

Product Specification

100m Multi-rate 100GE CFP2 Optical Transceiver Module

FTLC8221SCNM

PRODUCT FEATURES

- Hot-pluggable CFP2 form factor
- Supports 103.1Gb/s and 112Gb/s aggregate bit rates
- Power dissipation < 4W
- RoHS-6 compliant (lead-free)
- Commercial case temperature range of 0°C to 70°C
- Single 3.3V power supply
- Maximum link length of 100m on OM3 Multimode Fiber (MMF) and 150m on OM4 MMF
- Uncooled 10x10Gb/s 850nm transmitter
- CPPI electrical interface
- Single MPO24 receptacle
- MDIO management interface
- Tx/Rx optical power monitoring functionality



APPLICATIONS

- 100GBASE-SR10 Ethernet
- 10x11.2Gb/s Multimode OTN
- 2x 40GBASE-SR4 Ethernet
- 10x 10GE-SR Lite Ethernet

Finisar's FTLC8221SCNM 100GE CFP2 transceiver modules are designed for use in 100 Gigabit Ethernet links and 10x11.2G OTN client interfaces over multimode fiber. They are compliant with the CFP2 MSA¹ and with IEEE 802.3ba 100GBASE-SR10². Digital diagnostics functions are available via the MDIO interface as specified by Finisar Application Note AN-21xx⁵. The transceiver is RoHS-6 compliant and lead-free per Directive 2011/65/EU³, and Finisar Application Note AN-2038⁴.

PRODUCT SELECTION

FTLC8221SCNM

- S: OTU4 maximum bit rate (112 Gb/s)
- C: 10x10G parallel optics
- N: Flat top module (no heat sink)
- M: MPO receptacle

I. Pin Descriptions

CFP2 ALT1 configuration, per CFP MSA¹.

	Top Row		Bottom Row
104	GND	1	GND
103	TX7n	2	TX9n
102	TX7p	3	TX9p
101	GND	4	GND
100	TX6n	5	TX8n
99	TX6p	6	TX8p
98	GND	7	3.3V_GND
97	TX5n	8	3.3V_GND
96	TX5p	9	3.3V
95	GND	10	3.3V
94	TX4n	11	3.3V
93	TX4p	12	3.3V
92	GND	13	3.3V_GND
91	TX3n	14	3.3V_GND
90	TX3p	15	VND_IO_A
89	GND	16	VND_IO_B
88	TX2n	17	PRG_CNTL1
87	TX2p	18	PRG_CNTL2
86	GND	19	PRG_CNTL3
85	TX1n	20	PRG_ALRM1
84	TX1p	21	PRG_ALRM2
83	GND	22	PRG_ALRM3
82	TX0n	23	GND
81	TX0p	24	TX_DIS
80	GND	25	RX_LOS
79	{REFCLKn}	26	MOD_LOPWR

	Top Row		Bottom Row
78	{REFCLKp}	27	MOD_ABS
77	GND	28	MOD_RSTn
76	RX7n	29	GLB_ALRMn
75	RX7p	30	GND
74	GND	31	MDC
73	RX6n	32	MDIO
72	RX6p	33	PRTADR0
71	GND	34	PRTADR1
70	RX5n	35	PRTADR2
69	RX5p	36	VND_IO_C
68	GND	37	VND_IO_D
67	RX4n	38	VND_IO_E
66	RX4p	39	3.3V_GND
65	GND	40	3.3V_GND
64	RX3n	41	3.3V
63	RX3p	42	3.3V
62	GND	43	3.3V
61	RX2n	44	3.3V
60	RX2p	45	3.3V_GND
59	GND	46	GND
58	RX1n	47	RX9n
57	RX1p	48	RX9p
56	GND	49	GND
55	RX0n	50	RX8n
54	RX0p	51	RX8p
53	GND	52	GND

Bottom Row Pin Descriptions

PIN #	Name	I/O	Logic	Description
1	GND			
2	TX9n	I		Lane #9 Transmitter pin (+)
3	TX9p	I		Lane #9 Transmitter pin (-)
4	GND			
5	TX8n	I		Lane #8 Transmitter pin (+)
6	TX8p	I		Lane #8 Transmitter pin (-)
7	GND			
8	3.3V_GND			3.3V Module Supply Voltage Return Ground, internally connected to Signal Ground
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			3.3V Module Supply Voltage Return Ground, internally connected to Signal Ground
14	3.3V_GND			3.3V Module Supply Voltage Return Ground, internally connected to Signal Ground
15	VND_IO_A	I/O		Module Vendor I/O A. Do Not Connect!
16	VND_IO_B	I/O		Module Vendor I/O B. Do Not Connect!
17	PRG_CNTL1	I	LVC MOS w/ PUR	Programmable Control 1 set over MDIO
18	PRG_CNTL2	I	LVC MOS w/ PUR	Programmable Control 2 set over MDIO
19	PRG_CNTL3	I	LVC MOS w/ PUR	Programmable Control 3 set over MDIO
20	PRG_ALRM1	O	LVC MOS	Programmable Alarm 1 set over MDIO
21	PRG_ALRM2	O	LVC MOS	Programmable Alarm 2 set over MDIO
22	PRG_ALRM3	O	LVC MOS	Programmable Alarm 3 set over MDIO
23	GND			
24	TX_DIS	I	LVC MOS w/ PUR	Transmitter Disable for all lanes, "1" or NC = transmitter disabled, "0" = transmitter enabled
25	RX_LOS	O	LVC MOS	Receiver Loss of Optical Signal, "1": low optical signal, "0": normal condition
26	MOD_LOPWR	I	LVC MOS w/ PUR	Module Low Power Mode. "1" or NC: module in low power (safe) mode, "0": power-on enabled
27	MOD_ABS	O	GND	Module Absent. "1" or NC: module absent, "0": module present, Pull Up Resistor on Host
28	MOD_RSTn	I	LVC MOS w/ PDR	Module Reset. "0" resets the module, "1" or NC = module enabled, Pull Down Resistor in Module
29	GLB_ALRMn	O	LVC MOS	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/O	1.2V CMOS	Management Data I/O bi-directional data (electrical specs as per 802.3ae and ba)
32	MDIO	I	1.2V CMOS	Management Data Clock (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			3.3V Module Supply Voltage Return Ground, internally connected to Signal Ground
40	3.3V_GND			3.3V Module Supply Voltage Return Ground, internally connected to Signal Ground
41	3.3V			3.3V Module Supply Voltage
42	3.3V			3.3V Module Supply Voltage
43	3.3V			3.3V Module Supply Voltage
44	3.3V			3.3V Module Supply Voltage
45	3.3V_GND			3.3V Module Supply Voltage Return Ground, internally connected to Signal Ground
46	GND			
47	RX9n	O		Lane #9 Receiver pin (+)
48	RX9p	O		Lane #9 Receiver pin (-)
49	GND			
50	RX8n	O		Lane #8 Receiver pin (+)
51	RX8p	O		Lane #8 Receiver pin (-)
52	GND			

Notes:

- REFCLK is not required.
- Tx_MCLK and Rx_MCLK functionality is not available in a CFP2 module with 10x10G electrical I/O.

II. Absolute Maximum Ratings

Module performance is not guaranteed beyond the operating range (see Section VI). Exceeding the limits below may damage the transceiver module permanently.

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Maximum Supply Voltage	V _{CC}	-0.5		4.0	V	
Storage Temperature	T _S	-40		85	°C	
Case Operating Temperature	T _{OP}	0		70	°C	
Relative Humidity	RH	15		85	%	1
Receiver Damage Threshold, per Lane	P _{Rdmg}	5.5			dBm	

Notes:

1. Non-condensing.

III. Electrical Characteristics (EOL, T_{OP} = 0 to 70 °C, V_{CC} = 3.13 to 3.47 Volts)

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Supply Voltage	V _{CC}	3.13		3.47	V	
Supply Current	I _{CC}			1.15	mA	
Module Total Power	P			4.0	W	1
Transmitter (per Lane)						
Signaling rate per lane		10.3125		11.1810	Gb/s	2
Single ended input voltage tolerance	V _{inT}	-0.3		4.0	V	
Differential data input swing	V _{in,pp}	120		1200	mV _{pp}	3
Differential input threshold			50		mV	
AC common mode input voltage tolerance (RMS)		15			mV	
Differential input return loss			Per IEEE 802.3ba, Section 86A.4.1.1		dB	4
J2 Jitter Tolerance	J _{t2}	0.17			UI	
J9 Jitter Tolerance	J _{t9}	0.29			UI	
Data Dependent Pulse Width Shrinkage	DDPWS	0.07			UI	
Eye mask coordinates {X1, X2 Y1, Y2}			0.11, 0.31 95, 350		UI mV	5
Receiver (per Lane)						
Signaling rate per lane		10.3125		11.1810	Gb/s	2
Single-ended output voltage		-0.3		4.0	V	
Differential data output swing	V _{out,pp}	300		800	mV _{pp}	6
AC common mode output voltage (RMS)				7.5	mV	
Termination mismatch at 1 MHz				5	%	
Differential output return loss			Per IEEE 802.3ba, Section 86A.4.2.1		dB	4
Common mode output return loss			Per IEEE 802.3ba, Section 86A.4.2.2		dB	4
Output transition time, 20% to 80%		28			ps	
J2 Jitter output	J _{o2}			0.42	UI	
J9 Jitter output	J _{o9}			0.65	UI	
Eye mask coordinates {X1, X2 Y1, Y2}			0.29, 0.5 150, 425		UI mV	5
Power Supply Ripple Tolerance	PSR		Per CFP MSA ¹		mV _{pp}	

Notes:

1. Maximum total power value is specified across the full temperature and voltage range.
2. +/- 100ppm at 10.3125 Gb/s and +/-20ppm at 11.1810 Gb/s.
3. After internal AC coupling. Self-biasing 100Ω differential input.
4. 10 MHz to 11.1 GHz range
5. Hit ratio = $5 \times 10E-5$
6. AC coupled with 100Ω differential output impedance. Limiting output.

FTLC8221SCNM Clocking Signals

Clock Name	Status	I/O	Value
REFCLK	Not Required	I	Not required; terminated internally.

IV. Optical Characteristics (EOL, T_{OP} = 0 to 70°C, V_{CC} = 3.13 to 3.47 Volts)

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Transmitter (per Lane)						
Signaling Speed per Lane		10.3125		11.1810	GBd	1
Center wavelength		840		860	nm	
RMS Spectral Width	SW			0.65	nm	
Average Launch Power per Lane	TXP _x	-7.6		2.4	dBm	
Transmit OMA per Lane	TxOMA	-5.6		3.0	dBm	2
Difference in Power between any two lanes [OMA]	DP _x			4.0	dB	
Peak Power per Lane	PP _x			4.0	dBm	
Launch Power [OMA] minus TDP per Lane	P-TDP	-6.5			dBm	
TDP per Lane	TDP			3.5	dBm	
Optical Extinction Ratio	ER	3.0			dB	
Optical Return Loss Tolerance	ORL			12	dB	
Encircled Flux	FLX	> 86% at 19 um < 30% at 4.5 um			dBm	
Average launch power of OFF transmitter, per lane				-30	dBm	
Relative Intensity Noise	RIN			-128	dB/Hz	3
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}		0.23, 0.34, 0.43, 0.27, 0.35, 0.4				
Receiver (per Lane)						
Signaling Speed per Lane		10.3125		11.1810	GBd	4
Center wavelength		840		860	nm	
Average Receive Power per Lane	RXP _x	-9.5		2.4	dBm	
Receive Power (OMA) per Lane	RxOMA			3	dBm	
Stressed Receiver Sensitivity (OMA) per Lane	SRS			-5.4	dBm	
Back to Back Receiver Sensitivity (OMA) per Lane	RxSens			-8.7	dBm	5
Peak Power, per lane	PP _x			4	dBm	
Receiver Reflectance	Rfl			-12	dB	
Vertical eye closure penalty, per lane				1.9	dB	
Stressed eye J2 jitter, per Lane				0.3	UI	
Stressed eye J9 jitter, per Lane				0.47	UI	
OMA of each aggressor lane				-0.4	dBm	
Receiver jitter tolerance [OMA], per Lane				-5.4	dBm	
Rx jitter tolerance: Jitter frequency and p-p amplitude		(75, 5)			kHz, UI	
		(375, 1)			kHz, UI	
LOS De-Assert	LOS _D			-11	dBm	
LOS Assert	LOS _A	-30		-14	dBm	
LOS Hysteresis		0.5			dB	

Notes:

1. Transmitter consists of 10 lasers operating at a maximum rate of 11.1810 Gb/s each.
2. Even if TDP is <0.9dB, the OMA min must exceed this value.
3. RIN is scaled by 10*log(10/4) to maintain SNR outside of transmitter.
4. Receiver consists of 10 photodetectors operating at a maximum rate of 11.1810 Gb/s each.
5. Measured using DUT Tx and DUT Rx; no golden transmitters shall be used.

V. General Specifications

Parameter	Symbol	Min	Typ	Max	Units	Ref.
Bit Rate (all lanes combined)	BR	103.1		112.0	Gb/s	1
Bit Error Ratio	BER			10^{-12}		2
Maximum Supported Distances						
Fiber Type						
OM3 MMF	Lmax1			100	m	
OM4 MMF	Lmax2			150	m	

Notes:

- Supports 100GBASE-SR10 per IEEE 802.3ba and 10x11.2 multimode OTN.
- Tested with a $2^{31} - 1$ PRBS

VI. Environmental Specifications

Finisar FTLC8221 CFP2 transceivers have an operating case temperature range of 0°C to +70°C.

Parameter	Symbol	Min	Typ	Max	Units	Ref.
Case Operating Temperature	T _{op}	0		70	°C	
Storage Temperature	T _{sto}	-40		85	°C	

VII. Regulatory Compliance

Finisar FTLC8221 CFP2 transceivers are Class 1 laser eye safety compliant per IEC 60825-1. They are certified per the following standards:

Feature	Agency	Standard	Certificate Number
Laser Eye Safety	FDA/CDRH	CDRH 21 CFR 1040 and Laser Notice 50	9210176
Laser Eye Safety	TÜV	EN 60950-1: 2006+A11 EN 60825-1: 2007 EN 60825-2: 2004+A1+A2	R 72130387
Electrical Safety	TÜV	EN 60950	R 72130387
Electrical Safety	UL/CSA	CLASS 3862.13 CLASS 3862.93	190993- 2375840

Copies of the referenced certificates are available at Finisar Corporation upon request.

VIII. Digital Diagnostics Functions

FTLC1121 CFP2 transceivers support the MDIO-based diagnostics interface specified in the CFP MSA Management Interface Specification, Rev 2.2¹. See also Finisar Application Note AN-20xx (TBD). Note that Tx/Rx optical power monitoring functionality is supported by this product.

IX. Memory Contents

Per the CFP MSA¹. See Finisar Application Note AN-20xx (TBD).

X. Host PCB Layout and Bezel Recommendations

Per CFP2 Hardware Specification¹.

XI. Mechanical Specifications

Finisar FTLC8221 CFP2 transceivers are compatible with the CFP2 Hardware Specification for pluggable form factor modules.

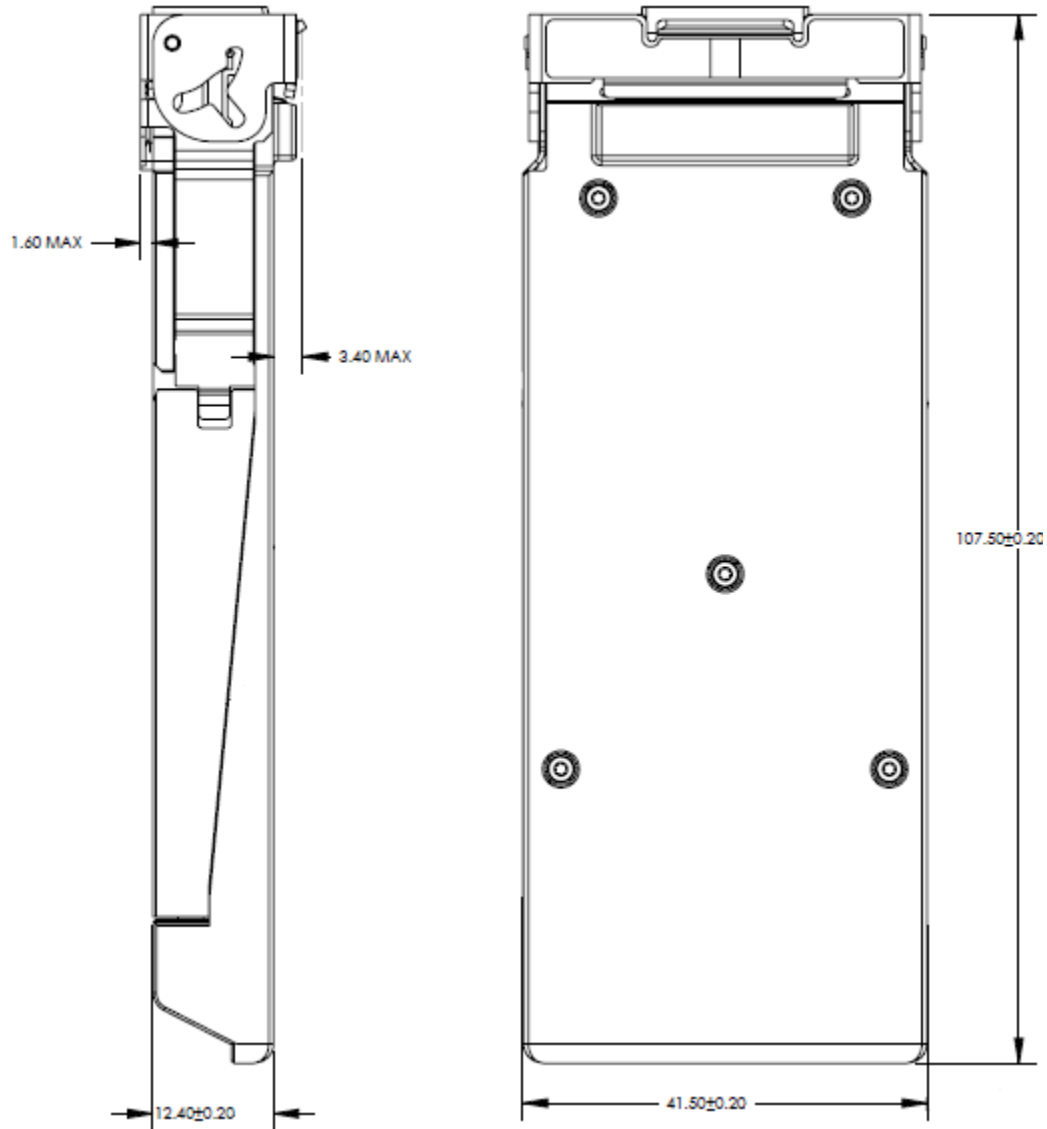


Figure 1. FTLC8221SCNM Mechanical Dimensions.

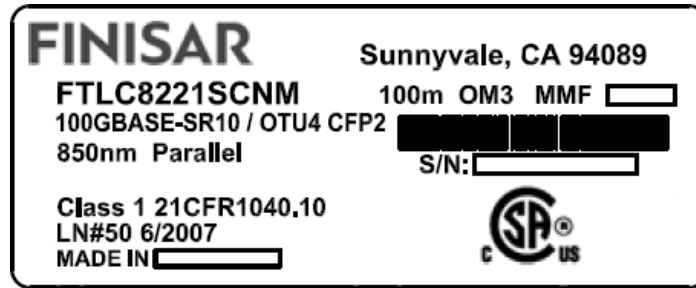


Figure 2. Standard Product Label

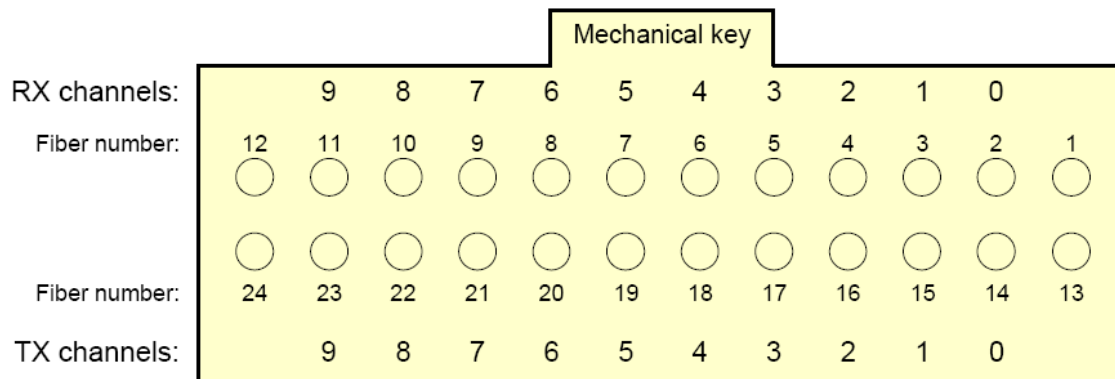


Figure 3. Optical Lane Assignment
(View from the front, looking into the MPO receptacle)

XII. References

1. CFP2 Hardware Specification and CFP MSA Management Interface Specifications (MIS), Rev 2.2; CFP MSA, www.cfp-msa.org
2. IEEE 802.3ba, PMD Type 100GBASE-SR10.
3. Directive 2011/65/EU of the European Council Parliament and of the Council, “on the restriction of the use of certain hazardous substances in electrical and electronic equipment,” June 8, 2011.
4. “Application Note AN-2038: Finisar Implementation Of RoHS Compliant Transceivers”, Finisar Corporation, January 21, 2005.
5. “Application Note AN-2xxx: NVR1 and NVR2, 100GBASE-SR10 CFP2 Transceiver Module (FTLC8221xxxx)”, Finisar Corporation.

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