

Product Specification

100GBASE-SR10 100m CXP Optical Transceiver Module FTLD10CE1C

PRODUCT FEATURES

- 12-channel full-duplex transceiver module
- Hot Pluggable CXP form factor
- Maximum link length of 100m on OM3 Multimode Fiber (MMF)
- Multirate capability: 1.06Gb/s to 10.5Gb/s per channel
- Unretimed CPPI electrical interface
- Requires 3.3V power supply only
- Low power dissipation: < 3.5W
- Reliable VCSEL array technology
- Built-in digital diagnostic functions
- Commercial operating case temperature range: 0°C to 70°C
- Single MPO connector receptacle
- RoHS-6 Compliant (lead-free)



APPLICATIONS

- 100GBASE-SR10 100G Ethernet
- Multiple 4G/8G/10G Fibre Channel

Finisar's FTLD10CE1C CXP transceiver modules are designed for use in up to 100 Gigabit per second links over multimode fiber. They are compliant with the CXP Specification¹ and IEEE 802.3ba 100GBASE-SR10 and CPPI interfaces². The transceiver is RoHS-6 compliant and lead-free per Directive 2002/95/EC³, and Finisar Application Note AN-2038⁴. For applications up to 12.5 Gb/s per channel please contact Finisar.

PRODUCT SELECTION

FTLD10CE1C

- 10: Up to 10.5 Gb/s per channel
- E: Ethernet-compliant optical interface
- 1: First generation product
- C: Commercial temperature rate

I. Pin Descriptions

| Bottom side | | | Top Side | | |
|-----------------------------------|---------------|----------------|----------------|-----------|-------|
| I/O # | Name | Contact Length | Contact Length | Name | I/O # |
| Receiver -- Top Card | | | | | |
| C1 | GND | | | GND | D1 |
| C2 | RX1p | | | RX0p | D2 |
| C3 | RX1n | | | RX0n | D3 |
| C4 | GND | | | GND | D4 |
| C5 | RX3p | | | RX2p | D5 |
| C6 | RX3n | | | RX2n | D6 |
| C7 | GND | | | GND | D7 |
| C8 | RX5p | | | RX4p | D8 |
| C9 | RX5n | | | RX4n | D9 |
| C10 | GND | | | GND | D10 |
| C11 | RX7p | | | RX6p | D11 |
| C12 | RX7n | | | RX6n | D12 |
| C13 | GND | | | GND | D13 |
| C14 | RX9p | | | RX8p | D14 |
| C15 | RX9n | | | RX8n | D15 |
| C16 | GND | | | GND | D16 |
| C17 | RX11p | | | RX10p | D17 |
| C18 | RX11n | | | RX10n | D18 |
| C19 | GND | | | GND | D19 |
| C20 | PRSENT_L | | | Vcc3.3-RX | D20 |
| C21 | Int_L/Reset_L | | | Vcc12-RX | D21 |
| Transmitter -- Bottom Card | | | | | |
| A1 | GND | | | GND | B1 |
| A2 | TX1p | | | TX0p | B2 |
| A3 | TX1n | | | TX0n | B3 |
| A4 | GND | | | GND | B4 |
| A5 | TX3p | | | TX2p | B5 |
| A6 | TX3n | | | TX2n | B6 |
| A7 | GND | | | GND | B7 |
| A8 | TX5p | | | TX4p | B8 |
| A9 | TX5n | | | TX4n | B9 |
| A10 | GND | | | GND | B10 |
| A11 | TX7p | | | TX6p | B11 |
| A12 | TX7n | | | TX6n | B12 |
| A13 | GND | | | GND | B13 |
| A14 | TX9p | | | TX8p | B14 |
| A15 | TX9n | | | TX8n | B15 |
| A16 | GND | | | GND | B16 |
| A17 | TX11p | | | TX10p | B17 |
| A18 | TX11n | | | TX10n | B18 |
| A19 | GND | | | GND | B19 |
| A20 | SCL | | | VCC3.3-TX | B20 |
| A21 | SDA | | | VCC12-TX | B21 |

Figure 1 – CXP-compliant 84-pin connector

| Pin | Symbol | Name/Description | Notes |
|-----|-----------|---|-------|
| A1 | GND | Ground | 1 |
| A2 | Tx1p | Transmitter Non-Inverted Data Input | |
| A3 | Tx1n | Transmitter Inverted Data Input | |
| A4 | GND | Ground | 1 |
| A5 | Tx3p | Transmitter Non-Inverted Data Input | |
| A6 | Tx3n | Transmitter Inverted Data Input | |
| A7 | GND | Ground | 1 |
| A8 | Tx5p | Transmitter Non-Inverted Data Input | |
| A9 | Tx5n | Transmitter Inverted Data Input | |
| A10 | GND | Ground | 1 |
| A11 | Tx7p | Transmitter Non-Inverted Data Input | |
| A12 | Tx7n | Transmitter Inverted Data Input | |
| A13 | GND | Ground | 1 |
| A14 | Tx9p | Transmitter Non-Inverted Data Input | |
| A15 | Tx9n | Transmitter Inverted Data Input | |
| A16 | GND | Ground | 1 |
| A17 | Tx11p | Transmitter Non-Inverted Data Input | |
| A18 | Tx11n | Transmitter Inverted Data Input | |
| A19 | GND | Ground | 1 |
| A20 | SCL | 2-wire serial interface clock | |
| A21 | SDA | 2-wire serial interface data | |
| B1 | GND | Ground | 1 |
| B2 | Tx0p | Transmitter Non-Inverted Data Input | |
| B3 | Tx0n | Transmitter Inverted Data Input | |
| B4 | GND | Ground | 1 |
| B5 | Tx2p | Transmitter Non-Inverted Data Input | |
| B6 | Tx2n | Transmitter Inverted Data Input | |
| B7 | GND | Ground | 1 |
| B8 | Tx4p | Transmitter Non-Inverted Data Input | |
| B9 | Tx4n | Transmitter Inverted Data Input | |
| B10 | GND | Ground | 1 |
| B11 | Tx6p | Transmitter Non-Inverted Data Input | |
| B12 | Tx6n | Transmitter Inverted Data Input | |
| B13 | GND | Ground | 1 |
| B14 | Tx8p | Transmitter Non-Inverted Data Input | |
| B15 | Tx8n | Transmitter Inverted Data Input | |
| B16 | GND | Ground | 1 |
| B17 | Tx10p | Transmitter Non-Inverted Data Input | |
| B18 | Tx10n | Transmitter Inverted Data Input | |
| B19 | GND | Ground | 1 |
| B20 | VCC3.3-TX | +3.3 V Power supply transmitter | |
| B21 | VCC12-TX | +12.0 V Power supply transmitter - NOT CONNECTED | 2 |
| C1 | GND | Ground | 1 |
| C2 | Rx1p | Receiver Non-Inverted Data Output | |
| C3 | Rx1n | Receiver Inverted Data Output | |
| C4 | GND | Ground | 1 |
| C5 | Rx3p | Receiver Non-Inverted Data Output | |
| C6 | Rx3n | Receiver Inverted Data Output | |
| C7 | GND | Ground | 1 |
| C8 | Rx5p | Receiver Non-Inverted Data Output | |
| C9 | Rx5n | Receiver Inverted Data Output | |
| C10 | GND | Ground | 1 |

| | | | |
|-----|---------------|--|---|
| C11 | Rx7p | Receiver Non-Inverted Data Output | |
| C12 | Rx7n | Receiver Inverted Data Output | |
| C13 | GND | Ground | 1 |
| C14 | Rx9p | Receiver Non-Inverted Data Output | |
| C15 | Rx9n | Receiver Inverted Data Output | |
| C16 | GND | Ground | 1 |
| C17 | Rx11p | Receiver Non-Inverted Data Output | |
| C18 | Rx11n | Receiver Inverted Data Output | |
| C19 | GND | Ground | 1 |
| C20 | PRSNT_L | Module Present | |
| C21 | Int_L/Reset_L | Interrupt / Reset | |
| D1 | GND | Ground | 1 |
| D2 | Rx0p | Receiver Non-Inverted Data Output | |
| D3 | Rx0n | Receiver Inverted Data Output | |
| D4 | GND | Ground | 1 |
| D5 | Rx2p | Receiver Non-Inverted Data Output | |
| D6 | Rx2n | Receiver Inverted Data Output | |
| D7 | GND | Ground | 1 |
| D8 | Rx4p | Receiver Non-Inverted Data Output | |
| D9 | Rx4n | Receiver Inverted Data Output | |
| D10 | GND | Ground | 1 |
| D11 | Rx6p | Receiver Non-Inverted Data Output | |
| D12 | Rx6n | Receiver Inverted Data Output | |
| D13 | GND | Ground | 1 |
| D14 | Rx8p | Receiver Non-Inverted Data Output | |
| D15 | Rx8n | Receiver Inverted Data Output | |
| D16 | GND | Ground | 1 |
| D17 | Rx10p | Receiver Non-Inverted Data Output | |
| D18 | Rx10n | Receiver Inverted Data Output | |
| D19 | GND | Ground | 1 |
| D20 | Vcc3.3-RX | +3.3 V Power supply receiver | |
| D21 | Vcc12-RX | +12.0 V Power supply receiver - NOT CONNECTED | 2 |

Notes

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

II. General Product Characteristics

| Parameter | Value | Unit | Notes |
|-----------------------------------|--|-------|---|
| Module Form Factor | CXP | | |
| Number of Lanes | 12 Tx and 12 Rx | | |
| Maximum Aggregate Data Rate | 126 | Gb/s | |
| Maximum Data Rate per Lane | 10.5 | Gb/s | |
| Protocols Supported | Typical applications include 100G Ethernet, Infiniband, Fibre Channel, SATA/SAS3 | | |
| Electrical Interface and Pin-out | 84-pin edge connector | | Pin-out as defined by the CXP Specification |
| Optical Cable Type Required | Multimode ribbon 24-fiber cable assembly, MPO connector | | |
| Maximum Power Consumption per End | 3.5 | Watts | Varies with output voltage swing and pre-emphasis settings (see Figure 2) |
| Management Interface | Serial, I2C-based, 450 kHz maximum frequency | | As defined by the CXP Specification |

| Data Rate Specifications | Symbol | Min | Typ | Max | Units | Ref. |
|--------------------------|--------|------|-----|------------|--------|------|
| Bit Rate per Lane | BR | 1000 | | 10500 | Mb/sec | 1 |
| Bit Error Ratio | BER | | | 10^{-12} | | 2 |
| Link distance on OM3 MMF | d | | | 100 | meters | 3 |

Notes:

- Infiniband SDR/DDR/QDR, 1/10/40/100 Gigabit Ethernet, 1/2/4/8/10G Fibre Channel.
- Tested with a PRBS $2^{31}-1$ test pattern.
- Per 100GBASE-SR10 PMD maximum link distance in IEEE 802.3.ba.

III. Absolute Maximum Ratings

| Parameter | Symbol | Min | Typ | Max | Unit | Ref. |
|----------------------------|--|------|-----|-----|------|------|
| Maximum Supply Voltage | V _{cc1} , V _{ccTx} , V _{ccRx} | -0.5 | | 3.6 | V | |
| Storage Temperature | T _S | -40 | | 85 | °C | |
| Case Operating Temperature | T _{OP} | 0 | | 70 | °C | |
| Relative Humidity | RH | 0 | | 85 | % | 1 |

Notes:

- Non-condensing.

IV. Electrical Characteristics (T_{OP} = 0 to 70°C, V_{CC} = 3.3 ± 5% Volts)

NOTE: The FTLD10CE1C 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.

| Parameter | Symbol | Min | Typ | Max | Unit | Ref. |
|--|--|--|-----|------|------------------|------|
| Supply Voltage | V _{cc1} , V _{ccTx} , V _{ccRx} | 3.15 | | 3.45 | V | |
| Supply Current | I _{cc} | | 850 | 1000 | mA | |
| Module Total Power | P | | | 3.5 | W | 1 |
| Link Turn-On Time | | | | | | |
| Transmit turn-on time | | | | 2000 | ms | 2 |
| Transmitter (per Lane) | | | | | | |
| 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) | | | | | | |
| Single-ended output voltage | | -0.3 | | 4.0 | V | |
| Differential data output swing | V _{out,pp} | 0 | | 800 | mV _{pp} | 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 |
| 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 | 50 | | | mV _{pp} | |

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 V_{out} settings.

| Power (mW) | | Pre-Emphasis into 100ohms (mV) | | | |
|------------|-----|--------------------------------|------|------|------|
| | | 0 | 125 | 175 | 325 |
| Vo (mV) | 0 | 1189 | | | |
| | 317 | 1645 | 2197 | 2305 | 2617 |
| | 422 | 1753 | 2305 | 2413 | 2725 |
| | 739 | 2041 | 2557 | 2701 | 2962 |

Figure 2 – Power Dissipation (mW, typical) vs. Rx Output Conditions

V. Optical Characteristics ($T_{OP} = 0$ to 70°C , $V_{CC} = 3.3 \pm 5\%$ Volts)

| Parameter | Symbol | Min | Typ | Max | Unit | Ref. |
|--|---------|---|------|------|---------|------|
| Transmitter (per Lane) | | | | | | |
| Signaling Speed per Lane | | | 10.5 | | 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 μm < 30% at 4.5 μm | | | 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 | | | 10.5 | | GBd | 4 |
| Center wavelength | | 840 | | 860 | nm | |
| Damage Threshold | DT | 3.4 | | | dBm | |
| Average Receive Power per Lane | RXP_x | -9.5 | | 2.4 | dBm | |
| Receive Power (OMA) per Lane | $RxOMA$ | | | 3.0 | dBm | |
| Stressed Receiver Sensitivity (OMA) per Lane | SRS | | | -5.4 | dBm | |
| 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 | | (75, 5) | | | kHz, UI | |

| | | | | | | |
|-------------------|------------------|----------|--|-----|---------|--|
| and p-p amplitude | | (375, 1) | | | kHz, UI | |
| LOS De-Assert | LOS _D | | | -11 | dBm | |
| LOS Assert | LOS _A | | | -14 | dBm | |
| LOS Hysteresis | | 1 | | | dB | |

Notes:

1. Transmitter consists of 12 lasers operating at a maximum rate of 10.5Gb/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 10.5Gb/s each.

VI. Memory Map and Control Registers

Compatible with the CXP Specification. Please see Finisar Application Note AN-2085 for a detailed description.

VII. Environmental Specifications

Finisar FTLD10C transceiver modules have an operating temperature range from 0°C to +70°C case temperature.

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

VIII. Regulatory Compliance

Finisar FTLD10C transceiver modules are RoHS-6 Compliant. Copies of certificates are available at Finisar Corporation upon request.

FTLD10C transceiver modules are Class 1M laser eye safety compliant per IEC 60825-1, which means that they are eye safe under normal “unaided” viewing conditions. Laser radiation may be hazardous if viewed with magnifying optics.

IX. Mechanical Specifications

The FTLD10C transceiver module mechanical specifications are based on the CXP Specification.

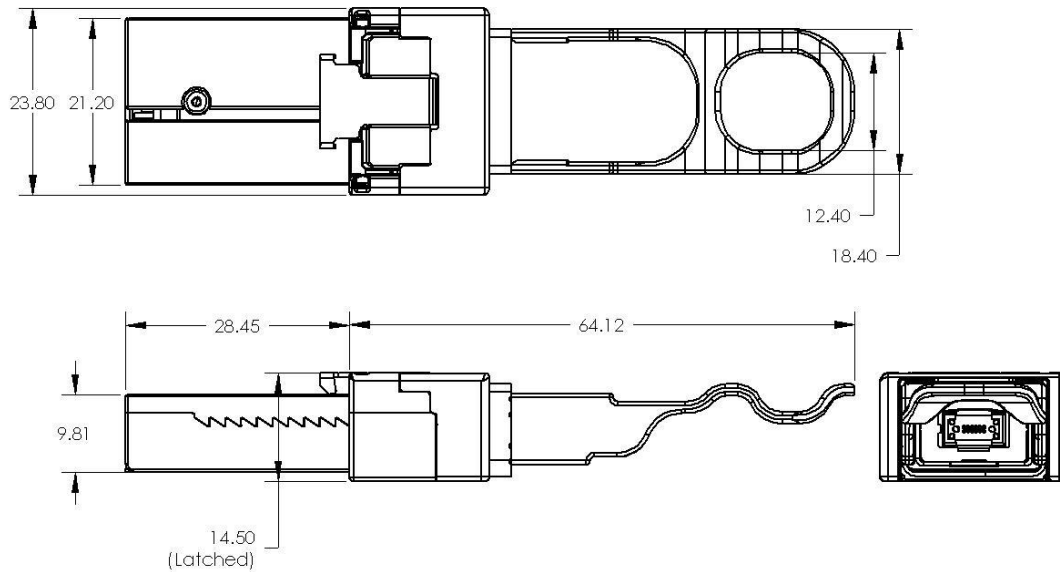


Figure 5 – FTLD10C mechanical drawing

X. References

1. Supplement to Infiniband Architecture Specification, Volume 2, Release 1.2.1., Annex A6: "120 Gb/s 12x Small Form-factor Pluggable (CXP) - Interface Specification for Cables, Active Cables, & Transceivers", September 2009
2. IEEE 802.3ba, PMD Type 100GBASE-SR10
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.
5. "Application Note AN-2085: CXP Transceiver EEPROM Mapping", Finisar Corporation.

XI. For More Information

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