Datacenter Enterprise networking

## Description

This product is a 400Gb/s Quad Small Form Factor Pluggable-double density (QSFP-DD) optical module designed for 500m optical communication applications. The module converts 8 channels of 50Gb/s (PAM4) electrical input 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 8 channels of 50Gb/s (PAM4) electrical output data.

An optical fiber cable with an MTP/MPO-12 connector can be plugged into the QSFP-DD 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 QSFP-DD MSA-compliant edge type connector.

The product is designed with form factor, optical/electrical connection and digital diagnostic interface according to the QSFP-DD 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	
Supply Voltage	$V_{cc}$	-0.5	3.6	V	
Case Operating Temperature	$T_{op}$	0	70	°C	
Humidity (non-condensing)	$Rh$	0	85	%	
Damage Threshold, each Lane	$THd$	5		dBm	

## Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Units
Operating Case Temperature	$T_{ca}$	0		70	°C
Supply Voltage	$V_{cc}$	3.135	3.3	3.465	V
Data Rate, each Lane	$fd$		26.5625		GBd
Data Rate Accuracy		-100		100	ppm
Pre-FEC Bit Error Ration				$2.4 \times 10^{-4}$	
Post-FEC Bit Error Ration				$1 \times 10^{-12}$	
Link Distance	$D$	2		500	M

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

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.

**Optical Characteristics**

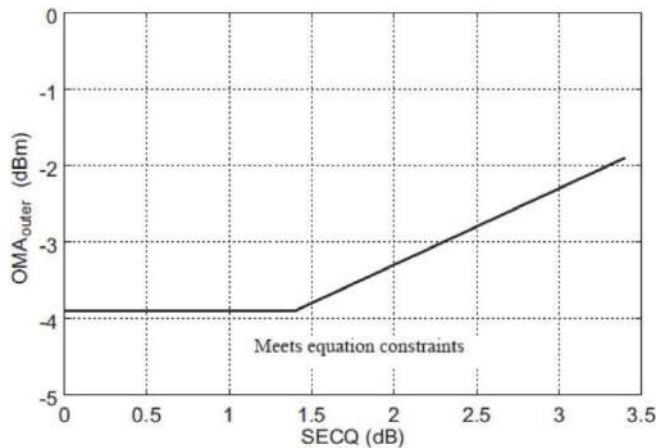
Parameter	Symbol	Min.	Typ.	Max.	Units	Note
Center Wavelength	$\lambda_c$	1304.5	1310	1317.5	nm	
<b>Transmitter</b>						
Data Rate, each Lane		53.125 ± 100ppm			GBd	
Modulation Format			PAM4			
Side-mode Suppression Ratio	<i>SMSR</i>	30			dB	
Average Launch Power, each Lane	<i>P<sub>AVG</sub></i>	-2.9		4	dBm	1
Optical Modulation Amplitude						
(OMA <sub>outer</sub> ), each Lane	<i>P<sub>OMA</sub></i>	-0.8		4.2	dBm	2
Launch Power in OMA <sub>outer</sub> minus		-2.2			dB	For ER ≥ 5dB
TDECQ, each Lane		-1.9			dB	For ER ≤ 5dB
Transmitter and Dispersion Eye Closure						
for PAM4, each Lane	<i>TDECQ</i>			3.4	dB	
Extinction Ratio	<i>ER</i>	3.5			dB	
RIN <sub>21.4</sub> OMA	<i>RIN</i>			-136	dB/Hz	
Optical Return Loss Tolerance	<i>TOL</i>			21.4	dB	
Transmitter Reflectance	<i>T<sub>R</sub></i>			-26	dB	
Transmitter Transition Time				17	ps	
Average Launch Power of OFF						
Transmitter, each Lane	<i>P<sub>off</sub></i>			-15	dBm	
<b>Receiver</b>						
Damage Threshold, each Lane	<i>THd</i>	5			dBm	4
Average receiver Power, each Lane		-5.9		4	dBm	5
Receiver Power (OMA <sub>outer</sub> ), each Lane				4.2	dBm	
Receiver Sensitivity (OMA <sub>outer</sub> ), each Lane			Equation			
	<i>SEN</i>		-1		dBm	6
Stressed Receiver Sensitivity in OMA						
outer, each Lane	<i>SRS</i>			-1.9	dBm	7
Receiver Reflectance	<i>R<sub>R</sub></i>			-26	dB	
LOS Assert	<i>LOSA</i>	-15			dBm	
LOS De-assert	<i>LOSD</i>			-8.9	dBm	
LOS Hysteresis						

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	
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 compliant.
2. Even if the TDECQ < 1.4dB for an extinction ratio of ≥5dB or TDECQ < 1.1dB for an extinction ratio of < 5dB, the OMA<sub>outer</sub> (min) must exceed the minimum value specified here.
3. C<sub>eq</sub> is a coefficient defined in IEEE Std 802.3-2018 clause 121.8.5.3 which accounts for reference equalizer noise enhancement.
4. Average receiver 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 (OMA<sub>outer</sub>), each lane (max) is informative and is defined for a transmitter with a value of SECQ up to 3.4dB. 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  
 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<sup>-4</sup>
8. These test conditions are for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

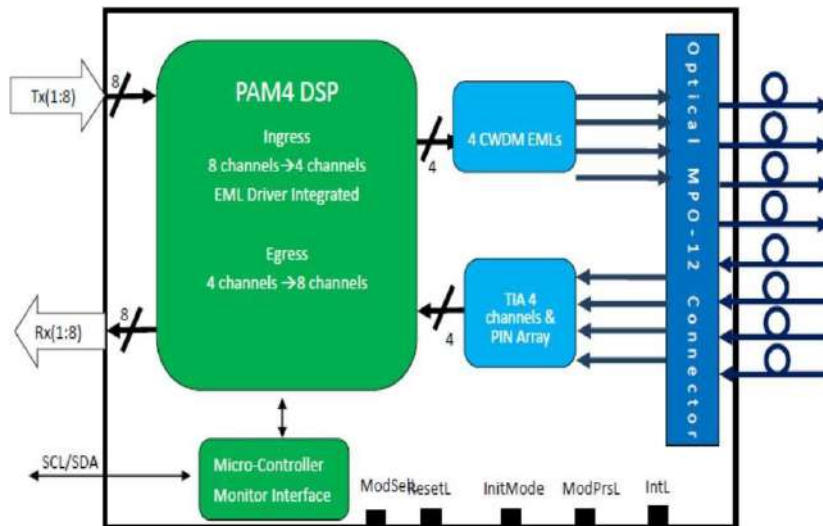


**Electronical Characteristics**

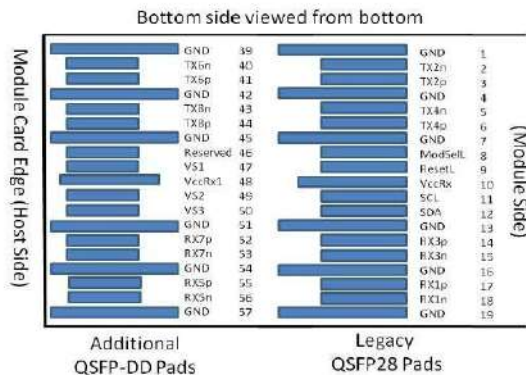
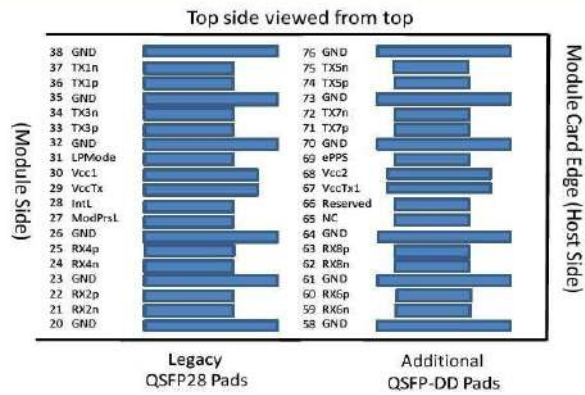
Parameter	Symbol	Min.	Typ.	Max.	Units	Note
Power Consumption				10.5	W	
Supply Current			I <sub>cc</sub>	3.18	A	
Transmitter (each Lane)						
Signaling Rate, each Lane	TP1	26.5625 ± 100 ppm			GBd	
Differential pk-pk Input voltage Tolerance	TP1a	900			mVpp	1
Differential Termination Mismatch	TP1			10	%	
Differential Input Return Loss	TP1	IEEE 802.3- 2015 Equation -(83E-5)			Db	
Differential to Common Mode Input Return Loss	TP1	IEEE 802.3- 2015 Equation -(83E-6)			Db	
Module Stressed Input Test	TP1a	See IEEE 802.3bs 120E.3.4.1		2		

Single-ended Voltage Tolerance Range (Min)	TP1a	-0.4 to 3.3			V	
DC Common Mode Input Voltage	TP1	-350		2850	mV	3
<b>Receiver (each Lane)</b>						
Differential Peak to Peak output voltage	TP4		900		mVpp	
AC Common Mode Output Voltage, RMS	TP4		17.5		mV	
Differential Termination Mismatch	TP4		10		%	
Differential Output Return Loss	TP4	IEEE 802.3- 2015 Equation (83E-2)				
Common to Differential Mode Conversion Return	TP4	IEEE 802.3-2015 Equation (83E-3)				
Transition Time, 20% to 80%	TP4	9.5			Ps	
Near-end Eye Symmetry Mask Width (ESMW)	TP4		0.265		UI	
Near-end Eye Height, Differential	TP4	70			mV	
Far-end Eye Symmetry Mask Width (ESMW)	TP4		0.2		UI	
Far-end Eye Height, Differential	TP4	30			mV	
Far-end Pre-cursor ISI Ratio	TP4	-4.5		2.5	%	
Common Mode Output Voltage (Vcm)	TP4	-350		2850	mV	3

**Block Diagram of Transceiver**



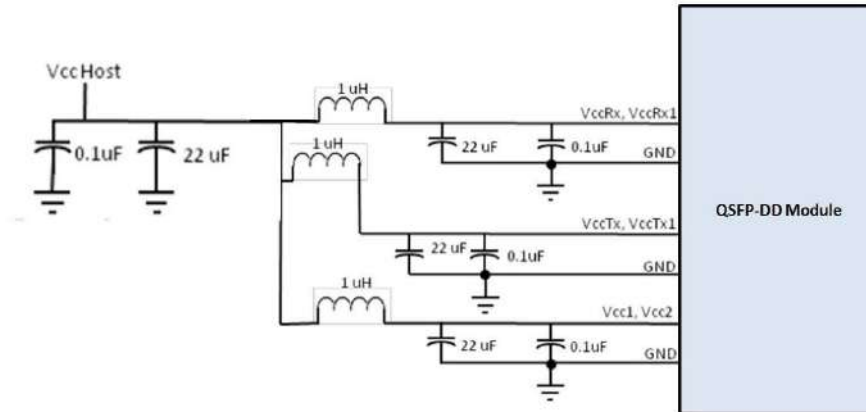
**Pin Assignment and Description**



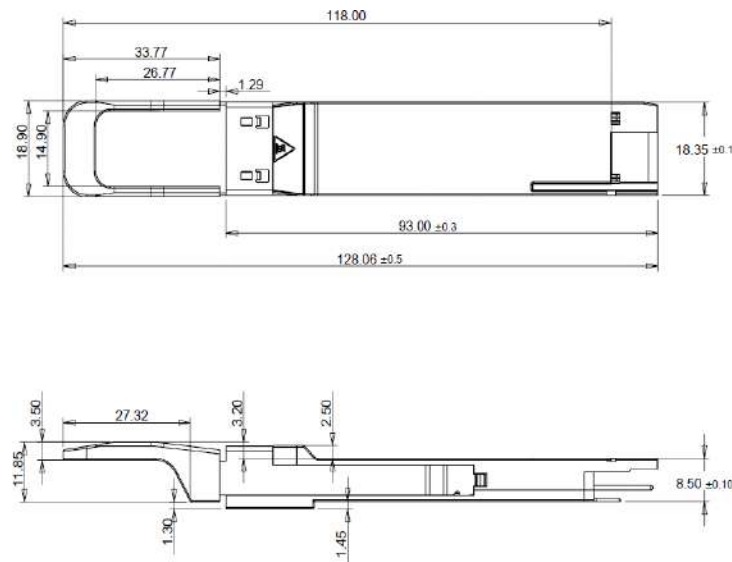
PIN	Logic	Symbol	Name / Description	Note
1		GND	Ground	
2	CML-I	Tx2n	Transmitter inverted data input	
3	CML-I	Tx2p	Transmitter non-inverted data input	
4		GND	Ground	
5	CML-I	Tx4n	Transmitter inverted data input	
6	CML-I	Tx4p	Transmitter non-inverted data input	
7		GND	Ground	
8	LVTTL-I	MoDSelL	Module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

27	LVTTL-O	ModPrsL	Module Present
28	LVTTL-O	IntL	Interrupt
29		VccTx	+3.3v Power supply transmitter
30		Vcc1	+3.3v Power supply
31	LVTTL-I	LPMode	Low Power Mode
32		GND	Ground
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input
34	CML-I	Tx3n	Transmitter Inverted Data Input
35		GND	Ground
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input
37	CML-I	Tx1n	Transmitter Inverted Data Input
38		GND	Ground
39		GND	Ground
40	CML-I	Tx6n	Transmitter Inverted Data Input
41	CML-I	Tx6p	Transmitter Non-Inverted Data Input
42		GND	Ground
43	CML-I	Tx8n	Transmitter Inverted Data Input
44	CML-I	Tx8p	Transmitter Non-Inverted Data Input
45		GND	Ground
46		Reserved	For future use
47		VS1	Module Vendor Specific 1
48		VccRx1	3.3V Power Supply
49		VS2	Module Vendor Specific 2
50		VS3	Module Vendor Specific 3
51		GND	Ground
52	CML-O	Rx7p-	Receiver Non-Inverted Data Output
53	CML-O	Rx7n	Receiver Inverted Data Output
54		GND	Ground
55	CML-O	Rx5p-	Receiver Non-Inverted Data Output
56	CML-O	Rx5n	Receiver Inverted Data Output
57		GND	Ground
58		GND	Ground
59	CML-O	Rx6n-	Receiver Inverted Data Output
60	CML-O	Rx6p	Receiver Non-Inverted Data Output
61		GND	Ground
62	CML-O	Rx8n	Receiver Inverted Data Output
63	CML-O	Rx8p	Receiver Non-Inverted Data Output
64		GND	Ground
65		NC	No connect
66		Reserved	For future use
67		VccTx1	3.3V Power Supply
68		Vcc2	3.3V Power Supply
69		Reserved	For Future Use
70		GND	Ground
71	CML-I	Tx7p	Transmitter Non-Inverted Data Input
72	CML-I	Tx7n	Transmitter Inverted Data Input
73		GND	Ground
74	CML-I	Tx5p	Transmitter Non-Inverted Data Input
75	CML-I	Tx5n	Transmitter Inverted Data Input
76		GND	Ground

**Recommended Power Supply Filter**


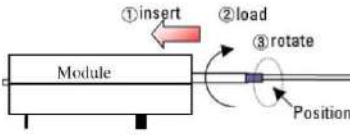


**Dimensions**



**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.

<p><b>Cleaning of patch-cord</b></p> 	<p><b>Cleaning of fiber stub</b></p>  <ol style="list-style-type: none"> <li><b>1. Insert</b> Ensure that stick is held straight when inserting into sleeve.</li> <li><b>2. Load</b> Apply sufficient pressure (approx 600-700g) to ensure ferrule a little depressed in sleeve.</li> <li><b>3. Rotate</b> Rotate stick clockwise 4-5 times, while ensuring direct contact with ferrule end-face is maintained.</li> </ol> <p><i>Notice: Number of possible wipes: Maintenance (repair) ~1 use / piece Equipment construction: 4 uses / piece (max.)</i></p>
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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>Wavelength</i>	<i>Temperature</i>
QSFP-DD 400G DR4	OPDY-SX5-13-CB	500m	1310nm	0°C to 70°C

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

