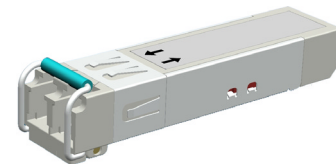




The LTD8502 SFP Gigabit Ethernet LC duplex transceiver is intended for 550 m reach service in 1250 Mb/s 850 nm multi mode high-speed LAN and SAN data communications equipment where low-cost, extraordinary performance and reliability are essential. It meets the requirements of IEEE802.3z 1000 BASE-SX, consumes low power, operates from a 3.3 volt DC power supply and is offered in the 0°C to 70°C commercial and the -40°C to +85°C industrial temperature ranges. The industry standard 2x10 small form pluggable (SFP) package is fabricated with a rugged die cast metal housing and cage assembly. An optional plastic housing is also offered. The low jitter and low bit error rate optical assembly features a 850 nm VCSEL 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. The SFP MSA Diagnostics are accessible via the two-wire I<sup>2</sup>C bus. 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.



LTD8502 - METAL HOUSING

#### APPLICATIONS

- 1250 Mb/s Gigabit Ethernet data links
- 1062.5 Mb/s Fibre Channel 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
- Multi Mode operation
- 550 m reach
- 1063 / 1250 Mb/s data rate
- +3.3 V power supply
- Low DC power consumption
- 2x10 SFP MSA compliant packages
  - Metal
  - Plastic
- Bail or pull latch option
- Hot swappable
- High performance 850 nm VCSEL laser
- High sensitivity PIN/TIA receiver
- BER < 1X10<sup>-12</sup> (2<sup>7</sup> - 1 NRZ PRBS)
- IEEE 802.3z 1000 BASE-SX compliant
- Operating temperature ranges:
  - Commercial: 0°C to 70°C
  - Industrial: -40°C to +85°C
- Monitor and control functions
  - Loss of Signal (Rx\_LOS), LVTTTL
  - Tx Disable (Tx\_DIS), LVTTTL
  - Tx Fault (Tx\_FAULT), LVTTTL
  - 2-wire I<sup>2</sup>C data bus
- RX\_DATA
  - LVPECL differential data interface
  - Internally AC-coupled
- Tx\_DATA
  - LVPECL differential data interface
  - Internally AC-coupled and terminated

#### HOW TO ORDER - METAL HOUSING

Ligent Part Number	Lambda	Reach	Mode	Laser	Optical Output	Latch	Case Operating Temperature Range
LTD8502 BC	850 nm	550 m	Multi Mode	VCSEL	-9.5 to -2 dBm	Bail = B	C = 0°C to 70°C
LTD8502 BH	850 nm	550 m	Multi Mode	VCSEL	-9.5 to -2 dBm	Bail = B	H = -40°C to +85°C
LTD8502 PC	850 nm	550 m	Multi Mode	VCSEL	-9.5 to -2 dBm	Pull = P	C = 0°C to 70°C
LTD8502 PH	850 nm	550 m	Multi Mode	VCSEL	-9.5 to -2 dBm	Pull = P	H = -40°C to +85°C

#### HOW TO ORDER - PLASTIC HOUSING

LTD8502 NE	850 nm	550 m	Multi Mode	VCSEL	-9.5 to -3 dBm	Button = N	E = -10°C to +85°C
LTD8502 NC	850 nm	550 m	Multi Mode	VCSEL	-9.5 to -3 dBm	Button = N	C = 0°C to 70°C



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

Parameter	Symbol	Minimum	Maximum	Units
Storage Temperature	T <sub>stg</sub>	-40	+85	°C
Relative Humidity - Storage	RH <sub>S</sub>	0	95	%
Relative Humidity - Operating	RH <sub>O</sub>	0	85	%
DC Supply Voltage	V <sub>CC</sub>	0	3.6	V
Soldering Temperature	T <sub>slid</sub>	0	260	°C
Soldering Time Duration	t <sub>slid</sub>	0	10	seconds
Tx DATA	V <sub>in</sub>	0	V <sub>CC</sub> + 0.5	V

**Optical and Electrical Signal Absolute Maximum Ratings**

Signal / Data Input Voltage (Tx_DATA )	V <sub>IN PK-PK</sub>	-	2.4	V
Rx Optical Input Power	P <sub>IN-MAX</sub>		3	dBm

**Logic State Absolute Maximum Ratings**

Tx_DISABLE Logic HIGH State	Tx_DISABLE	-	V <sub>CC</sub> +0.5	V
Tx_FAULT Logic HIGH State	Tx_FAULT	-	V <sub>CC</sub> +0.5	V
Rx_LOS Logic HIGH State	Rx_LOS	-	V <sub>CC</sub> +0.5	V

**Recommended Operating Conditions**

Parameter	Symbol	Min	Typ	Max	Units	Notes
Ambient Operating Temperature	T <sub>amb</sub>	0	25	+70	°C	Temperature Range = C
Ambient Operating Temperature	T <sub>amb</sub>	-40	25	+85	°C	Temperature Range = H
Ambient Operating Temperature	T <sub>amb</sub>	-10	25	+85	°C	Temperature Range = E
DC Supply Voltage	V <sub>CC</sub>	3.14	3.30	3.46	Volts	
Module Supply Current	I <sub>IN</sub>	-	150	200	mA	
Power Dissipation	P <sub>D</sub>	-	500	700	mW	



**Transmitter Logic**

Parameter	Function	Logic State	Logic Type	Min	Max	Units	Notes
Tx DIS	DISABLE	HIGH	LVTTL	2.0	V <sub>CC</sub> +0.3	V	Laser is OFF
Tx DIS	ENABLE	LOW	LVTTL	0	0.8	V	Laser is ON
Tx DIS	Assert Time	-	LVTTL	-	10	µs	
Tx FAULT	FAULT	HIGH	LVTTL	2.0	V <sub>CC</sub> +0.3	V	Transmitter is OFF
Tx FAULT	NORMAL	LOW	LVTTL	0	0.8	V	Transmitter is ON

**Receiver Logic**

Parameter	Function	Logic State	Logic Type	Min	Max	Units	Notes
Rx_LOS	LOSS OF SIGNAL	HIGH	LVTTL	2.0	V <sub>CC</sub> +0.3	V	Receiver is OFF
Rx_LOS	NORMAL	LOW	LVTTL	0	0.8	V	Receiver is ON

**Transmitter Electro-Optical Characteristics**

Parameter	Symbol	LTD8502			Units	Notes
		Min	Typ	Max		
Laser Type		850 nm VCSEL				
Optical Output Power	P <sub>o</sub>	-9.5		0	dBm	Average Optical Output
Center Wavelength	λ	830	850	860	nm	
RMS Spectral Line Width	Δλ	-	-	0.85	nm	
Extinction Ratio	ER	9	-	-	dB	
Optical Rise and Fall Time	t <sub>r</sub> , t <sub>f</sub>	-	150	260	ps	20% - 80%
Relative Intensity Noise	RIN	-	-	-117	dB/Hz	
Deterministic Jitter	DJ	-	-	0.2	UI	
Transmitter Generated RMS Jitter	J <sub>RMS</sub>	-	-	0.01	UI	
Output Eye		IEEE 802.3z 1000 BASE-SX compliant				
Tx Differential Input Impedance	Z <sub>in</sub>	-	100	-	Ohms	
Tx Differential Input Voltage	V <sub>IN</sub>	300	-	2400	mV p-p	LVPECL Tx DATA (Note 1)

Note 1: Internally AC coupled and terminated

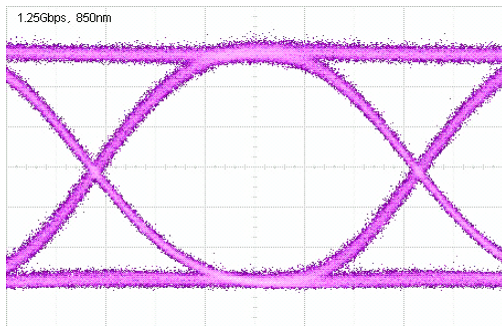


Receiver Electro-Optical Characteristics						
Parameter	Symbol	LTD8502			Units	Notes
		Min	Typ	Max		
Package Type		SFP				
Signaling Rate		1.25			Gb/s	±100 ppm
Receiver Type		PIN / TIA				
Receiver Optical Sensitivity	$P_{IN}$	-	-	-17	dBm	Average Received Power (Note 1)
Receiver Optical Overload	$P_{IN MAX}$	-	-	0	dBm	
Center Wavelength	$\lambda$	1270	1310	1355	nm	
Optical Return Loss	RL	12	-	-	dB	
Rx Upper 3 dB Cutoff Frequency	$f_c$	-	-	1500	MHz	
Signal Loss - Assert	$P_{SLA}$	-31	-	-18.5	dBm	
Signal Loss - Deassert	$P_{SLD}$	-30	-	-18	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

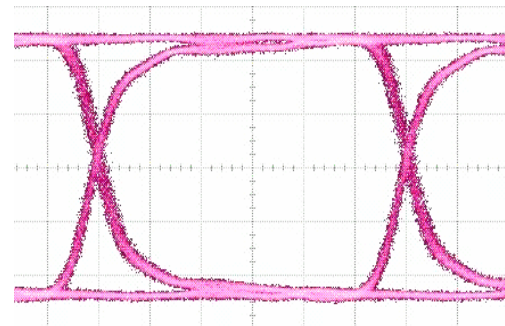
Note 2: Internally AC coupled

**EYE DIAGRAM**



**Transmitter Test Conditions**

- Optical Output Power = **-5 dBm**
- Test Pattern =  $2^7-1$  NRZ PRBS



**Receiver Test Conditions**

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

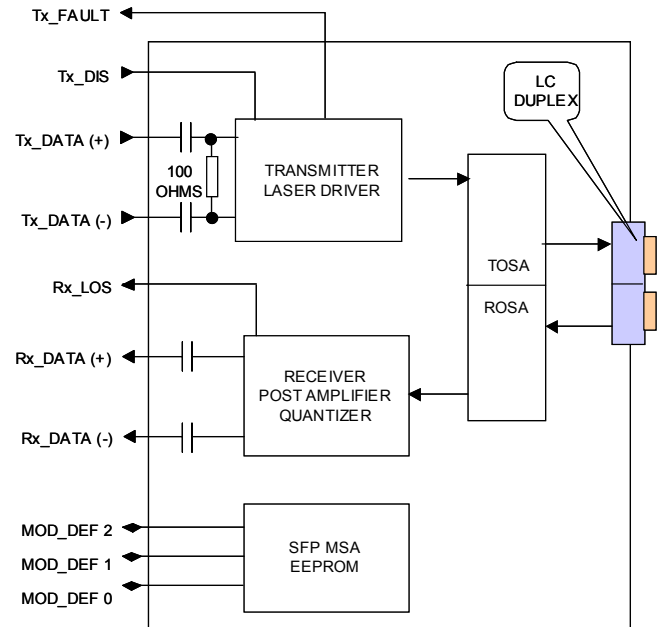
### TRANSCEIVER BLOCK DIAGRAM

#### Transmitter Section

The transmitter section consists of a high reliability 850 nm VCSEL 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.

#### Receiver Section

The receiver section consists of a high-speed GaAs PIN 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 drain/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

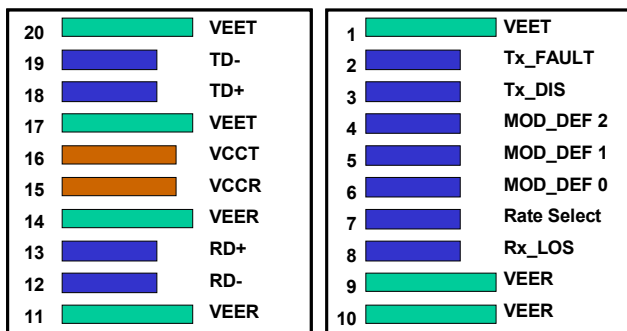
The Tx\_DIS (Transmit Disable) is a LVTTTL control port that is controlled by a logic signal on the host (system) printed circuit board. If the system is ready to send data then the Tx\_DIS line is set LOW to enable the laser driver and the laser transmitter. If the system is not ready to send data,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

#### Tx Fault (Tx\_FAULT) Description

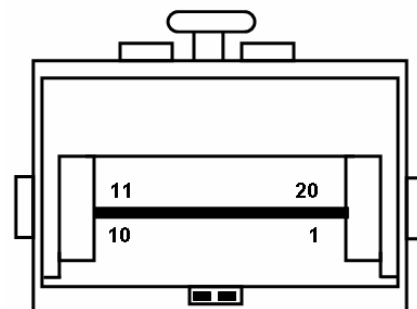
The Tx\_FAULT (Transmit Fault) is an open drain/collector LVTTTL monitor port. It switches states based on the condition of the laser driver and the laser including the end of life condition of the laser. If the parameters of the laser driver and laser are within specifications then the Tx\_FAULT is 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.



**PIN ASSIGNMENT**



**Transceiver Electrical Pad Layout**  
Top View Bottom View



**Transceiver Pin Locations**

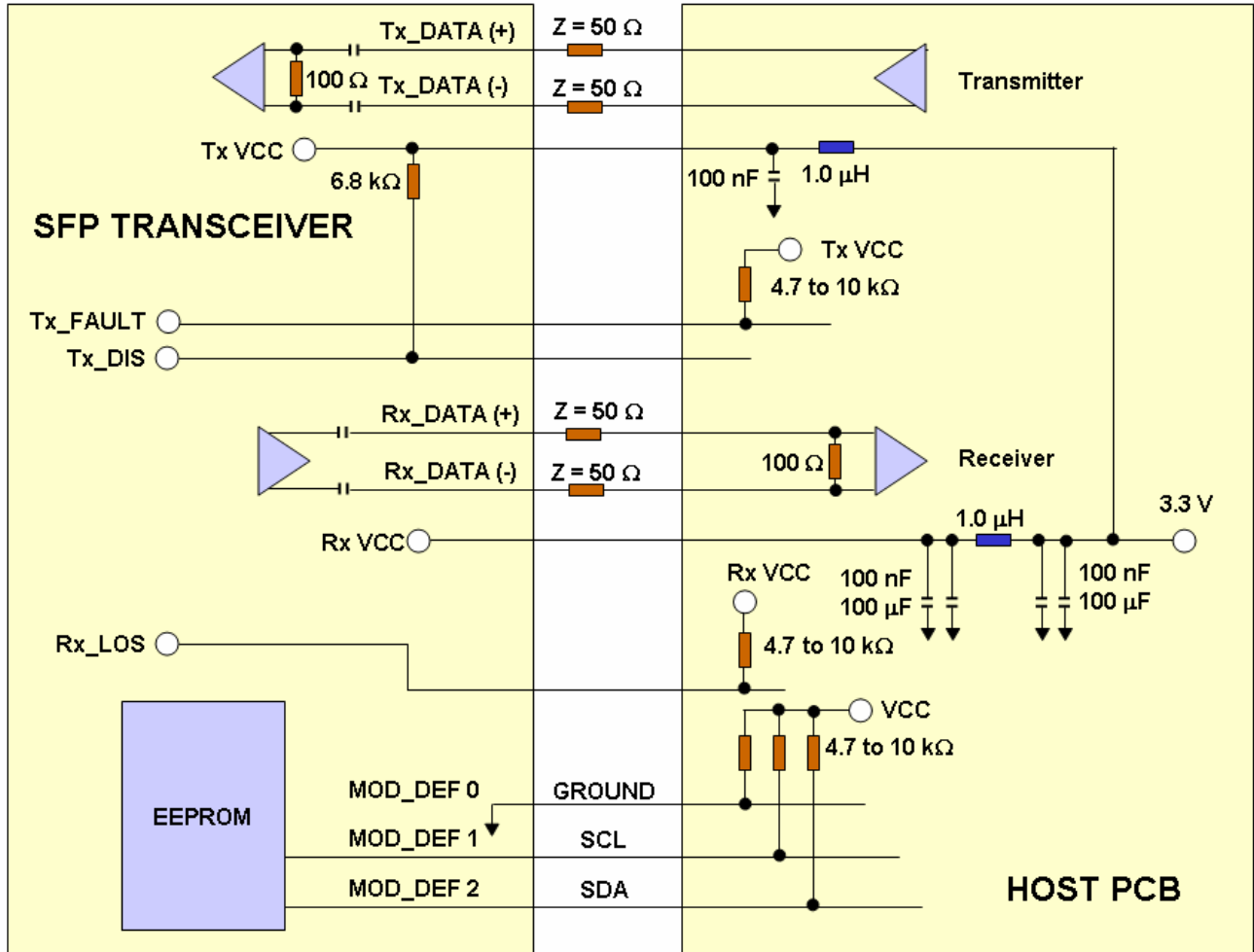
SFP Pin Assignment				
Pin	Symbol	Logic Type	Description	Notes
1	V <sub>EET</sub>	N/A	Transmitter Ground	
2	Tx_FAULT	LVTTL	Transmitter Fault, LOW = Normal Operation, HIGH = Fault Indication	Note 1
3	Tx_DIS	LVTTL	Transmit Disable, LOW = Normal Operation, HIGH = Disables Module	
4	MOD_DEF 2	LVTTL	Module Definition 2 - Two-Wire Interface - Serial Data	Note 1
5	MOD_DEF 1	LVTTL	Module Definition 1 - Two-Wire Interface - Clock Signal	Note 1
6	MOD_DEF 0	LVTTL	Module Definition 0 - Two-Wire Interface Digital Ground	Note 1
7	Rate Select	N/A	Not Connected	
8	Rx_LOS	LVTTL	Receiver Loss of Signal, LOW = Normal Operation, HIGH = Loss of Signal	Note 1
9	V <sub>EER</sub>	N/A	Receiver Ground	
10	V <sub>EER</sub>	N/A	Receiver Ground	
11	V <sub>EER</sub>	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 <sub>EER</sub>	N/A	Receiver Ground	
15	V <sub>CCR</sub>	N/A	Receiver DC Power	3.3 V +/- 5%
16	V <sub>CCT</sub>	N/A	Transmitter DC Power	3.3 V +/- 5%
17	V <sub>EET</sub>	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 <sub>EET</sub>	N/A	Transmitter Ground	

**Notes**

- The uncommitted Tx\_Fault, Rx\_LOS, MOD\_DEF 0, MOD\_DEF 1 and MOD\_DEF 2 LVTTL monitor and control pins each require a pull up resistor of 4.7K to 10K Ohms.
- The 100 Ohm differential Rx Data output is internally AC coupled and must be terminated with 100 Ohms at the differential user interface.
- The 100 Ohm differential Tx Data input is internally AC coupled and terminated.



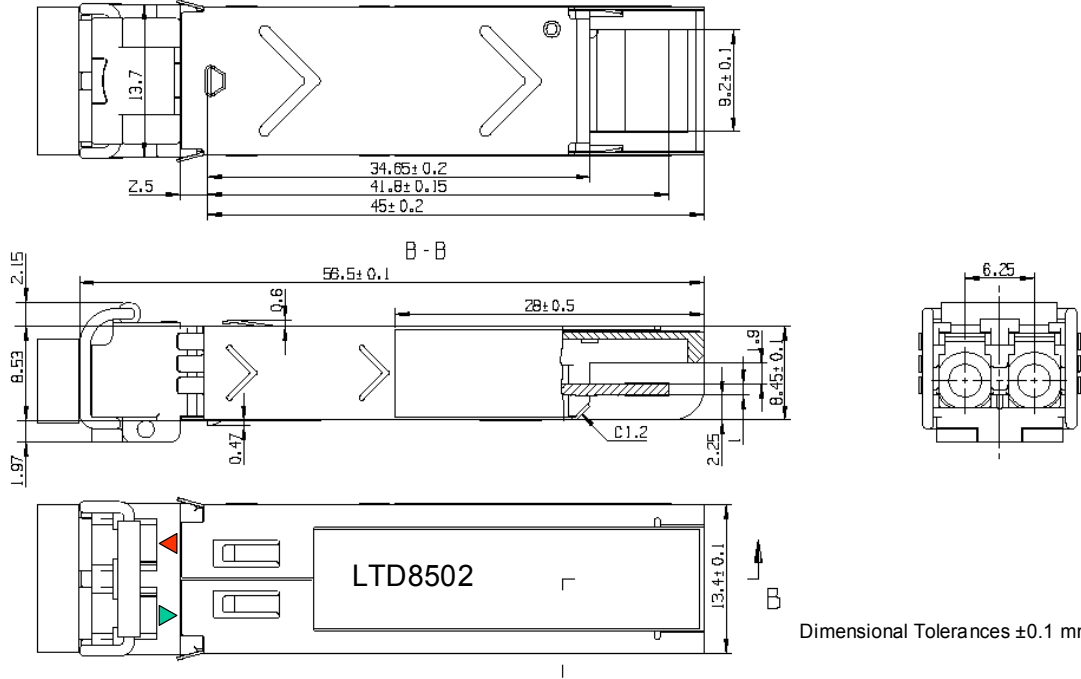
ELECTRICAL INTERFACE



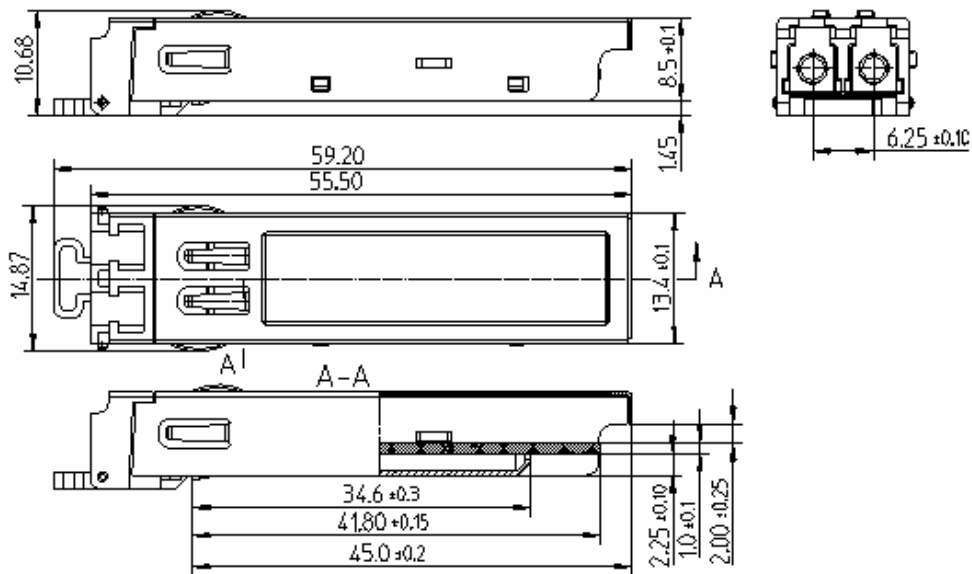




**MECHANICAL DIMENSIONS - METAL HOUSING / BAIL LATCH**



**MECHANICAL DIMENSIONS - METAL HOUSING / PULL LATCH**



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



**Ligent**

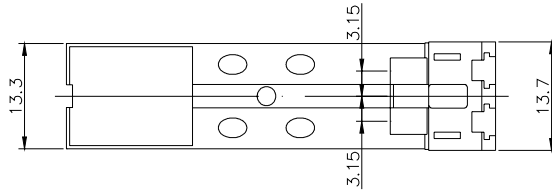
intelligent photonics

# LTD8502 850 nm SFP Optical Transceiver

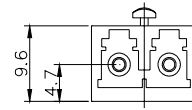
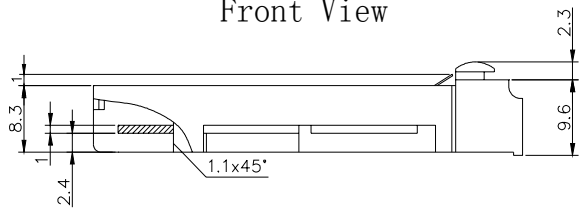
1250 / 1062.5 Mb/s Gigabit Ethernet / Fibre Channel

## MECHANICAL DIMENSIONS - PLASTIC HOUSING / BAIL LATCH

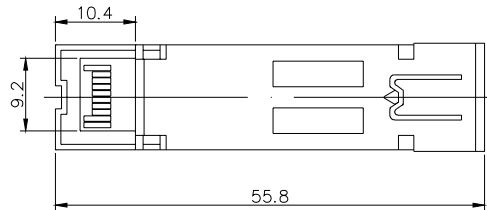
Top View



Front View



Side View



Bottom View



#### REGULATORY INFORMATION

##### Eye Safety

The transceiver is a Class 1 eye-safe device according to FDA 21CFR1040.10 and IEC 60825-2. The transceiver has been assigned the accession number 0422608 by the Department of Health and Human Services, FDA Center for Devices and Radiological Health (CDRH).

##### Electromagnetic Interference (EMI), Immunity and Product Safety

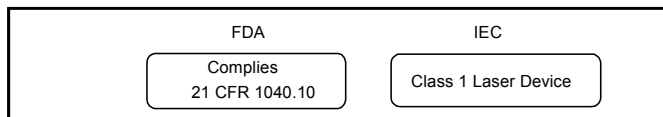
The transceiver is ESD safe (electrical pins) when tested according to MIL-STD-883, Method 3015.7 and ESD safe (optical connector) when tested according to IEC 61000-4-2. The device is immune to strong RF fields when tested in accordance with IEC 61000-4-3. The device complies with (US) FCC, Part 15, 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	850 nm
FDA Total Pout: 7 mm aperture at 20 cm distance	< 76 microwatts
IEC Total Pout : 7 mm aperture at 10 cm distance	< 778 microwatts
Beam Divergence	17.58°

##### Required Label



##### Laser Emission

