

## 400G QSFP-DD LR4 Optical Transceiver

### P/N: AE-QSFPDD-LR4

This product is a 400Gb/s QSFP-DD optical module designed for 10km optical communication applications. The module converts 8 channels of 50Gb/s (PAM4) electrical input data to 4 channels of CWDM optical signals and multiplexes them into a single channel for 400Gb/s optical transmission.

on the receiver side, the module optically de-multiplexes a 400Gb/s optical input into 4 channels of CWDM optical signals and converts them to 8 channels of 50Gb/s (PAM4) electrical output data.

The central wavelengths of the 4 CWDM channels are 1271, 1291, 1311 and 1331 nm as members of the CWDM wavelength grid defined in ITU-T G.694.2.

Host FEC is required to support up to 10km fiber transmission.

### Features

- Compliant with QSFP-DD MSA
- Compliant with 100G Lambda MSA 400G-LR4 Specification compliant
- Compliant with CMIS5.0
- Compliant with IEEE Std 802.3bs
- 8x53.125Gb/s electrical interface (400GAUI-8)
- Cooled EML laser with CWDM wavelength
- Up to 10km transmission on single mode fiber (SMF) with FEC
- Single +3.3V power supply
- Case temperature range: 0 ~ +70°C
- Maximum power consumption 12W
- Duplex LC connector
- RoHS complaint

### Applications

- 400G BASE-LR4 Ethernet
- Data Center Interconnect
- Enterprise Networking

## 1. Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
Storage Temperature Range	T <sub>STG</sub>	-40	+85	°C
Supply Voltage	V <sub>CC</sub>	0	4	V
Relative Humidity	RH	10% to 90% Non-condensing		

## 2. Operating Conditions

Parameter	Symbol	Min	Max	Unit
Case Temperature-Operating	T <sub>CASE</sub>	0	70	°C
Supply Voltage	V <sub>CC</sub>	3.14	3.46	V
Power Consumption	P <sub>DISS</sub>		12	W
Pre-FEC Bit Error Ratio			2.4x10 <sup>-4</sup>	
Link Distance	2		10,000	M

### 3. Optical Characteristics

Transmitter Parameter	Lane	Min	Typical	Max	Units
Lane Wavelength Range	Lane 0	1264.5	1271	1277.5	nm
	Lane 1	1284.5	1291	1297.5	nm
	Lane 2	1304.5	1311	1317.5	nm
	Lane 3	1324.5	1331	1337.5	nm
Signal rate per lane			53.125		GBd
Average launch Power per lane		-2.7		5.1	dBm
Total Average launch power				11.1	dBm
Outer Optical Modulation Amplitude (OMA <sub>outer</sub> ), each lane for TDECQ<1.4 dB for 1.4dB<=TDECQ<=3.9dB		0.3 -1.1+ TDECQ		4.4	dBm
Difference in launch power between any two lanes (OMA <sub>outer</sub> )				4	dB
Average Launch Power per Lane @ TX Off State				-16	dBm
Transmitter Eye Closure for PAM4(TECQ), each Lane				3.9	dB
Transmitter and dispersion Eye Closure for PAM4(TDECQ), each Lane				3.9	dB
TDECQ – TECQ				2.5	dB
Extinction Ratio		3.5			dB
Relative Intensity Noise (OMA)				-136	dB/Hz
Side-Mode Suppression Ration (SMSR)		30			dB
Optical Return Loss Tolerance				15.6	dB
Transmitter Reflectance				-26	dB
Transmitter over/under-shoot				25	%
Transmitter peak-to-peak power				5.2	dBm
Transmitter transition time				17	ps

### Receiver Optical Specifications

Receiver Parameter	Lane	Min	Typical	Max	Units
Lane Wavelength Range	Lane 0	1264.5	1271	1277.5	nm
	Lane 1	1284.5	1291	1297.5	nm
	Lane 2	1304.5	1311	1317.5	nm
	Lane 3	1324.5	1331	1337.5	nm
Signal rate per lane			53.125		GBd
Damage Threshold		6.1			dBm
Average Receive Power, each lane		-9		5.1	dBm
Receiver Power, each lane (OMA)				4.4	dBm
Receiver Reflectance				-26	dB
Difference in receive Power between any Two Lanes(OMA <sub>outer</sub> )				4.3	dBm
Receiver Sensitivity each lane (OMA <sub>outer</sub> ) for TECQ<1.4dB for 1.4dB<=TECQ<=3.9dB				-6.8 -8.2 +TECQ	dBm
Stressed Receiver Sensitivity (OMA <sub>outer</sub> ), each				-4.3	dBm
Stressed Conditions for Stress Receiver Sensitivity					
Stressed Eye Closure for PAM4 (SECQ),Lane under Test			3.9		dB
OMA <sub>outer</sub> of each Aggressor Lane			-0.4		dBm

#### 4. Electrical Characteristics

Parameter	Min	Typical	Max	Unit	Notes
<b>Receiver electrical output characteristics at TP4</b>					
Signaling rate per lane		26.5625		GBd	
AC common-mode output voltage(RMS)		-	17.5	mV	
Differential peak-to-peak output voltage			900	mV	
Near-end ESMW (Eye symmetry mask width)		0.265		UI	
Near-end Eye height, differential	70			mV	
Near-end vertical eye closure			7.5	dB	
Far-end ESMW (Eye symmetry mask width)		0.20		UI	
Far-end Eye height, differential	30			mV	
Far-end vertical eye closure			7.5	dB	
Far-end pre-cursor ISI ratio	-4.5		2.5	%	
Common mode to differential conversion return loss	802.3 Equation(83E-3)			dB	
Differential output return loss	802.3 Equation(83E-2)			dB	
Differential termination mismatch			10	%	
Transition time (min, 20% to 80%)		9.5		ps	
DC common mode voltage	-350		2850	mV	
<b>Transmitter electrical input characteristics at TP1</b>					
Signaling rate, per lane		26.5625		GBd	
Differential peak-to-peak input voltage tolerance	900			mV	
Differential input return loss	802.3 Equation(83E-5)				
Differential to common mode input return loss	802.3 Equation(83E-6)			mV	
AC common-mode output voltage(RMS)			17.5	mV	
Single-ended voltage tolerance range	-0.4		3.3	V	
Module stressed input	802.3 120E.3.4.1			UI	
Differential termination mismatch			10	%	
DC common mode voltage	-350			mV	

## 5. Receiver Output Power Thresholds for Loss of Signal(LOS)

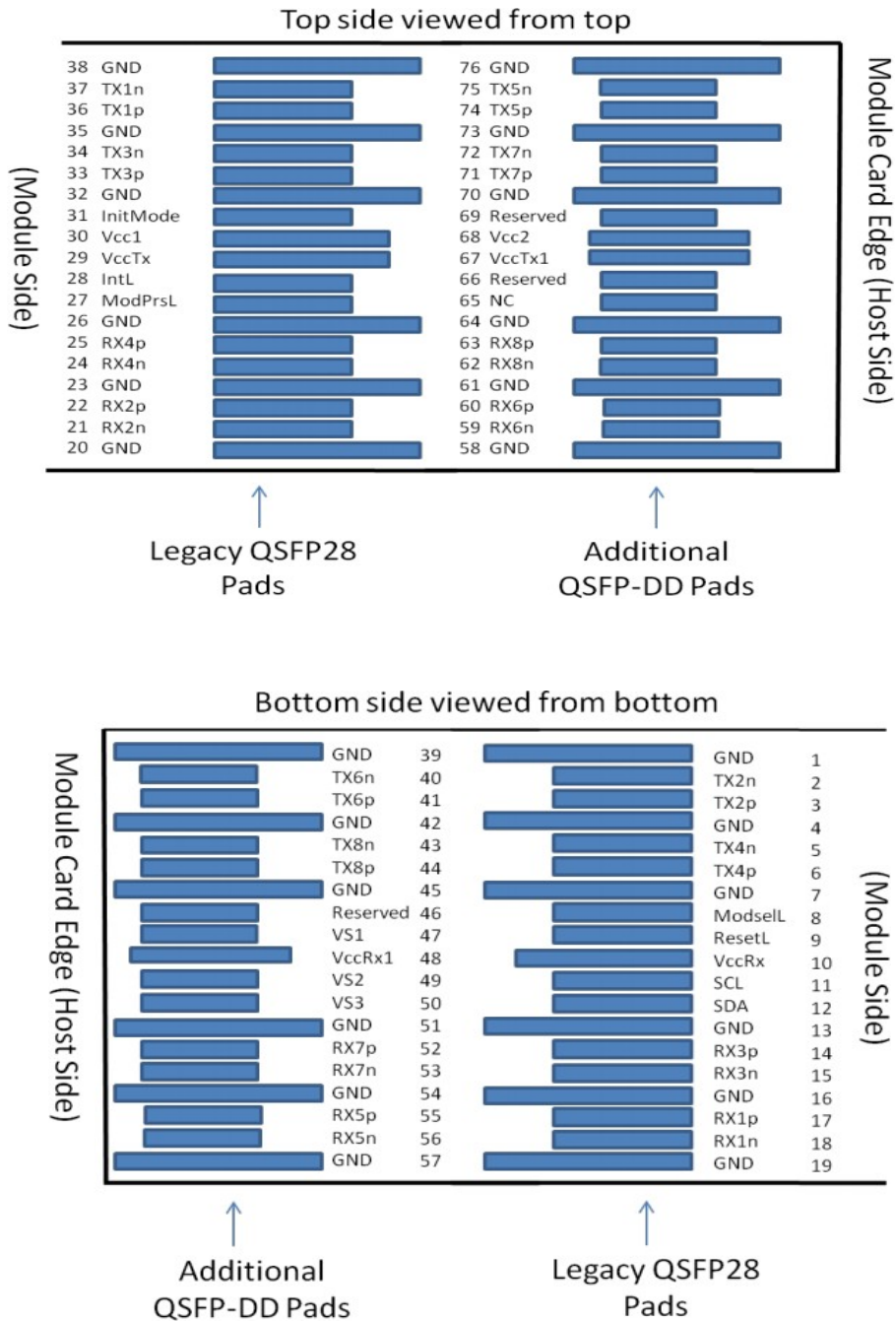
Parameter	Min	Typical	Max	Unit
RX_LOS_Assert Min/Max	-20.0			dBm
RX_LOS_De-Assert Min/Max			-12.2	dBm
RX_LOS_Hysteresis	0.5			dB

## 6. Digital Diagnostic Monitoring Specifications

Parameters	Unit	Specification
Temperature Monitor absolute error	°C	±3
Supply Voltage Monitor absolute error	%	±5
I_bias Monitor absolute error	%	±10
Received Power (Rx) Monitor absolute error	dB	±3.0
Transmit Power (Tx) Monitor absolute error	dB	±3.0

### 7. QSFP-DD Edge Connector and Pinout Description

The electrical pinout of the QSFP-DD module is shown in Figure 1 below.



**Figure 1. QSFP-DD pad assignment top view**

Pin No.	Symbol	Description	Note
1	GND	Ground	1
2	Tx2n	Transmitter Inverted Data Input	
3	Tx2p	Transmitter Non-Inverted Data output	
4	GND	Ground	1
5	Tx4n	Transmitter Inverted Data Input	
6	Tx4p	Transmitter Non-Inverted Data output	
7	GND	Ground	1
8	ModSelL	Module Select	
9	ResetL	Module Reset	
10	VccRx	3.3V Power Supply Receiver	2
11	SCL	2-Wire serial Interface Clock	
12	SDA	2-Wire serial Interface Data	
13	GND	Ground	1
14	Rx3p	Receiver Non-Inverted Data Output	
15	Rx3n	Receiver Inverted Data Output	
16	GND	Ground	1
17	Rx1p	Receiver Non-Inverted Data Output	
18	Rx1n	Receiver Inverted Data Output	
19	GND	Ground	1
20	GND	Ground	1
21	Rx2n	Receiver Inverted Data Output	
22	Rx2p	Receiver Non-Inverted Data Output	
23	GND	Ground	1
24	Rx4n	Receiver Inverted Data Output	
25	Rx4p	Receiver Non-Inverted Data Output	
26	GND	Ground	1
27	ModPrsL	Module Present	
28	IntL	Interrupt	
29	VccTx	3.3V power supply transmitter	2
30	Vcc1	3.3V power supply	2
31	Init Mode	Initialization mode	
32	GND	Ground	1
33	Tx3p	Transmitter Non-Inverted Data Input	
34	Tx3n	Transmitter Inverted Data Output	
35	GND	Ground	1
36	Tx1p	Transmitter Non-Inverted Data Input	
37	Tx1n	Transmitter Inverted Data Output	
38	GND	Ground	1

39	GND	Ground	1
40	Tx6n	Transmitter Inverted Data Input	
41	Tx6p	Transmitter Non-Inverted Data output	
42	GND	Ground	1
43	Tx8n	Transmitter Inverted Data Input	
44	Tx8p	Transmitter Non-Inverted Data output	
45	GND	Ground	1
46	Reserved	For Future Use	3
47	VS1	Module Vendor Specific 1	3
48	VccRx1	3.3V Power Supply	2
49	VS2	Module Vendor Specific 2	3
50	VS3	Module Vendor Specific 3	3
51	GND	Ground	1
52	Rx7p	Receiver Non-Inverted Data Output	
53	Rx7n	Receiver Inverted Data Output	
54	GND	Ground	1
55	Rx5p	Receiver Non-Inverted Data Output	
56	Rx5n	Receiver Inverted Data Output	
57	GND	Ground	1
58	GND	Ground	1
59	Rx6n	Receiver Inverted Data Output	
60	Rx6p	Receiver Non-Inverted Data Output	
61	GND	Ground	1
62	Rx8n	Receiver Inverted Data Output	
63	Rx8p	Receiver Non-Inverted Data Output	
64	GND	Ground	1
65	NC	No Connect	3
66	Reserved	For Future Use	3
67	VccTx1	3.3V power supply	2
68	Vcc2	3.3V power supply	2
69	Reserved	For Future Use	3
70	GND	Ground	1
71	Tx7p	Transmitter Non-Inverted Data Input	
72	Tx7n	Transmitter Inverted Data Output	
73	GND	Ground	1
74	Tx5p	Transmitter Non-Inverted Data Input	
75	Tx5n	Transmitter Inverted Data Output	
76	GND	Ground	1



### 8. Module Block Diagram

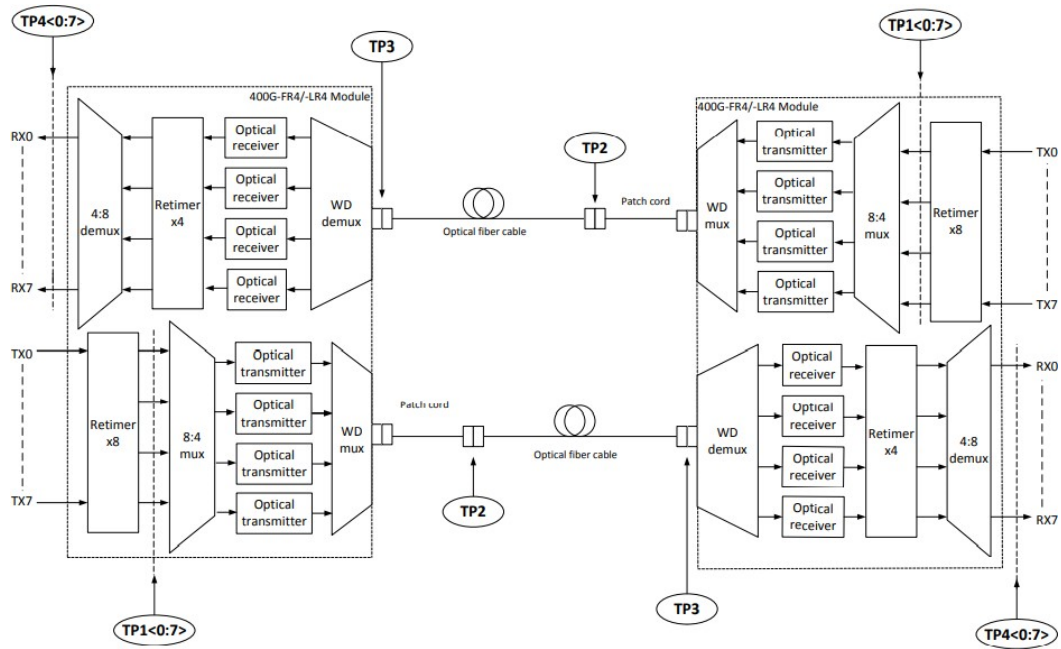


Figure 2. Module Block Diagram

### 9. Memory map

Compatible with CMIS 5.0

### 10. Mechanical Specifications

Unit: mm  
 Pull tab color: Blue

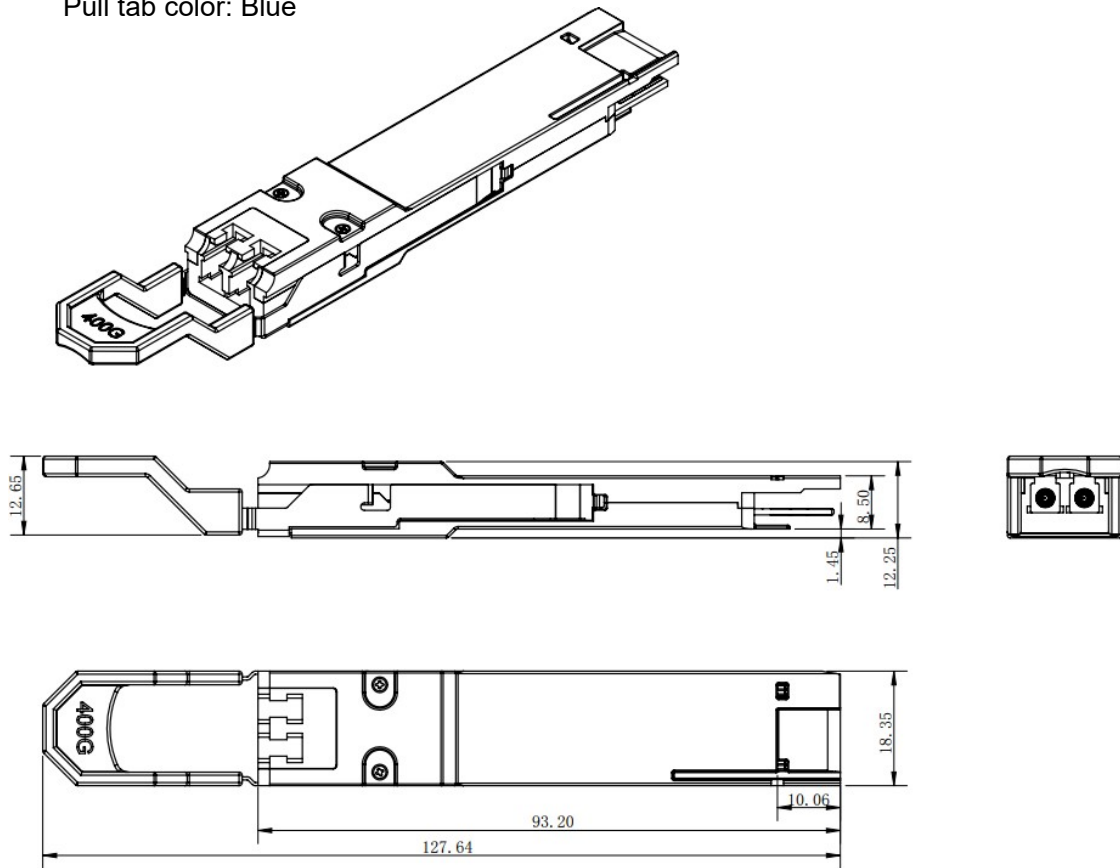


Figure 3. Mechanical Dimensions

### 13. Ordering information

Part Number	Description
AE-QSFPDD-LR4	400G QSFP-DD LR4 Optical Transceiver