

200Gb/s QSFP56 FR4 2km SMF Optical Transceiver

P/N: WST-QS56-FR4-C



Applications:

- Data Center Interconnect
- 200G Ethernet
- Enterprise networking

Features:

- IEEE802.3bs 200GBASE-FR4 compliant
- QSFP56 MSA compliant
- 4 CWDM lanes MUX/DEMUX design
- Supports 212.5Gb/s aggregate bit rate
- Up to 2km transmission on single mode fiber (SMF) with FEC
- 200GAUI-4 electrical interface
- Maximum power consumption 6.5W
- LC duplex connector
- Operating case temperature: 10 to 60°C
- RoHS compliant

Description

This product is a 200Gb/s transceiver module designed for 2km optical communication applications. The design is compliant to IEEE802.3bs 200GBASE-FR4 standard. The module converts 4 inputs channels (ch) of 50Gb/s (PAM4) electrical data to 4 CWDM optical signals, and multiplexes them into a single channel for 200Gb/s(PAM4) optical transmission. Reversely, on the receiver side, the module optically de-multiplexes a 200Gb/s(PAM4) 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 G.694.2. 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. Host FEC is required to support up to 2km fiber transmission.

The product is designed with form factor, optical/electrical connection and digital diagnostic interface according to the QSFP56 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 200Gb/s(PAM4) electrical input data into CWDM optical signals (light), by a driven 4-wavelength EMLs. The light is combined by the MUX parts as a 200Gb/s data, propagating out of the transmitter module from the SMF. The receiver module accepts the 200Gb/s CWDM

optical signals input, and de-multiplexes it into 4 individual 50Gb/s channels with different wavelength. Each wavelength light is collected by a discrete photo diode, and then outputted as electric data after amplified by a TIA and a post amplifier. Analog CDR is used to recovery PAM4 signals. Figure 1 shows the functional block diagram of this product.

A single +3.3V power supply is required to power up this product. 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, this product responds to 2- wire serial communication commands. The ModSelL allows the use of this product on a single 2- wire interface bus – individual ModSelL lines 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 reset, returning the 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 it indicates a completion of the reset interrupt. The product 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 product 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 product, is normally pulled up to the host Vcc. When the product is inserted into the connector, it completes the path to ground through a resistor on the host board and asserts the signal. ModPrsL then indicates its present by setting ModPrsL to a “Low” state.

Interrupt (IntL) is an output pin. “Low” indicates a possible 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.

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	TS	-40	85	deg C	
Operating Case Temperature	TOP	10	60	deg C	
Power Supply Voltage	VCC	0.5	3.6	V	
Relative Humidity (non-condensation)	RH	0	85	%	
Damage Threshold, each Lane	TH _d	3.5		dBm	

Recommended Operating Conditions

Parameter	Symbol	Min	Typical	Max	Units	Notes
Operating Case Temperature	TOP	10		60	deg C	
Power Supply Voltage	VCC	3.135	3.3	3.465	V	
Data Rate, each Lane			26.56		GBd	
			53.125			
Data Rate Accuracy		-100		100	ppm	
Pre-FEC Bit Error Ratio				2.4x10 ⁻⁴		
Post-FEC Bit Error Ratio				1x10 ⁻¹²		1
Control Input Voltage High		2		V _{cc}	V	
Control Input Voltage Low		0		0.8	V	
Link Distance with G.652	D	0.002		2	km	2

Notes:

1. FEC provided by host system.
2. FEC required on host system to support maximum distance.

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				6.5	W	
Supply Current	I _{cc}			1.96	A	
Transmitter (each Lane)						
Signaling Rate, each Lane	TP 1	26.5625 ± 100 ppm			GBd	
Differential pk-pk Input Voltage Tolerance	TP 1a	900			mVpp	1
Differential Termination Mismatch	TP 1			10	%	
Differential Input Return Loss	TP 1	IEEE 802.3-2015 Equation (83E-5)			dB	
Differential to Common Mode Input Return Loss	TP 1	IEEE 802.3-2015 Equation (83E-6)			dB	
Module Stressed Input Test	TP 1a	See IEEE 802.3bs 120E.3.4.1				2
Single-ended Voltage Tolerance Range (Min)	TP 1a	-0.4 to 3.3			V	
DC Common Mode Input Voltage	TP	-		2850	mV	3

	1	350				
Receiver (each Lane)						
Signaling Rate, each lane	TP 4	26.5625 ± 100 ppm			GBd	
Differential Peak-to-Peak Output Voltage	TP 4			9 0 0	mVpp	
AC Common Mode Output Voltage, RMS	TP 4			17.5	mV	
Differential Termination Mismatch	TP 4			1 0	%	
Differential Output Return Loss	TP 4	IEEE 802.3-2015 Equation (83E-2)				
Common to Differential Mode Conversion Return Loss	TP 4	IEEE 802.3-2015 Equation (83E-3)				
Transition Time, 20% to 80%	TP4	9.5			ps	
Near-end Eye Symmetry Mask Width (ESMW)	TP 4		0.26 5		UI	
Near-end Eye Height, Differential	TP 4	7 0			mV	
Far-end Eye Symmetry Mask Width (ESMW)	TP 4		0.2		UI	
Far-end Eye Height, Differential	TP 4	3 0			mV	
Far-end Pre-cursor ISI Ratio	TP 4	- 4 . 5		2 . 5	%	
Common Mode Output Voltage (Vcm)	TP 4	-350		2850	mV	3

Notes:

1. With the exception to IEEE 802.3bs 120E.3.1.2 that the pattern is PRBS31Q or scrambled idle.
2. Meets BER specified in IEEE 802.3bs 120E.1.1.
3. DC common mode voltage generated by the host. Specification includes effects of ground offset voltage.

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	
Transmitter						
Data Rate, each Lane		26.5625 ± 100 ppm			GBd	
Modulation Format		PAM4				
Side-mode Suppression Ratio	SMSR	30			dB	Modulated
Total Average Launch Power	PT			10.7	dBm	
Average Launch Power, each Lane	PAVG	-4.2		4.7	dBm	1
Outer Optical Modulation Amplitude (OMA _{outer}), each Lane	POMA	-1.2		4.5	dBm	2
Launch Power in OMA _{outer} minus TDECQ, each Lane		-2.6			dB	For ER ≥4.5dB
Launch Power in OMA _{outer} minus TDECQ, each Lane		-2.5			dB	For ER <4.5dB
Transmitter and Dispersion Eye Clouser for PAM4, each Lane	TDECQ			3.3	dB	
Extinction Ratio	ER	3.5			dB	
Difference in Launch Power between any Two Lanes (OMA _{outer})				4	dB	
RIN _{16.5OMA}	RIN			-132	dB/Hz	

Optical Return Loss Tolerance	TOL			16.5	dB	
Transmitter Reflectance	T_R			-26	dB	
Average Launch Power of OFF Transmitter, each Lane	P_{off}			-20	dB m	
Receiver						
Data Rate, each Lane		26.5625 ± 100 ppm			GBd	
Modulation Format		PAM4				
Damage Threshold, each Lane	TH_d	5.7			dB m	3
Average Receive Power, each Lane		-8.2		4.7	dB m	4
Receive Power (OMA_{outer}), each Lane				4.5	dB m	
Difference in Receiver Power between any Two Lanes (OMA_{outer})				4.1	dB	
Receiver Sensitivity (OMA_{outer}), each Lane	SEN			-6.0	dB m	For BER of 2.4E-4
Stressed Receiver Sensitivity (OMA_{outer}), each Lane	SRS			-3.6	dB m	5
Receiver Reflectance	RR			-26	dB	
LOS Assert	LOSA	-30			dB m	
LOS De-assert	LOSD			-12	dB m	
LOS Hysteresis	LOSH	0.5			dB	
Stressed Conditions for Stress Receiver Sensitivity (Note 6)						
Stressed Eye Closure for PAM4 (SECQ), Lane under Test		0.9		3. 4	dB	
OMA_{outer} of each Aggressor Lane			1.5		dB m	

Notes:

1. Average launch power, each lane (min) is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value

above this does not ensure compliance.

2. Even if the TDECQ < 1.4 dB for an extinction ratio of ≥ 4.5 dB or TDECQ < 1.3 dB for an extinction ratio of < 4.5 dB, the OMA_{outer} (min) must exceed the minimum value specified here.
3. The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level.
4. Average receive power, each lane (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.
5. Measured with conformance test signal for BER = 2.4×10^{-4} .
6. These test conditions are for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

Digital Diagnostic Functions

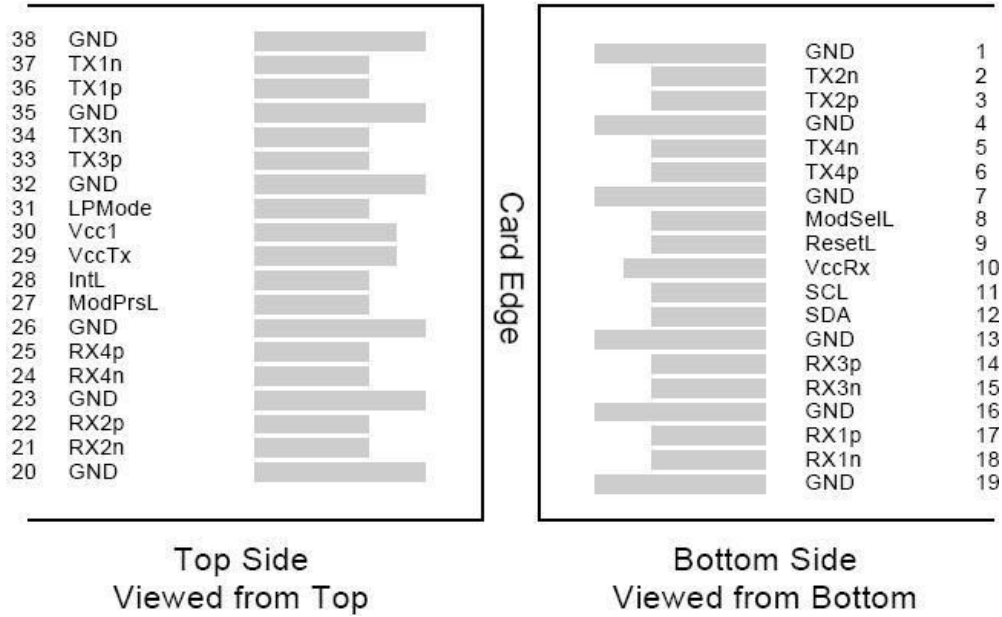
The following digital diagnostic characteristics are defined over the normal operating conditions unless otherwise specified.

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:

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

Pin Assignment



Pin out of Connector Block on Host Board

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	

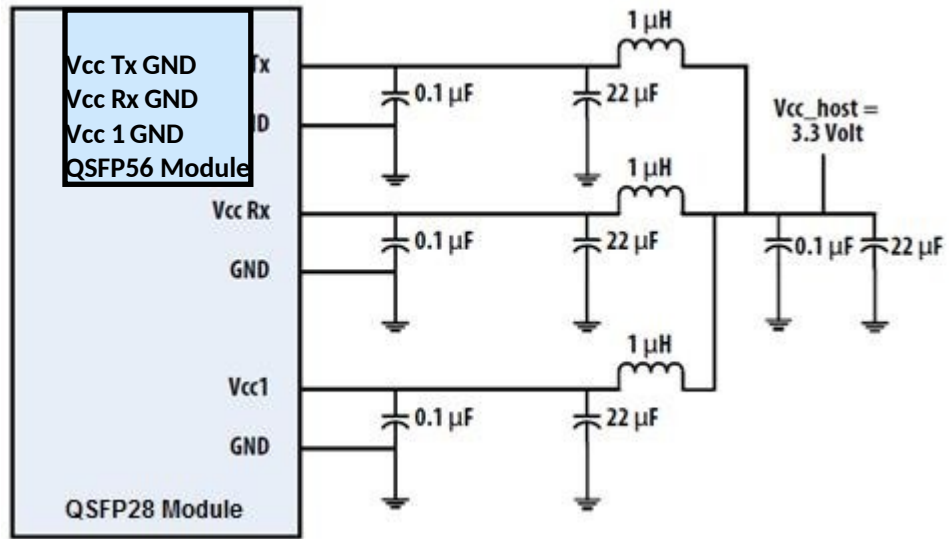
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1 4	CML-O	Rx3p	Receiver Non-Inverted Data Output	
1 5	CML-O	Rx3n	Receiver Inverted Data Output	
1 6		GND	Ground	1
1 7	CML-O	Rx1p	Receiver Non-Inverted Data Output	
1 8	CML-O	Rx1n	Receiver Inverted Data Output	
1 9		GND	Ground	1
2 0		GND	Ground	1
2 1	CML-O	Rx2n	Receiver Inverted Data Output	
2 2	CML-O	Rx2p	Receiver Non-Inverted Data Output	
2 3		GND	Ground	1
2 4	CML-O	Rx4n	Receiver Inverted Data Output	1
2 5	CML-O	Rx4p	Receiver Non-Inverted Data Output	
2 6		GND	Ground	1
2 7	LVTTTL-O	ModPrsL	Module Present	
2 8	LVTTTL-O	IntL	Interrupt	
2 9		VccTx	+3.3 V Power Supply transmitter	2
3		Vcc1	+3.3 V Power Supply	2

0				
3 1	LVTTTL-I	LPMode	Low Power Mode	
3 2		GND	Ground	1
3 3	CML-I	Tx3p	Transmitter Non-Inverted Data Input	
3 4	CML-I	Tx3n	Transmitter Inverted Data Output	
3 5		GND	Ground	1
3 6	CML-I	Tx1p	Transmitter Non-Inverted Data Input	
3 7	CML-I	Tx1n	Transmitter Inverted Data Output	
3 8		GND	Ground	1

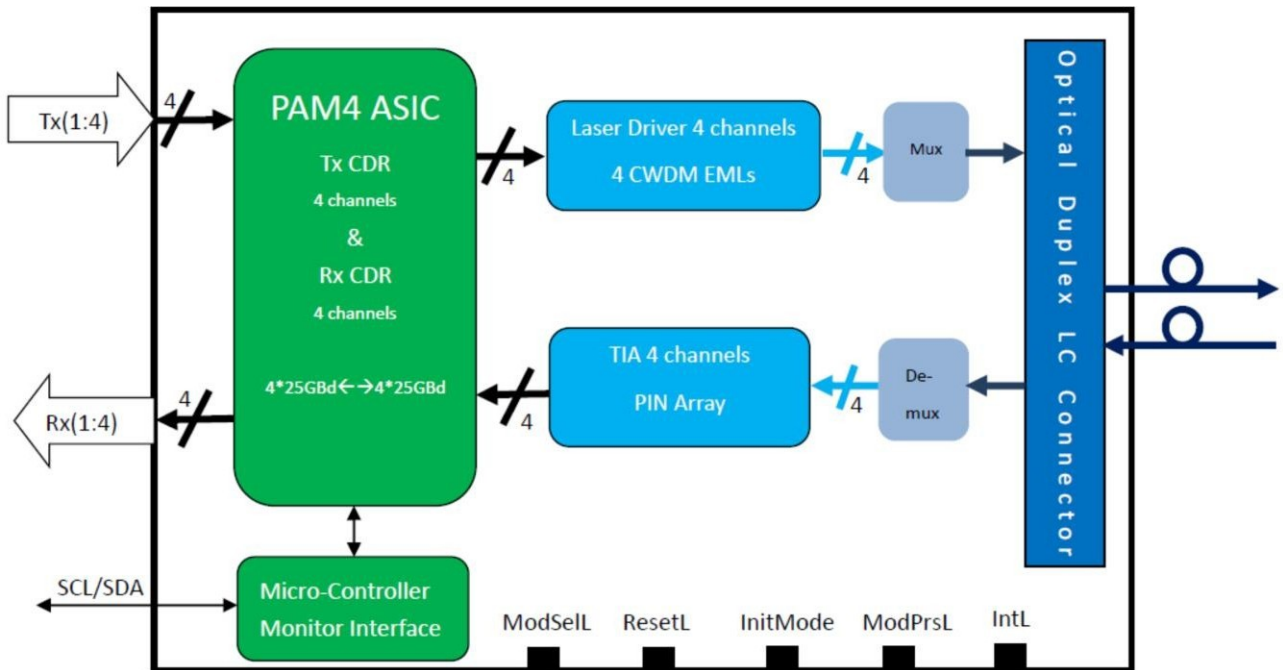
Notes:

1. GND is the symbol for signal and supply (power) common for QSFP56 modules. All are common within the QSFP56 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 below. VccRx, Vcc1 and Vcc Tx may be internally connected within the QSFP56 transceiver module in any combination. The connector pins are each rated for a maximum current of 1000mA.

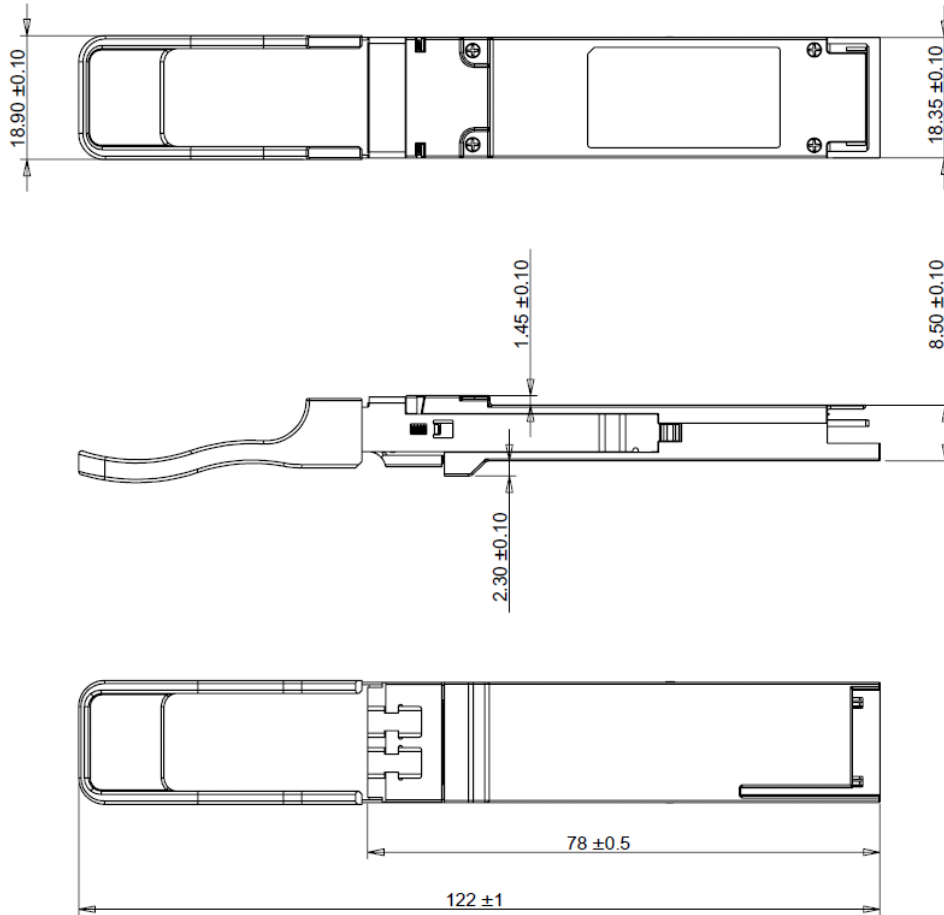
Recommended Power Supply Filter



Recommended Host - Transceiver Interface Block Diagram



Mechanical Drawing



Unit: mm

Ordering Information

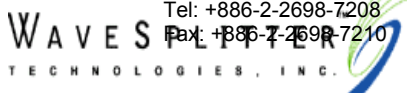
Part No	Specification									
	Package	Data rate	Laser	Optical Power	Detector	Max. Receive Sensitivity (OMA)	Temp	Reach	Other	Application code
WST-QS56-FR4-C	QSFP56	53.125Gbps (PAM4) per channel	1271nm 1291nm 1311nm 1331nm EML	-4.2~ +4.7 dBm each Channel	PIN	-6.0 dBm each Channel	10~60°C	2km	DDM RoHS	200G Ethernet

Modification History

Revision	Date	Description	Originator	Review	Approved
V1.0	22-Jan-2020	New Issue	Lulu Chen	Tom Tang	Wayne Liao

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