

## COL-QSFP-40G-xxxAOC/COL-4SFP-40G-xxxAOC 40G QSFP+ Active Optical Cables

### ◆ Features

- ◆ 4 channels full-duplex 850nm parallel active optical cable
- ◆ Transmission data rate up to 10.3Gbps per channel
- ◆ 4 channels 850nm VCSEL array
- ◆ 4 channels PIN photo-detector array
- ◆ SFF-8436 QSFP+ compliant
- ◆ Hot-pluggable electrical interface
- ◆ Differential AC-coupled high-speed data interface
- ◆ Up to 300m on OM3 MMF
- ◆ Low power consumption < 1.5W
- ◆ Operating case temperature range 0°C to +70°C
- ◆ 3.3V power supply voltage
- ◆ RoHS 6 compliant

### Applications

- ◆ IEEE 802.3ba 40GBASE-SR4
- ◆ InfiniBand SDR/DDR/QDR

### Description

The Coptolink 40G QSFP+ Active Optic Cables (AOCs) are direct-attach fiber assemblies with QSFP+ connectors, compliant with the QSFP MSA, 40G Ethernet IEEE 802.3ba 40GBASE-SR4, and InfiniBand SDR/DDR/QDR standards. They are suitable for short distances and offer a cost-effective solution to connect within racks and across adjacent racks. The 40G QSFP+ AOC is an assembly of 4 full-duplex lanes and each lane is capable of transmitting data at rates up to 10.3Gb/s, providing an aggregated rate of 41.2Gb/s. The length is up to 300 meters using OM3 MMF.

The 40G QSFP+ AOC is a kind of parallel transceiver optics assembly. VCSEL and PIN array package is key technique, through I<sup>2</sup>C system can contact with module.

## Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
Supply Voltage	Vcc	-0.3	3.6	V
Input Voltage	Vin	-0.3	+0.3	V
Storage Temperature	Tst	-20	85	°C
Case Operating Temperature	Top	0	70	°C
Humidity(non-condensing)	Rh	5	95	%

## Recommended Operating Conditions

Parameter	Symbol	Min	Typical	Max	Unit
Supply Voltage	Vcc	3.13	3.3	3.47	V
Operating Case temperature	Tca	0		70	°C
Data Rate Per Lane	fd	2.5	10.3	11.1	Gbps
Humidity	Rh	5		85	%
Power Dissipation	Pm			1.5	W
Fiber Bend Radius	Rb	3			cm

## Specifications

Parameter	Symbol	Min	Typical	Max	Unit
Differential input impedance	Zin	90	100	110	ohm
Differential Output impedance	Zout	90	100	110	ohm
Differential input voltage amplitude	$\Delta V_{in}$	300		1100	mVp-p
Differential output voltage amplitude	$\Delta V_{out}$	500		800	mVp-p
Skew	Sw			300	ps
Bit Error Rate	BR			E-12	
Input Logic Level High	VIH	2.0		VCC	V
Input Logic Level Low	VIL	0		0.8	V
Output Logic Level High	VOH	VCC-0.5		VCC	V
Output Logic Level Low	VOL	0		0.4	V

**Note:**

1. BER=10<sup>-12</sup>; PRBS 2<sup>31</sup>-1@10.3125Gbps.
2. Differential input voltage amplitude is measured between TxnP and TxnN
3. Differential output voltage amplitude is measured between RxNP and RxnN

## Optical Characteristics

Parameter	Symbol	Min	Typical	Max	Unit	Notes
<b>Transmitter</b>						
Centre Wavelength	$\lambda_c$	840	850	860	nm	-
RMS spectral width	$\Delta\lambda$	-	-	0.65	nm	-
Average launch power, each lane	Pout	-7.6	-	2.4	dBm	-
Difference in launch power between any two lanes (OMA)				4	dB	-
Extinction Ratio	ER	3	-	-	dB	-
Peak power, each lane				4	dBm	-
Transmitter and dispersion penalty (TDP), each lane	TDP			3.5	dB	-
Average launch power of OFF transmitter, each lane				-30	dBm	-
Eye Mask coordinates: X1, X2, X3, Y1, Y2, Y3		SPECIFICATION VALUES 0.23, 0.34, 0.43, 0.27, 0.35, 0.4				Hit Ratio = 5x10 <sup>-5</sup>
<b>Receiver</b>						
Centre Wavelength	$\lambda_c$	840	850	860	nm	-
Stressed receiver sensitivity in OMA, each lane				-5.4	dBm	1

Maximum Average power at receiver input, each lane				2.4	dBm	-
Receiver Reflectance				-12	dB	-
Peak power, each lane				4	dBm	-
LOS Assert		-30			dBm	-
LOS De-Assert – OMA				-7.5	dBm	-
LOS Hysteresis		0.5			dB	-

**Note:**

1. Measured with conformance test signal at TP3 for BER = 10e-12

## Pin Descriptions

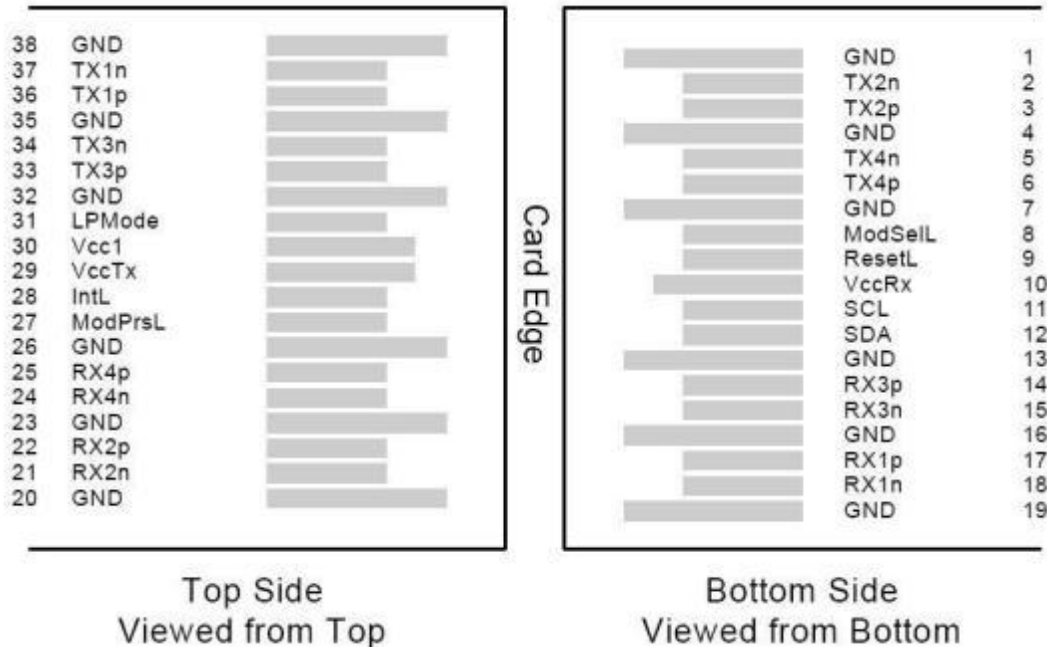
Pin	Logic	Symbol	Name/Description	Ref.
1		GND	Module Ground	1
2	CML-I	Tx2-	Transmitter inverted data input	
3	CML-I	Tx2+	Transmitter non-inverted data input	
4		GND	Module Ground	1
5	CML-I	Tx4-	Transmitter inverted data input	
6	CML-I	Tx4+	Transmitter non-inverted data input	
7		GND	Module Ground	1
8	LVTTL-I	MODSEIL	Module Select	2
9	LVTTL-I	ResetL	Module Reset	2
10		VCCR <sub>x</sub>	+3.3v Receiver Power Supply	
11	LVC <sub>MOS</sub> -I	SCL	2-wire Serial interface clock	2
12	LVC <sub>MOS</sub> -I/O	SDA	2-wire Serial interface data	2
13		GND	Module Ground	1
14	CML-O	RX3+	Receiver non-inverted data output	
15	CML-O	RX3-	Receiver inverted data output	
16		GND	Module Ground	1
17	CML-O	RX1+	Receiver non-inverted data output	
18	CML-O	RX1-	Receiver inverted data output	
19		GND	Module Ground	1
20		GND	Module Ground	1
21	CML-O	RX2-	Receiver inverted data output	
22	CML-O	RX2+	Receiver non-inverted data output	
23		GND	Module Ground	1

24	CML-O	RX4-	Receiver inverted data output	
25	CML-O	RX4+	Receiver non-inverted data output	
26		GND	Module Ground	1
27	LVTTTL-O	ModPrsL	Module Present, internal pulled down to GND	

28	LVTTTL-O	IntL	Interrupt output, should be pulled up on host board	2
29		VCCTx	+3.3v Transmitter Power Supply	
30		VCC1	+3.3v Power Supply	
31	LVTTTL-I	LPMode	Low Power Mode	2
32		GND	Module Ground	1
33	CML-I	Tx3+	Transmitter non-inverted data input	
34	CML-I	Tx3-	Transmitter inverted data input	
35		GND	Module Ground	1
36	CML-I	Tx1+	Transmitter non-inverted data input	
37	CML-I	Tx1-	Transmitter inverted data input	
38		GND	Module Ground	1

**Notes:**

1. Module circuit ground is isolated from module chassis ground within the module.
2. Open collector; should be pulled up with 4.7k – 10k ohms on host board to a voltage between 3.15V and 3.6V.



**Figure2. Electrical Pin-out Details**

## **ModSelL Pin**

The ModSelL is an input pin. When held low by the host, the module responds to 2-wire serial communication commands. The ModSelL allows the use of multiple QSFP modules on a single 2-wire interface bus. When the ModSelL is “High”, the module will not respond to any 2-wire interface communication from the host.

ModSelL has an internal pull-up in the module.

## **ResetL Pin**

Reset. LPMoDe\_Reset has an internal pull-up in the module. A low level on the ResetL pin for longer than the minimum pulse length ( $t_{Reset\_init}$ ) initiates a complete module reset, returning all user module settings to their default state. Module Reset Assert Time ( $t_{init}$ ) starts on the rising edge after the low level on the ResetL pin is released. During the execution of a reset ( $t_{init}$ ) the host shall disregard all status bits until the module indicates a completion of the reset interrupt. The module indicates this by posting an IntL signal with the Data\_Not\_Ready bit negated. Note that on power up (including hot insertion) the module will post this completion of reset interrupt without requiring a reset.

## **LPMoDe Pin**

Coptolink QSFP AOC operate in the low power mode (less than 1.5 W power consumption)

This pin active high will decrease power consumption to less than 1W.

## **ModPrsL Pin**

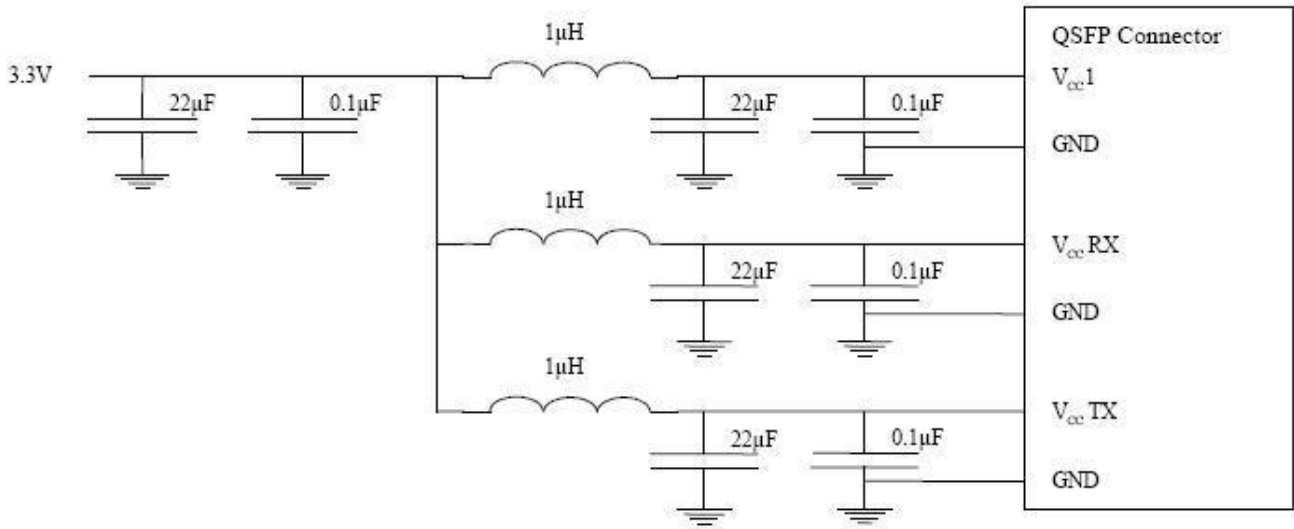
ModPrsL is pulled up to Vcc on the host board and grounded in the module. The ModPrsL is asserted “Low” when the module is inserted and deasserted “High” when the module is physically absent from the host connector.

## **IntL Pin**

IntL is an output pin. When “Low”, it indicates a possible module operational fault or a status critical to the host system. The host identifies the source of the interrupt by using the 2-wire serial interface. The IntL pin is an open collector output and must be pulled up to Vcc on the host board.

## **Power Supply Filtering**

The host board should use the power supply filtering shown in Figure3.



**Figure3. Host Board Power Supply Filtering**

**DIAGNOSTIC MONITORING INTERFACE (OPTIONAL)**

Digital diagnostics monitoring function is available on all Coptolink QSFP AOCs. A 2-wire serial interface provides user to contact with module.

The structure of the memory is shown in Figure 4. The memory space is arranged into a lower, single page, address space of 128 bytes and multiple upper address space pages. This structure permits timely access to addresses in the lower page, such as Interrupt Flags and Monitors. Less time critical time entries, such as serial ID information and threshold settings, are available with the Page Select function.

The interface address used is A0xh and is mainly used for time critical data like interrupt handling in order to enable a one-time-read for all data related to an interrupt situation. After an interrupt, IntL, has been asserted, the host can read out the flag field to determine the affected channel and type of flag.

**Timing for Soft Control and Status Functions**

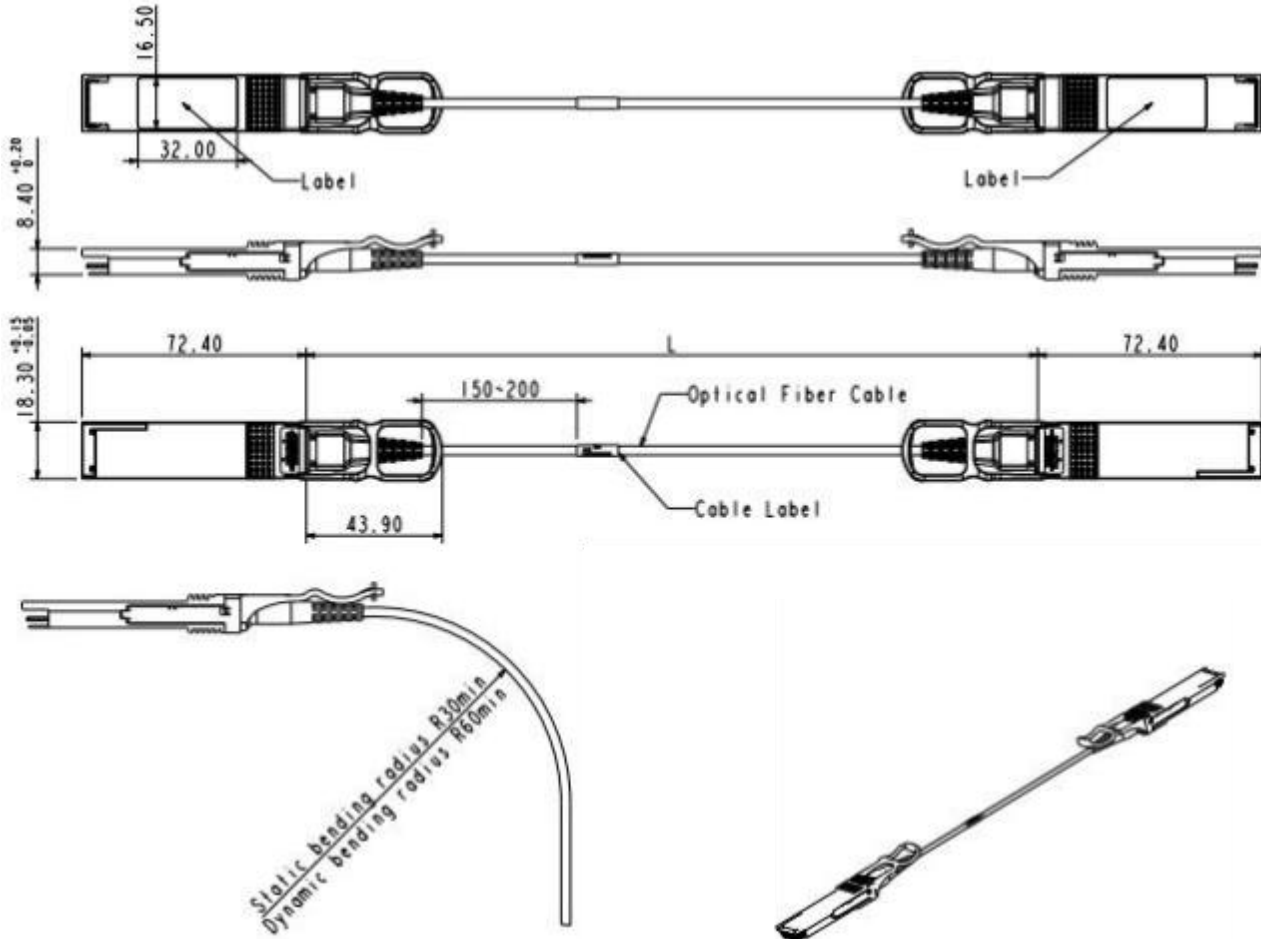
Parameter	Symbol	Max	Unit	Conditions
Initialization Time	t_init	2000	ms	Time from power on <sup>2</sup> , hot plug or rising edge of Reset until the module is fully functional <sup>3</sup> This time does not apply to non-Power Level 0 modules in the Low Power State
Reset Init Assert Time	t_reset_init	2	μs	A Reset is generated by a low level longer than the minimum reset pulse time present on the ResetL pin.
Serial Bus Hardware Ready Time	t_serial	2000	ms	Time from power on <sup>2</sup> until module responds to data transmission over the 2-wire serial bus
Monitor Data Ready Time	t_data	2000	ms	Time from power on <sup>2</sup> to data not ready, bit 0 of Byte 2, deasserted and IntL asserted
Reset Assert Time	t_reset	2000	ms	Time from rising edge on the ResetL pin until the module is fully functional <sup>3</sup>
LPMODE Assert Time	ton_LPMODE	100	μs	Time from assertion of LPMODE (Vin:LPMODE = Vih) until module power consumption enters lower Power Level 1
LPMODE Deassert Time	Toff_LPMODE	300	ms	Time for deassertion of LPMODE (Vin:LPMODE=Vil) until module is fully functional <sup>3,5</sup>
IntL Assert Time	ton_IntL	200	ms	Time from occurrence of condition triggering IntL until Vout: IntL = Vol
IntL Deassert Time	toff_IntL	500	μs	Time from clear on read <sup>4</sup> operation of associated flag until Vout: IntL = Voh. This includes deassert times for Rx LOS, Tx Fault and other flag bits
Rx LOS Assert Time	ton_los	100	ms	Time from Rx LOS state to Rx LOS bit set (value=1b) and IntL asserted
Tx Fault Assert Time	ton_Txfault	200	ms	Time from Tx Fault state to Tx Fault bit set (value=1b) and IntL asserted
Flag Assert Time	ton_flag	200	ms	Time from occurrence of condition triggering flag to associated flag bit set (value=1b) and IntL asserted
Mask Assert Time	ton_mask	100	ms	Time from mask bit set(value=1b) <sup>1</sup> until associated IntL assertion is inhibited
Mask Deassert Time	toff_mask	100	ms	Time from mask bit cleared (value=0b) <sup>1</sup> until associated IntL operation resumes
Application or Rate Select Change Time	t_ratesel	100	μs	Time from change of state of Application or Rate Select Bit <sup>1</sup> until transmitter or receiver bandwidth is in conformance with appropriate specification
Power over-ride or Power-set Assert Time	ton_Pdown	100	ms	Time from P_Down bit set (value=1b) <sup>1</sup> until module power consumption enters lower Power Level 1
Power over-ride or Power-set Deassert Time	toff_Pdown	300	ms	Time from P_Down bit cleared(value=0b) <sup>1</sup> until the module is fully functional <sup>3</sup>



**Note:**

1. Power on is defined as the instant when supply voltages reach and remain at or above the minimum specified value.
2. Fully functional is defined as IntL asserted due to data not ready bit, bit 0 byte 2 deasserted.
3. Measured from falling clock edge after stop bit of read transaction.
4. Measured from falling clock edge after stop bit of write transaction.

**Mechanical Dimensions**



**Mechanical Specifications**

## Ordering information

Part Number	Product Description
COL-QSFP-40G-XXXAOC	xxx-Representative distance, 1~150 Length in meters on OM3 MMF
COL-4SFP-40G-XXXAOC	xxx-Representative distance, 1~150 Length in meters on OM3 MMF
Further details are available from any Coptolink sales representative.	

**Note: You can be customized diameter and distance.**

## References

1. SFF-8436 QSFP+
2. Infiniband IB-4x-SX, IB-4x-DDR-SX, IB-4x-QDR-SX
3. Ethernet 40GBASE-SR4

## Important Notice

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