1000BASE-T Copper SFP Transceiver coded for Cisco (GLC-T)

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PRODUCT FEATURES

- Up to 1.25 Gb/s bi-directional data links
- Hot-pluggable SFP footprint
- Low power dissipation(1.05W typical)
- Compact RJ-45 connector assembly
- Fully metal enclosure, for lower EMI
- RoHS compliant and lead-free
- Single +3.3V power supply
- 1.25 Gigabit Ethernet over Cat 5 cable
- Case operating temperature: Commercial: 0°C to +70°C

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PRODUCT DESCRIPTION

The **TR0015** is a **1000BASE-T Copper Small Form-Factor Pluggable (SFP) transceiver**, designed for use in Cisco® and Cisco-compatible network equipment.

The module is compliant with the SFP Multi-Source Agreement (MSA) and IEEE 802.3 requirements and is **programmed for maximum host interoperability**, including **Cisco-specific SFP identification behavior via EEPROM**.

The TR0015 presents itself to the host system using **EEPROM data derived directly from the module**, ensuring proper detection, qualification, and link operation on Cisco platforms.

FUNCTIONAL DESCRIPTION

The TR0015 integrates a **Realtek-based 1000BASE-T PHY (internal code: SX 1G)** that supports **full-duplex Gigabit Ethernet transmission** over standard **Category 5 or better UTP cabling up to 100 meters**.

Internally, the physical layer operates in accordance with **IEEE 802.3 1000BASE-T** specifications using multi-level copper signaling.

For **host compatibility**, the module reports a **fixed nominal serial rate and encoding via the SFP EEPROM**, consistent with **common Cisco 1000BASE-T SFP identification conventions**.

These EEPROM-reported parameters represent **host-facing identification data** and do not describe the internal copper modulation scheme.

The RX_LOS pin is used as a link status indication, as commonly implemented in Cisco-compatible 1000BASE-T SFP modules.

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EEPROM / SFP Identification Compliance

The TR0015 EEPROM contents, accessible via the SFP A0h and A2h address spaces, represent the **authoritative identification of the module as reported to the host system**.

The EEPROM is intentionally populated to satisfy Cisco platform validation requirements and reflects the actual programmed contents of the SFP.

Reported EEPROM Identification Parameters

- **Vendor Name:** CISCO-OEM
- **Vendor Part Number:** TR0015
- **Compliance Code:** Gigabit Ethernet
- **Nominal Bit Rate:** 1300 MBd
- **Encoding (reported):** 8B/10B
- **Copper Cable Length:** 100 m
- **Connector Type:** Copper (RJ-45)

The reported nominal rate and encoding values are **host-compatibility fields defined by the SFP MSA** and are commonly used by Cisco 1000BASE-T SFP modules. These values **do not indicate optical transmission** and do not impact actual data throughput or link integrity.

Encoding and Data Rate Clarification

Although the internal 1000BASE-T physical layer uses copper-based multi-level signaling as defined by IEEE 802.3, the TR0015 reports **8B/10B encoding and a nominal 1300 MBd rate via EEPROM**.
This behavior is intentional and ensures compatibility with Cisco hosts that validate SFP modules primarily through EEPROM-based identification fields originally defined for optical transceivers.

Digital Diagnostic Monitoring (DDM)

The TR0015 implements **Digital Diagnostic Monitoring (DDM)** fields in accordance with the SFP MSA via the A2h EEPROM address space.
For copper SFP applications:

- Temperature and supply voltage measurements are valid
- Optical Tx and Rx power fields are populated with **static or representative values**
- Optical power values are **not functionally relevant** for copper transmission

All DDM fields are populated to meet host qualification and monitoring expectations.

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I. SFP to Host Connector Pin Out

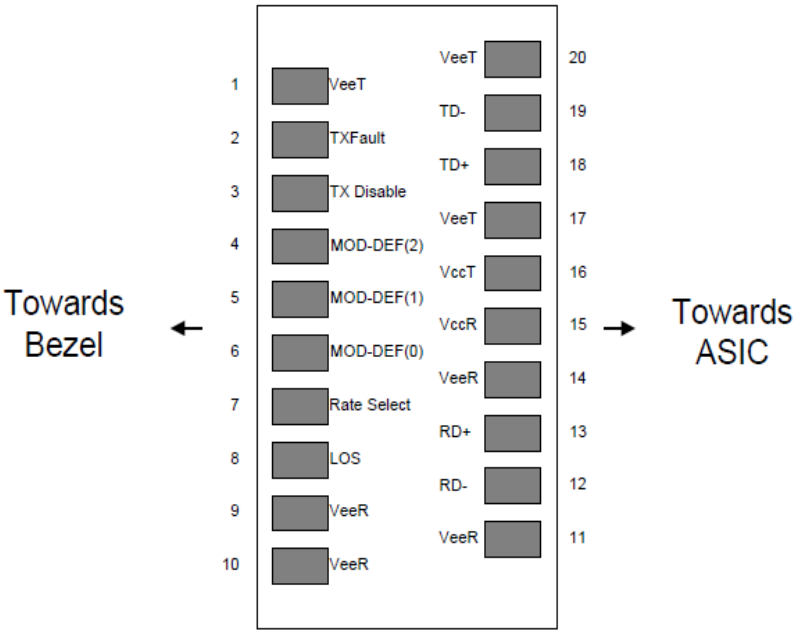

Figure 1. Diagram of host board connector block pin numbers and names

Pin	Symbol	Name/Description	Ref.
1	VEET	Transmitter Ground (Common with Receiver Ground)	1
2	TFAULT	Transmitter Fault. Not supported.	
3	TDIS	Transmitter Disable. Not supported.	
4	MOD_DEF(2)	Module Definition 2. Data line for Serial ID.	2
5	MOD_DEF(1)	Module Definition 1. Clock line for Serial ID.	2
6	MOD_DEF(0)	Module Definition 0. Grounded within the module.	2
7	Rate Select	No connection required	
8	LOS	Loss of Signal indication. Logic 0 indicates normal operation.	3
9	VEER	Receiver Ground (Common with Transmitter Ground)	1
10	VEER	Receiver Ground (Common with Transmitter Ground)	1
11	VEER	Receiver Ground (Common with Transmitter Ground)	1
12	RD-	Receiver Inverted DATA out. AC Coupled	
13	RD+	Receiver Non-inverted DATA out. AC Coupled	
14	VEER	Receiver Ground (Common with Transmitter Ground)	1
15	VCCR	Receiver Power Supply	
16	VCCT	Transmitter Power Supply	
17	VEET	Transmitter Ground (Common with Receiver Ground)	1
18	TD+	Transmitter Non-Inverted DATA in. AC Coupled.	
19	TD-	Transmitter Inverted DATA in. AC Coupled.	
20	VEET	Transmitter Ground (Common with Receiver Ground)	1

Notes:

1. Circuit ground is connected to chassis ground
2. Should be pulled up with 4.7k - 10k Ohms on host board to a voltage between 2.0 V and 3.6 V. MOD_DEF(0) pulls line low to indicate module is plugged in.
3. LVTTL compatible with a maximum voltage of 2.5V.

II. +3.3V Volt Electrical Power Interface

The 1000-T has an input voltage range of 3.3 V +/- 5%. The 4V maximum voltage is not allowed for continuous operation.

+3.3 Volt Electrical Power Interface						
Parameter	Symbol	Min	Typ	Max	unit	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			4	V	
Surge Current	Isurge			30	mA	Hot plug above steady state current. See caution note below

Caution: Power consumption and surge current are higher than the specified values in the SFP MSA

III. Low-Speed Signals

MOD_DEF(1) (SCL) and MOD_DEF(2) (SDA), are open drain CMOS signals (see section VII, "Serial Communication Protocol"). Both MOD_DEF(1) and MOD_DEF(2) must be pulled up to host_Vcc

Low-Speed Signals, Electronic Characteristics					
Parameter	Symbol	Min	Max	unit	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

IV. High-Speed Electrical Interface

All high-speed signals are AC-coupled internally.

High-Speed Electrical Interface, Transmission Line-SFP						
Parameter	Symbol	Min	Typ	Max	unit	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						
Parameter	Symbol	Min	Typ	Max	unit	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	T_r,T_f		175		psec	20%-80%
Tx Input Impedance	Zin		50		Ohm	Single ended
Rx Output Impedance	Zout		50		Ohm	Single ended

V. General Specifications

General						
Parameter	Symbol	Min	Typ	Max	unit	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

Notes:

1. Clock tolerance is +/- 50 ppm
2. By default, the TR0015 is a full duplex device in preferred master mode
3. Automatic crossover detection is enabled. External crossover cable is not required
4. 1000base-T does not support SGMII .With a SERDES the module will operate at 1000BASE-T only

VI. Environmental Specifications

Environmental Specifications						
Parameter	Symbol	Min	Typ	Max	unit	Notes/Conditions
Case Operating Temperature	Tcase	0		70	°C	
		-10		80	°C	
		-40		85	°C	
Storage Temperature	Tsto	-40		85	°C	Ambient temperature

VII. Serial Communication Protocol

1000base-T support the 2-wire serial communication protocol outlined in the SFP MSA. It uses use an Atmel AT24C02B 256 byte EEPROM with an address of A0h.

Serial Bus Timing Requirements						
Parameter	Symbol	Min	Typ	Max	unit	Notes/Conditions
I ^{2}C Clock Rate		0		100,000	Hz	

VIII. Mechanical Specifications (Unit:mm)