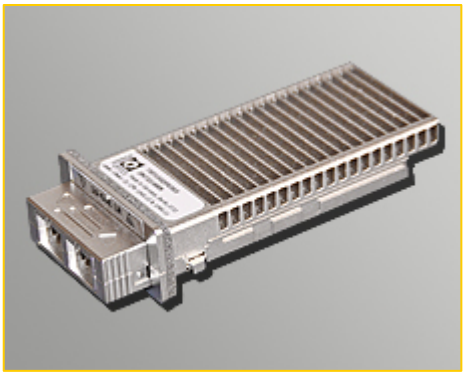
# 10Gbit/s X2 850 nm Transponder (TRP10GVP200x / TRP10GVP210x)

## Features



- Compatible with X2 MSA Rev. 2.0b
- Support of IEEE 802.3ae 10GBASE-SR at 10.3125 Gbit/s (TRP10GVP200x)
- Compliance to Fibre Channel 1200-M5-SN-I, 1200-M5E-SN-I, 1200-M6-SN-I at 10.51875 Gbit/s (TRP10GVP210x)
- Transmission distance up to 300m (special MMF)
- Power Consumption 1.7 W (typ.)
- Temperature Range 0…70°C
- Laser Class 1 compliant
- Vertical Cavity Surface Emitting Laser at 850 nm (VCSEL)
- 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 environmental requirements

## General Description and Applications

The TRP10GVP200x/210x is a highly integrated, serial optical transponder module for high-speed, 10Gbit/s data transmission applications. It is ideally suited for 10 GbE datacom (belly-to-belly for high density applications) and storage area network (SAN / NAS) applications based on the IEEE 802.3ae standard as well as the Fiber 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 a XAUI-Attachment Interface, an integrated Coder / Decoder and multiplexer / demultiplexer (SERDES: Serializer / Deserializer). The transponder operates within a wide temperature range of 0°C to +70°C and offers optimum heat dissipation and excellent electromagnetic shielding thus enabling high port densities for 10 GbE or 10GFC 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-2002 (TRP10GVP200x) | 10 GBASE-SR | 10.3125 | GBd |
| Fiber Channel 10GFC Rev. 4.0 (TRP10GVP212x) | 1200-SM-L-LL | 10.51875 | GBd |

# Content:

# Electrical Characteristics

## Absolute Maximum Ratings

| *Rating* | *Conditions/Remark* | *Symbol* | *Min* | *Max* | *Units* |
|---|---|---|---|---|---|
| Storage Ambient Temperature | non condensing | $\vartheta_{stg}$ | -40 | +85 | °C |
| Powered Case Temperature | non condensing | $\vartheta_{c}$ | 0 | +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 | | $V_{CC5}$ | -0.3 | 6.0 | V |
| Input Voltage Low Speed Signals | RESET, TxOn/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 | Inputs are AC coupled | $\|V_{IDXAUI}\|$ | | 2500 | mV |
| Optical Receiver Input Power | Maximum receive power for demage | $P_{Rx}$ | | +4.0 | 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.

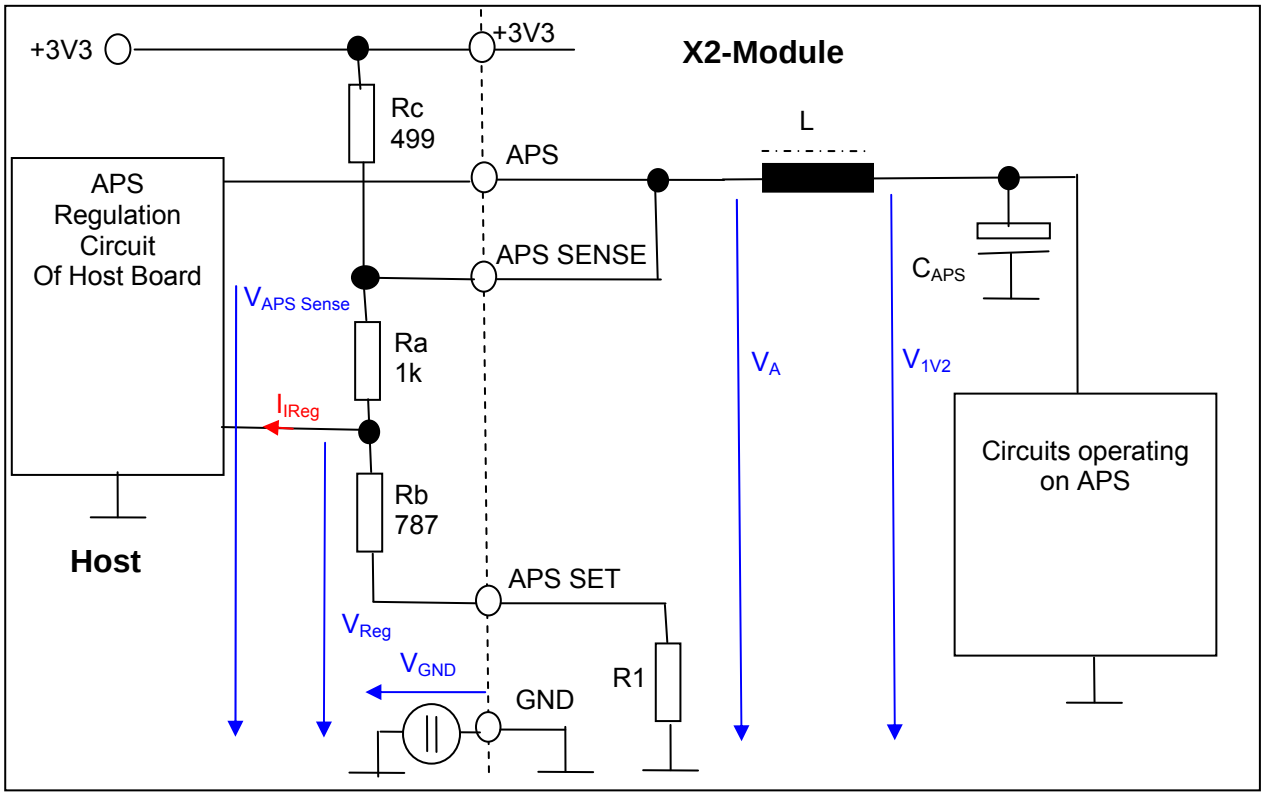
## Recommended Operating Conditions

| *Parameter* | *Conditions / Remark* | *Symbol* | *Min* | *Typ* | *Max* | *Units* |
|---|---|---|---|---|---|---|
| Operating Case Temperature Range | worst case thermal location | $\vartheta_{Case}$ | 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)] | Just for informational purposes | $V_{APSsense}$ | 1.164 | 1.205 | 1.235 | 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 | | $I_{VCC5}$ | 3 | 5 | 8 | mA |
| 3.3V Supply Current | | $I_{VCC3}$ | 200 | 235 | 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 |

Note: RESET=H, TxOn/Off = H

## XAUI Input Characteristics

| *Parameter* | *Conditions* | *Symbol* | *Min* | *Typ* | *Max* | *Units* |
|---|---|---|---|---|---|---|
| Nominal XAUI Baud Rate | Ethernet<br>Fibre Channel | | | 3.125<br>3.1875 | | GBd |
| Nominal XAUI Baud Rate Tolerance | Relative 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<br>(Referenced to 100Ω) | SDD11 | 10 | | | dB |
| Common Mode Return Loss | 100MHz – 2.5GHz<br>(Referenced to 25Ω) | SCC11 | 6 | | | dB |
| Input differential skew | at crossing point | $T_{jRDS}$ | | | 75 | $ps_{P-P}$ |
| Total Peak-to-Peak Jitter Tolerance | Sinusoidal Jitter @ 0 … 20MHz | $T_{jRDS}$ | 0.55 | | | $UI_{P-P}$ |
| Differential Input Impedance | | $R_{IND}$ | 80 | 100 | 120 | Ω |

Note: XAUI-input-Lanes are ac-coupled

## XAUI Output Characteristics

| *Parameter* | *Conditions* | *Symbol* | *Min* | *Typ* | *Max* | *Units* |
|---|---|---|---|---|---|---|
| Nominal XAUI Baud Rate | Ethernet<br>Fibre Channel | | | 3.125<br>3.1875 | | GBd |
| Nominal XAUI Baud Rate Tolerance | Relative Tolerance | | -100 | | +100 | ppm |
| Differential Output Voltage Swing | $R_{LOAD}$ = 100Ω ± 5% | | | 800 | 1600 | $mV_{P-P}$ |
| 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-output-Lanes are ac-coupled

# Optical Interface

## Recommended Operating Conditions

| *Parameter* | *Conditions* | *Min Modal Bandwidth (MHz*km)* | *Symbol* | *Min* | *Typ* | *Max* | *Units* |
|---|---|---|---|---|---|---|---|
| Operating Range | 62.5 µm MMF<br>50 µm MMF<br>62.5 µm MMF<br>50 µm MMF<br>50 µm MMF | 160<br>400<br>200<br>500<br>2000 | $l_{OP}$ | 2<br>2<br>0.5<br>0.5<br>0.5 | | 26<br>66<br>33<br>82<br>300 | m |
| Receiver Input Signal | Center Wavelength | | $\lambda_C$ | 840 | 850 | 860 | nm |
| | Average Input Power | | $P_{IN}$ | -9.9 | | -1.0 | dBm |

## Transmitter Characteristics

| *Parameter* | *Conditions* | *Symbol* | *Min* | *Typ* | *Max* | *Units* |
|---|---|---|---|---|---|---|
| Data Rate | TRP10GVP200x<br>TRP10GVP210x | DR | | 10.3125<br>10.51875 | | Gbps |
| | relative tolerance | $\Delta DR/DR_{typ}$ | -100 | | 100 | ppm |
| Nominal Wavelength | | $\lambda_{TRP}$ | 840 | 850 | 860 | nm |
| Spectral Width | | $\Delta\lambda$ | | 0.4 | 0.45 | nm |
| Optical Output Power | | $P_{opt, avg}$ | -3 | -2.3 | -1 | dBm |
| Extinction Ratio | | ER | 5 | 6.5 | | dB |
| Optical Modulation Amplitude | | OMA | 525 | | | µW |
| Transmitter and Dispersion Penalty | | TDP | | | 3.9 | dB |
| Relative Intensity Noise | | RIN | | | -128 | dB/Hz |

## Receiver Characteristics

| *Parameter* | *Conditions* | *Symbol* | *Min* | *Typ* | *Max* | *Units* |
|---|---|---|---|---|---|---|
| Data Rate | TRP10GVP200x<br>TRP10GVP210x | DR | | 10.3125<br>10.51875 | | Gbps |
| | relative tolerance | $\Delta DR/DR_{typ}$ | -100 | | 100 | ppm |
| 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 | | $P_{SAT}$ | +1.0 | | | 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. 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 operating conditions.

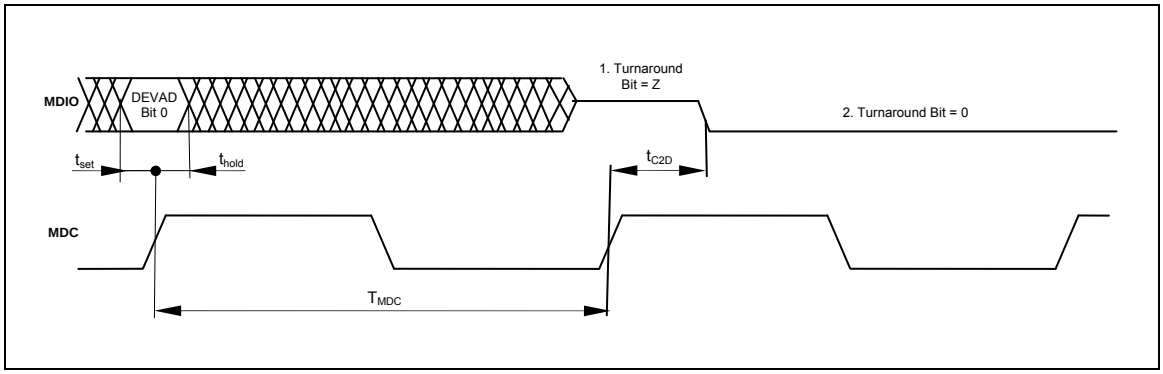
| Characteristic | Condition | Symbol | Minimum | Typ | Maximum | Unit |
|---|---|---|---|---|---|---|
| Pull-up supply voltage | | $V_{pu}$ | | 1.2 | | V |
| Input high voltage | 3.3V tolerant | $V_{IH}$ | 0.84 | | | V |
| Input low voltage | | $V_{IL}$ | | | 0.36 | V |
| Output low voltage | $I_{OL}$ = 4mA | $V_{QL}$ | | | 0.2 | V |
| Output high voltage | $I_{OH}$ = - 100µA | $V_{QH}$ | | | $V_{pu}$ | V |
| Input capacitance | $V_I$ = 0…$V_{pu}$ | $C_{in}$ | | | 10 | pF |
| Load capacitance | $V_I$ = 0…$V_{pu}$ | $C_{load}$ | | | 470 | pF |
| Pull-up resistance | with 1.2V pull-up voltage | $R_{pu}$ | 180 | | | Ω |
| | with 3.3V pull-up voltage | $R_{pu}$ | 500 | | | Ω |

## AC Characteristics

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 | 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) Note: delay is measured from MDC rising edge Vih_min level (0.84V) to MDIO rising edge Vih_min level (0.84V) or MDIO falling edge Vil_max level (0.36V)




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 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. Airflow direction and air speed needs to be chosen accordingly.

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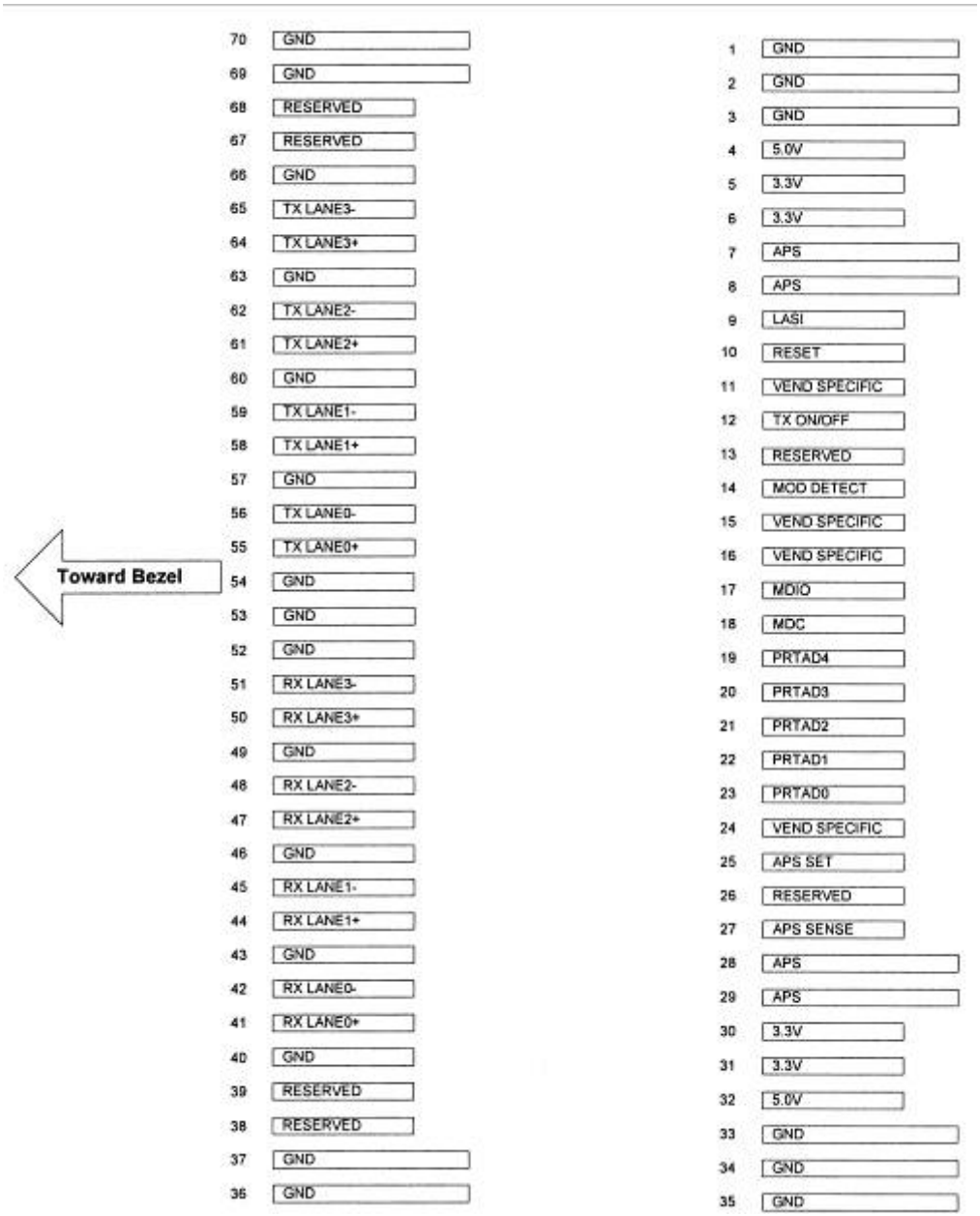
# Edge-Board-Connector-Pinning and Layout




**Top of Transceiver PCB** **Bottom of Transceiver PCB**

(as viewed through top)

## Electrical Pin Definition (Part 1)

| *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<br>A pull-up resistor with 10-22KΩ to 1,2V is expected.<br>Logic High: Normal Operation<br>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 Bit 0 | |
| PRTAD1 | 1.2V CMOS | I | 22 | Port Address Bit 1 | |
| PRTAD2 | 1.2V CMOS | I | 21 | Port Address Bit 2 | |
| PRTAD3 | 1.2V CMOS | I | 20 | Port Address Bit 3 | |
| PRTAD4 | 1.2V CMOS | I | 19 | Port Address Bit 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<br>10KΩ pull-up on Transceiver<br>Logic high = Normal Operation<br>Logic Low = Reset asserted | |
| TX ON/OFF | 1.2V CMOS Open Drain | I | 12 | High active Transmitter Enable Input<br>10KΩ pull-up on Transceiver<br>Logic high = Transmitter active (normal Operation)<br>And Register Bit 1.9.0 set to low as well<br>Logic Low = shut down of Transmitter | |
| VEND SPECIFIC | | | 11, 15, 16, 24 | Vendor Specific Pin. Leave unconnected. | 5 |

## Electrical Pin Definition (Part 2)

| *Symbol* | *Logic* | *I/O* | *PIN* | *Name / Description* | *Note* |
|---|---|---|---|---|---|
| RX LANE0+ | AC-coupled, internally based differential CML | O | 41 | Module XAUI Output Lane 0+ | 4 |
| RX LANE0- | | O | 42 | Module XAUI Output Lane 0- | 4 |
| RX LANE1+ | | O | 44 | Module XAUI Output Lane 1+ | 4 |
| RX LANE1- | | 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 |
| TX LANE0+ | AC-coupled, internally based differential CML | I | 55 | Module XAUI Input Lane 0+ | 4 |
| TX LANE0- | | I | 56 | Module XAUI Input Lane 0- | 4 |
| TX LANE1+ | | I | 58 | Module XAUI Input Lane 1+ | 4 |
| TX LANE1- | | I | 59 | Module XAUI Input Lane 1- | 4 |
| TX LANE2+ | | I | 61 | Module XAUI Input Lane 2+ | 4 |
| TX LANE2- | | 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

# Eye Safety

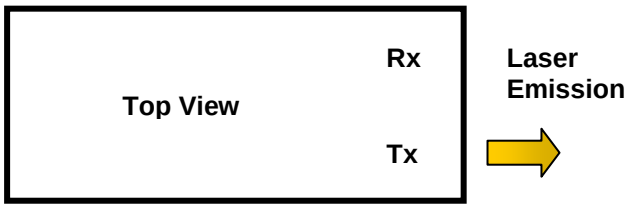
This laser based multimode transceiver is a Class 1 product. It complies with IEC 60825-1 Ed.2 : 2007 and FDA performance standards for laser products (21 CFR 1040.10 and 1040.11) except for deviations pursuant to Laser Notice 50, dated June 24, 2007.

**CLASS 1 LASER PRODUCT**
**DO NOT VIEW DIRECTLY WITH OPTICAL INSTRUMENTS**

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 | >840 nm |
| Accessible Emission Limit<br>(as defined by IEC: 7 mm aperture at 70 mm distance) | <743 µW |
| Beam divergence (full angle) | 20° / 0.18rad |

## Required Labeling

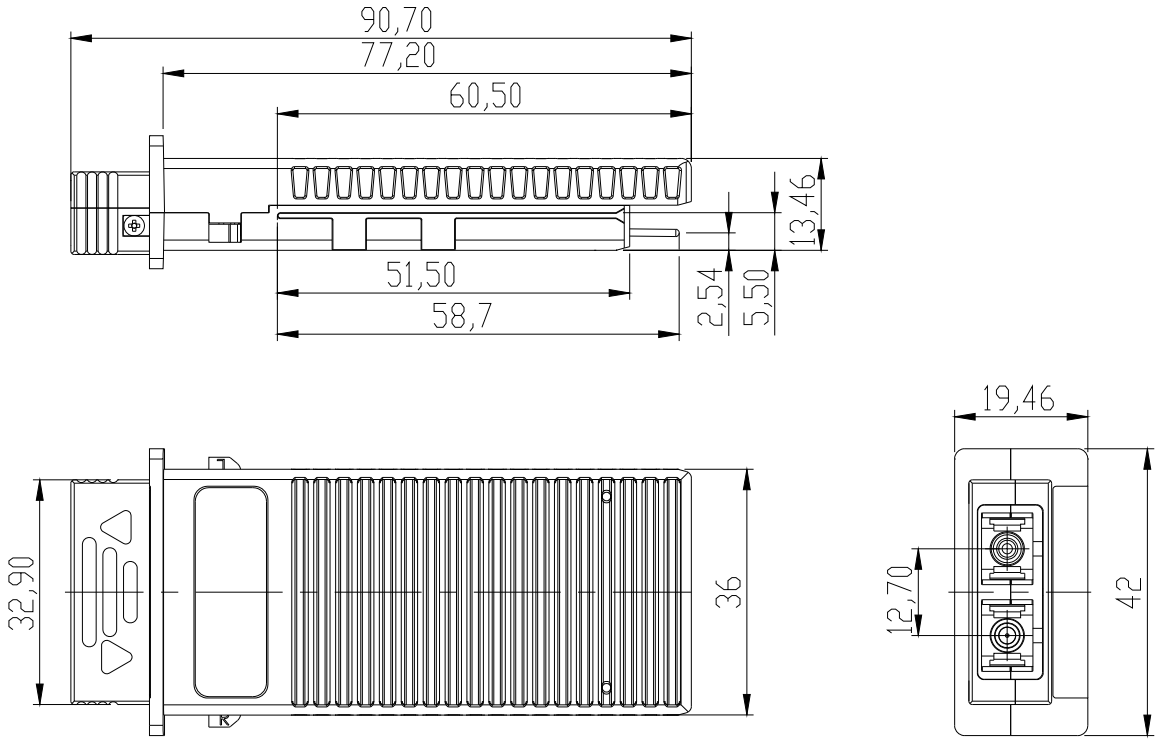
**FDA**

Compliant to 21 CFR 1040.10 and 1040.11

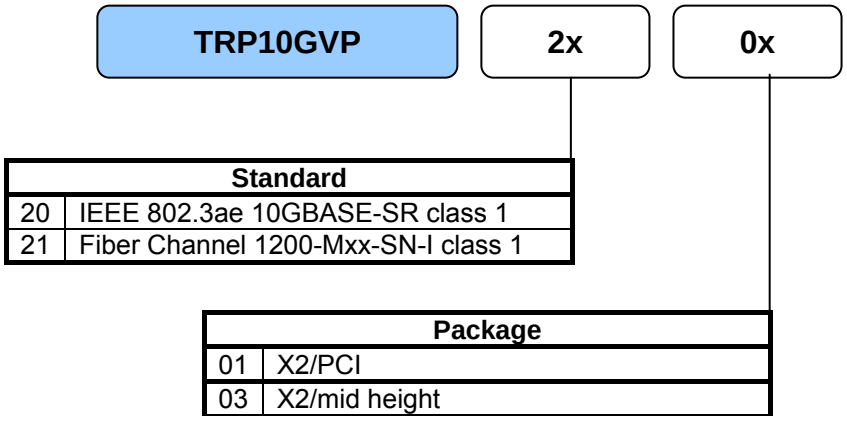
**IEC**

Class 1M Laser Product

# Mechanical Drawing



# Ordering Information




| Standard | |
|---|---|
| 20 | IEEE 802.3ae 10GBASE-SR class 1 |
| 21 | Fiber Channel 1200-Mxx-SN-I class 1 |

| Package | |
|---|---|
| 01 | X2/PCI |
| 03 | X2/mid height |

For more information on our products, please email us at info@mergeoptics.com or visit our website www.mergeoptics.com.