Product Specification
10GBd X2 850nm Transponder
TRP10GVP2003, TRP10GVP20CA
TRP10GVP2103

General Description and Applications

Mergeoptics X2 transponder TRP10GVP2x03 is a highly integrated, serial optical transponder module for high-speed, 10Gbit/s data transmission applications. It is ideally suited for 10GbE datacom and storage area network (SAN / NAS) applications based on the IEEE 802.3ae standard as well as the Fibre Channel 10GFC Rev. 4.0. Designed for short range distances the transponder module comprises a transmitter with a vertical cavity surface emitting laser (VCSEL), a receiver with a PIN photodiode and an integrated four channel SERDES. The transponder offers optimum heat dissipation and excellent electromagnetic shielding. A 70 pin electrical connector and a duplex SC optical connector assure that connectivity is compliant to the X2 and Xenpak MSA.

Supported Standards

Application	Standard	Data Rate
10G Ethernet LAN	IEEE 802.3ae 10GBASE-SR	10.3125Gb/s
10G Fibre Channel	1200-M5-SN-I, 1200-M5E-SN-I	10.51875 Gb/s

FEATURES & BENEFITS

- Compatible with X2 MSA Rev. 2.0b
- Support IEEE 802.3ae 10GBASE-SR at 10.3125 Gb/s
- Support Fibre Channel 1200-M5(E)-SN-I at 10.51875 Gb/s
- Transmission distance up to 300m MO3 MMF
- Power Consumption 1.7 W (typ.)
- Temperature Range 0°C to 70°C
- Laser Class 1 compliant
- 850nm VCSEL Laser
- SC duplex connector
- Hot pluggable 70-pin connector with XAUI electrical interface
- Management and control via MDIO 2-wire interface
- Compliant with the EU RoHS 6

Absolute Maximum Ratings[1)]

Rating	*Conditions/Remark*	*Symbol*	*Min*	*Typ*	*Max*	*Units*
Storage Ambient Temperature	non condensing	ϑ_{stg}	-40		+85	°C
Operating Case Temperature	non condensing	ϑ_c	0		+80	°C
Adaptable Power Supply (APS)	Voltage @ Pin APS Sense	$V_{APSsense}$	0		1.5	V
Supply Voltage 3.3V Rail		V_{CC3}	0		4.0	V
Supply Voltage 5V Rail		V_{CC5}	0		6.0	V
Input Voltage of Low Speed Signals	Reset, Tx On/Off, PRTADR4…0, MDIO, MDC	V_I	-0.5		3.6	V
LASI Voltage		V_Q	-0.5		1.5	V
Differential XAUI Input Amplitude		$\|V_{IDXAUI}\|$			2500	mV
Optical Receiver Input Power	Average Receiver Input Power	P_{Rx}			4	dBm
Static Discharge Voltage	MIL STD 883 Method 3015.1				500	V

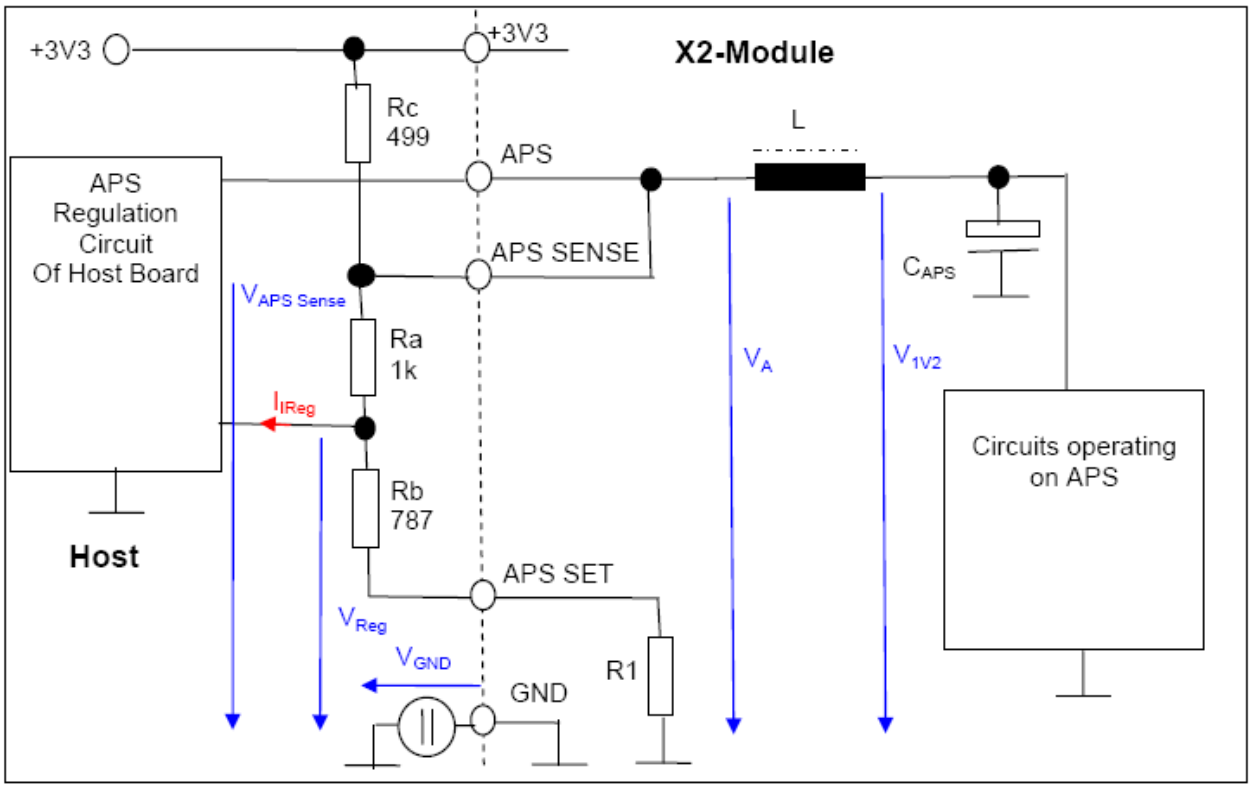
1) Any stress beyond the maximum ratings can result in permanent damage. The device specifications are guaranteed only under the recommended operating conditions.

Recommended Operating Conditions

Parameter	*Conditions / Remark*	*Symbol*	*Min*	*Typ*	*Max*	*Units*
Operating Case Temperature	worst case thermal location	ϑ_{Case}	0		+70	°C
APS Feedback Voltage[1), 2)]	Ra= 1kΩ ± 1%, Rb = 787Ω ± 1%	$V_{Feedback}$	786	800	812	mV
APS Sense Voltage [1), 2)]	For information only	$V_{APSsense}$	1.164	1.2	1.235	V
Power Supply Voltage @ 3.3V		V_{CC3}	3.14	3.3	3.47	V
Power Supply Voltage @ 5.0V		V_{CC5}	4.75	5.00	5.25	V
Power Supply Voltage APS		V_{APS}	1.164	1.2	1.235	V

1) The device is supposed to operate in the APS control environment described and specified in Xenpak MSA (page 22 to 24 of Rev 3.0). In this environment the APS-sense Voltage requirements will be automatically satisfied if APS-Feedback Voltage is within tis recommended rage. The operating APD-sense Voltage is for information purposes and is subject to be changed.
2) More detailed description on the APS control circuit can also be found on page 3.

Functional Block Diagram of APS Regulation



Electrical Characteristics

Parameter	*Conditions*	*Symbol*	*Min*	*Typ*	*Max*	*Units*
5V Supply Current		I_{VCC5}	8	3	29	mA
3.3V Supply Current		I_{VCC3}	160	220	280	mA
APS Supply Current	$V_{Feedback}$ = 786…800…812mV	I_{VCCAPS}	740	820	1070	mA
Total Power Consumption		P_{tot}	1.4	1.7	2.4	W

XAUI Input Characteristics

Parameter	*Conditions*	*Symbol*	*Min*	*Typ*	*Max*	*Units*
Nominal XAUI Baud Rate	Ethernet Fibre Channel			3.125 3.1875		GBd
Nominal XAUI Baud Rate Tolerance			-100		+100	ppm
Differential Input Voltage Swing	8B/10B coded input signal	V_{ID}	220		1600	mV_{p-p}
Differential Return Loss	100 MHz – 2.5 GHz (Reference to 100Ω)	SDD11	10			dB
Common Mode Return Loss	100 MHz – 2.5 GHz (Reference to 25Ω)	SCC11	6			
Input differential skew	at crossing point	T_{jRDS}			75	ps_{P-P}
Total Peak-to-Peak Jitter Tolerance	Sinusoidal Jitter @ 0…20MHz		0.55			UI_{p-p}
Differential Input Impedance		R_{IND}	80	100	120	Ω

Note: XAUI input lanes are AC-coupled.

XAUI Output (AC-Coupled)

Parameter	*Conditions*	*Symbol*	*Min*	*Typ*	*Max*	*Units*
Nominal XAUI Baud Rate	Ethernet Fibre Channel			3.125 3.1875		GBd
Nominal XAUI Baud Rate Tolerance	Relative tolerance		-100		+100	ppm
Differential Output Voltage Swing	R_{LAOD} = 100 Ω ±5%			800	1600	mVp-p
Output Differential Skew		$t_{skew,\ out}$			15	ps
Output Differential Impedance		$Z_{XAUI,\ out}$	80	100	120	Ω
Differential Transition Time	20% - 80%		40		100	ps
Total Output Jitter	no pre-equalization	TJ_{XAUI}			0.35	UI
Total Deterministic Output Jitter	no pre-equalization	DJ_{XAUI}			0.17	UI
Differential Output Return Loss	312.5 to 625 MHz	S22	10			dB

Note: XAUI input lanes are AC-coupled.

Optical Characteristics

Recommended Operating Conditions

Parameter	*Conditions*	*Min Modal Bandwidth (MHz*km)*	*Symbol*	*Min*	*Typ*	*Max*	*Units*
Operating Range	62.5 µm MMF 50 µm MMF 62.5 µm MMF 50 µm MMF 50 µm MMF	160 400 200 500 2000	l_{OP}	2 2 0.5 0.5 0.5		26 66 33 82 300	m
Nominal Signalling Speed	Ethernet		f_{OPT}		10.3125		Gb/s
	Fibre Channel				10.51875		Gb/s
	Relative tolerance			-100		100	ppm

Transmitter Optical Characteristics

Parameter	*Conditions*	*Symbol*	*Min*	*Typ*	*Max*	*Units*
Nominal Wavelength		λ_{TRP}	840	850	860	nm
Spectral Width		$\Delta\lambda$		0.4	0.45	nm
Launch Power	in OMA	$P_{opt,OMA}$	-2.0			dBm
Average Launch Power		$P_{opt, avg}$	-3	-2	-1	dBm
Optical Modulation Amplitude		OMA	525			µW
Extinction Ratio		ER	5	6.5		dB
Transmitter and Dispersion Penalty		TDP			3.9	dB
Relative Intensity Noise		RIN			-128	dB/Hz

Receiver Optical Characteristics

Parameter	*Conditions*	*Symbol*	*Min*	*Typ*	*Max*	*Units*
Center Wavelength		λ_C	840	850	860	nm
Receiver Sensitivity	in OMA, BER 10^{-12} @ 2^{31}-1 [1)]	P_{IN}			-11.1	dBm
Stressed Receiver Sensitivity	in OMA	P_{IN}			-7.5	dBm
Saturation Input Power		P_{SAT}	1			dBm

1) with ideal transmitter
Note: The specified characteristics are met within the recommended range of operating conditions and under the default settings of output power and modulation amplitude. A change in setting of the optical output power influences especially the dynamic behavior of the output signal. Unless otherwise noted typical data are quoted at nominal voltages and +25°C ambient temperature.

MDIO Interface

DC Characteristics

If not otherwise mentioned under the recommended operation conditions.

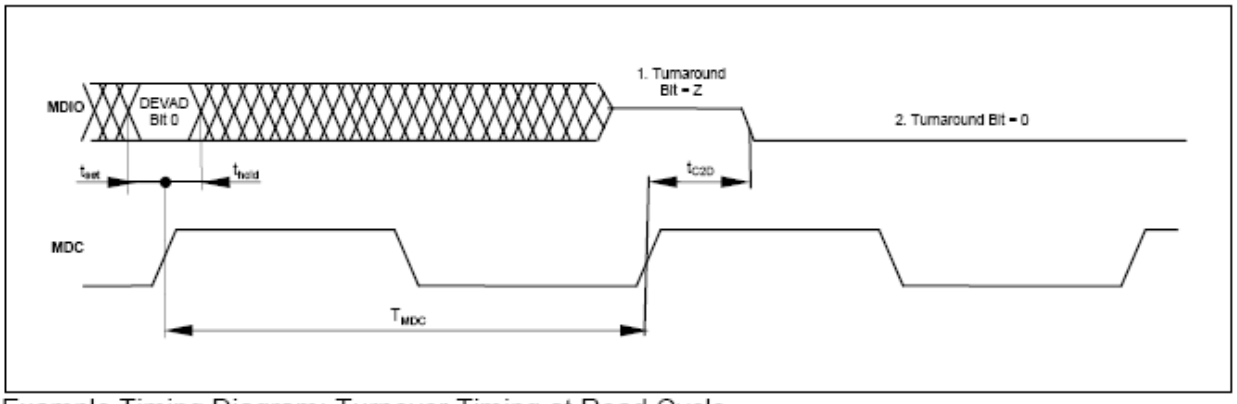
Parameter	*Conditions*	*Symbol*	*Min*	*Typ*	*Max*	*Units*
Pull-up supply voltage		V_{pu}		1.2		V
Input high voltage	3.3V tolerant	VIH	0.84			V
Input low voltage		VIL			0.36	V
Output low voltage	I_{OL} = 4mA	VOL			0.2	V
Output high voltage	I_{OH} = -100µA	VOH			V_{pu}	V
Input low voltage	V_I = 0…V_{pu}	Cin			10	pF
Load capacitance	V_I = 0…V_{pu}	CIcad			470	pF
Pull-up resistance	With 1.2V puu-up voltage	R_{pu}	180			Ω
	With 3.3V puu-up voltage	R_{pu}	500			Ω

AC Characteristics

not less than 310ns, and the sum of input of loads on the bus does not exceed 256uA at high and at low not blow -320uA.

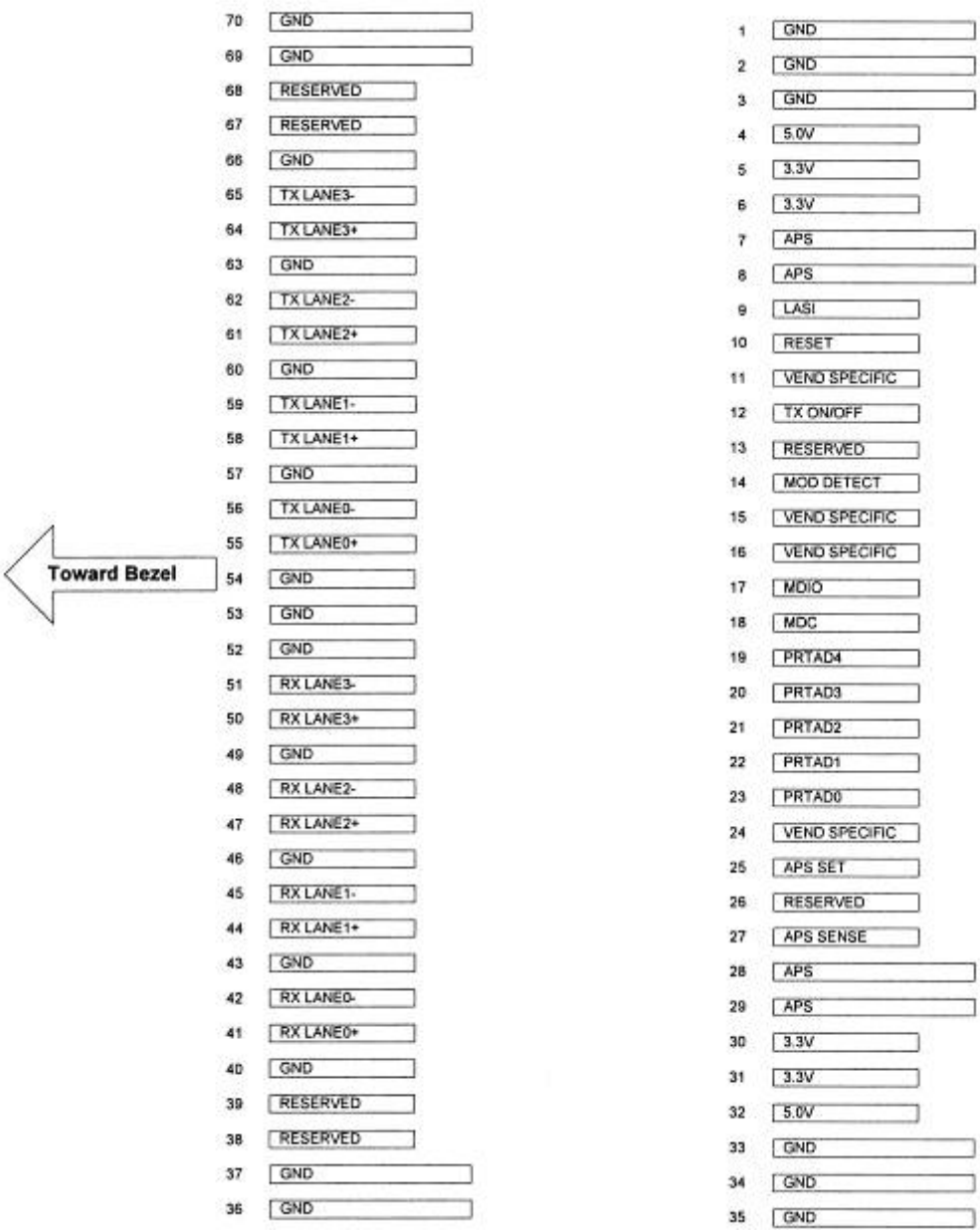
Parameter	*Conditions*	*Symbol*	*Min*	*Typ*	*Max*	*Units*
Setup Time	wrt MDC rising edge	t_{set}			10	ns
Hold Time	wrt MDC rising edge	t_{hold}			10	ns
Clock to Data Time[1)]	V_{pu} = 1.2V, R_{pu} = 400Ω±1%, C_{BUS} ≤470pF	t_{C2D}	0		300	ns
Clock to Data Time[1)]	V_{pu} = 1.2V, R_{pu} = 400Ω±1%, C_{BUS} ≤50pF	t_{C2D}			30	ns
MDC clock rate	V_{pu} = 1.2V, R_{pu} = 400Ω±1%, C_{BUS} ≤470pF	F_{max}			3.125	MHz
MDC H and L Times	V_{pu} = 1.2V, R_{pu} = 400Ω±1%, C_{BUS} ≤470pF	t_H, t_L	160			ns
Clock to Data Time[1)]	V_{pu} = 1.2V, R_{pu} = 180Ω±1%, C_{BUS} ≤100pF	t_{C2D}	0		32	ns
Clock to Data Time[1)]	V_{pu} = 1.2V, R_{pu} = 180Ω±1%, C_{BUS} ≤50pF	t_{C2D}			20	ns
MDC clock rate	V_{pu} = 1.2V, R_{pu} = 180Ω±1%, C_{BUS} ≤100pF	F_{max}			25	MHz
MDC H and L Times	V_{pu} = 1.2V, R_{pu} = 180Ω±1%, C_{BUS} ≤100pF	t_H, t_L	20			ns

1) Delay is measured from MDC rising edge Vih_min level (0.84V) to MDIO rising edge Vih_min (0.84V) or MDIO falling edge Vil_max level (0.36V).



Example Timing Diagram: Turnover Timing at Read Cycle

Edge-Board-Connector-Pinning and Layout



Top of Transceiver PCB

Bottom of Transceiver PCB
(as viewed through top)

Electrical Pin Definition

Symbol	Logic	I/O	PIN	Name / Description	Note
3.3V	+3.3 V DC	I	5, 6, 30, 31	Power Supply of Optical Receiver and Transmitter and Control Circuits	2
5.0V	+5.0 V DC	I	4, 32	Power Supply of Optical Receiver Frontend	2
APS	+1.2 V	I	7, 8, 28, 29	Adaptive Power Supply, Supply of PHY XS and PCS Layer Devices	2
APS SENSE	+1.2 V	O	27	APS Sense Output for APS Control Circuit	
APS SET	GND	I	25	Feedback Input for APS, Input of APS Setting Resistor	
GND	0 V DC	I	1, 2, 3, 33, 34, 35, 36, 37, 40, 43, 46, 49, 52, 53, 54, 57, 60, 63, 66, 69, 70	Common Electrical Ground	1
LASI	1.2V CMOS Open Drain	O	9	Link Alarm Status Indicator, low active, Open Drain Output Supposed to operate with 10KΩ - 22KΩ pull upon host. Logic High: Normal Operation Logic Low: Link Alarm is indicated	
MDC	1.2 V CMOS	I	18	Management Clock Input	3
MDIO	Open Drain	I/O	17	Management Data I/O. Requires external 10-22 kΩ pull-up to 1.2 V on host.	3
MOD DETECT		O	14	1kΩ it Ground for APS Circuit Environment	
PRTADO	1.2V CMOS	I	23	Port Address Setting 0	
PRTAD1	1.2V CMOS	I	22	Port Address Setting 1	
PRTAD2	1.2V CMOS	I	21	Port Address Setting 2	
PRTAD3	1.2V CMOS	I	20	Port Address Setting 3	
PRTAD4	1.2V CMOS	I	19	Port Address Setting 4	
RESERVED			13, 38, 39, 67, 68	Reserved for future use, pins w/o function, leave unconnected	
RESERVED			26	Reserved for Avalanche Photodiode use, not in use	5
RESET	1.2V CMOS Open Drain	I	10	Low active Reset Input, 10KΩ pull-up on Transceiver High = Normal Operation, Low = Reset asserted	
Tx On/Off	1.2V CMOS Open Drain	I	12	High active Transmitter Enable Input 10kΩ pull-up on transceiver Logic high = Normal operation Logic low = Reset asserted	
VEND Specific			11.15.16.24	Vendor specific Pin. Leave unconnected.	5
RX LANE0+	AC-coupled, internally based differential XAUI	O	41	Module XAUI Output Lane 0+	4
RX LANE0-		O	42	Module XAUI Output Lane 0-	4
RXLANE1+		O	44	Module XAUI Output Lane 1+	4
RXLANE1-		O	45	Module XAUI Output Lane 1-	4
RX LANE2+		O	47	Module XAUI Output Lane 2+	4
RX LANE2-		O	48	Module XAUI Output Lane 2-	4
RX LANE3+		O	50	Module XAUI Output Lane 3+	4
RX LANE3-		O	51	Module XAUI Output Lane 3-	4

Electrical Pin Definition

Symbol	Logic	I/O	PIN	Name / Description	Note
TX LANE0+		I	55	Module XAUI Input Lane 0+	4
TX LANE0-		I	56	Module XAUI Input Lane 0-	4
TXLANE1 +		I	58	Module XAUI Input Lane 1+	4
TXLANE1-		I	59	Module XAUI Input Lane 1-	4
TX LANE2+		I	61	Module XAUI Input Lane 2+	4

Symbol	Logic	I/O	PIN	Name / Description	Note
TX LANE2-	AC-coupled, internally based differential XAU	I	62	Module XAUI Input Lane 2-	4
TX LANE3+		I	64	Module XAUI Input Lane 3+	4
TX LANE3-		I	65	Module XAUI Input Lane 3-	4

1) Ground connections are common for TX and RX.
2) All connector contacts are rated at 0.5A nominal.
3) MDIO and MDC timing must comply with IEEE 802.3ae clause 45.3.
4) XAUI output characteristics comply with IEEE 802.3ae clause 47.
5) Transceivers will be MSA compliant when no signals are present on the vendor specific pins

Electro Static Discharge (ESD)

The maximum electrostatic charge based on a human body model and the conditions as outlined below is:

Parameter	Conditions	Symbol	Min	Typ	Max	Units
Static Discharge Voltage	MIL STD 883 Method 3015.1				1000	V

Thermal Management

The transponder is designed for an operation within a case temperature range between 0 to +70°C at an altitude of < 3km. The built in heatsink provides an optimized thermal performance.
The user needs to guarantee per system design to not exceed this temperature range. A temperature rise among modules has to be considered in case multiples modules are being used side by side on a single hostboard (see figure below). Airflow direction and air speed needs to be chosen accordingly.
For further information it is referred to the MSA document.

Eye Safety

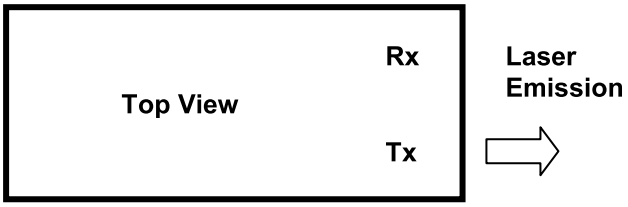
This laser based multimode transceiver is a Class 1 product. It complies with IEC 60825-1/A2: 2001 and FDA performance standards for laser products (21 CFR 1040.10 and 1040.11) except for deviations pursuant to Laser Notice 50, dated July 26, 2001.

CLASS 1 LASER PRODUCT

To meet laser safety requirements the transceiver shall be operated within the Absolute Maximum Ratings.

Note: All adjustments have been made at the factory prior to shipment of the devices. No maintenance or alteration to the device is required. Tampering with or modifying the performance of the device will result in voided product warranty. Failure to adhere to the above restrictions could result in a modification that is considered an act of "manufacturing", and will require, under law, recertification of the modified product with the U.S. Food and Drug Administration (ref. 21 CFR 1040.10 (i)).

Laser Emission Data



Wavelength	>840 nm
Accessible Emission Limit (as defined by IEC: 7 mm aperture at 70 mm distance)	<743 µW

Required Labeling

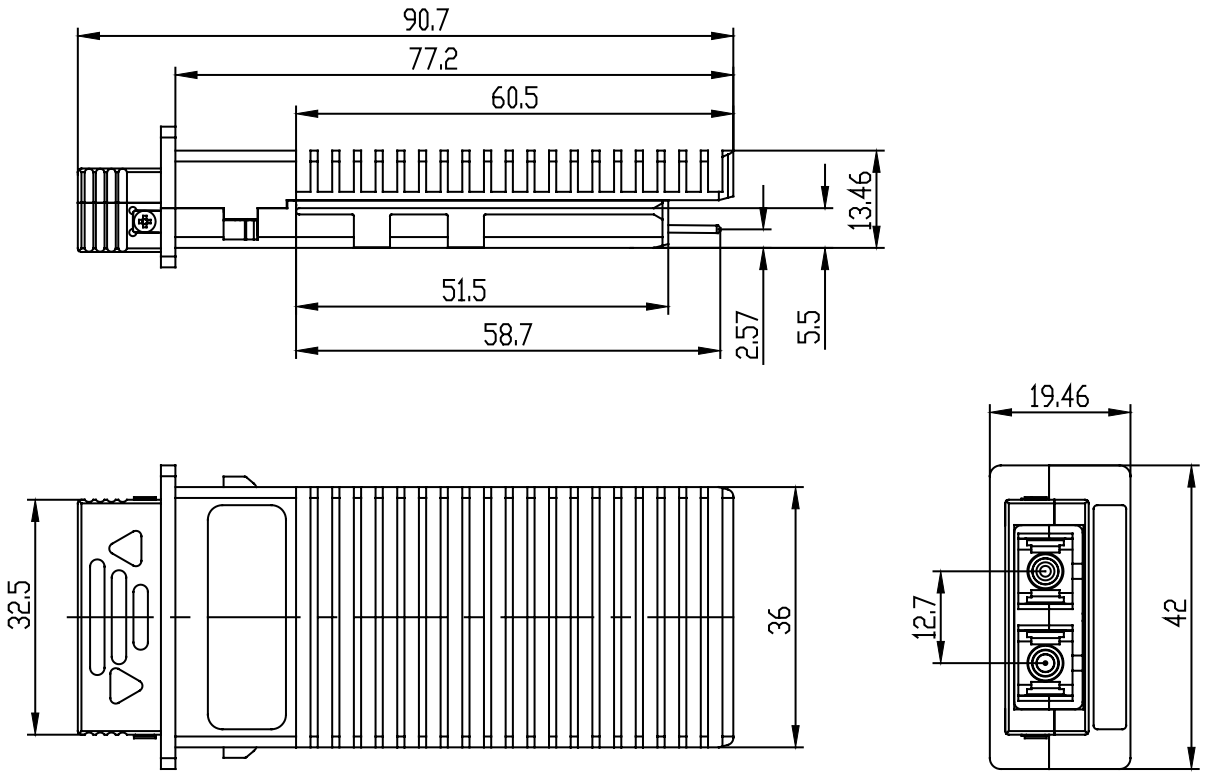
FDA

Compliant to 21 CFR 1040.10 and 1040.11

IEC

Class 1 Laser Product

Mechanical Drawing



Ordering Information

Application	Standard	Part Number
10G Ethernet	IEEE 802.3ae 10GBASE-SR	TRP10GVP2003 TRP10GVP20CA (HP customized)
10G Fibre Channel	1200-M5-SN-I, 1200-M5E-SN-I	TRP10GVP2103

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