

FTLX1475D3BCV

RoHS-6 Compliant 10Gb/s 10km Single Mode Datacom SFP+ Transceiver

FTLX1475D3BCV 10Gb/s Enhanced Small Form Factor Pluggable SFP+ transceivers are designed for use in 1-Gigabit and 10-Gigabit Ethernet links up to 10km over Single Mode fiber. They are compliant with SFF-8431¹, SFF-8432² and IEEE 802.3ae 10GBASE-LR/LW³, and 10G Fibre Channel 1200-SM-LL-L4. This product is for applications specifically designed for 10G SFP+ ports and 1G/10G SFP+ ports and not native 1G SFP ports. Digital diagnostics monitoring is available via a 2-wire serial interface, as specified in SFF-8472⁵. The FTLX1475D3BCV employs a limiting receiver. FTLX1475D3BCV transceivers are RoHS compliant per Directive 2011/65/EU⁶, and Finisar Application Note AN-2038⁷.



FEATURES

- Hot-pluggable SFP+ footprint
- Supports rate selectable 1.25Gb/s and 9.95 to 10.5Gb/s bit rates
- Power dissipation < 1W
- RoHS-6 compliant (lead-free)
- Commercial temperature range -5°C to 70°C
- Single 3.3V power supply
- Maximum link length of 10km
- Uncooled 1310nm DFB laser
- Receiver limiting electrical interface
- Duplex LC connector
- Built-in digital diagnostic functions

APPLICATIONS

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

Product Selection

FTLX1475D3BCV

I. Pin Descriptions

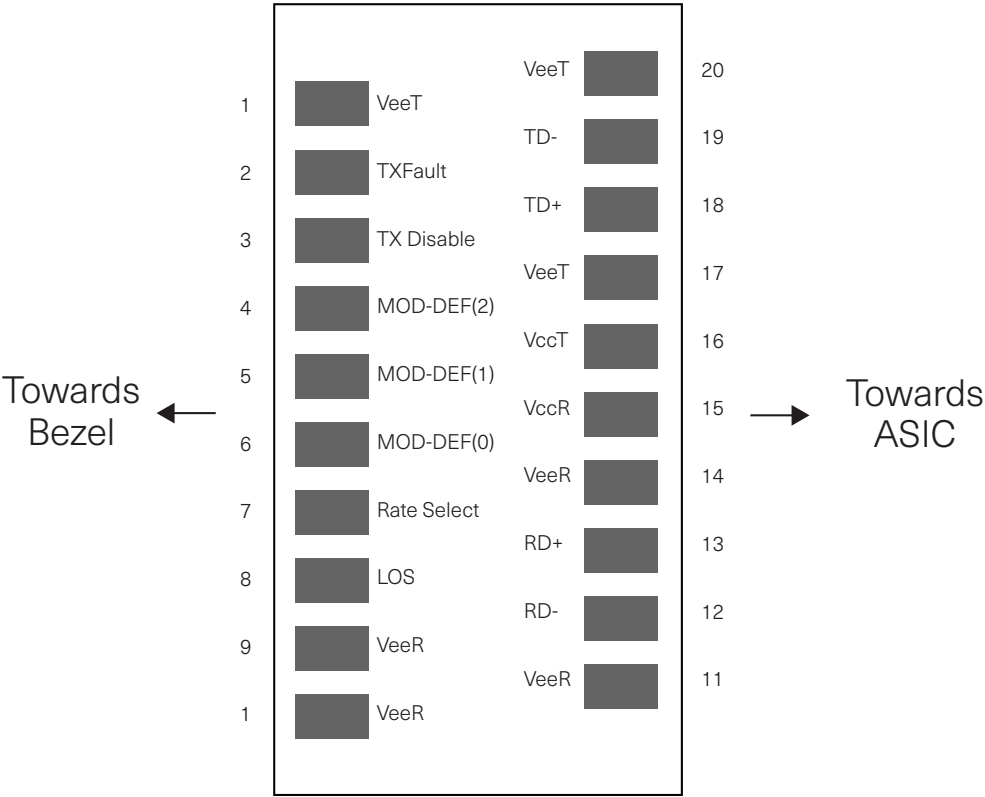


Diagram of Host Board Connector Block Pin Numbers and Names

Pin	Symbol	Name/Description	Notes
1	V _{EET}	Transmitter 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	SCA	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 supp High = Module supports 9.95 Gb/s to 10.312	5
8	RX_LOS	Loss of Signal indication. Logic 0 indicates normal operation.	6
9	RS1	Rate Select 1. No Connection Required	
10	V _{EER}	Receiver Ground.	1
11	V _{EER}	Receiver Ground.	1
12	RD-	Receiver Inverted DATA out. AC Coupled.	
13	RD+	Receiver Non-inverted DATA out. AC Coupled.	
14	V _{EER}	Receiver Ground.	1
15	V _{CCR}	Receiver Power Supply.	
16	V _{CCT}	Transmitter Power Supply.	
17	V _{EET}	Transmitter Ground.	1
18	TD+	Transmitter Non-Inverted DATA in. AC Coupled.	
19	TD-	Transmitter Inverted DATA in. AC Coupled.	
20	V _{EET}	Transmitter 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 thresholds. 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. Internally pulled down per SFF-8431 Rev 4.1.
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. Should be pulled up with 4.7k – 10kΩ on host board to a voltage between 2.0V and 3.6V. Logic 0 indicates normal operation; logic 1 indicates loss of signal.

II. Absolute Maximum Ratings

Exceeding the limits below may damage the transceiver module permanently.

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Maximum Supply Voltage	V _{cc}	-0.5		4.0	V	
Storage Temperature	T _s	-40		85	°C	
Relative Humidity	RH	0		85	%	1

Notes:

1. Non Condensing

III. Electrical Characteristics (T_{OP} = -5 to 70°C, V_{CC} = 3.14 to 3.46 Volts)

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Supply Voltage	V _{cc}	3.14	3.30	3.46	V	
Supply Current	I _{cc}		200	285	mA	
Transmitter						
Input differential impedance	R _{in}		100		Ω	1
Differential data input swing	V _{in,pp}	180		700	mV	
Transmit Disable Voltage	V _D	2		V _{cc}	V	
Transmit Enable Voltage	V _{EN}	V _{ee}		V _{ee} + 0.8	V	
Receiver						
Differential data output swing	V _{out,pp}	300		850	mV	2,6
Data output rise time, fall time	t _r	28			ps	3
LOS Fault	V _{LOS fault}	2		V _{cc,HOST}	V	4
LOS Normal	V _{LOS norm}	V _{ee}		V _{ee} +0.8	V	4
Power Supply Noise Tolerance	V _{ccT/VccR}	Per SFF-8431 Rev 4.1			mVpp	5

Notes:

1. Connected directly to TX data input pins. AC coupling from pins into laser driver IC.
2. Into 100Ω differential termination.
3. 20 – 80%. Measured with Module Compliance Test Board and OMA test pattern. Use of four 1's and four 0's sequence in the PRBS 9 is an acceptable alternative. SFF-8431 Rev 4.1.
4. LOS is an open collector output. Should be pulled up with 4.7kΩ – 10kΩ on the host board. Normal operation is logic 0; loss of signal is logic 1.
5. See Section 2.8.3 of SFF-8431 Rev 4.1.
6. The FTLX1475D3BCV is a "limiting module", i.e., it employs a limiting receiver. Host board designers using an EDC PHY IC should follow the IC manufacturer's recommended settings for interoperating the host-board EDC PHY with a limiting receiver SFP+ module.

IV. Optical Characteristics for RS0 = Low (1G Operation)
($T_{OP} = -5$ to 70°C , $V_{CC} = 3.14$ to 3.46 Volts)

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Transmitter						
Average Launch Power	P_{AVE}	-11		-3	dBm	1
Optical Wavelength	λ	1260		1355	nm	
Rise-Fall Time	T_{rise}/T_{fall}			0.26	ns	2
RMS Spectral Width	$\Delta\lambda_{rms}$			4	nm	
Optical Extinction Ratio	ER	9			dB	
Average Launch power of OFF transmitter	P_{OFF}			-30	dBm	
Tx Jitter	Txj	Per 802.3-2005 requirements				
Relative Intensity Noise	RIN			-120	dB/Hz	
Receiver						
Receiver Sensitivity	R_{SENS}			-19	dBm	3
Stressed Receiver Sensitivity	SRS			-14.4	dBm	4
Average Receive Power	P_{AVE}			-3	dBm	
Optical Center Wavelength	λ_C	1260		1600	nm	
Return Loss	R_{rx}	12			dB	
Receive electrical 3dB upper cutoff frequency			1500		MHz	
LOS De-Assert	LOS_D			-17	dBm	
LOS Assert	LOS_A	-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; $BER < 10^{-12}$; $2^{31} - 1$ PRBS.
4. Valid between 1260 and 1355 nm. Per IEEE 802.3-2005. 9dB extinction ratio transmitter.

V. Optical Characteristics for RS0 = Low (10G Operation)**(T_{OP} = -5 to 70°C, V_{CC} = 3.14 to 3.46 Volts)**

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Transmitter						
Optical Modulation Amplitude (OMA)	P _{OMA}	-5.2			dBm	
Average Launch Power	P _{AVE}	-8.2		+0.5	dBm	1
Optical Wavelength	λ	1260		1355	nm	
Side-Mode Suppression Ratio	SMSR	30			dB	
Optical Extinction Ratio	ER	3.5			dB	
Transmitter and Dispersion Penalty	TDP			3.2	dB	
Average Launch power of OFF	P _{OFF}			-30	dBm	
transmitter	Txj	Per 802.3-2005 requirements				
Tx Jitter	RIN			-128	dB/Hz	
Relative Intensity Noise						
Receiver Sensitivity (OMA) @ 10.3Gb/s	R _{SENS1}			-12.6	dBm	2
Stressed Receiver Sensitivity (OMA) @ 10.3Gb/s	R _{SENS2}			-10.3	dBm	3
Average Receive Power	P _{AVE}	-14.2		+0.5	dBm	
Optical Center Wavelength	λ _C	1260		1600	nm	
Receiver Reflectance	R _{rx}			-12	dB	
LOS Assert	LOS _D			-17	dBm	
LOS Hysteresis	LOS _A	-30			dBm	
LOS Hysteresis		0.5			dB	

Notes:

1. Average power figures are informative only, per IEEE 802.3-2005.
2. Valid between 1260 and 1355 nm. Measured with worst ER; BER<10⁻¹²; 2³¹ – 1 PRBS.
3. Valid between 1260 and 1355 nm. Per IEEE 802.3-2005.

VI. General Specifications

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Bit Rate (RS0 = LOW)	BR		1.25		Gb/s	1
Bit Rate (RS0 = HIGH)	BR	9.95	10.3		Gb/s	2
Max. Supported Link Length	L_{MAX}		10		km	

Notes:

1. 1000BASE-LX. Tested with a $2^7 - 1$ PRBS. See Section I, Note 5 for RS0 conditions for 1.25Gb/s operation.

2. 10GBASE-LR/LW. Tested with a $2^{31} - 1$ PRBS. See Section I, Note 5 for RS0 conditions for 10.3 Gb/s operation.

VII. Environmental Specifications

Finisar FTLX1475D3BCV transceivers have an operating temperature range from -5°C to +70°C case temperature.

Environmental Specifications	Symbol	Min	Typ	Max	Units	Ref.
Case Operating Temperature	T_{op}	-5		70	°C	
Storage Temperature	T_{sto}	-40		85	°C	

VIII. Regulatory Compliance

Finisar transceivers are Class 1 Laser Products and comply with US FDA regulations. These products are certified by TÜV and CSA to meet the Class 1 eye safety requirements of EN (IEC) 60825 and the electrical safety requirements of EN (IEC) 60950. Copies of certificates are available at Finisar Corporation upon request.

VIX. Digital Diagnostic Functions

Finisar FTLX1475D3BCV SFP+ transceivers support the 2-wire serial communication protocol as defined in the SFP MSA¹. It is very closely related to the E²PROM defined in the GBIC standard, with the same electrical specifications.

The standard SFP serial ID provides access to identification information that describes the transceiver's capabilities, standard interfaces, manufacturer, and other information.

Additionally, Finisar SFP+ transceivers provide an 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 E²PROM 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 interface is identical to, and is thus fully backward compatible with both the GBIC Specification and the SFP Multi Source Agreement. The complete interface is described in Finisar Application Note AN-2030: "Digital Diagnostics Monitoring Interface for SFP Optical Transceivers".

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.

For more information, please see the SFP MSA documentation^{1,5} and Finisar Application Note AN-2030.

X. Digital Diagnostic Specifications

FTLX1475D3BCV transceivers can be used in host systems that require either internally or externally calibrated digital diagnostics.

Parameter	Symbol	Min	Max	Units	Ref.
Accuracy					
Internally measured transceiver temperature	ΔDD_{Temp}		± 5	$^{\circ}\text{C}$	
Internally measured transceiver supply voltage	$\Delta DD_{Voltage}$		3	mV	
Measured TX bias current	ΔDD_{Bias}		10	%	1
Measured TX output power	$\Delta DD_{Tx-Power}$		2	dB	
Measured RX received average optical power	$\Delta DD_{Rx-Power}$		2	dB	
Dynamic Range for Rated Accuracy					
Internally measured transceiver temperature	DD_{Temp}	-5	70	$^{\circ}\text{C}$	
Internally measured transceiver supply voltage	$DD_{Voltage}$	3.1	3.5	V	
Measured TX bias current	DD_{Bias}	10	90	mA	
Measured TX output power	$DD_{Tx-Power}$	-8.2	+0.5	dBm	
Measured RX received average optical power	$DD_{Rx-Power}$	-14.2	+0.5	dBm	
Max Reporting Range					
Internally measured transceiver temperature	DD_{Temp}	-40	125	$^{\circ}\text{C}$	
Internally measured transceiver supply voltage	$DD_{Voltage}$	2.8	4.0	V	
Measured TX bias current	DD_{Bias}	0	20	mA	
Measured TX output power	$DD_{Tx-Power}$	-10	+2	dBm	
Measured RX received average optical power	$DD_{Rx-Power}$	-22	+2	dBm	

Notes:

1. Accuracy of Measured Tx Bias Current is 10% of the actual Bias Current from the laser driver to the laser

XI. Mechanical Specifications

Finisar FTLX1475D3BCV SFP+ transceivers are compatible with the SFF-8432 specification for improved pluggable form factor, and shown here for reference purposes only. Bail color is blue.

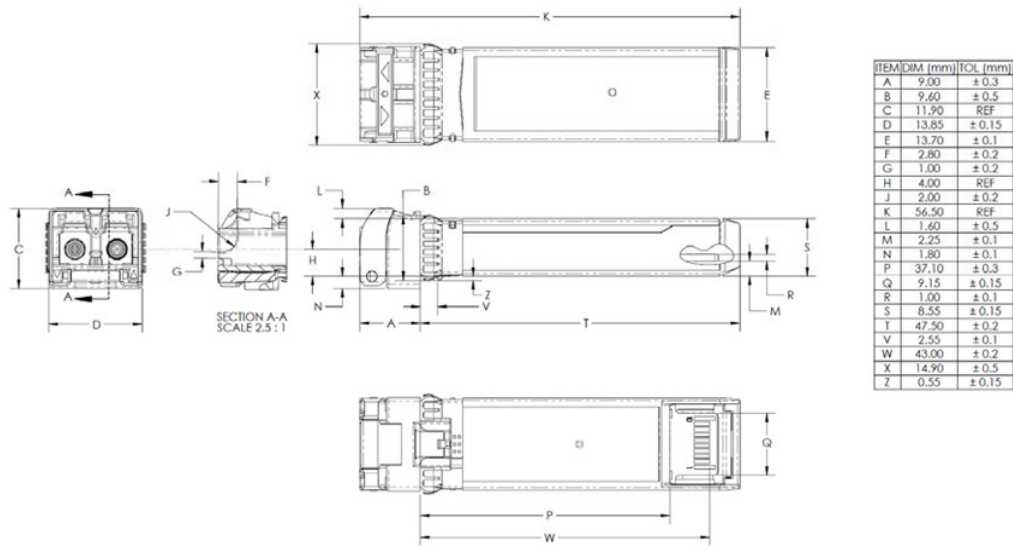
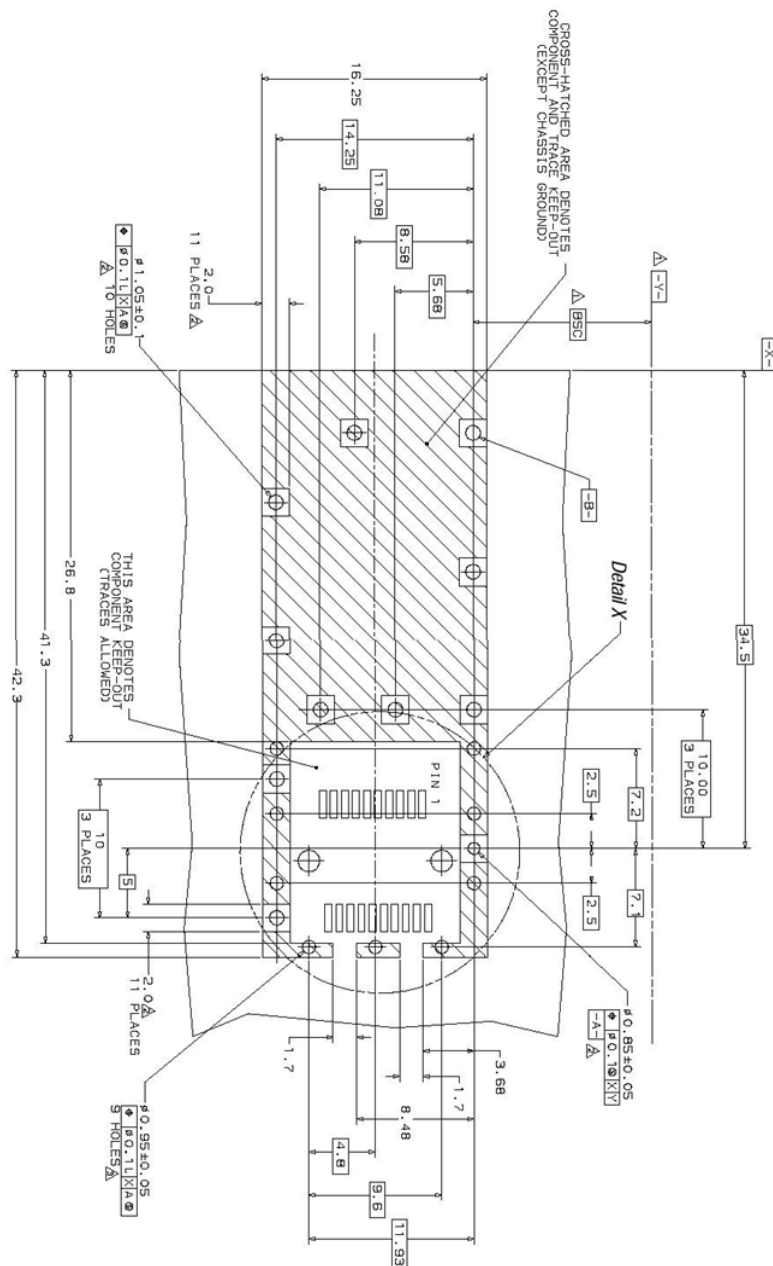


Figure 2. FTLX1475D3BCV Mechanical Dimensions and Tolerances.

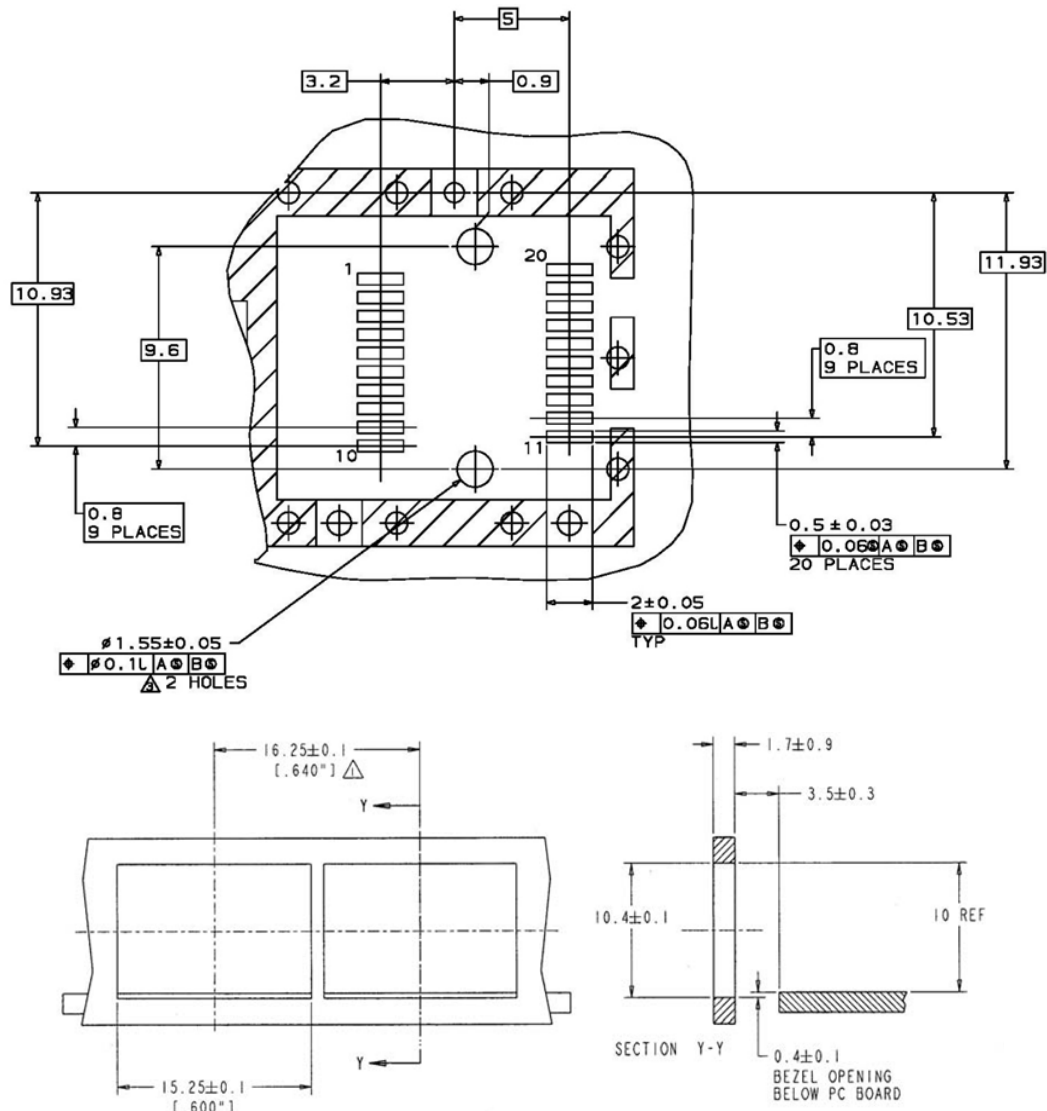
XII. PCB Layout and Bezel Recommendations



ΔDatum and Basic Dimension Established by Customer

△ Rads and Vias are Chassis Ground, 11 Places

⚠ Through Holes are Unplated



NOTES:

MINIMUM PITCH ILLUSTRATED, ENGLISH DIMENSIONS
ARE FOR REFERENCE ONLY

2. NOT RECOMMENDED FOR PCI EXPANSION CARD APPLICATIONS

XIII. Host - Transceiver Interface Block Diagram

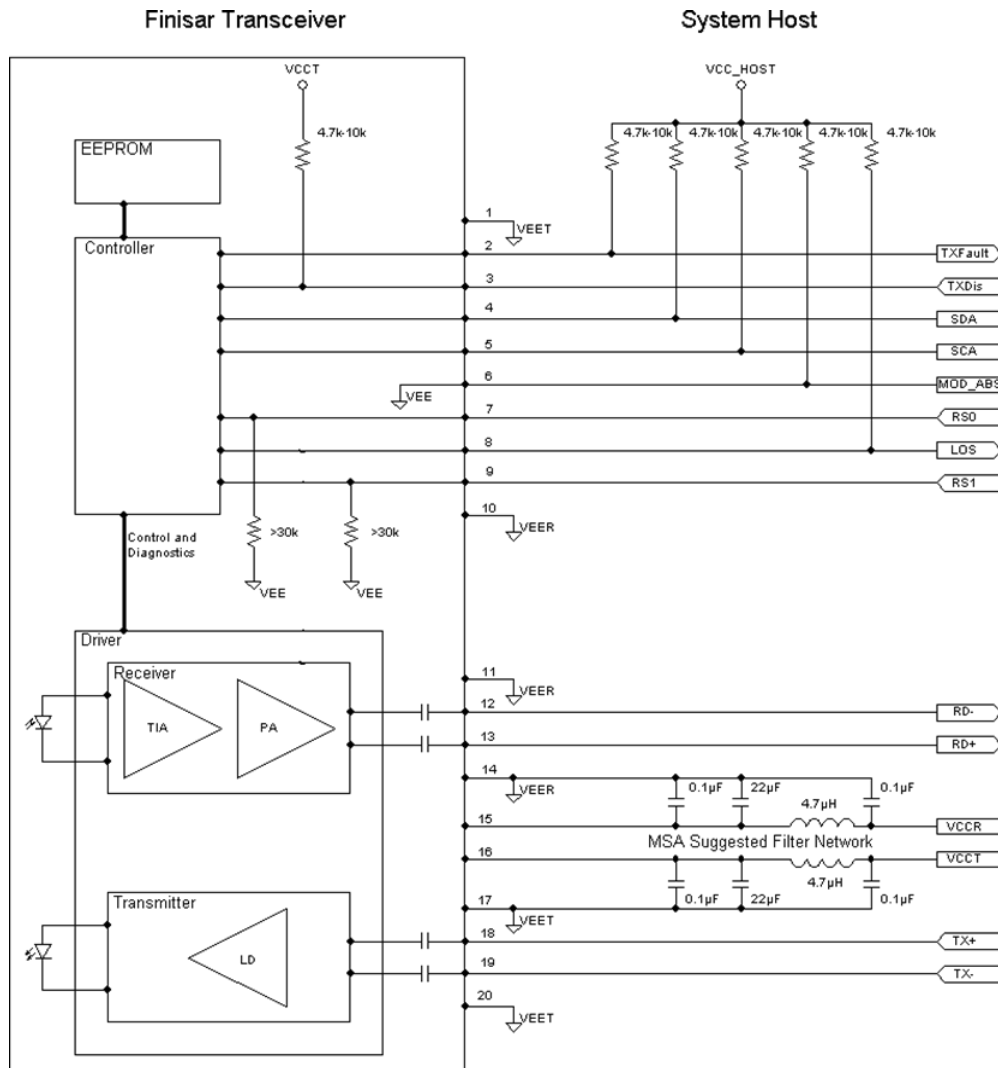


Figure 6. Host-Module Interface

XIII. References

1. "Specifications for Enhanced 8.5 and 10 Gigabit Small Form Factor Pluggable Module 'SFP+'", SFF Document Number SFF-8431, Revision 4.1.
2. "Improved Pluggable Form factor", SFF Document Number SFF-8432, Revision 4.2, April 18, 2007.
3. IEEE Std 802.3ae, Clause 52, PMD Type 10GBASE-LR. IEEE Standards Department.
4. American National Standard for Information Technology - Fibre Channel - 10 Gigabit Fibre Channel, Rev 3.5, April 9, 2003.
5. "Digital Diagnostics Monitoring Interface for Optical Transceivers". SFF Document Number SFF-8472, Revision 11.3.
6. Directive 2011/65/EU of the European Parliament and of the Council "on the restriction of the use of certain hazardous substances in electrical and electronic equipment". Certain products may use one or more exemption as allowed by the directive.
7. "Application Note AN-2038: Finisar Implementation Of RoHS Compliant Transceivers", Finisar Corporation, January 21, 2005.