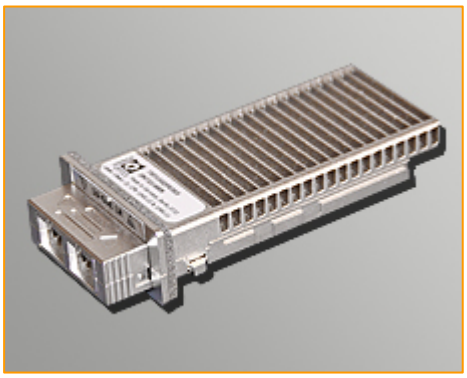
10Gbit/s X2 1310 nm Transponder (TRP10GDP0x03)

Features



- Compatible with X2 MSA Rev. 2.0b
- Support of IEEE 802.3ae 10GBASE-LR at 10.3125Gbit/s (TRP10GDP0303)
- Compliance to Fibre Channel 1200-SM-LL-L at 10.51875Gbit/s (TRP10GDP0403)
- Transmission distance up to 10 km over SMF
- Low Power Consumption 2.0 W (typ.)
- Case Temperature Range 0°C - 70°C
- Laser Class 1 compliant
- SC duplex connector
- Uncooled 1310nm DFB Laser
- Hot pluggable 70-pin connector with XAUI electrical interface
- Management and control via MDIO 2-wire interface
- Complaint with the EU RoHS 6 Environmental requirements

General Description and Applications

The TRP10GDP0x03 is a highly integrated, serial optical transponder module for high-speed, 10Gbit/s data transmission applications. The module is fully compliant to IEEE 802.3ae standard for Ethernet, making it ideally suited for 10 GbE datacom (rack-to-rack, client interconnection) applications. Designed for distances of up to 10km the transponder module comprises a transmitter with a directly modulated uncooled 1310nm DFB laser, a receiver with a PIN photodiode, a XAUI-Attachment Interface, an integrated Coder / Decoder and multiplexer / demultiplexer (SERDES: Serializer / Deserializer). The transponder operates within a wide case temperature range of 0°C to +70°C and offers optimum heat dissipation and excellent electromagnetic shielding which enables high port densities for 10 GbE systems. A 70 pin electrical connector and a duplex SC connector optical interface assure that connectivity is compliant to the X2 and XENPAK MSA.

Standard	*Description*	*Nominal Baud Rate*	*Unit*
IEEE 802.3ae	10 GBASE-LR	10.3125	GBd
10GFC Rev. 4.0	1200-SM-LL-L	10.5128	GBd

CONTENT:

Absolute Maximum Ratings

Rating	*Conditions/Remark*	*Symbol*	*Min*	*Max*	*Units*
Storage Ambient Temperature	non condensing	ϑ_{stg}	-40	+85	°C
Powered Case Temperature	non condensing	ϑ_{c}	-10	+75	°C
Adaptable Power Supply (APS)	Voltage @ Pin APS Sense	$V_{APSsense}$	-0.3	1.5	V
Supply Voltage 3.3V Rail		V_{CC3}	-0.3	4.0	V
Supply Voltage 5V Rail		V_{CC5}	-0.5	7.0	V
Input Voltage Low Speed Signals	RESET, TxOn/Off, PRTADR4..0	V_{I}	-0.5	3.3	V
Clamp Currents Low Speed Signals	RESET, TxOn/Off, PRTADR4..0 V<0V	I_{IK}	-50		mA
LASI Voltage		V_{Q}	-0.5	3.3	V
LASI Sink Current	Continuous Sink Current	I_{QL}		20	mA
XAUI Input Level		V_{IXAUI}	-0.4	2.3	V
Differential XAUI Input Amplitude		$\|V_{IDXAUI}\|$		1000	mV
Optical Receiver Input Power	Average Receiver Input Power	P_{Rx}		+1.5	dBm
Static Discharge Voltage	MIL STD 883 Method 3015.1			500	V

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

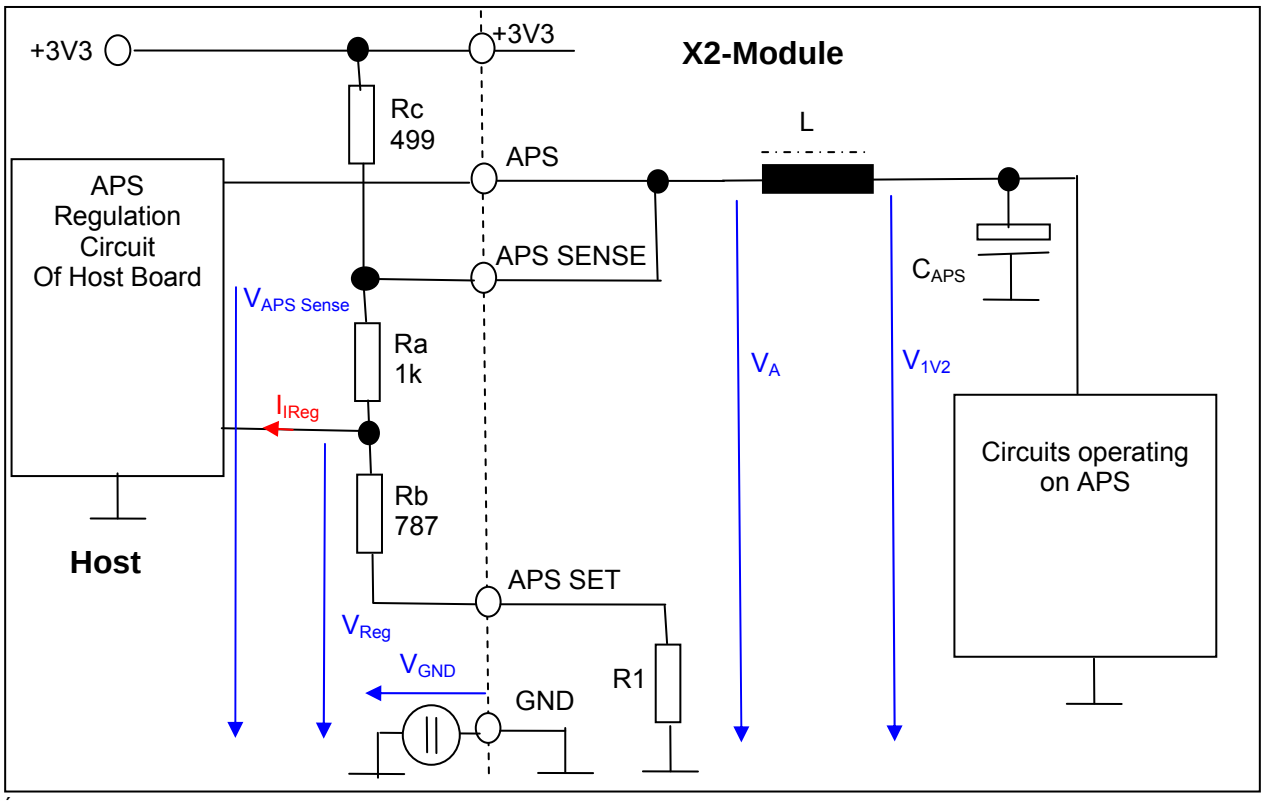
Recommended Operating Conditions

Parameter	*Conditions / Remark*	*Symbol*	*Min*	*Typ*	*Max*	*Units*
Operating Case Temperature Range		ϑ_{Case}	0		+70	°C
APS Feedback Voltage[1)2)]	Ra=1kΩ ±0,1%, Rb=787Ω±0,1%	$V_{Feedback}$	770	800	815	mV
	Ra=1kΩ ±1%, Rb=787Ω±1%	$V_{Feedback}$	785		812	mV
APS Sense Voltage[1)2)]	Just for informational purposes	$V_{APSsense}$	1.164	1.21	1.265	V
Power Supply Voltage @ 3.3V		V_{CC3}	3.135	3.3	3.465	V
Power Supply Voltage @ 5.0V		V_{CC5}	4.75	5.00	5.25	V

1) The device is supposed to operate in the APS control environment described and specified in the XENPAK-MSA (page 22 to 24 of Revision 3.0). In this environment the *APS-Sense Voltage* requirements will be automatically satisfied if *APS-Feedback Voltage* is within its recommended range. The operating *APS-Sense Voltage* is for informational purposes and is subject to be changed without further notice.

2) A 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	P_{Rx} = 0 …0.5… 1.125mW	I_{VCC5}	0.38	0.7	3.5	mA
3.3V Supply Current	RESET=H, TxOn/Off = H	I_{VCC3}	310	360	576	mA
APS Supply Current	$V_{Feedback}$ = 785…800…812mV	I_{VCCAPS}	550	650	755	mA
APS-Input Capacitance		C_{APS}	127	158	200	µF

XAUI - Interface

XAUI Input Characteristics

Parameter	Conditions	Symbol	Min	Typ	Max	Units
Data Rate	10GBASE-LR module			3.125		GBd
	1200-SM-LL-L module			3.1875		GBd
	Relative Tolerance		-100		+100	ppm
Differential Input Voltage Swing	8B/10B Coded Input Signal	V_{ID}	175		2,000	mV_{P-P}
Differential Return Loss	100MHz – 2.5GHz	SDD11	10			dB
Common Mode Return Loss	100MHz – 2.5GHz	SCC11	6			dB
Total Peak-to-Peak Jitter Tolerance	Sinusoidal Jitter @ 0 … 20MHz	T_{jRDS}	0.32			UI
Differential Input Impedance		R_{IND}	80	100	120	Ω

Note: XAUI-input-Lanes are ac-inputs.

XAUI Output Characteristics

Parameter	Conditions	Symbol	Min	Typ	Max	Units
XAUI Data Rate	10GBASE-LR module			3.125		GBd
	1200-SM-LL-L module			3.1875		GBd
	XAUI Data Rate Tolerance		-100		+100	ppm
Differential Output Voltage Swing	R_{LOAD} = 100Ω ± 5%		800		1,600	mV_{P-P}
Differential Output Impedance		R_{QD}	80	100	120	Ω
Differential Transition Time	20% - 80%		50		130	ps
Total Output Jitter					0.17	UI
Total Deterministic Output Jitter					0.08	UI

Note: XAUI-output-Lanes are ac-outputs.

Optical Interface

Recommended Operating Conditions

Parameter	*Remark*	*Symbol*	*Min*	*Typ*	*Max*	*Units*
Operating Range	Single Mode Fiber	I_{OP}	2		10,000	m
Input Data Rate	10GBASE-LR module	DR_o		10.3125		Gbd
	1200-SM-LL-L module			10.51875		GBd
	relative tolerance	$\Delta DR/DR_{typ}$	-100		+100	ppm
Receiver Input Signal	Center Wavelength	λ_C	1,260	1,310	1,360	nm
	Average Input Power	P_{IN}	-11		0.5	dBm
	Input Signal Amplitude[1]	P_{INP}	22.5		P_{IN}	μW_p

1) Amplitude means difference from average power to either eye opening boundary.

Transmitter Characteristics

if not otherwise mentioned under recommended operating conditions and standard compliant single mode fiber.

Characteristic	*Conditions*	*Symbol*	*Min*	*Typ*	*Max*	*Units*
Data Rate	10GBASE-LR module	DR		10.3125		Gbps
	1200-SM-LL-L module			10.51875		Gbps
	relative tolerance to nominal DR	$\Delta DR/DR_{typ}$	-100		100	ppm
Nominal Wavelength		λ_{TRP}	1,260	1,310	1,355	nm
Side Mode Suppression Ratio		SMSR	30			dB
Optical Output Power		P_{out}	-6		0.5	dBm
Extinction Ratio	EOL	ER	3.5	8		dB
Optical Modulation Amplitude		OMA	500			µW
Transmitter Penalty	Bessel-Thompson Filter	TP			3	dB
Overshoot	Bessel-Thompson Filter	OS			40	%

Receiver Characteristics

if not otherwise mentioned under recommended operating conditions and standard compliant single mode fiber.

Parameter	*Conditions*	*Symbol*	*Min*	*Typ*	*Max*	*Units*
Data Rate	10GBASE-LR module	DR		10.3125		Gbps
	1200-SM-LL-L module			10.51875		Gbps
	relative tolerance to nominal DR	$\Delta DR/DR_{typ}$	-100		100	ppm
Receiver Sensitivity	OMA, BER 10^{-12} @ 2^{31}-1	P_{INpp}			-12.6	dBm
Stressed Receiver Sensitivity	OMA	P_{INpp}			-10.3	dBm
Saturation Input Power		P_{SAT}	0.5			dBm

Note: [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. Changing the settings of the optical output power will affect the dynamic behavior of the output signal. Unless otherwise noted, typical data is quoted at nominal voltages and +25°C ambient temperature.

MDIO Interface

DC Characteristics

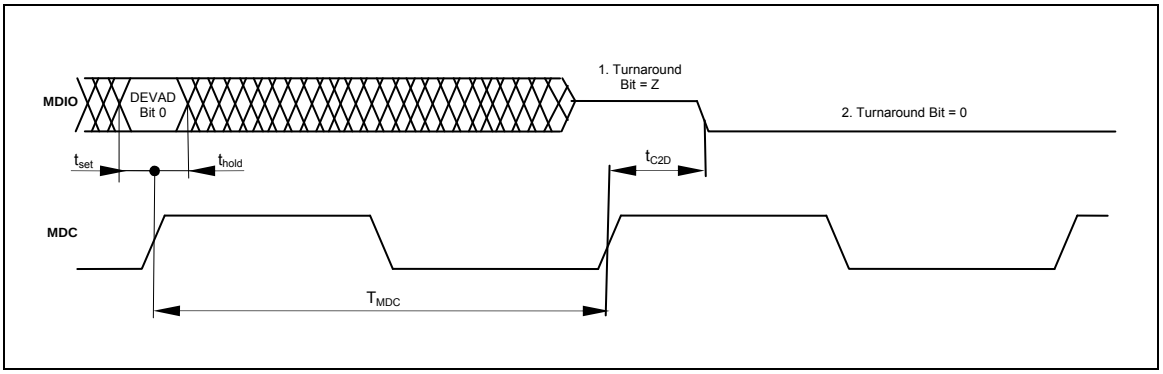
if not otherwise mentioned under the recommended operating conditions.

Characteristic	*Condition*	*Symbol*	*Minimum*	*Maximum*	*Unit*
Input high voltage		V_{IH}	0.84	1.5	V
Input low voltage		V_{IL}	-0.3	0.36	V
MDIO Input current	MMD Driver in tri-state	I_{IMDIO}	-10	8	µA
MDC Input current		I_{IMDC}	-5	5	µA
Output low voltage	I_{OL} = 100µA	V_{QL}	-0.3		V
	I_{OL} = 4mA	V_{QL}		0.2	V
Output high voltage	$R_{PULL-Up}$ = 357Ω ±1% $V_{PULL-Up}$ = 1.14…1.5V	V_{QH}	1.136	1.5	V
Output low current	V_I = 0.2V	I_{QL}	+4		mA
MDIO Input capacitance	V_I = 0…1.5V	C_{in}		10	pF

AC Characteristics

if not otherwise mentioned under the recommended operating conditions. Furthermore its recommended that clock period time T_{MDC} is not less than 310ns and the sum of input currents of loads on the bus does not exceed 256µA at high and at low not below -320µA.

Characteristic	*Condition*	*Symbol*	*Minimum*	*Maximum*	*Unit*
Set Up Time		t_{set}		10	ns
Hold Time		t_{hold}		10	ns
Clock to Data Time	$R_{PULL-Up}$ = 357Ω ±1%, C_{BUS}≤470pF	t_{C2D}	0	300	ns



Example Timing Diagram: Turnover Timing at Read Cycle

Electro Static Discharge (ESD)

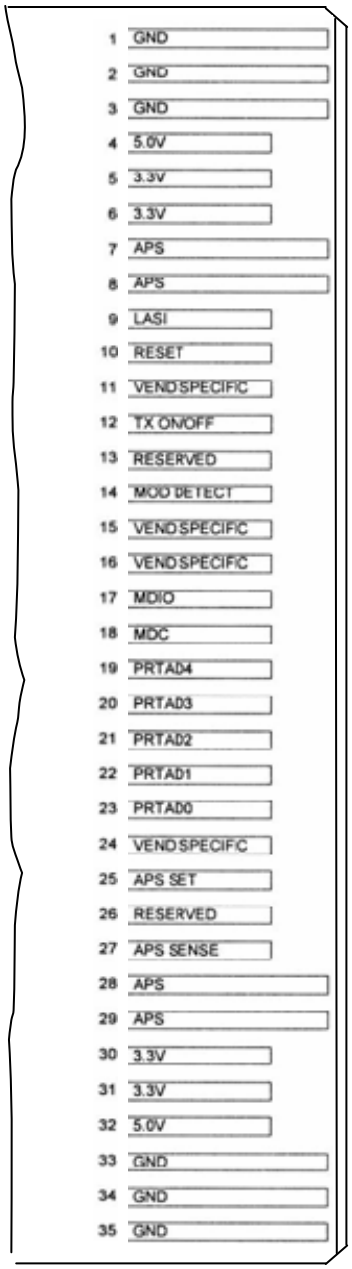
The maximum electrostatic charge based on a human body model and the conditions as outlined below is:

Parameter	*Conditions*	*Symbol*	*Min*	*Typ*	*Max*	*Units*
Static Discharge Voltage	MIL STD 883 Method 3015.1			500	V	

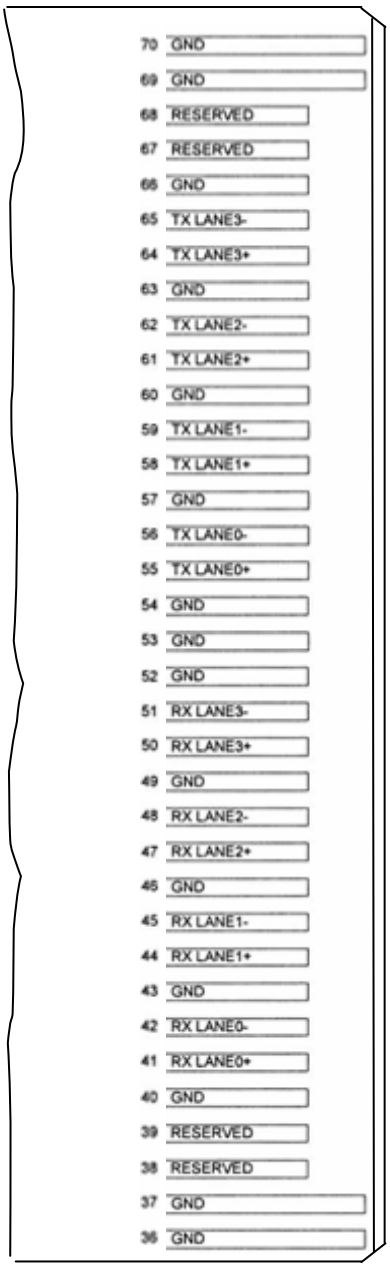
Thermal Management

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 not to exceed this temperature range. It has to be considered that in case of usage of multiple modules on a single hostboard that there is a temperature rise among the modules hosted side by side (see figure below). Airflow direction and air speed needs to be choosen accordingly. For further information it is referred to the MSA document.

Card-Edge-Connector-Pinning and Layout



Top view -Top side



Top view-Bottom row (as seen through PCB)

Electrical Pin Definition – Pins 01 to 40 of 70

Symbol	*Logic*	*PIN*	*Name / Description*	*Note*
3.3V		5, 6, 30, 31	Power Supply of Optical Receiver and Transmitter and Control Circuits	2
5.0V		4, 32	Power Supply of Optical Receiver Frontend	2
APS		7, 8, 28, 29	Adaptive Power Supply, Supply of PHY XS and PCS Layer Devices	2
APS SENSE		27	APS Sense Output for APS Control Circuit	
APS SET		25	Feedback Input for APS, Input of APS Setting Resistor	
GND		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 Output	9	Link Alarm Status Interrupt, 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		18	Management Clock Input	3
MDIO		17	Management Data IO	3
MOD DETECT		14	1kΩ to Ground for APS Circuit Environment	
PRTADO	1.2V CMOS Input	23	Port Address Bit 0 (Low = 0), internally pulled up by 18kΩ	
PRTAD1	1.2V CMOS Input	22	Port Address Bit 1 (Low = 0), internally pulled up by 18kΩ	
PRTAD2	1.2V CMOS Input	21	Port Address Bit 2 (Low = 0), internally pulled up by 18kΩ	
PRTAD3	1.2V CMOS Input	20	Port Address Bit 3 (Low = 0), internally pulled up by 18kΩ	
PRTAD4	1.2V CMOS Input	19	Port Address Bit 4 (Low = 0), internally pulled up by 18kΩ	
RESERVED		13, 38, 39, 67, 68	Reserved by MSA, internally not connected	
RESERVED		26	Reserved for Avalanche Photodiode use, internally not connected	5
RESET	1.2V CMOS Input	10	Low active Reset Input 10KΩ pull-up on Transceiver Logic high = Normal Operation Logic Low = Reset asserted	
TX ON/OFF	1.2V CMOS Input	12	High active Transmitter Enable Input 10KΩ pull-up on Transceiver Logic high = Transmitter active (normal Operation) And Register Bit 1.9.0 set to low as well Logic Low = shut down of Transmitter	
VENDSPECIFIC		11, 15, 16, 24	Vendor Specific Pin,. for proper operation leave unconnected	5

Electrical Pin Definition – Pins 41 to 70 of 70

Symbol	*Logic*	*PIN*	*Name / Description*	*Note*
RX LANE0+		41	Module XAUI Output Lane 0+	4
RX LANE0-		42	Module XAUI Output Lane 0-	4
RXLANE1+		44	Module XAUI Output Lane 1+	4
RXLANE1-		45	Module XAUI Output Lane 1-	4
RX LANE2+		47	Module XAUI Output Lane 2+	4
RX LANE2-		48	Module XAUI Output Lane 2-	4
RX LANE3+		50	Module XAUI Output Lane 3+	4
RX LANE3-		51	Module XAUI Output Lane 3-	4
TX LANE0+		55	Module XAUI Input Lane 0+	4
TX LANE0-		56	Module XAUI Input Lane 0-	4
TXLANE1 +		58	Module XAUI Input Lane 1+	4
TXLANE1-		59	Module XAUI Input Lane 1-	4
TX LANE2+		61	Module XAUI Input Lane 2+	4
TX LANE2-		62	Module XAUI Input Lane 2-	4
TX LANE3+		64	Module XAUI Input Lane 3+	4
TX LANE3-		65	Module XAUI Input Lane 3-	4

1) Ground connections are common for TX and RX.
2) Each connector contact is rated at 0.5A.
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

Eye Safety

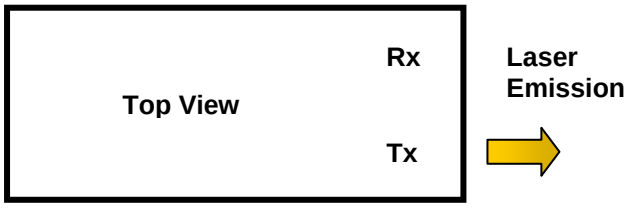
This laser based multimode transceiver is a Class 1 product. It complies with IEC 60825-1: 2007 and FDA performance standards for laser products (21 CFR 1040.10 and 1040.11) except for deviations pursuant to Laser Notice 50, dated June 24, 2007.

CLASS 1 LASER PRODUCT

Caution: use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation.

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	1310 nm
Maximum total output power (as defined by IEC: 7 mm aperture at 70 mm distance)	15.6 mW / 11.9 dBm
Beam divergence (full angle) / NA (half angle)	11° / 0.1 rad

Required Labeling

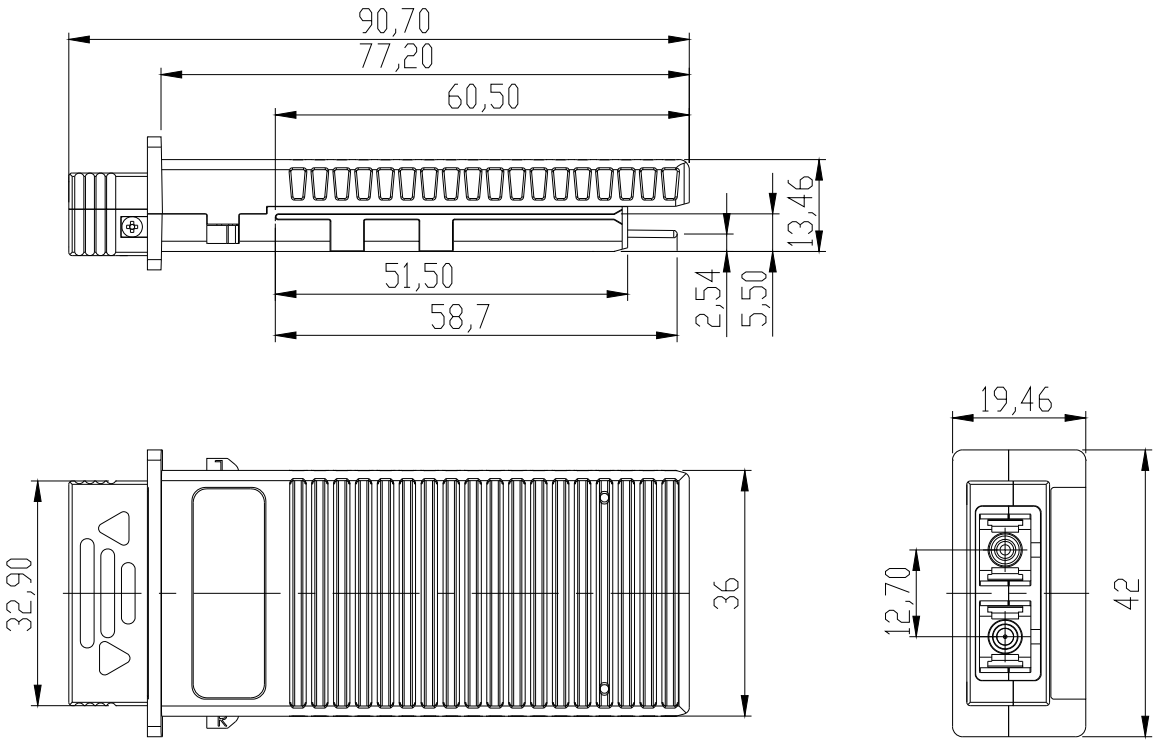
FDA

Compliant to 21 CFR 1040.10 and 1040.11

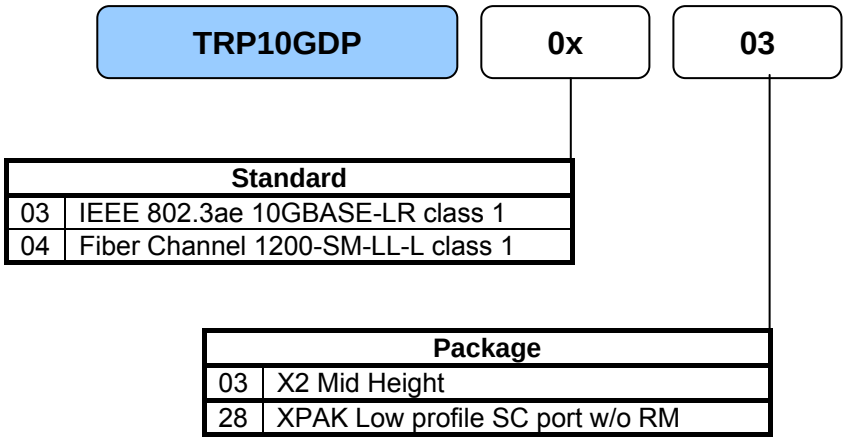
IEC

Class 1 Laser Product

Mechanical Drawing



Order Information



Standard	
03	IEEE 802.3ae 10GBASE-LR class 1
04	Fiber Channel 1200-SM-LL-L class 1

Package	
03	X2 Mid Height
28	XPAK Low profile SC port w/o RM

For further information please contact us at info@mergeoptics.com or visit our website www.mergeoptics.com.