# SFP-1G-Copper
## 1000Base-T (RJ45) Copper SFP Transceiver

### Features

♦ Up to 1.25Gbps bi-directional data links

♦ Hot-pluggable SFP footprint

♦ TX Disable function

♦ Fully metallic enclosure for low EMI

♦ +3.3V single power supply

♦ Low power dissipation (1.05 W typical)

♦ Compact RJ-45 connector assembly

♦ Access to physical layer IC via 2-wire serial bus

♦ 1000 BASE-T operation in host systems with SERDES interface

♦ Industrial operating case temperature: -40 to +85°C

### Applications

♦ 1.25 Gigabit Ethernet over Cat 5 cable

### Product description

This Small Form Pluggable (SFP) transceiver is high performance, cost effective module compliant with the Gigabit Ethernet and 1000BASE-T standards as specified in IEEE 802. 3-2002 and IEEE 802.3ab, which supporting 1000Mbps data-rate up to 100 meters reach over unshielded twisted-pair category 5 cable. The module supports1000 Mbps full duplex data-links with 5-level Pulse Amplitude Modulation (PAM) signals. The module provides standard serial ID information compliant with SFP MSA, which can be accessed with address of A0h via the 2wire serial CMOS EEPROM protocol. The physical IC can also be accessed via 2wire serial bus at address ACh.
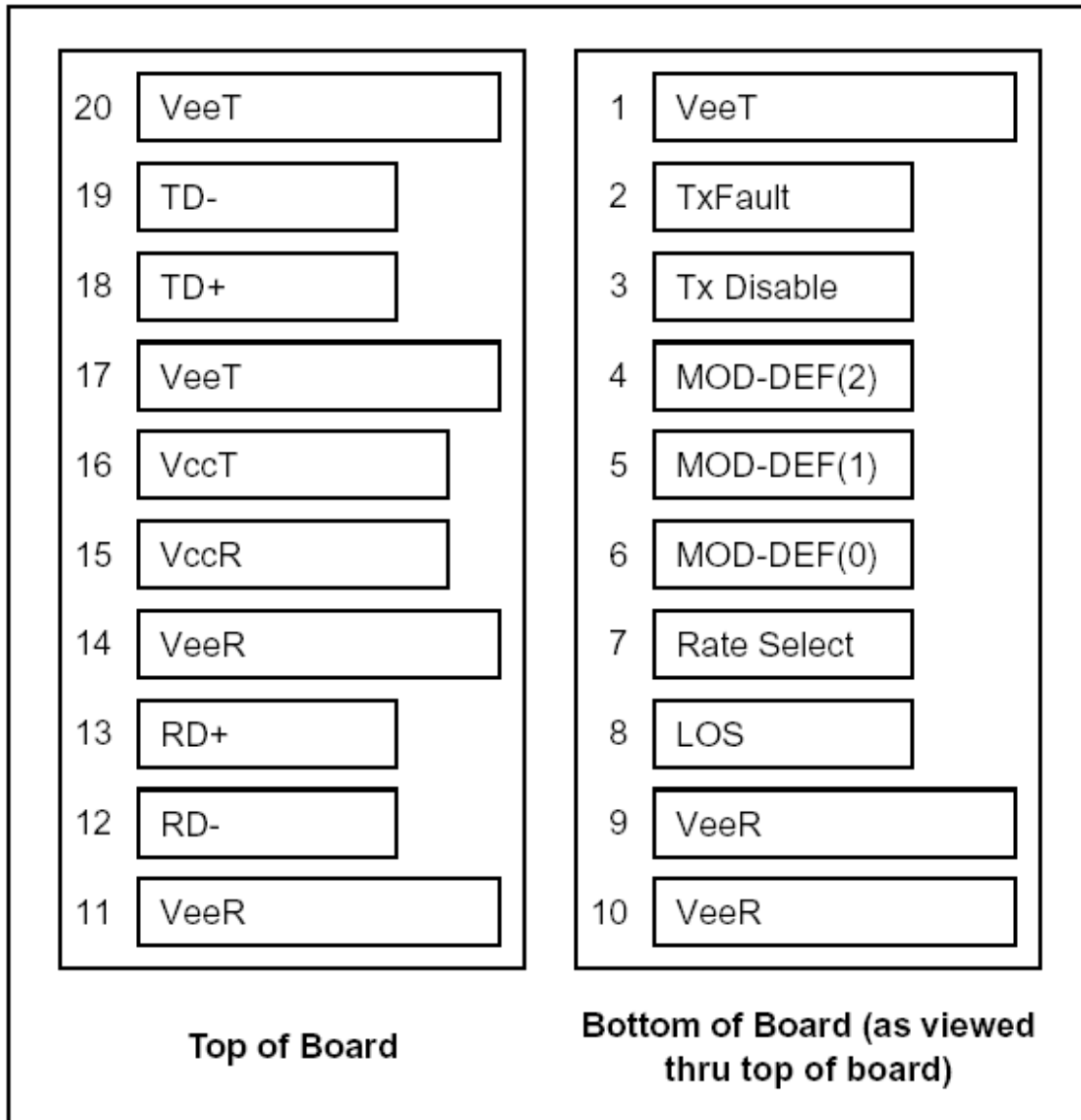
## Pin Definitions

**Pin Diagram**



**Figure 1. Pin Definitions**

## Pin Descriptions

| Pin | Signal Name | Description | Plug Seq. | Notes |
|-----|-------------|-------------|-----------|-------|
| 1 | V$_{EET}$ | Transmitter Ground | 1 | |
| 2 | TX FAULT | Transmitter Fault Indication | 3 | Note1 |
| 3 | TX DISABLE | Transmitter Disable | 3 | Note2 |
| 4 | MOD_DEF(2) | SDA Serial Data Signal | 3 | Note3 |
| 5 | MOD_DEF(1) | SCL Serial Clock Signal | 3 | Note3 |
| 6 | MOD_DEF(0) | TTL Low | 3 | Note3 |
| 7 | Rate Select | Not Connected | 3 | |
| 8 | LOS | Loss of Signal | 3 | Note4 |
| 9 | V$_{EER}$ | Receiver ground | 1 | |
| 10 | V$_{EER}$ | Receiver ground | 1 | |
| 11 | V$_{EER}$ | Receiver ground | 1 | |
| 12 | RX- | Inv. Received Data Out | 3 | Note 5 |
| 13 | RX+ | Received Data Out | 3 | Note 5 |
| 14 | V$_{EER}$ | Receiver ground | 1 | |
| 15 | V$_{CCR}$ | Receiver Power Supply | 2 | |
| 16 | V$_{CCT}$ | Transmitter Power Supply | 2 | |
| 17 | V$_{EET}$ | Transmitter Ground | 1 | |
| 18 | TX+ | Transmit Data In | 3 | Note 6 |
| 19 | TX- | Inv. Transmit Data In | 3 | Note 6 |
| 20 | V$_{EET}$ | Transmitter Ground | 1 | |

**Notes:**

Plug Seq.: Pin engagement sequence during hot plugging.

1) TX Fault is not supported and is always connected to ground.

2) TX disable, an input used to reset the transceiver module, This pin is pulled up within the module with a 4.7 KΩ resistor.
   Low (0–0.8 V): Transceiver on
   Between (0.8 V and 2.0 V): Undefined
   High (2.0–3.465 V): Transceiver in reset state
   Open: Transceiver in reset state

3) Mod-Def 0,1,2. These are the module definition pins. They should be pulled up with a 4.7K~10K resistor on the host board.
   The pull-up voltage shall be VccT or VccR
   Mod-Def 0 is grounded by the module to indicate that the module is present
   Mod-Def 1 is the clock line of two wire serial interface for serial ID
   Mod-Def 2 is the data line of two wire serial interface for serial ID

4) RX_LOS (Loss of Signal): LVTTL compatible with a maximum voltage of Host_Vcc. RX_LOS can enabled or disabled
   (Refer to Ordering information),RX_LOS is not used and is always tied to ground via 100-ohm resistor.

5) RD-/+: These are the differential receiver outputs. They are AC coupled 100 differential lines which should be terminated with
   100 (differential) at the user SERDES.

6) TD-/+: These are the differential transmitter inputs. They are AC-coupled, differential lines with 100 differential termination
   inside the module.

## +3.3V Volt Electrical Power Interface

| +3.3V volt Electrical Power Interface | | | | | | |
|---|---|---|---|---|---|---|
| Parameter | Symbol | Min | Typ | Max | Units | Notes/Conditions |
| Supply Current | Is | | 320 | 375 | mA | 1.2W max power over full range of voltage and temperature. See caution note below |
| Input Voltage | Vcc | 3.13 | 3.3 | 3.47 | V | Referenced to GND |
| Maximum Voltage | Vmax | | | 3.6 | V | |

## Low-speed signals, electronic characteristics

| Low-Speed Signals, Electronic Characteristics | | | | | |
|---|---|---|---|---|---|
| Parameter | Symbol | Min | Max | Units | Notes/Conditions |
| SFP Output LOW | VOL | 0 | 0.5 | V | 4.7k to 10k pull-up to host_Vcc, measured at host side of connector |
| SFP Output HIGH | VOH | host_Vcc - 0.5 | host_Vcc + 0.3 | V | 4.7k to 10k pull-up to host_Vcc, measured at host side of connector |
| SFP Input LOW | VIL | 0 | 0.8 | V | 4.7k to 10k pull-up to Vcc, measured at SFP side of connector |
| SFP Input HIGH | VIH | 2 | Vcc + 0.3 | V | 4.7k to 10k pull-up to Vcc, measured at SFP side of connector |

## High-speed electrical interface, transmission line-SFP

| High-Speed Electrical Interface Transmission Line-SFP | | | | | | |
|---|---|---|---|---|---|---|
| Parameter | Symbol | Min | Typ | Max | Units | Notes/Conditions |
| Line Frequency | fL | | 125 | | MHz | 5-level encoding, per IEEE 802.3 |
| Tx Output Impedance | Zout,TX | | 100 | | Ohm | Differential, for all Frequencies between 1MHz and 125MHz |
| Rx Input Impedance | Zin,RX | | 100 | | Ohm | Differential, for all Frequencies between 1MHz and 125MHz |

## High-speed electrical interface, host-SFP

| High-Speed Electrical Interface, Host-SFP | | | | | | |
|---|---|---|---|---|---|---|
| Parameter | Symbol | Min | Typ | Max | Units | Notes/Conditions |
| Single ended data input swing | Vinsing | 250 | | 1200 | mV | Single ended |
| Single ended data output swing | Voutsing | 350 | | 800 | mV | Single ended |
| Rise/Fall Time | Tr,Tf | | 175 | | psec | 20%-80% |
| Tx Input Impedance | Zin | | 50 | | Ohm | Single ended |
| Rx Output Impedance | Zout | | 50 | | Ohm | Single ended |

## General specifications

| General | | | | | | |
|---|---|---|---|---|---|---|
| Parameter | Symbol | Min | Typ | Max | Units | Notes/Conditions |
| Data Rate | BR | 10 | | 1000 | Mb/sec | IEEE 802.3 compatible. See Notes 2 through 4 below |
| Cable Length | L | | | 100 | m | Category 5 UTP. BER <10-12 |

**Notes:**
1. Clock tolerance is +/- 50 ppm
2. By default, the SFP-1G-Copper is a full duplex device in preferred master mode
3. Automatic crossover detection is enabled. External crossover cable is not required

## Environmental specifications

| Parameter | Symbol | Min | Typical | Max | Unit |
|---|---|---|---|---|---|
| Operating Case Temperature | Tc | -40 | | +85 | °C |
| Storage Temperature | | -40 | | +85 | °C |

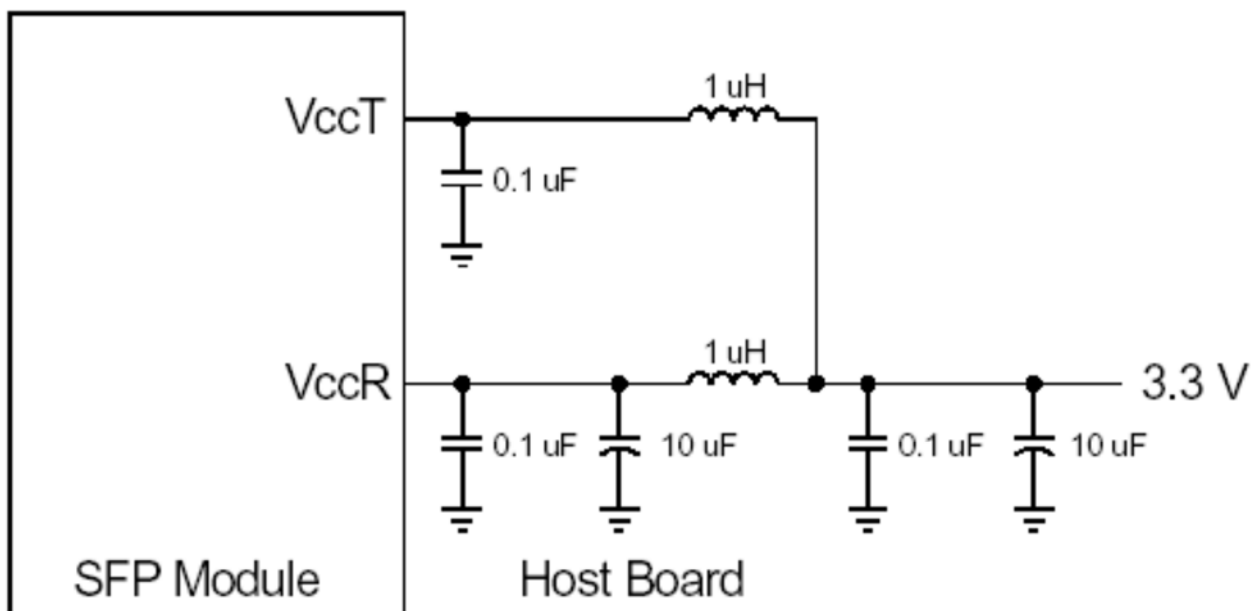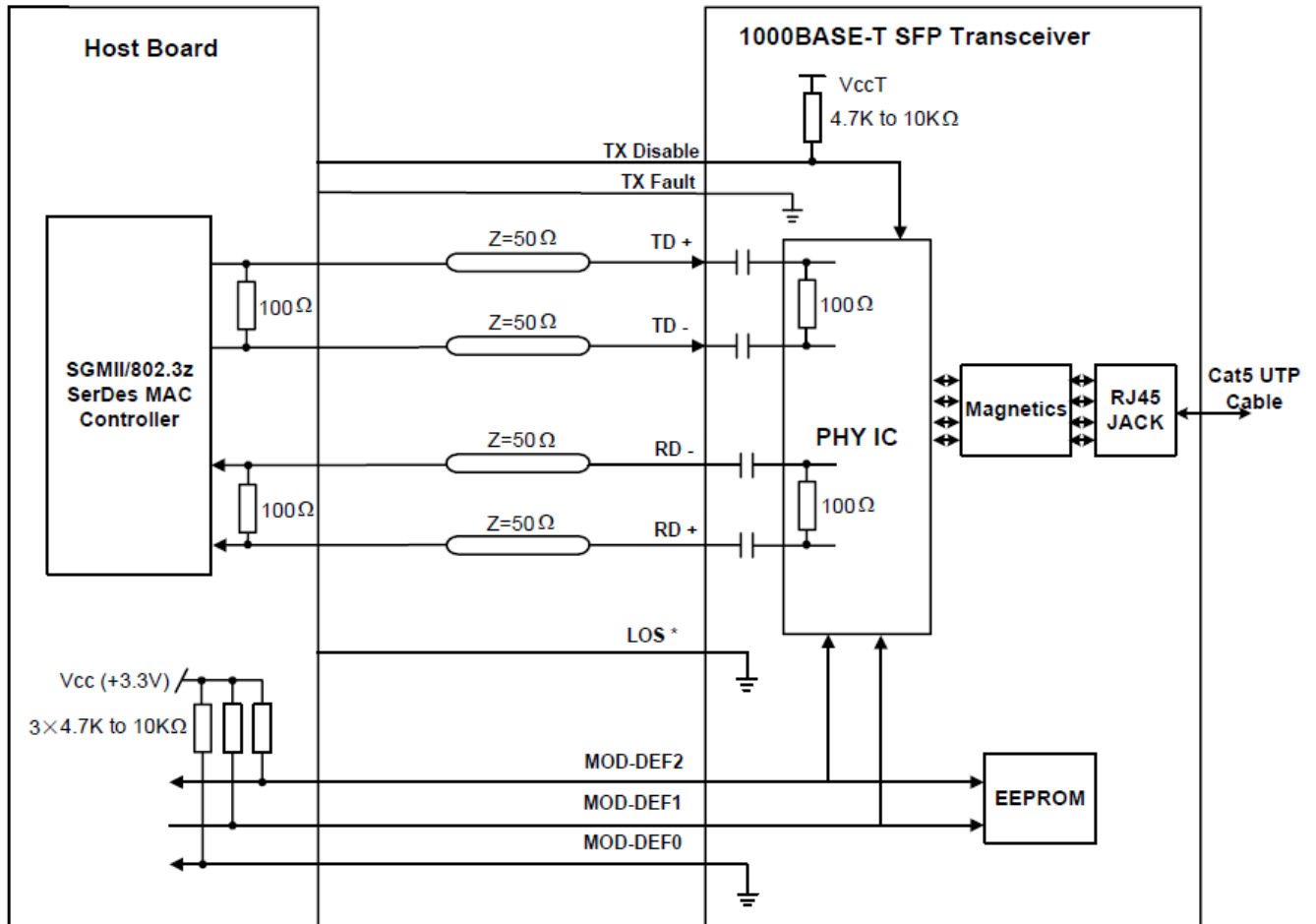## Recommended Host Board Power Supply Circuit



**Figure 2.   Recommended Host Board Power Supply Circuit**

## Recommended Interface Circuit



*NOTE: The consumer can choose whether the module has los signal or not, please refer to the Pin Descriptions (page2-page3) and the Ordering Information (page11).

**Figure 3.   Recommended Host Board Power Supply Circuit**
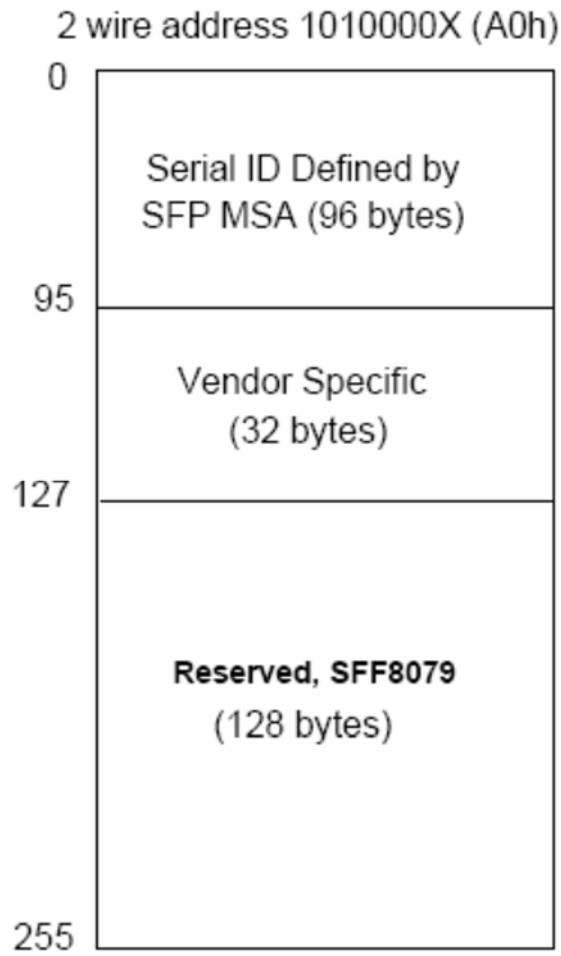
**EEPROM Information**

2 wire address 1010000X (A0h)



**Figure 4.    2-wire Serial Memory Map**

## Physical Layer IC Register

| | | Page 0 (Copper) | Page 1 (Fiber) |
|---|---|---|---|
| | | **Page Address** | |
| | 0 | Control Register | Control Register |
| | 1 | Status Register | Status Register |
| | 2 | PHY Identifier | |
| | 3 | PHY Identifier | |
| | 4 | Auto-Neg Advertisement Register | Auto-Neg Advertisement Register |
| | 5 | Link Partner Ability Register | Link Partner Ability Register |
| | 6 | Auto-Neg Expansion Register | Auto-Neg Expansion Register |
| | 7 | Next Page Transmit Register | Next Page Transmit Register |
| | 8 | Link Partner Next Page Register | Link Partner Next Page Register |
| | 9 | 1000BASE-T Control Register | |
| | 10 | 1000BASE-T Status Register | |
| | 15 | Extended Status Register | |
| | 16 | PHY Specific Control Register | |
| | 17 | PHY Specific Status Register | PHY Specific Status Register |
| | 18 | Interrupt Enable Register | Interrupt Enable Register |
| | 19 | Interrupt Status Register | Interrupt Status Register |
| | 20 | Extended PHY Specific Control Register | |
| | 21 | Receive Error Counter Register | |
| | 22 | Extended Address Register | |
| | 23 | Global Status Register | |
| | 24 | LED Control Register | |
| | 25 | Manual LED Override Register | |
| | 26 | Extended PHY Specific Control 2 Register | |
| | 27 | Extended PHY Specific Status Register | |
| | 28 | MDI[0:3] Virtual Cable Tester™ Status (Pages 0-3); 1000BASE-T Pair Skew (Page 4); 100BASE-T Pair, 1000BASE-T Pair Swap and Polarity (Page 5) | |
| | 29 | Extended Address | |
| | 30 | Calibration Override (Page 3); Force Gigabit (Page7); Class A (Page 11); CRC Checker result (Page 12); Test Enable Control (Page 16); Miscellaneous Control (Page 18) | |

**Figure 5. Phy IC Register List**

Register Address (label on left side vertical)

## Mechanical Specifications

The host-side conforms to the mechanical specifications outlined in the SFP MSA1. The front portion of the SFP (part extending beyond the face plate of the host) is larger to accommodate the RJ-45 connector
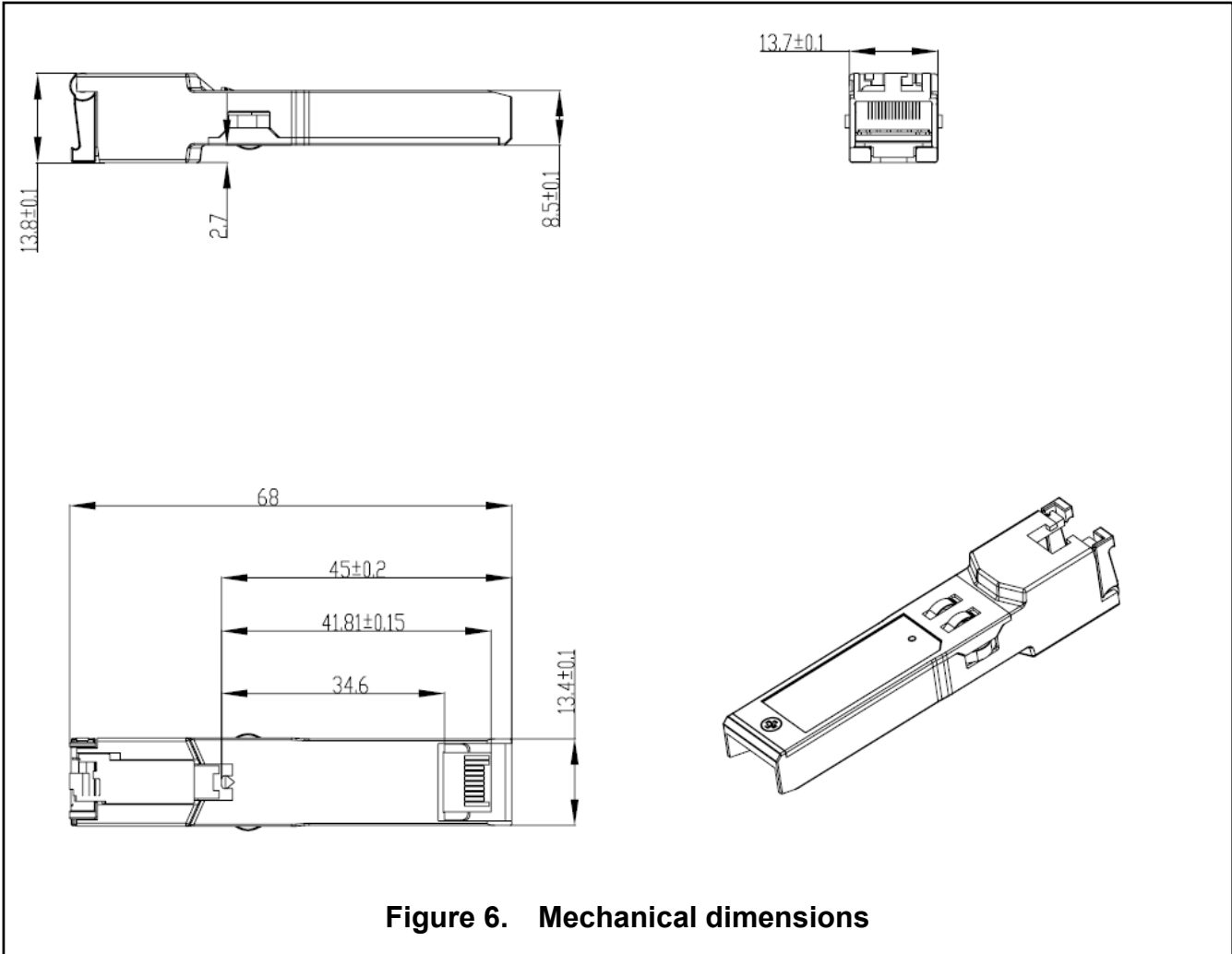


**Figure 6.   Mechanical dimensions**

## Regulatory Compliance
This SFP-Copper transceiver is designed to be Class I Laser safety compliant and is certified per the following standards:

| Feature | Agency | Standard | Certificate / Comments |
|---|---|---|---|
| Environmental protection | SGS | RoHS Directive 2011/65/EU | GZ090319751A/CHEM |

## Ordering Information

| Part Number | Product Description |
|---|---|
| SFP-1G-Copper | 1000Base-T (RJ45) Copper SFP Transceiver     -45ºC to +85ºC |

## References
1. Small Form Factor Pluggable (SFP) Transceiver Multi-Source Agreement (MSA), September 2000.
2. IEEE802.3 – 2002.
3. "AT24C01A/02/04/08/16 2-Wire Serial CMOS E2PROM", Atmel Corporation.

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