# TX-1310/RX-1550 nm Single-mode Bi-directional (Single-Fiber)Transceiver
# 2×5 SC Simplex Connector, 3.3 V (17dB Margin)
# 155 Mbps ATM/SONET OC-3/SDH STM-1

## Features

- Compatible with 155 Mbps ATM and SONET OC-3 SDH STM-1
- Industry standard 2×5 footprint
- SC connector
- Single power supply 3.3 V
- Differential PECL inputs and outputs
- Compatible with solder and aqueous wash processes
- Class 1 laser product complies with EN 60825-1

## Description

The TSE series is a single-mode single fiber transceiver. The transmitter operates at a nominal wavelength of 1310 nm and receiver at 1550 nm. There is a 1310/1550 nm WDM filter integrated in the optical subassembly to form a bi-directional single fiber transceiver.

## Ordering Information

| *PART NUMBER* | *TX* | *RX* | *VOLTAGE* | *TEMPERATURE* |
|---|---|---|---|---|
| TSE-0155-32S-P1-3 | 1310 nm | 1550 nm | 3.3 V | 0 °C to 70 °C |

## Absolute Maximum Ratings

| *PARAMETER* | *SYMBOL* | *MIN* | *MAX* | *UNITS* | *NOTE* |
|---|---|---|---|---|---|
| Storage Temperature | $T_S$ | –40 | 85 | °C | |
| Supply Voltage | *Vcc* | –0.5 | 6.0 | V | |
| Input Voltage | $V_{IN}$ | –0.5 | *Vcc* | V | |
| Output Current | $I_o$ | --- | 50 | mA | |
| Operating Current | $I_{OP}$ | --- | 400 | mA | |
| Soldering Temperature | $T_{SOLD}$ | --- | 260 | °C | 10 seconds on leads |

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## Operating Environment

| *PARAMETER* | *SYMBOL* | *MIN* | *MAX* | *UNITS* | *NOTE* |
|---|---|---|---|---|---|
| Ambient Operating Temperature | $T_{AMB}$ | 0 | 70 | °C | |
| Supply Voltage | *Vcc* | 3.0 | 3.6 | V | |
| Supply Current | $I_{TX} + I_{RX}$ | --- | 200 | mA | |

## Transmitter Electro-optical Characteristics

***Vcc* = 3.0 V to 3.6 V, $T_A$ = 0 °C to 70 °C**

| *PARAMETER* | *SYMBOL* | *MIN* | *TYP.* | *MAX* | *UNITS* | *NOTE* |
|---|---|---|---|---|---|---|
| Data Rate | *B* | 50 | 155 | 200 | Mb/s | |
| Output Optical Power 9/125 μm fiber | *Pout* | –14 | --- | –8 | dBm | Average |
| Extinction Ratio | *ER* | 9 | --- | --- | dB | |
| Center Wavelength | $\lambda_C$ | 1260 | 1310 | 1360 | nm | |
| Spectral Width (RMS) | $\Delta\lambda$ | --- | --- | 4 | nm | |
| Rise/Fall Time (10–90%) | $T_{r,f}$ | --- | 1 | 2 | ns | |
| Output Eye | Compliant with Telcordia GR-253-CORE Issue 3 and ITU-T recommendation G-957 | | | | | |
| Data Input Current-Low | $I_{IL}$ | –350 | --- | --- | μA | |
| Data Input Current-High | $I_{IH}$ | --- | --- | 350 | μA | |
| Transmitter Data Input Voltage-High | $V_{IH} - V_{CC}$ | –1.1 | --- | –0.74 | V | Note 1 |
| Transmitter Data Input Voltage-Low | $V_{IL} - V_{CC}$ | –2.0 | --- | –1.58 | V | Note 1 |
| Transmitter Data Input Differential Voltage | $V_{DIFF}$ | 0.3 | --- | 1.6 | V | Note 1 |

Note 1 : These inputs are compatible with 10K, 10KH and 100K ECL and PECL input.

## Receiver Electro-optical Characteristics

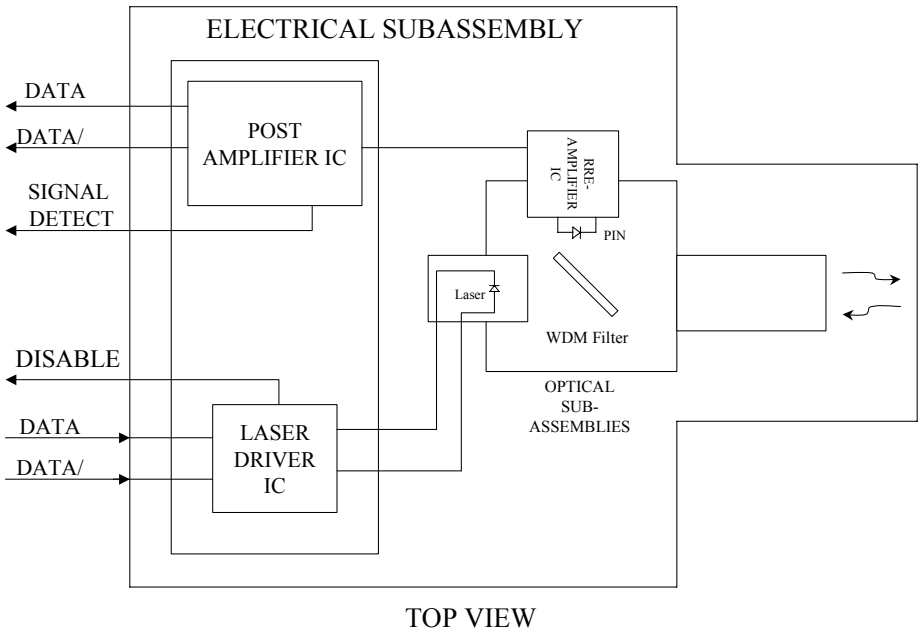
***Vcc* = 3.0 V to 3.6 V, $T_A$ = 0 °C to 70 °C**

| *PARAMETER* | *SYMBOL* | *MIN* | *TYP.* | *MAX* | *UNITS* | *NOTE* |
|---|---|---|---|---|---|---|
| Data Rate | $B$ | 50 | 155 | 200 | Mb/s | |
| Optical Input Power-maximum | $P_{IN}$ | 0 | --- | --- | dBm | Note 1 |
| Optical Input Power-minimum (Sensitivity) | $P_{IN}$ | --- | --- | –31 | dBm | Note 1 |
| Operating Center Wavelength | $\lambda_C$ | 1480 | --- | 1600 | nm | |
| Return Loss | $RL$ | --- | --- | –14 | dB | λ=1480~1600nm |
| Signal Detect-Asserted | $P_A$ | --- | --- | –31 | dBm | Average |
| Signal Detect-Deasserted | $P_D$ | –45 | --- | --- | dBm | Average |
| Signal Detect-Hysteresis | $P_A - P_D$ | 1.0 | --- | --- | dB | |
| Signal Detect Assert Time | $T_{SD+}$ | --- | --- | 100 | μs | |
| Signal Detect Deasssert Time | $T_{SD-}$ | --- | --- | 100 | μs | |
| Signal Detect Output voltage-High | $V_{OH} - V_{CC}$ | –1.1 | --- | –0.74 | V | Note 2 |
| Signal Detect Output voltage-Low | $V_{OL} - V_{CC}$ | –2.0 | --- | –1.58 | V | Note 2 |
| Crosstalk | $CRT$ | --- | --- | –45 | dB | |
| Data Output Rise, Fall Time | $T_{r,f}$ | --- | 1 | 2 | ns | |
| Data Output Voltage-High | $V_{OH} - V_{CC}$ | –1.1 | --- | –0.74 | V | Note 2 |
| Data Output Voltage-Low | $V_{OL} - V_{CC}$ | –2.0 | --- | –1.58 | V | Note 2 |

Note 1: The input data is at 155.52 Mbps, $2^{23} - 1$ PRBS data pattern with 72 “1”s and 72 “0”s inserted per the ITU-T recommendation G.958 Appendix 1. The receiver is guaranteed to provide output data with Bit Error Rate (BER) better than or equal to $1 \times 10^{-10}$.

Note 2: These outputs are compatible with 10K, 10KH and 100K ECL and PECL input.

## Block Diagram of Transceiver




**Transmitter and Receiver Optical Sub-assembly Section**

A 1310 nm InGaAsP laser and an InGaAs PIN photodiode integrate with an WDM filter to form a bi-directional single fiber optical subassembly (OSA). The laser of OSA is driven by a LD driver IC which converts differential input LVPECL logic signals into an analog laser driving current. And, The photodiode of OSA is connected to a circuit providing post-amplification quantization, and optical signal detection.

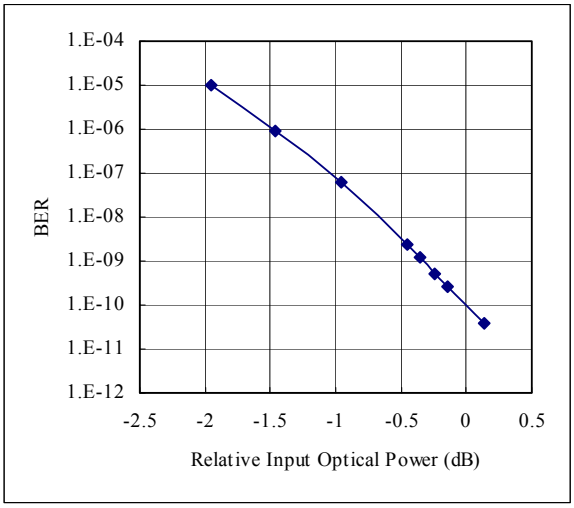
**Transmitter Disable**

Transmitter Disable is a TTL control pin. To disable the module, connect this pin to +3.3 V TTL logic high “1”. While, to enable module connect to TTL logic low “0”.

**Receiver Signal Detect**

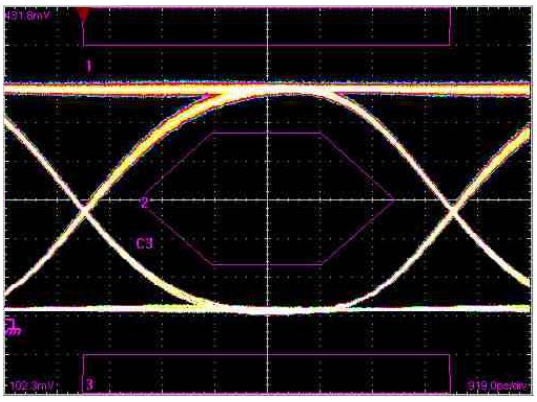
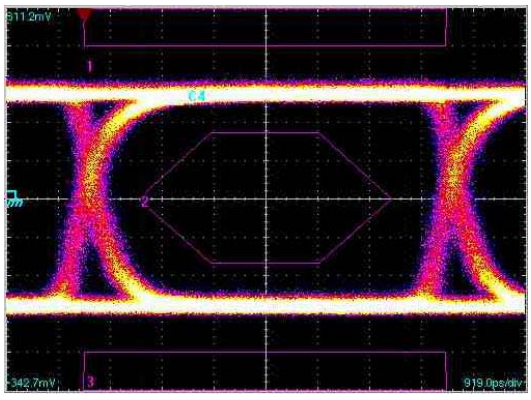
Signal Detect is a basic fiber failure indicator. This is a single-ended LVPECL output. As the input optical power is decreased, Signal Detect will switch from high to low (deassert point) somewhere between sensitivity and the no light input level. As the input optical power is increased from very low levels, Signal Detect will switch back from low to high (assert point). The assert level will be at least 1.0 dB higher than the deassert level.

## Typical BER Performance of Receiver versus Input Optical Power Level




The figure shows the relationship between typical trade-off of BER and Relative Input Optical Power. Besides the required BER =$1 \times 10^{-10}$ of the ATM Forum 155.52 Mbps Physical Layer Standard, The transceiver can be operated at other Bit-Error-Rate conditions. The Relative Input Optical Power in dB is referenced to the actual sensitivity of the device. For BER conditions better than $1 \times 10^{-10}$, more input signal is needed (+dB).

## Eye Diagram

| Transmitter | Receiver |
|---|---|
|  |  |
| Signal pattern: PRBS 23 | Signal pattern: PRBS 23<br>Input Power: –32 dBm |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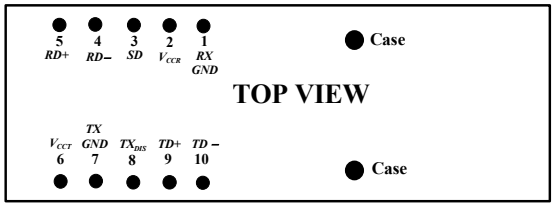
## Connection Diagram

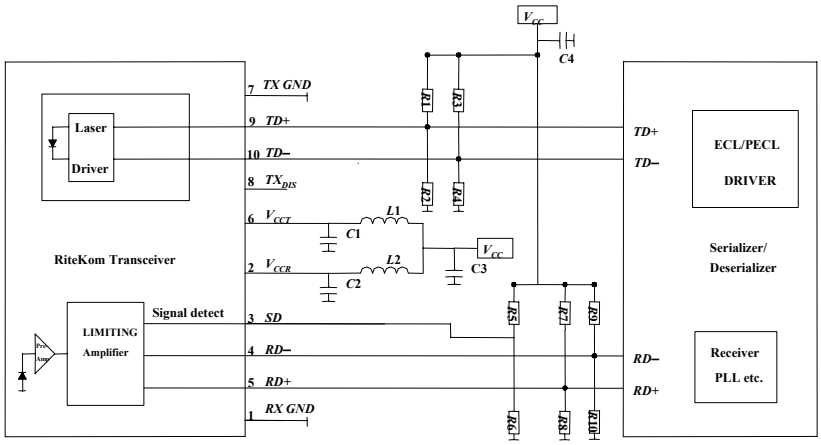
Pin-Out




| *PIN* | *SYMBOL* | *DESCRIPTION* |
|---|---|---|
| 1 | *RX GND* | Receiver Signal Ground, Directly connect this pin to the receiver ground plane. |
| 2 | $V_{CCR}$ | Receiver Power Supply<br>Provide +3.3 Vdc via the recommended receiver power supply filter circuit. Locate the power supply filter circuit as close as possible to the $V_{CCR}$ pin. |
| 3 | *SD* | Signal Detect.<br>Normal optical input levels to the receiver result in a logic "1" output, $V_{OH}$, asserted. Low input optical levels to the receiver result in a fault condition indicated by a logic "0" output $V_{OL}$, deasserted Signal Detect is a single-ended LVPECL output. *SD* can be terminated with LVPECL techniques via 50Ω to $V_{CCR}$ – 2 V. Alternatively, *SD* can be loaded with a 180 Ω resistor to *RX GND* to conserve electrical power with small compromise to signal quality. If Signal Detect output is not used, leave it open-circuited. This Signal Detect output can be used to drive a LVPECL input on an upstream circuit, such as, Signal Detect input or Loss of Signal-bar. |
| 4 | *RD–* | *RD–* is an open-emitter output circuit.<br>Terminate this high-speed differential LVPECL output with standard LVPECL techniques at the follow-on device input pin. (See recommended circuit schematic) |
| 5 | *RD+* | *RD+* is an open-emitter output circuit.<br>Terminate this high-speed differential LVPECL output with standard LVPECL techniques at the follow-on device input pin. (See recommended circuit schematic) |
| 6 | $V_{CCT}$ | Transmitter Power Supply<br>Provide +3.3 Vdc via the recommended transmitter power supply filter circuit. Locate the power supply filter circuit as close as possible to the $V_{CCT}$ pin. |
| 7 | *TX GND* | Transmitter Signal Ground<br>Directly connect this pin to the transmitter signal ground plane. Directly connect this pin to the transmitter ground plane. |
| 8 | $TX_{DIS}$ | Transmitter Disable<br>Connect this pin to +3.3V TTL logic high "1" to disable transmitter. To enable module connect to TTL logic low "0" or open. |
| 9 | *TD+* | Transmitter Data In<br>Terminate this high-speed differential LVPECL input with standard LVPECL techniques at the transmitter input pin. (See recommended circuit schematic) |
| 10 | *TD–* | Transmitter Data In-Bar<br>Terminate this high-speed differential LVPECL input with standard LVPECL techniques at the transmitter input pin. (See recommended circuit schematic) |

## Recommended Circuit Schematic

**DC/DC Coupling**




$C1/C2/C4 = 0.1\ \mu F$ $C3 = 4.7\ \mu F$

$L1/L2 = 1\ \mu H$

$R1/R3/R5/R7/R9 = 130\ \Omega$ $R2/R4/R6/R8/R10 = 82\ \Omega$

In order to get proper functionality, a recommended circuit is provided in above recommended circuit schematic. When designing the circuit interface, there are a few fundamental guidelines to follow.

(1) The differential data lines should be treated as 50 Ω Micro strip or strip line transmission lines. This will help to minimize the parasitic inductance and capacitance effects. Locate termination at the received signal end of the transmission line. The length of these lines should be kept short and of equal length.

(2) For the high speed signal lines, differential signals should be used, not single-ended signals, and these differential signals need to be loaded symmetrically to prevent unbalanced currents which will cause distortion in the signal.

(3) Multi layer plane PCB is best for distribution of $V_{CC}$, returning ground currents, forming transmission lines and shielding, Also, it is important to suppress noise from influencing the fiber-optic transceiver performance, especially the receiver circuit.

(4) A separate proper power supply filter circuits shown in Figure for the transmitter and receiver sections. These filter circuits suppress $V_{CC}$ noise over a broad frequency range, this prevents receiver sensitivity degradation due to $V_{CC}$ noise.

(5) Surface-mount components are recommended. Use ceramic bypass capacitors for the 0.1 μF capacitors and a surface-mount coil inductor for 1 μH inductor. Ferrite beads can be used to replace the coil inductors when using quieter $V_{CC}$ supplies, but a coil inductor is recommended over a ferrite bead. All power supply components need to be placed physically next to the $V_{CC}$ pins of the receiver and transmitter.

(6) Use a good, uniform ground plane with a minimum number of holes to provide a low-inductance ground current return for the power supply currents.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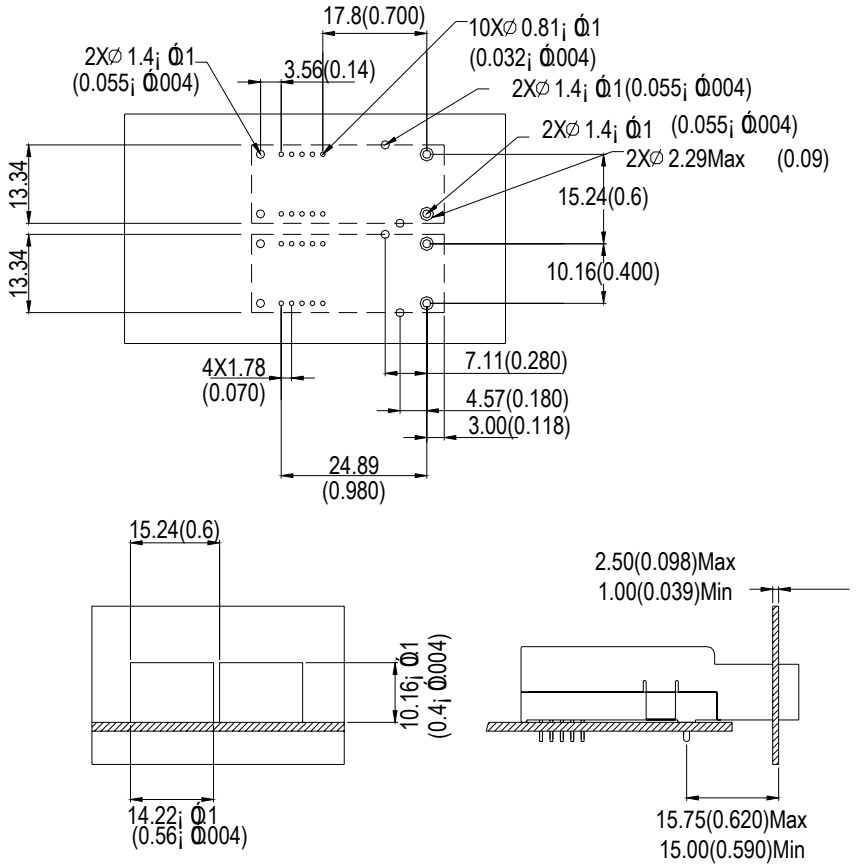
## Recommended Board Layout Hole Pattern

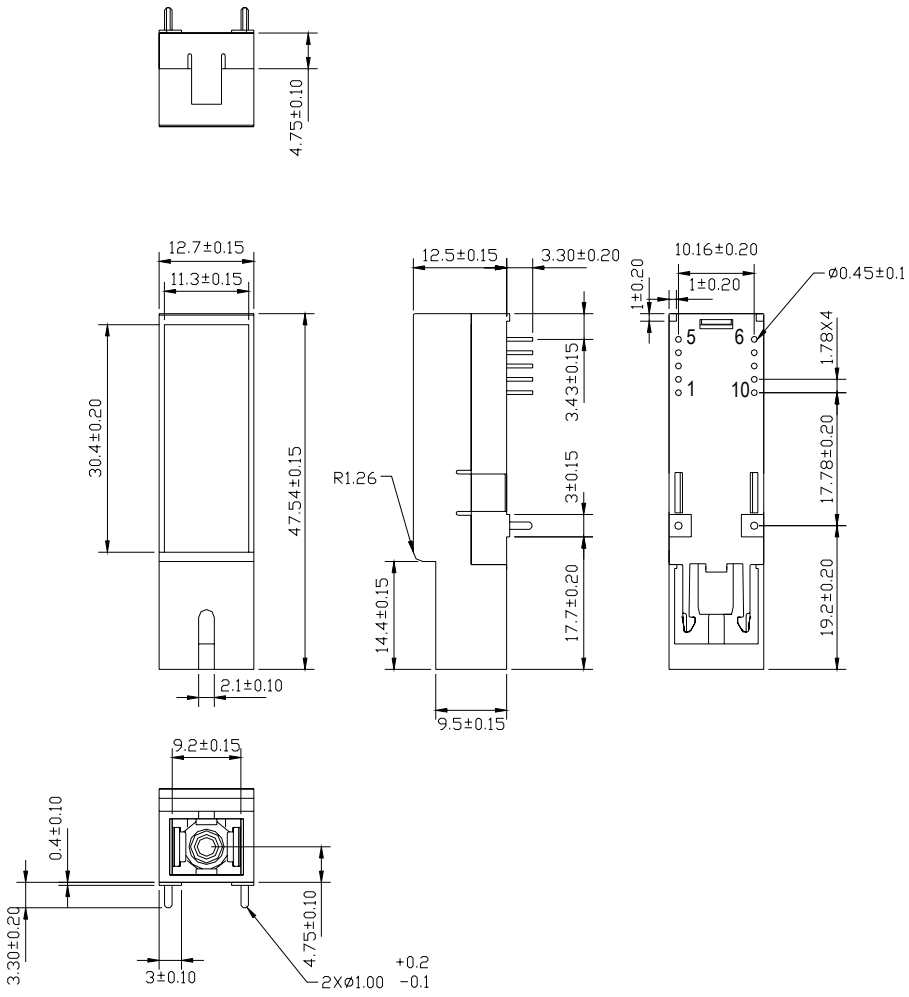



Unit : mm(inches)

This transceiver is compatible with industry standard wave or hand solder processes. After wash process, all moisture must be completely remove from the module. The transceiver is supplied with a process plug to prevent contamination during wave solder and aqueous rinse as well as during handling, shipping or storage.

Solder fluxes should be water-soluble, organic solder fluxes. Recommended cleaning and degreasing chemicals for these transceivers are alcohol's (methyl, isopropyl, isobutyl), aliphatics (hexane, heptane) and other chemicals, such as soap solution or naphtha. Do not use partially halogenated hydrocarbons for cleaning/degreasing.

## Drawing Dimensions




Unit : mm

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## Regulatory Compliance

| *FEATURE* | *TEST METHOD* | *PERFORMANCE* |
|---|---|---|
| Electrostatic discharge (ESD) to the electrical pins | MIL-STD-883D Method 3015.7 | Class 1(>1 kV) – Human Body Model |
| Electromagnetic interference (EMI) | FCC Class B<br>EN55022 Class B | The transceiver is mounded on a circuit card without a chassis enclosure at frequencies up to 1000 MHz. Margins will be dependent on customer's board and chassis designs. |
| Immunity | Variation of IEC801-3 | Typically show no measurable effect from a 10 V/m filed swept from 30 MHz to 1000 MHz applied to the transceiver without a chassis enclosure. |
| Eye safety | FDA 21 CFR 1040.10 and 1040.11 Class 1 | FDA Accession Number: 0012715-04 |
| | EN 60825-1:1994+A11<br>EN 60950: 1992+A1+A2+A3+A4+A11<br>EN 60825-2: 1994+A1 | TUV certificated Number: R 50011969 |

## Eye Safety

The TSE series Single mode transceiver is a class 1 laser product. It complies with EN 60825-1 and FDA 21 CFR 1040.10 and 1040.11. In order to meet laser safety requirements the transceiver shall be operated within the Absolute Maximum Ratings.

***Caution***

**All adjustments have been done at the factory before the shipment of the devices. No maintenance and user serviceable part is required. Tampering with and modifying the performance of the device will result in voided product warranty.**

**Required Mark**

**Class 1 Laser Product**
**Complies with**
**21 CFR 1040.10 and 1040.11**

Note : All information contained in this document is subject to change without notice.