

# Tunable SFP+ Optical Transceiver with Limiting Electrical Interface

JST Series



The Lumentum tunable SFP+ optical transceiver is a full duplex, integrated fiber optic transceiver that provides a high-speed serial link at 9.95 to 11.3 Gbps signaling rates. The transceiver supports the enhanced small form factor pluggable module (SFP+) specification SFF-8431 Rev. 4.1 for the electrical interface, SFF-8432 Rev. 5.0 for the mechanical interface, SFF-8690 Rev. 1.4 for the tunability interface, and SFF-8472 Rev. 11.3 for the management interface.

The transceiver complies with IEEE 802.3-2012 clause 52 and it supports 10GBase-ZR/ZW (Ethernet), 10 G Fibre Channel (FC), and corresponding forward error correction (FEC) rates. It supports Telcordia GR-253-CORE OC-192 LR-2 and ITU-T G.959.1 P1L1-2D2 data rates.

It integrates the receive and transmit path on one module. On the transmit side, the serial data stream is passed from the electrical connector to a modulator driver. The modulator driver biases and modulates a C-band cooled tunable transmitter, enabling data transmission over up to 80 km of single-mode fiber through an industry-standard LC connector. On the receive side, the 10 G optical data stream is recovered from an avalanche photodetector (APD) through a transimpedance amplifier to the electrical connector. This module features a hot-pluggable SFI-compliant electrical interface.

#### Key Features

- SFF-8431 MSA Revision 4.1 compliant
- SFF-8690 MSA Revision 1.4 compliant
- Full C-band tunable laser source
- 50 GHz ITU channel spacing
- 80 km reach
- Operating temperature range of -5 to 70°C
- Maximum power dissipation of 1.5 W
- RoHS 6/6 compliant
- Limiting SFI AC-coupled electrical output interface
- Supports digital diagnostic monitoring

#### Applications

- Wide area networks (WAN)
- Local area networks (LAN)
- Storage area networks (SAN)
- Ethernet switches and applications
- FC switches and applications

#### Compliance

- IEEE 802.3-2012 clause 52 standard
- 10 G FC standard
- SFF-8431 Rev 4.1
- SFF-8432 Rev 5.0
- SFF-8472 Rev 11.3
- SFF-8690 Rev 1.4
- Class 1 laser safety
- Tested in accordance with Telcordia GR-468
- ROHS 6/6

## Section 1 Functional Description

The tunable SFP+ optical transceiver is a full duplex serial electric, serial optical device with both transmit and receive functions contained in a single module that provides a high-speed serial link at 9.95 to 11.3 Gbps signaling rates. The transceiver supports the Enhanced Small Form Factor Pluggable Module SFP+ specification SFF-8431 Rev. 4.1 for the electrical interface, SFF-8690 Rev 1.4 for the tunability interface, SFF-8432 Rev. 5.0 for the mechanical interface, and SFF-8472 Rev. 11.3 for the management interface. Figure 1 shows a block diagram.

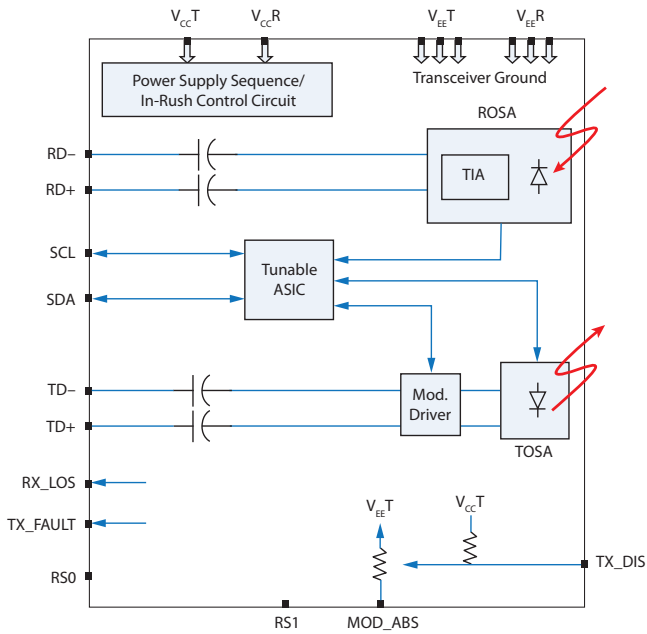


Figure 1. Lumentum tunable SFP+ optical transceiver functional block diagram

The transceiver has several low-speed interface connections. These connections include: transmitter fault (Tx\_Fault), transmitter disable (Tx\_Disable), module absent (Mod\_ABS), receive loss of signal (Rx\_LOS), and a 2-wire serial interface clock (SCL) and data (SDA). Rate select (RSO and RS1) is not used in this product.

The transceiver supports the SFI electrical interface. The electrical interface is based on a high-speed, low-voltage logic AC-coupled linear interface with a 100 Ω nominal differential impedance.

### Transmitter

The transmitter path converts serial NRZ electrical data from 9.95 to 11.3 Gbps line rates to a standard compliant optical signal.

Inside the module, the differential signal is coupled into the modulator driver which transforms the small swing voltage to an output modulation that drives a cooled InP Integrated Laser Mach-Zehnder (ILMZ) modulator. The optical signal is engineered to meet the 10 Gigabit Ethernet, 10 G FC, and corresponding FEC-rates and DWDM specifications at ITU grids with 50 GHz channel spacing. Closed-loop control of the transmitted laser power and modulation swing over temperature and voltage variations are provided. The laser is coupled to a single-mode optical fiber through an industry-standard LC optical connector.

### Receiver

The receiver converts incoming DC-balanced serial NRZ 9.95 to 11.3 Gbps line rate optical data into serial SFI electrical data. Light is coupled to an APD from single-mode optical fiber through an industry-standard LC optical connector. The electrical current from the APD is converted to voltage in a limiting transimpedance amplifier.

The amplified signal is output directly on the RD+ and RD- pins as a 100 Ω CML signal.

### Low-Speed Signaling

Low-speed signaling is based on low-voltage TTL (LVTTTL) operating at a nominal voltage of 3.3 V. Hosts should use a pull-up resistor connected to V<sub>cc</sub> 3.3 V on the 2-wire interface SCL, SDA, and all low-speed outputs.

Low-Speed Interface Connections	Definition
SCL/SDA	2-wire serial interface clock and data line.
Tx_Fault	Output pin. When asserted high, indicates that the module has detected a transmitter fault condition related to laser operation or safety.
Tx_Disable	Input pin. When asserted high or left open, the transmitter output is turned off. When Tx_Disable is asserted low or grounded, the module transmitter is operating normally.
RSO and RS1	Input pins. These pins are not used in this product.
Mod_ABS	Output pin. Asserted high when the SFP+ module is absent and is pulled low when the SFP+ module is inserted.
Rx_LOS	Output pin. Asserted high when insufficient optical power for reliable signal reception is received.

## Section 2 Application Schematics

Tunable SFP+ modules are hot pluggable and active connections are powered by individual power connections for the transmitter (VCCT) and the receiver (VCCR). Multiple modules can share a single 3.3 V power supply with individual filtering for each VCCT and VCCR. The host shall generate an effective weighted integrated spectrum RMS noise of less than 25 mV in the 10 Hz to 10 MHz frequency range. Detailed power supply specifications are given in SFF-8431 Rev. 4.1 Section 2.8. Figure 2 shows a typical application schematic.

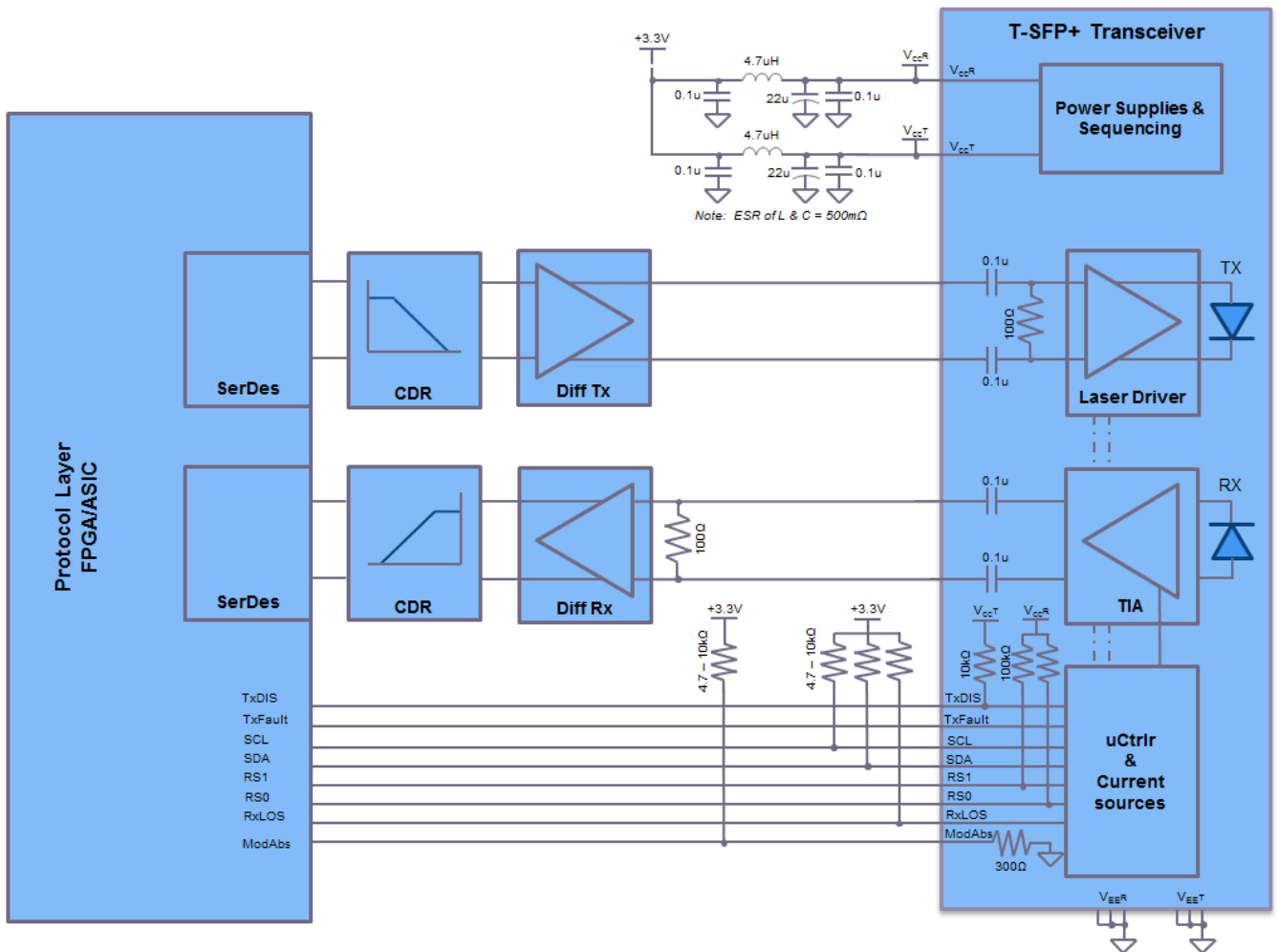


Figure 2. Typical application schematic

### Section 3 Technical Specifications

- Section 3.1 Pin Function Definitions
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#### 3.1 Pin Function Definitions

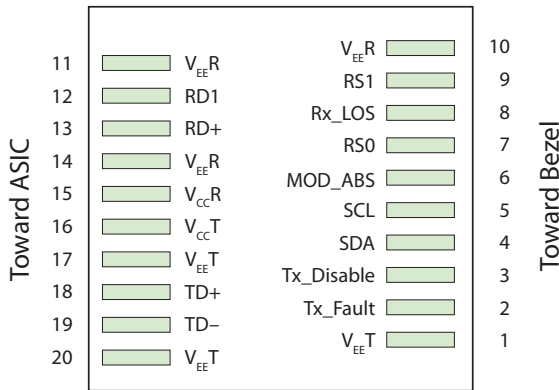


Figure 3. Tunable SFP+ optical transceiver host board pin assignments

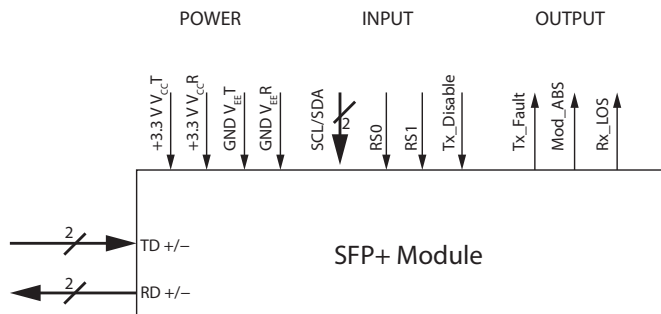


Figure 4. Lumentum tunable SFP+ optical transceiver functional schematic

Table 1. SFP+ optical transceiver pin descriptions

Pin No.	Type	Name	Description
1		$V_{EE}^T$ <sup>1</sup>	Module transmitter ground
2	LVTTTL-O	Tx_Fault	Module transmitter fault; when asserted high, it indicates that the module has detected a transmitter fault condition related to laser operation or safety.
3	LVTTTL-I	Tx_Disable	Transmitter disable; when asserted high or left open, transmitter laser source turned off; when Tx_Disable is asserted low or grounded, the module transmitter is operating normally.
4	LVTTTL-I/O	SDA <sup>2</sup>	2-wire interface data line
5	LVTTTL-I	SCL <sup>2</sup>	2-wire interface clock
6		Mod_ABS <sup>2</sup>	Indicates module is not present. Grounded to $V_{EE}^T$ or $V_{EE}^R$ in the module. Asserted high when SFP+ module is absent and pulled low when the SFP+ module is inserted
7	LVTTTL-I	RS0 <sup>3</sup>	Rate select 0 (not used)
8	LVTTTL-O	Rx_LOS <sup>2</sup>	Receiver loss of signal indicator. Asserted high when receiving insufficient optical power for reliable signal reception.
9	LVTTTL-I	RS1 <sup>3</sup>	Rate select 1 (not used)
10		$V_{EE}^R$ <sup>1</sup>	Module receiver ground
11		$V_{EE}^R$ <sup>1</sup>	Module receiver ground
12	CML-O	RD-	Receiver inverted data output
13	CML-O	RD+	Receiver non-inverted data output
14		$V_{EE}^R$ <sup>1</sup>	Module receiver ground
15		$V_{CC}^R$	Module receiver +3.3 V supply
16		$V_{CC}^T$	Module transmitter +3.3 V supply
17		$V_{EE}^T$ <sup>1</sup>	Module transmitter ground
18	CML-I	TD+	Transmitter non-inverted data input
19	CML-I	TD-	Transmitter inverted data input
20		$V_{EE}^T$ <sup>1</sup>	Module transmitter ground

1. Module ground pins (GND) are isolated from the module case and chassis ground within the module
2. Shall be pulled up with 4.7 to 10 kΩ to a voltage between 3.135 and 3.465 V on the host board
3. Pulled high to  $V_{CC}^T$  with >100 kΩ in the module

### 3.2 SFP+ SFI Reference Model Compliance Points

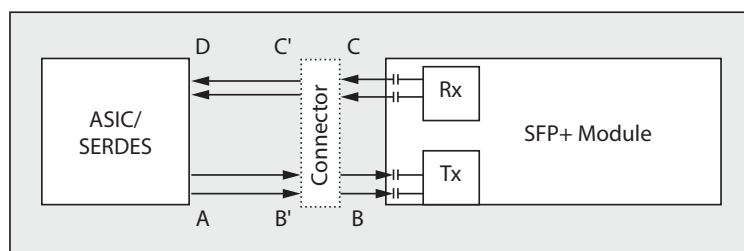


Figure 5. SFP+ optical transceiver model compliance points

### 3.3 Absolute Maximum Ratings

Absolute maximum ratings represent the device's damage thresholds. Permanent damage may occur if the device is stressed beyond the limits stated here.

Parameter	Symbol	Ratings	Unit
Storage temperature	$T_{ST}$	-40 to +85	°C
Relative humidity	RH	5 to 85 (noncondensing)	%
Static electrical discharge (human body model)	ESD	1000	V
Power supply voltages	$V_{CC,T}, V_{CC,R}$	-0.3 to 4.0	V
Receive input optical power (damage threshold)	$P_{dth}$	+4	dBm

### 3.4 Operating Conditions

Operating conditions establish the range over which the electrical and optical specifications are defined, unless otherwise noted. Performance is not guaranteed for operation at any condition outside the operating limits indicated in this section, except as otherwise noted.

Parameter	Symbol	Min	Max	Unit
Operating case temperature	$T_{OP}$	-5	+70	°C
Power supply voltages	$V_{CC,T}, V_{CC,R}$	3.135	3.465	V
Receiver wavelength range	$\lambda$	1528.38	1568.77	nm

### 3.5 Low-Speed Electrical and Power Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
<b>Supply Currents and Voltages</b>						
Voltage	$V_{CC,T}, V_{CC,R}$	3.135	3.3	3.465	V	With respect to GND
Instantaneous operating peak current				600	mA	Per supply pin $V_{CC,T}$ and $V_{CC,R}$ Compliant with SFF-8431
Sustained operating peak current				500	mA	Per supply pin $V_{CC,T}$ and $V_{CC,R}$ Compliant with SFF-8431
Power dissipation	$P_{wr}$			1.5	W	
<b>Low-Speed Control and Sense Signals (detailed specification in SFP+ MSA SFF-8431 Rev. 4.1)</b>						
Outputs (Tx_Fault, Rx_LOS)	$V_{OL}$	-0.3		0.4	V	At 0.7 mA
	$I_{OH}$	-50		37.5	μA	Measured with a 4.7 kΩ load pulled up to $V_{CC\_host}$ <sup>1</sup>
Inputs (Tx_Disable, RS0, RS1)	$V_{IL}$	-0.3		0.8	V	Pulled up in module to $V_{CC,T}$
	$V_{IH}$	2		$V_{CC}3+0.3$	V	
SCL and SDA inputs	$V_{IL}$	-0.3		$V_{CC}3*0.3$	V	
	$V_{IH}$	$V_{CC}3*0.7$		$V_{CC}3+0.5$	V	Pulled up on host to $V_{CC\_host}$ <sup>1</sup> (typical 4.7 - 10 kΩ)

1.  $V_{CC\_host}$  (min) 3.135 V - (max) 3.465 V

### 3.6 High-Speed Electrical Specifications

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
<b>Transmitter Electrical Input Jitter from Host at B" (detailed specification in SFP+ MSA SFF-8431 Rev. 4.1)</b>						
Data-dependent jitter <sup>1</sup>	DDJ			0.10	UI <sub>(p-p)</sub>	
Uncorrelated jitter <sup>2</sup>	UJ			0.023	UI <sub>(rms)</sub>	
Data-dependent pulse width shrinkage jitter <sup>1</sup>	DDPWS			0.055	UI <sub>(p-p)</sub>	
Total jitter <sup>3</sup>	TJ			0.28	UI <sub>(p-p)</sub>	
Eye mask	X1			0.12	UI	Mask hit ratio of 5x10 <sup>-5</sup>
	X2			0.33	UI	
	Y1	95			mV	
	Y2			350	mV	
Input impedance, differential			100		Ω	
<b>Limiting Module Receiver Electrical Output Jitter to Host at C' (detailed specification in SFP+ MSA SFF 8431 Rev. 4.1)</b>						
Output rise and fall time (20% to 80%)	T <sub>r</sub> , T <sub>f</sub>	28			ps	
Total jitter <sup>3</sup>	TJ			0.70	UI	
99% jitter <sup>3</sup>	J2			0.42	UI	
Eye mask	X1			0.35	UI	Rx input power at -23 dBm Mask hit ratio of 1x10 <sup>-12</sup>
	Y1	65			mV	
	Y2			425	mV	

### 3.7 Optical Transmitter Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Average optical power <sup>4</sup>	P <sub>avg</sub>	-1		3	dBm	
Extinction ratio <sup>5</sup>	ER	9.0			dB	
Wavelength range <sup>4</sup>	λ <sub>c</sub>	1528.38		1568.77	nm	ITU Grid wavelength in Sec. 3.14
Frequency range	f <sub>c</sub>	191.1		196.15	THz	ITU Grid frequency in Sec. 3.14
Frequency center spacing			50		GHz	
Frequency stability (BOL)		f <sub>c</sub> -1.5		f <sub>c</sub> +1.5	GHz	
Frequency stability (EOL)		f <sub>c</sub> -2.5		f <sub>c</sub> +2.5	GHz	
Channel tuning time				50	ms	Any channel to any channel
Side mode suppression ratio	SMSR	35			dB	
Jitter generation	4 MHz to 80 MHz			0.1	UI <sub>(p-p)</sub>	
	20 kHz to 80 MHz			0.3	UI <sub>(p-p)</sub>	
Spectral width				200	pm	At -20 dB, 0.01 nm RBW
Relative intensity noise	RIN			-130	dB/Hz	
Return loss <sup>6</sup>		24			dB	

1. PRBS9 pattern, 10.3 Gbps

2. PRBS31 or valid 64B/66B, 10.3 Gbps

3. PRBS31 pattern, BER<1x10<sup>-12</sup>, 10.3 Gbps

4. Optical power and wavelength range are only guaranteed when the electrical input applied to TD+ and TD- is greater than the minimum specified in section 3.6

5. Tested with a PRBS 2<sup>31-1</sup> pattern

6. Minimum optical return loss at the source reference point, MPI-S (per ITU-T G.959.1)

### 3.8 Optical Receiver Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit
Receiver overload <sup>1</sup>	$P_{max}$	-7			dBm
Receiver reflectance <sup>2</sup>	$R_{rx}$			-27	dB
LOS assert <sup>3</sup>	$P_{los\_en}$	-33.5			dBm
LOS deassert	$P_{los\_off}$			-26	dBm
LOS hysteresis		0.5		4	dB
Data Rate (Gbps)	BER	Rx Sensitivity <sup>4</sup>		Unit	
		0 ps/nm	-400 to +1450 ps/nm		
		Max	Max		
9.95, 10.3, 10.5	$1 \times 10^{-12}$	-23	-21	dBm	
10.709	$1 \times 10^{-4}$	-27	-25	dBm	
11.1	$1 \times 10^{-4}$	-27	-25	dBm	
11.3	$1 \times 10^{-4}$	-26.5	-24	dBm	

### 3.9 OSNR Characteristics with External CDR Implemented on the Host Board<sup>5,6</sup>

Data Rate (Gbps)	BER	Dispersion (ps/nm)	Rx Power Range (dBm)		OSNR (dB)
			Min	Max	
10.709	$1 \times 10^{-4}$	0	-18	-7	16
10.709	$1 \times 10^{-4}$	-400 to +1450	-18	-7	19
11.1	$1 \times 10^{-4}$	0	-18	-7	17
11.1	$1 \times 10^{-4}$	-400 to +1450	-18	-7	20

- Guaranteed up to 10.709 Gbps; BER  $< 10^{-12}$ ; PRBS  $2^{31}-1$
- Maximum discrete reflectance between source reference point, MPI-S, and receive reference point, MPI-R (per ITU-T G.959.1)
- Receiver LOS Assert Level (per average power) is programmable upon request
- Measured with worst ER; PRBS  $2^{31}-1$ ; over specified wavelength range; OSNR  $> 30$  dB; with external clock and data recovery (CDR) board
- Specifications apply under these conditions:
  - Fixed RxDTV, OSNR at 0.1 nm NBW, 0.55 nm filter BW, PRBS  $2^{31}-1$  pattern, over wavelength range specified in section 3.4
  - External CDR board required for all measurements
  - No threshold adjustment available for optimization
- Product with threshold adjustment available upon request.



**3.10 Tunable SFP+ Channel Number and Wavelength**

Channel	Frequency (THz)	Center Wavelength (nm)
1	191.10	1568.77
2	191.15	1568.36
3	191.20	1567.95
4	191.25	1567.54
5	191.30	1567.13
6	191.35	1566.72
7	191.40	1566.31
8	191.45	1565.90
9	191.50	1565.50
10	191.55	1565.09
11	191.60	1564.68
12	191.65	1564.27
13	191.70	1563.86
14	191.75	1563.45
15	191.80	1563.05
16	191.85	1562.64
17	191.90	1562.23
18	191.95	1561.83
19	192.00	1561.42
20	192.05	1561.01
21	192.10	1560.61
22	192.15	1560.20
23	192.20	1559.79
24	192.25	1559.39
25	192.30	1558.98
26	192.35	1558.58
27	192.40	1558.17
28	192.45	1557.77
29	192.50	1557.36
30	192.55	1556.96
31	192.60	1556.55
32	192.65	1556.15
33	192.70	1555.75
34	192.75	1555.34
35	192.80	1554.94
36	192.85	1554.54
37	192.90	1554.13
38	192.95	1553.73
39	193.00	1553.33
40	193.05	1552.93
41	193.10	1552.52
42	193.15	1552.12
43	193.20	1551.72
44	193.25	1551.32
45	193.30	1550.92
46	193.35	1550.52
47	193.40	1550.12
48	193.45	1549.72
49	193.50	1549.32
50	193.55	1548.91
51	193.60	1548.51

Channel	Frequency (THz)	Center Wavelength (nm)
52	193.65	1548.11
53	193.70	1547.72
54	193.75	1547.32
55	193.80	1546.92
56	193.85	1546.52
57	193.90	1546.12
58	193.95	1545.72
59	194.00	1545.32
60	194.05	1544.92
61	194.10	1544.53
62	194.15	1544.13
63	194.20	1543.73
64	194.25	1543.33
65	194.30	1542.94
66	194.35	1542.54
67	194.40	1542.14
68	194.45	1541.75
69	194.50	1541.35
70	194.55	1540.95
71	194.60	1540.56
72	194.65	1540.16
73	194.70	1539.77
74	194.75	1539.37
75	194.80	1538.98
76	194.85	1538.58
77	194.90	1538.19
78	194.95	1537.79
79	195.00	1537.40
80	195.05	1537.00
81	195.10	1536.61
82	195.15	1536.22
83	195.20	1535.82
84	195.25	1535.43
85	195.30	1535.04
86	195.35	1534.64
87	195.40	1534.25
88	195.45	1533.86
89	195.50	1533.47
90	195.55	1533.07
91	195.60	1532.68
92	195.65	1532.29
93	195.70	1531.90
94	195.75	1531.51
95	195.80	1531.12
96	195.85	1530.72
97	195.90	1530.33
98	195.95	1529.94
99	196.00	1529.55
100	196.05	1529.16
101	196.10	1528.77
102	196.15	1528.38

### 3.11 SFP+ 2-Wire Interface Protocol and Management Interface

The transceiver incorporates a 2-wire management interface which is used for serial ID, digital diagnostics, and certain control functions. It is modeled on the SFF-8472 Rev 11.3 specification modified to accommodate a single 2-wire interface address. Details of the protocol and interface are explicitly described in the MSA. Please refer to the MSA for design reference

### 3.12 Digital Diagnostic Monitoring Accuracy

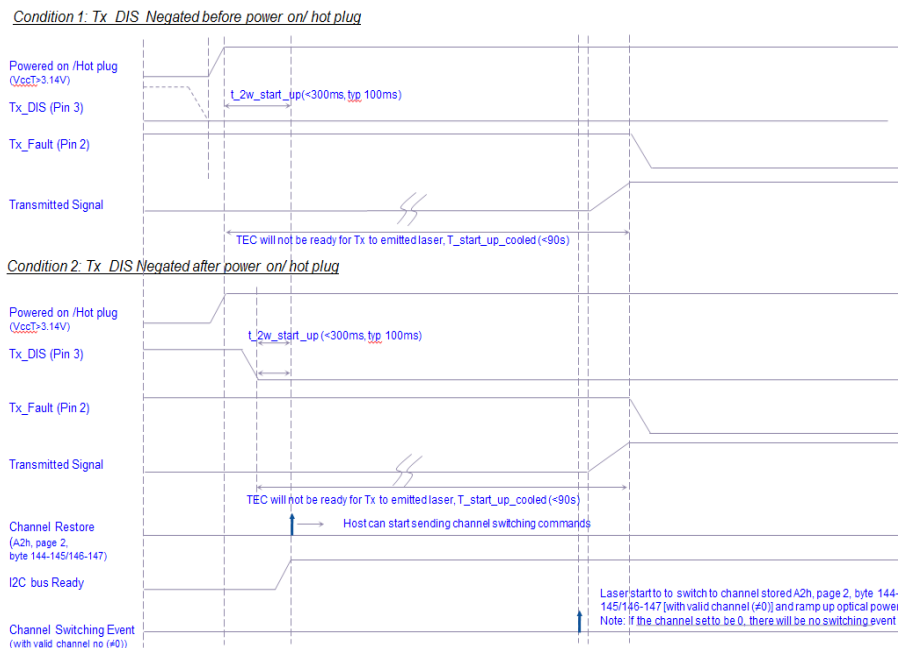
Parameter	Symbol	Max.	Unit	Notes
Transceiver internal temperature	$\Delta\text{DDM\_T}_{\text{int}}$	$\pm 3$	$^{\circ}\text{C}$	
Transceiver internal supply voltage	$\Delta\text{DDM\_V}_{\text{int}}$	$\pm 3$	%	
Transmitter bias current	$\Delta\text{DDM\_I}_{\text{bias}}$	$\pm 10$	%	
TX output optical power	$\Delta\text{DDM\_P}_{\text{Tx}}$	$\pm 3$	dB	
RX input optical power	$\Delta\text{DDM\_P}_{\text{Rx}}$	$\pm 3$	dB	Between Rx overload and sensitivity levels

### 3.13 Timing Requirement of Control and Status I/O

Parameter	Symbol	Min.	Max.	Unit	Notes
Tx_Disable assert time	t_off		100	$\mu\text{s}$	Rising edge of Tx_Disable to fall of output signal below 10% of nominal
Tx_Disable negate time	t_on		50	ms	Falling edge of Tx_Disable to rise of output signal above 90% of nominal <sup>1</sup>
Time to initialize 2-wire interface	t_2w_start_up		300	ms	From power on or hot plug
Time to initialize	t_start_up_cooled		90	s	From power on or hot plug
Tx_Fault assert	Tx_Fault_on_cooled		50	ms	From occurrence of fault to assertion of Tx_Fault
Tx_Fault reset	Tx_Fault_reset	10		$\mu\text{s}$	Time Tx_Disable must be held high to reset Tx_Fault
Rx_LOS assert delay	t_loss_on		100	$\mu\text{s}$	From occurrence of loss of signal to assertion of Rx_LOS
RX_LOS negate delay	t_loss_off		100	$\mu\text{s}$	From occurrence of return of signal to negation of Rx_LOS

1. The transceiver is thermally stabilized prior to Tx\_Disable negating event

### 3.14 Timing Diagram for Power-On/Hot-Plug and Tx Disable Event (Not to Scale)



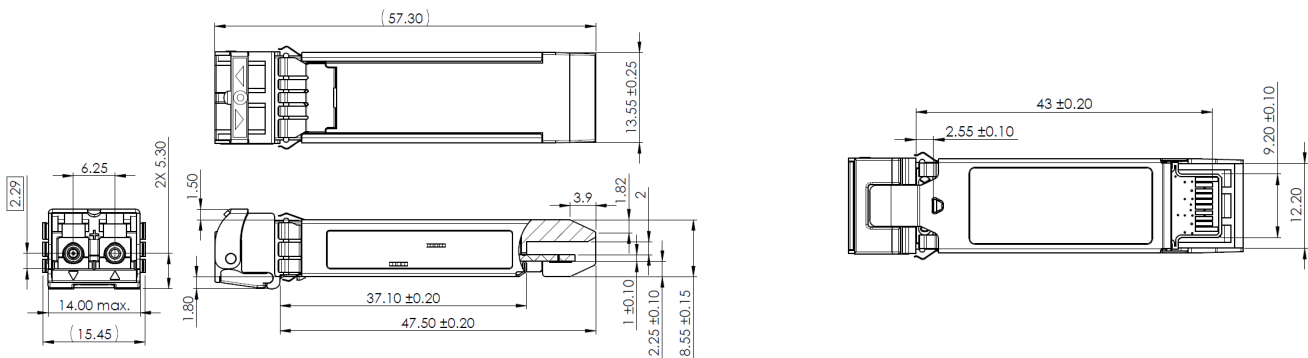
### 3.15 Regulatory Compliance

The transceiver complies with international safety and electromagnetic compatibility (EMC) requirements and standards. EMC performance depends on the overall system design. The transceiver is also lead-free and RoHS 6/6 compliant.

**Table 2. Regulatory Compliance**

Feature	Test Method	Performance
<b>Safety</b>		
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 point 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
<b>Electromagnetic Compatibility</b>		
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. Requires good system EMI design practice 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 V-3	
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 10 MHz to 6 GHz. No detectable effect on transmitter/receiver performance between these limits.
<b>Restriction of Hazardous Substances (RoHS)</b>		
RoHS	EU Directive 2011/65/EU	Compliant per the European Parliament Directive 2011/65/EU of the 8 June 2011 on the restricted use of certain hazardous substances in electrical and electronic equipment (recast). A RoHS Certificate of Conformance (C of C) is available upon request. The product may use certain RoHS exemptions.

### 3.16 T-SFP+ Transceiver Mechanical Diagram



## Section 4 Other Related Information

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

### 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, such as trichloroethane or ketones such as acetone, chloroform, ethyl acetate, MEK, methylene chloride, methylene dichloride, phenol, and N-methylpyrrolidone.

This product is not designed for aqueous wash.

#### Housing

The transceiver housing is made from zinc.

### 4.2 Electrostatic Discharge

#### Handling

Normal electrostatic discharge (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 60825-1:2014 2nd edition and is considered non-hazardous when operated within the limits of this specification.

The transceiver 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 data sheet 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, and microscopes) within a distance of 100 mm may pose an eye hazard.

#### 4.4 EMC (Electromagnetic) Compliance

The transceiver has been tested and complies 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.



##### 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
2. This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and complies 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, we cannot guarantee that interference will not occur in a particular installation. If this equipment causes harmful interference to radio or television reception, which can be determined by turning the equipment off and on, users are encouraged to try to correct the interference by one or more of these measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment to 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.

Caution: Any changes or modifications to the product not expressly approved by Lumentum could void the user's authority to operate this equipment.

##### 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 Operations LLC 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](mailto:customer.service@lumentum.com).

Description	Product Code
Generic DWDM tunable 50 GHz C-band, 10 G multi-rate, commercial temperature range, ROHS 6, limiting, SFP+ optical transceiver	JST01TMAC1CY5GE3



North America  
Toll Free: 844 810 LITE (5483)

Outside North America  
Toll Free: 800 000 LITE (5483)

China  
Toll Free: 400 120 LITE (5483)

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