10Gbps Copper SFP Transceiver

Copper SFP Speedy Series

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The OTP-10G-T-BRO Copper SFP transceiver features simple application in data center for managers to leverage their installed base of switches and servers equipped with SPF+ empty cages, delivering 10G data rate over Cate6a up to 100m. The hot swappable copper solution offers the new option of on-demand purchases and flexibility for network managers to optimize capital expense. The transceiver provides standard SFP MSA compliant serial ID information, which can be read/written via the 2-wire serial CMOS EEPROM protocol and its inside PHY IC can be accessed via 2-wire serial bus.

Features

- Supports 10Gbps links up to 100 m (Cat 6a Cable)
- Low Power Consumption
- IEEE 802.3bz Compliant
- SFF-8431 and SFF-8432 MSA Compliant
- Access EEPROM/PHY IC via 2-wire Serial Bus
- Fast Retrain and EMI Cancellation Algorithm
- Compliant with RoHS
- +3.3V Single Power Supply
- Operating Case Temperature: 0~70°C, -40~85°C

Applications

- Data Center Migration
- 10Gbps Ethernet over Category 6a Cable
- High speed I/O for file server or high-end workstation
- Switch/Router to Switch/Router Link

Specifications

Interface

Line Side	10Gbps
Host Side	10Gbps

Key Parameters

Bit rate support	10Gbps
Maximum link up distance	100m@10Gbps
Cable support	Cat6a for 10Gbps
Power consumption	1.62W@10Gbps

Environmental

Case Temperature	0℃-70℃, -40℃ +85℃ Operating
Humidity	10-85% Operating 5-90% Storage Relative Humidity Non-Condensing

Outline

13.66(W) x 67.77(D) x 13.77(H) mm

RJ-45 receptacle (Line side)

SFP+ 20 pin host contact (Host side)

Net weight：25g

Package Contents

10G-SFP Copper Transceiver	10G-SFP Copper Transceiver tray (10pcs)

Package weight: 285g (1tray)

Safety Regulation

CE and FCC Approved

Ordering Information

OTP-10G-T-BRO (commercial grade, 0℃-70℃)

OTP-10G-T-I-BRO (Industrial grade, -40℃ +85℃)

Parameter	Symbol	Min	Max	Units	Note
Storage Temperature	Ts	-45	90	℃	
Storage Humidity	Hs	5	90	%	

Recommended Operating Conditions

Parameter	Symbol	Min	Max	Units	Note
Operating Temperature	T	0	70	℃	C-grade
		-40	85	℃	I-grade
Operating Humidity	Ho	10	85	%	
Supply Voltage	Vcc	3.135	3.465	V	Typ 3.3V
Surge Current	Isurge		30	mA	Hot Plug

Electrical Characteristics

Parameter	Symbol	Min	TYP	Max	Units	Note
Transmitter						
Data Input differential Voltage	VD,TX	85		1200	mV	(1)
Differential Input Impedance	ZTX		100		Ohm	
Transmitter Disable Input-High	VDISH		N/A		V	Not implement
Transmitter Disable Input-Low	VDISL		N/A		V	Not implement
Receiver						
Data Output Differential Voltage	VD, RX	400		1200	mV	(3)
Differential Output Impedance	ZRX		100		Ohm	
LOS Output Voltage – High	VSDHL	2.4		Vcc	V	(2)
LOS Output Voltage – Low	VSDL	0		0.5	V	(2)

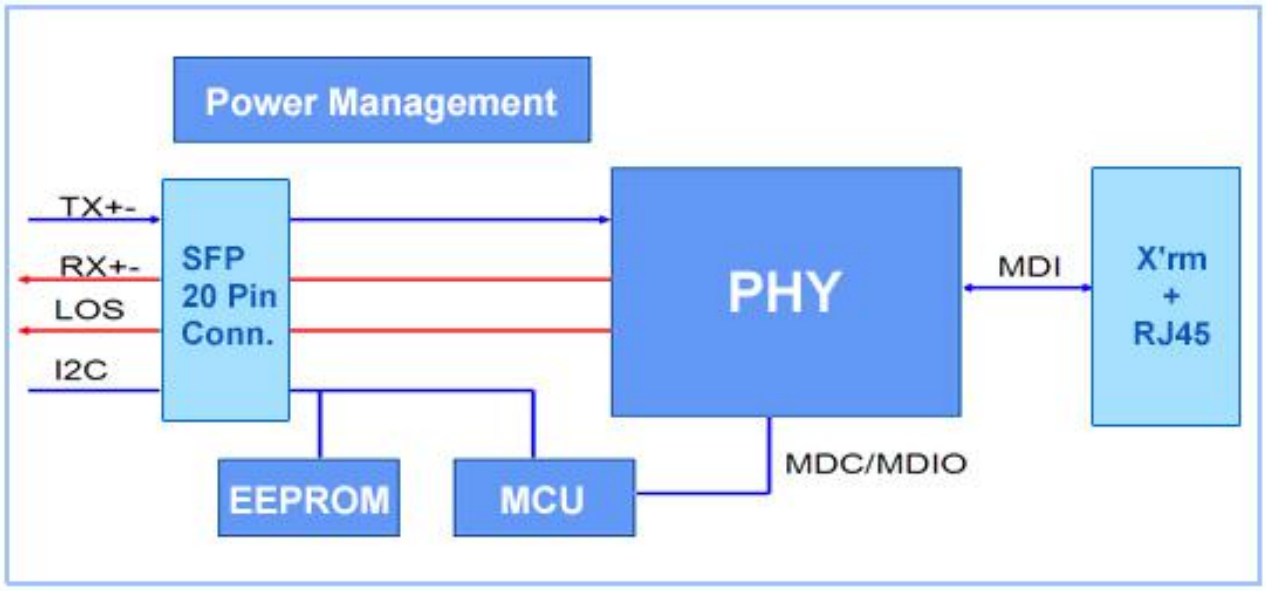
Note:

1) Internally AC coupled to PHY chip

2) Pull up to VCC with a 4.7K – 10K Ohm resistor on host Board

3) Internally AC coupled, but requires a 100 Ohm differential termination at MAC side

Block Diagram of Transceiver



LOS Function

The SFP MSA specification defines a pin called LOS to indicate loss of signal to the motherboard. This should be pulled up with a 4.7K to 10K resistor. Pull up voltage between 2.0V and Vcc-T/R+0.3V. When high, this output indicates link fail. Low indicates normal operation. In the low state, the output will be pulled to <0.5V.

Termination Circuits

Inputs to the transceiver are AC coupled and internally terminated through 50 ohms. The input signal must have at least an 110mV differential peak-to-peak signal swing. Output from the receiver section of the module is also AC coupled and is expected to drive a 50 ohm load. Different termination strategies may be required depending on the particular Serializer/Deserializer chip set used. The transceiver is designed with AC coupled data inputs and outputs to provide the following advantages:

Close positioning of SERDES with respect to transceiver; allows for shorter line lengths and at high speeds reduces EMI. Minimize number of external components. Internal termination reduces the potential for un-terminated stubs which would otherwise increase jitter and reduce transmission margin.

Subsequently, this affords the customer capability to optimally locate the SERDES as close to the transceiver as possible and save valuable real estate. At 10Gbps rates this can provide a significant advantage resulting in better transmission performance and accordingly better signal integrity.

Power Coupling

A suggested layout for power and ground connections is given in Figure 1 below. Connections are made via separate voltage and ground planes. The mounting posts are at case ground and should not be connected to circuit ground. The ferrite bead should provide a real impedance of 50 to 100 ohms at 100 to 1000 MHz. Bypass capacitors should be placed as close to the 20 pin connector as possible.

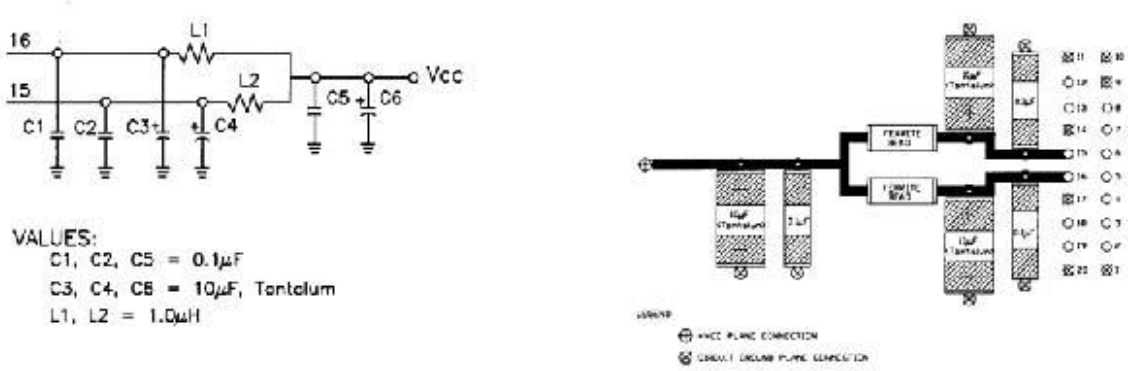


Figure 1: Suggested Power Coupling

Serial Communication Protocol

OTP-10G-T-BRO supports the 2-wire serial communication protocol defined in the SFP MSA. This SFP uses a 256 bytes EEPROM with an address of 0xA0. The physical layer IC can also be accessed via the 2-wire serial bus at address 0xAC/0xAD.

EEPROM Serial ID Memory Conten

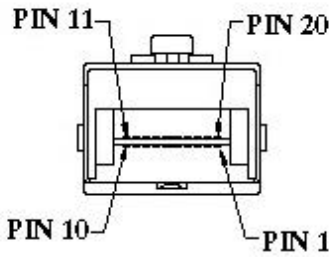
Accessing Serial ID Memory uses the 2 wire address 10100000 (A0H). Memory Contents of Serial ID are shown in Table 1.

Table 1 Serial ID Memory Contents

Addr.	Size (Bytes)	Name of Field	Hex	Description
0	1	identifier	03	SFP or SFP+
1	1	Ext.Identifier	04	GBIC/SFP function is defined by two-wire interface ID only
2	1	Connector	22	RJ45
3-10	8	Transceiver	XX XX XX XX XX XX	Transceiver Code
11	1	Encoding	00	
12	1	BR(Nominal)	64	10Gbps
13	1	Rate Identifier	00	Unspecified
14	1	Length(SMFm)-km	00	N/A
15	1	Length(SMF)	00	N/A
16	1	Length(50μm)	00	N/A
17	1	Length(62.5μm)	00	N/A
18	1	Length(cable)	64	100(units of meters)
19	1	Length(OM3)	00	N/A
20-35	16	Vendor name	XX XX XX XX XX XX XX 20 20 20 20 20 20 20 20 20	Vendor name (ASCII)
36	1	Transceiver	00	Unallocated
37-39	3	Vendor OUI	XX XX XX	Vendor OUI
40-55	16	Vendor PN	XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX	Transceiver part number
56-59	4	Vendor rev	XX XX XX XX	Vendor rev

60-61	2	Wavelength	00	0nm
62	1	Unallocated	00	Unallocated
63	1	CC_BASE	Check Sum (Variable)	Check code for Base ID Fields
64-65	2	Options	00 02	RATE_SELECT functionality is implemented
66	1	BR	00	max
67	1	BR	00	min
68-83	16	Vendor SN	41 34 32 30 33 30 30 34 20 20 20 20 20 20 20 20	Serial Number of transceiver (ASCII). For example“A4203004”.
84-91	8	Date code	XX XX XX XX XX XX XX XX	Manufacture date code
92	1	Diagnostic Monitoring Type	00	N/A
93	1	Enhanced Options	00	N/A
94	1	SFF-8472 Compliance	00	Digital diagnostic function not included or undefined
95	1	CC_EXT	Check Sum (Variable)	Check sum for Extended ID Field.
96-127	32	Vendor Specific	Read only	Depends on customer information

Connection Diagram



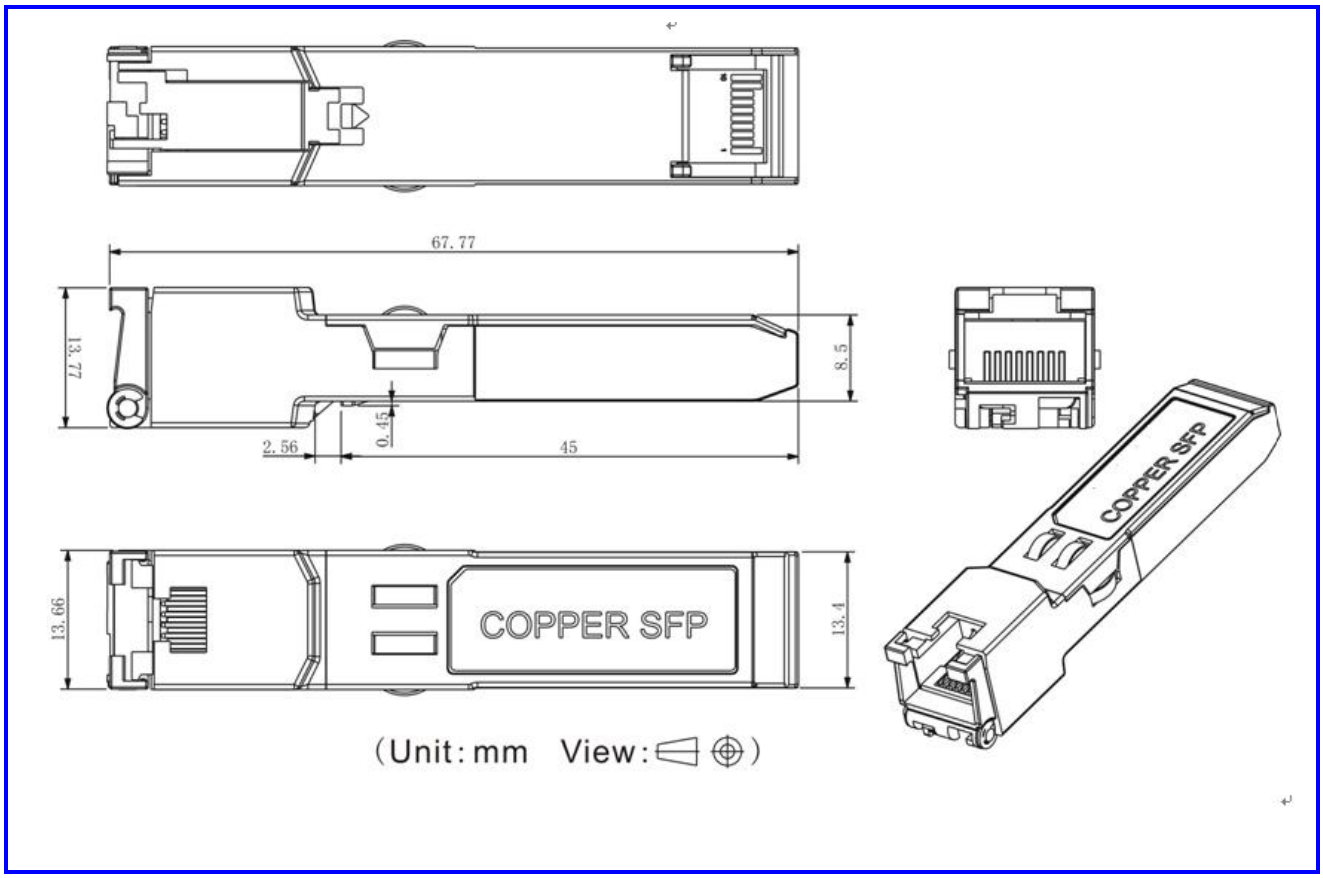
Pin	Signal Name	Function	NOTES

Note:

1) TX Fault is not used and is always tied to ground.
2) TX Disable as described in the MSA is not applicable to the copper SFP module.
3) Mod-Def 0, 1, 2. These are the module definition pins. They should be pulled up with a 4.7-10 K resistor on the host board to a supply less than VCCT + 0.3 V or VCCR + 0.3 V.
4) 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.
5) VCCR and VCCT are the receiver and transmitter power supplies. They are defined as 3.3 V ± 5% at the SFP connector pin.
6) 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.

13	RD+	Non-Inverted Received Data out	AC coupled 100 ohm differential high speed data lines
14	VeeR	Receiver Ground	VeeT and VeeR are connected in SFP
15	VccR	Receiver Power	VccR and VccT are connected in SFP
16	VccT	Transmitter Power	AC coupled 100 ohm differential high speed data lines
17	VeeT	Transmitter Ground	VeeT and VeeR are connected in SFP
18	TD+	Non-inverted Data	VccR and VccT are connected in SFP
19	TD-	Inverted Data In	VccR and VccT are connected in SFP
20	VeeT	Transmitter Ground	VeeT and VeeR are connected in SFP

Drawing Dimensions



Mating of SFP Transceiver to SFP Host Board Connector

The pads on the PCB of the SFP transceiver shall be designed for a sequenced mating as follows: First mate: Ground contacts. Second mate: Power contacts. Third mate: Signal contacts The SFP MSA specification for a typical contact pad plating for the PCB is 0.38 micrometers minimum hard gold over 1.27 micrometers minimum thick nickel. To ensure the long term reliability performance after a minimum of 50 insertion removal cycles, the contact plating of the transceiver is 0.762 micron (30 micro-inches) over 3.81 micron (150 micro-inches) of Ni on Cu contact pads.

RJ45 Connector

RJ45 connector shall support shielded and unshielded cables. Also, the connector is mechanically robust enough and designed to prevent loss of link, when the cable is positioned or moves in different angles. The connector shall pass the “wiggle” RJ45 connector operational stress test. During the test, after the cable is plugged in, the cable is moved in circle to cover all 360 deg in the vertical plane, while the data traffic is on. There shall be no link or data loss.