

Specification

Quad Small Form-factor Pluggable

Optical Transceiver Module

40GBASE-ESR4



Ordering Information

TQS-Q1LH9-PCA

Model Name	Voltage	Category	Device type	Interface	Temperature	Distance
TQS-Q1LH9-PCA	3.3V	With DDMI	850 nm VCSEL	CML/CML	0°C ~ +70°C	33m / 82m / 300m (OM1/OM2/OM3)

Description

Formerica OptoElectronics Inc. Quad Small Form-factor Pluggable Plus (QSFP+) product is a new high speed pluggable I/O interface products. This interconnecting system offers 4 channels and maximum bandwidth of 40Gbps which are based on the proprietary technique Silicon Optical Bench (SiOB) optical engine. Compared to common 40GBASE-SR4 transceiver only can support cable length up to 100-m via OM3 MMF, this product can extend the cable length up to 300-m via common OM3 MMF by special dispersion suppression technique. This module provides high performance and extra longer cable distance for datacom applications.

Features

- Compliant with 40GBASE-SR4 per IEEE 802.3ba D3.2 and SFF-8436 QSFP+ MSA Rev. 4.1.
- Operating at 10.3125-Gbps per lane with 64b/66b coded data
- Low power dissipation < 1.5W (Power Level-1)
- Full Digital Diagnostics Monitor Interface
- Hot pluggable electrical interface
- Standard 12/8 lane optical fiber with MPO pluggable optical connector.
- 0 to 70°C case temperature operating range
- 300/400-m Link Length via OM3/OM4 with MPO Optical Connector
- RoHS Compliance

Applications

- 40GBASE-SR4 Ethernet links
- InfiniBand QDR, DDR and SDR
- 4G / 8G / 10G Fiber Channel
- SATA / SAS Storage
- HPC Interconnects
- Proprietary Interconnections

Absolute Maximum Rating

Not necessarily applied together. Exceeding these values may cause permanent damage.
Functional operation under these conditions is not implied.

Parameter	Symbol	Min	Typ.	Max	Unit	Note
Storage Temperature	Ts	-40		85	°C	
3.3V Power Supply Voltage	Vcc	-0.5		3.6	V	
Data Input Voltage-Single Ended		-0.5		V _{cc} +0.5	V	
Relative Humidity	RH	5		85	%	
Rx Optical Damage Threshold / Lane	DT	3.4			dBm	

Recommended Operating Conditions

Parameter	Symbol	Min	Typ.	Max	Unit	Note
Case Temperature	Top	0	40	70	°C	
3.3 V Power Supply Voltage	Vcc	3.135	3.3	3.465	V	
Signal Rate per Channel		2.5		10.3125	Gbps	1
Control* Input Voltage High	Vih	2		V _{cc} +3	V	
Control* Input Voltage Low	Vil	-0.3		0.8	V	
Two Wire Serial (TWS) Interface Clock Rate			100		kHz	
Power Supply Noise Ripple Susceptibility (PSNR)	PSNR			50	mVpp	2
Receiver Differential Data Output Load			100		Ohms	
Fiber Length: 2000 MHz·km 50µm MMF (OM3)		0.5		300	m	3
Fiber Length: 4700 MHz·km 50µm MMF (OM4)		0.5		400	m	3

Note:

1. Lane speed up to 12.5-Gbps is available upon customer requests.
2. Power supply noise is defined as peak-to-peak noise amplitude over 1K to 15 MHz frequency range at

host supply side by the recommended power supply filter for module. See Section 10 for the recommended power supply filter.

3. Extended 300-m /400-m via OM3/OM4 MMF is only supported as long as two ends of QSFP+ transceiver module belonging to Extended SR4; otherwise, the link length might only supports to 100-m/150-m via OM3/OM4 MMF according to 40GBase-SR4.

Electrical Characteristics

Parameter	Symbol	Min	Typ.	Max	Unit	Note
Transceiver Electrical Characteristics						
TRx Power Consumption				1.5	W	
TRx Power Supply Current	I _{cc}			420	mA	
TRx Power-On Initialization Time	T _{pwr_init}			2000	ms	1
Transmitter Electrical Characteristics						
Data Input Differential Peak-to-Peak Voltage Swing	ΔVDI PP			1200	mVpp	
Differential Input Return Loss		Per IEEE 802.3ba, Section 86A.4.1.1			dB	2
Differential to Common Mode Input Return Loss		10			dB	2
J2 Jitter Tolerance	Jt2	0.17			UI	
J9 Jitter Tolerance	Jt9	0.29			UI	
Eye Mask Coordinates: X1, X2; Y1, Y2		Specification Value 0.11, 0.31; 95, 350			UI; mV	3
Receiver Electrical Characteristics						
Data Output Differential Peak-to-Peak Voltage Swing	ΔVDO PP	200		900	mVpp	4
Output Transition Time 20% to 80%	t _{rise} , t _{fall}	28			ps	
Output Transition Return Loss		Per IEEE 802.3ba, Section 86A.4.2.1			dB	2
Common Mode Output Return Loss		Per IEEE 802.3ba, Section 86A.4.2.2			dB	2
Output Total Jitter				62	Ps	
J2 Jitter Output				0.42	UI	
J9 Jitter Output				0.65	UI	
Eye Mask Coordinates: X1, X2; Y1, Y2		Specification Value 0.29, 0.5; 150, 425			UI; mV	3

Notes:

1. "Initialization Time" is the time from when the supply voltages reach and remain above the minimum "Recommended Operating Conditions" to the time when the module enables TWS access. The module at that point is fully functional.
2. 10M to 11.1 GHz according to IEEE 802.3ba specification.
3. Hit ratio= 5×10^{-5} per sample.
4. AC-Coupled with 100Ω differential output impedance.

Optical Characteristics

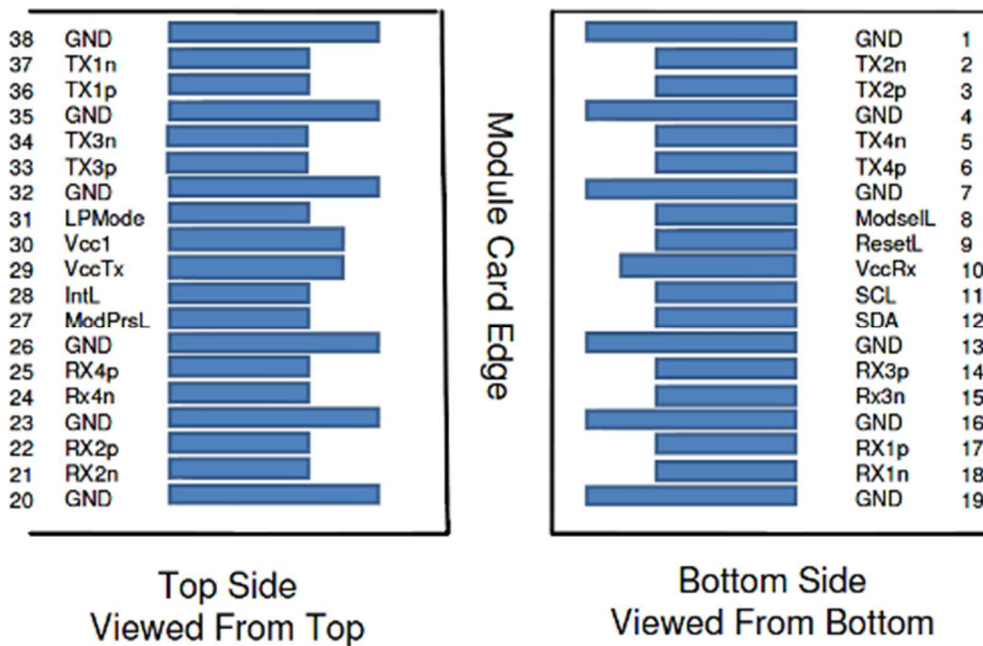
Parameter	Symbol	Min	Typ.	Max	Unit	Note
Transmitter Optical Characteristics						
Center Wavelength	λ	840		860	nm	1
Spectral Width – RMS	$\sigma\lambda$			0.55	nm	
Output Optical Power: Average	PO AVE	-7.6		2.4	dBm	
Output Optical Modulation Amplitude, per lane	OMA	-2.5			dBm	
Difference in Power between any Two Lanes in OMA				4.0	dB	
Transmitter and Dispersion Penalty (TDP,) each Lane				3.5	dB	
Extinction Ratio	ER	3			dB	
Output Optical Power: Disabled	PO_OFF			-30	dBm	
Eye Mask Coordinates: X1, X2, X3; Y1, Y2, Y3		Specification Value 0.23, 0.34, 0.43; 0.27, 0.35, 0.4			UI	2
Receiver Optical Characteristics						
Center wavelength, each lane	λ	840	850	860	nm	
Damage Threshold		3.4			dBm	
Maximum Average power at receiver input, each lane				2.4	dBm	
OMA, each Lane				3	dBm	
Non-Stressed receiver sensitivity (Avg)				-7.5	dBm	3
LOS Assert		-30			dB	

LOS De-Assert				-7.5	dB	
LOS Hysteresis		0.5			dB	

Notes:

1. RMS spectral width is measured at 10.3125-Gbps of PRBS-31 signals injected.
2. Hit ratio= 5×10^{-5} per sample.
3. Measured with 10.3125-Gbps of PRBS-31 at 10-12 BER.

QSFP+ Module Pad Assignments and Descriptions



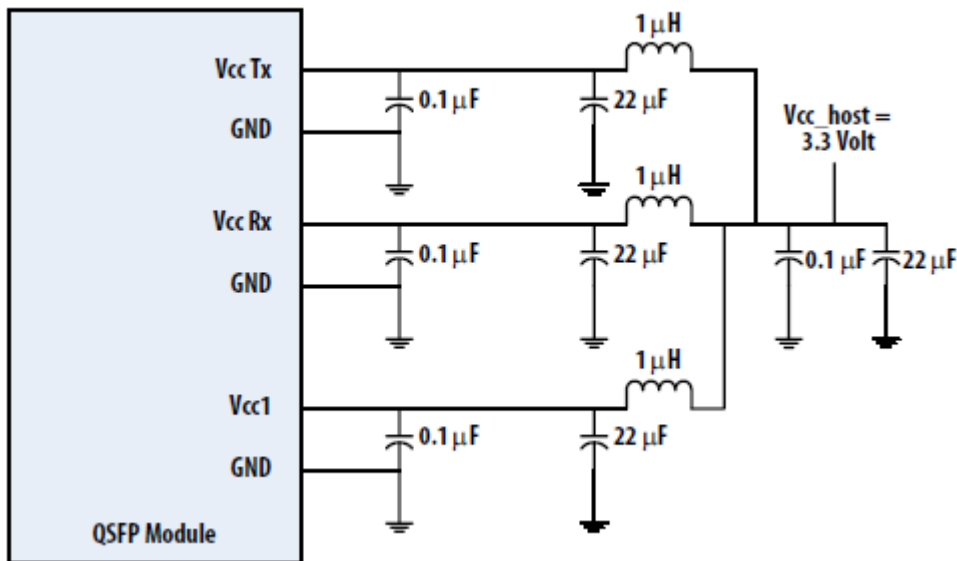
Pin	Logic	Symbol	Description	Plug Sequence	Notes
1		GND	Ground	1	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	3	
3	CML-I	Tx2p	Transmitter Non-Inverted Data Input	3	
4		GND	Ground	1	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	3	
6	CML-I	Tx4p	Transmitter Non-Inverted Data Input	3	
7		GND	Ground	1	1
8	LVTTL-I	ModSelL	Module Select	3	
9	LVTTL-I	ResetL	Module Reset	3	
10		Vcc Rx	+3.3V Power Supply Receiver	2	2
11	LVC MOS-I/O	SCL	2-wire serial interface clock	3	
12	LVC MOS-I/O	SDA	2-wire serial interface data	3	
13		GND	Ground	1	2
14	CML-O	Rx3p	Receiver Non-Inverted Data Output	3	
15	CML-O	Rx3n	Receiver Inverted Data Output	3	
16		GND	Ground	1	1
17	CML-O	Rx1p	Receiver Non-Inverted Data Output	3	
18	CML-O	Rx1n	Receiver Inverted Data Output	3	
19		GND	Ground	1	1
20		GND	Ground	1	1
21	CML-O	Rx2n	Receiver Inverted Data Output	3	
22	CML-O	Rx2p	Receiver Non-Inverted Data Output	3	
23		GND	Ground	1	1
24	CML-O	Rx4n	Receiver Inverted Data Output	3	
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	3	
26		GND	Ground	1	1
27	LVTTL-O	ModPrsL	Module Present	3	
28	LVTTL-O	IntL	Interrupt	3	
29		Vcc Tx	+3.3V Power supply transmitter	2	2
30		Vcc1	+3.3V Power supply	2	2
31	LVTTL-I	LPMode	Low Power Mode	3	
32		GND	Ground	1	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	3	
34	CML-I	Tx3n	Transmitter Inverted Data Input	3	
35		GND	Ground	1	1

36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	3	
37	CML-I	Tx1n	Transmitter Inverted Data Input	3	
38		GND	Ground	1	1

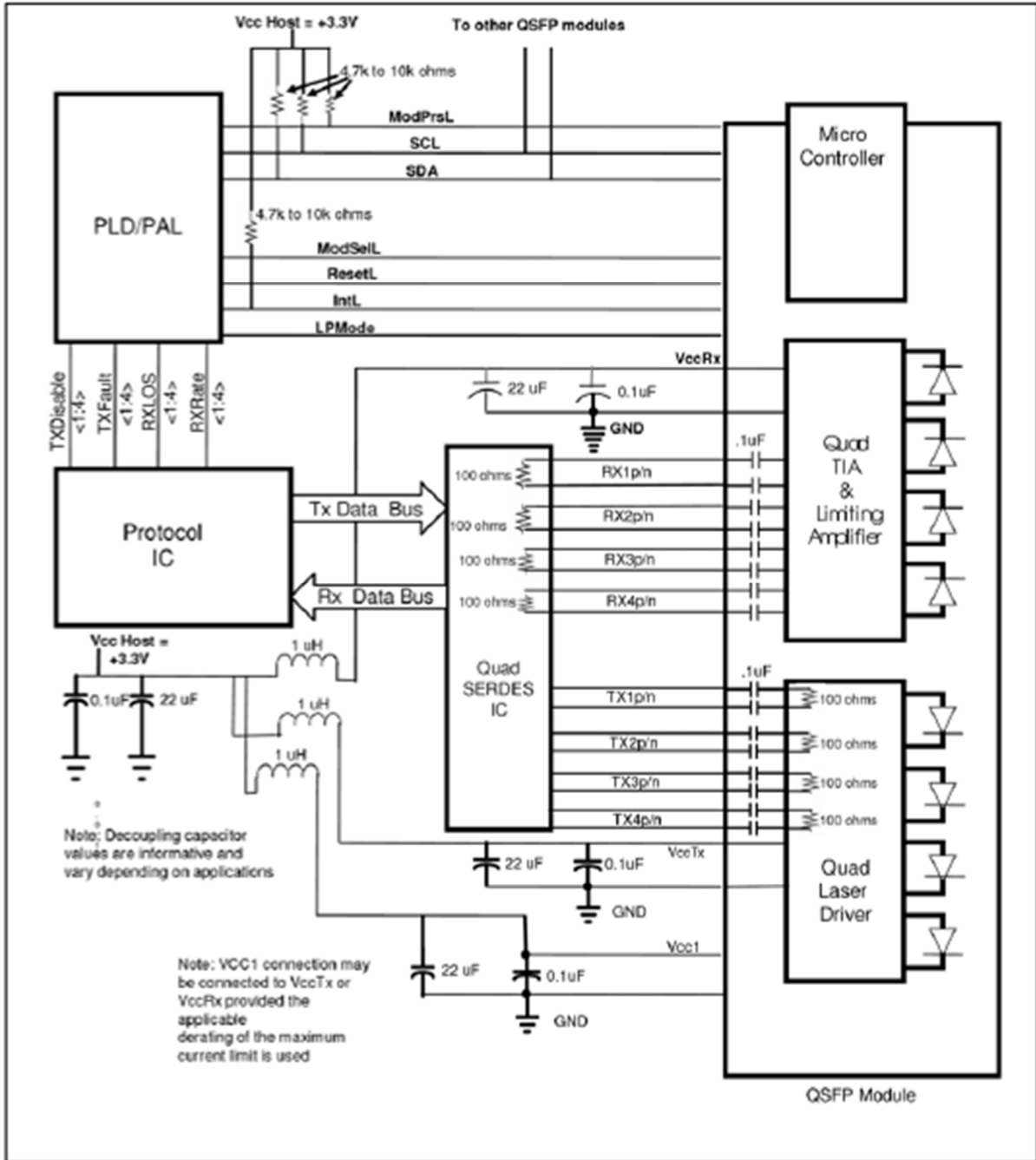
Note:

1. GND is the symbol for signal and supply (power) common for the QSFP+ module. All are common within the QSFP+ 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. Vcc Rx, Vcc1 and Vcc Tx are the receiver and transmitter power supplies and shall be applied concurrently. Requirements defined for the host side of the Host Edge Card Connector are listed in Table . Recommended host board power supply filtering is shown in next page. Vcc Rx Vcc1 and Vcc Tx may be internally connected within the QSFP+ module in any combination. The connector pins are each rated for a maximum current of 500 mA.

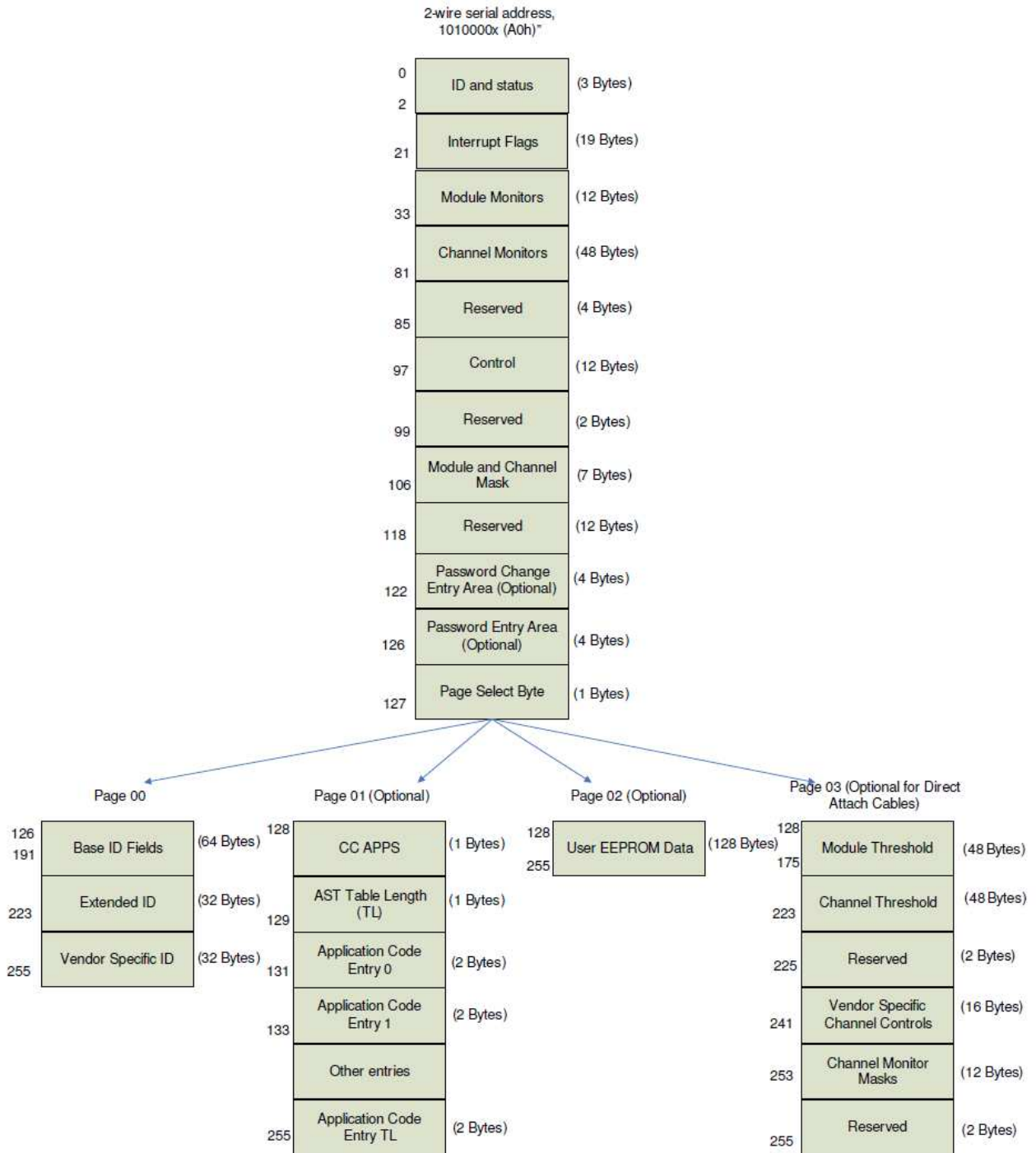
Recommended Host Board Power Supply Circuit



Recommended Interface Circuit

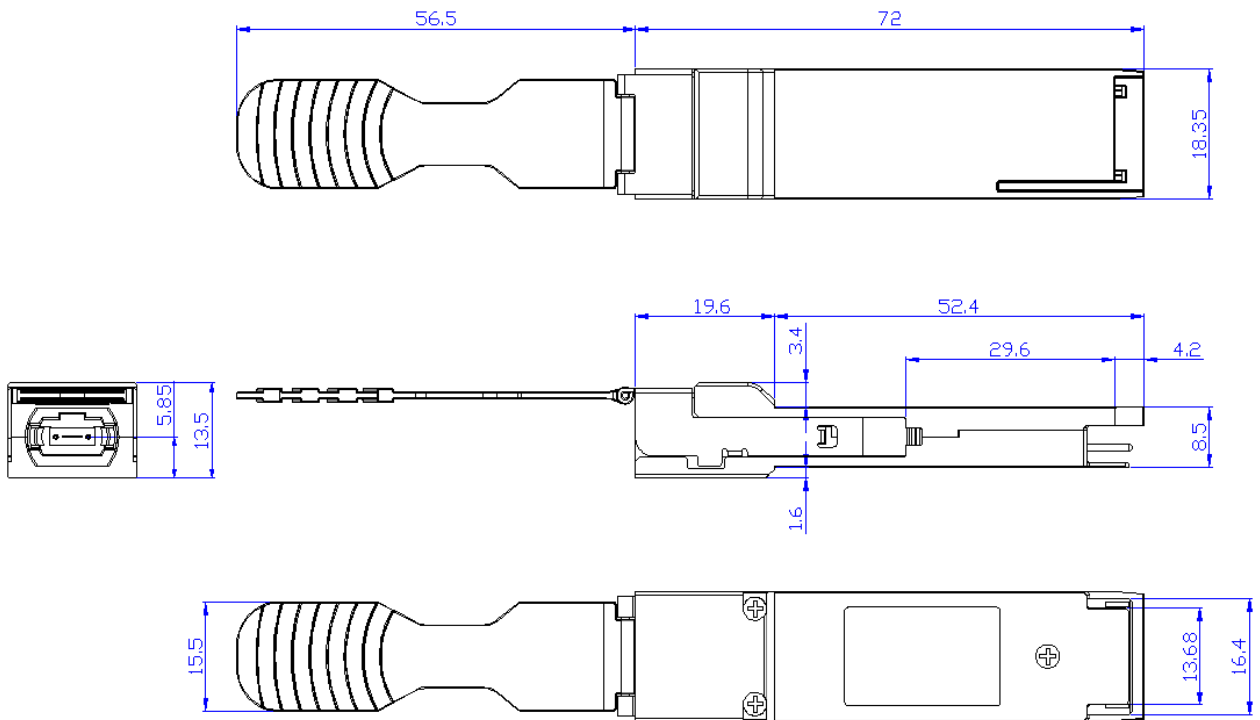


Memory Map



Mechanical Design Diagram

Unit: mm



ESD

Normal ESD precautions are required during the handling of this module. This transceiver is shipped in ESD protective packaging. It should be removed from the packaging and handled only in an ESD protected environment.

Laser Safety

This is a laser class 1M product according to IEC / EN 60825-1: 2014 (Third Edition). This product complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007.

Contact Information

Formerica OptoElectronics Inc.

5F-11, No.38, Taiyuan St., Zhubei City,
Hsinchu County 30265, Taiwan

Tel: +886-3-5600286

Fax: +886-3-5600239

San Diego, CA

Tel: 1-949-466-8069

inquiry@formericaoe.com

www.formericaoe.com