

CFP4 LR4 Optical Transceiver – 100 Gigabit Ethernet with up to 10 km Reach

JC4 Series - JC4-10Lx4A



The Lumentum 100G CFP4 LR4 optical transceiver is a full duplex, photonic-integrated optic transceiver that provides a high-speed link with an aggregated data rate of either 103.125 Gbps or 111.81 Gbps over up to 10 km of SMF28. The module complies with the CFP MSA CFP4 Hardware Specification Rev. 1.0, IEEE802.3-2012 Clause 88, IEEE 802.3bm CAUI-4 chip to module electrical standard and ITU-T G.959.1-2012-02.

The transceiver integrates the receive and transmit paths on one module. On the transmit side, four lanes of serial data streams are recovered, retimed, and passed to four laser drivers. The laser drivers control four electric-absorption modulated lasers (EMLs) with center wavelengths of 1296 nm, 1300 nm, 1305 nm and 1309 nm. The optical signals are multiplexed to a single-mode fiber through an industry standard LC connector. On the receive side, the four lanes of optical data streams are optically de-multiplexed by the integrated optical demultiplexer. Each data stream is recovered by a PIN photodetector and transimpedance amplifier, retimed and passed to an output driver. This module features a hot-pluggable electrical interface, low power consumption, and an MDIO management interface

Key Features

- Compliant with 100GBASE-LR4 and OTU4
- Support line rates of 103.125 Gbps or 111.81 Gbps
- Integrated LAN WDM TOSA / ROSA for up to 10 km reach over SMF-28
- Duplex LC optical receptacle
- Operating temperature range from -5°C to 70°C
- Low power dissipation <6W
- RoHS6/6 compliant
- Single 3.3 V power supply
- No external reference clock
- Compliant with CEI-28G-VSR/CAUI-4 electrical interface
- Digital diagnostic monitoring support

Applications

- Local area networks (LAN)
- Wide area networks (WAN)
- Ethernet switches and router applications
- ITU-T OTU4 OTL4.4 applications

Compliance

- IEEE 802.3-2012 Clause 88 standard
- IEEE 802.3bm CAUI-4 chip to module electrical standard
- ITU-T G.959.1-2012-02 standard
- OIF-CEI-03.1 CEI-28G-VSR standard
- CFP MSA CFP4 Hardware Specification Rev. 1.0
- CFP MSA Management Interface Specification V2p2 r0.6a
- CFP MSA Management Interface Specification V2p2_r06a Addendum 1.0r1
- Class 1 Laser Safety
- Tested in accordance with Telcordia GR-468

Section 1 Functional Description

The Lumentum 100G CFP4 LR4 optical transceiver is a fully duplex parallel optical, parallel electric device with both transmit and receive functions contained in a single module. The optical signals are multiplexed to a single-mode fiber through an industry standard LC connector.

The module provides a high speed link at an aggregated signaling rate of 103.125 Gbps or 111.81 Gbps. It is compliant with IEEE 802.3-2012 Clause 88 100GBASE-LR4 and ITU-T G.959.1-2012-02 OTL4.4 (OTU4 striped across four physical lanes) 4I1-9D1F for up to 10 km reach over SMF28 fiber. The MDIO management interface complies with IEEE 802.3-2012 Clause 45 standard. The transceiver complies with CFP MSA Hardware Specification Rev. 1.4, CFP MSA CFP4 Hardware Specification Rev. 1.0, CFP MSA Management Interface Specification Rev. 2p2r06a, CFP MSA Management Interface Specification Rev. 2p2r06a Addendum 1.0r1, IEEE 802.3bm CAUI-4 chip to module electrical standard and OIF-CEI-03.1 CEI-28G-VSR standards. A block diagram is shown in Figure 1.

Transmitter

The transmitter path converts four lanes of serial NRZ electrical data from line rate of 25.78 Gbps to 27.95 Gbps to a standard compliant optical signal. Each signal path, or CEI lane, accepts a 100 Ω differential 100 mV peak-to-peak to 900 mV peak-to-peak 25 Gbps CEI electrical signal on TDxn and TDxp pins.

Inside the module, each differential pair of electric signals is input to a CDR (clock-data recovery) chip. The recovered and retimed signals are then passed to a laser driver which transforms the small swing voltage to an output modulation that drives a cooled EML laser. The laser drivers control four EMLs with center wavelengths of 1296 nm, 1300 nm, 1305 nm and 1309 nm, respectively. Closed-loop control of the transmitted laser power and modulation swing over temperature and voltage variations is provided on each laser. The optical signals from the four lasers are multiplexed together optically. The combined optical signals are coupled to single-mode optical fiber through an industry standard LC optical connector. The optical signals are engineered to meet the 100 Gigabit Ethernet or OTU4 specifications.

Receiver

The receiver takes incoming combined four lanes of DC balanced LAN-WDM NRZ optical data from line rate of 25.78 Gbps to 27.95 Gbps through an industry standard LC optical connector. The four incoming wavelengths are separated by an optical demultiplexer into four separated channels. Each output is coupled to a PIN photodetector. The electrical currents from each PIN photodetector are converted to a voltage in a high-gain transimpedance amplifier. The electrical output is recovered and retimed by the CDR chip. The four lanes of reshaped electrical signals are output on the RDxp and RDxn pins as a 100 Ω differential CEI signals.

Low-Speed Signaling

Low-speed signaling is based on low voltage CMOS (LVCMOS) operating at a nominal voltage of 3.3 V for the control and alarm signals, and at a nominal voltage of 1.2 V for MDIO address, clock and data signals. All low speed inputs and outputs are based on the CFP MSA CFP4 Hardware Specification Rev. 1.0, CFP MSA Management Interface Specification Rev. 2p2r0.6a and CFP MSA Management Interface Specification Rev. 2p2r06a Addendum 1.0r1 requirements.

MDC/MDIO: Management interface clock and data lines.

PRTADRO, 1, 2: Input pins. MDIO physical port addresses.

GLB_ALRMn: Output pin. When asserted low indicates that the module has detected an alarm condition in any MDIO alarm register.

TX_Disable (optionally configurable as PRG_CNTL1 after reset): Input pin. When asserted high or left open the transmitter output is turned off. When Tx_Dsiable is asserted low or grounded the module transmitter is operating normally. Pulled up with 4.7 k Ω to 10 k Ω resistors to 3.3 V inside the CFP4 module. The CFP MSA specifies that the default function be TX Disable (TX_DIS) with active-high logic. If the other function besides TX_DIS is configured for this pin, there is no way to assert TX disable via a hardware pin. One MDIO register which defines if the module supports this optional configuration or not is prepared in NVR region.

MOD_LOPWR: Input pin. When asserted high or left open the CFP4 module is in low power mode. When asserted low or grounded the module is operating normally. Pulled up with 4.7 k Ω to 10 k Ω resistors to 3.3 V inside the CFP4 module.

MOD_RSTn: Input pin. When asserted low or grounded the module is in Reset mode. When asserted high or left open the CFP4 module is operating normally after an initialization process. Pulled down with 4.7 k Ω to 10 k Ω resistors to ground inside the CFP4 module.

PRG_ALARM1, 2, 3: Output pins. Programmable alarm lines defined in the CFP MSA Management Interface Specification.

Mod_ABS: Output pin. Asserted high when the CFP4 module is absent and is pulled low when the CFP4 module is inserted.

RX_LOS (optionally configurable as PRG_ALARM1 after reset): Output pin. Asserted high when insufficient optical power for reliable signal reception is received. CFP-MSA specifies the default function to be Receiver Loss of Signal (RX_LOS) indicator with active-high logic. One MDIO register which defines if the module supports this optional configuration or not is prepared in NVR region.

Section 2 Application Schematics

Recommended MSA connections to the transceiver are shown in Figure 2 below.

CFP4 modules are hot pluggable and active connections are powered by individual power connection at 3.3 V nominal voltage. Multiple modules can share a single 3.3 V power supply with individual filtering. A possible example of a power supply filtering circuit that might be used on the host system is a PI (proportional integral) C-L-C filter. To limit wide band noise power, the host system and module shall each meet a maximum of 2% peak-to-peak noise when measured with a 1 MHz low pass filter. In addition, the host system and the module shall each meet a maximum of 3% peak-to-peak noise when measured with a filter from 1 MHz - 10 MHz.

A module will meet all electrical requirements and remain fully operational in the presence of noise on the 3.3V power supply which is less than that defined in the CFP MSA CFP4 Hardware Specification Table 4-1. Power supply filtering components should be placed as close to the Vcc pins of the host connector as possible for optimal performance.

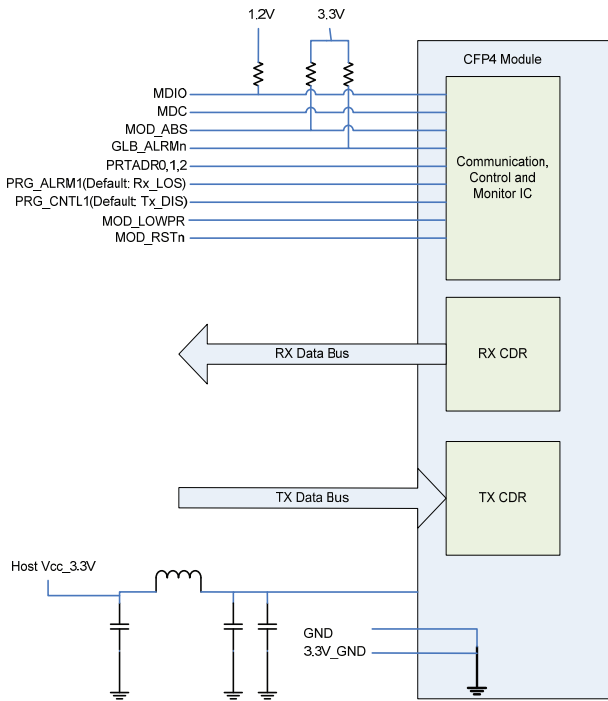


Figure 1 Application schematics

Section 3 Technical Specifications

Technical specifications related to the transceiver include:

- Section 3.1 Pin Function Definitions
- Section 3.2 CFP4 Lane Assignment
- Section 3.3 Absolute Maximum Ratings
- Section 3.4 Low-Speed Electrical Characteristics
- Section 3.5 High-Speed Electrical Characteristics
- Section 3.6 Timing Requirements of Control and Status I/O
- Section 3.7 MDIO Management Interface
- Section 3.8 Module CTLE Behavior
- Section 3.8 Optical Transmitter Characteristics
- Section 3.9 Optical Receiver Characteristics
- Section 3.10 Regulatory Compliance
- Section 3.11 Module Outline
- Section 3.12 Connectors

3.1 Pin Function Definitions

CFP4		CFP4	
Bottom		Top	
1	3.3V_GND	56	GND
2	3.3V_GND	55	TX3n
3	3.3V	54	TX3p
4	3.3V	53	GND
5	3.3V	52	TX2n
6	3.3V	51	TX2p
7	3.3V_GND	50	GND
8	3.3V_GND	49	TX1n
9	VND_IO_A	48	TX1p
10	VND_IO_B	47	GND
11	TX_DIS (PRG_CNTL)	46	TX0n
12	RX_LOS (PRG_ALRM)	45	TX0p
13	GLB_ALRMn	44	GND
14	MOD_LOPWR	43	(REFCLKn)
15	MOD_ABS	42	(REFCLKp)
16	MOD_RSTn	41	GND
17	MDC	40	RX3n
18	MDIO	39	RX3p
19	PRTADR0	38	GND
20	PRTADR1	37	RX2n
21	PRTADR2	36	RX2p
22	VND_IO_C	35	GND
23	VND_IO_D	34	RX1n
24	VND_IO_E	33	RX1p
25	GND	32	GND
26	(MCLKn)	31	RX0n
27	(MCLKp)	30	RX0p
28	GND	29	GND

Figure 2. CFP4 optical transceiver pin-out

3.2 CFP4 Lane Assignment

Lane	Center Frequency	Center Wavelength	Wavelength Range
L0	231.4 THz	1295.56 nm	1294.53 to 1296.59 nm
L1	230.6 THz	1300.05 nm	1299.02 to 1301.09 nm
L2	229.8 THz	1304.58 nm	1303.54 to 1305.63 nm
L3	229.0 THz	1309.14 nm	1308.09 to 1310.19 nm

3.3 Absolute Maximum Ratings

Absolute maximum ratings represent the damage threshold of the device. Damage may occur if the device is operated above the limits stated here except for brief excursions. Performance is not guaranteed and reliability is not implied for operation at any condition outside the recommended operating limits.

Parameter	Symbol	Ratings	Unit
Storage temperature	T_{ST}	-40 to +85	°C
Operating case temperature	T_{OP}	-5 to +70	°C
Relative humidity	RH	5 to 85 (noncondensing)	%
Static electrical discharge (human body model)	ESD	500	V
Power supply voltages	V_{CC1} max	-0.3 to 3.6	V
Receive input optical power (damage threshold)	P_{dmg}	+ 5.5	dBm

3.4 Low-Speed Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Supply Currents and Voltages						
Voltage	V_{CC}	3.2	3.3	3.4	V	With respect to GND
Supply current	I_{CC}			1.87	A	
Power dissipation	P_{wr}			6.0	W	
Power dissipation (low power mode)	P_{lp}			1.0	W	
Inrush current	I_{inrush}			100	mA/μs	
Turn-off current	$I_{turnoff}$	-100			mA/μs	
Low-Speed Control and Sense Signals, 3.3 V LVCMOS						
Outputs low voltage	V_{OL}			0.2	V	$I_{OH} = 100 \mu A$
Output high voltage	V_{OH}	$V_{CC} - 0.2$			V	$I_{OH} = -100 \mu A$
Input low voltage	V_{IL}	-0.3		0.8	V	
Input high voltage	V_{IH}	2		$V_{CC} + 0.3$	V	
Input leakage current	I_{IN}	-10		10	μA	
Low-Speed Control and Sense Signals, 1.2 V LVCMOS						
Outputs low voltage	V_{OL}	-0.3		0.2	V	
Output high voltage	V_{OH}	1.0		1.5	V	
Output low current	I_{OL}	4			mA	
Output high current	I_{OH}			-4	mA	
Input low voltage	V_{IL}	-0.3		0.36	V	
Input high voltage	V_{IH}	0.84		1.5	V	
Input leakage current	I_{IN}	-100		100	μA	
Input capacitance	C			10	pF	
MDC clock rate		0.1		4	MHz	

3.5 High-Speed Electrical Specifications

Parameter	Symbol	Min.	Max.	Unit	Notes
Transmitter Electrical Input from Host at TP1a (detailed specification in CEI-28G-VSR)					
Differential voltage pk-pk			900	mV	
Common mode noise (rms)			17.5	mV	
Differential termination mismatch			10	%	
Transition time		10		ps	20/80%
Common mode voltage		-0.3	2.8	V	
Eye width	EW15	0.46		UI	At 10 ⁻¹⁵ probability
Eye height	EH15	100		mV	At 10 ⁻¹⁵ probability
Receiver Electrical Output to Host at TP4 (detailed specification in CEI-28G-VSR)					
Differential voltage pk-pk			900	mV	
Common mode noise (rms)			17.5	mV	
Differential termination mismatch			10	%	
Transition time		9.5		ps	20/80%
Vertical eye closure	VEC		5.5	dB	
Eye width	EW15	0.57		UI	At 10 ⁻¹⁵ probability
Eye height	EH15	228		mV	At 10 ⁻¹⁵ probability

3.6 Timing Requirement of Control and Status I/O

Parameter	Symbol	Min.	Max.	Unit	Notes
Minimum pulse width of control pin signal	t_CNTL	100		μs	
Hardware MOD_LOPWR assert	t_MOD_LOPWR_assert		1	ms	
Hardware MOD_LOPWR deassert	t_MOD_LOPWR_deassert		30	s	Stored in NVR register 8072h
RX_LOS assert time	t_loss_assert		100	μs	From occurrence of loss of signal to assertion of RX_LOS
RX_LOS deassert time	t_loss_deassert		100	μs	From occurrence of return of signal to deassert of RX_LOS
GLB_ALRM assert time	GLB_ALRMn_assert		150	ms	A logic "OR" of associated MDIO alarm and status registers
GLB_ALRM deassert time	GLB_ALRMn_deassert		150	ms	A logic "OR" of associated MDIO alarm and status registers
Management interface clock period	t_prd	250		ns	MDC is 4 MHz rate or less
Host MDIO setup time	t_setup	10		ns	
Host MDIO hold time	t_hold	10		ns	
CFP4 MDIO delay time	t_delay	0	175	ns	
Initialization time from reset	t_initialize		2.5	s	
TX_Disable assert time	t_deassert		100	μs	Transmitter disable, application specific
TX_Disable deassert time ¹	t_assert		3	ms	Time from Tx Disable pin deasserted until CFP4 module enters the Tx-turn-on state Stored in NVR register 8073h

1. The transceiver is stabilized prior to TX_Disable deassert event.

3.7 MDIO Management Interface

The transceiver incorporates MDIO management interface which is used for serial ID, digital diagnostics, and certain control and status report functions. The CFP4 transceiver supports MDIO pages 8000h NVR 1 Based ID registers, NVR 2 Alarm / Warning threshold registers, and NVR 4 tables, and pages A000h VR 1 and VR 3 tables.

Details of the protocol and interface are explicitly described in IEEE 802.3-2012 Clause 45, CFP MSA Management Interface Specification V2p2_r06a and CFP MSA Management Interface Specification Rev. 2p2r06a Addendum 1.0r1. Please refer to the specifications for design reference.

3.8 Module CTLE Behavior

The transceiver supports continuously automatic (adaptive) equalization with non-readable CTLE gain. Please contact Lumentum for details if manual (programmable) equalization is preferred.

3.9 Optical Transmitter Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes	
Signaling rate, each lane		25.78125 ±100 ppm			GBd	100GBase-LR4	
		27.9525 ±20 ppm				OTU4	
<i>The following specifications are applicable within the operating case temperature range</i>							
Side-mode suppression ratio	SMSR	30			dB		
Total launch power					10.5	dBm	100GBase-LR4
					10.0		OTU4
Average launch power, each lane ¹	P _{avg}	-4.3 ^a		4.5	dBm	100GBase-LR4	
		-0.6		4.0		OTU4	
Extinction ratio	ER	4			dB	100GBase-LR4	
		4		6.5		OTU4	
Optical modulation amplitude, each lane (OMA) ²	OMA	-1.3 ^b		4.5	dBm	100GBase-LR4	
Difference in launch power between any two lanes (OMA)				5	dB	100GBase-LR4, OTU4	
Transmitter and dispersion penalty, each lane	TDP			2.2	dB	100GBase-LR4	
OMA minus TDP, each lane	OMA-TDP	-2.3			dBm	100GBase-LR4	
Average launch power of OFF transmitter, each lane				-30	dBm	100GBase-LR4	
Optical return loss tolerance				20	dB		
Relative intensity noise	RIN ₂₀ OMA			-130	dB/Hz	100GBase-LR4	
Transmitter reflectance ³				-12 ^c	dB		
Transmitter eye mask {X1, X2, X3, Y1, Y2, Y3}		{0.25, 0.4, 0.45, 0.25, 0.28, 0.4}				100GBase-LR4	

1. Average launch power, each lane (min) is informative for 100GBase-LR4, not the principal indicator of signal strength.

2. Even if the TDP < 1 dB, the OMA (min) must exceed this value.

3. Transmitter reflectance is defined looking into the transmitter.

3.9 Optical Receiver Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Signaling rate, each lane		25.78125 ±100 ppm			GBd	100GBase-LR4
		27.9525 ±20 ppm				OTU4
The following specifications are applicable within the operating case temperature range						
Average receive power, each lane ¹	P _{avg}	-10.6		4.5	dBm	100GBase-LR4
Average receive power, each lane ²	P _{avg}	-6.9		4	dBm	OTU4 with Tx ER of 4 to 6.5 dB
		-8.8		2.9		OTU4 with Tx ER > 7 dB
Receive power, each lane (OMA)				4.5	dBm	100GBase-LR4
Difference in launch power between any two lanes (OMA)				5.5	dB	100GBase-LR4
						OTU4
Receiver Sensitivity (OMA), each lane ¹ at BER= 1x10 ⁻¹²	R _{sen}			-8.6	dBm	100GBase-LR4
Equivalent receiver sensitivity ² at BER=1.8x10 ⁻⁴				-8.4	dBm	OTU4 with Tx ER of 4 to 6.5 dB
				-10.3		OTU4 with Tx ER > 7 dB
Optical path penalty				1.5	dB	OTU4
Stressed receiver sensitivity (OMA), each lane	SRS			-6.8	dBm	100GBase-LR4, at TP3 for BER= 1x10 ⁻¹²
Stressed receiver sensitivity test conditions						
Vertical eye closure penalty, each lane ³	VECP		1.8		dB	100GBase-LR4
Stressed sys J2 jitter, each lane ³	J2		0.3		UI	100GBase-LR4
Stressed sys J9 jitter, each lane ³	J9		0.47		UI	100GBase-LR4
Receiver reflectance				-26	dB	100GBase-LR4, OTU4
LOS assert ⁴	Plos_on			-15	dBm	
LOS hysteresis ⁴		0.5		4	dB	

1. Minimum average receive power and maximum receiver sensitivity (OMA), each lane, is informative for 100GBase-LR4.

2. For OTU4, 411-9D1F defines two sets of specification based on two options of transmitter ER. The minimum average receive power represents an Rx_sensitivity (OMA) of -7.5 dBm at worst case ER over all condition with 10 km fiber link at post GFEC of BER 1x10⁻¹². The maximum receiver sensitivity is informative and representing Rx_sensitivity (OMA) of -9.05 dBm at worst case ER over all condition at pre-GFEC of BER 1.8 x 10⁻⁴.

3. Vertical eye closure penalty, stressed eye J2 jitter, and stressed eye J9 jitter are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

4. LOS function is implemented per modulated input signal.

3.11 Regulatory compliance

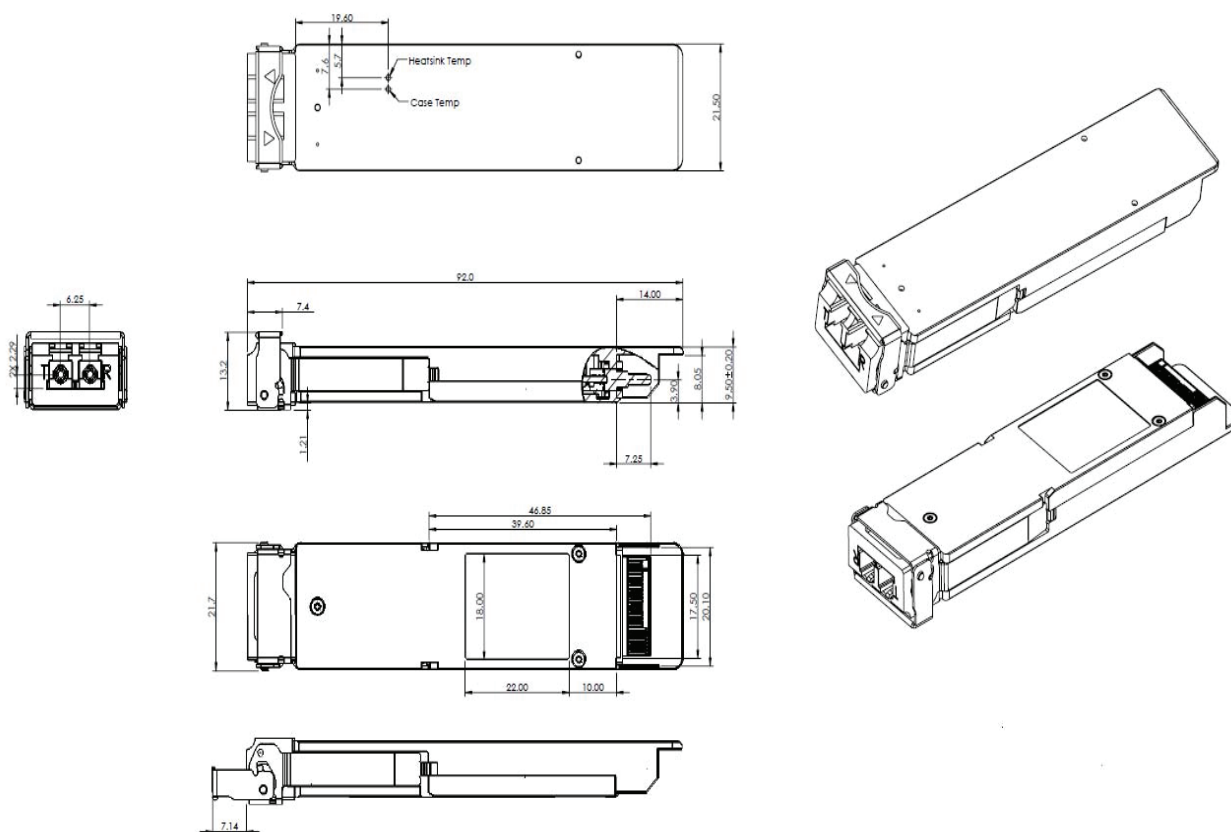
The transceiver is lead-free and RoHS 6/6 compliant.

The transceiver complies with international Electromagnetic Compatibility (EMC) and international safety requirements and standards. EMC performance is dependent on the overall system design.

Table 2. Regulatory Compliance

Feature	Test Method	Performance
Safety		
Product	UL 60950-1	UL recognized component for US and CAN
	CSA C22.2 No. 60950-1	
	EN 60950-1	TUV certificate
	IEC 60950-1	CB certificate
	Flame Class V-0	Passes Needle Flame Test for component flammability verification
	Low Voltage Directive 2006/95/EC	Certified to harmonized standards listed; Declaration of Conformity issued
Laser	EN 60825-1, EN 60825-2	TUV certificate
	IEC 60825-1	CB certificate
	U.S. 21 CFR 1040.10	FDA/CDRH certified with accession number
Electromagnetic Compatibility		
Radiated emissions	EMC Directive 2004/108/EC	Class B digital device with a minimum -6 dB margin to the limit. Final margin may vary depending on system implementation. Tested frequency range: 30 MHz to 40 GHz or 5th harmonic (5 times the highest frequency), whichever is less. Good system EMI design practice is required to achieve Class B margins at the system level.
	FCC rules 47 CFR Part 15	
	CISPR 22	
	AS/NZS CISPR22	
	EN 55022	
	ICES-003, Issue 5	
	VCCI regulations	
Immunity	EMC Directive 2004/108/EC	Certified to harmonized standards listed; Declaration of Conformity issued
	CISPR 24	
	EN 55024	
ESD	IEC/EN 61000-4-2	Exceeds requirements. Withstands discharges of ± 8 kV contact, ± 15 kV air.
Radiated immunity	IEC/EN 61000-4-3	Exceeds requirements. Field strength of 10 V/m from 80 MHz to 6 GHz. No effect on transmitter/receiver performance is detectable between these limits.
Restriction of Hazardous Substances (RoHS)		
RoHS	EU Directive 2011/65/EU	Compliant per the Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast). A RoHS Certificate of Compliance (C of C) is available upon request. The product may use certain RoHS exemptions.

3.12 Module Outline



3.13 Connectors

Fiber

The CFP4 module has a duplex LC receptacle connector.

Electrical

The electrical connector is the 56-way, two row PCB edge connector. Customer connector is Yamaichi or equivalent.

Section 4 Other Related Information

Other information related to the transceiver includes:

Section 4.1	Packing and Handling Instructions
Section 4.2	Electrostatic Discharge
Section 4.3	Laser Safety
Section 4.4	Electromagnetic Compliance (EMC)

4.1 Package and Handling Instructions

Connector Covers

The transceiver is supplied with an LC duplex receptacle. The connector plug supplied protects the connector during standard manufacturing processes and handling by preventing contamination from dust, aqueous solutions, body oils, or airborne particles.

Note: It is recommended that the connector plug remain on whenever the transceiver optical fiber connector is not inserted.

Recommended Cleaning and Degreasing Chemicals

Lumentum recommends the use of methyl, isopropyl and isobutyl alcohols for cleaning.

Do not use halogenated hydrocarbons (for example, trichloroethane, ketones such as acetone, chloroform, ethyl acetate, MEK, methylene chloride, methylene dichloride, phenol, N-methylpyrrolidone).

This product is not designed for aqueous wash.

Housing

The transceiver housing is made from zinc.

4.2 Electrostatic Discharge (ESD)

Handling

Normal ESD precautions are required during the handling of this module. This transceiver is shipped in ESD protective packaging. It should be removed from the packaging and otherwise handled in an ESD protected environment utilizing standard grounded benches, floor mats, and wrist straps.

Test and Operation

In most applications, the optical connector will protrude through the system chassis and be subjected to the same ESD environment as the system. Once properly installed in the system, this transceiver should meet and exceed common ESD testing practices and fulfill system ESD requirements.

Typical of optical transceivers, this module's receiver contains a highly sensitive optical detector and amplifier which may become temporarily saturated during an ESD strike. This could result in a short burst of bit errors. Such an event might require that the application re-acquire synchronization at the higher layers (for example, a serializer/deserializer chip).

4.3 Laser Safety

The transceiver is certified as a Class 1 laser product per international standard IEC 60825-1:2007 2nd edition and is considered non-hazardous when operated within the limits of this specification. This device complies with 21 CFR 1040.10 except for deviations pursuant to Laser Notice No. 50 dated June 24, 2007.



Caution

Operating this product in a manner inconsistent with intended usage and specifications may result in hazardous radiation exposure.

Use of controls or adjustments or performance of procedures other than these specified in this product datasheet may result in hazardous radiation exposure.

Tampering with this laser product or operating this product outside the limits of this specification may be considered an 'act of manufacturing' and may require recertification of the modified product.

Viewing the laser output with certain optical instruments (for example, eye loupes, magnifiers, microscopes) within a distance of 100mm may pose an eye hazard.

4.4 Electromagnetic Compliance (EMC)

The transceiver has been tested and found compliant with international electromagnetic compatibility (EMC) standards and regulations and is declared EMC compliant as stated below. Note, EMC performance depends on the overall system design.

US	CAN	EU	AU/NZ	Japan
	CAN ICES-3 (B) NMB-3 (B)			

United States

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that

interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Canada

ICES-3 (B) / NMB-3 (B)

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

European Union

This product complies with the European Union's Low Voltage Directive 2006/95/EC and EMC Directive 2004/108/EC and is properly CE marked. This declaration is made by Lumentum who is solely responsible for the declared compliance.

Japan

この装置は、クラスB情報技術装置です。この装置は、家庭環境で使用することを目的としていますが、この装置がラジオやテレビジョン受信機に近接して使用されると、受信障害を引き起こすことがあります。
取扱説明書に従って正しい取り扱いをして下さい。 VCCI-B

Translation: This is a Class B product based on the standard of the Voluntary Control Council for Interference from Information Technology Equipment (VCCI). If this is used near a radio or television receiver in a domestic environment, it may cause radio interference. Install and use the equipment according to the instruction manual.

Ordering Information

For more information on this or other products and their availability, please contact your local Lumentum account manager or Lumentum directly at customer.service@lumentum.com.

Description	Product Code
100GE, 10 km reach, LR4, Commercial Temperature range, CFP4 Optical transceiver	JC4-10LR4AA1
100GE and OTU4, 10 km reach, LR4, Commercial Temperature range, CFP4 Optical transceiver	JC4-10LM4AA1



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