Finisar

Product Specification

100GBASE-SR10 100m CXP Optical Transceiver Module

FTLD10CE3C

PRODUCT FEATURES

- 12-channel full-duplex transceiver module
- Hot Pluggable CXP form factor
- Multirate capability: 1Gb/s to 11.3Gb/s per channel
- Maximum link length of 100m on OM3 Multimode Fiber (MMF)
- Unretimed CPPI electrical interface
- Requires 3.3V power supply only
- Low power dissipation: < 3.5W
- Reliable VCSEL array technology
- Digital Diagnostics including Tx and Rx optical power monitoring
- Commercial operating case temperature range: 0°C to 70°C
- RoHS-6 Compliant (lead-free)

APPLICATIONS

- Infiniband 12x SDR/DDR/QDR
- 100GBASE-SR10 100G Ethernet
- OTU4/OTU2e
- 12x 10GBASE-SR Ethernet (compatible)
- PCIe (Gen1/2/3)
- SATA3
- Proprietary protocols

Finisar’s FTLD10CE3C second-generation CXP transceiver modules are designed for use in up to 136 Gigabit per second links over 12 duplex multimode fiber pairs. They are compliant with the IBTA CXP Specification\(^1\), IEEE 802.3ba 100GBASE-SR10 and CPPI electrical interfaces\(^2\). The transceiver is RoHS-6 compliant and lead-free per Directive 2002/95/EC\(^3\), and Finisar Application Note AN-2038\(^4\). They support Tx/Rx optical power monitoring functionality. For applications up to 14 Gb/s per channel please contact Finisar.

PRODUCT SELECTION

**FTLD10CE3C**

E: Ethernet-compliant optical interface
3: Second generation product
C: Commercial temperature rate
## I. Pin Descriptions

<table>
<thead>
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<td>C19</td>
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<td>C21</td>
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**Figure 1 – CXP-compliant 84-pin connector**
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<td>Ground</td>
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<td>Rx11p</td>
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<td>C18</td>
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<td>Receiver Inverted Data Output</td>
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<td>GND</td>
<td>Ground</td>
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<tr>
<td>D2</td>
<td>Rx0p</td>
<td>Receiver Non-Inverted Data Output</td>
<td></td>
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<tr>
<td>D3</td>
<td>Rx0n</td>
<td>Receiver Inverted Data Output</td>
<td></td>
</tr>
<tr>
<td>D4</td>
<td>GND</td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>D5</td>
<td>Rx2p</td>
<td>Receiver Non-Inverted Data Output</td>
<td></td>
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<td>D6</td>
<td>Rx2n</td>
<td>Receiver Inverted Data Output</td>
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<td>D7</td>
<td>GND</td>
<td>Ground</td>
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</tr>
<tr>
<td>D8</td>
<td>Rx4p</td>
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</tr>
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<td>D9</td>
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<td>Receiver Inverted Data Output</td>
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</tr>
<tr>
<td>D10</td>
<td>GND</td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>D11</td>
<td>Rx6p</td>
<td>Receiver Non-Inverted Data Output</td>
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<tr>
<td>D12</td>
<td>Rx6n</td>
<td>Receiver Inverted Data Output</td>
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<td>D13</td>
<td>GND</td>
<td>Ground</td>
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<tr>
<td>D14</td>
<td>Rx8p</td>
<td>Receiver Non-Inverted Data Output</td>
<td></td>
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<tr>
<td>D15</td>
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<td>Receiver Inverted Data Output</td>
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<td>D16</td>
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<td>Rx10p</td>
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<td>D19</td>
<td>GND</td>
<td>Ground</td>
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</tr>
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<td>D20</td>
<td>Vcc3.3-RX</td>
<td>+3.3 V Power supply receiver</td>
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</tr>
<tr>
<td>D21</td>
<td>Vcc12-RX</td>
<td>+12.0 V Power supply receiver - NOT CONNECTED</td>
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**Notes**

1. Circuit ground is internally isolated from chassis ground.
2. 12V power supply not required.
II. General Product Characteristics

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<th>Parameter</th>
<th>Value</th>
<th>Unit</th>
<th>Notes</th>
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<tr>
<td>Module Form Factor</td>
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<tr>
<td>Number of Lanes</td>
<td>12 Tx and 12 Rx</td>
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<tr>
<td>Maximum Aggregate Data Rate</td>
<td>135.816</td>
<td>Gb/s</td>
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<td>Maximum Data Rate per Lane</td>
<td>11.318</td>
<td>Gb/s</td>
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<td>Protocols Supported</td>
<td>Typical applications include Infiniband DDR/QDR, 100GBASE-SR10 Ethernet, OTU4, OTU2e, PCIe-Gen1/2/3, 12x10GBASE-SR Ethernet</td>
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<tr>
<td>Electrical Interface and Pin-out</td>
<td>84-pin edge connector</td>
<td></td>
<td>Pin-out as defined by the CXP Specification</td>
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<td>Optical Cable Type Required</td>
<td>Multimode ribbon 24-fiber cable assembly, MPO connector</td>
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<tr>
<td>Maximum Power Consumption per End</td>
<td>3.5</td>
<td>Watts</td>
<td>Varies with output voltage swing and pre-emphasis settings</td>
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<tr>
<td>Management Interface</td>
<td>Serial, I2C-based, 400 kHz maximum frequency</td>
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<td>As defined by the CXP Specification</td>
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**Data Rate Specifications**

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<th>Typ</th>
<th>Max</th>
<th>Units</th>
<th>Ref.</th>
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<td>11318</td>
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<td>10^-6</td>
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<td>Bit Error Ratio @11.2Gb/s per Lane</td>
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<td>10^-6</td>
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<td>Bit Error Ratio @11.3Gb/s per Lane</td>
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<td>meters</td>
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<td>Link distance on OM4 MMF</td>
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<td>meters</td>
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**Notes:**
1. Infiniband SDR/DDR/QDR, 100GBASE-SR10 100G Ethernet, OTU2e, OTU4, PCIe Gen1/2/3, 12x10GBASE-SR 10G Ethernet.
2. Tested with a PRBS 2^31-1 test pattern.

III. Absolute Maximum Ratings

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<th>Parameter</th>
<th>Symbol</th>
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<th>Ref.</th>
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<td>Maximum Supply Voltage</td>
<td>Vcc1, VccTx, VccRx</td>
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<td>3.6</td>
<td>V</td>
<td>1</td>
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<td>Storage Temperature</td>
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<td>°C</td>
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<td>Case Operating Temperature</td>
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<td>85</td>
<td>%</td>
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**Notes:**
1. Non-condensing.
IV. Electrical Characteristics (T<sub>op</sub> = 0 to 70°C, V<sub>cc</sub> = 3.3 ± 5% Volts)

NOTE: The FTLD10CE3C requires that a CPPI-compliant CXP electrical connector be used on the host board in order to guarantee its electrical interface specification. Please check with your connector supplier.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
<th>Ref.</th>
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<td>mA</td>
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<td>Transmitter (per Lane)</td>
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<td>Single ended input voltage tolerance</td>
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<td>Differential data input swing</td>
<td>Vin,pp</td>
<td>120</td>
<td>1200</td>
<td>mVpp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Differential input threshold</td>
<td></td>
<td>50</td>
<td></td>
<td>mV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AC common mode input voltage tolerance (RMS)</td>
<td></td>
<td>15</td>
<td></td>
<td>mV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Differential input return loss Per IEEE 802.3ba, Section 86A.4.1.1</td>
<td></td>
<td></td>
<td></td>
<td>dB</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>J2 Jitter Tolerance</td>
<td>Jr2</td>
<td>0.17</td>
<td></td>
<td>UI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J9 Jitter Tolerance</td>
<td>Jr9</td>
<td>0.29</td>
<td></td>
<td>UI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data Dependent Pulse Width Shrinkage DDPWS</td>
<td></td>
<td>0.07</td>
<td></td>
<td>UI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eye mask coordinates {X1, X2 Y1, Y2}</td>
<td></td>
<td>0.11, 0.31 95, 350</td>
<td></td>
<td>UI</td>
<td>mV</td>
<td>5</td>
</tr>
</tbody>
</table>

| Receiver (per Lane)        |        |      |      |      |      |      |
| Single-ended output voltage |        | -0.3 | 4.0  | V    |      |      |
| Differential data output swing | Vout,pp | 0   | 800  | mVpp | 6, 7 |      |
| 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    | 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 | Jo2 | 0.42 |      | UI   |      |      |
| J9 Jitter output | Jo9 | 0.65 |      | UI   |      |      |
| Eye mask coordinates {X1, X2 Y1, Y2} |        | 0.29, 0.5 150, 425 |      | UI   | mV   | 5    |
| Power Supply Ripple Tolerance | PSR | 50   |      |      | mVpp |      |

Notes:
1. Maximum total power value is specified across the full temperature and voltage range.
2. From power-on and end of any fault conditions.
3. After internal AC coupling. Self-biasing 100Ω differential input.
4. 10 MHz to 11.1 GHz range
5. Hit ratio = 5 x 10E-5
6. AC coupled with 100Ω differential output impedance.
7. Settable in 4 discrete steps via the I2C interface. See Figure 2 for Vout settings.
Figure 2 – Transmitter Input Differential Signal Mask

Figure 3 – Receiver Output Differential Signal Mask
Receiver Output Amplitude Settings

<table>
<thead>
<tr>
<th>Code</th>
<th>Receiver Output Amplitude (mV)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Nominal</td>
</tr>
<tr>
<td>1xxxb</td>
<td>650</td>
<td>750</td>
</tr>
<tr>
<td>0111b</td>
<td>550</td>
<td>650</td>
</tr>
<tr>
<td>0101b</td>
<td>450</td>
<td>550</td>
</tr>
<tr>
<td>0100b</td>
<td>350</td>
<td>450</td>
</tr>
<tr>
<td>0011b</td>
<td>300</td>
<td>400</td>
</tr>
<tr>
<td>0010b</td>
<td>250</td>
<td>350</td>
</tr>
<tr>
<td>0001b</td>
<td>200</td>
<td>300</td>
</tr>
<tr>
<td>0000b</td>
<td>150</td>
<td>250</td>
</tr>
</tbody>
</table>

Receiver Pre-Emphasis Settings

<table>
<thead>
<tr>
<th>Code</th>
<th>Pre-emphasis (dB)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>0111b</td>
<td>4.5 +/- 0.25</td>
<td></td>
</tr>
<tr>
<td>0110b</td>
<td>4.0 +/- 0.5</td>
<td></td>
</tr>
<tr>
<td>0101b</td>
<td>3.5 +/- 0.5</td>
<td></td>
</tr>
<tr>
<td>0100b</td>
<td>3.0 +/- 0.5</td>
<td></td>
</tr>
<tr>
<td>0011b</td>
<td>2.5 +/- 0.5</td>
<td>Default Setting</td>
</tr>
<tr>
<td>0010b</td>
<td>2.0 +/- 0.5</td>
<td></td>
</tr>
<tr>
<td>0001b</td>
<td>1.5 +/- 0.5</td>
<td></td>
</tr>
<tr>
<td>0000b</td>
<td>0.5 +/- 0.25</td>
<td></td>
</tr>
</tbody>
</table>

Module-end, Typical Power Consumption

<table>
<thead>
<tr>
<th>Rx Output</th>
<th>Power (mW)</th>
<th>Pre-Emphasis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Code</td>
<td>Pre-Emphasis</td>
</tr>
<tr>
<td></td>
<td>0000b</td>
<td>0001b</td>
</tr>
<tr>
<td>Rx Output</td>
<td>Code</td>
<td>Pre-Emphasis</td>
</tr>
<tr>
<td>-----------</td>
<td>------------</td>
<td>--------------</td>
</tr>
<tr>
<td>0101b</td>
<td>2023</td>
<td>2023</td>
</tr>
<tr>
<td>0110b</td>
<td>2026</td>
<td>2026</td>
</tr>
<tr>
<td>0111b</td>
<td>2026</td>
<td>2026</td>
</tr>
</tbody>
</table>
V. Optical Characteristics (\(T_{OP} = 0\) to 70°C, \(V_{CC} = 3.3 \pm 5\%\) Volts)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transmitter (per Lane)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signaling Speed per Lane</td>
<td></td>
<td></td>
<td>11.3</td>
<td>GBd</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Center wavelength</td>
<td></td>
<td></td>
<td>840</td>
<td>GBd</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>RMS Spectral Width</td>
<td>SW</td>
<td></td>
<td>0.65</td>
<td>nm</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Average Launch Power per Lane</td>
<td>TXP</td>
<td></td>
<td>-7.6</td>
<td>dBm</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Transmit OMA per Lane</td>
<td>TxOMA</td>
<td></td>
<td>-5.6</td>
<td>dBm</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Difference in Power between any two lanes [OMA]</td>
<td>DP</td>
<td></td>
<td>4.0</td>
<td>dB</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Peak Power per Lane</td>
<td>PP</td>
<td></td>
<td>4.0</td>
<td>dBm</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Launch Power [OMA] minus TDP per Lane</td>
<td>P-TDP</td>
<td></td>
<td>-6.5</td>
<td>dBm</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>TDP per Lane</td>
<td>TDP</td>
<td></td>
<td>3.5</td>
<td>dBm</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Optical Extinction Ratio</td>
<td>ER</td>
<td></td>
<td>3.0</td>
<td>dB</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Optical Return Loss Tolerance</td>
<td>ORL</td>
<td></td>
<td>12</td>
<td>dB</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Encircled Flux</td>
<td>FLX</td>
<td>&gt; 86% at 19 um</td>
<td></td>
<td>dBm</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt; 30% at 4.5 um</td>
<td></td>
<td>dBm</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Average launch power of OFF transmitter, per lane</td>
<td></td>
<td></td>
<td>-30</td>
<td>dB</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Relative Intensity Noise</td>
<td>RIN</td>
<td></td>
<td>-128</td>
<td>dB/Hz</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}</td>
<td></td>
<td></td>
<td>0.23, 0.34, 0.43, 0.27, 0.35, 0.4</td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td><strong>Receiver (per Lane)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signaling Speed per Lane</td>
<td></td>
<td></td>
<td>11.3</td>
<td>GBd</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Center wavelength</td>
<td></td>
<td></td>
<td>840</td>
<td>GBd</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Damage Threshold</td>
<td>DT</td>
<td></td>
<td>3.4</td>
<td>dBm</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Average Receive Power per Lane</td>
<td>RXP</td>
<td></td>
<td>-9.5</td>
<td>dBm</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Receive Power (OMA) per Lane</td>
<td>RxOMA</td>
<td></td>
<td>3.0</td>
<td>dBm</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Stressed Receiver Sensitivity (OMA) per Lane</td>
<td>SRS</td>
<td></td>
<td>-5.4</td>
<td>dBm</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Peak Power, per lane</td>
<td>PP</td>
<td></td>
<td>4</td>
<td>dBm</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Receiver Reflectance</td>
<td>Rfl</td>
<td></td>
<td>-12</td>
<td>dB</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Vertical eye closure penalty, per lane</td>
<td></td>
<td></td>
<td>19</td>
<td>dB</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Stressed eye J2 jitter, per Lane</td>
<td></td>
<td></td>
<td>0.3</td>
<td>UI</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Stressed eye J9 jitter, per Lane</td>
<td></td>
<td></td>
<td>0.47</td>
<td>UI</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>OMA of each aggressor lane</td>
<td></td>
<td></td>
<td>-0.4</td>
<td>dBm</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Receiver jitter tolerance [OMA], per Lane</td>
<td></td>
<td></td>
<td>-5.4</td>
<td>dBm</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Rx jitter tolerance: Jitter frequency and p-p amplitude</td>
<td></td>
<td></td>
<td>(75, 5)</td>
<td>kHz, UI</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(375, 1)</td>
<td>kHz, UI</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>LOS De-Assert</td>
<td>LOSD</td>
<td></td>
<td>-12.5</td>
<td>dBm</td>
<td>4</td>
<td></td>
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<tr>
<td>LOS Assert</td>
<td>LOSA</td>
<td></td>
<td>-30.0</td>
<td>dBm</td>
<td>4</td>
<td></td>
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<tr>
<td>LOS Hysteresis</td>
<td></td>
<td></td>
<td>1</td>
<td>dB</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. Transmitter consists of 12 lasers operating at a maximum rate of 11.3Gb/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 12 photodetectors operating at a maximum rate of 11.3Gb/s each.
VI. Memory Map and Control Registers


VII. Environmental Specifications

Finisar FTLD10CE3C transceiver modules have an operating temperature range from 0°C to +70°C case temperature.

<table>
<thead>
<tr>
<th>Environmental Specifications</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case Operating Temperature</td>
<td>T_{op}</td>
<td>0</td>
<td></td>
<td>70</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>T_{st}</td>
<td>-5</td>
<td></td>
<td>75</td>
<td>°C</td>
<td></td>
</tr>
</tbody>
</table>

VIII. Regulatory Compliance

Finisar FTLD10CE3C transceiver modules are RoHS-6 Compliant. Copies of certificates are available at Finisar Corporation upon request.

FTLD10CE3C transceiver modules are classified as Class 1 laser eye safety compliant per IEC 60825-1.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Agency</th>
<th>Standard</th>
<th>Certificate Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser Eye Safety</td>
<td>FDA/CDRH</td>
<td>CDRH 21 CFR 1040 and Laser Notice 50</td>
<td>0620885-043</td>
</tr>
<tr>
<td>Electrical Safety</td>
<td>TÜV</td>
<td>EN 60950:2006+A11</td>
<td>R72120958</td>
</tr>
<tr>
<td>Electrical Safety</td>
<td>UL/CSA</td>
<td>CLASS 3862.07</td>
<td>2397145</td>
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<tr>
<td></td>
<td></td>
<td>CLASS 3862.87</td>
<td></td>
</tr>
</tbody>
</table>

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

The FTLD10CE3C transceiver module mechanical specifications are based on the CXP Specification.

Figure 3 – FTLD10CE3C mechanical drawing

Figure 4 – FTLD10CE3C production-level product label
X. References


2. IEEE 802.3ba, PMD Type 100GBASE-SR10


XI. For More Information

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