

## GNQ7L0CLM

### 100G-ZR4 QSFP28 80KM Optical Transceiver

#### Features:

- Compliant with QSFP28 Standard: SFF-8661 Rev 2.5, SFF-8636 Rev 2.10a
- High speed I/O electrical interface (CAUI-4) compliant with IEEE 802.3bm-2015
- 100GBASE-ZR4 point-to-point Ethernet links
- Rx sensitivity of -27.5dBm with enabled KR4 FEC in host for up to 80km SMF
- Single 3.3V Supply Voltage
- Maximum power consumption 5W
- 0-70 °C Case Operating Temperature
- LAN WDM EML laser and SOA+PIN Receiver
- Universal 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

#### Module Characteristics

**Table 1 – Absolute Maximum Ratings**

Parameter	Symbol	Min.	Max.	Unit	Notes
Storage Temperature	TS	-40	85	°C	
Supply Voltage	VCC	-0.5	3.6	V	
Relative Humidity (non-condensing)	RH	5	95	%	
Data Input Voltage Differential	IVDIP-VDINI	-	1	V	
Control Input Voltage	VI	-0.3	VCC+0.5	V	
Control Output Current	IO	-20	20	mA	

**Table 2 – Recommended Operating Conditions**

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Operating Case Temperature	T <sub>OPR</sub>	0	-	70	°C	

Power Supply Voltage	VCC	3.135	3.3	3.465	V	
Instantaneous peak current at hot plug	ICC_IP	-	-	2000	mA	1
Sustained peak current at hot plug	ICC_SP	-	-	1650	mA	
Maximum Power Dissipation	PD	-	-	5	W	
Maximum Power Dissipation, Low Power Mode	PDLP	-	-	1.5	W	
Aggregate Bit Rate	ABR	-	103.125	-	Gb/s	
Data Rate per Lane	DRL	-	25.78	-	Gb/s	
Control Input Voltage High	VIH	VCC*0.7	-	VCC+0.3	V	

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Control Input Voltage Low	VIL	-0.3	-	VCC*0.3	V	
Two Wire Serial Interface Clock Rate	-	-	-	400	kHz	
Module power supply noise tolerance 10 Hz - 10 MHz (peak-to-peak)	-	-	-	66	mVpp	
Rx Differential Data Output Load	-	-	100	-	ohms	
Operating Distance	-	2	-	80,000	m	Note

Note : 40km without FEC and 80km with FEC.

## Functional Characteristics (Optical)

The following tables list the performance specifications for the various functional blocks of the integrated optical transceiver module.

**Table 3 – Transmitter Optical Specifications**

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Wavelength L0	$\lambda_{C0}$	1294.53	1295.56	1296.59	nm	
Wavelength L1	$\lambda_{C1}$	1299.02	1300.05	1301.09	nm	
Wavelength L2	$\lambda_{C2}$	1303.54	1304.58	1305.63	nm	
Wavelength L3	$\lambda_{C3}$	1308.09	1309.14	1310.19	nm	
Side-mode suppression ratio	SMSR	30			dB	
Total Average Optical Launch Power	POUT	-	-	12.5	dBm	
Average Launch Power Tx_Off (Each Lane)	POUT_OFF	-	-	-30	dBm	
Average Optical Launch Power (Each Lane)	POUTL	2	-	6.5	dBm	
Extinction Ratio	ER	6	-	-	dB	
Spectral Width	$\Delta\lambda$	-	-	1	nm	
Optical Modulation Amplitude (Each Lane)	OMA	2.5	-	7	dBm	
Transmitter and Dispersion Penalty (Each Lane)	TDP	-	-	2.2	dB	
Launch Power in OMA minus TDP (Each Lane)	OMA-TDP	1.5	-	-	dBm	

Difference in launch power between any two lanes (OMA)	DT_OMA	-	-	4	dB	
Optical Return Loss Tolerance	ORLT	-	-	20	dB	
RIN <sub>20OMA</sub>	RIN	-	-	-130	dB/Hz	
Transmitter Reflectance	TR	-	-	-26	dB	
Transmitter Eye Mask Definition	-	IEEE 802.3bs-2010 {0.25, 0.4, 0.45, 0.25, 0.28, 0.4}				

**Table 4 – Receiver Optical Specifications**

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Wavelength L0	$\lambda_{C0}$	1294.5 <sub>3</sub>	1295.5 <sub>6</sub>	1296.5 <sub>9</sub>	nm	
Wavelength L1	$\lambda_{C1}$	1299.0 <sub>2</sub>	1300.0 <sub>5</sub>	1301.0 <sub>9</sub>	nm	
Wavelength L2	$\lambda_{C2}$	1303.5 <sub>4</sub>	1304.5 <sub>8</sub>	1305.6 <sub>3</sub>	nm	
Wavelength L3	$\lambda_{C3}$	1308.0 <sub>9</sub>	1309.1 <sub>4</sub>	1310.1 <sub>9</sub>	nm	
Receiver Sensitivity (OMA) per Lane				-27.5	dBm	Note
Stressed Receiver Sensitivity in OMA (Each Lane)	-	-	-	TBD	dBm	
Stressed Receiver Sensitivity Test Conditions:						
Stressed Eye J2 Jitter (Each Lane)	-	-	0.33	-	UI	
Stressed Eye J9 Jitter (Each Lane)	-	-	0.48	-	UI	
Vertical Eye Closure Penalty	-	-	2	-	dB	
Damage Threshold for Receiver	P <sub>in, damage</sub>	TBD	-	-	dBm	
Average Receive Power (Each Lane)	-	-28	-	-5	dBm	Note
Receive Power in OMA (Each Lane), Overload	OMA	-	-	-4.5	dBm	
Receiver Reflectance	RXR	-	-	-26	dB	
LOS Assert	LOSA	-40	-	-	dBm	
LOS De-assert	LOSD	-	-	-30	dBm	
LOS hysteresis	LOSH	0.5	-	-	dB	

Note: Measured with conformance test signal at TP3 for the BER = 5x10<sup>-5</sup>

## Functional Characteristics (Electrical)

**Table 5 – Electrical Specification**

High-Speed Signal: Compliant to IEEE802.3 CAUI-4 C2M

Low-Speed Signal: Compliant to SFF-8679

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Differential Data Input Amplitude	$V_{IN,P-P}$	95	-	900	mVpp	
Differential Termination Mismatch		-	-	10	%	
LPMode, Reset and ModSelL	$V_{IL}$	-0.3	-	0.8	V	
	$V_{IH}$	2	-	$V_{CC}+0.3$	V	
<b>Transmitter (Module Input)</b>						
Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Differential Data Output Amplitude	$V_{OUT,P-P}$	-	-	900	mVpp	
Differential Termination Mismatch		-	-	10	%	
Output Rise/Fall Time, 20%~80%	$T_R$	12	-	-	ps	
ModPrsL and IntL	$V_{OL}$	0	-	0.4	V	$I_{OL}=4mA$
	$V_{OH}$	$V_{CC}-0.5$	-	$V_{CC}+0.3$	V	$I_{OL}=-4mA$

### Pin Definitions

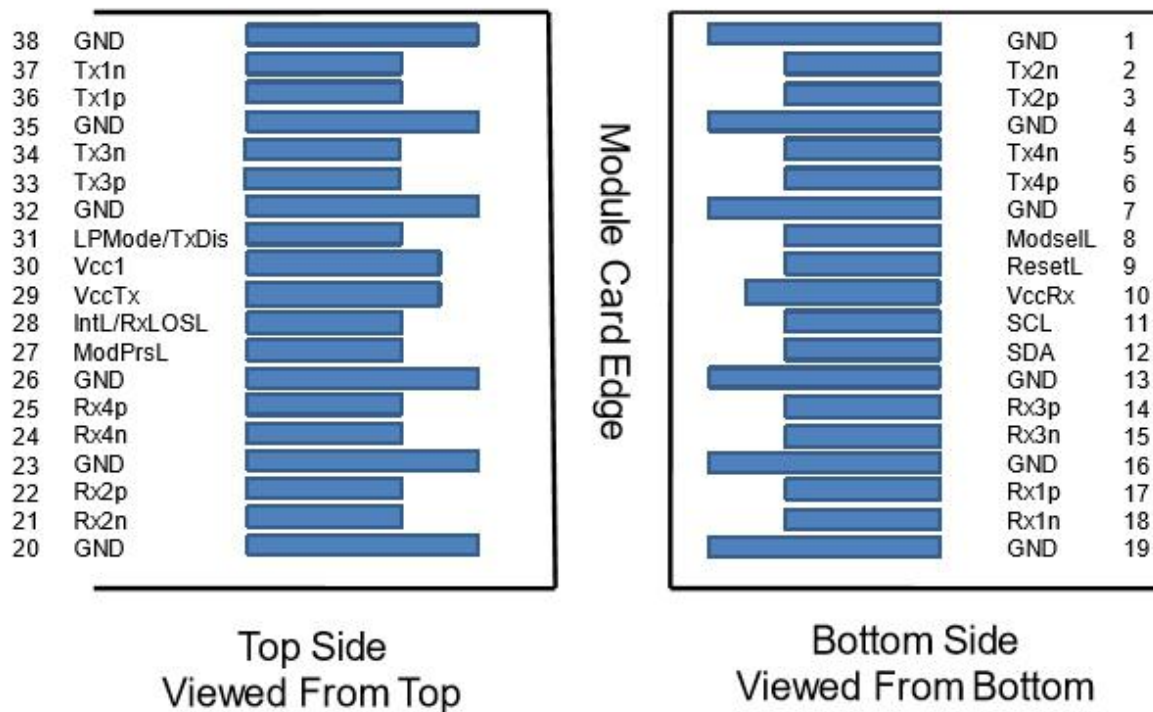


Figure 1 – Pinout definitions of QSFP28 module inputs/outputs

**Table 7 – Module 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/Rx LO S L	Interrupt. Optionally configurable as RxLOSL via the management interface (SFF-8636). Interrupt. Optionally configurable as RxLOSL via the management interface (SFF-8636).	3	
29		Vcc Tx	+3.3V Power supply transmitter	2	2
30		Vcc1	+3.3V Power supply	2	2
31	LVTTL-I	LPMoDe/ T xD is	Low Power Mode. Optionally configurable as TxDis via the management interface (SFF-8636).	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

Note 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 referenced to this potential unless otherwise noted. Connect these directly to the host board signal-common ground plane.

Note 2: VccRx, Vcc1 and VccTx are applied concurrently and may be internally connected within the module in any combination. Vcc contacts in SFF-8662 and SFF-8672 each have a steady state current rating of 1 A.

## Recommended Host Board Power Supply Filtering

See SFF-8679

**Table 8 – Timing for Soft Control and Status Functions**

Parameter	Symbol	Min.	Max.	Unit	Notes
Initialization Time	t_init	-	TBD	s	
Reset Init Assert Time	t_reset_init	10	-	μs	
Serial Bus Hardware Ready Time	t_serial	-	2000	ms	
Monitor Data Ready Time	t_data	-	2000	ms	
Reset Assert Time	t_reset	-	2	s	
LPMMode Assert Time	ton_LPMMode	-	100	ms	
LPMMode De-assert Time	toff_LPMMode	-	300	ms	
IntL Assert Time	ton_IntL	-	200	ms	
IntL Deassert Time	toff_IntL	-	500	μs	
RxLOSL Assert Time (Optional Fast Mode)	ton_f_LOS	-	1	ms	
RxLOSL Deassert Time (Optional Fast Mode)	toff_f_LOS	-	3	ms	
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	
Power_over-ride or Power-set Assert Time	ton_Pdown	-	100	ms	
Power_over-ride or Power-set De-assert Time	toff_Pdown	-	300	ms	

**Table 9 – I/O Timing for Squelch and Disable**

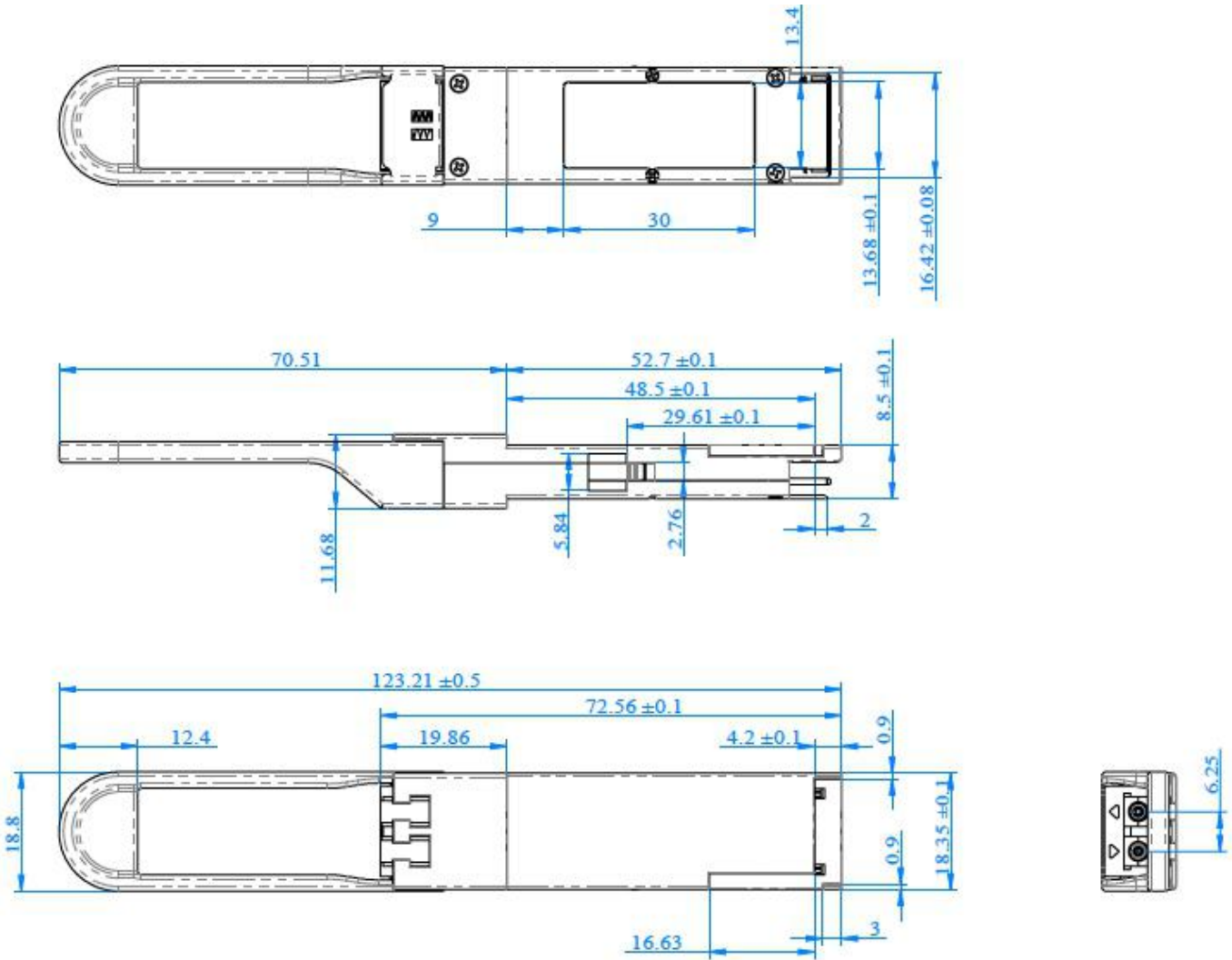
Parameter	Symbol	Min.	Max.	Unit	Notes
Rx Squelch Assert Time	ton_Rxsq	-	15	ms	
Rx Squelch Deassert Time	toff_Rxsq	-	15	ms	
Tx Squelch Assert Time	ton_Txsq	-	400	ms	
Tx Squelch Deassert Time	toff_Txsq	-	400	ms	
Tx Disable Assert Time (fast mode)	ton_Txdisf	-	3	ms	
Tx Disable Deassert Time (fast mode)	toff_Txdisf	-	10	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	

Parameter	Symbol	Min.	Max.	Unit	Notes
Rx Squelch Assert Time	ton_Rxsq	-	15	ms	
Rx Squelch Deassert Time	toff_Rxsq	-	15	ms	
Tx Squelch Assert Time	ton_Txsq	-	400	ms	
Tx Squelch Deassert Time	toff_Txsq	-	400	ms	
Parameter	Symbol	Min.	Max.	Unit	Notes
Tx Disable Assert Time (fast mode)	ton_Txdisf	-	3	ms	
Tx Disable Deassert Time (fast mode)	toff_Txdisf	-	10	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 10 – Digital Diagnostics**

Parameter	Range	Accuracy	Unit	Calibration
Temperature	0 to 70	±3	°C	Internal
Voltage	0 to VCC	±3%	V	Internal
Tx Bias Current (Each Lane)	0 to 100	10%	mA	Internal
Tx Output Power (Each Lane)	2 to +6.5	±3	dB	Internal
Rx Receive Power (Each Lane)	-28 to -5	±3	dB	Internal

**Mechanical Diagram**



**Ordering Information**

Table 11 - Ordering Information

Part No.	Application	Data Rate	Laser Source	Fiber Type
QSFP28-100G-80KM	100GBASE-ZR4	100Gb Ethernet	EML	Single Mode Fiber