



Product Specification

10Gbit/s X2 1550 nm Transponder (TRP10GEP3003, TRP10GEP30CA)

General Description and Applications

The TRP10GEP3003 is a highly integrated, serial optical transponder module designed for high-speed, 10Gbit/s data transmission applications. The module is fully compliant to the IEEE 802.3ae standard for 10GBASE-ER making it ideally suited for 10 GbE datacom applications (belly-to-belly for high density applications). Designed for long range distances, the transponder module comprises a transmitter with an externally modulated laser (EML), a receiver with a PIN photodiode and an integrated four channel 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 which enables high port densities for 10 GbE systems.



| Standard | Description | Nominal Baud Rate | Unit |
|--------------|----------------------|-------------------|------|
| IEEE 802.3ae | 10 GBASE-ER Ethernet | 10.3125 | GBd |

FEATURES & BENEFITS

- Compatible with X2 MSA Rev. 2.0b
- Compliant to IEEE 802.3ae 10GBASE-ER at 10.3125 Gbit/s
- Transmission distance up to 40km over single mode fiber
- Low Power Consumption 3,0 W (typ.)
- Temperature Range 0°C to + 70°C
- Laser Class 1 compliant
- External Modulated Laser (EML)
- 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

Electrical Characteristics

Absolute Maximum Ratings

| Rating | Conditions/Remark | Symbol | Min | Typ | Max | Units |
|---|----------------------------------|-------------------|------|-----|------|-------|
| Storage Ambient Temperature | non condensing | ϑ_{stg} | -20 | | +85 | °C |
| Operating Case Temperature | non condensing | ϑ_c | 0 | | +80 | °C |
| Adaptable Power Supply (APS) | Voltage @ Pin APS Sense | $V_{APSSense}$ | -0.5 | | 1.5 | V |
| Supply Voltage 3.3V Rail | | V_{CC3} | -0.5 | | 4.0 | V |
| Supply Voltage 5V Rail | | V_{CC5} | -0.5 | | 6.0 | V |
| CMOS Input Voltage Low Speed Signals | RESET, TxON, PRTADR4..0, LASI | V_I | -0.5 | | 3.6 | V |
| CMOS Sink Current CMOS Low Speed Signals | Continuous Sink Current | I_{QL} | | | 20 | mA |
| XAUI DC Voltage | | V_{DCXAUI} | -4 | | +4 | V |
| Differential XAUI Input Amplitude | | $ V_{IDXAUI} $ | 200 | | 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 |

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

DC-Characteristics

| Parameter | Conditions / Remark | Symbol | Min | Typ | Max | Units |
|--|-----------------------------|--------------------|-------|------|-------|-------|
| Operating Case Temperature | worst case thermal location | ϑ_{Case} | 0 | (25) | +70 | °C |
| 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 | 1.236 | V |
| CMOS Output low voltage | | | | | | |
| CMOS Output low current | | | | | | |
| CMOS Input low coltage | | | | | | |
| CMOS Input high voltage | | | | | | |
| CMOS Open-drain output off-state leakage | | | | | | |
| CMOS input / output capacitance | | | | | | |

DC-Characteristics

| Parameter | Conditions | Symbol | Min | Typ | Max | Units |
|-------------------------|-------------------------|---------------------|-----|-------------|------------|-------|
| 5V Supply Current | TXON =1 | I _{VCC5} | | 160 | 210 | mA |
| 3.3V Supply Current | TXON =1 | I _{VCC3} | | 350 | 600 | mA |
| 1,2V APS Supply Current | TXON =1 | I _{VCCAPS} | | 890 | 1,08 | mA |
| Total Power Consumption | TXON =1 | P _{tot} | | 3.0 | 3.6 | W |
| 5V Supply Current | TXON =0, low power mode | I _{VCC5} | | 45 | 50 | mA |
| 3.3V Supply Current | TXON =0, low power mode | I _{VCC3} | | 290 | 330 | mA |
| 1,2V APS Supply Current | TXON =0, low power mode | I _{VCCAPS} | | 150 | 160 | mA |
| Total Power Consumption | TXON =0, low power mode | P _{tot} | | 1,36 | 1,9 | W |

XAUI Output (AC-Coupled)

| Parameter | Conditions | Symbol | Min | Typ | Max | Units |
|------------------------------------|---------------------|------------------------|------|-------|------|-------|
| Nominal XAUI Baud Rate | | | | 3.125 | | GBd |
| Nominal XAUI Baud Rate Tolerance | | | -100 | | +100 | ppm |
| 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 | T _{JXAUI} | | | 0.35 | UI |
| Total Deterministic Output Jitter | no pre-equalization | D _{JXAUI} | | | 0.17 | UI |
| Differential Output Return Loss | 312.5 to 625 MHz | S22 | 8 | | | dB |
| Differential XAUI Output Amplitude | | V _{ODXAUI} | 800 | 1000 | | mVpp |

XAUI Input (AC-Coupled)

| Parameter | Conditions | Symbol | Min | Typ | Max | Units |
|----------------------------------|-------------------|-------------------|------|-------|------|-------|
| Nominal XAUI Baud Rate | | | | 3.125 | | GBd |
| Nominal XAUI Baud Rate Tolerance | | | -100 | | +100 | ppm |
| Differential Return Loss | 100 MHz – 2.5 GHz | SDD11 | 10 | | | dB |
| Input differential skew | At crossing point | T _{JRDS} | | | 75 | pSP-P |
| Differential Input Impedance | | R _{IND} | 80 | 100 | 120 | Ω |

MDIO-Characteristics

Power-On-Characteristics

Register Settings

Optical Characteristics

General Parameters

| Parameter | Conditions | Symbol | Min | Typ | Max | Units |
|--------------------------|------------|-----------|-----|---------|-----|-------|
| Operating Range | | I_{OP} | | | 40 | km |
| Nominal Signalling Speed | | f_{OPT} | | 10.3125 | | GBd |

Optical Transmitter

| Parameter | Conditions | Symbol | Min | Typ | Max | Units |
|--------------------------------|------------|--------------------|------|------|------|-------|
| Nominal Wavelength | | λ_{TRP} | 1530 | 1550 | 1565 | nm |
| Side Mode Suppression Ratio | | SMSR | 30 | | | dB |
| Average Launch Power | | $P_{opt, avg}$ | -4,7 | 0 | 4 | dBm |
| Average Launch Power of OFF TX | | $P_{opt, avg OFF}$ | | | -30 | dBm |
| Extinction Ratio | | ER | 8,2 | 9 | | dB |
| Relative Intensity Noise | | RIN | | | -128 | dB/Hz |

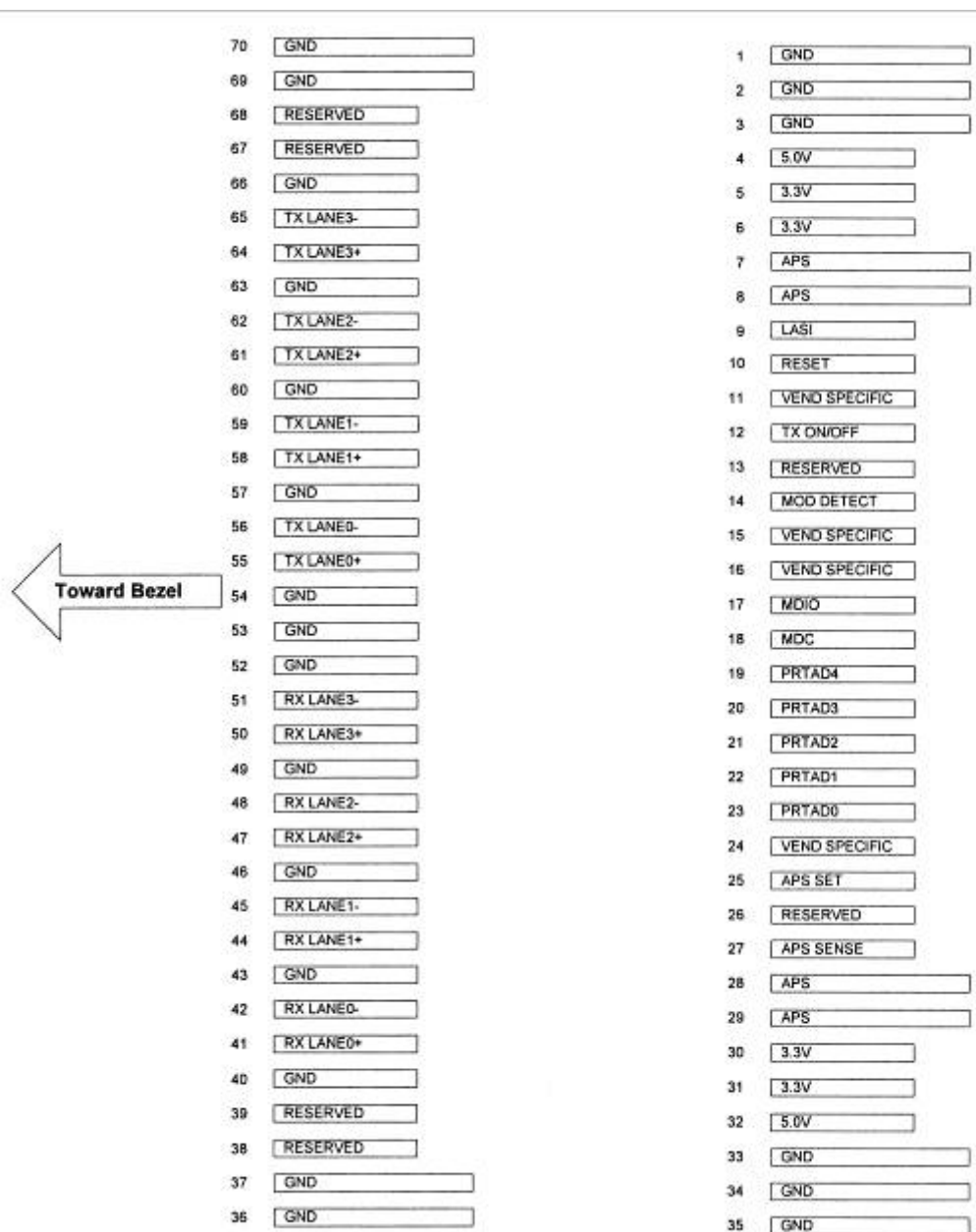
Optical Receiver

| Parameter | Conditions | Symbol | Min | Typ | Max | Units |
|--------------------------------|------------|--------------------|------|------|------|-------|
| Nominal Wavelength | | λ_{TRP} | 1530 | 1550 | 1565 | nm |
| Side Mode Suppression Ratio | | SMSR | 30 | | | dB |
| Average Launch Power | | $P_{opt, avg}$ | -4,7 | -0,5 | 4 | dBm |
| Average Launch Power of OFF TX | | $P_{opt, avg OFF}$ | | | -30 | dBm |
| Extinction Ratio | | ER | 8,2 | 9 | | dB |
| Rx OMA | | | | | | |
| Relative Intensity Noise | | RIN | | | -128 | dB/Hz |

Note: ¹with 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.

Edge-Board-Connector-Pinning and Layout



Top of Transceiver PCB

Bottom of Transceiver PCB

(as viewed through the 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 Front-end | 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 10K Ω - 22K Ω 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 k Ω pull-up to 1.2 V on host. | 3 |
| MOD DETECT | | O | 14 | 1k Ω to 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 10K Ω pull-up on Transceiver Logic high = Normal Operation Logic Low = Reset asserted | |
| RX LANE0+ | AC-coupled, internally biased differential XAUI | 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 |

Electrical Pin Definition

| <i>Symbol</i> | <i>Logic</i> | <i>I/O</i> | <i>PIN</i> | <i>Name / Description</i> | <i>Note</i> |
|------------------|---|------------|----------------|--|-------------|
| TX LANE0+ | AC-coupled, internally based differential XAU | 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 |
| TX ON/OFF | 1.2V CMOS Open Drain | I | 12 | High active Transmitter Enable Input 10K Ω 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 | |
| VEND SPECIFIC | | | 11, 15, 16, 24 | Vendor Specific Pin. Leave unconnected. | 5 |

- 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:

| <i>Parameter</i> | <i>Conditions</i> | <i>Symbol</i> | <i>Min</i> | <i>Typ</i> | <i>Max</i> | <i>Units</i> |
|--------------------------|---------------------------|---------------|------------|------------|------------|--------------|
| Static Discharge Voltage | MIL STD 883 Method 3015.1 | | | | 500 | V |

Thermal Management

The transponder is designed for -operation within a case temperature range between 0°C to +70°C at an altitude of < 3km. The built in heat-sink provides 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 host-board, the temperature will rise among the modules hosted side by side (see figure below). Airflow direction and air speed needs to be chosen accordingly.

Please refer to the MSA document for further information.

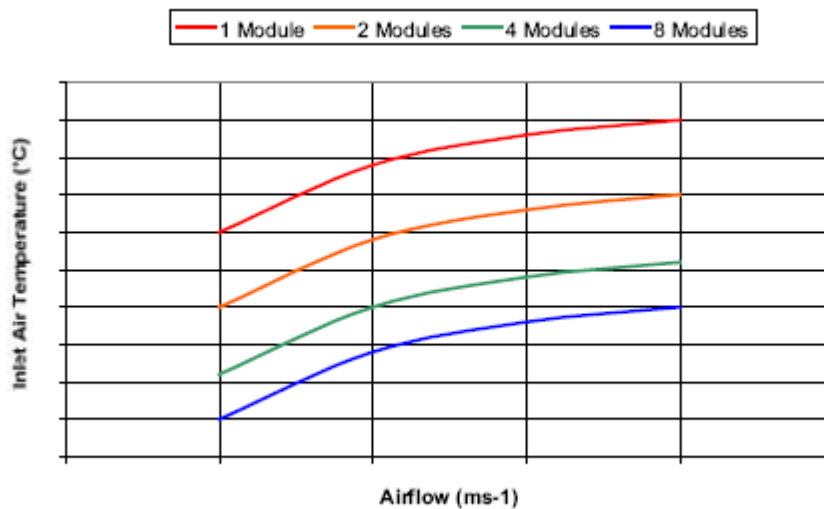
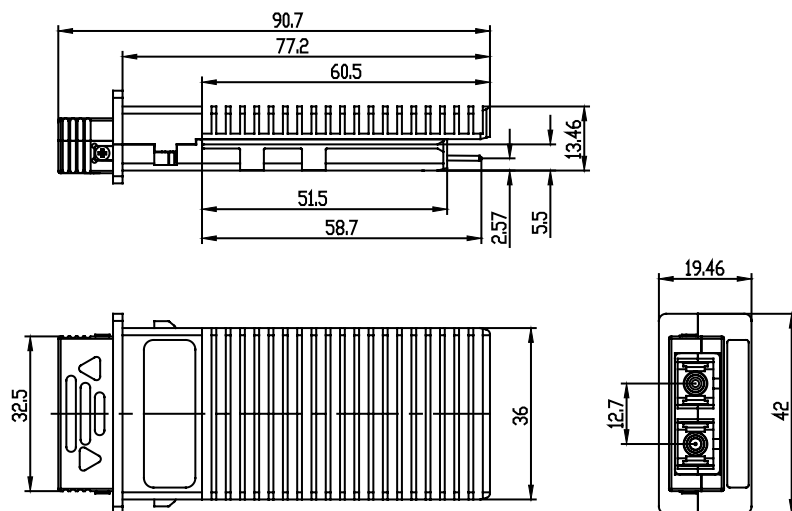


Figure 1 Thermal behaviour of multiple modules

Mechanical Drawing



Eye Safety

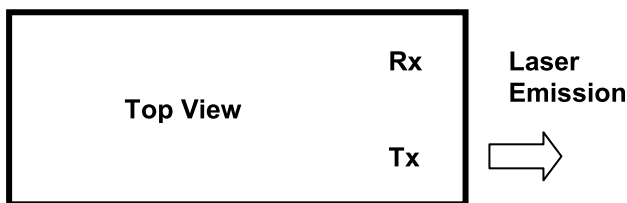
This laser based multimode transceiver is a Class 1 product. It complies with IEC 60825-1/A2: 2001 and FDA performance standards for laser products (21 CFR 1040.10 and 1040.11) except for deviations pursuant to Laser Notice 50, dated July 26, 2001.

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 | 1550 nm |
| Maximum total output power (as defined by IEC: 7 mm aperture at 14 mm distance) | <10 mW / <10 dBm |
| Beam divergence (full angle) / NA (half angle) | 16° / 0.11 mrad |

Required Labeling

FDA

Compliant to 21 CFR
1040.10 and 1040.11

IEC

Class 1 Laser Product

Ordering Information

| Application | Standard | Part Number |
|--------------|-------------------------|--|
| 10G Ethernet | IEEE 802.3ae 10GBASE-ER | TRP10GEP3003 TRP10GEP30CA (HP customized) |

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