

## 40G QSFP+ to 4x10G SFP+ Active Optical Cables HTOC-QPA5-xx01MB

### **Feature**

- ◆ SFF-8436 QSFP+ compliant
- ◆ SFF-8431 SFP+ compliant
- ◆ Hot-pluggable electrical interface
- ◆ 850nm VCSEL transmitter
- ◆ PIN photo-detector receiver
- ◆ Up to 150m on OM4 MMF
- ◆ Low power consumption < 1.5W (QSFP+) < 1W (SFP+)
- ◆ Operating case temperature range 0°C to +70°C
- ◆ All-metal housing for superior EMI performance
- ◆ RoHS compliant (lead free)

### **Applications**

- ◆ IEEE 802.3ba 40GBASE-SR4
- ◆ IEEE 802.3ae 10GBASE-SR
- ◆ Servers, switches, storage and host card adapters

### **Standards**

- ◆ IEEE 802.3ba 40GBASE-SR4
- ◆ IEEE 802.3ae 10GBASE-SR
- ◆ SFF-8431 SFF-8436 SFF-8472
- ◆ ROHS

### **Description**

The Hirundo ' s HTOC-QPA5-xx01MB are 40G QSFP+ to 4x 10G SFP+ breakout Active Optical Cables (AOCs), compliant with the IEEE 802.3ba 40GBASE-SR4,IEEE 802.3ae 10GBASE-SR,SFF-8431 and SFF-8436 standards. The length is up to 100 meters using OM3 MMF. Digital diagnostics functions are available via an I2C interface, as specified by the QSFP+ MSA.

## 1. Ordering Information

**Table 1.1 Ordering Information**

Part No.	Specifications							
	Package	Date rate (Gbps)	Wavelength (nm)	Optical Power (dBm)	StressSensitivity OMA(dBm)	Temp (°C)	Reach (m)	Other
HTOC-QPA5-xx01MB <sup>[1]</sup>	QSFP+	41.25	850	-7.5~2.4	<-5.4	0~70	150	DDM
	4*SFP+	10.3125		-6.5~-1	<-7.5			
<b>PN</b>	HTOC-QPA5-xx01MB <sup>[1]</sup>							
<b>Description</b>	40G QSFP+ to 4x10G SFP+ Active Optical Cables, up to 150m, 0-70°C							
<b>SAP No</b>	-							
<b>Customer PN</b>	-							

**Notes:**

1. Refer to Chapter 9 Ordering Information.

## 2. Revision History

**Table 2.1 Revision History**

Version	Initiated	Reviewed	Revision	Date
V1.0	Leo	Virgil	LiuSJ	2020.12.30

## 3. Absolute Maximum Ratings and Recommended Operating Conditions

**Table 3.1 Absolute Maximum Ratings**

Parameter	Symbol	Unit	Min	Max
Storage Temperature Range	Ts	°C	-40	+85
Relative Humidity	RH	%	5	95
Power Supply Voltage	Vcc	V	-0.5	4.0
Signal Input Voltage		V	-0.3	Vcc+0.3

**Table 3.2 Recommended Operating Conditions**

Parameter	Symbol	Unit	Min	Typ	Max
Operating Case Temperature	Tc	°C	0		70
Power Supply Voltage	Vcc	V	3.135	3.3	3.465
Power Dissipation (QSFP+)	Pm	W			1.5
Power Dissipation (SFP+)	Pm	W			1
Bit Rate(Per channel)	BR	Gbps		10.3215	
Bit Error Ratio	BER				10 <sup>-12</sup>
Max Supported Link Length(OM4)	L	m			150

## 4. Optical Specification

### 4.1 QSFP+

Measured condition: Channel Data Rate 10.3125 Gbps, VRCCR=3.3V, PRBS31, Case Operating Temperature 0~70°C

**Table 4.1 Optical Specifications**

Parameter	Symbol	Unit	Min	Typ	Max	Notes
<b>Transmitter (per Lane)</b>						
Signaling rate per lane		Gbps		10.3125		
Center wavelength	$\lambda_c$	nm	840		860	
RMS Spectral Width	SW	nm			0.65	
Average Launch Power per Lane	TXPx	dBm	-7.6		2.4	
Optical Extinction Ratio	ER	dB	3			
Relative Intensity Noise	RIN	dB/Hz			-128	
Optical Return Loss Tolerance		dB			12	
Average launch power of OFF Transmitter, each lane		dBm			-30	
Transmitter Eye mask definition {X1,X2,X3, Y1,Y2,Y3}			Compliant with IEEE 802.3ba			
<b>Receiver(per Lane)</b>						
Signaling rate per lane		Gbps		10.3125		
Center wavelength	$\lambda_{IN}$	nm	840		860	
Average power each lane	RXPx	dBm	-9.5		2.4	
Stressed receiver sensitivity in OMA, each lane	R <sub>SENS</sub>	dBm			-5.4	Note1
Receiver reflectance	R <sub>fl</sub>	dB			-12	
LOS De-Assert—OMA	LOSD	dBm			-7.5	
LOS Assert	LOSA	dBm	-30			
LOS Hysteresis		dB	0.5			

Note1: Measured with a PRBS 2<sup>31</sup>-1 test pattern, @10.3125Gb/s, BER<10<sup>-12</sup>.

## 4.2 SFP+

Measured condition: Channel Data Rate 10.3125 Gbps, VRCCR=3.3V, PRBS31, Case Operating Temperature 0~70°C

**Table 4.1 Optical Specifications**

Parameter	Symbol	Unit	Min	Typ	Max	Notes
<b>Transmitter (per Lane)</b>						
Signaling rate per lane		Gbps		10.3125		
Center wavelength	$\lambda_c$	nm	840		860	
RMS Spectral Width	SW	nm			0.45	
Average Launch Power per Lane	TXPx	dBm	-6.5		-1	
Optical Extinction Ratio	ER	dB	3.5			
Relative Intensity Noise	RIN	dB/Hz			-128	
Optical Return Loss Tolerance		dB			12	
Average launch power of OFF Transmitter, each lane		dBm			-30	
Transmitter Eye mask definition {X1,X2,X3, Y1,Y2,Y3}			Compliant with IEEE 802.3ae			
<b>Receiver(per Lane)</b>						
Signaling rate per lane		Gbps		10.3125		
Center wavelength	$\lambda_{IN}$	nm	840		860	
Average power each lane	RXPx	dBm	-9.5		2.4	
Stressed receiver sensitivity in OMA, each lane	R <sub>SENS</sub>	dBm			-7.5	Note1
Receiver reflectance	R <sub>fl</sub>	dB			-12	
LOS De-Assert	LOSD	dBm			-12	
LOS Assert	LOSA	dBm	-30			
LOS Hysteresis		dB	0.5			

Note1: Measured with a PRBS 2<sup>31</sup>-1 test pattern, @10.3125Gb/s, BER<10<sup>-12</sup>.

## 5. Electrical Specification

**Table 5.1 Electrical Specifications**

Parameter	Symbol	Unit	Min	Typ	Max	Notes
Supply Voltage	VCC	V	3.15	3.3	3.45	
Supply Current (QSFP+)	ICC	A			0.45	
Supply Current (SFP+)	ICC	A			0.3	
Power Consumption (QSFP+)	Pc	W			1.5	
Power Consumption (SFP+)	Pc	W			1	
<b>Transmitter</b>						
Signaling rate per lane		Gbps		10.3125		
Input Differential Impedance	R <sub>IN</sub>	Ω	90	100	110	
Differential data input swing	V <sub>IN</sub>	mVp-p	300		1100	
<b>Receiver</b>						
Signaling rate per lane		Gbps		10.3125		
Output Differential Impedance	R <sub>OUT</sub>	Ω	90	100	110	
Differential data output swing	V <sub>OUT</sub>	mVp-p	400		800	
<b>IIC communication</b>						
IIC Clock frequency	-	KHz	100		400	

## 6. Module Memory Map

### 6.1 QSFP+

The common memory map for managed external cable interfaces is utilized for serial ID, digital monitoring and control functions. The map is arranged into a single lower page address space of 128 bytes and multiple upper address pages.

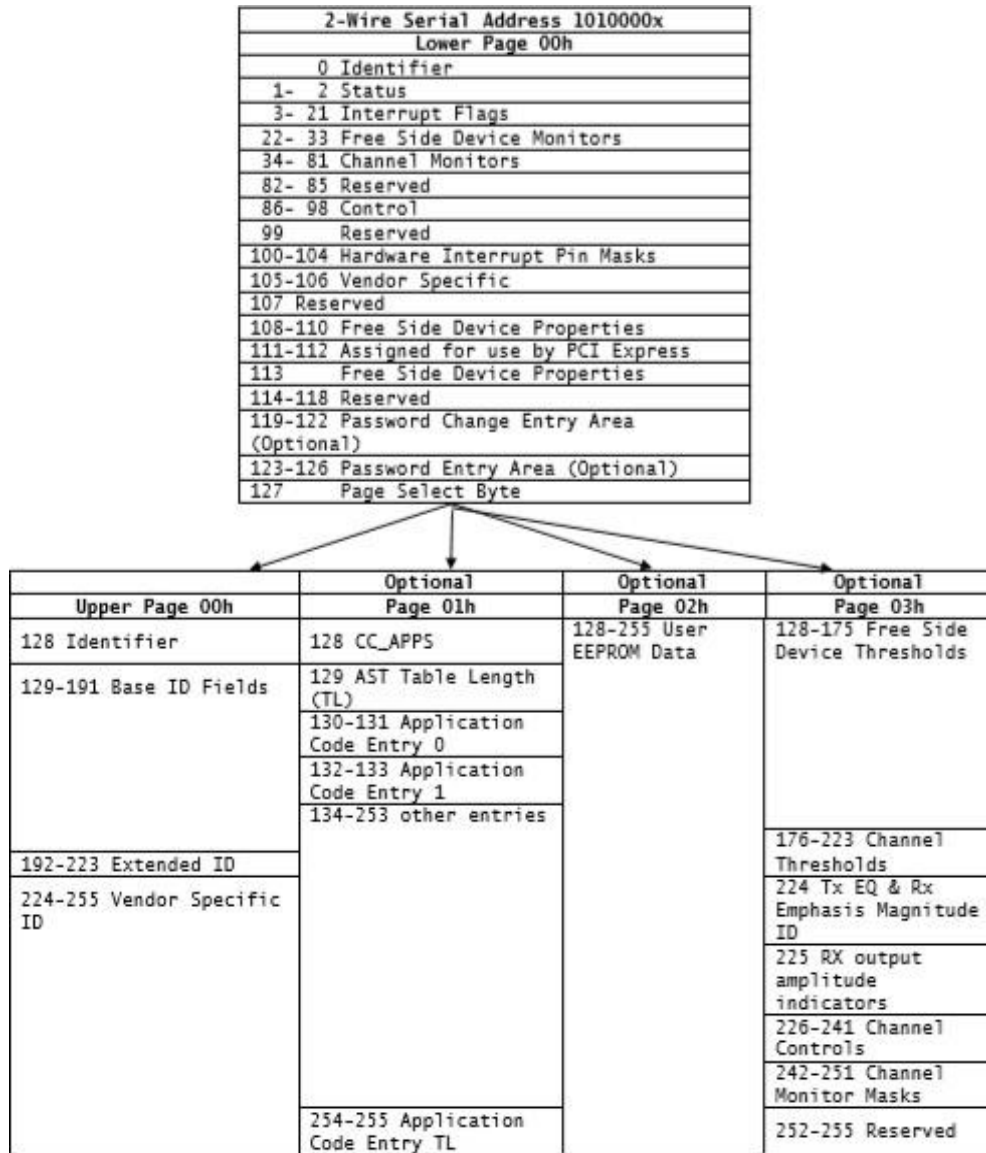


Figure 1 Digital Diagnostic Memory Map

## 6.2 SFP+

The SFP modules implement the 2-wire serial communication protocol as defined in the SFP - 8472. The serial ID information of the SFP modules and Digital Diagnostic Monitor parameters can be accessed through the I2C interface at address A0h and A2h. The memory is mapped in Figure 2.

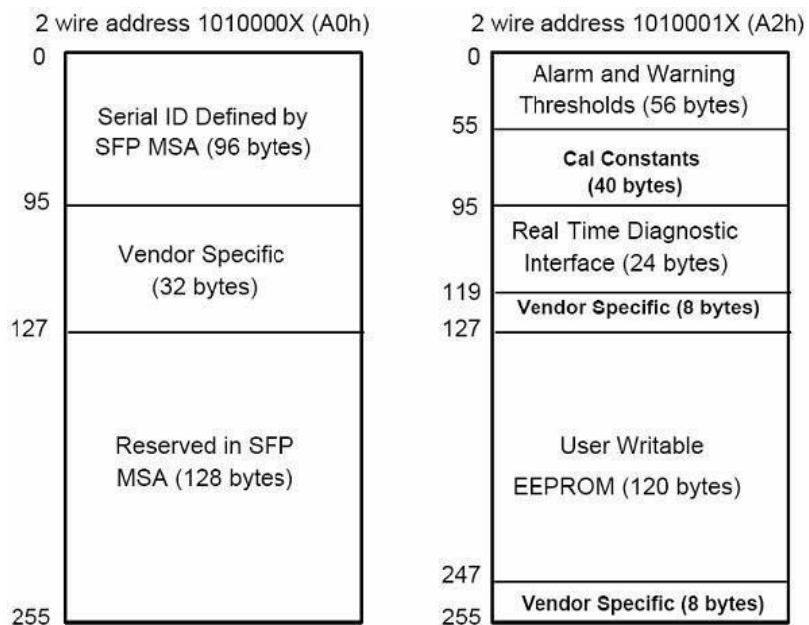


Figure 2 Digital Diagnostic Memory Map

## 7. Pin Assignment and Pin Description

### 7.1 QSFP+

#### 7.1.1 Pin Assignment

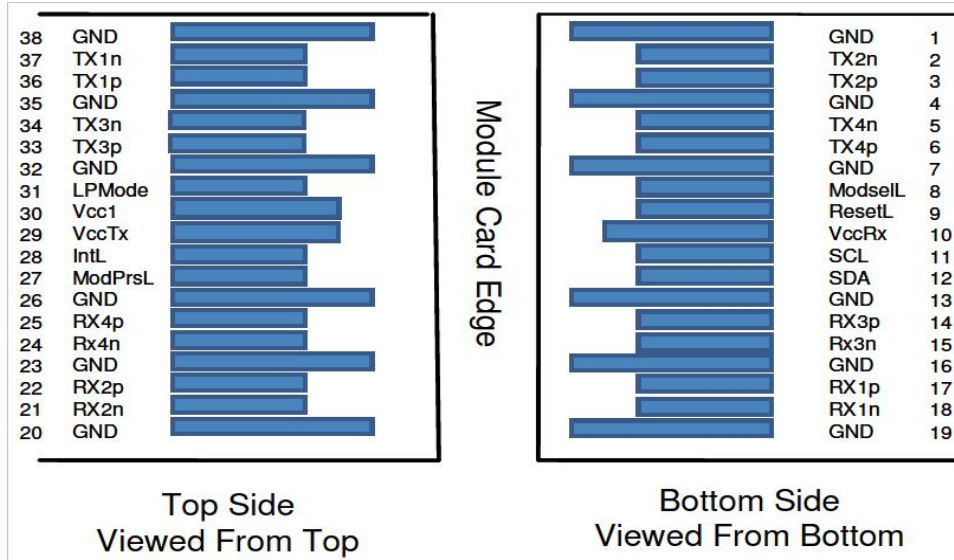


Figure 3 Electrical Pin-out Details

#### 7.1.2 Pin Description

Table 7.1 Pin Description

Pin	Symbol	Name/Description	Note
1	GND	Ground	1
2	Tx2n	Transmitter Inverted Data Input	
3	Tx2p	Transmitter Non-Inverted Data Input	
4	GND	Ground	1
5	Tx4n	Transmitter Inverted Data Input	
6	Tx4p	Transmitter Non-Inverted Data Input	
7	GND	Ground	1
8	ModSe1L	Module Select	
9	ResetL	Module Reset	
10	Vcc Rx	+3.3V Power supply receiver	
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	



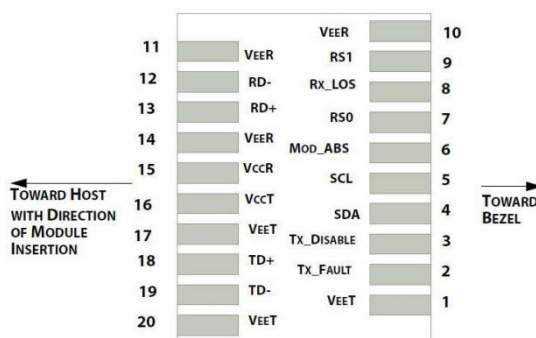
29	VccTx	+3.3V Power supply transmitter	
30	Vcc1	+3.3V Power Supply	
31	LPMODE	Low Power Mode	
32	GND	Ground	1
33	Tx3p	Transmitter Non-Inverted Data Input	
34	Tx3n	Transmitter Inverted Data Input	
35	GND	Ground	1
36	Tx1p	Transmitter Non-Inverted Data Input	
37	Tx1n	Transmitter Inverted Data Input	
38	GND	Ground	1

**Notes:**

1.GND is the symbol for signal and supply (power) common for the QSFP+ module. All are common within the module and all module voltages are referenced to this potential unless otherwise noted. Connect these directly to the host board signal common ground plane.Circuit ground is internally isolated from chassis ground.

## 7.2 SFP+

### 7.2.1 Pin Assignment



**Figure 4 Electrical Pin-out Details**

### 7.2.2 Pin Description

**Table 7.2 Pin Description**

PIN #	Name	Function	Notes
1	VeeT	Module transmitter ground	1
2	Tx Fault	Module transmitter fault	2
3	Tx Disable	Transmitter Disable; Turns off transmitter laser output	3
4	SDL	2 wire serial interface data input/output (SDA)	4
5	SCL	2 wire serial interface clock input (SCL)	4
6	MOD-ABS	Module Absent, connect to VeeR or VeeT in the module	2
7	RS0	Rate select0: module inputs and are pulled low to VeeT with > 30 kΩ resistors in the module	
8	LOS	Receiver Loss of Signal Indication	
9	RS1	Rate select1: module inputs and are pulled low to VeeT with > 30 kΩ resistors in the module.	
10	VeeR	Module receiver ground	1
11	VeeR	Module receiver ground	1
12	RD-	Receiver inverted data out put	
13	RD+	Receiver non-inverted data out put	
14	VeeR	Module receiver ground	1
15	VccR	Module receiver 3.3V supply	

16	VccT	Module transmitter 3.3V supply	
17	VeeT	Module transmitter ground	1
18	TD+	Transmitter non-inverted data out put	
19	TD-	Transmitter inverted data out put	
20	VeeT	Module transmitter ground	1

**Notes:**

- 1.The module ground pins shall be isolated from the module case.
- 2.This pin is an open collector/drain output pin and shall be pulled up with 4.7K-10Kohms to Host\_Vcc on the host board.
- 3.This pin shall be pulled up with 4.7K-10Kohms to VccT in the module.
- 4.This pin is an open collector/drain output pin and shall be pulled up with 4.7K-10Kohms to Host\_Vcc on the host board.

## 8. Package Dimensions

### 8.1 QSFP+ AOC end Mechanical Specifications

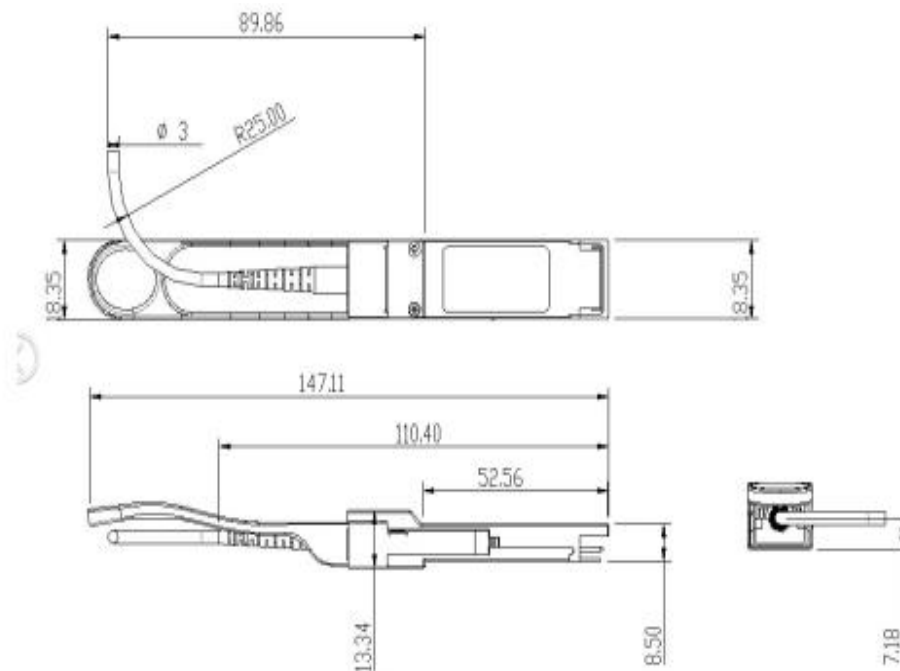


Figure 5 Package Dimensions

8.2 SFP+ AOC end Mechanical Specifications

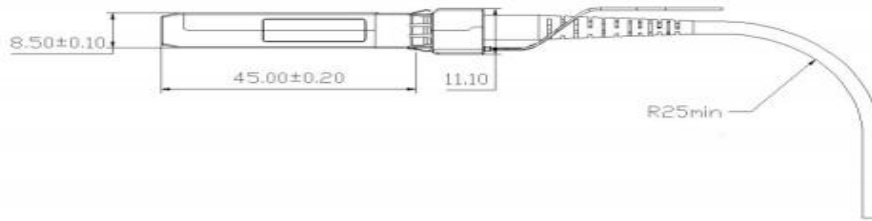
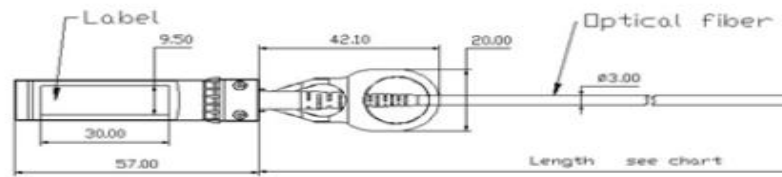


Figure 6 Package Dimensions

9. Ordering Information:

Table 9.1 Ordering Information

Part Number	Description
HTOC-QPA5-xx01MB	40G QSFP+ to 4x10G SFP+ Active Optical Cables, up to 150m, 0-70°C
xx :Represents: wire type, type has: O2/O3/O4/O5=OM2/OM3/OM4/OM5 01~150,1~150 Length in meters. (OM4 fiber is available)	

10. For More Information

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