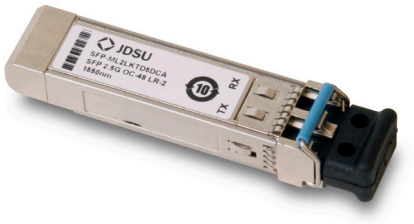
SFP Optical Transceiver—OC-48 CWDM for up to 80-km Reach and Gigabit Ethernet for up to 120-km Reach



Key Features

- Line rates from 100 Mbps to 3.1 Gbps
- CWDM wavelengths from 1271 nm or 1471 nm to 1611 nm, depending on applications
- Extended operating case temperature supported; industrial operating case temperature compatible
- 1.2 W maximum power dissipation
- PIN- or APD-based receiver
- Lead free
- Single 3.3 V power supply
- Digital diagnostic monitoring support

Applications

- Metro access and metro core
- Wide area networks
- Optical cross-connects
- CWDM

Compliance

- SFF 8074i MSA
- SFF 8472 Revision 10.4
- GR-253-CORE
- ITU-T G.695 and G.957
- IEEE 802.3-2005
- Telcordia GR-468
- RoHS 6/6

This integrated fiber optic transceiver provides a high-speed serial link at signaling rates from 100 Mbps to 3.1 Gbps. The module complies with the small form factor pluggable (SFP) multisource agreement (MSA).

The transceiver also complies with Telcordia GR-253-CORE, ITU-T G.695, and ITU-T G.957 standards (S-C8S1-1DX and S-C8L1-1DX) for up to 80-km reach (SONET OC-48/SDH STM-16) and the IEEE 802.3-2005 CWDM standard for up to 120-km reach (Gigabit Ethernet and 1 G Fibre Channel). It is compatible with Fast Ethernet, SONET OC-3 and OC-12, and SDH STM-1 and STM-4 standards.

The transceiver integrates the receive and transmit path on one module. On the transmit side, the serial data stream is passed to a laser driver. The laser driver biases and modulates an uncooled direct modulated laser (DML), enabling data transmission over single-mode fiber through an industry-standard LC connector. On the receive side, the optical data stream is recovered from a PIN or avalanche photodetector (APD), sent to a transimpedance amplifier, and then passed to a post amplifier. This module features a hot-pluggable SFI-compliant electrical interface.

Section 1 Functional Description

The JDSU RoHS-compliant small form factor pluggable (SFP) optical transceiver is a fully 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 signaling rates from 100 Mbps to 3.1 Gbps. It is compliant with Telcordia GR-253-CORE, ITU-T G.957, and ITU-T G.695 (SONET OC-48/SDH STM-16) standards for 40-km reach (PIN-receiver based) or 80-km reach (APD-receiver based) as well as IEEE 802.3-2005 (Gigabit Ethernet) and 1 G Fibre Channel for 80-km reach (PIN-receiver based) or 120-km reach (APD-receiver based) applications. The transceiver is compatible with Fast Ethernet, SONET OC-3 and OC-12, and SDH STM-1 and STM-4 applications. The transceiver is also fully compliant with the SFP module Multi-Source Agreement INF-8074i Rev. 1.0. A block diagram of the transceiver is shown in Figure 1 below.

The transceiver does not need Rate Select to operate at the designated line rate. It has several low-speed interface connections including a two-wire serial interface. These connections also include: transceiver presence (Mod_Def(0)), transmitter fault (TX_FAULT), transmitter disable (TX_DIS), and receive loss (RX_LOS).

Transmitter

The transmitter path converts serial NRZ electrical data from line rates of 100 Mbps to 3.1 Gbps to a standard compliant optical signal. The transmitter accepts a 100 Ω differential 300 mV peak-to-peak to 1400 mV peak-to-peak CML electrical signal on TD- and TD+ pins.

Inside the module, differential signals pass through a laser driver which transforms the small-swing digital voltage to an output modulation that drives an uncooled DML laser. The optical signal meets SONET/SDH, Ethernet, and Fibre Channel CWDM rate specifications. Closed-loop control of the transmitted laser power, modulation swing, and center wavelength over temperature and voltage variations is provided. The laser is coupled to single-mode optical fiber through an industry standard LC optical connector.

Receiver

The receiver converts incoming DC-balanced serial NRZ optical data from line rates of 100 Mbps to 3.1 Gbps into serial electrical data. Light is coupled to a PIN or APD photodetector from single-mode optical fiber through an industry-standard LC optical connector. The electrical current from the PIN or APD photodetector is converted to a voltage in a high-gain transimpedance amplifier.

The amplified signal is passed to a post amplifier. Loss-of-signal and signal-lock-detection is included in the receive circuitry that is reflected in the RX_LOS status pin. The recovered data is output on the RD+ and RD- pins as a 100 Ω differential 600 mV to 1600 mV peak-to-peak CML signal. The output signal meets SFP MSA requirements.

Low-speed Signaling

Low speed signaling is based on low-voltage transistor-transistor logic (LVTTL) operating at a nominal voltage of 3.3 V.

MOD_DEF(1)/MOD_DEF(2) serial interface clock and data line. Hosts should use a pull-up resistor connected to Vcc 3.3 V on the two-wire interface MOD_DEF(1) (clock), MOD_DEF(2) (data), and all low-speed outputs.

TX_FAULT: Output pin. When high, indicates possible transmitter operational fault or a status critical to the host system.

TX_DIS: Input pin. When asserted high, the transmitter output is turned off.

Mod_DEF(0): Output pin. Pulled to ground by the module to indicate that the module is present.

RX_LOS: Output pin. Asserted high when insufficient optical power for reliable signal reception is received.

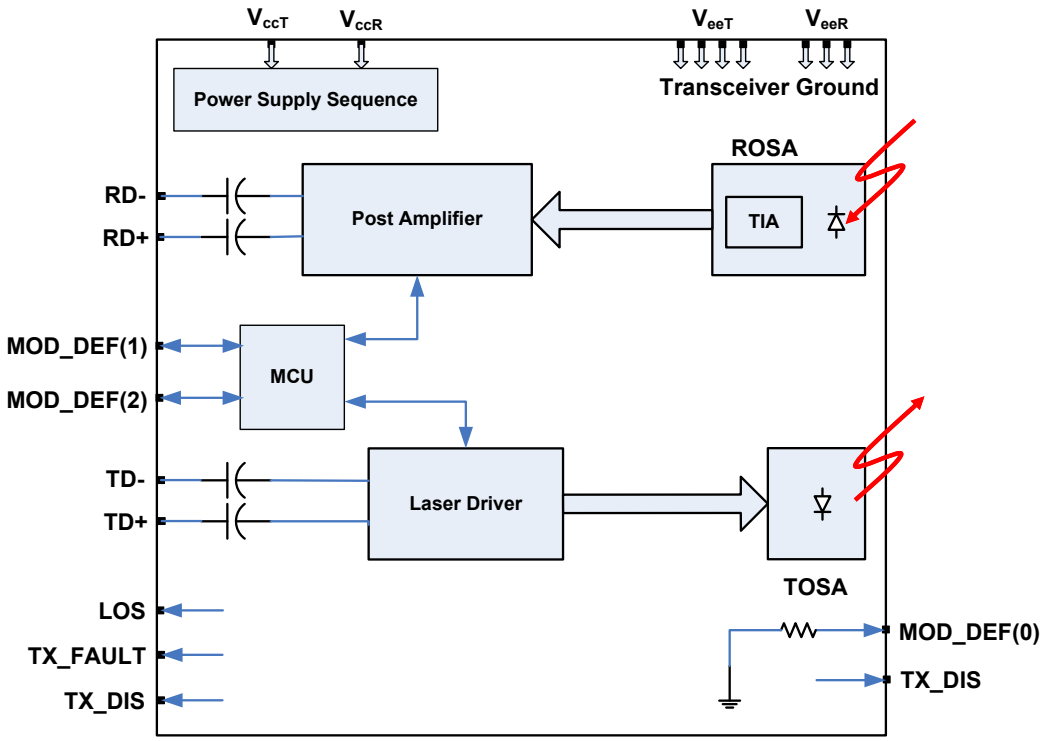


Figure 1. Transceiver functional block diagram

Section 2 Application Schematics

Power supply filtering is recommended for the transceiver. 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. Recommended power supply network connections to the transceiver are shown in Figure 2 below.

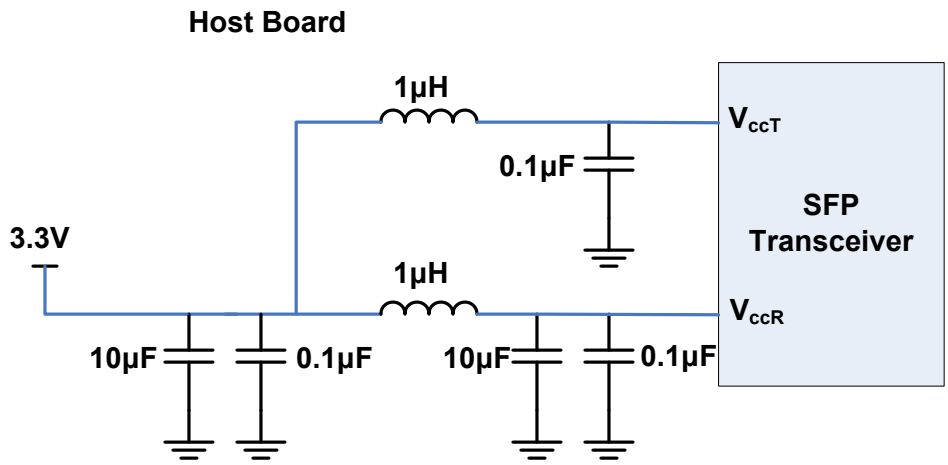


Figure 2. Recommended power supply filter network

Notes:
1. Power supply filtering components should be placed as close to the Vcc pins of the host connector as possible for optimal performance.
2. ESR of inductor should be less than 0.5 Ω to ensure proper power supply levels.

Section 3 Specifications

Technical specifications related to the transceiver include:

3.1 Pin Function Definitions

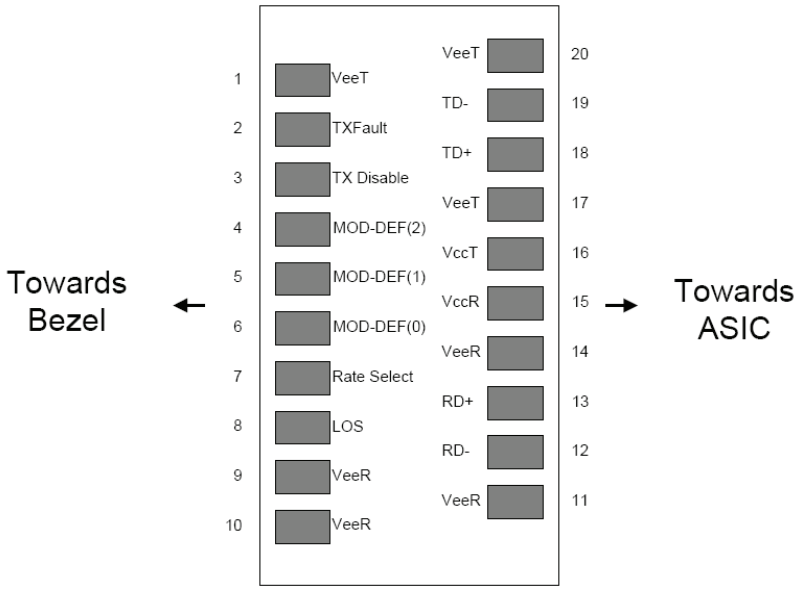


Figure 3. Transceiver pin-out on host board

Table 1 SFP optical transceiver pin descriptions

Pin no.	Name	Type	Description
1	VeeT	GND[1]	Transmit ground
2	TX_FAULT[2]	LVTTL-O	Transmitter fault indicator
3	TX_DIS	LVTTL-I	Transmitter disable; transmitter laser source turned off
4	MOD_DEF(2)	LVTTL-I	Two-wire serial interface data
5	MOD_DEF(1)	LVTTL-I	Two-wire serial interface clock
6	MOD_DEF(0)		Transceiver presence, pull down to GND via a 499 Ω resistor.
7	Rate_select	CMOS	No connect
8	RX_LOS[2]	LVTTL-O	Receive loss of signal
9	VeeT	GND[1]	Transmit ground
10	VeeR	GND[1]	Receive ground
11	VeeR	GND[1]	Receive ground
12	RD-	CML	Receiver inverted data output
13	RD+	CML	Receiver non-inverted data output
14	VeeR	GND[1]	Receive ground
15	VccR		Receive power; 3.3 V
16	VccT		Transmit power; 3.3 V
17	VeeT	GND[1]	Transmit ground
18	TD+	CML	Transmitter non-inverted data input
19	TD-	CML	Transmitter inverted data input
20	VeeT	GND[1]	Transmit 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 kΩ – 10 kΩ to a voltage between 3.15 V and 3.45 V on the host board.

3.2 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}	-40 to +85	˚C
Relative humidity	RH	5 to 95 (non-condensing)	%
Static electrical discharge (human body model)	ESD	500	V
Power supply voltages	V_{CC}	-0.3 to 4.0	V
Receive input optical power (damage threshold)			
- PIN	P_{dth}	5	dBm
- APD	P_{dth}	3	dBm

3.3 Operating Conditions

Performance is not guaranteed and reliability is not implied for operation at any condition outside the recommended operating limits.

Part Number	Gigabit Ethernet	SONET/SDH (OC-48/STM-16)	Commercial Temperature (-5 to 70˚C)	Industrial Temperature (-5˚C – 85˚C) *
SFP-GS2LCCxxDCA	40 km		X	
SFP-GS2LKCxxDCA	40 km		X	X
SFP-GI2LCCxxDCA	80 km		X	
SFP-GI2LKCxxDCA	80 km		X	X
SFP-GL2LCCxxDCA	120 km		X	
SFP-GL2LKCxxDCA	120 km		X	X
SFP-MI2LKCxxDCA		40 km	X	
SFP-MI2LKCxxDCA		40 km	X	X
SFP-ML2LCCxxDCA		80 km	X	
SFP-ML2LKCxxDCA		80 km	X	X

* Industrial operating case temperature range (-40°C to 85°C) compatible.
** The marks xx indicates the wavelength channel and is defined in Section 3.13.

3.4 Electrical Characteristics

Parameter	Symbol	Min	Typ.	Max	Unit	Notes
Supply voltage	V_{CC}	3.13	3.3	3.47	V	With respect to GND
Supply current	I_{CC}			346	mA	
Power dissipation(EOL)	P_{wr}			1.0	W	Up to 70°C transceiver case temperature
	P_{wr}			1.2	W	Up to 85°C transceiver case temperature
Data rate		100		3125	Mbps	
Low-speed control and sense signals (detailed specification in SFP MSA INF8074i Rev. 1.0)						
Outputs (TX_FAULT, RX_LOS)	V_{OL}	0		0.4	V	Rpullup pulled to host _Vcc, measured at host side of connector. I_{OL}(max)=3 mA
	V_{OH}	host_Vcc-0.5		host_Vcc+0.3	V	Rpullup pulled to host _Vcc, measured at host side of connector
Inputs (TX_DIS)	V_{IL}	-0.3		0.8	V	Pulled up in module to Vcc
	V_{IH}	2		Vcc3+0.3	V	Pulled up in module to Vcc
MOD_DEF(1) /MOD_DEF(2)	V_{IL}	-0.3		Vcc3*0.3		Rpullup pulled to host _Vcc, measured at SFP side of connector
	V_{IH}	Vcc3*0.7		Vcc3+0.5		Rpullup pulled to host _Vcc, measured at SFP side of connector
Low-speed control and sense signals						Detailed specification in SFP MSA IN F8074i Rev. 1.0
High speed signals (detailed specification in SFP MSA INF8074i Rev. 1.0)						
Input data signal levels	DV_{IN}	300		1400	mV	Differential voltage swing[1]
Output data signal levels	DV_{OUT}	400		1600	mV	Differential voltage swing[1]
Data output rise/fall time	tr / tf			175	ps	20% – 80%, differential

1. Internally AC coupled. Terminated into 100 Ω differential. These levels are guaranteed down to 2 dB lower than the typical receiver sensitivity for each data rate and reach.

3.5 Jitter Specifications

Parameter	Min	Max	Unit	Notes
Jitter generation (peak to peak)		70	mUI(p-p)	PRBS 2^{23}-1 data pattern, at OC-48 data rate
Jitter generation (rms)		7	mUI(rms)	
Jitter transfer/jitter tolerance		Compliant with Telcordia GR253 when operated with a SONET-compliant CDR		

3.6 Timing Requirement of Control and Status I/O

Parameter	Symbol	Min	Max	Unit	Notes
TX_DIS assert time	t_off		10	µsec	Rising edge of TX_DIS to fall of output signal below 10% of nominal
TX_DIS negate time	t_on		5	msec	Falling edge of TX_DIS to rise of output signal above 90% of nominal
Time to initialize	t_init		60	sec	Upon power up or negation of TX_FAULT due to TX_DISABLE
Time to initialize after reset of TX_FAULT/INT in normal operation	t_init reset		300	msec	From negation of TX_FAULT/INT using TX_DISABLE Optical power going to 90% of final value
TX_FAULT assert time	t_fault		100	µsec	Time from a fault condition to TX_FAULT assertion
TX_DISABLE for reset	t_reset	10		µsec	Time TX_DISABLE must be held HIGH to reset TX_FAULT
RX_LOS assert time[1]	t_loss_on		100	µsec	Time from loss of signal to assertion of RX_LOS
RX_LOS deassert time	t_loss_off		100	µsec	Time from non-loss condition to RX_LOS deassertion
Two-wire serial clock rate	f_serial_clock		100	kHz	

1. The RX_LOS assert time can be 200 µsec max when the optical input power is greater than -10 dBm immediately prior to the RX_LOS condition.

3.7 SFP Two-wire Interface Protocol and Management Interface

The transceiver incorporates an SFP-compliant two-wire management interface which is used for serial ID, digital diagnostics, and certain control functions. It is modeled on the SFF 8472 Rev. 10.4 specification modified to accommodate a single two-wire interface address. Details of the protocol and interface are explicitly described in the MSA. Please refer to the MSA for design reference.

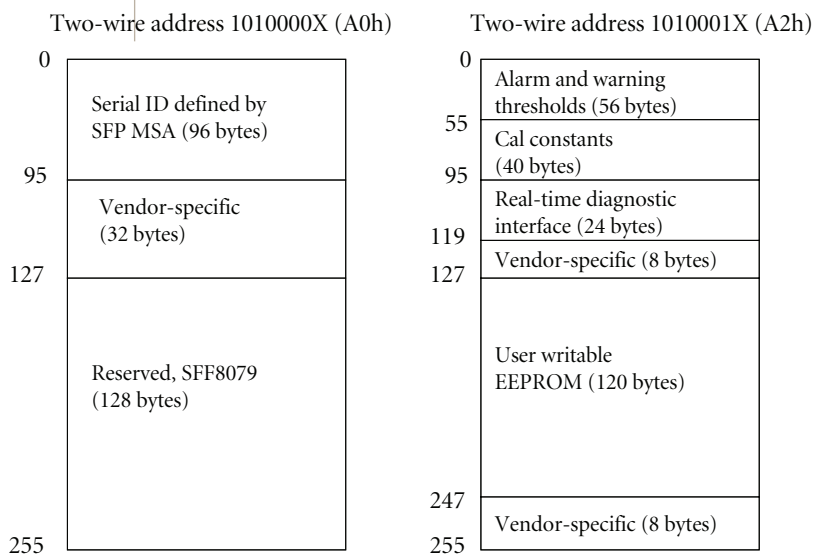


Figure 4. SFP Two-wire serial digital diagnostic memory map

3.8 Optical Characteristics (1.25 Gbps, 40 km, PIN Receiver)

Parameter	Symbol	Min	Typ.	Max	Unit	Notes
Average optical power (EOL)	P_{avg}	-7.0		0	dBm	
Chromatic dispersion tolerance	DT_{CD}			800	ps/nm	
Extinction ratio	ER	9.0			dB	1
Optical power with transmitter disabled				-40	dBm	
Center wavelength spacing			20		nm	
Wavelength stability (case temperature -5°C to 85°C)		λc–6.5	λc	λc+6.5	nm	Available wavelength in Sec. 3.13
Wavelength stability (case temperature below -5°C)		λc–9.8	λc	λc+6.5	nm	Available wavelength in Sec. 3.13
-20dB spectral width	Δλ		0.3	1.0	nm	
Sidemode suppression ratio	SMSR	30			dB	
Optical rise/fall time (20% – 80%)				200	ps	
Optical eye mask margin	MM	10			%	2
Optical path penalty	P_{PATH}			1	dB	
Optical return loss		24			dB	
Receiver center wavelength	λ	1260		1620	nm	
Receiver sensitivity (EOL)	R_{sen}		-25	-23	dBm	1
Receive overload	P_{max}	0.0			dBm	1
Receiver reflectance	R_{rx}			-27	dB	
RX_LOS assert	P_{los_on}	-25		-31	dBm	
RX_LOS deassert	P_{los_off}			-24.5	dBm	
RX_LOS hysteresis		0.5		4	dB	

1. Tested with PRBS 2^7–1 pattern. 2. Measured with PRBS 2^7 – 1 pattern; with 1000 waveforms. 3. Measured with worst ER; BER < 10^{-12}; PRBS 2^7–1 pattern.

3.9 Optical Characteristics (1.25 Gbps, 80 km, PIN Receiver)

Parameter	Symbol	Min	Typ.	Max	Unit	Notes
Average optical power (EOL)	P_{avg}	0.0	2.0	4.0	dBm	
Chromatic dispersion tolerance	DT_{CD}			1600	ps/nm	
Extinction ratio	ER	9.0			dB	1
Optical power with transmitter disabled				-40	dBm	
Center wavelength spacing			20		nm	
Wavelength stability (case temperature -5°C to 85°C)		λ_c-6.5	λ_c	λ_c+6.5	nm	Available wavelength in Sec. 3.13
Wavelength stability (case temperature below -5°C)		λ_c-9.8	λ_c	λ_c+6.5	nm	Available wavelength in Sec. 3.13
-20 dB spectral width	$\Delta\lambda$		0.3	1.0	nm	
Sidemode suppression ratio	SMSR	30			dB	
Optical rise/fall time (20%– 80%)				200	ps	
Optical eye mask margin	MM	10			%	2
Optical path penalty	P_{PATH}			1	dB	
Optical return loss		24			dB	
Receiver center wavelength	λ	1260		1620	nm	
Receiver sensitivity (EOL)	R_{sen}		-25	-23	dBm	1
Receive overload	P_{max}	0.0			dBm	1
Receiver reflectance	R_{rx}			-27	dB	
RX_LOS assert	P_{los_on}	-25		-31	dBm	
RX_LOS deassert	P_{los_off}			-24.5	dBm	
RX_LOS hysteresis		0.5		4	dB	

1. Tested with PRBS 2^7–1 pattern. 2. Measured with PRBS 2^7 – 1 pattern; with 1000 waveforms. 3. Measured with worst ER; BER < 10^{-12}; PRBS 2^7–1 pattern.

3.10 Optical Characteristics (1.25 Gbps, 120 km, APD Receiver)

Parameter	Symbol	Min	Typ.	Max	Unit	Notes
Average optical power (EOL)	P_{avg}	0.0	2.0	4.0	dBm	
Chromatic dispersion tolerance	DT_{CD}			2400	ps/nm	
Extinction ratio	ER	9.0			dB	1
Optical power with transmitter disabled				-40	dBm	
Center wavelength spacing			20		nm	
Wavelength stability (case temperature -5°C to 85°C)		λ_c-6.5	λ_c	λ_c+6.5	nm	Available wavelength in Sec. 3.13
Wavelength stability (case temperature below -5°C)		λ_c-9.8	λ_c	λ_c+6.5	nm	Available wavelength in Sec. 3.13
-20 dB spectral width	$\Delta\lambda$		0.3	1.0	nm	
Sidemode suppression ratio	SMSR	30			dB	
Optical rise/fall time (20% – 80%)				200	ps	
Optical eye mask margin	MM	10			%	2
Optical path penalty	P_{PATH}			2	dB	
Optical return loss		24			dB	
Receiver center wavelength	λ	1260		1620	nm	
Receiver sensitivity (EOL)	R_{sen}			-32	dBm	1
Receive overload	P_{max}	-8			dBm	1
Receiver reflectance	R_{rx}			-27	dB	
RX_LOS assert	P_{los_on}	-35		-46	dBm	
RX_LOS deassert	P_{los_off}			-34.5	dBm	
RX_LOS hysteresis		0.5		4	dB	

1. Tested with PRBS 2^7–1 pattern. 2. Measured with PRBS 2^7 – 1 pattern; with 1000 waveforms. 3. Measured with worst ER; BER < 10^{-12}; PRBS 2^7–1 pattern.

3.11 Optical Characteristics (2.5 Gbps, 40 km, PIN Receiver)

Parameter	Symbol	Min	Typ.	Max	Unit	Notes
Average optical power (EOL)	P_{avg}	0.0	2.0	4.0	dBm	
Chromatic dispersion tolerance	DT_{CD}			800	ps/nm	
Extinction ratio	ER	8.2			dB	1
Optical power with transmitter disabled				-40	dBm	
Center wavelength spacing			20		nm	
Wavelength stability (case temperature -5°C to 85°C)		λ_c-6.5	λ_c	λ_c+6.5	nm	Available wavelength in Sec. 3.13
Wavelength stability (case temperature below -5°C)		λ_c-9.8	λ_c	λ_c+6.5	nm	Available wavelength in Sec. 3.13
-20 dB spectral width	$\Delta\lambda$		0.3	1.0	nm	
Sidemode suppression ratio	SMSR	30			dB	
Optical rise/fall time (20%– 80%)				200	ps	
Optical eye mask margin	MM	10			%	2
Optical path penalty	P_{PATH}			1	dB	
Optical return loss		24			dB	
Receiver center wavelength	λ	1260		1620	nm	
Receiver sensitivity (EOL)	R_{sen}			-19	dBm	1
Receive overload	P_{max}	0.0			dBm	1
Receiver reflectance	R_{rx}			-27	dB	
RX_LOS assert	P_{los_on}	-25		-31	dBm	
RX_LOS deassert	P_{los_off}			-24.5	dBm	
RX_LOS hysteresis		0.5		4	dB	

1. Tested with PRBS 2^{23}–1 pattern. 2. Measured with PRBS 2^{23} – 1 pattern; with 1000 waveforms. 3. Measured with worst ER; BER < 10^{-12}; PRBS 2^{7}–1 pattern.

3.12 Optical Characteristics (2.5 Gbps, 80 km, APD Receiver)

Parameter	Symbol	Minimum	Typical	Maximum	Unit	Notes
Average optical power (EOL)	P_{avg}	0.0	2.0	4.0	dBm	
Chromatic dispersion tolerance	DT_{CD}			1600	ps/nm	
Extinction ratio	ER	8.2			dB	1
Optical power with transmitter disabled				-40	dBm	
Center wavelength spacing			20		nm	
Wavelength stability (case temperature -5°C to 85°C)		λ_c-6.5	λ_c	λ_c+6.5	nm	Available wavelength in Sec. 3.13
Wavelength stability (case temperature below -5°C)		λ_c-9.8	λ_c	λ_c+6.5	nm	Available wavelength in Sec. 3.13
-20 dB spectral width	$\Delta\lambda$		0.3	1.0	nm	
Sidemode suppression ratio	SMSR	30			dB	
Optical rise/fall time (20% – 80%)				200	ps	
Optical eye mask margin	MM	10			%	2
Optical path penalty	P_{PATH}			2	dB	
Optical return loss		24			dB	
Receiver center wavelength	λ	1260		1620	nm	
Receiver sensitivity (EOL)	R_{sen}		-29	-28	dBm	1
Receive overload	P_{max}	-8			dBm	1
Receiver reflectance	R_{rx}			-27	dB	
RX_LOS assert	P_{los_on}	-33		-38	dBm	
RX_LOS deassert	P_{los_off}			-32.5	dBm	
RX_LOS hysteresis		0.5		4	dB	

1. Tested with PRBS 2^{23}–1 pattern. 2. Measured with PRBS 2^{23} – 1 pattern; with 1000 waveforms. 3. Measured with worst ER; BER < 10^{-12}; PRBS 2^{7}–1 pattern.

3.13 Wavelength Availability

Table 2 Wavelength Table

Channel	Center wavelengh(nm)	Operating case temperature (°C)		Gigabit Ethernet rate (1.25 Gbps)			SONET OC-48 rate (2.5 Gbps)		Bail color
		-5 to 70	-5 to 85 *	40 km	80 km	120 km	40 km	80 km	
27	1271	Y		Y	Y				Black
29	1291	Y		Y	Y				Black
31	1311	Y		Y	Y				Black
33	1331	Y		Y	Y				Black
35	1351	Y		Y	Y				Black
37	1371	Y		Y	Y				Black
39	1391	Y		Y	Y				Black
41	1411	Y		Y	Y				Black
43	1431	Y		Y	Y				Black
45	1451	Y		Y	Y				Black
47	1471	Y	Y	Y	Y	Y	Y	Y	Gray
49	1491	Y	Y	Y	Y	Y	Y	Y	Violet
51	1511	Y	Y	Y	Y	Y	Y	Y	Blue
53	1531	Y	Y	Y	Y	Y	Y	Y	Green
55	1551	Y	Y	Y	Y	Y	Y	Y	Yellow
57	1571	Y	Y	Y	Y	Y	Y	Y	Orange
59	1591	Y	Y	Y	Y	Y	Y	Y	Red
61	1611	Y	Y	Y	Y	Y	Y	Y	Brown

* Industrial operating case temperature range (-40°C to 85°C) compatible.

3.14 Regulatory Compliance

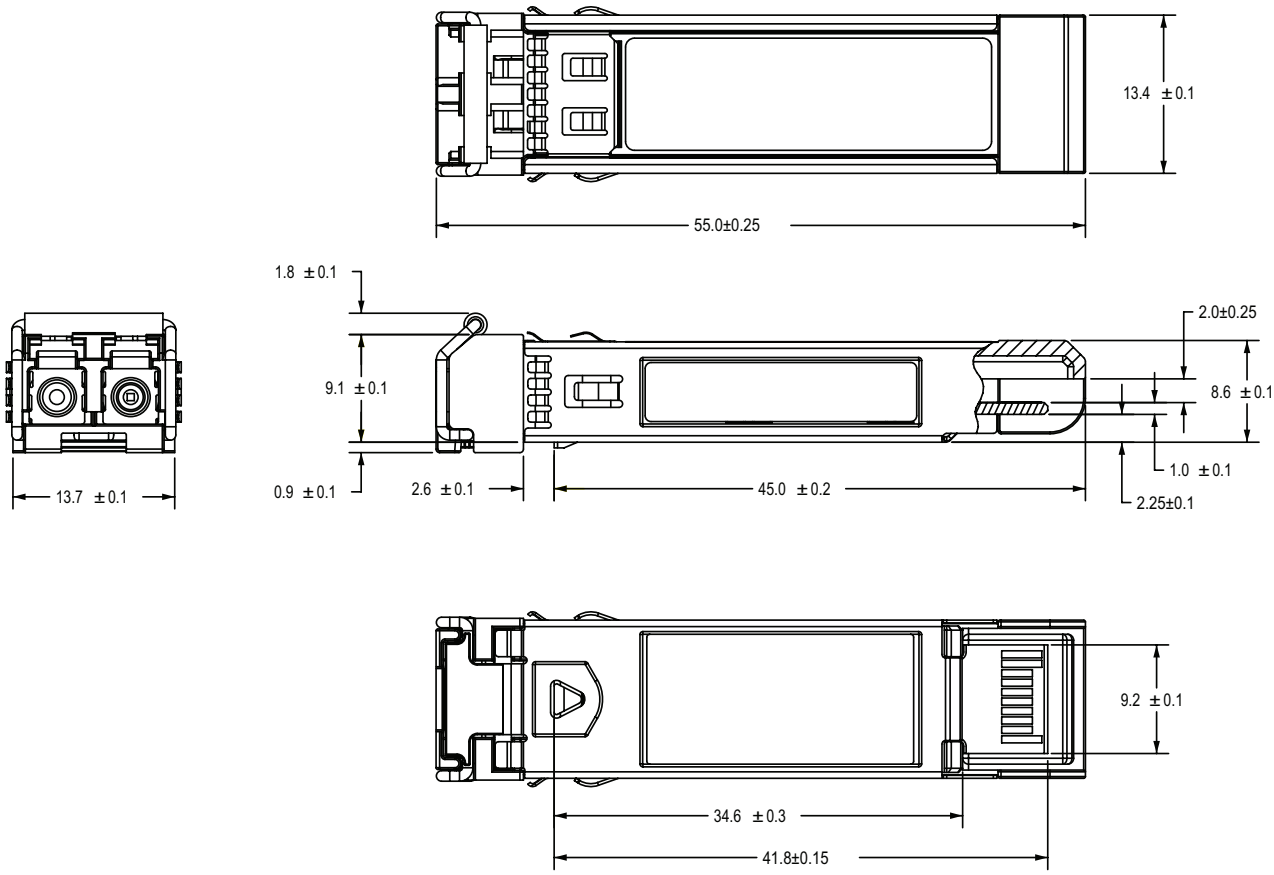
The transceiver is lead-free and RoHS 6/6 compliant per Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

The transceiver complies with international electromagnetic compatibility (EMC) and international safety requirements and standards. EMC performance is dependent on the overall system design. Information included herein is intended as a figure of merit for designers to use as a basis for design decisions.

Table 3 Regulatory Compliance

Feature	Test Method	Performance
Component safety	UL 60950 UL94-V0 EN 60950	TUV Certificate TUV Certificate TUV Report / Certificate (CB Scheme)
RoHS-compliance	Directive 2002/95/EC	Compliant per the Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.
Laser eye safety	EN 60825 U.S. 21CFR 1040.10	TUV Certificate CDRH compliant and Class 1 laser eye safe
Electromagnetic Compatibility		
Electromagnetic emissions	EMC Directive 89/336/EEC FCC CFR47 Part 15 IEC/CISPR 22 AS/NZS CISPR22 EN 55022 ICES-003, Issue 4 VCCI-03	Noise frequency range: 30 MHz to 40 GHz. Good system EMI design practice required to achieve Class B margins.
Electromagnetic immunity	EMC Directive 89/336/EEC IEC /CISPR/24 EN 55024	
ESD immunity	EN 61000-4-2	Exceeds requirements. Withstands discharges of; 8kV contact, 15kV air
Radiated immunity	EN 61000-4-3	Exceeds requirements. Field strength of 10V/m RMS, from 10 MHz to 1 GHz. No effect on transmitter / receiver performance is detectable between these limits.

3.15 Module Outline



3.16 Connectors

Fiber

The SFP module has a duplex LC receptacle connector.

Electrical

The electrical connector is the 20-way, two-row PCB edge connector.

Section 4 Related Information

Other information related to the transceiver includes:
- Section 4.1 Packing and Handling Instructions
- Section 4.2 Electrostatic Discharge
- Section 4.3 Eye Safety

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 De-greasing Chemicals
JDSU 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-methylpyrolldone).

This product is not designed for aqueous wash.

Housing
The transceiver housing is made from die-cast zinc and stainless steel sheet metal.

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, the serializer/deserializer chip).

CLASS 1 LASER PRODUCT

4.3 Eye Safety

The transceiver is an international Class 1 laser product per IEC 60825-1 second edition 2007. The product also complies with U.S.A. regulations for Class 1 products contained in 21 CFR 1040.10 and 1040.11. Laser emissions from Class 1 laser products are not considered hazardous when operated within the limits of this specification.

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

Caution!

Tampering with this laser based product or operating this product outside the limits of this specification may be considered an act of "manufacturing," and will require, under law, recertification of the modified product with the U.S. Food and Drug Administration (21 CFR 1040).

Ordering Information

For more information on this or other products and their availability, please contact your local JDSU account manager or JDSU directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide, or via e-mail at customer.service@jdsu.com.

Product Code	Description
SFP-GS2LCCxxDCA	SFP CWDM GbE 40 km commercial temperature transceiver
SFP-GS2LKCxxDCA	SFP CWDM GbE 40 km extended temperature transceiver
SFP-GI2LCCxxDCA	SFP CWDM GbE 80 km commercial temperature transceiver
SFP-GI2LKCxxDCA	SFP CWDM GbE 80 km extended temperature transceiver
SFP-GL2LCCxxDCA	SFP CWDM GbE 120 km commercial temperature transceiver
SFP-GL2LKCxxDCA	SFP CWDM GbE 120 km extended temperature transceiver
SFP-MI2LCCxxDCA	SFP CWDM OC48 40 km commercial temperature transceiver
SFP-MI2LKCxxDCA	SFP CWDM OC48 40 km extended temperature transceiver
SFP-ML2LCCxxDCA	SFP CWDM OC48 80 km commercial temperature transceiver
SFP-ML2LKCxxDCA	SFP CWDM OC48 80 km extended temperature transceiver

* The marks xx in the Product Code above indicate the CWDM channel number in Section 3.13.