Finisar

Product Specification

RoHS-6 Compliant
10GBASE-LR X2 Transponder
FTLX1441E2/FTLX1441F2

PRODUCT FEATURES

- Hot pluggable X2 MSA form factor
- Total power consumption: 3.5 W maximum
- RoHS-6 compliant (lead-free)
- Temperature range 0°C to 70°C
- Transmission distance of 10Km
- Uncooled directly modulated Distributed Feedback (DFB) laser at 1310 nm
- SC connector, single mode fiber
- Full duplex transmission mode
- Digital Optics Monitoring (DOM)
- Power supply: +5.0 V, +3.3 V, Adaptable Power Supply (APS: +1.2 V)
- XAUI electrical interface
  4x 3.125 Gb/s Ethernet (FTLX1441E2)
  4x 3.1875 Gb/s Fibre Channel (FTLX1441F2)
- Management and control via MDIO 2-wire bus
- 70-pin connector
- Separated signal/chassis ground
- Mid Pak module variance for front panel mounting
- De-latch mechanism with low extraction force



APPLICATIONS

- 10GBASE-LR 10G Ethernet (FTLX1441E2)
- 1200-SM-LL-L 10G Fibre Channel (FTLX1441F2)

PRODUCT SELECTION

Part Number	Application
FTLX1441E2	10G Ethernet
FTLX1441F2	10G Fibre Channel

I. PIN DESCRIPTION

Signal Name	Level	I/O	Pin No.	Description
Management and Monitoring Ports				
MDIO	Open Drain	I/O	17	Management Data I/O. Requires external 10 - 22 kΩ pull-up to the APS on host.
MDC	1.2 V CMOS	I	18	Management Data Clock Input
PRTAD4	1.2 V CMOS	1	19	Port Address Input bit 4
PRTAD3	1.2 V CMOS	I	20	Port Address Input bit 3
PRTAD2	1.2 V CMOS	I	21	Port Address Input bit 2
PRTAD1	1.2 V CMOS	I	22	Port Address Input bit 1
PRTAD0	1.2 V CMOS	I	23	Port Address Input bit 0
LASI	Open Drain	O	9	Link Alarm Status Interrupt Output. Open Drain Compatible Output with 10 - 20 kΩ pull-up on host. Logic high = Normal Operation Logic low = Status Flag Triggered
RESET	Open Drain	I	10	Reset Input. Open Drain Compatible Input with 22 kΩ pull-up to APS internal to transponder. Logic high = Normal Operation Logic low = RESET
Vendor Specific			11,15,16,24	Vendor Specific Pins. Leave unconnected when not used.
TX ON/OFF	Open Drain	I	12	TX ON/OFF Input. Open Drain Compatible Input with 22 kΩ pull-up to APS internal to transponder. Logic high = Transmitter On Logic low = Transmitter Off
MOD DETECT		O	14	Pulled low inside transponder through a 1 kΩ resistor to Ground
Transmit Functions				
Reserved Reserved		I I	68 67	Reserved For Future Use Reserved For Future Use
TX LANE 3– TX LANE 3+	AC-coupled, Internally biased differential XAUI	I I	65 64	Module XAUI Input Lane 3– Module XAUI Input Lane 3+
TX LANE 2– TX LANE 2+		I I	62 61	Module XAUI Input Lane 2– Module XAUI Input Lane 2+
TX LANE 1– TX LANE 1+		I I	59 58	Module XAUI Input Lane 1– Module XAUI Input Lane 1+
TX LANE 0– TX LANE 0+		I I	56 55	Module XAUI Input Lane 0– Module XAUI Input Lane 0+

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Receive Functions				
Reserved Reserved		O O	38 39	Reserved For Future Use Reserved For Future Use
RX LANE 0+ RX LANE 0–	AC-coupled, Internally biased differential XAUI	O O	41 42	Module XAUI Output Lane 0+ Module XAUI Output Lane 0–
RX LANE 1+ RX LANE 1–		O O	44 45	Module XAUI Output Lane 1+ Module XAUI Output Lane 1–
RX LANE 2+ RX LANE 2–		O O	47 48	Module XAUI Output Lane 2+ Module XAUI Output Lane 2–
RX LANE 3+ RX LANE 3–		O O	50 51	Module XAUI Output Lane 3+ Module XAUI Output Lane 3–
DC Power				
GND	0 V DC		1, 2, 3, 33, 34, 35, 36, 37, 40, 43, 46, 49, 52, 53, 54, 57, 60, 63, 66, 69, 70	Ground connection for signal ground on the module
APS	+1.2 V		7, 8, 28, 29	Input from Adaptive Power Supply
APS SENSE	+1.2 V		27	APS Sense Output. Connected to the APS input inside transponder.
APS SET			25	Feedback input from APS. Connected to GND through a 1180Ω resistor inside the transponder.
3.3 V	+3.3 V DC		5, 6, 30, 31	DC Power Input, +3.3 V DC, Nominal
5.0 V	+5.0 V DC		4, 32	DC Power Input, +5.0 V DC, Nominal
Reserved			26	Reserved for APD.
Reserved			13	Reserved.

Electrical Pad Layout

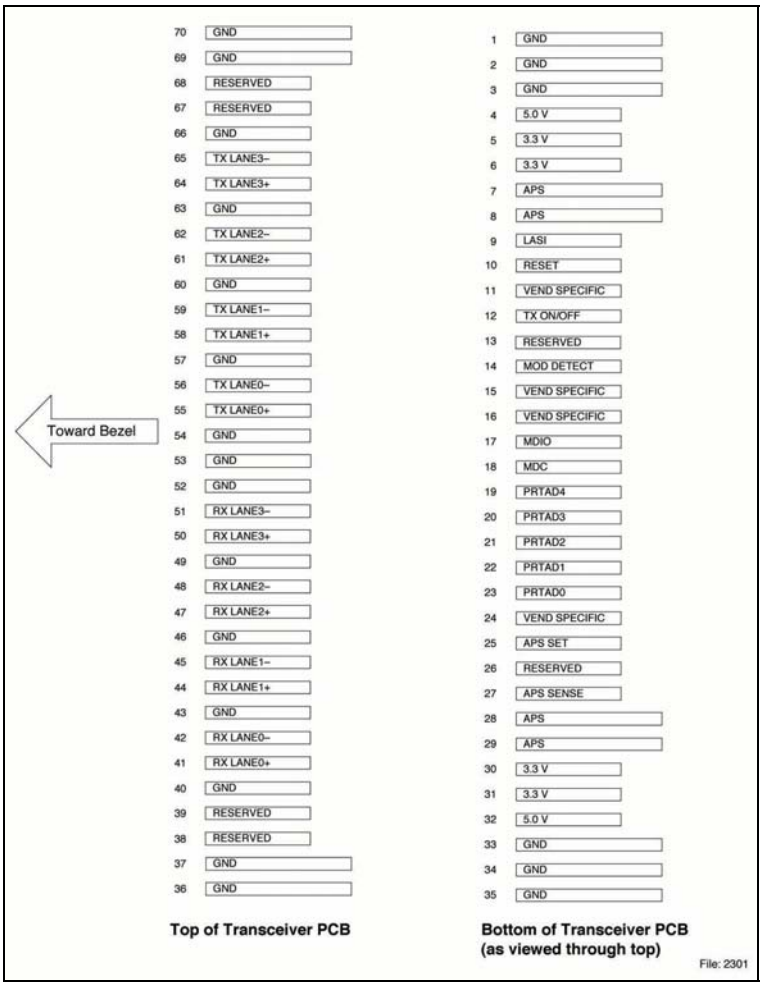


Fig 1-X2 Transponder Electrical Pad Layout

II. Absolute Maximum Ratings

Parameter	Symbol	Limit Values		Unit
		min.	max.	
Storage Ambient Temperature[1)]	T_S	-40	85	°C
Operating Case Temperature[1)]	T_C	0	70	°C
Supply Voltage +5.0 V	V_5	0	6	V
Supply Voltage +3.3 V	V_3	0	4	V
Supply Voltage APS	V_{aps}	0	1.5	V
Static Discharge Voltage, All Pins[2)]	ST_d		500	V
Average Receive Optical Power	$Rx_{P\ max}$		1.5	dBm

Notes:

1) Non-condensing.

2) HBM

Exceeding any one of these values may permanently destroy the device.

III. Electrical Characteristics

Recommended Operating Conditions

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Operating Case Temperature[1)]	T_C	0		70	°C
Transponder Total Power Consumption	P			3.5	W
Supply Voltage +5.0 V	V_{CC5}	4.75	5.0	5.25	V
Supply Current +5.0 V	I_{CC5}			300	mA
Supply Voltage +3.3 V	V_{CC3}	3.14	3.3	3.47	V
Supply Current +3.3 V	I_{CC3}			300	mA
Supply Voltage APS	$V_{CC\ aps}$	1.152	1.2	1.248	V
Supply Current APS	$I_{CC\ aps}$			1000	mA

[1)] Worst case thermal location, see **Figure 11**.
See also **Environmental Performance.**

Electrical DC Characteristics

(V_{CC5} = 4.75 V to 5.25 V, V_{CC3} = 3.14 V to 3.47 V, $V_{CC\ aps}$ = 1.152 V to 1.248 V, T_C = 0°C to 70°C)

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
1.2 V CMOS (1.8 V CMOS Compatible[1)]) I/O DC Characteristics (PRTAD; LASI; RESET; TX_ONOFF)					
External Pull-up Resistor for Open Drain	R_{pullup}	10		22	kΩ
Output High Voltage[2)]	V_{oh}	1			V
Output Low Voltage[2)]	V_{ol}			0.15	V
Input High Voltage	V_{ih}	0.84		1.5	V
Input Low Voltage	V_{il}			0.36	V
Input Pull-down Current[3)]	I_{pd}	20		120	µA
XAUI I/O DC Characteristics (TXLANE[0..3]; RXLANE[0..3])					
Differential Input Amplitude (pk-pk)[4)]	$V_{in\ xaui}$	200		2500	mV
Differential Output Amplitude (pk-pk)[4)]	$V_{out\ xaui}$	800		1600	mV
MDIO I/O DC Characteristics (MDIO; MDC)					
Output Low Voltage[5)]	V_{OL}	–0.3		0.2	V
Output Low Current	I_{OL}			4	mA
Input High Voltage	V_{IH}	0.84		1.5	V
Input Low Voltage	V_{IL}	–0.3		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_{LOAD}	200			Ω

[1)] For 1.8 V CMOS V_{oh} = 1.65 V min., V_{ol} = 0.15 V max., V_{ih} = 1.17 V min., V_{il} = 0.63 V max.
[2)] $R_{pull\text{-}up}$ = 10 kΩ to 1.8 V.
[3)] V_{in} = 1.2 V.
[4)] AC coupled.
[5)] I_{OL} = 100 µA.

Electrical AC Characteristics

(V_{CC5} = 4.75 V to 5.25 V, V_{CC3} = 3.14 V to 3.47 V, $V_{CC\ aps}$ = 1.152 V to 1.248 V, T_C = 0°C to 70°C)

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
XAUI Input AC Characteristics (TXLANE[0..3])					
Baud Rate Fibre Channel Ethernet	R_{XAUIIN}		 3.1875 3.125		Gbit/s
Baud Rate Tolerance	$R_{TOLXAUI}$	–100		100	ppm
Differential Input Impedance	Z_{INXAUI}	80	100	120	Ω
Differential Return Loss[1)]	$\|S_{11}\|$	10			dB
Input Differential Skew[2)]	t_{SKEWIN}			75	ps
Jitter Amplitude Tolerance[3)]	$J_{XAUITOL}$			0.65	UI_{p-p}
XAUI Output AC Characteristics (RXLANE[0..3])					
Baud Rate Fibre Channel Ethernet	$R_{XAUIOUT}$		 3.1875 3.125		Gbit/s
Baud Rate Variation	$R_{XAUIVAR}$	–100		100	ppm
XAUI Eye Mask (far-end)	According to IEEE 802.3ae and Fibre Channel 1200-SM-LL-L				
Output Differential Skew	$t_{SKEWOUT}$			15	ps
Output Differential Impedance	$Z_{OUTXAUI}$	80	100	120	Ω
Differential Output Return Loss[1)]	$\|S_{22}\|$	10			dB
Total Jitter[4)]	TJ_{XAUI}			0.35	UI
Deterministic Jitter[4)]	DJ_{XAUI}			0.37	UI
Power-On Reset AC Characteristics					
Power-On Reset and TX_ONOFF Characteristics	According to XENPAK MSA Issue 3.0, 2002-9-18				
MDIO I/O AC Characteristics (MDIO; MDC)					
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

1) 100 MHz to 2.5 GHz.
2) At crossing point.
3) Per IEEE Std 802.3ae.
4) At near-end, No pre-equalization, 1 UI = 320 ps.

IV. Optical Characteristics

(V_{CC5} = 4.75 V to 5.25 V, V_{CC3} = 3.14 V to 3.47 V, $V_{CC\ aps}$ = 1.152 V to 1.248 V, T_C = 0°C to 70°C, BER 1E-12, Bit Rate 10.3125)

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Transmitter					
Launch Power in OMA minus TDP	$P_{O\text{-}OMA}$	–5.2			dBm
Average Launch Power	$P_{O\text{-}Avg}$	–8.2		0.5	dBm
Center Wavelength Range	$\lambda_{C\text{-}Tx}$	1290		1330	nm
Spectral Width (-20 dB)	σ_I			0.6	nm
Side Mode Suppression Ratio	SMSR	30			dB
Extinction Ratio	ER	3.5			dB
Relative Intensity Noise$_{12}$OMA	RIN			–128	dB/Hz
Optical Modulation Aplitude (OMA)	OMA	–5.2			dBm
Transmitter and Dispersion Penalty	TDP			3.2	dB
Average Launch Power of OFF Transmitter	$P_{O\text{-}OFF}$			–30	dBm
Optical Return Loss Tolerance	ORL_T			12	dB
Transmitter Reflectance	REF_{TX}			–12	dB
Eye Mask Definition	According to IEEE 802.3ae and Fibre Channel 1200-SM-LL-L				
Receiver					
Stressed Receiver Sensitivity	$P_{IN\text{-}S}$			–10.3	dBm
Rx Sensitivity in OMA[1)]	$P_{IN\text{-}O}$			–12.6	dBm
Average Receiver Power[1)]	P_{IN}	-14.4		0.5	dBm
Receiver Damage Power	$P_{IN\text{-}dmg}$			1.5	dBm
Loss Of Signal Assert Level	P_{LOSa}			–13	dBm
Loss Of Signal Hysteresis	P_{LOSh}	1			dB
Receiver Reflectance	REF_{RX}			–12	dB
Receive Electrical 3dB Upper Cutoff Frequency	F_C			12.3	GHz
Center Wavelength Range	$\lambda_{C\text{-}RX}$	1260		1355	nm
Stressed Signal Calibration					
Vertical Eye Closure Penalty		2.2			dB
Stressed Eye Jitter		0.3			UIpp

[1)] Average Receiver Power (min), which is defined for an ideal input signal, is informative only.

V. General Specifications

Optical Interface Standard Specifications

Standard	Differential Group Delay Maximum (ps)	Operating Range [1)] (meters)
B1.1 SMF	10	2 to 10,000
B1.3 SMF	10	2 to 10,000

Notes:
1) Operating range as defined by IEEE and Fibre Channel standards. Longer reach possible depending upon link implementation.

Environmental Performance

Operating case temperature: 0°C to +70°C
Operating humidity: 0% -95% RH non-condensing

Fibers and Connectors

The transponder has SC receptacles for both Tx and Rx. The transponder is designed for single mode SC cables, 0° polished endface (PC).

70-pin Connector

The module interface connector is a 70-pin, printed circuit board edge connection with a 0.5 mm pitch. The appropriate mating connector for the customer PCB is a 70-pin SMT, dual row, right angled, edge connector, 0.5 mm pitch (Tyco Electronics part number 1367337-1, Molex part number 74441-0003 or equivalent).

Rail Requirement

The X2 rail system required to mount the X2 module is fully defined by the MSA. (Tyco Electronics part number 1367608-1: designed for belly to belly applications; and 1367610-1: designed for single sided board mount to fit into the standard host PCB footprint, or equivalent). For further details, please refer to vendor-supplied information.

Aqueous Wash

Finisar X2 transponders are neither solderable nor aqueous washable and are not intended for these processes.

VI. Regulatory Compliance

Feature	Standard	Comments
ESD: Electrostatic Discharge to the Electrical Pins (HBM)	EIA/JESD22-A114-B (MIL-STD 883D Method 3015.7)	Class 1a (> 500 V)
Immunity: Against Electrostatic Discharge (ESD) to the Module Receptacle	EN 61000-4-2 IEC 61000-4-2	Discharges ranging from ±2 kV to ±25 kV to the front end / faceplate / receptacle cause no damage to module (under recommended conditions).
Immunity: Against Radio Frequency Electromagnetic Field	EN 61000-4-3 IEC 61000-4-3	With a field strength of 10 V/m, noise frequency ranges from 10 MHz to 2 GHz. No effect on module performance between the specification limits.
Emission: Electromagnetic Interference (EMI)	FCC 47 CFR Part 15, Class B EN 55022 Class B CISPR 22	Noise frequency range: 30 MHz to 40 GHz Radiated emission does not exceed specified limits when measured inside a shielding enclosure with MSA conform cutout.

Eye Safety

Finisar FTLX1441 transponders are Class 1 Laser Products. They are certified per the following standards:

Feature	Agency	Standard	Certificate Number
Laser Eye Safety	FDA/CDRH	CDRH 21 CFR 1040 and Laser Notice 50	9210976-77
Laser Eye Safety	TÜV	EN 60825-1: 1994+A11:1996+A2:2001 IEC 60825-1: 1993+A1:1997+A2:2001 IEC 60825-2: 2000, Edition 2	R 72052602
Electrical Safety	TÜV	EN 60950	R 72052602
Electrical Safety	UL/CSA	CLASS 3862.07 CLASS 3862.87	1439230

Copies of the referenced certificates will be available at Finisar Corporation upon request.

VII. DOM Parameters

Parameter	Values			Unit
	min.	typ.	max.	
Transponder Temperature Monitor Accuracy[1)]	-5		+5	°C
Laser Bias Current Monitor Accuracy[2)]	-10		+10	%
Transmit Power Monitor Accuracy[3)]	-3		+3	dB
Receive Power Monitor Accuracy[3)]	-3		+3	dB

[1)] 0 to 70°C case temperature.
[2)] 0 to 12.5 mA.
[3)] -8.2 dBm to +0.5 dBm.

VIII. Mechanical Characteristics

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Module Retention Force (latch strength)	F_{RET}		200		N
Module Insertion Force	F_{IN}		40		N
Module Extraction Force (with kick-out)	F_{EXT-K}		16		N
Module Extraction Force (without kick-out)	F_{EXT}		25		N

Pull Sleeve front face color is blue.

Package Outline

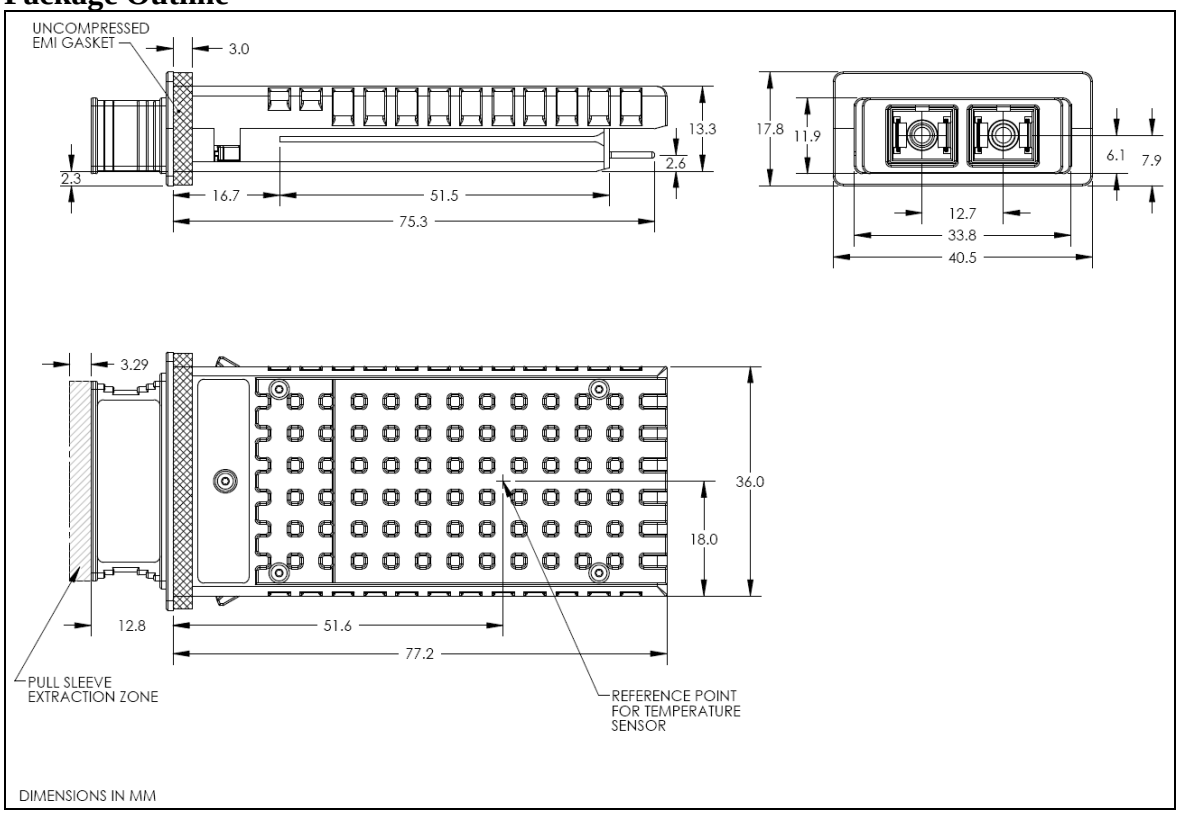


Figure 2-X2 Mechanical Dimensions

IX. References

The following references are provided for informational purposes only. The parameters and operational behavior outlined in this specification describe the complete functionality of the 10G Transponder. Contact Finisar for any items concerning the operational characteristics of this device.

- IEEE Std 802.3æ™-2002 clause 52, 10GBASE-LR
- Fibre Channel 10GFC Draft 4.0, 1200-SM-LL-L
- X2 MSA Issue 2.0b

X. For More Information

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