

## 100Gbps QSFP28 LR4 10Km SMF TKQS28-100G-LR4

### Overview

TKQS28-100G-LR4 is a 100Gbps transceiver module designed for optical communication applications compliant to 100GBASE-LR4 of the IEEE P802.3ba standard. The module converts 4 input channels of 25Gbps electrical data to 4 channels of LAN WDM optical signals and then multiplexes them into a single channel for 100Gbps optical transmission. Reversely on the receiver side, the module de-multiplexes a 100Gbps optical input into 4 channels of LAN WDM optical signals and then converts them to 4 output channels of electrical data.

The central wavelengths of the 4 LAN WDM channels are 1295.56, 1300.05, 1304.58 and 1309.14 nm as members of the LAN WDM wavelength grid defined in IEEE 802.3ba. The high performance cooled LAN WDM EA-DFB transmitters and high sensitivity PIN receivers provide superior performance for 100Gigabit Ethernet applications up to 10km links and compliant to optical interface with IEEE802.3ba Clause 88 100GBASE-LR4 requirements.

The product is designed with form factor, optical/electrical connection and digital diagnostic interface according to the QSFP+ Multi-Source Agreement (MSA). It has been designed to meet the harshest external operating conditions including temperature, humidity and EMI interference.

### Features

- Hot pluggable QSFP28 MSA form factor
- Compliant to IEEE 802.3ba 100GBASE-LR4
- Up to 10km reach for G.652 SMF
- Single +3.3V power supply
- Operating case temperature: 0~70°C
- Transmitter: cooled 4x25Gb/s LAN WDM EML
- TOSA (1295.56, 1300.05, 1304.58, 1309.14nm)
- Receiver: 4x25Gb/s PIN ROSA
- 4x28G Electrical Serial Interface (CEI-28G-VSR)
- Maximum power consumption 4.0W
- Duplex LC receptacle
- RoHS-6 compliant

### Applications

- 100GBASE-LR4 Ethernet Links
- Infiniband QDR and DDR interconnects
- Client-side 100G Telecom connections



TKQS28-100G-LR4

## Ordering Information

Part Number	Product Description
TKQS28-100G-LR4	QSFP28 100Gbps LR4 10Km with full real-time digital diagnostic monitoring and pull tab

## Absolute Maximum Ratings

It has to be noted that operation in excess of any individual absolute maximum ratings might cause permanent damage to this module.

Parameter	Symbol	Min	Max	Unit
Supply Voltage	Vcc	-0.5	3.6	V
Storage Temperature	Tst	-40	85	°C
Case Operating Temperature	Top	0	70	°C
Humidity(non-condensing)	Rh	0	85	%
Damage Threshold, each Lane	TH <sub>d</sub>	5.5		dBm

## Recommended Operating Conditions

Parameter	Symbol	Min	Typical	Max	Unit
Supply Voltage	Vcc	3.135	3.3	3.465	V
Operating Case temperature	Top	0		70	°C
Data Rate Per Lane	fd		25.78125		Gbps
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

## Electrical Specifications

Parameter	Symbol	Min	Typical	Max	Unit	Notes
Power Consumption				4.0	W	
Supply Current	Icc			1.21	A	
Transceiver Power-on Initialization Time				2000	ms	1
<b>Transmitter (Each Lane)</b>						
Single-ended Input Voltage Tolerance (Note 2)		-0.3		4.0	V	Referred to TP1 signal common
AC Common Mode Input Voltage Tolerance		15			mV	RMS
Differential Input Voltage Swing Threshold		50			mVpp	LOSA Threshold
Differential Input Voltage Swing	Vin, pp	190		700	mVpp	
Differential Input Impedance	Zin	90	100	110	ohm	
<b>Receiver (Each Lane)</b>						
Single-ended Output Voltage		-0.3		4.0	V	Referred to signal common

AC Common Mode Output Voltage				7.5	mV	RMS
Differential Output Voltage Swing	Vout, pp	300		850	mVpp	
Differential Output Impedance	Zout	90	100	110	ohm	

**Note:**

1. Power-on Initialization Time is the time from when the power supply voltages reach and remain above the minimum recommended operating supply voltages to the time when the module is fully functional.
2. The single ended input voltage tolerance is the allowable range of the instantaneous input signals.

## Optical Characteristics

Parameter	Symbol	Min	Typical	Max	Unit	Notes
Lane Wavelength	L0	1294.53	1295.56	1296.59	nm	
	L1	1299.02	1300.05	1301.09	nm	
	L2	1303.54	1304.58	1305.63	nm	
	L3	1308.09	1309.14	1310.19	nm	
<b>Transmitter</b>						
SMSR	SMSR	30			dB	
Total Average Launch Power	P <sub>T</sub>			10.5	dBm	
Average Launch Power, each Lane	P <sub>AVG</sub>	-4.3		4.5	dBm	
OMA, each Lane	P <sub>OMA</sub>	-1.3		4.5	dBm	1
Difference in Launch Power between any Two Lanes (OMA)	P <sub>tx,diff</sub>			5	dB	
Launch Power in OMA minus Transmitter and Dispersion Penalty (TDP), each Lane		-2.3			dBm	
TDP, each Lane	TDP			2.2	dB	
Extinction Ratio	ER	4			dB	
RIN <sub>20OMA</sub>	RIN			-130	dB/Hz	
Optical Return Loss Tolerance	TOL			20	dB	
Transmitter Reflectance	R <sub>T</sub>			-12	dB	
Eye Mask {X1, X2, X3, Y1, Y2, Y3}		{0.25, 0.4, 0.45, 0.25, 0.28, 0.4}				2
Average Launch Power OFF Transmitter, each Lane	P <sub>off</sub>			-30	dBm	
<b>Receiver</b>						
Damage Threshold, each Lane	TH <sub>d</sub>	5.5			dBm	3
Total Average Receive Power				10.5	dBm	
Average Receive Power, each Lane		-10.6		4.5	dBm	
Receive Power (OMA), each Lane				4.5	dBm	

Receiver Sensitivity (OMA), each Lane	SEN			-8.6	dBm	
Stressed Receiver Sensitivity (OMA), each Lane				-6.8	dBm	4
Difference in Receive Power between any Two Lanes (OMA)	Prx,diff			5.5	dB	
LOS Assert	LOSA		-18		dBm	
LOS Deassert	LOSD		-15		dBm	
LOS Hysteresis	LOSH	0.5			dB	
Receiver Electrical 3 dB upper Cutoff Frequency, each Lane	Fc				GHz	
<b>Conditions of Stress Receiver Sensitivity Test (Note 5)</b>						
Vertical Eye Closure Penalty, each Lane			1.8		dB	
Stressed Eye J2 Jitter, each Lane			0.3		UI	
Stressed Eye J9 Jitter, each Lane			0.47		UI	

**Note:**

1. Even if the TDP < 1 dB, the OMA min must exceed the minimum value specified here.
2. See Figure 2 below.
3. 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.
4. Measured with conformance test signal at receiver input for BER =  $1 \times 10^{-12}$ .
5. Vertical eye closure penalty and stressed eye jitter are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

## Module Block Diagram

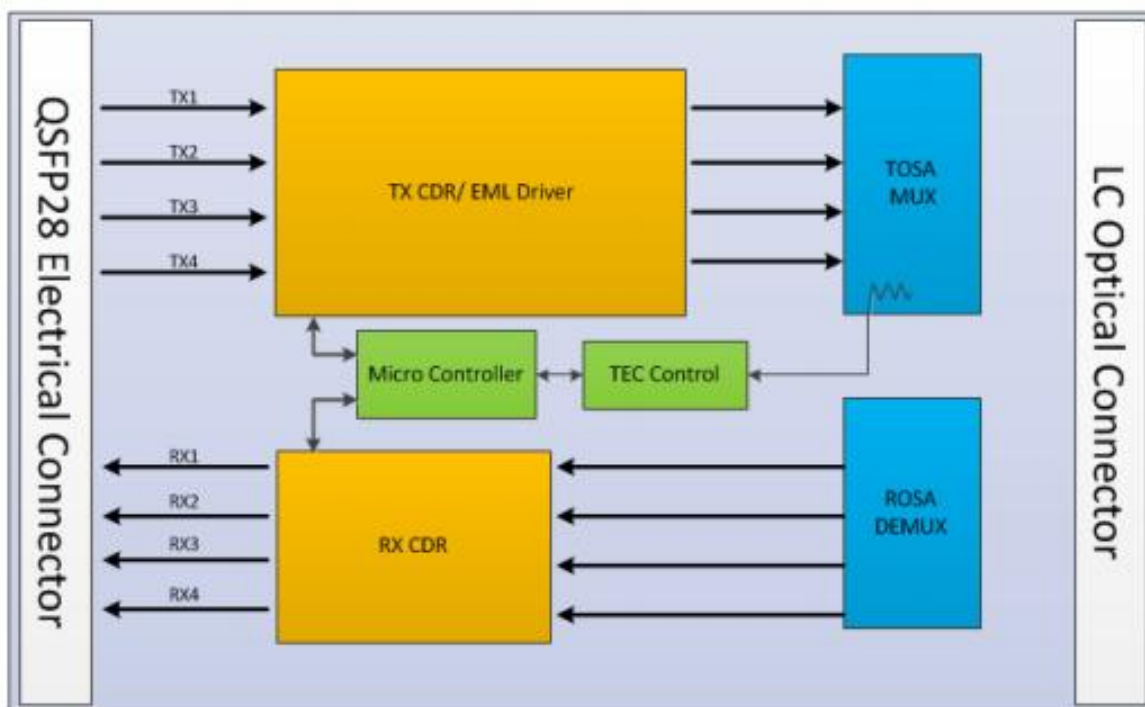


Figure1. Module Block Diagram

Eye Mask Definition

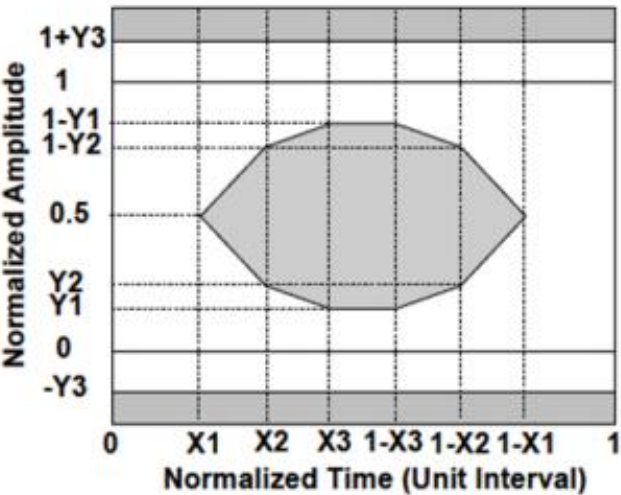


Figure2. Eye Mask Definition

Electrical Pin-out Details

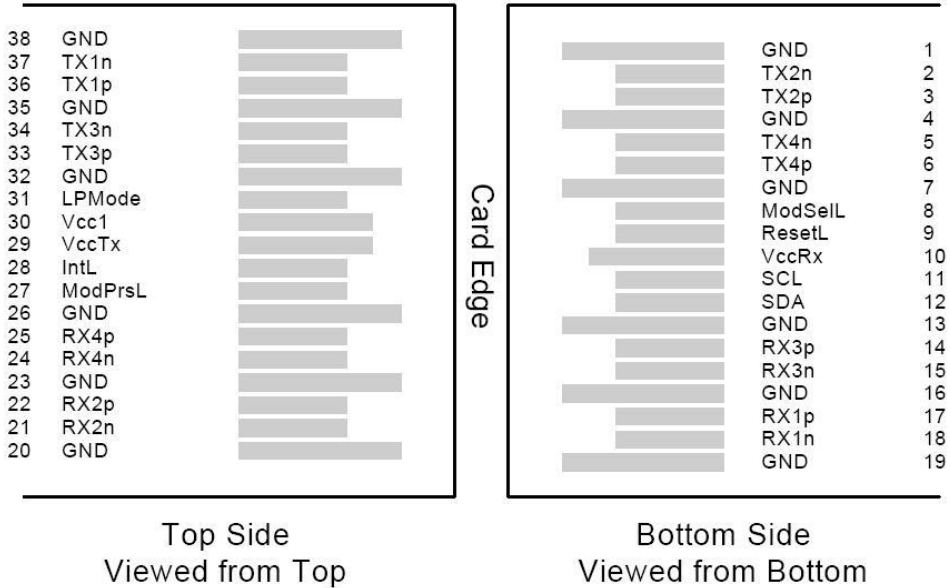


Figure3. Electrical Pin-out Details

Pin Descriptions

Pin	Logic	Symbol	Name/Description	Ref.
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	ModPrsL	Module Present	
28	LVTTL-O	IntL	Interrupt	
29		VccTx	+3.3 V Power Supply transmitter	2
30		Vcc1	+3.3 V Power Supply	2
31	LVTTL-I	LPMODE	Low Power Mode	
32		GND	Ground	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	
34	CML-I	Tx3n	Transmitter Inverted Data Input	
35		GND	Ground	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	
37	CML-I	Tx1n	Transmitter Inverted Data Input	
38		GND	Ground	1

**Notes:**

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

## Recommended Power Supply Filter

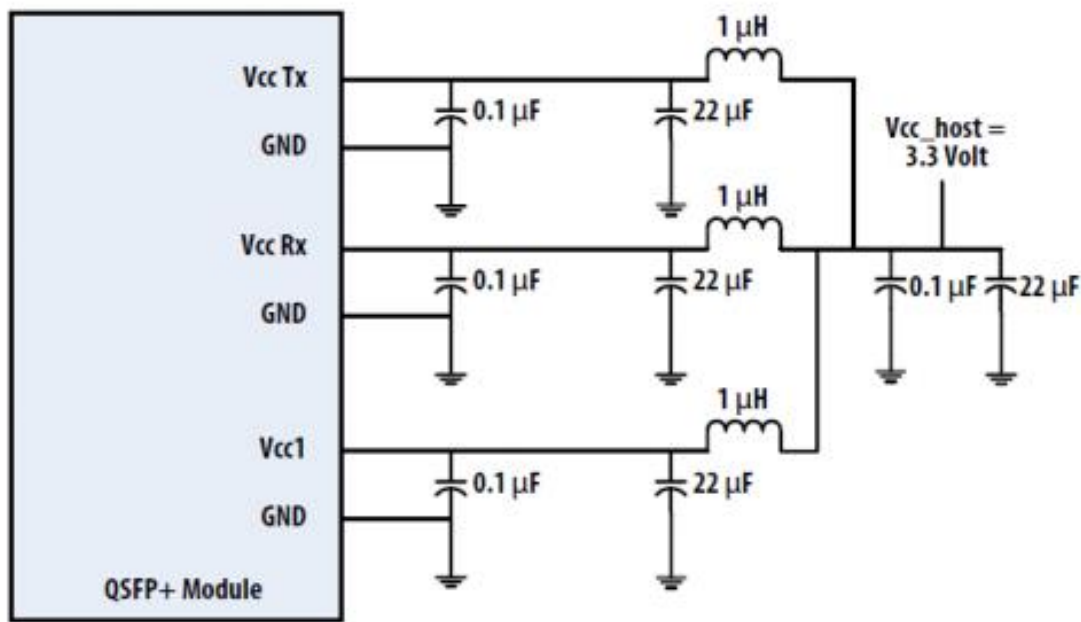


Figure4. Recommended Power Supply Filter

## Digital Diagnostic Functions

The following digital diagnostic characteristics are defined over the normal operating conditions unless otherwise specified.

Parameter	Symbol	Min	Max	Unit	Notes
Temperature monitor absolute error	DMI_Temp	-3	+3	degC	Over operating temperature rang
Supply voltage monitor absolute error	DMI_VCC	-0.1	0.1	V	Over full operating
Channel RX power monitor absolute error	DMI_RX_Ch	-2	2	dB	1
Channel Bias current monitor	DMI_Ibias_Ch	-10%	10%	mA	
Channel TX power monitor absolute error	DMI_TX_Ch	-2	2	dB	1

### Notes:

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

## Mechanical Dimensions

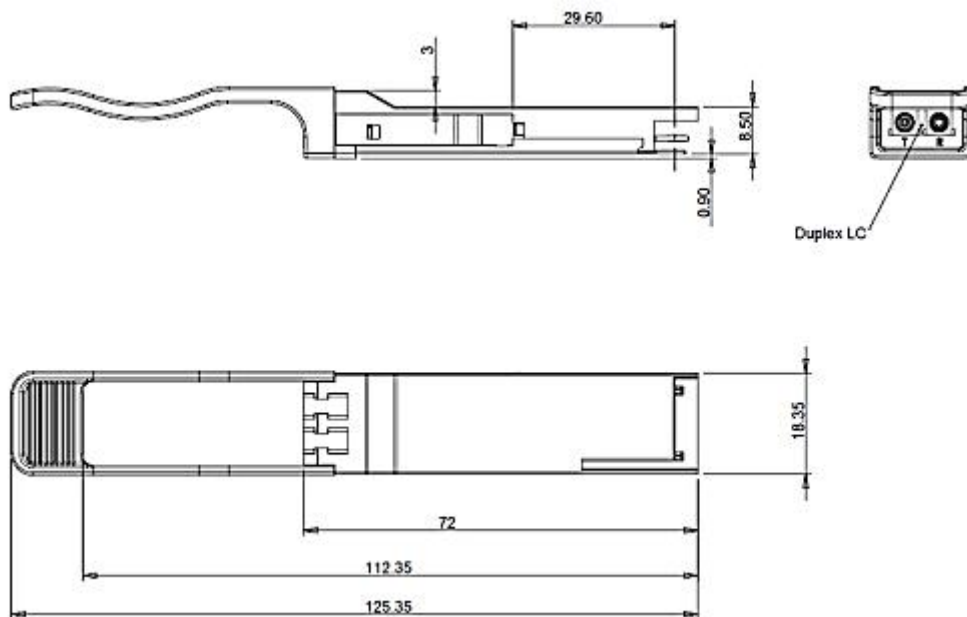


Figure5. Mechanical Specifications

## ESD

This transceiver is specified as ESD threshold 1kV for SFI pins and 2kV for all other electrical input pins, tested per MIL-STD-883, Method 3015.4 /JESD22-A114-A (HBM). However, normal ESD precautions are still required during the handling of this module. This transceiver is shipped in ESD protective packaging. It should be removed from the packaging and handled only in an ESD protected environment.

## Laser Safety

This is a Class 1 Laser Product according to IEC 60825-1:2007. This product complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated (June 24, 2007).