

## **XP-1396-10D-4**

### **10Gb/s 1310nm SFP+ 10km Transceiver**

#### **PRODUCT FEATURES**

- Support rate selectable 1.25Gb/s and 9.95Gb/s to 10.5Gb/s bit rates
- Up to 10km transmission on SMF
- DFB Laser and PIN receiver
- Metal enclosure, for lower EMI
- 2-wire interface with integrated Digital Diagnostic monitoring
- Specifications compliant with SFF 8472
- Compliant with SFP+ MSA with LC connector
- Single 3.3V power supply
- Power dissipation < 1 W
- Case operating temperature range: Commercial: -5 °C to +70 °C

#### **APPLICATIONS**

- 1000BASE-LX 1G Ethernet
- 10GBASE-LR/LW & 10G Ethernet

#### **STANDARD**

- Compliant to SFF-8431
- Compliant to SFF 8472
- RoHS Compliant.

## Ordering information

Product part Number	Data Rate (Gbps)	Media	Wavelength (nm)	Transmission Distance(km)	Temperature Range (Tcase) (°C)
XP-1396-10D-SI	1.25/10.3125	Single mode fiber	1310	10	-5~70

## I Absolute Maximum Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Storage Temperature	Ts	-40	-	85	°C	
Relative Humidity	RH	0	-	85	%	
Power Supply Voltage	VCC	-0.3	-	4	V	

## II Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Case Operating Temperature	Tcase	-5	-	70	°C	
Power Supply Voltage	VCC	3.14	3.30	3.47	V	
Power Supply Current	ICC	-		300	mA	
Data Rate	BR		1.25/10.3125		Gbps	
Transmission Distance	TD		-	10	km	
Coupled fiber	Single mode fiber					9/125um SMF

## III Optical Characteristics

### Optical Characteristics for RS0 = High (10G Operation)

Parameter	Symbol	Min	Typ	Max	Unit	NOTE
<b>Transmitter</b>						
Optical Modulation Amplitude (OMA)	POMA	-5.2			dBm	1
Average Launch Power	Pave	-8.2		+0.5	dBm	1
Optical Wavelength	$\lambda$	1260		1355	nm	
Side-Mode Suppression Ratio	SMSR	30			dB	
Spectral Width (-20dB)	$\sigma$			1	nm	
Optical Extinction Ratio	ER	3.5			dB	
Average Launch power of OFF	Poff			-30	dBm	
Output Eye Mask	Compliant with IEEE 802.3ae					

Receiver						
Rx Sensitivity	R <sub>AVE</sub>			-14.4	dBm	2
Receiver Sensitivity (OMA)	R <sub>OMA</sub>			-12.6	dBm	2
Average Receive Power	P <sub>AVE</sub>	-14.2		+0.5	dBm	
Wavelength Range	$\lambda_c$	1260		1600	nm	
LOS De -Assert	LOSD			-17	dBm	
LOS Assert	LOSA	-30			dBm	
LOS Hysteresis		0.5			dB	

**Notes:**

- Class 1 Laser Safety per FDA/CDRH and IEC-825-1 regulations.
- Measured with a PRBS 2<sup>31</sup>-1 test pattern, @ 10.3125Gb/s, BER<10<sup>-12</sup>.

**Optical Characteristics for RS0 = Low (1G Operation)**

Parameter	Symbol	Min	Typ	Max	Unit	NOTE
Transmitter						
Average Launch Power	P <sub>ave</sub>	-11		-3	dBm	1
Optical Wavelength	$\lambda$	1260		1355	nm	
Rise-Fall Time	T <sub>rise</sub> /T <sub>fall</sub>			0.26	ns	2
RMS Spectral Width	$\Delta\lambda_{rms}$			4	nm	
Optical Extinction Ratio	ER	9			dB	
Average Launch power of OFF	P <sub>off</sub>			-30	dBm	
Output Eye Mask	Compliant with IEEE 802.3ae					
Receiver						
Rx Sensitivity	R <sub>sens</sub>			-19	dBm	3
Average Receive Power	P <sub>AVE</sub>			-3	dBm	
Wavelength Range	$\lambda_c$	1260		1600	nm	
LOS De -Assert	LOSD			-17	dBm	
LOS Assert	LOSA	-30			dBm	
LOS Hysteresis		0.5			dB	

**Notes:**

1. Average power figures are informative only, per IEEE 802.3-2005.
2. 20%-80%.
3. Valid between 1260 and 1355 nm. Measured with worst-case ER; BER<10<sup>-12</sup>; 2<sup>7</sup> – 1 PRBS.

## IV. General Specifications

Parameter	Symbol	Min	Typ	Max	Units	Ref.
Bit Rate (RS0 = LOW)	BR		1.25		Gb/s	1
Bit Rate (RS0 = HIGH)	BR		10.3		Gb/s	2
Max. Supported Link Length	Lmax		10		km	

### Notes:

1. 1000BASE-LX. Tested with a 2<sup>7</sup> – 1 PRBS. See Section I, Note 5 for RS0 conditions for 1.25Gb/s operation.
2. 10GBASE-LR/LW. Tested with a 2<sup>31</sup> – 1 PRBS. See Section I, Note 5 for RS0 conditions for 10.3 Gb/s operation.

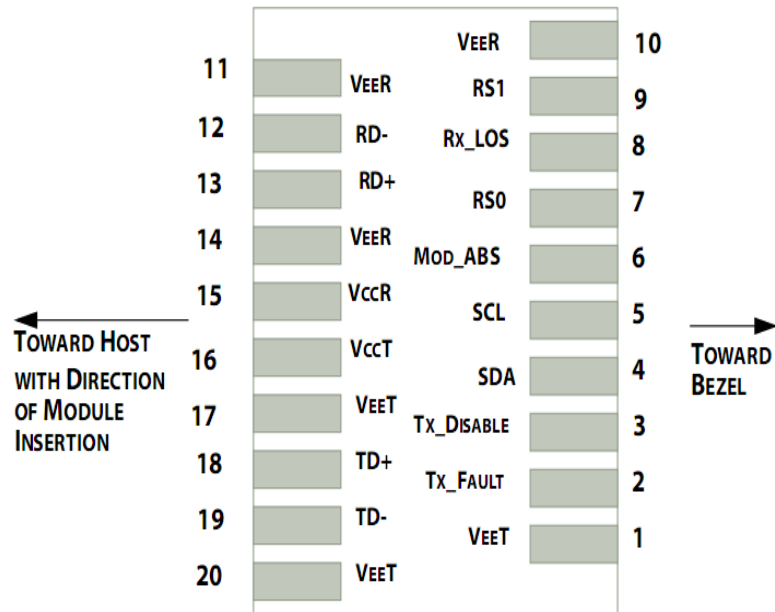
## V. Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	NOTE
Supply Voltage	Vcc	3.14	3.3	3.46	V	
Supply Current	Icc			300	mA	
<b>Transmitter</b>						
Input differential impedance	Rin		100		Ω	1
Single ended data input swing	Vin,pp	180		700	mV	
Transmit Disable Voltage	VD	Vcc-1.3		Vcc	V	
Transmit Enable Voltage	VEN	Vee		Vee+ 0.8	V	2
<b>Receiver</b>						
Differential data output swing	Vout,pp	300		850	mV	3
LOS Fault	VLOS fault	Vcc-1.3		VccHOST	V	4
LOS Normal	VLOS norm	Vee		Vee+0.8	V	4

### Notes:

1. Connected directly to TX data input pins. AC coupled thereafter.
2. Or open circuit.
3. Into 100 ohms differential termination.
4. Loss Of Signal is LVTTTL. Logic 0 indicates normal operation; logic 1 indicates no signal detected.

## VI. Pin Assignment



Pin out of Connector Block on Host Board

Pin	Symbol	Name/Description	NOTE
1	$V_{EET}$	Transmitter Ground (Common with Receiver Ground)	1
2	$T_{FAULT}$	Transmitter Fault.	2
3	$T_{DIS}$	Transmitter Disable. Laser output disabled on high or open.	3
4	SDA	2-wire Serial Interface Data Line	4
5	SCL	2-wire Serial Interface Clock Line	4
6	MOD_ABS	Module Absent. Grounded within the module	4
7	RS0	Rate Select 0. Open or Low = Module support 1.25Gb/s High = Module supports 9.95 Gb/s to 10.312	5
8	LOS	Loss of Signal indication. Logic 0 indicates normal operation.	6
9	RS1	No connection required	1
10	$V_{EER}$	Receiver Ground (Common with Transmitter Ground)	1
11	$V_{EER}$	Receiver Ground (Common with Transmitter Ground)	1
12	RD-	Receiver Inverted DATA out. AC Coupled	
13	RD+	Receiver Non-inverted DATA out. AC Coupled	
14	$V_{EER}$	Receiver Ground (Common with Transmitter Ground)	1
15	$V_{CCR}$	Receiver Power Supply	
16	$V_{CCT}$	Transmitter Power Supply	
17	$V_{EET}$	Transmitter Ground (Common with Receiver Ground)	1
18	TD+	Transmitter Non-Inverted DATA in. AC Coupled.	
19	TD-	Transmitter Inverted DATA in. AC Coupled.	
20	$V_{EET}$	Transmitter Ground (Common with Receiver Ground)	1

### Notes:

1. Circuit ground is internally isolated from chassis ground.
2.  $T_{FAULT}$  is an open collector/drain output, which should be pulled up with a 4.7k – 10k Ohms resistor on the host

- board if intended for use. Pull up voltage should be between 2.0V to  $V_{cc} + 0.3V$ . A high output indicates a transmitter fault caused by either the TX bias current or the TX output power exceeding the preset alarm threshold. A low output indicates normal operation. In the low state, the output is pulled to  $<0.8V$ .
3. Laser output disabled on  $T_{DIS} > 2.0V$  or open, enabled on  $T_{DIS} < 0.8V$ .
  4. Should be pulled up with 4.7k $\Omega$ - 10k $\Omega$  host board to a voltage between 2.0V and 3.6V. MOD\_ABS pulls line low to indicate module is plugged in.
  5. Transceiver data rate selected through the 2-wire bus in accordance with SFF-8472 Rev. 10.3. Soft RS0 is set at Bit3, Byte 110, Address A2h. Soft RS0 default state on power up is '0' LOW, and the state is reset following a power cycle. Writing '1' HIGH selects max. data rate operation. Transceiver data rate is the logic OR of the input state of the RS0 pin and soft RS0 bit. Thus, if either the RS0 pin OR the soft RS0 bit is HIGH then the selected data rate will be 9.95 and 10.3 Gb/s. Conversely, to select data rate 1.25 Gb/s both the RS0 pin and the soft RS0 bit are set LOW.
  6. LOS is open collector output. It should be pulled up with 4.7k $\Omega$  – 10k $\Omega$  on host board to a voltage between 2.0V and 3.6V. Logic 0 indicates normal operation; logic 1 indicates loss of signal.

## VII. Digital Diagnostic Functions

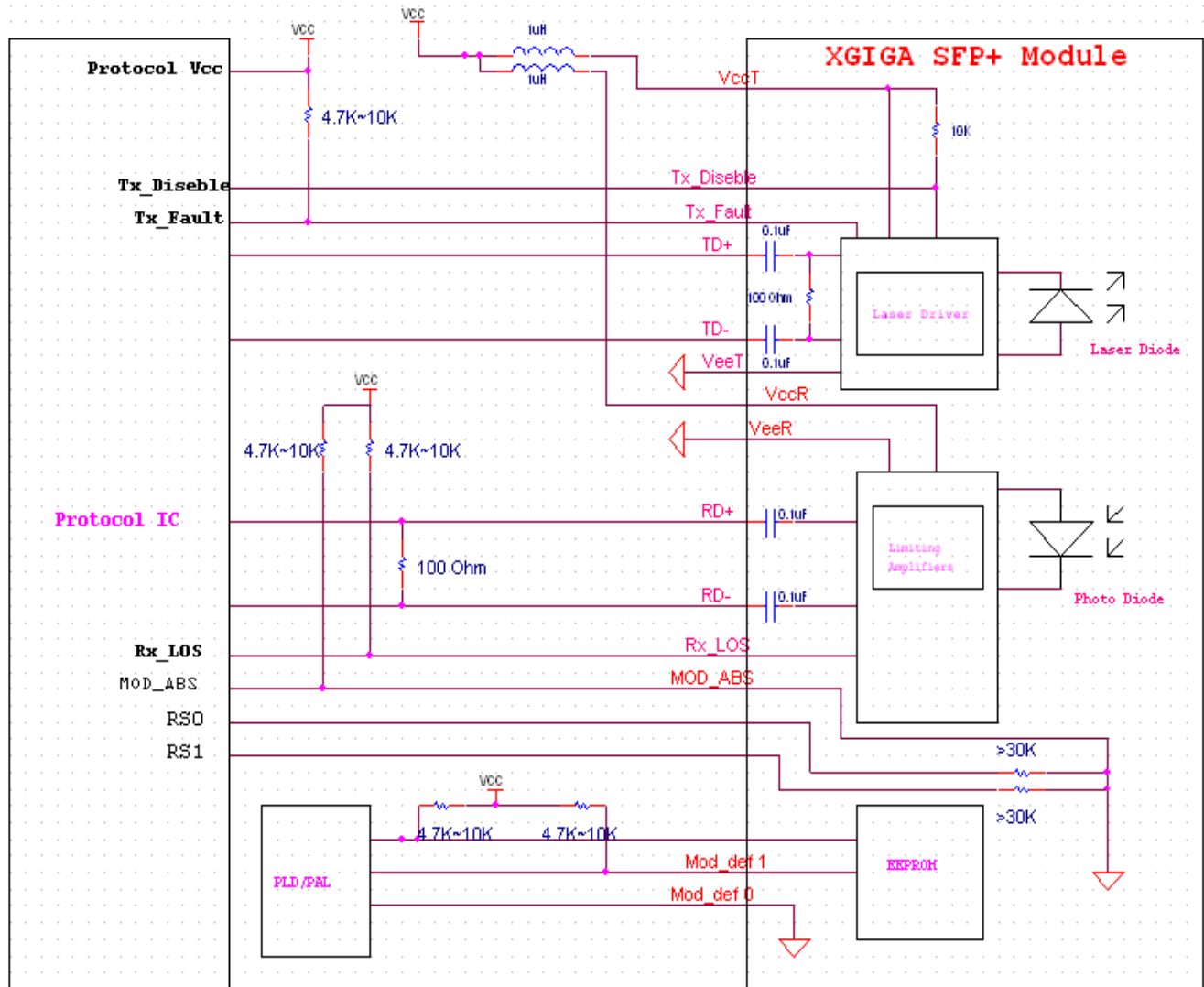
XGIGA XP-1396-10D-4 transceivers support the 2-wire serial communication protocol as defined in the SFP+ MSA. The standard SFP serial ID provides access to identification information that describes the transceiver's capabilities, standard interfaces, manufacturer, and other information.

Additionally, XGIGA SFP+ transceivers provide a unique enhanced digital diagnostic monitoring interface, which allows real-time access to device operating parameters such as transceiver temperature, laser bias current, transmitted optical power, received optical power and transceiver supply voltage. It also defines a sophisticated system of alarm and warning flags, which alerts end-users when particular operating parameters are outside of a factory set normal range.

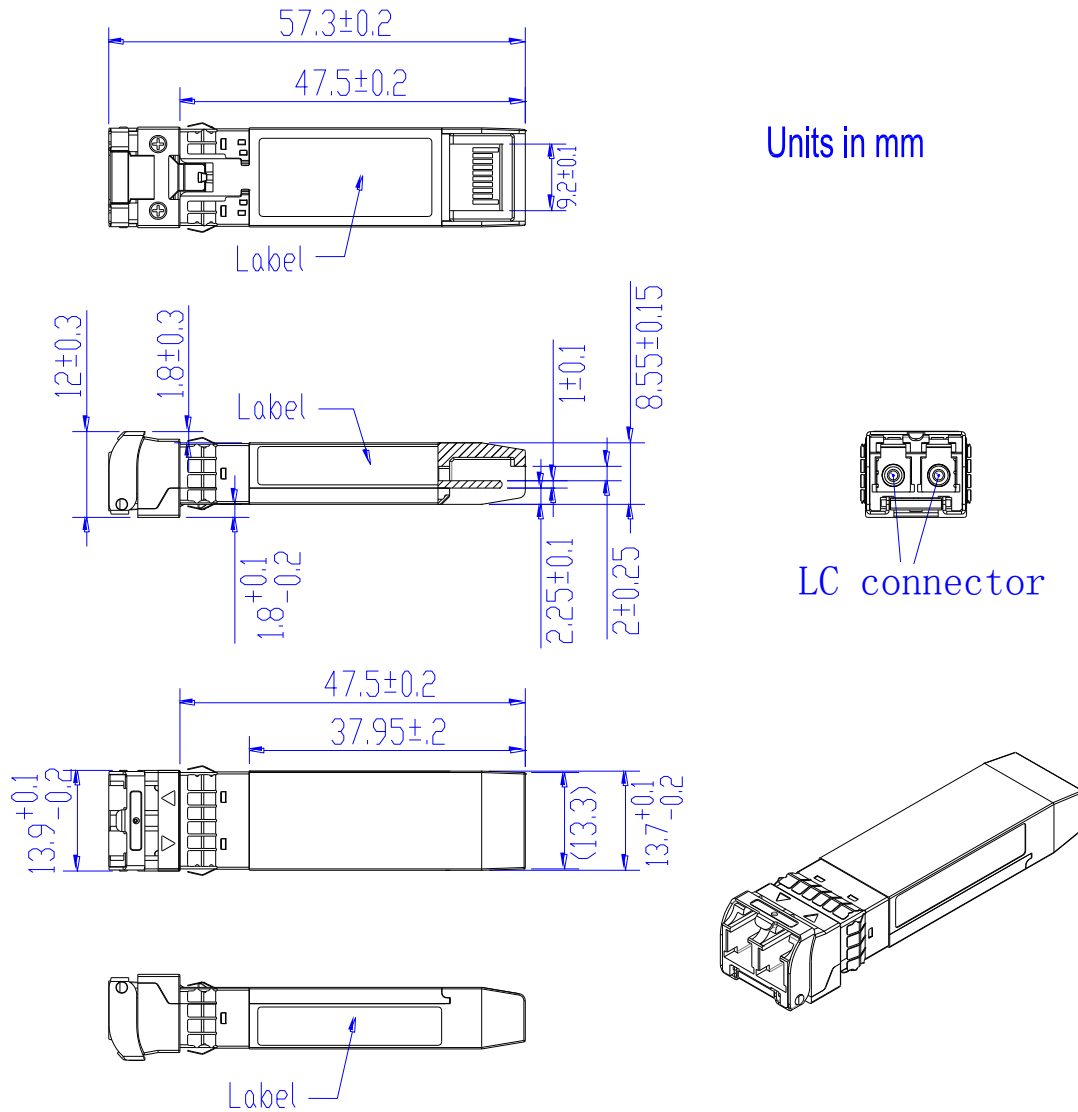
The SFP MSA defines a 256-byte memory map in EEPROM that is accessible over a 2-wire serial interface at the 8 bit address 1010000X (A0h). The digital diagnostic monitoring interface makes use of the 8 bit address 1010001X (A2h), so the originally defined serial ID memory map remains unchanged.

The operating and diagnostics information is monitored and reported by a Digital Diagnostics Transceiver Controller (DDTC) inside the transceiver, which is accessed through a 2-wire serial interface. When the serial protocol is activated, the serial clock signal (SCL, Mod Def 1) is generated by the host. The positive edge clocks data into the SFP transceiver into those segments of the E2PROM that are not write-protected. The negative edge clocks data from the SFP transceiver. The serial data signal (SDA, Mod Def 2) is bi-directional for serial data transfer. The host uses SDA in conjunction with SCL to mark the start and end of serial protocol activation. The memories are organized as a series of 8-bit data words that can be addressed individually or sequentially.

### VIII. Host - Transceiver Interface Block Diagram



## IX. Outline Dimensions



## X. Regulatory Compliance

Feature	Reference	Performance
Electrostatic discharge (ESD)	IEC/EN 61000-4-2	Compatible with standards
Electromagnetic Interference (EMI)	FCC Part 15 Class B EN 55022 Class B (CISPR 22A)	Compatible with standards
Laser Eye Safety	FDA 21CFR 1040.10, 1040.11 IEC/EN 60825-1, 2	Class 1 laser product
Component Recognition	IEC/EN 60950, UL	Compatible with standards
ROHS	2011/65/EU and (EU)2015/863	Compatible with standards
EMC	EN61000-3	Compatible with standards



**Appendix A. Document Revision**

Version No.	Date	Description
1.0	2020-07-09	Preliminary datasheet

**Note:** This product is covered by the following U.S. patents owned by Finisar Corporation and licensed to XGIGA: 7,184,668; 7,079,775; 6,957,021; 7,058,310; 6,952,531; 7,162,160; and 7,050,720.