

## Data Sheet

# 40Gb/s QSFP+ ER4 Optical Transceiver

P/N: WST-QSFP+ER4-C



### Features:

- Compliant with 40G Ethernet IEEE802.3bm and 40GBASE-ER4 Standard
- QSFP+ MSA compliant
- Compliant with QDR/DDR InfiniBand data rates
- Up to 11.3Gb/s data rate per wavelength
- 4 CWDM lanes MUX/DEMUX design
- Up to 40km transmission on single mode fiber (SMF)
- Maximum power consumption 3.5W
- LC duplex connector
- RoHS compliant
- Operating case temperature: 0 to 70°C

### Applications:

- 40GBASE-ER4 Ethernet Links
- InfiniBand QDR and DDR interconnects
- Client-side 40G Telecom connections
- Compatible with OTU3

### General Description

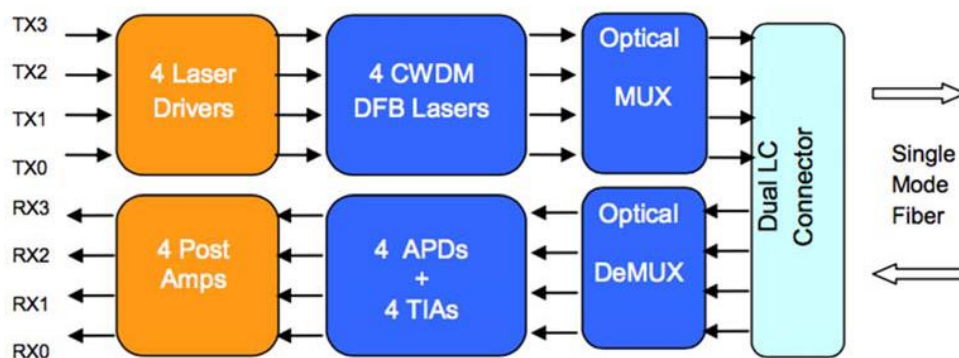
This product is a transceiver module designed for 40km optical communication applications. The design is compliant to 40GBASE-ER4 of the IEEE P802.3bm standard. The module converts 4 inputs channels (ch) of 10Gb/s electrical data to 4 CWDM optical signals, and multiplexes them into a single channel for 40Gb/s optical transmission. Reversely, on the receiver side, the module optically de-multiplexes a 40Gb/s input into 4 CWDM channels signals, and converts them to 4 channel output electrical data.

The central wavelengths of the 4 CWDM channels are 1271, 1291, 1311 and 1331 nm as members of the CWDM wavelength grid defined in ITU-T G694.2. It contains a duplex LC connector for the optical interface and a 38-pin connector for the electrical interface. To minimize the optical dispersion in the long-haul system, single-mode fiber (SMF) has to be applied in this module.

The product is designed with form factor, optical/electrical connection and digital diagnostic interface according to the QSFP+ Multi-Source Agreement (MSA). It has been designed to meet the harshest external operating conditions including temperature, humidity and EMI interference.

### Functional Description

This product converts the 4-channel 10Gb/s electrical input data into CWDM optical signals (light), by a driven 4-wavelength Distributed Feedback Laser (DFB) array. The light is combined by the MUX parts as a 40Gb/s data, propagating out of the transmitter module from the SMF. The receiver module accepts the 40Gb/s CWDM optical signals input, and de-multiplexes it into 4 individual 10Gb/s channels with different wavelength. Each wavelength light is collected by a discrete avalanche photodiode (APD), and then outputted as electric data after amplified first by a TIA and then by a post amplifier. Figure 1 shows the functional block diagram of this product.



Transceiver Block Diagram

### Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Units	Notes
Storage Temperature	T <sub>s</sub>	-40	85	deg C	
Power Supply Voltage	V <sub>CC</sub>	-0.5	4.0	V	
Relative Humidity (non-condensation)	RH	0	85	%	
Damage Threshold, each Lane	TH <sub>d</sub>	3.8		dBm	

### Recommended Operating Conditions and Power Supply Requirements

Parameter	Symbol	Min	Typical	Max	Units
Operating Case Temperature	T <sub>OP</sub>	0		70	deg C
Power Supply Voltage	V <sub>CC</sub>	3.135	3.3	3.465	V
Data Rate, each Lane			10.3125		Gb/s
Control Input Voltage High		2		V <sub>CC</sub>	V
Control Input Voltage Low		0		0.8	V
Link Distance with G.652	D			40	km

**Electrical Characteristics**

The following electrical characteristics are defined over the Recommended Operating Environment unless otherwise specified.

Parameter	Symbol	Min	Typical	Max	Units	Notes
Power Consumption				3.5	W	
Supply Current	I <sub>cc</sub>			1.1	A	
Transceiver Power-on Initialization Time				2000	ms	

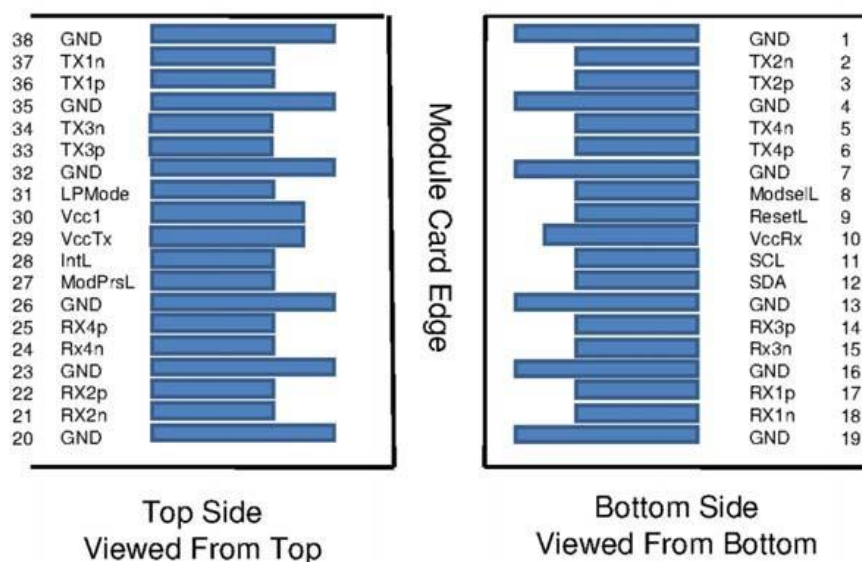
**Optical Characteristics**

Parameter	Symbol	Min	Typical	Max	Units	Notes
Wavelength Assignment	L0	1264.5	1271	1277.5	nm	
	L1	1284.5	1291	1297.5	nm	
	L2	1304.5	1311	1317.5	nm	
	L3	1324.5	1331	1337.5	nm	
<b>Transmitter</b>						
Side Mode Suppression Ratio	SMSR	30			dB	
Total Average Launch Power	P <sub>T</sub>			10.5	dBm	1
Average Launch Power, each Lane	P <sub>AVG</sub>	-2.7		4.5	dBm	1
Optical Modulation Amplitude (OMA), each Lane	P <sub>OMA</sub>	0.3		5.0	dBm	
Difference in Launch Power between any Two Lanes (OMA)	P <sub>tx,diff</sub>			4.7	dB	1
TDP, each Lane	TDP			2.6	dB	2
Average launch power of OFF transmitter, each lane				-30	dBm	
Extinction Ratio	ER	4.5			dB	
Optical Return Loss Tolerance	TOL			20	dB	
Transmitter Reflectance	R <sub>T</sub>			-12	dB	
Transmitter Eye Mask Definition {X1, X2, X3, Y1, Y2, Y3}		{0.25,0.4,0.45,0.25,0.28,0.4}				
Average Launch Power OFF Transmitter, each Lane	P <sub>off</sub>			-30	dBm	
<b>Receiver</b>						
Damage Threshold, each Lane	TH <sub>d</sub>	3			dBm	2
Average Receive Power, each Lane		-21.2		-4.5	dBm	

Receiver Reflectance	R <sub>R</sub>			-26	dB	
Receiver sensitivity (OMA) per Lane	SOMA			-19	dBm	3
LOS Assert	LOSA	-35			dBm	
LOS De-Assert	LOSD			-19	dBm	

## Notes:

1. Even if the TDP < 0.8 dB, the OMA min must exceed the minimum value specified here.
2. 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.
3. Measured with conformance test signal at receiver input for BER =  $1 \times 10^{-12}$ , and no error bit between the power range

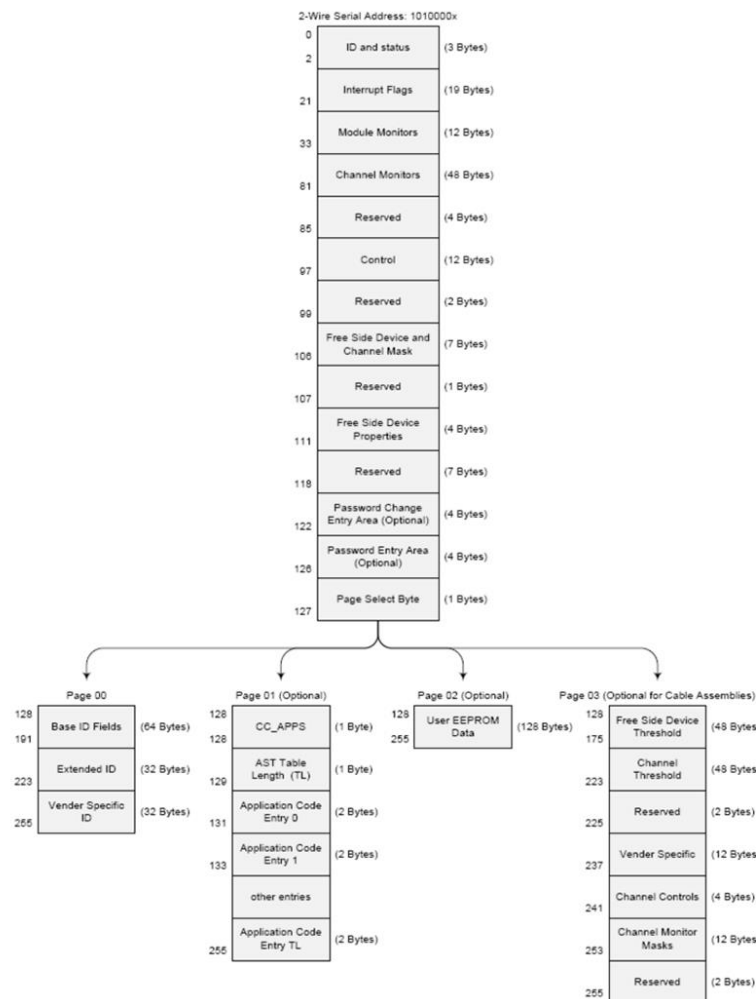
***Pin Assignments and Descriptions*****Figure 2. MSA compliant Connector**

PIN	Logic	Symbol	Name/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	LVC MOS-I/O	SCL	2-Wire Serial Interface Clock	
12	LVC MOS-I/O	SDA	2-Wire Serial Interface Data	
13		GND	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	
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	+3.3 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 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 receiving and transmission power suppliers and shall be applied concurrently. Recommended host board power supply filtering is shown in Figure 3 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.

***QSFP Memory Map***

### Digital Diagnostic Functions

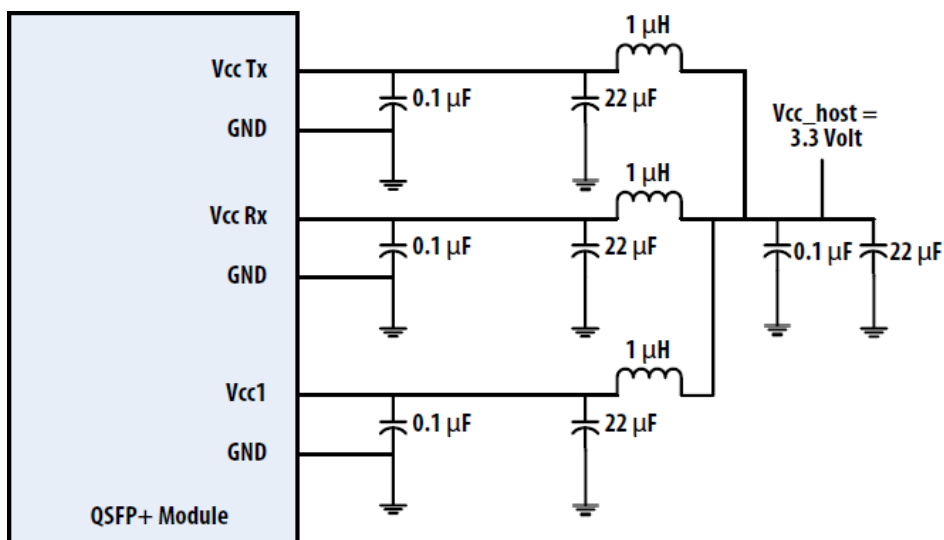
The following digital diagnostic characteristics are defined over the normal operating conditions unless otherwise specified.

Parameter	Symbol	Min	Max	Units	Notes
Temperature monitor absolute error	DMI_Temp	-3	+3	deg C	Over operating temperature range
Supply voltage monitor absolute error	DMI_VCC	-0.1	0.1	V	Over full operating range
Channel RX power monitor absolute error	DMI_RX_Ch	-2	2	dB	1
Channel Bias current monitor	DMI_Ibias_Ch	-10%	10%	mA	
Channel TX power monitor absolute error	DMI_TX_Ch	-2	2	dB	1

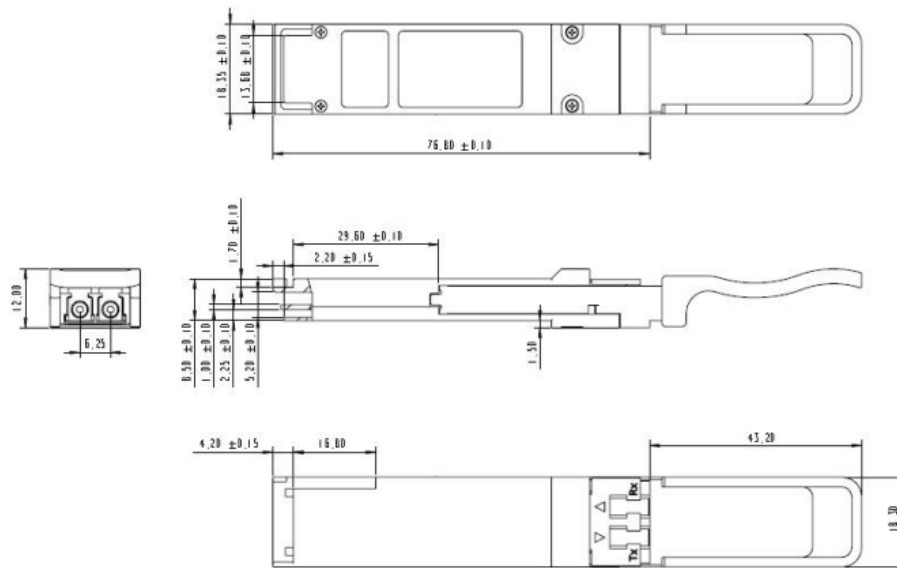
Notes:

- Due to measurement accuracy of different single mode fibers, there could be an additional +/-1 dB fluctuation, or a +/- 3 dB total accuracy.

### Recommended Power Supply Filter



Recommended Power Supply Filter

**Mechanical Design Diagram**

Unit: mm

**Figure 4. Mechanical Outline**

**Ordering Information**

Part No	Specification									
	Package	Data rate per Lane	Laser	Optical Power	Detector	Max. Receive Sensitivity (OMA)	Temp	Reach	Other	Application code
WST-QSFP+ER4-C	QSFP+	10.3125 Gbps each Channel	CWDM DFB	-2.7~ +4.5 each Channel	APD	-19 dBm each Channel	0~70°C	40 km	DDM RoHS	40G Ethernet InfiniBand QDR DDR

**Modification History**

Revision	Date	Description	Originator	Review	Approved
V1.0	20-May-2018	New Issue	Ivy Chen	Wayne Liao	Wayne Liao
V1.1	22-Sep-2022	Update Order information	ShaoYu Lee	Tom Tang	Wayne Liao
V1.2	18-Feb-2022	Update Applications	ShaoYu Lee	Tom Tang	Wayne Liao

**Headquarters**

16F-5, No. 75, Sec. 1, Xintai 5th Rd., Xizhi Dist.,  
New Taipei City 22101, Taiwan  
Tel: +886-2-2698-7208  
Fax: +886-2-2698-7210  
Email: [sales@wavesplitter.com](mailto:sales@wavesplitter.com)  
Website: <https://wavesplitter.com/>