Accelar™

2 Gbps 850 nm SFP Transceivers with Optional Triple-Rate, Extended Temperature & Voltage, and Digital Diagnostics

PL-XPL-Vx-S2x-xx

This standard dual-rate Small Form Factor Pluggable (SFP) transceiver provides superior performance for Fibre Channel applications, and is another in Picolight's family of *Accelar* products customized for high speed, short reach LAN, SAN, and intra-POP applications. The multi-rate feature enables its use in a wider range of system applications without the need to provide the rate select input. It is fully compliant with both FC-PI 100-M5/M6-SN-I and 200-M5/M6-SN-I specifications and is optionally compliant with IEEE 802.3 1000Base-SX. This transceiver features the highly reliable 850 nm oxide vertical-cavity surface-emitting laser (VCSEL) coupled to a LC optical connector. Its small size allows for high-density board designs that, in turn, enable greater total aggregate bandwidth.

Key benefits

- Compliant with industry-wide physical and optical specifications
- Dual-rate FC performance
- Optional 1000Base-SX, Gigabit Ethernet Compliance
- Enables higher port densities
- Proven high reliability
- In-house precision alignment

Applications

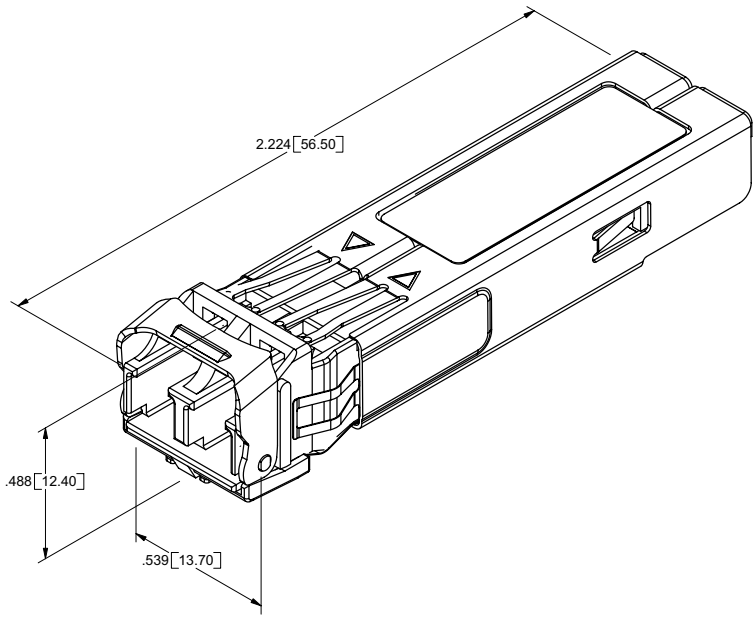
- High-speed storage area networks
  - Switch and hub interconnect
  - Mass storage systems interconnect
  - Host adapter interconnect
- Computer cluster cross-connect
- Custom high-speed data pipes

Highlights

- ***Enhanced Digital Diagnostic feature set*** *allows real-time monitoring of transceiver performance and system stability. (Optional Feature)*
- ***Bail mechanism*** *enables superior ergonomics and functionality in all port configurations*
- ***Extended Voltage and Extended Temperature*** *enable deployment for applications requiring a larger range of environmental conditions and a lower sensitivity to power supply variations. (Optional Feature)*
- ***Puggability enables just-in-time (JIT) inventory control of populated cards*** *by allowing separate control of cards and transceivers*
- ***MSA-compliant small form factor footprint*** *is half the size of current implementations, doubling port density and reducing overall system cost*
- ***Serial ID*** *allows customer and vendor system specific information to be placed in transceiver*
- ***All-metal housing*** *provides superior EMI performance*

PL-XPL-Vx-S2x-xx features

- Utilizes a highly reliable, high speed, 850 nm, oxide VCSEL
- Hot pluggable
- Digital Diagnostics available; SFF-8472 rev 9.3 compliant
- Compliant with Fibre Channel 200-M5/M6-SN-I and 100-M5/M6-SN-I
- Compliance with IEEE 802.3 1000Base-SX available
- Interoperable with all CD-based 1 Gbps transeivers
- Low nominal power consumption (< 550 mW)
- -20°C to 85°C operating temperature range available
- Single +3.3 V power supply
- ± 10% extended operating voltage range available
- Bit error rate < $1x10^{-12}$
- OC transmit disable, loss of signal and transmitter fault functions
- CDRH and IEC 60825-1 Class 1 laser eye safe
- FCC Class B compliant
- ESD Class 2 per MIL-STD 883 Method 3015



An eye-safe, cost effective serial transceiver, the PL-XPL-Vx-S2x-xx features a small, low power, pluggable package that manufacturers can upgrade in the field, adding bandwidth incrementally. The robust mechanical design features a unique all-metal housing that provides superior EMI shielding.

Ordering information

Part Number:	Temp. Range:	Power Supply Tolerance:	Dual Rate Fiber Channel:	1000Base-SX Compliant	Digital Diagnostics	PCI Compliant
PL-XPL-VC-S23-11	0 to 70°C	±5%	X			
PL-XPL-VE-S24-11	-20 to 85°C	±10%	X			
PL-XPL-VE-S24-31	-5 to 70°C	±10%	X			X
PL-XPL-VE-S24-23	-5 to 70°C	±10%	X		X	X
PL-XPL-VC-S23-21	0 to 70°C	±5%	X		X	
PL-XPL-VC-S23-12	0 to 70°C	±5%	X	X		
PL-XPL-VC-S23-22	0 to 70°C	±5%	X	X	X	
PL-XPL-VE-S24-2C	-20 to 85°C	±10%	X	X	X	
Contact Information:	Picolight Incorporated 4665 Nautilus Court S Boulder, CO 80301		Tel: 303.530.3189 Email: sales@picolight.com Web site: www.picolight.com			

Section 1 Functional description

The PL-XPL-Vx-S2x-xx 850 nm VCSEL Gigabit Transceiver is designed to transmit and receive 8B/10B encoded serial optical data over 50/125 μm or 62.5/125 μm multimode optical fiber.

Transmitter

The transmitter converts 8B/10B encoded serial PECL electrical data into serial optical data meeting the requirements of 100-M5/M6-SN-I and 200-M5/M6-SN-I Fibre Channel and 1000Base-SX (Optional Feature) specifications. Transmit data lines (TD+ & TD-) are internally AC coupled with 100 Ω differential termination.

An open collector compatible Transmit Disable (TD_{is}) is provided. This pin is internally terminated with a 10 kΩ resistor to Vcc_T. 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 is used to ensure constant optical power output across supply voltage and temperature variations.

An open collector compatible Transmit Fault (TFault) is provided. The Transmit 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 the part is not fully seated and the transmitter is disabled. A logic “0” on this pin indicates normal operation.

Receiver

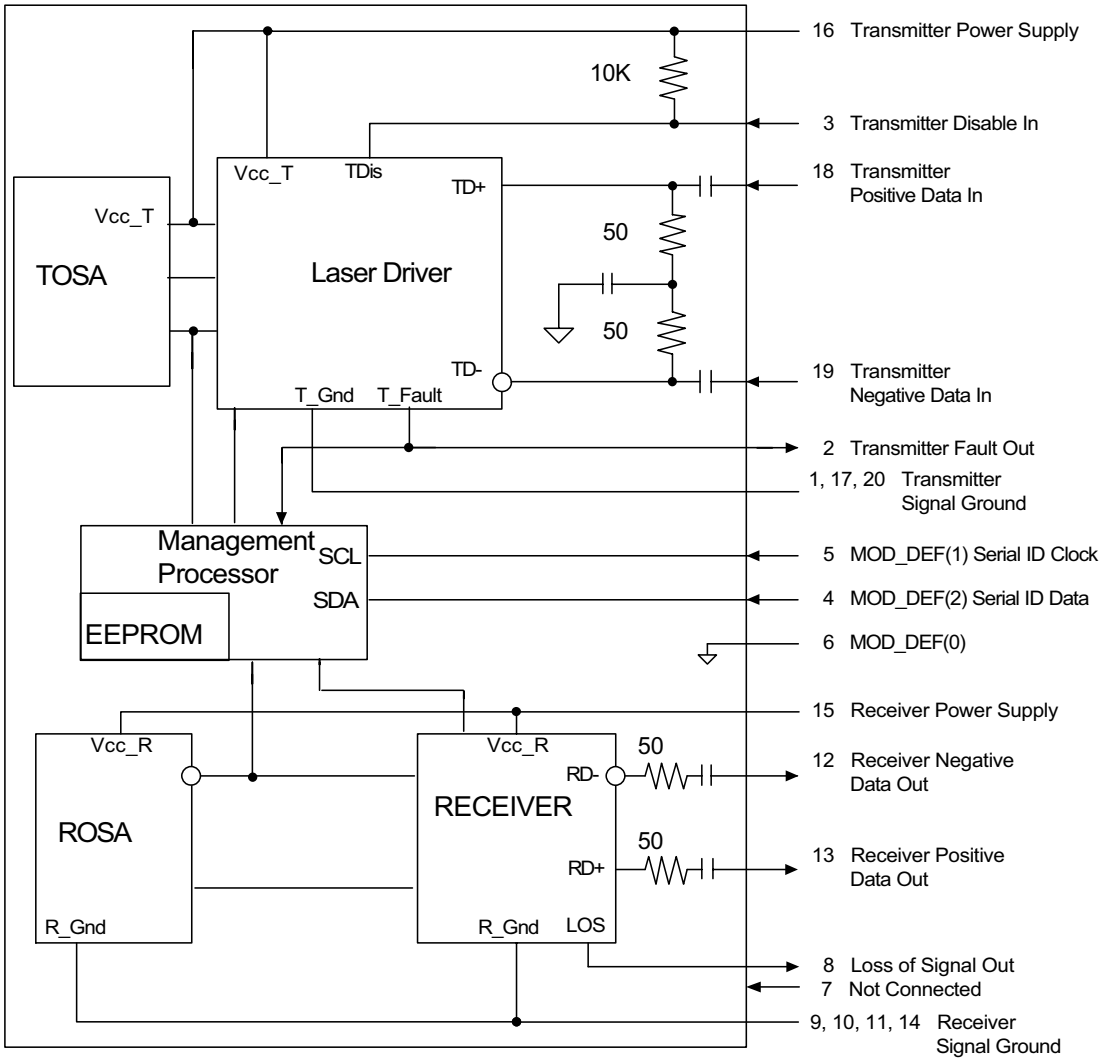
The receiver converts 8B/10B encoded serial optical data into serial PECL electrical data. Receive data lines (RD+ & RD-) are internally AC coupled with 100 Ω differential source impedance, and must be terminated with a 100 Ω differential load.

An open collector compatible Loss of Signal 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 Section 3.4 Optical characteristic, Loss of Signal Assert/Deassert Time on page 10). A logic “1” output indicates that insufficient light has been detected for proper operation.

Power supply filtering is recommended for both the transmitter and receiver. Filtering should be placed on the host assembly as close to the Vcc pins as possible for optimal performance.

Recommended “Application Schematics” are shown in Figure 3 on page 6.

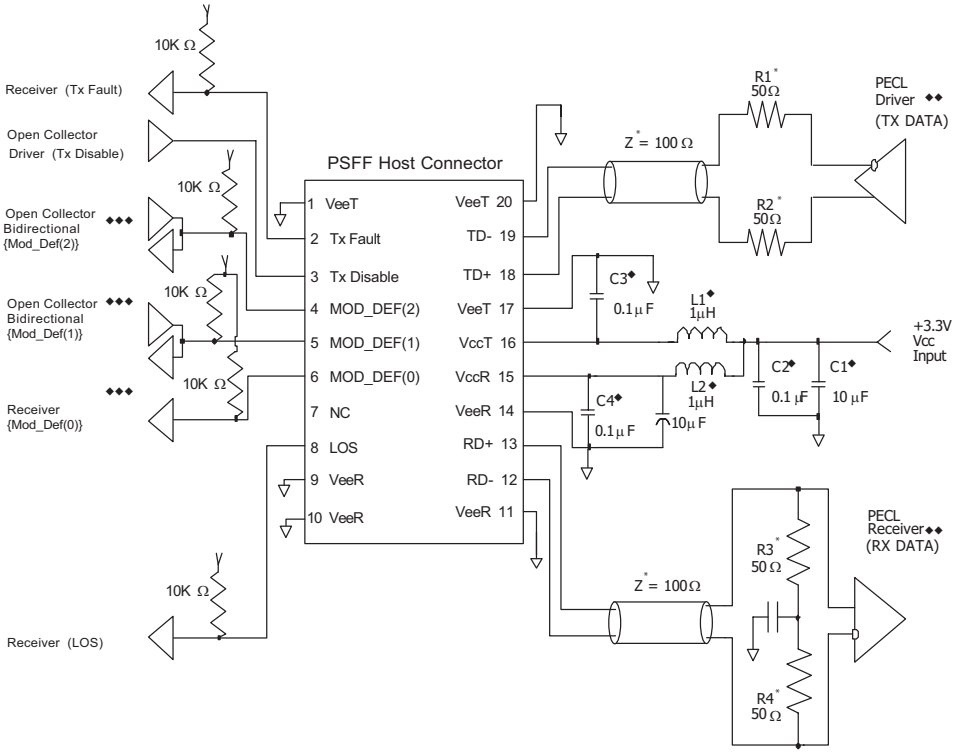
Figure 1 Block diagram



Section 2 Application schematics

Recommended connections to the PL-XPL-Vx-S2x-xx transceiver are shown in Table 2 below.

Figure 2 Recommended application schematic for the PL-XPL-Vx-S2x-xx 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 will require biasing networks. Please consult application notes from suppliers of these components.

◆◆◆ MOD_DEF(2) and MOD_DEF(1) should be bi-directional open collector connections in order to implement serial ID (MOD_DEF[0,1,1]) PL-XPL-Vx-S2x-xx transceiver.

* Transmission lines should be 100 Ω differential traces. It is recommended that the termination resistor for the PECL Receiver (R3 + R4) be placed beyond the input pins of the PECL Receiver. Series Source Termination Resistors on the PECL Driver (R1+R2) should be placed as close to the driver output pins as possible.

Section 3 Technical data

Technical data related to these transceivers:

3.1 Pin function definitions

Figure 3 Transceiver pin descriptions

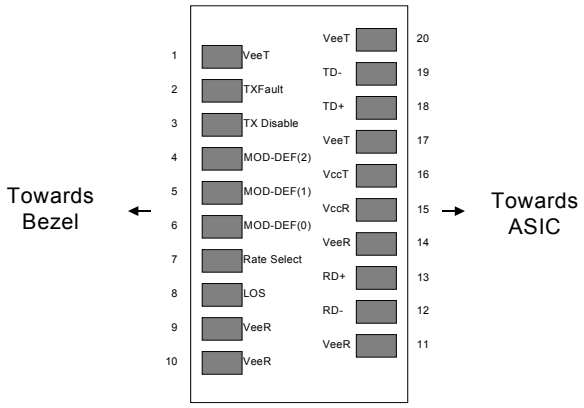


Table 1 Transceiver pin descriptions

Pin Number	Symbol	Name	Description
Receiver			
8	LOS	Loss of Signal Out (OC)	Sufficient optical signal for potential BER < $1x10^{-12}$ = Logic "0" Insufficient optical signal for potential BER < $1x10^{-12}$ = Logic "1" This pin is open collector compatible, and should be pulled up to Host Vcc with a 10 kΩ resistor.
9, 10, 11, 14	VeeR	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 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 Receiver DATA output is internally AC coupled and series terminated with a 50 Ω resistor.
15	VccR	Receiver Power Supply	This pin should be connected to a filtered +3.3V power supply on the host board. See Application schematics on page 5 for filtering suggestions.
7	Rate	Rate Select (LVTTL)	Not connected.
Transmitter			
3	TX Disable	Transmitter Disable In (LVTTL)	Logic "1" Input (or no connection) = Laser off Logic "0" Input = Laser on This pin is internally pulled up to Vcc_T with a 10 kΩ resistor.
1, 17, 20	VeeT	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_fault) Logic "0" Output = Normal Operation This pin is open collector compatible, and should be pulled up to Host Vcc with a 10 kΩ resistor.
16	VccT	Transmitter Power Supply	This pin should be connected to a filtered +3.3V power supply on the host board. See Application schematics on page 5 for filtering suggestions.
18	TD+	Transmitter Positive DATA In (PECL)	Logic "1" Input = Light on 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 Transmitter DATA inputs are internally AC coupled and terminated with a differential 100 Ω resistor.
Module Definition			
6, 5, 4	MOD_DEF (0:2)	Module Definition Identifiers	Serial ID with optional SFF 8472 Diagnostics (See Annex A) Module Definition pins should be pulled up to Host Vcc with 10 kΩ resistors.

3.2 Absolute maximum ratings

Parameter	Symbol	Ratings	Unit
Storage Temperature	T_{st}	-40 to +95	°C
Operating Case Temperature	T_c	-20 to +85	°C
Power Supply Voltage	V_{cc}	0 to +4.0	V
Transmitter Differential Input Voltage	V_D	2.5	V_{P-P}
Relative Humidity	RH	5 to 95	%

3.3 Electrical characteristics

Parameter	Symbol	Min	Typical	Max	Unit	Notes[1]
Supply Voltage	Vcc	3.15	3.3	3.45	V	PL-XPL-Vx-S23-xx part numbers
	Vcc	2.97	3.3	3.63	V	PL-XPL-Vx-S24-xx part numbers
Data Rate		1.0	2.125	2.2	Gbps	BER < 1x10-12
Operating Temperature Range	Tc	0		70	°C	PL-XPL-VC part numbers
	Tc	-5		70	°C	PL-XPL-VE-S24-31
	Tc	-20		85	°C	PL-XPL-VE part numbers
Transmitter						
Supply Current	I_{CCT}		55	75	mA	PL-XPL-VC-S23-xx
	I_{CCT}		55	85	mA	PL-XPL-VE-S24-xy; x=odd
	I_{CCT}		60	90	mA	PL-XPL-Vx-S2x-2x
Data Input Voltage Swing	V_{TDp-p}	250	800	2200	mV_{p-p}	Differential, peak to peak
Data Input Rise/Fall Time		60		175	ps	20% - 80%, Differential 2 GBd operation,[3]
		60		350	ps	20% - 80%, Differential 1 GBd operation only,[3]
Data Input Skew				35	ps	
Data Input Deterministic Jitter	DJ			0.12	UI	±K28.5 pattern, δ_T, @1.062 Gbps[1,5]
Data Input Deterministic Jitter	DJ			0.14	UI	±K28.5 pattern, δ_T, @ 2.125 Gbps[1,5]
Data Input Deterministic Jitter	DJ			0.1	UI	±K28.5 pattern, T1, @ 1.25 Gbps[1,5]; PL-XPL-Vx-S2x-xy; y=even
Data Input Total Jitter	TJ			0.25	UI	2^7-1 pattern, δ_T, BER < $1x10^{-12}$, @ 1.062 Gbps[1,5]
Data Input Total Jitter	TJ			0.26	UI	2^7-1 pattern, δ_T, BER < $1x10^{-12}$, @ 2.125Gbps[1,5]
1. See Specification notes on page 11 for referenced notes.						

3.3 Electrical characteristics (continued)

Parameter	Symbol	Min	Typical	Max	Unit	Notes[1]
Data Input Total Jitter	TJ			0.24	UI	2^7-1 pattern, T1, BER < $1x10^{-12}$, @ 1.25 Gbps[1,5]; PL-XPL-Vx-S2x-x2 only
Transmit Disable Voltage Level	V_{IH}	Vcc -1.0		Vcc	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}
	V_{IL}	0		0.8	V	
Transmit Disable/Enable Assert Time	T_{TD}			10	µs	
	T_{TEN}			1	ms	
Transmit Fault Output Voltage Level	V_{OH}	Vcc -0.5		Vcc	V	Transmit fault level is V_{OH} and Laser output disabled T_{Fault} after laser fault.
	V_{OL}	0		0.5	V	
Transmit Fault Assert and Reset Times	T_{Fault}			100	µs	Transmitter fault is V_{OL} and Laser output restored T_{INI} after transmitter disable is asserted for T_{Reset}, then disabled.
	T_{Reset}	10			µs	
Initialization Time	T_{INI}			300	ms	After Hot Plug or Vcc ≥ 2.97V
Receiver						
Supply Current	I_{CCR}		100	135	mA	PL-XPL-Vx-S2x-yz; y=odd; without diagnostics
	I_{CCR}			145	mA	PL-XPL-Vx-S2x-yz; y=even, with diagnostics
Data Output Voltage Swing		500		1300	mV_{p-p}	R_{LOAD} = 100 Ω, Differential; PL-XPL-Vx-S23
Data Output Voltage Swing		450			mV_{p-p}	R_{LOAD} = 100 Ω, Differential; PL-XPL-Vx-S24
Data Output Voltage Swing		600			mV_{p-p}	R_{LOAD} = 100 Ω, Differential; PL-XPL-VE-S24-23
Data Output Rise/Fall Time			90	150	ps	20% - 80%, Differential
Data Output Skew				50	ps	R_{LOAD} = 100 Ω, Differential
Data Output Deterministic Jitter	DJ			0.36	UI	±K28.5 pattern, δ_R, @ 1.062 Gbps[1,9]
Data Output Deterministic Jitter	DJ			0.39	UI	±K28.5 pattern, δ_R, @ 2.125 Gbps[1,5]
Data Output Deterministic Jitter	DJ			0.46	UI	±K28.5 pattern, TP4, @ 1.25Gbps[1,5]; PL-XPL-Vx-S2x-xy; y=even
Total Jitter	TJ			0.61	UI	2^7-1 pattern, δ_R, BER < $1x10^{-12}$ @ 1.062 Gbps[1,5]
Total Jitter	TJ			0.64	UI	2^7-1 pattern, δ_R, @ 2.125 Gbps[1,5]
Total Jitter	TJ			0.75	UI	2^7-1 pattern, TP4, @ 1.25Gbps[1,5]; PL-XPL-Vx-S2x-x2 only

1. See Specification notes on page 11 for referenced notes.

3.3 Electrical characteristics (continued)

Parameter	Symbol	Min	Typical	Max	Unit	Notes[1]
Loss of Signal Voltage Level	V_{OH}	Vcc -0.5		Vcc	V	LOS output level V_{OL} T_{LOSD} after light input > LOSD, [2] LOS output level V_{OH} T_{LOSA} after light input < LOSA, [2]
	V_{OL}	0		0.5	V	
Loss of Signal Assert/Deassert Time	T_{LOSA}			100	µs	
	T_{LOSD}			100	µs	
1. See Specification notes on page 11 for referenced notes.						

3.4 Optical characteristic

Parameter	Symbol	Min.	Typical	Max	Unit	Notes[1]
Transmitter						
Wavelength	λ_p	830	850	860	nm	
RMS Spectral Width	$\Delta\lambda$		0.5	0.85	nm	
Average Optical Power	P_{AVG}	-9.5	-5.0	-2.5	dBm	
Optical Output Rise/Fall Time	$t_{rise/fall}$			150	ps	20% - 80%
Optical Modulation Amplitude	OMA	200	450	1125	µW	Minimum is equivalent to 9 dB ER at P_{AVG} = -9dBm
Extinction Ratio	ER	9			dB	PL-XPL-Vx-S2x-x2
Deterministic Jitter	DJ			0.21	UI	±K28.5 pattern, γ_T, @ 1.062 Gbps, [1,5]
Deterministic Jitter	DJ			0.26	UI	±K28.5 pattern, γ_T, @ 2.125 Gbps[1,5]
Deterministic Jitter	DJ			0.20	UI	±K28.5 pattern, TP2, @ 1.25 Gbps[1,5] ; PL-XPL-Vx-S2x-x2 only
Total Jitter	TJ			0.43	UI	2^7-1 pattern, γ_T, @ 1.062 Gbps, [1,5]
Total Jitter	TJ			0.44	UI	2^7-1 pattern, γ_T, @ 2.125 Gbps[1,5]
Total Jitter	TJ			0.43	UI	2^7-1 pattern,TP2, @ 1.25 Gbps[1,5] ; PL-XPL-Vx-S2x-x2 only
Relative Intensity Noise	RIN		-125	-117	dB/Hz	2GHz, 12 dB reflection
Receiver						
Wavelength	λ	770	850	860	nm	
Maximum Input Power	Pm	0			dBm	
Sensitivity (OMA)	S_1		18	31	μW_{p-p}	1 Gbps operation, maximum is equivalent to -17dBm @9dB ER
	S_2		25	49	μW_{p-p}	2 Gbps operation
1. See Specification notes on page 11 for referenced notes.						

3.4 Optical characteristic (continued)

Parameter	Symbol	Min.	Typical	Max	Unit	Notes[1]
Stressed Sensitivity (OMA) $S_{S1.06}$	ISI = 0.96 dB	55			μW_{P-P}	1.062G operation
	ISI = 2.18 dB	67				
$S_{S1.25}$	ISI = 2.2 dB	69			μW_{P-P}	1.25G operation
	ISI = 2.6 dB	87				
$S_{S2.125}$	ISI = 1.26 dB	96			μW_{P-P}	2.125G operation
	ISI = 2.03 dB	109				
Loss of Signal Assert/Deassert Level	LOSD		-21	-17	dBm	Chatter Free Operation
	LOSA	-30			dBm	
Low Frequency Cutoff	F_C		0.2	0.3	MHz	-3 dB, P<-16 dBm
1. See Specification notes on page 11 for referenced notes.						

3.5 Link length

Data Rate / Standard	Fiber Type	Modal Bandwidth @ 850 nm (MHz*km)	Distance Range (m)	Notes[1]
1.0625 GBd Fibre Channel 100-M5-SN-I 100-M6-SN-I	62.5/125 μm MMF	200	.5 to 300	6
	50/125 μm MMF	500	.5 to 500	6
	50/125 μm MMF	900	.5 to 630	6
	50/125 μm MMF	1500	.5 to 755	6
	50/125 μm MMF	2000	.5 to 860	6
1.25 Gbps IEEE 802.3 1000Base-SX	62.5/125 μm MMF	200	.5 to 275	6
	50/125 μm MMF	500	.5 to 550	6
	50/125 μm MMF	900	.5 to 595	6
	50/125 μm MMF	1500	.5 to 740	6
	50/125 μm MMF	2000	.5 to 860	6
2.125 GBd Fibre Channel 200-M5-SN-I, 200-M6-SN-I	62.5/125 μm MMF	200	.5to 150	6
	50/125 μm MMF	500	.5 to 300	6
	50/125 μm MMF	900	.5 to 350	6
	50/125 μm MMF	1500	.5 to 430	6
	50/125 μm MMF	2000	.5 to 500	6
1. See Specification notes on page 11 for referenced notes.				

Specification notes

1. UI (Unit Interval): one UI is equal to one bit time. For example, 2.125 Gbits/s corresponds to a UI of 470.588ps.
2. For LOSA and LOSD definitions see Loss of Signal Assert/Deassert Level in Section 3.4 Optical characteristic on page 10.
3. When operating the transceiver at 1.0 - 1.3 Gbaud only, a slower input rise and fall time is acceptable. If it is planned to operate the module in the 1.0 - 2.5 Gbaud range, faster input rise and fall times are required.
4. Measured with stressed eye pattern as per FC-PI (Fibre Channel) and Gigabit Ethernet using the worst case specifications.
5. All jitter measurements performed with worst case input jitter according to FC-PI.
6. Distances, shown in the “Link Length” table, are the distances specified in the Fibre Channel standards. “Link Length” distances are calculated for worst case fiber and transceiver characteristics based on the optical and electrical specifications shown in this document using techniques utilized in IEEE 802.3 (Gigabit Ethernet). In the nominal case, longer distances are achievable.

3.6 Regulatory compliance

The PL-XPL-Vx-S2x-xx complies with common ESD, EMI, Immunity, and Component recognition requirements and specification (see details in Table 2 on page 13).

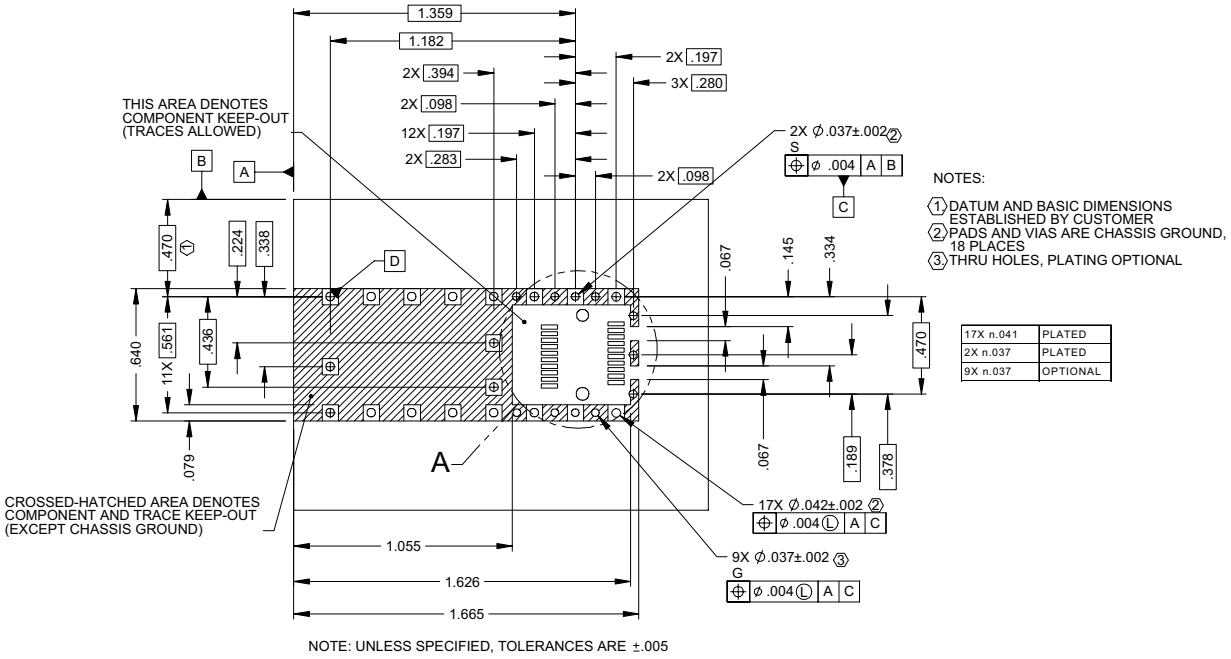
ESD, EMI, and Immunity are dependent on the overall system design. Information included herein is intended as a figure of merit for designers to use as a basis for design decisions.

Table 2 Regulatory compliance

Feature	Test Method	Performance
Laser Eye Safety	U.S. 21CFR (J) 1040.10 & 1040.11 IEC 60825-2 1997	CDRH compliant and Class 1 laser safe. Accession # 0320910-00 TUV Certificate # B 03 06 38649 022 IEC Certificate # CB DE3-51529M1
Electrostatic Discharge (ESD) to optical connector	IEC 61000-4-2: 1999	Withstand discharges of 15 kV using a “Human Body Model” probe
Electromagnetic Interference (EMI)	FCC Part 15 Subpart J Class B CISPR 22: 1997 EN 55022: 1998 Class B VCCI Class I	Noise frequency range: 30 MHz to 10 GHz. Good system EMI design practice required to achieve Class B margins.
Immunity	IEC 61000-4-3: 1998	Field strength of 3 V/m RMS, from 10 MHz to 1 GHz. No effect on transceiver performance is detectable between these limits.
Component	UL 1950 CSA C22.2 #950 IEC 60950: 1999	UL File #E209897 CSA File # TUV Certificate # B 03 06 38649 022 IEC Certificate # CB DE3-51529M1

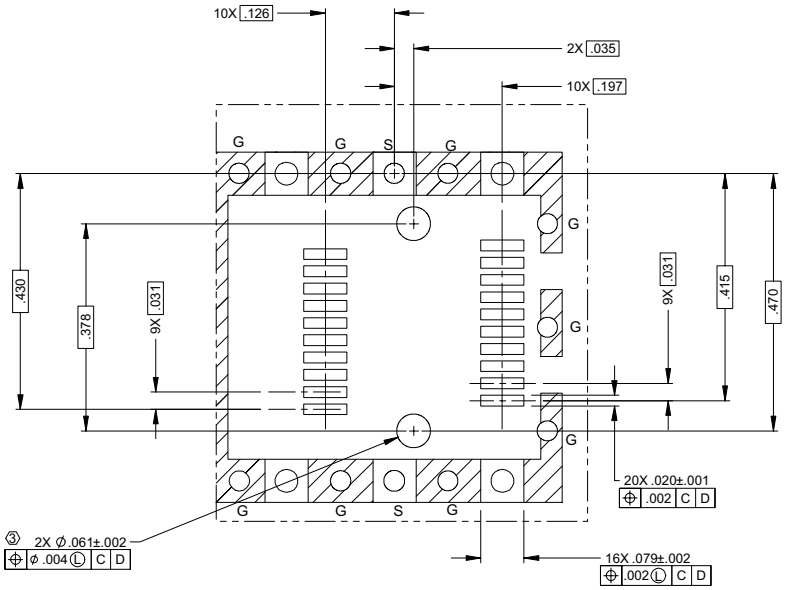
3.7 PCB layout

Figure 4 Board layout



NOTE: UNLESS SPECIFIED, TOLERANCES ARE ±.005

Figure 5 Detail layout

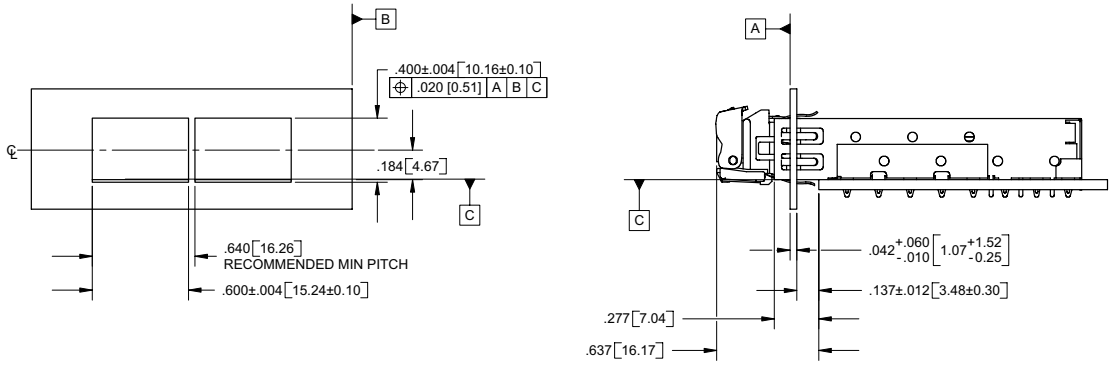


NOTE: UNLESS SPECIFIED, TOLERANCES ARE ±.005

DETAIL A
SCALE 7 : 1

3.8 Front panel opening

Figure 6



3.9 Module outline

Figure 7 PCI Compliant

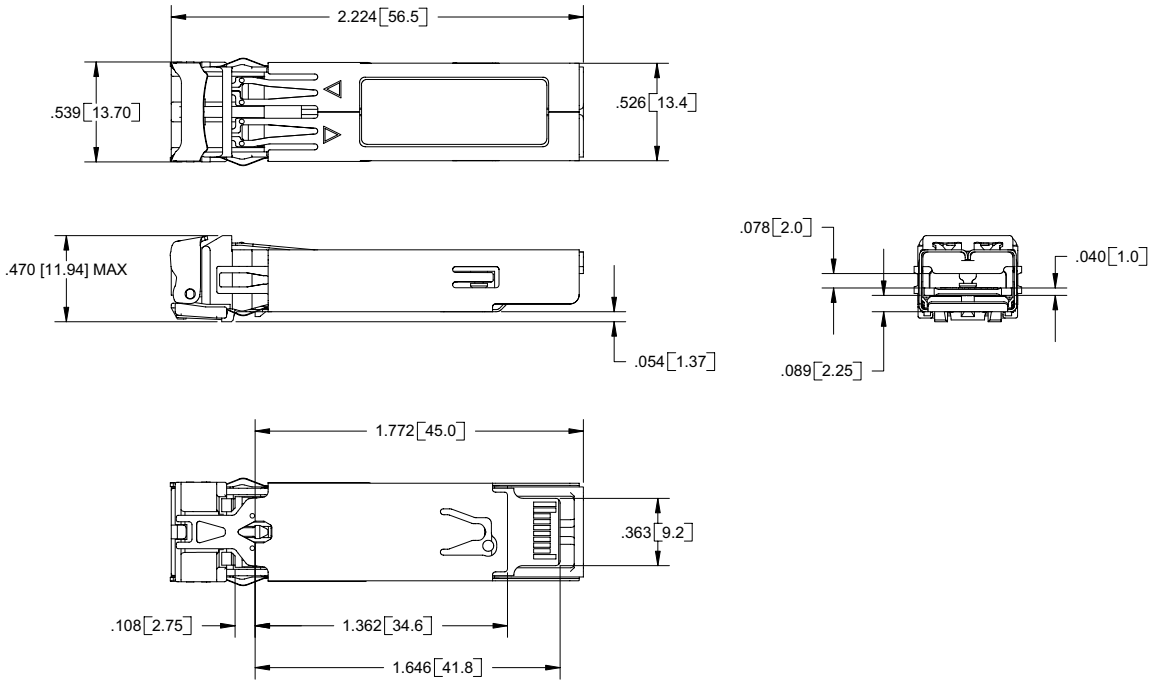
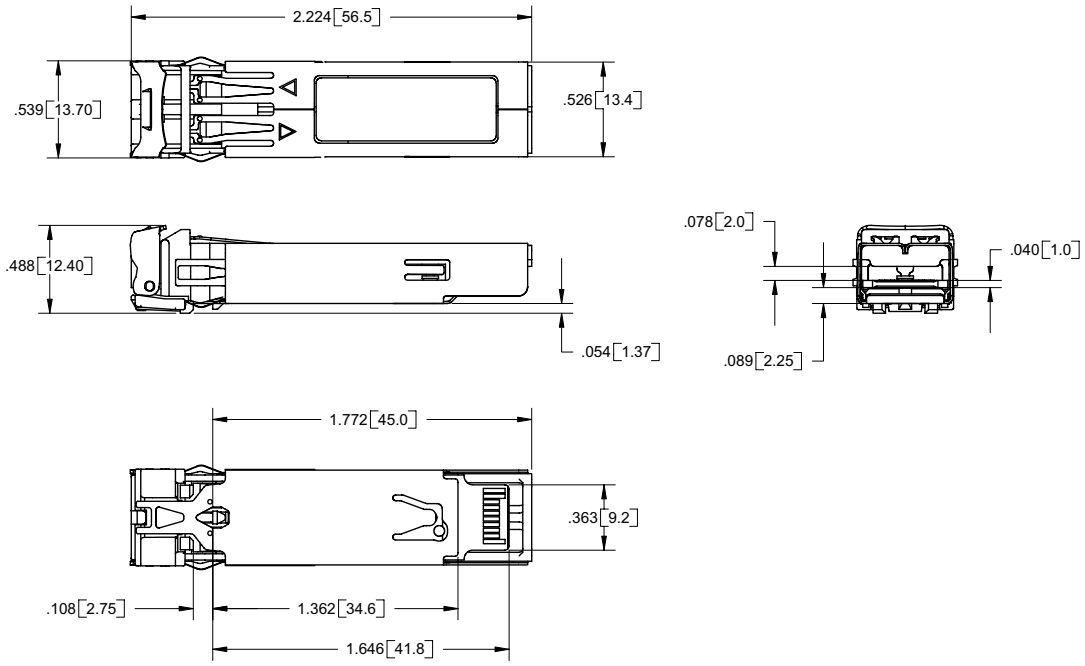
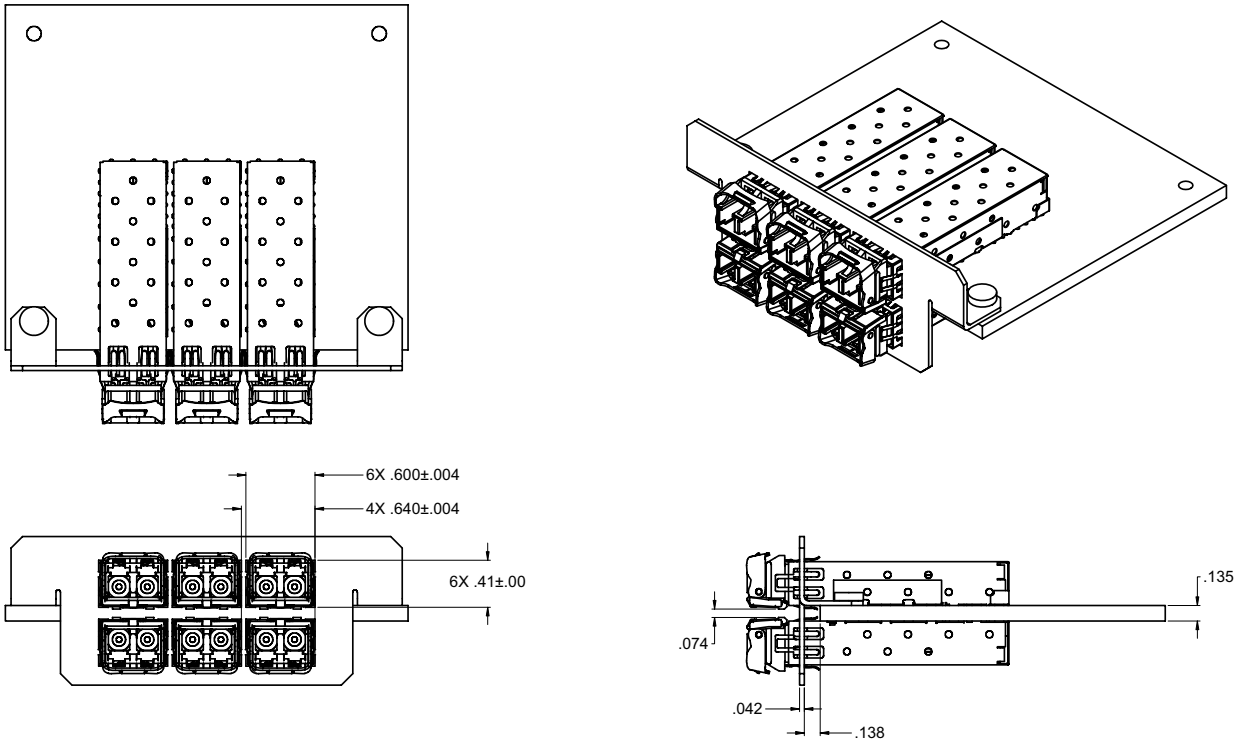


Figure 8 Standard



3.10 Transceiver belly-to-belly mounting

Figure 9



Section 4 Related information

Other information related to the 2 Gbps 850 nm SFP Transceivers with Optional Triple-Rate, Extended Temperature & Voltage, and Digital Diagnostics includes:

- Section 4.1 Digital Diagnostic Monitoring and Serial ID Operation below
- Section 4.2 Package and handling instructions on page 22
- Section 4.3 ESD Discharge (ESD) on page 22
- Section 4.4 Eye safety on page 22

4.1 Digital Diagnostic Monitoring and Serial ID Operation

The PL-XPL-Vx-S2x-xx is equipped with a 2-wire serial EEPROM that is used to store specific information about the type/identification of the transceiver as well as real-time digitized information relating to the transceiver's performance. See Section IV, "Module Definition Interface and Data Field Description" of the SFP-MSA Pin Definitions and Host Board Layout document for memory/address organization of the identification data and the Small Form Factor Commitee's document number SFF-8472 Rev 9.3, dated March 28, 2002 for memory/address organization of the digital diagnostic data.

The optional enhanced digital diagnostics feature monitors five key transceiver parameters which are Internally Calibrated and should be read as absolute values and interpreted as follows; available on PL-XPL-Vx-S2x-2x part numbers.

Transceiver Temperature in degrees Celsius: Internally measured. Represented as a 16 bit signed two's complement value in increments of 1/256 degrees Celsius from -40 to +125°C with LSB equal to 1/256 degrees C. Accuracy is ± 3 degrees Celsius 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 100μV with a measurement range of 0 to +6.55V. Accuracy is ± 3% of nominal value over the specified operating temperature and voltage ranges.

TX Bias Current in μA: Represented as a 16 bit unsigned integer with current defined as the full 16 bit value(0-65535) with LSB equal to 2μA with a measurement range of 0 - 131mA. Accuracy is ± 10% 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 0.1μW. Accuracy is ± 2dB over the specified temperature and voltage ranges over the permitted range of 100μW to 800μW(-10dBm to -1dBm). 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 0.1μW. Accuracy is ± 3dB over the specified temperature and voltage ranges over the power range of 30μW to 1000μW (-15dBm to 0dBm).

Reading the data

The information is accessed through the MOD_DEF(1), and MOD_DEF(2) connector pins of the module. The specification for this EEPROM (ATMEL AT24CO1A family) 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), available on all SFP part numbers, and the address to read the diagnostic data is 1010001X(A2h), on PL-XPL-Vx-S2x-2x part numbers only. Any other device addresses will be ignored. Refer to Table 3, Table 4, and Table 5 for information regarding addresses and data field descriptions

MOD_DEF(0), pin 6 on the transceiver, is connected to Logic 0 (Ground) on the transceiver.

MOD_DEF(1), pin 5 on the transceiver, is connected to the SCL pin of the EEPROM.

MOD_DEF(2), pin 4 ont the transceiver, is connected to the SDA pin of the EEPROM.

The EEPROM WP 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 organization is defined in the Small Form-Factor Pluggable Multisource (SFP-MSA) Pin Definitions and Host Board Layout document, dated 3/13/00, Section IV. The digital diagnostic information stored in the EEPROM is defined in the Small Form-Factor document SFF-8472 draft rev 9.3, dated 3/28/02.

Table 3 Data Field Descriptions

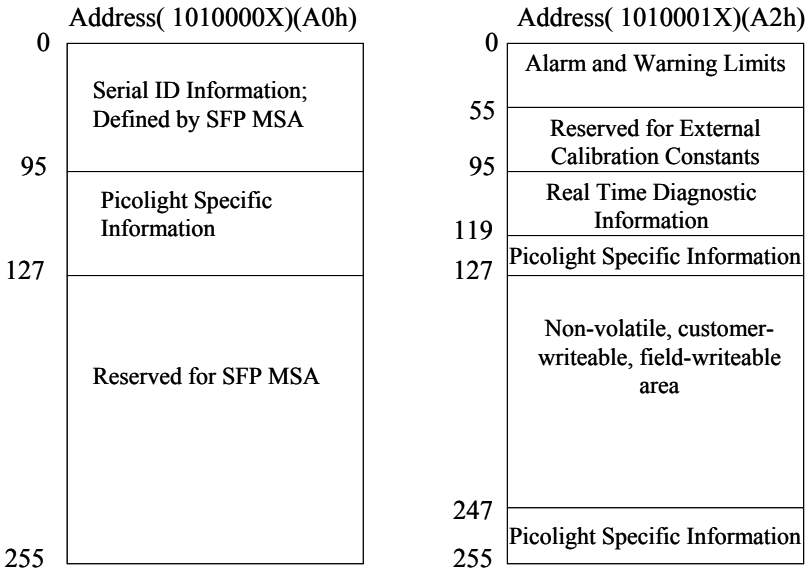


Table 4 Serial ID Data and Map

Address (1010000X)(A0h) Memory Address	Value	Comments
0	03	SFP Transceiver
1	04	SFP with Serial ID
2	07	LC Connector
3-10	0000000020400C05	850nm multimode, 1.062/2.125 FC, Intermediate Distance
3-10	0000000120400C05	850nm multimode, 1.062/2.125 FC, 1000Base-SX, Intermediate Distance; on PL-XPL-Vx-S2x-x2
11	01	8B/10B encoding mechanism
12	15	2.125 Gbps
13	00	Reserved
14	00	Single mode fiber in km; 2 or 15 km
15	00	Single mode fiber in 100 meters; 20 or 150
16	1E	50/125 um fiber
17	0F	62.5/125 um fiber
18	00	Copper not supported
19	00	Reserved
20-35	PICOLIGHT	Vendor Name
36	00	Reserved
37-39	000485	IEEE Company ID
40-55		Part Number
56		Rev of part number
60-61	0352	WaveLength of laser of laser in nm; 1310
62		Reserved
63	00_62	Check Code; Lower 8 bits of sum from byte 0 through 62
64	00	Reserved
65	1A	No Rate Select, Tx_Disable, Tx Fault, Loss of Signal implemented
66	04	
67	34	
68-83		Serial Number
84-91		Date Code
92	00	No Digital Diagnostics; PL-XPL-Vx-S2x-1x
92	68	Digital Diagnostic Monitoring implemented, Internally calibrated, Receiver Power type is Average Power; PL-XPL-Vx-S2x-2x
93	00	No Digital Diagnostics; PL-XPL-Vx-S2x-1x
93	B0	Alarms & Warnings, TX_Fault and Rx_LOS monitoring implemented; PL-XPL-Vx-S2x-2x
94	0	No Digital Diagnostics; PL-XPL-Vx-S2x-1x
94	1	SFF-8472 Rev 9.3
95	64_94	Check Code; Lower 8 bits of sum from byte 64 through 94
96-127		Picolight specific EEPROM
128-255		Reserved

Table 5 Diagnostic Data Map

Address (1010001X)(A2h)

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	External Calibration Constant	Refer to SFF-8472 rev 9.3
60-63	External Calibration Constant	Refer to SFF-8472 rev 9.3
64-67	External Calibration Constant	Refer to SFF-8472 rev 9.3
68-71	External Calibration Constant	Refer to SFF-8472 rev 9.3
72-75	External Calibration Constant	Refer to SFF-8472 rev 9.3
76-77	External Calibration Constant	Refer to SFF-8472 rev 9.3
78-79	External Calibration Constant	Refer to SFF-8472 rev 9.3
80-81	External Calibration Constant	Refer to SFF-8472 rev 9.3
82-83	External Calibration Constant	Refer to SFF-8472 rev 9.3
84-85	External Calibration Constant	Refer to SFF-8472 rev 9.3
86-87	External Calibration Constant	Refer to SFF-8472 rev 9.3
88-89	External Calibration Constant	Refer to SFF-8472 rev 9.3
90-91	External Calibration Constant	Refer to SFF-8472 rev 9.3
92-94	Reserved	Reserved
95	Checksum	0_95
90-91	External Calibration Constant	Refer to SFF-8472 rev 9.3
92-94	Reserved	Reserved
95	Checksum	Low order 8 bits of sum from 0-94
99	Vcc LSB	
100	TX Bias MSB	Internally measure TX Bias Current
101	TX Bias LSB	
102	TX Power MSB	Measured TX output power
103	TX Power LSB	
104	RX Power MSB	Measured RX input power
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	Optional Status/Control Bits	Refer to SFF-8472 rev 9.3
111	Reserved	Reserved
112-119	Optional alarm & warning flag bits	Refer to SFF-8472 rev 9.3
120-127	Vendor specific	Vendor specific
128-247	User/Customer EEPROM	Field writeable EEPROM
248-255	Vendor specific	Vendor specific

* Alarm and warning flags are latched high (user writes 0 to clear). Address 117 bit 0 indicates that 12C writes have been made persistent; 1= writes to EEPROM in progress, 0= writes complete

4.2 Package and handling instructions

Process plug

The PL-XPL-Vx-S2x-xx is supplied with a dust cover. This plug protects the transceiver's 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 de-greasing chemicals

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

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

Flammability

The PL-XPL-Vx-S2x-xx housing is made of cast zinc and sheet metal.

4.3 ESD 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 might require that the application re-acquire synchronization at the higher layers (e.g. Serializer/Deserializer chip).

4.4 Eye safety

The PL-XPL-Vx-S2x-xx is an international Class 1 laser product per IEC 825-1/2: 1988/1997, and per CDRH, 21 CFR 1040 Laser Safety Requirements. The PL-XPL-Vx-S2x-xx is an eye safe device 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).

CAUTION!

The use of optical instruments with this product will increase eye hazard. At the normal operating current, optical output power with an unaided eye can be as much as 30 uW at a wavelength of 850 nm. Approximately ten times this power level could be collected with an eye loupe.