

# RoHS-compliant 2.125, 1.25 and 1.063 Gbps, Single-mode 1310 nm eSFP Transceiver

## JSH-12L1DD1



### Key Features

- 1310 nm FP laser
- 10 km distance
- Case operating temperature of -40 – 85°C
- Single +3.3 V power supply
- Hot pluggable
- EEPROM with serial ID functionality
- Industry-standard duplex LC optical connector
- Operates with 9/125  $\mu\text{m}$  single-mode optical fibers

### Applications

- Gigabit Ethernet
- 2.125 and 1.25 Gbps Fibre Channel
- High-speed storage area networks
  - Switch and hub interconnect
  - Mass storage systems interconnect
  - Host adapter interconnect
- Computer cluster cross-connect
- Custom high-speed data pipes
- Client/server environments
- Distributed multiprocessing
- Visualization, real-time video, collaboration
- Data acquisition

### Compliance

- Gigabit Ethernet (1000 Base-LX) at 1.25 Gbps
- 2 G, 1 G ANSI Fibre Channel
- Small form factor pluggable (SFP) multisource agreement (MSA) or digital diagnostics SFF-8472

The JDSU JSH-12L1DD1 SFP transceivers are hot-pluggable, 3.3 V duplex-LC transceivers that provide a high-speed serial link at a signaling rate of up to 2.125 Gbps. They are designed for use in ANSI Fibre Channel and Gigabit Ethernet applications. These transceives provide the LC optical receptacle that is compatible with the industry-standard LC connector.

The transceiver consists of an optical subassembly housing the transmitter and receiver, and an electrical subassembly. All are packaged together with a top metal cover and bottom shield. The optical subassembly consists of two parts. The transmitter side has a high-performance, 1310 nm, back-facet monitor. The receiver side has an InGaAs PIN and a preamplifier.

The digital diagnostic monitoring (DDM) interface uses the same two-wire serial ID interface defined in the SFP MSA specification. The standard serial ID information is located at address A0h. Using address A2h, the user can monitor transceiver parameters, including temperature, voltage, laser bias current, laser power, and receiver power. Alarms and warnings are provided when the monitored parameters exceed predefined threshold values. All transceivers include a loss-of-signal-detect circuit, which provides a TTL logic high output when an unusable input optical signal level is detected.

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### Absolute Maximum Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit
Storage temperature <sup>1</sup>	T <sub>S</sub>	-40		+95	°C
Relative humidity <sup>2</sup>	RH	5		95	%
Supply voltage	V <sub>CC</sub>			4.0	V

1. Case temperature

2. Noncondensing

### Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Ambient operating temperature at -40°C and case temperature at 85°C	T <sub>OP</sub>	-40		+85	°C
Supply voltage	V <sub>CC</sub>	2.97		3.6	V
Transmitter differential input voltage	V <sub>D</sub>	0.6		2.0	V
Transmit disable input volt—low	TD <sub>Lo</sub>			0.3	V
Transmit disable Input Volt—high	TD <sub>Hi</sub>	2.3			V

### 3

#### Electrical Characteristics

 (Over specified  $T_{op}$  range,  $V_{CC} = +2.97$  V to  $+3.6$  V)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power consumption	$P_{diss}$			1000	mW
<b>Transmitter</b>					
TX fault output—high	$V_{oh}$ , TTL	2.0		$V_{CC}$	V
TX fault output—low	$V_{ol}$ , TTL	0.0		0.8	V
Initialization time				300	ms
<b>Receiver</b>					
Data output voltage swing (differential)	$V_{diff}$	0.5		1.2	V
Data output rise and fall times <sup>1</sup>	$t_r$ , $t_f$			0.26	ns
Loss of signal detect output—high	$V_{oh}$ , TTL	2.0		$V_{CC}$	V
Loss of signal detect output—low	$V_{ol}$ , TTL	0.0		0.8	V

1. 20 – 80 %

#### Optical Characteristics

 (Over specified  $T_{op}$  range,  $V_{CC} = +2.97$  V to  $+3.6$  V)

Parameter	Symbol	Min.	Typ.	Max.	Unit
<b>Transmitter</b>					
Output optical power <sup>1</sup> 9/125 $\mu$ m, NA = 0.10 fiber	$P_{OUT}$	-9.5		-2.5	dBm avg.
Optical extinction ratio—GbE		9			dB
Center wavelength	$\lambda_c$	1290		1330	nm
Spectral width			0.1	0.5	nm
Side mode suppression ratio	SMSR	30			dB
Optical rise/fall time <sup>2</sup>	$t_r$ / $t_f$			0.26	ns
Relative intensity noise	RIN			-120	dB/Hz
Transmitter optical contributed jitter (total) TJ				225	ps
<b>Receiver</b>					
Minimum optical input power (sensitivity)	$P_{IN}$			-21	dBm avg.
Maximum optical input power (saturation)	$P_{IN}$	1.0			dBm avg.
Operating center wavelength	$\lambda_c$	1265		1625	nm
Return loss		12			dB
Loss of signal—deasserted	$P_A$			-21	dBm avg.
Loss of signal—asserted	$P_D$	-30			dBm avg.
Loss of signal—hysteresis	$P_A - P_D$	0.5		5.0	dB

1. JSH-12L1DD1

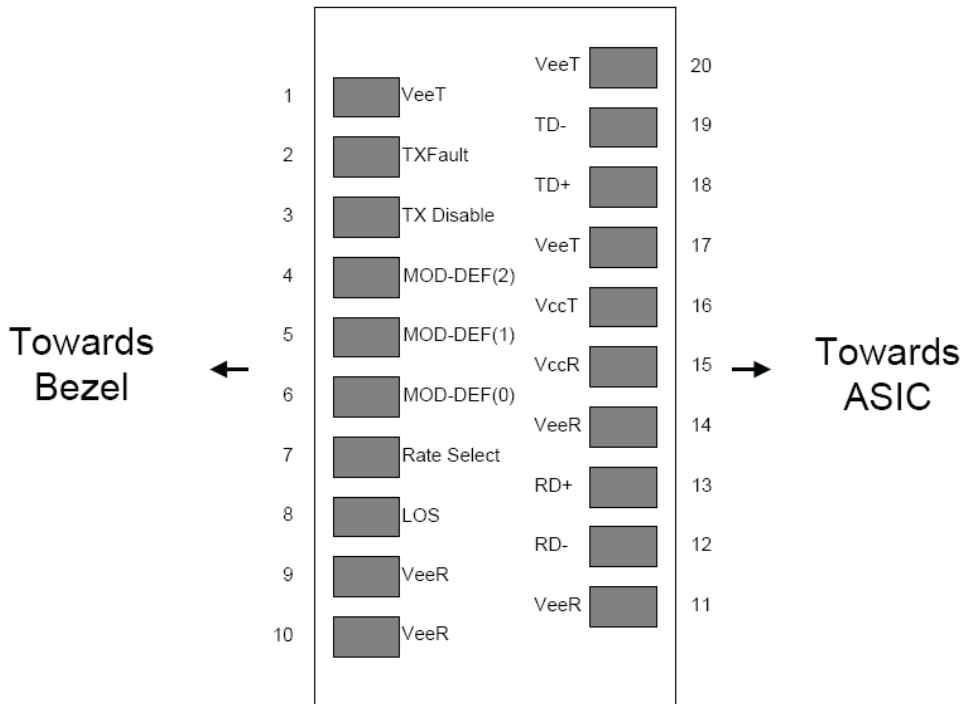
2. 20 – 80 %

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## SFP Pin Definitions

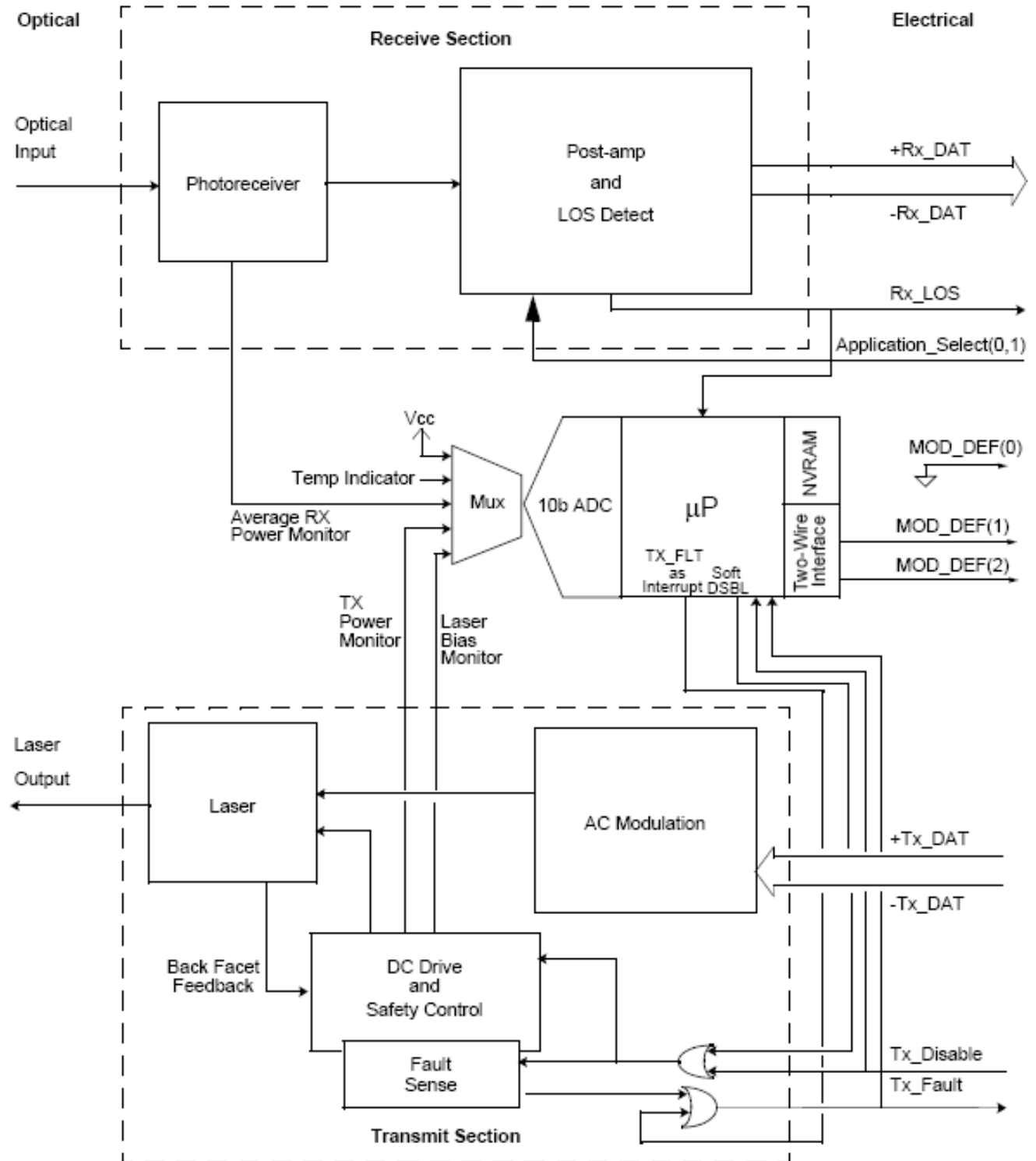
Pin	Symbol	Description of Function
1	VeeT	Transmitter Signal Ground
2	TX Fault	Transmitter Fault Indication
3	TX Disable	Transmitter Disable
4	MOD – DEF2	Module Definition 2
5	MOD – DEF1	Module Definition 1
6	MOD – DEF0	Module Definition 0
7	Rate Select	Select between full or reduced receiver bandwidth (not implemented)
8	LOS	Loss of Signal
9	VeeR	Receiver Signal Ground
10	VeeR	Receiver Signal Ground
11	VeeR	Receiver Signal Ground
12	RD-	Received Data Inverted Differential Output
13	RD+	Received Data Noninverted Differential Output
14	VeeR	Receiver Signal Ground
15	VccR	+3.3 V Receiver Power Supply
16	VccT	+3.3 V Transmitter Power Supply
17	VeeT	Transmitter Signal Ground
18	TD+	Transmitter Data Noninverted Differential Input
19	TD-	Transmitter Data Inverted Differential Input
20	VeeT	Transmitter Signal Ground

## Pin Function Definitions



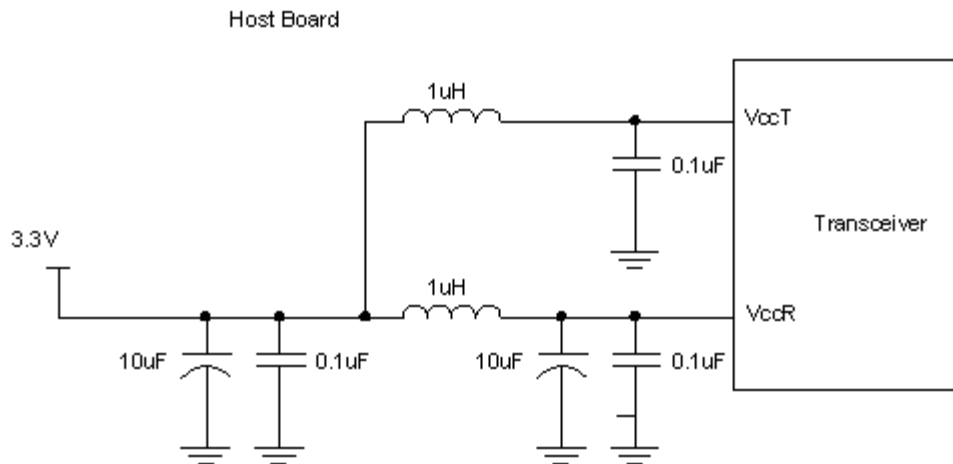
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Block Diagram



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### 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 ohm to ensure proper power supply levels.

## Regulatory Compliance

The JSH-12L1DD1 complies with international electromagnetic compatibility (EMC) and international safety requirements and standards (see details in table below). 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.

The JSH-12L1DD1 is lead-free and RoHS-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 JSH-12L1DD1 is engineered for product safety and regulatory agency compliance. Approvals are anticipated based on engineering design and manufacturing practices that have been historically demonstrated by JDSU.

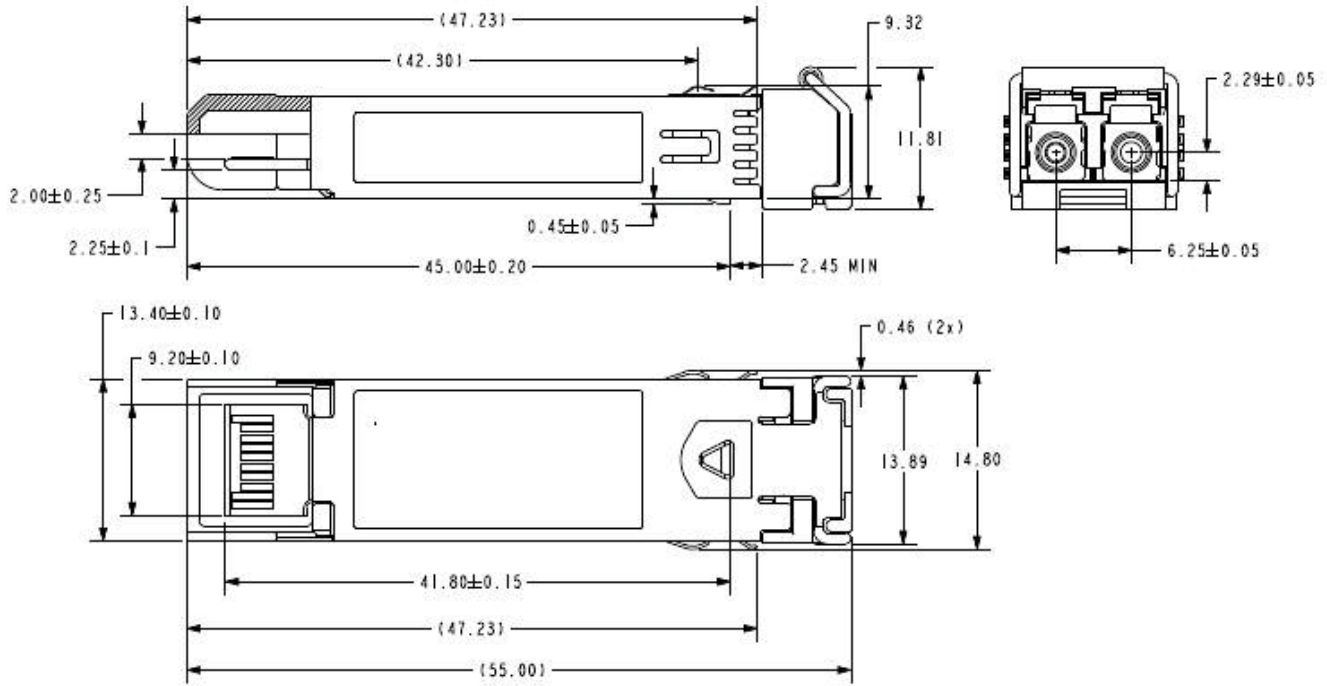
### Regulatory compliance

Feature	Test Method	Performance
Component safety	UL 60950 UL94-V0 IEC 60950	UL File E209897
RoHS compliance	Directive 2002/95/EC	TUV Report/Certificate (CB scheme) 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
<b>Electromagnetic Compatibility</b>		
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; 8 kV contact, 15 kV air
Radiated immunity	EN 61000-4-3	Exceeds requirements. Field strength of 10 V/m RMS, from 10 MHz to 1 GHz. No effect on transmitter/receiver performance is detectable between these limits.

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## SFP Transceiver Package Outline

(Dimensions in mm unless otherwise noted.)





## Digital Diagnostic Monitoring and Serial ID Operation

The JSH-12L1DD1 is equipped with a two-wire serial management processor/EEPROM used to store information about the type and identification of the transceiver, as well as real-time digitized information relating to transceiver performance. See the SFF Committee document SFF-8472 Rev. 10.3, dated December 1, 2007, for memory/address organization of the identification data and digital diagnostic data.

The enhanced digital diagnostics feature monitors five key transceiver parameters that are internally calibrated and should be read as absolute values and interpreted as follows:

**Transceiver Temperature in Degrees Celsius:** Internally measured. Represented as a 16 bit signed two's complement value in increments of  $1/256^{\circ}\text{C}$  from  $-40$  to  $+85^{\circ}\text{C}$  with LSB equal to  $1/256^{\circ}\text{C}$ . Accuracy is  $\pm 5^{\circ}\text{C}$  over the specified operating temperature and voltage range.

**Vcc/Supply Voltage in Volts:** Internally measured. Represented as a 16 bit unsigned integer with the voltage defined as the full 16-bit value (0 – 65535) with LSB equal to 100  $\mu\text{V}$  with a measurement range of 0 to +6.55 V. Accuracy is  $\pm 3$  percent of nominal value over the specified operating temperature and voltage ranges.

**TX Bias Current in mA:** Represented as a 16-bit unsigned integer with current defined as the full 16-bit value (0 – 65535) with LSB equal to 2  $\mu\text{A}$  with a measurement range of 0 – 131 mA. Accuracy is  $\pm 10$  percent of nominal value over the specified operating temperature and voltage ranges.

**TX Output Power in mW:** Represented as a 16-bit unsigned integer with the power defined as the full 16-bit value (0 – 65535) with LSB equal to 0.1  $\mu\text{W}$ . Accuracy is  $\pm 2$  dB over the specified temperature and voltage ranges over the range of -8.2 dBm to 0.5 dBm. Data is not valid when transmitter is disabled.

**RX Received Optical Power in mW:** Represented as average power as a 16-bit unsigned integer with the power defined as the full 16-bit value (0 – 65535) with LSB equal to 0.1  $\mu\text{W}$ . Accuracy is  $\pm 3$  dB over the specified temperature and voltage ranges over the power range of -14.5 dBm to 0.5 dBm.

### Reading the data

The information is accessed through the SCL and SDA connector pins of the module. The specification for the EEPROM contains all the timing and addressing information required for accessing the data.

The device address used to read the Serial ID data is 1010000X(A0h), and the address to read the diagnostic data is 1010001X(A2h). Any other device addresses will be ignored.

MOD\_ABS, pin 6 on the transceiver, is connected to Logic 0 (ground) on the transceiver.

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SCL, pin 5 on the transceiver, is connected to the SCL pin of the Management Processor/EEPROM.

SDA, pin 4 on the transceiver, is connected to the SDA pin of the Management Processor/EEPROM.

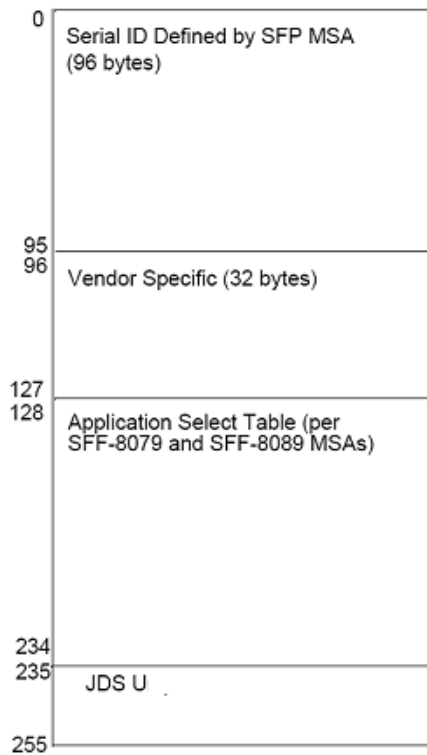
The EEPROM Write Protect pin is internally tied to ground with no external access, allowing write access to the customer-writable field (bytes 128 – 247 of address 1010001X). Note: address bytes 0 – 27 are not write protected and may cause diagnostic malfunctions if written over.

### Decoding the data

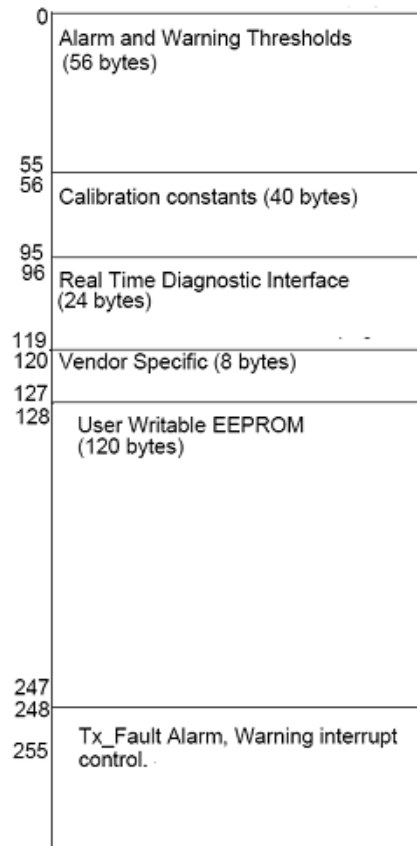
The information stored in the EEPROM, including the organization and the digital diagnostic information, is defined in SFF-8472 Revision 10.3, dated December 1, 2007.

### Data Field Descriptions

Address 0xA0



Address 0xA2



## Package and Handling Instructions

### Process plug

The JSH-12L1DD1 is supplied with a dust plug that protects the transceiver optics during standard manufacturing processes by preventing contamination from air borne particles.

Note: It is recommended that the dust cover remain in the transceiver whenever an optical fiber connector is not inserted.

### Flammability

The JSH-12L1DD1 housing is made of cast zinc and sheet metal.

## 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 handled only 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 that may become temporarily saturated during an ESD strike. This could result in a short burst of bit errors. Such an event might require the application to reacquire synchronization at the higher layers (serializer/deserializer chip).

## Electromagnetic Interference (EMI) and Immunity

To assist customers in managing overall equipment EMI performance, these transceivers are compatible with the industry-standard SFP cage, which provides protection for EMI emission and EMI susceptibility. All transceivers comply with FCC Class B limits.

### Eye Safety

The JDSU JSH-12L1DD1 1310 nm, laser-based transceivers are Class 1 laser products. They conform to FDA regulations 21 CFR 1040.10 and 1040.11 laser safety requirements,, including deviations pursuant to Laser Notice No. 50, dated July 26, 2001. They are also certified to comply with IEC standards 60825-1, 60825-2, and 60950, as well as CDHR. The transceivers are UL Listed and are eye safe when operated within the limits of these specifications.

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).

The use of optical instruments with this product will increase eye hazard.

### 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](mailto:customer.service@jdsu.com).

Product Code	Description
JSH-12L1DD1	RoHS-Compliant 2.125, 1.25 and 1.063 Gbps, Single-mode 1310nm eSFP Transceiver