

## 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_ALARM1 |
| 84  | TX1p      | 21 | PRG_ALARM2 |
| 83  | GND       | 22 | PRG_ALARM3 |
| 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_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  |     |                | <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:

1. REFCLK is not required.
2. 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<sup>9</sup> 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. |
|----------------------------------------------------------|--------------------|------------------------------------|-----|---------|-------|------|
| Transmitter (per Lane)                                   |                    |                                    |     |         |       |      |
| 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<br>< 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 |     |         |       |      |
| Receiver (per Lane)                                      |                    |                                    |     |         |       |      |
| 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    |       |     | $10^{-12}$ |       | 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  $2^{31} - 1$  PRBS

## VI. Environmental Specifications

Finisar FTL8221 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 FTL8221 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<br>EN 60825-1: 2007<br>EN 60825-2: 2004+A1+A2 | R 72130387         |
| Electrical Safety | TÜV      | EN 60950                                                           | R 72130387         |
| Electrical Safety | UL/CSA   | CLASS 3862.13<br>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**

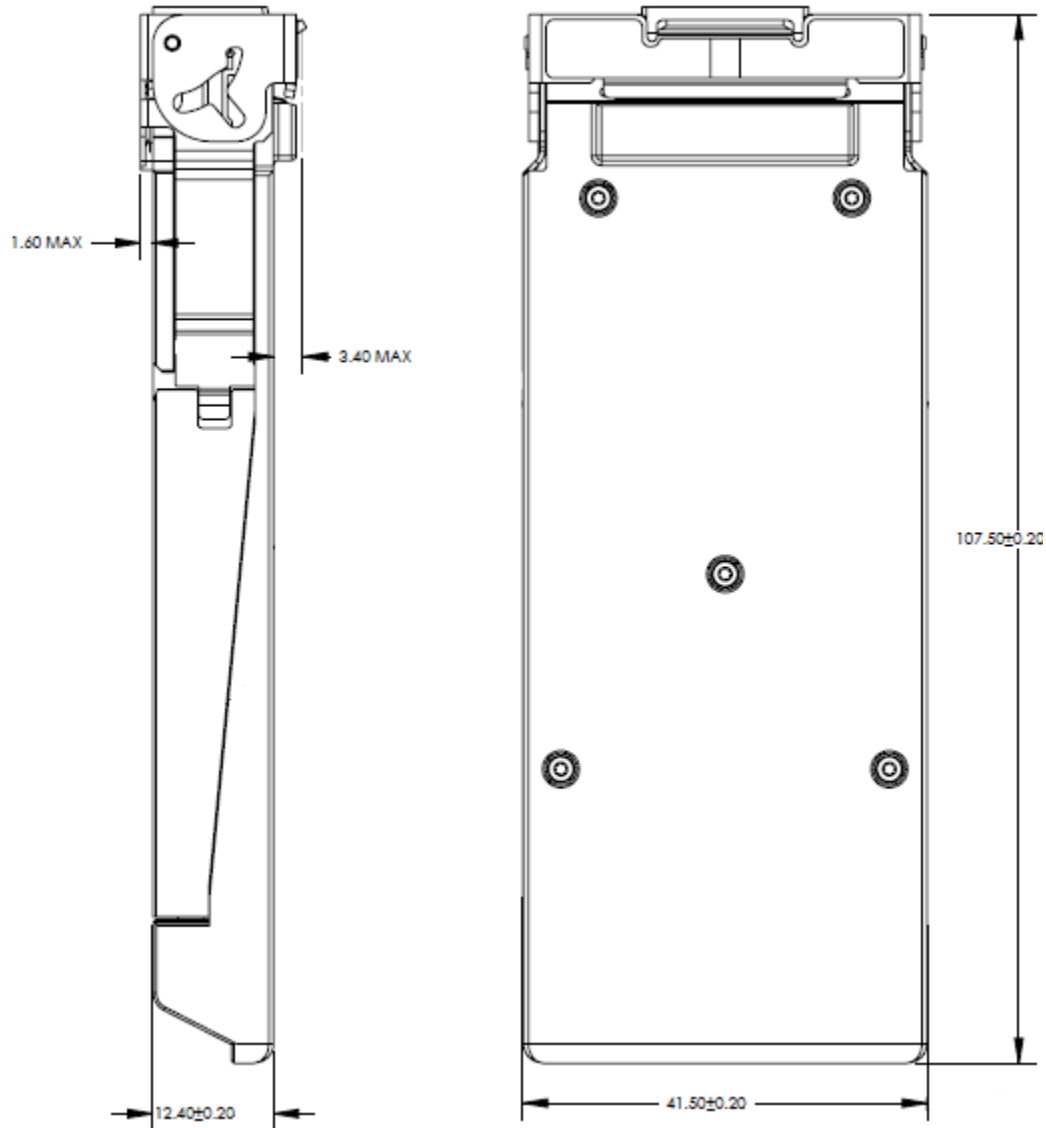
Per the CFP MSA<sup>1</sup>. See Finisar Application Note AN-20xx (TBD).

## **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.**

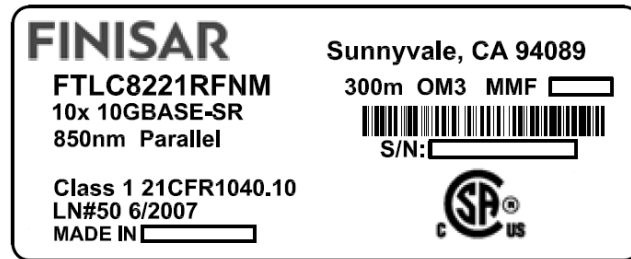
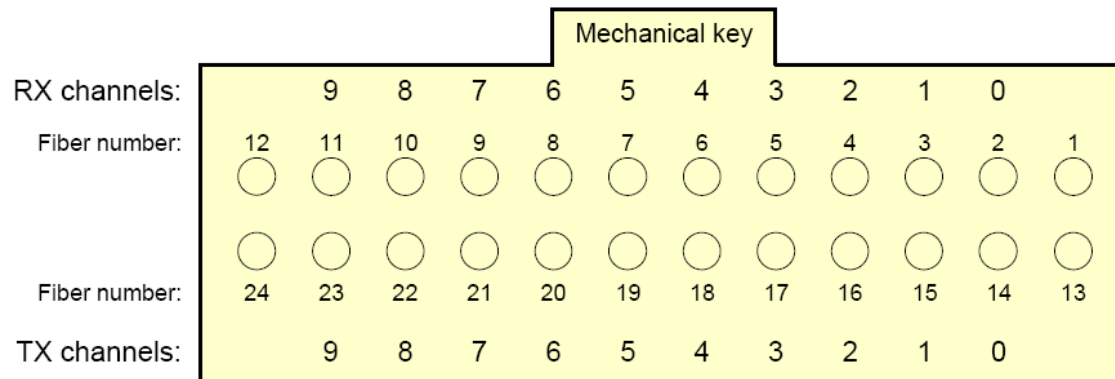


Figure 2. Standard Product Label



**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

### **For More Information:**

Finisar Corporation  
1389 Moffett Park Drive  
Sunnyvale, CA 94089-1133  
Tel. 1-408-548-1000  
Fax 1-408-541-6138  
[sales@finisar.com](mailto:sales@finisar.com)  
[www.finisar.com](http://www.finisar.com)

Компания «Life Electronics» занимается поставками электронных компонентов импортного и отечественного производства от производителей и со складов крупных дистрибьюторов Европы, Америки и Азии.

С конца 2013 года компания активно расширяет линейку поставок компонентов по направлению коаксиальный кабель, кварцевые генераторы и конденсаторы (керамические, пленочные, электролитические), за счёт заключения дистрибьюторских договоров

Мы предлагаем:

- Конкурентоспособные цены и скидки постоянным клиентам.
- Специальные условия для постоянных клиентов.
- Подбор аналогов.
- Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.
- Приемлемые сроки поставки, возможна ускоренная поставка.
- Доставку товара в любую точку России и стран СНГ.
- Комплексную поставку.
- Работу по проектам и поставку образцов.
- Формирование склада под заказчика.
- Сертификаты соответствия на поставляемую продукцию (по желанию клиента).
- Тестирование поставляемой продукции.
- Поставку компонентов, требующих военную и космическую приемку.
- Входной контроль качества.
- Наличие сертификата ISO.

В составе нашей компании организован Конструкторский отдел, призванный помогать разработчикам, и инженерам.

Конструкторский отдел помогает осуществить:

- Регистрацию проекта у производителя компонентов.
- Техническую поддержку проекта.
- Защиту от снятия компонента с производства.
- Оценку стоимости проекта по компонентам.
- Изготовление тестовой платы монтаж и пусконаладочные работы.



Тел: +7 (812) 336 43 04 (многоканальный)

Email: [org@lifeelectronics.ru](mailto:org@lifeelectronics.ru)

[www.lifeelectronics.ru](http://www.lifeelectronics.ru)