

Product Specification

Industrial Temperature DWDM 1.2G-11.3G, 40km SFP+ Transceiver

FTLX3971DTCxx

PRODUCT FEATURES

- 100 GHz spacing, DWDM C-band
- Up to 40km link length
- 1.2 through 11.3 Gb/s data rates
- -40/85°C case temperature range
- 1.6W max power consumption* at 85°C
- Single 3.3V power supply
- Cooled 1550nm EML laser
- Hot-pluggable SFP+ footprint
- Limiting electrical interface receiver
- Duplex LC connector
- Built-in digital diagnostic functions
- RoHS-6 compliant



APPLICATIONS

- DWDM 40km links for:
 - 2x through 10x Fibre Channel
 - 1G through 10G Ethernet
 - CPRI options 2 through 8
 - OTN OTU 1, 2 and 2f

Finisar's FTLX3971DTCxx transceivers are Enhanced Small Form Factor Pluggable SFP+ transceivers designed for use in DWDM links up to 40km of G.652 single mode fiber, for multi-rate applications from 1.2 through 11.3 Gb/s, carrying 1G-10G Ethernet, 2x-10x Fibre Channel, 10G OTN traffic and CPRI options 2 through 8 traffic. The FTLX3971DTCxx transceivers are compliant with SFF-8431¹ and SFF-8432².

Digital diagnostics functions are available via a 2-wire serial interface, as specified in SFF-8472³. Finisar's FTLX3971DTCxx transceivers are RoHS compliant per Directive 2011/65/EU^{4,5}.

PRODUCT SELECTION

Product Part Number

FTLX3971DTCxx

xx=ITU-T Grid Channel (see next page)

(*) Please contact Finisar if 1.5W power consumption variant is required.

Product Ordering Codes / Channel Selection

Channel	Product Code	Frequency (THz)	Center Wavelength (nm)		Channel	Product Code	Frequency (THz)	Center Wavelength (nm)
C20	FTLX3971DTC20	192.00	1561.42		C41	FTLX3971DTC41	194.10	1544.53
C21	FTLX3971DTC21	192.10	1560.61		C42	FTLX3971DTC42	194.20	1543.73
C22	FTLX3971DTC22	192.20	1559.79		C43	FTLX3971DTC43	194.30	1542.94
C23	FTLX3971DTC23	192.30	1558.98		C44	FTLX3971DTC44	194.40	1542.14
C24	FTLX3971DTC24	192.40	1558.17		C45	FTLX3971DTC45	194.50	1541.35
C25	FTLX3971DTC25	192.50	1557.36		C46	FTLX3971DTC46	194.60	1540.56
C26	FTLX3971DTC26	192.60	1556.55		C47	FTLX3971DTC47	194.70	1539.77
C27	FTLX3971DTC27	192.70	1555.75		C48	FTLX3971DTC48	194.80	1538.98
C28	FTLX3971DTC28	192.80	1554.94		C49	FTLX3971DTC49	194.90	1538.19
C29	FTLX3971DTC29	192.90	1554.13		C50	FTLX3971DTC50	195.00	1537.40
C30	FTLX3971DTC30	193.00	1553.33		C51	FTLX3971DTC51	195.10	1536.61
C31	FTLX3971DTC31	193.10	1552.52		C52	FTLX3971DTC52	195.20	1535.82
C32	FTLX3971DTC32	193.20	1551.72		C53	FTLX3971DTC53	195.30	1535.04
C33	FTLX3971DTC33	193.30	1550.92		C54	FTLX3971DTC54	195.40	1534.25
C34	FTLX3971DTC34	193.40	1550.12		C55	FTLX3971DTC55	195.50	1533.47
C35	FTLX3971DTC35	193.50	1549.32		C56	FTLX3971DTC56	195.60	1532.68
C36	FTLX3971DTC36	193.60	1548.51		C57	FTLX3971DTC57	195.70	1531.90
C37	FTLX3971DTC37	193.70	1547.72		C58	FTLX3971DTC58	195.80	1531.12
C38	FTLX3971DTC38	193.80	1546.92		C59	FTLX3971DTC59	195.90	1530.33
C39	FTLX3971DTC39	193.90	1546.12		C60	FTLX3971DTC60	196.00	1529.55
C40	FTLX3971DTC40	194.00	1545.32					

Table 1. Product ordering codes: the central wavelength is defined as per ITU-T 694.1

I. Pin Descriptions

Pin	Symbol	Name/Description	Ref.
1	V _{EET}	Transmitter Ground	1
2	T _{FAULT}	Transmitter Fault	2,3
3	T _{DIS}	Transmitter Disable. Laser output disabled on high or open.	4
4	SDA	2-wire Serial Interface Data Line	2
5	SCL	2-wire Serial Interface Clock Line	2
6	MOD_ABS	Module Absent. Grounded within the module	5
7	RS0	Rate Select 0. Not used.	
8	RX_LOS	Loss of Signal indication. Logic 0 indicates normal operation.	6
9	RS1	Rate Select 1. Not used.	
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	7
16	V _{CCT}	Transmitter Power Supply	7
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. 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 Vcc + 0.3V.
3. 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.
4. Laser output disabled on T_{DIS} >2.0V or open, enabled on T_{DIS} <0.8V.
5. Internally pulled down per SFF-8431 Rev 4.1.
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.
7. Internally connected

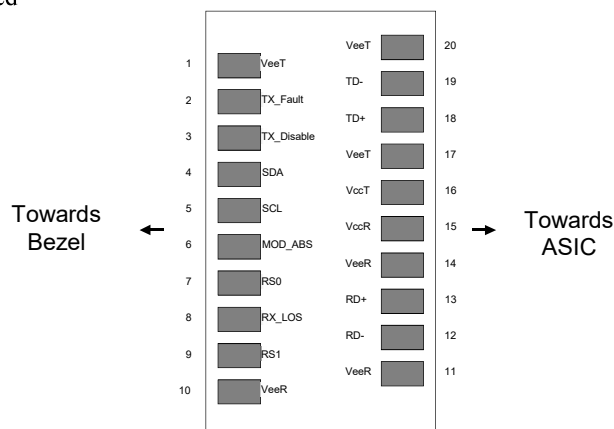


Figure 1. Diagram of Host Board Connector Block Pin Numbers and Names.

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
Receiver Optical Damage Threshold	RxDamage	5			dBm	

Notes:

1. Non-condensing

III. Electrical Characteristics (T_{OP} = -40 to 85 °C)

Parameter	Symbol	Min	Typ.	Max	Unit	Ref.
Supply Voltage	V _{cc}	3.14		3.46		
Transmitter						
Input differential impedance	R _{in}	80	100	120	Ω	
Differential data input swing	V _{in,pp}	120		850	mV	1
Transmit Disable Voltage	V _D	V _{cc} -0.8		V _{cc}	V	
Transmit Enable Voltage	V _{EN}	V _{ee}		V _{cc} + 0.8	V	
Receiver						
Output differential impedance	R _{out}	80	100	120	Ω	
Differential data output swing	V _{out,pp}	300		850	mV	1
Output rise time and fall time	T _r , T _f	24			ps	2
LOS asserted	V _{LOS A}	V _{cc} -0.8		V _{cc}	V	3
LOS de-asserted	V _{LOS D}	V _{ee}		V _{cc} +0.8	V	3
Power Supply Noise Tolerance	V _{ccT} /V _{ccR}	Per SFF-8431 Rev 4.1			mV _{pp}	4
Power Consumption				1.6	W	5,6

Notes:

1. Internally AC coupled.
2. 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.
3. 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.
4. See Section 2.8.3 of SFF-8431 Rev 4.1.
5. Power consumption measured at 85°C case temperature, beginning of life and 3.3V supply voltage.
6. Please, contact Finisar if 1.5W power consumption variant is required.

IV. Optical Characteristics (TOP = -40 to 85 °C, VCC = 3.14 to 3.46 Volts)

Parameter			Symbol	Min	Typ	Max	Unit	Ref.
Transmitter (Tx)								
Average Launch Power			P_{AVE}	1		+4	dBm	
Optical Wavelength			λ_c	As per ITU-T 694.1			nm	1
Center Wavelength (End of Life)			λ_{c_EOL}	$\lambda_c \pm 100\text{pm}$				
Side-Mode Suppression Ratio			SMSR	30			dB	
Optical Extinction Ratio			ER	8.2			dB	
Average Launch power when Tx is OFF			P_{OFF}			-30	dBm	
Relative Intensity Noise			RIN			-128	dB/Hz	
Receiver (Rx)								
Optical Center Wavelength			λ_c	1260		1600	nm	
Reflectance			R_{rx}			-27	dB	
Sensitivity (0ps/nm)	Bit Rate (Gb/s)	BER						
	1.2÷10.7	$<10^{-12}$	R_{SENS1}			-24.0	dBm	2
	11.1÷11.3	$<10^{-6}$	R_{SENS3}			-24.0		
Sensitivity (800ps/nm)	1.2÷10.7	$<10^{-12}$	R_{SENS4}			-22.0	dBm	2,3
	11.1÷11.3	$<10^{-6}$	R_{SENS6}			-22.0		2,3
Overload	<9.83		P_{AVE1}	-10			dBm	4
	≥ 9.83		P_{AVE2}	-7			dBm	2

Notes:

1. Refer to Tab. 1.
2. Measured with worst ER=8.2dB; $2^{31} - 1$ PRBS.
3. 800ps/nm max chromatic dispersion tolerance over 40km of G.652 single mode fiber
4. Measured with worst ER=8.2dB; $2^7 - 1$ PRBS.

V. General Specifications

Parameter	Symbol	Min	Typ	Max	Units	Ref.
Bit Rate	BR	1.2288		11.3176	Gb/s	1
Max. Supported Link Length	L _{MAX}			40	km	2

Notes:

1. Tested with patterns and BER defined in Table IV.
2. Over G.652 single mode fiber.

Timing Parameters

Parameter	Symbol	Min	Max	Units	Ref.
Time to initialize cooled module	t _{start up cooled}		10	s	

VI. Environmental Specifications

Finisar FTLX3971DTCxx's operating case temperature range:

Parameter	Symbol	Min	Typ	Max	Units	Ref.
Case Operating Temperature	T _{op}	-40		85	°C	
Storage Temperature	T _{sto}	-40		85	°C	

VII. 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.

VIII. Digital Diagnostic Functions

Finisar FTLX3971DTCxx SFP+ transceivers support the 2-wire serial communication protocol as defined in the SFP MSA¹. It is very closely related to the memory map 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 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"⁷.

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 documentation⁶ and Finisar Application Note AN-2030.

Please note that evaluation board FDB-1027 is available with Finisar ModDEMO software that allows simple to use communication over the 2-wire serial interface.

IX. Digital Diagnostic Specifications

FTLX3971DTCxx transceivers can be used in host systems that require either internally or externally calibrated digital diagnostics.

Parameter	Symbol	Units	Min	Max	Accuracy	Ref.
Transceiver temperature	$\Delta_{DD}Temp$	°C	-40	+85	±5°C	1
Transceiver supply voltage	$\Delta_{DD}Voltage$	V	2.8	4.0	±3%	
Transmitter bias current	$\Delta_{DD}Bias$	mA	0	127	±10%	2
Transmitter output power	$\Delta_{DD}Tx-Power$	dBm	-2	+3	±2dB	
Receiver average optical input power	$\Delta_{DD}Rx-Power$	dBm	-25	-7	±2dB	

Notes:

- Internally measured
- The accuracy of the Tx bias current is 10% of the actual current from the laser driver to the laser

X. SFF-8431 Power-up Sequence

The typical power consumption of the FTLX3971DTCxx exceeds the limit of 1.5W specified for the Power Level II transceivers in [1], for which a power-up sequence is recommended. However, the FTLX3971DTCxx is factory set to power-up directly to its operating conditions in Power Level Mode II. Upon request, it can be factory set to follow the power-up sequence specified for transceivers exceeding 1W, as per [1]. In power level I, the FTLX3971DTCxx does not carry traffic, but the 2-wire serial communication is active.

Please refer to [1] and Finisar Application Note AN-2076 for additional details.

XI. Receiver Decision Threshold Control

The host can control the Receiver Decision Threshold (RxDT) of Finisar FTLX3971DTCxx SFP+ transceivers via the 2-wire serial communication, by setting the byte 131 of Table 02h. The availability of this function is indicated in Bit 3, Byte 64 of A0h in the serial ID section. Byte 131 is a 2's complement 7 bit value (-128 - +127) The decision threshold set is given by:

$$RxDT = \text{default RxDT} + [\text{Byte}(131)/256]*100\%.$$

On power-up the byte 131 defaults to 0, corresponding to the RxDT optimum value. The actual RxDT range the formula covers is about ±20% around the default optimum value.

XII. Mechanical Specifications

Finisar FTLX3971DTCxx SFP+ transceivers are compatible with the SFF-8432 specification for improved pluggable form factor, and shown here for reference purposes only. Bail color is red.

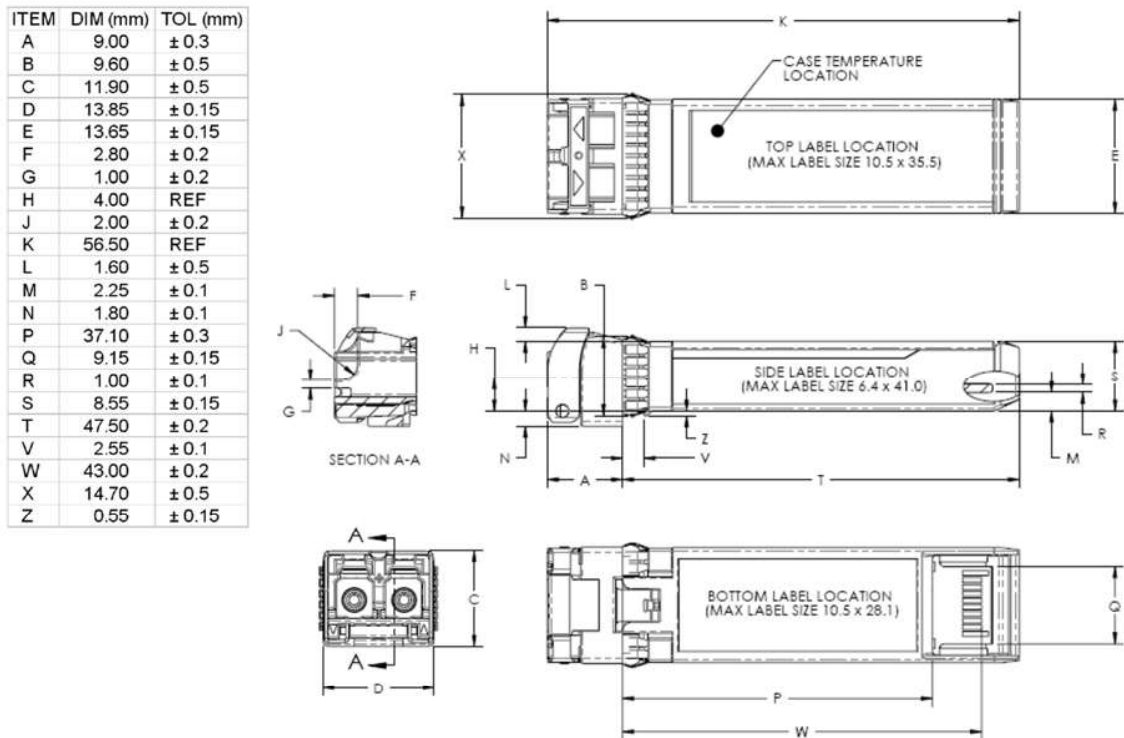


Figure 2. Mechanical Dimensions

Note: the option of the label on the top side of the transceiver is not recommended.

XIII. Host Board SFP+ Connector Recommendations

- Datum and Basic Dimension Established by Customer
- Plates and Vias are Chassis Ground, 11 Places
- Through Holes are Unplated

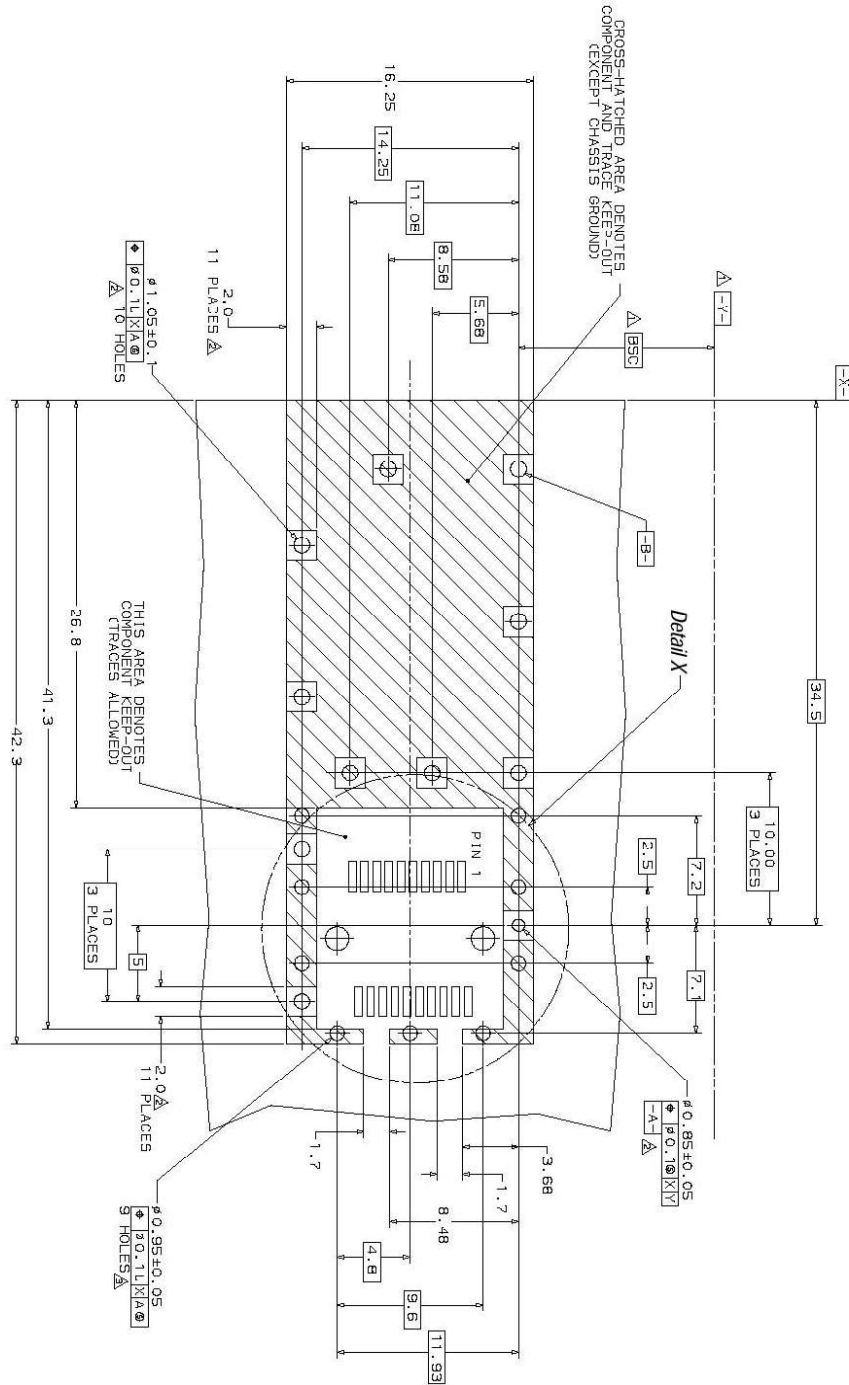
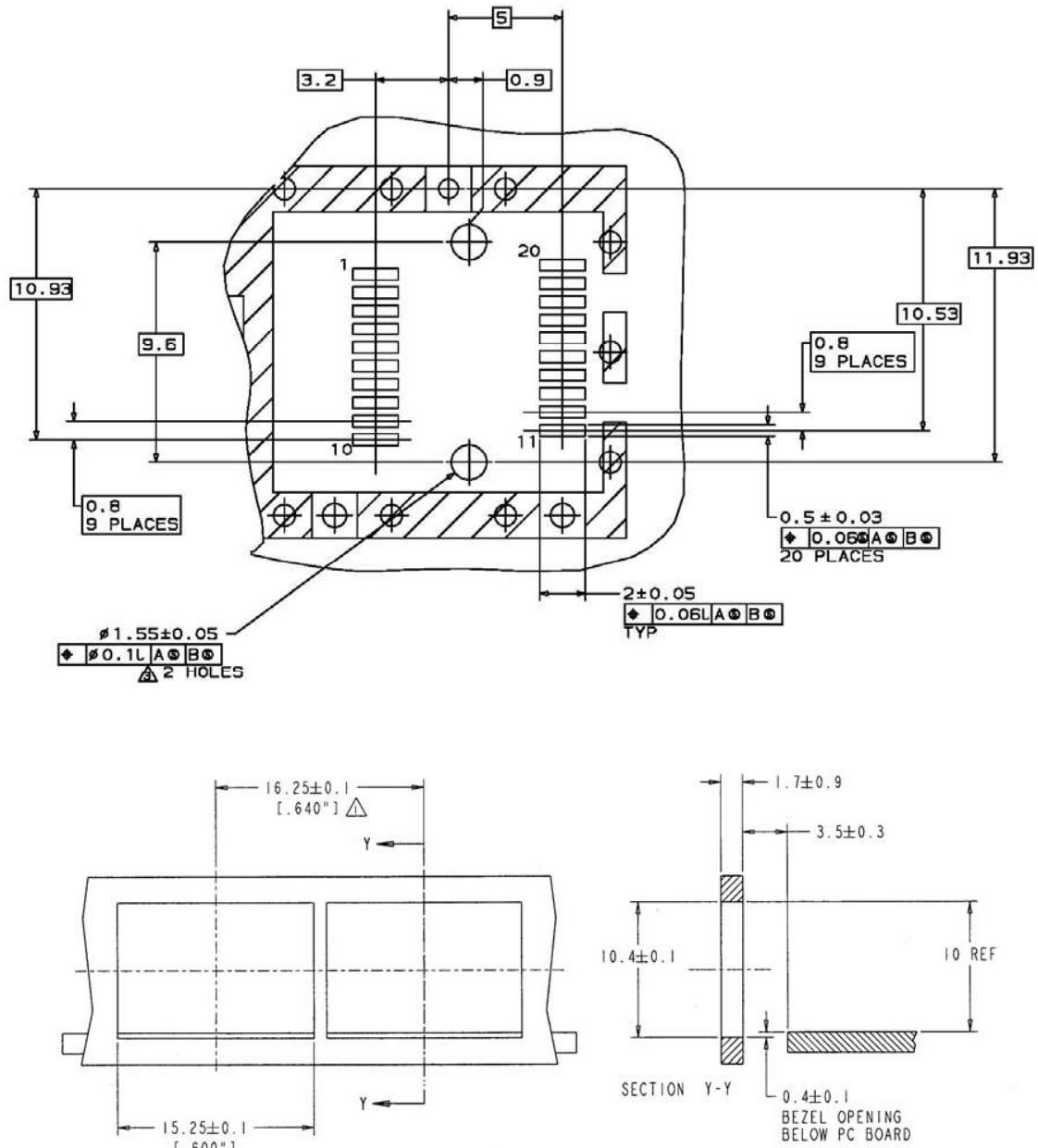


Figure 3. PCB Layout and Bezel Recommendations, as per [9]



- NOTES:
- 1. △ MINIMUM PITCH ILLUSTRATED, ENGLISH DIMENSIONS ARE FOR REFERENCE ONLY
 - 2. NOT RECOMMENDED FOR PCI EXPANSION CARD APPLICATIONS

Figure 4

XIV. Host-Module Interface Diagram

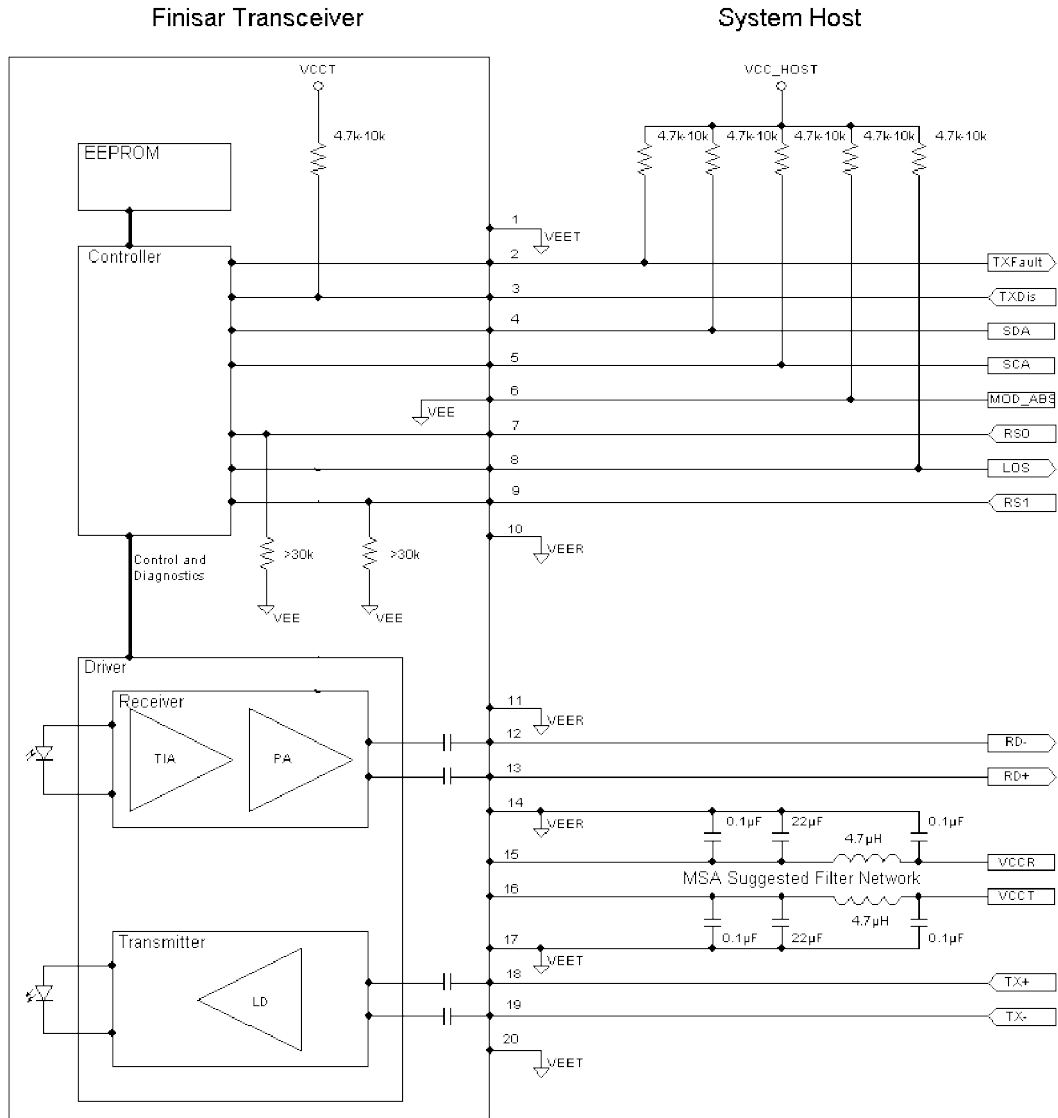


Figure 5

XV. 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. “Digital Diagnostics Monitoring Interface for Optical Transceivers”. SFF Document Number SFF-8472, Revision 12.2, November 21, 2014.
4. 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.
5. “Application Note AN-2038: Finisar Implementation of RoHS Compliant Transceivers”, Finisar Corporation, January 21, 2005.
6. Small Form-factor Pluggable (SFP) Transceiver Multi-Source Agreement (MSA)
7. “Application Note AN-2030: Digital Diagnostic Monitoring Interface for SFP Optical Transceivers”
8. “Application Note AN-2076: SFP+ Level II Power Up Sequence”, Rev B
9. “Application Note AN-2124: Addendum to AN-2030 with changes from SFF-8472 revision 12.2”

XVI. For More Information

Finisar Corporation
1389 Moffett Park Drive
Sunnyvale, CA 94089-1133
Tel. 1-408-548-1000
Fax 1-408-541-6138
sales@finisar.com
www.finisar.com