



# Precision Rated Optics

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## X2-10GB-LR



The X2-10GB-LR is programmed to be fully compatible and functional with all intended CISCO switching devices. This X2 optical transceiver is designed for IEEE 802.3ae 10GBASE-LR interconnects and is compliant with the X2 Multi-Source Agreement (MSA) Specification. This module is designed for single mode fiber and operates at a nominal wavelength of 1310nm up to 10KM.

### Compliance:

- IEEE 802.3ae
- 10GBASE-LR
- X2 MSA
- RoHS

### Applications:

- 10Gb Ethernet

### Features:

- Up to 10 GbD bi-directional bit rates
- 1310nm DFB laser
- PIN photo-detector
- XAUI electrical interface: 4 lanes @ 3.125 GbD
- MDIO, DOM (Digital Optics Monitoring) support
- Hot-pluggable X2 footprint
- Duplex SC Connector
- Up to 10km over singlemode fiber
- Adaptable 5V / 3.3V / 1.2V power supply
- Operating Case Temperature: C-Temp: 0° to 70°

### Absolute Maximum Ratings

Parameter	Symbol	Min	Type	Max	Unit	Remarks
Storage Ambient Temperature	$T_s$	-40		85	°C	
Supply Voltage (5V)	$V_s$	0		6	V	
Supply Voltage (3.3V)	$V_3$	0		4	V	
Supply Voltage (APS)	$V_{APS}$	0		1.5	V	
Optical Receiver Input	$P_{IMAX}$			1.5	dBm	Average



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## General Specifications

Parameter	Symbol	Min	Type	Max	Unit	Remarks
Data Rate	DR		10.3125		GBd	
Bit Error Rate	BER			10 <sup>-12</sup>		
Total Power Consumption	P			3	W	
Supply Voltage (5V)	V <sub>CC5</sub>	4.75	5	5.25	V	Operating Env
Supply Voltage (+3.3V)	V <sub>CC3</sub>	3.14	3.3	3.47	V	Operating Env
Supply Voltage (APS)	V <sub>CCAPS</sub>	1.152	1.2	1.248	V	Operating Env
Supply Current (5V)	I <sub>CC5</sub>			100	mA	
Supply Current (+3.3V)	I <sub>CC3</sub>			300	mA	
Supply Current (APS)	I <sub>CCAPS</sub>			1000	mA	

## Link Distances

Parameter	Fiber Type	Distance Range (m)
10.3GBd	9/125um SMF	2-10,000

## Optical Characteristics - Transmitter

Parameter	Symbol	Min	Type	Max	Unit	Remarks
Optical Wavelength	$\lambda$	1290		1330	nm	
Launch Power	P <sub>OUT</sub>	-8.2		0.5	dBm	Average
Launch Power in OMA	P <sub>OMA</sub>	-5.2			dBm	
Launch Power of OFF	P <sub>OUT_OFF</sub>			-30	dBm	Average
Side Mode Suppression Ratio	SMSR	30			dB	
Spectral Width (-20 dB)	$\Delta\lambda$			0.6	nm	
Optical Extinction Ratio	ER	3.5			dB	
Optical Modulation Amplitude	OMA	-5.2				
Optical Return Loss Tolerance	ORL <sub>T</sub>			12	dB	
Relative Intensity Noise	RIN			-128	dB/Hz	
Transmitter Dispersion Penalty	TDP			3.2	dB	

## Optical Characteristics Receiver

Parameter	Symbol	Min	Type	Max	Unit	Remarks
Center Wavelength Range	$\lambda_c$	1260		1600	nm	
Optical Input Power	P <sub>IN</sub>	-14.4		0.5	dBm	Average, Informative
Receiver Sensitivity in OMA	P <sub>IN_OMA</sub>			-12.6	dBm	Informative
Stressed Receiver Sensitivity	P <sub>IN_S</sub>			-10.3	dBm	
Receive Reflectance	TR <sub>RX</sub>			-12	dB	
Loss of Signal Assert Level	P <sub>LOS_A</sub>	-25			dBm	
Loss of Signal DeAssert Level	P <sub>LOS_D</sub>			-16	dBm	
Loss of Signal Hysteresis	P <sub>LOS_H</sub>	1			dBm	
RX electrical 3dB upper cutoff-frequency	FR			12.3	GHz	



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## Electrical Characteristics - DC

Parameter	Symbol	Min	Type	Max	Unit	Remarks
<b>A) 1.2V COMS I/O DC Characteristics (PRTAD; LASI; RESET; TX_ON/OFF)</b>						
External Pull-Up Resistor For Open Drain	$R_{PU}$	10		22	k $\Omega$	
Output High Voltage	$V_{OH}$	1			V	
Output Low Voltage	$V_{OL}$			0.15	V	
Input High Voltage	$V_{IH}$	0.84		1.2	V	
Input Low Voltage	$V_{IL}$			0.36	V	
Input Pull-Down Current	$I_{PD}$	20		120	$\mu$ A	$V_{IN}=1.2V$
<b>B) XAUI I/O DC Charateristics (TXLANE[0..3]; RXLANE[0..3])</b>						
Differential Input Amplitude	$V_{IN\_XAUI}$	200		2500	mV	AC Coupled
Differential Output Amplitude	$V_{OUT\_XAUI}$	800		1600	mV	AC Coupled
<b>C) MDIO I/O DC Charateristics (MDIO; MDC)</b>						
Output Low Voltage	$V_{OL}$			0.2	V	$I_{OL}=100\mu A$
Output Low Current	$I_{OL}$			4	mA	
Input High Voltage	$V_{IH}$	0.84		1.2	V	
Input Low Voltage	$V_{IL}$			0.36	V	
Pull-Up Supply Voltage	$V_{PU}$	1.152	1.2	1.248	V	
Input Capacitance	$C_{IN}$			10	pF	
Load Capacitance	$C_{LOAD}$			470	pF	
External Pull-Up Resistance	$R_{PU}$	200			$\Omega$	

## Electrical Characteristics - AC

Parameter	Symbol	Min	Type	Max	Unit	Remarks
<b>A) XAUI Input AC Characteristics (TXLANE[0..3])</b>						
Baud Rate	$BR_{XAUI\_IN}$		3.125		GBd	
Baud Rate Tolerance	$BR_{TOL\_XAUI}$	-100		100	ppm	
Differential Input Impedance	$Z_{IN\_XAUI}$	80	100	120	$\Omega$	
Differential Return Loss	$RL_{IN}$	10			dB	100MHz to 2.5GHz
Input Differential Skew	$T_{IN\_SKEW}$			75	ps	Crossing Point
Jitter Amplitude Tolerance	$J_{XAUI\_TOL}$			0.65	UI <sub>pp</sub>	IEEE 802.3ae
<b>B) XAUI Output AC Characteristics (RXLANE[0..3])</b>						
Baud Rate	$BR_{XAUI\_OUT}$		3.125		GBd	
Baud Rate Variation	$BR_{XAUI\_VAR}$	-100		100	ppm	
XAUI Eye Mask (far-end)						According to IEEE 802.3ae
Output Differential Skew	$T_{OUT\_SKEW}$			15	ps	
Output Differential Impedance	$Z_{OUT\_XAUI}$	80	100	120	$\Omega$	
Differential Output Return Loss	$RL_{OUT}$	10			dB	100MHz to 2.5GHz
Total Jitter	$TJ_{XAUI}$			0.35	UI	Near-end No pre-equalization 1 UI=320 ps
Deterministic Jitter	$DJ_{XAUI}$			0.17	UI	
<b>C) Power-On Reset Characteristics</b>						
Power-On Reset and TX_ONOFF Characteristics						According to X2 MSA Issue
<b>D) MDIO I/O AC Characteristics (MDIO; MDC)</b>						
MDIO Data Hold Time	$T_{HOLD}$	10			ns	
MDIO Data Setup Time	$T_{SU}$	10			ns	
Delay from MDC Rising Edge to MDIO Data Change	$T_{DELAY}$			300	ns	
MDC Clock Rate	$f_{MAX}$			2.5	MHz	

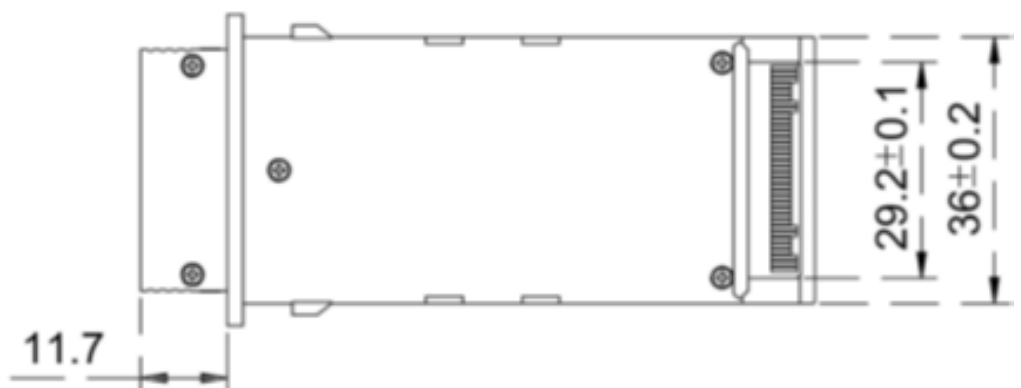
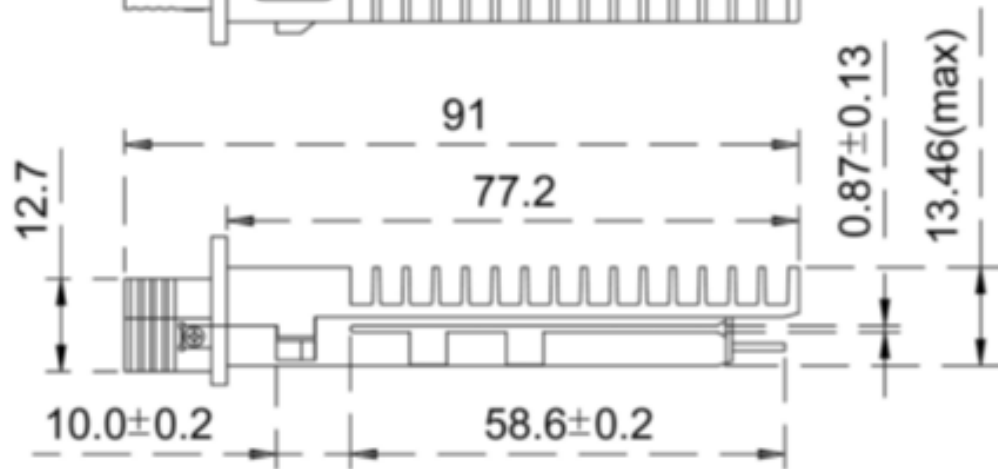
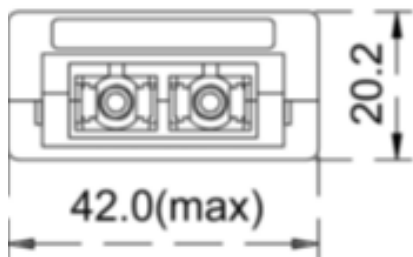
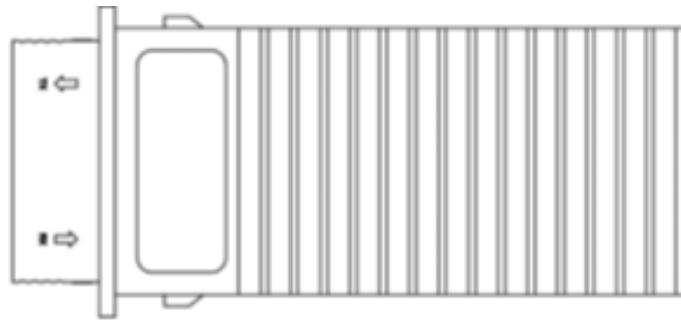


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## Digital Diagnostic

Parameter	Symbol	Min	Type	Max	Unit	Remarks
Temperature Monitor	T <sub>MON</sub>	-5		+5	°C	
Laser Bias Monitor	I <sub>MON</sub>	-10		10	%	
TX Power Monitor	P <sub>TX</sub>	-3		+3	dBm	
RX Power Monitor	P <sub>RX</sub>	-3		+3	dBm	



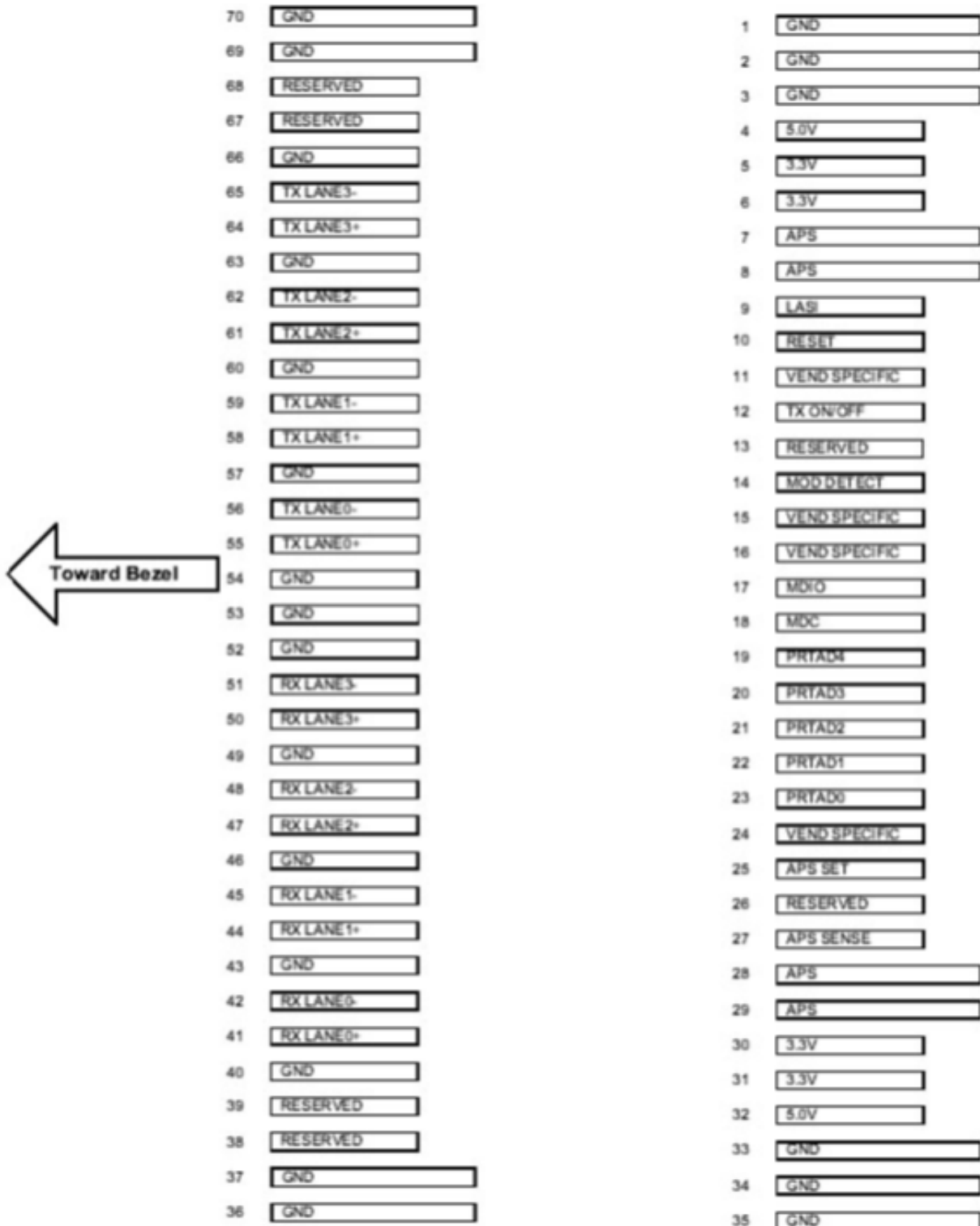
Unit: millimeter



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## Electrical Pad Layout





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## Pin Assignment - Pin 1 to Pin 35:

PIN #	Symbol	I/O	Logic	Description
1	GND	I	Supply	Electrical ground
2	GND	I	Supply	Electrical ground
3	GND	I	Supply	Electrical ground
4	5.0V	I	Supply	Power
5	3.3V	I	Supply	Power
6	3.3V	I	Supply	Power
7	APS	I	Supply	Adaptive Power Supply
8	APS	I	Supply	Adaptive Power Supply
9	LASI	O	Open Drain	Link Alarm Status Interrupt. 10-22k ohm pull up on host
10	RESET	I	1.2V CMOS	TX OFF when MDIO RESET
11	VEND SPECIFIC			Vendor Specific Pin. Leave unconnected
12	TX ON/OFF	I	1.2V CMOS	Transmitter ON/OFF
13	RESERVED			Reserved
14	MOD DETECT	O		Pulled low inside module through 1k ohm
15	VEND SPECIFIC			Vendor Specific Pin. Leave unconnected
16	VEND SPECIFIC			Vendor Specific Pin. Leave unconnected
17	MDIO	I/O	Open Drain	Management Data IO
18	MDC	I	1.2V CMOS	Management Data Clock
19	PRTAD4	I	1.2V CMOS	Port Address bit 4 (Low=0)
20	PRTAD3	I	1.2V CMOS	Port Address bit 3 (Low=0)
21	PRTAD2	I	1.2V CMOS	Port Address bit 2 (Low=0)
22	PRTAD1	I	1.2V CMOS	Port Address bit 1 (Low=0)
23	PRTAD0	I	1.2V CMOS	Port Address bit 0 (Low=0)
24	VEND SPECIFIC			Vendor Specific Pin. Leave unconnected
25	APS SET	O		Feedback output for APS
26	RESERVED			Reserved for Avalanche Photodiode use
27	APS SENSE	O	Analog	APS Sense Connection
28	APS	I	Supply	Adaptive Power Supply
29	APS	I	Supply	Adaptive Power Supply
30	3.3V	I	Supply	Power
31	3.3V	I	Supply	Power
32	5.0V		Supply	Power
33	GND	I	Supply	Electrical Ground
34	GND	I	Supply	Electrical Ground
35	GND	I	Supply	Electrical Ground



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## Pin Assignment - Pin 36 to Pin 70:

PIN #	Symbol	I/O	Logic	Description
36	GND	I	Supply	Electrical ground
37	GND	I	Supply	Electrical ground
38	RESERVED			Reserved
39	RESERVED			Reserved
40	GND	I	Supply	Electrical ground
41	RX LANE 0+	O	AC	Module XAUI Output Lane 0+
42	RX LANE 0-	O	AC	Module XAUI Output Lane 0-
43	GND	I	Supply	Electrical ground
44	RX LANE 1+	O	AC	Module XAUI Output Lane 1+
45	RX LANE 1-	O	AC	Module XAUI Output Lane 1-
46	GND	I	Supply	Electrical ground
47	RX LANE 2+	O	AC	Module XAUI Output Lane 2+
48	RX LANE 2-	O	AC	Module XAUI Output Lane 2-
49	GND	I	Supply	Electrical ground
50	RX LANE 3+	O	AC	Module XAUI Output Lane 3+
51	RX LANE 3-	O	AC	Module XAUI Output Lane 3-
52	GND	I	Supply	Electrical ground
53	GND	I	Supply	Electrical ground
54	GND	I	Supply	Electrical ground
55	TX LANE 0+	O	AC	Module XAUI Input Lane 0+
56	TX LANE 0-	O	AC	Module XAUI Input Lane 0-
57	GND	I	Supply	Electrical ground
58	TX LANE 1+	O	AC	Module XAUI Input Lane 1+
59	TX LANE 1-	O	AC	Module XAUI Input Lane 1-
60	GND	I	Supply	Electrical ground
61	TX LANE 2+	O	AC	Module XAUI Input Lane 2+
62	TX LANE 2-	O	AC	Module XAUI Input Lane 2-
63	GND	I	Supply	Electrical ground
64	TX LANE 3+	O	AC	Module XAUI Input Lane 3+
65	TX LANE 3-	O	AC	Module XAUI Input Lane 3-
66	GND	I	Supply	Electrical ground
67	RESERVED			Reserved
68	RESERVED			Reserved
69	GND	I	Supply	Electrical Ground
70	GND	I	Supply	Electrical Ground

## Remarks

1. IEEE standard 802.3. IEEE Standard Department, 2005., 10GBASE-SR
2. XENPAK Multi-Source Agreement (MSA).