GPON OLT CLASS B+/C+/C++/C+++ Transceiver With Digital Diagnostic Function

Data Sheet

Features:

- Single fiber bi-directional data links asymmetric TX 2.488Gbps/RX 1.244Gbps application
- 1490nm DFB-LD Transmitter and 1310nm burst-mode APD-TIA Receiver
- Distance up to 20km
- Single 3.3V Power supply and TTL Logic Interface
- Digital burst RSSI function to monitor the input optical power level
- Single SC/UPC Connector Interface
- Hot Pluggable
- Compliant with MSA SFP Specification SFF-8472
- Compliant with ITU-T G.984
- Low EMI and Excellent ESD protection

Applications:

- FTTH
- Gigabit Passive Optical Networks

Product Description

The GPON OLT transceiver is small form factor pluggable module for serial optical data communications such as ITU-T G.984. It is with the SFP 20-pin connector to allow hot plug capability.

This module is designed for single mode fiber and operates at a nominal wavelength of 1490 nm.

The transmitter section uses a 1490nm DFB laser and is a class 1 laser compliant according to International Safety Standard IEC-60825.

Ordering information

Part No.	Data Rate	Laser	Fiber Type	Bail Color	Application	Optical Interface	Temp.	DDMI
TSP-GQ21-43DCS	TX 2.488Gbps RX 1.244Gbps	DFB	Single-mode	Blue	Class C+	SC/UPC	C	Yes
TSP-GQ21-43DIS	TX 2.488Gbps RX 1.244Gbps	DFB	Single-mode	Blue	Class C+	SC/UPC	I	Yes
TSP-GR21-43DCS	TX 2.488Gbps RX 1.244Gbps	DFB	Single-mode	Blue	Class C++	SC/UPC	C	Yes
TSP-GS21-43DCS	TX 2.488Gbps RX 1.244Gbps	DFB	Single-mode	Blue	Class C+++	SC/UPC	C	Yes
TSP-GB21-43DCS	TX 2.488Gbps RX 1.244Gbps	DFB	Single-mode	Blue	Class B+	SC/UPC	C	Yes
TSP-GB21-43DIS	TX 2.488Gbps RX 1.244Gbps	DFB	Single-mode	Blue	Class B+	SC/UPC	I	Yes

Regulatory Compliance

Feature	Standard	Performance
Electrostatic Discharge (ESD) to the Electrical Pins	MIL-STD-883G Method 3015.7	Class 1C (>1000 V)
Electrostatic Discharge to the enclosure	EN 55024:1998+A1+A2 IEC-61000-4-2 GR-1089-CORE	Compliant with standards
Electromagnetic Interference (EMI)	FCC Part 15 Class B EN55022:2006 CISPR 22B :2006 VCCI Class B	Compliant with standards Noise frequency range: 30 MHz to 6 GHz. Good system EMI design practice required to achieve Class B margins. System margins depend on customer host board and chassis design.
Immunity	EN 55024:1998+A1+A2 IEC 61000-4-3	Compliant with standards. 1kHz sine-wave, 80% AM, from 80 MHz to 1 GHz. No effect on transmitter/receiver performance is detectable between these limits.
RoHS6	2002/95/EC 4.1&4.2 2005/747/EC 5&7&13	Compliant with standards*[note1]

Note1: For update of the equipment and strict control of raw materials, Trixon has the ability to supply the customized products since Sep.2008, which meets the requirements of RoHS6 (Restrictions on use of certain Hazardous Substances) of European Union.

In light of item 5 in RoHS exemption list of RoHS Directive 2002/95/EC, Item 5: Lead in glass of cathode ray tubes, electronic components and fluorescent tubes.

In light of item 13 in RoHS exemption list of RoHS Directive 2005/747/EC, Item 13: Lead and cadmium in optical and filter glass. The three exemptions are being concerned for Trixon transceivers, because Trixon transceivers use glass, which may contain Pb, for components such as lenses, windows, isolators, and other electronic components.

Absolute Maximum Ratings*note2

Parameter	Symbol	Min	Max	Unit
Storage Temperature	T_S	-40	85	°C
Supply Voltage	VCC	0	4	V
Operating Relative Humidity	OH	5	95	%

Note2: Exceeding any one of these values may destroy the device permanently.

Recommended Operating Conditions

Parameter	Symbol	Min	Typical	Max	Unit
Operating Case Temperature	C-TEMP	-5		70	°C
	I-TEMP	-40		85	°C
Power Supply Voltage	VCC	3.13	3.3	3.47	V
Bit Rate			TX 2.488 RX 1.244		Gbps

Performance Specifications – Electrical

Parameter	Symbol	Min	Typ.	Max	Unit	Notes
Transmitter						
LVPECL Inputs Voltage (Differential)	Vin	200		1600	mVpp	AC coupled inputs
Input Impedance (Differential)	Zin	90	100	110	Ohm	
Tx_DISABLE Input Voltage – High		2.0		VCC	V	
Tx_DISABLE Input Voltage – Low		0		0.8	V	
Tx_FAULT Output Voltage – High		2.4		VCC	V	
Tx_FAULT Output Voltage – Low		0		0.4	V	
Receiver						
LVPECL Outputs Voltage (Differential)	Vout	400		1600	mVpp	DC coupled outputs
Output Impedance (Differential)	Zout	90	100	110	Ohm	
Signal Detect Voltage – High		2.4		VCC	V	
Signal Detect Voltage – Low		0		0.4	V	
Reset width	Treset	16			Bits	
Reset-Low		0		0.4	V	
Reset-High		2.4		VCC	V	
RSSI Trigger-High		2.0		VCC	V	
RSSI Trigger-Low		0		0.8	V	

Timing Specifications

Parameter	Symbol	Min	Typ.	Max	Unit
TX Disable Assert Time	T_off			10	us
TX Disable Negate Time	T_on			1	ms
Time to initialize, include reset of TX_FAULT	T_int			300	ms

TX_FAULT from fault to assertion	T_fault			100	us
Signal Detect Assert Time				100	ns
Signal Detect De-Assert Time				12.8	ns
Guard Time	Tg	25.6			ns
Reset Pulse Width	Tr			12.8	ns
Reset Delay	Trd			12.8	ns
RSSI Trigger Delay (Ttd)	Ttd	25			ns
RSSI Trigger Pulse Width (Tw)	Tw	500			
Receiver Preamble Time (Tp)	Tp			140	ns
I2C Access Prohibited Time			100	500	us

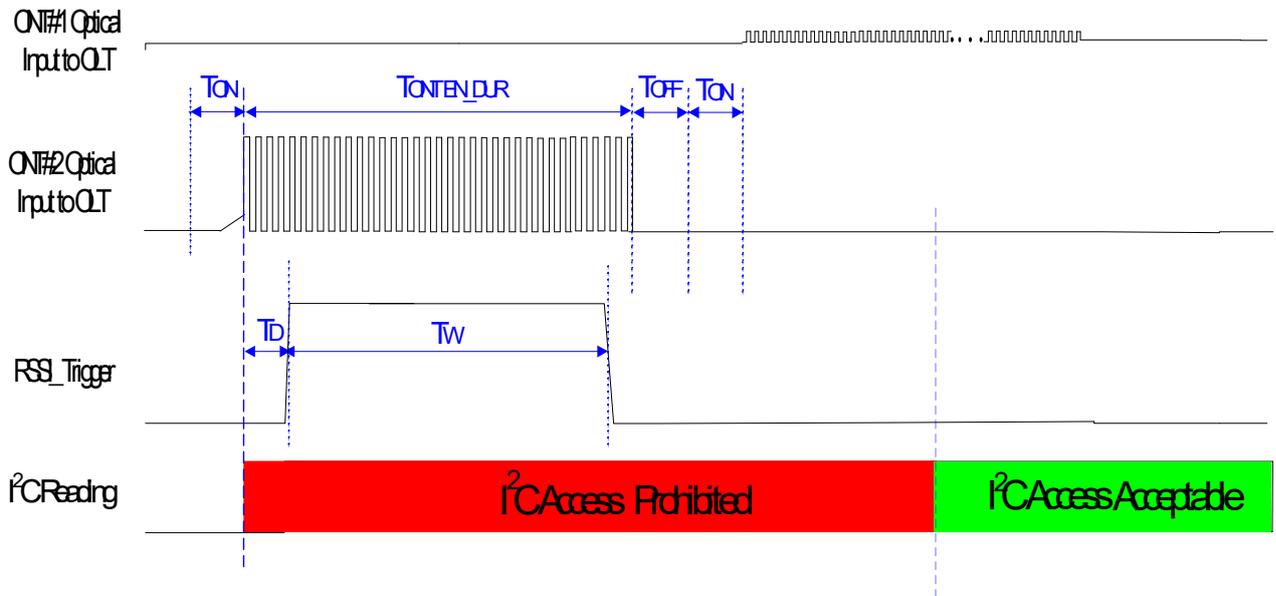# Timing Parameter Definitions In Burst Mode Sequence
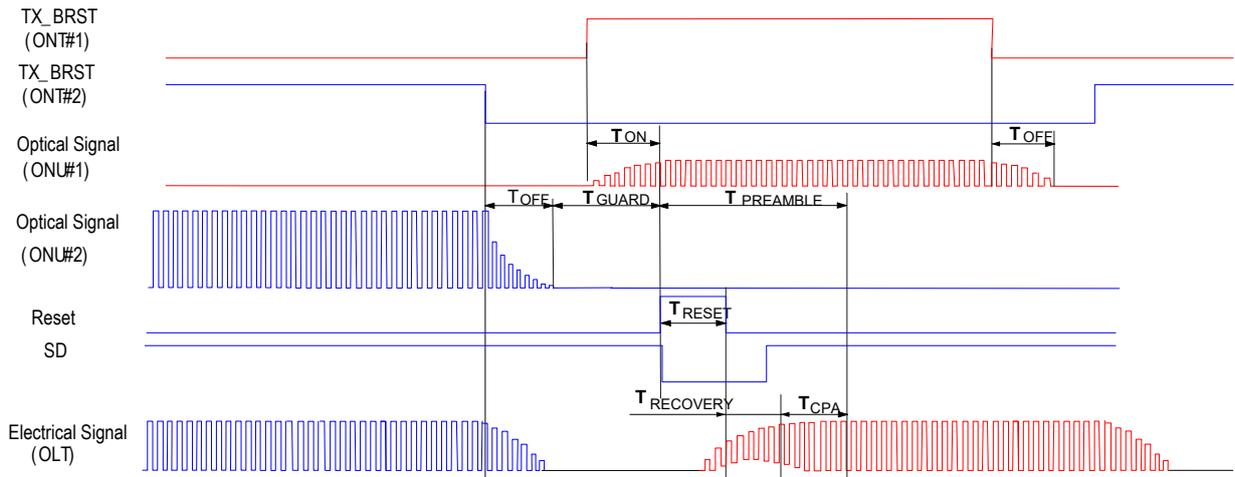
Burst Mode Receiver Dynamic Range In Gpon System

Fast RSSI Sequence

ONT#1 Optical Input to OLT

T_{ON} $T_{ONT\_EN\_DUR}$ T_{OFF} T_{ON}

ONT#2 Optical Input to OLT

T_D T_W

RSSI_Trigger

I^2C Reading

I^2C Access Prohibited
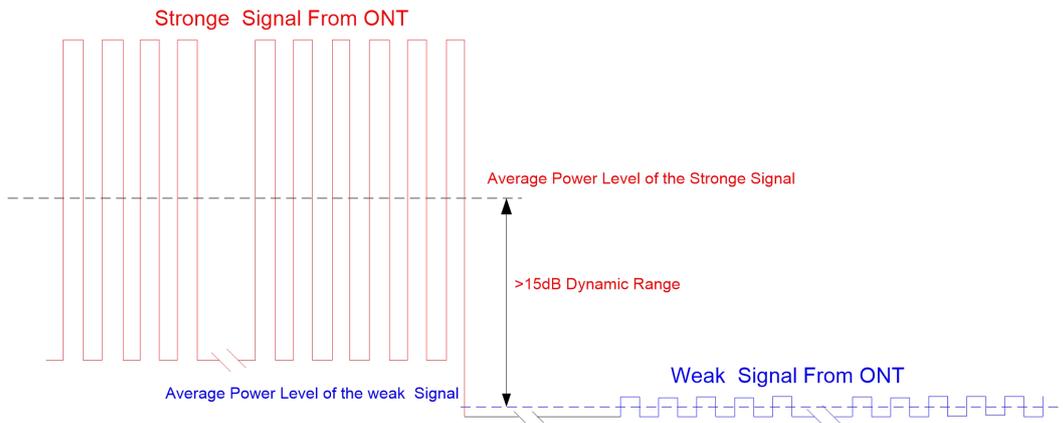
I^2C Access Acceptable

Performance Specifications – Optical

（CLASS B+）

Parameter	Symbol	Min	Typ.	Max	Unit
9μm Core Diameter SMF			20		Km
Data Rate			TX 2.488 RX 1.244		Gbps
Transmitter					
Centre Wavelength	λ_C	1480	1490	1500	nm
Spectral Width (-20dB)	$\Delta\lambda$			1	nm
Average Output Power	AOP	+1.5		+5	dBm
Extinction Ratio	ER	8.2			dB
Average Power of OFF Transmitter				-39	dBm
Transmitter Dispersion Penalty	TDP			1	dB
Output Optical Eye		Compliant with ITU-T G.984.2			
Receiver					
Centre Wavelength		1290	1310	1330	nm
Sensitivity*[note3]	SEN			-28	dBm
Receiver Overload	SAT	-8			dBm
Optical Return Loss				-20	dB
LOS De-Assert				-32	dBm
LOS Assert		-45			dBm
LOS Hysteresis		0.5		4	dB

（CLASS C+）

Parameter	Symbol	Min	Typ.	Max	Unit
9μm Core Diameter SMF			20		Km
Data Rate			TX 2.488 RX 1.244		Gbps
Transmitter					

Centre Wavelength	λ_C	1480	1490	1500	nm
Spectral Width (-20dB)	Δλ			1	nm
Average Output Power	AOP	+3		+7	dBm
Extinction Ratio	ER	8.2			dB
Average Power of OFF Transmitter				-39	dBm
Transmitter Dispersion Penalty	TDP			1	dB
Output Optical Eye		Compliant with ITU-T G.984.2			

Receiver					
Centre Wavelength		1290	1310	1330	nm
Sensitivity*note3	SEN			-30	dBm
Receiver Overload	SAT	-12			dBm
Receiver Burst Mode Dynamic Range		15			dB
Optical Return Loss				-20	dB
LOS De-Assert				-33	dBm
LOS Assert		-45			dBm
LOS Hysteresis		0.5		4	dB

（CLASS C++）

Parameter	Symbol	Min	Typ.	Max	Unit
9μm Core Diameter SMF			20		Km
Data Rate			TX 2.488 RX 1.244		Gbps

Transmitter					
Centre Wavelength	λ_C	1480	1490	1500	nm
Spectral Width (-20dB)	Δλ			1	nm
Average Output Power	AOP	+5		+9	dBm
Extinction Ratio	ER	8.2			dB
Average Power of OFF Transmitter				-39	dBm
Transmitter Dispersion Penalty	TDP			1	dB
Output Optical Eye		Compliant with ITU-T G.984.2			

Receiver					
Centre Wavelength		1290	1310	1330	nm
Sensitivity*note3	SEN			-32	dBm
Receiver Overload	SAT	-12			dBm
Receiver Burst Mode Dynamic Range		15			dB
Optical Return Loss				-20	dB
LOS De-Assert				-33	dBm
LOS Assert		-45			dBm
LOS Hysteresis		0.5		4	dB

（CLASS C+++）

Parameter	Symbol	Min	Typ.	Max	Unit
9μm Core Diameter SMF			20		Km

| Data Rate | | TX 2.488 | | | Gbps |
		RX 1.244			
Transmitter					
Centre Wavelength	λ_C	1480	1490	1500	nm
Spectral Width (-20dB)	$\Delta\lambda$			1	nm
Average Output Power	AOP	+7		+10	dBm
Extinction Ratio	ER	8.2			dB
Average Power of OFF Transmitter				-39	dBm
Transmitter Dispersion Penalty	TDP			1	dB
Output Optical Eye		Compliant with ITU-T G.984.2			
Receiver					
Centre Wavelength		1290	1310	1330	nm
Sensitivity*[note3]	SEN			-32	dBm
Receiver Overload	SAT	-12			dBm
Receiver Burst Mode Dynamic Range		15			dB
Optical Return Loss				-20	dB
LOS De-Assert				-33	dBm
LOS Assert		-45			dBm
LOS Hysteresis		0.5		4	dB

Note3: Minimum average optical power measured at the BER less than 1E-10, back to back. The measure pattern is PRBS $2^{23}-1+72\text{CID}@1244\text{Mbps}$.
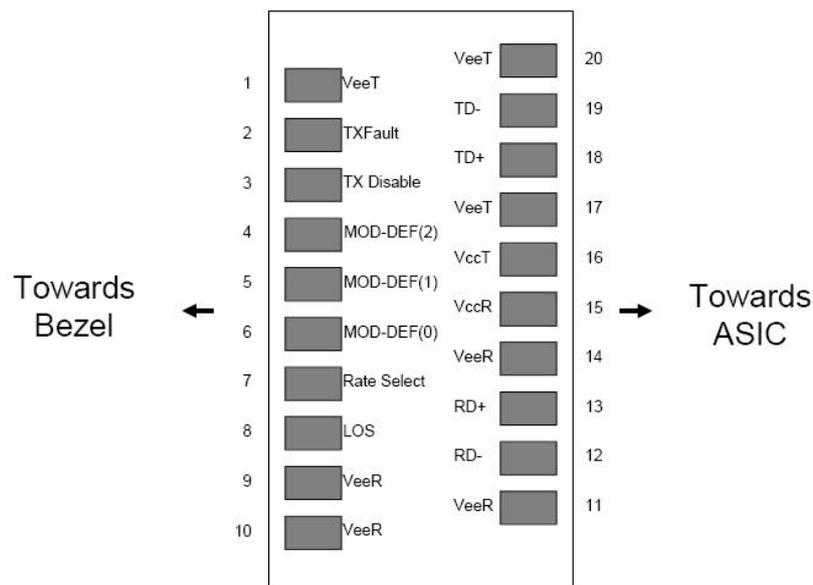
GPON OLT Transceiver Electrical Pad Layout

Diagram of Host Board Connector Block Pin Numbers and Names

Pin Function Definitions

Pin Num.	Name	Function	Plug Seq.	Notes

1	VeeT	Transmitter Ground	1	Note 7
2	TX Fault	Transmitter Fault Indication	3	Note 4
3	TX Disable	Transmitter Disable	3	Note 5, Module disables on high or open.
4	MOD_DEF2	Module Definition 2	3	2-wire Serial Interface Data Line.
5	MOD_DEF1	Module Definition 1	3	2-wire Serial Interface Clock.
6	MOD_DEF0	Module Definition 0	3	Connected to Ground in the transceiver
7	Reset	Receiver Reset	3	High: reset the receiver
8	SD	Signal Detect	3	High: Signal Detect; Low: Loss of Signal，Note6
9	RSSI Trigger	RSSI Trigger for Transceiver A/D Conversion	1	High: enable RSSI A/D Conversion Note 7
10	VeeR	Receiver Ground	1	Note 7
11	VeeR	Receiver Ground	1	Note 7
12	RD-	Inv. Received Data Out	3	Note 8
13	RD+	Received Data Out	3	Note 8
14	VeeR	Receiver Ground	1	Note 7
15	VccR	Receiver Power	2	3.3V ± 5%, Note 9
16	VccT	Transmitter Power	2	3.3V ± 5%, Note 9
17	VeeT	Transmitter Ground	1	Note 7
18	TD+	Transmit Data In	3	Note 10
19	TD-	Inv. Transmit Data In	3	Note 10
20	VeeT	Transmitter Ground	1	Note 7

Note4: TX Fault is an open collector/drain output, which should be pulled up with a 4.7K – 10K_ resistor on the host board. Pull up voltage between 2.0V and VccT/R+0.3V. When high, output indicates a laser fault of some kind. Low indicates normal operation. In the low state, the output will be pulled to < 0.8V.

Note5: TX disable is an input that is used to shut down the transmitter optical output. It is pulled up within the module with a 4.7K – 10 K_ 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.

Note6: SD (Signal Detect) is an open collector/drain output, which should be pulled up with a 4.7K –10K_ resistor. Pull up voltage between 2.0V and VccT/R+0.3V. When low, this output indicates the received optical power is below the worst-case receiver sensitivity (as defined by the standard in use). High indicates normal operation. In the low state, the output will be pulled to < 0.8V.

Note7: The module signal ground contacts, VeeR and VeeT, should be isolated from the module case.

Note8: RD-/+: These are the differential receiver outputs. They are DC-coupled.

Note9: VccR and VccT are the receiver and transmitter power supplies. They are defined as 3.3V ±5% at the SFP connector pin. Maximum supply current is 300mA. Inductors with DC resistance of less than 1 ohm should be used in order to maintain the required voltage at the SFP input pin with 3.3V supply voltage. When the recommended supply-filtering network is used, hot plugging of the SFP transceiver module will result in an inrush current of no more than 30mA greater than the steady state value. VccR and VccT may be internally connected within the transceiver module.

Note10: TD-/+: These are the differential transmitter inputs. They are AC-coupled, differential lines with 100_ differential termination inside the module. The AC coupling is done inside the module and is thus not required on the host board
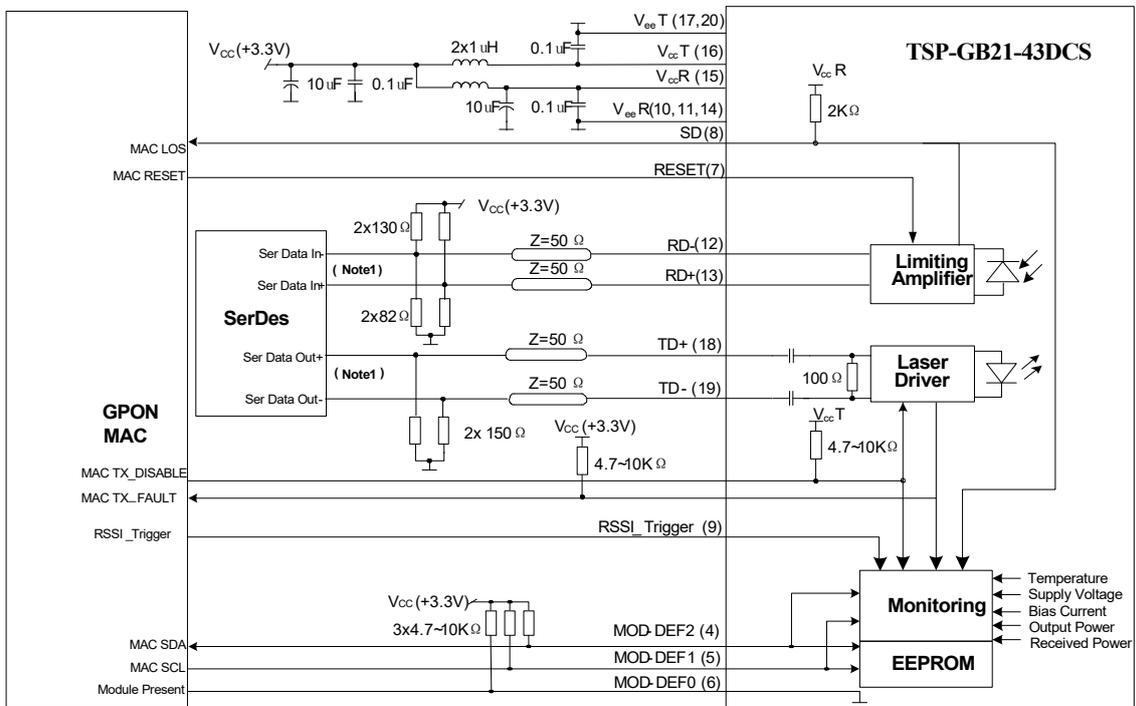
Digital Diagnostic Specifications

Parameter	Min	Typ	Max	Units	Ref
Monitor accuracy					
Internally measured transceiver temperature			±3	ºC	

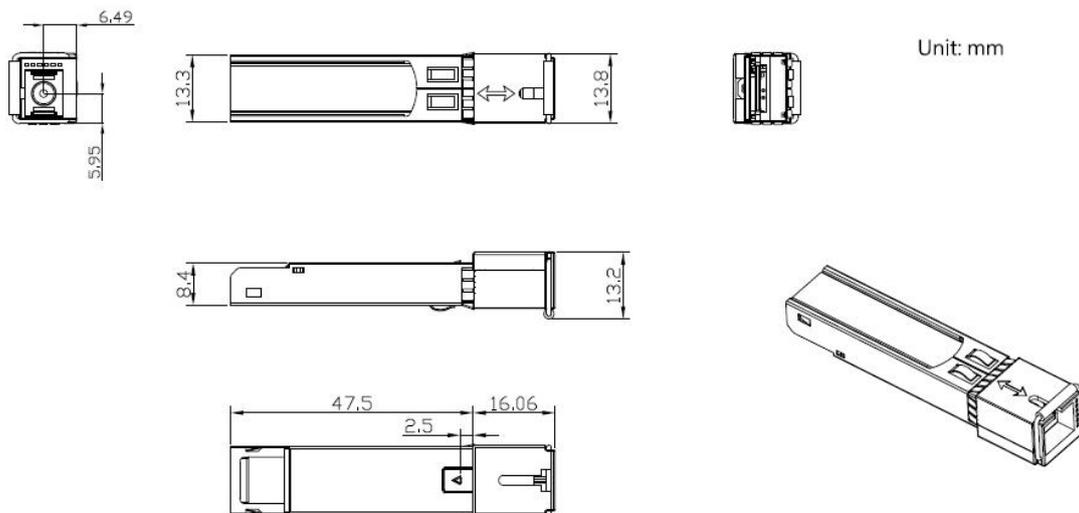|			
Internally measured transceiver supply voltage		±3%	mV
Measured TX bias current		±10	%
Measured TX output power		±1	dB
Measured RX received average optical power		±3	dB

Digital Diagnostic Functions:

1) GPON OLT transceiver supports the 2-wire serial communication protocol as defined in SFF-8472: in which defines a 256-byte memory map in EEPROM at 8 bit address 1010000X (A0h). The digital diagnostic monitoring interface be assigned with 8 bit address 1010001X (A2h). Additionally, SFP transceivers provide a unique digital diagnostic monitoring interface (DDMI), which allows real-time access to product operating parameters such as transceiver supply voltage, transceiver temperature, transmitted optical power, laser bias current and received optical power. It also defines alarm and warning threshold, which alerts end-users when particular operating parameters are outside of factory setting.

2) 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 those segments of the EEPROM that are not write-protected. The negative edge clocks data from the SFP transceiver. The serial data signal (SDA, Mod Def 2) is bi-DCRectional 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.

3) Digital diagnostics for the TSP-GB21-43DCS are internally calibrated by default: Calibration and alarm/warning threshold data is written during device manufacturing.

PCB Layout and Bezel Recommendations

Notes:
1. Datum and basic dimensions established by customer
2. Pads and vias are chassis ground, 11 places
3. Thru holes, plating optional

11.93
9.6
4.8
3.68
1.7
8.48
1.7

∅0.85±0.05
⊕ ∅0.1ⓈⓍⓎ
-A-

∅0.95±0.05
⊕ ∅0.1ⓁⓍⒶⓈ
9 HOLES

2.0
11 PLACES

7.1
2.5

10
3 PLACES
5

7.2
2.5

PIN 1

10.00
3 PLACES

THIS AREA DENOTES
COMPONENT KEEP-OUT
(TRACES ALLOWED)

41.3
42.3
26.8

34.5

SEE DETAIL X

-B-

-X-

-Y-

BSC

5.68

8.58

11.08

14.25

16.25

2.0
11 PLACES

∅1.05±0.1
⊕ ∅0.1ⓁⓍⒶⓈ
10 HOLES

CROSS-HATCHED AREA DENOTES
COMPONENT AND TRACE KEEP-OUT
(EXCEPT CHASSIS GROUND)

3.2
0.9
S

10.93
3.6

1
20

10
11

0.8
9 PLACES

11.93
10.53

0.8
9 PLACES

0.5±0.03
⊕ 0.06ⒶⓑⒷⓟ
20 PLACES

∅1.55±0.05
⊕ ∅0.1LⒶⓟⒷⓟ
2 HOLES

2±0.05
⊕ 0.06ⒶⓑⒷⓟ
TYP

16.25±0.1
[.640"]
Y

15.25±0.1
[.600"]
Y

1.7±0.9
3.5±0.3

10.4±0.1

10 REF

SECTION Y-Y

0.4±0.1
BEZEL OPENING
BELOW PC BOARD

NOTES:
△ MINIMUM PITCH ILLUSTRATED, ENGLISH DIMENSIONS
ARE FOR REFERENCE ONLY

2. NOT RECOMMENDED FOR PCI EXPANSION
CARD APPLICATIONS

V_ee T (17,20)
V_cc T (16)
V_cc R (15)
V_ee R(10,11,14)
SD (8)
RESET(7)
RD-(12)
RD+(13)
TD+ (18)
TD- (19)
RSSI_Trigger (9)
MOD-DEF2 (4)
MOD-DEF1 (5)
MOD-DEF0 (6)

V_CC (+3.3V)   2x1 uH   0.1 uF
10 uF   0.1 uF
10 uF   0.1 uF
V_cc R
2KΩ

MAC LOS
MAC RESET

2x130Ω   V_CC(+3.3V)
Z=50Ω
Ser Data In-
(Note1)
Ser Data In+
SerDes
2x82Ω
Ser Data Out+   Z=50Ω
(Note1)
Ser Data Out-   Z=50Ω

GPON MAC
2x 150Ω   V_CC(+3.3V)
MAC TX_DISABLE   4.7~10KΩ
MAC TX_FAULT
RSSI_Trigger

Limiting Amplifier
Laser Driver
100Ω
V_cc T
4.7~10KΩ

Monitoring
Temperature
Supply Voltage
Bias Current
Output Power
Received Power
EEPROM

V_CC (+3.3V)
3x4.7~10KΩ
MAC SDA
MAC SCL
Module Present

Mechanical Dimension

6,49
13.3
13.8
5.95
Unit: mm

8.4
13.2

47.5   16.06
2.5

Eye Safety

This single-mode transceiver is a Class 1 laser product. It complies with IEC-60825 and FDA 21 CFR 1040.10 and 1040.11. The transceiver must be operated within the specified temperature and voltage limits. The optical ports of the module shall be terminated with an optical connector or with a dust plug.

Obtaining Document

You can visit our website: http://www.trixontech.com
Or contact Trixon Inc. listed at the end of the documentation to get the latest document.

Notice

Trixon reserves the right to make changes to or discontinue any optical link product or service identified in this

publication, without notice, in order to improve design and/or performance.

Applications that are described herein for any of the optical link products are for illustrative purposes only. Trixon makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.