

## Product Specification

### 300m, 10x10.3GbE CFP2 Optical Transceiver Module

#### FTLC8221RFNM

#### PRODUCT FEATURES

- Hot-pluggable CFP2 form factor
- Supports 103.1Gb/s aggregate bit rate
- 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 300m on OM3 Multimode Fiber (MMF)
- Uncooled 10x10Gb/s 850nm transmitter
- 10x SFI limiting electrical interface
- Single MPO24 receptacle
- MDIO management interface
- Tx/Rx optical power monitoring functionality



#### APPLICATIONS

- 10x 10GBASE-SR Ethernet
- 2x 40GBASE-SR4 Ethernet
- 100GBASE-SR10 Ethernet

Finisar's FTLC8221RFNM 10x10.3GbE CFP2 transceiver modules are designed for fan-out applications interconnecting to either ten 10GBASE-SR SFP+ or XFP modules, or to two 40GBASE-SR4 QSFP+ or CFP modules over up to 300 meters of multimode fiber. They can also be used for 100G Ethernet links. They are compliant with the CFP2 MSA<sup>1</sup>, with IEEE 802.3ae 10GBASE-SR<sup>2</sup> and SFI per SFF-8431<sup>5</sup>. Digital diagnostics functions are available via the MDIO interface as specified by Finisar Application Note AN-21xx<sup>5</sup>. The transceiver is RoHS-6 compliant and lead-free per Directive 2011/65/EU<sup>3</sup>, and Finisar Application Note AN-2038<sup>4</sup>. For a 100m OTU4/100G Ethernet compliant product, see FTLC8221SCNM.

#### PRODUCT SELECTION

### FTLC8221RFNM

- R: Ethernet maximum bit rate (10.3 Gb/s per lane)
- F: 10x10G parallel optics, 10G Ethernet compliant
- N: Flat top module (no heat sink)
- M: MPO receptacle

## I. Pin Descriptions

CFP2 ALT1 configuration, per CFP MSA<sup>1</sup>.

	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			<b>3.3V Module Supply Voltage Return Ground, internally connected to Signal Ground</b>
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			<b>3.3V Module Supply Voltage Return Ground, internally connected to Signal Ground</b>
14	3.3V_GND			<b>3.3V Module Supply Voltage Return Ground, internally connected to Signal Ground</b>
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_ALARM1	O	LVC MOS	Programmable Alarm 1 set over MDIO
21	PRG_ALARM2	O	LVC MOS	Programmable Alarm 2 set over MDIO
22	PRG_ALARM3	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_ALARMn	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			<b>3.3V Module Supply Voltage Return Ground, internally connected to Signal Ground</b>
40	3.3V_GND			<b>3.3V Module Supply Voltage Return Ground, internally connected to Signal Ground</b>
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			<b>3.3V Module Supply Voltage Return Ground, internally connected to Signal Ground</b>
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, per the CFP MSA.

## 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 <sub>CC</sub>	-0.5		4.0	V	
Storage Temperature	T <sub>S</sub>	-40		85	°C	
Case Operating Temperature	T <sub>OP</sub>	0		70	°C	
Relative Humidity	RH	15		85	%	1
Receiver Damage Threshold, per Lane	P <sub>Rdmg</sub>	5.5			dBm	

### Notes:

1. Non-condensing.

## III. Electrical Characteristics (EOL, T<sub>OP</sub> = 0 to 70 °C, V<sub>CC</sub> = 3.13 to 3.47 Volts)

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Supply Voltage	V <sub>CC</sub>	3.13		3.47	V	
Supply Current	I <sub>CC</sub>			1.15	mA	
Module Total Power	P			4.0	W	1
<b>Transmitter (per Lane)</b>						
Signaling rate per lane		10.3125		10.3125	Gb/s	2
Differential data input swing	V <sub>in,pp</sub>	120		1200	mV <sub>pp</sub>	3
<b>Receiver (per Lane)</b>						
Signaling rate per lane		10.3125		10.3125	Gb/s	2
Differential data output swing	V <sub>out,pp</sub>	300		800	mV <sub>pp</sub>	4
Output transition time, 20% to 80%		28			ps	5
Power Supply Ripple Tolerance	PSR	Per CFP MSA <sup>1</sup>			mV <sub>pp</sub>	

### Notes:

1. Maximum total power value is specified across the full temperature and voltage range.
2. +/- 100ppm at 10.3125 Gb/s
3. After internal AC coupling. Self-biasing 100Ω differential input.
4. AC coupled with 100Ω differential output impedance. Limiting output.
5. 20 – 80 % . Measured with Module Compliance Test Board and OMA test pattern. Use of four 1's and four 0's in sequence in the PRBS^9 is an acceptable alternative. SFF-8431 Rev 4.1

## FTLC8221RFNM Clocking Signals

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

**IV. Optical Characteristics (EOL, T<sub>OP</sub> = 0 to 70°C, V<sub>CC</sub> = 3.13 to 3.47 Volts)**

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
<b>Transmitter (per Lane)</b>						
Signaling Speed per Lane		10.3125		10.3125	GBd	1
Center wavelength		840		860	nm	
RMS Spectral Width	SW			0.45	nm	
Average Launch Power per Lane	TXP <sub>x</sub>	-3		+0.5	dBm	2
Transmit OMA per Lane	TxOMA	-2.5			dBm	3
TDP per Lane	TDP			3.9	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	4
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}		0.25, 0.40, 0.45, 0.25, 0.28, 0.40				
<b>Receiver (per Lane)</b>						
Signaling Speed per Lane		10.3125		10.3125	GBd	5
Center wavelength		840		860	nm	
Maximum Input Power per Lane	RXP <sub>max</sub>	+0.5			dBm	
Stressed Receiver Sensitivity (OMA) per Lane	SRS			-7.5	dBm	6
Back to Back Receiver Sensitivity (OMA) per Lane	RxSens			-11.1	dBm	7
Receiver Reflectance	Rfl			-12	dB	
LOS De-Assert	LOS <sub>D</sub>			-11	dBm	
LOS Assert	LOS <sub>A</sub>	-30		-14	dBm	
LOS Hysteresis		0.5			dB	

**Notes:**

1. Transmitter consists of 10 lasers operating at a maximum rate of 10.3125 Gb/s each.
2. Average launch power (min) is informative and not the principal indicator of signal strength.
3. Per the IEEE 802.3ae triple trade-off table 52.8.
4. RIN is scaled by 10\*log (10/4) to maintain SNR outside of transmitter.
5. Receiver consists of 10 photodetectors operating at a maximum rate of 10.3125 Gb/s each.
6. Per IEEE 802.3ae.
7. Informative value only. Measured with worst-case ER; BER<10<sup>-12</sup>; 2<sup>31</sup> – 1 PRBS.

## V. General Specifications

Parameter	Symbol	Min	Typ	Max	Units	Ref.
Bit Rate (all lanes combined)	BR	103.1		103.1	Gb/s	1
Bit Error Ratio	BER			10 <sup>-12</sup>		2
<b>Maximum Supported Distances</b>						
Fiber Type						
OM2 MMF	Lmax1			82	m	
OM3 MMF	Lmax2			300	m	

### Notes:

- Each lane supports 10GBASE-SR per IEEE 802.3ae.
- Tested with a 2<sup>31</sup> – 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 <sub>op</sub>	0		70	°C	
Storage Temperature	T <sub>sto</sub>	-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	921076
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**

FTLC8221 CFP2 transceivers support the MDIO-based diagnostics interface specified in the CFP MSA Management Interface Specification, Rev 2.2<sup>1</sup>. See also Finisar Application Note AN-20xx (TBD). Note that Tx/Rx optical power monitoring functionality is supported by this product.

### **IX. Memory Contents**

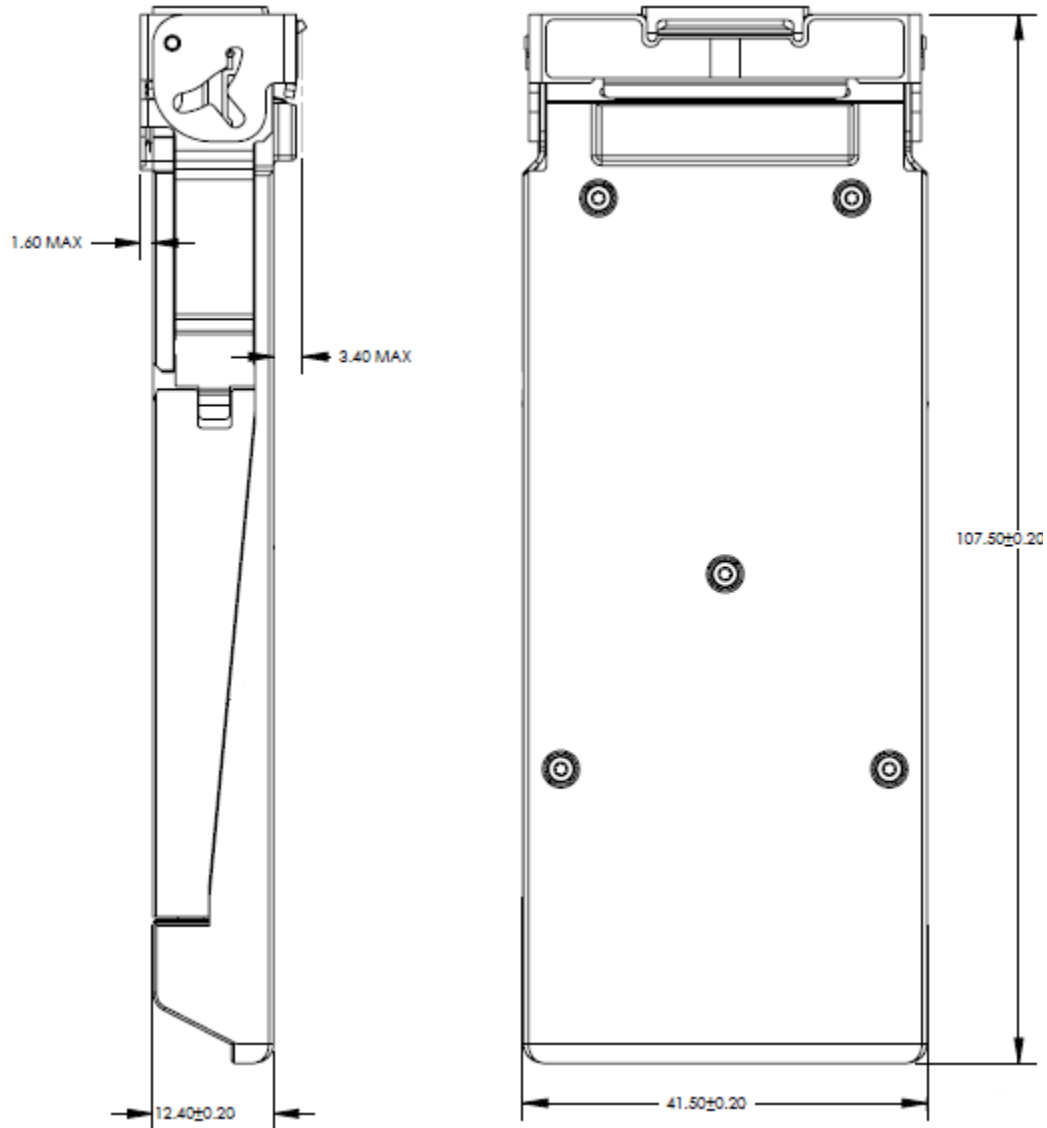
Per the CFP MSA<sup>1</sup>. See Finisar Application Note AN-20xx (TBD).

### **X. Host PCB Layout and Bezel Recommendations**

Per CFP2 Hardware Specification<sup>1</sup>.

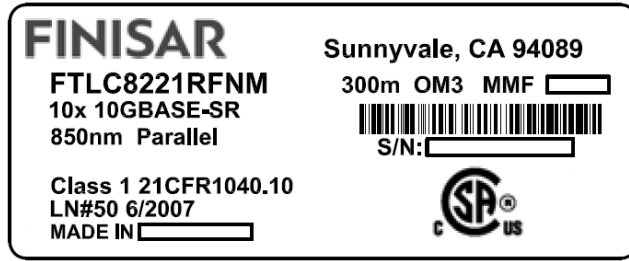
## XI. Mechanical Specifications

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

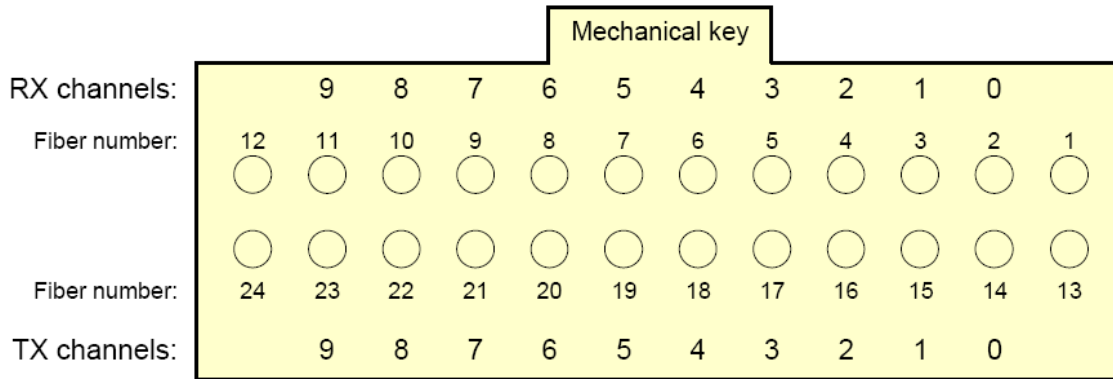


**Figure 1. FTLC8221RFNM Mechanical Dimensions.**





**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](http://www.cfp-msa.org)
2. IEEE 802.3ae, PMD Type 10GBASE-SR.
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.
6. “Specifications for Enhanced 8.5 and 10 Gigabit Small Form Factor Pluggable Module ‘SFP+ ‘”, SFF Document Number SFF-8431, Revision 4.1, July 6, 2009

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