



A 40G QSFP-DD DAC transceiver with a yellow handle. The label on the device includes the part number APQD31XC-DW04C, the model 400G-QSFP-DD, the type DR4 (8B10), the serial number W-APR17000000000, and the text "China 1 Laser Product" and "RoHS CE". A QR code is also present on the label.

400G QSFP-DD DR4 Silicon Photonics Transceiver

APQD31HCDMD4C

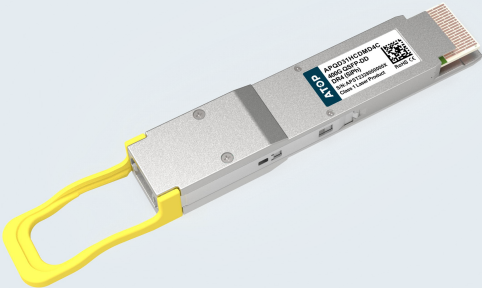
ATOP's APQD31HCDMD4C 400G QSFP-DD DR4 transceiver module is a cost-effective module with high Performance, which is designed for use in 400 Gigabit Ethernet links on up to 500m of single mode fiber. It combines 8x 26.5625GBd PAM4 electrical lanes into 4x 53.125GBd PAM4 optical channels in compliance with IEEE 400GBASE-DR4. This product is compliant with the QSFP-DD MSA.

Product Features

- ✓ Supports 425Gb/s aggregate bit rate
- ✓ Power dissipation <9W
- ✓ Commercial case temperature range of 0°C to 70°C
- ✓ Single 3.3V power supply
- ✓ Up to 500m transmission on single mode fiber
- ✓ 4x106.25G PAM4 optical interface
- ✓ 8x53.125Gb/s PAM4 electrical interface(400GAUI-8)
- ✓ MPO-12 receptacles
- ✓ I2C management interface
- ✓ RoHS compliant

Applications

- ✓ 400G Ethernet
- ✓ InfiniBand Interconnects
- ✓ Data Center and Enterprise Networking



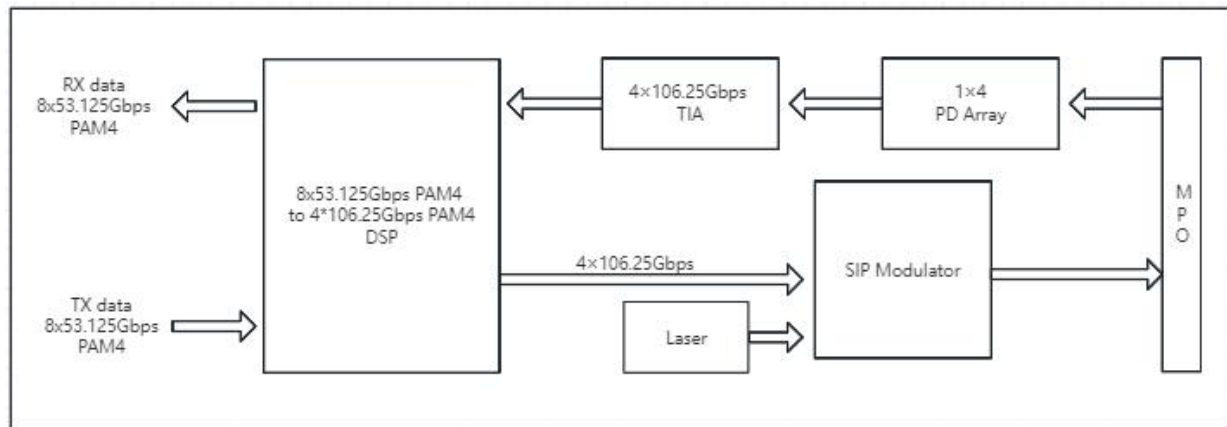
Product Selection

Part Number	Operating case temperature	DDMI
APQD31HCDMD4C	Commercial (0~70°C)	Yes

Regulatory Compliance

- QSFP-DD MSA
- IEEE 802.3bs
- RoHS compliance

Transceiver Block Diagram



Pin Descriptions

Pin	Logic	Symbol	Description	Plug	Notes
1		GND	Ground	1B	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	3B	
3	CML-I	Tx2p	Transmitter Non-Inverted Data Input	3B	
4		GND	Ground	1B	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	3B	
6	CML-I	Tx4p	Transmitter Non-Inverted Data Input	3B	
7		GND	Ground	1B	1
8	LVTTL-I	ModSelL	Module Select	3B	
9	LVTTL-I	ResetL	Module Reset	3B	
10		VccRx	+ 3.3V Power Supply Receiver	2B	2
11	LVC MOS-I/O	SCL	2-Wire Serial Interface Clock	3B	
12	LVC MOS-I/O	SDA	2-Wire Serial Interface Data	3B	
13		GND	Ground	1B	1
14	CML-O	Rx3p	Receiver Non-Inverted Data Output	3B	
15	CML-O	Rx3n	Receiver Inverted Data Output	3B	
16		GND	Ground	1B	1
17	CML-O	Rx1p	Receiver Non-Inverted Data Output	3B	
18	CML-O	Rx1n	Receiver Inverted Data Output	3B	
19		GND	Ground	1B	1
20		GND	Ground	1B	1
21	CML-O	Rx2n	Receiver Inverted Data Output	3B	
22	CML-O	Rx2p	Receiver Non-Inverted Data Output	3B	
23		GND	Ground	1B	1
24	CML-O	Rx4n	Receiver Inverted Data Output	3B	
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	3B	
26		GND	Ground	1B	1
27	LVTTL-O	Mod-PrsL	Module Present	3B	

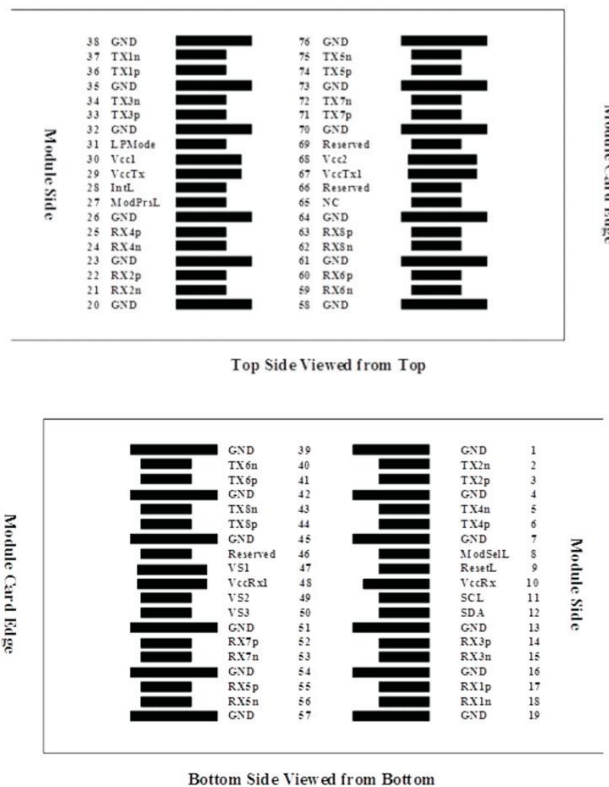
28	LVTTTL-O	IntL	Interrupt	3B	
29		VccTx	+3.3V Power supply transmitter	2B	2
30		Vcc1	+3.3V Power supply	2B	2
31	LVTTTL-I	LPMode	Low Power mode	3B	
32		GND	Ground	1B	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	3B	
34	CML-I	Tx3n	Transmitter Inverted Data Input	3B	
35		GND	Ground	1B	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	3B	
37	CML-I	Tx1n	Transmitter Inverted Data Input	3B	
38		GND	Ground	1B	1
39		GND	Ground	1A	1
40	CML-I	Tx6n	Transmitter Inverted Data Input	3A	
41	CML-I	Tx6p	Transmitter Non-Inverted Data Input	3A	
42		GND	Ground	1A	1
43	CML-I	Tx8n	Transmitter Inverted Data Input	3A	
44	CML-I	Tx8p	Transmitter Non-Inverted Data Input	3A	
45		GND	Ground	1A	1
46		Reserved	For future use	3A	3
47		Vs1	Module Vendor Specific 1	3A	3
48		VccRx1	+3.3V Power supply	2A	2
49		Vs2	Module Vendor Specific 2	3A	3
50		Vs3	Module Vendor Specific 3	3A	3
51		GND	Ground	1A	1
52	CML-O	Rx7p	Receiver Non-Inverted Data Output	3A	
53	CML-O	Rx7n	Receiver Inverted Data Output	3A	
54		GND	Ground	1A	1
55	CML-O	Rx5p	Receiver Non-Inverted Data Output	3A	
56	CML-O	Rx5n	Receiver Inverted Data Output	3A	
57		GND	Ground	1A	1
58		GND	Ground	1A	1
59	CML-O	Rx6n	Receiver Inverted Data Output	3A	
60	CML-O	Rx6p	Receiver Non-Inverted Data Output	3A	
61		GND	Ground	1A	1
62	CML-O	Rx8n	Receiver Inverted Data Output	3A	
63	CML-O	Rx8p	Receiver Non-Inverted Data Output	3A	
64		GND	Ground	1A	1
65		NC	No Connect	3A	3
66		Reserved	For future use	3A	3
67		VccTx1	+3.3V Power supply	2A	2
68		Vcc2	+3.3V Power supply	2A	2
69	LVTTTL-I	Reserved	Precision Time Protocol (PTP) reference clock input	3A	3

70		GND	Ground	1A	1
71	CML-I	Tx7p	Transmitter Non-Inverted Data Input	3A	
72	CML-I	Tx7n	Transmitter Inverted Data Input	3A	
73		GND	Ground	1A	1
74	CML-I	Tx5p	Transmitter Non-Inverted Data Input	3A	
75	CML-I	Tx5n	Transmitter Inverted Data Input	3A	
76		GND	Ground	1A	1

Notes:

1. QSFP-DD uses common ground (GND) for all signals and supply (power). All are common within the QSFP-DD 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, VccRx1, Vcc1, Vcc2, VccTx and VccTx1 shall be applied concurrently. Requirements defined for the host side of the Host Card Edge Connector are listed in Table. VccRx, VccRx1, Vcc1, Vcc2, VccTx and VccTx1 may be internally connected within the module in any combination. The connector Vcc pins are each rated for a maximum current of 1000mA.
3. All Vendor Specific, Reserved and No Connect pins may be terminated with 50 ohms to ground on the host. Pad 65 (No Connect) shall be left unconnected within the module. Vendor specific and Reserved pads shall have an impedance to GND that is greater than 10kOhms and less than 100pF.

Plug Sequence specifies the mating sequence of the host connector and module



Pin-out of Connector Block on Host Board

Absolute Maximum Ratings

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Supply Voltage	VCC	-0.3	3.3	3.6	V	
Storage Temperature	Tstg	-40		+85	°C	
Operating Relative Humidity	RH	5		85	%	Non-condensing

Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Case Operating Temperature	Tc	0		+70	°C	
Power Supply Voltage	Vcc	3.135	3.3	+3.465	V	
Supply Current	ICC			2.7	A	
Module Power Dissipation	P			9	W	
Link Distance		2		500	m	

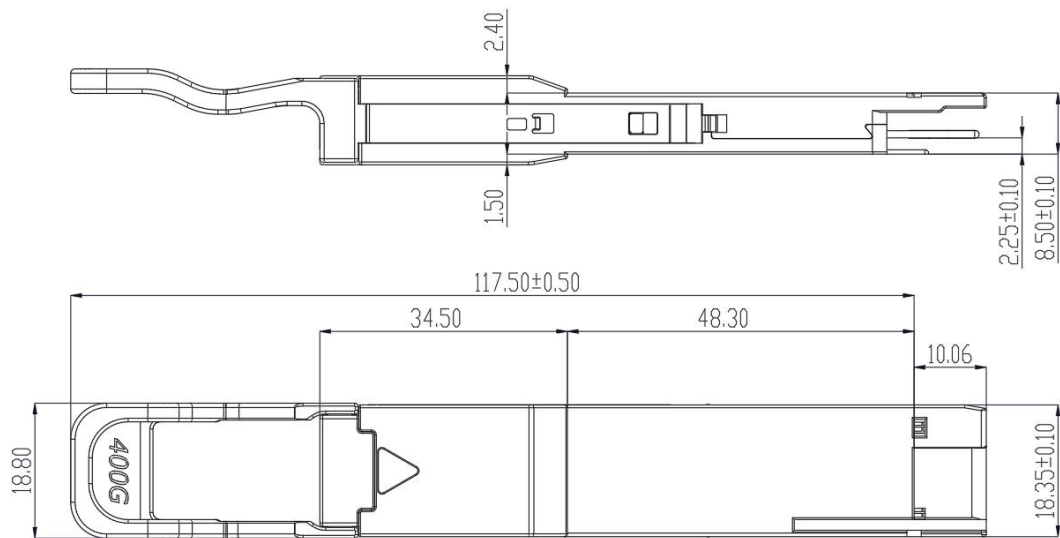
Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Notes
module output						
Signaling rate per lane (range)			26.5625±100ppm		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	
Far-end ESMW (Eye symmetry mask width)		0.2			UI	
Far-end Eye height, differential		30			mV	
Far-end precursor ISI ratio		-4.5		2.5	%	
Differential output return loss		Equation (83E-2)			dB	
Common to differential mode conversion return loss		Equation (83E-3)			dB	
Differential termination mismatch				10	%	
Transition time (20% to 80%)		9.5			ps	
DC common mode voltage		-350		2850	mV	
module input						
Signaling rate per lane (range)			26.5625±100ppm		GBd	
Differential pk-pk input voltage tolerance		900			mV	
Differential input return loss		Equation (83E-5)			dB	
Differential to common mode input return loss		Equation (83E-6)			dB	
Differential termination mismatch				10	%	
ESMW (Eye symmetry mask width)		0.22			UI	
Eye width		0.22			UI	
Applied pk-pk sinusoidal jitter			Table 120E-6		MHz, UI	
Eye height		32			mV	
Single-ended input voltage tolerance range		-0.4		3.3	V	
DC common mode voltage		-350		2850	mV	

Optical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Channel data rate			106.25		Gb/s	
Signaling rate			53.125±100ppm		GBd	PAM4
Transmitter						
Center Wavelength	λ	1304.5	1310	1317.5	nm	
Side-mode Suppression Ratio	SMRS	30			dB	
Average Optical Power, each lane	Pavg	-2.9		4	dBm	
Outer Optical Modulation Amplitude (OMA _{outer}), each lane		-0.8		4.2	dBm	
Launch power in OMA _{outer} minus TDECQ, each lane		-2.2			dBm	
Transmitter and dispersion eye closure for PAM4, each lane	TDECQ			3.4	dB	
Average Optical Output Power of Off Transmitter, each lane	P _{off}			-15	dBm	
Extinction Ratio, each lane	ER	3.5			dB	
RIN _{21.4OMA}				-136	dB/Hz	
Optical return loss tolerance				21.4	dB	
Transmitter reflectance				-26	dB	
Receiver						
Average receive power, each lane		-5.9		4.0	dBm	
Receive power (OMA _{outer}), each lane				4.2	dBm	
Receiver reflectance				-26	dB	
Receiver sensitivity (OMA _{outer}), each lane				-4.4	dBm	
Stressed receiver sensitivity(OMA _{outer}), each lane				-1.9	dBm	
LOS De-Assert	LOSD			-8.4	dBm	
LOS Assert	LOSA	-15			dBm	
Hysteresis		0.5			dB	
Conditions of Stressed Receiver Sensitivity						
Stressed eye closure for PAM4 (SECQ), lane under test		0.9		3.4	dB	
OMA _{outer} of each aggressor lane				4.2	dBm	

Mechanical Specifications



APQD31HCDMD4C

Digital Diagnostic Monitoring Interface

Five transceiver parameter values are monitored. The following table defines the Monitory parameter's accuracy.

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Temperature monitor absolute error	DMI_Temp	-3		3	°C	
Supply voltage monitor absolute error	DMI_VCC	-3		3	%	
Bias current monitor absolute error	DMI_I Bias	-10		10	%	
Tx power monitor absolute error	DMI_TX	-3		3	dB	
Rx power monitor absolute error	DMI_RX	-3		3	dB	



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