
2.5Gb/s 1310nm 10km PIN SFP Optical Transceiver

GTR1SP2-L10

Features

- Hot Pluggable SFP MSA package
- SFF-8472 and ITU-T G.957 compliant
- Telcordia GR-468-CORE compliant
- Up to 10km for 9/125μm SMF
- Multi-rate operation, optimized at 2.5Gb/s
- 1310nm DFB laser and PIN receiver
- SFI high speed electrical interface
- 2-wire serial interface with Digital Diagnostic
- +3.3V power supply
- Power consumption less than 1W
- Operating case temperature: -40 to 85 °C
- Duplex LC Receptacle
- ROHS-6 compliant



Applications

- SDH STM-16 and SONET OC-48 System
- 2G Fiber Channel, etc

Description

GWORLD Opto's GTR1SP2-L10 2.5G 1310nm DFB transceivers are designed for use in SDH STM-16 and SONET OC-48 System and 2G Fiber Channel, etc, and it can support multi-rate, optimized at 2.5Gb/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

GTR1SP2-L10

G: GWorld
TR: Transceiver
SP2: SFP 2.5Gb/s
L10: 10km

1 2.5Gb/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 2.5Gb/s SFP module limit the maximum value

Parameter	Symbol	Conditions	Min.	Max	Unit
Storage temperature (case)	T _{stg}	—	-40	+85	°C
Operating case temperature	T _{op}	—	-40	+85	°C
Relative humidity	RH	—	5	95	%
Damage Threshold for Receiver	P _{max}	—	—	+2.0	dBm
Power Supply	V _{cc} 3.3V	—	-0.5	+3.6	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 2.5Gb/s SFP recommended working conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Operating Case Temperature	T _c	0		+70	°C
		-10		+80	°C
		-40		+85	°C
Supply voltage	V _{cc} 3.3V	+3.15	+3.3	+3.45	V
Supply Current	I _{cc} 3.3V	—	—	220	mA
Power dissipation	P	—	—	1.0	W
Link Distance	L	2	—	10km	SMF

2 2.5Gb/s SFP Specifications

2.1 Optical Specifications

Table 3 2.5Gb/s SFP Optical Specifications (transmission distance 10km)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Transmitter						
Center Wavelength	λ _c		1270	1310	1360	nm
Signal speed(nominal)	f _D			2.5	—	Gbps
Average Optical Output Power	P _{out}		-6	—	+1	dBm
Average launch power of OFF transmitter	P _{out-off}		—	—	-30	dBm
Optical Eye Mask		2.5Gb/s	ITU-T G.957 Compliant			

Extinction Ratio	E_R		8.5	—	—	dB
Spectral Width (RMS)	$\sigma \lambda$				1	nm
Side mode Suppression Ratio	SMSR		30			dB
Receiver						
Center Wavelength Range	λ_c		1270		1610	nm
Average Receiver Sensitivity	P_{sen}		—	—	-18	dBm
Receiver Overload	P_{ov}		-3	—	—	dBm
LOS Assert	LOS _{ass}		-30	—	—	dBm
LOS Deassert	LOS _{de-ass}		—	—	-19	dBm
LOS Hysteresis			0.5	—	6	dB

Note1. Measured with PRBS $2^{31}-1$ @ 2.5Gb/s

2.2 Electrical specifications

Table 4 2.5Gb/s SFP Electrical Interface Specifications

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Transmitter						
Differential Data Input Amplitude	$V_{in-diff}$		300	—	1800	mVpp
Input Differential Impedance	Z_{diff}		—	100	—	ohm
Tx_Fault	L	V_{OL}	0	—	0.5	V
	H	V_{OH}	2.0	—	$V_{cc}+0.3$	V
Tx_Disable	L	V_{IL}	0	—	0.8	V
	H	V_{IH}	2.0	—	$V_{cc}+0.3$	V
Receiver						
Differential Data Output amplitude	$V_{out-diff}$		400	—	1000	mVpp
Output Differential Impedance	Z_{diff}		—	100	—	ohm
Rx_LOS	L	V_{OL}	0	—	0.8	V
	H	V_{OH}	2.0	—	$V_{cc}+0.3$	V

3 2.5Gb/s SFP Function Diagram

3.1 Internal reference structure

The internal structure of 2.5Gb/s SFP shown as Figure 1.

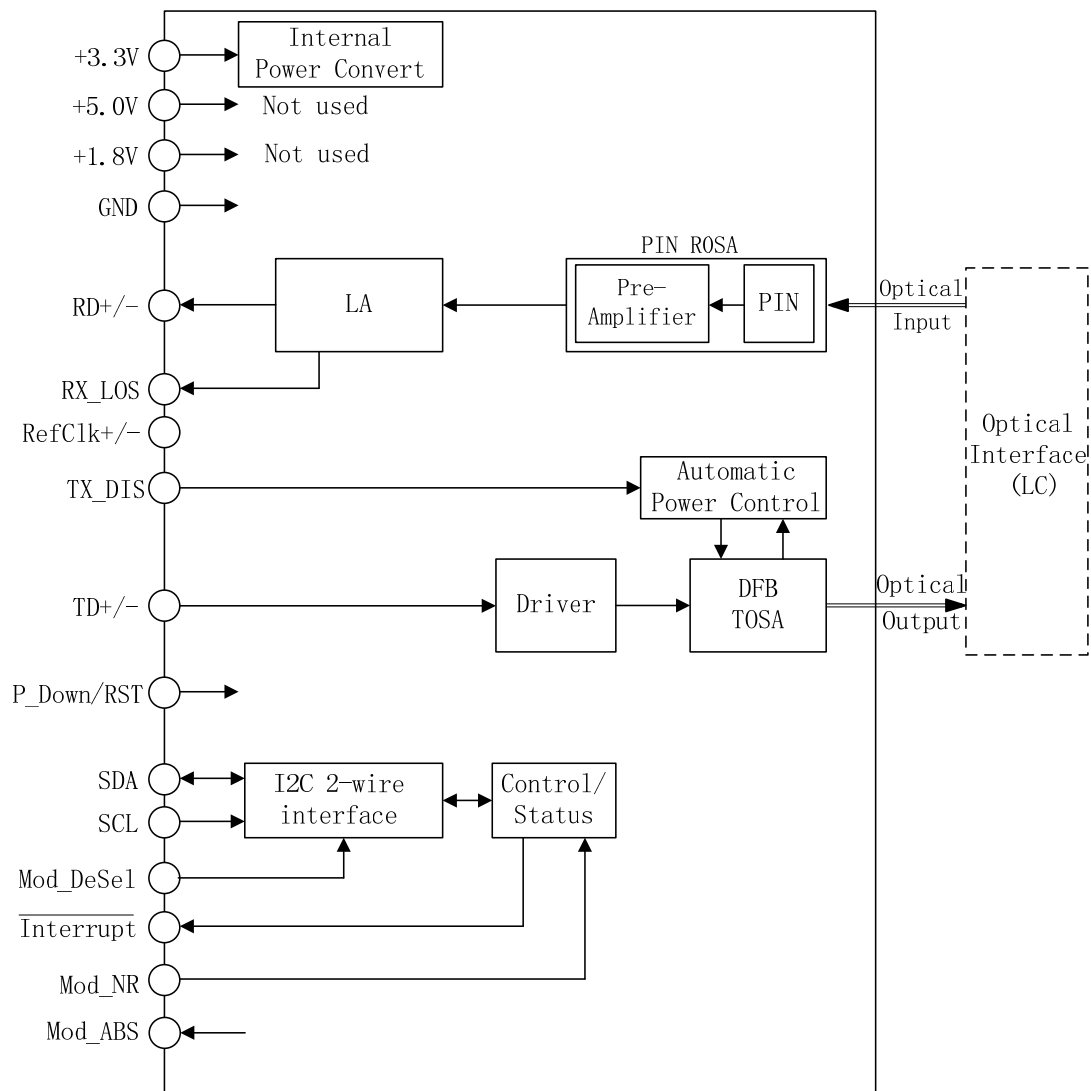


Figure 1. 2.5Gb/s SFP internal structure

The schematic diagram illustrates the internal circuitry of an SFP module. It shows the following components and connections:

- Controller:** Connected to the **Interface IC** and the **EEPROM**.
- Interface IC:** Receives **TX Disable** and **TX Fault** signals. It drives the **TD+** and **TD-** signals through $Z=50R$ terminators. It also receives **RD+** and **RD-** signals through $Z=50R$ terminators and a $100R$ resistor. It is connected to the **RX_Los** signal through a network of four $4.7k$ to $10k$ resistors.
- Filter network:** Connected to the **Interface IC** and the **SFP Module** power supply.
- SFP Module:** Includes the **Laser Driver** and **Post Amplifier**. The **Laser Driver** receives **TD+** and **TD-** signals through $100R$ resistors and is powered by **Vcc_T** and **Vcc_R**. The **Post Amplifier** receives **RD+** and **RD-** signals through capacitors and is powered by **Vcc_R**. Both drivers are connected to the **EEPROM** and the **Mod_def** signals.
- EEPROM:** Stores module configuration data, including **Mod_def 1**, **Mod_def 2**, and **Mod_def 0**.
- Power Supply:** The module is powered by **+3.3V** and **Vcc_T**. A $4.7k$ to $10k$ resistor is connected between **+3.3V** and the **Interface IC**.

Figure 2. Recommended Interface Circuit

The diagram shows two vertical columns of pin headers. The left column is labeled 'Top of Board' and the right column is labeled 'Bottom of Board (as viewed thru top of board)'. Each pin is represented by a number and a label in a box.

Pin Number	Label
20	VeeT
19	TD-
18	TD+
17	VeeT
16	VccT
15	VccR
14	VeeR
13	RD+
12	RD-
11	VeeR
1	VeeT
2	TxFault
3	Tx Disable
4	MOD-DEF(2)
5	MOD-DEF(1)
6	MOD-DEF(0)
7	Rate Select
8	LOS
9	VeeR
10	VeeR

Figure 3. SFP Transceiver Electrical Pad Layout

3.4 Pin definition

Table 5 2.5Gb/s SFP Pin Definition

PIN	Name	Description
1	V _{EE} T	Module Transmitter Ground
2	TX_FAULT	Tx fault indication, Open Collector Output, active “H” ¹
3	TX_DISABLE	LVTTTL Input, internal pull-up, Tx disabled on “H” ²
4	MOD-DEF2	2 wire serial interface data input/output (SDA) ³
5	MOD-DEF1	2 wire serial interface clock input (SCL) ³
6	MOD-DEF0	Model present indication ³
7	Rate select	No connection
8	LOS	Rx loss of signal, Open Collector Output, active “H” ⁴
9	VeeR	Module Rx ground
10	VeeR	Module Rx ground
11	VeeR	Module Rx ground
12	RD-	Inverse received data out ⁵
13	RD+	Received data out ⁵
14	VeeR	Module Rx ground
15	VccR	Rx power supply
16	VccT	Tx power supply
17	VeeT	Tx ground
18	TD+	Transmit data in ⁶
19	TD-	Inverse transmit data in ⁶
20	VeeT	Tx ground

Note1: When high, this output indicates a laser fault of some kind. Low indicates normal operation. And should be pulled up with a 4.7 – 10KΩ resistor on the host board.

Note2: TX disable is an input that is used to shut down the transmitter optical output.

It is pulled up within the module with a 4.7 – 10KΩ resistor. Its states are:

Low (0 – 0.8V):	Transmitter on
(>0.8, < 2.0V):	Undefined
High (2.0 – 3.465V):	Transmitter Disabled
Open:	Transmitter Disabled

Note3: Mod-Def 0,1,2. These are the module definition pins. They should be pulled up with a 4.7K – 10KΩ resistor on the host board. The pull-up voltage shall be VccT or VccR (see Section IV for further details).

Mod-Def 0 is grounded by the module to indicate that the module is present

Mod-Def 1 is the clock line of two wire serial interface for serial ID

Mod-Def 2 is the data line of two wire serial interface for serial ID

Note4: When high, this output indicates loss of signal (LOS). Low indicates normal operation.

Note5: RD+/-: These are the differential receiver outputs. They are AC coupled 100Ω differential lines which should be terminated with 100Ω (differential) at the user SERDES. The AC coupling is done inside the module and is thus not required on

the host board.

Note6: TD+/-: These are the differential transmitter inputs. They are AC-coupled, differential lines with 100Ω differential termination inside the module. The AC coupling is done inside the module and is thus not required on the host board.

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.

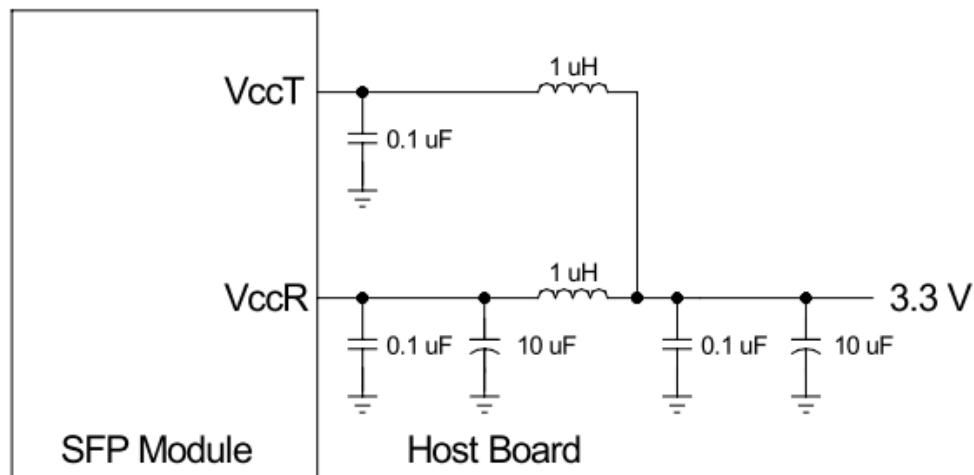


Figure 4. Example of Host Board Supply Filtering Network

4 2.5Gb/s SFP Mechanical Specifications

2.5Gb/s SFP mechanical dimensions should be compliant with SFF-8432. Detailed dimensions are shown in Figure 5.

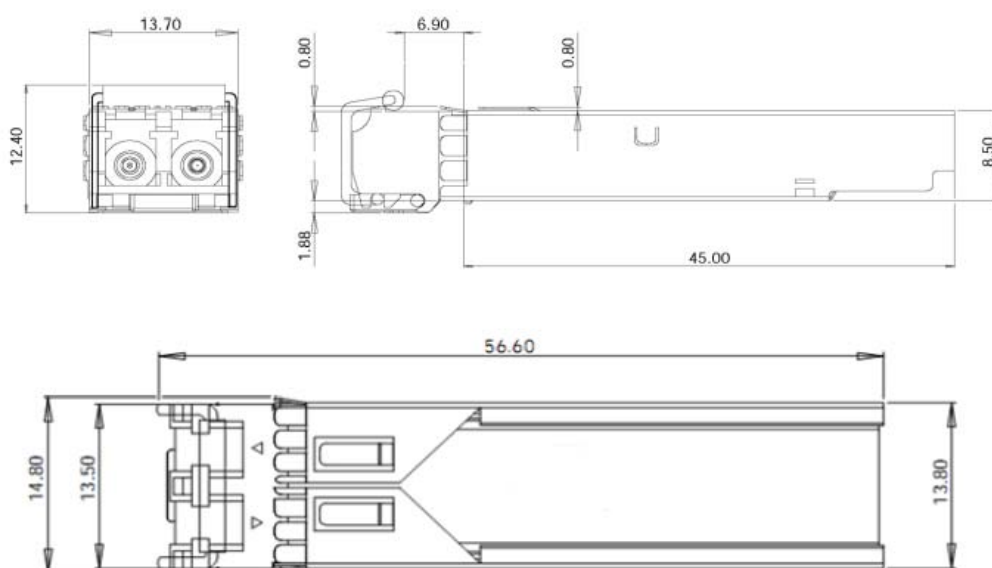


Figure 5. 2.5Gb/s SFP Mechanical Dimensions

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

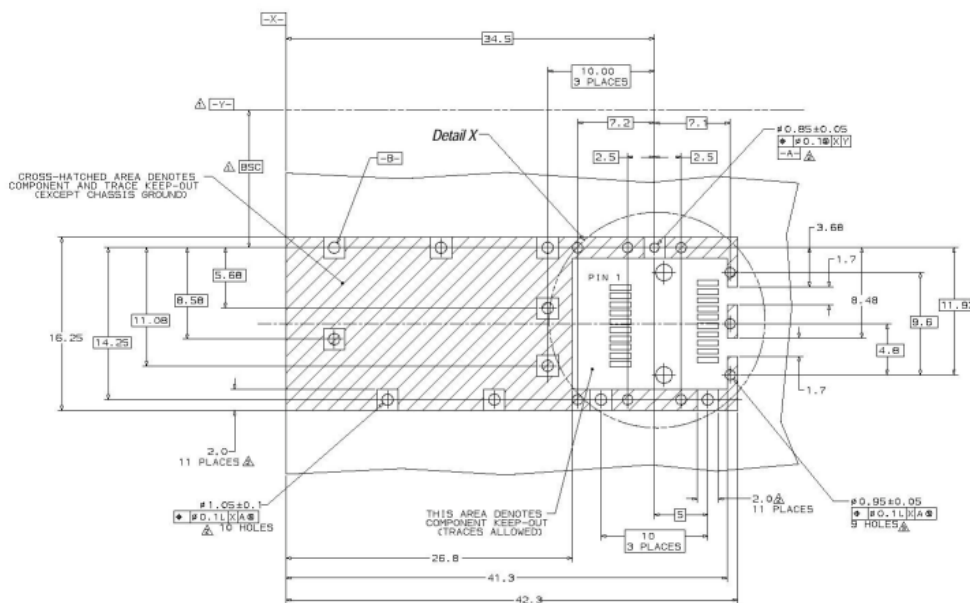


Figure 6 Mechanical Dimensions of Electrical Connectors on SFP module PCB

Table 6 specifies the fiber and fiber connector for 2.5Gb/s SFP, for applications, a configuration of the optical connector should be supported.

Table 6 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 GTR1SP2-L10 SFP transceivers support the 2-wire serial communication protocol as defined in the SFP MSA .

The serial ID information of the SFP modules and Digital Diagnostic Monitor parameters can be accessed through the I2C interface at address A0h and A2h. The memory is mapped in Table 8. Detailed ID information(A0h) is listed in Table 9. And the DDM specification(A2h) is described in Table 10. For more details of the memory map and byte definitions, please refer to the SFF-8472 (Rev 9.3, Aug. 2002), “Digital Diagnostic Monitoring Interface for Optical Transceivers”.

The DDM parameters have been internally calibrated.

Table 7 Digital Diagnostic Memory Map (Specific Data Field Descriptions)

2 wire address 1010000X (A0h)		2 wire address 1010001X (A2h)	
Address	Information	Address	Information
0~95	Serial ID Defined by SFP MSA (96 bytes)	0~55	Alarm and Warning Thresholds (56 bytes)
		56~95	Calibration Constants (40 bytes)
96~127	Vendor Specific (32 bytes)	96~119	Real Time Diagnostic Interface (24 bytes)
		120~127	Vender Specific (8 bytes)
128~255	Reserved,SFF8079 (128 bytes)	128~247	User Writable EEPROM (120 bytes)
		248~255	Vender Specific (8 bytes)

Table 8 EEPROM Serial ID Memory Contents (A0h)

Data Address	Size (Bytes)	Name of Field	Value(Hex)	Description of Field
BASE ID FIELDS				
0	1	Identifier	03	SFP
1	1	Ext. Identifier	04	MOD4
2	1	Connector	07	LC
3-10	8	Transceiver	0000000212000101	
11	1	Encoding	01	8B10B
12	1	BR, Nominal	0D	2.5Gbps
13	1	Reserved	00	
14	1	Length(9μm,km)	26	10km
15	1	Length (9μm)	FF	
16	1	Length (50μm)	00	
17	1	Length (62.5μm)	00	
18	1	Length (Copper)	00	
19	1	Reserved	00	
20-35	16	Vendor name		GWorld
36	1	Reserved	00	

37-39	3	Vendor OUI	000000	
40-55	16	Vendor PN		GTR1SP2-L10
56-59	4	Vendor rev	31 30 20 20	10
60-61	2	Wavelength	051E	1310nm
62	1	Reserved	00	
63	1	CC_BASE	XX	Check code for Base ID Fields
EXTENDED ID FIELDS				
64-65	2	Options	001A	Los, Tx_falt, Tx_diabie
66	1	BR, max	00	Upper bit rate margin, units of %
67	1	BR, min	00	Lower bit rate margin, units of %
68-83	16	Vendor SN	xx xx xx xx xx xx xx xx xx xx xx xx xx xx xx xx	Serial number(ASCII)
84-91	8	Date code	xx xx xx xx xx xx xx xx	Vendor's manufacturing date code (ASCII)
92	1	Diagnostic Monitoring Type	68	Digital diagnostics and internal calibration
93	1	Enhanced Options	80	Alarm/Warning flags implemented
94	1	SFF-8472 Compliance	01	
95	1	CC_EXT	xx	Check code for the Extended ID Fields
VENDOR SPECIFIC ID FIELDS				
96-127	32	Vendor Specific		Vendor Specific EEPROM
128-255	128	Reserved		Reserved for SFF-8079.

Note: The "xx" byte should be filled in according to practical case. For more information, please refer to the related document of SFF- 8472 Rev 9.3

Table 10 DDM Specification

Parameter	Range	Accuracy	Calibration
Temperature	-40 ~ 85 °C	±3°C	Internal
Voltage	3.0 ~ 3.6 V	±3%	Internal
Bias Current	0 ~ 100mA	±10%	Internal
TX Power	-8 ~ +3dBm	±3dBm	Internal
RX Power	-21 ~ 0dBm	±3dBm	Internal

6 Ordering Information

Table 11 Order Information

Part No.	Application	Data Rate	Transmitter	Receiver	Fiber Type	Connector	Note
GTR1SP2-L10-D	STM-16,OC-48, 2G FC, etc	2.5Gb/s	DFB laser	PIN	SMF	LC/PC	With DDM
GTR1SP2-L10-N	STM-16,OC-48, 2G FC, etc	2.5Gb/s	DFB laser	PIN	SMF	LC/PC	Without DDM

7 Revision History

Rev.	Date	Modification	Note
V1.0	Oct 10 th , 2012		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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