



LTD1519 SFP Optical Transceiver Gigabit Ethernet, 1550 nm, 1250 Mb/s, 80 km

Product Description

The LTD1519 SFP Gigabit-Ethernet LC duplex transceiver is intended for 80 km reach service in 1250 Mb/s 1550 nm single mode high-speed LAN and SAN data communications equipment where low-cost, extraordinary performance and reliability are essential. It meets the requirements of IEEE802.3z 1000 BASE-LH, consumes low power, operates from a 3.3 volt DC power supply and is offered in the 0 to 70°C commercial temperature range. The industry standard 2x10 small form pluggable (SFP) package is fabricated with a rugged die cast metal housing and cage assembly. The low jitter and low bit error rate optical assembly features a 1550 nm DFB laser transmitter and PIN/TIA receiver. It incorporates the SFP MSA LVTTTL Loss of Signal (Rx_LOS), Tx Fault (Tx_FAULT) and Tx Disable (Tx_DIS) monitor and control functions and the SFF-8472 Rev 9.3 compliant digital diagnostic monitor feature which is accessed via the I²C 2-wire serial ID interface. The differential AC coupled Tx and Rx data interfaces (50 ohms to ground, 100 ohms line to line) are LVPECL compatible. The device is Class I laser safety compliant.



Applications

- 1250 Mb/s Gigabit Ethernet data links
- Channel extenders
- Bus extenders
- High speed I/O file servers
- Data storage networks
- LAN
- SAN
- RSAN
- Host adapters
- Switch-to-switch interfaces
- Mass storage system interconnects
- Hub interconnects
- Router interconnects
- Distributed multi processing
- Telecom switches

Features

- LC Duplex optical interface
- 80 km reach
- 1250 Mb/s data rate
- +3.3 V power supply
- Low DC power consumption
- 2x10 SFP MSA compliant package
- Bail or pull latch option
- Hot swappable
- High performance 1550 nm DFB laser
- High sensitivity PIN/TIA optical receiver:
- Single Mode operation
- BER < 1X10⁻¹² (2⁷ - 1 NRZ PRBS test pattern)
- IEEE 802.3z 1000 BASE-LH compliant
- Operating temperature range:
 - Commercial: 0 to 70°C
- Monitor and Control Functions
 - Loss of Signal (Rx_LOS), LVTTTL
 - Tx Disable (Tx_DIS), LVTTTL
 - Tx Fault (Tx_FAULT), LVTTTL
 - 2-wire I²C data bus
 - SFF-8472 Rev 9.3 MSA compliant
 - Internally AC coupled and terminated
 - LVPECL Rx and Tx data interface
 - 100 Ohms differential (line to line)
 - 50 Ohms single ended (line to ground)



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Absolute Maximum Ratings (EXCEEDING THESE RATINGS MAY CAUSE IRREVERSIBLE DAMAGE TO THE DEVICE)

| Parameter | Symbol | Minimum | Maximum | Units |
|-------------------------------|-------------------|---------|-----------------------|---------|
| Storage Temperature | T _{stg} | -40 | +85 | °C |
| Relative Humidity - Storage | RH _S | 0 | 95 | % |
| Relative Humidity - Operating | RH _O | 0 | 85 | % |
| DC Supply Voltage | V _{CC} | 0 | 3.6 | V |
| Soldering Temperature | T _{slid} | 0 | 260 | °C |
| Soldering Time Duration | t _{slid} | 0 | 10 | seconds |
| Tx DATA | V _{in} | 0 | V _{CC} + 0.5 | V |

Optical and Electrical Signal Absolute Maximum Ratings

| | | | | |
|--|-----------------------|-----|-----|-----|
| Signal / Data Input Voltage (Tx_DATA) | V _{IN PK-PK} | - | 2.4 | V |
| 8472 Clock Signal (Standard Mode) | I _{CLOCK} | 100 | - | kHz |
| 8472 Clock Signal (Fast Mode) | I _{CLOCK} | - | 400 | kHz |
| Rx Optical Input Power | P _{IN-MAX} | | 3 | dBm |

Logic State Absolute Maximum Ratings

| | | | | |
|-----------------------------|----------|---|----------------------|---|
| Tx_DISABLE Logic HIGH State | Tx_DIS | - | V _{CC} +0.5 | V |
| Tx_FAULT Logic HIGH State | Tx_FAULT | - | V _{CC} +0.5 | V |
| Rx_LOS Logic HIGH State | Rx_LOS | - | V _{CC} +0.5 | V |
| 8472 MOD-DEF2 | MOD_DEF2 | - | V _{CC} +0.5 | V |

Recommended Operating Conditions

| Parameter | Symbol | Min | Typ | Max | Units | Notes |
|-------------------------------|------------------|-----|-----|-----|-------|-----------------------|
| Ambient Operating Temperature | T _{amb} | 0 | 25 | +70 | °C | Temperature Range = C |
| DC Supply Voltage | V _{CC} | 3.1 | 3.3 | 3.5 | Volts | |
| Module Supply Current | I _{IN} | - | 150 | 200 | mA | |
| Power Dissipation | P _D | - | 500 | 700 | mW | |

Ordering Information

| | |
|-------------------------------|---|
| Latch Options | Bail and Pull Latches are compatible with the dimensions defined by the SFP MSA |
| Ambient Operating Temperature | Commercial |

| Part Number | Latch Option (X) | | Temperature Option (Y) | |
|-------------------|------------------|------|------------------------|------------|
| LTD1519 XY | B | Bail | C | 0 to 70 °C |
| | P | Pull | | |



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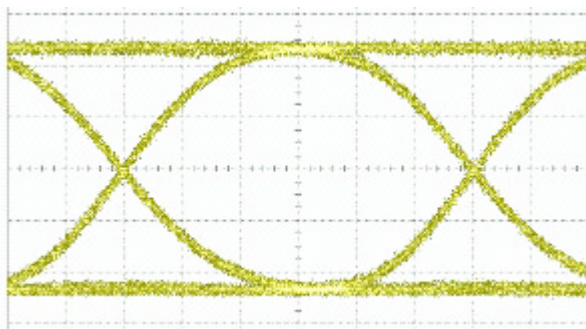
| Transmitter Logic | | | | | | |
|----------------------------------|----------------|-------------|------------|-----|----------------------|-------|
| Parameter | Function | Logic State | Logic Type | Min | Max | Units |
| Tx_DIS and Tx_FAULT | DISABLE | HIGH | LVTTL | 2.4 | V _{CC} +0.3 | V |
| Tx_DIS and Tx_FAULT | ENABLE | LOW | LVTTL | 0 | 0.8 | V |
| Tx_DIS | Assert Time | - | LVTTL | - | 10 | μs |
| Receiver Logic | | | | | | |
| Parameter | Function | Logic State | Logic Type | Min | Max | Units |
| Rx_LOS | LOSS OF SIGNAL | HIGH | LVTTL | 2.4 | V _{CC} +0.3 | V |
| Rx_LOS | NORMAL | LOW | LVTTL | 0 | 0.8 | V |
| I ² C Serial ID Logic | | | | | | |
| Parameter | Function | Logic State | Logic Type | Min | Max | Units |
| MOD_DEF 0 | Digital Ground | Ground | N/A | 0 | 0 | V |
| MOD_DEF 1 | Clock Signal | HIGH | LVTTL | 2.4 | V _{CC} +0.3 | V |
| | | LOW | LVTTL | 0 | 0.8 | V |
| MOD_DEF 2 | Serial Data | HIGH | LVTTL | 2.4 | V _{CC} +0.3 | V |
| | | LOW | LVTTL | 0 | 0.8 | V |

| Transmitter Electro-Optical Characteristics | | | | | | |
|--|---------------------------------|------------------------------------|------|------|--------|-------------------------|
| Parameter | Symbol | LTD1519 | | | Units | Notes |
| | | Min | Typ | Max | | |
| Laser Type | | 1550 nm DFB | | | | |
| Optical Output Power | P _o | 0 | | 4 | dBm | Average Optical Output |
| Optical Modulation Amplitude | OMA | 196 | - | - | μW | |
| Center Wavelength | λ | | 1550 | | nm | |
| Spectral Line Width @ -20dB | Δλ | - | - | 1 | nm | |
| Side Mode Suppression Ratio | SMSR | 30 | - | - | dB | |
| Extinction Ratio | ER | 9 | - | - | dB | |
| Optical Rise and Fall Time | t _r , t _f | - | 150 | 260 | ps | 20% - 80% |
| Relative Intensity Noise | RIN | - | - | -120 | dB/Hz | |
| Deterministic Jitter | DJ | - | - | 0.2 | UI | |
| RMS Jitter | J _{RMS} | - | - | 0.01 | UI | |
| Output Eye | | IEEE 802.3z 1000 BASE-LH compliant | | | | |
| Tx Differential Input Impedance | Z _{in} | - | 100 | - | Ohms | |
| Tx Differential Input Voltage | V _{IN} | 300 | - | 2400 | mV p-p | LVPECL Tx DATA (Note 1) |
| Note 1: Internally AC coupled and terminated | | | | | | |



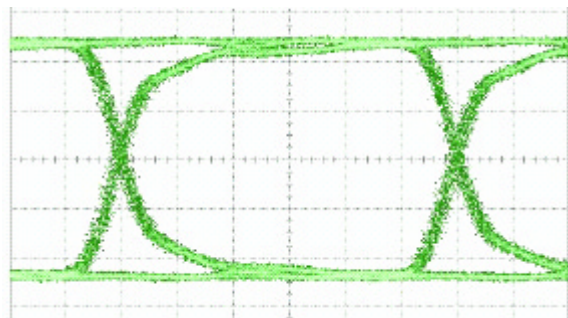
| Receiver Electro-Optical Characteristics | | | | | | |
|--|--------------|-----------|------|-------|--------|---------------------------------|
| Parameter | Symbol | LTD1519 | | | Units | Notes |
| | | Min | Typ | Max | | |
| Receiver Type | | PIN / TIA | | | | |
| Receiver Optical Sensitivity | P_{IN} | - | - | -24 | dBm | Average Received Power (Note 1) |
| Receiver Optical Overload | $P_{IN MAX}$ | - | - | 0 | dBm | |
| Center Wavelength | λ | | 1550 | | nm | |
| Optical Return Loss | RL | 12 | - | - | dB | |
| Rx Upper 3 dB Cutoff Frequency | f_c | - | - | 1500 | MHz | |
| Signal Loss - Assert | P_{SLA} | -32.5 | - | -25 | dBm | |
| Signal Loss - Deassert | P_{SLD} | -32 | - | -24.5 | dBm | |
| Signal Loss - Hysteresis | P_H | 0.5 | 2 | 5 | dB | |
| Data Output Rise / Fall Time | t_r / t_f | | 150 | - | ps | 20 - 80 % |
| Rx Differential Load Impedance | Z_{LOAD} | - | 100 | - | Ohms | |
| Rx Differential Output Voltage | V_{OUT} | 400 | - | 1200 | mV p-p | LVPECL Rx DATA (Note 2) |
| Note 1: Average received power where the BER = 10^{-12} , measured with a 2^7-1 NRZ test pattern | | | | | | |
| Note 2: Internally AC coupled and terminated | | | | | | |

Eye Diagram



Transmitter Test Conditions

- Optical Output Power = **0 dBm**
- Test Pattern = 2^7-1 NRZ PRBS



Receiver Test Conditions

- Optical Input Power = **-17 dBm**
- Test Pattern = 2^7-1 NRZ PRBS



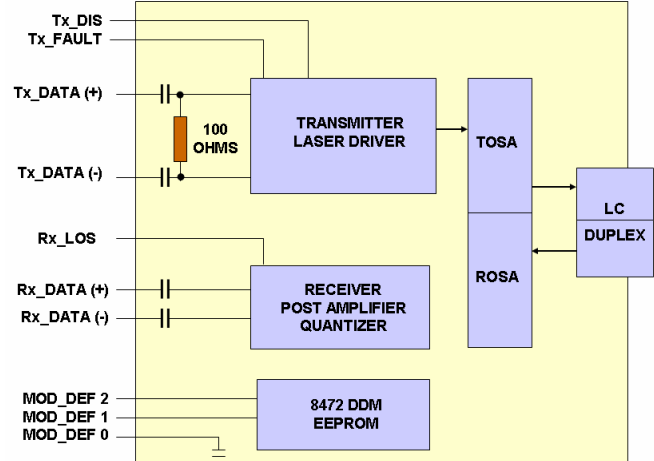
Transceiver Block Diagram

Transmitter Section

The transmitter section consists of a high reliability 1550 nm DFB laser diode (LD) with back facet monitor photo detector (PD) in an eye safe optical sub-assembly (TOSA), which is mated to the Tx port of the fiber optic LC duplex receptacle. A driver IC converts LVPECL differential input data signals into an analog current source that drives the LD. The transmitter is provided with the Tx_Disable and Tx_FAULT control and monitoring functions. SFF-8472 Rev 9.3 MSA digital diagnostics are enabled via the 2-wire I²C data bus.

Receiver Section

The receiver section consists of a high-speed PIN / TIA photodiode and transimpedance preamplifier mounted in an optical subassembly (ROSA), which is mated to the Rx port of the fiber optic LC duplex receptacle. The output of the PD drives the post-amplification, quantizing, and optical signal detection circuits. The receiver is equipped with the Rx_LOS (Loss of Signal) monitoring function.



Transceiver Monitor and Control Functions

Rx Signal Loss (Rx_LOS) Description

The Rx_LOS (Loss of Signal) is an open collector LVTTTL monitor port. It switches state based on the received optical input signal level that passes through the photo detector (PD), post amplifier and quantizer. If the received signal is above the Rx threshold, then Rx_LOS is set LOW indicating normal operation. If the received signal is below the Rx threshold, then Rx_LOS is set HIGH indicating a possible broken fiber, unplugged connector or low Tx signal from the host. The Rx_LOS pin requires an external 4.7K to 10 K Ohm pull-up resistor.

Tx Disable (Tx_DIS) Description

The Tx_DIS (Transmit Disable) is an open collector LVTTTL control port that is controlled by a logic signal on the host (system) printed circuit board. If the system is ready to send data then the Tx_DIS line is set LOW to enable the laser driver and the laser transmitter. If the system is not ready to send data, then the Tx_DIS line is set HIGH to disable the transmitter.

Tx Fault (Tx_FAULT) Description

The Tx_FAULT (Transmit Fault) is an open collector LVTTTL monitor port. It switches states based on the condition of the laser driver and the laser including the end of life condition of the laser. If the parameters of the laser driver and laser are within specifications then the Tx_FAULT is set LOW indicating normal transceiver operation. If a fault occurs, including excess optical output power then Tx_FAULT is set HIGH which disables the transmitter. The Tx_FAULT can be reset to normal operation by toggling Tx_DIS or switching the power supply. The Tx_FAULT pin requires an external 4.7K to 10K Ohm pull-up resistor.



SFP MSA and SFF 8472 Rev 9.3 Digital Diagnostics

This device incorporates digital diagnostic monitoring and control functions that are compliant with the SFF-8472 Rev 9.3 Specifications that provides backward compatibility with the digital diagnostic interface defined by the SFP-MSA. The data entry point A0 (hex) is the entry point for the legacy information including Serial ID and Vendor specific information such as the part number, date code, vendor identification, product serial number, type of transceiver and the transceiver parameters. The data entry point A2 (hex) is the entry point for the advanced diagnostic feature sets outlined in the SFF-8472 Rev 9.3 specification. The device is internally calibrated at the time of manufacture and the parameter sets corresponding to the Alarm and Warning functions are programmed into memory. The SFF-8472 Rev 9.3 digital diagnostic interface enables the system host to discover the transceiver's parametric and data functions via a 2-wire system with one wire providing the clock and timing information and the other wire providing two-way communications with the transceiver. Additional information can be found in the SFF-8472 Rev 9.3 documentation.

A0 (hex) Table - Summary of Parameters in the A0 (hex) Parametric Table

SFP Optical transceiver with LC Duplex connector

Type of transceiver by application

Encoding - 8B10B

The maximum reach of this transceiver over a specified length of fiber type

Vendor Name - Ligent Photonics

Vendor OUI - None

Vendor Part Number - the Ligent Photonics part number on this data sheet

Vendor Revision - the Ligent revision number

Laser Operating Wavelength - the wavelength specified on this data sheet

Options Supported by this Transceiver (LVTTTL digital interface)

Tx_DISABLE

Tx_FAULT

Rx_LOS

Bit Rate MIN and MAX Limits - the limits determined by the Bit Rate tolerances specified on this data sheet

Vendor Serial Number - the Ligent serial number in ASCII format

Diagnostic Monitoring Type - Internally Calibrated

Enhanced Monitoring Features for Software Control are Enabled in this device

Alarm and Warning Flags are enabled

Software support for monitoring and control of Tx_DISABLE is enabled

Software support for monitoring and control of Tx_FAULT is enabled

Software support for monitoring and control of Rx_LOS is enabled

Software support for monitoring and control of RATE_SELECT is not supported on this device



A2 (hex) 8472 Digital Diagnostic Table - Summary of Parameters in the A2 (hex) Parametric Table

The data in the parameter tables are compared with the data in the measured data tables in order to create a warning or alarm status bit

Parameters stored in memory are the reference data for this device. There are two tables for each parameter (Warning and Alarm):

| | |
|-------------------------|---|
| Case Temperature | High and Low Values for Alarm and Warning |
| Operating Voltage | High and Low Values for Alarm and Warning |
| Laser Bias Current | High and Low Values for Alarm and Warning |
| Tx Optical Output Power | High and Low Values for Alarm and Warning |
| Rx Optical Input Power | High and Low Values for Alarm and Warning |

The following parameters return the value of zero because this device is internally calibrated

Rx_PWR(4), Rx_PWR(3), Rx_PWR(2), Rx_PWR(1), Rx_PWR(0)
Tx_I(SLOPE), Tx_I(OFFSET), Tx_PWR(SLOPE), Tx_PWR(OFFSET)
T(SLOPE), T(OFFSET)
V(SLOPE, V(OFFSET))

Measured A/D values are stored in two bytes corresponding to the MSB and LSB data

| | |
|-------------------------|---|
| Case Temperature | Signed integer, LSB equal to 1/256C |
| Operating Voltage | Unsigned integer, LSB equal to 100 μ Volt |
| Laser Bias Current | Unsigned integer, LSB equal to 2 μ A |
| Tx Optical Output Power | Unsigned integer, LSB equal to 0.1 μ W |
| Rx Optical Input Power | Unsigned integer, LSB equal to 0.1 μ W |

Software status bits for software control of this device

| | |
|----------------|--|
| Tx_DISABLE | Set or cleared status bit indicates the state of the Tx_DISABLE control function |
| Tx_DISABLE | Read/Write bit for software control of Tx_DISABLE |
| Rx_RATE_SELECT | Not used on this device |
| Tx_FAULT | Set or cleared status bit indicates the state of the Tx_FAULT monitor function |
| Rx_LOS | Set or cleared status bit indicates the state of the Rx_LOS control function |
| Data_Ready_Bar | Bit is set at power up and remains set to indicate data is ready to be read |
| Data_Ready_Bar | Bits is set low when reading data from the transceiver |

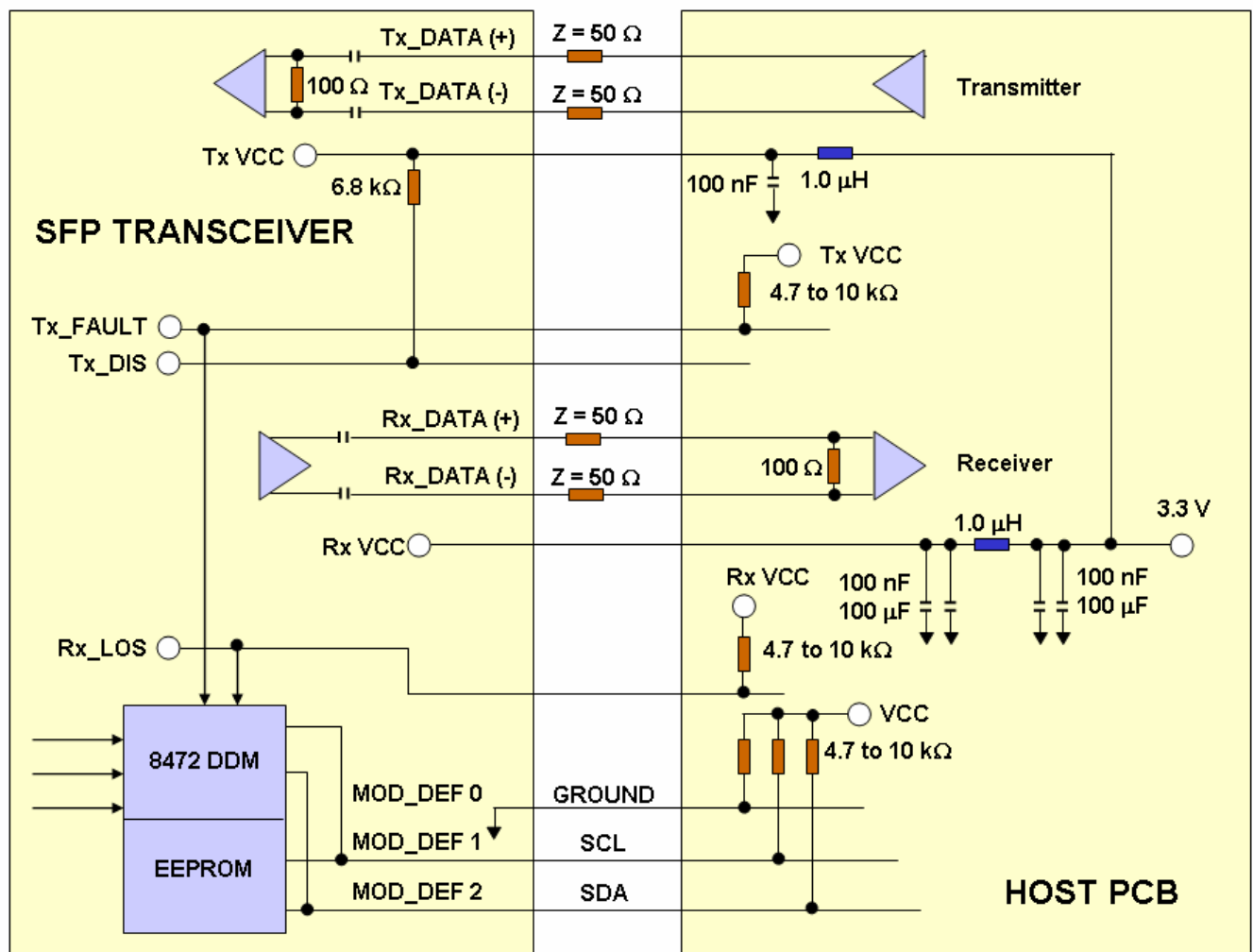
The Warning or Alarm bit is set when the parameter drops below or exceeds the Low or High values stored in memory. The parametric values are such the Warning bit is set before the Alarm bit:

Case Temperature
Operating Voltage
Laser Bias Current
Tx Optical Output Power
Rx Optical Input Power



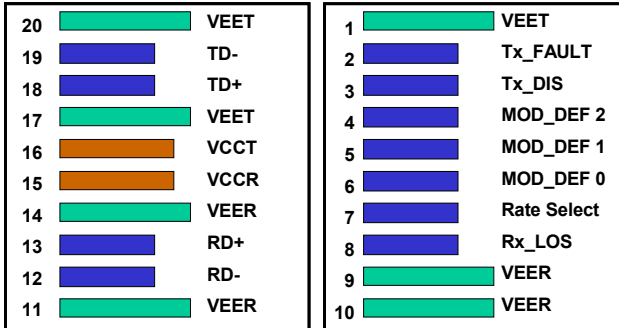
| SFF-8472 Rev 9.3 A2 (HEX) Address Table for Alarm and Warning Data | | | | | | | | | | | | | | |
|--|----------------------|-----|-----------|-----|------------------------|-----|-----------|-----|----------------------------|-----|------------------------------------|--------|--------------------------------------|--------|
| 8472 Parameter | Alarm Threshold Data | | | | Warning Threshold Data | | | | Internally Measured Values | | Alarm Bit (Set) Address + Position | | Warning Bit (Set) Address + Position | |
| | High Value | | Low Value | | High Value | | Low Value | | | | High | Low | High | Low |
| | MSB | LSB | MSB | LSB | MSB | LSB | MSB | LSB | MSB | LSB | High | Low | High | Low |
| Temperature | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 96 | 97 | 112(7) | 112(6) | 116(7) | 116(6) |
| Vcc | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 98 | 99 | 112(5) | 112(4) | 116(5) | 116(4) |
| Tx Bias | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 100 | 101 | 112(3) | 112(2) | 116(3) | 116(2) |
| Tx Out | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 102 | 103 | 112(1) | 112(0) | 116(1) | 116(0) |
| Rx Input | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 104 | 105 | 113(7) | 113(8) | 117(7) | 117(6) |

Electrical Interface

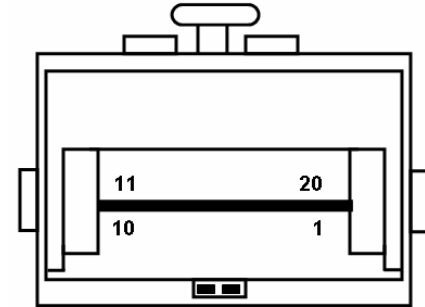




Pin Assignment



Transceiver Electrical Pad Layout
Top View Bottom View



Transceiver Pin Locations

SFP Pin Assignment

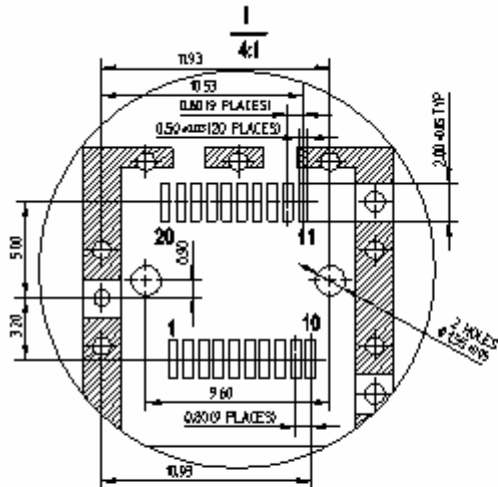
| Pin | Symbol | Logic Type | Description | Notes |
|-----|------------------|------------|--|--------------|
| 1 | V _{EET} | N/A | Transmitter Ground | |
| 2 | Tx_FAULT | LVTTTL | Transmitter Fault, LOW = Normal Operation, HIGH = Fault Indication | Note 1 |
| 3 | Tx_DIS | LVTTTL | Transmit Disable, LOW = Normal Operation, HIGH = Disables Module | Note 1 |
| 4 | MOD_DEF 2 | LVTTTL | Module Definition 2 - Two-Wire Interface - Serial Data | Note 1 |
| 5 | MOD_DEF 1 | LVTTTL | Module Definition 1 - Two-Wire Interface - Clock Signal | Note 1 |
| 6 | MOD_DEF 0 | LVTTTL | Module Definition 0 - Two-Wire Interface Digital Ground | |
| 7 | Rate Select | N/A | Not Connected | |
| 8 | Rx_LOS | LVTTTL | Receiver Loss of Signal, LOW = Normal Operation, HIGH = Loss of Signal | Note 1 |
| 9 | V _{EER} | N/A | Receiver Ground | |
| 10 | V _{EER} | N/A | Receiver Ground | |
| 11 | V _{EER} | N/A | Receiver Ground | |
| 12 | RD- | LVPECL | Rx_Data Output (Inverted) | Note 2 |
| 13 | RD+ | LCPECL | Rx_Data Output (Non Inverted) | Note 2 |
| 14 | V _{EER} | N/A | Receiver Ground | |
| 15 | V _{CCR} | N/A | Receiver DC Power | 3.3 V +/- 5% |
| 16 | V _{CCT} | N/A | Transmitter DC Power | 3.3 V +/- 5% |
| 17 | V _{EET} | N/A | Transmitter Ground | |
| 18 | TD+ | LVPECL | Tx_Data Input (Non Inverted) | Note 3 |
| 19 | TD- | LVPECL | Tx_Data Input (Inverted) | Note 3 |
| 20 | V _{EET} | N/A | Transmitter Ground | |

Notes

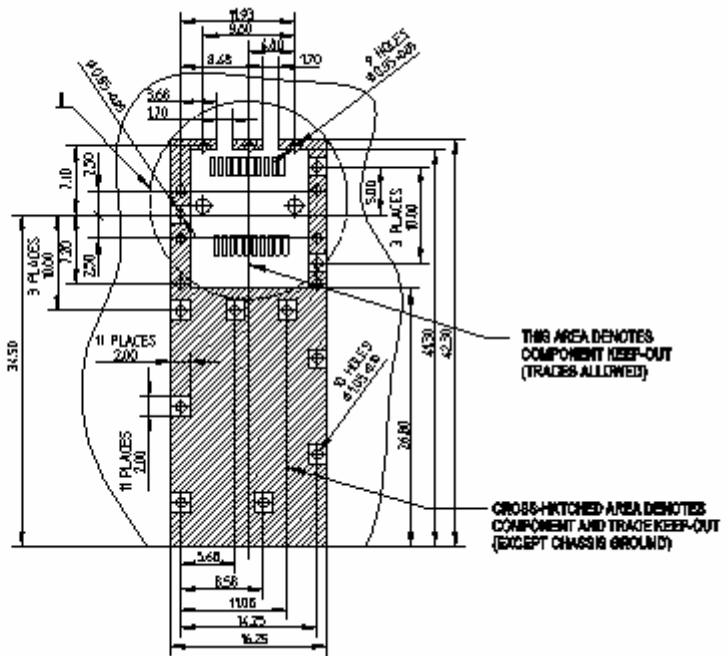
| | |
|---|--|
| 1 | The uncommitted Tx_Fault, Rx_LOS, MOD_DEF 1 and MOD_DEF 2 LVTTTL monitor and control pins each require a pull up resistor of 4.7K to 10K Ohms. |
| 2 | The 100 Ohm differential Rx Data output is internally AC coupled and must be terminated with 100 Ohms at the differential user interface. |
| 3 | The 100 Ohm differential Tx Data input is internally AC coupled and terminated. |



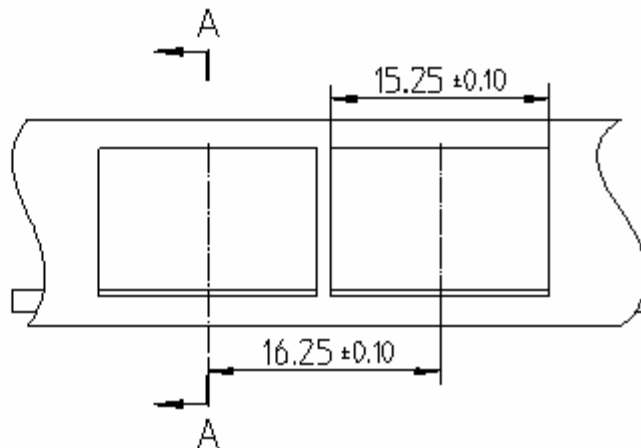
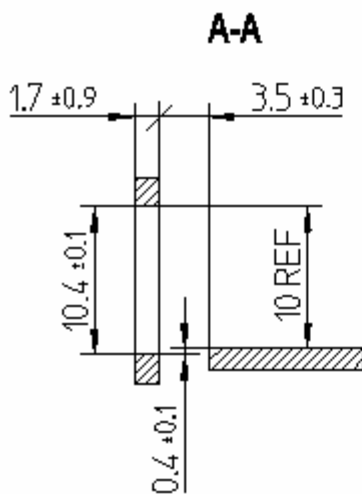
Recommended PCB Layout



- Notes:**
1. Datum and basic dimensions established by customer
 2. Pads and vias are chassis ground, 11 places
 3. Thru holes, plating optional



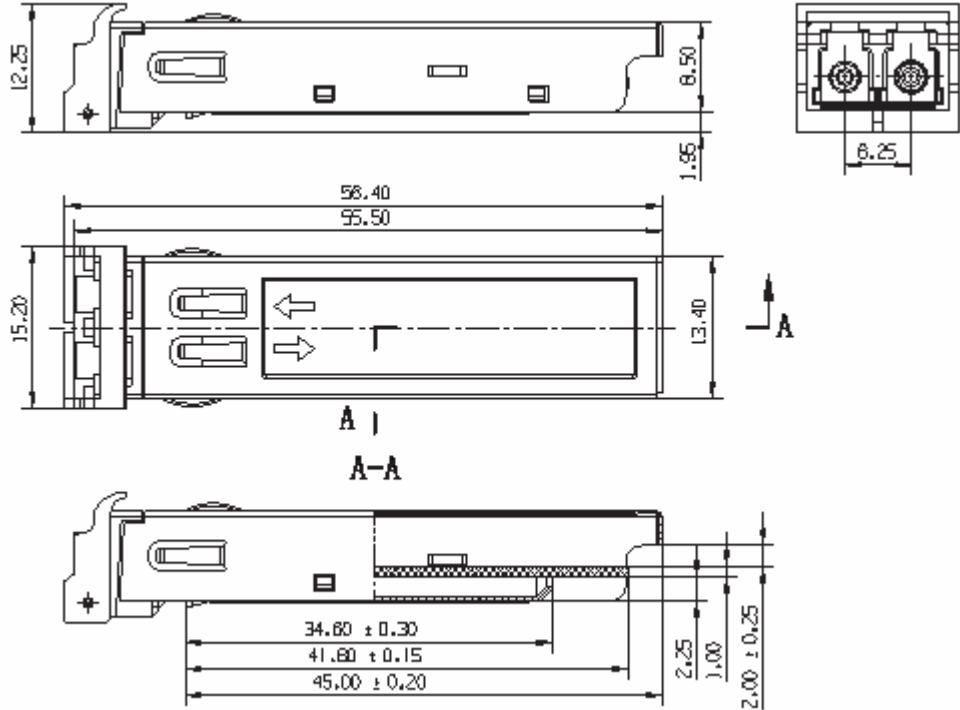
Recommended Front Panel Layout Opening for LC



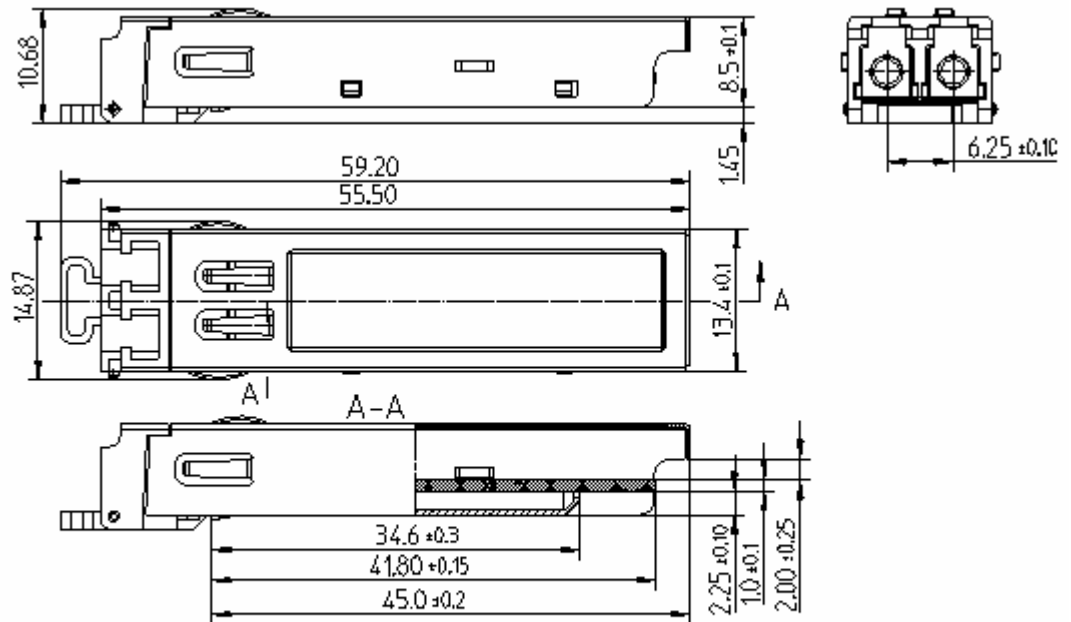


Mechanical Dimensions

Bail Latch



Pull Latch



Dimensions are in millimeters
Dimension tolerance is ± 0.1mm unless otherwise specified

Regulatory Information

Eye Safety

The transceiver is a Class 1 eye-safe device according to FDA 21CFR1040.10 and IEC 60825-2.

Electromagnetic Interference (EMI), Immunity and Product Safety

The transceiver is ESD safe (electrical pins) when tested according to MIL-STD-883, Method 3015.7 and ESD safe (optical connector) when tested according to IEC 61000-4-2. The device is immune to strong RF fields when tested in accordance with IEC 61000-4-3. The device complies with (US) FCC, Part 15, Subpart J; (Europe) CENELEC EN 55022; (Canada) Class B (CISPR22A); and (Japan) VCCI Class 1. The device has been designed to conform to product safety requirements including UL1950, CSA 22.2, and IEC 60950-1, and has been designed to meet the flammability requirements of UL94.

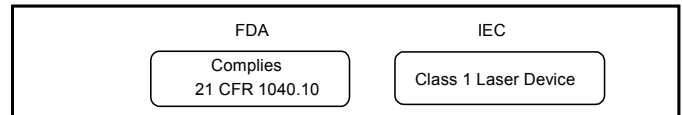
Notice

The factory has made all adjustments to this device prior to shipment. No adjustments or modifications to the device are required or permitted. Any adjustment, modification or tampering of the device voids the product warranty. The US Food and Drug Administration may consider that any adjustment or modification to this device is an act of manufacturing and therefore will require that the device be recertified in accordance with 21 CFR 1040.10 Subpart j.

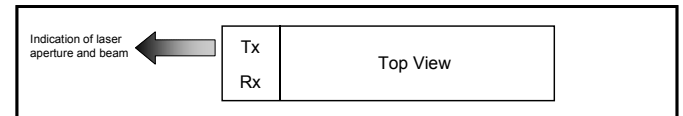
Laser Radiation Information

| | |
|--|---------------------|
| Wavelength | 1550 nm |
| FDA Total Pout: 7 mm aperture at 20 cm distance | < 790 microwatts |
| IEC Total Pout : 7 mm aperture at 10 cm distance | < 10,000 microwatts |
| Beam Divergence | 17.25° |

Required Label



Laser Emission



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