

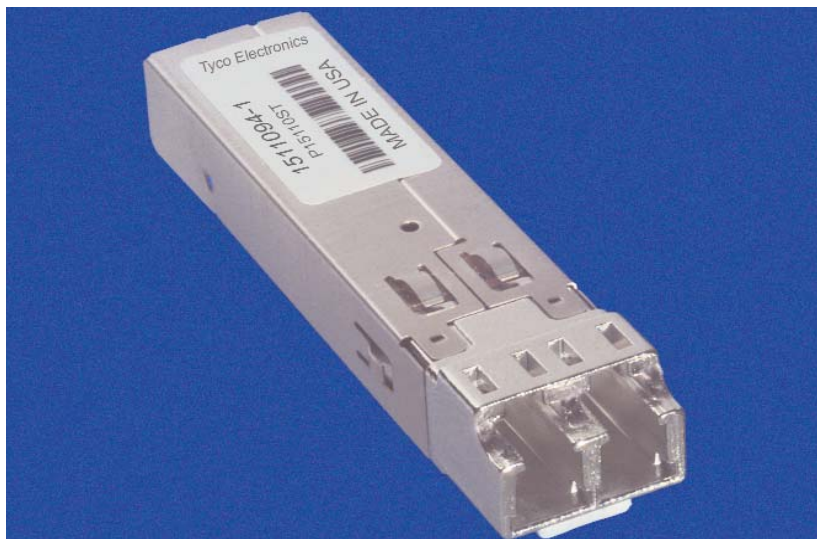
Gigabit Ethernet Singlemode SFP LC Transceivers

Product Facts

- Complies with IEEE Standard 802.3z Gigabit Ethernet 1000BASE-LX PMD requirements
- Complies with Small Form-factor Pluggable (SFP) Multi-Source Agreement (MSA)
- High density LC connector interface
- Operates to 5000m with singlemode fiber
- Hot Pluggable
- Single +3.3-volt power supply
- PECL and LVPECL AC-coupled data Interface
- Transmitter uses 1300nm FP Laser
- Class 1 Laser Safe per FDA/CDRH and IEC 60825-1
- UL 60950 recognized
- Compatible with standard Gigabit Ethernet chipsets
- Units are supplied with dust plugs
- Mates to MSA compliant Host Connector and Cage Assembly
- Digital Diagnostics per SFF-8472, Rev. 9.3

Applications

- Switched Backplanes
- Switch to Switch Links
- Network Interface cards
- Hubs
- Routers



Tyco Electronics, recognizing the market need for higher optical port density, is developing an entire product platform of Tyco Electronics' Small Form-factor Pluggable (SFP) transceivers with the popular LC connector. These transceivers are less than half the width of the functionally similar GBICs and simply plug into a SFP compatible surface mount connector and cage on the customer board. The smaller size and 0.64-inch port-to-port centerline spacing enables equipment manufacturers to cost-effectively double the fiber optic port density of a given product. Tyco Electronics' LC connector footprint is equivalent to the RJ-45 electrical connector and the small size of the LC nose also allows for increased EMI shielding.

The Tyco Electronics' SFP LC Transceivers 1511094-X are 1300nm FP LASER-based fiber optic transceiver modules for use in 1.25 Gb/s Gigabit Ethernet and high-speed proprietary link applications. The transceivers send and receive pre-encoded data over a singlemode optical fiber. The modules, which operate from a single +3.3V power supply, contain separate AC-coupled transmitter and receiver sections that have PECL/LVPECL compatible data

interfaces. The transceivers provide diagnostic and alarm features such as temperature, bias, current and output power. Tyco Electronics also offers a wide variety of Small Form Factor (SFF) and Small Form-factor Pluggable (SFP) transceivers for both singlemode and multimode applications.

All Tyco Electronics' Singlemode LC SFP Transceivers provide digital diagnostics through an I²C bus interface based on the SFF-8472, Rev 9.3 Standard. The diagnostics monitor the supply voltage, laser bus connects, temperature, and laser output power. Alarm and warning functionalities are included.

The Tyco Electronics' Gigabit Ethernet SFP LC Transceivers have been extensively tested to comply with the Gigabit Ethernet industry standard. The FP LASER-based transmitter is certified to be Class 1 laser safe, as defined by U.S. and international standards. The modules have been designed with grounding and shielding features that minimize EMI susceptibility and radiated emissions. Units are supplied with dust plugs.

Gigabit Ethernet Singlemode SFP LC Transceivers (Continued)

Gigabit Ethernet
Singlemode SFP
LC Transceivers

Part Numbers
1511094-1 w/Push Button
Actuator
1511094-2 w/Bail Latch

Transmitter Performance Specifications:

(T_c=0 to 70°C, V_{CC}-V_{EE}=3.135 to 3.465V DC)

Parameter	Symbol	Notes	Min	Typ	Max	Units
Operating Data Rate			.1	—	1.25	Gb/s
Optical Output (avg.) SM	P _{OUT}	1,2	-11	—	-3	dBm
Extinction Ratio	—	3	9	—	—	dB
Transmit Disabled Optical Output (avg.)	P _{OUT DIS}	—	—	—	0	mw
Center Wavelength	λ _{OUT}	4	1270	1310	1355	nm
Spectral Width (RMS)	Δλ	4	—	—	4	nm (RMS)
Relative Intensity Noise*	RIN ₁₂	5	—	—	120	dB/Hz
Deterministic Jitter	DJ	6	—	—	80	ps
Total Jitter	TJ	6	—	—	227	ps
Output Rise Time	t _{TLH}	7,8	—	—	260	ps
Output Fall Time	t _{THL}	7,8	—	—	260	ps
Pk-Pk Differential Input Voltage	V _{DIFF}	9	500	—	2000	mV
Transmit Fault Voltage Levels						
Tx_Fault_On		10	2	—	V _{CC}	V
Tx_Fault_Off		10	0	—	0.8	V
Transmit Disable Voltage Levels						
Tx Disabled		—	1.835	—	V _{CC} +0.2	V
Tx Enabled		—	0	—	0.8	V
Power Supply Voltage	V _{CC} - V _{EE}	—	3.135	3.3	3.465	V
Supply Current	I _{CC}	—	—	100	160	mA
Operating Temperature	T _C	—	0	—	70	°C
TX Disable Assert time	T _{Off}				10	μs
TX Disable Negate Time	T _{On}				1	ms
Time to initialize including reset of TX_Fault	T _{Init}				300	ms
TX_Fault Assert Time	TX_Fault				100	μs
TX_Disable to reset	TX_Reset		10			μs

Note: All optical measurements made through a short patch cable, between 2 and 5 meters in length, using 10μm Singlemode fiber unless stated otherwise.

Note: For details on timing requirements of control and status I/O parameters, and module interface and data field descriptions, please refer to the SFP MSA, Appendix B Electrical Interface guidelines.

- Meets Class 1 laser safety requirements of IEC 60825-1 and IEC 60825-2 and U.S. Department of Health Services 21 CFR 1040.10 and 1040.11 when operated within the specified temperature and power supply ranges.
- Transmitter optical output power measured per TIA/EIA 455-95. Transmitter modulated with a valid 8b/10b data pattern.
- Extinction ratio measured per TIA/EIA 526-4A with a repeating K28.7 data pattern.
- Center wavelength and spectral width measured per TIA/EIA 455-127 using optical spectrum analyzer with a valid 8b/10b data pattern.
- RIN measured per ANSI X.230-1994 annex A with valid 8b/10b data pattern. RF power meter and current meter test set replaced with microwave spectrum analyzer and calibrated high-speed photoreceiver. Polarization rotator omitted.
- DJ and TJ measured per OC-48 Standard.
- Measured from 20% to 80% points on rising and falling edge of transmitted waveform.
- Transmitter optical waveform characteristics including rise time, fall time, pulse undershoot, pulse overshoot, and ringing comply with the eye diagram shown in this document. These characteristics are controlled to help prevent excessive degradation of the receiver sensitivity. The eye mask test is performed using a receiver with a fourth-order Bessel Thompson filter.
- Compatible with 10 K, 10 KH and 100 K ECL, PECL and LVPECL.
- Open Collector/Drain output.
- Time from rising edge of TX Disable to when the optical output falls below 10% of nominal.
- Time from falling edge of TX Disable to when the modulated optical output rises above 90% of nominal.
- From power on or negation of TX_Fault using TX Disable.
- Time from fault to TX_Fault on.
- Time TX Disable must be held high to reset TX_Fault.

* Measured @ 500 MHz

Gigabit Ethernet Singlemode SFP LC Transceivers (Continued)

Gigabit Ethernet Singlemode SFP LC Transceivers

Part Numbers
1511094-1 w/Push
Button Actuator
1511094-2 w/Bail Latch

Receiver Performance Specifications:

(TC=0 to 70°C, V_{CC}-V_{EE}=3.135 to 3.465V DC)

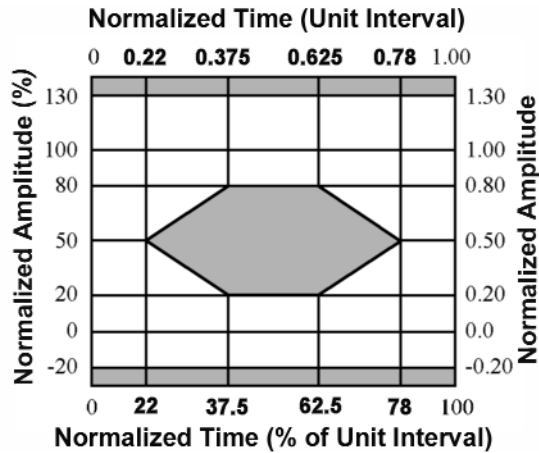
Parameter	Symbol	Notes	Min	Typ	Max	Units
Operating Data Rate	B	0.1	.1	—	1.25	Gb/s
Optical Input Sensitivity	P _{IN}	1	—	—	-19	dBm
Average Receive Power		—	—	—	-3	dBm
Optical wavelength	λ _{IN}	—	1270	1310	13550	Nm
Receiver Reflectance	—				-14	dB
Receiver Loss of Signal	LOS					
Output Voltage						
Assert	V _A	4	2	2	V _{CC} + .3	V
Deassert	V _D	4	0	—	0.8	V
Rx LOS Power Levels (avg.)						
Assert	P _A	—	-31	—	—	dBm
Deassert	P _D	—	—	—	-19	dBm
Hysteresis	—	—	0.5	—	—	dB
Power Supply Voltage	V _{CC} - V _{EE}	—	3.135	3.3	3.465	V
Supply Current	I _{CC}	—	—	95	115	mA
Operating Temperature	T _C	—	0	—	70	°C
LOS Assert Time	T _{Loss_On}				100	μs
LOS Deassert Time	T _{Loss_Off}				100	μs
Serial ID Clock Rate	F _{Serial_Clock}				100	kHz

Note: All optical measurements made through a short patch cable, between 2 and 5 meters in length, using singlemode fiber unless stated otherwise.

Note: For details on timing requirements of control and status I/O parameters, and module interface and data field descriptions, please refer to the SFP MSA< Appendix B Electrical Interface guidelines.

1. Minimum average optical input power (receive sensitivity) at which the BER is less than 10E-10 measured with a 1.25 G Baud Rate 2E7 — 1 NRZ PRBS data pattern.
2. Per IEEE 802.3Z Gigabit Ethernet Standard.
3. Return loss measured per TIA/EIA 455-107.
4. This is an open drain output that should be pulled up with a 4.7K ohm - 10K ohm resistor on the host board. Pull-up voltage level should be between 2.0 V and V_{CC} + 0.3 V per the SFP MSA.

Gigabit Ethernet Singlemode SFP LC Transceivers (Continued)




NOTE: Transmitter optical waveform characteristics including rise time, fall time, pulse undershoot, pulse overshoot, and ringing comply with this eye diagram. These characteristics are controlled to help prevent excessive degradation of the receiver sensitivity. The eye mask test is performed using a receiver with a fourth-order Bessel Thompson filter.

Absolute Maximum Ratings:

Parameter	Symbol	Units	Min	Max
Storage Temperature	T_s	$^{\circ}\text{C}$	-40	85
Data Input Voltage	V_{INPUT}	V	-0.5	V_{CC}
Differential Input Voltage	V_{DIFF}	V	—	2.4
Supply Voltage	$V_{\text{CC}}-V_{\text{EE}}$	V	-0.2	5.0

Regulatory Compliance:

Agency	Test Method	Listing Document
FDA	CDRH 21-CFR 1040 Class 1	Accession Number: 9122051-XX
TUV	EN60825-1:1994+A11:1996 EN60825-2:1994+A1 EN60950:1992+A1+A2+A3+A4+A11	TUV Product Services Laser Class I Protection Class III TUV Certificate Number: B020546940001
UL /  US	UL60950	E208513

ESD Testing:

Test	Test Method	Procedure
ESD1	JEDEC/EIA JESD22-A-114-A (C=100 pF, R=1500 ohm - Human body model)	Pulses applied to each pin and Ground at 1 KV
ESD2	25 KV maximum air discharge (simulates human body discharge into a DUT)	40 discharges are applied per DUT (10 at each of the top, nose, right, and left). Each module is tested with both power ON and OFF

NOTE

All products which contain a laser must comply with government regulations for laser safety. In the U.S., the applicable standard is FDA 21 CFR 1040. In other parts of the world, IEC 60825-1 applies. These transceivers were designed and tested to the requirements of the above standards and found to be in compliance with class 1 laser safety limits. When operated within the limits specified in this document, this product conforms to IEC 60825-1: 1993 + A1 : 1997 + A2: 2001, class 1 laser product, requirements.

CAUTION!

Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Gigabit Ethernet Singlemode SFP LC Transceivers (Continued)

Pad Description:

Symbol	Pad #	Function
VEET	1	Signal Ground. Directly connect to ground. [SEE NOTE 1].
Tx_Fault	2	Transmitter Fault. This is an open collector output that should be pulled up with a 4.7K - 10K Ω resistor on the host board. [SEE NOTE 2].
Tx_Disable	3	Transmitter Disable Input. Module disables on high or open. The input is pulled up within the module with a 4.7K - 10K Ω resistor. Its states are: Low (0 - 0.8V) : Transmitter on (>0.8, <2.0V) : Undefined High (2.0 - 3.465V) : Transmitter Disabled Open: Transmitter Disabled.
MOD-DEF2	4	Module Definition 2. This is the data line of two wire serial interface for serial ID. This pad should be pulled up with a 4.7K - 10K Ω resistor on the host board. [SEE NOTE 2].
MOD-DEF1	5	Module Definition 1. This is the clock line of two wire serial interface for serial ID. This pad should be pulled up with a 4.7K - 10K Ω resistor on the host board. [SEE NOTE 2].
MOD-DEF0	6	Module Definition 0. MOD-DEF0 is grounded by the module to indicate that the module is present. The pad should be pulled up with a 4.7K - 10K Ω resistor on the host board. [SEE NOTE 2].
Rate Select	7	This function is not implemented and the pad is floating. Per the SFP MSA, this is an optional input used to control the receiver bandwidth for multiple data rate operation.
LOS	8	Loss of Signal. This is an open collector output that should be pulled up with a 4.7K - 10K Ω resistor on the host board. [SEE NOTE 2]. Normal operation is when LOS is Deasserted. Abnormally low receive signal level is indicated by LOS Asserted.
VEER	9	Signal Ground. Directly connect to ground. [SEE NOTE 1].
VEER	10	Signal Ground. Directly connect to ground. [SEE NOTE 1].
VEER	11	Signal Ground. Directly connect to ground. [SEE NOTE 1].
RD-	12	Received Data Out Bar. Output is internally AC coupled. Use SerDes chip IC manufacturer's termination recommendation to achieve a 50 Ω termination impedance.
RD+	13	Received Data Out. Output is internally AC coupled. Use SerDes chip IC manufacturer's termination recommendation to achieve a 50 Ω termination impedance.
VEER	14	Signal Ground. Directly connect to ground. [SEE NOTE 1].
VccR	15	Receiver Power Supply. Connect as shown in the Recommended Host Board Supply Filtering Network. [SEE NOTE 3].
VccT	16	Transmitter Power Supply. Connect as shown in the Recommended Host Board Supply Filtering Network. [SEE NOTE 3].
VEET	17	Signal Ground. Directly connect to ground. [SEE NOTE 1].
TD+	18	Transmitter Data In. Input is internally AC coupled. There is an internal 100 Ω resistor across TD+ and TD-, which provides a 50 Ω termination for each data input.
TD-	19	Transmitter Data In Bar. Input is internally AC coupled. There is an internal 100 Ω resistor across TD+ and TD-, which provides a 50 Ω termination for each data input.
VEET	20	Signal Ground. Directly connect to ground. [SEE NOTE 1].

NOTE 1: Transmitter and receiver grounds are connected together inside the transceiver module.

NOTE 2: Pull-up voltage between 2.0V and VccT + 0.3V

NOTE 3: VccT and VccR are separate inside the transceiver module.

Gigabit Ethernet Singlemode SFP LC Transceivers (Continued)

Figure 2: Transceiver Pad Descriptions

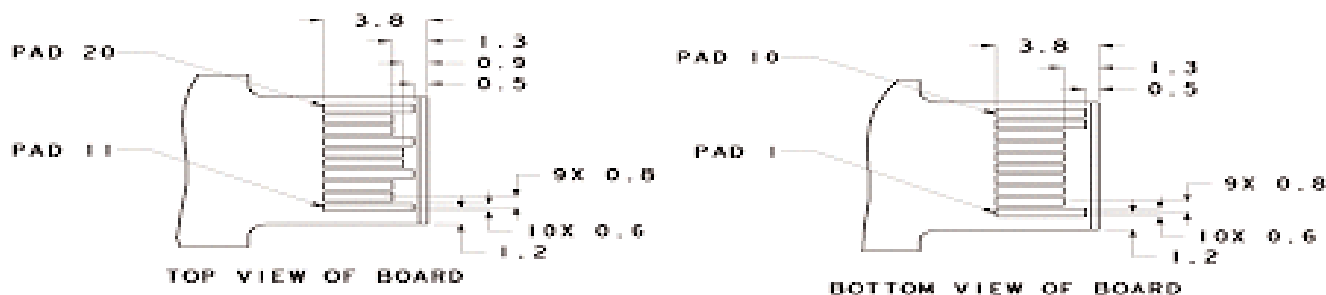
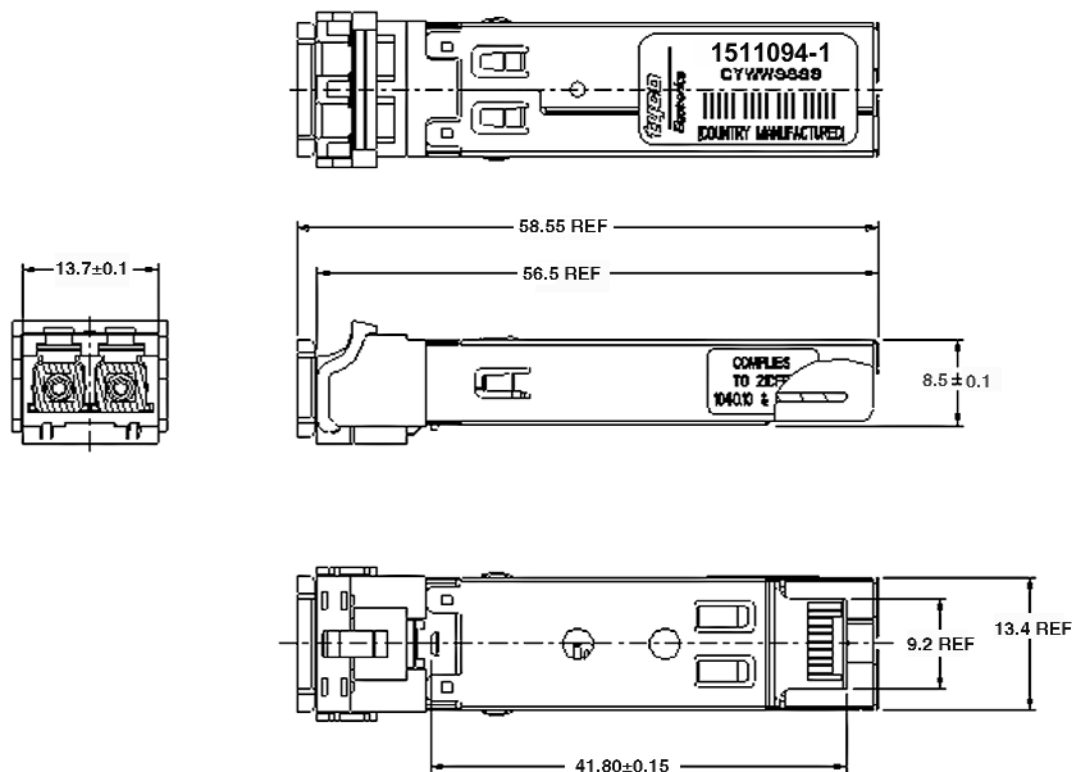


Figure 2: Transceiver Outline Descriptions



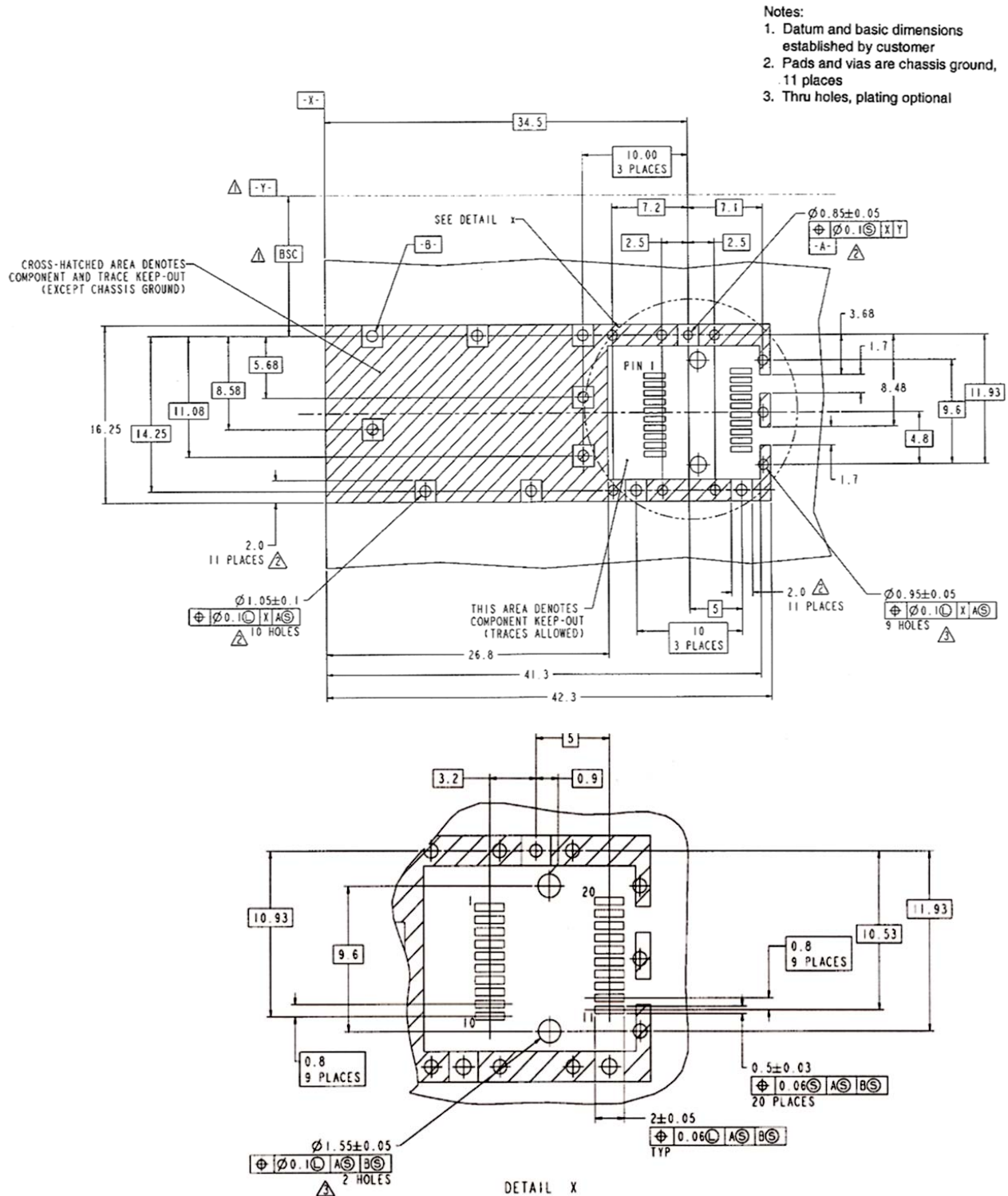
Note: All dimensions are in mm.

IMPORTANT: PLEASE REFER TO THE TYCO ELECTRONICS CUSTOMER DRAWING 1511094 FOR TRANSCEIVER HOUSING DIMENSIONS AND TOLERANCES. DRAWINGS CAN BE OBTAINED ON OUR WEBSITE AT: <http://www.tycoelectronics.com> OR CALL AMPFAX 1-800-522-6752 FOR 24HR FAX SERVICE.

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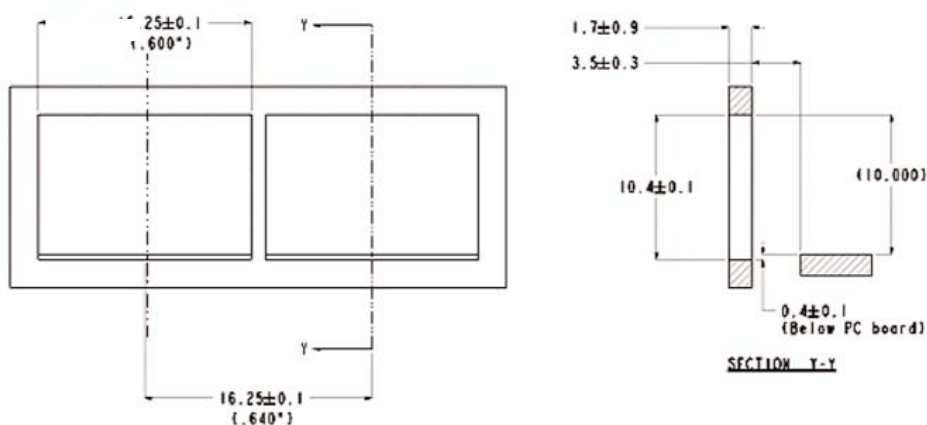
Gigabit Ethernet Singlemode SFP LC Transceivers (Continued)

Figure 4: SFP MSA Recommended Circuit Board Layout



Gigabit Ethernet Singlemode SFP LC Transceivers (Continued)

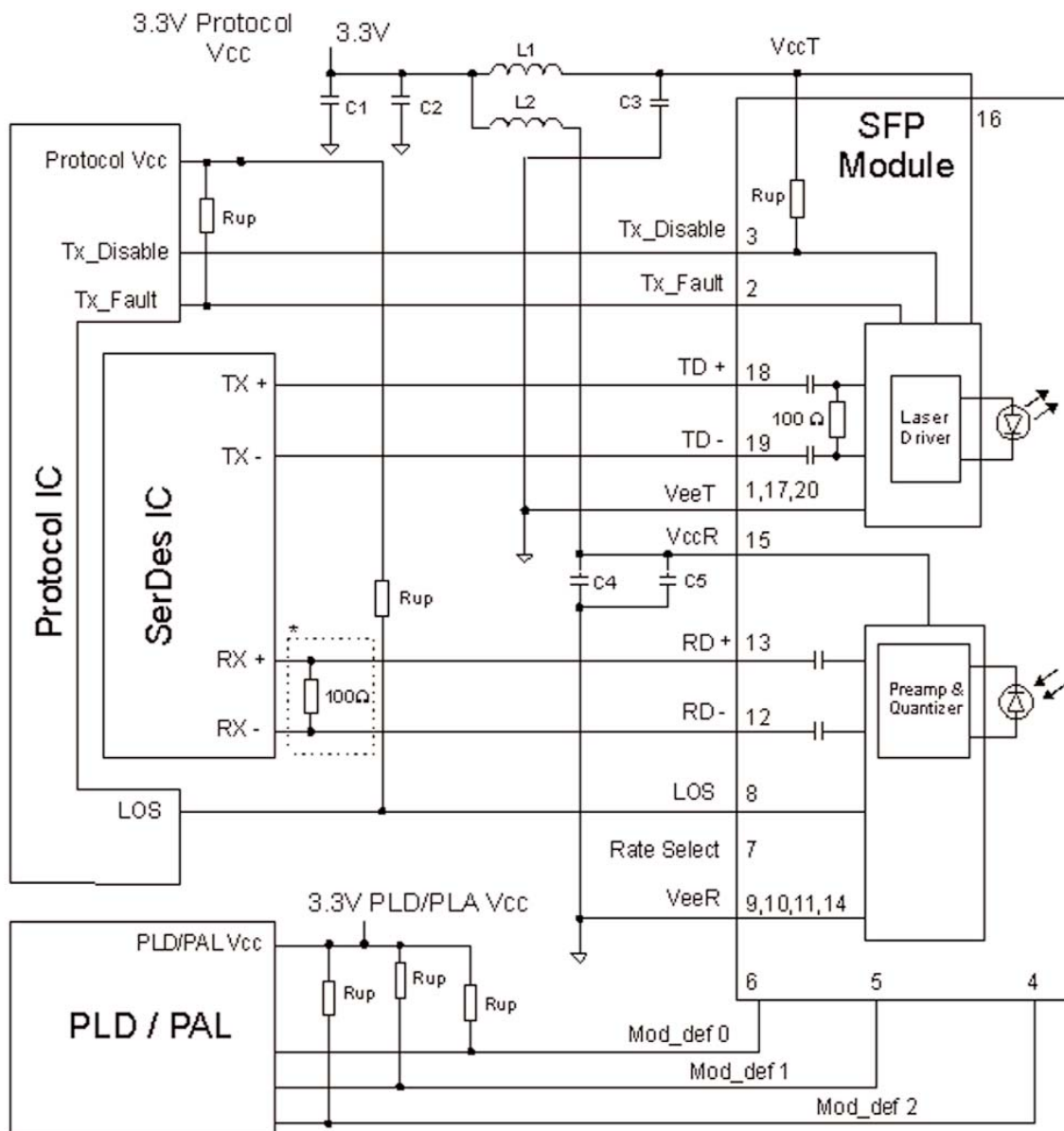
Figure 5: SFP MSA Recommended Bezel Opening



Note: Minimum pitch illustrated. All dimensions are in mm only.

Gigabit Ethernet Singlemode SFP LC Transceivers (Continued)

Figure 6: Recommended Termination and Power Supply Filtering



*Use SERDES IC manufacturer's termination recommendation.

C1=C4 = 10 μ F

C2=C3=C5 = 0.1 μ F

Note: X7R or better MLC types are recommended for all capacitors

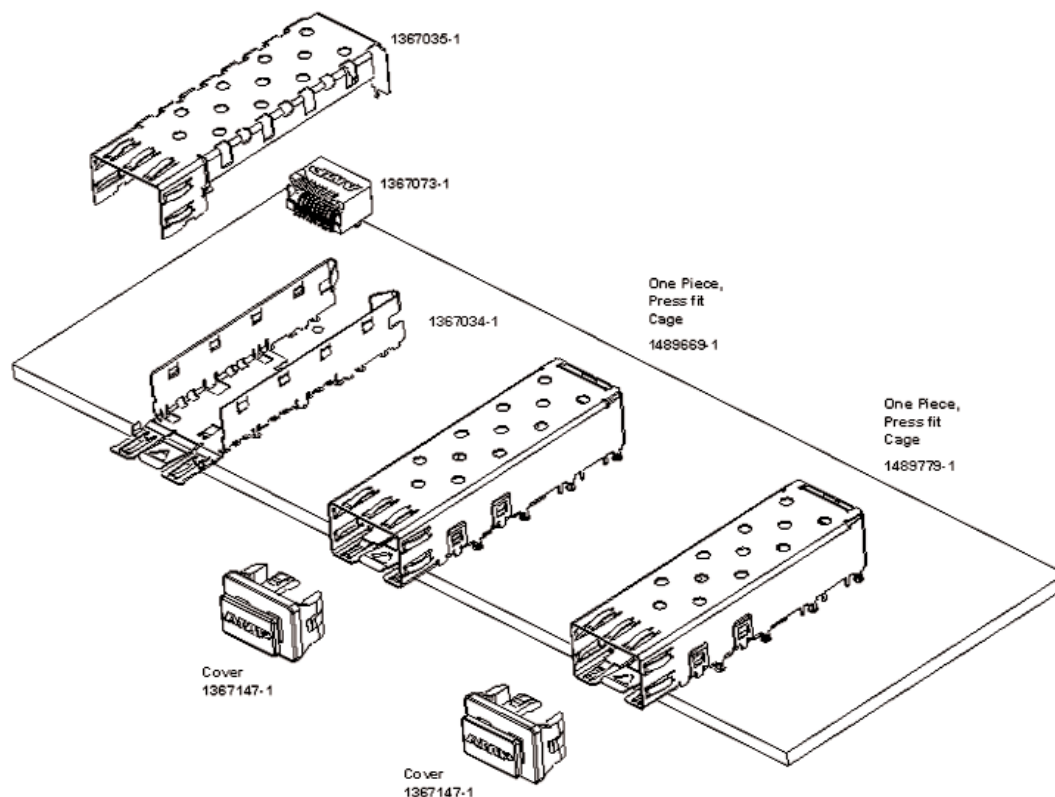
L1=L2 = 1 μ H 4.7 μ H, max 1.0 Ω [Ferrite inductors may be used]

Rup = 4.7 K Ω 10 K Ω

NOTE: TO IMPROVE EMI, THE SIGNALS TO THE CONNECTOR SHOULD BE SHUT OFF WHEN THE TRANSCEIVER IS REMOVED.

Gigabit Ethernet Singlemode SFP LC Transceivers (Continued)

Related Products:



Related Documents:

SFP Connector & Cage Assembly Application Specification 114-13017

Gigabit Ethernet Singlemode SFP LC Transceiver Application Specification 114-13085

FOR DETAILED INFORMATION ON ALL TYCO ELECTRONICS FIBER OPTIC TRANSCEIVERS, VISIT OUR WEB-SITE AT: http://www.amp.com/fiberoptics/electro-optics/transceivers_family.stm