WAVESPLITTER™ TECHNOLOGIES, INC.

Data Sheet

100G/40G QSFP28 SR4, 100m Transceiver
P/N: WST-QS28-SR4-C

Features:

- Hot Pluggable QSFP28 form factor
- Supports 25.78125Gb/s per channel
- Supports 10.3125Gb/s per channel
- Up to 70m transmission with OM3 multi- mode fiber
- Up to 100m transmission with OM4 multi- mode fiber
- Standard MPO pluggable connector
- Low Power Dissipation, Max 1.8W
- Operating Case Temperature: 0°C ~70°C
- SFF-8636 Management Interface
- SFF-8661: Pluggable Module
- SFF-8679: General Electrical
- IEEE 802.3bm: Physical Layer Specifications and Management Parameters
- ROHS 2.0: Environment Safety
- Class 1M Laser Safety per IEC 60825-1

Applications:

- Ethernet for 100G/ 40G SR4
- InfiniBand EDR, FDR, & QDR
- Proprietary Interconnections

General Product Characteristics

Parameter	Value	Unit	Comments
Module Form Factor	QSFP28	As defined by SFF-8661	Module Form Factor
Number of Lanes	4 TX and 4 RX		
Aggregate Data Rate	103.125	Gb/s	
Data Rate per Lane	25.78125	Gb/s	
Aggregate Data Rate	41.25	Gb/s	
Data Rate per Lane	10.3125	Gb/s	
Protocols Supported	InfiniBand, Ethernet		
Electrical Interface and Pin-out	38-pin edge connector		Pin-out as defined by SFF- 8679
Standard Optical Cable Type	Multimode OM3 (<70m) Multimode OM4 (≤100m)		
Maximum Power Consumption	1.8	Watts	Varies with output voltage swing and pre-emphasis settings

Management Interface	Serial, I²C-based, 400 kHz maximum frequency		As defined by SFF-8636
BER	$<10^{-12}$		PRBS:31, input signal swing 800mV differential

Absolute Maximum Ratings

Exceeding the limits below may damage the active optical cable permanently.

Parameter	Symbol	Min.	Typ.	Max.	Unit.	Ref.
Maximum Supply Voltage	V_{cc}	-0.5		3.6	V	
Storage Temperature	T_{sto}	-40		85	℃	
Case Operating Temperature	T_{op}	0		70	℃	
Relative Humidity	RH	0		85	%	Note1

Notes:

1. Non-condensing.

Parameters

Parameter	Symbol	Min.	Typ.	Max.	Unit.	Ref.
Supply Voltage	V_{cc}	3.14		3.46	V	
Power Consumption	P_{Con}			1.8	W	
Bit Rate	BR		25.78125		Gb/s	①
			10.3125		Gb/s	
Bit Error Ratio	BER			10^{-12}		②
Center wavelength	λ_c	840		860	nm	③
Number of Lanes		4				
Management Interface		Serial, I2C-based, maximum frequency 400 kHz				④
Logic Input Voltage High	V_{ih}	2		Vcc+0.3	V	
Logic Input Voltage Low	V_{il}	-0.3		0.8	V	

1. Single lane
2. PRBS= 2^{31}-1 @ 25.78125Gb/s
3. As defined by IEEE Std. 802.3bm -2015
4. As defined by SFF-8636

Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit.	Ref.
Transceiver Power Supply Current	I_{cc}			600	mA	
Transceiver Power on Initialization Time	T_{init}			2000	ms	
Transmitter at TP1a						
Differential Data Input Voltage Peak to Peak Swing	$V_{in,pp}$			900	mV	
Common Mode Noise RMS				17.5	mV	
Differential Input Return Loss	SDD22	Per OIF CEI-28G-VSR and CAUI-4 Requirements			dB	
Common Mode to Differential Conversion and Differential to Common Mode Conversion	SDD22 SCD22				dB	
Common Mode Return Loss	SCC22				dB	
Transition Time, 20% to 80%	T_r, T_f	10			ps	
Common Mode Voltage	V_{cm}	-0.3		2.8	V	
Eye Width @ 1E-15 Probability	EW15	0.46			UI	
Eye Height @ 1E-15 Probability	EH15	94			mv	
Receiver at TP4						
Differential Data Output Voltage Peak to Peak Swing	V_{opp}	300		900	mV	
Differential Output Impedance	Zos	90	100	110	Ohms	
Common Mode Voltage	V_{cm}	-0.35		2.85	V	
Common Mode Noise RMS				17.5	mV	
Differential Output Return Loss	SDD22	Per OIF CEI-28G-VSR and CAUI-4 Requirements			dB	
Common Mode to Differential Conversion and Differential to Common Mode Conversion	SDD22 SCD22					
Common Mode Return Loss	SCC22			-2	dB	
Transition Time, 20% to 80%	T_r, T_f	10			ps	
Eye Width @ 1E-15 Probability	EW15	0.57			UI	
Eye Height @ 1E-15 Probability	EH15	228			mV	

Optical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit.	Ref.
Transmitter						
Signaling Speed per Lane		25.78125 ± 100ppm			Gb/s	
		10.3125 ± 100ppm				
Lane wavelengths (Range)	λ	840		860	nm	
RMS Spectral Width	△λ			0.6	nm	
Average launch power, each lane	P_{avg}	-8.4		2.4	dBm	
Transmit OMA per Lane	OMA	-6.4		3	dBm	
Transmitter and dispersion eye closure (TDEC), each lane	TDEC			4.3	dBm	
Launch power in OMA minus TDEC		–7.3			dBm	
Extinction ratio	ER	2			dB	
Average launch power of OFF transmitter, each lane	P_{off}			-30	dBm	
Encircled flux		≥ 86% at 19μm ≤ 30% at 4.5μm				
Transmitter eye mask definition		{0.3, 0.38, 0.45, 0.35, 0.41, 0.50}				①
Receiver						
Signaling Speed per Lane		25.78125 ± 100ppm			Gb/s	
Lane wavelengths (Range)	λ	840		860	nm	
Damage threshold		+3.4			dBm	
Average power at receiver input, each lane		-10.3		2.4	dBm	②
Receive Power, each lane (OMA)				3	dBm	
Receiver Reflectance				-12	dB	
Receiver sensitivity in OMA				-7.2	dBm	③

Notes:

1. Hit ratio = $5x10^{-5}$ per sample.
2. Average receive power, each lane (min) is informative and not the principal indicator of signal strength.
3. Measured with conformance test signal for BER=$5x10^{-5}$

Pin Descriptions

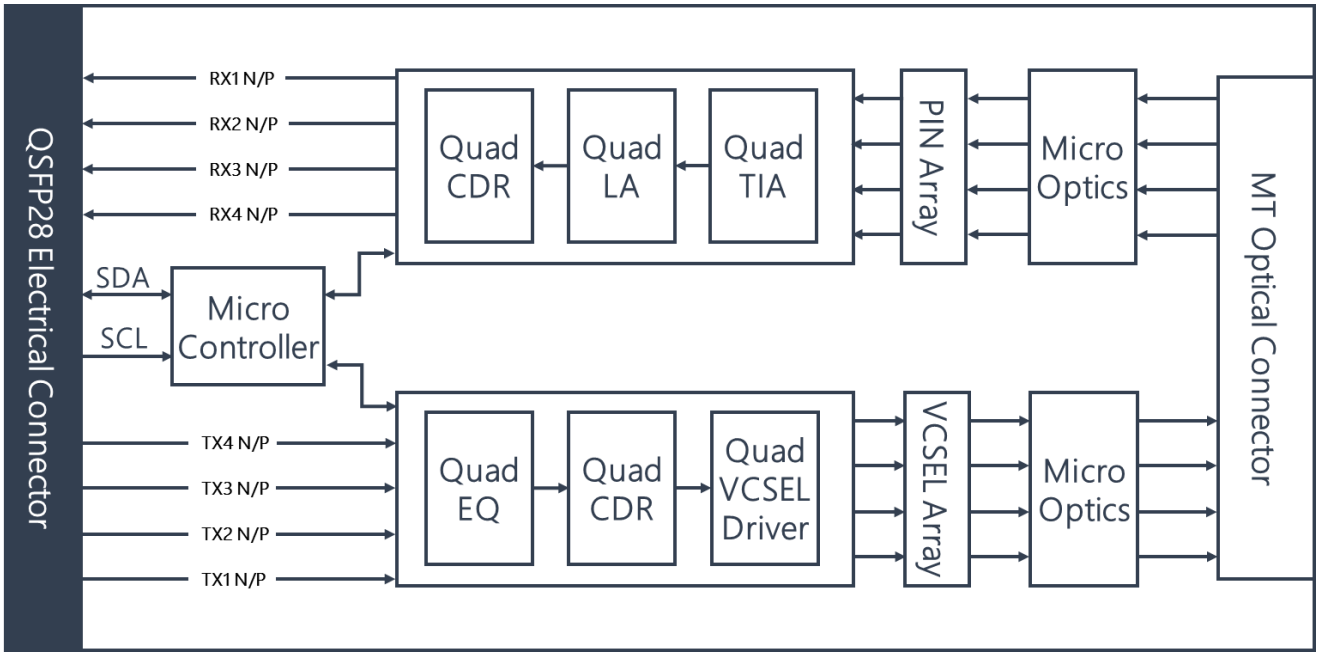
PIN	Symbol	Description	Ref.
1	GND	Ground	
2	TX2n	Transmitter Inverted Data Input	
3	TX2p	Transmitter Non-Inverted Data Input	
4	GND	Ground	Note1
5	TX4n	Transmitter Inverted Data Input	
6	TX4p	Transmitter Non-Inverted Data Input	
7	GND	Ground	Note1
8	ModSelL	Module Select	Note2
9	ResetL	Module Reset	Note2
10	V_{cc} RX	+3.3V Receiver Power Supply Receiver	
11	SCL	2-wire Serial Interface Clock	Note2
12	SDA	2-wire Serial Interface Data	Note2
13	GND	Ground	Note1
14	RX3p	Receiver Non-Inverted Data Output	
15	RX3n	Receiver Inverted Data Output	
16	GND	Ground	Note1
17	RX1p	Receiver Non-Inverted Data Output	
18	RX1n	Receiver Inverted Data Output	
19	GND	Ground	Note1
20	GND	Ground	Note1
21	RX2n	Receiver Inverted Data Output	
22	RX2p	Receiver Non-Inverted Data Output	
23	GND	Ground	Note1
24	RX4n	Receiver Inverted Data Output	
25	RX4p	Receiver Non-Inverted Data Output	
26	GND	Ground	Note1
27	ModPrsL	Module Present, internal pulled down to GND	
28	IntL	Interrupt output, should be pulled up on host board	
29	Vcc TX	+3.3V Transmitter Power Supply	
30	Vcc1	+3.3V Power Supply	
31	LPMode	Low Power Mode	Note2
32	GND	Ground	
33	TX3p	Transmitter Non-Inverted Data Input	
34	TX3n	Transmitter Inverted Data Input	
35	GND	Ground	

36	TX1p	Transmitter Non-Inverted Data Input	
37	TX1n	Transmitter Inverted Data Input	
38	GND	Ground	Note1

Notes:

1. GND is the symbol for signal and supply (power) common for the module. All are common within the module and all module voltages are reference to this potential unless otherwise noted. Module circuit ground is isolated from module chassis ground within the module.
2. Open collector should be pulled up with 4.7~10K ohms on the host board to a voltage between 3.15V and 3.6V.

Recommended Host Board Schematic



Memory Map

	2-Wire Serial Address 1010000x
	Lower Page 00h
0	Identifier
1 - 2	Status
3 - 21	Interrupt Flags
22-23	Free Side Device Monitors
34-81	Channel Monitors
82-85	Reserved
86-98	Control
99	Reserved
100 - 104	Hardware Interrupt Pin Masks
105 - 106	Vendor Specific
107	Reserved
108 - 110	Free Side Device Properties
111 - 112	Assigned for use by PCI Express
113	Free Side Device Properties
114 - 118	Reserved
119 - 122	Password Change Entry Area (Optional)
123 -	Password Entry Area (Optional) 126
127	Page Select Byte

	Optional	Optional	Optional
Upper Page 00h	Page 01h	Page 02h	Page 03h
128 Identifier	128 CC_APPS		
129-191 Base ID Fields	129 AST Table Length (TL)		128-175 Free Side Device Thresholds
	130-131 Application Code Entry 0		
	132-133 Application Code Entry 1		
192-223 Extended ID	134-253 other entries	128-255 User EEPROM data	176-223 Channel Thresholds
224-255 Vendor Specific ID			224 TX EQ & RX Emphasis Magnitude ID
			225 RX output amplitude indicators
			226-241 Channel Monitor Masks
	254-255 Application Code Entry TL		252-255 Reserved

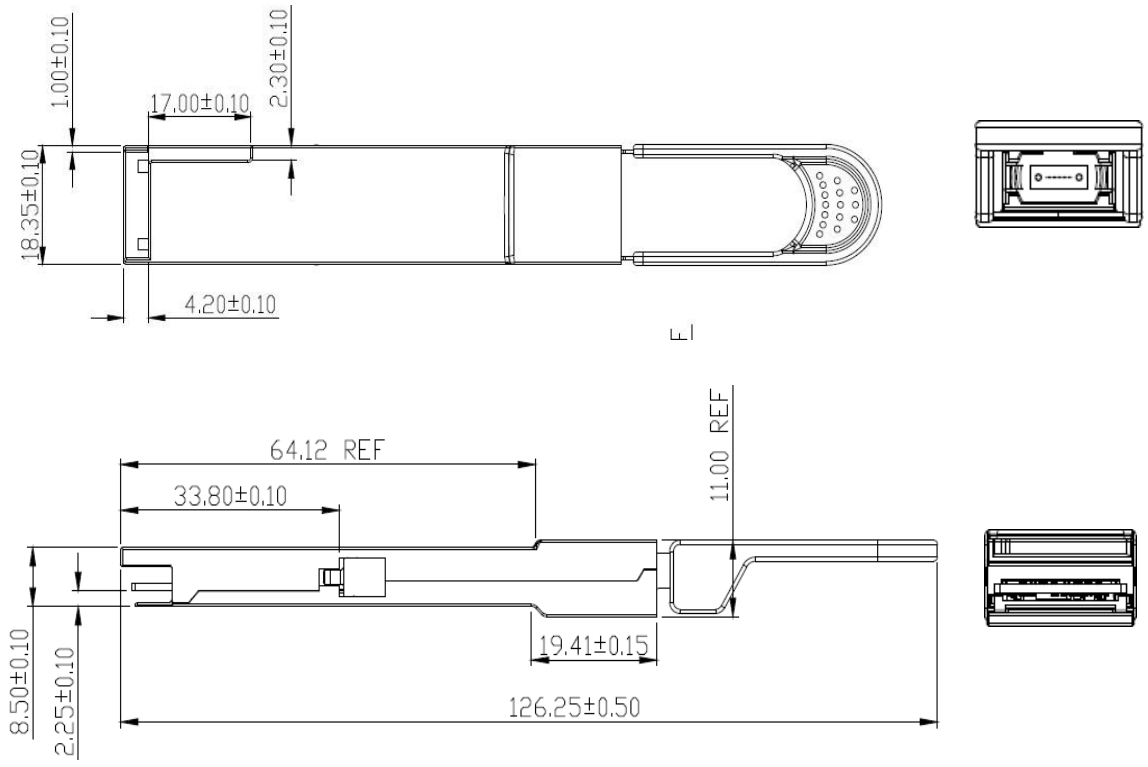
Data Address	Length (Byte)	Name of Length	Description and Contents
Base ID Fields			
128	1	Identifier	Type of Serial transceiver (11h=QSFP28)
129	1	Ext. Identifier	Extended identifier of type serial transceiver (8Ch=2.0W Max)
130	1	Connector	Code of optical connector type (0Ch=MPO)
131-138	8	Specification compliance	100G-SR4
139	1	Encoding	64B/66B
140	1	BR, Nominal	Nominal baud rate, unit of 100Mbps
141	1	Ext. RateSelect	(0000h)
142	1	Length (SMF)	Link length supported for 9/125um fiber, units of 1km
143	1	Length (OM3 50um)	Link length supported for OM3 fiber, units of 2m
144	1	Length (OM2 50um)	Link length supported for 50/125um OM2 fiber, units of 1m
145	1	Length (OM1 62.5um)	Link length supported for 62.5/125um fiber, units of 1m
146	1	Length (Copper)	Link length of copper or active cable, units of 1 m (note 1)Link length supported for 50/125 um fiber (OM4), units of 2 m) when Byte 147 declares 850nm VCSEL
147	1	Device Tech	850nm VCSEL
148-163	16	Vendor Name	Vendor name: WAVESPLITTER
164	1	Extended Module	Module code for Infiniband (07h=SDR/DDR/QDR)
165-167	3	Vendor OUI	SFP transceiver vendor OUI ID: 00 0F 0E
168-183	16	Vendor PN	Part Number: “WST-QS28-SR4-C” (ASCII)
184-185	2	Vendor rev	Revision level for part number: 40
186-187	2	Wavelength or Copper cable Attenuation	Noninal Laser Wavelength (Wavelength=value/20 in nm) (4268h=850nm)
188-189	2	Wavelength tolerance	07D0h=10nm
190	1	Max case temp.	Maximum case temperature in degrees C (46h=70C)
191	1	CC_BASE	Check code for base ID fields (addresses 128-190)

Extended ID Fields			
192	1	Extended specification	02h: 100GBASE-SR4 or 25GBASE-SR
193-195	3	Option	(0FC114h = Fixed on Tx EQ and Rx Emph/Amp, Tx squelch on and Rx squelch disable, Tx/Rx CDR on, TX_FAULT and_DISABLE supported)
196-211	16	Vendor SN	Serial number “THYQ420001” (ASCII)
212-219	8	Date code	Manufacturing date code
220	1	Diagnostic Monitoring Type	Average power, Transmitter power measurement =3Ch
221	1	Enhanced Options	00h
222	1	Reserved	67h=25.78125G per channel
223	1	CC_EXT	Check code for the extended ID Fields (addresses 192 to 222)
Vendor Specific ID Fields			
224-255	12	Reserved	Reserved for SFF-8436

Table 1 - EEPROM Serial ID Memory Contents (A2h)

Mechanical Design Diagram

Product shall be of design, construction and physical dimensions specified on applicable product drawing.



Unit: mm

Laser Safety

All WaveSplitter transceivers are Class I products per CDRH 21 CFR 1040 and Laser Notice 50 standards. They must be operated under specified operating condition.

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-SR4-C	QSFP28	25.78125 Gbps/ 10.3125 GBs each Channel	850nm VCSEL	-8.4~ +2.4 each Channel	PIN	-7.2dBm each Channel	0~70°C	70m via OM3 and 100m via OM4	DDM RoHS	100GBASE-SR4 Ethernet

Modification History

Revision	Date	Description	Originator	Review	Approved
V1	5-Jul-2019	New Issue	Ivy Chen	Wayne Liao	Wayne Liao
V1.1	12-Jul-2019	Update connector type	Ivy Chen	Wayne Liao	Wayne Liao
V1.2	13-Jul-2020	Add EEPROM table	Elma Yueh	Ivy Chen	Wayne Liao
V1.3	10-May-2021	Update Product Characteristics	Shao-Yu Lee	Wayne Liao	Wayne Liao

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