

## PRELIMINARY Product Specification

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### 10km Multi-rate 100G CFP4 Optical Transceiver Module

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#### FTLC1141SDNL

#### PRODUCT FEATURES

- Hot-pluggable CFP4 form factor
- Supports 103.1Gb/s and 112Gb/s aggregate bit rates
- Power dissipation < 5W
- RoHS-6 compliant (lead-free)
- Commercial case temperature range of -5°C to 75°C
- Single 3.3V power supply
- Maximum link length of 10km on Single Mode Fiber (SMF)
- 4x28Gb/s DFB-based LAN-WDM transmitter
- 4x28G electrical interface
- Duplex LC receptacles
- MDIO management interface



#### APPLICATIONS

- OTN OTU4 4I1-9D1F
- 100GBASE-LR4 100G Ethernet

Finisar's FTLC1141SDNx 100G CFP4 transceiver modules are designed for use in 100 Gigabit Ethernet and 4x28G OTN client interfaces over single mode fiber. They are compliant with the CFP MSA<sup>1</sup>, IEEE 802.3ba 100GBASE-LR4<sup>2</sup> and OTU4 4I1-9D1F requirements specified in ITU-T Recommendations G.959.1/G.709 and Supplement 39 (G.sup39). Digital diagnostics functions are available via the MDIO interface, as specified by the CFP MSA and Finisar Application Note AN-20xx<sup>5</sup>. The transceiver is RoHS-6 compliant and lead-free per Directive 2002/95/EC<sup>3</sup>, and Finisar Application Note AN-2038<sup>4</sup>.

#### PRODUCT SELECTION

#### FTLC1141SDNL

- S: OTU4 maximum bit rate (112 Gb/s)
- D: 4x25G LAN-WDM optical architecture
- N: Flat top module (no heat sink)
- L: LC straight receptacles

**I. Pin Descriptions**Per CFP MSA<sup>1</sup>.

Pins views from the top.

|    | Top Row   |    | Bottom Row |
|----|-----------|----|------------|
| 56 | GND       | 1  | 3.3V_GND   |
| 55 | TX3n      | 2  | 3.3V_GND   |
| 54 | TX3p      | 3  | 3.3V       |
| 53 | GND       | 4  | 3.3V       |
| 52 | TX2n      | 5  | 3.3V       |
| 51 | TX2p      | 6  | 3.3V       |
| 50 | GND       | 7  | 3.3V_GND   |
| 49 | TX1n      | 8  | 3.3V_GND   |
| 48 | TX1p      | 9  | VND_IO_A   |
| 47 | GND       | 10 | VND_IO_B   |
| 46 | TX0n      | 11 | TX_DIS     |
| 45 | TX0p      | 12 | RX_LOS     |
| 44 | GND       | 13 | GLB_ALRMn  |
| 43 | {REFCLKn} | 14 | MOD_LOPWR  |
| 42 | {REFCLKp} | 15 | MOD_ABS    |
| 41 | GND       | 16 | MOD_RSTn   |
| 40 | RX3n      | 17 | MDC        |
| 39 | RX3p      | 18 | MDIO       |
| 38 | GND       | 19 | PRTADR0    |
| 37 | RX2n      | 20 | PRTADR1    |
| 36 | RX2p      | 21 | PRTADR2    |
| 35 | GND       | 22 | VND_IO_C   |
| 34 | RX1n      | 23 | VND_IO_D   |
| 33 | RX1p      | 24 | VND_IO_E   |
| 32 | GND       | 25 | GND        |
| 31 | RX0n      | 26 | {MCLKn}    |
| 30 | RX0p      | 27 | {MCLKp}    |
| 29 | GND       | 28 | GND        |

## Bottom Row Pin Descriptions

| PIN # | Name      | I/O | Logic          | Description                                                                                                                  |
|-------|-----------|-----|----------------|------------------------------------------------------------------------------------------------------------------------------|
| 1     | 3.3V_GND  |     |                | 3.3V Module Supply Voltage Return Ground, internally connected to Signal Ground                                              |
| 2     | 3.3V_GND  |     |                | 3.3V Module Supply Voltage Return Ground, internally connected to Signal Ground                                              |
| 3     | 3.3V      |     |                | 3.3V Module Supply Voltage                                                                                                   |
| 4     | 3.3V      |     |                | 3.3V Module Supply Voltage                                                                                                   |
| 5     | 3.3V      |     |                | 3.3V Module Supply Voltage                                                                                                   |
| 6     | 3.3V      |     |                | 3.3V Module Supply Voltage                                                                                                   |
| 7     | 3.3V_GND  |     |                | 3.3V Module Supply Voltage Return Ground, internally connected to Signal Ground                                              |
| 8     | 3.3V_GND  |     |                | 3.3V Module Supply Voltage Return Ground, internally connected to Signal Ground                                              |
| 9     | VND_IO_A  | I/O |                | Module Vendor I/O A. Do Not Connect!                                                                                         |
| 10    | VND_IO_B  | I/O |                | Module Vendor I/O B. Do Not Connect!                                                                                         |
| 11    | TX_DIS    | I   | LVC MOS w/ PUR | Transmitter Disable for all lanes, "1" or NC = transmitter disabled, "0" = transmitter enabled                               |
| 12    | RX_LOS    | O   | LVC MOS        | Receiver Loss of Optical Signal, "1": low optical signal, "0": normal condition                                              |
| 13    | 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 |
| 14    | MOD_LOPWR | I   | LVC MOS w/ PUR | Module Low Power Mode. "1" or NC: module in low power (safe) mode, "0": power-on enabled                                     |
| 15    | MOD_ABS   | O   | GND            | Module Absent. "1" or NC: module absent, "0": module present, Pull Up Resistor on Host                                       |
| 16    | MOD_RSTn  | I   | LVC MOS w/ PDR | Module Reset. "0" resets the module, "1" or NC = module enabled, Pull Down Resistor in Module                                |
| 17    | MDC       | I/O | 1.2V CMOS      | Management Data I/O bi-directional data (electrical specs as per 802.3ae and ba)                                             |
| 18    | MDIO      | I   | 1.2V CMOS      | Management Data Clock (electrical specs as per 802.3ae and ba)                                                               |
| 19    | PRTADR0   | I   | 1.2V CMOS      | MDIO Physical Port address bit 0                                                                                             |
| 20    | PRTADR1   | I   | 1.2V CMOS      | MDIO Physical Port address bit 1                                                                                             |
| 21    | PRTADR2   | I   | 1.2V CMOS      | MDIO Physical Port address bit 2                                                                                             |
| 22    | VND_IO_C  | I/O |                | Module Vendor I/O C. Do Not Connect!                                                                                         |
| 23    | VND_IO_D  | I/O |                | Module Vendor I/O D. Do Not Connect!                                                                                         |
| 24    | VND_IO_E  | I/O |                | Module Vendor I/O E. Do Not Connect!                                                                                         |
| 25    | GND       |     |                |                                                                                                                              |
| 26    | MCLKn     |     |                | Monitor Clock – Support is TBD                                                                                               |
| 27    | MCLKp     |     |                | Monitor Clock – Support is TBD                                                                                               |
| 28    | GND       |     |                |                                                                                                                              |

## 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>   | -5   |     | 75  | °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> = -5 to 75 °C, V<sub>CC</sub> = 3.2 to 3.4 Volts)

| Parameter                               | Symbol               | Min                                  | Typ | Max   | Unit     | Ref. |
|-----------------------------------------|----------------------|--------------------------------------|-----|-------|----------|------|
| Supply Voltage                          | V <sub>CC</sub>      | 3.2                                  |     | 3.4   | V        |      |
| Supply Current                          | I <sub>CC</sub>      |                                      |     | TBD   | A        |      |
| Module total power                      | P                    |                                      |     | 5.0   | W        | 1    |
| Transmitter                             |                      |                                      |     |       |          |      |
| Signaling rate per lane                 |                      |                                      |     | 27.95 | Gb/s     | 2    |
| Input differential impedance            | R <sub>in</sub>      | CEI-28G-VSR as defined by<br>the OIF |     |       | Ω        |      |
| Differential data input swing per lane  | V <sub>in,pp</sub>   |                                      |     |       | mV       |      |
| Data input rise time tolerance          | t <sub>r</sub>       |                                      |     |       | ps       |      |
| Data input rise time tolerance          | t <sub>f</sub>       |                                      |     |       | ps       |      |
| Electrical input eye mask definition    | {X1, X2}<br>{Y1, Y2} |                                      |     |       | UI<br>mV |      |
| Receiver                                |                      |                                      |     |       |          |      |
| Signaling rate per lane                 |                      |                                      |     | 27.95 | Gb/s     | 2    |
| Differential data output swing per lane | V <sub>out,pp</sub>  | CEI-28G-VSR as defined by<br>the OIF |     |       | mV       |      |
| Data output rise time                   | t <sub>r</sub>       |                                      |     |       | ps       |      |
| Data output fall time                   | t <sub>f</sub>       |                                      |     |       | ps       |      |
| Electrical output eye mask definition   | {X1, X2}<br>{Y1, Y2} |                                      |     |       | UI<br>mV |      |
| Power Supply Noise Tolerance            | V <sub>rip</sub>     | TBD                                  |     |       |          |      |

### Notes:

1. Maximum total power value is specified across the full temperature and voltage range.
2. +/- 100ppm

## FTLC1141SDNx Clocking Signals

| Clock Name | Status       | I/O | Value                       |
|------------|--------------|-----|-----------------------------|
| REFCLK     | Not Required | I   | N/A (terminated internally) |
| TX_MCLK    | TBD          | O   | TBD                         |
| RX_MCLK    | TBD          | O   | TBD                         |

**IV. Optical Characteristics (EOL,  $T_{OP} = -5$  to  $75^{\circ}\text{C}$ ,  $V_{CC} = 3.2$  to  $3.4$  Volts)****OTU4 4I1-9D1F Operation**

| Parameter                                            | Symbol            | Min                                                                              | Typ | Max   | Unit | Ref. |
|------------------------------------------------------|-------------------|----------------------------------------------------------------------------------|-----|-------|------|------|
| Transmitter                                          |                   |                                                                                  |     |       |      |      |
| Signaling Speed per Channel                          |                   | 27.95                                                                            |     | 27.95 | Gb/s | 1    |
| Channel center wavelengths (range)                   |                   | 1294.53 – 1296.59<br>1299.02 – 1301.09<br>1303.54 – 1305.63<br>1308.09 – 1310.19 |     |       | nm   |      |
| Total Average Launch Power                           | P <sub>OUT</sub>  |                                                                                  |     | 10    | dBm  |      |
| Average Launch Power per Channel                     | TXP <sub>x</sub>  | -0.6                                                                             |     | 4.0   | dBm  |      |
| Optical Channel Extinction Ratio                     | ER                | 4.0                                                                              |     | 6.5   | dB   |      |
| Channel Power Difference                             | ΔP <sub>OUT</sub> |                                                                                  |     | 5     | dB   |      |
| Optical Return Loss                                  | ORL               |                                                                                  |     | 20    | dB   |      |
| Receiver                                             |                   |                                                                                  |     |       |      |      |
| Signaling Speed per Channel                          |                   | 27.95                                                                            |     | 27.95 | GBd  | 2    |
| Channel center wavelengths (range)                   |                   | 1294.53 – 1296.59<br>1299.02 – 1301.09<br>1303.54 – 1305.63<br>1308.09 – 1310.19 |     |       | nm   |      |
| Receiver parameters for an optical input with ER>4dB |                   |                                                                                  |     |       |      |      |
| Average Input Power per Channel                      | RXP <sub>x</sub>  | -6.9                                                                             |     | 4.0   | dBm  |      |
| Equivalent Sensitivity per Channel                   | Rxsens            |                                                                                  |     | -8.4  | dBm  | 3    |
| Receiver parameters for an optical input with ER>7dB |                   |                                                                                  |     |       |      |      |
| Average Input Power per Channel                      | RXP <sub>x</sub>  | -8.8                                                                             |     | 2.9   | dBm  |      |
| Equivalent Sensitivity per Channel                   | Rxsens            |                                                                                  |     | -10.3 | dBm  | 3    |
| Optical Path Penalty                                 | OPP               |                                                                                  |     | 1.5   | dB   |      |
| Total Average Input Power                            | P <sub>IN</sub>   |                                                                                  |     | 10.0  | dBm  |      |
| Channel Power Difference                             | ΔP <sub>IN</sub>  |                                                                                  |     | 5.5   | dB   |      |
| LOS De-Assert                                        | LOS <sub>D</sub>  |                                                                                  |     | -11.6 | dBm  |      |
| LOS Assert                                           | LOS <sub>A</sub>  |                                                                                  |     | -13.6 | dBm  |      |
| LOS Hysteresis                                       |                   |                                                                                  | 1   |       | dBm  |      |

**Notes:**

1. Transmitter consists of 4 lasers operating at 27.95Gb/s each.
2. Receiver consists of 4 photodetectors operating at 27.95Gb/s each.
3. Specified at a BER of  $10^{-6}$  (pre-FEC), per ITU-T G.sup39.

**100GBASE-LR4 Operation**

| Parameter                                                | Symbol                      | Min                                                                              | Typ | Max   | Unit  | Ref. |
|----------------------------------------------------------|-----------------------------|----------------------------------------------------------------------------------|-----|-------|-------|------|
| Transmitter                                              |                             |                                                                                  |     |       |       |      |
| Signaling Speed per Lane                                 |                             | 25.78                                                                            |     | 25.78 | Gb/s  | 1    |
| Lane center wavelengths (range)                          |                             | 1294.53 – 1296.59<br>1299.02 – 1301.09<br>1303.54 – 1305.63<br>1308.09 – 1310.19 |     |       | nm    |      |
| Total Average Launch Power                               | P <sub>OUT</sub>            |                                                                                  |     | 10.5  | dBm   |      |
| Transmit OMA per Lane                                    | T <sub>x</sub> OMA          | -1.3                                                                             |     | 4.5   | dBm   |      |
| Average Launch Power per Lane                            | T <sub>XP<sub>x</sub></sub> | -4.3                                                                             |     | 4.5   | dBm   | 2    |
| Optical Extinction Ratio                                 | ER                          | 4                                                                                |     |       | dB    |      |
| Sidemode Suppression ratio                               | SSR <sub>min</sub>          | 30                                                                               |     |       | dB    |      |
| Average launch power of OFF transmitter, per lane        |                             |                                                                                  |     | -30   | dBm   |      |
| Relative Intensity Noise                                 | RIN                         |                                                                                  |     | -130  | dB/Hz |      |
| Optical Return Loss Tolerance                            |                             |                                                                                  |     | 20    | dB    |      |
| Transmitter Reflectance                                  |                             |                                                                                  |     | -12   | dB    |      |
| Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3} |                             | {0.25, 0.4, 0.45, 0.25, 0.28, 0.4}                                               |     |       |       |      |
| Receiver                                                 |                             |                                                                                  |     |       |       |      |
| Signaling Speed per Lane                                 |                             | 25.78                                                                            |     | 25.78 | GBd   | 3    |
| Lane center wavelengths (range)                          |                             | 1294.53 – 1296.59<br>1299.02 – 1301.09<br>1303.54 – 1305.63<br>1308.09 – 1310.19 |     |       | nm    |      |
| Receive Power (OMA) per Lane                             | R <sub>x</sub> OMA          |                                                                                  |     | 4.5   | dBm   |      |
| Average Receive Power per Lane                           | R <sub>XP<sub>x</sub></sub> | -10.6                                                                            |     | 4.5   | dBm   | 4    |
| Receiver Sensitivity (OMA) per Lane                      | R <sub>xsens</sub>          |                                                                                  |     | -8.6  | dBm   |      |
| Stressed Receiver Sensitivity (OMA) per Lane             | SRS                         |                                                                                  |     | -6.8  | dBm   |      |
| Return Loss                                              | RL                          | -26                                                                              |     |       | dB    |      |
| Vertical eye closure penalty, per lane                   |                             |                                                                                  |     | 1.8   | dB    |      |
| Receive electrical 3 dB upper cutoff frequency, per lane |                             |                                                                                  |     | 31    | GHz   |      |
| LOS De-Assert                                            | LOS <sub>D</sub>            |                                                                                  |     | -11.6 | dBm   |      |
| LOS Assert                                               | LOS <sub>A</sub>            |                                                                                  |     | -13.6 | dBm   |      |
| LOS Hysteresis                                           |                             |                                                                                  | 1   |       | dBm   |      |

**Notes:**

1. Transmitter consists of 4 lasers operating at 25.78Gb/s each.
2. Minimum value is informative.
3. Receiver consists of 4 photodetectors operating at 25.78Gb/s each.
4. Minimum value is informative, equals min  $TxOMA$  with infinite ER and max channel insertion loss.

**V. General Specifications**

| Parameter                           | Symbol | Min   | Typ | Max        | Units | Ref. |
|-------------------------------------|--------|-------|-----|------------|-------|------|
| Bit Rate (all wavelengths combined) | BR     | 103.1 |     | 112.0      | Gb/s  | 1    |
| Bit Error Ratio @25.78Gb/s          | BER1   |       |     | $10^{-12}$ |       | 2    |
| Bit Error Ratio @27.95Gb/s          | BER2   |       |     | $10^{-6}$  |       | 3    |
| <b>Maximum Supported Distances</b>  |        |       |     |            |       |      |
| Fiber Type                          |        |       |     |            |       |      |
| SMF per G.652                       | Lmax1  |       |     | 10         | km    |      |

**Notes:**

1. Supports OTU4 4I1-9D1F per ITU-T G.959.1 and 100GBASE-LR4 per IEEE 802.3ba.
2. Tested with a  $2^{31} - 1$  PRBS.
3. Tested with a  $2^{31} - 1$  PRBS. Per ITU-T G.959.1 and G.sup39, the BER of  $10^{-12}$  for the OTU4 (112 Gb/s) application code is required to be met only after forward error correction has been applied. ITU-T G.sup39 defines the pre-FEC BER to be met as  $10^{-6}$ . The values for receiver sensitivity and optical path penalty measured at the receiver output at a BER of  $10^{-6}$  will normally be conservative estimates of the values for receiver sensitivity and path penalty at the BER of  $10^{-12}$  after the FEC decoder.

**VI. Environmental Specifications**

Finisar FTLC1141 CFP4 transceivers have a commercial operating case temperature range of -5°C to +75°C.

| Parameter                  | Symbol           | Min | Typ | Max | Units | Ref. |
|----------------------------|------------------|-----|-----|-----|-------|------|
| Case Operating Temperature | T <sub>op</sub>  | -5  |     | 75  | °C    |      |
| Storage Temperature        | T <sub>sto</sub> | -40 |     | 85  | °C    |      |

**VII. Regulatory Compliance**

Finisar FTLC1141 CFP4 transceivers are Class 1 Laser Products. 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                                                                   | TBD                |
| Laser Eye Safety  | TÜV      | EN 60825-1: 1994+A11:1996+A2:2001<br>IEC 60825-1: 1993+A1:1997+A2:2001<br>IEC 60825-2: 2000, Edition 2 | TBD                |
| Electrical Safety | TÜV      | EN 60950                                                                                               | TBD                |
| Electrical Safety | UL/CSA   | CLASS 3862.07<br>CLASS 3862.87                                                                         | TBD                |

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

## **VIII. Digital Diagnostics Functions**

FTLC1141 CFP4 transceivers support the MDIO-based diagnostics interface specified in the CFP MSA<sup>1</sup>. See Finisar Application Note AN-20xx (TBD).

## **IX. Memory Contents**

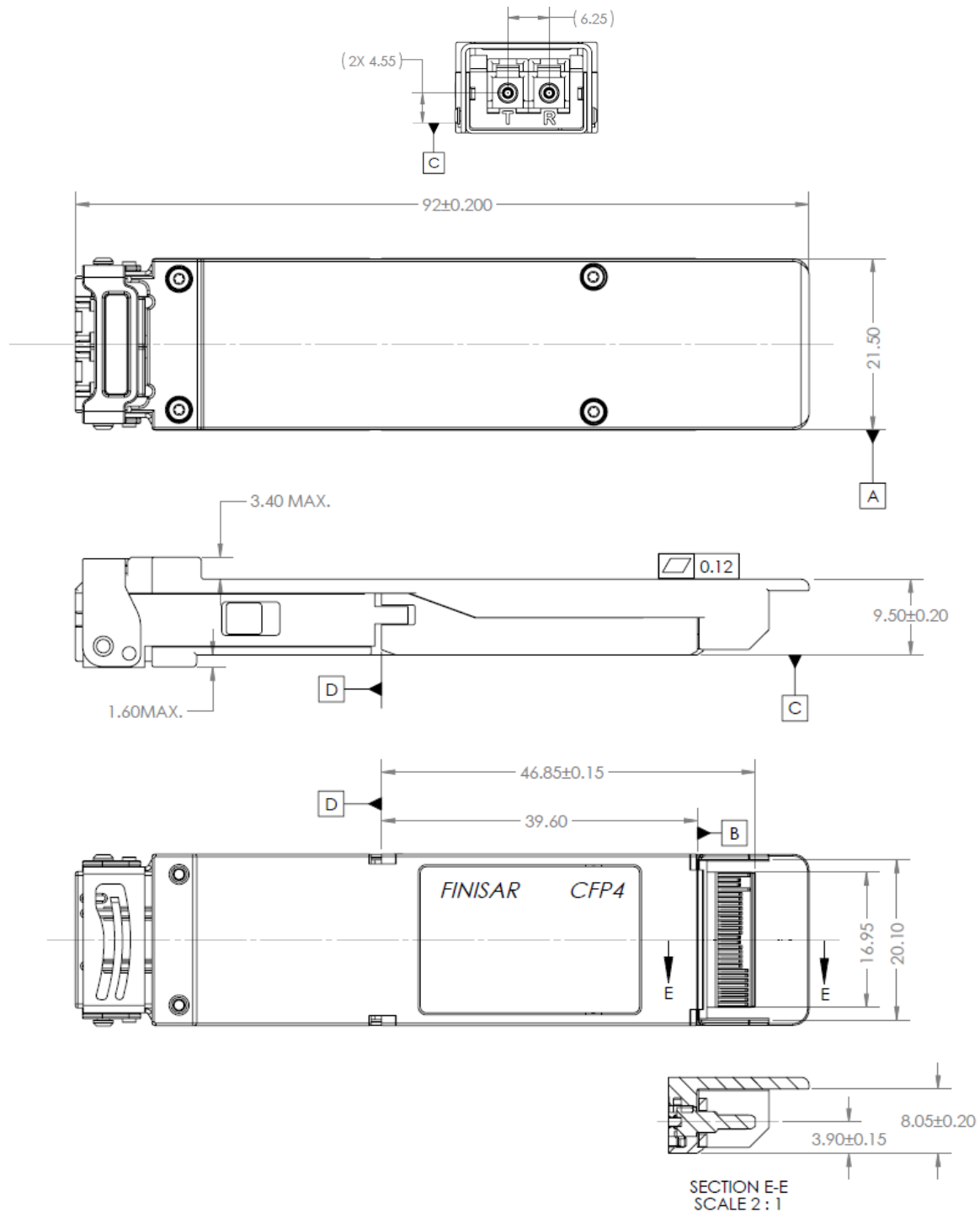
Per the CFP MSA<sup>1</sup>. See Finisar Application Note AN-20xx (TBD).

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

Per CFP4 Hardware Specification<sup>1</sup>.

## XI. Mechanical Specifications

Finisar FTLC1141 CFP4 transceivers are compatible with the CFP4 Hardware Specification for pluggable form factor modules.



**Figure 1. FTLC1141SDNL Mechanical Dimensions.**



**Figure 2. Standard Product Label**

## **XII. References**

1. CFP4 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 802.3ba, PMD Type 100GBASE-LR4.
3. Directive 2002/95/EC of the European Council Parliament and of the Council, “on the restriction of the use of certain hazardous substances in electrical and electronic equipment”. January 27, 2003.
4. “Application Note AN-2038: Finisar Implementation Of RoHS Compliant Transceivers”, Finisar Corporation, January 21, 2005.
5. Application Note AN-20xx (TBD), Finisar Corporation.
6. IEEE 802.3bm, Annex 83E, CAUI-4 Interface.
7. ITU-T Recommendations G.959.1/G.709 and Supplement 39 (G.sup39)
8. OIF CEI-28G-VSR Interface

**XIII. Revision History**

| Revision | Date      | Description                                                                                                                                                                                                       |
|----------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A1       | 8/20/2013 | <ul style="list-style-type: none"><li>Preliminary document released.</li></ul>                                                                                                                                    |
| A2       | 9/12/2014 | <ul style="list-style-type: none"><li>Added product photo and label. Changed maximum power dissipation specification to 5.5W. Added Receiver specification for high ER Transmitters for OTU4 operation.</li></ul> |
| A3       | 2/6/2015  | <ul style="list-style-type: none"><li>Added mechanical drawing. Changed maximum power dissipation specification to 5W.</li></ul>                                                                                  |

**For More Information:**

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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

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- 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.

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- 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.



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