

## 10Gb/s 80km 1550nm APD SFP+ Optical Transceiver

### GTR2SP1Z

#### Features

- Hot Pluggable SFP+ MSA package
- SFF-8431, SFF-8432 compliant
- IEEE802.3ae 10Gbase-ZR/ZW compliant
- Up to 80km for G.652 SMF
- Multi rate 9.953Gb/s~10.5Gb/s
- Cooled 1550nm EML laser and APD receiver
- SFI high speed electrical interface
- 2-wire serial interface with Digital Diagnostic
- +3.3V power supply
- Power consumption less than 1.5W
- Operating case temperature: 0 to 70 °C
- Duplex LC Receptacle
- ROHs-6 compliant



#### Applications

- 10GBase-ZR/ZW Ethernet
- 10G Fiber Channel, etc

#### Description

GWORLD Opto's GTR2SP1Z 10G cooled 1550nm EML transceivers are designed for use in 10G Ethernet links and 10G Fiber Channel, etc, and it can support multi-rate from 9.953Gb/s to 10.5Gb/s. Digital diagnostics are available via 2-wire serial interface as specified in the SFF-8472.

The transceiver's designs are optimized for high performance and cost efficiency to provide customers the best solutions for Datacom and Telecom applications.

The transceiver is RoHS-6 compliant and lead-free per Directive 2002/95/EC.

#### Product Selection

### GTR2SP1Z

G: GWorld  
TR: Transceiver  
SP1: SFP+ Solution 1  
Z: 10G Base-ZR/ZW 80km

# 1 10Gb/s SFP+ electrical parameters

## 1.1 Absolute Maximum Ratings

The limit of the maximum value is shown as below Table 1. (If operating out the limit of the maximum value will cause permanent damage).

Table 1 10Gb/s SFP+ module limit the maximum value

Parameter	Symbol	Conditions	Min.	Max	Unit
Storage temperature (case)	T <sub>stg</sub>	—	-40	+85	°C
Operating case temperature	T <sub>op</sub>	—	-5	+70	°C
Relative humidity	RH	0	—	85	%
Damage Threshold for Receiver	P <sub>max</sub>	—	—	+2.0	dBm
Power Supply	V <sub>cc</sub> 3.3V	—	-0.5	+4.0	V
	V <sub>cc</sub> 5.0V	—	—	—	V
ESD Sensitivity on module and all host pins	HBM	Human Body model R=1.5K, C=100pF	—	2000	V

## 1.2 Recommended operating conditions

The recommended working conditions are shown as below Table 2.

Table 2 10Gb/s SFP+ recommended working conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Operating Case Temperature	T <sub>c</sub>	0		+70	°C
Supply voltage	V <sub>cc</sub> 3.3V	+3.15	+3.3	+3.45	V
	V <sub>cc</sub> 5.0V	-	—	—	V
Supply Current	I <sub>cc</sub> 3.3V	—	—	450	mA
	I <sub>cc</sub> 5.0V	—	—	—	mA
Power dissipation	P	—	—	1.5	W
Link Distance	L	—	—	80km	G.652 SMF

# 2 10Gb/s SFP+ Specifications

## 2.1 Optical Specifications

Table 3 10Gb/s SFP+ Optical Specifications (transmission distance 80km)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
<b>Transmitter</b>						
Center Wavelength	λ <sub>c</sub>		1530		1565	nm
Signal speed(nominal)	f <sub>D</sub>	CDR lock	9.953	10.3125	10.5	Gbps
Average Optical Output Power	P <sub>out</sub>		0	—	5.0	dBm
Average Optical Output Power of TX_DIS Transmitter	P <sub>off</sub>	TX_DIS=H	—	—	-30	dBm
Optical Eye Mask		10.3125Gb/s	Compliant	with	IEEE	

		802.3-2008				
Extinction Ratio	$E_R$		4.5	—	—	dB
Side Mode Suppression Ratio	SMSR		30			dB
Dispersion Penalty	DP	80km SMF	—	—	3	dB
Relative Intensity Noise	RIN	Mod off	—	—	-130	dB/Hz
Optical Return Loss Tolerance	ORLT		—	—	21	dB
<b>Receiver</b>						
Center Wavelength Range	$\lambda_c$		1260	—	1600	nm
Receiver Sensitivity	$P_{sen}$		—	—	-24	dBm
Stressed Receiver Sensitivity	$P_{sen\_str}$				-21	dBm
Receiver Overload	$P_{ov}$		-7	—	—	dBm
Receiver Reflectance	Ref		—	—	-26	dB
LOS Assert	LOS <sub>ass</sub>		-32	—	—	dBm
LOS Deassert	LOS <sub>de-ass</sub>		—	—	-25	dBm
LOS Hysteresis			0.5	—	4	dB

Note1. Measured with PRBS 2<sup>31</sup>-1 @ 10.3125Gb/s

## 2.2 Electrical specifications

Table 4 10Gb/s SFP+ Electrical Interface Specifications

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
<b>Transmitter</b>						
Differential Data Input Amplitude	$V_{in-diff}$		120	—	820	mVpp
Input Impedance	$Z_{diff}$		85	100	115	ohm
Tx_Fault	Normal Operation	$V_{OL}$	0	—	0.8	V
	Transmitter Fault	$V_{OH}$	2.0	—	$V_{cc}+0.3$	V
Tx_Disable	Normal Operation	$V_{IL}$	0	—	0.8	V
	Laser Disable	$V_{IH}$	2.0	—	$V_{cc}+0.3$	V
<b>Receiver</b>						
Differential Data Output amplitude	$V_{out-diff}$		340	650	800	mVpp
Output Impedance	$Z_{diff}$		80	100	120	ohm
Rx_LOS	Normal Operation	$V_{OL}$	0	—	0.8	V
	Lose Signal	$V_{OH}$	2.0	—	$V_{cc}+0.3$	V

### 3 10Gb/s SFP+ Function Diagram

#### 3.1 Internal reference structure

The internal structure of 10Gb/s SFP+ shown as Figure 1.

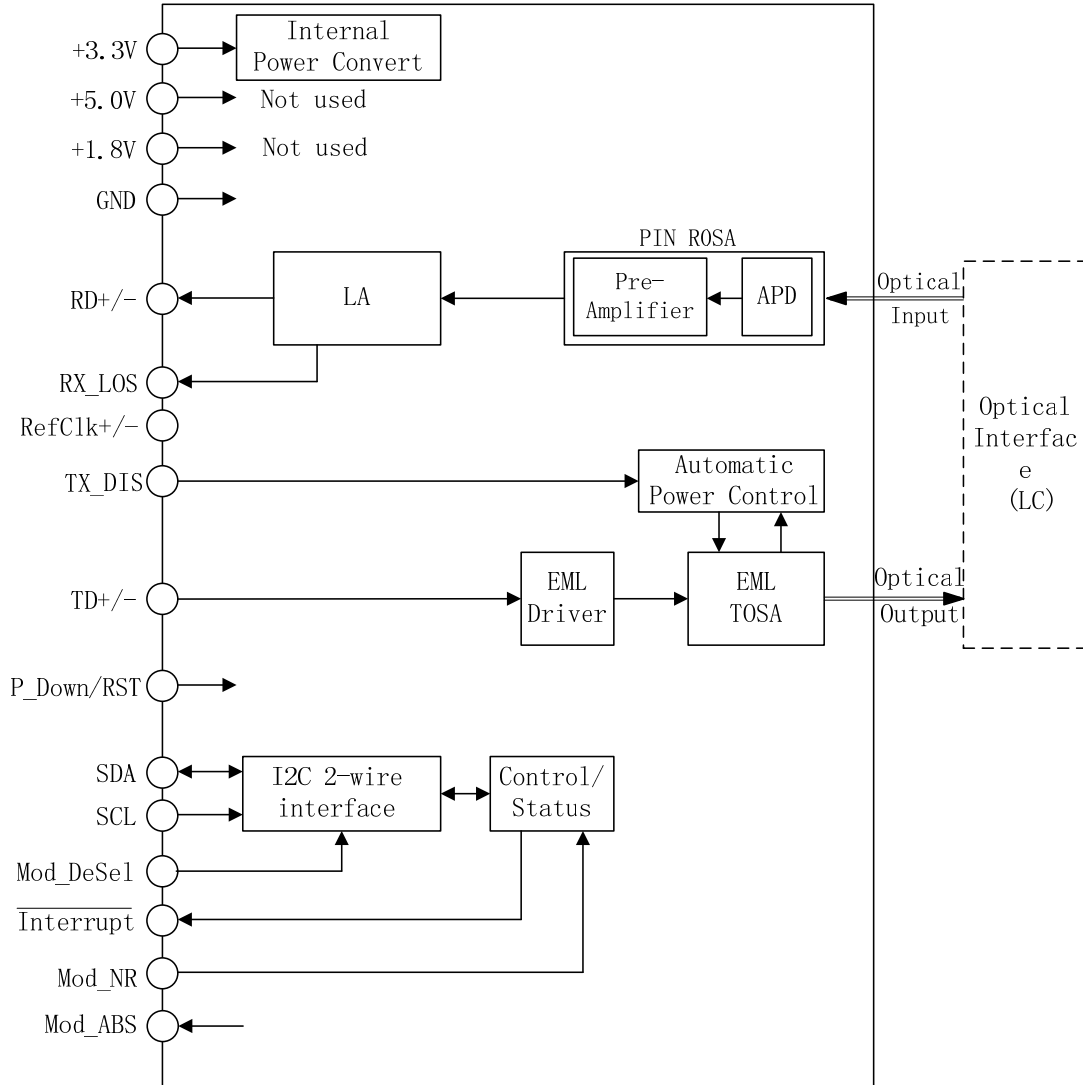


Figure 1. 80km 10Gb/s SFP+ internal structure

### 3.2 Recommended Interface Circuit

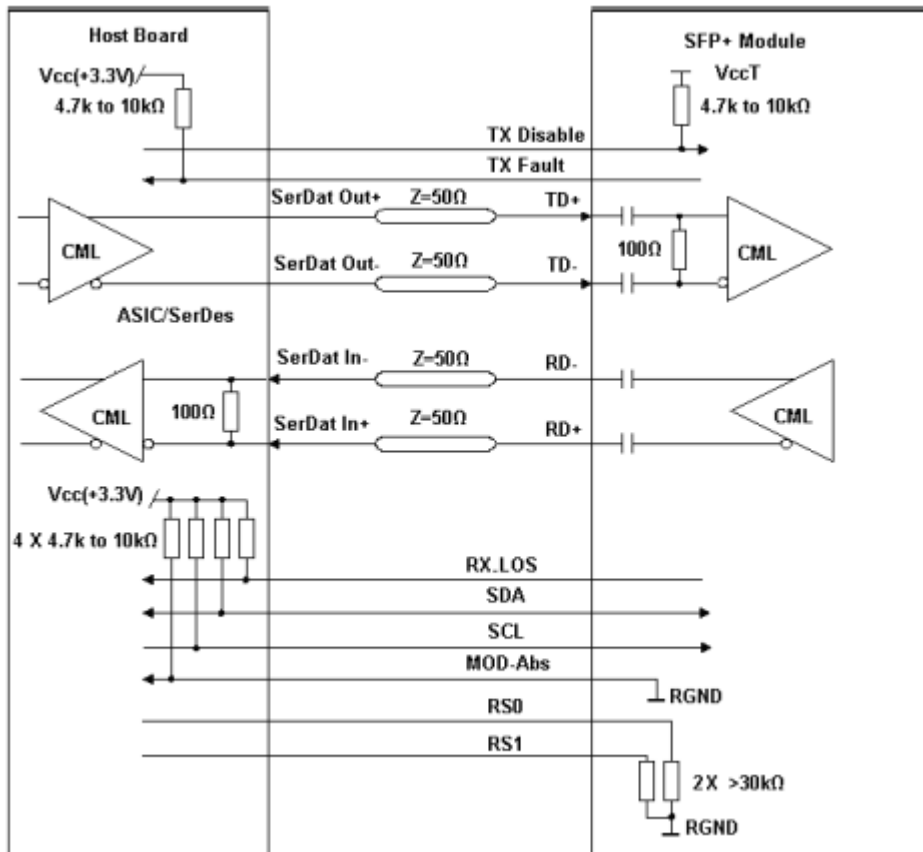


Figure 2. Recommended Interface Circuit

### 3.3 Pin layout

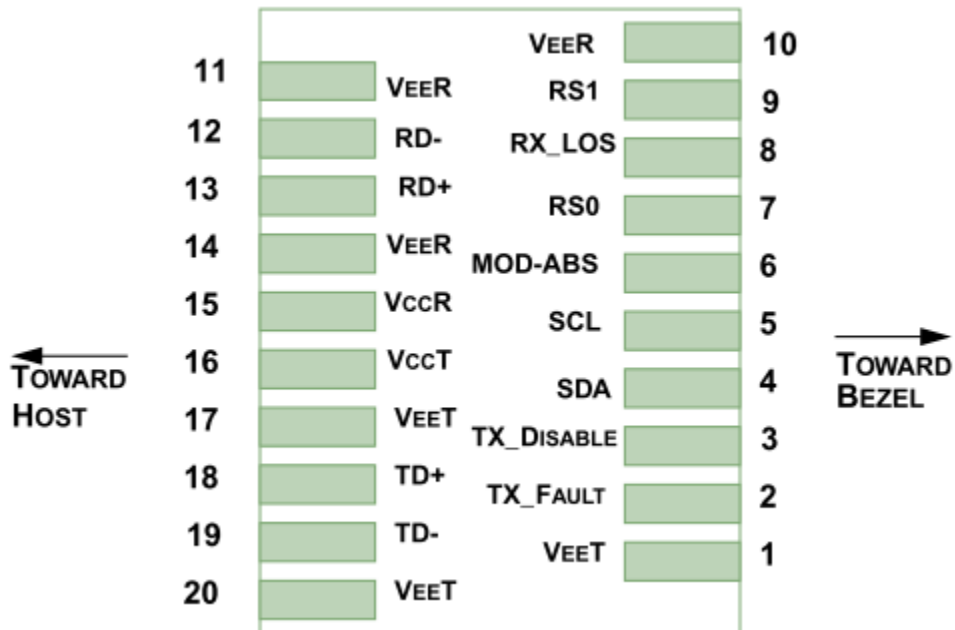


Figure 3. Host PCB SFP+ Pinout Top View

### 3.4 Pin definition

Table 5 10Gb/s SFP+ Pin Definition(first raw)

PIN	Name	Logic	Description
1	V <sub>EE</sub> T	GND	Module Transmitter Ground <sup>1</sup>
2	TX_FAULT	LVTTTL-O	Module Transmitter Fault <sup>2</sup>
3	TX_DISABLE	LVTTTL-I	Transmitter Disable; Turns off transmitter laser output <sup>3</sup>
4	SDL	LVTTTL-I/O	2-Wire Serial Interface Data Line (MOD-DEF2)
5	SCL	LVTTTL-I/O	2-Wire Serial Interface Clock (MOD-DEF1)
6	MOD_ABS		Module Absent, connected to V <sub>EE</sub> T or V <sub>EE</sub> R in the module <sup>2</sup>
7	RS0	LVTTTL-I	Rate Select 0, NOT implement <sup>4</sup>
8	RX_LOS	LVTTTL-O	Receiver Loss of Signal Indication (in FC designated as RX_LOS, in SONET designated as LOS, and in Ethernet designated as NOT Signal Detect) <sup>2</sup>
9	RS1	LVTTTL-I	Rate Select 1, NOT implement <sup>4</sup>
10	V <sub>EE</sub> R	GND	Module Receiver Ground <sup>1</sup>

Table 6 10Gb/s SFP+ Pin Definition(second raw)

PIN	Name	Logic	Description
11	V <sub>EE</sub> R	GND	Module Receiver Ground <sup>1</sup>
12	RD-	CML-O	Receiver Inverted Data Output
13	RD+	CML-O	Receiver Non-Inverted Data Output
14	V <sub>EE</sub> R	LVTTTL-O	Module Receiver Ground <sup>1</sup>
15	V <sub>CC</sub> R	Power	Module Receiver 3.3 V Supply
16	V <sub>CC</sub> T	Power	Module Transmitter 3.3 V Supply
17	V <sub>EE</sub> T	GND	Module Transmitter Ground <sup>1</sup>
18	TD+	CML-I	Transmitter Non-Inverted Data Input
19	TD-	CML-I	Transmitter Inverted Data Input
20	V <sub>EE</sub> T	GND	Module Transmitter Ground <sup>1</sup>

Note1: Module ground pins GND are isolated from the module case and chassis ground within the module.

Note2: Shall be pulled up with 4.7~10kohm to a voltage between 3.15V and 3.45V on the host board.

Note3: The pin is pulled up to V<sub>CC</sub>T with a 4.7K-10KΩ resistor in the module

Note4: The pins are pulled low to V<sub>EE</sub>T with a >30kΩ resistor in the module.

The host board power supply should be well filtered shown in Figure 4, to meet the noise filtering requirements in most system and achieve SFP+ module specifications performance.

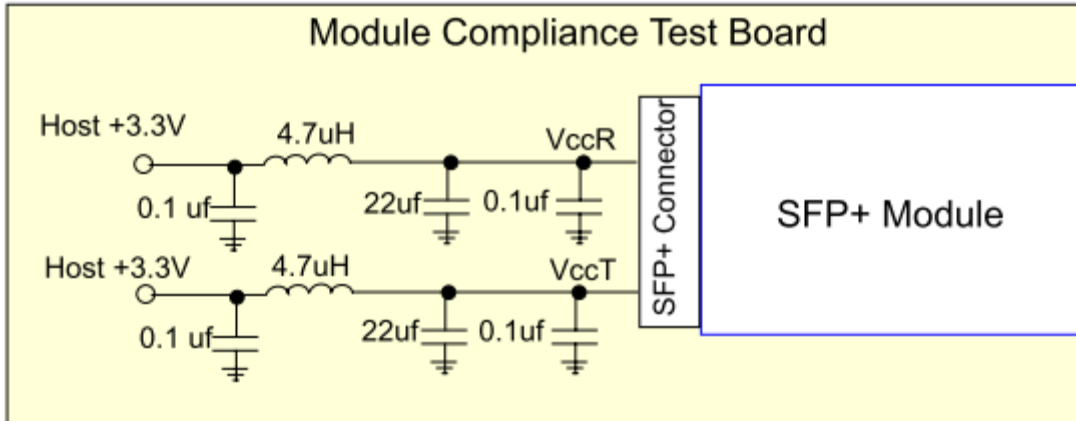


Figure 4. Example of Host Board Supply Filtering Network

### 4 10Gb/s SFP+ Mechanical Specifications

10Gb/s SFP+ mechanical dimensions should be compliant with SFF-8432. Detailed dimensions are shown in Figure 5.

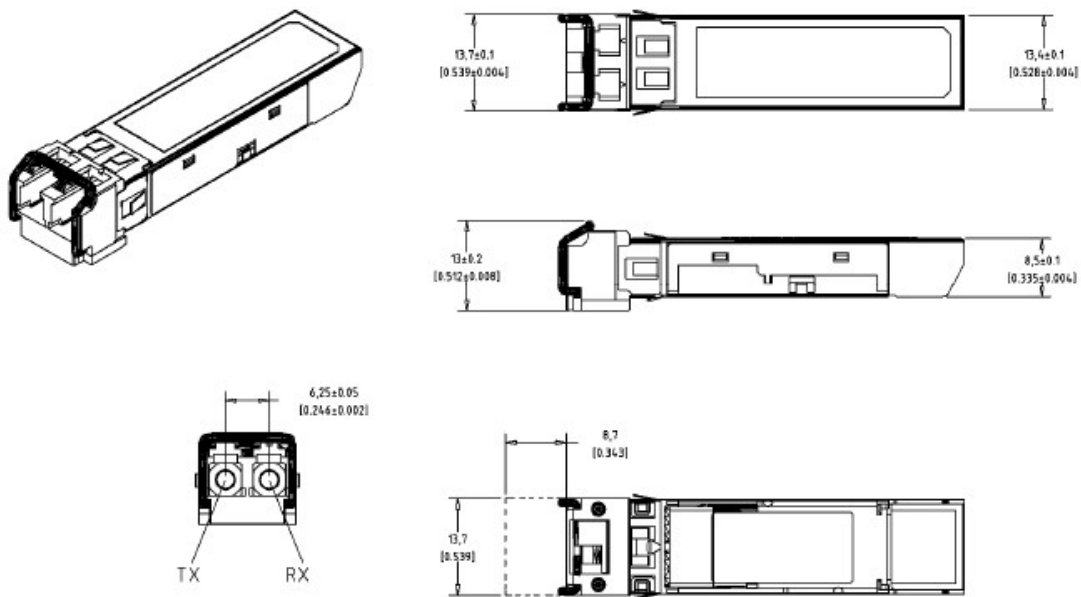


Figure 5. 10Gb/s SFP+ Mechanical Dimensions

The mechanical dimensions of the electrical connectors on the SFP+ module PCB are shown in Figure 6.

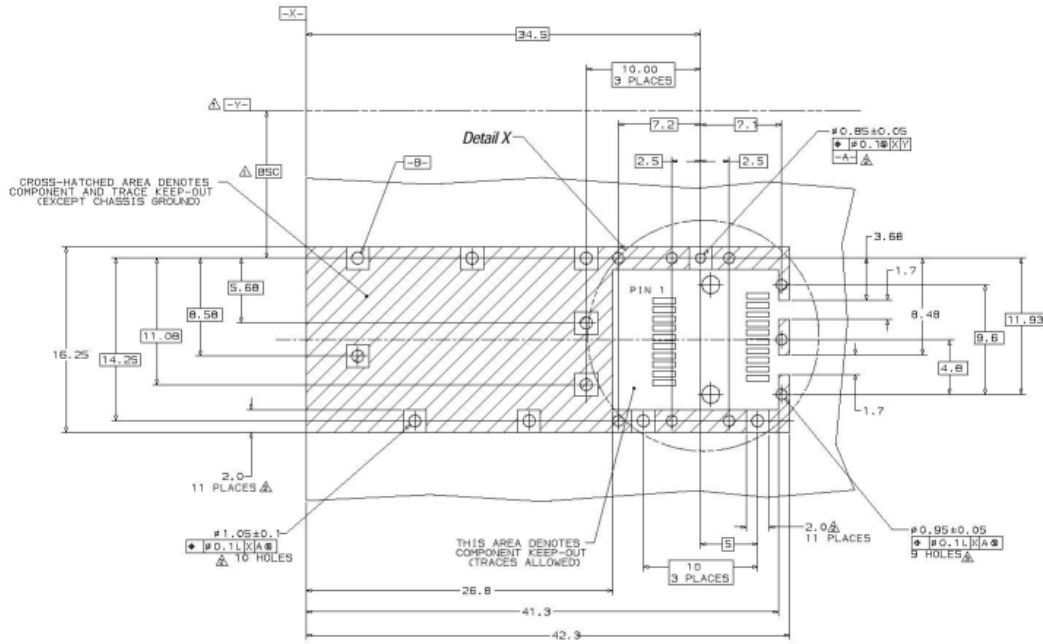


Figure 6 Mechanical Dimensions of Electrical Connectors on SFP+ module PCB

Table 7 specifies the fiber and fiber connector for 10Gb/s SFP+, for applications, a configuration of the optical connector should be supported.

Table 7 Fiber Connector Type

Parameter	Specification	Units
Weight	<250	g
Flatness	<0.05	mm
Roughness	<6.5	Ra
Connector	Straight LC/PC	



## 5 Management Interface

GWorld GTR2SP1Z SFP+ transceivers support the 2-wire serial communication protocol as defined in the SFP MSA . It is very closely related to the E<sup>2</sup>PROM defined in the GBIC standard, with the same electrical specifications.

The standard SFP serial ID provides access to identification information that describes the transceiver's capabilities, standard interfaces, manufacturer, and other information.

Additionally, GWorld SFP+ transceivers provide a enhanced digital diagnostic monitoring interface, which allows real-time access to device operating parameters such as transceiver temperature, laser bias current, transmitted optical power, received optical power and transceiver supply voltage. It also defines a sophisticated system of alarm and warning flags, which alerts end-users when particular operating parameters are outside of a factory set normal range.

The SFP MSA defines a 256-byte memory map in E<sup>2</sup>PROM that is accessible over a 2-wire serial interface at the 8 bit address 1010000X (A0h). The digital diagnostic monitoring interface makes use of the 8 bit address 1010001X (A2h), so the originally defined serial ID memory map remains unchanged. The interface is identical to, and is thus fully backward compatible with both the GBIC Specification and the SFP Multi Source Agreement.

The operating and diagnostics information is monitored and reported by a Digital Diagnostics Transceiver Controller inside the transceiver, which is accessed through a 2-wire serial interface. When the serial protocol is activated, the serial clock signal (SCL, Mod Def 1) is generated by the host. The positive edge clocks data into the SFP transceiver into those segments of the E<sup>2</sup>PROM that are not write-protected. The negative edge clocks data from the SFP transceiver. The serial data signal (SDA, Mod Def 2) is bi-directional for serial data transfer. The host uses SDA in conjunction with SCL to mark the start and end of serial protocol activation. The memories are organized as a series of 8-bit data words that can be addressed individually or sequentially.

## 6 Ordering Information

Table 8 Order Information

Part No.	Application	Data Rate	Transmitter	Receiver	Fiber Type	Connector
GTR2SP1Z	10GBase-ZR/ZW Ethernet 10G FC	10.3125Gb/s 10.5Gb/s	1550nm EML Laser	APD	SMF	LC/PC
GR2SP1Z	10GBase-ZR/ZW Ethernet 10G FC	10.3125Gb/s 10.5Gb/s	NC	APD	SMF	LC/PC
GT2SP1Z	10GBase-ZR/ZW Ethernet 10G FC	10.3125Gb/s 10.5Gb/s	1550nm EML Laser	NC	SMF	LC/PC

## 7 Revision History

Rev.	Date	Modification	Note
V1.0	Aug 10 <sup>th</sup> , 2013		New
V2.0	Dec 15 <sup>th</sup> , 2015	Add RX and TX module in ordering information	Modified

## Warnings

**Handling Precautions:** This device is susceptible to damage as a result of electrostatic discharge (ESD). A static free environment is highly recommended. Follow guidelines according to proper ESD procedures.

**Laser Safety:** Radiation emitted by laser devices can be dangerous to human eyes. Avoid eye exposure to direct or indirect radiation.

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