

**PAN-QSFP28-LR1-100G-SL-C**

Palo Alto Networks® PAN-QSFP28-LR1-100G-SL Compatible TAA 100GBase-LR QSFP28 Single Lambda Transceiver (SMF, 1310nm, 10km, LC, DOM, with FEC)

**Features:**

- SFF-8665 Compliance
- Duplex LC Connector
- Single-mode Fiber
- Commercial Temperature 0 to 70 Celsius
- Hot Pluggable
- Metal with Lower EMI
- Excellent ESD Protection
- RoHS Compliant and Lead Free

**Applications:**

- 100GBase Ethernet

**Product Description**

This Palo Alto Networks® PAN-QSFP28-LR1-100G-SL compatible QSFP28 transceiver provides 100GBase-LR throughput up to 10km w/host FEC over single-mode fiber (SMF) using a wavelength of 1310nm via an LC connector. It can operate at temperatures between 0 and 70C. Our transceiver is built to meet or exceed OEM specifications and is guaranteed to be 100% compatible with Palo Alto Networks®. It has been programmed, uniquely serialized, and tested for data-traffic and application to ensure that it will initialize and perform identically. All of our transceivers comply with Multi-Source Agreement (MSA) standards to provide seamless network integration. Additional product features include Digital Optical Monitoring (DOM) support which allows access to real-time operating parameters. This transceiver is Trade Agreements Act (TAA) compliant. We stand behind the quality of our products and proudly offer a limited lifetime warranty.

ProLabs' transceivers are RoHS compliant and lead-free.

TAA refers to the Trade Agreements Act (19 U.S.C. & 2501-2581), which is intended to foster fair and open international trade. TAA requires that the U.S. Government may acquire only "U.S.-made or designated country end products.")



### Absolute Maximum Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit
Maximum Supply Voltage	Vcc	-0.5		3.6	V
Storage Temperature	Ts	-40		85	°C
Operating Case Temperature	Top	0		70	°C
Operating Humidity (non-condensing)	RH	5		85	%
Damage Threshold	THd	5.5			dBm

### Recommended Operating Conditions and Power Supply Requirements

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Operating Case Temperature	TOP	0		70	degC	
Power Supply Voltage	VCC	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	
Pre-FEC Bit Error Ratio				$2.4 \times 10^{-4}$		
Post-FEC Bit Error Ratio				$1 \times 10^{-12}$		1
Control Input Voltage High		2		Vcc	V	
Control Input Voltage Low		0		0.8	V	
Link Distance with G.652	D	0.002		10	km	2

#### Notes:

1. FEC feature is embedded in the module.
2. FEC required to be turned on to support maximum transmission distance.

## Electrical Characteristics

Parameter	Test Point	Min.	Typ.	Max.	Unit	Notes
<b>Power Consumption</b>				4.0	W	
<b>Supply Current</b>	Icc			1.36	A	
<b>Transmitter (each Lane)</b>						
<b>Overload Differential Voltagepk-pk</b>	TP1a	900			mV	
<b>Common Mode Voltage(Vcm)</b>	TP1	-350		2850	mV	1
<b>Differential TerminationResistance Mismatch</b>	TP1			10	%	At 1MHz
<b>Differential Return Loss(SDD11)</b>	TP1			See CEI-28G-VSR Equation 13-19	dB	
<b>Common Mode to Differential Conversion and Differential to Common Mode Conversion (SDC11, SCD11)</b>	TP1			See CEI-28G-VSR Equation 13-20	dB	
<b>Stressed Input Test</b>	TP1a	See CEI-28G-VSR Section 13.3.11.2.1				
<b>Receiver (each Lane)</b>						
<b>Differential Voltage, pk-pk</b>	TP4			900	mV	
<b>Common Mode Voltage(Vcm)</b>	TP4	-350		2850	mV	1
<b>Common Mode Noise, RMS</b>	TP4			17.5	mV	
<b>Differential Termination Resistance Mismatch</b>	TP4			10	%	At 1MHz
<b>Differential Return Loss(SDD22)</b>	TP4			See CEI-28G-VSR Equation 13-19	dB	
<b>Common Mode to Differential Conversion and Differential to Common Mode Conversion (SDC22, SCD22)</b>	TP4			See CEI-28G-VSR Equation 13-21	dB	
<b>Common Mode Return Loss(SCC22)</b>	TP4			-2	dB	2
<b>Transition Time, 20 to 80%</b>	TP4	9.5			ps	
<b>Vertical Eye Closure (VEC)</b>	TP4			5.5	dB	
<b>Eye Width at <math>10^{-15}</math> probability(EW15)</b>	TP4	0.57			UI	
<b>Eye Height at <math>10^{-15}</math> probability (EH15)</b>	TP4	228			mV	

### 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.	Typ.	Max.	Unit	Notes
<b>Transmitter</b>						
Center Wavelength	$\lambda_t$	1304.5		1317.5	nm	
Side Mode Suppression Ratio	SMSR	30			dB	
Average Launch Power	PAVG	-1.4		4.5	dBm	1
Outer Optical Modulation Amplitude (OMA <sub>outer</sub> )	POMA	0.7		4.7	dBm	2
Launch Power in OMA <sub>outer</sub> terminus TDECQ	for ER $\geq$ 4.5dB		-0.7		dBm	
	for ER < 4.5dB		-0.6		dBm	
Transmitter and Dispersion Eye Closure for PAM4	TDECQ			3.4	dB	
TDECQ - $10 \cdot \log_{10}(C_{eq})$				3.4	dB	3
Extinction Ratio	ER	3.5			dB	
RIN <sub>15.6</sub> OMA	RIN			-136	dB/Hz	
Optical Return Loss Tolerance	TOL			15.6	dB	
Transmitter Reflectance	RT			-26	dB	
Transmitter Transition Time				17	ps	
Average Launch Power of OFF Transmitter	Poff			-15	dBm	
<b>Receiver</b>						
Center Wavelength	$\lambda_r$	1304.5		1317.5	nm	
Damage Threshold	THd	5.5			dBm	4
Average Receive Power		-7.7		4.5	dBm	5
Receive Power (OMA <sub>outer</sub> )				4.7	dBm	
Receiver Sensitivity (OMA <sub>outer</sub> )	SEN			Equation (1)	dBm	6
Stressed Receiver Sensitivity (OMA <sub>outer</sub> )	SRS			-4.1	dBm	7
Receiver Reflectance	RR			-26	dB	
LOS Assert	LOSA	-15			dBm	
LOS Deassert	LOSD			-10.7	dBm	
LOS Hysteresis	LOSH	0.5			dB	
<b>Conditions of stressed receiver sensitivity test</b>						
Stressed Eye Closure for PAM4 (SECQ)			3.4		dB	
SECQ - $10 \cdot \log_{10}(C_{eq})$				3.4	dB	

### 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 < 1.4dB for an extinction ratio of  $\geq$  4.5dB or TDECQ < 1.3dB for an extinction ratio of < 4.5dB, the OMA<sub>outer</sub> (min) must exceed the minimum value specified here.

3.  $C_{eq}$  is a coefficient defined in IEEE Std 802.3-2018 clause 121.8.5.3 which accounts for reference equalizer noise enhancement.
4. Average receive power (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. The receiver shall be able to tolerate, without damage, continuous exposure to a modulated optical input signal having this power level on one lane. The receiver does not have to operate correctly at this input power.
6. Receiver sensitivity ( $OMA_{outer}$ ) (max) is informative and is defined for a transmitter with a value of SECQ up to 3.4 dB. It should meet Equation (1), which is illustrated in the figure in note 8.

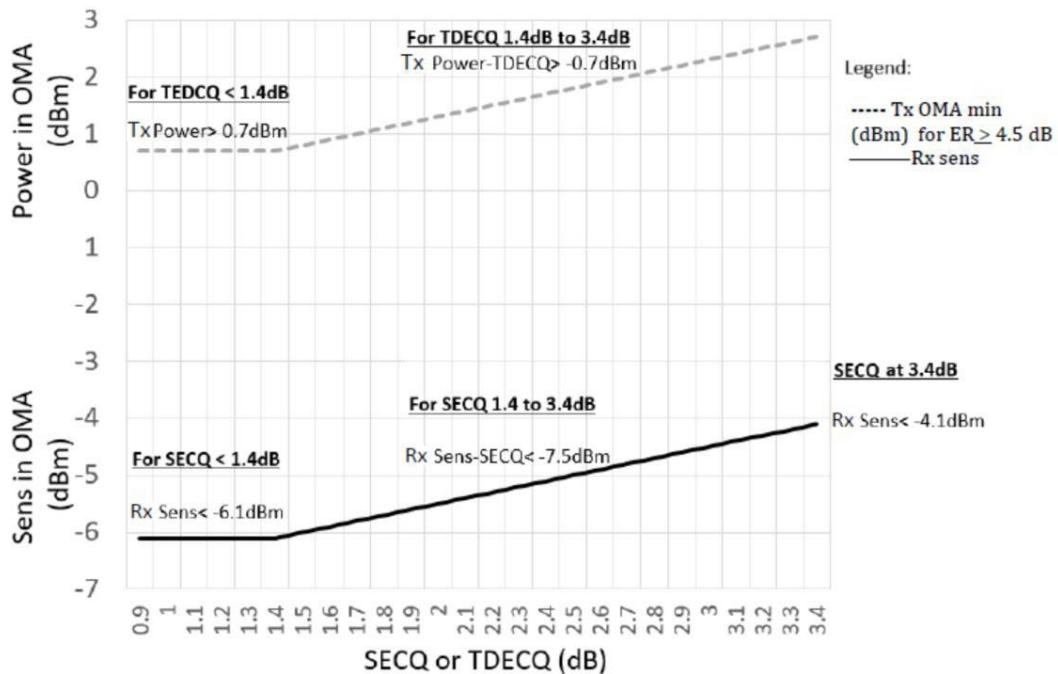
$$RRRR = \max(-6.1, RSSSSSS - 7.5) \text{ dddddd} \quad (1)$$

Where:

$RS$  is the receiver sensitivity, and

$SECQ$  is the SECQ of the transmitter used to measure the receiver sensitivity.

7. Measured with conformance test signal at TP3 for the BER equal to  $2.4 \times 10^{-4}$ .
8. These test conditions are for measuring stressed receiver sensitivity. They are not characteristics of the receiver.



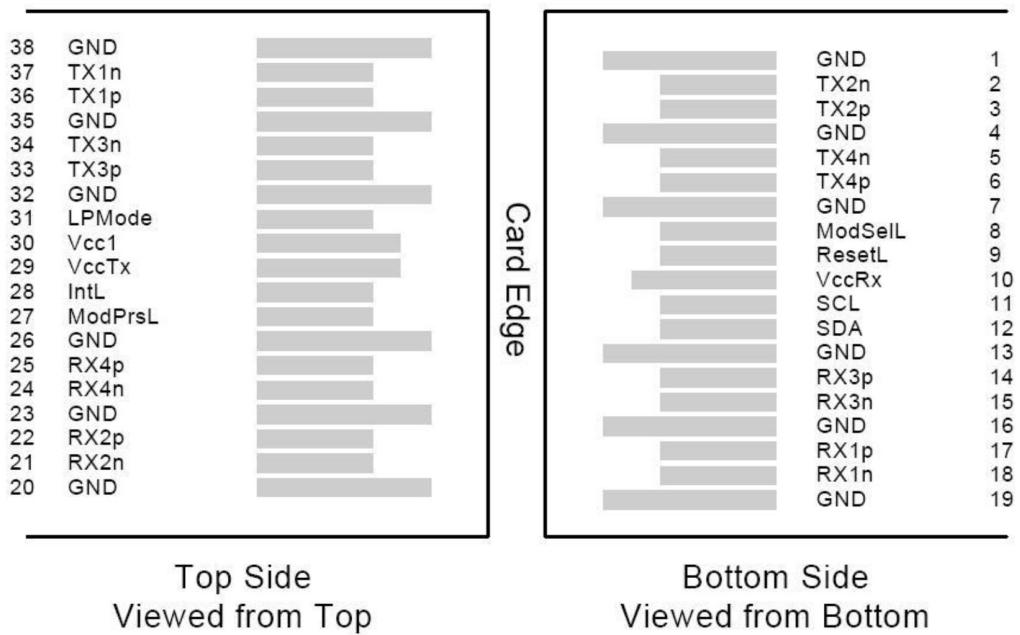
## Pin Descriptions

Pin	Logic	Symbol	Name/Descriptions	Ref.
1		GND	Module Ground	1
2	CML-I	Tx2-	Transmitter inverted data input	
3	CML-I	Tx2+	Transmitter non-inverted data input	
4		GND	Module Ground	1
5	CML-I	Tx4-	Transmitter inverted data input	
6	CML-I	Tx4+	Transmitter non-inverted data input	
7		GND	Module Ground	1
8	LVTTI-I	MODSEIL	Module Select	2
9	LVTTI-I	ResetL	Module Reset	2
10		VCCRx	+3.3v Receiver Power Supply	
11	LVCMOS-I	SCL	2-wire Serial interface clock	2
12	LVCMOS-I/O	SDA	2-wire Serial interface data	2
13		GND	Module Ground	1
14	CML-O	RX3+	Receiver non-inverted data output	
15	CML-O	RX3-	Receiver inverted data output	
16		GND	Module Ground	1
17	CML-O	RX1+	Receiver non-inverted data output	
18	CML-O	RX1-	Receiver inverted data output	
19		GND	Module Ground	1
20		GND	Module Ground	1
21	CML-O	RX2-	Receiver inverted data output	
22	CML-O	RX2+	Receiver non-inverted data output	
23		GND	Module Ground	1
24	CML-O	RX4-	Receiver inverted data output	
25	CML-O	RX4+	Receiver non-inverted data output	
26		GND	Module Ground	1
27	LVTTI-O	ModPrsL	Module Present, internal pulled down to GND	
28	LVTTI-O	IntL	Interrupt output, should be pulled up on host board	2
29		VCCTx	+3.3v Transmitter Power Supply	
30		VCC1	+3.3v Power Supply	
31	LVTTI-I	LPMode	Low Power Mode	2
32		GND	Module Ground	1
33	CML-I	Tx3+	Transmitter non-inverted data input	
34	CML-I	Tx3-	Transmitter inverted data input	
35		GND	Module Ground	1
36	CML-I	Tx1+	Transmitter non-inverted data input	
37	CML-I	Tx1-	Transmitter inverted data input	
38		GND	Module Ground	1

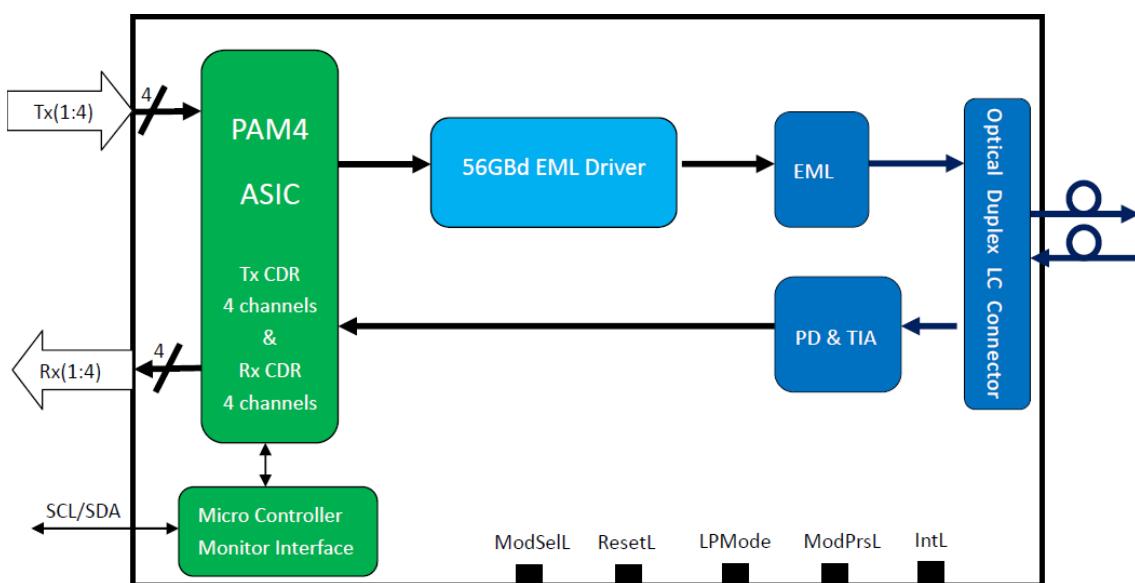
**Notes:**

1. Module circuit ground is isolated from module chassis ground with in the module.
2. Open collector; should be pulled up with 4.7k-10k ohms on host board to a voltage between 3.15V and 3.6V.

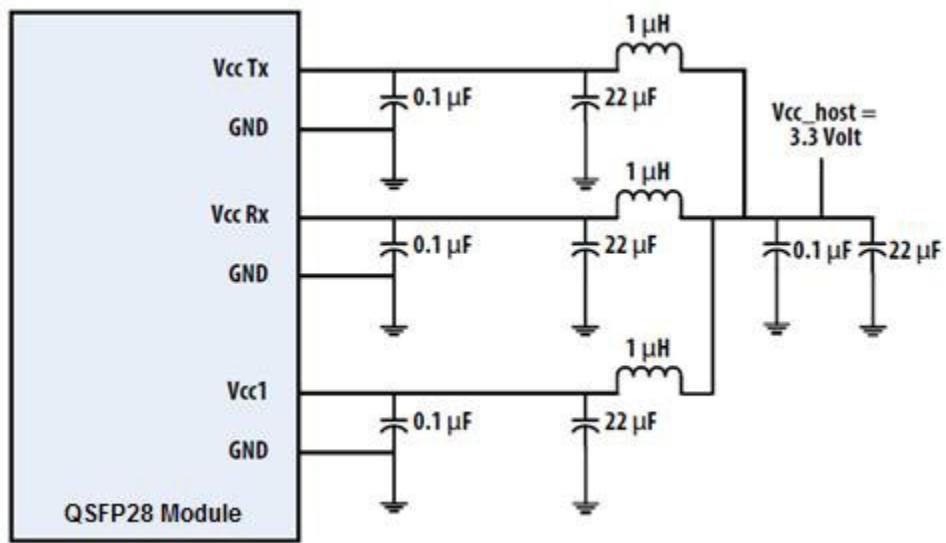
**Electrical Pin-out Details**



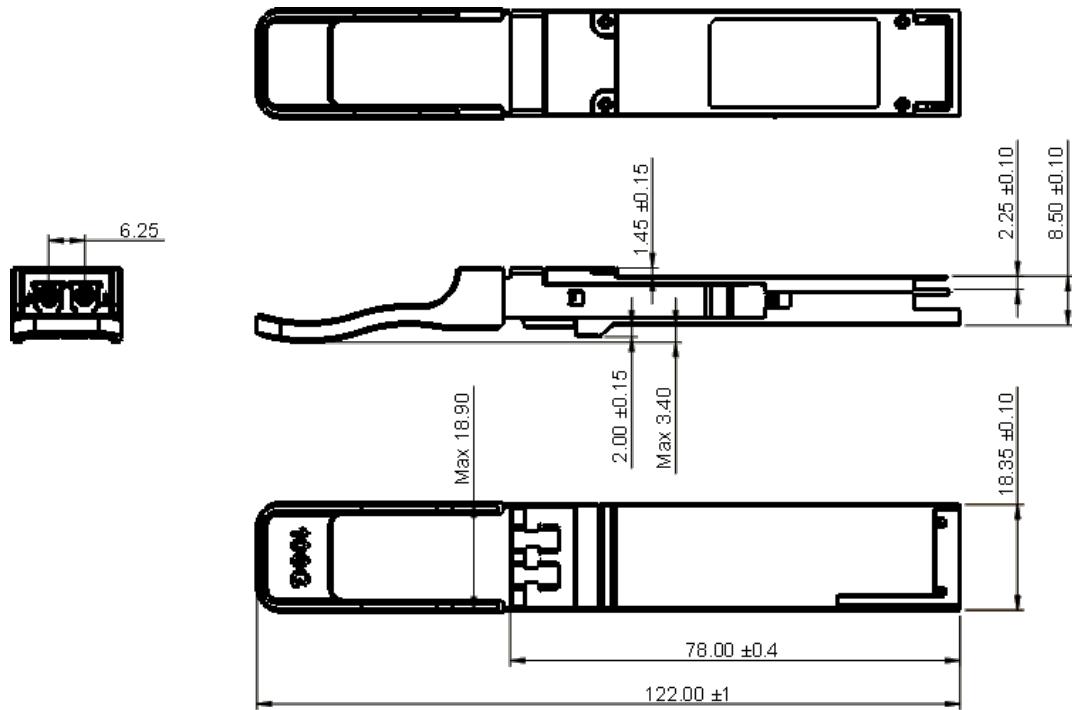
**Transceiver Block Diagram**



## Recommended Power Supply Filter



## Mechanical Specifications



## About ProLabs

Our experience comes as standard; for over 15 years ProLabs has delivered optical connectivity solutions that give our customers freedom and choice through our ability to provide seamless interoperability. At the heart of our company is the ability to provide state-of-the-art optical transport and connectivity solutions that are compatible with over 90 optical switching and transport platforms.

## Complete Portfolio of Network Solutions

ProLabs is focused on innovations in optical transport and connectivity. The combination of our knowledge of optics and networking equipment enables ProLabs to be your single source for optical transport and connectivity solutions from 100Mb to 400G while providing innovative solutions that increase network efficiency. We provide the optical connectivity expertise that is compatible with and enhances your switching and transport equipment.

## Trusted Partner

Customer service is our number one value. ProLabs has invested in people, labs and manufacturing capacity to ensure that you get immediate answers to your questions and compatible product when needed. With Engineering and Manufacturing offices in the U.K. and U.S. augmented by field offices throughout the U.S., U.K. and Asia, ProLabs is able to be our customers best advocate 24 hours a day.



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