40Gb/s QSFP+ SR Bi-Directional Optical Transceiver

Product Features

- Compliant to the 40GbE XLPPI electrical specification per IEEE 802.3ba-2010
- Compliant to QSFP+ SFF-8436 Specification
- Power Consumption: ⩽3.5W
- Class 1M Eye Safety
- Operates at 10.3125Gbps per electrical channel with 64b/66b encoded data
- Links up to 100m over OM3 and 150m over OM4 optical fiber
- +10 to +70^{0}C case temperature operating range
- Proven High Reliability technology: VCSEL transmitters and PIN receiver
- Hot pluggable transceiver for ease of installation and servicing
- Utilizes a standard LC duplex fiber cable allowing reuse of existing cable infrastructure

Applications

- 40 Gigabit Ethernet interconnects

The AC-V-Q40SRBI-xx is a Four-Channel, Pluggable, LC Duplex, Fiber-Optic QSFP+ Transceiver for 40 Gigabit Ethernet Applications. This transceiver is a high performance module for short-range duplex data communication and interconnect applications. It integrates four electrical data lanes in each direction into transmission over a single LC duplex fiber optic cable. Each electrical lane operates at 10.3125Gbps and conforms to the 40GE XLPPI interface.

Ordering Information

Part Number	Description
AC-V-Q40SRBI-xx	QSFP+ 40G SR Bi-Directional Duplex LC 100m/150m over OM3/OM4 optical transceiver

Regulatory Compliance

Feature	Standard	Performance
Electromagnetic Interference (EMI)	FCC Part 15 CENELEC EN55022 (CISPR 22A) VCCI Class 1	Typically passes with 10 dB margin. Actual performance dependent on enclosure design
Electrostatic Discharge (ESD) to the Electrical Contacts	JEDEC Human Body Model (HBM) (JESD22-A114-B)	Transceiver module withstands 1kV on high speed pins and 2kV on low speed pins
Electrostatic Discharge (ESD) to Optical connector	GR1089	10 discharges of 8 kV on the electrical face- plate with device inserted into a panel
Electrostatic Discharge (ESD) to Optical connector	Variation of EN 61000-4-2	Air discharge of 15kV(min) to connector w/o damage
Laser Eye Safety and Equipment Type Testing	IEC standard (EN 60825-1:2007 and EN 60825-2:2004+A1+A2:2010) CFR 21 Section 1040	Pout: EN AEL & US FDA CDRH Class 1M

Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit	Notes
Storage Temperature	TS	-40	85	℃	
Operating Case Temperature	TOP	10	70	℃	
Power Supply Voltage	V_{CC}	-0.5	3.6	V	
Relative Humidity (non-condensation)	RH	5	95	%	
Input Voltage	Vin	-0.5	Vcc+0.5	V	

Recommended Operating Conditions and Power Supply Requirements

Parameter	Symbol	Min	Typical	Max	Unit	Notes
Operating Case Temperature	TOP	10		70	℃	
Power Supply Voltage	V_{CC}	3.1	3.3	3.47	V	
Power Consumption				3.5	W	
Signal Rate per Electrical Channel (4 x 10GBd)			10.3125		GBd	
Signal Rate per Optical Channel (2 x 20GBd)			20.625		GBd	
Link Distance with OM3 fiber	D	0.5		100	m	
Link Distance with OM4 fiber	D	0.5		150	m	

Transmitter Electrical Characteristics

The following characteristics are defined over the Recommended Operating Conditions unless otherwise noted. Typical values are for Tc = 40 °C, Vcc = 3.3 V

Parameter	Symbols	Min	Typical	Max	Units	Reference
LOS Assert Threshold: Tx Data Input Differential Peak-to-Peak Voltage Swing	ΔVdi pp los	40	80	190	mVpp	
LOS Hysteresis		0.5		4	dB	1

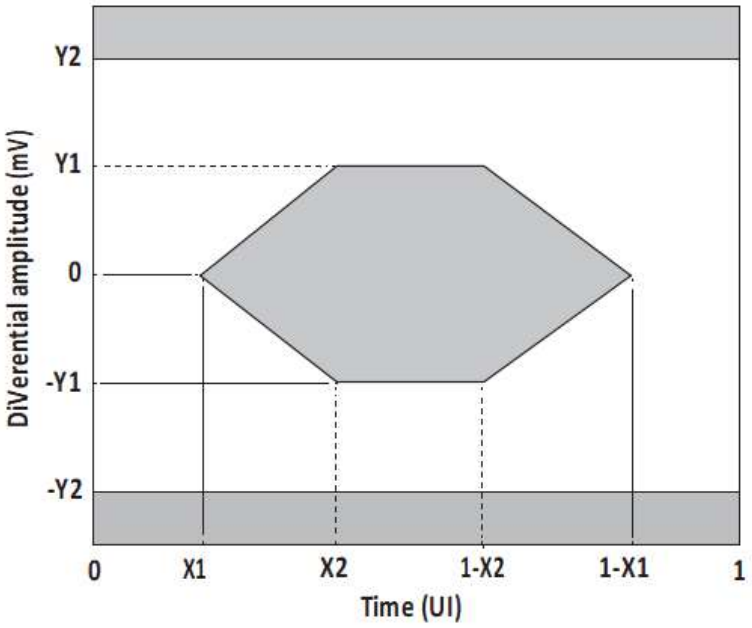
Parameter (From Table 86A-2 of IEEE 802.3ba)	Test Point*	Min	Typical	Max	Units	Notes/Conditions
Single ended input voltage tolerance [2]	TP1a	-0.3		4	V	Referred to TP1 signal common
AC common mode input voltage tolerance	TP1a	15			mV	RMS
Differential input return loss	TP1	See IEEE 802.3ba 86A.4.1.1			dB	10 MHz to 11.1 GHz
Differential to common-mode input return loss	TP1	10			dB	10 MHz to 11.1 GHz
J2 Jitter tolerance	TP1a	0.17			UI	Defined in IEEE 802.3ba spec
J9 Jitter tolerance	TP1a	0.29			UI	Defined in IEEE 802.3ba spec
Data Dependent Pulse Width Shrinkage (DDPWS) tolerance	TP1a	0.07			UI	
Eye Mask Coordinates:	TP1a	SPECIFICATION VALUES				
X1, X2		0.11, 0.31			UI	Hit Ratio = $5x10^{-5}$
Y1, Y2		95, 350			mV	

*See Figure 1 for Test Point definitions.

Note:

1. LOS Hysteresis is defined as 20*Log(LOS De-assert Level / LOS Assert Level).

2. The single ended input voltage tolerance is the allowable range of the instantaneous input signals.



Tx Electrical Eye Mask Coordinates at Hit ratio 5 x 10^{-5} hits per sample

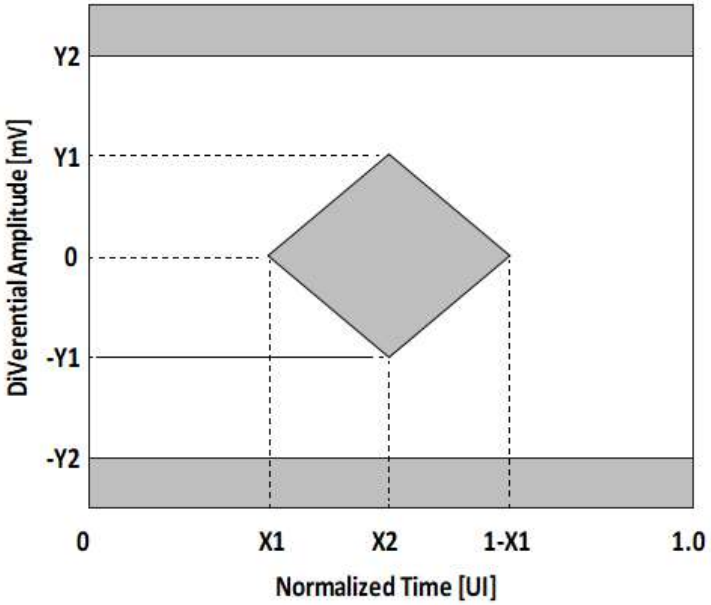
Receiver Electrical Characteristics

The following characteristics are defined over the Recommended Operating Conditions unless otherwise noted. Typical values are for Tc = 40 ° C, Vcc = 3.3 V

Parameter	Test Point*	Min	Typical	Max	Units	Notes/Conditions
Single ended output voltage tolerance	TP4	-0.3		4	V	Referred to signal common
AC common mode voltage (RMS)	TP4			7.5	mV	RMS
Termination mismatch at 1MHz	TP4			5	%	
Differential output return loss	TP4	See IEEE 802.3ba 86A.4.2.1			dB	10 MHz to 11.1 GHz
Common-mode output return loss	TP4	See IEEE 802.3ba 86A.4.1.2			dB	10 MHz to 11.1 GHz
Output transition time 20% to 80%	TP4	28			ps	
J2 Jitter output	TP4			0.41	UI	
J9 Jitter output	TP4			0.62	UI	

Eye Mask Coordinates:	TP1a	SPECIFICATION VALUES		
X1, X2		0.29, 0.5	UI	Hit Ratio = $5x10^{-5}$
Y1, Y2		150, 425	mV	

*See Figure 1 for Test Point definitions.



Rx Electrical Eye Mask Coordinates (TP4) at Hit ratio 5 x 10-5 hits per sample

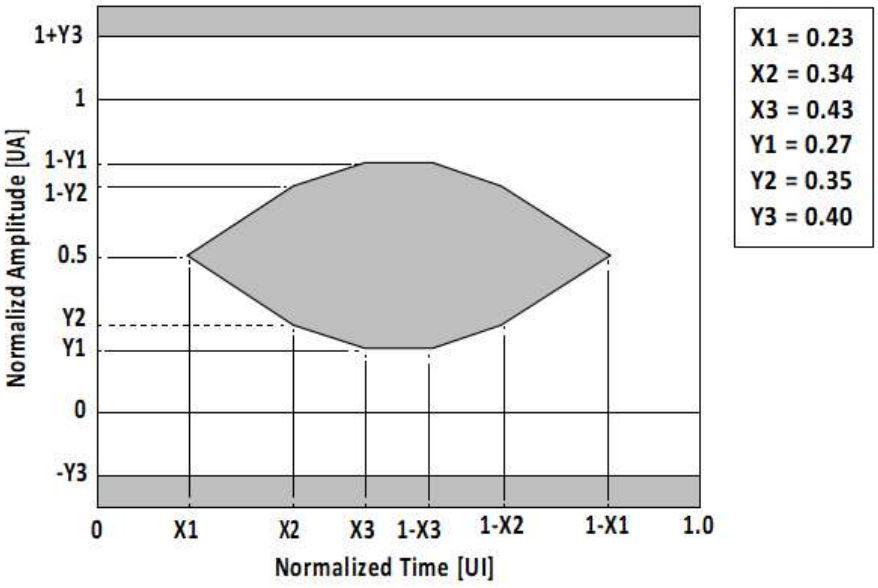
Transmitter Optical Characteristics

The following characteristics are defined over the Recommended Operating Conditions unless otherwise noted. Typical values are for Tc = 40 ° C, Vcc = 3.3 V

Parameter	Test Point*	Min	Typical	Max	Units	Notes/Conditions
Center wavelength 1	TP2	832	850	868	nm	
Center wavelength 2	TP2	882	900	918	nm	
RMS spectral width	TP2			0.59	nm	RMS Spectral Width is the standard deviation of the spectrum
Average launch power, 850nm lane	TP2	-4.0	0	5	dBm	Max: Set by the lower of Class 1M or Rx

						overload
Average launch power, 900nm lane	TP2	-4.0	0	5	dBm	Max: Set by the lower of Class 1M or Rx overload
Optical Modulation Amplitude (OMA) 850nm lane	TP2	-1.0	0	5	dBm	
Optical Modulation Amplitude (OMA) 900nm lane	TP2	-1.0	0	5	dBm	
Peak power, each lane	TP2			7	dBm	
Extinction ratio, each lane	TP2	3	4.5		dB	
RIN12OMA	TP2			-130	dB/Hz	
Optical rise and fall time, 20-80%	TP2		21		ps	
Optical return loss tolerance	TP2			12	dB	
Encircled flux	TP2	≥ 86% at 19 µm, ≤ 30% at 4.5 µm				If measured into type A1a.2 50 µm fiber in accordance with EN 61280-1-4
20.625 Gb/s Eye Mask: X1, X2, X3, Y1, Y2, Y3	TP2	SPECIFICATION VALUES 0.23, 0.34, 0.43, 0.27, 0.35, 0.40				Scaled IEEE 802.3ba 40GBASE-SR4 TX mask; Hit Ratio = $5x10^{-5}$
Average launch power of OFF transmitter, each lane	TP2			-30	dBm	

*See Figure 1 for Test Point definitions.



Transmitter Optical Eye Mask definitions at Hit Ratio 5 x 10^{-5} hits per sample

Receiver Optical Characteristics

The following characteristics are defined over the Recommended Operating Conditions unless otherwise noted. Typical values are for Tc = 40 ° C, Vcc = 3.3 V

Parameter	Test Point*	Min	Typical	Max	Units	Notes/Conditions
Center wavelength 1	TP3		850		nm	
Center wavelength 2	TP3		900		nm	
Damage Threshold [1]	TP3	+7.0			dBm	
Maximum Average power at receiver input, each lane (overload)	TP3			+5.0	dBm	
Transceiver Reflectance	TP3			-15	dB	
Peak power, each lane	TP3			7	dBm	
Optical Modulation Amplitude (OMA), 850nm lane (unstressed sensitivity)	TP3			-7.1	dBm	BER = 1e-12

Optical Modulation Amplitude (OMA), 900nm lane (unstressed sensitivity)	TP3			-7.7	dBm	BER = 1e-12
Stressed receiver sensitivity in OMA, 850nm lane	TP3		-4.5	-3.83	dBm	BER = 1e-12
Stressed receiver sensitivity in OMA, 900nm lane	TP3		-4.5	-3.86	dBm	BER = 1e-12
Conditions of stressed receiver sensitivity: [2]	TP3					
Vertical Eye Closure Penalty, 850nm	TP3			2.4	dB	
Vertical Eye Closure Penalty, 900nm	TP3			3.1	dB	
Stressed eye Jitter, each lane	TP3		0.13		UI	
LOS Assert	TP3	-30		-9.1	dBm	
LOS De-Assert (850nm)	TP3			-8.6	dBm	
LOS De-Assert (900nm)	TP3			-8.6	dBm	
LOS Hysteresis	TP3	0.5			dB	

* See Figure 1 for Test Point definitions.

Notes:

1. The receiver shall be able to tolerate, without damage, continuous exposure to a modulated optical input signal having this power level on one lane. The receiver does not have to operate correctly at this input power.

2. Vertical eye closure penalty and stressed eye jitter are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

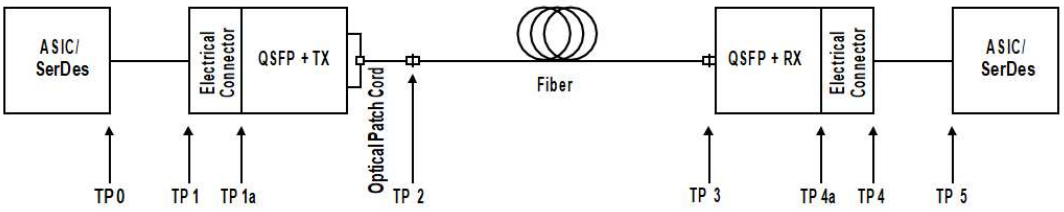


Figure 1. Test point definitions

TP0: Host ASIC transmitter output at ASIC package contact on the Host board

TP1: Host ASIC transmitter output across the Host Board at the input side of the Host QSFP+ electrical connector

TP2: QSFP+ transmitter LC Duplex optical output at the end of a 2m to 5m patch cord

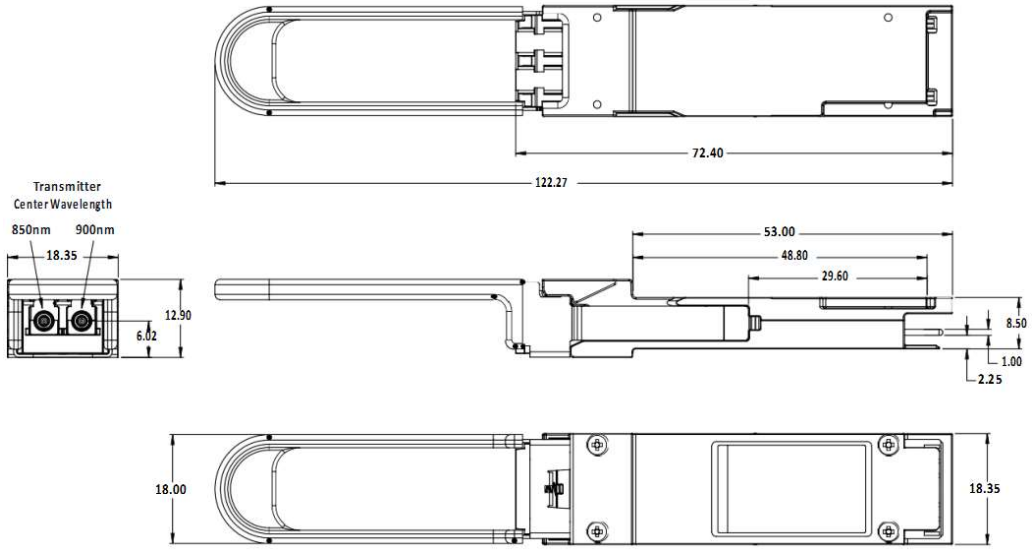
TP3: QSFP+ receiver LC Duplex optical input at the end of the fiber

TP4a: QSFP+ receiver electrical output at the input side of the Host QSFP+ electrical connector

TP4: QSFP+ receiver electrical output at the output side of the Host QSFP+ electrical connector

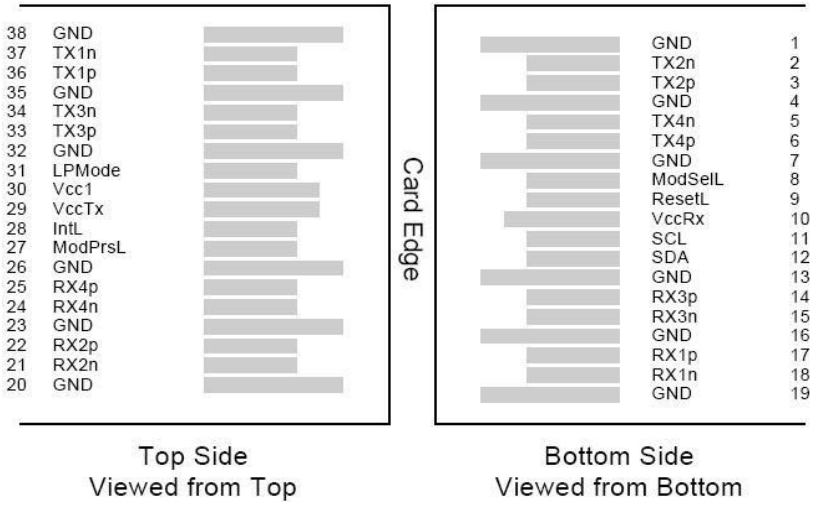
TP5: Host ASIC receiver input at ASIC package contact on the Host board

Mechanical Dimensions



Unit:mm

Pin Assignment and Description



Pin Assignment

PIN #	Logic	Symbol	Description	Notes
1		GND	Ground	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	
3	CML-I	Tx2p	Transmitter Non-Inverted Data output	
4		GND	Ground	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	
6	CML-I	Tx4p	Transmitter Non-Inverted Data output	
7		GND	Ground	1
8	LVTLL-I	ModSelL	Module Select	
9	LVTLL-I	ResetL	Module Reset	
10		VccRx	+3.3V Power Supply Receiver	2
11	LVCMOS-I/O	SCL	2-Wire Serial Interface Clock	
12	LVCMOS-I/O	SDA	2-Wire Serial Interface Data	
13		GND	Ground	1

14	CML-O	Rx3p	Receiver Non-Inverted Data Output	
15	CML-O	Rx3n	Receiver Inverted Data Output	
16		GND	Ground	1
17	CML-O	Rx1p	Receiver Non-Inverted Data Output	
18	CML-O	Rx1n	Receiver Inverted Data Output	
19		GND	Ground	1
20		GND	Ground	1
21	CML-O	Rx2n	Receiver Inverted Data Output	
22	CML-O	Rx2p	Receiver Non-Inverted Data Output	
23		GND	Ground	1
24	CML-O	Rx4n	Receiver Inverted Data Output	
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	
26		GND	Ground	1
27	LVTTL-O	ModPrsL	Module Present	
28	LVTTL-O	IntL	Interrupt	
29		VccTx	+3.3 V Power Supply transmitter	2
30		Vcc1	+3.3 V Power Supply	2
31	LVTTL-I	LPMode	Low Power Mode	
32		GND	Ground	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	
34	CML-I	Tx3n	Transmitter Inverted Data Output	
35		GND	Ground	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	
37	CML-I	Tx1n	Transmitter Inverted Data Output	
38		GND	Ground	1

Notes:

1. GND is the symbol for signal 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.