100Gb/s CFP2 LR4 Optical Transceiver

Product Features

- Hot Pluggable CFP2 MSA package
- IEEE 802.3ba 100GBASE-LR4 compliant
- ITU-T 4I1-9D1F compliant
- CFP-MSA-CFP2-HW-Specification compliant
- Up to 10km for G.652 SMF
- Receiver: up to 4 x 28Gb/s PIN ROSA
- Transmitter: up to 4 x 28Gb/s WDM TOSA
- (1295.56,1300.05,1304.58,1309.14nm)
- 4 x 28G Electrical Serial Interface (CEI-28G-VSR)
- MDIO management interface with Digital Diagnostic
- +3.3V power supply
- Power consumption less than 9W
- Compact size: 107.5 x 41.5 x 12.4 mm
- Operating case temperature: 0 to +70 ℃
- Duplex LC Receptacle
- ROHs-6 compliant

Applications

- 100GE Routers and Switches
- 100G DWDM/OTN
- 100G Network Security
- And Monitoring

This 100G CFP2 LR4 optical Transceiver integrates receiver and transmitter path on one module. In the transmit side, four lanes of serial data streams are recovered, retimed, and passed to four laser drivers. The laser drivers control four EMLs (Electric-absorption Modulated Lasers) with center wavelength of 1296 nm, 1300nm, 1305nm and 1309 nm. The optical signals are multiplexed to a single−mode fiber through an industry standard LC connector. In the receive side, the four lanes of optical data streams are optically de-multiplexed by the integrated optical de-multiplexer. Each data stream is recovered by a PIN photo-detector and trans-impedance amplifier, retimed. This module features a hot-pluggable electrical interface, low power consumption and MDIO management interface.

Ordering Information

Part Number	Description
AC-E-CFP2LR4O4-xx	CFP2 100G LR4 10km optical transceiver with full real- time digital diagnostic monitoring

Regulatory Compliance

Feature	Standard	Performance
Electromagnetic Interference (EMI)	FCC Part 15 Class B EN 55022:2010, Class B	Compatible with standards
Electromagnetic susceptibility (EMS)	EN 55024:2010	Compatible with standards
Laser Eye Safety	FDA 21CFR 1040.10 and 1040.11 EN60950, EN (IEC) 60825-1,2	Compatible with Class I laser product

Absolute Maximum Ratings

Parameter	Symbol	Conditions	Min.	Max	Unit
Storage temperature（case）	T_{stg}	—	-40	+85	℃
Relative humidity	RH	-	5	85	%
Damage Threshold for Receiver	Pmax	—	—	+10.0	dBm
Power Supply	Vcc 3.3V	—	-0.3	+3.6	V
	Vcc 5.0V	—	—	—	V
Input 3.3V LVCMOS signal level	Vi	—	-0.3	Vcc+0.3	V
Input 1.2V LVCMOS signal level	Vi		-0.3	1.6	V
ESD Sensitivity on module and all host pins	HBM	Human Body model R=1.5K, C=100pF	—	2000	V

Recommended operating conditions

100Gb/s CFP2 recommended working conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Operating Case Temperature	Tc	0	—	+70	℃
Supply voltage	Vcc 3.3V	+3.14	+3.3	+3.47	V
Supply Current	Icc 3.3V	—	—	2.56	A
Power dissipation	P	—	—	9	W
Low Power dissipation	P_{Low}			2	W
In-rush Curent	I-inrush			200	mA/us
Turn-off rush Curent	I-turnoff	-200			mA/us
Link Distance	L	2M	—	10km	G.652 SMF

Low Speed Electrical Characteristics

100Gb/s CFP2 3.3V LVCMOS Electrical Characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage	Vcc		3.2	3.3	3.4	V
Input High Voltage	V_{IH}		2		Vcc+0.3	V
Input Low Voltage	V_{IL}		-0.3		0.8	V
Input Leakage Current	I_{IN}		-10		+10	mA
Output High Voltage (I_{OH} =-100uA)	V_{OH}		Vcc-0.2		Vcc+0.3	V
Output Low Voltage (I_{OL} =100uA)	V_{OL}		-0.3		0.2	V
Minimum Pulse Width of Control Pin Signal	t_CNTL		100			us

100Gb/s CFP2 1.2V LVCMOS Electrical Characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Input High Voltage	V_{IH}		0.84		1.5	V
Input Low Voltage	V_{IL}		-0.3		0.36	V
Input Leakage Current	I_{IN}		-100		+100	uA
Output High Voltage	V_{OH}		1.0		1.5	V
Output Low Voltage	V_{OL}		-0.3		0.2	V
Output High Current	I_{OH}				-4	mA
Output Low Current	I_{OL}		+4			mA
Input capacitance	Ci				10	pF

100Gb/s CFP2 Timing Parameters for CFP2 Hardware Signal Pins

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Hardware MOD_LOPWR assert	t_MOD_LOPWR_assert				1	ms
Hardware MOD_LOPWR deassert	t_MOD_LOPWR_deassert				10	s
Receiver Loss of Signal Assert Time	t_loss_assert				100	us
Receiver Loss of Signal De-Assert Time	t_loss_deassert				100	us
Global Alarm Assert Delay Time	GLB_ALRMn_assert				150	ms
Global Alarm De-Assert Delay Time	GLB_ALRMn_deassert				150	ms
Management Interface Clock Period	t_prd		250			ns
Host MDIO t_setup	t_setup		10			ns
Host MDIO t_hold	t_hold		10			ns
CFP2 MDIO t_delay	t_delay		0		175	ns
Initialization time from Reset	t_initialize				2.5	s
Transmitter Disabled (TX_DIS asserted)	t_deassert				100	us
Transmitter Enabled (TX_DIS de-asserted)	t_assert				2	ms

100Gb/s CFP2 MDIO and MDC Timing Characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Management Interface Clock Frequency	F_MDC		0.1		4	MHz

Management Interface Clock Period	t_prd		250		10000	ns
Host MDIO t_setup	t_setup		10			ns
Host MDIO t_hold	t_hold		10			ns
CFP2 MDIO t_delay[1]	t_delay		0		175	ns
MDC high and low time	twidth		40		60	%
			160			ns
MDIO/MDC termination in CFP2	Zt		100			kOhm

High Speed Electrical Characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Transmitter (CEI-28G-VSR input interface)						
Signal Rate Per Lane		100GE		25.7812		Gb/s
Signal Rate Per Lane		OTU4		27.9525		Gb/s
Signal Rate Tolerance		100GE	-100		100	ppm
Signal Rate Tolerance		OTU4	-20		20	ppm
Input Differential Voltage	Vdiff	Emphasis off			1200	mVppd
Differential Input Resistance	Rdin		85	100	115	Ω
Input Impedance Mismatch	Rm				5	%
Sinusoidal Jitter, Maximum					5	UIpp
Sinusoidal Jitter, High Frequency					0.05	UIpp
Receiver (CEI-28G-VSR output interface)						
Signal Rate Per Lane		100GE		25.7812		Gb/s
Signal Rate Per Lane		OTU4		27.9525		Gb/s

Signal Rate Tolerance		100GE	-100		100	ppm
Signal Rate Tolerance		OTU4	-20		20	ppm
Output Differential Voltage	Vdiff	Equalization off	600	750	900	mVppd
Differential Resistance	Rdo		85	100	115	Ω
Differential Termination Resistance Mismatch	Rdm				5	%
Output Rise and Fall Time	T_tr, T_tf	20% to 80%			15	ps
Common Mode Noise(RMS)	Ncm				12	mV
Uncorrelated Unbounded Gaussian Jitter				0.1	0.15	UIpp
Uncorrelated Bounded High Probability Jitter				0.18	0.28	UIpp
Total Jitter	T_j			0.28	0.43	UIpp

Optical Characteristics(100G Ethernet)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Transmitter						
Channel data rate				25.7812		Gbps
Aggregate data rate				103.125		Gbps
Data rate variation			-100		+100	ppm
Lane Center Wavelength	λc_{T0}		1294.53	1295.56	1296.59	nm
	λc_{T1}		1299.02	1300.05	1301.09	nm
	λc_{T2}		1303.54	1304.58	1305.63	nm
	λc_{T3}		1308.09	1309.14	1310.19	nm
Total Average Launch Power	Pout		—	—	10.5	dBm

Average Launch Power per Lane	Peach		-4.3	—	4.5	dBm
Optical Modulation Amplitude per Lane	OMA		-1.3	—	4.5	dBm
Difference in Launch power between any two lances(OMA)			—	—	5.0	dB
Launch power in OMA minus TDP, per lane	Pomatdp		-2.3	—	—	dBm
Average Launch Power of TX_DIS Transmitter per lane	Poff	TX_DIS=H	—	—	-30	dBm
Extinction Ratio	E_R		4	5.5	—	dB
SMSR	SMSR		30	—	—	dB
Dispersion Penalty	DP	10km SMF	—	—	2.2	dB
Relative Intensity Noise	RIN	Mod off	—	—	-130	dB/Hz
Opitcal Return Loss Tolerance	T_{RL}		—	—	20	dB
Transmitter reflectance	Tef		—	—	-12	dB
Optical Eye Mask {X1, X2, X3, Y1, Y2, Y3}[1]	EM		{0.25, 0.4, 0.45, 0.25, 0.28, 0.4}			
Receiver						
Channel data rate				25.7812		Gbps
Data rate variation			-100		+100	ppm
Lane Center Wavelength	λ_{CR0}		1294.53	1295.56	1296.59	nm
	λ_{CR1}		1299.02	1300.05	1301.09	nm
	λ_{CR2}		1303.54	1304.58	1305.63	nm
	λ_{CR3}		1308.09	1309.14	1310.19	nm
Damage threshold	P_{DT}		—	5.5	—	dBm
Average receiver power per lane	Rpow		-10.6	—	4.5	dBm

Receive power OMA per lane	Rovl		—	—	4.5	dBm
Difference in receive power between any two lanes(OMA)			—	—	5.5	dB
Receiver Sensitivity(OMA) per lane	Psen		—	—	-8.6	dBm
Stressed Receiver Sensitivity per Lane	Psen_str		—	—	-6.8	dBm
Receiver Reflectance	Ref		—	—	-26	dB
Conditions of stressed receiver sensitivity test						
Vertical eye closure penalty per Lane			—	—	1.8	dB
Stressed eye jitter per Lane			—	—	0.3	UI
Rx-Lane LOS Assert			—	—	-12	dBm
Rx-Lane LOS Deassert			-13.6	—	—	dBm
Rx-Lane LOS Hysteresis			0.5	—	—	dB

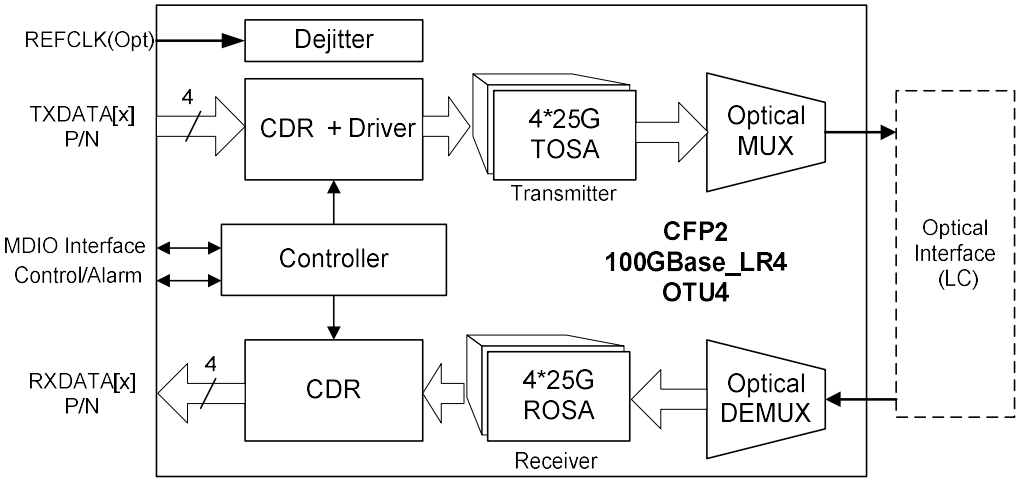
Optical Characteristics(OTU4)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Transmitter						
Channel data rate				27.9525		Gbps
Aggregate data rate				111.809		Gbps
Data rate variation			-20		+20	ppm
Lane Center Wavelength	λc_{T0}		1294.53	1295.56	1296.59	nm
	λc_{T1}		1299.02	1300.05	1301.09	nm
	λc_{T2}		1303.54	1304.58	1305.63	nm
	λc_{T3}		1308.09	1309.14	1310.19	nm
Total Average Launch Power	Pout		—	—	8.9	dBm

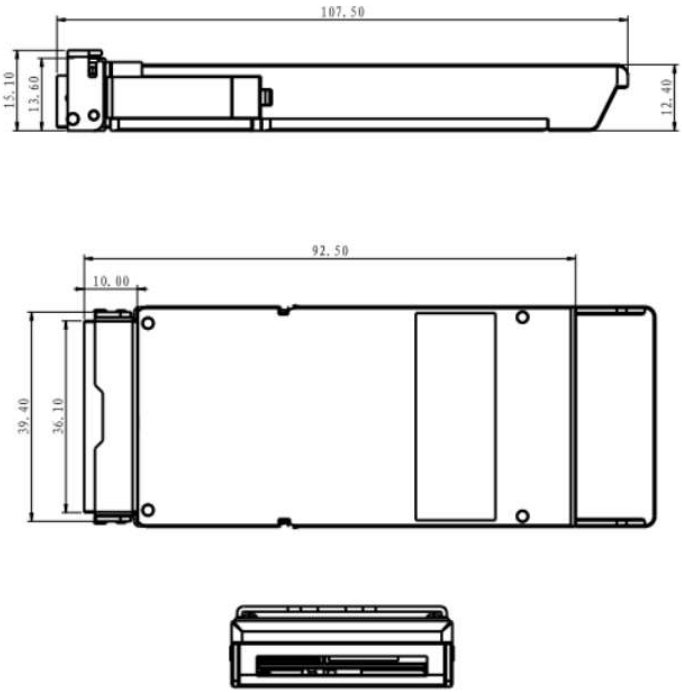
Average Launch Power per Lane	Peach		-2.5	—	2.9	dBm
Optical Modulation Amplitude per Lane	OMA		-1.2	—	4.5	dBm
Difference in Launch power between any two lances(OMA)			—	—	5.0	dB
Average Launch Power of TX_DIS Transmitter per lane	Poff	TX_DIS=H	—	—	-30	dBm
Extinction Ratio	E_R		7	—	—	dB
SMSR	SMSR		30			dB
Relative Intensity Noise	RIN	Mod off	—	—	-130	dB/Hz
Opitcal Return Loss Tolerance	T_{RL}		—	—	20	dB
Transmitter reflectance	Tef		—	—	-26	dB
Optical Eye Mask {X1, X2, X3, Y1, Y2, Y3}[1]	EM	Test 20000 Points	NRZ 25G RATIO {x1:0.25,x2:0.4,x3:0.45, y1:0.25,y2:0.28,y3:0.4}			
Receiver						
Channel data rate				27.9525		Gbps
Data rate variation			-20		+20	ppm
Lane Center Wavelength	λ_{CR0}		1294.53	1295.56	1296.59	nm
	λ_{CR1}		1299.02	1300.05	1301.09	nm
	λ_{CR2}		1303.54	1304.58	1305.63	nm
	λ_{CR3}		1308.09	1309.14	1310.19	nm
Damage threshold	P_{DT}		—	5.5	—	dBm
Average receiver power per lane	Rpow		-8.8	—	2.9	dBm
Average total input power					8.9	dBm

Channel power difference					5.5	dB
Optical path penalty					1.5	dB
Receiver Sensitivity per lane[2]	Psen		—	—	-10.3	dBm
Receiver Reflectance	Ref		—	—	-26	dB
Rx-Lane LOS Assert			-13.6	—	—	dBm
Rx-Lane LOS Deassert			—	—	-12	dBm
Rx-Lane LOS Hysteresis			0.5	—	—	dB

Function Diagram

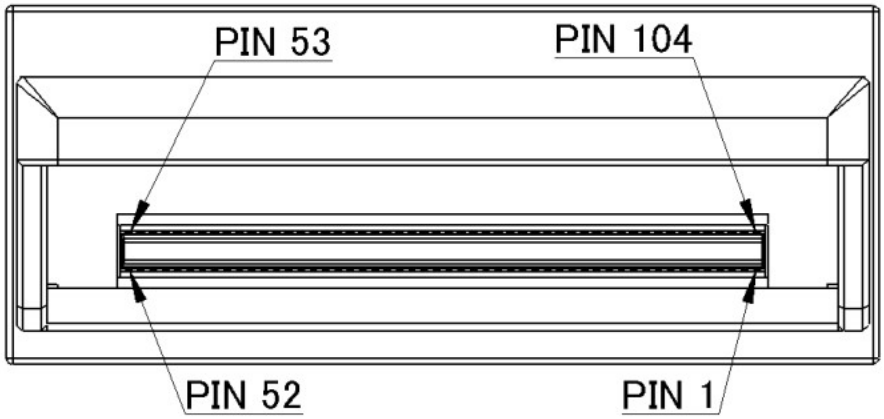


Mechanical Dimension

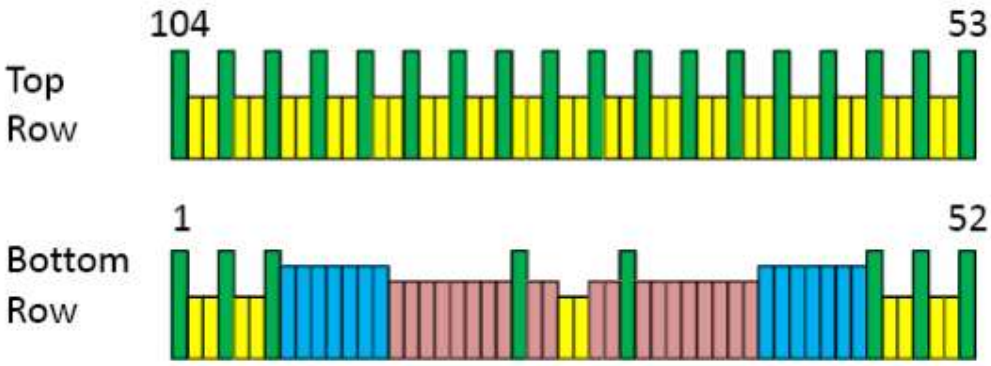


(unit mm)

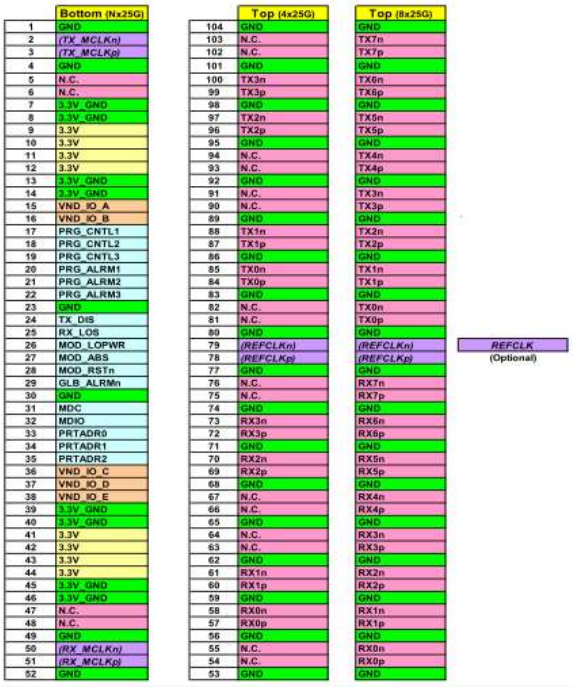
Pin Assignment and Description



CFP2 Connector Pin Map Orientation



CFP2 Pin Map Connector



Pin Assignment

PIN	Name	I/O	Logic	Description
1	GND			
2	(TX_MCLKn)	O	CML	Not Support
3	(TX_MCLKp)	O	CML	Not Support
4	GND			
5	N.C			No Connect
6	N.C			No Connect
7	3.3V_GND			3.3V Module Supply Voltage Return Ground, can be separate or tied together with Signal Ground
8	3.3V_GND			
9	3.3V			3.3V Module Supply Voltage
10	3.3V			3.3V Module Supply Voltage

11	3.3V			3.3V Module Supply Voltage
12	3.3V			3.3V Module Supply Voltage
13	3.3V_GND			
14	3.3V_GND			
15	VND_IO_A	I/O		Module Vendor I/O. Must No Connect at host board
16	VND_IO_B	I/O		Module Vendor I/O. Must No Connect at host board
17	PRG_CNTL1	I	LVCMOS w/ PUR	Programmable Control 1 set over MDIO, MSA Default: TRXIC_RSTn, TX & RX ICs reset, "0": reset, "1" or NC: enabled = not used 4.75kohm pull up in the module
18	PRG_CNTL2	I	LVCMOS w/ PUR	Programmable Control 2 set over MDIO, MSA Default: Hardware Interlock LSB, "00": ≤3W, "01":≤6W, "10": ≤9W, "11" or NC: ≤12W = not used 4.75kohm pull up in the module
19	PRG_CNTL3	I	LVCMOS w/ PUR	Programmable Control 3 set over MDIO, MSA Default: Hardware Interlock MSB, "00": ≤3W, "01": ≤6W, "10": ≤9W, "11" or NC: ≤12W = not used 4.75kohm pull up in the module
20	PRG_ALRM1	O	LVCMOS	Programmable Alarm 1 set over MDIO, MSA Default: HIPWR_ON, "1": module power up completed, "0": module not high powered up
21	PRG_ALRM2	O	LVCMOS	Programmable Alarm 2 set over MDIO, MSA Default: MOD_READY, "1": Ready, "0": not Ready.
22	PRG_ALRM3	O	LVCMOS	Programmable Alarm 3 set over MDIO, MSA Default: MOD_FAULT, fault detected, "1": Fault, "0": No Fault
23	GND			
24	TX_DIS	I	LVCMOS w/ PUR	Transmitter Disable for all lanes, "1" or NC = transmitter disabled, "0" = transmitter enabled

25	RX_LOS	O	LVCMOS	Receiver Loss of Optical Signal, "1": low optical signal, "0": normal condition
26	MOD_LOPWR	I	LVCMOS w/ PUR	Module Low Power Mode. "1" or NC: module in low power (safe) mode, "0": power-on enabled 4.75kohm pull up in the module
27	MOD_ABS	O	GND	Module Absent. "1" or NC: module absent, "0": module present, Pull Up Resistor on Host
28	MOD_RSTn	I	LVCMOS w/ PDR	Module Reset. "0" resets the module, "1" or NC = module enabled, 4.75kohm pull down in the module
29	GLB_ALRMn	O	LVCMOS	Global Alarm. “0": alarm condition in any MDIO Alarm register, "1": no alarm condition, Open Drain, Pull Up Resistor on Host
30	GND			
31	MDC	I	1.2V CMOS	Management Data Clock (electrical specs as per 802.3ae and ba)
32	MDIO	I/O	1.2V CMOS	Management Data I/O bi-directional data (electrical specs as per 802.3ae and ba)
33	PRTADR0	I	1.2V CMOS	MDIO Physical Port address bit 0
34	PRTADR1	I	1.2V CMOS	MDIO Physical Port address bit 1
35	PRTADR2	I	1.2V CMOS	MDIO Physical Port address bit 2
36	VND_IO_C	I/O		Module Vendor I/O C. Do Not Connect!
37	VND_IO_D	I/O		Module Vendor I/O D. Do Not Connect!
38	VND_IO_E	I/O		Module Vendor I/O E. Do Not Connect!
39	3.3V_GND			

40	3.3V_GND			
41	3.3V			3.3V Module Supply Voltage
42	3.3V			
43	3.3V			
44	3.3V			
45	3.3V_GND			
46	3.3V_GND			
47	N.C			No Connect
48	N.C			No Connect
49	GND			
50	(RX_MCLKn)	O	CML	Not Support
51	(RX_MCLKp)	O	CML	Not Support
52	GND			