40Gbps QSFP SR4 Optical Transceiver Module
OPCS-MX3-85-CB datasheet

Features

- QSFP MSA compliant
- 4 independent full-duplex channels
- Up to 11.2Gbps data rate per channel
- MTP/MPO optical connector
- Digital diagnostic capabilities
- Capable of over 300m transmission on OM3 multi-mode ribbon fiber
- CML compatible electrical I/O
- XLPPI electric interface (with 1.5W max power)
- RoHS Compliant

Applications

- Rack to rack
- Data center
- Infiniband QDR, DDR and SDR
- 40G Ethernet

Absolute Maximum Ratings

Parameter	*Symbol*	*Min.*	*Max.*	*Units*	*Note*
Storage Temperature	Ts	-20	85	℃	
Supply Voltage	V_{cc}	-0.5	3.6	V	
Operating Case Temperature	T_{opc}	0	70	℃	Note 1
Voltage on LVTTL Input	Vilvttl	-0.5	V_{cc}+0.5	V	
LVTTL Output Current	Lolvttl	-	15	mA	
Voltage on Open Collector Output	Voco	0	6	V	
Relative Humidity	RH	-	85	%	
Receiver Input Optical power	Mip		2.4	dBm	Average, Note 2

Note 1: Ta: -10 to 60℃ with 1.5m/s airflow with an additional heat sink.

Note 2: Pin Receiver.

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Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Units	Note
Operating Temperature	Topc	0		70	℃	
Power Supply Voltage	V_{cc}	3.1	3.3	3.5	V	
Power Supply Current	I_{cc}			350	mA	
Total Power Consumption (XLPPI)				1.5	W	

Diagnostics Monitoring

Parameter	Symbol	Accuracy	Unit	Notes
Temperature	DMI_Temp	± 3	°C	Over operating temp
Voltage	DMI_VCC	± 0.15	V	Full operating range
Bias Current	DMI_RX_Ch	±10%	mA	Ch1~Ch4
RX Power	DMI_Ibias_Ch	± 2 dB	dBm	Ch1~Ch4

Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units	Notes
Power Consumption (XLPPI)				1.5	W	
Supply Current	ICC		300	350	mA	
Control I/O voltage, High	VIH	2.0		Vcc	V	
Control I/O voltage, Low	VIL	0		0.7	V	
Inter-Channel Skew	TSK			150	ps	
RESETL Duration			10		us	
RESETL De-assert time				100	ms	
Power on time				100	ms	

Transmitter Electro-optical Characteristics

***Vcc* = 3.1 V to 3.5 V, T_C = 0 °C to 70 °C**

Parameter	*Symbol*	*Min.*	*Typ.*	*Max.*	*Units*	*Notes*
Data Rate, each lane			10.3125	11.2	Gbps	
Average Optical power, each lane	Pavg	-7.6	-2	+1	dBm	
Optical Modulation Amplitude (OMA)	Poma	-5.6		+3	dBm	
Optical Center Wavelength	λ_C	840	850	860	nm	
RMS Spectrum Width	Pm			0.45	nm	
Extinction Ratio	ER	3	-	-	dB	
Peak Power, each lane	PPt			4	dBm	
Launch Power in OMA minus transmitter and Dispersion Penalty (TDP), each lane		-6.5			dB	
TDP, each lane				3.5	dB	
Relative Intensity Noise	Rin			-128	dB/Hz	12dB reflection
Optical Return Loss Tolerance				12	dB	
Encircled Flux		>86% at 19um <30% at 4.5um				
Transmitter Eye Mask Definition {X1,X2,X3,Y1,Y2,Y3}		0.23,0.34,0.43,0.27,0.33,0.4				
Average Launch Power OFF Transmitter, each lane	Poff			-30	dBm	
Single Ended output Voltage Tolerance		-0.3		4	V	Referred to signal common
AC common mode Voltage Tolerance		15			mV	RMS
Tx Input Differential Voltage	VI	90		1600	mV	
Tx Input Differential Impedance	ZIN	80	100	120	Ω	
Differential Input Return Loss		See IEEE 802.3ba 86A.4.11			dB	100MHz-11.1GHz
J2 Jitter Tolerance	Jt2			0.18	UI	
J9 Jitter Tolerance	Jt9			0.26	UI	
Data Dependent Pulse Width Shrinkage	DDPWS			0.07	UI	
Eye Mask Coordinates {X1,X2,Y1,Y2}		0.1, 0.31 95, 350			UI mV	

Receiver Electro-optical Characteristics

***Vcc* = 3.1 V to 3.5 V, T_C = 0 °C to 70 °C**

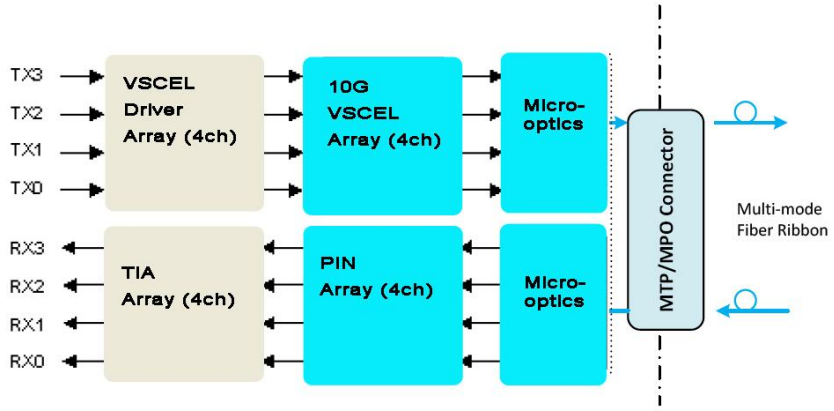
Parameter	*Symbol*	*Min.*	*Typ.*	*Max.*	*Units*	*Note*
Center Wavelength	λ_C	840	850	860	nm	
Damage Threshold	Thd	3.4			dBm	1
Average Power at Receiver Input, each lane		-9.5		2.4	dBm	
Receiver Reflectance				-12	dB	
OMA, each Lane				3	dBm	
Stressed Receiver Sensitivity in OMA, each Lane				-5.4	dBm	
Receiver Sensitivity per Channel	Psens		-12	-10	dBm	
Peak Power, each lane	PPr			4	dBm	
Receiver Jitter Tolerance Signal Level in OMA, each lane				-5.4	dBm	
Signal Detect -- Asserted	LosA	-21		-16	dBm	
Signal Detect -- Deasserted	LosD	-19		-13	dBm	
Signal Detect -- Hysteresis	LosH	0.5			dB	
Overload	Pin	+2.4			dBm	
Vertical Eye closure Penalty, each lane			1.9		dB	
Stressed Eye J2 Jitter, each lane			0.3		UI	
Stressed Eye J9 Jitter, each lane			0.47		UI	
Jitter Frequency and Peak-peak Amplitude		(75,5)			KHz	
		(375,1)			UI	
Single Ended Output Voltage tolerance		-0.3		4	V	Note 2
AC Common mode Voltage Tolerance				7.5	mV	RMS

Parameter	Symbol	Min.	Typ.	Max.	Units	Note
Termination Mismatch at 1MHz				5	%	
Differential Output Return Loss			See IEEE 802.3ba 86A.4.2.1		dB	100MHz-11.1GHz
Common-mode Output Return Loss			See IEEE 802.3ba 86A.4.2.2		dB	100MHz-11.1GHz
Rx Output Differential Voltage	Vo		600	800	mV	
Rx Output Rise and Fall Time	Tr/Tf			35	ps	20%~80%
J2 Jitter Tolerance	Jr2			0.46	UI	
J9 Jitter Tolerance	Jr9			0.63	UI	
Eye Mask Coordinates {X1,X2,Y1,Y2}			0.29,0.5 150,425		UI mV	

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

Note2: The single ended input voltage tolerance is the allowable range of the instantaneous input signals.

Block Diagram of Transceiver



The OPCS-MX3-85-CB converts parallel electrical input signals into parallel optical signals, by a driven Vertical Cavity Surface Emitting Laser (VCSEL) array. The transmitter module accepts electrical input signals compatible with Common Mode Logic (CML) levels. All input data signals are differential and internally terminated. The receiver module converts parallel optical input signals via a photo detector array into parallel electrical output signals. The receiver module outputs electrical signals are also voltage compatible with Common Mode Logic (CML) levels. All data signals are differential and support a data rates up to 10 Gbps per channel. Figure 1 shows the functional block diagram of the OPCS-MX3-85-CB QSFP Transceiver.

A single +3.3V power supply is required to power up the module. Both power supply pins VccTx and VccRx are internally connected and should be applied concurrently. As per MSA specifications the module offers 7 low speed hardware control pins (including the 2-wire serial interface): ModSelL, SCL, SDA, ResetL, LPMode, ModPrsL and IntL.

Module Select (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 – individual ModSelL lines for each QSFP module must be used.

Serial Clock (SCL) and Serial Data (SDA) are required for the 2-wire serial bus communication interface and enable the host to access the QSFP memory map.

The ResetL pin enables a complete module reset, returning module settings to their default state, when a low level on the ResetL pin is held for longer than the minimum pulse length. During the execution of a reset 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 (Interrupt) signal with the Data_Not_Ready bit negated in the memory map. Note that on power up (including hot insertion) the module should post this completion of reset interrupt without requiring a reset.

Low Power Mode (LPMode) pin is used to set the maximum power consumption for the module in order to protect hosts that are not capable of cooling higher power modules, should such modules be accidentally inserted.
Module Present (ModPrsL) is a signal local to the host board which, in the absence of a module, is normally pulled up to the host Vcc. When a module is inserted into the connector, it completes the path to ground though a resistor on the host board and asserts the signal. ModPrsL then indicates a module is present by setting ModPrsL to a “Low” state.

Interrupt (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 using the 2-wire serial interface. The IntL pin is an open collector output and must be pulled to the Host Vcc voltage on the Host board.

Pin Assignment

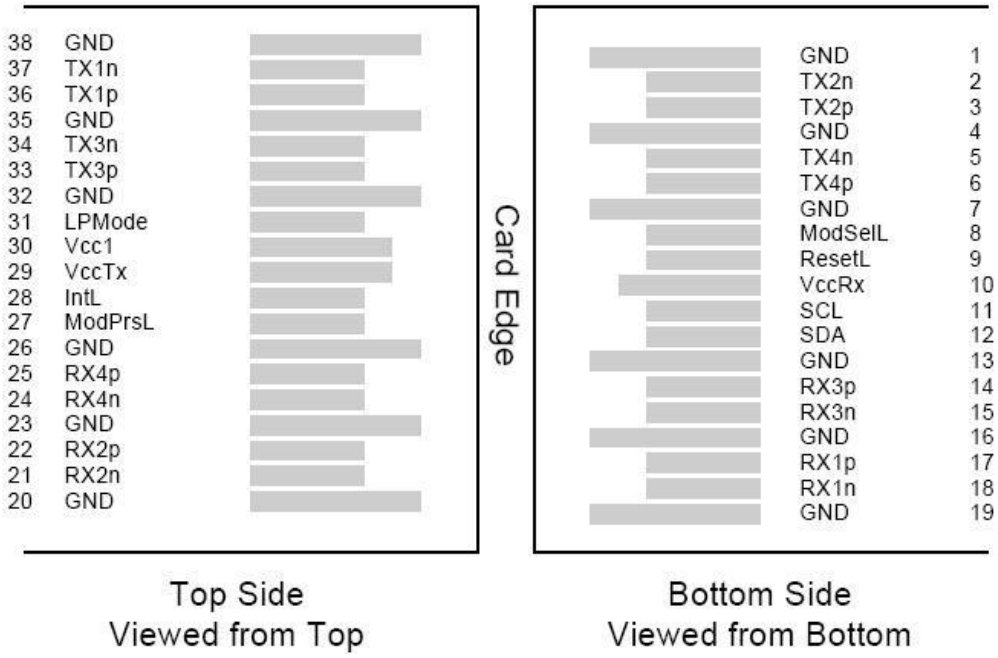


Figure: QSFP Transceiver Electrical Pad Layout

Pin Description

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	

PIN	Logic	Symbol	Name/Description	Note
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	+3.3V Power Supply transmitter	
30		Vcc1	+3.3V Power Supply	
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 and supply (power) common for QSFP modules. 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. VccRx, Vcc1 and VccTx are the receiver and transmitter power suppliers and shall be applied concurrently. Recommended host board power supply filtering is shown below. Vcc Rx, Vcc1 and Vcc Tx may be internally connected within the QSFP transceiver module in any combination. The connector pins are each rated for a maximum current of 500mA.

Optical Interface Lanes and Assignment

Figure 3 shows the orientation of the multi-mode fiber facets of the optical connector. Table 1 provides the lane assignment.

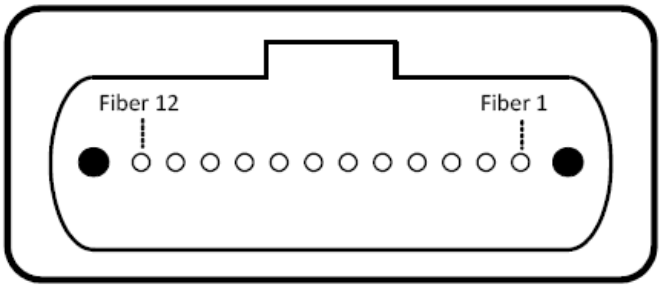
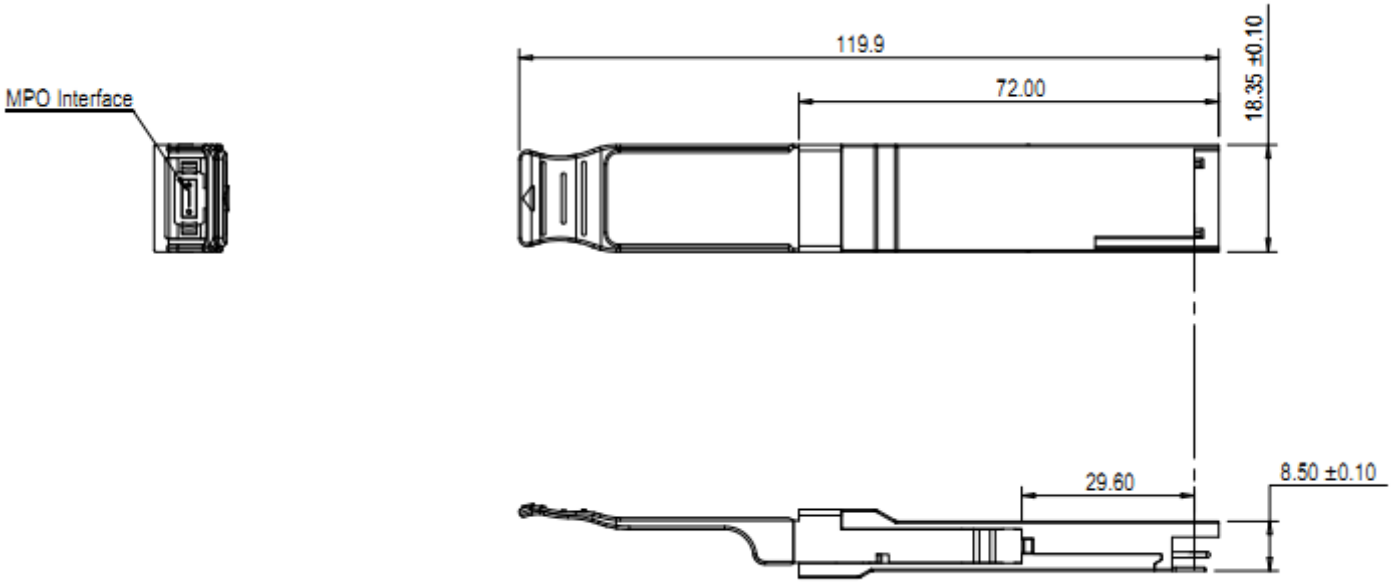


Figure 3: Outside view of the QSFP module MPO

Table 1: Lane assignment

Fiber #	Lane Assignment
1	RX0
2	RX1
3	RX2
4	RX3
5	Not used
6	Not used
7	Not used
8	Not used
9	TX3
10	TX2
11	TX1
12	TX0

Dimensions

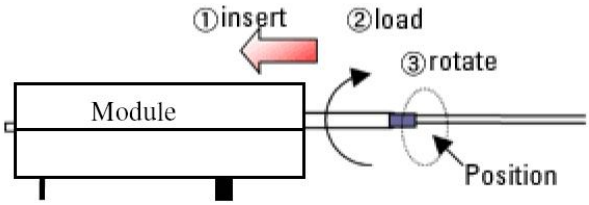


Optical Receptacle Cleaning Recommendations :

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 6 C - S 10 - 13 - C M

Product Code:
5=GBIC;
6=SFP-LC;
7=XFP;
8=XENPAK;
9=X2;
A=SFP+;
C=QSFP;
F=CFP;
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=11.09Gb/s;
R=20Gb/s;
S=40Gb/s;
M=100Base-X SGMII;
N=100/1000Base-X SGMII;

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

Reach:
Normal:
X1=Under 150m;
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)

Additional Feature:
M=Digital Optical Monitoring (DOM)
(RX_LOS for Copper TX);
F=with Fiber Stub;
I=with Isolator;
S=Customized Style

Model Number	*Part Number*	*Voltage*	*Temperature*
QSFP-40G-SR4	OPCS-MX3-85-CB	3.3V	0°C to 70 °C

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

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