



**CL-Q28-DR1-500**  
**100G QSFP28 Optical Transceiver Module**  
**RoHS 6 compliant**

**Features**



- QSFP28 MSA compliant
- Supports 53.125Gbaud
- IEEE 802.3cd 100GBASE-DR Specification compliant
- Up to 500m transmission on single mode fiber (SMF) with FEC
- Operating case temperature: - 5 to 70°C
- 4x25G electrical interface (OIF CEI-28G- VSR)
- Maximum power consumption 4.5W
- LC duplex connector
- RoHS compliant

**Applications**

- Data Center and LAN

**Standard**

- Compliant to IEEE 802.3ba, IEEE 802.3bm and 100G
- Compliant to SFF-8436
- RoHS Compliant.

PART NUMBER	Monitor	INPUT/OUTPUT	SIGNAL DETECT	TEMPERATURE
CL-Q28-DR1-500	X	AC/AC	TTL	-5°C to 70 °C
CL-Q28-DR1-500i	X	AC/AC	TTL	-40°C to 85 °C



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**Description**

**I. Absolute Maximum Ratings**

Parameter	Symbol	Min	Max	Units	Notes
Storage Temperature	T <sub>s</sub>	-40	85	degC	
Operating Case Temperature	T <sub>OP</sub>	-5	70	degC	
Power Supply Voltage	V <sub>CC</sub>	-0.5	3.6	V	
Relative Humidity (non-condensation)	RH	0	85	%	
Damage Threshold	THd	5		dBm	

**II. Recommended Operating Conditions**

Parameter	Symbol	Min	Typical	Max	Units	Notes
Operating Case Temperature	T <sub>OP</sub>	0		70	degC	
Power Supply Voltage	V <sub>CC</sub>	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				2.4x10 <sup>-4</sup>		
Post-FEC Bit Error Ratio				1x10 <sup>-12</sup>		1
Control Input Voltage High		2		V <sub>CC</sub>	V	
Control Input Voltage Low		0		0.8	V	
Link Distance with G.652	D	2		500	m	2

Notes:

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



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### III. Optical Characteristics

Parameter	Symbol	Min	Typical	Max	Units	Notes
<b>Transmitter</b>						
Center Wavelength	$\lambda_t$	1304.5		1317.5	nm	
Side Mode Suppression Ratio	SMSR	30			dB	
Average Launch Power	$P_{AVG}$	-2.9		4	dBm	1
Outer Optical Modulation Amplitude ( $OMA_{outer}$ )	$P_{OMA}$	-0.8		4.2	dBm	2
Launch Power in $OMA_{outer}$ minus TDECQ for $ER \geq 5dB$ for $ER < 5dB$		-2.2 -1.9			dBm	
Transmitter and Dispersion Eye Closure for PAM4 (TDECQ)	TDECQ			3.4	dB	
TDECQ – $10 \cdot \log_{10}(C_{eq})$				3.4	dB	3
Extinction Ratio	ER	3.5			dB	
RIN <sub>15.5OMA</sub>	RIN			-136	dB/H	
Optical Return Loss Tolerance	TOL			15.5	dB	
Transmitter Reflectance	RT			-26	dB	
Transmitter Transition Time				17	ps	
Average Launch Power of OFF	$P_{off}$			-15	dBm	
<b>Receiver</b>						
Center Wavelength	$\lambda_r$	1304.5		1317.5	nm	
Damage Threshold	$TH_d$	5			dBm	4
Average Receive Power		-5.9		4	dBm	5
Receive Power ( $OMA_{outer}$ )				4.2	dBm	
Receiver Sensitivity ( $OMA_{outer}$ )	SEN			Equation (1)	dBm	6
Stressed Receiver Sensitivity ( $OMA_{outer}$ )	SRS			-1.9	dBm	7
Receiver Reflectance	$R_R$			-26	dB	
LOS Assert	LOSA	-15			dBm	
LOS Deassert	LOSD			-8.9	dBm	
LOS Hysteresis	LOSH	0.5			dB	
<b>Conditions of Stress Receiver Sensitivity Test (Note 8)</b>						
Stressed Eye Closure for PAM4 (SECQ)			3.4		dB	
SECQ – $10 \cdot \log_{10}(C_{eq})$				3.4	dB	



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Notes:

1. Average launch power (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  $\geq 5$ dB or TDECQ < 1.1dB for an extinction ratio of < 5dB, the  $OMA_{outer}$  (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 Figure 4.

$$RS = \max(-3.9, SECQ - 5.3) \text{ dBm} \quad (1)$$

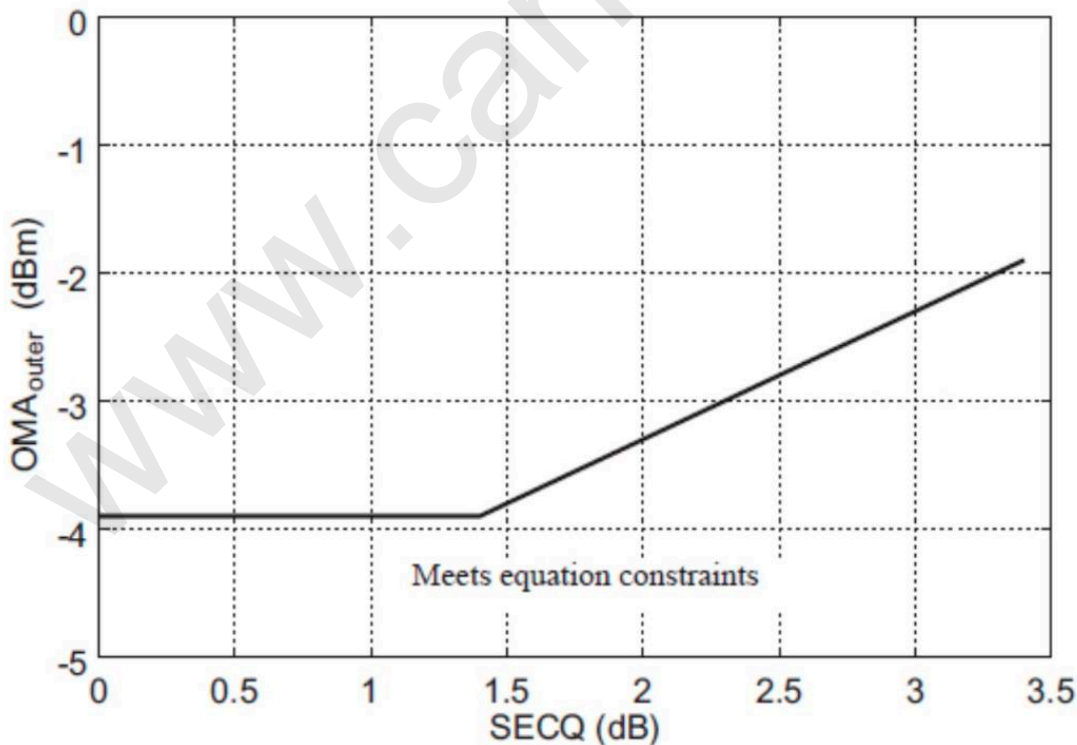
Where:

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.





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#### IV. Electrical Specifications

Parameter	Test Point	Min	Typical	Max	Units	Notes
Power Consumption				4.5	W	
Supply Current	I <sub>cc</sub>			1.36	A	
<b>Transmitter (each Lane)</b>						
Overload Differential Voltage pk-pk	TP1a	900			mV	
Common Mode Voltage (V <sub>cm</sub> )	TP1	-350		2850	mV	1
Differential Termination Resistance Mismatch	TP1			10	%	At 1MHz
Differential Return Loss (SDD11)	TP1			See CEI-28G-VSR Equation 13-19	dB	
Common Mode to Differential Conversion and Differential to Common Mode Conversion (SDC11, SCD11)	TP1			See CEI-28G-VSR Equation 13-20	dB	
Stressed Input Test	TP1a	See CEI-28G-VSR Section 13.3.11.2.1				
<b>Receiver (each Lane)</b>						
Differential Voltage, pk-pk	TP4			900	mV	
Common Mode Voltage (V <sub>cm</sub> )	TP4	-350		2850	mV	1
Common Mode Noise, RMS	TP4			17.5	mV	
Differential Termination Resistance Mismatch	TP4			10	%	At 1MHz
Differential Return Loss (SDD22)	TP4			See CEI-28G-VSR Equation 13-19	dB	
Common Mode to Differential Conversion and Differential to Common Mode Conversion (SDC22, SCD22)	TP4			See CEI-28G-VSR Equation 13-21	dB	



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Common Mode Return Loss (SCC22)	TP4			-2	dB	2
Transition Time, 20 to 80%	TP4	9.5			ps	
Vertical Eye Closure (VEC)	TP4			5.5	dB	
Eye Width at 10-15 probability (EW15)	TP4	0.57			UI	
Eye Height at 10-15 probability (EH15)	TP4	228			mV	

Notes:

1. Vcm is generated by the host. Specification includes effects of ground offset voltage.
2. From 250MHz to 30GHz.

## V. Digital Diagnostic Functions

Parameter	Symbol	Min	Max	Units	Notes
Temperature Monitor Absolute Error	DMI_Temp	-3	3	degC	Over operating temperature range
Supply Voltage Monitor Absolute Error	DMI_VCC	-0.1	0.1	V	Over full operating range
RX Power Monitor Absolute Error	DMI_RX	-2	2	dB	1
Bias Current Monitor	DMI_Ibias	-10%	10%	mA	
TX Power Monitor Absolute Error	DMI_TX	-2	2	dB	1

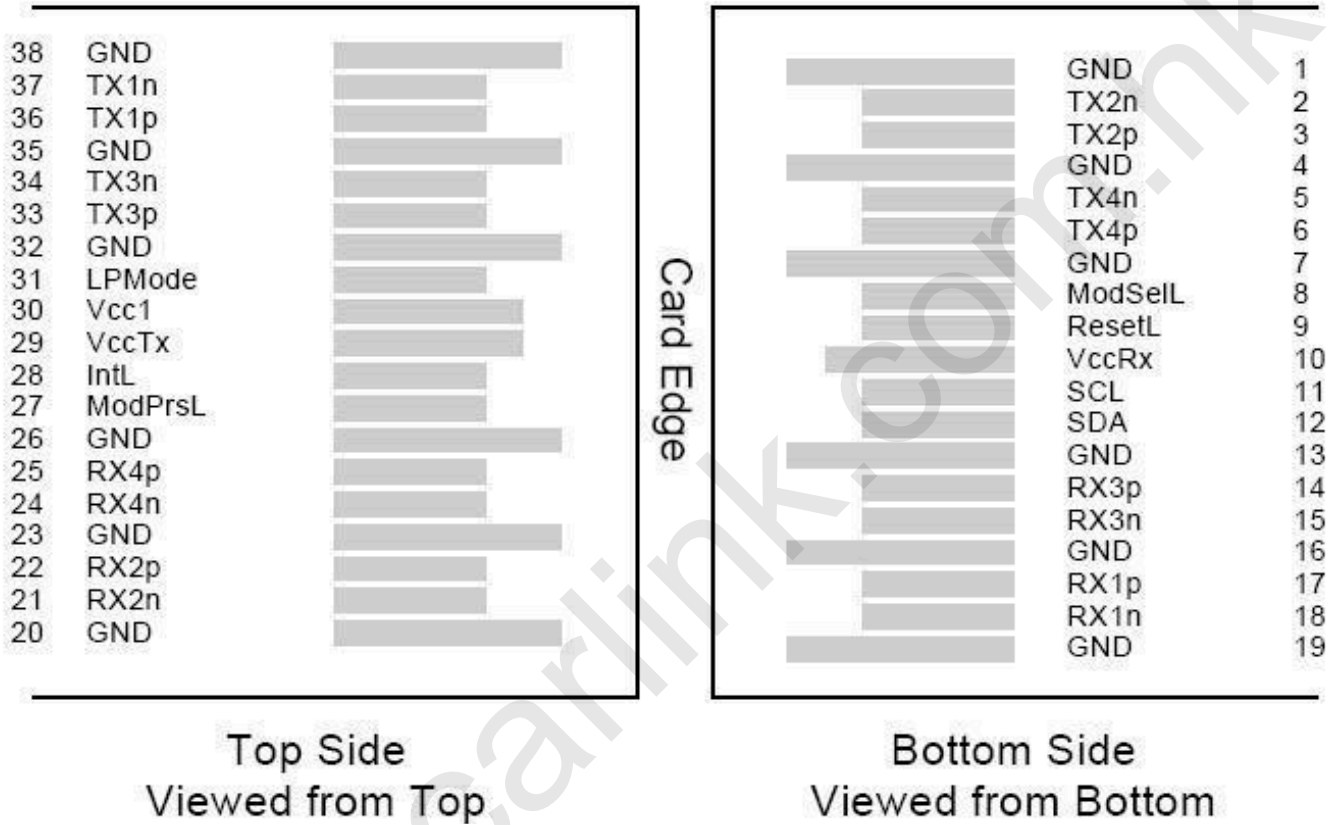
Notes:

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



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**VI. Pin Assignment**





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## VII. Pin Definitions

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	
14	CML-O	Rx3p	Receiver Non-Inverted Data Output	
15	CML-O	Rx3n	Receiver Inverted Data Output	
16		GND	Ground	1
17	CML-O	Rx1p	Receiver Non-Inverted Data Output	
18	CML-O	Rx1n	Receiver Inverted Data Output	
19		GND	Ground	1
20		GND	Ground	1
21	CML-O	Rx2n	Receiver Inverted Data Output	
22	CML-O	Rx2p	Receiver Non-Inverted Data Output	
23		GND	Ground	1
24	CML-O	Rx4n	Receiver Inverted Data Output	1
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	
26		GND	Ground	1
27	LVTTL-O	Mod Pres	Module Present	
28	LVTTL-O	IntL	Interrupt	
29		VccT	+3.3 V Power Supply transmitter	2





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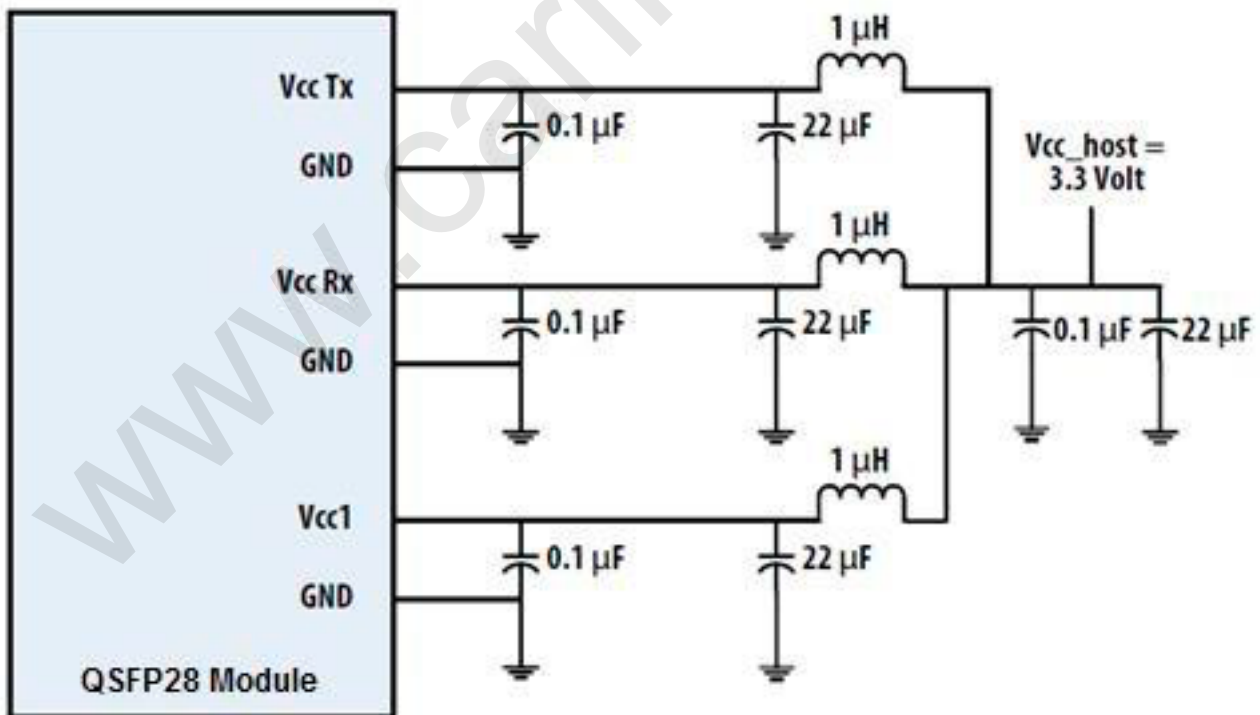
30		Vcc1	+3.3 V Power Supply	2
31	LVTTL-I	LPM	Low Power Mode	
32		GND	Ground	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	
34	CML-I	Tx3n	Transmitter Inverted Data Output	
35		GND	Ground	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	
37	CML-I	Tx1n	Transmitter Inverted Data Output	
38		GND	Ground	1

**Notes:**

1. GND is the symbol for signal and supply (power) common for QSFP28 modules. All are common within the QSFP28 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 3 below. Vcc Rx, Vcc1 and Vcc Tx may be internally connected within the QSFP28 transceiver module in any combination. The connector pins are each rated for a maximum current of 1000mA.

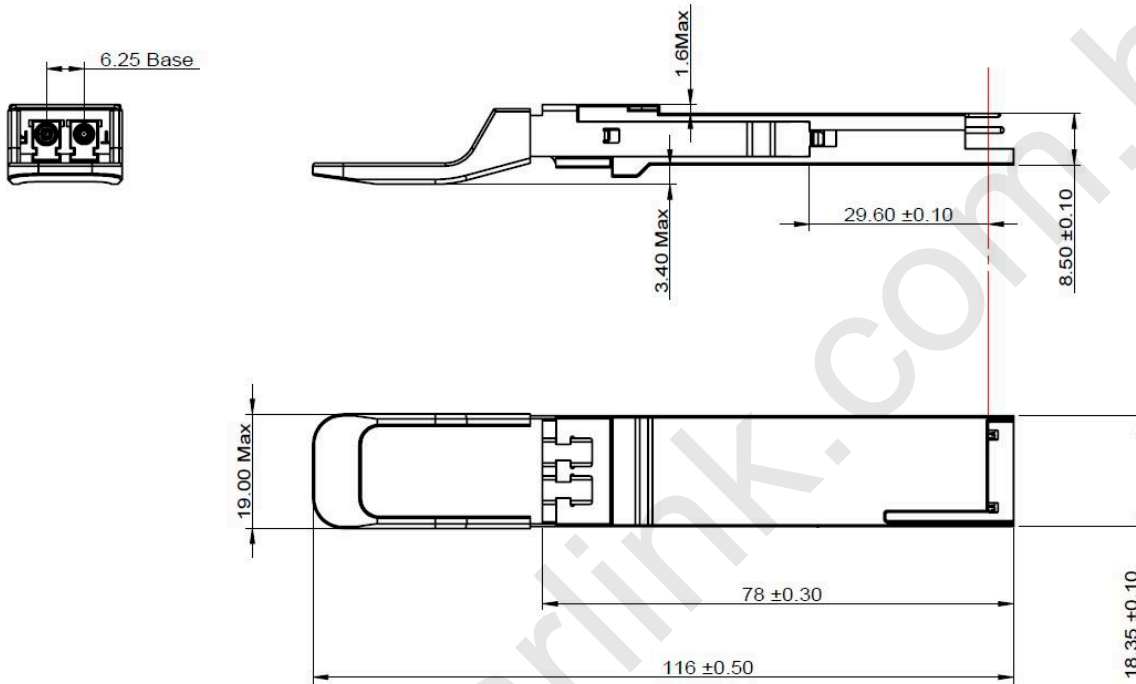
**VIII. Recommended Power Supply Filter**





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## IX. Mechanical Diagram



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