

Product Description

The LTD1302 SFP Gigabit Ethernet LC duplex transceiver is intended for 10 km reach service in 1250 Mb/s 1310 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-LX, consumes low power, operates from a 3.3 volt DC power supply and is offered in the commercial, extended and industrial temperature ranges. 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 1310 nm F-P 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 (MOD_DEF 0-1-2). 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 (2⁷ - 1 NRZ PRBS test pattern)
- 10 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 1310 nm F-P laser
- High sensitivity PIN/TIA optical receiver:
- Single Mode operation
- BER < 1X10⁻¹²
- IEEE 802.3z 1000 BASE-LX compliant
- Operating temperature range options:
 - Commercial: 0 to 70°C
 - Extended: -10 to 80°C
 - Industrial: -40 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 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)



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
		-10	25	+80	°C	Temperature Range = E
		-40	25	+85	°C	Temperature Range = H
DC Supply Voltage	V _{CC}	3.14	3.30	3.46	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, Extended or Industrial

Part Number	Latch Option (X)		Temperature Option (Y)	
LTD1302 XY	B	Bail	C	0 to 70 °C
	P	Pull	E	-10 to 80 °C
			H	-40 to 85 °C



LTD1302 SFP Optical Transceiver

Gigabit Ethernet, 1310 nm, 1250 Mb/s, 10 km

Transmitter Logic						
Parameter	Function	Logic State	Logic Type	Min	Max	Units
Tx_DIS and Tx_FAULT	DISABLE	HIGH	LVTTTL	2.4	V _{CC} +0.3	V
Tx_DIS and Tx_FAULT	ENABLE	LOW	LVTTTL	0	0.8	V
Tx_DIS	Assert Time	-	LVTTTL	-	10	μs

Receiver Logic						
Parameter	Function	Logic State	Logic Type	Min	Max	Units
Rx_LOS	LOSS OF SIGNAL	HIGH	LVTTTL	2.4	V _{CC} +0.3	V
Rx_LOS	NORMAL	LOW	LVTTTL	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	LVTTTL	2.4	V _{CC} +0.3	V
		LOW	LVTTTL	0	0.8	V
MOD_DEF 2	Serial Data	HIGH	LVTTTL	2.4	V _{CC} +0.3	V
		LOW	LVTTTL	0	0.8	V

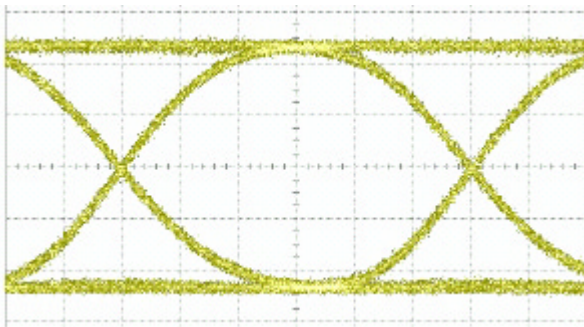
Transmitter Electro-Optical Characteristics						
Parameter	Symbol	LTD1302			Units	Notes
		Min	Typ	Max		
Laser Type		1310 nm F-P				
Optical Output Power	P _o	-9.5	0	-3	dBm	Average Optical Output
Center Wavelength	λ	1270	1310	1355	nm	
RMS Spectral Line Width	Δλ	-	-	4	nm	
Extinction Ratio	ER	9	-	-	dB	
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}	-	0.03	-	UI	
Output Eye		IEEE 802.3z 1000 BASE-LX 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



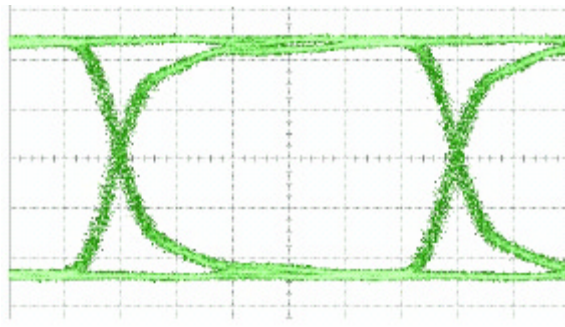
Receiver Electro-Optical Characteristics						
Parameter	Symbol	LTD1302			Units	Notes
		Min	Typ	Max		
Receiver Type		PIN / TIA				
Receiver Optical Sensitivity	P_{IN}	-	-	-19	dBm	Average Received Power (Note 1)
Receiver Optical Overload	P_{INMAX}	-	-	-3	dBm	
Center Wavelength	λ	1270	1310	1355	nm	
Optical Return Loss	RL	12	-	-	dB	
Rx Upper 3 dB Cutoff Frequency	f_c	-	-	1500	MHz	
Signal Loss - Assert	P_{SLA}	-29	-	-21.5	dBm	
Signal Loss - Deassert	P_{SLD}	-28.5	-	-21	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 = **-5 dBm**
- Test Pattern = 2^7-1 NRZ PRBS



Receiver Test Conditions

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



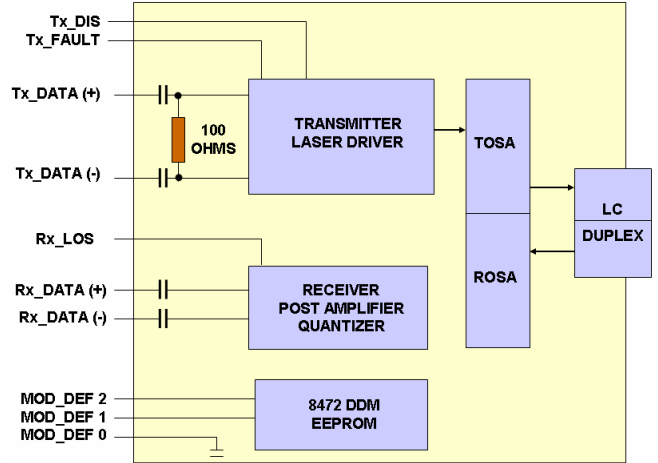
Transceiver Block Diagram

Transmitter Section

The transmitter section consists of a high reliability 1310 nm FP 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 InGaAs 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 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

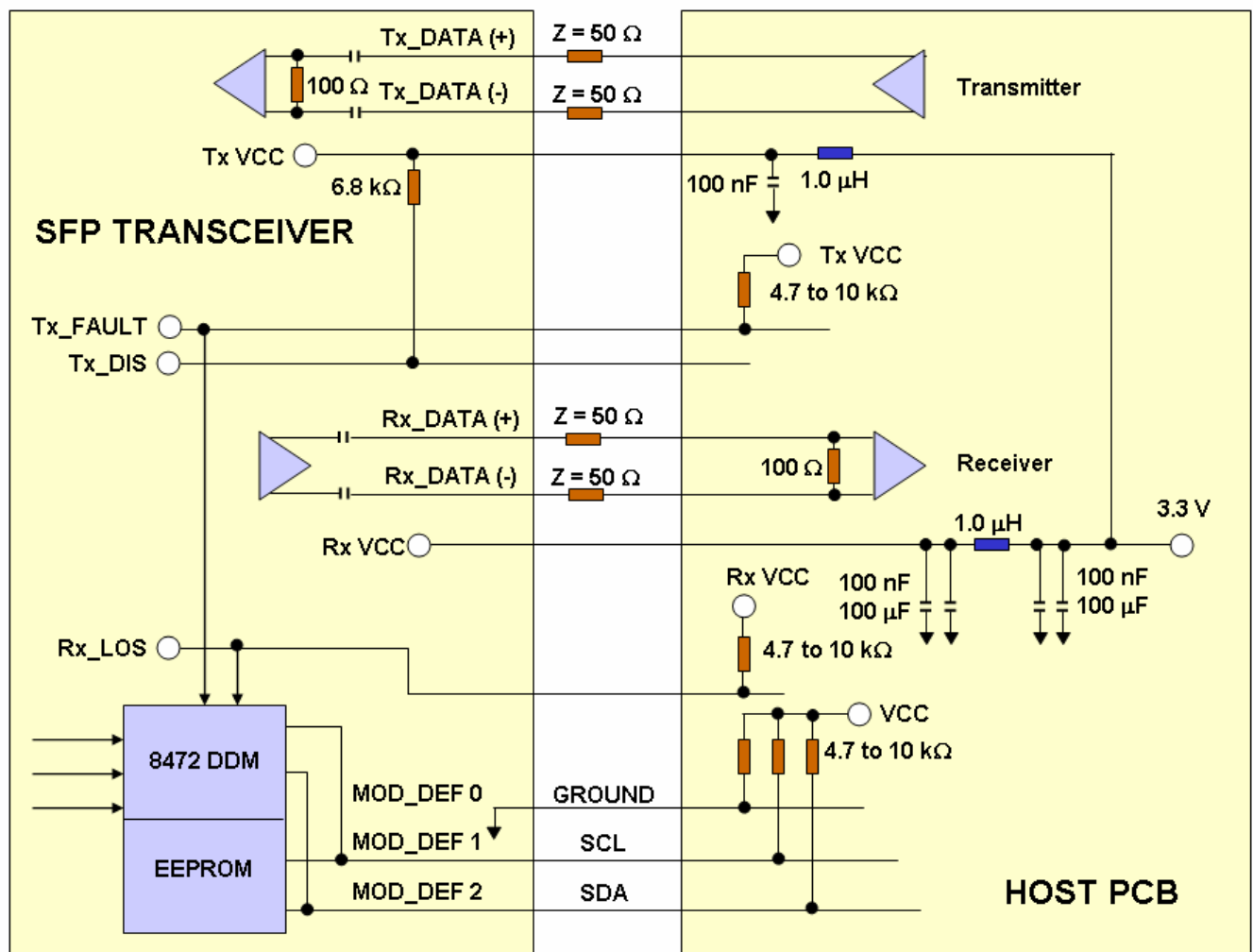
The Warning or Alarm bit is set when the parameter drops below or exceeds the Low or High values stored in memory. The parametric values are such the Warning bit is set before the Alarm bit:

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



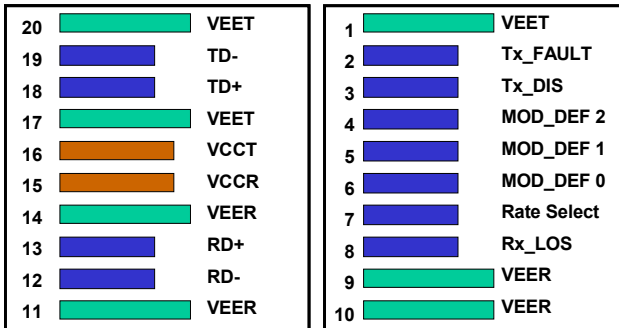
SFF-8472 Rev 9.3 A2 (HEX) Address Table for Alarm and Warning Data														
8472 Parameter	Alarm Threshold Data				Warning Threshold Data				Internally Measured Values		Alarm Bit (Set) Address + Position		Warning Bit (Set) Address + Position	
	High Value		Low Value		High Value		Low Value				High	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

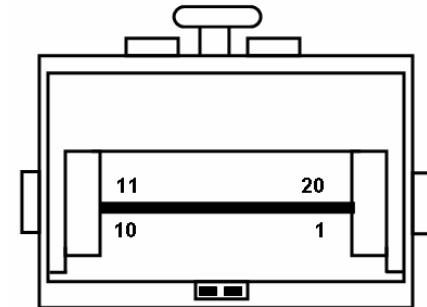




Pin Assignment



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 _C CR	N/A	Receiver DC Power	3.3 V +/- 5%
16	V _C CT	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	

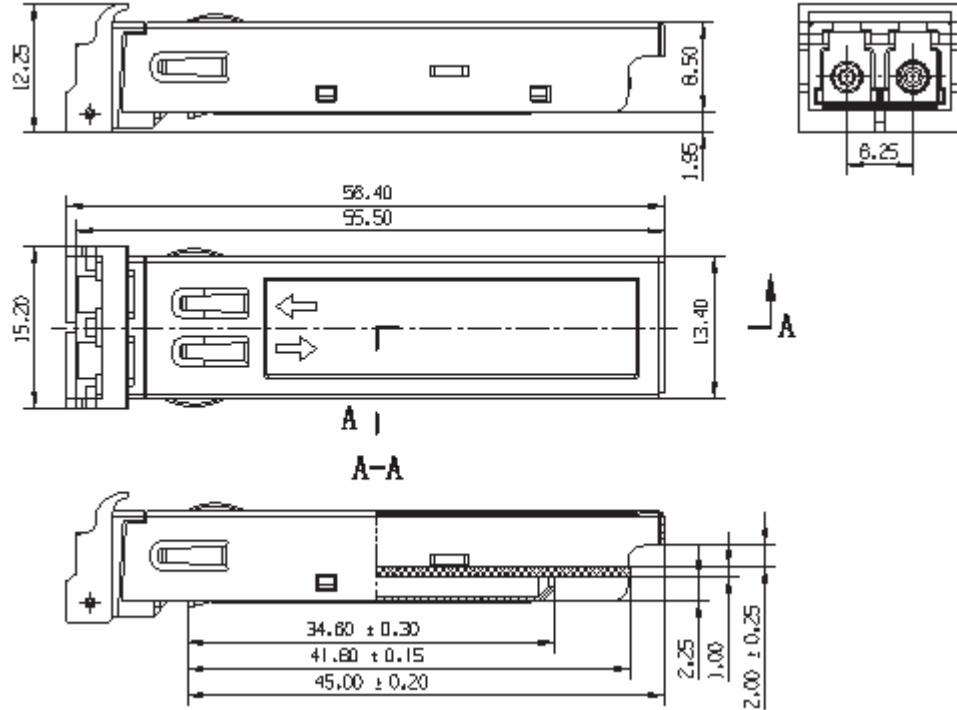
Notes

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.

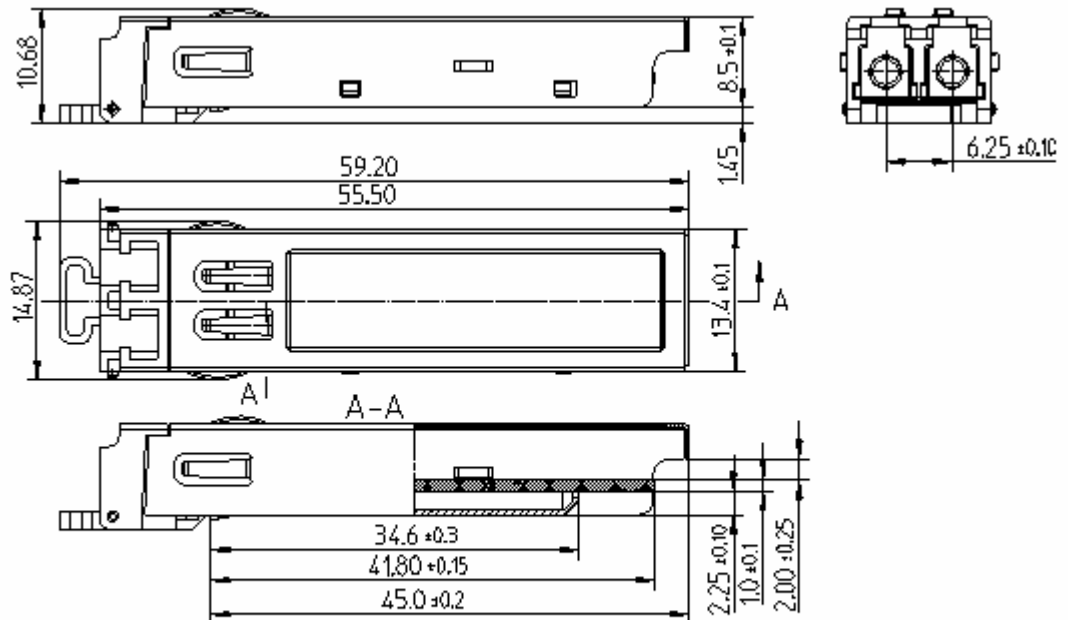


Mechanical Dimensions

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.

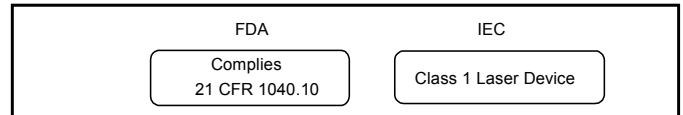
Notice

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.

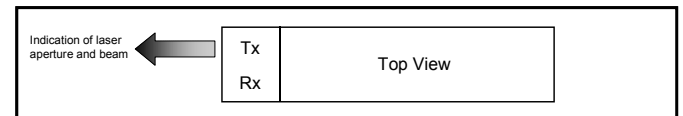
Laser Radiation Information

Wavelength	1310 nm
FDA Total Pout: 7 mm aperture at 20 cm distance	< 195 microwatts
IEC Total Pout : 7 mm aperture at 10 cm distance	< 15,600 microwatts
Beam Divergence	17.25°

Required Label



Laser Emission



Ligent Sales Offices - USA

Ligent Photonics, Inc.

2701 Dukane Drive
Suite 200
St. Charles, IL 60174
PH (630) 513-7226
FX (630) 513-9173
WS www.ligentphotonics.com

Ligent Photonics, Inc.

(Virginia Sales Office)
8210 Strathmore Lane
Roanoke, VA 24019
PH (540) 797-5793
FX (540) 366-5793
WS www.ligentphotonics.com

New Age Electronics

3000 Northwood's Parkway
Suite 280
Norcross, GA 30071
PH (770) 242-8800
FX (770) 242-8180
WS www.newagelec.com

New Age Electronics

8376 Six Forks Road
Suite 202
Raleigh, NC 27615
PH (919) 866-0620
FX (919) 866-0621
WS www.newagelec.com

New Age Electronics

4940 Corporate Drive
Suite B
Huntsville, AL 35805
PH (256) 430-8000
FX (256) 430-8414
WS www.newagelec.com

K-Tech Sales

100 Century Center Court
Suite 405
San Jose, CA 95112
PH (408) 437-1808
FX (408) 437-1883
WS www.ktechsales.com

Kruvand Associates

1202 Richardson Drive
Suite 113
Richardson, TX 75080
PH (972) 437-3355
FX (972) 680-8854
WS www.kruvand.com

Kruvand Associates

8100 Shoal Creek Boulevard
Suite 250
Austin, TX 75080
PH (512) 454-1111
FX (512) 454-9858
WS www.kruvand.com

Kruvand Associates

10601 Grant Road
Suite 104
Houston, TX 77070
PH (713) 956-6741
FX (713) 972-680-8854
WS www.kruvand.com

VAL Technical Sales

183 Prospect Street
Hingham, MA 02043
PH (781) (781) 749-8358
FX (781) 740-4663
WS www.valtechnical.com

Ligent Sales Offices - Asia

Hisense Optoelectronics Technology Co., Limited

No.11, Jiangxi Road
Qingdao, Shandong
China 266071
PH 86 (532) 601-0000
FX 86 (532) 601-6007
WS www.hisenseopto.com

Summit Hisense Company, Limited

Triton Square
Office Tower Z 19F 1-8-12
Harumi Chuo-ku 104-6219
Japan
PH 81-3-5547-1252
FX 81-3-5547-1268