

# 10 G SFP+ 850 nm Limiting Transceiver, 10 Gigabit Ethernet Compatible

## PLRXPL-VC-S43-21-N and PLRXPL-VC-S43-22-N Series



### Key Features

- Compatible with 10 G links
- Uses a highly reliable, 850 nm oxide VCSEL
- Lead-free and RoHS 6/6-compliant
- 0 – 70°C case operating temperature
- Single 3.3 V power supply
- Low power consumption (typically 450 mW)
- Bit error rate <math>< 1 \times 10^{-12}</math>
- Hot pluggable

### Applications

- Intra data center connectivity
  - Switch and hub
  - Mass storage systems
  - Host bus adapters
- Enterprise access interconnect
- High-speed storage interconnect
- Disaster recovery/backup connectivity
- High-speed cluster/grid computing aggregation

### Compliance

- SFF 8431 Revision 2.2
- SFF 8432 Revision 5.0
- SFF 8472 Revision 10.3
- CDRH and IEC60825-1 Class 1 Laser Eye Safety
- FCC Class B
- ESD Class 2 per MIL-STD 883
- UL 94, V0
- Reliability tested per Telcordia GR-468

The lead-free and RoHS-compliant small form factor pluggable (SFP+) transceiver from JDSU improves the performance for 10 Gigabit Ethernet (10 G) applications, and is ideal for high-speed campus and large data center applications. This transceiver features a highly reliable, 850 nm, oxide, vertical-cavity surface-emitting laser (VCSEL) coupled to an LC optical connector. The transceiver is fully compatible with 10GBASE-SR and 10GBASE-SW specifications at shorter link distances, with internal AC coupling on both transmit and receive data signals. The all-metal housing design provides low EMI emissions in demanding 10 G applications and conforms to IPF specifications. An enhanced digital diagnostic feature set allows for real-time monitoring of transceiver performance and system stability, and the serial ID allows for customer and vendor system specific information to be stored in the transceiver. Transmit disable, loss-of-signal, and transmitter fault functions are also provided. The small size of the transceiver allows for high-density board designs that, in turn, enable greater aggregate bandwidth.

## Section 1 Functional Description

The PLRXPL-VC-S43-xx-N 10G SFP+ 850 nm optical transceiver is designed to transmit and receive 10 G serial optical data over 50/125  $\mu\text{m}$  or 62.5/125  $\mu\text{m}$  multimode optical fiber.

### Transmitter

The transmitter converts serial PECL or CML electrical data into serial optical data compatible with the 10GBASE-SR and 10GBASE-SW standard. Transmit data lines (TD+ and TD-) are internally AC coupled, with 100  $\Omega$  differential termination.

Transmitter rate select (RS1) pin 9 is assigned to control the SFP+ module transmitter rate. It is connected internally to a 30 k $\Omega$  pull-down resistor. A data signal on this pin does not affect the operation of the transmitter.

An open collector-compatible transmit disable (Tx\_Disable) is provided. This pin is internally terminated with a 10 k $\Omega$  resistor to  $V_{ccT}$ . A logic "1," or no connection, on this pin will disable the laser from transmitting. A logic "0" on this pin provides normal operation.

The transmitter has an internal PIN monitor diode that ensures constant optical power output, independent of supply voltage. It is also used to control the laser output power over temperature to ensure reliability at high temperatures.

An open collector-compatible transmit fault (Tx\_Fault) is provided. The Tx\_Fault signal must be pulled high on the host board for proper operation. A logic "1" output from this pin indicates that a transmitter fault has occurred or that the part is not fully seated and the transmitter is disabled. A logic "0" on this pin indicates normal operation.

### Receiver

The receiver converts serial optical data into serial PECL/CML electrical data. Receive data lines (RD+ and RD-) are internally AC coupled with 100  $\Omega$  differential source impedance, and must be terminated with a 100  $\Omega$  differential load.

Receiver Rate Select (RS0) pin 7 is assigned to control the SFP+ module receiver rate. It is connected internally to a 30 k $\Omega$  pull-down resistor. A data signal on this pin has no affect on the operation of the receiver.

An open collector compatible loss of signal (LOS) is provided. The LOS must be pulled high on the host board for proper operation. A logic "0" indicates that light has been detected at the input to the receiver (see Optical characteristics, Loss of Signal Assert/Deassert Time). A logic "1" output indicates that insufficient light has been detected for proper operation.

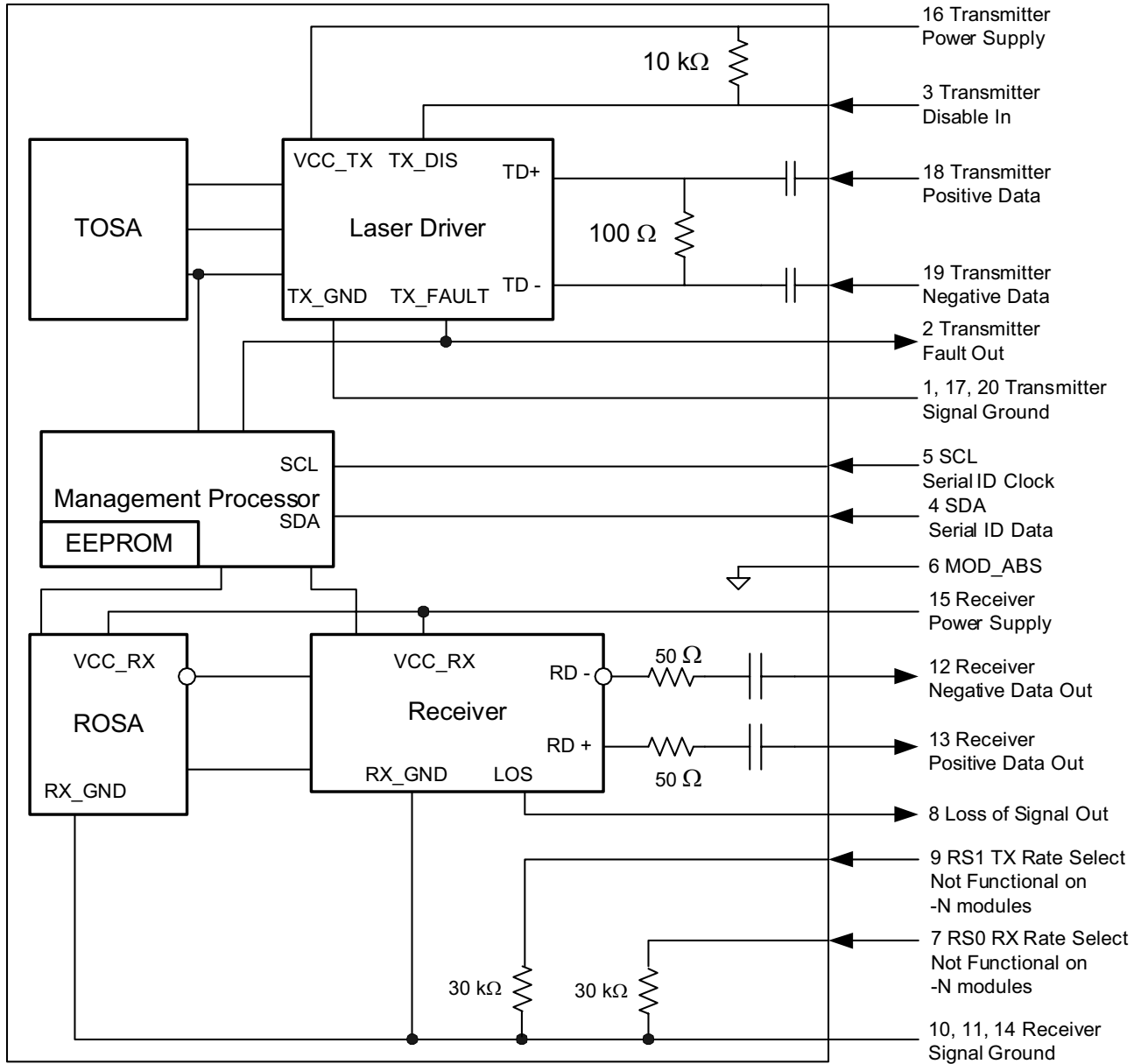
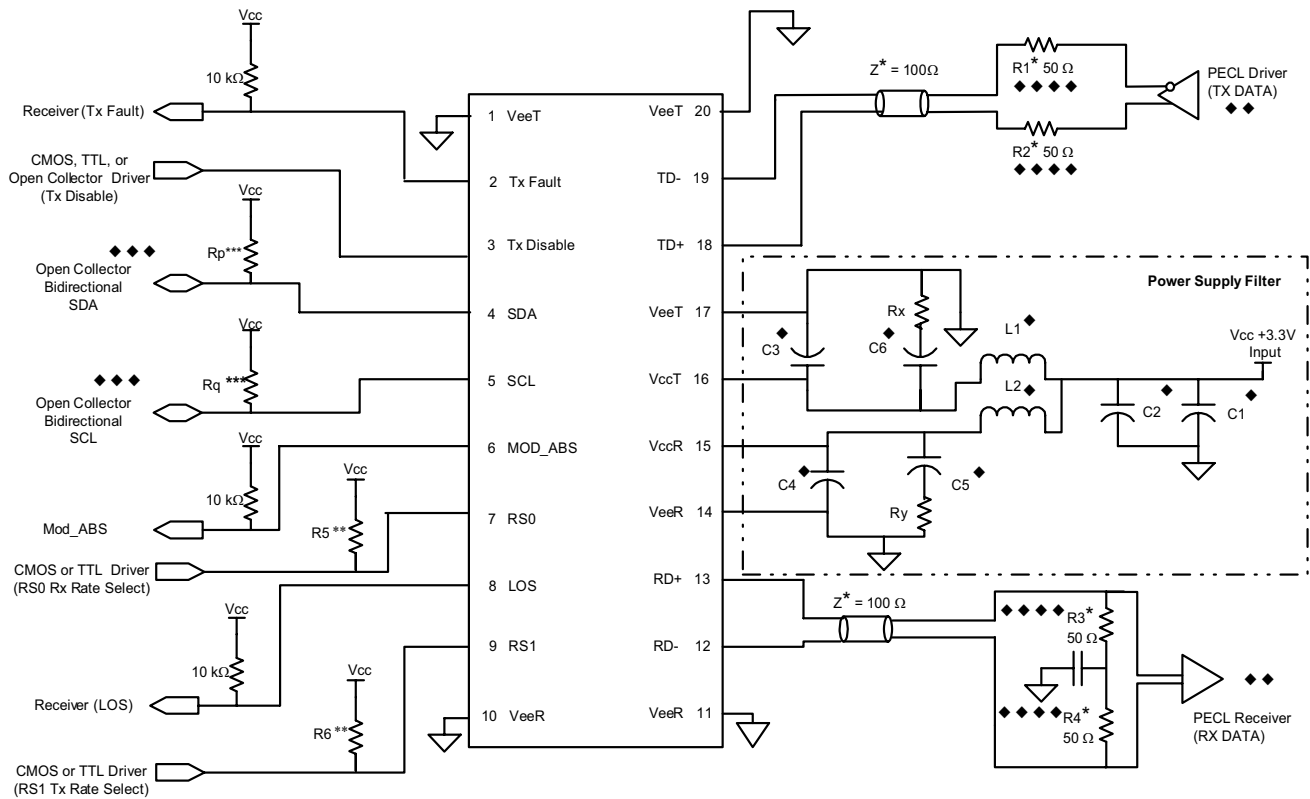


Figure 1 SFP+ optical transceiver functional block diagram

## Section 2 Application Schematic



**Figure 2 Recommended application schematic for the 10 G SFP+ optical transceiver**

**Notes**

- ◆ Power supply filtering components should be placed as close to the  $V_{cc}$  pins of the host connector as possible for optimal performance.
  - ◆◆ PECL driver and receiver components will require biasing networks. Please consult application notes from suppliers of these components. CML I/O on the PHY are supported. Good impedance matching for the driver and receiver is required.
  - ◆◆◆ SDA and SCL should be bi-directional open collector connections in order to implement serial ID in JDSU SFP+ transceiver modules.
  - ◆◆◆◆ R1/R2 and R3/R4 are normally included in the output and input of the PHY. Please check the application notes for the IC in use.
- \* Transmission lines should be 100  $\Omega$  differential traces. Vias and other transmission line discontinuities should be avoided. In order to meet the host TP1 output jitter and TP4 jitter tolerance requirements it is recommended that the PHY has both transmitter pre-emphasis to equalize the transmitter traces and receiver equalization to equalize the receiver traces. With appropriate transmitter pre-emphasis and receiver equalization, up to 8 dB of loss at 5 GHz can be tolerated.
- \*\* R5 and R6 are required when an Open Collector driver is used in place of CMOS or TTL drivers. 5 k $\Omega$  value is appropriate.
- \*\*\* The value of  $R_p$  and  $R_q$  depend on the capacitive loading of these lines and the two wire interface clock frequency. See SFF-8431. A value of 10 k $\Omega$  is appropriate for 80 pF capacitive loading at 100 kHz clock frequency.

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Power supply filtering is recommended for both the transmitter and receiver. Filtering should be placed on the host assembly as close to the V<sub>CC</sub> pins as possible for optimal performance. V<sub>CC,R</sub> and V<sub>CC,T</sub> should have separate filters.

Power supply filter component values from Figure 2 are shown in the table below for two different implementations.

### Power Supply Filter Component Values

| Component  | Option A     | Option B | Units |
|------------|--------------|----------|-------|
| L1, L2     | 1.0          | 4.7      | μH    |
| Rx, Ry     | 0.5*         | 0.5*     | Ω     |
| C1, C5     | 10           | 22       | μF    |
| C2, C3, C4 | 0.1          | 0.1      | μF    |
| C6         | Not required | 22       | μF    |

Notes:

Option A is recommended for use in applications with space constraints with power supply noise less than 33 mV<sub>p-p</sub>.

Option B is used in the module compliance board in SFF-8431.

\*If the total series resistance of L1+C6 and L2+C5 exceeds the values of Rx and Ry in the table, then Rx and Ry can be omitted.

## Section 3 Specifications

Technical specifications related to the SFP+ optical transceiver include:

- Section 3.1 Pin Function Definitions
- Section 3.2 Absolute Maximum Ratings
- Section 3.3 Operating Conditions
- Section 3.4 Electrical Characteristics
- Section 3.5 Optical Characteristics
- Section 3.6 Link Length
- Section 3.7 Regulatory Compliance
- Section 3.8 PCB Layout
- Section 3.9 Front Panel Opening
- Section 3.10 Module Outline
- Section 3.11 Transceiver Belly-to-belly Mounting

### 3.1 Pin Function Definitions

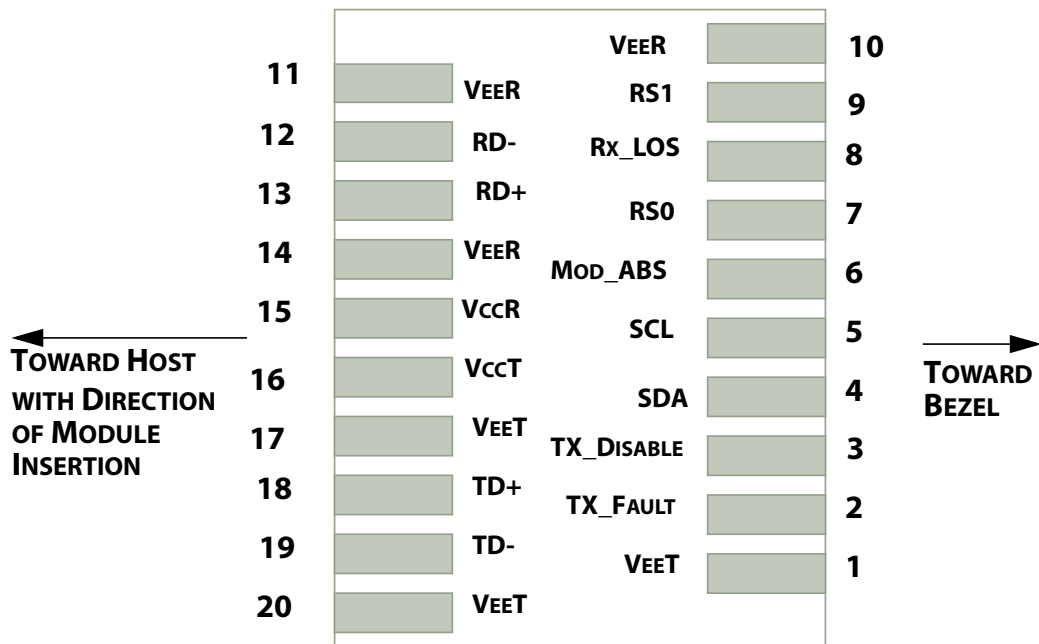


Figure 3 Host PCB SFP+ Pad assignment top view

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## SFP+ Optical Transceiver Pin Descriptions

| Pin Number               | Symbol           | Name                                | Description   |
|--------------------------|------------------|-------------------------------------|---|
| <b>Receiver</b>          |                  |                                     |   |
| 8                        | LOS              | Loss of Signal Out (OC)             | Sufficient optical signal for potential BER < $1 \times 10^{-12}$ = Logic "0"<br>Insufficient optical signal for potential BER < $1 \times 10^{-12}$ = Logic "1"<br>This pin is open collector compatible, and should be pulled up to Host V <sub>cc</sub> with a 10 kΩ resistor. |
| 10, 11, 14               | V <sub>ccR</sub> | Receiver Signal Ground              | These pins should be connected to signal ground on the host board.  |
| 12                       | RD-              | Receiver Negative DATA Out (PECL)   | Light on = Logic "0" Output<br>Receiver DATA output is internally AC coupled and series terminated with a 50 Ω resistor.  |
| 13                       | RD+              | Receiver Positive DATA Out (PECL)   | Light on = Logic "1" Output<br>Receiver DATA output is internally AC coupled and series terminated with a 50 Ω resistor.  |
| 15                       | V <sub>ccR</sub> | Receiver Power Supply               | This pin should be connected to a filtered +3.3 V power supply on the host board. See Application schematics on page 4 for filtering suggestions.   |
| 7                        | RS0              | RX Rate Select (LVTTL)              | This pin has an internal 30 kΩ pull-down to ground. A signal on this pin will not affect module performance.  |
| <b>Transmitter</b>       |                  |                                     |   |
| 3                        | TX_Disable       | Transmitter Disable In (LVTTL)      | Logic "1" Input (or no connection) = Laser off<br>Logic "0" Input = Laser on<br>This pin is internally pulled up to V <sub>ccT</sub> with a 10 kΩ resistor.   |
| 1, 17, 20                | V <sub>ccT</sub> | Transmitter Signal Ground           | These pins should be connected to signal ground on the host board.  |
| 2                        | TX_Fault         | Transmitter Fault Out (OC)          | Logic "1" Output = Laser Fault (Laser off before t <sub>fault</sub> )<br>Logic "0" Output = Normal Operation<br>This pin is open collector compatible, and should be pulled up to Host V <sub>cc</sub> with a 10 kΩ resistor.   |
| 16                       | V <sub>ccT</sub> | Transmitter Power Supply            | This pin should be connected to a filtered +3.3 V power supply on the host board. See Application schematics on page 4 for filtering suggestions.   |
| 18                       | TD+              | Transmitter Positive DATA In (PECL) | Logic "1" Input = Light on<br>Transmitter DATA inputs are internally AC coupled and terminated with a differential 100 Ω resistor.  |
| 19                       | TD-              | Transmitter Negative DATA In (PECL) | Logic "0" Input = Light on<br>Transmitter DATA inputs are internally AC coupled and terminated with a differential 100 Ω resistor.  |
| 9                        | RS1              | TX Rate Select (LVTTL)              | This pin has an internal 30 kΩ pulldown to ground. A signal on this pin will not affect module performance.   |
| <b>Module Definition</b> |                  |                                     |   |
| 4                        | SDA              | Two-wire Serial Data                | Serial ID with SFF 8472 Diagnostics.<br>Module definition pins should be pulled up to Host V <sub>cc</sub> with appropriate resistors for the speed and capacitive loading of the bus. See SFF8431.   |
| 5                        | SCL              | Two-wire Serial Clock               | Serial ID with SFF 8472 Diagnostics.<br>Module definition pins should be pulled up to Host V <sub>cc</sub> with appropriate resistors for the speed and capacitive loading of the bus. See SFF8431.   |
| 6                        | MOD_ABS          | Module Absent                       | Pin should be pulled up to Host V <sub>cc</sub> with 10 kΩ resistor.<br>MOD_ABS is asserted "high" when the SFP+ module is physically absent from the host slot.  |

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## 3.2 Absolute Maximum Ratings

| Parameter                              | Symbol   | Ratings                | Unit      |
|--|----------|------------------------|-----------|
| Storage temperature                    | $T_{ST}$ | -40 to +95             | °C        |
| Case temperature                       | $T_C$    | -40 to +90             | °C        |
| Relative humidity                      | RH       | 5 – 95 (noncondensing) | %         |
| Transmitter differential input voltage | $V_D$    | 2.5                    | V         |
| Power supply voltage                   | $V_{CC}$ | 0 to +4.0              | $V_{P.P}$ |

Note:  
Absolute maximum ratings represent the damage threshold of the device.  
Damage may occur if the device is subjected to conditions beyond the limits stated here.

## 3.3 Operating Conditions

| Part Number        | Temperature Rating | Unit |
|--------------------|--------------------|------|
| PLRXPL-VC-S43-xx-N | 0 – 70             | °C   |

Note:  
Performance is not guaranteed and reliability is not implied for operation at any condition outside these limits.



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## 3.4 Electrical Characteristics

| Parameter                             | Symbol                     | Min.                | Typical | Max.                  | Unit               | Notes   |
|---------------------------------------|----------------------------|---------------------|---------|-----------------------|--------------------|---|
| Supply voltage                        | $V_{cc}$                   | 3.14                | 3.3     | 3.47                  | V                  | All electrical and optical specifications valid within this range   |
| Power consumption                     | $P_{diss}$                 |                     | 480     | 1000                  | mW                 |   |
| Data rate                             |                            |                     | 10.3125 | 10.4                  | Gbps               | $BER < 1 \times 10^{-12}$   |
| <b>Transmitter</b>                    |                            |                     |         |                       |                    |   |
| Supply current                        | $I_{ccT}$                  |                     |         | 110                   | mA                 |   |
| Data input voltage swing              | $V_{TDP-p}$                | 150                 | 800     | 1600                  | mV <sub>p-p</sub>  | Differential, peak to peak  |
| Data input rise/fall time             |                            | 15                  |         | 40                    | ps                 |   |
| Data input skew                       | $\Delta t$                 |                     |         | 8                     | ps                 |   |
| Data dependent input jitter           | DDJ                        |                     |         | 0.12                  | UI                 | $\pm K28.5$ pattern, TP1, at 10.3 Gbps (Note 1)   |
| Data input total jitter               | TJ                         |                     |         | 0.25                  | UI                 | $2^{31}-1$ pattern, TP1, $BER < 1 \times 10^{-12}$ , at 10.3 Gbps (Notes 1, 8)  |
| Transmit disable voltage level        | $V_{IH}$<br>$V_{IL}$       | 2.0<br>-0.3         |         | $V_{cc} + 0.3$<br>0.8 | V<br>V             | Laser output disabled after $T_{TD}$ if input level is $V_{IH}$ ; Laser output enabled after $T_{TEN}$ if input level is $V_{IL}$   |
| Transmit disable/enable assert time   | $T_{TD}$<br>$T_{TEN}$      |                     |         | 10<br>2               | $\mu s$<br>ms      | Laser output disabled after $T_{TD}$ if input level is $V_{IH}$ ; Laser output enabled after $T_{TEN}$ if input level is $V_{IL}$   |
| Transmit fault output voltage level   | $I_{OH}$<br>$V_{OL}$       | -50<br>-0.3         |         | +37.5<br>0.4          | $\mu A$<br>V       | Transmit fault level is $I_{OH}$ and Laser output disabled $T_{Fault}$ after laser fault. $I_{OH}$ is measured with a 4.7 k $\Omega$ load pulled up to $V_{cc}$ host. $V_{OL}$ is measured at 0.7 mA. |
| Transmit fault assert and reset times | $T_{Fault}$<br>$T_{Reset}$ | 10                  |         | 100                   | $\mu s$<br>$\mu s$ | Transmitter fault is $V_{OL}$ and Laser output restored $T_{INI}$ after transmitter disable is asserted for $T_{Reset}$ then disabled.  |
| Initialization time                   | $T_{INI}$                  |                     |         | 300                   | ms                 | After hot plug or $V_{cc} \geq 2.97$ V  |
| <b>Receiver</b>                       |                            |                     |         |                       |                    |   |
| Supply current                        | $I_{CCR}$                  |                     |         | 120                   | mA                 |   |
| Data output voltage swing             | $\Delta V$                 | 300                 |         | 1000                  | mV <sub>p-p</sub>  | $R_{LOAD} = 100 \Omega$ , differential  |
| Data output rise/fall time            | tr/tf                      |                     |         | 45                    | ps                 | 20% – 80%, differential   |
| Data output skew                      | Dt                         |                     |         | 15                    | ps                 | $R_{LOAD} = 100 \Omega$ , differential  |
| Deterministic jitter                  | DJ                         |                     |         | 0.4                   | UI                 | $\pm K28.5$ pattern, TP4, at 10.3 Gbps (Notes 1, 4)   |
| Total jitter                          | TJ                         |                     |         | 0.65                  | UI                 | $2^{31}-1$ pattern, TP4, $BER < 1 \times 10^{-12}$ at 10.3 Gbps (Notes 1, 4, 6)   |
| Loss of signal voltage level          | $V_{OH}$<br>$V_{OL}$       | $V_{cc} - 0.5$<br>0 |         | $V_{cc}$<br>0.5       | V<br>V             | LOS output level $V_{OL}$ $T_{LOSD}$ after light input > LOSD (Note 2)<br>LOS output level $V_{OH}$ $T_{LOSA}$ after light input < LOSA (Note 2)  |
| Loss of signal assert/deassert time   | $T_{LOSA}$<br>$T_{LOSD}$   |                     |         | 100<br>100            | $\mu s$<br>$\mu s$ | LOS output level $V_{OL}$ $T_{LOSD}$ after light input > LOSD (Note 2)<br>LOS output level $V_{OH}$ $T_{LOSA}$ after light input < LOSA (Note 2)  |

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## 3.5 Optical Characteristics

| Parameter                            | Symbol        | Min. | Typical | Max.   | Unit          | Notes  |
|--------------------------------------|---------------|------|---------|--------|---------------|--|
| <b>Transmitter</b>                   |               |      |         |        |               |  |
| Wavelength                           | $\lambda_p$   | 840  | 850     | 860    | nm            |  |
| RMS spectral width                   |               |      |         | 0.45   | nm            |  |
| Transmitter dispersion penalty       | TDP           |      |         | 3.9    | dB            | (Note 3)   |
| Average optical power                | $P_{AVG}$     | -8   |         | Note 6 | dBm           |  |
| Optical modulation amplitude         | OMA           | *    |         |        | $\mu W$       |  |
| Relative intensity noise             | $RIN_{12}OMA$ |      |         | -128   | dB/Hz         | 12 dB reflection   |
| <b>Receiver</b>                      |               |      |         |        |               |  |
| Wavelength                           | $\lambda$     | 840  | 850     | 860    | nm            |  |
| Maximum input power                  | $P_{max}$     | -1   |         |        | dBm           |  |
| Sensitivity (OMA)                    | S             |      |         | 85     | $\mu W_{p,p}$ | (Note 7)   |
| Stressed sensitivity (OMA)           | ISI = 2.8 dB  |      |         | 166    | $\mu W_{p,p}$ |  |
| Loss of signal assert/deassert level | LOSD          |      |         | -11    | dBm           | Chatter-free operation; LOSD is OMA, LOSA is average power |
|                                      | LOSA          | -30  |         |        | dBm           |  |
| Low frequency cutoff                 | $F_C$         |      |         | 0.3    | MHz           | -3 dB, $P < -16$ dBm                                       |

Note:

\* Tradeoffs between center wavelength, spectral width, and minimum OMA are used. Refer to the table on Minimum Optical Modulation Amplitude in dBm for details.

### Minimum Optical Modulation Amplitude in dBm

| Wavelength (nm) | Spectral Width (nm) |            |            |            |             |            |            |            |
|-----------------|---------------------|------------|------------|------------|-------------|------------|------------|------------|
|                 | <0.1                | 0.1 – 0.15 | 0.15 – 0.2 | 0.2 – 0.25 | 0.25 – 0.30 | 0.3 – 0.35 | 0.35 – 0.4 | 0.4 – 0.45 |
| 840 – 845       | -4.3                | -4.2       | -4.2       | -4.1       | -4.1        | -4.0       | -3.9       | -3.7       |
| 845 – 850       | -4.3                | -4.2       | -4.2       | -4.2       | -4.1        | -4.0       | -3.9       | -3.8       |
| 850 – 855       | -4.3                | -4.3       | -4.2       | -4.2       | -4.1        | -4.0       | -3.9       | -3.8       |
| 855 – 860       | -4.3                | -4.3       | -4.2       | -4.2       | -4.1        | -4.1       | -4.0       | -3.9       |

Note:

\* Tradeoffs between center wavelength, spectral width, and minimum OMA are used.

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## 3.6 Link Length

| Data Rate / Standard | Fiber Type                 | Modal Bandwidth at 850 nm (MHz*km) | Distance Range (m) | Notes |
|----------------------|----------------------------|------------------------------------|--------------------|-------|
| 10.3 GBd             | 62.5/125 $\mu\text{m}$ MMF | 200                                | 2 – 20             | 5     |
|                      | 50/125 $\mu\text{m}$ MMF   | 500                                | 2 – 40             | 5     |
|                      | 50/125 $\mu\text{m}$ MMF   | 900                                | 2 – 90             | 5     |
|                      | 50/125 $\mu\text{m}$ MMF   | 1500                               | 2 – 160            | 5     |
|                      | 50/125 $\mu\text{m}$ MMF   | 2000                               | 2 – 200            | 5     |

### Specification Notes

1. UI (unit interval): one UI is equal to one bit period. For example, 10.3125 Gbps corresponds to a UI of 96.97 ps.
2. For LOSA and LOSD definitions, see Loss of Signal Assert/Deassert Level in Optical Characteristics.
3. Transmitter dispersion penalty is measured using the methods specified in the IEEE standard 802.3-2005 Clause 52 except that the transversal filter differential delay is 33 ps.
4. Measured with stressed eye pattern as per IEEE standard 802.3-2005, Clause 52 except that the vertical eye opening penalty is as specified in Optical Characteristics.
5. Distances, shown in the “Link Length” table, are calculated for worst-case fiber and transceiver characteristics based on the optical and electrical specifications shown in this document using techniques specified in IEEE 802.3. In the nominal case, longer distances are achievable.
6. The maximum transmitter output power is the lesser of the Class 1 laser eye safety limit and the maximum receiver input power limit.
7. Sensitivity is for informational purposes only.
8. The data pattern for the total jitter measurement is one of IEEE 802.3 CL52.9 Pattern 1, Pattern 3, or valid 64/66B data traffic.

### 3.7 Regulatory Compliance

The PLRXPL-VC-S43-xx-N optical 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.

The PLRXPL-VC-S43-xx-N optical transceiver 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.

| Regulatory Compliance                |   |   |
|--------------------------------------|---|---|
| Feature                              | Test Method   | Performance   |
| Component safety                     | UL 60950<br>UL 94, V0<br>IEC 60950  | UL File E209897<br><br>TUV Report/Certificate (CB scheme)   |
| RoHS-compliant                       | 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 <sup>1</sup>        | EN 60825<br>U. S. 21CFR 1040.10   | TUV Certificate<br>CDRH compliant and Class 1 laser eye safe  |
| <b>Electromagnetic Compatibility</b> |   |   |
| Electromagnetic emissions            | EMC Directive 89/336/EEC<br>FCC CFR47 Part 15<br>IEC/CISPR 22<br>AS/NZS CISPR22<br>EN 55022<br>ICES-003, Issue 4<br>VCCI-03 | Noise frequency range: 30 MHz to 40 GHz.<br>Good system EMI design practice required to achieve Class B margins.  |
| Electromagnetic immunity             | EMC Directive 89/336/EEC<br>IEC/CISPR/24<br>EN 55024  |   |
| ESD immunity                         | EN 61000-4-2  | Exceeds requirements. Withstand discharges of 4 kV contact and 8 kV air discharge to Criterion A, and 8 kV contact and 25 kV air discharge to Criterion B.  |
| 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.   |

1. For further details, see Eye Safety

3.8 PCB Layout

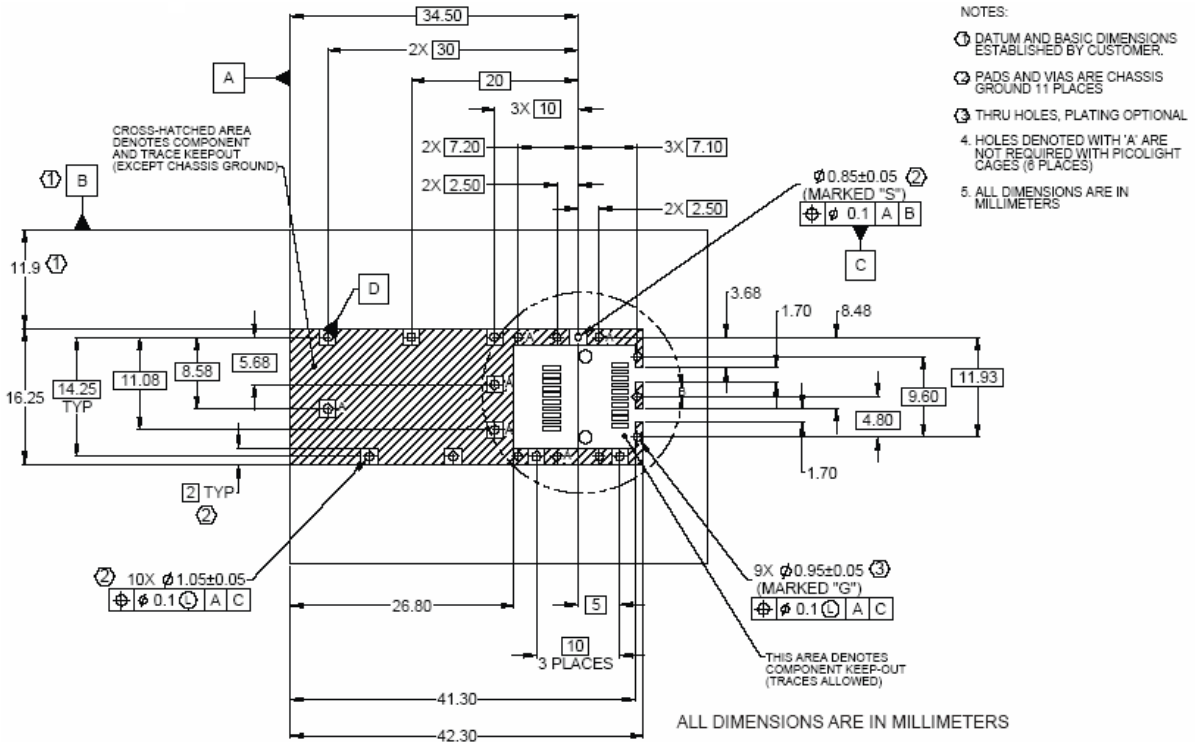


Figure 4 Board layout

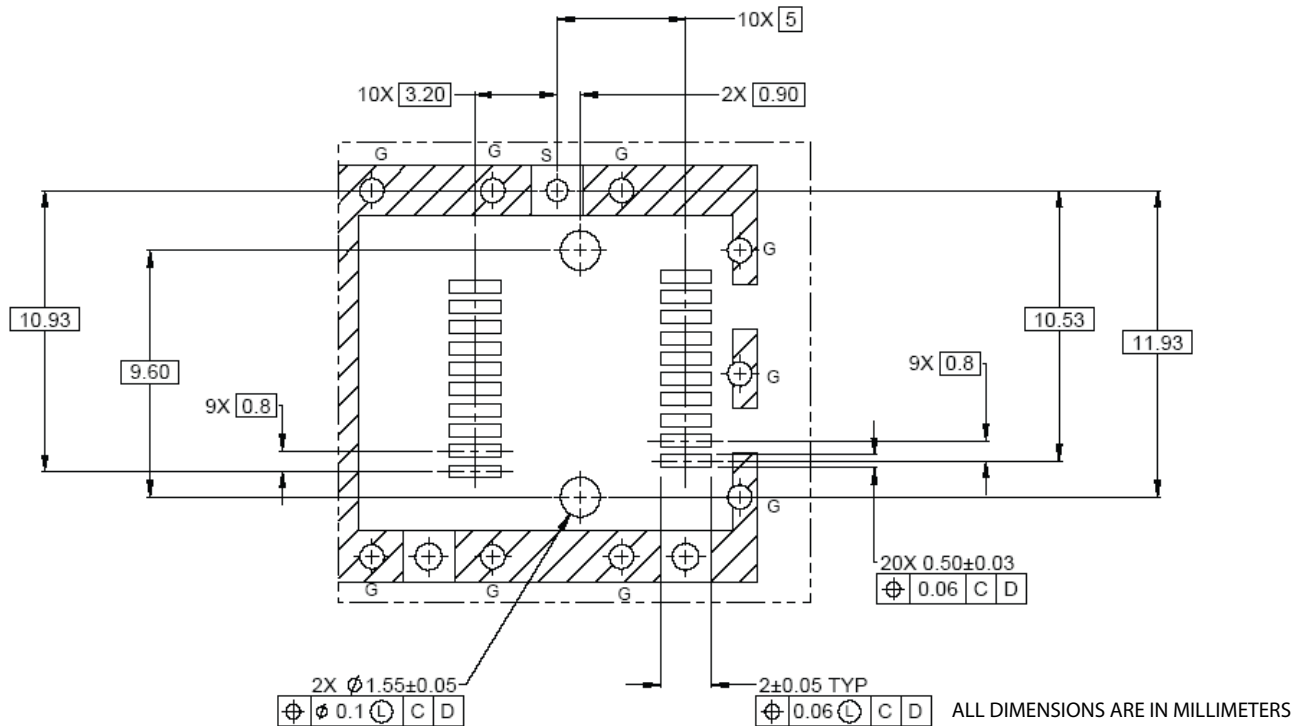


Figure 5 Detail layout

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## 3.9 Front Panel Opening

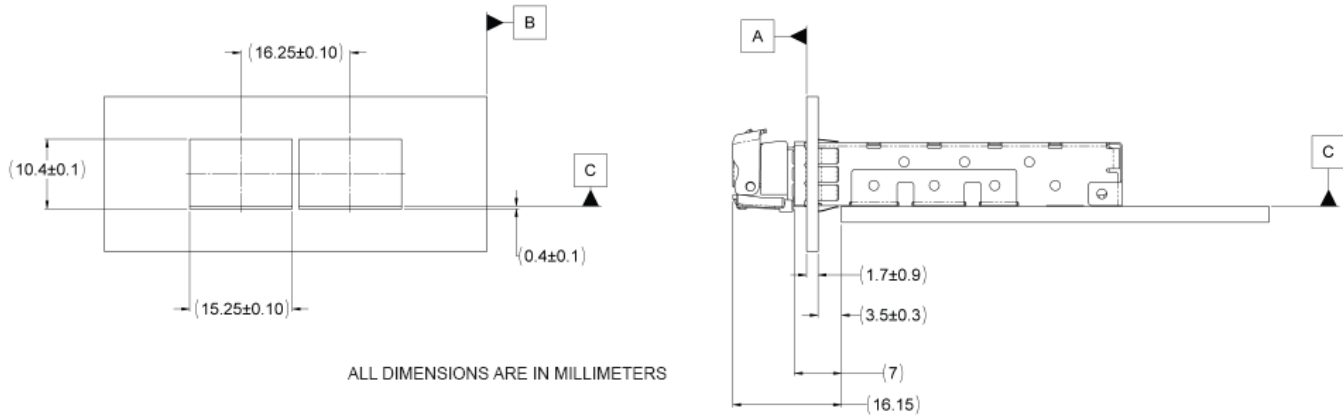


Figure 6

## 3.10 Module Outline

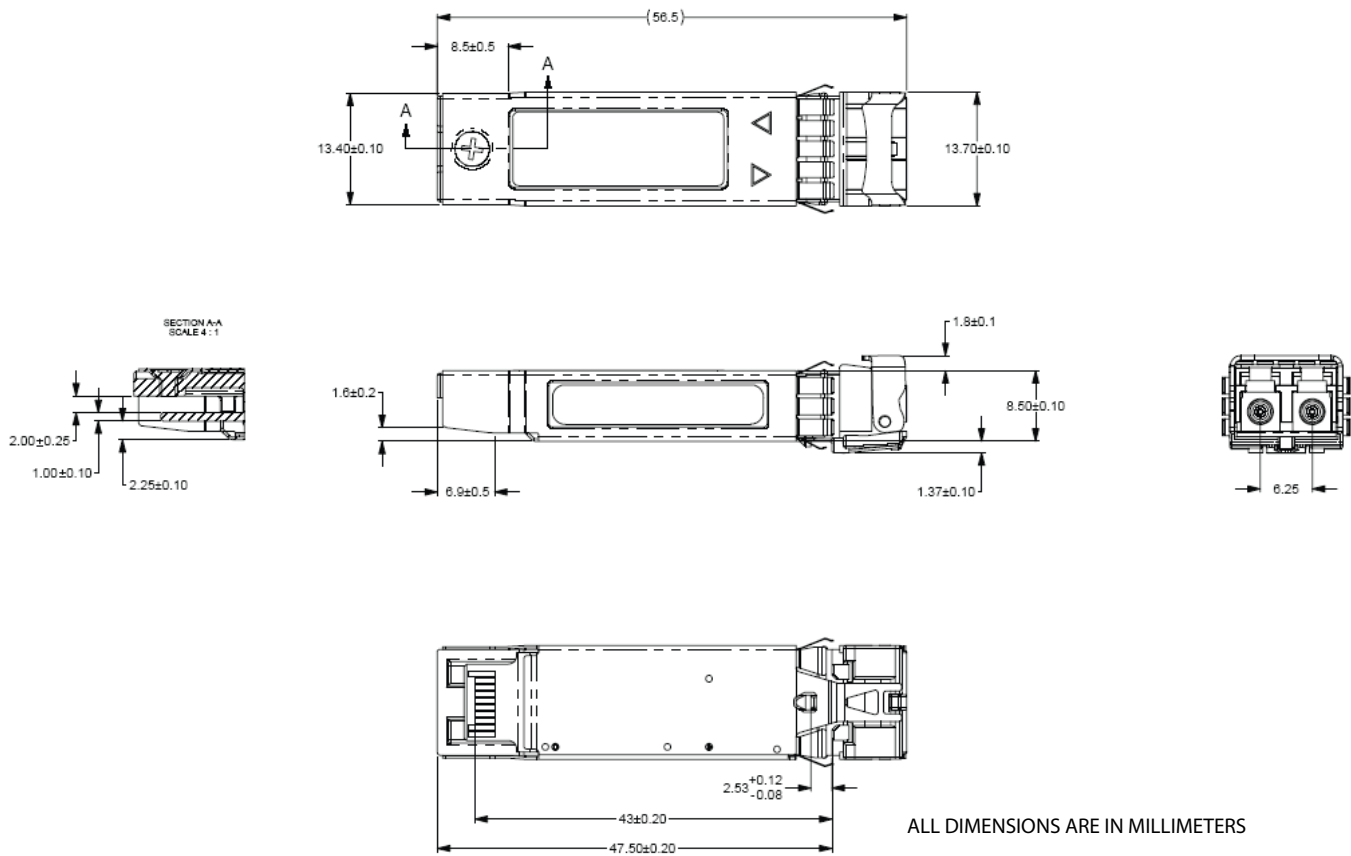


Figure 7

### 3.11 Transceiver Belly-to-belly Mounting

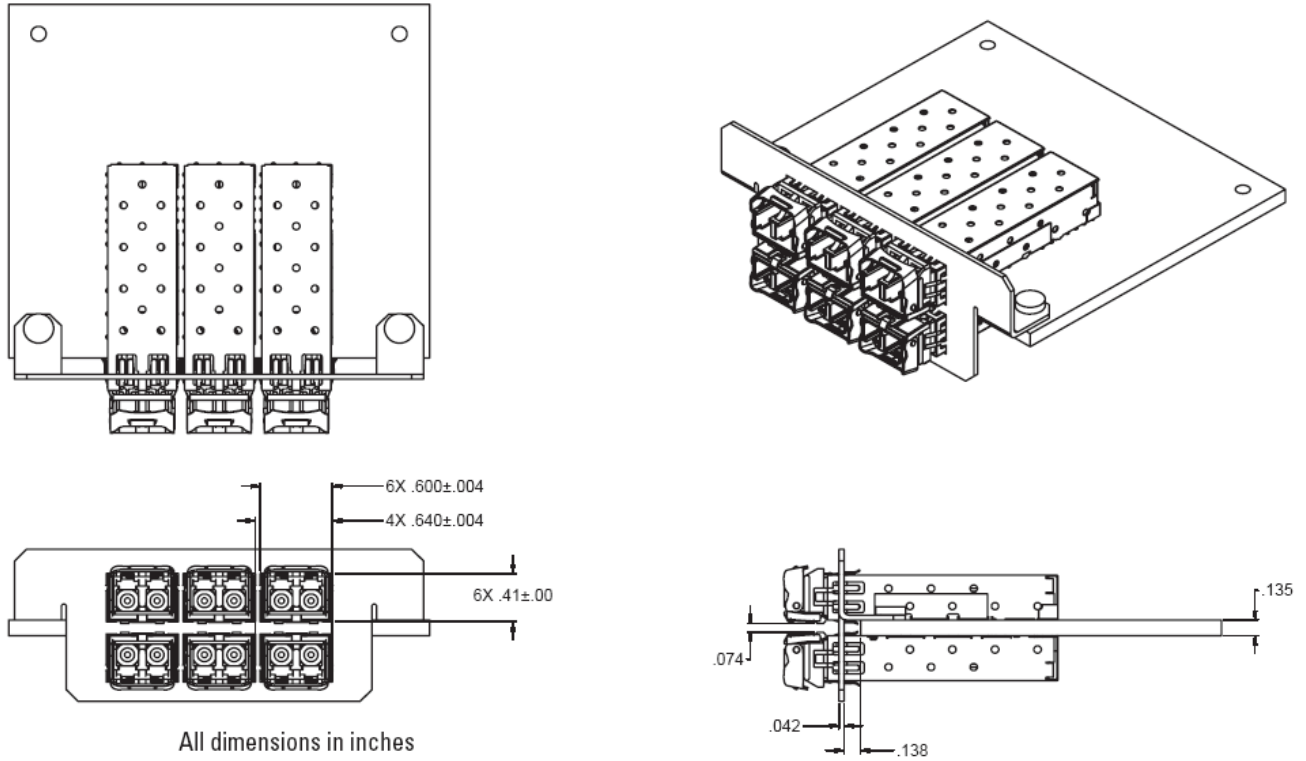


Figure 8

## Section 4 Related Information

Other information related to the SFP+ optical transceiver includes:

- Section 4.1 Digital diagnostic monitoring and serial ID operation
- Section 4.2 Package and handling instructions
- Section 4.3 ESD discharge (ESD)
- Section 4.4 Eye safety

### 4.1 Digital Diagnostic Monitoring and Serial ID Operation

The PLRXPL-VC-S43-xx-N optical transceiver is equipped with a two-wire serial EEPROM that is used to store specific information about the type and identification of the transceiver as well as real-time digitized information relating to the transceiver's performance. See the Small Form Factor Committee document number SFF-8472 Revision 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 which 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  $+70^{\circ}\text{C}$  with LSB equal to  $1/256^{\circ}\text{C}$ . Accuracy is  $\pm 3^{\circ}\text{C}$  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  $\pm$  three 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 SFF-8431 Revision 2.2 specification contains all the timing and addressing information required for accessing the data in the EEPROM.

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.

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

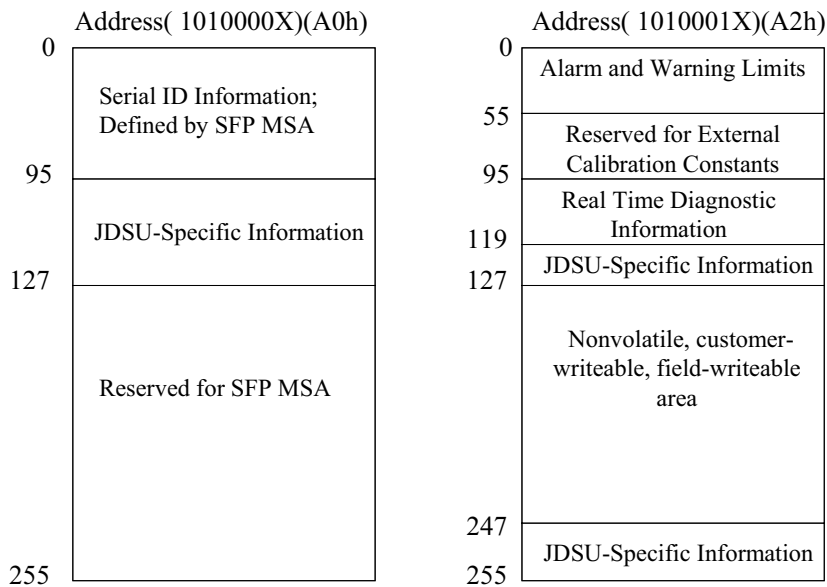
SDA, pin 4 on the transceiver, is connected to the SDA pin of the EEPROM.

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 – 127 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 the Small Form Factor Committee document SFF-8472 Revision 10.3, dated December 1, 2007.

**Data Field Descriptions**



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## Serial ID Data and Map

| Memory Address | Value            | Comments  |
|----------------|------------------|---|
| 0              | 03               | SFP Transceiver   |
| 1              | 04               | SFP with Serial ID  |
| 2              | 07               | LC Connector  |
| 3-10           | 0000000000000000 |   |
| 11             | 06               | 64B/66B   |
| 12             | 67               | Nominal Bit rate of 10.3 Gbps   |
| 13             | 00               | Rate Identifier (for Rate-selectable modules)   |
| 14             | 00               | Single-mode fiber not supported   |
| 15             | 00               | Single-mode fiber not supported   |
| 16             | 04               | 40 meters of OM2 50/125 $\mu$ m multimode fiber   |
| 17             | 02               | 20 meters of OM1 62.5/125 $\mu$ m multimode fiber   |
| 18             | 00               | Copper not supported  |
| 19             | 14               | 200 meters of OM3 50/125 $\mu$ m multimode fiber  |
| 20-35          | JDSU             | Vendor Name (ASCII)   |
| 36             | 00               | Reserved  |
| 37-39          | 00019C           | IEEE Company ID (ASCII)   |
| 40-55          | PLRXPLVCS43xxN   | Part Number (ASCII), x = part number variable   |
| 56-59          |                  | Revision of part number (ASCII)   |
| 60-61          | 0352             | Wavelength of laser in nm; 850  |
| 62             |                  | Unallocated   |
| 63             | CC_BASE          | Check Code; Lower 8 bits of sum from byte 0 through 62  |
| 64             | 00               | Conventional uncooled laser, Class 1 power level,<br>Conventional limiting receiver output                    |
| 65             | 1A               | Tx_Disable, Tx Fault, Loss of Signal implemented  |
| 66             | 00               |   |
| 67             | 00               |   |
| 68-83          |                  | Serial Number (ASCII)   |
| 84-91          |                  | Date Code (ASCII)   |
| 92             | 68               | Diagnostic monitoring implemented, internally calibrated,<br>Receiver Power Measurement type is Average Power |
| 93             | F0               | Alarms and Warnings, TX_Fault and Rx_LOS monitoring<br>implemented, TX_Disable Control and Monitoring.        |
| 94             | 03               | SFF-8472 Revision 10.3 compliant  |
| 95             | CC_EXT           | Check Code; Lower 8 bits of sum from byte 64 through 94   |
| 96-127         |                  | JDSU-specific EEPROM  |
| 128-255        |                  | Reserved for SFF-8079   |

# 19

## Diagnostics Data Map

| Memory Address | Value                 | Comments                                     |
|----------------|-----------------------|--|
| 00-01          | Temp High Alarm       | MSB at low address                           |
| 02-03          | Temp Low Alarm        | MSB at low address                           |
| 04-05          | Temp High Warning     | MSB at low address                           |
| 06-07          | Temp Low Warning      | MSB at low address                           |
| 08-09          | Voltage High Alarm    | MSB at low address                           |
| 10-11          | Voltage Low Alarm     | MSB at low address                           |
| 12-13          | Voltage High Warning  | MSB at low address                           |
| 14-15          | Voltage Low Warning   | MSB at low address                           |
| 16-17          | Bias High Alarm       | MSB at low address                           |
| 18-19          | Bias Low Alarm        | MSB at low address                           |
| 20-21          | Bias High Warning     | MSB at low address                           |
| 22-23          | Bias Low Warning      | MSB at low address                           |
| 24-25          | TX Power High Alarm   | MSB at low address                           |
| 26-27          | TX Power Low Alarm    | MSB at low address                           |
| 28-29          | TX Power High Warning | MSB at low address                           |
| 30-31          | TX Power Low Warning  | MSB at low address                           |
| 32-33          | RX Power High Alarm   | MSB at low address                           |
| 34-35          | RX Power Low Alarm    | MSB at low address                           |
| 36-37          | RX Power High Warning | MSB at low address                           |
| 38-39          | RX Power Low Warning  | MSB at low address                           |
| 40-55          | Reserved              | For future monitoring quantities             |
| 56-59          | RP4                   | External Calibration Constant                |
| 60-63          | RP3                   | External Calibration Constant                |
| 64-67          | RP2                   | External Calibration Constant                |
| 68-71          | RP1                   | External Calibration Constant                |
| 72-75          | RP0                   | External Calibration Constant                |
| 76-77          | Islope                | External Calibration Constant                |
| 78-79          | Ioffset               | External Calibration Constant                |
| 80-81          | TPslope               | External Calibration Constant                |
| 82-83          | TPoffset              | External Calibration Constant                |
| 84-85          | Tslope                | External Calibration Constant                |
| 86-87          | Toffset               | External Calibration Constant                |
| 88-89          | Vslope                | External Calibration Constant                |
| 90-91          | Voffset               | External Calibration Constant                |
| 92-94          | Reserved              | Reserved                                     |
| 95             | Checksum              | Low order 8 bits of sum from 0 – 94          |
| 96             | Temperature MSB       | Internal temperature AD values               |
| 97             | Temperature LSB       |  |
| 98             | Vcc MSB               | Internally measured supply voltage AD values |
| 99             | Vcc LSB               |  |
| 100            | TX Bias MSB (Note 1)  | TX Bias Current AD values                    |

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### Diagnosics Data Map

(continued)

| Memory Address | Value                                       | Comments   |
|----------------|---|--|
| 101            | TX Bias LSB (Note 1)                        |  |
| 102            | TX Power MSB (Note 1)                       | Measured TX output power AD values                               |
| 103            | TX Power LSB (Note 1)                       |  |
| 104            | RX Power MSB                                | Measured RX input power AD values                                |
| 105            | RX Power LSB                                |  |
| 106            | Reserved MSB                                | For 1st future definition of digitized analog input              |
| 107            | Reserved LSB                                |  |
| 108            | Reserved MSB                                | For 2nd future definition of digitized analog input              |
| 109            | Reserved LSB                                |  |
| 110-7          | Tx Disable State                            | Digital State of Tx Disable Pin                                  |
| 110-6          | Soft Tx Disable Control                     | Writing "1" OR pulling the Tx_Disable pin will disable the laser |
| 110-5          | Reserved                                    |  |
| 110-4          | Rate Select State                           | Digital State of Rate Select Pin                                 |
| 110-3          | Soft Rate Select Control                    | Writing to this bit has no effect                                |
| 110-2          | Tx Fault State                              | Digital State  |
| 110-1          | LOS State                                   | Digital State  |
| 110-0          | Data Ready State                            | Digital State; "1" until transceiver is ready                    |
| 111            | Reserved                                    | Reserved   |
| 112-119        | Optional alarm & warning flag bits (Note 2) | Refer to SFF-8472 Revision 10.3                                  |
| 120-127        | Vendor specific                             | JDSU specific  |
| 128-247        | User/Customer EEPROM                        | Field writeable EEPROM   |
| 248-255        | Vendor specific                             | Vendor-specific control  |

Note :

1. During Tx disable, Tx bias and Tx power will not be monitored.
2. Alarm and warning are latched. The flag registers are cleared when the system Reads AND the alarm/warning condition no longer exists.

## 4.2 Package and Handling Instructions

This product is not compatible with any aqueous wash process.

### Process plug

The PLRXPL-VC-S43-xx-N optical transceiver is supplied with a process plug. This plug 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.

### Recommended cleaning and degreasing chemicals

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

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

### Flammability

The housing is made of cast zinc and sheet metal.

## 4.3 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 which may become temporarily saturated during an ESD strike. This could result in a short burst of bit errors. Such an event would call for the application to reacquire synchronization at the higher layers (serializer/deserializer chip).

#### 4.4 Eye Safety



The PLRXPL-VC-S43-xx-N Optical Transceiver is a CLASS 1 LASER PRODUCT as defined by the international standard IEC 60825-1 Second Edition 2007-03 and by U.S.A. regulations for Class 1 products per CDRH 21 CFR 1040.10 and 1040.11. Laser emissions from Class 1 laser products are not considered hazardous when operated according to product specifications. Operating the product with a power supply voltage exceeding 4.0 volts may compromise the reliability of the product, and could result in laser emissions exceeding Class 1 limits.

#### 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).

#### Sample: PLRXPL-VC-S43-21-N

| Part Number        | Product Description  |
|--------------------|--|
| PLRXPL-VC-S43-21-N | 10 G SFP+ SR compatible, limiting electrical interface, 0 – 70°C, ± 5% Vcc, no rate select, generic, first generation  |
| PLRXPL-VC-S43-22-N | 10 G SFP+ SR compatible, limiting electrical interface, 0 – 70°C, ± 5% Vcc, no rate select, generic, second generation |

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