Finisar

Product Specification

10Gb/s, 80km Single Mode, Multi-Rate SFP+ Transceiver

FTLX1871M3BCL

PRODUCT FEATURES

- Hot-pluggable SFP+ footprint
- Supports 8.5 and 9.95 to 11.3 Gb/s
- 80km link length
- 1600ps/nm chromatic dispersion tolerance
- -5/70°C case temperature range
- Internal transmitter/receiver CDR
- 1.5W/1.7W power consumption options
- Cooled 1550nm EML laser
- Limiting electrical interface receiver
- Duplex LC connector
- Built-in digital diagnostic functions
- RoHS-6 compliant (lead-free)

APPLICATIONS

- SONET OC-192, SDH STM-64 and OTN G.959.1 P1L1-2D2
- 10G Ethernet ZR and 10G Fibre Channel
- OTN G.709 OTU1e/2/2e FEC bit rates
- 8.5Gb/s Fibre Channel

Finisar's FTLX1871M3BCL transceivers are Enhanced Small Form Factor Pluggable SFP+ transceivers designed for use in 10-Gigabit multi-rate links up to 80km of G.652 single mode fiber. They are compliant with SFF-8431[1], SFF-8432[2] and G.959.1 P1L1-2D2, and support SONET OC-192, SDH STM-64, 10G Ethernet ZR and 10G Fibre Channel. Finisar's FTLX1871M3BCL transceivers use internal clock and data recovery (CDR) IC's for the transmitter and the receiver. This guarantees compliance with the SONET/SDH jitter requirements and it can be used to set the electrical interface to be XFI-compliant.

Digital diagnostics functions are available via a 2-wire serial interface, as specified in SFF-8472[3]. Finisar's FTLX1871M3BCL transceivers are RoHS compliant and lead free per Directive 2002/95/EC[4], and Finisar Application Note AN-2038[5].

PRODUCT SELECTION

FTLX1871M3BCL

I. Pin Descriptions

Pin	Symbol	Name/Description	Ref.
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	2
5	SCL	2-wire Serial Interface Clock Line	2
6	MOD_ABS	Module Absent. Grounded within the module	2
7	RS0	Rate Select 0.	4
8	RX_LOS	Loss of Signal indication. Logic 0 indicates normal operation.	5
9	RS1	Rate Select 1.	4
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	6
16	V_{CCT}	Transmitter Power Supply	6
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 Vcc + 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. See Sec. X of this datasheet for the logic table to use for the internal CDRs locking modes.
5. 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.
6. Internally connected

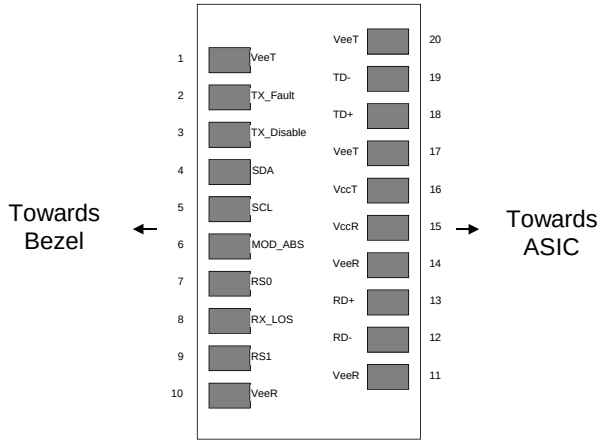


Figure 1. Diagram of Host Board Connector Block Pin Numbers and Names.

II. Absolute Maximum Ratings

Exceeding the limits below may damage the transceiver module permanently.

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Maximum Supply Voltage	Vcc	-0.5		4.0	V	
Storage Temperature	T_S	-40		85	°C	
Relative Humidity	RH	0		85	%	1
Receiver Optical Damage Threshold	RX_{Damage}	5			dBm	

Notes:

1. Non-condensing

III. Electrical Characteristics (T_{OP} = -5 to 70 °C)

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Supply Voltage	Vcc	3.14	3.30	3.46	V	
Transmitter (Tx)						
Input differential impedance	R_{in}	80	100	120	Ω	
Differential data input swing	Vin,pp	120		850	mV	1
Transmit Disable Voltage	V_D	V_{cc}-0.8		V_{cc}	V	
Transmit Enable Voltage	V_{EN}	0		0.8	V	
Receiver (Rx)						
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	28			ps	2
LOS asserted	V_{LOS_A}	V_{cc}-0.8		V_{cc}	V	3
LOS de-asserted	V_{LOS_D}	0		0.8	V	3
Power Supply Noise Tolerance	VccT/VccR	Per SFF-8431 Rev 4.1			mVpp	4
Power Consumption						
Tx and Rx CDR's ON	P_{diss}		1.6	1.7	W	5
Tx CDR OFF and Rx CDR ON			1.5	1.6	W	5
Tx & Rx CDR's OFF and Ethernet spec.				1.5	W	5

Notes:

1. Internally AC coupled. Data pins connect directly to the CDR.
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. Typical power consumption values refer to 3.3V, 70°C case temperature and beginning of life.

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

Parameter			Symbol	Min	Typ	Max	Unit	Ref.
Transmitter (Tx)								
Average Launch Power			P_{AVE}	0		4	dBm	
Optical Wavelength			λ	1530		1565	nm	
Side-Mode Suppression Ratio			SMSR	30			dB	
Optical Extinction Ratio			ER	9			dB	
Average Launch power when Tx is OFF			P_{OFF}			-30	dBm	
Jitter Generation 20kHz-80MHz, peak to peak			$Tx_{jpk2pk1}$			0.3	UI	1
Jitter Generation 4MHz-80MHz, peak to peak			$Tx_{jpk2pj2}$			0.1	UI	1
Relative Intensity Noise			RIN			-128	dB/Hz	
Receiver (Rx)								
Optical Center Wavelength			λ_C	1260		1600	nm	
Receiver Reflectance			R_{rx}			-27	dB	
Sensitivity	Bit Rate (Gb/s)	BER						
	8.5, 9.95-10.7	$<10^{-12}$	R_{SENS1}			-24	dBm	2,3
	11.1	$<10^{-12}$	R_{SENS2}			-23	dBm	2
		$<10^{-4}$	R_{SENS3}			-27	dBm	2
	11.3	$<10^{-4}$	R_{SENS4}			-27	dBm	2
Overload (Average Power)			P_{AVE}	-7			dBm	
LOS De-Assert			LOS_D			-28	dBm	
LOS Assert			LOS_A	-37		-30	dBm	
LOS Hysteresis			LOS_H	0.5			dB	
Path Penalty	Bit Rate (Gb/s)	BER						
	8.5, 9.95	$<10^{-12}$	PP_1			2	dB	4.a
	10.3-10.7	$<10^{-12}$	PP_2			3	dB	4.a
	11.1	$<10^{-4}$	PP_3			3	dB	4.b
	11.3	$<10^{-4}$	PP_4			3	dB	4.c

Notes:
1. SONET/SDH Tx jitter generation limits are guaranteed with the Tx CDR enabled and locked.
2. Measured with worst ER=9 dB; PRBS $2^{31} - 1$.
3. For 10GEthernet application, -24dBm is equivalent to an OMA of -22.09dBm for an ER = 9 dB.
4. Max chromatic dispersion tolerance over 80km of G.652 single mode fiber:
   a. 1600ps/nm
   b. 1450ps/nm
   c. 1300ps/nm

V. General Specifications

Parameter	Symbol	Min	Typ	Max	Units	Ref.
Bit Rate	BR	8.5		11.3168	Gb/s	1
Max. Supported Link Length	L_{MAX}			80	km	2

Notes:
1. Tested with a $2^{31} - 1$ PRBS pattern at the BER defined in Table IV.
2. Over G.652 single mode fiber.

Timing Parameters

Parameter	Symbol	Min	Typ	Max	Units	Ref.
Time to initialize	t_start_up			10	s	

VI. Environmental Specifications

Finisar FTLX1871M3BCL transceivers have an operating temperature range from -5°C to +70°C case temperature.

Parameter	Symbol	Min	Typ	Max	Units	Ref.
Case Operating Temperature	T_{op}	-5		70	°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 FTLX1871M3BCL SFP+ transceivers support the 2-wire serial communication protocol as defined in the SFP MSA[1]. It is very closely related to the E^{2}PROM 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 a 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 E^{2}PROM 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 E^{2}PROM 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[3] and Finisar Application Note AN-2030[7].

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

FTLX1871M3BCL transceivers can be used in host systems that require either internally or externally calibrated digital diagnostics.

Parameter	Symbol	Units	Min	Max	Accuracy	Ref.
Accuracy						
Transceiver temperature	ΔDD_{Temp}	ºC	-10	+75	±5ºC	1
Transceiver supply voltage	$\Delta DD_{Voltage}$	V	2.8	4.0	±3%	
Transmitter bias current	ΔDD_{Bias}	mA	0	127	±10%	2
Transmitter output power	$\Delta DD_{Tx\text{-}Power}$	dBm	-1	+5	±2dB	
Receiver average optical input power	$\Delta DD_{Rx\text{-}Power}$	dBm	-28	-5	±2dB	

Notes:
1. Internally measured
2. The accuracy of the Tx bias current is 10% of the actual current from the laser driver to the laser

X. Internal CDR's Locking Modes

The FTLX1871M3BCL is equipped with internal CDR units on both the receiver and the transmitter sides. The host can set the CDR's to lock at 8.5Gb/s, 10G (9.95-11.3Gb/s), or in by-pass mode, by setting the rate select pins or the soft bits (logic OR). The different locking modes are shown in the following logic table:

R/S 0 Logic OR of: pin 7 & bit 110.3	R/S 1 Logic OR of: pin 9 & bit 118.3	CDR's Locking Mode
Low or 0	Low or 0	Both CDR's lock at 8.5Gb/s
Low or 0	High or 1	Tx CDR is in bypass mode. Rx CDR locks at 10G (9.95-11.3Gb/s)
High or 1	Low or 0	Tx & Rx CDR's in bypass mode
High or 1	High or 1	Both CDR's lock at 10G (9.95-11.3Gb/s) The bits 110.3 and 118.3 are set to 1 by default at power-up

The RS0 and RS1 pins are internally pulled-down to ground as per [1]. The soft bits 110.3 and 118.3 are both set to "1" at the transceiver power-up, to select the 10G locking mode by default. The host can change this configuration via the 2-wire communication as described in the SFP MSA [1]. Alternative configurations can be factory set upon request. Please refer to Finisar for additional details.

XI. SFF-8431 Power-up Sequence

If either CDR is enabled, the typical power consumption of the FTLX1871M3BCL may exceed the limit of 1.5W specified for the Power Level II transceivers in [1], for which a power-up sequence is recommended. However, the FTLX1871M3BCL is factory set to power-up directly to its operating conditions. 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 FTLX1871M3BCL 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.

XII. Mechanical Specifications

Finisar FTLX1871M3BCL SFP+ transceivers are compatible with the SFF-8432 specification for improved pluggable form factor, and shown here for reference purposes only. Bail color is white.

ITEM	DIM (mm)	TOL (mm)
A	9.00	± 0.3
B	9.60	± 0.5
C	11.90	± 0.5
D	13.85	± 0.15
E	13.65	± 0.15
F	2.80	± 0.2
G	1.00	± 0.2
H	4.00	REF
J	2.00	± 0.2
K	56.50	REF
L	1.60	± 0.5
M	2.25	± 0.1
N	1.80	± 0.1
P	37.10	± 0.3
Q	9.15	± 0.15
R	1.00	± 0.1
S	8.55	± 0.15
T	47.50	± 0.2
V	2.55	± 0.1
W	43.00	± 0.2
X	14.70	± 0.5
Z	0.55	± 0.15

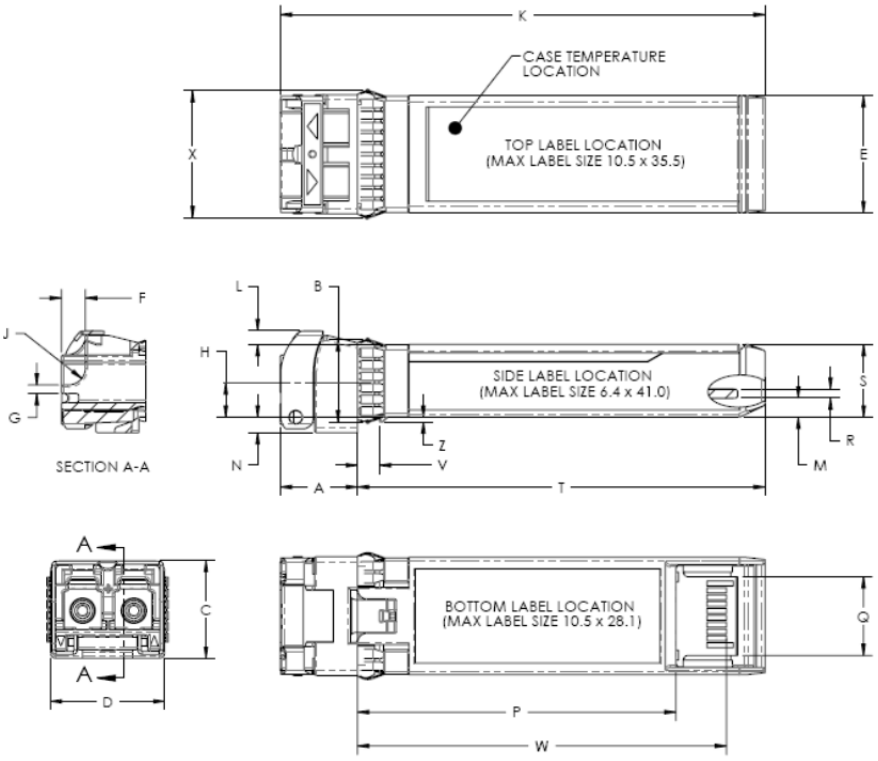


Figure 2. Mechanical Dimensions

XIII. Host Board SFP+ Connector Recommendations

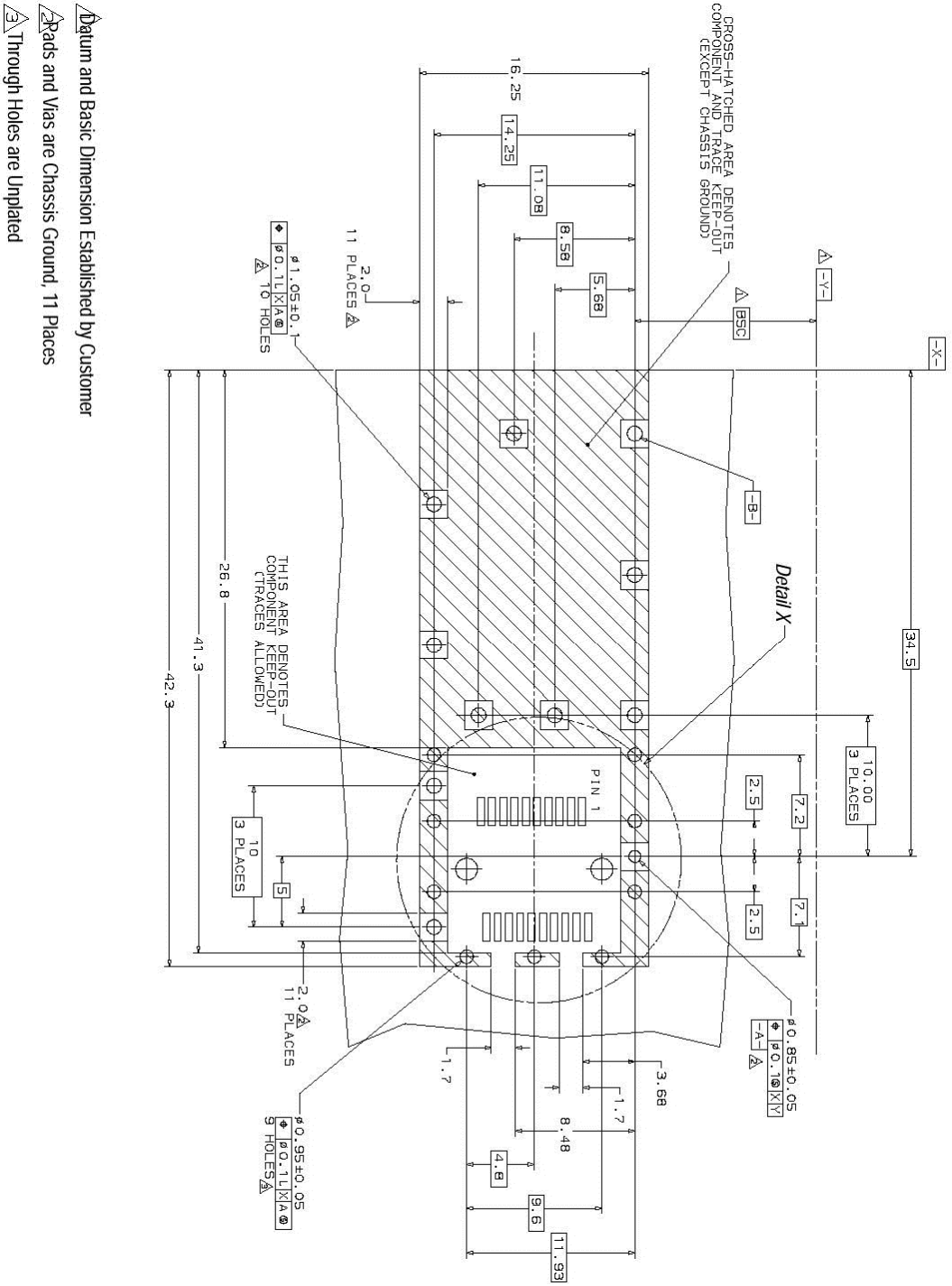
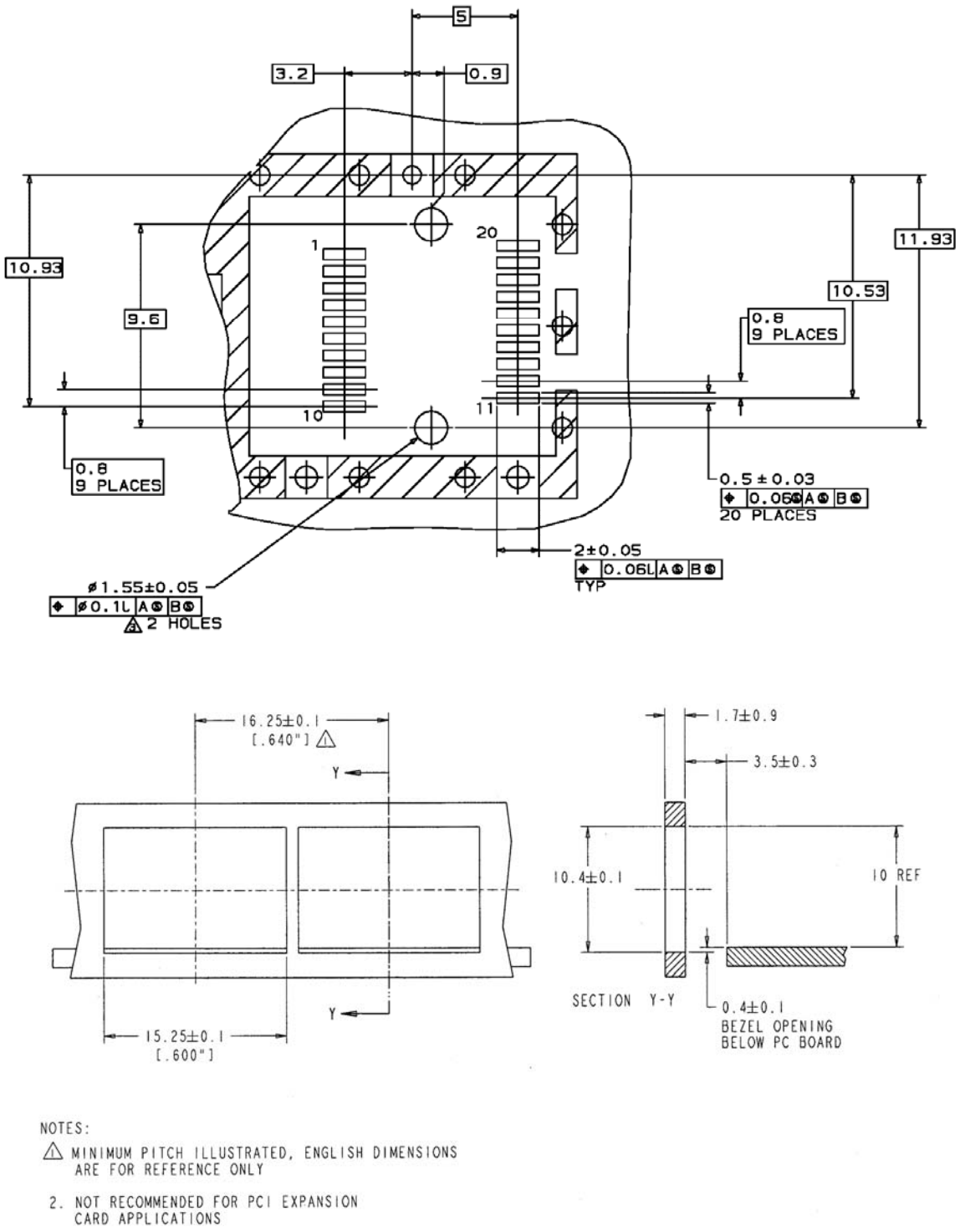


Figure 3. PCB Layout and Bezel Recommendations, as per [9]



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

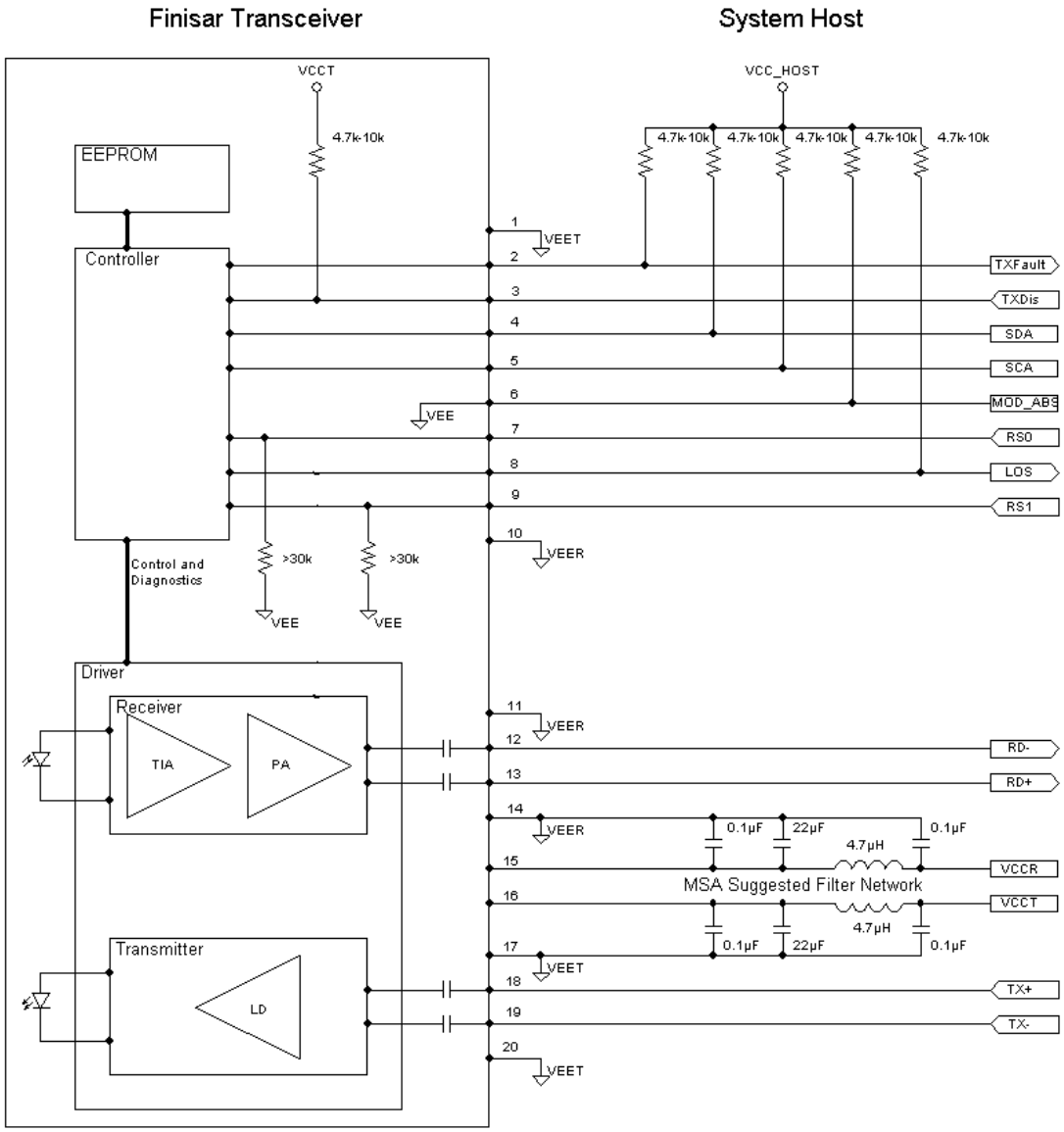


Figure 5

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, including SFF-8431 Rev 4.1 Addendum. September 15, 2013
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 10.1, March 1, 2007.
4. Directive 2002/95/EC of the European Council Parliament and of the Council, "on the restriction of the use of certain hazardous substances in electrical and electronic equipment". January 27, 2003.
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"

XVI. Revision History

Revision	Date	Description
B1	01/22/2013	Production Release
B2	12/15/2013	Modified CDR's control logic table

XVII. 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

Общество с ограниченной ответственностью «МосЧип» ИНН 7719860671 / КПП 771901001
Адрес: 105318, г.Москва, ул.Щербаковская д.3, офис 1107

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Офис по работе с юридическими лицами:

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: info@moschip.ru

Skype отдела продаж:
moschip.ru
moschip.ru_4
moschip.ru_6
moschip.ru_9