

Copper SFP Transceiver

DataSheet

Features:

- ✧ Hot-pluggable SFP Footprint
- ✧ Fully Metallic Enclosure for Low EMI
- ✧ Low Power Dissipation
- ✧ Compact RJ-45 Connector Assembly
- ✧ Detailed Product Information in EEPROM
- ✧ +3.3V Single Power Supply
- ✧ Access to Physical Layer IC via 2-wire Serial Bus
- ✧ 10/100/1000 BASE-T Operation in Host Systems with SGMII Interface
- ✧ Compliant with SFP MSA
- ✧ Compliant with IEEE Std 802.3TM-2002
- ✧ Compliant with FCC 47 CFR Part 15, Class B
- ✧ Compliant with RoHs.
- ✧ Temperature range 0°C to +70°C



Applications:

- ✧ 1.25 Gigabit Ethernet over Category 5 Cable
- ✧ Switch/Route to Switch/Route Link
- ✧ High Speed I/O for File Servers

Descriptions:

The Copper SFP Transceiver 10/100/1000Base-T or 1000Base-T only SFP Copper 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 supports 1000Mb/s data-rate up to 100 meters reach over twisted-pair category 5 cable.

The Copper SFP Transceiver supports 1000 Mb/s full duplex data-links with 5-level Pulse Amplitude Modulation (PAM) signals. All four pairs in the cable are used with symbol rate at 250Mb/s on each pair.

The Copper SFP Transceiver provides standard serial ID information compliant with SFP MSA, which can be accessed with address of A0h via the 2-wire serial CMOS EEPROM protocol. The physical IC can also be accessed via 2-wire serial bus at address ACh. The address of the PHY is 1010110x, where x is the R/W bit.

1. Ordering Information:

Part No.	DESCRIPTION	Speed	Tx-disable	Rx_LOS
OTP-NT1	10/100/1000Mbps, with SGMII interface, enable the auto-negotiation default, without Tx-disable function, Not support Rx_LOS as link indication function,unshielded twisted-pair (UTP) Category 5 Cable,Transmission Distance 0.1Km,Temperature 0~70°C	10/100/1000M bps	No	No
OTP-NT2	1000Mbps, with 1Gbps SerDes interface, enable the auto-negotiation default, without Tx-disable function , support Rx_LOS as link indication function,nshielded twisted-pair (UTP) Category 5 Cable ,Transmission Distance 0.1Km,Temperature 0~70°C	1000Mbps	No	Yes
OTP-NT3	1000Mbps, with 1Gbps SerDes interface, enable the auto-negotiation default,without Tx_disable function, Not support Rx_LOS as link indication function,unshielded twisted-pair (UTP) Category 5 Cable,Transmission Distance 0.1Km,Temperature 0~70°C	1000Mbps	No	No
OTP-NT4	10/100/1000Mbps, with SGMII interface, enable the auto-negotiation default, without Tx-disable function, support Rx_LOS as link indication function,unshielded twisted-pair (UTP) Category 5 Cable,Transmission Distance 0.1Km,Temperature 0~70°C	10/100/1000M bps	No	Yes
OTP-NTT1	10/100/1000Mbps, with SGMII interface, enable the auto-negotiation default, with Tx_disable function, not support Rx_LOS as link indication function,unshielded twisted-pair (UTP) Category 5 Cable,Transmission Distance 0.1Km,Temperature 0~70°C	10/100/1000M bps	Yes	No
OTP-NTT2	1000Mbps, with 1Gbps SerDes interface, enable the auto-negotiation default, with Tx_disable function,support Rx_LOS as link indication function,unshielded twisted-pair (UTP) Category 5 Cable,Transmission Distance 0.1Km,Temperature 0~70°C	1000Mbps	Yes	Yes
OTP-NTT3	1000Mbps, with 1Gbps SerDes interface, enable the auto-negotiation default, with Tx_disable function, not support Rx_LOS as link indication function,unshielded twisted-pair (UTP) Category 5 Cable,Transmission Distance 0.1Km,Temperature 0~70°C	1000Mbps	Yes	No
OTP-NTT4	10/100/1000Mbps, with SGMII interface, enable the auto-negotiation default,with Tx_disable function, support Rx_LOS as link indication function,unshielded twisted-pair (UTP) Category 5 Cable,Transmission Distance 0.1Km,Temperature 0~70°C	10/100/1000M bps	Yes	Yes

Notes:

1. OTP-NT1(4) and OTP-NTT1(4) auto-negotiation capabilities is SGMII without Clock With SGMII auto-negotiation advertise all capabilities and prefer master to 10/100/1000Mbps copper, 10/100/1000 BASE-T operation requires the host system to have an SGMII interface without clocks. and auto-negotiation advertise all capabilities 10/100/1000Mbps
2. OTP-NT2(3) and OTP-NTT2(3) auto-negotiation capabilities is SERDES without Clock With SERDES

auto-negotiation , advertise only 1000BASE-T full duplex preferred master and 1000BASE-X auto-neg to 1000Mbps copper(GBIC). Only,. With a SERDES that does not support SGMII, the module will operate at 1000BASE-T only.

2. Specification:

2.1 SFP to Host Connector Pin Out

Pin	Signal Name	Description	MSA Note
1	VEET	Transmitter ground (common with receiver ground)	
2	TFAULT	Transmitter Fault. Not supported, Grounded in module	Note 1
3	TDIS	Transmitter Disable - Module disables on high or open	Note 2
4	MOD_DEF(2)	Module Definition 2. Data line for Serial ID.	Note 3
5	MOD_DEF(1)	Module Definition 1. Clock line for Serial ID.	Note 3
6	MOD_DEF(0)	Module Definition 0. Grounded in module.	Note 3
7	Rate Select	No connection	
8	LOS	Loss of Signal - High Indicates Loss of Signal	Note 4
9	VEER	Receiver Ground (common with transmitter ground)	
10	VEER	Receiver Ground (common with transmitter ground)	
11	VEER	Receiver Ground (common with transmitter ground)	
12	RD-	Receiver Inverted DATA out. AC Coupled	Note 5
13	RD+	Receiver Non-inverted DATA out. AC Coupled	Note 5
14	VEER	Receiver Ground (common with transmitter ground)	
15	VCCR	Receiver Power Supply	Note 6
16	VCCT	Transmitter Power Supply	Note 6
17	VEET	Transmitter Ground (Common with Receiver Ground)	
18	TD+	Transmitter Non-Inverted DATA in. AC Coupled.	Note 7
19	TD-	Transmitter Inverted DATA in. AC Coupled.	Note 7
20	VEET	Transmitter Ground (common with receiver ground)	

Notes:

- TX Fault is not used and is always tied to ground.
- TX Disable as described in the MSA is not applicable to the 1000BASE-T module, but is used for convenience as an input to reset the internal ASIC. This pin is pulled up within the module with a 4.7 Kohm 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 disable state
Open:	Transceiver in reset disable state
- Mod-Def 0, 1, 2. These are the module definition pins. They should be pulled up with a 4.7-10 Kohm resistor on the host board to a supply less than VCCT + 0.3 V or VCCR + 0.3 V.
Mod Def 0 is tied to ground to indicate that the module is present.
Mod-Def 1 is clock line of two wire serial interface for optional serial ID
Mod-Def 2 is data line of two wire serial interface for optional serial ID
- This pin is open drain CMOS output signals, They should be pulled up with a 4.7-10 Kohm resistor on the host board to a supply less than VCCT + 0.3 V or VCCR + 0.3 V. (see Table 3. Low-Speed Signals, Electronic Characteristics)
- RD-/+ : These are the differential receiver outputs. They are ac coupled 100 ohm differential lines which should be terminated with 100 ohm differential at the user SerDes. The ac coupling is done inside the module and is thus not required on the host board. The voltage swing on these lines will be between 370 and 2000 mV differential (185 – 1000 mV single ended) when properly terminated. These levels are compatible with CML and LVPECL voltage swings.
- VCCR and VCCT are the receiver and transmitter power supplies. They are defined as 3.3 V ± 5% at the SFP connector pin. The maximum supply current is about 300mA and the associated in-rush current will typically be no more than 30 mA above steady state after 500 nanoseconds.
- TD-/+ : These are the differential transmitter inputs. They are ac coupled differential lines with 100 ohm differential termination inside the module. The ac coupling is done inside the module and is thus not required on the host board. The inputs will accept differential swings of 500 – 2400 mV (250 – 1200 mV single ended), though it is recommended that values between 500 and 1200 mV differential (250 – 600 mV single ended) be used for best EMI performance. These levels are compatible with CML and LVPECL voltage swings.

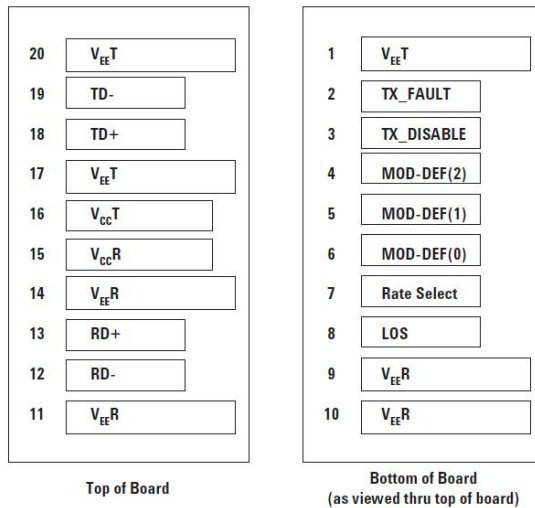


Figure 1a. Diagram of Host Board Connector Block Pin Numbers and Names

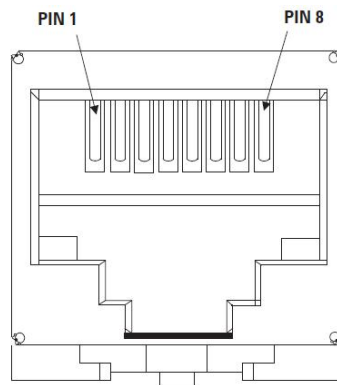


Figure1b. MDI (RJ 45 Jack) Pin Assignment

2.2 Recommended Interface Circuit

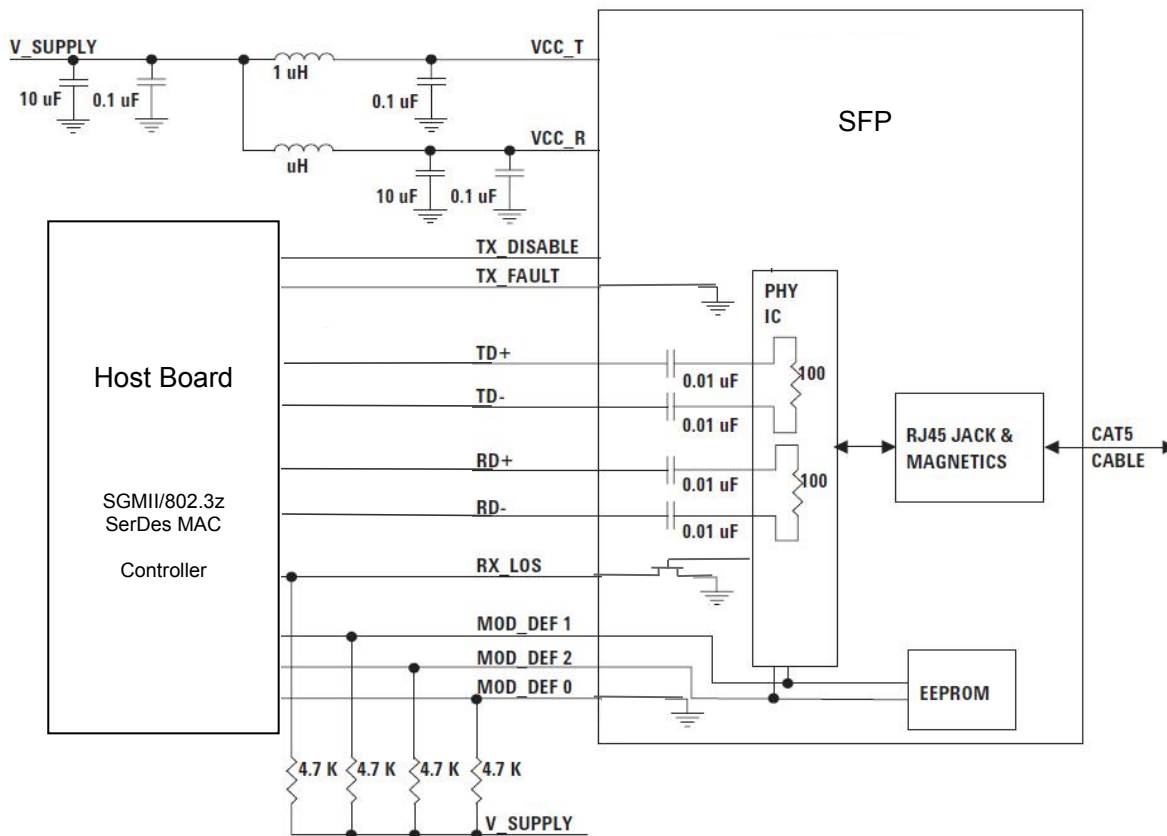


Figure 2 Recommended Interface Circuit

Recommended Host Board Power Supply Circuit

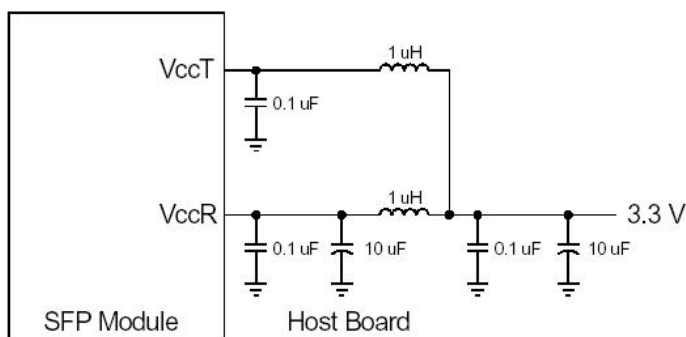


Figure 3, Recommended Host Board Power Supply Circuit

2.3 Power Supply Interface Electronic Characteristics

The Copper SFP has an input voltage range of $3.3\text{ V} \pm 5\%$. The 4 V maximum voltage is not allowed for continuous operation.

Power Supply Interface Electronic Characteristics

Parameter	Symbol	Min.	Typical	Max.	Unit	Note/Conditions
Supply Current	I _s		300	350	mA	1.2W max power over full range of voltage and temperature. See caution note below
Input Voltage	V _{cc}	3.135	3.3	3.465	V	Referenced to GND

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

Table 2. Power Supply Interface Electronic Characteristics

2.4 Low-Speed Signals

MOD_DEF (1) (SCL) and MOD_DEF (2) (SDA) are open drain CMOS signals. 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	Note/Conditions
SFP Output LOW	V _{OL}	0	0.5	V	4.7k to 10k pull-up to host_Vcc.
SFP Output HIGH	V _{OH}	host_Vcc - 0.5	host_Vcc + 0.3	V	4.7k to 10k pull-up to host_Vcc.
SFP Input LOW	V _{IL}	0	0.8	V	4.7k to 10k pull-up to Vcc.
SFP Input HIGH	V _{IH}	2	Vcc + 0.3 V	V	4.7k to 10k pull-up to Vcc.

Table 3. Low-Speed Signals, Electronic Characteristics

2.5 High-Speed Electrical Interface

All high-speed signals are AC-coupled internally.

High-Speed Electrical Interface, Transmission Line-SFP

Parameter	Symbol	Min.	Typical	Max.	Unit	Note/Conditions
Line Frequency	f _L		1.25		GHz	5-level encoding, per IEEE 802.3
Tx Output Impedance	Z _{out,TX}		100		Ohm	Differential
Rx Input Impedance	Z _{in,RX}		100		Ohm	Differential

Table 4. High-Speed Electrical Interface, Transmission Line-SFP

High-Speed Electrical Interface, Host-SFP

Parameter	Symbol	Min.	Typical	Max.	Unit	Note/Conditions
Data Input: Transmitter Differential Input Voltage (TD +/-)	Vinsing	500		2400	mV	
Data Output: Receiver Differential Output Voltage (RD +/-)	Voutsing	370	735	2000	mV	
Rise/Fall Time	Tr,Tf		100	250	psec	20%-80%
Tx Input Impedance	Zin		50		Ohm	Single ended
Rx Output Impedance	Zout		50		Ohm	Single ended

Table 5. High-Speed Electrical Interface, Host-SFP

General Specifications

Parameter	Symbol	Min.	Typical	Max.	Unit	Note/Conditions
Data Rate	BR		1.25		Gb/s	IEEE 802.3 compatible.
Cable Length	L			100	m	Category 5 UTP. BER 10^{-12}

Table 6. General Specifications

Notes:

1. Clock tolerance is +/- 50 ppm
2. By default, the copper SFP is a full duplex device in preferred master mode
3. Automatic crossover detection is enabled. External crossover cable is not required
4. 10/100/1000 BASE-T operation requires the host system to have an SGMII interface with no clocks. With a SERDES that does not support SGMII, the module will operate at 1000BASE-T only.

2.6 Environmental Specifications

Environmental Specifications

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes/Conditions
Operating Temperature	Top	0		70	°C	Case temperature
Storage Temperature	Tsto	-40		85	°C	Ambient temperature

Table 7. Environmental Specifications

2.7 Serial ID Memory Contents:

Address	Field Size (Byte)	Name of Field	Description and Contents	Hex
Base ID Fields				
0	1	Identifier	Type of Serial transceiver (SFP)	03
1	1	Reserved	Extended identifier of type serial transceiver (MOD4)	04
2	1	Connector	Code of optical connector type (Copper)	22
3-10	8	Transceiver	Gigabit Ethernet 1000Base-T Copper	00 00 00 08 00 00 00 00
11	1	Encoding	8B10B	01
12	1	BR, Nominal	Nominal baud rate, unit of 100Mbps 1000Base 1.25G/s	0d
13	1	Reserved		00
14	1	Length (9um)-km		00
15	1	Length (9um)	Link length supported for 9/125um fiber, units of 100m	00
16	1	Length (50um)	Link length supported for 50/125um fiber, units of 10m	00
17	1	Length (62.5um)	Link length supported for 62.5/125um fiber, units of 10m	00
18	1	Length (Copper)	Link length supported for copper, units of meters.	64
19	1	Reserved		00
20-35	16	Vendor Name	"GR" (ASCII)	
36	1	Reserved		00
37-39	3	Vendor OUI	SFP transceiver vendor OUI ID	00 00 00
40-55	16	Vendor PN	Part Number: "OTP-T1" (ASCII)	
56-59	4	Vendor rev	Revision level for part number (means 1.0 revision)	31 30 20 20
60-61	2	Wavelength		00 00
62	1	Reserved		00
63	1	CCID	Least significant byte of Check sum of data in address 0-62	xx
Extended ID Fields				
64-65	2	Option	Indicates which optical SFP signals are implemented	00 10
66	1	BR, max	Upper bit rate margin, units of %	00
67	1	BR, min	Lower bit rate margin, units of %	00
68-83	16	Vendor SN	Serial number (ASCII)	xx xx xx xx xx xx xx xx xx xx xx xx xx xx xx xx

84-91	8	Date code	Manufacturing date code Year (4 bytes), Month (2 bytes), Day (2 bytes)	XX XX XX XX XX XX XX XX
92-94	3	Reserved		00 00 00
95	1	CC_EX	Check code for the extended ID Fields (addresses 64 to 94)	xx
Vendor Specific ID Fields				
96-127	32	Vendor specific	specific date, read only	

2.8 Mechanical Drawing:

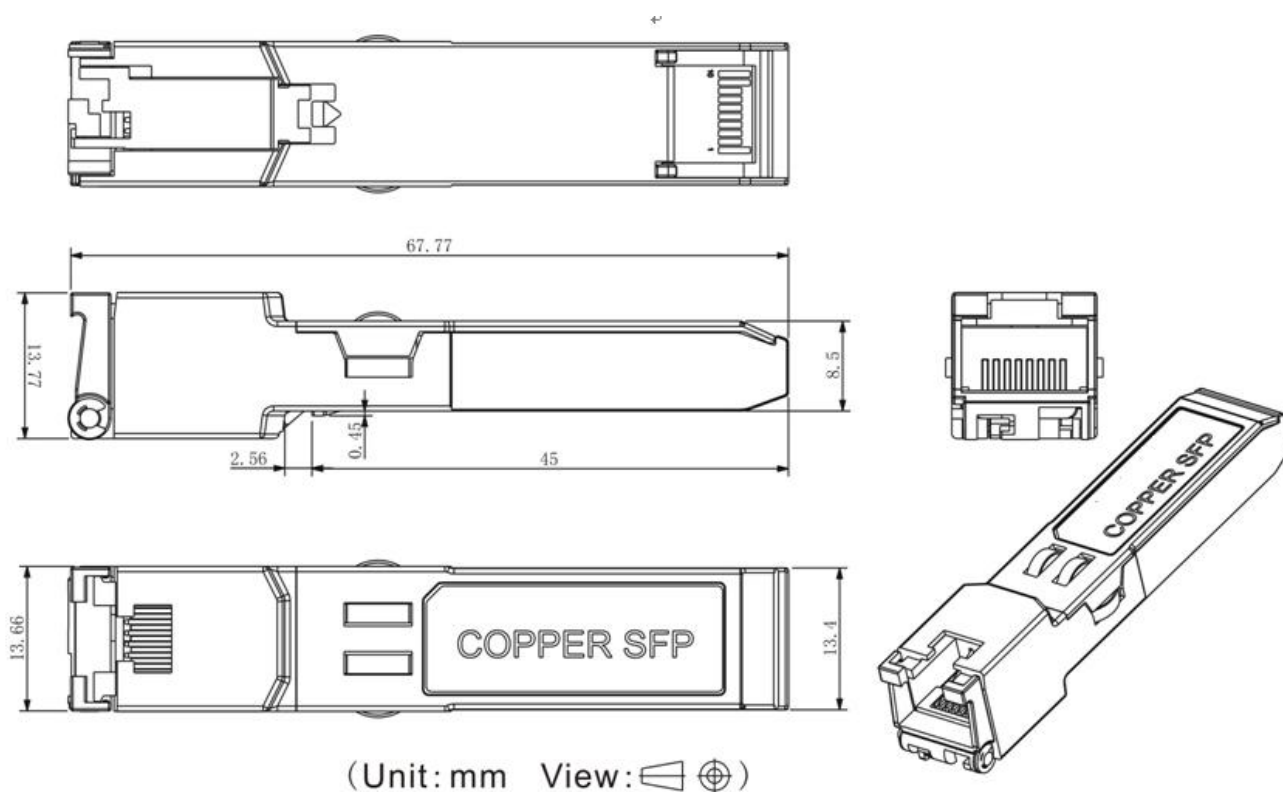


Figure 4, Mechanical Diagram of Copper SFP

References

1. Small Form Factor Pluggable (SFP) Transceiver Multi-Source Agreement (MSA), September 2000.
2. IEEE Std 802.3, 2002 Edition. IEEE Standards Department, 2002.
4. "AT24C01A/02/04/08/16 2-Wire Serial CMOS E²PROM", Atmel Corporation. www.Atmel.com
5. "Alaska Ultra 88E1111 Integrated 10/100/1000 Gigabit Ethernet Transceiver", Marvell Corporation. www.marvell.com