

## Gigabit Ethernet Multimode SFP MT-RJ Transceiver

### Product Facts

- Complies with IEEE Standard 802.3z Gigabit Ethernet 1000BASE-SX PMD requirements
- Complies with Small Form-factor Pluggable (SFP) Multi-Source Agreement (MSA)
- High density MT-RJ connector interface
- Operates to 550 m with 50/125  $\mu\text{m}$  or 275 m with 62.5/125  $\mu\text{m}$  fiber
- Hot Pluggable
- Single +3.3-volt power supply
- PECL and LVPECL AC-coupled data Interface
- Transmitter uses 850nm vertical cavity surface emitting laser (VCSEL)
- 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

### Applications

- Switches
- Repeaters
- 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 MT-RJ 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.

The Tyco Electronics' Gigabit Ethernet SFP MT-RJ Transceiver 1382350-1 is a short wavelength fiber optic transceiver module for use in 1.25 Gb/s Gigabit Ethernet and high-speed proprietary link applications. The transceiver sends and receives pre-encoded data over a pair of 62.5 $\mu\text{m}$  or 50 $\mu\text{m}$  core

multimode optical fibers. The module, which operates from a single +3.3V power supply, contains separate AC-coupled transmitter and receiver sections that have PECL/LVPECL compatible data interfaces. 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.

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

## Gigabit Ethernet Multimode SFP MT-RJ Transceiver (Continued)

### Gigabit Ethernet Multimode SFP MT-RJ Transceiver

Part Number 1382350-1

#### Transmitter Performance Specifications:

( $T_c=0$  to  $70^\circ\text{C}$ ,  $V_{CC}-V_{EE}=3.135$  to  $3.465\text{V DC}$ )

Parameter	Symbol	Notes	Min	Typ	Max	Units
Operating Data Rate			–	–	1.25	Gb/s
Optical Output (avg.)	$P_{OUT}$	1,2	-9.5	–	-4	dBm
Extinction Ratio	–	3	9	–	–	dB
Transmit Disabled Optical Output (avg.)	$P_{OUT\ DIS}$	–	–	–	-30	dBm
Center Wavelength	$\lambda_{OUT}$	4	770	845	860	nm
Spectral Width (RMS)	$\Delta\lambda$	4	–	–	0.85	nm
Relative Intensity Noise	$RIN_{12}$	5	–	–	-117	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	–	$V_{CC} + 3$	V
Tx_Fault_Off		10	0	–	0.8	V
Transmit Disable Voltage Levels						
Tx Disabled		–	2.0	–	3.465	V
Tx Enabled		–	0	–	0.8	V
Power Supply Voltage	$V_{CC} - V_{EE}$	–	3.135	3.3	3.465	V
Supply Current	$I_{CC}$	–	–	–	60	mA
Operating Temperature	$T_c$	–	0	–	70	$^\circ\text{C}$

Note: All optical measurements made through a short patch cable, between 2 and 5 meters in length, using 62.5  $\mu\text{m}$  multimode fiber unless stated otherwise.

1. 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.
2. Transmitter optical output power measured per TIA/EIA 455-95. Transmitter modulated with a valid 8b/10b data pattern. Specification applies for both 50  $\mu\text{m}$  and 62.5  $\mu\text{m}$  core multimode fiber.
3. Extinction ratio measured per TIA/EIA 526-4A with a repeating K28.7 data pattern.
4. Center wavelength and spectral width measured per TIA/EIA 455-127 using optical spectrum analyzer with a valid 8b/10b data pattern.
5. 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. Single mode fiber in test procedure replaced with multimode patch cable. Polarization rotator omitted.
6. DJ and TJ measured per IEEE 802.3Z Gigabit Ethernet Standard.
7. Measured from 20% to 80% points on rising and falling edge of transmitted waveform.
8. 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.
9. Compatible with 10 K, 10 KH and 100 K ECL, PECL and LVPECL.
10. Open Collector/Drain output

## Gigabit Ethernet Multimode SFP MT-RJ Transceiver (Continued)

### Gigabit Ethernet Multimode SFP MT-RJ Transceiver

Part Number 1382350-1

#### Receiver Performance Specifications:

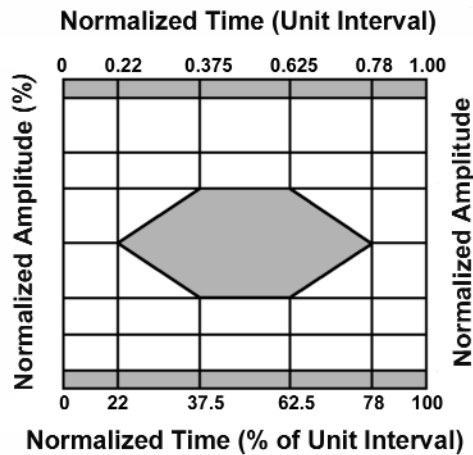
(TC=0 to 70°C, V<sub>CC</sub>-V<sub>EE</sub>=3.135 to 3.465V DC)

Parameter	Symbol	Notes	Min	Typ	Max	Units
Operating Data Rate			–	–	1.25	Gb/s
Average Receive Power	P <sub>IN</sub>		–	–	0	dBm
Receive Sensitivity		1	-17	–	–	dBm
Stressed Receive Sensitivity						
50 μm Fiber	–	2	-13.5	–	–	dBm
62.5 μm Fiber	–	2	-12.5	–	–	dBm
Electrical 3 dB Cut-Off	3 dB f <sub>C</sub>	2	–	–	1.5	GHz
Optical wavelength	λ <sub>IN</sub>	–	770	–	860	nm
Deterministic Jitter	DJ	5	–	–	170	ps
Total Jitter	TJ	5	–	–	266	ps
Return Loss	–	3	12	–	–	dB
Receiver Loss of Signal Output Voltage	LOS					
Assert	VA	4	2	–	V <sub>CC</sub> + .3	V
Deassert	VD	4	0	–	0.8	V
Rx LOS Power Levels (avg.)						
Assert	PA	–	-30	–	–	dBm
Deassert	PD	–	–	–	-17	dBm
Hysteresis	–	–	0.5	–	–	dB
Power Supply Voltage	V <sub>CC</sub> - V <sub>EE</sub>	–	3.135	3.3	3.465	V
Supply Current	I <sub>CC</sub>	–	–	–	100	mA
Operating Temperature	TC	–	0	–	70	°C

Note: All optical measurements made through a short patch cable, between 2 and 5 meters in length, using 62.5 μm multimode fiber unless stated otherwise.

1. Minimum average optical input power (receive sensitivity) at which the BER is less than 10E-12 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<sub>CC</sub> + 0.3 V per the SFP MSA.
5. DJ and TJ measured per IEEE 802.3Z Gigabit Ethernet Standard.

## Gigabit Ethernet Multimode SFP MT-RJ Transceiver (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.

### Timing Requirements of Control and Status I/O

Parameter	Symbol	Min	Max	Unit	Condition
TX Disable Assert Time	T_Off		10	μs	Time from rising edge of TX Disable to when the optical output falls below 10% of nominal
TX Disable Negate Time	T_On		1	ms	Time from falling edge of TX Disable to when the modulated optical output rises above 90% of nominal
Time to initialize, including reset of TX_Fault	T_Init		300	ms	From power on or negation of TX_Fault using TX Disable
TX_Fault Assert Time	TX_Fault		100	μs	Time from fault to TX-Fault on.
TX Disable to reset	T_Reset		10	μs	Time TX Disable must be held high to reset TX-Fault
LOS Assert Time	T_Loss_On		100	μs	Time from LOS state to LOS assert
LOS Deassert Time	T_Loss_Off		100	μs	Time from non-LOS state to LOS deassert
Serial ID Clock Rate	F_Serial_Clock		100	kHz	


**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.

### Absolute Maximum Ratings:

Parameter	Symbol	Units	Min	Max
Storage Temperature	T <sub>s</sub>	°C	-40	85
Data Input Voltage	V <sub>INPUT</sub>	V	-0.5	V <sub>CC</sub>
Differential Input Voltage	V <sub>DIFF</sub>	V	–	2.4
Supply Voltage	V <sub>CC</sub> -V <sub>EE</sub>	V	-0.2	5.0

## Gigabit Ethernet Multimode SFP MT-RJ Transceiver (Continued)

### Regulatory Compliance:

Agency	Test Method	Listing Document
FDA	CDRH 21-CFR 1040 Class 1	Accession Number: 9122051-08
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: B020546940003
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 Multimode SFP MT-RJ Transceiver (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 $\Omega$ 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 $\Omega$ 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 $\Omega$ 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 $\Omega$ 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 $\Omega$ 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 $\Omega$ 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 $\Omega$ termination impedance.
RD+	13	Received Data Out. Output is internally AC coupled. Use SerDes chip IC manufacturer's termination recommendation to achieve a 50 $\Omega$ 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 $\Omega$ resistor across TD+ and TD-, which provides a 50 $\Omega$ termination for each data input.
TD-	19	Transmitter Data In Bar. Input is internally AC coupled. There is an internal 100 $\Omega$ resistor across TD+ and TD-, which provides a 50 $\Omega$ termination for each data input.
VEET	20	Signal Ground. Directly connect to ground. [SEE NOTE 1].

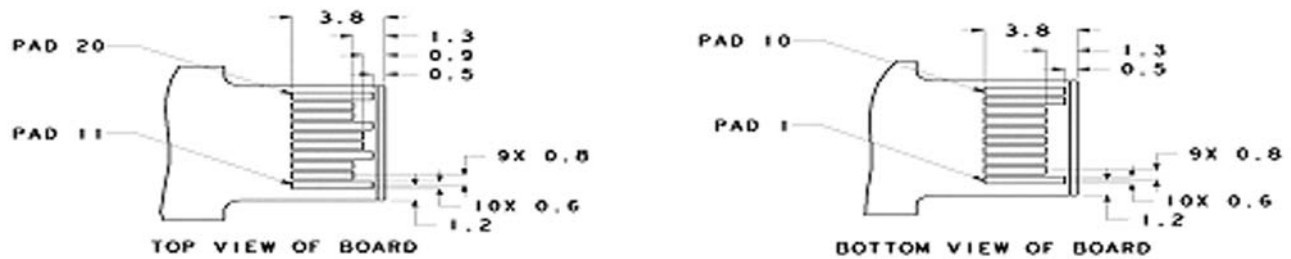
NOTE 1: Transmitter and receiver grounds are connected together inside the transceiver module.

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

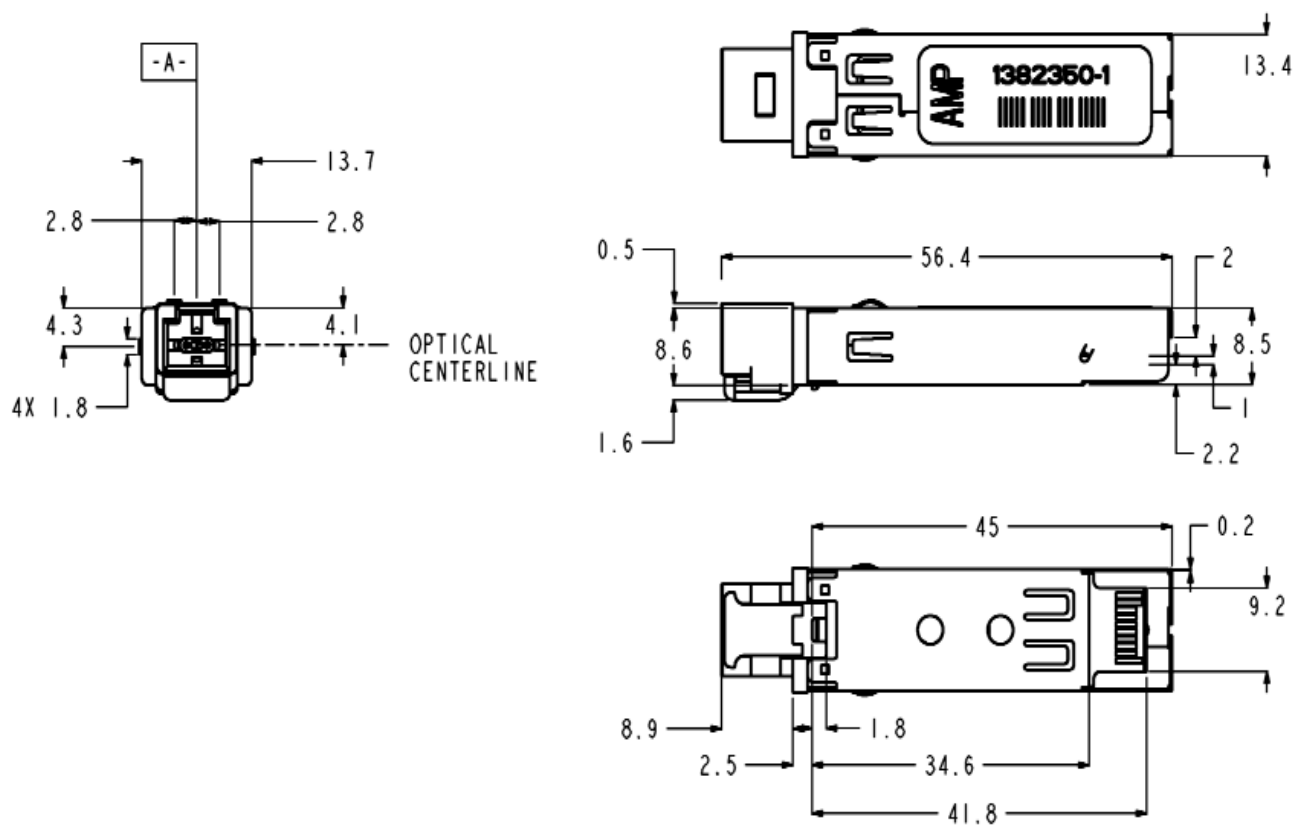
NOTE 3: VccT and VccR are separate inside the transceiver module.

**Gigabit Ethernet Multimode SFP MT-RJ Transceiver (Continued)**

**Figure 2: Transceiver Pad Descriptions**



**Figure 2: Transceiver Outline Descriptions**



Note: All dimensions are in mm.

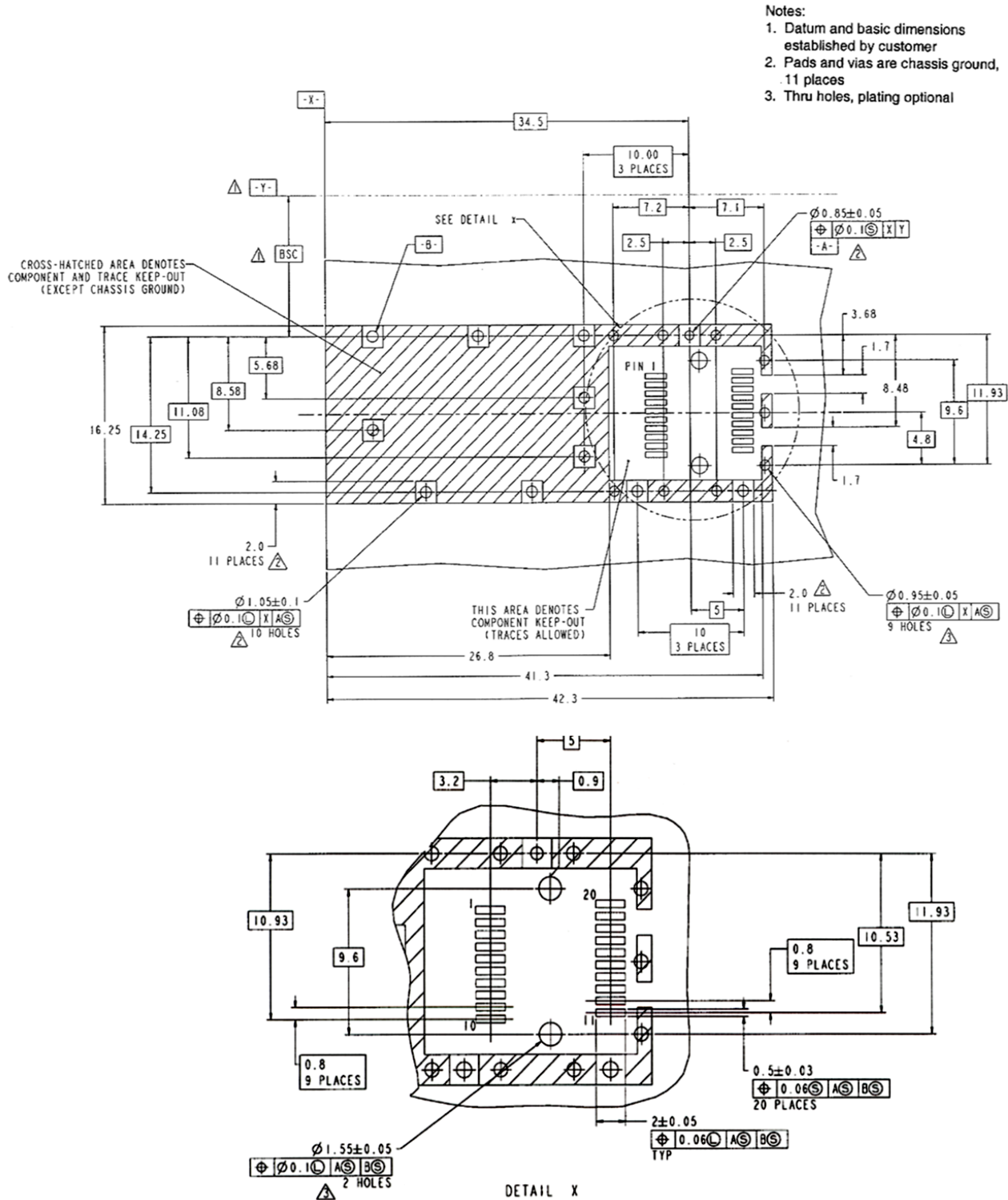
**IMPORTANT: PLEASE REFER TO THE TYCO ELECTRONICS CUSTOMER DRAWING 1382350-1 FOR TRANSCEIVER HOUSING DIMENSIONS AND TOLERANCES. CALL 1-800-522-6752 FOR 24HR FAX OR ON LINE AT: <http://www.tycoelectronics.com>.**

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**Gigabit Ethernet Multimode SFP MT-RJ Transceiver (Continued)**

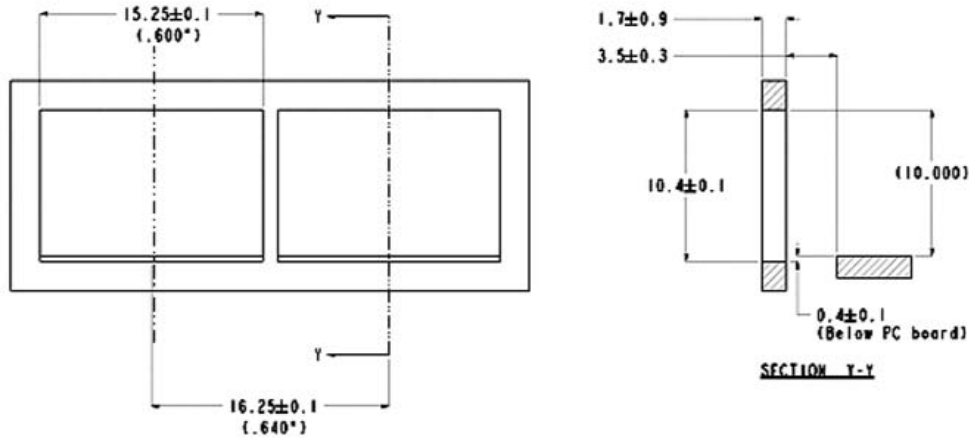
**Figure 4: SFP MSA Recommended Circuit Board Layout**





**Gigabit Ethernet Multimode SFP MT-RJ Transceiver (Continued)**

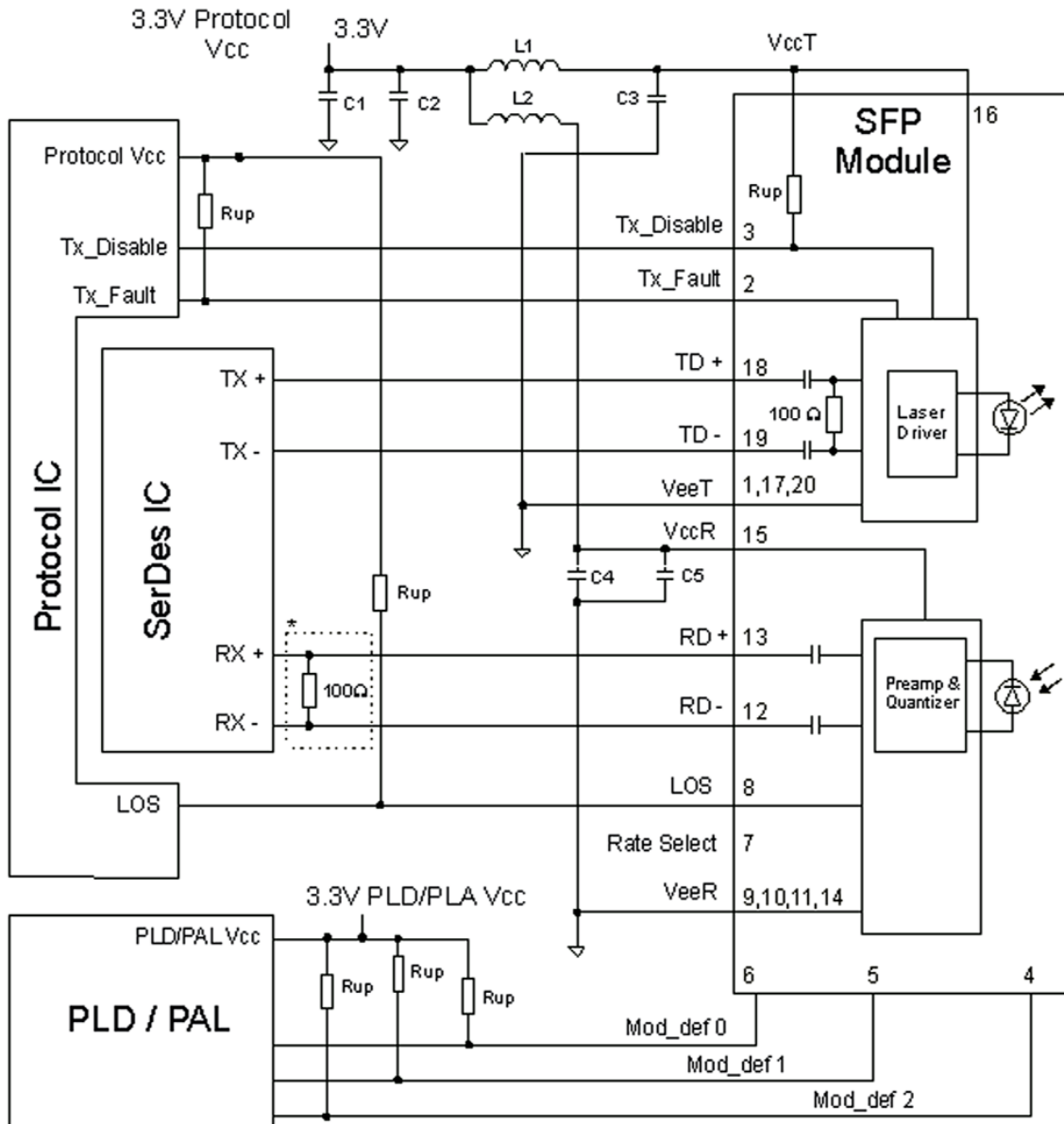
**Figure 5: SFP MSA Recommended Bezel Opening**



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

**Gigabit Ethernet Multimode SFP MT-RJ Transceiver (Continued)**

**Figure 6: Recommended Termination and Power Supply Filtering**



\*Use SERDES IC manufacturer's termination recommendation.

C1=C4 = 10  $\mu$ F

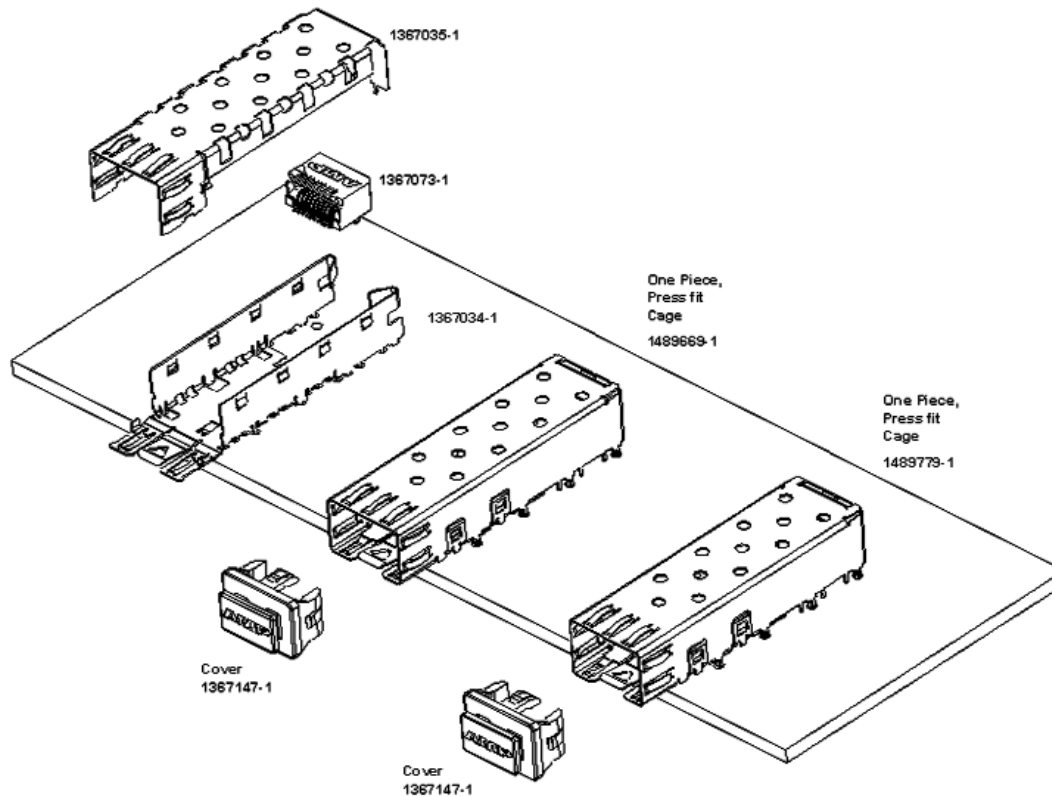
C2=C3=C5 = 0.1  $\mu$ F

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

L1=L2 = 1  $\mu$ H .... 4.7  $\mu$ H, max 1.0  $\Omega$  [Ferrite inductors may be used]

Rup = 4.7 K $\Omega$  .... 10 K $\Omega$

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

**Gigabit Ethernet Multimode SFP MT-RJ Transceiver (Continued)****Related Products:****Related Documents:**

SFP Connector &amp; Cage Assembly Application Specification 114-13017

Gigabit Ethernet Multimode SFP MT-RJ Transceiver Application Specification 114-13081

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