



Product Description

The LTD1391 SFP SONET/SDH LC duplex transceiver is intended for 15 km reach service in 155 Mb/s 1310 nm single mode high-speed telecommunications equipment where low-cost, extraordinary performance and reliability are essential. It meets the requirements of Telcordia SONET OC-3/IR-1 and ITU-T G.957 SDH STM-1/S-1.1, consumes low power, operates from 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 assemblies 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. 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.



a

Applications

- 155 Mb/s SONET/SDH telecom equipment
- Rack to rack system interconnects
- Metro / Access Networks
- Switch to switch interfaces
- Hub interconnects
- Bus extenders
- Channel extenders
- Host adapter interconnects
- Mass storage system interconnects
- Telecom switches
- Router interconnects

Features

- LC Duplex optical interface
- 15 km reach
- 155 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 < 1X10⁻¹⁰ (2²³ - 1 NRZ PRBS test pattern)
- Telcordia SONET OC-3/IR-1 compliant
- ITU-T G.957 SDH STM-1/S-1.1 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
- 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
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

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}	-	130	200	mA	
Power Dissipation	P _D	-	450	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)	
LTD1391 XY	B	Bail	C	0 to 70 °C
	P	Pull	E	-10 to 80 °C
			H	-40 to 85 °C



Transmitter Logic						
Parameter	Function	Logic State	Logic Type	Min	Max	Units
Tx DIS	DISABLE	HIGH	LVTTL	2.0	V _{CC} +0.3	V
Tx DIS	ENABLE	LOW	LVTTL	0	0.8	V
Tx DIS	Assert Time	-	LVTTL	-	10	μs
Tx FAULT	FAULT	HIGH	LVTTL	2.0	V _{CC} +0.3	V
Tx FAULT	NORMAL	LOW	LVTTL	0	0.8	V

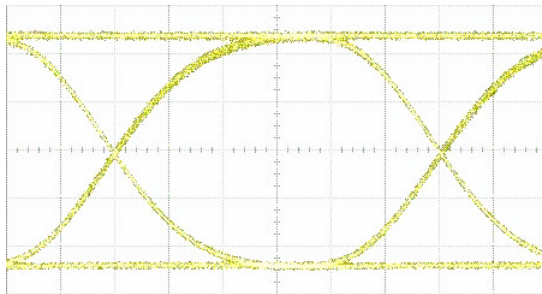
Receiver Logic						
Parameter	Function	Logic State	Logic Type	Min	Max	Units
Rx_LOS	LOSS OF SIGNAL	HIGH	LVTTL	2.0	V _{CC} +0.3	V
Rx_LOS	LOSS OF SIGNAL	LOW	LVTTL	0	0.8	V

Transmitter Electro-Optical Characteristics						
Parameter	Symbol	LTD1391			Units	Notes
		Min	Typ	Max		
Transmitter Type		1310 nm F-P				
Optical Output Power	P _o	-15		-8	dBm	Average Optical Output
Center Wavelength	λ	1260	1310	1360	nm	
RMS Spectral Line Width	Δλ	-	7	-	nm	
Extinction Ratio	ER	8.2	-	-	dB	
Optical Rise and Fall Time	t _r , t _f	-	1	2	ns	20% - 80%
Relative Intensity Noise	RIN	-	-	-117	dB/Hz	
Transmitter Generated RMS Jitter	J _{RMS}	-	-	0.007	UI	
Output Eye		ITU-T G.957 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						



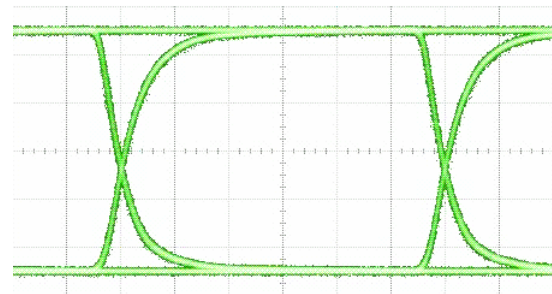
Receiver Electro-Optical Characteristics						
Parameter	Symbol	LTD1391			Units	Notes
		Min	Typ	Max		
Receiver Type		PIN / TIA				
Receiver Optical Sensitivity	P_{IN}	-	-	-30	dBm	Average Received Power (Note 1)
Receiver Optical Overload	$P_{IN MAX}$	-	-	-8	dBm	
Center Wavelength	λ	1263	1310	1360	nm	
Optical Return Loss	RL	12	-	-	dB	
Rx Upper 3 dB Cutoff Frequency	f_c	-	-	200	MHz	
Signal Loss - Assert	P_{SLA}	-45	-	-34.5	dBm	
Signal Loss - Deassert	P_{SLD}	-44.5	-	-34	dBm	
Signal Loss - Hysteresis	P_H	0.5	2	5	dB	
Data Output Rise / Fall Time	t_r / t_f		1	-	ns	20 - 80 %
Rx Differential Load Impedance	Z_{LOAD}	-	100	-	Ohms	
Rx Differential Output Voltage	V_{OUT}	400	-	1800	mV p-p	LVPECL Rx DATA (Note 2)
Note 1: Average received power where the BER = 10^{-10} , measured with a 2^{23} -1 NRZ test pattern						
Note 2: Internally AC coupled and terminated						

Eye Diagram



Transmitter Test Conditions

- Optical Output Power = **-10 dBm**
- Test Pattern = 2^{23} -1 NRZ PRBS



Receiver Test Conditions

- Optical Input Power = **-17 dBm**
- Test Pattern = 2^{23} -1 NRZ PRBS



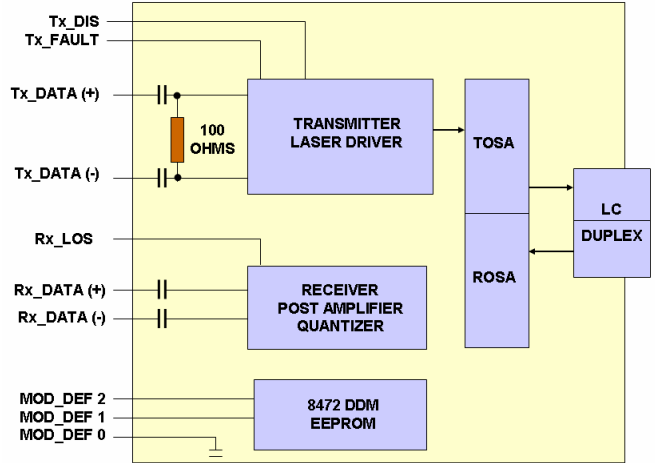
Transceiver Block Diagram

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.

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

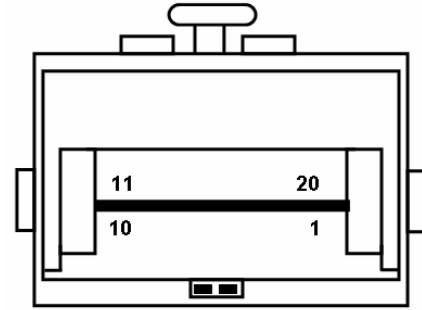
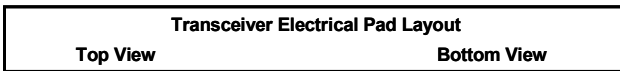
The Tx_FAULT (Transmit Fault) is an open collector LVTTTL monitor port. It switches states based on the condition of the laser driver and the laser including the end of life condition of the laser. If the parameters of the laser driver and laser are within specifications then the Tx_FAULT is set LOW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



Pin Assignment

20	VEET
19	TD-
18	TD+
17	VEET
16	VCCT
15	VCCR
14	VEER
13	RD+
12	RD-
11	VEER

1	VEET
2	Tx_FAULT
3	Tx_DIS
4	MOD_DEF 2
5	MOD_DEF 1
6	MOD_DEF 0
7	Rate Select
8	Rx_LOS
9	VEER
10	VEER



Transceiver Pin Locations

SFP Pin Assignment

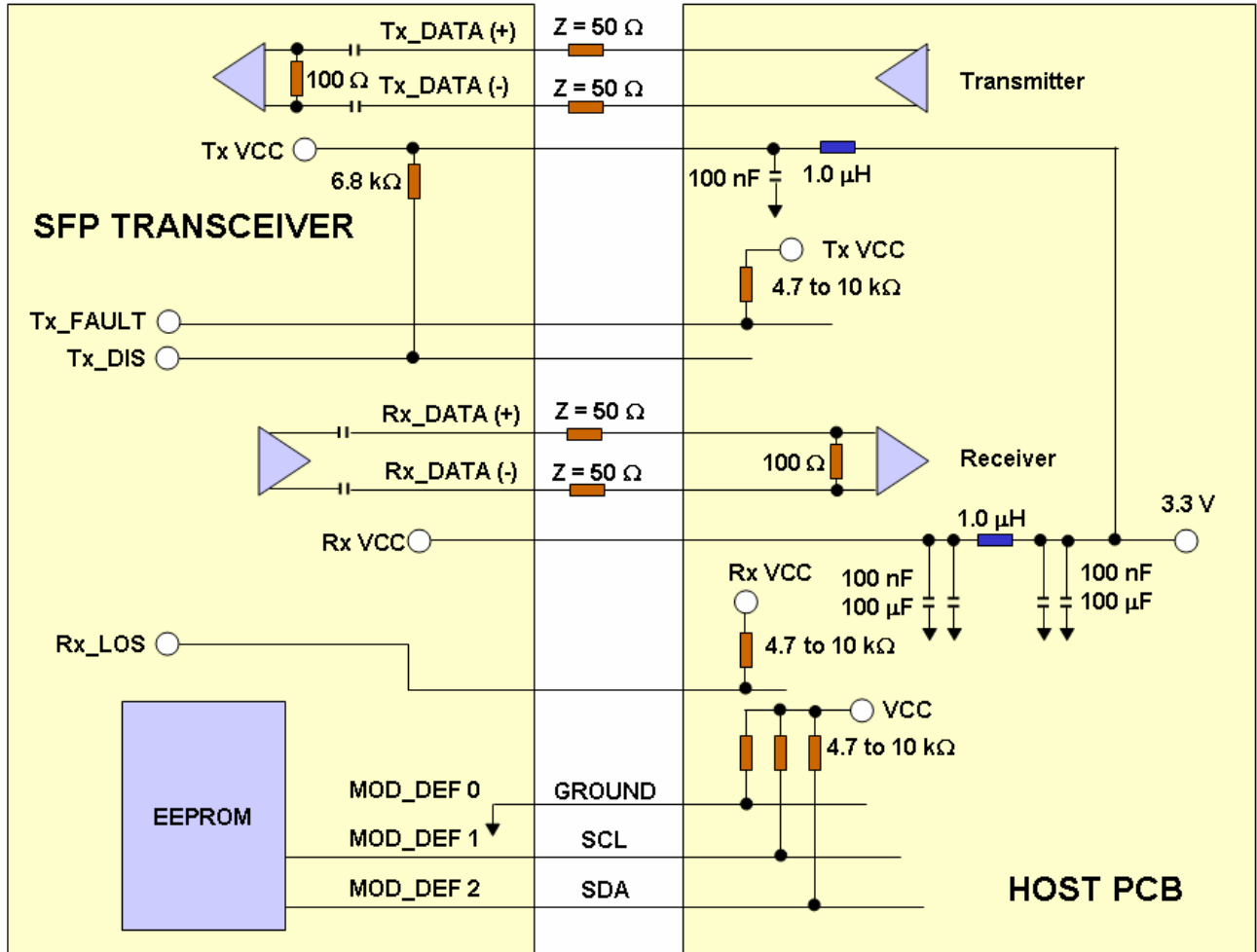
Pin	Symbol	Logic Type	Description	Notes
1	V _{EET}	N/A	Transmitter Ground	
2	Tx_FAULT	LVTTTL	Transmitter Fault, LOW = Normal Operation, HIGH = Fault Indication	Note 1
3	Tx_DIS	LVTTTL	Transmit Disable, LOW = Normal Operation, HIGH = Disables Module	Note 1
4	MOD_DEF 2	LVTTTL	Module Definition 2 - Two-Wire 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.



Electrical Interface





Regulatory Information

Eye Safety

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

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.

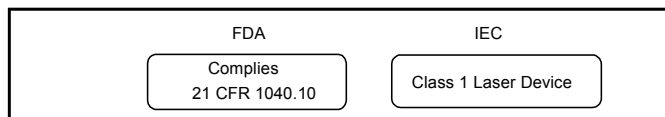
Notice

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.

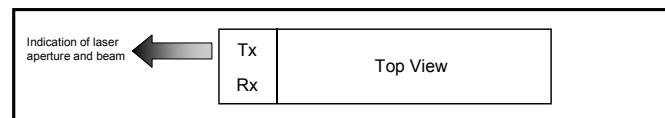
Laser Radiation Information

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.co

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