40Gbps QSFP+ Bi-Directional Optical Transceiver Module OPCS-WX1-85-C datasheet

Features

- Compliant to the 40GbE XLPPI electrical specification per IEEE 802.3ba-2010
- Compliant to QSFP+ SFF-8436 Specification
- Power Level 4: Max Power 3.5W
- Class 1M Eye Safety
- High port density: 21mm horizontal port pitch
- Operates at 10.3125 Gbps per electrical channel with 64b/66b encoded data
- Links up to 100m using OM3 and 150m using OM4 optical fiber
- +10 to +70ºC case temperature operating range
- Proven High Reliability technology: VCSEL transmitters and PIN receiver
- Hot pluggable transceiver for ease of installation and servicing
- Two wire Serial (TWS) Management Interface with maskable interrupts for expanded functionality
- Utilizes a standard LC duplex fiber cable allowing reuse of existing cable infrastructure

Applications

- 40 Gigabit Ethernet interconnects
- Datacom/Telecom switch & router connections
- Data aggregation and backplane applications
- Proprietary protocol and density applications

Absolute Maximum Ratings

Parameter	*Symbol*	*Min*	*Max*	*Unit*
Storage Temperature	*TS*	-40	85	°C
3.3 V Power Supply Voltage	*Vcc*	-0.5	3.6	V
Data Input Voltage – Single Ended		-0.5	Vcc+0.5	V
Data Input Voltage – Differential	|*Vdip - Vdin*|		1.0	V
Control Input Voltage	*Vi*	-0.5	Vcc+0.5, 3.6	V
Control Output Current	*Io*	-20	20	mA
Relative Humidity	*RH*	5	95	%

Note:

1. This is the maximum voltage that can be applied across the differential inputs without damaging the input circuitry.

Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit	Note
Case Temperature	*Tc*	+10		+70	°C	1
3.3 V Power Supply Voltage	*Vcc*	3.1	3.3	3.47	V	
Signal Rate per Electrical Channel (4 x 10GBd)			10.3125		GBd	2
Signal Rate per Optical Channel (2 x 20GBd)			20.625		GBd	2
Control Input Voltage High	*Vih*	2		V_{CC}+.3	V	3
Control Input Voltage Low	*Vil*	-0.3		0.8	V	3
Two Wire Serial (TWS) Interface Clock Rate				400	kHz	
Power Supply Noise				50	mVpp	4
Receiver Differential Data Output Load			100		Ω	
Fiber Length for OM3		0.5		100	m	5
Fiber Length for OM4		0.5		150	m	5
Transceiver Power Consumption				3.5	W	
Transceiver Power Supply Current				1150	mA	
Transceiver Power On Initialization Time	$t_{PWR\ INIT}$			2000	ms	6

Note:

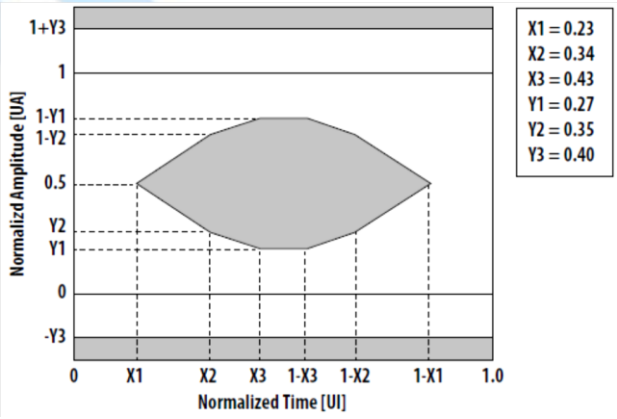
1. The position of case temperature measurement is shown in Dimensions (Case Temperature Measurement Point)
2. 64b/66b encoding is assumed.
3. Control signals, LVTTL (3.3 V) compatible
4. Power Supply Noise is defined as the peak-to-peak noise amplitude over the frequency range at the host supply side of the recommended power supply filter with the module and recommended filter in place. Voltage levels including peak-to-peak noise are limited to the recommended operating range of the associated power supply. See Figure 9 for recommended power supply filter.
5. Connection and splice loss of 1.5dB is allocated. Modal Bandwidth for OM3 fiber: 2000 MHz.km for 850nm channel, 1400MHz.km for 900nm channel. Modal Bandwidth for OM4 fiber: 3700 MHz.km for 850nm channel, 1500MHz.km for 900nm channel.
6. Power On 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.
7. For control signal timing including ModSelL, LPMode, ResetL, ModPrsL, IntL, SCL and SDA see Control Interface Section.

Transmitter Optical Characteristics

Parameter	Test Point*	Min	Typ	Max	Unit	Notes
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	5	dBm	Max: Set by the lower of Class 1M or Rx overload
Average launch power, 900nm lane	*TP2*	-4	0	5	dBm	Max: Set by the lower of Class 1M or Rx overload
Optical Modulation Amplitude (OMA) 850nm lane	*TP2*	-1	0	5	dBm	
Optical Modulation Amplitude (OMA) 900nm lane	*TP2*	-1	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 μ m, ⩽ 30% at 4.5 μ m			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	

Note:

1. Test Point* find below Figure 1. for Test Point definitions.
2. Below Figure shows Transmitter Optical Eye Mask definitions at Hit Ratio 5 x 10^{-5} hits per sample



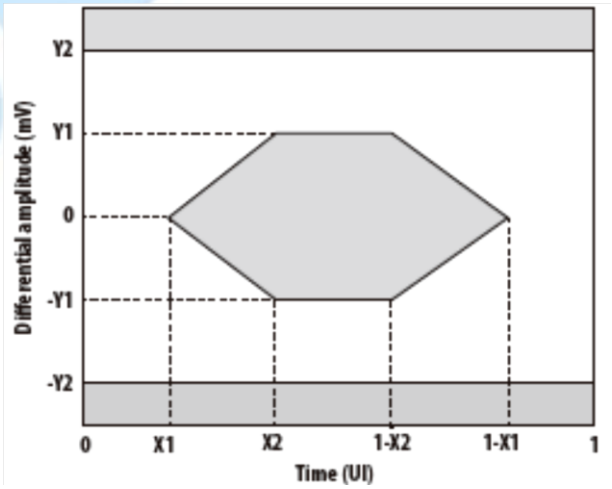
Transmitter Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Notes
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	Typ	Max	Unit	Notes
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 11.1GHz
Differential to common-mode input return loss	*TP1*	10			dB	10 MHz to 11.1GHz
J2 Jitter tolerance	*TP1a*	0.17			UI	3
J9 Jitter tolerance	*TP1a*	0.29			UI	3
Data Dependent Pulse Width Shrinkage (DDPWS) tolerance	*TP1a*	0.07			UI	
Eye Mask Coordinates: X1, X2 Y1, Y2	*TP1a*	SPECIFICATION VALUES 0.11, 0.31 95, 350			UI mV	Hit Ratio = $5x10^{-5}$

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.
3. Defined in IEEE 802.3ba spec
4. Test Point* find below Figure 1. for Test Point definitions.
5. Below Figure shows Tx Electrical Eye Mask Coordinates at Hit ratio 5 x 10^{-5} hits per sample



Receiver Optical Characteristics

Parameter	Test Point*	Min	Typ	Max	Unit	Notes
Center wavelength 1	*TP3*		850		nm	
Center wavelength 2	*TP3*		900		nm	
Damage Threshold	*TP3*	+7.0			dBm	1
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:	*TP3*					2
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	

Notes:

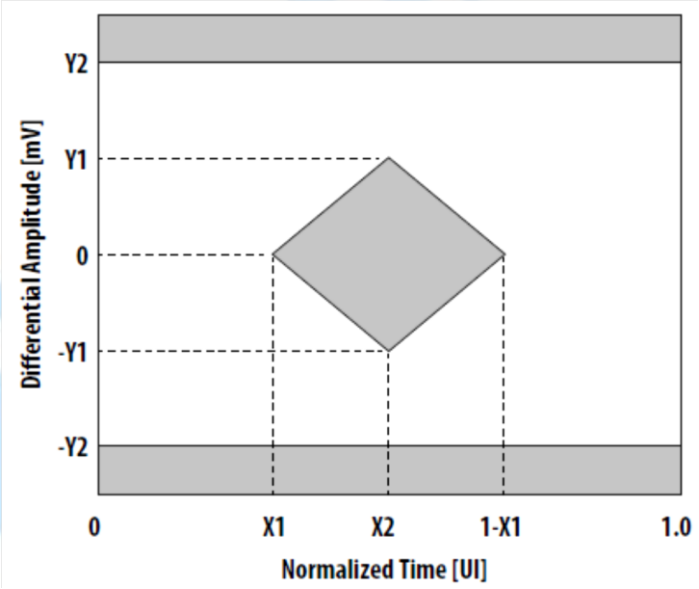
1. The receiver shall be able to tolerate, without damage, continuous exposure to a modulated optical input signal having this power level on one lane. The receiver does not have to operate correctly at this input power.
2. Vertical eye closure penalty and stressed eye jitter are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.
3. Test Point* find below Figure 1. for Test Point definitions.

Receiver Electrical Characteristics

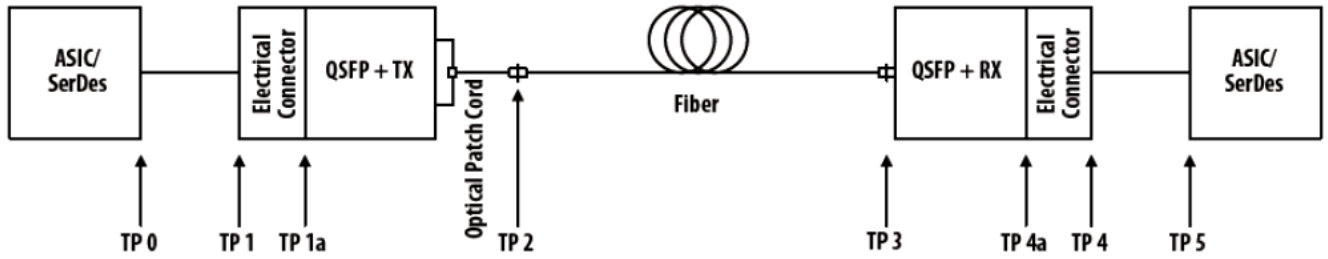
Parameter	Test Point*	Min	Typ	Max	Unit	Notes
Single ended output voltage tolerance	*TP4*	-0.3		4	V	Referred to signal common
AC common mode voltage (RMS)	*TP4*			7.5	mV	RMS
Termination mismatch at 1MHz	*TP4*			5	%	
Differential output return loss	*TP4*	See IEEE 802.3ba 86A.4.2.1			dB	10 MHz to 11.1 GHz
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: X1, X2 Y1, Y2	*TP4*	SPECIFICATION VALUES 0.29, 0.5 150, 425			UI mV	Hit Ratio = $5x10^{-5}$

Notes:

1. Test Point* find below Figure 1. for Test Point definitions.
2. Below Figure shows Rx Electrical Eye Mask Coordinates (TP4) at Hit ratio 5 x 10^{-5} hits per sample



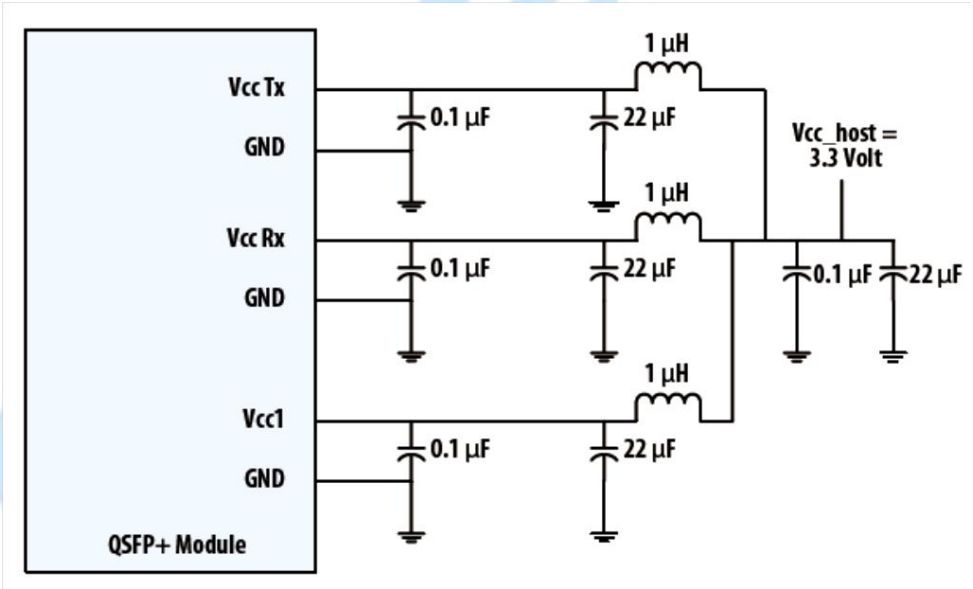
Test point definitions



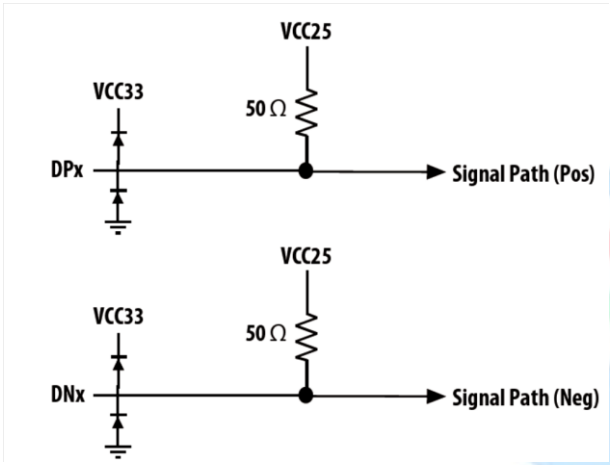
TP0: Host ASIC transmitter output at ASIC package contact on the Host board
TP1: Host ASIC transmitter output across the Host Board at the input side of the Host QSFP+ electrical connector
TP2: QSFP+ transmitter LC Duplex optical output at the end of a 2m to 5m patch cord
TP3: QSFP+ receiver LC Duplex 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

Figure 1. Test point definitions

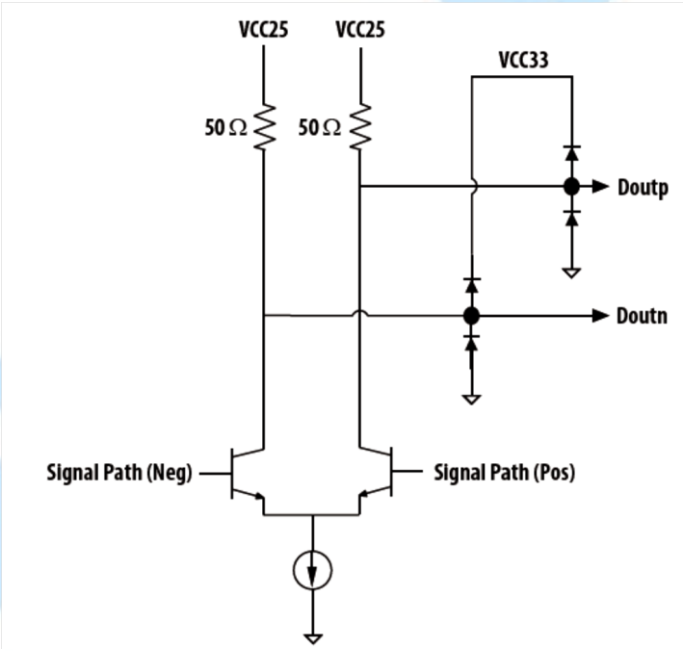
Recommended Power Supply Filter



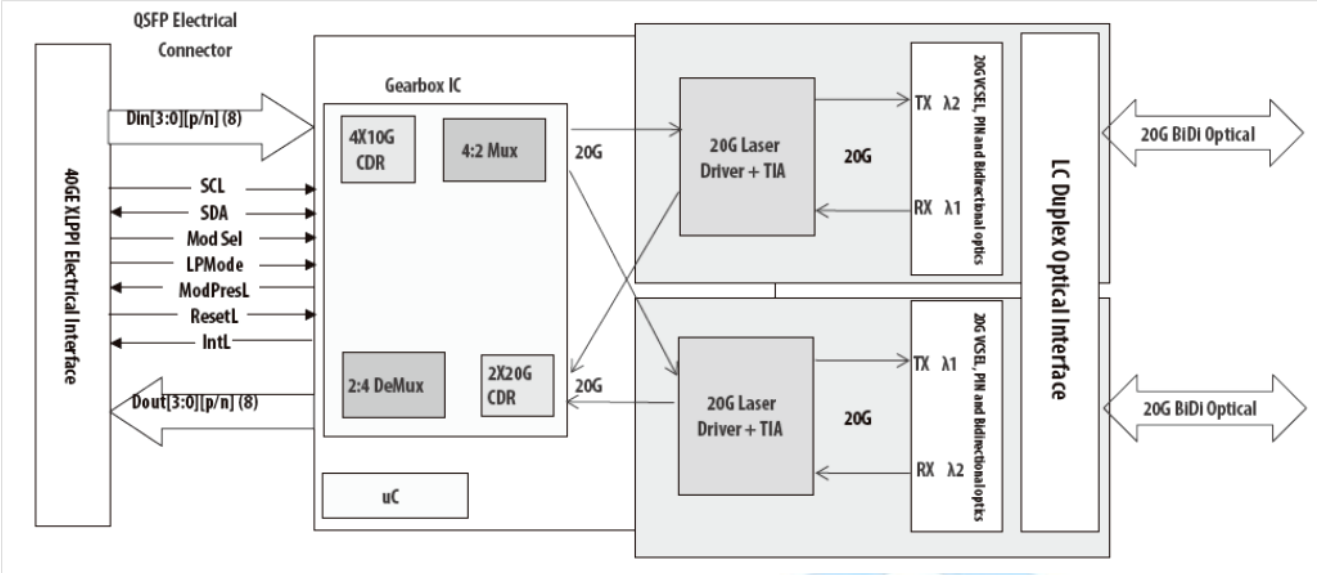
Transmitter Data Input Equivalent Circuit



Receiver Data Output Equivalent Circuit



Block Diagram of Transceiver



The optical transmitter portion of the transceiver (see above photo) incorporates a 4-channel XLPPI input buffer, electrical multiplexer, two laser drivers and two high speed VCSELs (Vertical Cavity Surface Emitting Laser). The transmitter is designed for EN 60825 and CDRH Class 1M eye safety compliance. The Tx Input Buffer provides XLPPI compatible differential inputs presenting a nominal differential input impedance of 100 Ohms. AC coupling capacitors are located inside the QSFP+ module and are not required on the host board. For module control and interrogation, the control interface (LVTTL compatible) incorporates a Two Wire Serial (TWS) interface of clock and data signals.

The optical receiver portion of the transceiver (see above photo) incorporates two high speed PIN photodiodes, TIAs, signal processors, electrical de-multiplexer and 4 channel electrical output buffer blocks. The Rx Output Buffer provides XLPPI compatible differential outputs for the high speed electrical interface presenting nominal single-ended output impedances of 50 Ohms to AC ground and 100 Ohms differentially that should be differentially terminated with 100 Ohms. AC coupling capacitors are located inside the QSFP+ module and are not required on the host board.

The electrical output will squelch for loss of input signal (unless squelch is disabled) and channel de-activation through TWS interface. To reduce the need for polling, a hardware interrupt signal INTL is provided to inform hosts of an assertion of LOS or Tx_FAULT.

Pin Assignment

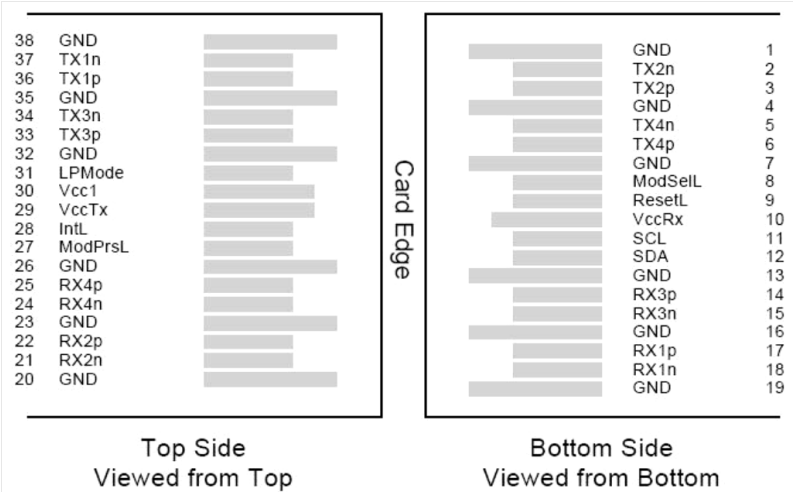


Figure: QSFP Transceiver Electrical Pad Layout

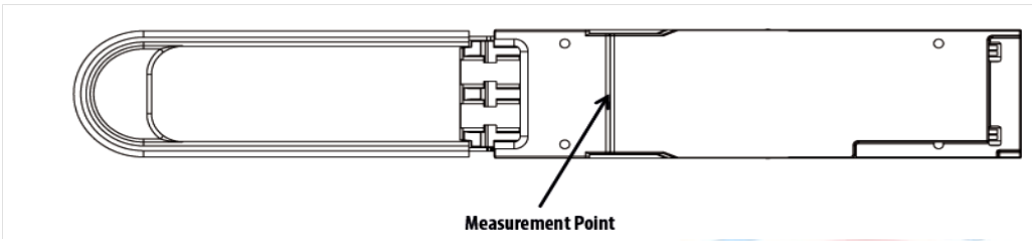
PIN	Logic	Symbol	Name/Description	Note
1		GND	Ground	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	
3	CML-I	Tx2p	Transmitter Non-Inverted Data output	
4		GND	Ground	1
5	CML-I	Tx4n	Transmitter inverted Data Input	
6	CML-I	Tx4p	Transmitter Non-Inverted Data output	
7		GND	Ground	1
8	LVTLL-I	ModSelL	Module 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		GNC	Ground	
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	

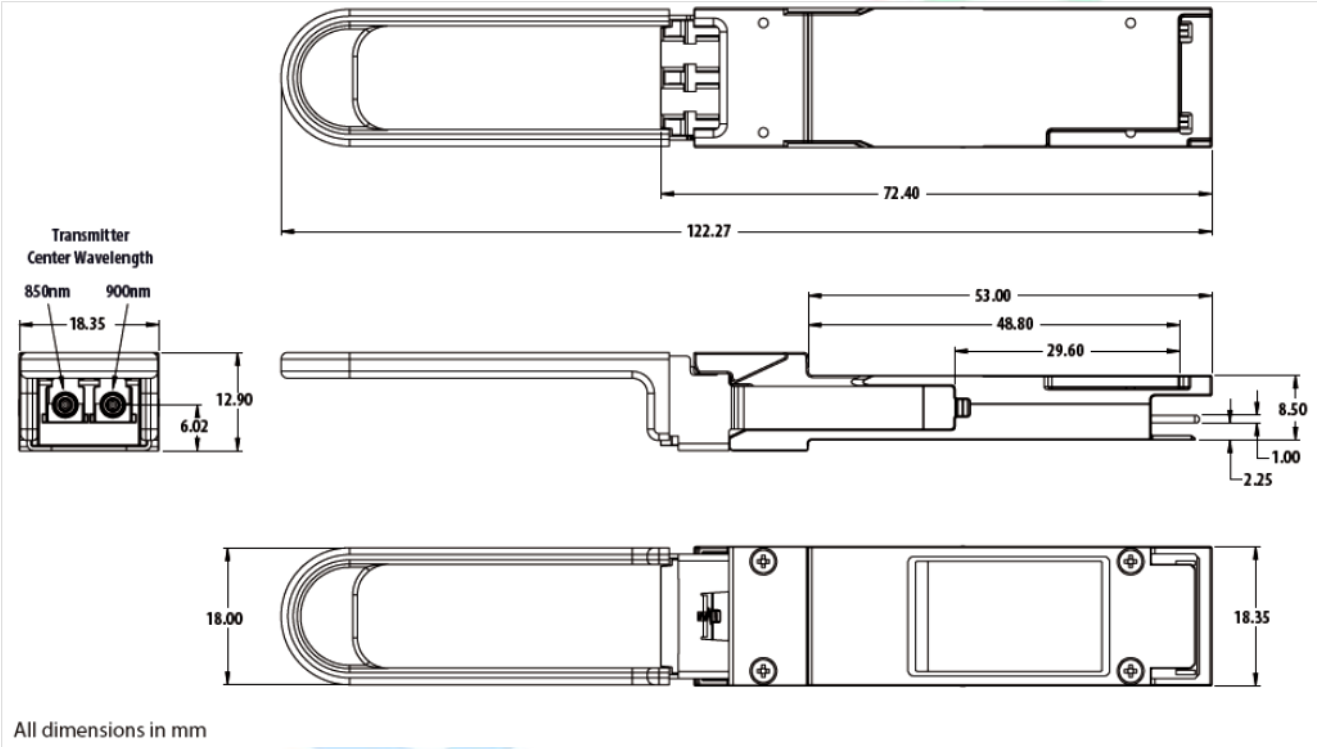
PIN	Logic	Symbol	Name/Description	Note
23		GND	Ground	1
24	CML-O	Rx4n	Receiver Inverted Data output	1
25	CML-O	Rx4p	Receiver Non-Inverted Data output	
26		GND	Ground	1
27	LVTTL-O	ModPrsL	Module Present	
28	LVTTL-O	IntL	Interrupt	
29		VccTx	+3.3V Power Supply transmitter	2
30		Vcc1	+3.3V Power Supply	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

Note:

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.

Dimensions





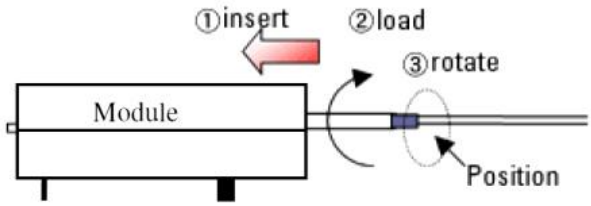
All dimensions in mm

Optical Receptacle Cleaning Recommendations :

All fiber stubs inside the receptacle portions were cleaned before shipment. In the event of contamination of the optical ports, the recommended cleaning process is the use of forced nitrogen. If contamination is thought to have remained, the optical ports can be cleaned using a NTT international Cletop® stick type and HFE7100 cleaning fluid. Before the mating of patch-cord, the fiber end should be cleaned up by using Cletop® cleaning cassette.

Cleaning of patch-cord

Cleaning of fiber stub



1. Insert
   Ensure that stick is held straight when inserting into sleeve.
2. Load
   Apply sufficient pressure (approx 600-700g) to ensure ferrule a little depressed in sleeve.
3. Rotate
   Rotate stick clockwise 4-5 times, while ensuring direct contact with ferrule end-face is maintained.

Notice: Number of possible wipes:
Maintenance (repair) ~1 use / piece
Equipment construction: 4 uses / piece (max.)

Note: The pictures were extracted from NTT-ME website. And the Cletop® is a trademark registered by NTT-ME

Ordering Information

OP C S - W X1 - 85 - C

Product Code:
5=GBIC;
6=SFP-LC;
7=XFP;
8=XENPAK;
9=X2;
A=SFP+ (SFP28);
C=QSFP+ (QSFP28);
F=CFP;
G=CFP2;
H=CFP4;
P=SFP-SC;
Q=SFP-MTRJ

Data Rate:
A=155Mb/s;
B=622Mb/s;
C=1.25Gb/s;
D=2.125Gb/s;
E=2.5Gb/s;
F=4.25Gb/s;
G=3.1Gb/s;
J=2.97G
P=6.144G:
Q=7.37G;
H=8.5Gb/s;
K=10Gb/s;
T=1/10Gb/s
L=16Gb/s;
R=20Gb/s;
X=25Gb/s;
S=40Gb/s;
W=100Gb/s (4x25G or 10x10G);
M=100Base-X SGMII;
N=100/1000Base-X SGMII;

Type:
S=Single-mode;
M=Multi-mode;
W=BWDM;
B=DUAL-BWDM;
C=CWDM;
D=DWDM;
T=Copper-T (RJ-45)
E=GEPON ONU;
F=GEPON OLT;
G=GPON ONU;
H=GPON OLT
X=MMF/SMF

Reach:
Normal:
X1=Under 150m;
X2=220m;
X3=300m;
X5=550m;
02=2km,
10=10km;
70=70km;
A0=100km;
C0=120km

CWDM:
20=20dB;
24=24dB;
28=28dB

Wavelength:
Normal:
85=850nm;
13=1310nm;
15=1550nm;
00=Copper T (RJ-45)

CWDM:
27=1270nm;
47=1470nm;
61=1610nm

BWDM:
B3=Tx1310/Rx1550; B5=Tx1550/Rx1310;
B4=Tx1310/Rx1490; B9=Tx1490/Rx1310;
51=Tx1510/Rx1570; 57=Tx1570/Rx1510;
27=Tx1270/Rx1330; 33=Tx1330/Rx1270;
B2=Tx1270/Rx1577; B7=Tx1577/Rx1270
T2=2TX1310nm; T3=TX1310nm;
T5=TX1550nm

DWDM:
17=Channel 17
34= Channel 34
00=Channel 17~61 Tunable

Operating Temperature:
C=Commercial Purpose
(0~70℃);
I= Industrial Purpose
(Extended Range)

Model Number	*Part Number*	*Voltage*	*Temperature*
QSFP-40G-BWDM-SR4	OPCS-WX1-85-C	3.3V	0°C to 70 °C

Note: All information contained in this document is subject to change without notice.