

## 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<sup>1</sup>, IEEE 802.3ba 100GBASE-SR10 and CPPI electrical interfaces<sup>2</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>. 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

Bottom side			Top Side		
I/O #	Name	Contact Length	Contact Length	Name	I/O #
<b>Receiver -- Top Card</b>					
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
<b>Transmitter -- Bottom Card</b>					
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 - <b>NOT CONNECTED</b>	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 - <b>NOT CONNECTED</b>	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	135.816	Gb/s	
Maximum Data Rate per Lane	11.318	Gb/s	
Protocols Supported	Typical applications include Infiniband DDR/QDR, 100GBASE-SR10 Ethernet, OTU4, OTU2e, PCIe-Gen1/2/3, 12x10GBASE-SR Ethernet		
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
Management Interface	Serial, I2C-based, 400 kHz maximum frequency		As defined by the CXP Specification

Data Rate Specifications	Symbol	Min	Typ	Max	Units	Ref.
Bit Rate per Lane	BR	1000		11318	Mb/sec	1
Bit Error Ratio @10.3Gb/s per Lane	BER1			$10^{-12}$		2
Bit Error Ratio @11.1Gb/s per Lane	BER2			$10^{-6}$		2
Bit Error Ratio @11.2Gb/s per Lane	BER3			$10^{-6}$		2
Bit Error Ratio @11.3Gb/s per Lane	BER4			$10^{-8}$		2
Link distance on OM3 MMF	D1			100	meters	
Link distance on OM4 MMF	D2			150	meters	

### Notes:

- Infiniband SDR/DDR/QDR, 100GBASE-SR10 100G Ethernet, OTU2e, OTU4, PCIe Gen1/2/3, 12x10GBASE-SR 10G Ethernet.
- Tested with a PRBS  $2^{31}-1$  test pattern.

## III. Absolute Maximum Ratings

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Maximum Supply Voltage	V <sub>cc1</sub> , V <sub>ccTx</sub> , V <sub>ccRx</sub>	-0.5		3.6	V	
Storage Temperature	T <sub>S</sub>	-40		85	°C	
Case Operating Temperature	T <sub>OP</sub>	0		70	°C	
Relative Humidity	RH	0		85	%	1

### Notes:

- 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.

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Supply Voltage	V <sub>cc1</sub> , V <sub>ccTx</sub> , V <sub>ccRx</sub>	3.15		3.45	V	
Supply Current	I <sub>cc</sub>		850	1000	mA	
Module Total Power	P			3.5	W	1, 7
<b>Link Turn-On Time</b>						
Transmit turn-on time				2000	ms	2
<b>Transmitter (per Lane)</b>						
Single ended input voltage tolerance	V <sub>inT</sub>	-0.3		4.0	V	
Differential data input swing	V <sub>in,pp</sub>	120		1200	mV <sub>pp</sub>	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 <sub>t2</sub>	0.17			UI	
J9 Jitter Tolerance	J <sub>t9</sub>	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
<b>Receiver (per Lane)</b>						
Single-ended output voltage		-0.3		4.0	V	
Differential data output swing	V <sub>out,pp</sub>	0		800	mV <sub>pp</sub>	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 <sub>o2</sub>			0.42	UI	
J9 Jitter output	J <sub>o9</sub>			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 <sub>pp</sub>	

**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<sub>out</sub> settings.

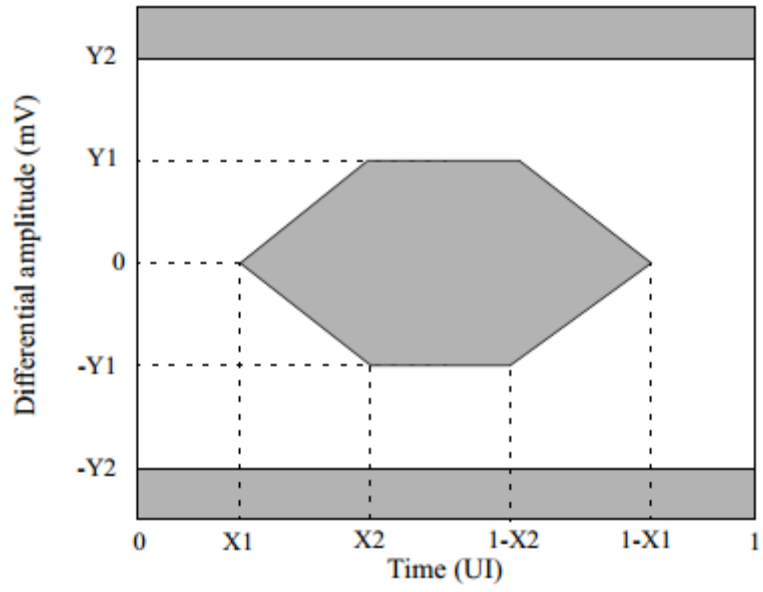


Figure 2 – Transmitter Input Differential Signal Mask

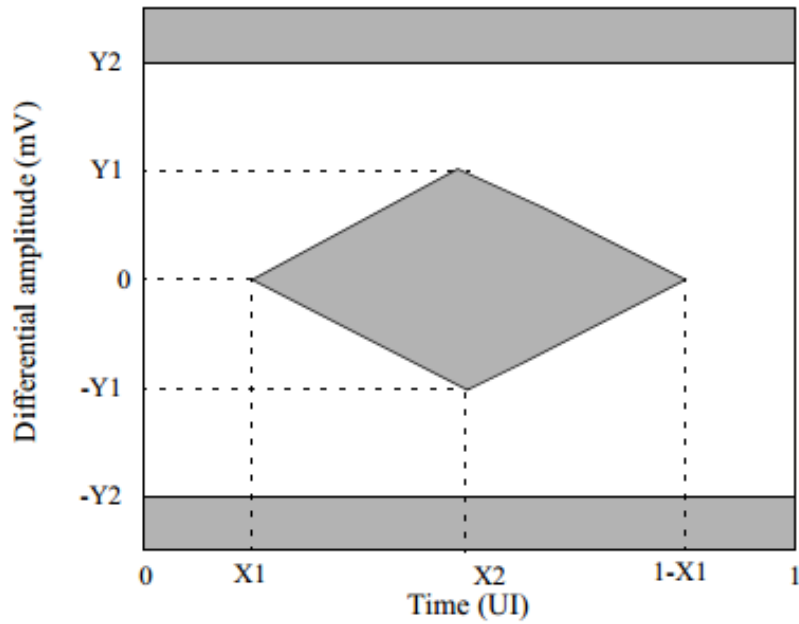


Figure 3 – Receiver Output Differential Signal Mask

## Receiver Output Amplitude Settings

Code	Receiver Output Amplitude (mV)			Reference
	Min	Nominal	Max	
<b>1xxx</b>				
<b>0111b</b>	650	750	850	
<b>0110b</b>	550	650	750	
<b>0101b</b>	450	550	650	Default Setting
<b>0100b</b>	350	450	550	
<b>0011b</b>	300	400	500	
<b>0010b</b>	250	350	450	
<b>0001b</b>	200	300	400	
<b>0000b</b>	150	250	350	

## Receiver Pre-Emphasis Settings

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

## Module-end, Typical Power Consumption

Power (mW)	Code	Pre-Emphasis							
		<b>0000b</b>	<b>0001b</b>	<b>0010b</b>	<b>0011b</b>	<b>0100b</b>	<b>0101b</b>	<b>0110b</b>	<b>0111b</b>
<b>Rx Output</b>	<b>0000b</b>	2006	2006	2009	2009	2009	2013	2013	2013
	<b>0001b</b>	2009	2009	2009	2013	2009	2013	2013	2016
	<b>0010b</b>	2013	2013	2013	2013	2013	2016	2016	2020
	<b>0011b</b>	2016	2013	2016	2016	2016	2020	2020	2023
	<b>0100b</b>	2020	2016	2020	2020	2020	2020	2023	2023
	<b>0101b</b>	2023	2020	2023	2023	2023	2026	2026	2026
	<b>0110b</b>	2026	2026	2026	2026	2026	2026	2030	2030
	<b>0111b</b>	2026	2026	2030	2030	2030	2030	2033	2033



**V. Optical Characteristics (T<sub>OP</sub> = 0 to 70°C, V<sub>CC</sub> = 3.3 ± 5% Volts)**

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
<b>Transmitter (per Lane)</b>						
Signaling Speed per Lane				11.3	GBd	1
Center wavelength		840		860	nm	
RMS Spectral Width	SW			0.65	nm	
Average Launch Power per Lane	TXP <sub>x</sub>	-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 <sub>x</sub>			4.0	dB	
Peak Power per Lane	PP <sub>x</sub>			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 um < 30% at 4.5 um			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				
<b>Receiver (per Lane)</b>						
Signaling Speed per Lane				11.3	GBd	4
Center wavelength		840		860	nm	
Damage Threshold	DT	3.4			dBm	
Average Receive Power per Lane	RXP <sub>x</sub>	-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 <sub>x</sub>			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 and p-p amplitude		(75, 5)			kHz, UI	
		(375, 1)			kHz, UI	
LOS De-Assert	LOS <sub>D</sub>			-12.5	dBm	
LOS Assert	LOS <sub>A</sub>	-30.0		-15.5	dBm	
LOS Hysteresis		1			dB	

**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**

Compliant with the Infiniband<sup>SM</sup> Trade Association's InfiniBand<sup>TM</sup> Architectural Release 1.3, Volume 2, CXP Specification Release, November 6<sup>th</sup>, 2012.

**VII. Environmental Specifications**

Finisar FTLD10CE3C 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 <sub>op</sub>	0		70	°C	
Storage Temperature	T <sub>sto</sub>	-5		75	°C	

**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.

Feature	Agency	Standard	Certificate Number
Laser Eye Safety	FDA/CDRH	CDRH 21 CFR 1040 and Laser Notice 50	0620885-043
Laser Eye Safety	TÜV	EN 60825-1: 2007, EN60825-2:2004+A1 IEC 60825-1: 2007 (2 <sup>nd</sup> Edition) IEC 60825-2: 2010 (3 <sup>rd</sup> Edition)	R72120958
Electrical Safety	TÜV	EN 60950:2006+A11	R72120958
Electrical Safety	UL/CSA	CLASS 3862.07 CLASS 3862.87	2397145

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.

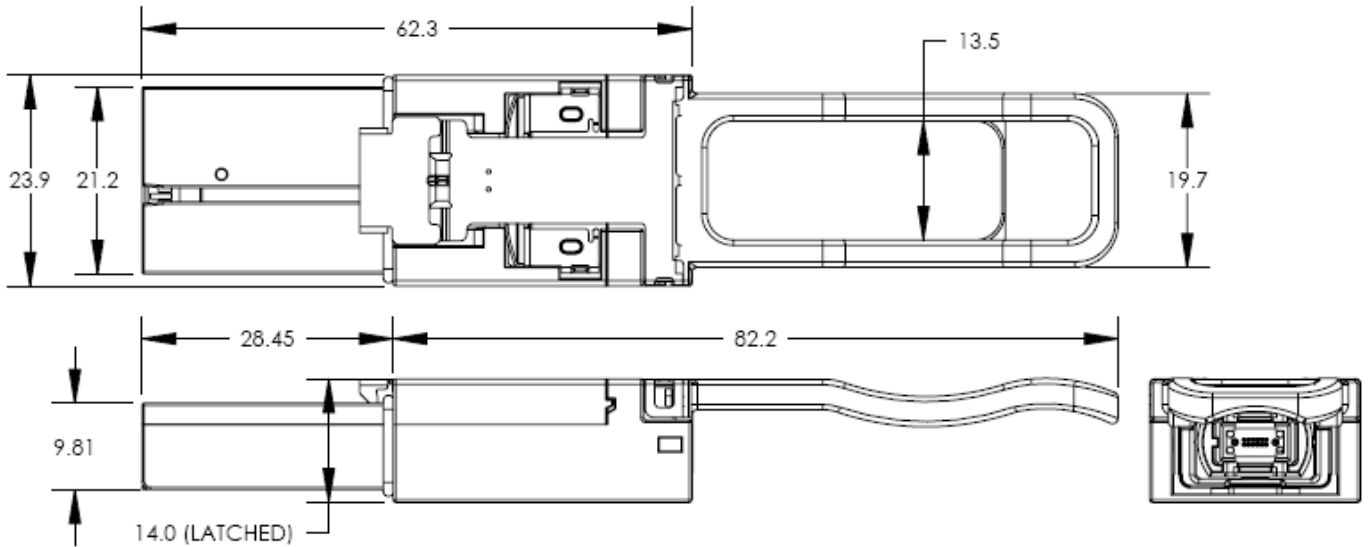


Figure 3 – FTLD10CE3C mechanical drawing

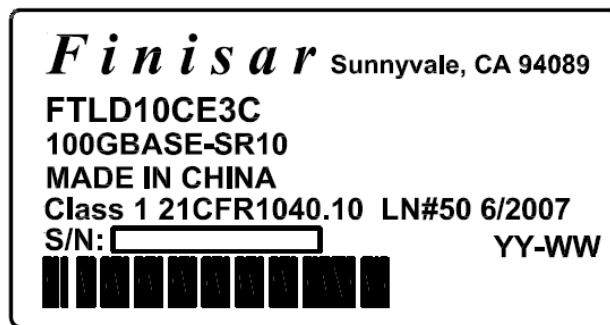


Figure 4 – FTLD10CE3C production-level product label

**X. References**

1. Supplement to Infiniband Architecture Specification, Volume 2, Release 1.3., Annex A6: " 12x Form-factor Pluggable (CXP) - Interface Specification for Cables, Active Cables, & Transceivers", November 6, 2012
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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