



Features

- Compliant with IEEE 802.3ba 40GBASE-LR4
- Compliant to MSA SFF-8436 QSFP+ Revision 4.8
- Single 3.3V Supply Voltage
- Max. Power consumption 2.8W, 1.5W in Low Power Mode
- 0-70 °C Case Operating Temperature
- CWDM DFB laser and PIN Receiver Array
- QSFP+ MSA package with duplex LC connector
- Maximum Data Rate per Lane: 10.3125Gb/s
- Two Wire Serial (TWS) Interface with Digital Diagnostic Monitoring
- Complies with EU Directive 2011/65/EU (RoHS 6/6)
- 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}	-0.5	-	3.6	V	
Relative Humidity (non-condensing)	RH	5	-	95	%	
Data Input Voltage – Differential	V _{DIP} -V _{DIN}	-	-	1.0	V	

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	
Maximum Sustained Supply Current	I _{CC}	-	-	900	mA	per pin
Maximum Power Dissipation	P _D	-	-	2.8	W	
Maximum Power Dissipation (LPM)	P _{DLP}			1.5	W	
Data Rate per Lane	DR	-	10.3125	-	Gb/s	IEEE802.3ba
Control Input Voltage High	V _{IH}	2	-	V _{CC} +0.3	V	
Control Input Voltage Low	V _{IL}	-0.3	-	0.8	V	
Two Wire Serial Interface Clock Rate	-	-	-	400	kHz	
Power Supply Noise	-	-	-	50	mVpp	
Rx Differential Data Output Load	-	-	100	-	ohms	
Operating Distance	-	-	-	10	km	

Optical and Electrical Characteristics

Table 3 – Transmitter Optical Specifications

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Wavelength L0	λ_1	1264.5	1271	1277.5	nm	
Wavelength L1	λ_2	1284.5	1291	1297.5	nm	
Wavelength L2	λ_3	1304.5	1311	1317.5	nm	
Wavelength L3	λ_4	1324.5	1331	1337.5	nm	
Side-mode Suppression Ratio	SMSR	30			dB	
Total Average Optical Launch Power	P _{OUT}			8.3	dBm	
Average Launch Power Tx_Off (per Lane)	P _{OUT-OFF}	-	-	-30	dBm	
Average Optical Launch Power (per Lane)	P _{OUTL}	-7	-	2.3	dBm	
Extinction Ratio	ER	3.5	-	-	dB	
Spectral Width	$\Delta\lambda$	-	-	1	nm	
Optical Modulation Amplitude (per Lane)	OMA	-4	-	3.5	dBm	
Launch Power in OMA minus TDP (per Lane)	OMA-TDP	-4.8	-	-	dBm	

Difference in Launch Power between any two lanes (OMA)	DLP	-	-	6.5	dB	
Transmitter and Dispersion Penalty (per Lane)	TDP	-	-	2.6	dB	
Optical Return Loss Tolerance	ORLT	-	-	20	dB	
Transmitter Eye Mask Definition	-	(IEEE802.3ba) 0.25, 0.4, 0.45, 0.25, 0.28, 0.4			UI	
Relative Intensity Noise	RIN	-	-	-128	dB/Hz	

Table 4 – Receiver Optical Specifications

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Wavelength L0	λ_1	1264.5	1271	1277.5	nm	
Wavelength L1	λ_2	1284.5	1291	1297.5	nm	
Wavelength L2	λ_3	1304.5	1311	1317.5	nm	
Wavelength L3	λ_4	1324.5	1331	1337.5	nm	
Receiver Sensitivity (OMA) per Lane	-	-	-	-11.5	dBm	
Stressed Receiver Sensitivity in OMA (per Lane)	-	-	-	-9.6	dBm	
Stressed Receiver Sensitivity Test Conditions:						
Stressed Eye J2 Jitter (Each Lane)	-	-	0.3	-	UI	
Stressed Eye J9 Jitter (Each Lane)	-	-	0.47	-	UI	
Vertical Eye Closure Penalty	-	-	1.9	-	dB	
Damage Threshold For Receiver	$P_{in, damage}$	3.3	-	-	dBm	
Average Power Input (Each Lane)	-	-13.7	-	2.3	dBm	
Optical Modulation Amplitude (per Lane)	OMA	-	-	3.5	dBm	
Receiver Reflectance	R_{XR}	-	-	-26	dB	
LOS Assert	LOS_A	-25	-	-	dBm	
LOS De-Assert	LOS_D	-	-	-15	dBm	
LOS Hysteresis	-	0.5	-		dB	

Note: Measured with a PRBS231-1 test pattern @10.3125Gbps, BER $\leq 10^{-12}$

Table 5 – Electrical Specifications

Transmitter (Module Input)						
Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Single Ended Input Voltage	V_{IN}	-0.3	-	4	V	
Differential Data Input Swing	$V_{IN, P-P}$	150	-	1000	mVpp	
AC Common Mode Input Voltage	-	15	-	-	mV	

(RMS)						
Differential to Common-Mode Input Return Loss	-	10	-	-	dB	
J2 Jitter Tolerance	-	0.17	-	-	UI	
J9 Jitter Tolerance	-	0.29	-	-	UI	
Data Dependent Pulse Width Shrinkage	-	0.07	-	-	UI	
LOS Assert Threshold: Tx Data Input Differential Peak-Peak Voltage Swing	-	50	-	-	mVpp	
Receiver (Module Output)						
Single Ended Output Voltage	V _{OUT}	-0.3	-	4	V	
Differential Data Output Swing	V _{OUT, P-P}	200	-	1000	mVpp	
AC Common Mode Output Voltage (RMS)	-	-	-	7.5	mV	
Output Transition Time, 20% to 80%	-	28	-	-	ps	
J2 Jitter Output	-	-	-	0.42	UI	
J9 Jitter Output	-	-	-	0.65	UI	
Power Supply Ripple Tolerance	-	50	-	-	mVpp	

Timing

Table 6 – Timing for QSFP+ Soft Control and Status Functions

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Initialization Time	t _{init}	-	-	2000	ms	
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}	-	-	2000	ms	
LPMODE Assert Time	ton_LPMODE	-	-	100	μs	
IntL Assert Time	ton_IntL	-	-	200	ms	
IntL Deassert Time	toff_IntL	-	-	500	μs	
Rx LOS Assert Time	ton_los	-	-	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}			100	ms	
Power _{over-ride} or Power-set Assert Time	ton_Pdown			100	ms	
Power _{over-ride} or Power-set Deassert Time	toff_Pdown			300	ms	

Table 7 – I/O Timing for Squelch & Disable

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Rx Squelch Assert Time	ton_Rxsq			80	μs	
Rx Squelch Deassert Time	toff_Rxsq			80	μs	
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}	0.1	V	Internal
Tx Bias Current (Each Lane)	0 to 80	10%	mA	Internal
Tx Output Power	+4 to -15	±3	dB	Internal
Rx Power (Each Lane)	-13.7 to +2.3	±3	dB	Internal

Table 9 – Pin Definitions

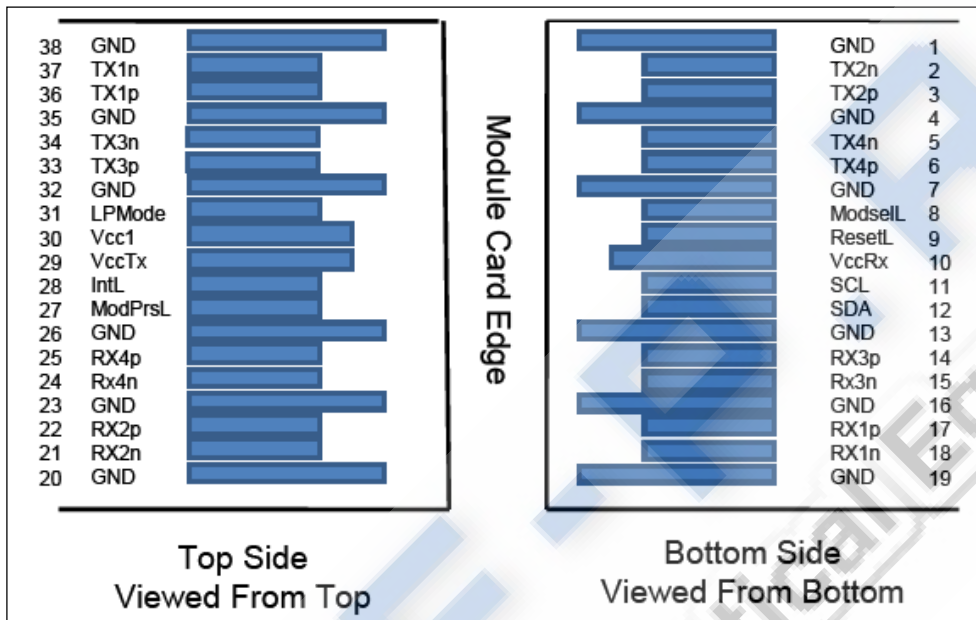
Pin	Logic	Symbol	Description	Plug Sequence	Notes
1		GND	Ground	1	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	3	
3	CML-I	Tx2p	Transmitter Non-Inverted Data Input	3	
4		GND	Ground	1	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	3	
6	CML-I	Tx4p	Transmitter Non-Inverted Data Input	3	
7		GND	Ground	1	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.

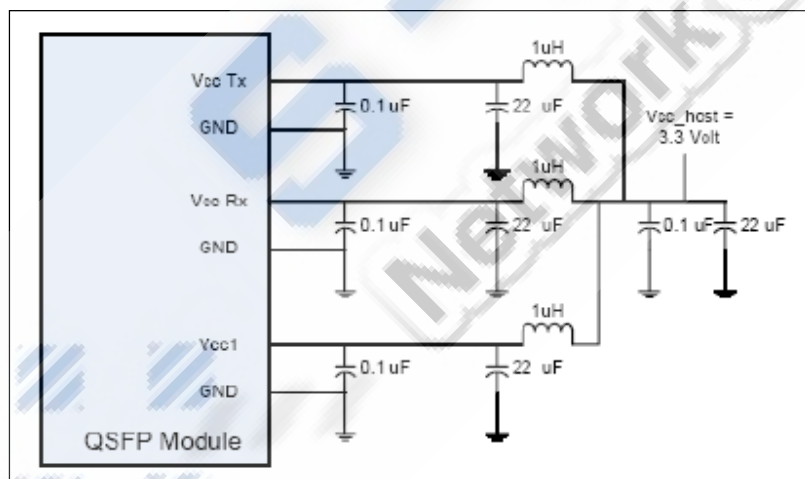
Connect these directly to the host board signal-common ground plane.

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

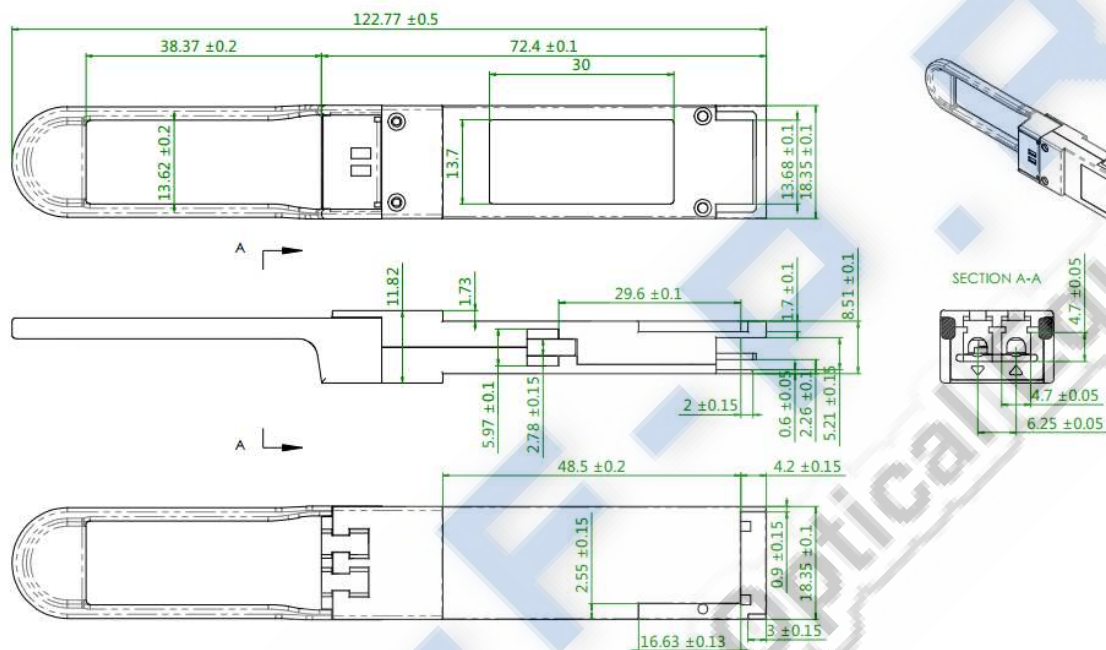
QSFP+ Module Pad Layout



Recommended Host Board Power Supply Filtering



Mechanical Diagram



Order Information

Table 10 – Order Information

Part No.	Application	Data Rate	Laser Source	Fiber Type
SPQ-10E-LR-CDFB	40GBASE-LR4	10.3125G	DFB	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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