



Features

- Compliant with QSFP28 Standard SFF-8636 Rev 2.9
- Compliant with 100G Lambda MSA 100G-LR Rev 2.0
- High speed I/O electrical interface (CAUI-4)
- Single 3.3V Supply Voltage
- Maximum power consumption 4.5W
- 0-70 °C Case Operating Temperature
- 1311nm EML laser and PIN Receiver Array
- QSFP28 MSA package with duplex LC connector
- Two Wire Serial Interface with Digital Diagnostic Monitoring
- Complies with EU Directive 2011/65/EU (RoHS compliant)
- Class 1 Laser

Absolute Maximum Ratings

Table 1 – Absolute Maximum Ratings

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Storage Temperature	T _s	-40	-	+85	°C	
Supply Voltage	V _{CC}	-0.3	-	3.6	V	
Relative Humidity (non-condensing)	RH	5	-	95	%	
Data Input Voltage – Differential	IV _{DIP} -V _{DIN} I	-	-	1.0	V	
Control Input Voltage	V _I	-0.3	-	V _{CC} +0.5	V	
Control Output Current	I _O	-20	-	20	mA	

Recommended Operating Conditions
Table 2 – Recommended Operating Conditions

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Operating Case Temperature	T_{OPR}	0	-	70	°C	
Power Supply Voltage	V_{CC}	3.135	3.3	3.465	V	
Instantaneous peak current at hot plug	I_{CC_IP}	-	-	1800	mA	
Sustained peak current at hot plug	I_{CC_SP}	-	-	1485	mA	
Maximum Power Dissipation	P_D	-	-	4.5	W	
Maximum Power Dissipation, Low Power Mode	P_{DLP}	-	-	1.5	W	
Signalling Rate	SR	-	53.125	-	GBd	
Control Input Voltage High	V_{IH}	$V_{CC} \cdot 0.7$	-	$V_{CC} + 0.3$	V	
Control Input Voltage Low	V_{IL}	-0.3	-	$V_{CC} \cdot 0.3$	V	
Two Wire Serial Interface Clock Rate	-	-	-	400	kHz	
Power Supply Noise	-	-	-	66	mVpp	10Hz -10MHz
Rx Differential Data Output Load	-	-	100	-	ohms	
Operating Distance	-	2	-	10000	m	

Optical and Electrical Characteristics

Table 3 – Transmitter Optical Specifications

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Wavelength	λ_c	1304.5	1311	1317.5	nm	
Side mode suppression ratio	SMSR	30	-	-	dB	
Average Optical Launch Power	P_{OUT}	-1.4	-	4.5	dBm	
Average Launch Power Tx_Off	P_{OUT_OFF}	-	-	-15	dBm	
Extinction Ratio	ER	3.5	-	-	dB	
Outer Optical Modulation Amplitude	OMA_{outer}	0.7	-	4.7	dBm	
Launch Power in OMA_{outer} minus TDECQ for ER ≥ 4.5 dB	$OMA_{outer} - TDECQ$	-0.7	-	-	dBm	
Launch Power in OMA_{outer} minus TDECQ for ER < 4.5 dB	$OMA_{outer} - TDECQ$	-0.6	-	-	dBm	
Transmitter and dispersion eye closure	TDECQ	-	-	3.4	dB	
TDECQ – $10 \cdot \log_{10}(C_{eq})$				3.4	dB	
$RIN_{15.6OMA}$	RIN	-	-	-136	dB/Hz	
Optical return loss tolerance	ORLT	-	-	15.6	dB	
Transmitter transition time		-	-	17	ps	
Transmitter reflectance	TR	-	-	-26	dB	

Table 4 – Receiver Optical Specifications

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Wavelength	λ_c	1304.5	1311	1317.5	nm	
Damage Threshold		5.5	-	-	dBm	
Average receive power		-7.7	-	4.5	dBm	
Receive power (OMA _{outer})	RP	-	-	4.7	dBm	
Receiver reflectance	RR			-26	dB	
Receiver sensitivity (OMA _{outer})	RS	max(-6.1, SECQ-7.5)			dBm	
Stressed receiver sensitivity	SRS	-	-	-4.1	dBm	
Stressed Receiver Sensitivity Test Conditions:						
Stressed eye closure for PAM4 (SECQ)	SECQ	-	-	3.4	dB	
SECQ – 10*log ₁₀ (C _{eq})				3.4	dB	

Table 5 – Electrical Specifications

High-Speed Signal: Compliant to CAUI-4 (IEEE 802.3bm)

Low-Speed Signal: Compliant to SFF-8679

Transmitter (Module Input)						
Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Differential Data Input Amplitude	$V_{IN,P-P}$	95	-	900	mVpp	Note 1
Differential Termination Mismatch		-	-	10	%	
LPMode, Reset and ModSelL	V_{IL}	-0.3	-	$V_{CC} \cdot 0.3$	V	
	V_{IH}	$V_{CC} \cdot 0.7$	-	$V_{CC} + 0.3$	V	
Receiver (Module Output)						
Differential Data Output Amplitude	$V_{OUT,P-P}$	250	-	900	mVpp	Note 1
Differential Termination Mismatch		-	-	10	%	
Output Rise/Fall Time, 20%~80%	T_R	9.5	-	-	ps	
ModPrsL and IntL	V_{OL}	0	-	0.4	V	$I_{OL} = 4mA$
	V_{OH}	$V_{CC} - 0.5$	-	$V_{CC} + 0.3$	V	$I_{OL} = -4mA$

Note 1: Amplitude customization beyond these specs is dependent on validation in customer system

Timing

Table 6 – Timing for QSFP28 Soft Control and Status Functions

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Initialization Time	t_init	-	-	10	s	Note 1
Reset Init Assert Time	t_reset_init	-	-	2	µs	
Serial Bus Hardware Ready Time	t_serial	-	-	2000	ms	
Monitor Data Ready Time	t_data	-	-	2000	ms	
Reset Assert Time	t_reset	-	-	10	s	Note 1
LPMODE Assert Time	ton_LPMODE	-	-	100	µs	
LPMODE De-assert Time	toff_LPMODE	-	-	10	s	Note 1
IntL Assert Time	ton_IntL	-	-	200	ms	
IntL Deassert Time	toff_IntL	-	-	500	µs	
Rx LOS Assert Time	ton_lol	-	-	100	ms	
Tx Fault Assert Time	ton_Txfault	-	-	200	ms	
Flag Assert Time	ton_flag	-	-	200	ms	
Mask Assert Time	ton_mask	-	-	100	ms	
Mask Deassert Time	toff_mask	-	-	100	ms	
Application or Rate Select Change Time	t_ratesel	-	-	N/A	ms	Note 2
Power_over-ride or Power-set Assert Time	ton_Pdown	-	-	100	ms	
Power_over-ride or Power-set De-assert Time	toff_Pdown	-	-	10	s	Note 1

Note 1: DSP limitation.

Note 2: This feature is unsupported.

Table 7 – I/O Timing for Squelch & Disable

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Rx Squelch Assert Time	ton_Rxsq			100	ms	
Rx Squelch Deassert Time	toff_Rxsq			1500	ms	
Tx Squelch Assert Time	ton_Txsq			400	ms	
Tx Squelch Deassert Time	toff_Txsq			400	ms	
Tx Disable Assert Time	ton_txdis			100	ms	
Tx Disable Deassert Time	toff_txdis			400	ms	
Rx Output Disable Assert Time	ton_rxdis			100	ms	
Rx Output Disable Deassert Time	toff_rxdis			100	ms	
Squelch Disable Assert Time	ton_sqdis			100	ms	
Squelch Disable Deassert Time	toff_sqdis			100	ms	

Table 8 – Digital Diagnostics

Parameter	Range	Accuracy	Unit	Calibration
Temperature	0 to 70	±3	°C	Internal
Voltage	0 to V _{CC}	3%	V	Internal
Tx Bias Current	0 to 100	10%	mA	Internal
Tx Output Power	-1.4 to 4.5	±3	dB	Internal
Rx Power	-7.7 to 4.5	±3	dB	Internal

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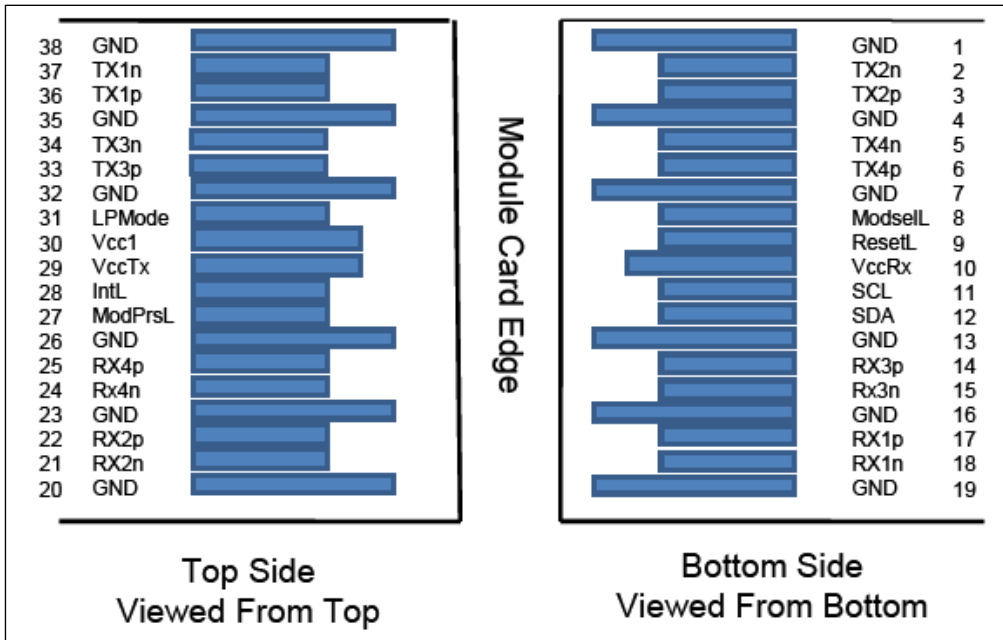
Table 9 – Pin Definitions

Pin	Logic	Symbol	Description	Plug Sequence	Notes
1		GND	Ground	1	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	3	
3	CML-I	Tx2p	Transmitter Non-Inverted Data Input	3	
4		GND	Ground	1	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	3	
6	CML-I	Tx4p	Transmitter Non-Inverted Data Input	3	
7		GND	Ground	1	1
8	LVTTL-I	ModselL	Module Select	3	
9	LVTTL-I	ResetL	Module Reset	3	
10		Vcc Rx	+3.3V Power Supply Receiver	2	2
11	LVC MOS-I/O	SCL	2-wire serial interface clock	3	
12	LVC MOS-I/O	SDA	2-wire serial interface data	3	
13		GND	Ground	1	1
14	CML-O	Rx3p	Receiver Non-Inverted Data Output	3	
15	CML-O	Rx3n	Receiver Inverted Data Output	3	
16		GND	Ground	1	1
17	CML-O	Rx1p	Receiver Non-Inverted Data Output	3	
18	CML-O	Rx1n	Receiver Inverted Data Output	3	
19		GND	Ground	1	1
20		GND	Ground	1	1
21	CML-O	Rx2n	Receiver Inverted Data Output	3	
22	CML-O	Rx2p	Receiver Non-Inverted Data Output	3	
23		GND	Ground	1	1
24	CML-O	Rx4n	Receiver Inverted Data Output	3	
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	3	
26		GND	Ground	1	1
27	LVTTL-O	ModPrsL	Module Present	3	
28	LVTTL-O	IntL	Interrupt	3	
29		Vcc Tx	+3.3V Power supply transmitter	2	2
30		Vcc1	+3.3V Power supply	2	2
31	LVTTL-I	LPMODE	Low Power Mode	3	
32		GND	Ground	1	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	3	
34	CML-I	Tx3n	Transmitter Inverted Data Input	3	
35		GND	Ground	1	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	3	
37	CML-I	Tx1n	Transmitter Inverted Data Input	3	
38		GND	Ground	1	1

Note1: GND is the symbol for signal and supply (power) common for the QSFP+ module. 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.

Note2: Vcc Rx, Vcc1 and Vcc Tx are the receiver and transmitter power supplies and shall be applied concurrently.

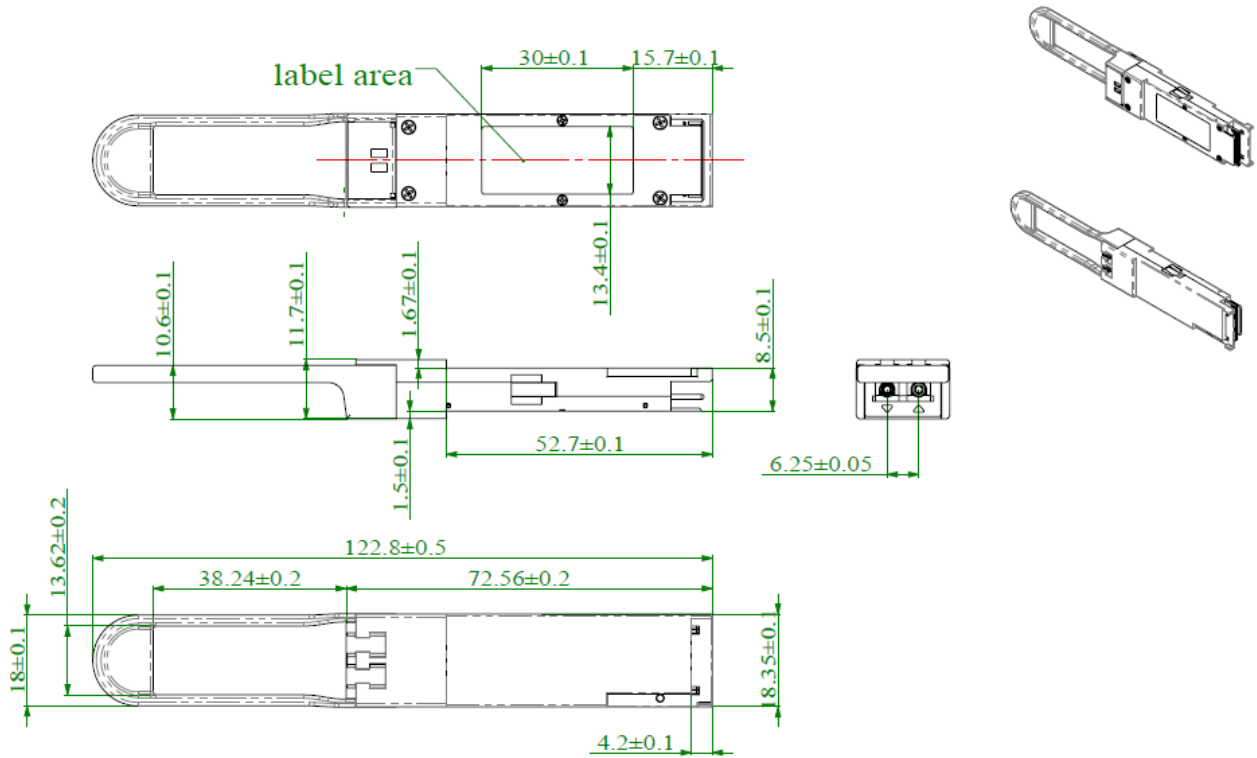
QSFP28 Module Pad Layout



Recommended Host Board Power Supply Filtering

See SFF-8679

Mechanical Diagram



Order Information

Table 10 – Order Information

Part No.	Application	Data Rate	Laser Source	Fiber Type
SPQ-CE-LR-CDFG	100GBASE-LR	100GE (53.125 GBd)	1311nm EML	SMF

Warnings

Handling Precautions: This device is susceptible to damage as a result of electrostatic discharge (ESD). A static free environment is highly recommended. Follow guidelines according to proper ESD procedures.

Laser Safety: Radiation emitted by laser devices can be dangerous to human eyes. Avoid eye exposure to direct or indirect radiation.

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Contacts

US Headquarters

8521 Fallbrook Ave, Suite 200
West Hills, CA 91306, USA
Tel: +1(818) 773-9044
Fax: +1(818) 576-9486

China

Building #2&5, West Export Processing
Zone No. 8 Kexin Road, Hi-Tech Zone
Chengdu, 611731, China
Tel: +86-28-8795-8788
Fax: +86-28-8795-8789

Taiwan

9F, No 81, Shui Lee Rd.
Hsinchu, Taiwan R.O.C.
Tel: +886-3-5169222
Fax: +886-3-5169213

www.sourcephotonics.com