Finisar

PRELIMINARY Product Specification

10km Multi-rate 100G CFP4 Optical Transceiver Module

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[1], IEEE 802.3ba 100GBASE-LR4[2] 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[5]. The transceiver is RoHS-6 compliant and lead-free per Directive 2002/95/EC[3], and Finisar Application Note AN-2038[4].

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[1].
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	LVCMOS w/ PUR	Transmitter Disable for all lanes, "1" or NC = transmitter disabled, "0" = transmitter enabled
12	RX_LOS	O	LVCMOS	Receiver Loss of Optical Signal, "1": low optical signal, "0": normal condition
13	GLB_ALRMn	O	LVCMOS	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	LVCMOS 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	LVCMOS 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	Vcc	-0.5		4.0	V	
Storage Temperature	T_S	-40		85	°C	
Case Operating Temperature	T_{OP}	-5		75	°C	
Relative Humidity	RH	15		85	%	1
Receiver Damage Threshold, per Lane	P_{Rdmg}	5.5			dBm	

Notes:
1. Non-condensing.

III. Electrical Characteristics (EOL, T_{OP} = -5 to 75 °C, V_{CC} = 3.2 to 3.4 Volts)

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Supply Voltage	Vcc	3.2		3.4	V	
Supply Current	Icc			TBD	A	
Module total power	P			5.0	W	1
Transmitter						
Signaling rate per lane				27.95	Gb/s	2
Input differential impedance	R_{in}	CEI-28G-VSR as defined by the OIF			Ω	
Differential data input swing per lane	Vin,pp				mV	
Data input rise time tolerance	t_r				ps	
Data input rise time tolerance	t_f				ps	
Electrical input eye mask definition	{X1, X2} {Y1, Y2}				UI mV	
Receiver						
Signaling rate per lane				27.95	Gb/s	2
Differential data output swing per lane	Vout,pp	CEI-28G-VSR as defined by the OIF			mV	
Data output rise time	t_r				ps	
Data output fall time	t_f				ps	
Electrical output eye mask definition	{X1, X2} {Y1, Y2}				UI mV	
Power Supply Noise Tolerance	Vrip	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°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 1299.02 – 1301.09 1303.54 – 1305.63 1308.09 – 1310.19			nm	
Total Average Launch Power	P_{OUT}			10	dBm	
Average Launch Power per Channel	TXP_x	-0.6		4.0	dBm	
Optical Channel Extinction Ratio	ER	4.0		6.5	dB	
Channel Power Difference	ΔP_{OUT}			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 1299.02 – 1301.09 1303.54 – 1305.63 1308.09 – 1310.19			nm	
Receiver parameters for an optical input with ER>4dB						
Average Input Power per Channel	RXP_x	-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_x	-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_{IN}			10.0	dBm	
Channel Power Difference	ΔP_{IN}			5.5	dB	
LOS De-Assert	LOS_D			-11.6	dBm	
LOS Assert	LOS_A			-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 1299.02 – 1301.09 1303.54 – 1305.63 1308.09 – 1310.19			nm	
Total Average Launch Power	P_{OUT}			10.5	dBm	
Transmit OMA per Lane	TxOMA	-1.3		4.5	dBm	
Average Launch Power per Lane	TXP_x	-4.3		4.5	dBm	2
Optical Extinction Ratio	ER	4			dB	
Sidemode Suppression ratio	SSR_{min}	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 1299.02 – 1301.09 1303.54 – 1305.63 1308.09 – 1310.19			nm	
Receive Power (OMA) per Lane	RxOMA			4.5	dBm	
Average Receive Power per Lane	RXP_x	-10.6		4.5	dBm	4
Receiver Sensitivity (OMA) per Lane	Rxsens			-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_D			-11.6	dBm	
LOS Assert	LOS_A			-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
Maximum Supported Distances							
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_{op}	-5		75	°C	
Storage Temperature	T_{sto}	-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 IEC 60825-1: 1993+A1:1997+A2:2001 IEC 60825-2: 2000, Edition 2	TBD
Electrical Safety	TÜV	EN 60950	TBD
Electrical Safety	UL/CSA	CLASS 3862.07 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[1]. See Finisar Application Note AN-20xx (TBD).

IX. Memory Contents

Per the CFP MSA[1]. See Finisar Application Note AN-20xx (TBD).

X. Host PCB Layout and Bezel Recommendations

Per CFP4 Hardware Specification[1].

XI. Mechanical Specifications

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

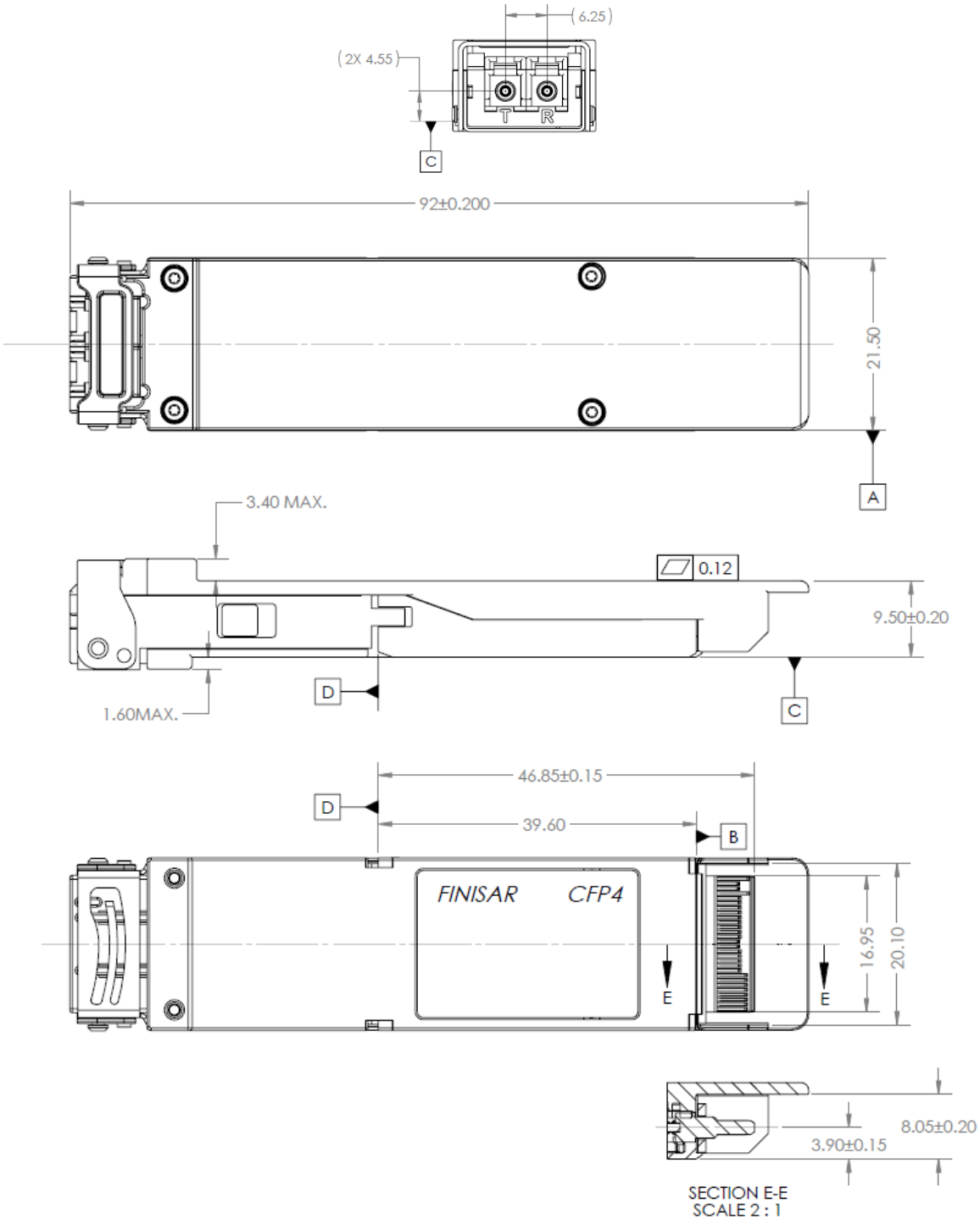

Figure 1. FTLC1141SDNL Mechanical Dimensions.

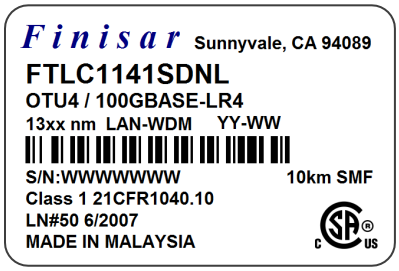

Figure 2. Standard Product Label

XII. References

1. CFP4 Hardware Specification and CFP MSA Management Interface Specifications (MIS), Rev 2.2.; CFP MSA, www.cfp-msa.org

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	• Preliminary document released.
A2	9/12/2014	• Added product photo and label. Changed maximum power dissipation specification to 5.5W. Added Receiver specification for high ER Transmitters for OTU4 operation.
A3	2/6/2015	• Added mechanical drawing. Changed maximum power dissipation specification to 5W.

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