

E-QSFP28-LR4

100GBASE-LR4 QSFP28 1310nm 10km DDM SMF Transceiver

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: 0~70oC
- 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 3.5W
- Duplex LC receptacle
- RoHS-6 compliant

Applications

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

1. Absolute Maximum Ratings

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

Parameter	Symbol	Min	Max	Units	Notes
Storage Temperature	TS	-40	85	degC	
Operating Case Temperature	TOP	0	70	degC	
Power Supply Voltage	VCC	-0.5	3.6	V	
Relative Humidity (non-condensation)	RH	0	85	%	
Damage Threshold, each Lane	THd	5.5		dBm	

2. Recommended Operating Conditions

Parameter	Symbol	Min	Typical	Max	Units
Operating Case Temperature	TOP	0		70	degC
Power Supply Voltage	VCC	3.135	3.3	3.465	V
Data Rate, each Lane			25.78125		Gb/s



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

3. Electrical Characteristics

The following electrical characteristics are defined over the Recommended Operating Environment unless otherwise specified.

Parameter	Symbol	Min	Typical	Max	Units	Notes
Power Consumption	_			4.0	W	
Supply Current	Icc			1.12	Α	
Transceiver Power-on Initialization Time				2000	ms	1
	Tra	nsmitter ((each Lane)			
Single-ended Input Voltage Tolerance (Note2)		-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	
	Re	eceiver (e	ach Lane)			
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	

Notes:

4. Optical Characteristics

QSFP28 100GBASE-LR4									
Parameter Symbol Min Typical Max Unit N									
	L0	1294.53	1295.56	1296.59	nm				
Lane Wavelength	L1	1299.02	1300.05	1301.09	nm				
	L2	1303.54	1304.58	1305.63	nm				
	L3	1308.09	1309.14	1310.19	nm				
Transmitter									
Side Mode Suppression Ratio	SMSR	30			dB				

^{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.



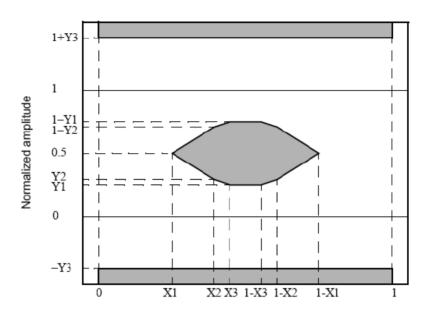
Average Launch Power, each Lane OMA, each Lane OMA, each Lane POMA Difference in Launch Power between any Two Lanes (OMA) Launch Power in OMA minus Transmitter and Dispersion Penalty (TDP), each Lane TDP, each Lane TOU Extinction Ratio ER A RIN200MA RIN Optical Return Loss Tolerance ToU Transmitter Reflectance Eye Mask(X1, X2, X3, Y1, Y2, Y3) Average Launch Power OFF Transmitter, each Lane Total Average Receive Power Average Receive Power, each Lane Receiver Sensitivity (OMA), each Lane Receiver Sensitivity (OMA), each Lane Receiver Sensitivity (OMA), each Lane Receiver Reflectance Difference in Receive Power Determine in Receiver Power Difference in Receive Power Difference in Receive Power Determine in Receiver Sensitivity (OMA), each Lane Receiver Sensitivity (OMA), each Lane Receiver Reflectance Difference in Receive Power Determine in Receiver Power	Total Average Launch Power	PT			10.5	dBm	
OMA, each Lane					10.0	uDiii	
Difference in Launch Power between any Two Lanes (OMA) Ptx,diff Launch Power in OMA minus Transmitter and Dispersion Penalty (TDP), each Lane TDP 2.2 dB	Average Launch Power, each Lane	PAVG	-4.3		4.5	dBm	
Detween any Two Lanes (OMA)	OMA, each Lane	POMA	-1.3		4.5	dBm	1
Launch Power in OMA minus Transmitter and Dispersion Penalty (TDP), each Lane TDP 2.2 dB	Difference in Launch Power						
Transmitter and Dispersion Penalty (TDP), each Lane		Ptx,diff			5	dB	
Extinction Ratio	Transmitter and Dispersion Penalty		-2.3			dBm	
RIN2OOMA	TDP, each Lane	TDP			2.2	dB	
Optical Return Loss Tolerance TOL 20 dB Transmitter Reflectance RT -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 Poff -30 dBm Receiver Damage Threshold, each Lane THd 5.5 dBm 3 Total Average Receive Power -10.6 dBm 4 Average Receive Power, each Lane -10.6 4.5 dBm Receiver Power (OMA), each Lane SEN -10.6 dBm Receiver Sensitivity (OMA), each Lane SEN -10.6 dBm Stressed Receiver Sensitivity (OMA), each Lane RR -6.8 dBm Stressed Receiver Sensitivity (OMA), each Lane Prx,diff 5.5 dB Difference in Receive Power between any Two Lanes (OMA) Prx,diff 5.5 dB LOS Assert LOSA -25 dBm LOS Hysteresis LOSH 0.5 dB Receiver Electrical 3 dB upper Cutoff Frequency, each Lane	Extinction Ratio	ER	4			dB	
Transmitter Reflectance	RIN20OMA	RIN			-130	dB/Hz	
Eye Mask{X1, X2, X3, Y1, Y2, Y3}	Optical Return Loss Tolerance	TOL			20	dB	
Average Launch Power OFF Transmitter, each Lane Receiver Damage Threshold, each Lane Average Receive Power Average Receive Power, each Lane Receiver Power (OMA), each Lane Receiver Sensitivity (OMA), each Lane Receiver Sensitivity (OMA), each Lane Average Receiver Sensitivity (OMA), each Lane Receiver Reflectance Receiver Reflectance Difference in Receive Power between any Two Lanes (OMA) LOS Assert LOS Deassert LOS Hysteresis Receiver Electrical 3 dB upper Cutoff Frequency, each Lane Conditions of Stress Receiver Sensitivity Test (Note 5) Vertical Eye Closure Penalty, each Lane Stressed Eye J2 Jitter, each Lane Receiver Sensitivity (Note 5) Vertical Eye Closure Penalty, each Lane Receiver Sensitivity (Note 5) Vertical Eye Closure Penalty, each Lane Receiver Sensitivity (Note 5) Vertical Stressed Eye J2 Jitter, each Lane Receiver Sensitivity Test (Note 5) Vertical Eye Closure Penalty, each Lane On Stressed Eye J2 Jitter, each Lane	Transmitter Reflectance	RT			-12	dB	
Name	Eye Mask{X1, X2, X3, Y1, Y2, Y3}		{0.25, 0		25, 0.28,		2
Damage Threshold, each Lane Total Average Receive Power Average Receive Power, each Lane Receive Power (OMA), each Lane Receiver Sensitivity (OMA), each Lane Stressed Receiver Sensitivity (OMA), each Lane Receiver Reflectance Difference in Receive Power between any Two Lanes (OMA) LOS Assert LOS Deassert LOS Deysteresis LOS Hysteresis LOSH Receiver Electrical 3 dB upper Cutoff Frequency, each Lane Conditions of Stress Receiver Sensitivity Test (Note 5) Vertical Eye Closure Penalty, each Lane Stressed Eye J2 Jitter, each Lane Thd 5.5 dBm -10.6 4.5 dBm 4.5 dBm 4 FE -26 dB Frx,diff 5.5 dB Frx,diff -10.6 DEM -10.6 4.5 dBm 4 Frx,diff -6.8 dBm 4 Frx,diff -10.6 dBm 4 Bereiver Reflectance RR -26 dB -25 dBm -13 dBm GHz Challe Stressed Eye J2 Jitter, each Lane 1.8 dB dB Stressed Eye J2 Jitter, each Lane		Poff			-30	dBm	
Total Average Receive Power Average Receive Power, each Lane Average Receive Power, each Lane Receive Power (OMA), each Lane Receiver Sensitivity (OMA), each Lane Stressed Receiver Sensitivity (OMA), each Lane Receiver Reflectance RR Receiver Reflectance RR Prx,diff Difference in Receive Power between any Two Lanes (OMA) LOS Assert LOSA LOS Deassert LOSD Assert LOSD Assert LOSH Conditions of Stress Receiver Sensitivity Test (Note 5) Vertical Eye Closure Penalty, each Lane Stressed Eye J2 Jitter, each Lane -10.6 4.5 dBm 4.5 dBm 4 FC Conditions of Stress Receiver Sensitivity Test (Note 5)		Red	ceiver			,	
Average Receive Power, each Lane Receive Power (OMA), each Lane Receiver Sensitivity (OMA), each Lane Stressed Receiver Sensitivity (OMA), each Lane Stressed Receiver Sensitivity (OMA), each Lane Receiver Reflectance RR Receiver Reflectance RR Prx,diff Stressed Receiver Power between any Two Lanes (OMA) LOS Assert LOSA LOS Deassert LOSD LOS Hysteresis LOSH Receiver Electrical 3 dB upper Cutoff Frequency, each Lane Conditions of Stress Receiver Sensitivity Test (Note 5) Vertical Eye Closure Penalty, each Lane Stressed Eye J2 Jitter, each Lane SEN -10.6 dBm -10.6 dBm 4.5 dBm 4.5 dBm 4 Fc JS JS dBm ABM ABM ABM ABM ABM ABM ABM A	Damage Threshold, each Lane	THd	5.5			dBm	3
Receive Power (OMA), each Lane Receiver Sensitivity (OMA), each Lane Stressed Receiver Sensitivity (OMA), each Lane Receiver Reflectance RR Receiver Reflectance RR Receiver Reflectance RR Prx,diff Stressed Receiver Sensitivity (OMA), each Lane Receiver Reflectance RR Receiver Reflectance RR Receiver Reflectance RR Receiver Reflectance RR Receiver Aghlectance RR Receiver In Receive Power Between any Two Lanes (OMA) LOS Assert LOSA LOSA LOSA LOSD Receiver Electrical 3 dB upper Cutoff Frequency, each Lane Conditions of Stress Receiver Sensitivity Test (Note 5) Vertical Eye Closure Penalty, each Lane Stressed Eye J2 Jitter, each Lane SEN -10.6 dBm 4 ABB 4 Conditions of Stress Receiver Sensitivity Test (Note 5)	Total Average Receive Power				-10.6	dBm	
Receiver Power (OMA), each Lane Receiver Sensitivity (OMA), each Lane Stressed Receiver Sensitivity (OMA), each Lane Receiver Reflectance RR Receiver Sensitivity Receiver Receiver Sensitivity Receiver Receiver Sensitivity Receiver	Average Receive Power, each Lane		-10.6		4.5	dBm	
Stressed Receiver Sensitivity (OMA), each Lane Receiver Reflectance RR Difference in Receive Power between any Two Lanes (OMA) LOS Assert LOSA LOS Deassert LOSD LOS Hysteresis LOSH Receiver Electrical 3 dB upper Cutoff Frequency, each Lane Conditions of Stress Receiver Sensitivity Test (Note 5) Vertical Eye Closure Penalty, each Lane Stressed Eye J2 Jitter, each Lane OMB -6.8 dBm 4 C-6.8 dBm 4 ENDE CHOSH 4 BENE CHOSH -6.8 dBm 4 ENDE CHOSH -725 dBm -730 dBm -730 dBm GHz GHz THE CHOSH -6.8 -6.8 dBm 4 BENE CHOSH -740 BENE CHOSH -750 BENE CHOSH -6.8 dB -6.8 4 BENE CHOSH -6.8 dB -6.8 4 BENE CHOSH -6.8 -6.8 dBm 4 BENE CHOSH -6.8 -6.8 dB -6.8 4 BENE CHOSH -6.8 -6.8 dB -6.8 -6.8 dB -6.8 -6.8 dB -6.8 -6.8 dB -700 BENE CHOSH -6.8 dB -6.8 -6.8 dB -6.8 -6.8 dB -6.8 -6.8 dB -6.8 dB -6.8 -6.8 dB -6.8 dB -6.8 dB -6.8 -6.8 dB -6	Receive Power (OMA), each Lane				4.5	dBm	
(OMA), each Lane-6.8dBm4Receiver ReflectanceRR-26dBDifference in Receive Power between any Two Lanes (OMA)Prx,diff5.5dBLOS AssertLOSA-25dBmLOS DeassertLOSD-13dBmLOS HysteresisLOSH0.5dBReceiver Electrical 3 dB upper Cutoff Frequency, each LaneFc31GHzConditions of Stress Receiver Sensitivity Test (Note 5)Vertical Eye Closure Penalty, each Lane1.8dBStressed Eye J2 Jitter, each Lane0.3UI	,	SEN			-10.6	dBm	
Difference in Receive Power between any Two Lanes (OMA) LOS Assert LOSA LOSD LOS Deassert LOSD LOS Hysteresis LOSH Receiver Electrical 3 dB upper Cutoff Frequency, each Lane Conditions of Stress Receiver Sensitivity Test (Note 5) Vertical Eye Closure Penalty, each Lane Stressed Eye J2 Jitter, each Lane Difference in Receive Power Prx, diff LOSD LOSA -25 dB dB CHZ TOSD FC 31 GHz THE GRAD AND AND AND AND AND AND AND AND AND A					-6.8	dBm	4
between any Two Lanes (OMA) LOS Assert LOSA LOS Deassert LOSD LOS Hysteresis LOSH Cutoff Frequency, each Lane Conditions of Stress Receiver Sensitivity Test (Note 5) Vertical Eye Closure Penalty, each Lane Stressed Eye J2 Jitter, each Lane DOSA -25 dB dB CHZ GHZ ABB ABB ABB ABB ABB ABB ABB A	Receiver Reflectance	RR			-26	dB	
LOS Deassert LOSD -13 dBm LOS Hysteresis LOSH 0.5 dB Receiver Electrical 3 dB upper Cutoff Frequency, each Lane Conditions of Stress Receiver Sensitivity Test (Note 5) Vertical Eye Closure Penalty, each Lane Stressed Eye J2 Jitter, each Lane 0.3 UI		Prx,diff			5.5	dB	
LOS Hysteresis LOSH 0.5 dB Receiver Electrical 3 dB upper Cutoff Frequency, each Lane Fc 31 GHz Conditions of Stress Receiver Sensitivity Test (Note 5) Vertical Eye Closure Penalty, each Lane 1.8 dB Stressed Eye J2 Jitter, each Lane 0.3 UI	LOS Assert	LOSA		-25		dBm	
Receiver Electrical 3 dB upper Cutoff Frequency, each Lane Conditions of Stress Receiver Sensitivity Test (Note 5) Vertical Eye Closure Penalty, each Lane Stressed Eye J2 Jitter, each Lane Tectory 1.8 4B 0.3 UI	LOS Deassert	LOSD		-13		dBm	
Receiver Electrical 3 dB upper Cutoff Frequency, each Lane Conditions of Stress Receiver Sensitivity Test (Note 5) Vertical Eye Closure Penalty, each Lane Stressed Eye J2 Jitter, each Lane Tectory 1.8 4B 0.3 UI	LOS Hysteresis	LOSH	0.5			dB	
Vertical Eye Closure Penalty, each Lane Stressed Eye J2 Jitter, each Lane 1.8 dB UI		Fc			31	GHz	
Lane 1.6 UI Stressed Eye J2 Jitter, each Lane 0.3 UI	Conditions of St	ress Rece	iver Sensi	tivity Test (Note 5)		
·	_			1.8		dB	
tressed Eye J9 Jitter, each Lane 0.47 UI	Stressed Eye J2 Jitter, each Lane			0.3		UI	
	tressed Eye J9 Jitter, each Lane			0.47		UI	

Notes:

- 1. Even if the TDP < 1 dB, the OMA min must exceed the minimum value specified here.
- 2. See Figure 4 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 = 1x10-12.
- 5. Vertical eye closure penalty and stressed eye jitter are test conditions for measuring stressed receiver sensitivity.

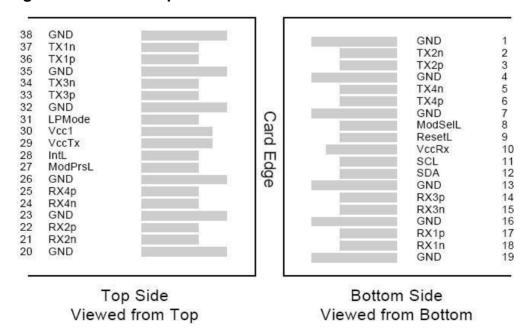


They are not characteristics of the receiver.



Normalized time (Unit Interval)
Figure 4. Eye Mask Definition

5. Pin Assignment and Description



6. Pin Definition

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	LVCMOS-I/O	SCL	2-Wire Serial Interface Clock	
12	LVCMOS-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	Тх3р	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 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 3 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.