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OP-QSFP28-LR4

100G/112G QSFP28 LR4 Transceiver 10km LC DDM

Features

- Hot pluggable QSFP28 MSA form factor
- Compliant to IEEE 802.3ba 100GBASE-LR4
- Support Data Rate from 103.125 Gbps to 111.81 Gbps
- Up to 10km reach for G.652 SMF
- Single +3.3V power supply
- Operating case temperature: 0~70^{O}C
- Integrated LAN WDM TOSA / PIN ROSA
- Maximum power consumption 4.0W
- Duplex LC receptacle
- RoHS-6 compliant

Applications

- 100GBASE-LR4 Ethernet Links
- ITU-T OTU4

General Description

OP-QSFP28-LR4 is a 100Gb/s transceiver module designed for optical communication applications compliant to 100GBASE-LR4 of the IEEE P802.3ba standard. The module converts 4

input channels of 25Gb/s electrical data to 4 channels of LAN WDM optical signals and then multiplexes them into a single channel for 100Gb/s optical transmission. Reversely on the receiver side, the module de-multiplexes a 100Gb/s 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.

OP-QSFP28-LR4 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.

Transceiver Block Diagram

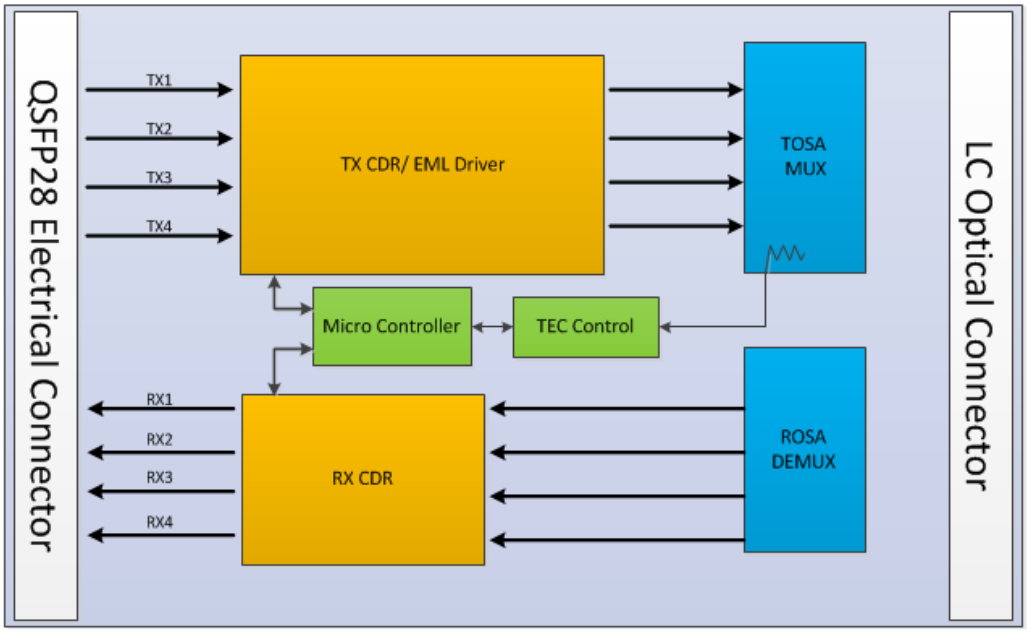

Figure 1. Transceiver Block Diagram

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Pin Assignment and Description

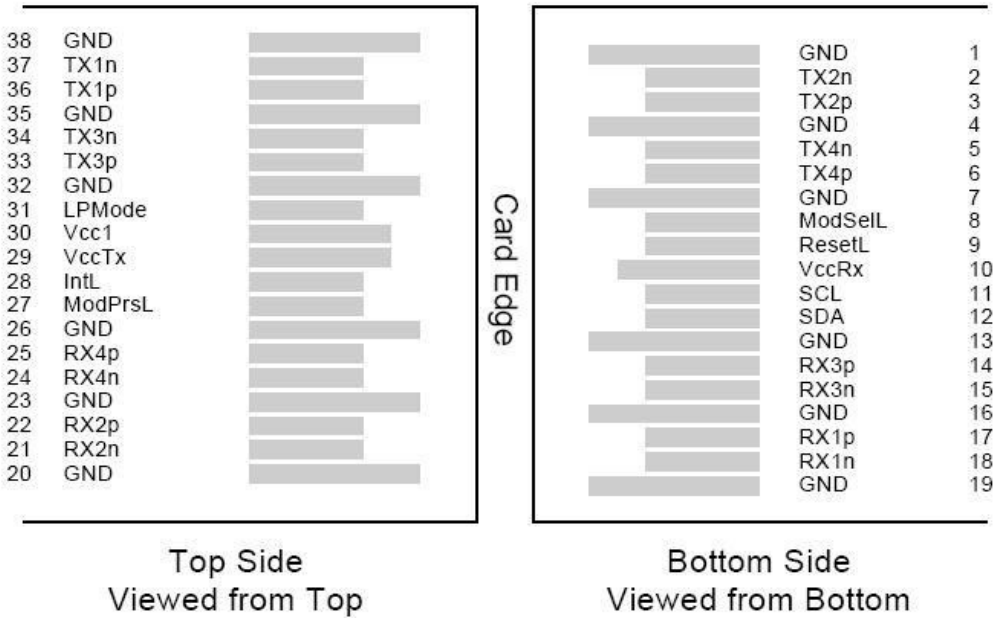

Figure 2. MSA compliant Connector

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	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 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.

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Recommended Power Supply Filter

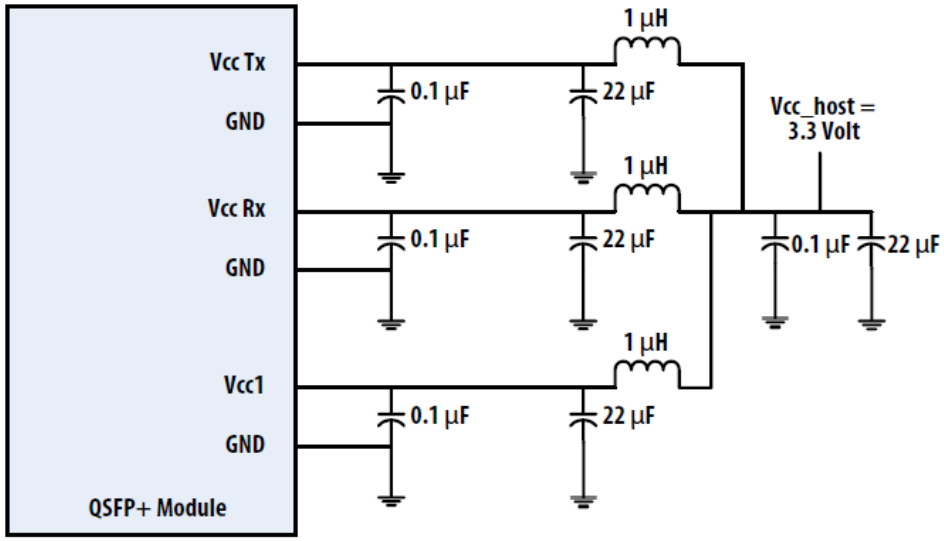

Figure 3. Recommended Power Supply Filter

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	

Recommended Operating Conditions and Power Supply Requirements

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

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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 Characteristics

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

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Transmitter (Module Input)						
Differential Data Input Amplitude	$V_{IN,P-P}$	100	-	1100	mVpp	
Input Impedance (Differential)	Z_{IN}	85	100	115	Ohms	
Differential Termination Mismatch		-	-	10	%	
Receiver (Module Output)						
Differential Data Output Amplitude	$V_{OUT,P-P}$	200	-	900	mVpp	
Output Impedance (Differential)	Z_{OUT}	85	100	115	Ohms	
Differential Termination Mismatch		-	-	10	%	
Output Rise/Fall Time, 20%~80%	T_R/T_F	12	-	-	ps	

Optical Characteristics

QSFP28 100GBASE-LR4						
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	
Transmitter						
Side Mode Suppression Ratio	SMSR	30			dB	
Total Average Launch Power	P_T			10.5	dBm	
Average Launch Power, each Lane	P_{AVG}	-4.3		4.5	dBm	
OMA, each Lane	P_{OMA}	-1.3		4.5	dBm	1
Difference in Launch Power between any Two Lanes (OMA)	Ptx,diff			5	dB	

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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	
$RIN_{20}OMA$	RIN			-130	dB/Hz	
Optical Return Loss Tolerance	TOL			20	dB	
Transmitter Reflectance	R_T			-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	TH_d	5.5			dBm	3
Total Average Receive Power				10.5	dBm	
Average Receive Power, each Lane		-10.6			dBm	
Receive Power (OMA), each Lane				4.5	dBm	
Receiver Sensitivity (OMA), each	SEN			-8.6	dBm	
Stressed Receiver Sensitivity (OMA), each Lane				-6.8	dBm	4
Receiver Reflectance	R_R			-26	dB	
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			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	
Stressed 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.

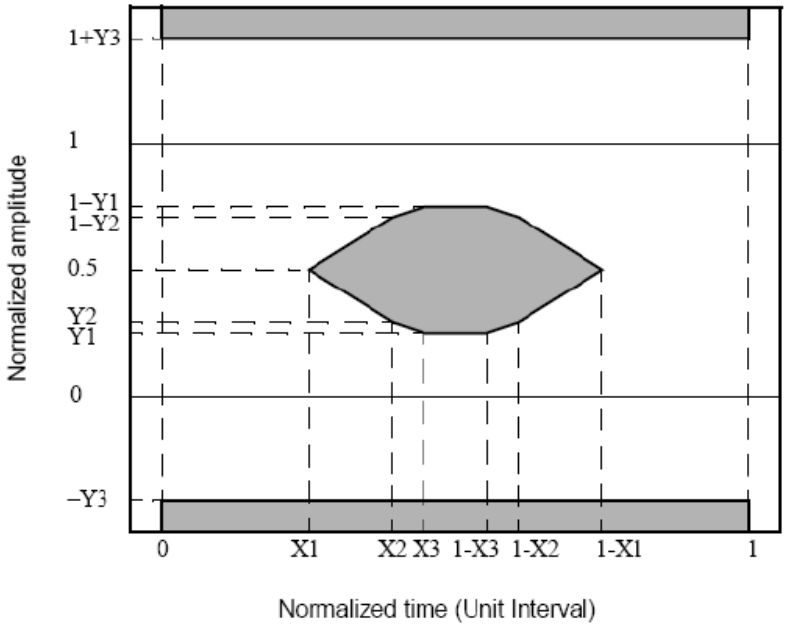

Figure 4. Eye Mask Definition

Digital Diagnostic Functions

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

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
Channel RX power monitor absolute error	DMI_RX_Ch	-2	2	dB	1

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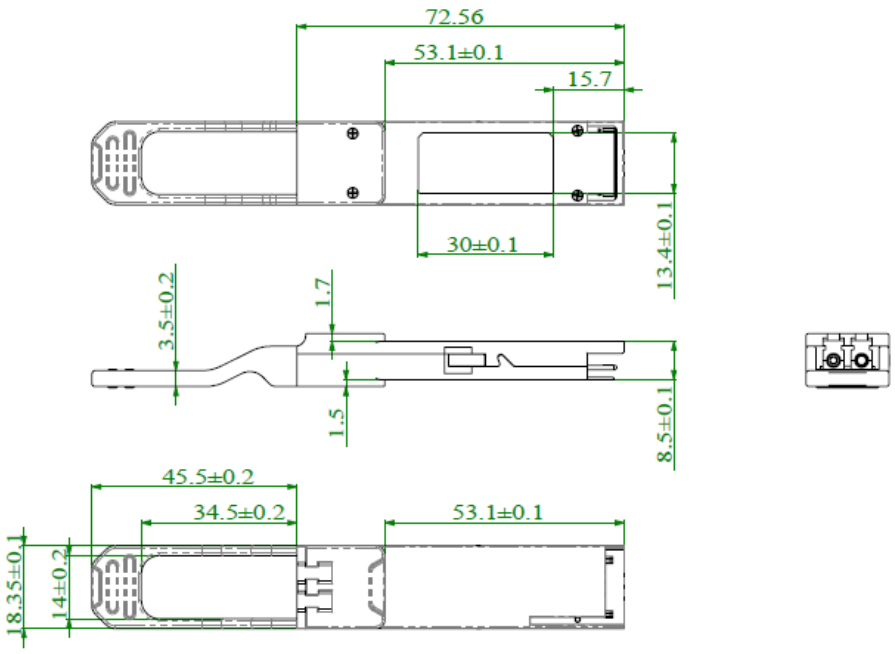
Channel Bias current monitor	DMI_Ibias_Ch	-10%	10%	mA	
Channel TX power monitor absolute error	DMI_TX_Ch	-2	2	dB	1

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.

Mechanical Dimensions



Ordering Information

Part Number	Product Description
OP-QSFP28-LR4	100G QSFP28 LR4 LWDM 10km LC DDM
OP-QSFP28-LR4 dual rate	103.1G~112G QSFP28 LR4 LWDM 10km LC DDM