

## 10Gb/s 40km PIN SFP+ SONET Optical Transceiver

### GTR2SPP1E

#### Features

- Hot Pluggable SFP+ MSA package
- SFF-8431, SFF-8432 compliant
- SONET OC192/SDH STM64 and IEEE802.3ae 10Gbase-ER/EW compliant
- Up to 40km for G.652 SMF
- Multi rate 9.953Gb/s~11.1Gb/s
- Cooled 1550nm EML laser and PIN receiver
- With built in dual CDR
- 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-ER/EW Ethernet
- 10G SDH/WDM
- 10G Fiber Channel, etc

#### Description

GWorld Opto's GTR2SPP1E 10G cooled 1550nm EML transceivers are designed for use in 10G Ethernet links, 10G SDH/WDM and 10G Fiber Channel, etc, and it can support multi-rate from 9.953Gb/s to 11.1Gb/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

### GTR2SPP1E

G: GWorld  
 TR: Transceiver  
 2: 10Gb/s  
 SPP1: SFP+ SONET Solution 1  
 E: 10G Base-ER/EW 40km

## 1 10Gb/s SFP+ SONET 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+ SONET 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+ SONET 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	—	—	420	mA
	I <sub>cc</sub> 5.0V	—	—	—	mA
Power dissipation	P	—	—	1.5	W
Link Distance	L	—	—	40km	G.652 SMF

## 2 10Gb/s SFP+ SONET Specifications

### 2.1 Optical Specifications

Table 3 10Gb/s SFP+ SONET Optical Specifications (transmission distance 40km)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
<b>Transmitter</b>						
Center Wavelength	λ <sub>c</sub>		1530	1550	1565	nm
Signal speed(nominal)	f <sub>D</sub>	CDR lock	9.953	10.3125	11.1	Gbps
Average Optical Output Power	P <sub>out</sub>		-1	—	+2	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	$E_R$		8.2	—	—	dB	
Side Mode Suppression Ratio	SMSR		30			dB	
Dispersion Penalty	DP	40km SMF	—	—	2	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	$P_{sen}$		—	—	-16	dBm	
Stressed Receiver Sensitivity	$P_{sen\_str}$				-14	dBm	
Receiver Overload	$P_{ov}$		-7	—	—	dBm	
Receiver Reflectance	Ref		—	—	-26	dB	
LOS Assert	LOS <sub>ass</sub>		-30	—	—	dBm	
LOS Deassert	LOS <sub>de-ass</sub>		—	—	-18	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+ SONET 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+ SONET Function Diagram

#### 3.1 Internal reference structure

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

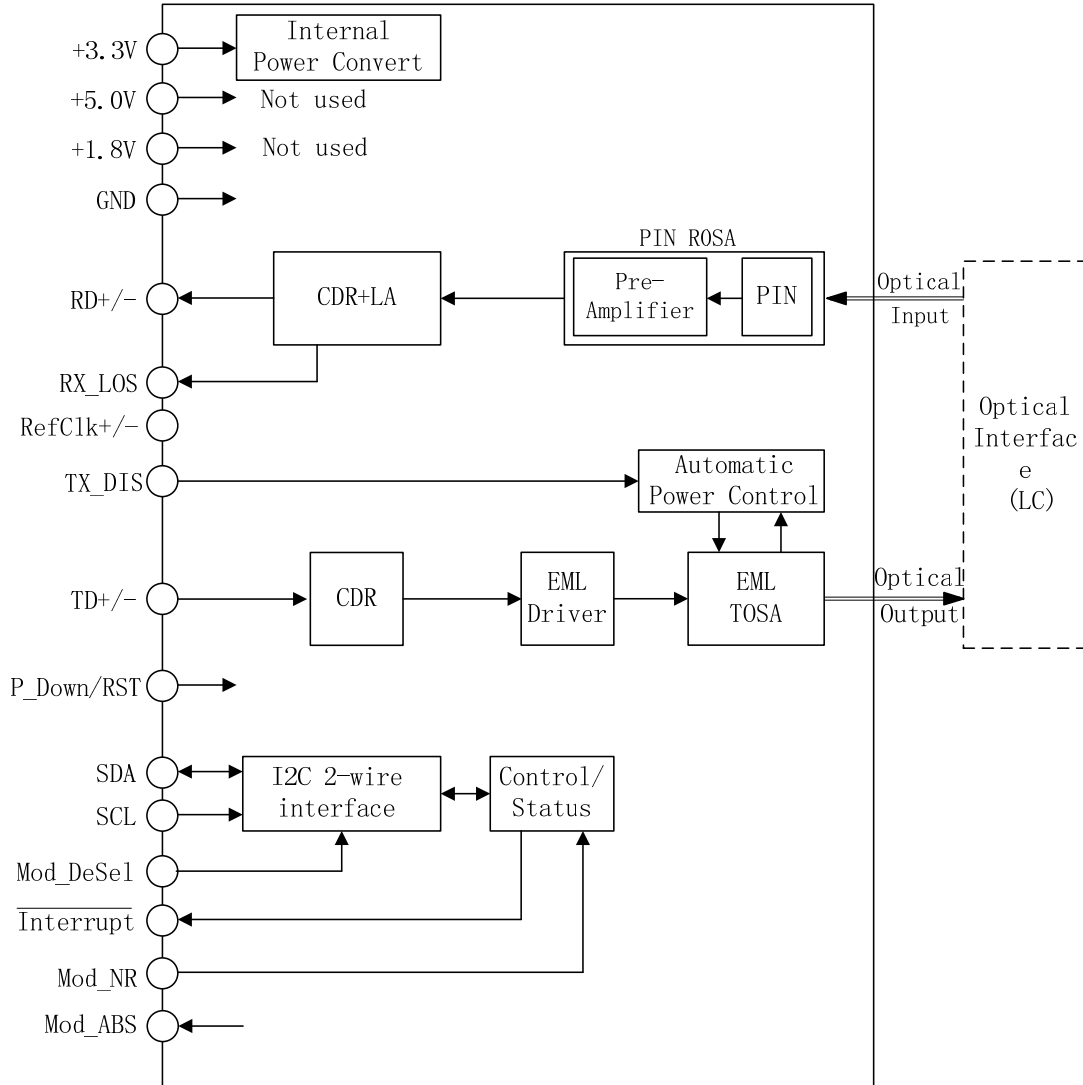


Figure 1. 40km 10Gb/s SFP+ SONET internal structure

### 3.2 Recommended Interface Circuit

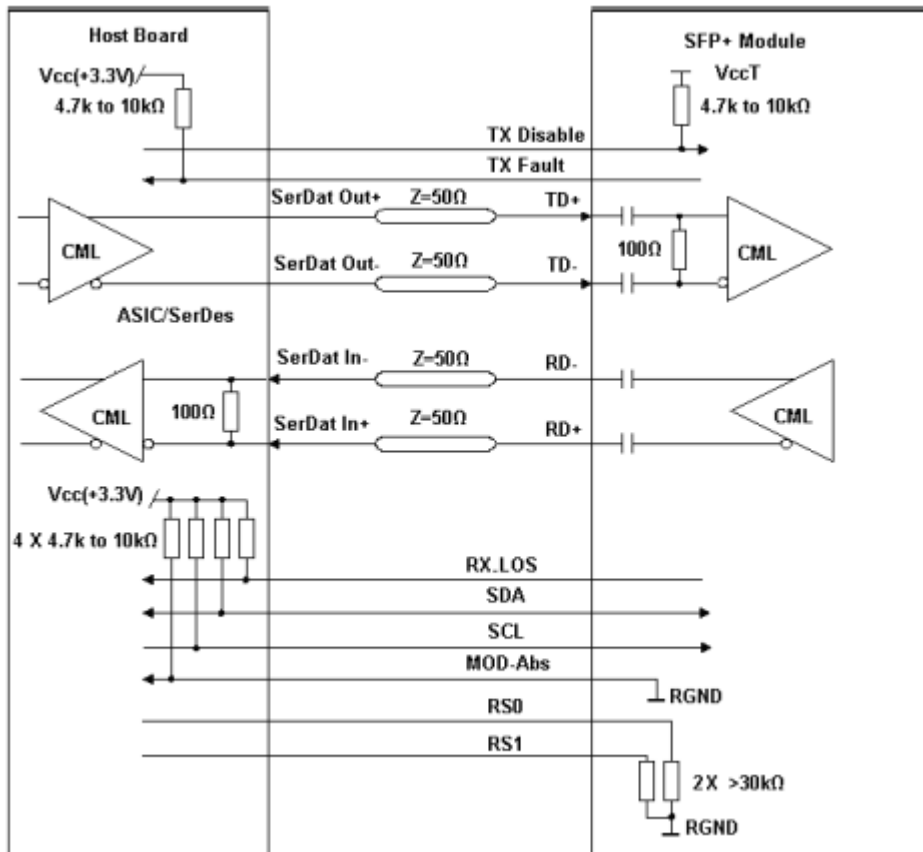


Figure 2. Recommended Interface Circuit

### 3.3 Pin layout

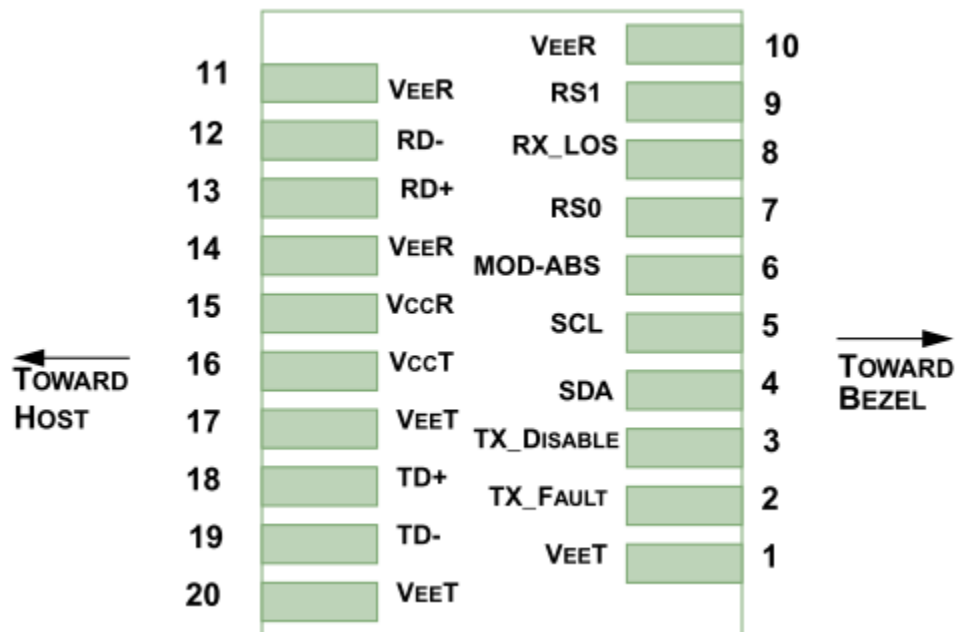


Figure 3. Host PCB SFP+ SONET Pinout Top View

### 3.4 Pin definition

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

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+ SONET Pin Definition(second row)

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+ SONET module specifications performance.

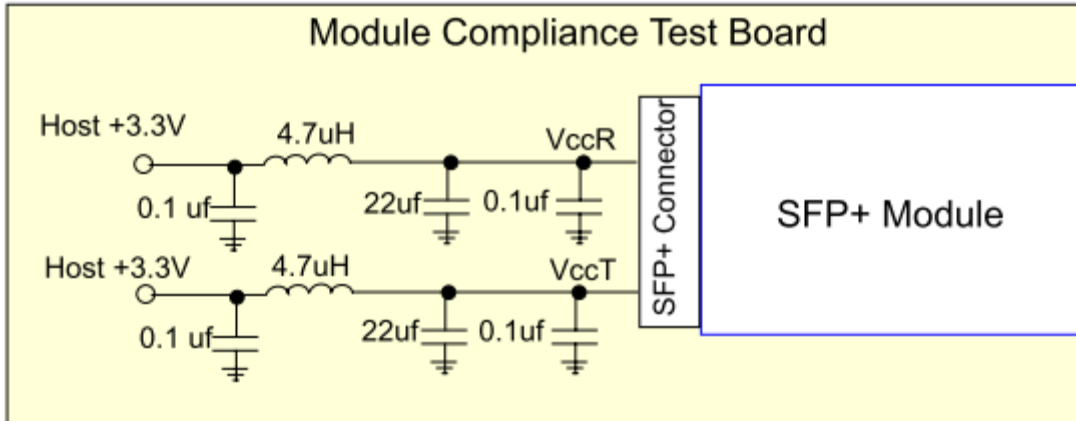


Figure 4. Example of Host Board Supply Filtering Network

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

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

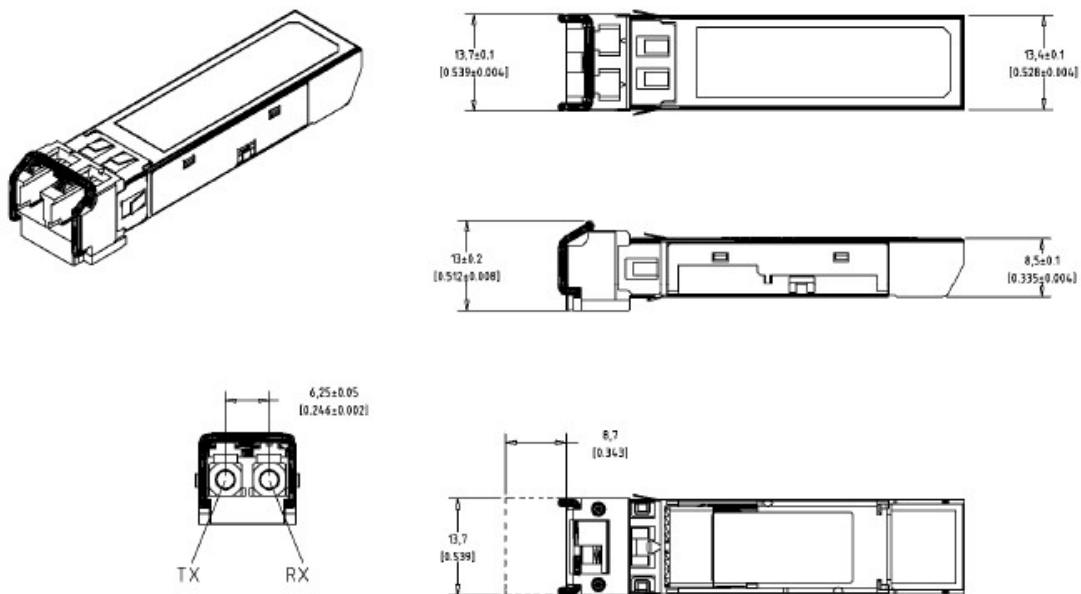


Figure 5. 10Gb/s SFP+ SONET Mechanical Dimensions

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

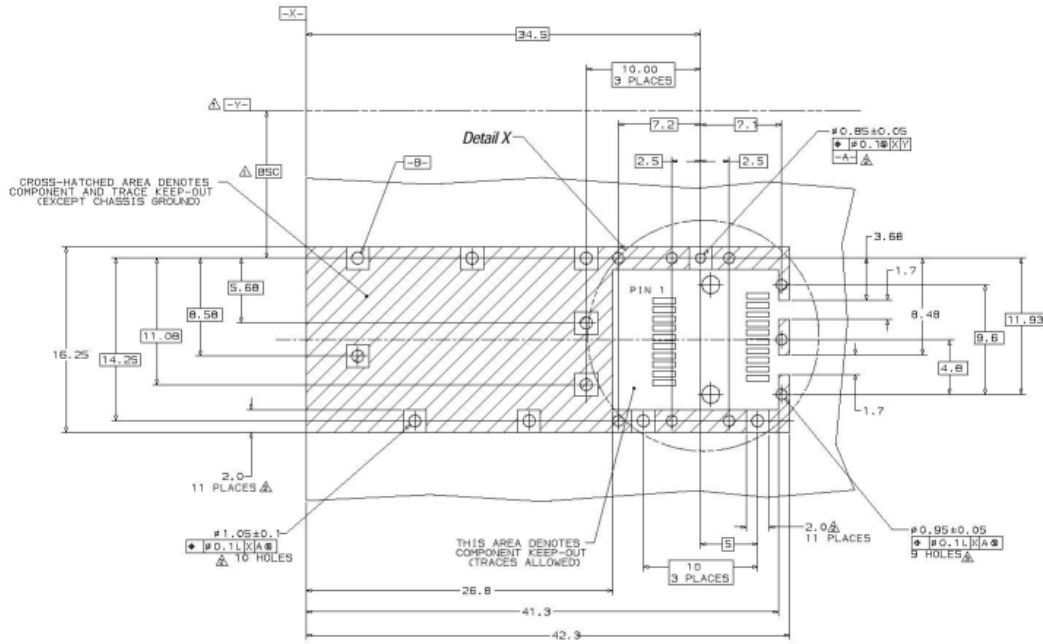


Figure 6 Mechanical Dimensions of Electrical Connectors on SFP+ SONET module PCB

Table 7 specifies the fiber and fiber connector for 10Gb/s SFP+ SONET, 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 GTR2SPP1E SFP+ SONET 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+ SONET 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
GTR2SPP1E	10GBase-ER/EW Ethernet 10G SDH/WDM 10G FC	10.3125Gb/s ~11.1Gb/s	1550nm EML Laser	PIN	SMF	LC/PC

## 7 Revision History

Rev.	Date	Modification	Note
V1.0	Aug 10 <sup>th</sup> , 2014		New

## 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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