

**SPE-7100(A)G / SPE-7101(A)G / SPE-7100(A)-SG / SPE-7101(A)-SG**  
**3.3V / 1.25 Gb/S / 100m / SFP RJ-45 COPPER TRANSCEIVER**

**(RoHS Compliant)**

### 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 with SGMII Interface
- Auto sense MDI/MDIX
- Compliant with SFP MSA
- Compliant with IEEE Std 802.3-2002
- Compliant with FCC 47 CFR Part 15, Class B
- Compliant with RoHs.
- 0 to 70°C Operating: SPE-7100G / SPE-7101G / SPE-7100-SG / SPE-7101-SG
- -40 to 85°C Operating: SPE-7100AG / SPE-7101AG / SPE-7100A-SG / SPE-7101A-SG

### APPLICATIONS

- 10/100/1000Mbps Ethernet over Category 5 Cable
- Distributed multi-processing
- High speed I/O for file server or high-end workstation
- Switch/Router to Switch/Router Link

### DESCRIPTION

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. With the hot plug ability, the module offers a flexible and easy way to be installed into SFP MSA compliant ports at any time without the interruption of the host equipment operating online.

The Copper SFP Transceiver supports 1000Mb/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.

### ORDER INFORMATION

P/No.	MAC Interfac	Speed (Mb/s)	LOS (Enable/Disable)	Distance (m)	Package	Temp. (°C)	RoHS Compliant
SPE-7100G	1.25Gbps SerDes	1000 only	Enable	100	SFP	0 to 70	Yes
SPE-7101G	1.25Gbps SerDes	1000 only	Disable	100	SFP	0 to 70	Yes
SPE-7100-SG	SGMII without clock	10 / 100 / 1000	Enable	100	SFP	0 to 70	Yes
SPE-7101-SG	SGMII without clock	10 / 100 / 1000	Disable	100	SFP	0 to 70	Yes
<b>SPE-7100AG</b>	1.25Gbps SerDes	1000 only	Enable	100	SFP	<b>-40 to 85</b>	Yes
<b>SPE-7101AG</b>	1.25Gbps SerDes	1000 only	Disable	100	SFP	<b>-40 to 85</b>	Yes
<b>SPE-7100A-SG</b>	SGMII without clock	10 / 100 / 1000	Enable	100	SFP	<b>-40 to 85</b>	Yes
<b>SPE-7101A-SG</b>	SGMII without clock	10 / 100 / 1000	Disable	100	SFP	<b>-40 to 85</b>	Yes

Notes:

SPE-7100G, SPE-7101G, SPE-7100AG and SPE-7101AG 1000Mbps with a SERDES interface that does not support SGMII, these modules will operate at 1000BASE-T only.

SPE-7100-SG, SPE-7101-SG, SPE-7100A-SG and SPE-7101A-SG 10/100/1000Mbps operation requires the host system to have an SGMII interface without clocks and auto-negotiation advertise all capabilities 10/100/1000Mbps.

### Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Units	Notes
Storage Temperature	Tstg	-40	85	°C	
Operating Case Temperature	Topr	0	70	°C	SPE-7100G / SPE-7101G SPE-7100-SG / SPE-7100-SG SPE-7100AG / SPE-7101AG SPE-7100A-SG / SPE-7100A-SG
		0	70		
		-40	85		
		-40	85		
Storage Humidity	Hs	5	95	%	
Power Supply Voltage	Vcc	-0.5	3.6	V	

### Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Units / Notes
Power Supply Voltage	Vcc	3.13	3.3	3.47	V
Operating Case Temperature	Topr	0		70	°C / SPE-7100G / SPE-7101G
		0		70	°C / SPE-7100-SG / SPE-7101-SG
		-40		85	°C / SPE-7100AG / SPE-7101AG
		-40		85	°C / SPE-7100A-SG / SPE-7101A-SG

### High Speed Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Units	Notes
<b>Host-SFP</b>						
Single ended Input swing	V <sub>IN_PP</sub>	250		1200	mV	
Single ended output swing	V <sub>OUT_PP</sub>	275		800	mV	
Rise Time /Fall Time (20%-80%)	T <sub>R</sub> /T <sub>F</sub>		175		Ps	
Tx Input impedance	Z <sub>IN</sub>		50		Ω	Single ended
Rx Output impedance	Z <sub>OUT</sub>		50		Ω	Single ended
<b>Line-SFP</b>						
Line Frequency	F <sub>L</sub>		125		MHz	1
Tx Output Impedance Differential	Z <sub>OUT_TX</sub>		100		Ω	2
Rx Input Impedance Differential	Z <sub>IN_RX</sub>		100		Ω	2

Note:

1. 5-level encoding.
2. For all frequencies between 1MHz and 125MHz

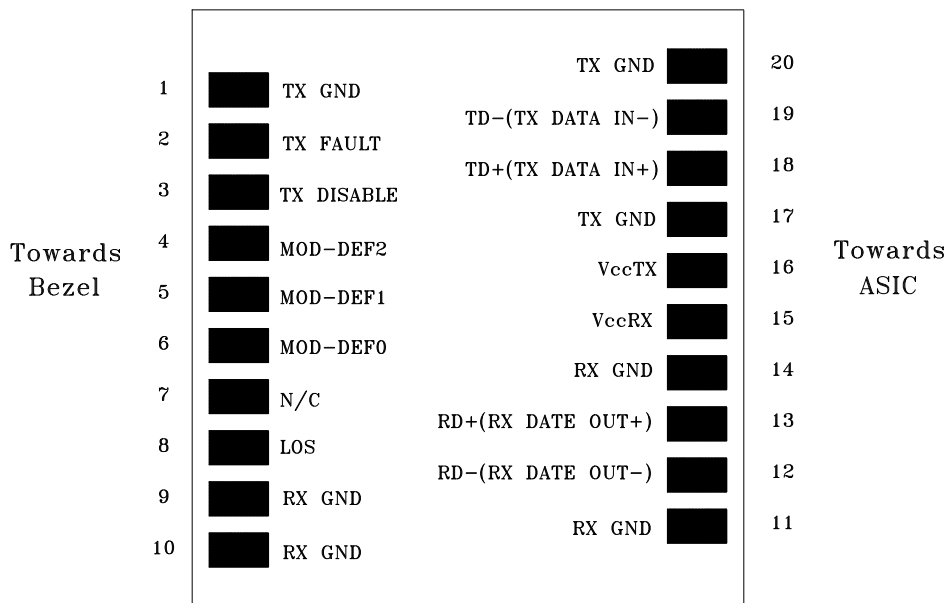
### Low Speed Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Units	Notes
SFP Output Low	V <sub>OL</sub>	0		0.5	V	1
SFP Output High	V <sub>OK</sub>	Host_V <sub>CC</sub> -0.5		Host_V <sub>CC</sub> +0.3	V	1
SFP Input Low	V <sub>IL</sub>	0		0.8	V	1
SFP Input High	V <sub>IH</sub>	2		V <sub>CC</sub> +0.3	V	1

Note:

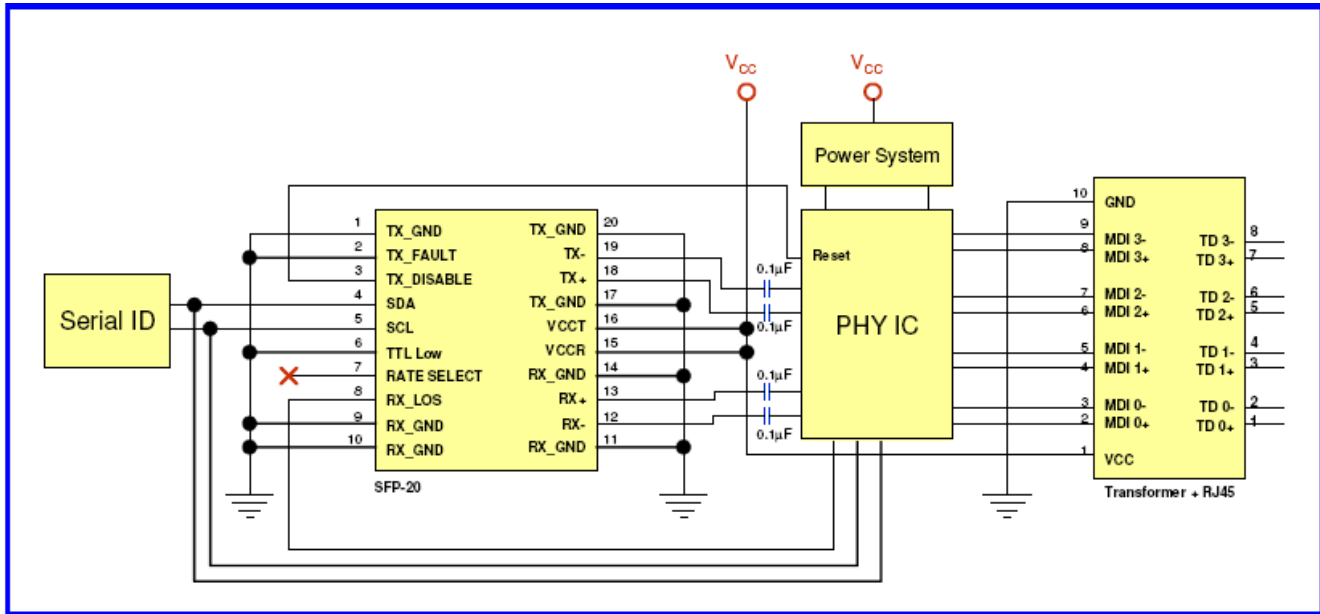
1. External 4.7-10k ohm pull-up resistor required.

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**CONNECTION DIAGRAM**



PIN	Signal Name	Description	PIN	Signal Name	Description
1	V <sub>EE</sub> T	Transmitter Ground	11	V <sub>EE</sub> R	Receiver Ground
2	TX_Fault	Not Implemented. Tied to VeeT in SFP	12	RD-	Inverted Received Data out
3	TX_Disable	Not Implemented. Floating in host	13	RD+	Non-Inverted Received Data out
4	SDA	Module Definition 2 - Data Line for Serial ID	14	V <sub>EE</sub> R	Receiver Ground
5	SDL	Module Definition 1 - Clock Line for Serial ID	15	V <sub>CC</sub> R	Receiver Power
6	MOD-ABS	Module Definition 0 - Tied to Vee in SFP	16	V <sub>CC</sub> T	Transmitter Power
7	RS0	Not Implemented	17	V <sub>EE</sub> T	Transmitter Ground
8	RX_LOS	Loss of Signal	18	TD+	Non-inverted Data In
9	V <sub>EE</sub> R	Receiver Ground	19	TD-	Inverted Data In
10	V <sub>EE</sub> R	Receiver Ground	20	V <sub>EE</sub> T	Transmitter Ground

## 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  $V_{cc}-T/R+0.3V$ . When high, this output indicates link fail. Low indicates normal operation. In the low state, the output will be pulled to  $<0.8V$ .

### Termination Circuits

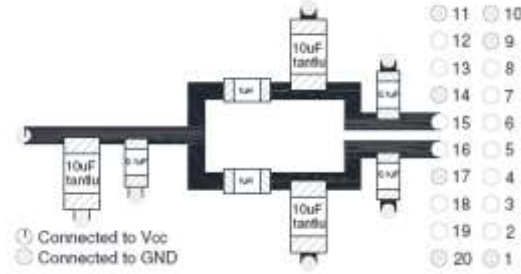
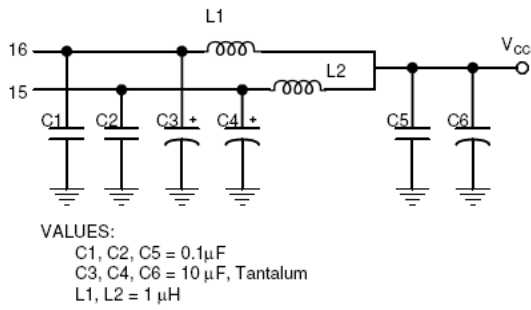
Inputs to the transceiver are AC coupled and internally terminated through 50 ohms. These modules can operate with PECL or ECL logic levels. The input signal must have at least a 250mV peak-to-peak (single ended) signal swing. Output from the receiver section of the module is also AC coupled and is expected 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 Gigabit speeds reduces EMI. It has minimum 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 the ability to optimally locate the SERDES as close to the transceiver as possible and save valuable real estate. At Gigabit 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.

## POWER COUPLING



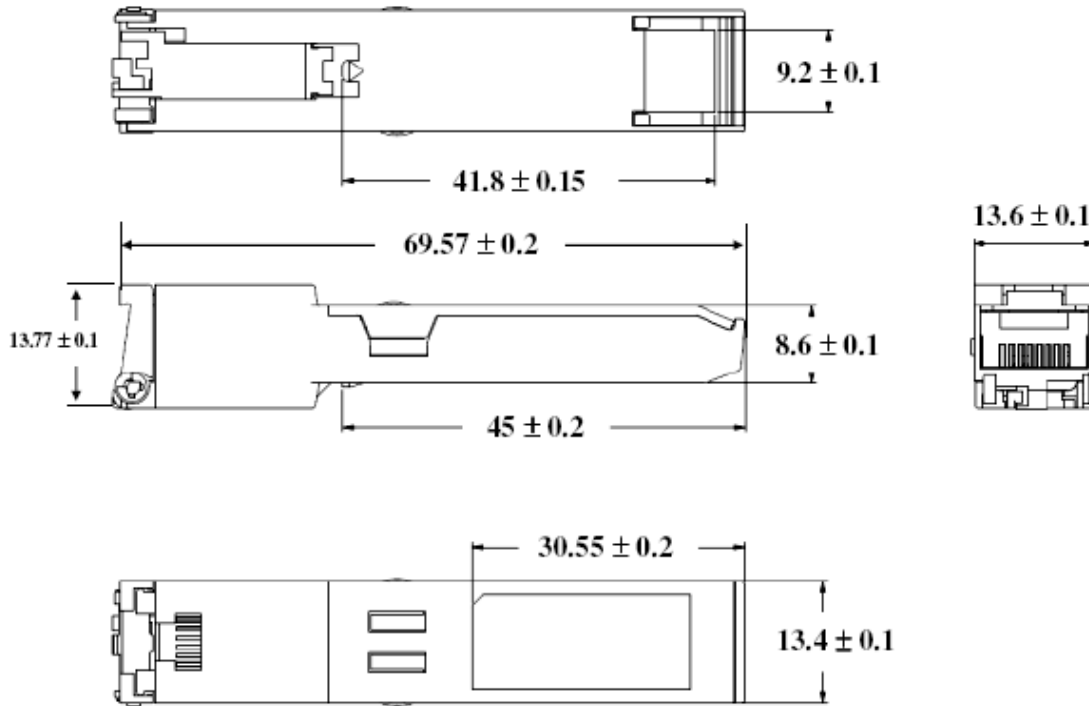
**Suggested Power Coupling**

### Serial Communication Protocol

OPTOWAY SPE-710XX-XG support the 2-wire serial communication protocol defined in the SFP MSA. These SFP use a 128 byte EEPROM with an address of A0H. The physical layer IC can also be accessed via the 2-wire serial bus at address ACH.

PACKAGE DIAGRAM

Units in mm



ALL DIMENSIONS ARE  $\pm 0.2$ mm UNLESS OTHERWISE SPECIFIED

UNIT: mm

**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.

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**REVISION HISTORY**

Version	Subject	Release Date
1.0	Initial datasheet	2019/1/16