

## 100Gb/s QSFP28 FR Single Lambda Optical Transceiver P/N: WST-QS28-FR-C



### Applications:

- Data Center Interconnect
- 100G Ethernet

### Features:

- QSFP28 MSA compliant
- 802.3cu compliant
- 100GE FR1 Specification compliant
- Non-hermetic package design
- Maximum power consumption 4.0 W
- LC connector
- Up to 2 km transmission on single mode fiber with FEC
- Operating case temperature: 0°C~70°C
- Single 3.3 V power supply
- RoHS 2 compliant

### Description

WST-QS28-FR-C is a transceiver module designed for 2 km optical communication applications, and it is compliant with IEEE 802.3cu 100GE FR1 MSA standard. This module can convert 4-channel 25.78125 Gbit/s electrical data to 1-channel 106.25 Gbit/s optical signals. Similarly, it can convert 1-channel 106.25 Gbit/s optical signals to 4-channel output electrical data on the receiver side. It has been designed to meet the harshest external operating conditions including temperature, humidity and EMI interference. The module offers very high functionality and feature integration, accessible via a two-wire serial interface.

**Absolute Maximum Ratings**

It has to be noted that the operation in excess of any individual absolute maximum ratings might cause permanent damage to this module.

Parameter	Symbol	Min	Max	Units	Notes
Storage Temperature	T <sub>S</sub>	-40	85	°C	
Power Supply Voltage	V <sub>CC</sub>	-0.3	3.6	V	
Relative Humidity (non-condensation)	RH	0	85	%	
Damage Threshold	TH <sub>d</sub>	5.5		dBm	

**Recommended Operating Conditions and Power Supply Requirement**

Parameter	Symbol	Min	Typical	Max	nits	Notes
Operating Case Temperature	T <sub>OP</sub>	0		70	°C	
Power Supply Voltage	V <sub>CC</sub>	3.135	3.3	3.465	V	
Electrical Data Rate, each Lane (NRZ)			25.78125		Gb/s	
Optical Data Rate (PAM4)			53.125		GBd	
Data Rate Accuracy		-100		100	ppm	
Link Distance with G.652	D	2		2000	m	

**Electrical Characteristics**

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

Parameter	Test Point	Min	Typical	Max	Units	Notes
Power Consumption				4.0	W	
Supply Current	I <sub>CC</sub>			1.212	A	
<b>Transmitter (each Lane)</b>						
Data Rate, each lane		25.78125 ± 100ppm			GBd	
Overload Differential Voltage pk-pk	TP1a			900	mV	
Common Mode Voltage (V <sub>cm</sub> )	TP1	-350		2850	mV	
Differential Termination Resistance Mismatch	TP1			10	%	At 1MHz

Common Mode Noise	RMS			17.5	mV	
Differential Return Loss	SDD22	See CEI-28-VSR Equation (13-2)			dB	
Common Mode to Differential	SDC22	See CEI-28-VSR Equation (13-4)			dB	
Common Mode Return Loss	SCC22			-2		From 250MHz to 30 GHz
Transition Time		9.5			ps	20%~80%
Vertical Eye Closure	VEC			5.5	dB	
Eye Width at 10-15 probability	EW15	0.57			UI	
Eye Height at 10-15 probability	EH15	228			mV	
<b>Receiver (each Lane)</b>						
Differential Voltage, pk-pk	TP4	900			mV	
Common Mode Voltage (Vcm)	TP4	-350		2850	mV	
Differential Termination Resistance Mismatch	TP4			10	%	At 1MHz
Differential Return Loss	SDD11	See CEI-28-VSR Equation (13-2)			dB	
Differential to Common Mode Conversion	SCD11	See CEI-28-VSR Equation (13-3)			dB	
Stressed Input Test		See CEI-28-VSR Section 13.3.11.2.1				

## Notes:

1. Vcm is generated by the host. Specification includes effects of ground offset voltage.
2. From 250MHz to 30GHz.

**Optical Characteristics**

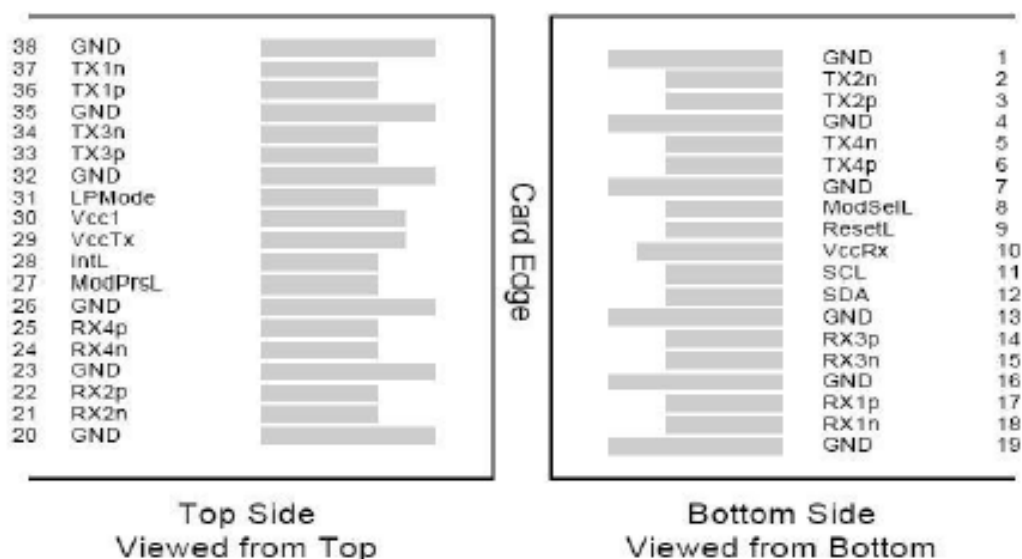
Parameter	Symbol	Min	Typical	Max	Units	Notes
<b>Transmitter</b>						
Data Rate		53.125 ± 100 ppm			GBd	
Modulation Format		PAM4				
Center Wavelength	$\lambda_t$	1304.5		1317.5	nm	
Side Mode Suppression Ratio	SMSR	30			dB	
Average Launch Power	P <sub>AVG</sub>	-3.1		4	dBm	1
Outer Optical Modulation Amplitude (OMA <sub>outer</sub> )	P <sub>OMA</sub>	-0.2		4.2	dBm	2
Launch Power in OMA <sub>outer</sub> minus for TDECQ < 1.4 dB		-0.1		4.2	dBm	

for $1.4 \text{ dB} \leq \text{TDECQ} \leq 3.4 \text{ dB}$		$-1.5 + \text{TDECQ}$				
Transmitter and Dispersion Eye Closure for PAM4 (TDECQ)	TDECQ			3.4	dB	
Transmitter eye closure for PAM4 (TECQ)	TECQ			3.4	dB	
Extinction Ratio	ER	3.5			dB	
Transmitter transition time	RIN			17	Ps	
Optical Return Loss Tolerance	TOL			17.1	dB	
Transmitter Reflectance	RT			-26	dB	
Average Launch Power of OFF Transmitter	Poff			-15	dBm	
<b>Receiver</b>						
Center Wavelength	$\lambda_r$	1304.5		1317.5	nm	
Damage Threshold	THd	5.0			dBm	
Average Receive Power		-7.1		4.0	dBm	
Receive Power ( $\text{OMA}_{\text{outer}}$ )				4.2	dBm	
Receiver Sensitivity ( $\text{OMA}_{\text{outer}}$ ) for $\text{TECQ} < 1.4 \text{ dB}$ for $1.4 \text{ dB} \leq \text{TECQ} \leq 3.4 \text{ dB}$	SEN			-4.5 $-5.9 + \text{SECQ}$	dBm	
Stressed Receiver Sensitivity ( $\text{OMA}_{\text{outer}}$ )	SRS			-2.5	dBm	
Receiver Reflectance	RR			-26	dB	
LOS Assert	LOSA	-15			dBm	
LOS Deassert	LOSD			-8.6	dBm	
LOS Hysteresis	LOSH	0.5			dB	
<b>Conditions of Stress Receiver Sensitivity Test (Note 8)</b>						
Stressed eye closure for PAM4 (SECQ), lane under test				3.4	dB	

## Notes:

1. Receiver Receiver sensitivity ( $\text{OMA}_{\text{outer}}$ ), each lane (max) is informative and is defined for a transmitter with a value of SECQ up to 3.4 dB
2. Measured with conformance test signal for  $\text{BER} = 2.4 \times 10^{-4}$ .
3. These test conditions are for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

## Pin Assignment

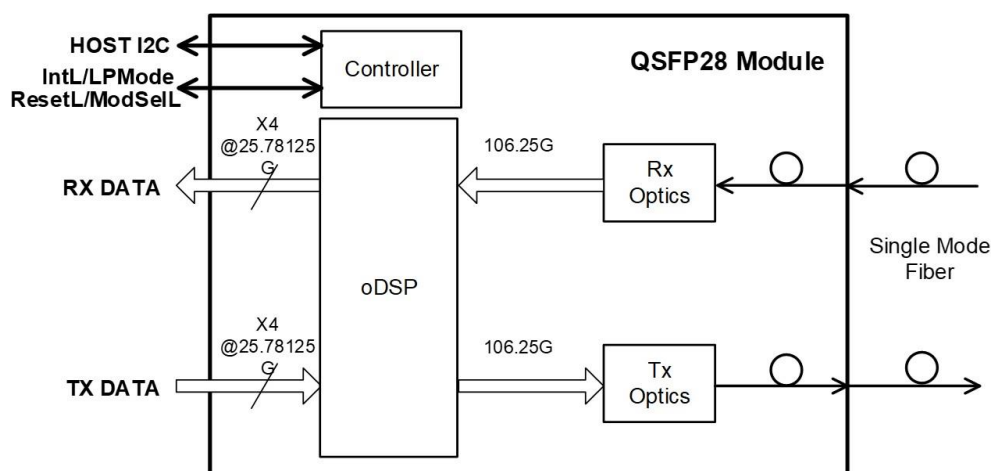


PIN	Logic	Symbol	Name/Description	Notes
1		GND	Ground	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	
3	CML-I	Tx2p	Transmitter Non-Inverted Data output	
4		GND	Ground	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	
6	CML-I	Tx4p	Transmitter Non-Inverted Data output	
7		GND	Ground	1
8	LVTTLL-I	ModSelL	Module Select	
9	LVTTLL-I	ResetL	Module Reset	
10		VccRx	+3.3V Power Supply Receiver	2
11	LVTMOS-I/O	SCL	2-Wire Serial Interface Clock	
12	LVTMOS-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 Non-Inverted Data Output	
25	CML-O	Rx4p	Receiver 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 QSFP28 modules. All are common within the QSFP28 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 below. Vcc Rx, Vcc1 and Vcc Tx may be internally connected within the QSFP28 transceiver module in any combination. The connector pins are each rated for a maximum current of 1000mA.

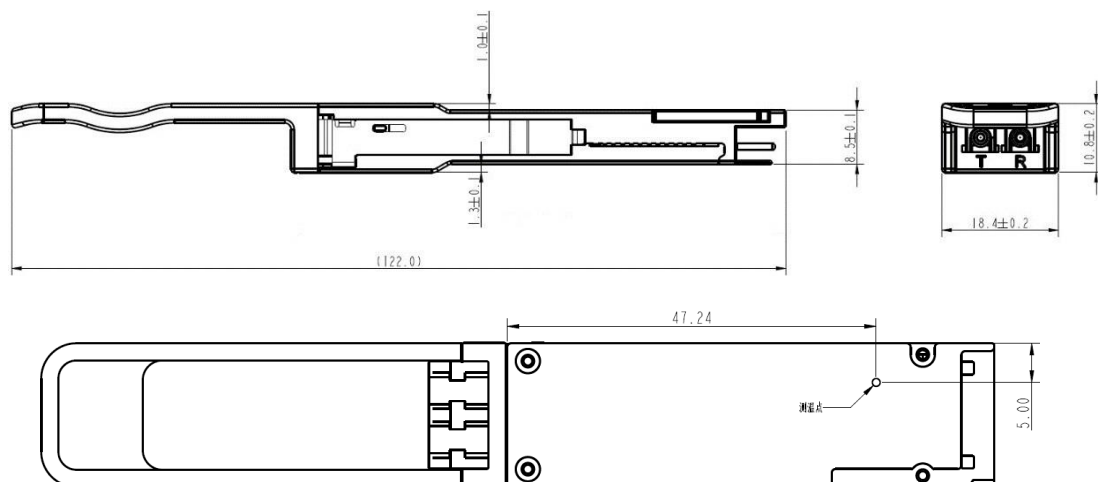
**Recommended Host - Transceiver Interface Block Diagram****Digital Diagnostic Functions**

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	degC	Over operating temperature range
Supply Voltage Monitor Absolute	DMI_VCC	-0.1	0.1	V	Over full operating range
RX Power Monitor Absolute Error	DMI_RX	-3	3	dB	1
Bias Current Monitor	DMI_Ibias	-10%	10%	mA	
TX Power Monitor Absolute Error	DMI_TX	-3	3	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

**Mechanical Drawing**

Unit: mm

**Ordering Information**

Part No	Specification									
	Package	Data rate per Lane	Laser	Optical Power	Detector	Max. Receive Sensitivity (OMA)	Temp	Reach	Other	Application code
WST-QS28-FR-C	QSFP28	Input 25.78 Gb/s per lane / Optical 53.125 Gbd (PAM4)	1310nm EML	-3.1 ~ +4 dBm	PIN	max(-4.5 · SECQ-5.9)	0~70°C	2km w/ FEC	DDM RoHS	100G Ethernet

**Modification History**

Revision	Date	Description	Originator	Review	Approved
V1.0	01-Sep-2021	New Issue	Shao Yu Lee	Tom Tang	Wayne Liao



**Taipei 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

**U.S. Branch**  
 2080 Rancho Higuera Ct.  
 Fremont, CA 94539,  
 USA  
 Tel: 510-651-7800  
 Fax: 510-651-7822

**ShenZhen Branch**  
 610#, 6F, No.204  
 Building, 2nd Industrial  
 zone Nanyou, Nanshan  
 district, Shenzhen,  
 Guangdong China  
 518054  
 Tel: +86-755-86265980

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